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CONTRIBUTIONS TO THE BIOLOGY OF THE PHILIPPINE ARCHIPELAGO AND ADJACENT REGIONS

PAPERS ON COLLECTIONS GATHERED BY THE "ALBATROSS" PHILIPPINE EXPEDITION 1907-1910

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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 *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.

The present work forms No. 100, volume 1 of the *Bulletin* series.

Alexander Wetmore,
Assistant Secretary, Smithsonian Institution.

Washington, D. C., *June 14, 1928.*

THE "ALBATROSS" PHILIPPINE EXPEDITION

In 1907 the President of the United States authorized and directed the assignment of the steamer *Albatross* of the United States Bureau of Fisheries to a survey of the aquatic resources and fisheries of the Philippine Islands. This investigation was undertaken partly at the request of the insular government and partly in pursuance of a plan that had been under consideration in the Bureau of Fisheries for some years.

The vessel, which, as formerly, was manned by naval officers and crew, was under command of Lieut. Commander (later Commander) Marbury Johnston from September 25, 1907, to June 10, 1908, and Lieut. Commander C. M. McCormick from June 10, 1908, to the end of the cruise.

The civilian staff of the vessel consisted of:

Hugh M. Smith, deputy commissioner of fisheries, director of the expedition;

Frederic M. Chamberlain, resident naturalist;

Lewis Radcliffe, general assistant and naturalist;

H. C. Fassett, fishery expert;

Paul Bartsch, zoologist, representing the United States National Museum;

Clarence E. Wells, assistant and clerk.

The *Albatross* left San Francisco, Calif., October 16, 1907, and, after making short stops at the Hawaiian, Midway, and Guam Islands, reached Manila November 28, 1907. During the next two years the vessel was actively engaged in the survey, with the exception of several months spent at Hong Kong in 1909 undergoing extensive repairs necessitated by hard and continuous service. The work was performed by a series of cruises to different parts of the Philippine Archipelago and adjacent waters, with Manila as a base for supplies and for the storage of collections.

After several months spent in operations in the vicinity of Manila Bay, the *Albatross* made three extensive cruises to the southward during February to June, 1908. One cruise was along the southwest side of Mindanao and thence through the Sulu Archipelago to the most southerly islets of the Philippines, and extended as far as Sandakan in British North Borneo. The second cruise was to the central group of islands of the Philippine Archipelago and included Panay, Negros, Cebu, Bohol, Leyte, Samar, Masbate, and Marinduque. The third cruise of this series was chiefly along the eastern and southeastern coasts of Mindanao, with some time spent also off southeastern and eastern Mindoro.

During July, 1908, operations were for the most part in the China Sea off the coast of southern Luzon; and in October and November there were further activities in the China Sea, including dredging off Hong Kong and Formosa, a visit to Pratas Reef, dredgings and soundings between that reef and the Batan Islands and in that group and the Babuyan Islands, and off northern and western Luzon.

In December, 1908, and January, 1909, there was a cruise through the Calamianes and to the western and southern parts of Palawan, the return trip being by way of British North Borneo, Cagayan Sulu, and Iloilo. This was followed by a special series of trials on grounds lying in and off Manila Bay, with cod trawl lines and hand lines, while collecting with seines and dynamite was conducted on adjacent shores and reefs.

During late February, all of March, and early April, 1909, there were operations along the southern coast of Luzon and among the small islands extending thence to Bohol, with the extension of the cruise through the Cagayanes to the east coast of Palawan and northward to the Cuyo Islands.

Following a visit to Lingayen Gulf in May, 1909, there was a cruise among the small islands north of Samar and on the southeastern coast of Luzon. During July, August, and September, 1909, the vessel was occupied along the southern coast of Samar, the southeastern coast of Leyte, and the northern coast of Mindanao, and thence about Bohol, Negros, Siquijor, and Cebu.

During the first half of September there was active reef collecting with dynamite on the coast of Mindanao south and east of Zamboanga, followed by another cruise through the Sulu Archipelago as far as Darvel Bay and Sibuko Bay, Borneo.

The last major cruise occurred during November and December, 1909, and January, 1910. This covered a part of the Dutch East Indies, including the gulfs of Tomini and Boni in Celebes, Molucca Passage, Patiente Strait, Pitt Passage, Molucca Sea, Briton Strait, Flores Sea, and Macassar Strait.

The homeward voyage from the Philippines was begun January 21, 1910, and, after a general overhauling at Nagasaki, Japan, San Francisco was reached May 4, 1910, thus concluding the most extensive of the many cruises made by this vessel during her long and varied career.

The collections brought back by the *Albatross* were as a whole and in many special groups of animals the largest and most complete ever obtained by one vessel on one expedition. In addition to the marine forms, noteworthy collections of land plants and land animals, especially birds, reptiles, and mollusks, were made, mostly by or under the immediate direction of Dr. Paul Bartsch.

In 1910 there was published Dredging and Hydrographic Records of the United States Bureau of Fisheries Steamer *Albatross* during the Philippine Expedition, 1907–1910 (Bureau of Fisheries Document No. 741, 97 pp.) This publication gives for each station occupied data as to the locality, date, time of day, depth of water, character of bottom, surface and bottom densities, apparatus used, duration of trial and depth at which apparatus was employed, and other particulars of the operations at sea, at anchorages, and on shores and reefs. It appears that 577 dredging stations were established, of which 220 were at depths of less than 100 fathoms, 120 at 100 fathoms or more but less than 200 fathoms, 153 between 200 and 499 fathoms, 72 between 500 and 999 fathoms, and 12 at over 1,000 fathoms. The greatest depths at which dredging was done were 1,804 fathoms in the China Sea off Formosa, 2,275 fathoms in the Sulu Sea, and 1,560 fathoms in the Molucca Sea. The hydrographic stations numbered 41. At these no apparatus for collecting natural history specimens was employed, although at times dip nets were incidentally used during the occupation of such stations; the usual physical data obtained as at dredging stations, including a sample of the bottom, were secured. Hydrographic stations of special interest, at which Lucas' sounding machine and Sigsbee sounding rod were used, were one of 1,570 fathoms in the Sulu Sea off Mindanao and three of 1,220, 1,498, and 1,758 fathoms in the China Sea off Hong Kong.

Immediately on the arrival of the collections in Washington, arrangements were made with specialists in America, Europe, and Asia for studying and reporting on them. The collections in some cases were assigned by the Bureau of Fisheries, in other cases they were transferred to the United States National Museum and by it assigned for study and report.

The series of reports on the aquatic resources of the Philippines and contiguous regions have been published as parts of Bulletin No. 100 of the United States National Museum. Some 23 such reports have been issued and others are in course of preparation and printing. For convenience, the reports are now bound together in volumes with separate title-pages, tables of contents, and indexes.

With the issuance of the outstanding reports, there will be published a general review of the scientific results of the *Albatross* Philippine Expedition.

Hugh M. Smith,
Director of the Expedition.

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POLYCHAETOUS ANNELIDS COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN THE WATERS ADJACENT TO THE PHILIPPINE ISLANDS IN 1907–1910

By A. L. TREADWELL

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By TOKIO KABURAKI

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THE PHILIPPINE LAND SHELLS OF THE GENUS AMPHIDROMUS.

By Paul Bartsch,

Curator, Division of Marine Invertebrates, United States National Museum.

INTRODUCTION.

George Brettingham Sowerby, jr., in his Conchological Illustrations, published between 1832 and 1841, gives the first record of *Amphidromus* in the Philippine Islands. On plate 145 he reproduces a front and back view (fig. 100) of *Bulinus maculiferus*, stating that the specimens are in Lady Harvey's collection. This plate, we are told by Mr. Sherborn [1] was published in 1836. A description of this species was furnished five years later by William John Broderip.[2] Here Broderip describes not only the typical form of *Bulinus maculiferus* Sowerby, but varieties A–F.

The material reported upon in this paper was collected by Hugh Cuming, who writes: "All the varieties, except variety C, were found in the Province of Misamis, in the islands of Mindanao. Variety C was found at Gindulman in the isle of Bohol. All were taken on trunks of trees."

In 1848 the greater part of Lovell Augustus Reeve's monograph of the genus *Bulimus* [3] appeared, and in it we find the following figures and descriptions of Philippine *Amphidromi*.

Plate 6, figures 26*a* and 26*b*, *Bulimus maculiferus* Sowerby from the Province of Misamis, collected by Cuming. These two figures represent 26*a*, *A. maculiferus maculiferus*, and 26*b*, *A. maculiferus cataganensis*, of the present text.

Plate 37, figure 223, represents and the text describes *Bulimus chloris* Reeve. "Eastern Island," the locality from whish this specimen is said to have come, is rather vague, but later references place it in our domain.

[1] Proc. Malac. Soc., vol. 8, 1909, p. 33?.

[2] Proc. Zool. Soc. London, vol. 9, 1841, pp. 14–15.

[3] Conchologia Iconica, vol. 5.

Ludwig Pfeiffer, in the second volume of his Monographia Heliceorum Viventium [1] assigns *Bulinus maculiferus* Sowerby to *Bulimus perversus* Linnaeus, as variety E, but a year later [2] changed his opinion and considered it a valid species. In the above work he gives a full description of this species (p. 134), and *Bulimus chloris* Reeve (p. 137), citing a variety B of the latter, and giving the Philippine Islands with Cuming as authority for the habitat of *A. chloris* Reeve.

In the part on Mollusca, of the Zoology of the Voyage of H. M. S. *Samarang*, 1850, by Arthur Adams and Lovell Reeve, the following statement is found (p. 58): "The animal of *Bulimus chloris* is of a pale brown color, always differing in this respect from that of *B. citrinus*, and of extremely vivacious habits. A bushel of them, collected on the mountains of Mindanao, soon dispersed themselves all over the cabin in which the basket was deposited. The shell was of the same elongated form and deep yellow color throughout, with no indication of bands or markings."

The same year Johan Christian Albers erected the genus *Amphidromus* [3] placing in it, among others, the two species *A. maculiferus* Sowerby and *A. chloris* Reeve., heretofore referred to.

Pfeiffer, in 1853,[4] retains *Bulimus* for the group. He redescribes (p. 319), *B. maculiferus* Reeve and adds a description of var. β, which in the present effort is referred to as *A. maculiferus gracilior* Fulton, and another form γ, which we consider synonymous with *A. maculiferus* as from Mindanao. He also relists *Bulimus chloris* Reeve as in volume 2.

In 1854 Jacques Bernard Hombron and Honore Jacquinot published the Molluscan part of the Voyage au Pole Sud et Dans L'Oceanie of the *Astrolabe* and *Velee*.[5] On page 29 of this work *Bulimus sulphuratus* is described from Samboanga. It is figured on plate 8, figures 10–12. This has since been placed in the synonomy of *Amphidromus chloris* Reeve.

In 1855, Pfeiffer's Monograph on the genus *Bulimus* was published.[6] In it, on pages 117–118, *Bulimus maculiferus* is described, and figured on plate 36, figures 1 and 2, and a variety β on plate 40, figure 9, which has since been described as *Amphidromus maculiferus gracilior* by Fulton.

In the same volume (p. 183), *Bulimus chloris* Reeve, is described and figured on plate 49, figures 7 and 8, and *Bulimus sulphuratus*, Hombron and Jacquinot is placed in the synonomy of it.

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[1] Page 38, 1848.
[2] Zeitschr. f. Malak., 1849, pp. 134, 137.
[3] Die Heliceen, Berlin, 1850, pp. 138–140.
[4] Monographia Helicorum Viventium, vol. 3.
[5] Zool., vol. 5.
[6] Martini-Chemnitz Conchylien Cabinet, vol. 1, pt. 13, p. 1.

The same year he published his Versucheiner Anordung der Heliceen nach naturlichen Gruppen.[1] In this he recognized *Amphidromus* as a subdivision of *Bulimus* (pp. 146–147), and referred the above-mentioned species to it. Here he also assigned a lot of *Helicostyla* erroneously to this group.

Henry and Arthur Adams in 1858 referred[2] *Bulimus chloris* Reeve, and *B. maculiferus* Sowerby, to the subgenus *Canistrum* Klein, which they considered synonymous with *Amphidromus* Albers and *Balea* of Blainville.

In the fourth volume of Pfeiffer's *Monographia Heliceorum Viventium* published in 1859, we find on pages 381 and 382 the references to *Bulimus maculiferus* Sowerby and *Bulimus chloris* Reeve, given in his third volume, and in the publications in which these species have been alluded to since that volume was issued, *Bulimus sulphuratus* is lisited under *B. chloris.*

In 1867 the volume on Mollusca of Die Preussische Expedition nach Ost.-Asien, by Edward von Martens, appeared. In this[3] (p. 351), *Bulimus sulphuratus* of Hombron and Jacquinot is made a subspecies of *Bulimus perversus* Linnaeus, and considered quite distinct from *Bulimus chloris* Reeve.

The sixth volume of Pfeiffer's Monographia Heliceorum Viventium, 1868 (pp. 25–26), cites references to the previous volume and gives the notations listed in our remarks since its publication in 1859.

Carl Semper, in his Reisen im Archipel der Philippinen[4] describes the anatomic characters for the genus *Amphidromus*, giving the anatomy of *Amphidromus maculiferus* Sowerby (p. 146), and illustrating it on plate 14, fig. 1; and on pages 141–149 he cites the places in Mindanao and Bohol from which he has seen specimens. He describes three yellow shells with a single or double varix, which had been given to him and were said to have come from Cebu, but does not bestow a name upon them.

He also lists *Amphidromus chloris* Reeve (p. 148), from Zamboanga, and considers *A. sulphuratus* Hombron and Jacquinot synonymous with it.

In 1877 Pfeiffer's eighth volume of his Monographia Heliceorum Viventium was published, and here, as in the previous volumes, he gives the additional references which have been occasioned since the publication of volume 6, in 1868.

In the same year Joaquin G. Hidalgo published a small paper entitled Description d'un Amphidromus et d'un Cyclophorus nou-

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[1] Malak Blat., vol. 2, 1855.
[2] Genera of Recent Mollusca, vol. 2, p. 143.
[3] Zoologischer Theil, vol. 2.
[4] Zweiter Theil, Wiss. Res., vol. 3, 1873.

veaux provenant les isles Philippines.[1] In this, *Amphidromus quadrasi* is described and figured (pl. 2, fig. 2), from Caramandanes Island.

The following year the same author reached the present genus in his series of papers entitled Recherches conchyliologiques de M. Quadras aux iles Philippines.[2] He discusses these Philippine forms (pp. 31–34).

He figures (pl. 6, fig. 1) the variety of *Amphidromus maculiferus* which is now named *A. philippinensis.* He assigns the yellow and pale form of what was later described as *A. entobaptus* Dohrn to *Amphidromus perversus* Linnaeus and refers at length to *A. chloris* and corrects the locality name given in the previous volume for *Amphidromus quadrasi* from Caramandanes to Candaramanes Island, a member of the Balabac group.

He also lists *Amphidromus contrarius* Muller from Balabac and Luzon. The second citation is undoubtedly due to a market specimen, as *Amphidromus* does not occur on Luzon, and the first may also be a market shell or else a form of the *A. quadrasi* group. *A. contrarius* Muller belongs to Timor.

In 1889 Dr. Heinrich Dohrn's Beitrag zur Conchylienfauna der Philippinischen Insel Palawan appeared.[3] In this the yellow *Amphidromus* from the region of Puerto Princesa is described as *Amphidromus entobaptus.* The next year the first part of Joaquin Gonzalez Hildago's Obros Malacologicos[4] appeared. On pages 17–18 the description of *A. quadrasi* Hidalgo is published.

In 1893 Edgar A. Smith published his report On a Small Collection of Land Shells from Palawan and Balabac, Philippine Islands.[5]

Here four figures (10–13, pl. 18) are given of *Amphidromus quadrasi* and forms *a—f*, described from a series of a hundred specimens from Balabac. The same year Otto Franz von Möllendorff's Materialien zur Fauna der Philippinen XI Die Insel Leyte appeared.[6] In this *Amphidromus maculiferus multicolor* is described from Leyte and Camotes.

The following year Edgar Albert Smith published his report On the Land Shells of the Zulu Archipelago.[7] In this (p. 55) he describes and figures (pl. 4, figs. 9, 9*a*) a variety of *Amphidromus maculiferus* from Bilitan Island, which is now named *A. philippinensis* Fulton.

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[1] Journ. d. Conch. Paris, vol. 35, 1887, pp. 36–37.
[2] Idem, vol. 36, 1888.
[3] Nachr. Deut. Malak. Ges., vol. 20, pp. 53–63.
[4] Mem. Real Acad. Clen., Madrid, vol. 14.
[5] Ann. Mag. Nat. Hist. London, ser. 6, vol. 11, 1893, pp. 347–353.
[6] Bericht, Senck. Natuz. Ges. Frankfurt am Main, 1893.
[7] Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894.

The same year Zur Mollusken Fauna der Sulu Inseln, by Otto Franz von Möllendorff, was published.[1] On pages 210 and 211 *Amphidromus roeseleri* is described from Sulu Island, and the variety of *A. maculiferus* mentioned, described, and figured by Smith from Bilitan Island, mentioned in the last reference, is described on page 211.

A year later Edgar Albert Smith's paper On a Collection of Land Shells from Sarawak, British North Borneo, Palawan, and other Neighboring Islands[2] appeared. In this he lists *Amphidromus quadrasi* Hidalgo (on pp. 98–99) from Candaraman, and *A. entobaptus* Dohrn (on p. 99) from Palawan.

In 1896 the genus *Amphidromus* was subjected to a critical revision by Hugh Fulton in A List of the Species of Amphidromus Albers, with Critical Notes and Descriptions of some Hitherto Undescribed Species and Varieties.[3] In this (p. 67) he refers *Amphidromus chloris* Reeve to *A. perversus* Linnaeus or a subspecies, and *A. entobaptus* Dohrn is also considered a subspecies of *A. perversus* Linnaeus. *Amphidromus maculiferus* and varieties *gracilior* Fulton, *strigata* v. Möllendorff, and *obscura* Fulton are described from Mindanao; while variety *inflata* Fulton is referred to Philippine Islands without specific locality. Variety *multicolor* Möllendorff is listed from the island of Leyte (pp. 74 and 75), and *Amphidromus roescleri* Möllendorff described (p. 75) from Bilitan Island.

Amphidromus quadrasi Hidalgo is reported from Balabac Island (p. 85), and *A. q.*, variety *solida* Fulton, is described (p. 86) and figured (pl. 5, fig. 16).

Amphidromus versicolor Fulton, described (p. 86), embraces part of the complex referred to by Smith[4] as varieties of *A. quadrasi*. *Amphidromus dubius* Fulton is diagnosed (pp. 86 and 87) and figured (pl. 6, figs. 1, 1*a*) and comes from Balabac Island, while *Amphidromus everetti* Fulton, also a member of the *A. quadrasi* complex described as a variety of that species by Smith[5] as coming from Palawan, is given specific rank on page 87.

In the same year R. P. Fr. Casto de Elera published the third volume of his Catalogo Sistematico de toda la Fauna de Filipinas. On pages 617 and 618 he lists *A. chloris* Reeve from Mindanao, Basilan, and Mindoro; *A. maculiferus* Sowerby from Bohol, Camotes, Leyte, Maasin, Bato, and Mindanao, and *Amphidromus* variety *multicolor* Möllendorff from Leyte, Maasin, Bato, and Camotes.

To *Amphidromus contrarius* Muller the rather large range of Luzon, Balabac, and Timor is assigned.

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[1] Nachr. Deut. Malak. Ges., vol. 26, pp. 205–215.
[2] Proc. Zool. Soc. London for 1895.
[3] Ann. Mag. Nat. Hist., ser. 6, vol. 17.
[4] Idem, vol. 11, 1893, p. 351, pl. 18, figs. 11–13.
[5] Idem, p. 350, pl. 18, fig. 12.

A. entobaptus is reported from Porto Princesa, Paragua (=Palawan); *A. perversus* Linnaeus variety from Busuanga, Mindanao, and Zamboanga, and *A. quadrasi* Hidalgo from Candaramanes.

A. cosmandanus Crosse is erroneously listed (p. 618) as *Amphidromus*. This, we learn later from Pilsbry,[1] is *Helicostyla crossmanniana* Crosse.

Joaquin Gonzales Hidalgo, in his beautiful Atlas Obras Malacologicas[1] reached Amphidromus in 1898. He devoted three plates to the Philippine forms, 99–101. On plate 99, figures 1 and 2 represent a large inflated yellow shell with a whitish band at the summit of its whorls, and a dark varix on the last turn, which is listed under the designation of *A. maculiferus* Sowerby var. This we learn from correspondence with Señor Hidalgo, comes from Dapitan, Mindanao. It is our *Amphidromus hidalgoi*. Figures 3 and 4 represent *A. chloris* Reeve, and 5–8, *A. entobaptus* Dohrn.

Plate 100 has 6 figures showing races of *A. maculiferus* Sowerby. Of these, figures 1, 4, 5, and 6 represent my *Amphidromus maculiferus cotabatoensis*, and figures 2 and 3 appear referable to my *Amphidromus maculiferus cataganensis*.

Plate 101, figures 1–4, are said to represent *A. nigrofilosus* Rochebrune. They are in reality *A. maculiferus gracilior* Fulton. Figures 5 and 6 illustrate *A. quadasi* Hidalgo and 7 and 8 *A. dubius* Fulton.

In his Verzeichness der auf Philippinen Lebenden Landmollusken,[2] Dr. Otto von Möllendorff lists on pages 148–150 the following: *A. entobaptus* Dohrn, from Paragua, with subspecies *gracilis* Möllendorff from Linapakan and Busuanga, and subspecies *contracta* Möllendorff from Koron and Kalamianes. These two names are *nomena nuda* and have no status. *Amphidromus chloris* Reeve is listed from Mindanao (Samboanga), *A. maculiferus* Sowerby from western Mindanao. Of this he lists subspecies *strigata* Möllendorff (="*Amph. mac.* var. *gracilior* et *strigata*, Fulton") from eastern Mindanao and Bohol. Subspecies *multicolor* Möllendorff, from Leyte and Camotes; subspecies *obscurus* Fulton from Mindanao and subspecies *inflatus* Fulton.

Amphidromus quadrasi Hidalgo is credited to Balabac and subspecies *solidus* Fulton to Paragua. *A. versicolor* Fulton and *A. dubius* Fulton are both listed from Balabac, and *A. everetti* Fulton from Paragua.

The last to give these shells consideration was Dr. Henry A. Pilsbry, who monographed the genus in 1900.[3] In this he recognizes

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[1] Mem. de la Real Acad. de Sci. Madrid, 1890–1904.
[2] Abhand. Narturf. Ges. Gorlitz, vol. 22, 1898.
[3] Man. Conch., vol. 13, pp. 127–234.

(pp. 130–133) *Amphidromus maculiferus* Sowerby with variety *obscurus* Fulton; subspecies *multicolor* Möllendorff; subspecies *gracilior* Fulton; variety *strigata* Möllendorff; subspecies *inflatus* Fulton, *Amphidromus chloris* Reeve (pp. 143–144) with variety *pallidulus* Pilsbry from Zamboanga and varieties *purissimus* Pilsbry and *rosa* Pilsbry from Basilan Island.

A. roeseleri Möllendorff is listed on pages 144–145—*A. entobaptus* Dohrn on pages 145–147. *A. lindstedti* Pfeiffer is referred to as coming from Balabac according to Fulton (pp. 228–229). As we have said before, the Balabac specimens cited probably refer to some of the forms of *A. quadrasi* Hidalgo. *A. lindstedti* Pfeiffer comes from Malacca.

Amphidromus quadrasi Hidalgo is treated (pp. 229–230) and *solidus*, *versicolor*, *dubius*, and *everetti* of Fulton are recognized.

GEOGRAPHIC DISTRIBUTION.

The genus *Amphidromus* presents some very fascinating zoogeographic problems in the Philippine Islands, and, when fully studied, will undoubtedly throw considerable light on the derivation and dispersal of the Philippine land shells. At present the available information is fragmentary, and more material with specific locality notes is badly needed.

There are several distinct groups which show a northward migration from Borneo into the Philippine Archipelago. One of these is the group of *Amphidromus quadrasi*, which has undoubtedly come from some Bornean stock and is extending its range northward into Palawan. At the present time it is distributed over Balabac and the adjacent islands.

Then there is the group of *Amphidromus entobaptus*, which extends over Palawan and the Calamianes group, apparently splitting up into races in the islands of the latter group, and a generic label "Calamianes," which was applied by the older collectors to material from this group, is absolutely insufficient to enable one to understand the complex or the conditions and causes for the variations presented by a mixture of forms assembled from the various places within the group. This is well shown by the specimens which we have had for examination which have enabled us to recognize a number of races, each practically confined to a separate island. The northernmost extension of the yellow *Amphidromus* is found in Mindoro in the large inflated species now described as *A. mindoroensis*.

No *Amphidromus* has been reported from Luzon (the term "Manila" seen at times on old labels simply means that they were purchased in the Manila markets and not that they occur at or about Manila), nor do any *Amphidromi* occur on any of the smaller islands, as far as known, intervening between Mindoro and Luzon or Panay.

The group of *A. chloris*, embracing *roeseleri* and *suluenis*, extends over the Sulu Archipelago and Zamboanga, Mindanao, and it appears as if it had been derived from Borneo and had reached Mindanao through the chain of islands which extend from Borneo to Mindanao, through Tawi Tawi, Jolo, etc.

Amphidromus inflatus, *pallidulus*, *mearnsi*, and *calista* are yellow forms which, though the last is at times variously marked with red, combine the yellow coloration of the *chloris* group with the black filations of *maculiferus*.

By far the most satisfactory lot of material which we have had for our study belongs to the group of *Amphidromus maculiferus*, which divides up into a series of geographic races, beautifully accounted for by the separate habitats which they occupy. A full discussion of this group will be found preceding the description of this species and its races.

I wish to acknowledge my deep appreciation of the courtesies extended to me by the authorities of the United States Bureau of Fisheries and the United States National Museum, in assigning the collection of mollusks made by the Fisheries steamer *Albatross* in the Philippines, to me for report. Also to the Philippine Bureau of Sciences for material sent for report, and to Dr. H. A. Pilsbry, of the Philadelphia Academy of Natural Sciences, for the loan of the Philippine Amphidromi in the collection of the academy, and to Dr. Frank C. Baker, of the Chicago Academy of Sciences, and Walter F. Webb, of Rochester, New York, for similar reasons. I wish also to express my sincere thanks to Dr. William H. Dall, honorary curator of the Section of Mollusks, United States National Museum, for his counsel and many suggestions.

The photographs used in the illustrations were made by the Division of Photography, United States National Museum, and were retouched by Mrs. E. B. Decker.

GROUP OF AMPHIDROMUS MACULIFERUS.

The group of *Amphidromus maculiferus* extends over the southeastern islands of the archipelago, its chief center being Mindanao. When one looks at a topographic or relief map of the Philippine Islands, particularly Mindanao, one sees that this island is composed of a series of smaller islands which have been fused into the large territory by a comparatively moderate raising of that part of the ocean floor, and the *Amphidromi* reflect this state of affairs beautifully.

Amphidromus maculiferus Sowerby ss. was described from material collected by Hugh Cuming in Misamis Province, Mindanao, and is undoubtedly a coastal race. The material before us agrees well with Sowerby's figure, which represents an elongate-ovate, spotted form without varices.

On the slopes of Mount Malindang another form occurs, which is decidedly shorter, more chubby, more brightly colored, with a few faint indications of varices. To this race I have given the subspecific name *cataganensis.*

In the Cotabato region, or, in other words, the lower Rio Grande Valley, we find another race which is profusely spotted and provided with very strong, dark, varicial bands. To this race I have applied the name *cotabatensis.*

In the upper regions of the Rio Grande, about Lake Buluan, we find another race, which lacks the spotting altogether, but has strong, brown varices, which I have called *buluanensis.*

On the southeast coast of Mindanao, along the shores of the Gulf of Davao, another race occurs, which is very elongate-ovate, has alternating pale-brown and hydrophanous axial bands and a general rosy suffusion on the surface. This is von Möllendorff's *strigatus.*

On northeastern Mindanao still another race is found, which is nearest allied to *strigatus*, but is always pale, lacking the rosy suffusion and also the dark varicial bands. This is *gracilior* Fulton.

North of Mindanao, the islands of Bohol, Leyte, and Samar each contain a race of *maculiferus.* That in Bohol is smaller than *strigatus* and *gracilior*, and is provided with alternating bands of pale brown and dingy white. This I shall term *boholensis.* On the island of Leyte we have the race named *multicolor* by von Möllendorff. It is an exceedingly dark-colored race, by far the most marked of all the forms so far mentioned. The race living on the island of Samar is more nearly related to that of Bohol than to that of Leyte. It is of darker color and stouter form than the Bohol race, and may be known as *samarensis* Bartsch.

South of Mindanao we have the race now described as *cosmius* Bartsch, occurring on Basilan Island. This race is the smallest of the entire group. It has the general form and markings of *gracilior* Fulton, but differs from it by its diminutive size and a much lesser number of hydrophanous bands and in being suffused with faint yellow.

An additional race from the island of Cebu is indicated by Semper, who is quoted on page 18.

As derived from the group of *maculiferus* may be considered the mountain species occurring on Mount Malindang and Mount Apo in Mindanao. Both of these forms have the dark filations on the early whorls, which indicate relationship to *maculiferus*, but the rest of the characters are sufficient in my estimation to entitle them to full specific rank, and so I have called them *malindangensis* and *apoensis.* These two forms have developed along parallel lines, but are quite distinct.

The little race of *Amphidromus* occurring on the island of Basilan, which I have called *basilanensis*, is related to these last two forms, as is the shell from Lampinigan Island, which is too poor to serve for diagnosis.

There remains but one shell of the group of *maculiferus* which is to be considered in this monograph and that is *Amphidromus floresi.* This form has indications of the black filations on the early whorls which would ally it to *maculiferus*, but it differs markedly in form from any of these and also in its sculpture, the surface being ornamented with numerous, slender, thread-like riblets. This shell comes from southeastern Mindanao.

DESCRIPTIONS OF SPECIES.

AMPHIDROMUS MACULIFERUS MACULIFERUS Sowerby.

Plate 2, figs. 1–5.

Bulinus maculiferus Sowerby, Conch. Ill., 1838, pl. 145, fig. 100.

Bulinus maculiferus Broderip, Proc. Zool. Soc. London, vol. 9, 1841, pp. 14–15.

Bulimus maculiferus Reeve, Conch. Icon., vol. 5, 1848, pl. 6, fig. 26*a*.

Bulimus perversus Linnaeus, var *E.* Pfeiffer, Mon. Hel. Viv., vol. 2, 1848, p. 38.

Bulimus maculiferus Pfeiffer, Zeitschr. f. Malak., 1849, p. 134.

Amphidromus maculiferus Albers, Heliceen, 1850, pp. 138–140.

Bulimus maculiferus Pfeiffer, Mon. Hel. Viv., vol. 3, 1853, p. 319.

Bulimus maculiferus, var Pfeiffer, Mon. Hel. Viv., vol. 3, 1853, p. 319.

Bulimus maculiferus Pfeiffer, Mart. Chem. Conch. Cab., vol. 1, pt. 13, 1855, pp. 117–118, pl. 36, figs. 1–2.

Bulimus (Amphidromus) maculiferus Pfeiffer, Malak. Blät., 1855, vol. 2, p. 147.

Bulimus (Canistrum) maculiferus H. and A. Adams, Gen. Rec. Moll., 1858, p. 143.

Bulimus maculiferus Pfeiffer, Mon. Hel. Viv., vol. 4, 1859, p. 381.

Bulimus maculiferus Pfeiffer, Mon. Hel. Viv., vol. 6, 1868, p. 25.

Amphidromus maculiferus Semper, Reis. Arch. Phil., vol. 3, 1873, p. 146, pl. 14, fig. 18.

Bulimus maculiferus Pfeiffer, Mon. Hel. Viv., vol. 8, 1877, p. 39.

Amphidromus maculiferus Hidalgo, Journ. de Conch., vol. 36, 1888, p. 31.

Amphidromus maculiferus Elera, Cat. Sist. Faun. Filip., 1896, p. 617.

Amphidromus maculiferus obscura Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

Amphidromus maculiferus von Möllendorff, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 149.

Amphidromus maculiferus obscura von Möllendorff, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 149.

Amphidromus maculiferus Pilsbry, Man. Conch., vol. 13, 1900, pp. 130–131, pl. 49, figs. 19–21.

Amphidromus maculiferus obscura Pilsbry, Man. Conch., vol. 13, 1900, p. 131.

Shell elongate-ovate, whorls moderately rounded, marked by incremental lines only. The first three whorls have a narrow, black band appearing above the suture, while the rest is white. The remaining turns are yellowish white, profusely spotted with irregularly shaped blotches of chestnut brown, which are bordered by a lighter area and usually preceded by a white area. There are no strongly developed varicial streaks; if shown at all they are indicated as mere faint lines.

The type of *A. maculiferus* was collected by Hugh Cuming in Misamis Province, Mindanao. The material which I have examined comes from the same region. The following table gives additional data as to number of whorls and measurements:

Cat. No. U.S.N.M.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
244668	7	70	32.7	Camp Overton, Mindanao	E. A. Mearns.
244668	6	59	32.7	....do	Do.
244669	7	66.5	31.6	....do	J. Clemens.
244670	6	60.5	32.8	Camp Pantar, Angus. R. 4 miles from Lake Lanao, Mindanao.	E. A. Mearns.
244671	......	......	......	Tangob, Misamis, Mindanao; a young individual.	
99567	6	62.3	32.2	P. I., without specific locality	

AMPHIDROMUS MACULIFERUS CATAGANENSIS, new subspecies.

Plate 3, figs. 1–5.

Bulimus maculiferus Reeve, Conch. Icon., vol. 5, 1848, pl. 6, fig. 26*b*.
Amphidromus maculiferus Hidalgo, Mem. Real Acad. Sci. Madrid, 1896, pl. 100, figs. 2–3.

Shell ovate, dextral, or sinistral. Whorls well rounded, appressed at the summit and marked by lines of growth only. Sutures strongly constricted. Aperture moderately large; outer lip expanded and reflected; inner lip almost vertical, slightly twisted and reflected over the narrow umbilicus; parietal wall covered with a moderately thick callus. The first two volutions are bordered with a narrow black band at the suture, the rest being white; the next two are yellowish white, while the succeeding may have the same ground color or they may be suffused with a rosy blush and are marked by irregular, wavy, somewhat protractive, brown axial bands and a few irregularly placed, scattered spots of brown which are usually preceded by a lighter area.

The type and two specimens of this species were collected by Lieut. Col. Edgar A. Mearns at Catagan, Mindanao, on the Mount Malindang Expedition, at 1,100 feet altitude. The type, Cat. No. 244672, U.S.N.M., has six whorls and measures—length, 52 mm.; diameter, 31 mm. The following additional specimens have been examined:

Cat. No., U.S.N.M.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
244672[1]	6	52	31	Catagan, Mindanao, 1100 feet	E. A. Mearns.
244672	6	56	31.2	.....do	Do.
244672	6.2	56.6	30	.....do	Do.
244673	6.2	55.5	29	Mount Malindang, 3500 to 9200 feet (fragment).	Do.
244274	......	......	29	.....do	Do.

[1] Type.

AMPHIDROMUS MACULIFERUS COTABATENSIS, new subspecies.

Plate 1, fig. 1; plate 4, figs. 1–8.

Amphidromus maculiferus Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, p. 74, 1896.

Amphidromus maculiferus Hidalgo, Mem. Real Acad. Sci., Madrid, pl. 100, figs. 1, 4, 5, 6, 1898.

Shell elongate-ovate with the whorls well rounded, appressed at the summit, with the sutures moderately constricted; lip normal. First two whorls white, excepting a narrow, black band immediately above the suture. The succeeding two are dingy white, and the remainder yellowish white, in places suffused with pale brown. The first one succeeding the dingy white turns bears a number of zigzag, axial bands of brown with a few spots of the same color, while the rest are marked with numerous, more or less elongate dots of brown, which are preceded by a whitish area. In addition to the above, the whorls are also crossed by a number of strong, dark brown varices.

The type (Cat. No. 244676 U.S.N.M.) comes from Cotabato, Mindanao. It has 6.2 whorls and measures—length 57 mm.; diameter 31.5 mm. The following specimens have been examined:

Cat. No. U.S.N.M.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
244676[1]	6.2	57	31.5	Cotabato, Mindanao	E. A. Mearns.
244676	6.3	60.5	32.1	....do	Do.
244676	6.5	59.5	31	....do	Do.
244676	6.7	61	31	....do	Do.
244676	......	......	......	Cotabato, Mindanao, one young specimen.	Do.
244677	6.6	60.3	30.3	Cotabato, Mindanao, five additional young specimens.	Do.
184564	6.5	57.4	30	Cotabato, Mindanao	von Möllendorff.
244678	6.5	61.7	33	....do	E. A. Mearns.
244678[2]	6.7	57.6	30.5	....do	Do.
244679	6.6	54	31	Libungan River and La'bas River, Rio Grande Valley, Mindanao.	Do.
244679	......	......	33.6	Libungan River and La'bas River, Rio Grande Valley, Mindanao, young individual, dextral.	Do.
105023	......	......	33.5	Loc.?	
215578	7.2	66.5	35.4	Kidapawan, Cotabato	Webb.
302840	6.3	58.2	32.8	Kidapawan, Cotabato, Mindanao.	Henderson.

[1] Type. [2] Dextral.

AMPHIDROMUS MACULIFERUS BULUANENSIS, new subspecies.

Plate 5, figs. 1–6.

Shell elongate-conic, with the whorls moderately rounded and appressed at the summit and the sutures moderately constricted, the first two whorls bearing the dark filation in the suture, the succeeding ones pale brown with an occasional retractive streak of light brown or dingy white. These varicial streaks become much intensified on the last two volutions. The spotting is entirely absent. Aperture normal.

The type (Cat. No. 244688, U.S.N.M.) was collected with two other specimens on the trail between Simpitan and Buluan, Mindanao, by Lieut. Col. Edgar A. Mearns. The type has seven whorls and measures—length, 66.2 mm.; diameter, 33.4 mm. Some of the specimens have the whorls a yellowish white instead of light brown. These are dead specimens and have probably been bleached. The following material has been examined:

Cat. No. U.S.N.M.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
244680	7.2	65.5	32.7	Trail from Simpitan to Buluan, Mindanao.	E. A. Mearns.
244680	7.1	64	32.8	.....do	Do.
244680	7	59.8	30.3	.....do	Do.
244680	......	......	......	Trail from Simpitan to Buluan, Mindanao, young individual.	Do.
244683	7	65	34	Trail from Simpitan to Buluan, Mindanao.	Do.
244683	7	60.7	32.3	.....do	Do.
244683	7	59.7	29.5	.....do	Do.
244683	......	......	......	Trail from Simpitan to Buluan, Mindanao, young.	Do.
244686	7	63.5	34	Trail from Simpitan to Buluan, Mindanao.	Do.
244686	6.8	59	32	.....do	Do.
244686	7	58	29.4	.....do	Do.
244686	......	......	......	Trail from Simpitan to Buluan, Mindanao, two young.	Do.
244688[1]	7	66.2	33.4	Trail from Simpitan to Buluan, Mindanao.	Do.
244688	7	58.6	30.8	.....do	Do.
244688	6.5	56.6	30	.....do	Do.
244687	6.5	59.5	33	Lake Buluan, Mindanao	Do.
105023a	......	......	......	Young individual without locality	Do.
244685	6.5	60	33.2	Buluan, Mindanao	Do.
244685	7	62.6	31.5	.....do	Do.
244685	7	64.9	31.7	.....do	Do.
244685	7	65.3	32.5	.....do	Do.
244682	7	62.5	33	.....do	Do.
244682	6.5	60	30.5	.....do	Do.
244682	6	63.5	32.2	.....do	Do.
244682	......	......	33	Buluan, Mindanao, fragment	Do.
244684	7	60.2	31.2	Buluan, Mindanao	Do.
244684	......	......	......	Buluan, Mindanao, one young individual.	Do.

[1] Type.

AMPHIDROMUS MACULIFERUS STRIGATUS (von Möllendorff) Fulton.

Plate 6, figs. 1–5.

Amphidromus maculiferus Hidalgo, Journ. de Conch., vol. 36, 1888, p. 31.

Amphidromus maculiferus, var. *strigata* Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

Amphidromus maculiferus Elera, Cat. Sist. Faun. Filip., 1896, p. 617.

Amphidromus maculiferus strigatus (von Möllendorf) Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

Amphidromus maculiferus strigatus von Möllendorff, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 149.

Amphidromus maculiferus gracilior Pilsbry, Man. Conch., vol. 13, 1900, p. 132.

Amphidromus maculiferus gracilior, var. *strigata* Pilsbry, Man. Conch., vol. 13, 1900, p. 132.

Shell very elongate-ovate. The first two whorls have the narrow dark band in the suture, the rest are white. The succeeding turns are flesh colored, with very retractively slanting dark brown varices and similarly disposed light hydrophanous bands. Some scattered, elongate dots are also present. Aperture normal.

This race is said by von Möllendorff to occur in Eastern Mindanao. Six specimens from the von Möllendorff collection, from Davao, Mindanao, are in the United States National Museum. The following material has been examined:

Cat. No.	Collection.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
184565	U.S.N.M......	6.5	67.5	33.5	Davao, Mindanao..	von Möllendorff.
184565	.....do.........	7	67.5	32.3	.....do..............	Do.
195849	.....do.........	7.1	70.5	32.4	.....do..............	Do.
195849	.....do.........	7	67.3	31.4	.....do..............	Do.
195849	.....do.........	7	69.7	34.5	.....do..............	Do.
195849	.....do.........	6.5	60	32.3	.....do..............	Do.
	Webb.........	7	66	30.2	.....do..............	Quadras.

AMPHIDROMUS MACULIFERUS GRACILIOR Fulton.

Plate 7, figs. 5–6.

Bulimus maculiferus, var. β PFEIFFER, Mon. Hel. Viv., vol. 3, 1853, p. 319.

Bulimus maculiferus, var. β PFEIFFER, Mart. Chem. Conch. Cab., vol. 1, 1855, pl. 40, fig. 9.

Amphidromus maculiferus, var. β SEMPER, Reis. Arch. Phil., vol. 3, 1873, p. 149.

Amphidromus maculiferus, var. *gracilior* FULTON, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 74.

Amphidromus maculiferus ELERA, Cat. Sist. Faun. Filip., 1896, p. 617.

Amphidromus nigrofilosus HIDALGO, Mem. Real Acad. Sci. Madrid, 1898, pl. 100, figs. 1–4.

Amphidromus maculiferus gracilior PILSBRY, Man. Conch., vol. 13, 1900, p. 132.

Shell very elongate-ovate; the first two whorls have a very broad, black band which frequently covers half of the turns, the rest of the early whorls being white. The whorls succeeding are yellowish white with numerous, retractively slanting hydrophanous bands, which are of irregular width and distribution. There are no dark varices. The whorls are rather high between the sutures, strongly appressed at the summit, and well rounded. The aperture is normal. The following material has been examined.

Cat. No.	Collection.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
184566	U. S. N. M.	7.3	72	32.8	Mindanao	von Möllendorff.
	Chicago Acad. Sci.	7	69.2	33	Mainit, Mindanao	Quadras.
	Webb	6.5	58.7	28.6	do	Do.
	do	6.5	64.5	29.5	do	Do.
	do	6.8	60	28.5	do	Do.

AMPHIDROMUS MACULIFERUS BOHOLENSIS, new subspecies.

Plate 1, fig. 2; plate 7, figs. 1–3.

Bulimus maculiferus, var. C. BRODERIP, Proc. Zool. Soc. London, vol. 9, 1841, pp. 14–15.
Amphidromus maculiferus SEMPER, Reis. Arch. Phil., vol. 3, 1873, p. 149.
Amphidromus maculiferus ELERA, Cat. Sist. Faun. Filip., 1896, p. 617.

Shell elongate-ovate. Whorls moderately well rounded and appressed at the summit; sutures moderately constricted; aperture normal. The first two turns show a faint, black band in the suture, the rest being white. The succeeding turns are marked by alternate retractively slanting bands of pale brown and dingy white, the latter usually a little broader than the brown areas. There are no distinct dark varices.

The type and nine specimens of this species were collected by A. Celestino, at Sevilla, Bohol. The type (Cat. No. 245563, U.S.N.M.) has six and a half whorls and measures—length, 57 mm.; diameter, 27.5 mm. The following specimens have been examined:

Cat. No.	Collection.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
245563 [1]	U. S. N. M.	6.5	57	27.5	Sevilla, Bohol	A. Celestino.
245563	do	6.5	57.5	28	do	Do.
245563	do	6.3	56.5	28.4	do	Do.
245563	do	6.1	51.3	27	do	Do.
215577	do	6.5	58.5	30.2	Belar	Webb.
	Phil. Bur. Sci.	6.5	55.5	28	Sevilla	A. Celestino.
	do	6.5	59.5	29.2	do	Do.
	do	6.1	55.3	28.6	do	Do.
	do	6.3	60.5	30.5	do	Do.
	do				Sevilla, Young	Do.
	Chicago Acad. Sci.	6.5	55	26.5	Bohol	Quadras.
	Webb	6.5	62.2	30	do	Do.
	do	6.3	55.4	28.5	Belar, Bohol	Webb.

[1] Type.

AMPHIDROMUS MACULIFERUS MULTICOLOR von Möllendorff.

Plate 8, figs. 1, 2, 4, 5.

Amphidromus maculiferus SEMPER, Reis. Arch. Phil., vol. 3, 1873, p. 149. 1893, p. 99.
Amphidromus maculiferus, var. *multicolor* FULTON, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 74.
Amphidromus maculiferus ELERA, Cat. Sist. Faun. Filip., 1896, p. 617.
Amphidromus maculiferus multicolor VON MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 149.
Amphidromus maculiferus multicolor PILSBRY, Man. Conch., vol. 13, 1900, pp. 131–132.

Shell elongate-ovate; the first two whorls with the usual narrow black band at the suture, the rest with alternating, retractive bands of yellowish white and brown, the brown bands on the last whorl following a somewhat zigzag course and being more closely spaced on the last turn than on those preceding. The white bands between the darker appear as if superimposed upon a dark ground. The inside of the lip is of a purplish blue color, while the peristome is white. The shell in its entirety is much darker than any of the other races of *A. maculiferus.* One of the specimens in the Webb collection has a tendency toward spiral lines of brown on the last volution. We have seen the following specimens:

Cat. No.	Collection.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Collector.
184562	U. S. N. M.	6.4	56.5	26	Leyte	von Möllendorff.
	Chicago Acad. Sci.......	6.2	60	29	Matalon, Leyte..	Quadras.
	.....do..........	6.3	59.5	29.9	Sitio Busay, Massin, Leyte	Do.
	Webb..........	6.5	58.5	28.5	Sitio, Jonas, Bato, Leyte.	Do.

AMPHIDROMUS MACULIFERUS SAMARENSIS, new subspecies.

Plate 7, fig. 4.

Shell very similar in outline to *boholensis*, but stouter, with the brown bands much darker. The narrow black band on the first two whorls is very faint. The lines of growth are also a little stronger in this than in *boholensis.* The type (Cat. No. 215579, U.S.N.M.) was collected by Quadras on the island of Samar. It has 6.5 whorls and measures—length, 56.4 mm.; diameter, 29 mm.—and was presented to the Museum by Mr. Webb.

AMPHIDROMUS MACULIFERUS, subspecies?

Semper, in his Reisen im Archipel der Philippinen (vol. 3, p. 149), 1873, writes:

> Finally, I have in my possession three examples of a form which were presented to me in Cebu, of which the specific locality in which they were found was unknown. The shell is much more inflated than in the named varieties of *maculiferus*, of a beautiful yellow color, with a simple or double brown varix. The apex is edged with black, and in two of the examples a few brown spots are present under the suture. The dimensions of the two extreme forms are:
>
> Long. 57, diam. maj. 35, min. 28; apert. alt. 29, lat. 15 mm.
>
> Long. 64, diam. maj. 31, min. 26; apert. alt. 30, lat. 14 mm.
>
> This probably is nearest related to *Amphidromus palaceus* var. *sulfureus*, but I dare not take the responsibility for deciding whether that should be placed here or not. I am equally reluctant to describe it as a new species, since I do not consider that I have sufficient material.

I have not seen specimens from the island of Cebu, and therefore simply call attention to the fact that these three specimens which Semper had seen may have come from that island; and if so, it is quite likely that they represent something different from any of the forms that are mentioned in this paper.

AMPHIDROMUS MACULIFERUS, subspecies?

From Lampinigan Island I have a shell which is badly worn, Cat. No. 244692, U.S.N.M., collected by Lieut. Col. Edgar A. Mearns, which differs from any of the described forms. There are traces of brown markings on the badly worn white surface which indicate that it probably belongs near *A. basilanensis*.

AMPHIDROMUS MACULIFERUS COSMIUS, new subspecies.

Plate 9, fig. 4.

Shell elongate-ovate, very thin, yellowish white, with the whorls moderately rounded and the summit of the whorls appressed. The first two whorls show the narrow, faint dark band immediately above the suture. The succeeding turns are marked by irregularly disposed, hydrophanous axial bands of variable width, which are most pronounced on the third and fourth turns. The last whorl is marked by weak axial threads, the remainder being marked by mere incremental lines. Aperture oval; outer lip somewhat expanded and reflected, thin and white at the edge; inner lip short, somewhat twisted, broadened at the base, and reflected partly over the narrow umbilicus; parietal wall covered by a thin callus, which is of pale rust color.

The type (Cat. No. 245562, U.S.N.M.) was collected by Lieut. Col. Edgar A. Mearns on Basilan Island. It has 6.2 whorls and measures—length, 52 mm.; diameter, 25.5 mm.

This shell somewhat resembles *Amphidromus maculiferus gracilior* Fulton, but the hydrophanous markings are considerably less strong in the present form, and it is much smaller and has a faint yellowish suffusion.

AMPHIDROMUS MALINDANGENSIS, new species.

Plate 9, figs. 1, 2.

Shell of medium size, elongate-ovate, dextral or sinistral, yellow with bands of brown. The suture of the first two whorls is bordered by a narrow black zone. The brown markings consist of rather irregularly placed longitudinal bands which extend only over the anterior two-thirds of the whorls between the sutures on the first two and a half whorls. These bands are of quite regular widths and about half as wide as the spaces that separate them. On the last turn the brown bands are irregular in width and assume a decidedly zigzag form, but not a regular definite pattern. They extend over the base to the umbilical area. The whorls are evenly rounded, separated by a moderately constricted suture, and are marked by exceedingly fine lines of growth. Aperture moderately large; outer lip thickened and reflected; inner lip somewhat curved, strong, and slightly twisted, reflected over the narrow umbilicus; parietal wall covered with a moderately thick callus; inside of shell, lip and callus white.

Two specimens of this species are before us, Cat. No. 244689, U.S.N.M. They were collected by Lieut. Col. Edgar A. Mearns at Mount Malindang, Mindanao, at an altitude of between 3,500 and 9,200 feet. Both have six whorls, the sinistral specimen, the type, measures—length, 48.5 mm.; greater diameter, 25 mm. The dextral—length, 46.8 mm.; greater diameter, 27.5 mm.

AMPHIDROMUS APOENSIS, new species.

Plate 9, figs. 5, 6.

Shell elongate-ovate, with the whorls moderately rounded and appressed at the summit, marked by fine lines of growth only. The first two volutions show the narrow black band in the suture, the remainder of these whorls being yellowish-white. The next turn is plain white. Beginning with the third, a series of closely spaced, somewhat retractively slanting zigzag markings of alternating brown and yellowish-white bands, the latter a little wider than the brown elements, make their appearance. These brown bands become a little more closely spaced on the last volution, particularly so on the base. Aperture moderately large; outer lip thin, showing the external markings within, thickened at the edge, which is reflected and slightly expanded; inner lip almost vertical, expanding at the base into a callus which fuses with the thin callus that covers the parietal wall; partly reflected over the narrow umbilicus.

The type, Cat. No. 244690, U.S.N.M., was collected by Lieut. Col. Edgar A. Mearns on Mount Apo, Mindanao. It has 6.5 whorls and measures—length, 59 mm.; diameter, 28.3 mm.

AMPHIDROMUS BASILANENSIS, new species.

Plate 9, fig. 3.

Shell of medium size; elongate-ovate. The first three whorls dingy white with a satiny luster, the remaining of the same ground color, marked at irregular intervals by more or less interrupted axial zigzag lines of light brown which have no definite form of disposition. The brown markings become more abundant on the last whorl. The whorls are moderately well rounded, appressed at the summit, and crossed by fine, very retractive axial lines of growth and exceedingly fine spiral striations. Sutures moderately constricted. Aperture moderately large, oval; outer lip thickened and reflected; inner lip thickened, somewhat sinuous and reflected over the umbilical chink; parietal wall covered with a moderately thick callus. The inside of the aperture shows the same coloration as the exterior, the brown markings extending through the shell. The outer edge of the peristome is white, while its inner border is of the same brown as the longitudinal bands.

Two specimens of this species were collected by Mr. McGregor, of the Philippine Bureau of Sciences, on Basilan Island. One of these, the type, is in the United States National Museum, Cat. No. 244691; the other is in the Philippine Bureau of Sciences. The type has six post-nuclear whorls and measures—length, 45.8 mm.; greater diameter, 24.2 mm.

AMPHIDROMUS FLORESI, new species.

Plate 8, fig. 3.

Shell ovate, sinistral. Early whorls well rounded, with a narrow band of gray immediately above the suture, the rest white. The succeeding turns are evenly rounded, appressed at the summit, and very feebly constricted at the sutures. All but the last one and a half turns are marked by faint lines of growth and exceedingly fine, spiral striations. On the last turn and a half, the axial sculpture becomes much strengthened, forming regular threadlike riblets. The shell is of bluish white ground color, marked with irregularly distributed, somewhat wavy, narrow, brown axial bands. These may be continuous from the summit to the umbilical region or interrupted. Inside of the aperture and peristome bluish white; outer lip reflected, and slightly expanded; inner lip broadened at its insertion, which fuses with the thin callus that covers the parietal wall, and reflected over the narrow umbilicus.

The type, Cat. No. 215580, U.S.N.M., was collected for Mr. Walter F. Webb by Mr. I. Flores in southeastern Mindanao. I have named it in honor of Mr. Flores at Mr. Webb's request.

GROUP OF AMPHIDROMUS INFLATUS.

The group of *Amphidromus inflatus* at present embraces six species: *A. inflatus* Fulton, *A. mearnsi* Bartsch, *A. pallidulus* Pilsbry, *A. hidalgoi* Bartsch, *A. bilatanensis* Bartsch, and *A. calista* Pilsbry. The type-locality of the first is not known. *A. pallidulus* comes from Zamboanga, *Amphidromus mearnsi* and *calista* from Basilan, *A. hidalgoi* from Dapitan, Mindanao, and *A. bilatanensis* from Bilatan Island. All of these forms have the narrow black band in the suture on the early turns. All but *calista* Pilsbry are yellow; this may be white, yellow, or streaked with red or rose pink. It is evidently the black, suprasutural band of the early whorls, which caused Fulton and subsequent writers to ally the described forms with *maculiferus*, but when one views the various races of *maculiferus* one sees readily that it would require considerable stretching of the imagination to believe these shells mere races of that species.

AMPHIDROMUS INFLATUS Fulton.

Plate 1, fig. 3; plate 10, figs. 6, 7.

Amphidromus maculiferus, var. Hidalgo, Journ. de Conch., vol. 36, 1888. p. 31, pl. 6, fig. 1.

Amphidromus maculiferus Smith, Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894. p. 55, in part.

Amphidromus maculiferus inflatus Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

Amphidromus maculiferus inflatus von Möllendorff, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 149.

Amphidromus maculiferus inflatus Pilsbry, Man. Conch., vol. 13, 1900, p. 133.

Shell ovate; pale yellow; outer edge of the reflected lip sometimes pale orange; the first three whorls have the narrow black band immediately above the suture. All the whorls are well rounded, appressed at the summit, marked by very strong, retractively slanting lines of growth and very fine, weakly impressed, spiral striations. Sutures feebly constricted. Aperture large, yellow within; the slightly expanded and reflected outer, as well as the inner lip is white; inner lip somewhat twisted, expanded at the base, and reflected over the narrow umbilicus which is sometimes closed by the reflected callus; parietal wall covered with a thin callus.

Two specimens of this species (Cat. No. 99568 U.S.N.M.) bear the label "Philippine Islands," without specific locality. They have six whorls each, and measure—length, 58.6 mm.; diameter, 31.4 mm.: and length, 55.5 mm.; diameter, 30.2 mm., respectively.

Fulton cites[1] Baranda, Philippine Islands, as the type-locality.

AMPHIDROMUS MEARNSI, new species.

Plate 10, figs. 1, 2.

Shell ovate, canary yellow, excepting the narrow dark band immediately above the suture on the first three whorls and a narrow band of white, which is separated from the summit by a band equaling the white band in width, which agrees with the general coloration of the surface. The whorls are well rounded, appressed at the summit, and marked by well-expressed lines of growth, which almost suggest rib striations and exceedingly fine spiral striations. Sutures moderately constricted. Aperture quite large, oval; outer lip expanded and reflected; inner lip expanded at its insertion and reflected over the narrow umbilicus; parietal wall covered by a moderately thick callus; inside of the aperture and peristome white.

The type (Cat. No. 245565, U.S.N.M.) was collected by Lieut. Col. Edgar A. Mearns, at Atingating, northwest coast of Basilan Island. It has six whorls and measures—length, 47 mm.; diameter, 25.5 mm. Cat. No. 245566, U.S.N.M., contains an adult specimen and a young individual, also from Basilan. The adult has 6.5 whorls and measures—length, 55 mm.; diameter, 28.7 mm.

AMPHIDROMUS PALLIDULUS Pilsbry.

Plate 10, figs. 3, 8.

Amphidromus chloris Elera, Cat. Sist. Faun. Filip., 1896, p. 617,

Amphidromus chloris, var. *pallidulus* Pilsbry, Man. Conch., vol. 13, 1900, pp. 143, 144, pl. 50, figs. 33, 34.

Shell stout, sinistral, straw colored, with a narrow white zone a little anterior to the suture. The nuclear whorls are marked with a narrow dark zone at the suture. The succeeding turns are well rounded, marked by numerous retractive lines of growth and very fine spiral striations. Aperture large; outer lip provided with a strong white peristome. Columella moderately long, expanded at the base, the outer edge extending over the base and fusing with the parietal callus.

This description is based upon Doctor Pilsbry's cotypes, which were collected by the Steere Expedition at Zamboanga, Mindanao. They both have six whorls and measure—length, 45 mm.; diameter,

[1] Am. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

28 mm.; and length, 46.4 mm.; diameter, 25.5 mm., respectively. They form Cat. No. 106459 of the collection of the Philadelphia Academy of Natural Sciences.

AMPHIDROMUS BILATANENSIS, new species.

Plate 10, figs. 4, 5.

Amphidromus maculiferus, var. SMITH, Ann. Mag. Nat. Hist., ser. 6, vol. 13, 1894, p. 55, pl. 4, figs. 9, 9*a*.

Amphidromus maculiferus VON MÖLLENDORFF, Nachr. Deut. Malak. Ges., vol. 26, 1894, p. 211.

I have not seen specimens of this species, but base my conclusions of its distinctiveness upon Mr. Smith's figures and remarks and the geographical isolation from any of the other forms of the group. I quote Mr. Smith's remarks:

The specimens from Bilatan present but the faintest trace of oblique strigation, like some of the Philippine examples. They more resemble the variety figured by Hidalgo, being either pale lemon-yellow or pinkish white. They are rather smaller than normal specimens, having an average length of about 50 to 55 millimeters. All as yet examined are sinistral.

Hab., Bilatan Island.

AMPHIDROMUS HIDALGOI, new species.

Plate 11, figs. 4, 6.

Amphidromus maculiferus SOWERBY, var. HIDALGO, Mem. Real Acad. Sci. Madrid, 1898, pl. 99, figs. 1, 2.

Shell large, inflated, the early whorls with the usual narrow black band immediately above the suture. The succeeding ones inflated, appressed at the summit, lemon-yellow with a narrow whitish band at the summit, and irregularly distributed markings of dark rust brown. A varicial streak of the same color marks the last turn. Aperture broad, flaring, strongly reflected; dark within, white at the edge.

I have based my description upon Señor Hidalgo's figures,[1] which measure—length, 60 mm.; diameter, 35.5 mm. Señor Hidalgo informs me that the specimen came from Dapitan, Mindanao.

AMPHIDROMUS CALISTA Pilsbry.

Plate 11, figs. 1–3.

Amphidromus chloris, col. var. *purissimus* PILSBRY, Man. Conch., vol. 13, 1900, p. 144, pl. 50, fig. 32.

Amphidromus chloris, col. var. *calista* PILSBRY, Man. Conch., vol. 13, 1900, p. 144, pl. 50, fig. 36.

Amphidromus chloris, col. var. *rosa* PILSBRY, Man. Conch., vol. 13, 1900, p. 144, pl. 50, fig. 38.

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[1] Mem. Real Acad. Sci. Madrid, 1898, pl. 99, figs. 1, 2.

The coloration of this species varies from pure white to pale yellow with reddish brown streaks on the spire, or it may be rose-pink throughout. The three specimens above cited are in the collection of the Philadelphia Academy of Natural Sciences. They have a very dark fillet in the suture of the early whorls, which places them in the *Amphidromus inflatus* group, of which they form the smallest known member. Only two of the three shells are adult and these yield the following measurements, respectively: Number of whorls, 6, and 5.6. Length, 42.4 mm., 39 mm.; diameter, 23 mm., 21.5 mm.

GROUP OF AMPHIDROMUS CHLORIS.

The group of *Amphidromus chloris* will probably be found to extend from Mindanao southward over the Sulu Archipelago. From the material examined it is possible to recognize three species—namely, *A. chloris*, *A. roeseleri*, and *A. suluensis;* the first coming from Zamboanga, Mindanao, the second from Jolo, while the material of the third one examined was listed as coming from the islands of the Sulu Sea. It is quite possible that when a complete exploration of the Sulu Archipelago will be completed that more island races of this group will be discovered.

AMPHIDROMUS CHLORIS Reeve.

Plate 1, fig. 4; plate 12, figs. 1–6, 8.

Bulimus chloris Reeve, Conch. Icon., 1848, pl. 37, p. 223.
Bulimus chloris Pfeiffer, Zeitschr. f. Malak., 1849, p. 137.
Bulimus chloris Pfeiffer, var. Zeitschr. f. Malak., 1849, p. 137.
Bulimus chloris Reeve, Zool. Voy. Samarang, 1850, p. 58, pl. 14, fig. 10.
Amphidromus chloris Albers, Heliceen, 1850, pp. 138–140.
Bulimus sulphuratus Hombron and Jacquinot, Voy. Ast. and Zelee, Zool., vol. 5, 1854, p. 29.
Bulimus chloris Pfeiffer, Conch. Cab. Mart. Chem., vol. 1, pt. 13, 1855, p. 183, pl. 49, figs. 7, 8.
Bulimus (Amphidromus) chloris Pfeiffer, Malak. Blat., vol. 2, 1855, p. 147.
Bulimus (Canistrum) chloris, A. and H. Adams, Gen. Rec. Shells, 1858, p. 143.
Bulimus chloris Pfeiffer, Mon. Hel. Viv., vol. 4, 1859, p. 382.
Bulimus sulphuratus Pfeiffer, Mon. Hel. Viv., vol. 4, 1859, p. 382.
Bulimus chloris von Martens, Preus. Exp. Ost. Asien, Zool., vol. 2, 1867, p. 351.
Bulimus sulphuratus Pfeiffer, Mon. Hel. Viv., vol. 6, 1868, p. 26.
Bulimus chloris Pfeiffer, Mon. Hel. Viv., vol. 6, 1868, p. 26.
Amphidromus chloris Semper, Reis. Arch. Phil., vol. 3, 1873, p. 148.
Amphidromus sulphuratus Semper, Reis. Arch. Phil., vol. 3, 1873, p. 148.
Amphidromus chloris Pfeiffer, Mon. Hel. Viv., vol. 8, 1877, p. 42.
Amphidromus chloris Hidalgo, Journ. de Conch., vol. 36, 1888, p. 32.
Amphidromus perversus chloris Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 67.
Amphidromus chloris Elera, Cat. Sist. Faun. Filip., vol. 3, 1896, p. 617.

Amphidromus chloris Hidalgo, Mem. Real Acad. Sci., Madrid, 1898, pl. 99, figs. 3–4.

Amphidromus chloris Pilsbry, Man. Conch., vol. 13, 1900, pp. 142–144.

Shell very elongate-ovate, pale canary yellow with a narrow white band at the summit. Peristome and aperture white. Whorls well rounded, somewhat constricted at the suture, marked by fine lines of growth only. Aperture elongate, oval; outer lip reflected and thickened; inner lip expanded at the base, partly reflected over the umbilicus where it joins the moderately thick callus of the parietal wall.

A specimen belonging to the Chicago Academy of Sciences, collected by Quadras at Zamboanga, Mindanao, has 6.5 whorls and measures—length, 44.7 mm.; diameter, 22.5 mm. This specimen might have served for Reeve's figure cited above, so perfectly does it agree with it in every feature.

Adams and Reeve state, locality cited, that the animal of *Bulimus chloris* is of pale brown color * * * and of extremely vivacious habits. A bushel of them, collected on the mountains of Mindanao, soon dispersed themselves all over the cabin in which the basket was deposited. The shell was of elongate form and deep yellow color throughout, with no indications of bands or markings. The figure, however, shows the pale sutural band of white.

Thanks to the kindness of Mr. Walter F. Webb, I have had the opportunity of examining 393 specimens of this species collected at Talantalan, Zamboanga, Mindanao. These give the following measurements:

	No. of whorls.	Altitude, mm.	Diameter, mm.
Average	6.198+	39.851	22.266+
Greatest	7	48.2	25
Least	5.5	34	18.8

The extremes represented by the seven specimens, Cat. No. 215641, U.S.N.M., which are figured, yield measurements as follows:

No. of whorls.	Length, mm.	Diameter, mm.	Remarks.
6.25	40	22.3	Norm.—i. e., typical average specimen.
7	45.1	23.2	Greatest number of whorls.
5.5	36.8	20.8	Least number of whorls.
6.75	48.2	24.3	Greatest length.
5.75	34	20.2	Least length.
6.5	45.5	25	Greatest diameter.
6.23	38.7	18.8	Least diameter.

Doctor Pilsbry, in the Manual of Conchology (p. 144), makes the following statement:

Basilan.—The Steere Expedition also collected examples of *chloris* on Basilian Island (figs. 32, 35, 36–38), where Semper did not find it. They are identical in form with Samboanga shells, but vary in color as follows: (*a*) Color of the typical yellow tint, but rapidly fading to white on the spire (pl. 50, fig. 35). (*b*) Pale citron or greenish-yellow, the spire white (fig. 37). (*c*) Similar to color-var. *pallidulus*, but with a slightly darker sutural border and no white band. (*d*) Pure white throughout, color-var. *purissimus* (fig. 32). (*e*) Pale yellow or rufous, with oblique reddish-brown streaks on the spire or throughout, the suture narrowly marked with the same, color-var. *calista* (fig. 36). (*f*) Brilliant rose-pink, with white subsutural band and darker sutural line to the apex, color-var. *rosa* (fig. 38).

From a very careful examination of these shells I am led to believe that a mix-up has occurred in handling collections and that two of the specimens referred to, namely, those represented by figures 35 and 37, are true *chloris* which I am inclined to believe came from Zamboanga, Mindanao. This is all the more probable since Professor Steere's expedition also collected in this place. The other three are sufficiently distinct to merit separation. They belong to the *inflata* group. I have listed them under the name *Amphidromus calista* Pilsbry.

AMPHIDROMUS SULUENSIS, new species.

Plate 1, fig. 5; plate 11, figs. 5, 7–9; plate 12, figs. 7 and 9.

Shell elongate-ovate, dextral or sinistral, sulphur yellow, with occasional, bluish gray varicial streaks. Aperture and peristome white. Whorls rather inflated, appressed at the summit, marked by very fine lines of growth and rather conspicuous varices; sutures moderately constricted. Aperture small, broadly oval; outer lip reflected and thickened; inner lip somewhat twisted and reflected over the umbilicus, which is covered in almost all the specimens, broadly expanded at its insertion, where it joins the thick parietal callus.

The type (Cat. No. 99564, U.S.N.M.) and five specimens bear the label "Islands of the Sulu Sea." The type has 6.5 whorls and measures—length, 45.5 mm.; diameter, 23.8 mm. The following specimens were examined:

Cat. No. U.S.N.M.	Number whorls.	Length in mm.	Diameter in mm.	Locality.	Remarks.
99564[1]	6.5	45.5	23.8	Islands of Sulu Sea....	(Sinistral).
99564	6.5	39	22	.....do...............	Do.
99564	6.5	44.5	23.8	.....do...............	Do.
99564	6.4	41.8	22.3	.....do...............	Do.
99564	6.1	37.4	22	.....do...............	Do.
99564	......	......	......	.....do...............	(Sinistral) young individual.
99565	6.5	39.5	23.4	.....do...............	(Dextral).
99565	6.5	42.4	23.5	.....do...............	Do.
99565	6.5	44.3	29.6	.....do...............	Do.

[1] Type.

This species is at once distinguished from all the other Philippine *Amphidromi* by its sulphur yellow color and by the fact that it is variced.

AMPHIDROMUS ROESELERI Möllendorff.

Plate 13, figs. 1–3.

Amphidromus roeseleri von Möllendorff, Nachr. Deut. Malak. Ges., vol. 26, 1894, pp. 210–211.

Amphidromus roeseleri Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 75.

Amphidromus roeseleri Pilsbry, Man. Conch., vol. 13, 1900, p. 144.

Shell elongate-ovate, white with a satiny luster. Whorls well rounded, appressed at the summit, marked by numerous, very retractive lines of growth and exceedingly fine, spiral striations. Sutures moderately impressed. Aperture auricular; outer lip expanded, reflected and thickened at the edge; inner lip twisted and expanded at its insertion where it joins the rather thick parietal callus and is reflected over the narrow umbilicus. Inside of aperture and peristome white.

There are three specimens of this species Cat. No. 215576, U.S. N.M., which were collected on Jolo Island, Philippines, by Lieut. Col. Edgar A. Mearns. All of them have six whorls. They measure—length, 46 mm.; diameter, 25 mm.; length, 47 mm.; diameter, 25.2 mm.; and length, 48 mm.; diameter, 28 mm., respectively. Von Möllendorff's type comes from Sulu (=Jolo) Island.

AMPHIDROMUS, species ?

The United States National Museum contains a specimen, Cat. No. 215638, collected by Lieut. Col. Edgar A. Mearns, on Loran Island, opposite the southern end of Ubian Island. This specimen is a dead, badly worn individual, which without question belongs to the group of *chloris*, but it is too poor to serve as the type of a distinct species.

GROUP OF AMPHIDROMUS ENTOBAPTUS.

The yellow *Amphidromi* of the Western Philippine Islands belong to a distinct group, of which we may take the oldest described species, *Amphidromus entobaptus* Dohrn, as the typical figure. This group is distributed over Palawan, the *Cuyos* group, the *Calamianes* to Mindoro, splitting up into races on the various islands. I have recognized *A. entobaptus*, *A. e. viridoflavus*, *A. e. linapancensis*, *A. e. culionensis*, *A. e. coronensis*, *A. e. busuangensis*, and *A. mindoroensis*. *Amphidromus entobaptus* s. s. comes from Palawan, and *A. viridoflavus* from Malubutglubut Island, while the location of the rest will easily be noted from the name, which is based upon the island of the type-locality.

AMPHIDROMUS ENTOBAPTUS ENTOBAPTUS Dohrn.

Plate 13, figs. 4–9.

Amphidromus perversus HIDALGO, Journ. de Conch., vol. 35, 1888, p. 32.
Amphidromus entobaptus DOHRN, Nach. Malak. Gesel., vol. 22, 1889, p. 62,
Amphidromus entobaptus SMITH, Proc. Zool. Soc. London, 1895, pp. 98–99.
Amphidromus perversus entobapta FULTON, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 67.
Amphidromus contrarius ELERA, Cat. Sist. Faun. Filip., 1896, p. 617.
Amphidromus entobaptus ELERA, Cat. Sist. Faun. Filip., 1896, p. 618.
Amphidromus entobaptus HIDALGO, Mem. Real Acad. Sci. Madrid, 1898, pl. 99, figs. 5–8.
Amphidromus entobaptus VON MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 148.
Amphidromus entobaptus PILSBRY, Man. Conch., vol. 13, 1900, pp. 145–6, pl. 51, figs. 42–6.

Shell sinistral, stout, elongate-ovate to ovate, varying in color from almost white to pinkish buff on the outside; inside, light orange buff or buffish yellow. The early whorls are usually soiled white, with a narrow ashy band immediately above the suture. All the whorls are decidedly appressed at the summit, strongly rounded, and marked by decidedly retractive lines of growth. Aperture large; outer lip reflected to form a thickened peristome, the edge of the lip being almost white; columella somewhat sigmoid, reflected over the base in the shape of a callus; parietal wall covered with a thick callus connecting with the columella; columella and the parietal callus of the same color as the edge of the outer lip.

Eighty-five specimens of this species were collected by the U. S. Fisheries steamer *Albatross* Philippine expedition, Cat. No. 254917, U.S.N.M., at Ulugan Bay, Palawan, which is a short distance to the north and across the island from the type-locality, Puerto Princesa. Twenty-five of these taken at random give the following measurements and data:

Number of whorls.	Length in mm.	Diameter in mm.
6	52	28.7
6	51.5	29
6	55.2	32.4
6	51.3	30
6	49.2	29
6	48.5	29
6	52	30
6.2	54.2	30.1
6.1	51.2	29.2
6	49.6	27.3
5.8	49.6	28.3
5.8	48	29.2
6	50.2	29
6.2	48.2	28
6	49.3	27
6	49.1	28
6.2	51.3	27.3
6	48.6	28.2
6	46.2	26.2
6.5	50.3	27.4
6	51.6	29
6.5	55	29.2
6	47.7	28
6	48	25.6
6.5	48.3	27
[1] 6.5	[1] 55.2	[1] 38.3
[2] 5.8	[2] 46.2	[2] 25.6
[3] 6.07	[3] 50.25	[3] 28.95

[1] Largest. [2] Smallest. [3] Average.

Two additional specimens, Cat. No. 254918, U.S.N.M., were collected at Poncal, Palawan, by the U. S. Bureau of Fisheries steamer *Albatross.*

AMPHIDROMUS ENTOBAPTUS VIRIDOFLAVUS, new subspecies.

Plate 14, figs. 1–3.

This race of *A. entobaptus* is of medium size. It is distinguished from the shells so far seen from other islands by the green coloration of the early whorls. In some specimens this reaches a depth of lettuce green. On the last turn the coloration usually corresponds with that of *Amphidromus entobaptus entobaptus.*

I have seen 17 specimens of the race, Cat. No. 215600, U.S.N.M., collected at the observatory on Malubutglubut Island. Only six of these are mature, and these yield the following data:

Number of whorls.	Length in mm.	Diameter in mm.
6	45.2	25.7
6.1	45	23.4
6	44	23.8
[1] 6	46.5	25.8
6.1	46	25.6
5.8	41.7	23.2

[1] Type.

AMPHIDROMUS ENTOBAPTUS LINAPACENSIS, new subspecies.

Plate 16, figs. 1–3.

Amphidromus entobaptus gracilis VON MÖLLENDORFF, Abhand, Nat. Gesel. Görlitz, vol. 22, 1898, p. 148, *nomen nudum*.

Shell elongate-ovate, varying in color from oil green through Naples yellow, through canary yellow to almost white. The greenish tints are usually confined to the early portion of the shell, the later turns being yellow. The inside is always of a deeper shade than the exterior. The peristome is white. The whorls are closely appressed at the summit, marked by decidedly protractively slanting lines of growth and exceedingly fine spiral striations.

We have seen 142 specimens of this race, Cat. No. 215599, U.S.N.M., from Malcochin Harbor, 450 feet altitude, on Linapacan Island, 25 of which taken at random give the following measurements:

Number of whorls.	Length in mm.	Diameter in mm.
6	42.6	23.3
5.5	42.4	23.1
6.2	47.5	25.8
5.7	41.2	23.4
6	47	23.6
6.1	43.2	22.6
6	43.6	24.5
6	43.4	24
6.1	46	25.1
5.5	39.2	22.5
6.2	45	25
6	45.1	25.6
6.1	42	23.3
6.2	45.6	25.6
5.7	45.7	24.1
5.6	41.6	23
6.3	49.9	25.2
5.7	41	23.5
6	41.3	22.5
5.8	41.3	21.3
5.6	39.2	22
6.3	47.2	24.4
6	44.6	22.8
[1] 6.3	49.2	25.1
5.5	40.4	24.2
[2] 6.3	49.9	25.8
[3] 5.5	39.2	21.3
[4] 5.93	43.8	23.82

[1] Type. [2] Largest. [3] Smallest. [4] Average.

This race seems nearest to typical *A. entobaptus*, but is uniformly more slender, and a greenish tint is much more apparent.

AMPHIDROMUS ENTOBAPTUS CULIONENSIS, new subspecies.

Plate 1, fig. 6; plate 14, figs. 4–9; plate 15, figs. 1–3.

Shell much smaller than typical *Amphidromus entobaptus entobaptus*, and much less inflated than *Amphidromus entobaptus busuangensis*. In general shape it resembles *Amphidromus entobaptus gracilis*, but is of a more uniform paler coloration than that race.

We have seen 21 specimens which were collected by Dr. D. C. Worcester on the Menage Scientific Expedition on Culion Island. These yield the following data:

Number of whorls.	Length in mm.	Diameter in mm.
6.1	44.7	24.8
6.2	44.6	24.4
5.7	42.6	23.4
6.1	46	25.7
[1] 5.8	45.8	[1] 25.6
5.7	41.2	23.7
5.5	40	24
6	44.9	25.5
6	38.9	22.6
6.1	47.8	27.1
5.7	48	25.7
5.6	40.5	24.1
5.6	45.6	26.8
5.8	46.3	26.1
5.7	40.6	24.7
5.5	38.6	23.2
6	43.5	24.8
5.6	41.6	24
6	48.2	27
6.1	46.1	24.7
5.2	36.4	23.7
[2] 5.8	[2] 43.42	[2] 24.83
[3] 6.2	[3] 48.2	[3] 27.1
[4] 5.2	[4] 36.4	[4] 22.6

[1] Type. [2] Average. [3] Greatest. [4] Least.

The type is Cat. No. 215642, U.S.N.M.

AMPHIDROMUS ENTOBAPTUS CORONENSIS, new subspecies.

Plate 15, figs. 6–8.

Amphidromus entobaptus contractus von Möllendorff, Abhand. Nat. Gesel. Görlitz, vol. 22, 1898, p. 148, *nomen nudum*.

The shells from Coron Island of the Calamianes Group have the shape of *Amphidromus chloris* Reeve; that is, they are very much more slender than typical *Amphidromus entobaptus*. Of course the typical deep coloration at once proclaims them members of the *Amphidromus entobaptus* complex.

The three specimens in the collection of the U.S.N.M. Cat. No. 195848*a* come from the von Möllendorff collection. They present the following data:

Cat. No. U.S.N.M.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.
195848*a*	5.8	43	24	Coron.
195848*a*	6.4 [1]	47.5	22.2	Do.
195848*a*	5.8	41.3	23	Do.

[1] Type.

AMPHIDROMUS ENTOBAPTUS BUSUANGENSIS, new subspecies.

Plate 16, figs. 4–9.

Amphidromus perversus LINNAEUS, var., ELERA, Cat. Sist. Faun. Filip., 1896, p. 618.

Amphidromus entobaptus PILSBRY, Man. Conch., vol. 13, p. 146, 1900, pl. 51, figs. 42–44.

Shell elongate-ovate to ovate; cream colored to Naples yellow, usually darker within. Whorls well rounded, appressed at the summit, marked by fine, retractive lines of growth and exceedingly fine spiral striations. The aperture is broadly oval; outer lip thick, expanded and reflected; inner lip expanded at the base where it fuses with the rather thick callus of the parietal wall; peristome white. The following specimens have been examined:

Cat. No.	Collection.	Num- of whorls.	Length in mm.	Diam- eter in mm.	Locality.	Collector.
184559	U.S.N.M.	6	43.3	23.1	Busuanga	Von Möllendorff.
302841	do.	5.5	40	23.2	do.	Henderson.
302841	do.	6	43.3	24.4	do.	Do.
	do.	5.6	43	23	Malbato Busuanga	Quadras.
	do.	6	45.5	25	do.	Do.
	do.	5.4	41.5	24	do.	Do.
	do.	6	47.8	24	do.	Do.
215643	do.	5.4	40.3	25.5	do.	Do.
215643 [1]	do.	5.7	46.5	27.3	do.	Do.
	Webb	5.4	40.6	24.2	do.	Do.
	do.	5.8	41.6	24.5	do.	Do.
	do.	5.8	44	25	do.	Do.
	do.	5.7	38.8	23	do.	Do.
	do.	5.9	40.2	22	do.	Do.
	Chicago Acad. Sci.	5.8	41.5	25	do.	Do.
	do.	5.8	45	25.3	do.	Do.
Largest		6	47.8	27.3		
Smallest		5.4	38.8	22		
Average		5.73	42.6	24.2		

[1] Type.

AMPHIDROMUS MINDOROENSIS, new species.

Plate 15, figs. 4, 5.

Shell inflated, ovate. The first whorl and a half white, the rest canary yellow excepting a very narrow band at the summit and the peristome, which are white. The whorls are inflated, well rounded, appressed at the summit, and marked by very retractive lines of growth and exceedingly fine spiral striations. Aperture rather large, oval; outer lip thick, somewhat expanded and reflected; inner lip twisted, expanded at the base; parietal wall covered with a thin callus. The inside of the aperture is colored like the exterior.

The type (Cat. No. 245564, U.S.N.M.) was collected by Mr. Weber, of the Philippine Bureau of Sciences, in Mindoro. It has six whorls and measures—length, 53.2 mm.; diameter, 29.2 mm.

GROUP OF AMPHIDROMUS QUADRASI.

I am quite perplexed by the following species and feel at a loss as to the treatment that should be accorded to it. My own collecting in the Philippines has taught me that specific locality data are absolutely necessary. Many forms, having a somewhat extended distribution, break up into distinct and easily recognizable races on the various islands. Not only is this true, but they may even become differentiated into several forms in one island; for example, *Cochlostyla ovoidea* on Masbate. In Cataingan Bay we find an extremely large, light-colored form on the hillsides of the west shore, while across the bay on Dumurug Point, in the somewhat swampy lowlands, we find a much smaller race which is always darker colored, while at the town of Masbate we find a third equally distinct race.

The perfectly uniform development at each place of these three lots of mollusks would incline one to consider them as three distinct species. It is only when one has made collections over the entire range of *Cochlostyla ovoidea* and has obtained good series of specimens from each locality that one sees that these races can be arranged in such a way as to show complete gradation from one extreme to another.

The old collections made in the Philippines consisted chiefly of purchased material collected by natives, frequently in widely separate localities, dumped together without any data regarding its source. This material has furnished little aid to the student of geographic distribution. It is a stumbling block and the workers who have amused themselves by describing *unicolor*, *unicincta*, *bicincta*, *tricincta*, and *quadricincta* of certain species would have saved time and trouble for their successors if they had chosen a different field for amusement, because these forms occur in varying numbers in a single brood of one parent.

Looking over the material of *Amphidromus quadrasi* Hidalgo before me, and all the printed matter relating to it, I am strongly inclined to believe that a large amount of the material which has found its way into collections consists of shells purchased from natives at Balabac. It is equally probable that these may have come from many of the smaller islands surrounding Balabac Island and that when careful collecting has been done in these places we may find constant races of *Amphidromus quadrasi* on them just as in the case of *Cochlostyla ovoidea* in other parts of the islands.

My belief in this is strengthened by the fact that the 86 specimens collected by the *Albatross* expedition at Caxisigan Island; also the 107 from Bekin, as well as the 41 from Candaraman Island, are of perfectly uniform shape and coloration. This is also true of the 50 specimens labeled Southern Palawan without specific locality.

AMPHIDROMUS QUADRASI QUADRASI Hidalgo.

Plate 1, fig. 11; plate 17, figs. 1–11.

Amphidromus quadrasi HIDALGO, Journ. de Conch., vol. 35, 1887, p. 36, pl. 2, fig. 2.

Amphidromus quadrasi HIDALGO, Journ. de Conch., vol. 36, 1888, pp. 33–34.

Amphidromus quadrasi HIDALGO, Mem. Real Acad. Sci. Madrid, vol. 14, 1889, pp. 17–18.

Amphidromus quadrasi, var. *a.b.d.* SMITH, Ann Mag. Nat. Hist., ser. 6, vol. 11, 1893, p. 351, pl. 18, fig. 10.

Amphidromus quadrasi FULTON, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 85.

Amphidromus quadrasi ELERA, Cat. Sist. Faun. Filip, 1896, p. 618.

Amphidromus quadrasi VON MÖLLENDORFF, Abhand. Naturf. Ges. Gorlitz, vol. 22, 1898, p. 149.

Amphidromus quadrasi HIDALGO, Mem. Real Acad. Sci. Madrid, 1898, pl. 100, figs. 5–6.

Shell sinistral, regular, elongate-conic. Early whorls white, nuclear whorls two, well rounded, marked with numerous very fine, evenly scattered granules, post-nuclear whorls appressed at the summit, smooth, excepting very fine, decidedly retractive lines of growth and numerous exceedingly fine spiral striations. Sutures only slightly constricted. Periphery of the last whorl angulated in young shells, and very feebly angulated in the adult; base well rounded, marked like the spire. Aperture moderately large, oblique; outer lip reflected; inner lip moderately reflected. Parietal wall glazed with a thin callus. The coloration of typical *quadrasi* is as follows: Early whorls white, without dark spot at tip of the nucleus; the rest yellow marked with numerous fine, decidedly retractive green lines which tend to become fused toward the latter part of the shell and give this a green aspect. These green lines do not quite extend to the summit. The summit is marked by a very slender yellowish-white line. This is followed by a moderately broad red band which, in turn, is followed by a narrow yellow zone anteriorly; a red area surrounds the umbilical area and this is followed at its posterior edge by a moderately broad yellow zone. The inside of the aperture and lip are white.

Cat. No. 66188, Philadelphia Academy of Natural Sciences, figured in Tryon's Manual of Conchology (vol. 13, pl. 71, fig. 78), is typical *quadrasi*, it is my figure 3, on plate 12. This comes from Balabac Island. It has a little more than six whorls and measures—length, 34 mm.; diameter, 17.8 mm. Another specimen in Mr. Webb's collection, which I have likewise figured (pl. 12, fig. 1), is also typical *quadrasi* and comes from the same island. It has 6½ whorls and measures—length, 36 mm.; diameter, 18.2 mm.

The United States National Museum has several lots of this form, all obtained by the United States Bureau of Fisheries' Expedition to the Philippine Islands, which I shall list in detail below. All of these are remarkably uniform in coloration, the green streaks being reduced to a minimum, the yellow predominating in every instance. They all have white tips.

Eighty-six specimens, Cat. No. 215603, U.S.N.M., were obtained at Caxisigan Island, near Balabac Island. Twenty-five of these, taken at random, give the following measurements:

Number of whorls.	Length in mm.	Diameter in mm.
6.5	38	20.2
6	37.3	20.2
6.5	30.3	15.2
7	36.5	18.3
6.5	34.5	16
6.5	32.3	16
6.3	31.6	16.2
6.7	34	16.7
6	30.6	15.7
6	33.5	15.5
6.5	35	16.5
6.5	34.5	17.2
6.5	37.5	17.5
7	41.2	19.8
6	28.2	15.3
6	35.8	17.7
7	42.3	22
7	41.5	21
7	36.2	17.2
6.5	34.6	18.5
6.5	37.7	19
6.5	39.6	20
6	22.5	14.5
6	29	15
6	28.6	15
[1] 6.4	34.5	17.4
[2] 7	42.3	22
[3] 6	22.5	15

[1] Average. [2] Greatest. [3] Least.

One hundred and seven specimens, Cat. No. 215606, U.S.N.M. come from Bekin; 25 of these, taken at random, give the following measurements:

Number of whorls.	Length in mm.	Diameter in mm.
6.5	37.8	17.3
6.5	38	18.5
6	27.8	15.2
6.5	32.3	16
6	28	17.5
6	28.2	15.5
5.8	30.7	16.5
6	30.2	15.2
6	28.3	17
6	30.5	15.3
6	31.3	17
6	30	15.5
6.3	35.5	18.2
5.5	25.4	14.5
5.5	28	15
6	30	15.6
6	31	16.6
6	32.5	17
6.5	34	17
6	31.5	16.2
6	30	15.5
6	26.6	15
5.5	27.5	15
6	26.6	14.2
6	29.3	16.7
[1] 6	31.11	16.2
[2] 6.5	38	18.5
[3] 5.5	26.6	14.2

[1] Average. [2] Greatest. [3] Least.

Forty-one specimens, Cat. No. 215605, U.S.N.M., were obtained from Candaraman Island, off Balabac Island; 10 of these, taken at random, measure:

Number of whorls.	Length in mm.	Diameter in mm.
7	40.7	19.2
7	37.2	18
6.5	36.7	18.4
7	43.5	19
6.5	35.6	18.4
6.5	35	18.2
6.5	35	17.5
6	32.7	18
6.5	35	17.5
7	39	18.5
[1] 6.65	37.04	18.27
[2] 7	43.5	19.2
[3] 6	32.7	17.5

1 Average. 2 Greatest. 3 Least.

Another lot of 50 specimens, Cat. No. 215604, is labeled "Southern Palawan region," without specific locality.

A specimen in Mr. Webb's collection from Balabac is figured on plate 12, figure 11. This has the whorls considerably more convex than any we have seen.

Plate 12, figures 4, 5, are specimens from Caxisigan Island and figures from Candaraman Island.

Another specimen in the Philadelphia Academy of Natural Sciences is entered as Cat. No. 95172 and comes from the Quadras collection from Balabac.

AMPHIDROMUS QUADRASI VERSICOLOR Fulton.

Plate 1, fig. 7; plate 18, figs. 1–10.

Amphidromus quadrasi, var. *c*. SMITH, Ann. Mag. Nat. Hist., ser. 6, vol. 11, 1893, p. 351, pl. 18, fig. 11.

Amphidromus versicolor FULTON, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 86.

Amphidromus quadrasi versicolor VON MÖLLENDORFF, Abhand. Naturf. Ges. Görlitz, vol. 22, 1898, p. 150.

Amphidromus quadrasi versicolor PILSBRY, Man. Conch., vol. 13, 1900, pp. 230–231, pl. 71, figs. 84, 87, and 90–91.

The present form agrees in general shape and size fairly well with typical *quadrasi*. All of the specimens, however, have the extreme tip black, and none show the strong red girdle immediately below the summit, although this is faintly indicated in one of the specimens in the Philadelphia Academy of Natural Sciences. The main coloration is pale yellow, the last whorl being frequently streaked with axial lines of green, which, in some instances, become so concentrated as to form broad green spiral bands. Some specimens have several narrow spiral bands. The aperture varies from white to rose-purple. This is also true of the outer lip and the umbilical area. Of the specimens which we would refer to this form we have seen the following:

Cat. No.	Collection.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.
302844	U. S. N. M.	7.1	41.4	20.5	Balabac Island.
215639	.....do	7.2	44.7	21	Balabac, Balabac Island.
215639	.....do	7.1	43.3	22.2	Do.
95173	Phila. Acad. Nat. Sci.	7	40.3	19	Cabo, Melbile, Balabac.
98852	.....do	......	......	......	Do.
79483	.....do	7	39	19.3	Balabac Island.
79483	.....do	6.5	34.7	19.7	Do.
79483	.....do	6	34	17.7	Do.
95172	.....do	6	31.5	15.5	Do.
......	Webb	6.5	36.6	18.1	Do.
......	.....do	6	35	19.2	Do.

AMPHIDROMUS QUADRASI SOLIDUS Fulton.

Plate 1, figs. 8, 9, 12, 13, 14; plate 19, figs. 1, 3, 7; and plate 20, figs. 3, 5.

Amphidromus quadrasi, var. *c*, Smith, Ann. Mag. Nat. Hist., ser. 6, vol. 11, 1893, p. 351, pl. 18, fig. 13.

Amphidromus quadrasi, var *solida* Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 86, pl. 5, fig. 16.

Amphidromus quadrasi solidus von Möllendorff, Abhand. Naturf. Ges. Gorlitz, vol. 22, 1898, p. 149.

Amphidromus quadasi solidus Pilsbry, Man. Conch., vol. 13, 1900, p. 230, pl. 66, figs. 47, 48, and pl. 71, figs. 72–76.

In the present form the conspicuous bands of the base are practically absent. If present at all, they are a mere suggestion. The coloration of the early whorls is blotched and streaked with brown, like that of *dubius*. The extreme apex also is black. The red subsutural band may or may not be present. The last whorl may be streaked with green as in typical *quadrasi*, or may be orange-yellow or white or even suffused with "Spinel red." Of this form, we have seen the following material:

Cat. No.	Collection.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.
215608	U.S.N.M.	7	42.3	19.5	Balabac (U.S.B.F.) *Albatross*.
215608	do	6.5	38.8	18.4	Do.
215608	do	6.5	40.5	20	Do.
215608	2 immature	......	......	......	Do.
302844	do	6.9	38.6	20.9	Balabac Id.
215607	do	6.5	40.5	19	Port Ciego, Balabac.
215607	do	6	34.8	17.8	Do.
215607	do	6	35.8	18.5	Do.
215607	do	6.2	32.3	16	Do.
215607	8 immature	......	......	......	Do.
215640	U.S.N.M.	7.3	43.0	20.4	Balabac, Balabac Id.
215640	do	7.2	47.5	23.0	Do.
215640	do	7.5	46.0	21.6	Do.
215640	do	7.2	44.3	21.2	Do.
215640	do	6.9	41.2	20.5	Do.
215640	U.S.N.M., young	......	......	......	Do.
98853	Phila. Acad. Nat. Sci.	6	32.7	17	Balabac (Steere Exp.).
98851	do	6.5	38.6	19	Do.
98851	do	6	33.5	19.1	Do.
....	Philippine Bur. Sci.	6.7	39.2	20.1	Do.
....	Webb	7	39.2	20.2	Do.

AMPHIDROMUS QUADRASI DUBIUS Fulton.

Plate 1, fig. 10; plate 19, figs. 2, 4, 5, 6, 8, 9; plate 20, fig. 2.

Amphidromus quadrasi, var. *f* Smith, Ann. Mag. Nat. Hist., ser. 6, vol. 11, 1893, p. 351, pl. 18, fig. 12.

Amphidromus dubius Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 86, pl. 6, figs. 1, 1*a*.

Amphidromus everetti Fulton, Ann. Mag. Nat. Hist., ser. 6, vol. 17, 1896, p. 87.

Amphidromus dubius HIDALGO, Mem. Acad. Real Sci., Madrid, 1898, pl. 101, figs. 7–8.

Amphidromus quadrasi dubius VON MÖLLENDORFF, Abhand. Naturf. Ges. Gorlitz, vol. 22, 1898, p. 150.

Amphidromus quadrasi everetti VON MÖLLENDORFF, Abhand. Naturf. Ges. Gorlitz, vol. 22, 1898, p. 150.

Amphidromus quadrasi dubius and *everetti* PILSBRY, Man. Conch., vol. 13, 1900, p. 231, pl. 71, figs. 79–83, and pl. 70, figs. 65–68.

In the present form the early extreme apex is dark. In every specimen before us the succeeding turn or turn and a half is white. Following this, we have axial, retractive, broad bands of brown separated by narrow bands of light yellow or white. At times these bands become forked and variously diversified, in some instances ending in a number of fine streaks on the upper half of the whorl. There may be or may not be a red subsutural band present as in typical *quadrasi.* On the last whorl the axial banding in all our specimens becomes very much enfeebled and in some has disappeared entirely. The base may be plain yellow or banded with spiral bands of brown and yellow. The umbilical area is usually red, bordered with a yellow band posteriorly, though in several of the specimens the red is entirely wanting, the yellow covering the entire area. The aperture may be pale purple, the yellow spiral bands appearing white within, or it may be white with the number of bands appearing paler on the inside. The lip may be white or purple. This form is distinguished from the next chiefly by the conspicuous coloring of the base, the spiral bands being practically absent in *solida.* I have seen the following specimens:

Cat. No.	Collection.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.
215609	U.S.N.M.	6.3	36.5	20.3	Balabac Id.
215610	U.S.N.M., 6 immature.				Pt. Ciego, Balabac.
79485	Phila. Acad. Nat. Sci.	6.5	40.5	21.5	Palawan (Fulton).
79485	.....do	6	30.5	16.3	Do.
79480	.....do	6	33.7	18	Balabac Id.
79480	.....do	6.5	35.2	17	Do.
79480	.....do	6	30.2	16.5	Do.
	Webb	7	39.5	20.6	Do.
	.....do	(?)	(?)	19.2	Do.
	Chicago Acad. Sci.	6	33.4	16.5	Do.
	Webb	6	35.6	18	Do.

AMPHIDROMUS QUADRASI PALAWANENSIS, new subspecies.

Plate 1, fig. 15; plate 20, figs. 1, 4, 6–9.

Shell more elongate than typical *quadrasi.* Apex black, the succeeding turn white, and all but the last turn or turn and a half are marked with axial bands of brown which usually break up into finer branches on the posterior half of the whorls. The last portion of the shells lacks this brown banding and is unicolor, excepting the spiral bands of yellow on the base. The entire surface of the shell is suffused with a brownish wash which gives the whole a dusky aspect. Aperture pale purple within, lip dark brown. In all but one specimen the middle of the base is encircled by a moderately broad yellow band. The columellar area also shows indications of a second yellow band surrounding it, though the portion immediately adjoining the columella is purplish brown. All of the shells have a subsutural red band which is toned down strongly by the brownish suffusion.

The specimens examined yield the following data:

Cat. No.	Collection.	Number of whorls.	Length in mm.	Diameter in mm.	Locality.
99570	U.S.N.M.	7.3	44	21.8	Palawan Passage.
99570	.....do	6.5	38	19.5	Do.
99570	.....do	7	37.6	18.5	Do.
302843	.....do	6.4	32.7	17.5	Do.
302843	.....do	6.3	32.6	17.7	Do.
....	Webb	7	43.5	20.4	Palawan.
....	.....do	7	38.3	19	Do.

EXPLANATION OF PLATES.

PLATE 1.

FIG. 1. *Amphidromus maculiferus cotabatensis* Bartsch.
2. *Amphidromus maculiferus boholensis* Bartsch.
3. *Amphidromus inflatus* Fulton.
4. *Amphidromus chloris* Reeve.
5. *Amphidromus suluensis* Bartsch.
6. *Amphidromus entobaptus culionensis* Bartsch.
7. *Amphidromus quadrasi versicolor* Fulton.
8. *Amphidromus quadrasi solidus* Fulton.
9. *Amphidromus quadrasi solidus* Fulton.
10. *Amphidromus quadrasi dubius* Fulton.
11. *Amphidromus quadrasi quadrasi* Hidalgo.
12. *Amphidromus quadrasi solidus* Fulton.
13. *Amphidromus quadrasi solidus* Fulton.
14. *Amphidromus quadrasi solidus* Fulton.
15. *Amphidromus quadrasi palawanensis* Bartsch.

PLATE 2.

FIG. 1. *Amphidromus maculiferus maculiferus* Sowerby, Camp Overton, Mindanao, Cat. No. 244668, U.S.N.M.
2. *Amphidromus maculiferus maculiferus* Sowerby, Camp Pantar, Mindanao, Cat. No. 24467, U.S.N.M.
3. *Amphidromus maculiferus maculiferus* Sowerby, Camp Overton, Mindanao, Cat. No. 244668, U.S.N.M.
4. *Amphidromus maculiferus maculiferus* Sowerby, Philippine Islands, Cat. No. 99567, U.S.N.M.
5. *Amphidromus maculiferus maculiferus* Sowerby, Camp Overton, Mindanao, Cat. No. 244669, U.S.N.M.

Plate 3.

Fig. 1. *Amphidromus maculiferus cataganensis* Bartsch, Mt. Malindang, Mindanao, Cat. No. 244672, U.S.N.M.
2. *Amphidromus maculiferus cataganensis* Bartsch, Mt. Malindang, Mindanao, Cat. No. 244672, U.S.N.M.
3. *Amphidromus maculiferus cataganensis* Bartsch, Mindanao, Cat. No. 244274, U.S.N.M.
4. *Amphidromus maculiferus cataganensis* Bartsch, Mt. Malindang, Mindanao, Cat. No. 244673, U.S.N.M.
5. *Amphidromus maculiferus cataganensis* Bartsch, Mt. Malindang, Mindanao, Cat. No. 244673, type.

Plate 4.

Fig. 1. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244676, U.S.N.M.
2. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244676, U.S.N.M.
3. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244678, U.S.N.M.
4. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244677, U.S.N.M.
5. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244677, U.S.N.M.
6. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 184564, U.S.N.M.
7. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244676, U.S.N.M.
8. *Amphidromus maculiferus cotabatensis* Bartsch, Cotabato, Mindanao, Cat. No. 244676, U.S.N.M., type.

Plate 5.

Fig. 1. *Amphidromus maculiferus buluanensis* Bartsch, near Lake Buluan, Mindanao, Cat. No. 244687, U.S.N.M.
2. *Amphidromus maculiferus buluanensis* Bartsch, Buluan to Simpitan, Mindanao, Cat. No. 244688, U.S.N.M.
3. *Amphidromus maculiferus buluanensis* Bartsch, Buluan to Simpitan, Mindanao, Cat. No. 244686, U.S.N.M.
4. *Amphidromus maculiferus buluanensis* Bartsch, Buluan to Simpitan, Mindanao, Cat. No. 244688, U.S.N.M., type.
5. *Amphidromus maculiferus buluanensis* Bartsch, Buluan to Simpitan, Mindanao, Cat. No. 244688, U.S.N.M.
6. *Amphidromus maculiferus buluanensis* Bartsch, Buluan to Simpitan, Mindanao, Cat. No. 244686, U.S.N.M.

Plate 6.

Fig. 1. *Amphidromus maculiferus strigatus* Möllendorff, Davao, Mindanao, Cat. No. 195849, U.S.N.M.
2. *Amphidromus maculiferus strigatus* Möllendorff, Davao, Mindanao, Cat. No. 195849, U.S.N.M.

FIG. 3. *Amphidromus maculiferus strigatus* Möllendorff, Davao, Mindanao, Cat. No. 184565, U.S.N.M.

4. *Amphidromus maculiferus strigatus* Möllendorff, Davao, Mindanao, Cat. No. 184565, U.S.N.M.

5. *Amphidromus maculiferus strigatus* Möllendorff, Mindanao, Cat. No. 185849, U.S.N.M.

PLATE 7.

FIG. 1. *Amphidromus maculiferus boholensis* Bartsch, Sevilla, Bohol, Cat. No. 245563, U.S.N.M.

2. *Amphidromus maculiferus boholensis* Bartsch, Sevilla, Bohol, Cat. No. 245563, U.S.N.M.

3. *Amphidromus maculiferus boholensis* Bartsch, Sevilla, Bohol, Cat. No. 245563, U.S.N.M., type.

4. *Amphidromus maculiferus samarensis* Bartsch, Samar, Cat. No. 215579, U.S.N.M., type.

5. *Amphidromus maculiferus gracilior* Fulton, Mainit, Mindanao, Chicago Acad. Sci.

6. *Amphidromus maculiferus gracilior* Fulton (no specific locality), Mindanao, Cat. No. 184566, U.S.N.M.

PLATE 8.

FIG. 1. *Amphidromus maculiferus multicolor* Möllendorff, Matalon, Leyte, Chicago Academy Sciences.

2. *Amphidromus maculiferus multicolor* Möllendorff, Maasin Leyte, Chicago Academy Sciences.

3. *Amphidromus floresi* Bartsch, Mindanao, Cat. No. 215580, U.S.N.M., type.

4. *Amphidromus maculiferus multicolor* Möllendorff, Leyte, Cat. No. 184562, U.S.N.M.

5. *Amphidromus maculiferus multicolor* Möllendorff, Bato, Leyte, Webb Coll.

PLATE 9.

FIG. 1. *Amphidromus malindangensis* Bartsch, Mount Malindang, Mindanao, Cat. No. 244689, U.S.N.M.

2. *Amphidromus malindangensis* Bartsch, Mount Malindang, Mindanao, Cat. No. 244689, U.S.N.M., type.

3. *Amphidromus basilanensis* Basilan Island, Cat. No. 244691, U.S.N.M., type.

4. *Amphidromus maculiferus cosmius* Bartsch, Basilan Island, Cat. No. 245562, U.S.N.M., type.

5. *Amphidromus apoensis* Bartsch, Mount Apo, Mindanao, Cat. No. 244690, U.S.N.M., type.

6. *Amphidromus apoensis* Bartsch, Mount Apo, Mindanao, Cat. No. 244690, U.S.N.M.

PLATE 10.

FIG. 1. *Amphidromus mearnsi* Bartsch, Basilan, Cat. No. 245566, U.S.N.M.

2. *Amphidromus mearnsi* Bartsch, Basilan, Cat. No. 245565, U.S.N.M. type.

3. *Amphidromus pallidulus* Pilsbry, Zamboanga, Mindanao, Cat. No. 106459, Phila. Acad. Nat. Sci., cotype.

4. *Amphidromus bilatanensis* Bartsch, Bilatan Island, British Museum, type.

FIG. 5. *Amphidromus bilatanensis* Bartsch, Bilatan Island, British Museum, type.
6. *Amphidromus inflatus* Fulton, Philippine Islands, Cat. No. 99568, U.S.N.M.
7. *Amphidromus inflatus* Fulton, Philippine Islands, Cat. No. 99568, U.S.N.M.
8. *Amphidromus pallidulus* Pilsbry, Zamboanga, Mindanao, Cat. No. 106459, Phila. Acad. Nat. Sci., cotype.

PLATE 11.

FIG. 1. *Amphidromus calista* Pilsbry, Basilan, Cat. No. 106458, Phila. Acad. Nat. Sci., cotype.
2. *Amphidromus calista* Pilsbry, Basilan, Cat. No. 106458, Phila. Acad. Nat. Sci., cotype.
3. *Amphidromus calista* Pilsbry, Basilan, Cat. No. 106458, Phila. Acad. Nat. Sci., cotype.
4. *Amphidromus hidalgoi* Bartsch, Dapitan, Mindanao, type. Hidalgo collection.
5. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99564, U.S.N.M.
6. *Amphidromus hidalgoi* Bartsch, Dapitan, Mindanao, type. Hidalgo collection.
7. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99564, U.S.N.M.
8. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99565, type.
9. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99565.

PLATE 12.

FIG. 1. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
2. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
3. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
4. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
5. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
6. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
7. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99565, U.S.N.M.
8. *Amphidromus chloris* Reeve, Talantalan, Zamboanga, Mindanao, Cat. No. 215641, U.S.N.M.
9. *Amphidromus suluensis* Bartsch, Islands of the Sulu Sea, Cat. No. 99564, U.S.N.M.

PLATE 13.

FIG. 1. *Amphidromus roeseleri* Möllendorff, Jolo Island, Cat. No. 215576, U.S.N.M.
2. *Amphidromus roeseleri* Möllendorff, Jolo Island, Cat. No. 215576, U.S.N.M.
3. *Amphidromus roeseleri* Möllendorff, Jolo Island, Cat. No. 215576, U.S.N.M.
4. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.

FIG. 5. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.
6. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.
7. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.
8. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.
9. *Amphidromus entobaptus* Dohrn, Puerto Princesa, Palawan, Cat. No. 254917, U.S.N.M.

PLATE 14.

FIG. 1. *Amphidromus entobaptus viridoflavus* Bartsch, Malubutglubut Island, Cat. No. 215600, U.S.N.M.
2. *Amphidromus entobaptus viridoflavus* Bartsch, Malubutglubut Island, Cat. No. 215600, U.S.N.M.
3. *Amphidromus entobaptus viridoflavus* Bartsch, Malubutglubut Island, Cat. No. 215600, U.S.N.M., type.
4. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
5. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
6. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
7. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
8. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M., type.
9. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.

PLATE 15.

FIG. 1. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
2. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
3. *Amphidromus entobaptus culionensis* Bartsch, Culion Island, Cat. No. 215642, U.S.N.M.
4. *Amphidromus mindoroensis* Bartsch, Mindoro, Cat. No. 245564, U.S.N.M., type.
5. *Amphidromus mindoroensis* Bartsch, Mindoro, Cat. No. 245564, U.S.N.M., type.
6. *Amphidromus entobaptus coronensis* Bartsch, Coron Island, Cat. No. 195848*a*, U.S.N.M.
7. *Amphidromus entobaptus coronensis* Bartsch, Coron Island, Cat. No. 195848*a*, U.S.N.M., type.
8. *Amphidromus entobaptus coronensis* Bartsch, Coron Island, Cat. No. 195848*a*, U.S.N.M.

PLATE 16.

FIG. 1. *Amphidromus entobaptus linapacensis* Bartsch, Linapacan Island, Cat. No. 215599, U.S.N.M.
2. *Amphidromus entobaptus linapacensis* Bartsch, Linapacan Island, Cat. No. 215599, U.S.N.M., type.

Fig. 3. *Amphidromus entobaptus linapacensis* Bartsch, Linapacan Island, Cat. No. 215599, U.S.N.M.

4. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Cat. No. 215643, U.S.N.M.
5. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Webb Collection.
6. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Webb Collection.
7. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Cat. No. 215643, U.S.N.M., type.
8. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Webb Collection.
9. *Amphidromus entobaptus busuangensis* Bartsch, Malbato, Busuanga, Webb Collection.

Plate 17.

Fig. 1. *Amphidromus quadrasi quadrasi* Hidalgo, Balabac Island, Webb Collection.

2. *Amphidromus quadrasi quadrasi* Hidalgo, Candaraman Island, Cat. No. 215605, U.S.N.M.
3. *Amphidromus quadrasi quadrasi* Hidalgo, Balabac Island, Cat. No. 66188, Phila. Acad. Nat. Sci.
4. *Amphidromus quadrasi quadrasi* Hidalgo, Caxisigan Island, Cat. No. 215603, U.S.N.M.
5. *Amphidromus quadrasi quadrasi* Hidalgo, Caxisigan Island, Cat. No. 215603, U.S.N.M.
6. *Amphidromus quadrasi quadrasi* Hidalgo, Candaraman Island, Cat. No. 215605, U.S.N.M.
7. *Amphidromus quadrasi quadrasi* Hidalgo, Candaraman Island, Cat. No. 215605, U.S.N.M.
8. *Amphidromus quadrasi quadrasi* Hidalgo, Candaraman Island, Cat. No. 215605, U.S.N.M.
9. *Amphidromus quadrasi quadrasi* Hidalgo, Caxisigan Island, Cat. No. 215603, U.S.N.M.
10. *Amphidromus quadrasi quadrasi* Hidalgo, Candaraman Island, Cat. No. 215605, U.S.N.M.
11. *Amphidromus quadrasi quadrasi* Hidalgo, Balabac Island, Webb Collection.

Plate 18.

Fig. 1. *Amphidromus quadrasi versicolor* Fulton, Balabac, Cat. No. 79483, Phila. Acad. Nat. Sci.

2. *Amphidromus quadrasi versicolor* Fulton, Balabac, Cat. No. 98852, Phila. Acad. Nat. Sci.
3. *Amphidromus quadrasi versicolor* Fulton, Webb Collection.
4. *Amphidromus quadrasi versicolor* Fulton, Balabac, Cat. No. 95152, Phila. Acad. Nat. Sci.
5. *Amphidromus quadrasi versicolor* Fulton, Webb Collection.
6. *Amphidromus quadrasi versicolor* Fulton, Cat. No. 79483, Phila. Acad. Nat. Sci.
7. *Amphidromus quadrasi versicolor* Fulton, Cat. No. 98852, Phila. Acad. Nat. Sci.

FIG. 8. *Amphidromus quadrasi versicolor* Fulton, Cat. No. 79483, Phila. Acad. Nat. Sci.
9. *Amphidromus quadrasi versicolor* Fulton, Cat. No. 95172, Phila. Acad. Nat. Sci.
10. *Amphidromus quadrasi versicolor* Fulton, Cat. No. 95173, Phila. Acad. Nat. Sci.

PLATE 19.

FIG. 1. *Amphidromus quadrasi solidus* Fulton, Balabac, Cat. No. 98851, Phila, Acad. Nat. Sci.
2. *Amphidromus quadrasi dubius* Fulton, Balabac, Cat. No. 79480, Phila. Acad. Nat. Sci.
3. *Amphidromus quadrasi solidus* Fulton, Balabac, Cat. No. 98851, Phila. Acad. Nat. Sci.
4. *Amphidromus quadrasi dubius* Fulton, Balabac, Cat. No. 79480, Phila. Acad. Nat. Sci.
5. *Amphidromus quadrasi dubius* Fulton, Balabac, Cat. No. 79480, Phila. Acad. Nat. Sci.
6. *Amphidromus quadrasi dubius* Fulton, Balabac, Webb Collection.
7. *Amphidromus quadrasi solidus* Fulton, Balabac, Cat. No. 79483, Phila. Acad. Nat. Sci.
8. *Amphidromus quadrasi dubius* Fulton, Balabac, Chicago Acad. Sci.
9. *Amphidromus quadrasi dubius* Fulton, Palawan, Cat. No. 79485, Phila. Acad. Nat. Sci.

PLATE 20.

FIG. 1. *Amphidromus quadrasi palawanensis* Bartsch, Palawan, Cat. No. 302843, U.S.N.M.
2. *Amphidromus quadrasi dubius* Fulton, Palawan, Cat. No. 79485, Phila. Acad. Nat. Sci.
3. *Amphidromus quadrasi solidus* Fulton, Balabac, Cat. No. 98853, Phila. Acad. Nat. Sci.
4. *Amphidromus quadrasi palawanensis* Fulton, Palawan Passage, Cat. No. 99570, U.S.N.M.
5. *Amphidromus quadrasi solidus* Fulton, Balabac Island, Cat. No. 302844*a*, U.S.N.M.
6. *Amphidromus quadrasi palawanensis* Fulton, Palawan, Webb Collection.
7. *Amphidromus quadrasi palawanensis* Fulton, Palawan Passage, Cat. No. 99570, U.S.N.M.
8. *Amphidromus quadrasi palawanensis* Fulton, Palawan Passage, Cat. No. 99570, U.S.N.M.
9. *Amphidromus quadrasi palawanensis* Fulton, Palawan, Webb Collection.

PLATE 21.

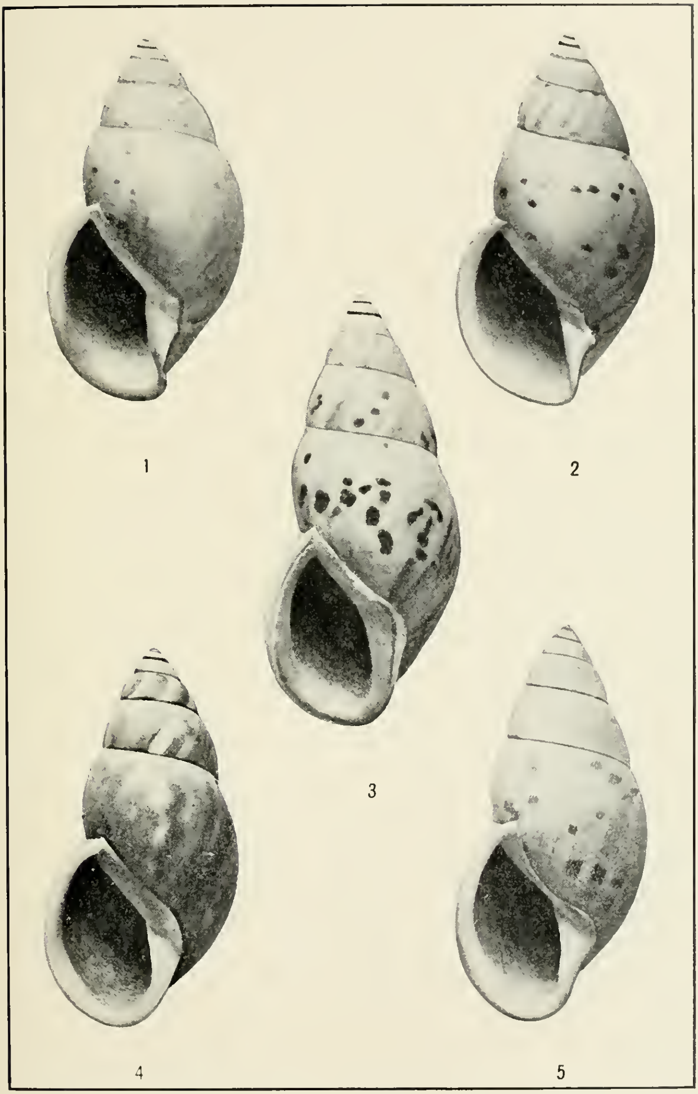
Relief map showing the distribution of the *Amphidromus maculiferus* group, numbers 1 to 16, and *Amphidromus hidalgoi*, number 21.

1. *maculiferus.*	5. *strigatus.*	9. *samarensis.*	13. *malindangensis.*
2. *cataganensis.*	6. *gracilior.*	10. (?).	14. *apoensis.*
3. *cotabatensis.*	7. *boholensis.*	11. (?).	15. *basilanensis.*
4. *buluanensis.*	8. *multicolor.*	12. *cosmius.*	16. *floresi.*

PLATE 22.

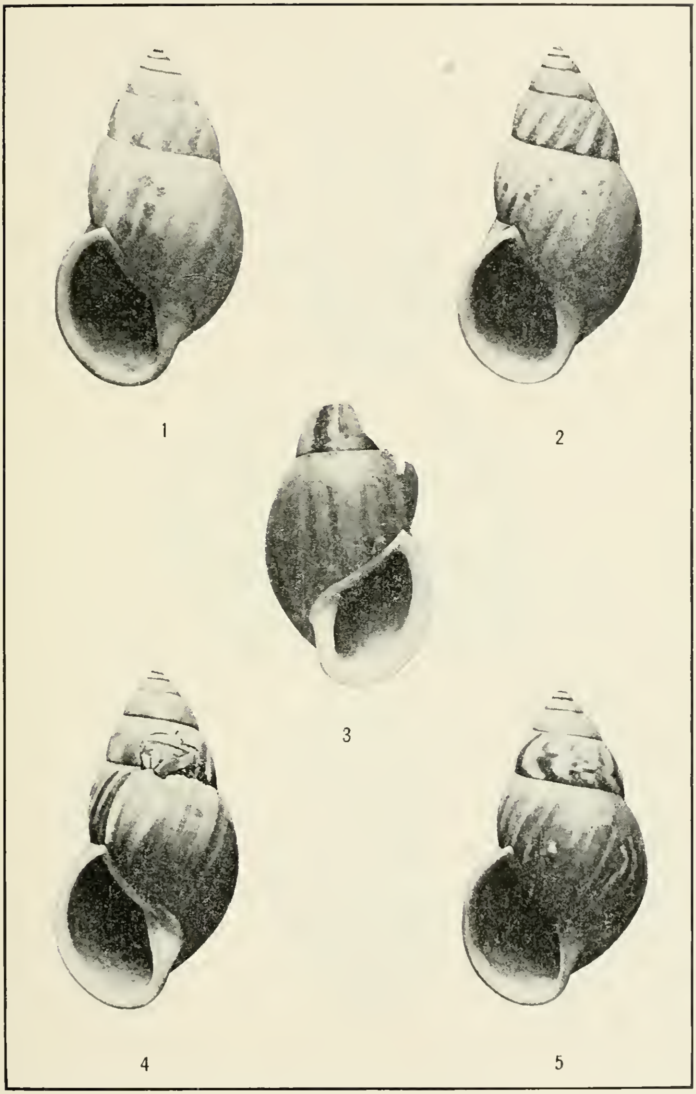
Relief map showing the distribution of the group of *Amphidromus inflatus*, numbers 17–22; the group of *Amphidromus chloris*, numbers 23–25; the group of *Amphidromus entobaptus*, numbers 27–33; and the group of *Amphidromus quadrasi*, numbers 34–38:

17. *inflatus.*	23. *chloris* .	29. *linapacensis.*	35. *versicolor.*
18. *mearnsi.*	24. *roeseleri.*	30. *culionensis.*	36. *solidus.*
19. *pallidulus.*	25. *suluensis.*	31. *coronensis.*	37. *dubius.*
20. *bilatanensis.*	26. species (?).	32. *busuangensis.*	38. *palawanensis.*
21. *hidalgoi.*	27. *entobaptus.*	33. *mindoroensis.*	
22. *calista.*	28. *viridoflavus.*	34. *quadrasi.*	



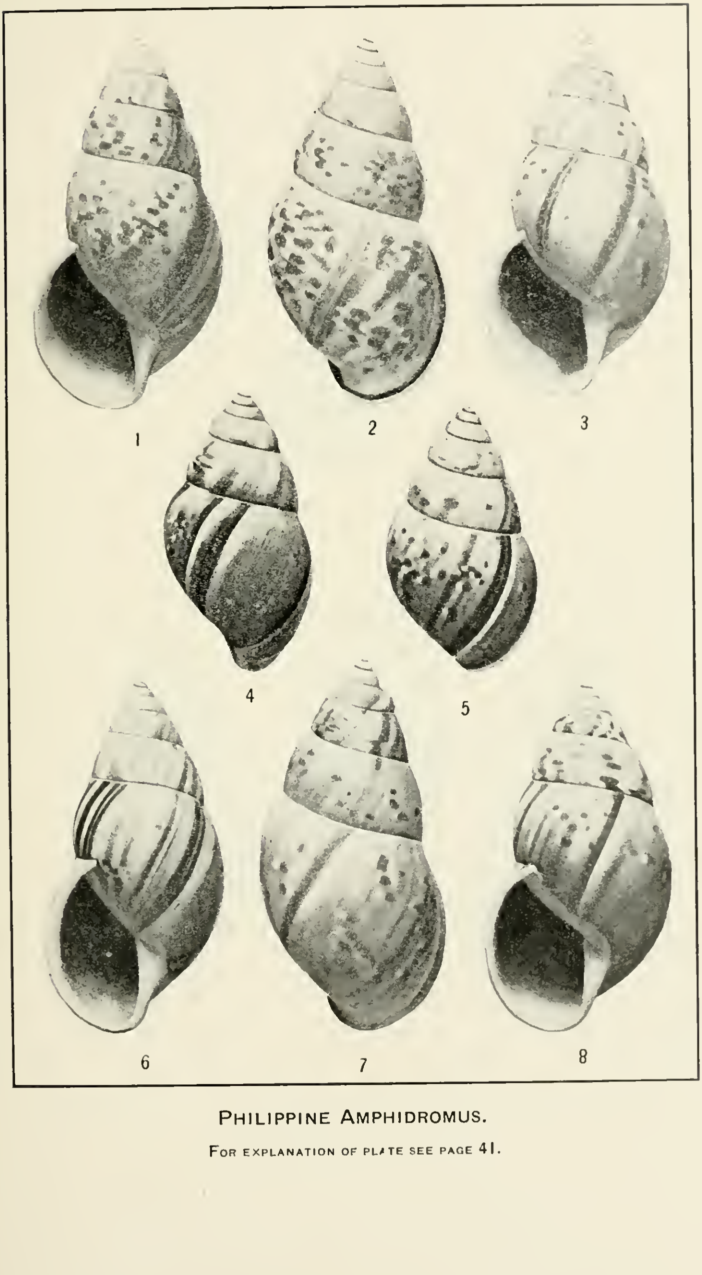
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 40.



PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 41.



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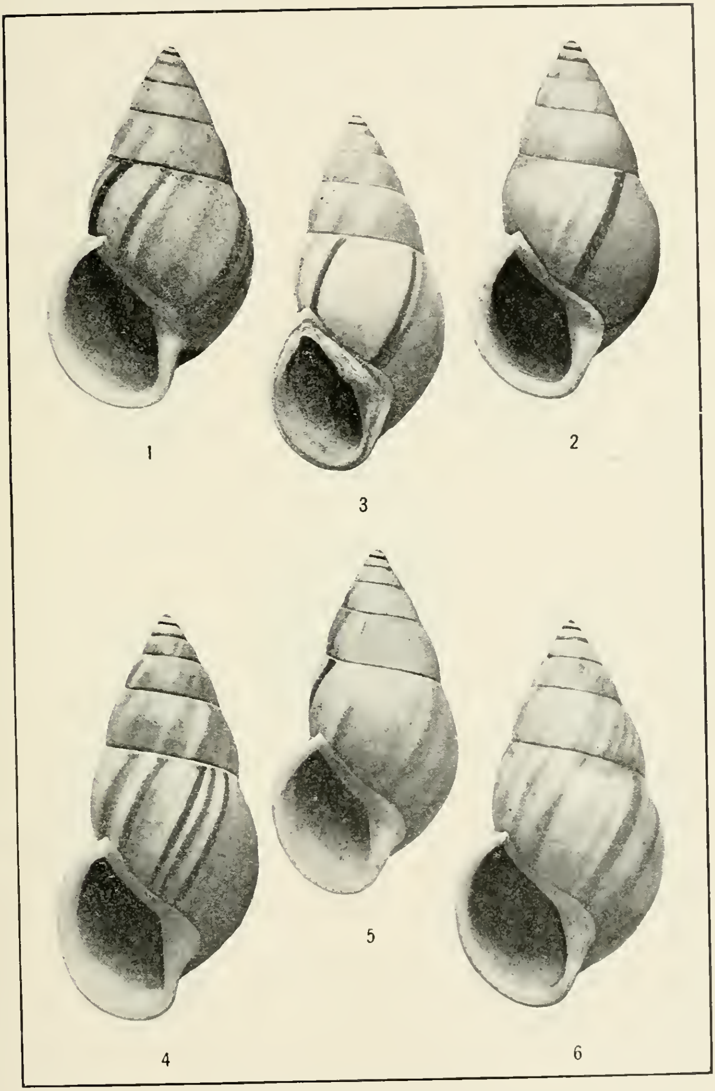
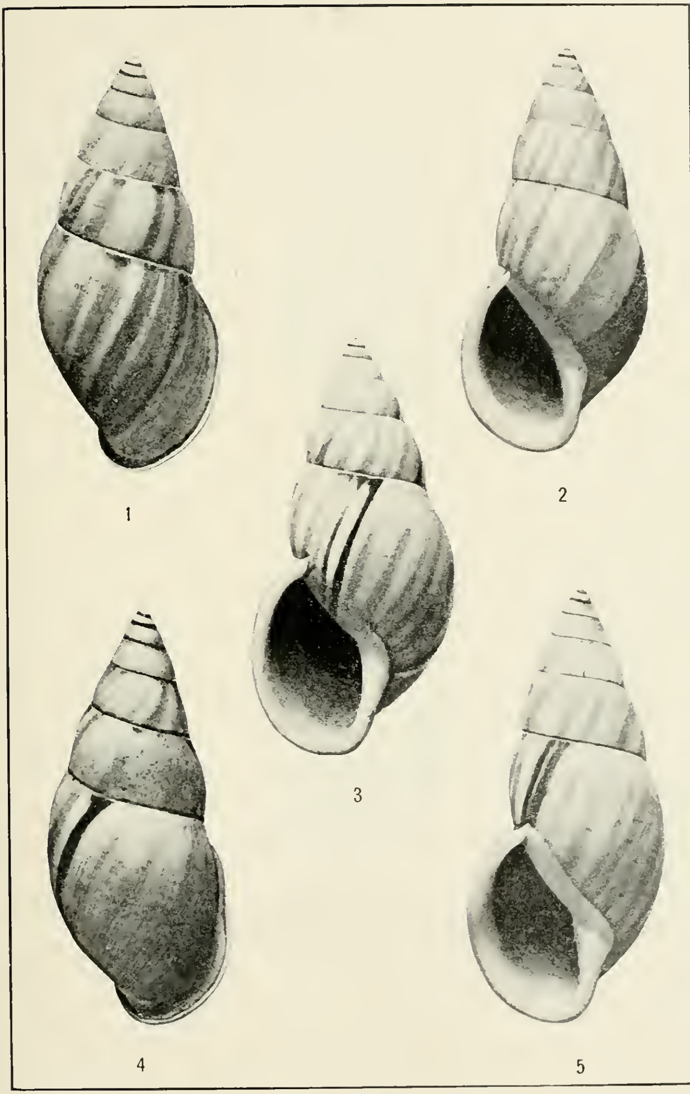
FOR EXPLANATION OF PLATE SEE PAGE 41.



PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 41



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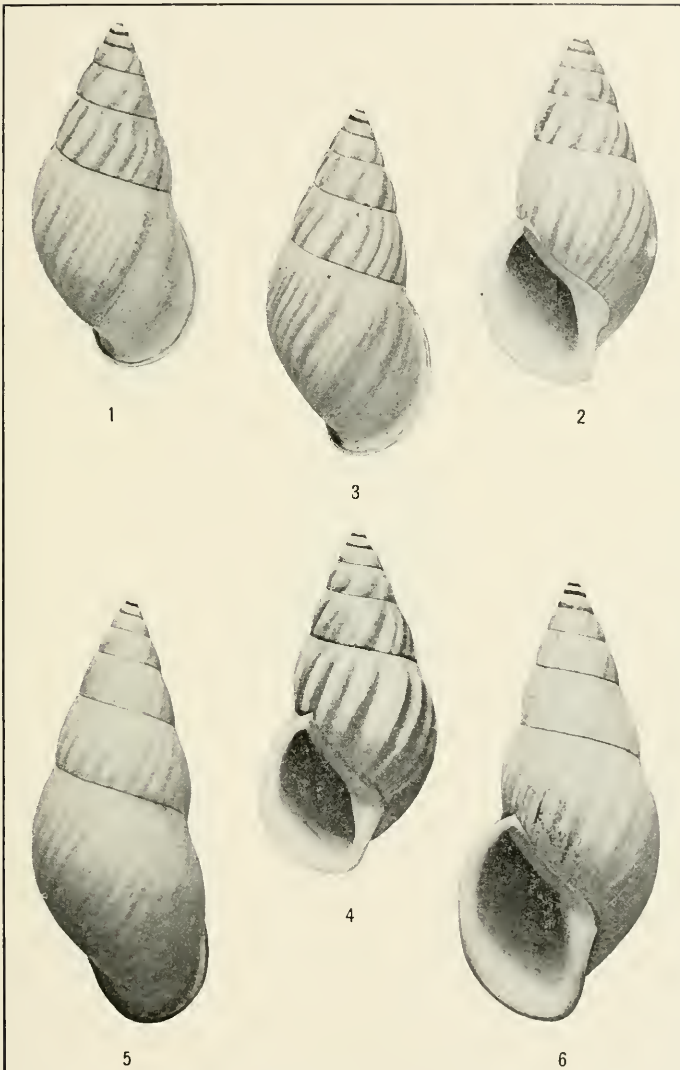
FOR EXPLANATION OF PLATE SEE PAGES 41 AND 42



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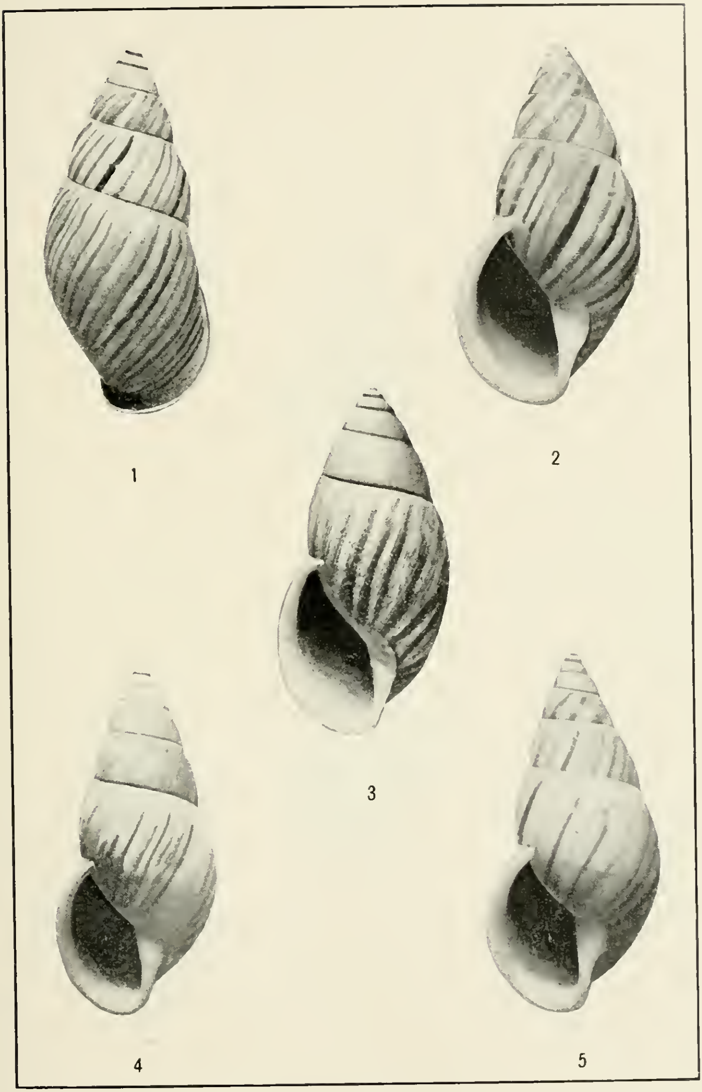
FOR EXPLANATION OF PLATE SEE PAGE 42.



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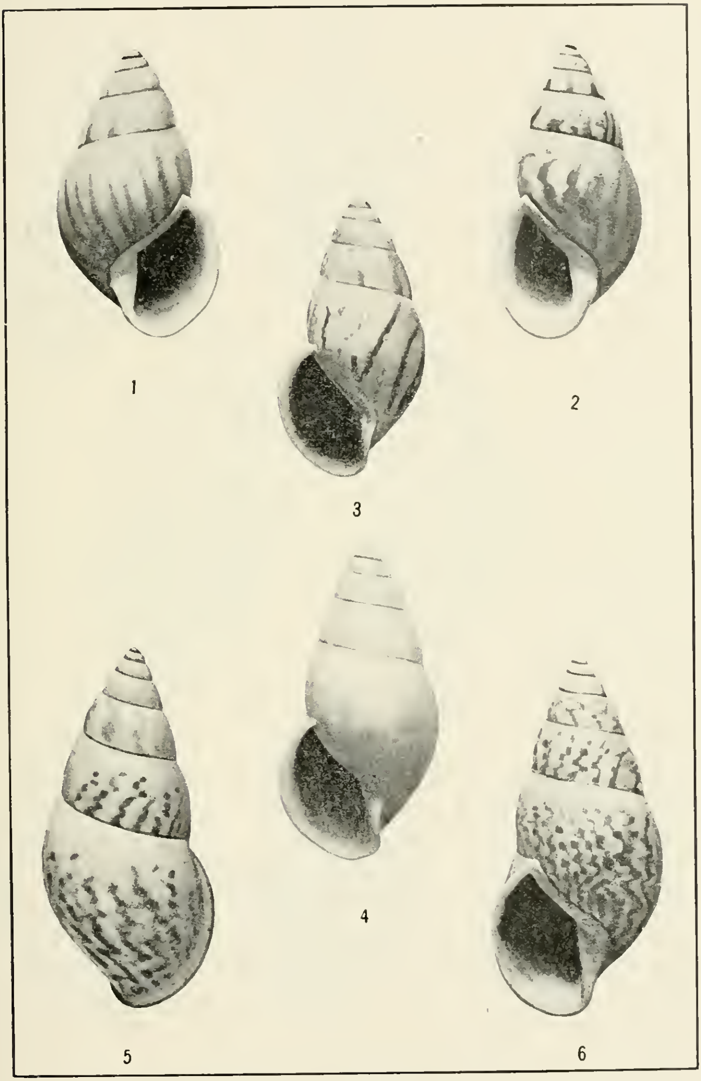
FOR EXPLANATION OF PLATE SEE PAGE 42.



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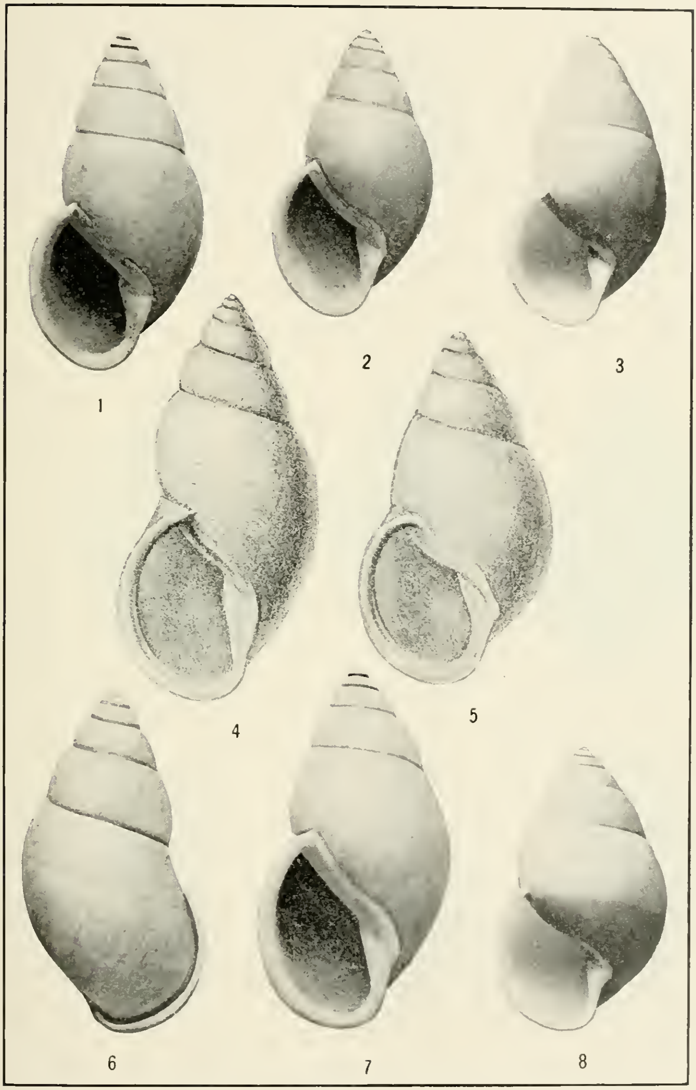
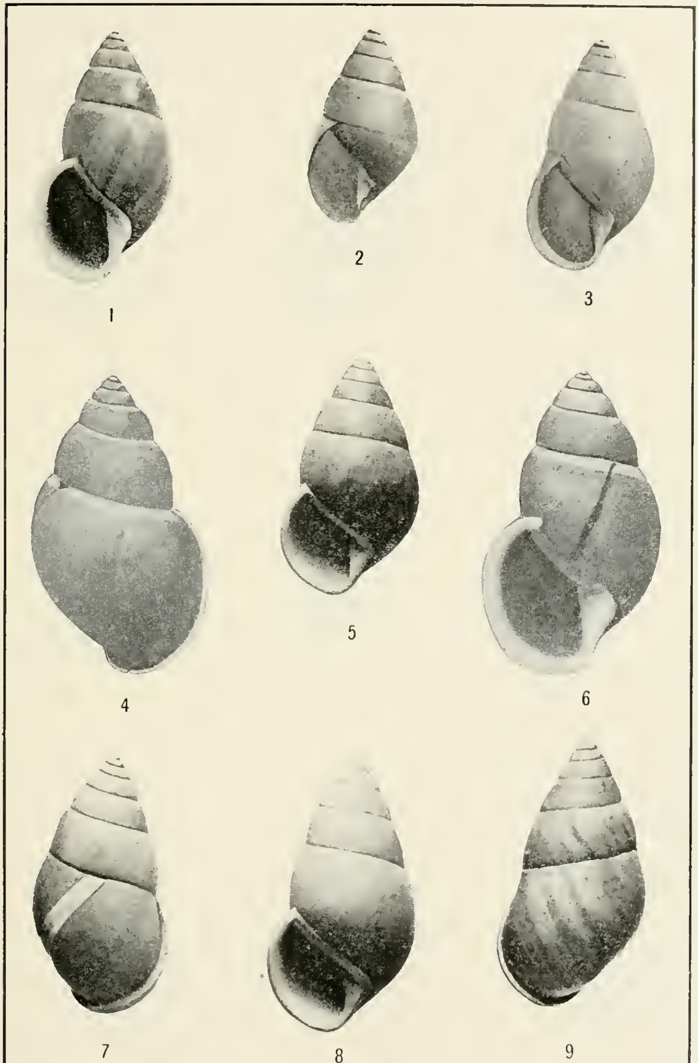
FOR EXPLANATION OF PLATE SEE PAGE 42.



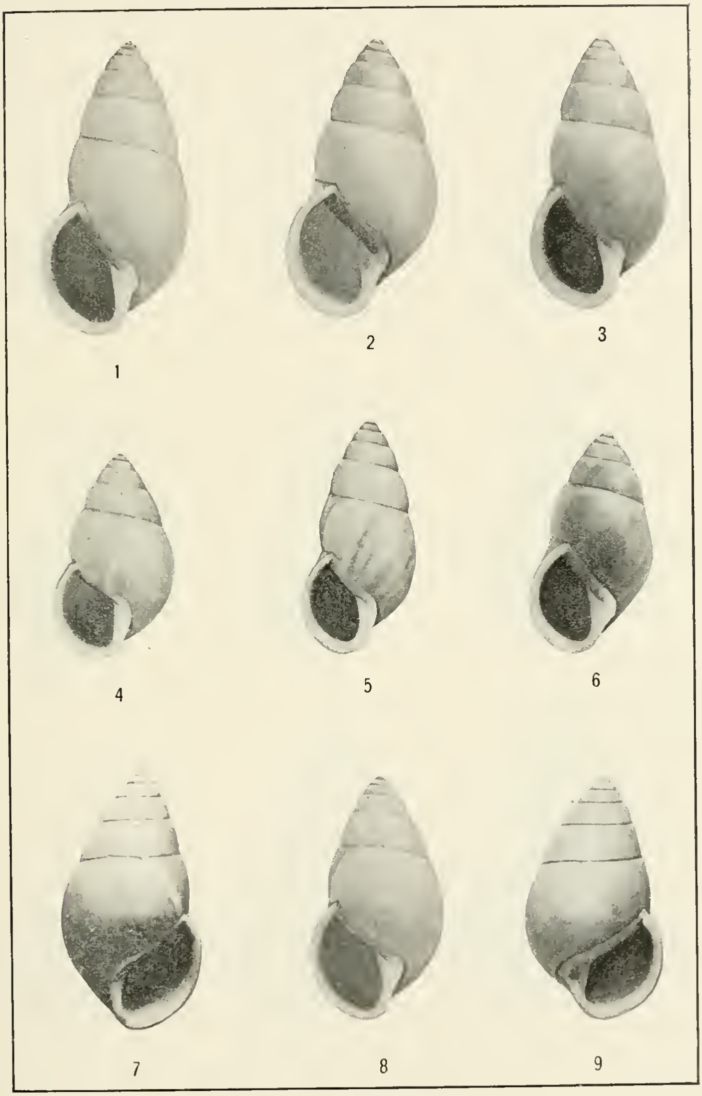
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGES 42 AND 43



PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 43.



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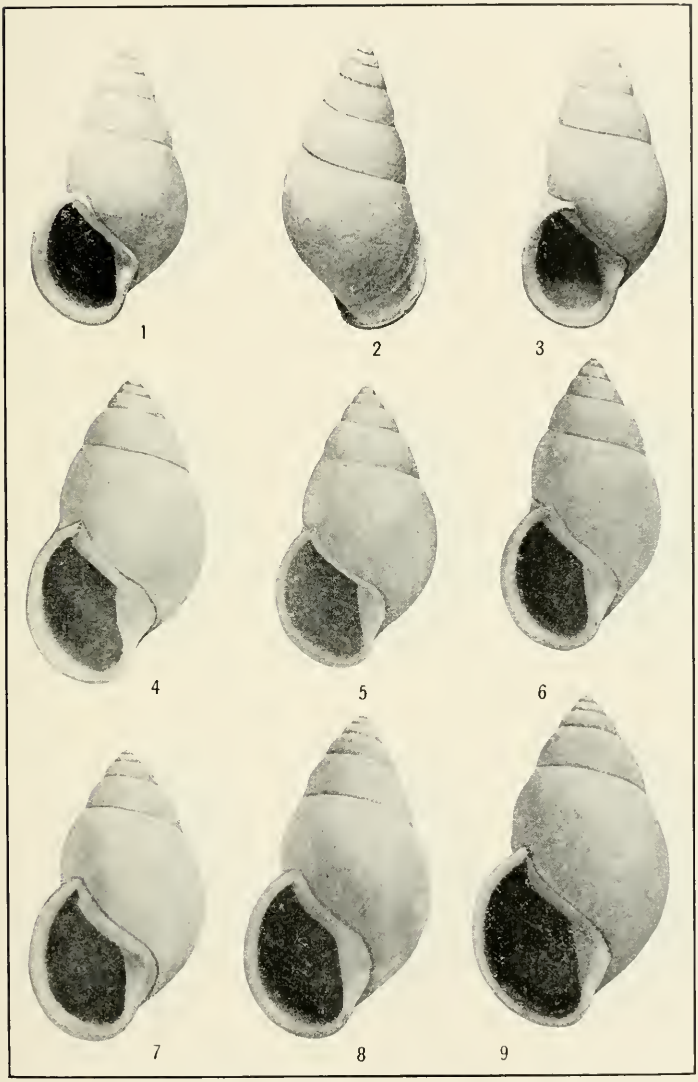
FOR EXPLANATION OF PLATE SEE PAGE 43.



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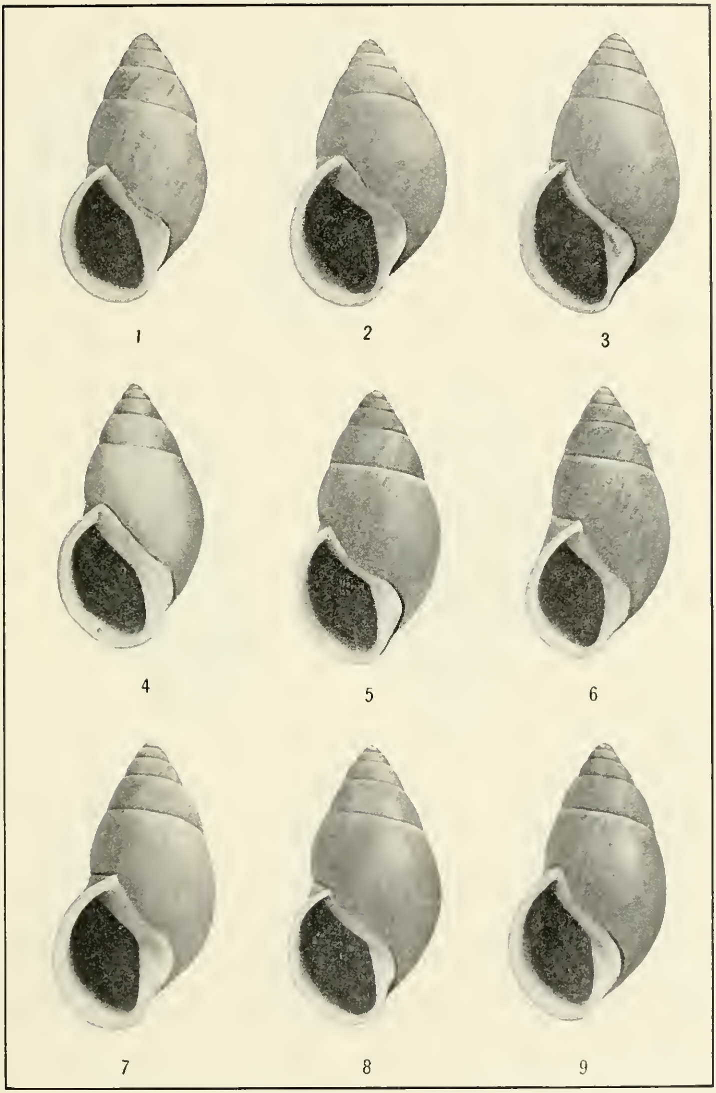
FOR EXPLANATION OF PLATE SEE PAGES 43 AND 44.



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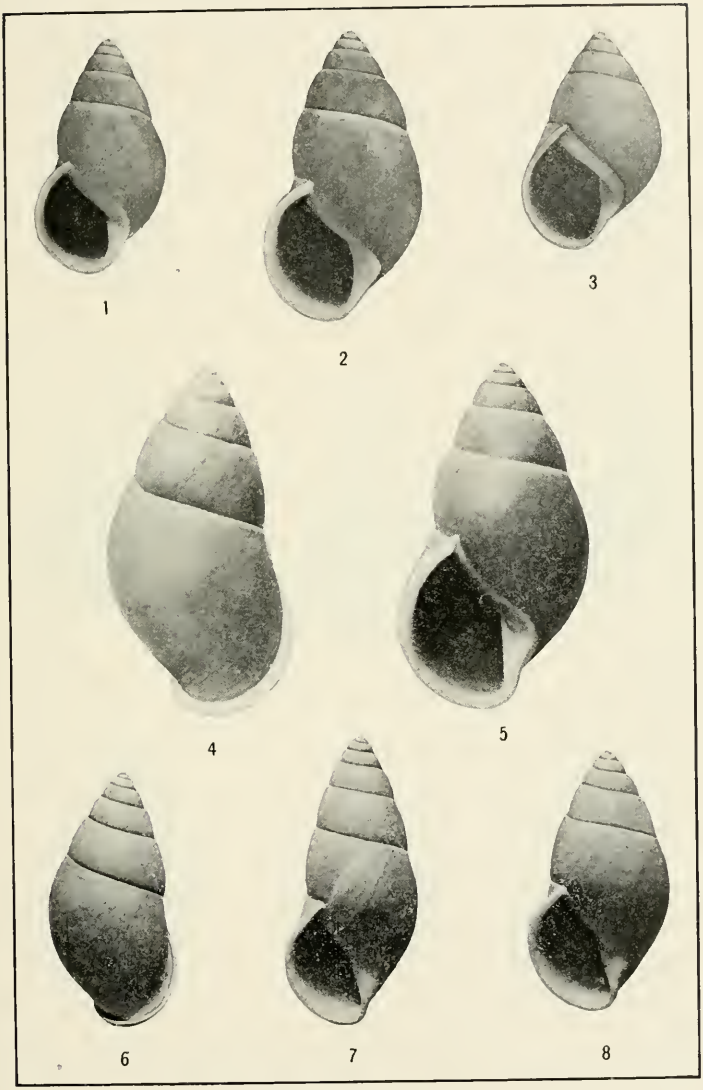

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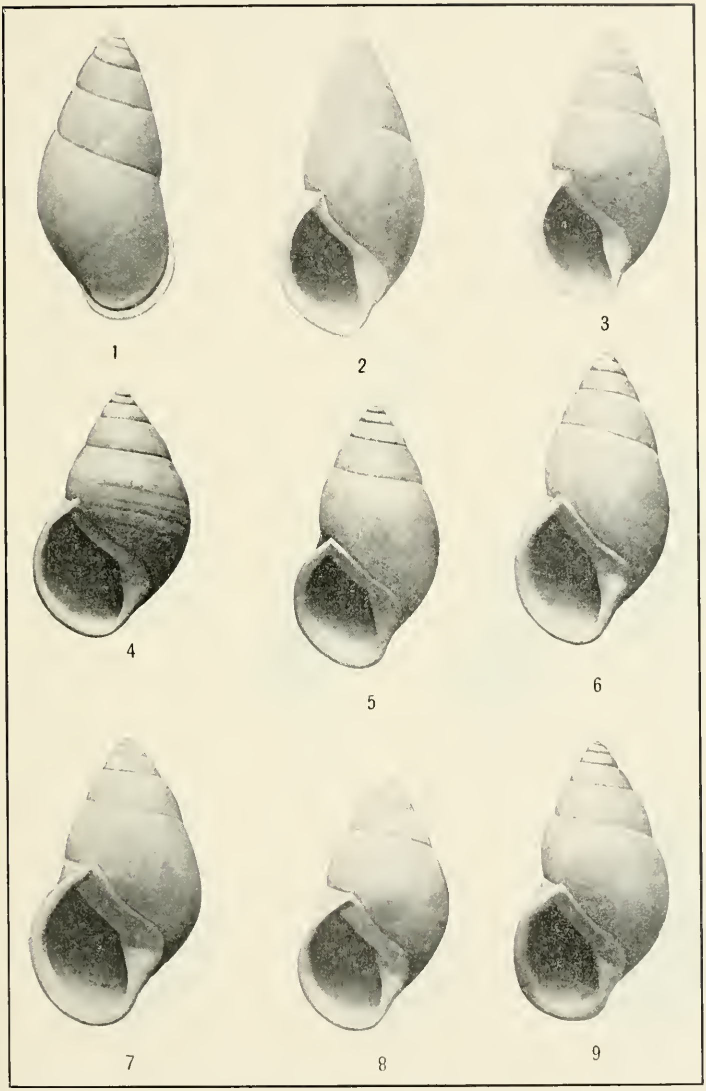
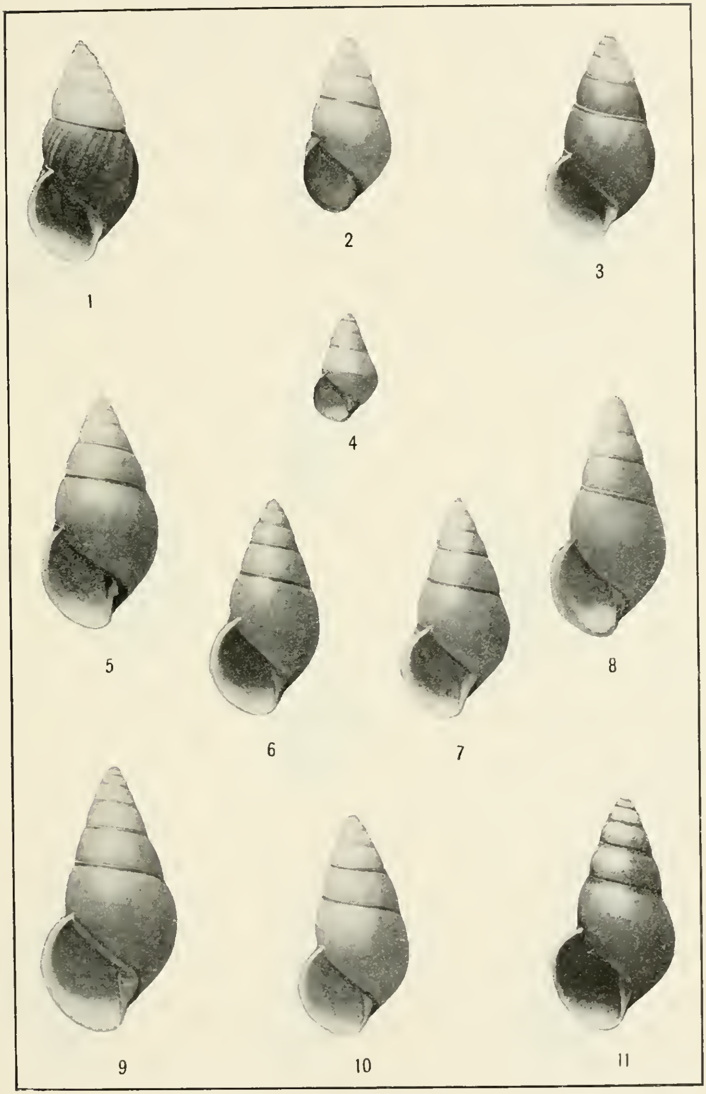
FOR EXPLANATION OF PLATE SEE PAGE 44.



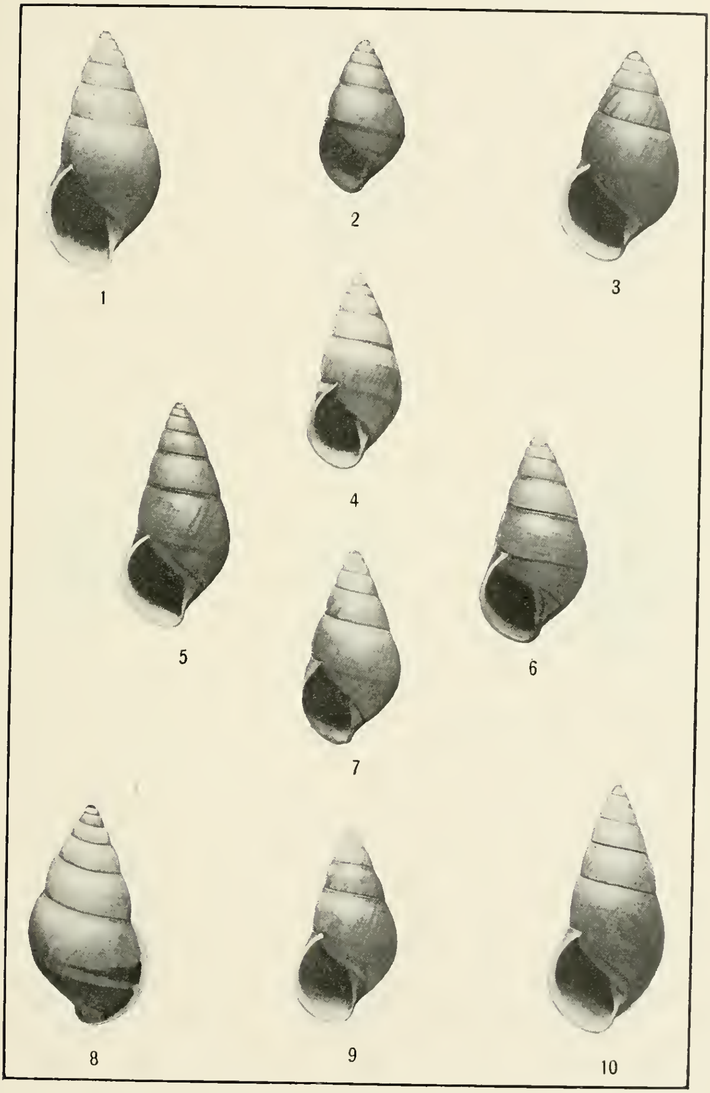
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGES 44 AND 45



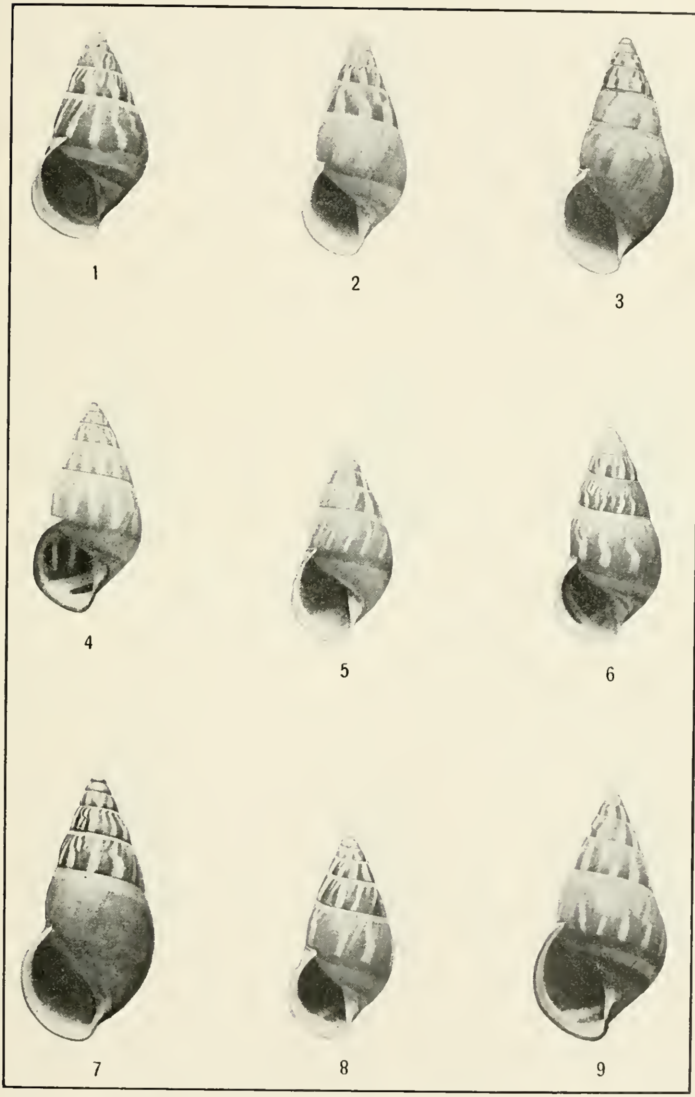
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 45.



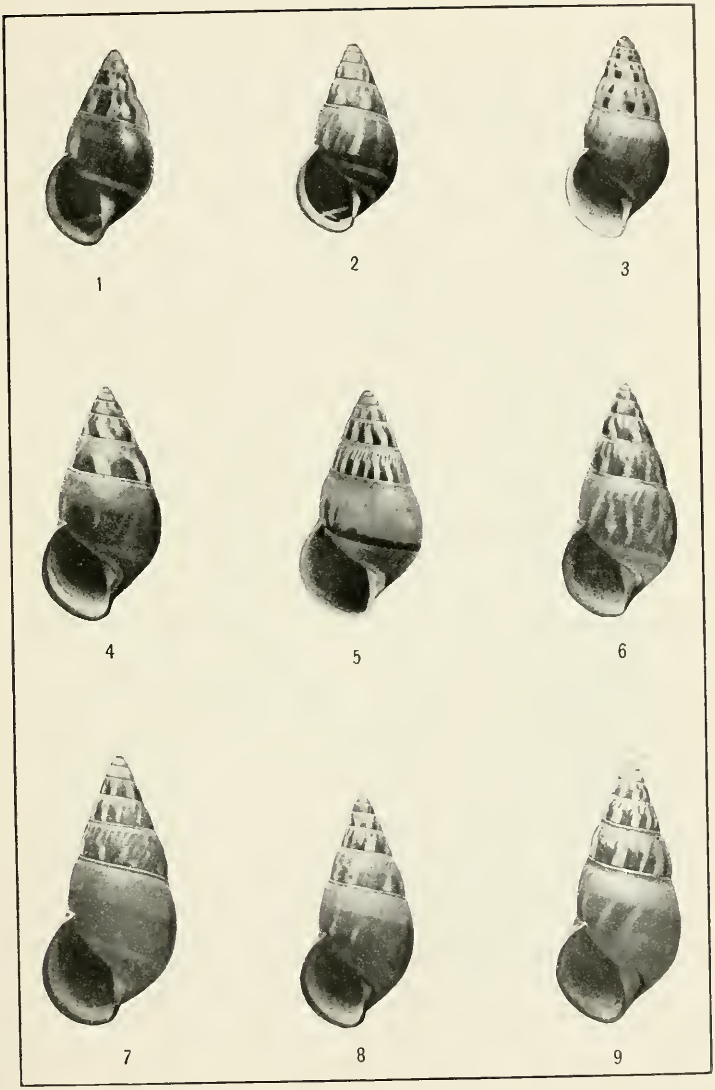
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGES 45 AND 46



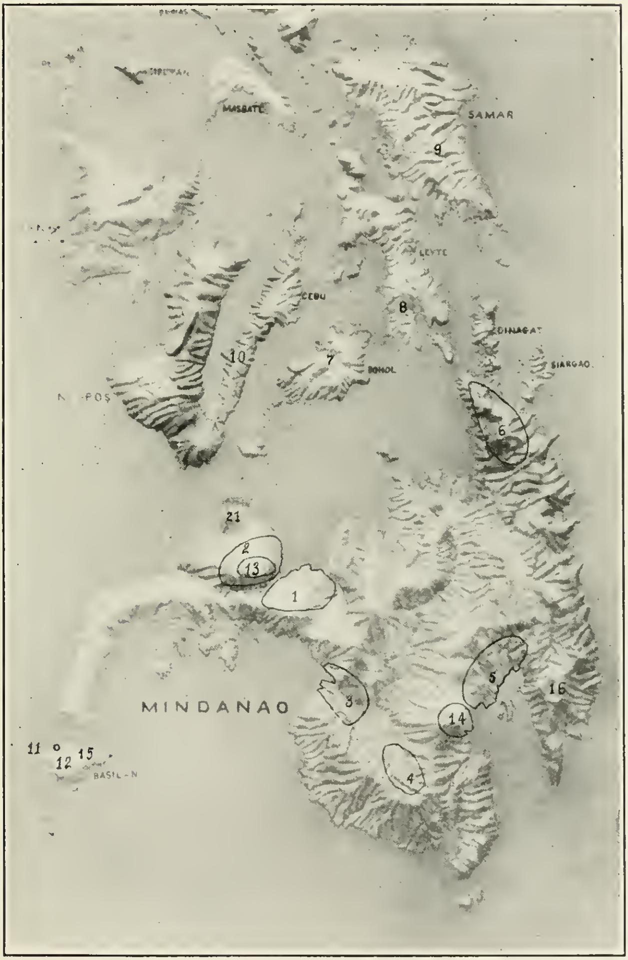
PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 46.



PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 46.



PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 46

PHILIPPINE AMPHIDROMUS.

FOR EXPLANATION OF PLATE SEE PAGE 47.

ASCIDIANS FROM THE PHILIPPINES AND ADJACENT WATERS.

By Willard G. Van Name,

Of the American Museum of Natural History, New York.

INTRODUCTION.

Although the ascidians of the Malay Archipelago have already been so much studied that it seems unlikely that many of the commoner and more widely distributed species have escaped discovery, the Philippine Islands form one of the parts of that region that have been but little investigated as far as their ascidian fauna is concerned. As a whole the Malay region is remarkably rich in ascidians, both in variety of form and number of individuals, and some 200 species have been recorded from it, but among these supposed species there are undoubtedly many synonyms. Several important expeditions that have made collections in the Malay region, the United States Exploring Expedition, the *Challenger* Expedition, and the *Siboga* Expedition, extended their operations into the southern part of the Philippine group, and though as a result of their work a considerable number of species of ascidians have been described or recorded from Philippine waters, the localities investigated were too few and too near together, and the amount of material too small to give anything approaching a complete view of the ascidian fauna.

The collection made by the *Albatross* Expedition affords for the first time an opportunity for a general and comprehensive study of the ascidians of the Philippines and their vicinity. That the collection falls very far short of containing all the species found there is very evident. Many forms obtained by other expeditions are not contained in it, and much more extensive collecting in the northern part of the group would have been desirable. Future collectors will find plenty of localities, quite extensive regions in fact, which have been passed by entirely, and they will no doubt add many species and some genera to the list of Philippine forms, yet the *Albatross* collection seems to be a sufficiently representative one to determine the general character of the ascidian fauna of the Philippines and its relation to that of the surrounding regions.

It clearly indicates that this fauna is an integral part of that of the Malay region, not a distinct and separate one, and that in the southern part, especially in the Sulu Archipelago, the abundance and variety of ascidians is very great. Proceeding northward among the islands, the ascidians appear to gradually diminish both in abundance and variety. The *Albatross* collection fails to give any indication that this decrease is compensated for by the appearance of northern forms ranging southward from the temperate regions of China and Japan. The very few forms common to these regions and the Philippines are widely distributed species whose presence does not signify any special faunal relationship between places where they happen to occur. The ascidian fauna of the Philippines is distinctly a tropical one. Its relations to that of the temperate portions of the Australian coast are in fact much closer than to those of the less distant regions on the north, since on account of the warm currents many tropical Malayan forms range southward along the east coast of Australia to and even through Bass Strait. In arriving at these conclusions the fact must be kept in mind that insufficient collecting has been done in the northern part of the Philippines, and the presence of certain northern forms there may yet be established, but it seems hardly likely that they occur there to such an extent as to render necessary any great modification of the views here expressed.

REVIEW OF LITERATURE.

Gould (1852–1856) [1] figures several ascidians from the Sulu Sea, but accompanies the illustrations with very little description or other information. On plate 52 of Gould's Atlas (1856) the following are shown:

Figs. 613, 613*a*. "Ascidian from Balabac Passage, Sooloo Sea." (This is apparently a compound species of the family Styelidae different from any collected by the *Albatross*, perhaps a member of the genus *Diandrocarpa*.)

Figs. 616, 616*a*. "EUCOELIUM ERUBESCENS G., of a spongy texture, attached to coral from the Sooloo Sea."

Figs. 617, 617*a*. "EUCOELIUM ———, from coral reef, Balabac Passage, Sooloo Sea." (The figures do not suffice to determine what these were, but it is possible that they are both identical with *Polysyncraton dubium* Sluiter of the present paper.)

Figs. 621, 621*a*, 621*b*. "NEPHTHEIS (?) ———, dredged from about 9 fathoms, Sooloo Sea." (This is *Nephtheis thompsoni* (Herdman) of the present paper.)

The *Challenger* Expedition, 1873–1876, collected a number of ascidians in Philippine waters which were described as species new to science by Herdman (1881, 1882, 1886) in the reports of that expedition. The list of them follows. The names for these species adopted

[1] See list of literature at the end of this paper.

by the present writer (when different from the original) are given in the second column.

Polycarpa pedata------------------------(*Pandocia pedata*).
Polycarpa irregularis---------------------(*Pandocia irregularis*).
Synstyela incrustans---------------------(*Diandrocarpa monocarpa*, var. *philippinensis*).
Botrylloides tyreum (syn. *B. purpureum*).
Botrylloides perspicuum.
Botrylloides perspicuum, var. *rubicundeum*.
Cystodytes philippinensis.
Distaplia vallii--------------------------(*Holozoa vallii*).
Colella thompsoni------------------------(*Nephtheis thompsoni*).
Leptoclinum moseleyi--------------------(*Didemnum moseleyi*).
Leptoclinum albidum, var. *grande*---------(*Didemnum grande*).
Aplidium fumigatum.

Traustedt (1885) in listing the simple ascidians of the Pacific Ocean again records from the Philippines on Herdman's authority:

Polycarpa irregularis---------------------(*Pandocia irregularis*).
Polycarpa pedata------------------------(*Pandocia pedata*).

Herdman (1891) in his Revised Classification of the Tunicata again lists the forms collected by the *Challenger* Expedition.

The *Siboga* Expedition, though its collecting was mainly done in the Dutch possessions, extended its operations into the extreme southern part of the Philippine region and added a large number of species to the list. These were described by Sluiter in volumes 56*a* (1904) and 56*b* (1909) of the report of that expedition. The species recorded are as follows:

In volume 56*a* (1904):

Halocynthia jacatrensis (Sluiter), 1900----(*Pyura jacatrensis*).
Culeolus thysanotus, new species.
Styela procera Sluiter, 1885---------------(*Pandocia procera*).
Styela thelyphanes, new species-----------(*Pandocia thelyphanes*).
Styela circumarata, new species-----------(*Pandocia circumarata*).
Botrylloides perspicuum Herdman, 1886.
Chelyosoma sibogae, new species.
Ascidia kreagra Sluiter, 1895-------------(*Phallusia kreagra*).
Ascidia melanostoma Sluiter, 1885--------(*Phallusia melanostoma*).
Ecteinascidia diaphanis Sluiter, 1885.
Ecteinascidia garstangi Sluiter, 1887.

In volume 56*b* (1909):

Polycitor discolor, new species.
Cystodites rufus, new species.
Cystodites semicataphractus, new species.
Sycoza sedens, new species--------------------(*Polycitor sedens*).
Tridideminum granosum, new species.
Didemnum moseleyi (Herdman), 1886.
Didemnum digestum, new species.

Didemnum makropnous, new species.
Didemnum ramosum, new species.
Leptoclinum calificiforme, new species.
Diplosomoides molle Herdman, 1886.
Polyclinum mikropnous, new species.
Amaroucium crateriferum, new species.
Atopogaster tropicum, new species.
Morchellium intercedens, new species------------(*Synoicum intercedens*).

Michaelsen (1904, p. 48) discusses again Herdman's (1886) *Synstyela incrustans* and shows that the Philippine specimen which Herdman included under that name is different from the others. He gives it the new name *Diandrocarpa monocarpa*, var. *philippinensis*.

Caullery (1909, p. 46), evidently through an oversight, implies that *Nephtheis* [*Oxycorynia*] *fascicularis* (v. Drasche) was from the Philippines. It was from the Caroline Islands, and is not known from the Philippines, unless *Nephtheis thompsoni* (Herdman), 1886. should prove identical with von Drasche's species.

Hartmeyer (1909) in Bronn's Tier-reich has compiled a list of all the known species of ascidians with brief indications of their distribution in the various regions. He states (p. 1439) that he has received specimens of *Nephtheis* from Gould's type-locality (the Sulu Sea).

COLLECTION OF THE PHILIPPINE EXPEDITION, 1907–1910.

The ascidians collected by the *Albatross* Expedition and turned over to the writer for study comprise 163 lots of specimens, representing 46 species and, according to the classification here adopted, 29 genera and 12 families. Owing to the large number of species previously described from the Malay region, there could be little doubt that most of the forms had already been described, and the writer has been able to refer all but eight of them to species already known, although in identifying some of the less clearly characterized forms without an actual comparison of specimens an element of doubt could not be eliminated. Of the eight species which it has seemed necessary to treat as new to science, two are so distinct from any thus far described as to require the formation of a new genus for each. The others present no striking peculiarities.

The writer has also examined a few other specimens of Ascidians from the Philippines contained in the collections of the United States National Museum. No additional species were found among them, but their localities have been recorded in this paper.

The following are the species collected by the *Albatross* Expedition:

Family Molgulidae Lacaze-Dulhiers, 1877.

1. *Molgula vitrea* Sluiter, 1904.

Family TETHYIDAE Huntsman. 1912 not Hartmeyer, 1908 and 1909 [CYNTHIIDAE, HALOCYNTHIIDAE s. PYURIDAE Authors].

2. *Ctenyura intermedia*, new genus, new species.
3. *Pyura inflata*, new species.
4. *Pyura pallida* (Heller), 1878.
5. *Pyura duplicata*, new species.
6. *Microcosmus exasperatus* Heller, 1878.
7. *Culeolus herdmani* Sluiter, 1904. (Not collected in the Philippine region.)

Family STYELIDAE Sluiter, 1895 [=TETHYIDAE Hartmeyer, 1908-1909, and Van Name, 1912, not Huntsman, 1912].

8. *Styela areolata* Heller, 1878.
9. *Styela tinaktae*, new species.
10. *Styela maeandria* Sluiter, 1904.
11. *Pandocia circumarata* (Sluiter), 1904.
12. *Pandocia aurata* (Quoy and Gaimard), 1834.
13. *Pandocia pedata* (Herdman), 1881.
14. *Pandocia quadrata* (Herdman), 1881.
15. *Pandocia ovata* (Pizon), 1908.
16. *Polyandrocarpa maxima* (Sluiter), 1904.
17. *Eusynstela latericius* (Sluiter), 1904.
18. *Stolonica styeliformis*, new species.
19. *Stolonica vesicularis*, new species.

Family BOTRYLLIDAE Verrill, 1871.

20. *Botrylloides tyreum* Herdman, 1886.

Family RHODOSOMATIDAE Hartmeyer, 1908.

21. *Rhodosoma papillosum* (Stimpson), 1855.

Family PHALLUSIIDAE Traustedt, 1882 [=ASCIDIIDAE Authors].

22. *Phallusia depressiuscula* (Heller), 1878.
23. *Phallusia aperta* (Sluiter), 1904.

Family PEROPHORIDAE Giard, 1872.

24. *Perophora hutchisoni* MacDonald, 1859.

Family CIONIDAE Lahille, 1887.

25. *Ciallusia longa*, new genus, new species.

Family DIAZONIDAE Garstang, 1891.

26. *Rhopalopsis crassa* (Herdman), 1880.

Family CLAVELINIDAE Forbes, 1848 [=CLAVELINIDAE+POLYCITORIDAE s. DISTOMIDEA Authors].

27. *Clavelina molluccensis* (Sluiter), 1904.
28. *Clavelina detorta* (Sluiter), 1904.
29. *Polycitor ianthinus* Sluiter, 1909.
30. *Polycitor torosus* Sluiter, 1909.
31. *Cystodites philippinensis* Herdman, 1886.
32. *Holozoa vallii* (Herdman), 1886.
33. *Sycozoa pulchra* (Herdman), 1886.
34. *Nephtheis thompsoni* (Herdman), 1886.

Family DIDEMNIDAE Verrill, 1871.

35. *Didemnopsis jolense*, new species.
36. *Didemnum grande* (Herdman), 1886.
37. *Didemnum moseleyi* (Herdman), 1886.
38. *Didemnum ternatanum* (Gottschaldt), 1898.
39. *Polysyncraton dubium* Sluiter, 1909.
40. *Leptoclinum macdonaldi* (Herdman), 1886.
41. *Leptoclinum calificiforme* Sluiter, 1909.

Family SYNOICIDAE Hartmeyer, 1908 [=POLYCLINIDAE Authors].

42. *Polyclinum festum* Hartmeyer, 1905.
43. *Amaroucium crateriferum* Sluiter, 1909.
44. *Amaroucium multiplicatum* (Sluiter), 1909.
45. *Amaroucium constrictum* Sluiter, 1909.
46. *Aplidium depressum* Sluiter, 1909.

All the above species except the deep water *Culeolus herdmani* were collected at stations among the Philippine Islands. Although only eight are new species, a majority of them have not been previously recorded from the Philippines.

ADDITIONAL SPECIES COLLECTED BY OTHER EXPEDITIONS.

To arrive at the total number of forms known from the Philippines, the following list of species (25, with one very doubtfully valid variety) previously recorded, but not collected by the *Albatross* Expedition, must be added to the above 45. In order to avoid the necessity of repeating this list, the synonyms of the several species and the locality in the Philippines from which they have been reported are also given. Leaving Gould's doubtful and insufficiently characterized forms out of account, the species credited to the Philippines number 70, representing 36 genera and 12 families. Among these 70 species are doubtless some synonyms.

Family TETHYIDAE.

PYURA JACATRENSIS (Sluiter), 1890.

1890. *Cynthia jacatrensis* SLUITER, Nat. Tijds. Ned. Ind., vol. 50, p. 331.
1891. *Cynthia jacatrensis* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 576.
1904. *Halocynthia jacatrensis* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 47.
1909. *Pyura jacatrensis* HARTMEYER, Bronn's Tier-reich, vol. 3. suppl., p. 1340.

Pearl Bank, Sulu Archipelago, 15 meters. (Sluiter, 1904.)

CULEOLUS THYSANOTUS Sluiter, 1904.

1903. *Culeolus*, sp. WEBER, *Siboga*-Exped., vol. 1, p. 55, text-fig.
1904. *Culeolus thysanotus* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 106, pl. 2, fig. 1; pl. 12, figs. 10–13.
1909. *Culeolus thysanotus* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1347.

Lat. 5° 11.2′ N.; long. 119° 35.4′ E., 450 meters. (Sluiter, 1904.)

Family STYELIDAE.

PANDOCIA PROCERA (Sluiter), 1885.

1885. *Styela procera* SLUITER, Nat. Tijds. Ned. Ind., vol. 45, p. 196.
1891. *Polycarpa procera* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 584.
1904. *Styela procera* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 59.
1909. *Pandocia procera* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1364.

Pearl Bank, Sulu Archipelago, 15 meters. (Sluiter, 1904.)

PANDOCIA IRREGULARIS (Herdman).

1881. *Polycarpa irregularis* HERDMAN, Proc. Roy. Soc. Edinburgh, vol. 11, p. 72.
1882. *Polycarpa irregularis* HERDMAN, Rep. Voy. *Challenger*, vol. 6, Tunicata, p. 178, pl. 23, figs. 7 and 8.
1885. *Polycarpa irregularis* TRAUSTEDT, Vid. Meddel. Nat. For. Kjobenhavn, ann. 1884, p. 48.
1891. *Polycarpa irregularis* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 585.
1909. *Pandocia irregularis* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1363.

Lat. 11° 37′ N.; long. 123° 12′ E., 18 fathoms. (Herdman, 1886.) This species may not be distinct from *P. pedata* (Herdman).

PANDOCIA THELYPHANES (Sluiter), 1904.

1904. *Styela thelyphanes* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 68, pl. 8, figs. 17–19.
1909. *Pandocia thelyphanes* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1364.

Sulu Archipelago, 14 meters. (Sluiter, 1904.)

DIANDROCARPA MONOCARPA, var. PHILIPPINENSIS Michaelsen, 1904.

1886. *Synstyela incrustans* (part) HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 342, pl. 46, figs. 9–14.
1891. *Synstyela incrustans* (part) HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 637.
1904. *Diandrocarpa monocarpa*, var. *philippinensis* MICHAELSEN, Mitth. Naturhist Mus. Hamburg, vol. 21, suppl. 2, p. 48, pl. 1, fig. 5.
1909. *Diandrocarpa monocarpa*, var. *philippinensis* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1371.

Zamboanga, Philippines. (Herdman, 1886.)

Family BOTRYLLIDAE.

BOTRYLLOIDES PERSPICUUM Herdman, 1886.

1886. *Botrylloides perspicuum* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 45, pl. 1, figs. 4–5; pl. 3, figs. 9–14.
1891. *Botrylloides perspicuum* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 608.

1900. *Botrylloides perspicuum* SLUITER, Zool. Jahrbücher, Syst., vol. 13, p. 21.
1904. *Botrylloides perspicuum* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 101.
1909. *Botrylloides perspicuum* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1380.

Lat. 6° 54′ N.; long. 122° 18′ E., 10 fathoms. (Herdman, 1886.)

BOTRYLLOIDES PERSPICUUM, var. RUBICUNDUM Herdman, 1886.

1886. *Botrylloides perspicuum*, var. *rubicundum* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 48, pl. 1, figs. 6–7; pl. 3, figs. 15–18.
1891. *Botrylloides perspicuum*, var. *rubicundum* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 608.
1909. *Botrylloides perspicuum*, var. *rubicundum* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1380.

Lat. 6° 54′ N.; long. 122° 18′ E., 10 fathoms. (Herdman, 1886.)

This form seems to be only very doubtfully distinguishable, even as a variety, from the typical *B. perspicuum.*

Family RHODOSOMATIDAE.

CHELYOSOMA SIBOGAE Sluiter, 1904.

1904. *Chelyosoma sibogae* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 18, pl. 1, fig. 3; pl. 4, figs. 11–12.
1909. *Chelyosoma sibogae* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1392.
1911. *Chelyosoma sibogae* REDIKORZEW, Ann. Mus. Zool. Acad. Sci. St. Pétersbourg, vol. 16, p. 150.

Lat. 6° 8′ N.; long. 121° 19′ E., 275 meters. (Sluiter, 1904.)

Family PHALLUSIIDAE.

PHALLUSIA KREAGRA (Sluiter), 1895.

1895. *Ascidia kreagra* SLUITER, Denkschr. Med.-Nat. Gesell, Jena, vol. 8, p. 178, pl. 9, figs. 10–11.
1904. *Ascidia kreagra* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 29.
1909. *Phallusia kreagra* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1402.

Pearl Bank, Sulu Archipelago, 15 meters. (Sluiter, 1904.)

PHALLUSIA MELANOSTOMA (Sluiter), 1885.

1885. *Ascidia melanostoma* SLUITER, Nat. Tijds. Ned. Ind., vol. 45, p. 172.
1890. *Ascidia melanostoma* SLUITER, Nat. Tijds. Ned. Ind., vol. 50, p. 342.
1891. *Ascidia melanostoma* HERDMAN, Jour. Linn. Soc. London, Zool., vol. 23, p. 592.
1909. *Phallusia melanostoma* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1402.

Pearl Bank, Sulu Archipelago, 15 meters. (Sluiter, 1904.)

Family PEROPHORIDAE.

ECTEINASCIDIA DIAPHANIS Sluiter, 1885.

1885. *Ecteinascidia diaphanis* SLUITER, Nat. Tijds. Ned. Ind., vol. 45, p. 168.
1890. *Ecteinascidia diaphanis* SLUITER, Nat. Tijds. Ned. Ind., vol. 50, p. 348.
1891. *Ecteinascidia diaphanis* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 602.
1904. *Ecteinascidia diaphanis* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 10.
1909. *Ecteinascidia diaphanis* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1411.

Pearl Bank, Sulu Archipelago, 15 meters; lat. 5° 48.7′ N.; long. 119° 49.6′ E., 564 meters; lat. 6° 10.3′ N.; long. 121° 32′ E., 13 meters. (Sluiter, 1904.)

ECTEINASCIDIA GARSTANGI Sluiter, 1897.

1897. *Ecteinascidia garstangi* SLUITER, Zool. Jahrbücher, Syst., vol 11, p. 10.
1904. *Estcinascidia garstangi* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 10.
1909. *Ecteinascidia garstangi* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1412.

Pearl Bank, Sulu Archipelago, 15 meters. (Sluiter, 1904.)

Family CLAVELINIDAE.

POLYCITOR DISCOLOR Sluiter, 1909.

1909. *Polycitor discolor* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 17, pl. 1, fig. 18.
1909. *Eudistoma discolor* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

POLYCITOR SEDENS (Sluiter), 1909.

1909. *Sycozoa sedens* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 34, pl. 3, figs. 5–7; pl. 7, fig. 1.
1909. *Eudistoma sedens* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

Sanguisiapo, Sulu Archipelago, reef. (Sluiter, 1909.)

CYSTODITES RUFUS Sluiter, 1909.

1909. *Cystodites rufus* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 29.
1909. *Cystodites rufus* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

Sulu Island, 14 meters. (Sluiter, 1909.)

CYSTODITES SEMICATAPHRACTUS Sluiter, 1909.

1909. *Cystodites semicataphractus* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 30.
1909. *Cystodites semicataphractus* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

Family DIDEMNIDAE.

TRIDIDEMNUM GRANOSUM Sluiter, 1909.

1909. *Trididemnum granosum* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 41, pl. 3, fig. 11; pl. 7, figs. 5–6.

Pulu Sanguisiapo, Sulu Archipelago, 12 meters. (Sluiter, 1909.)

DIDEMNUM DIGESTUM Sluiter, 1909.

1909. *Didemnum digestum* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 54, pl. 3, fig. 24; pl. 6, fig. 10.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

DIDEMNUM MAKROPNOUS Sluiter, 1909.

1909. *Didemnum makropnous* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 56.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

DIDEMNUM RAMOSUM Sluiter, 1909.

1909. *Didemnum ramosum* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 63.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

DIPLOSOMOIDES MOLLE Herdman, 1886.

1886. *Diplosomoides molle* HERDMAN, Rep. Voy. *Challenger*, vol. 14. Tunicata, p. 310, pl. 42, figs. 5–16.
1891. *Diplosomoides molle* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 630.
1909. *Diplosomoides molle* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 85.
1909. *Diplosomoides molle* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1456.

Sulu Archipelago, 13 meters. (Sluiter, 1909).

Family SYNOICIDAE.

POLYCLINUM MIKROPNOUS Sluiter, 1909.

1909. *Polyclinum mikropnous* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 94, pl. 5, fig. 1.
1909. *Polyclinum mikropnous* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1461.

Lat. 6° 7.5′ N.; long. 120° 26′ E., 16–23 meters. (Sluiter, 1909.)

APLIDIUM FUMIGATUM Herdman, 1886.

1886. *Aplidium fumigatum* HERDMAN, Rep. Voy. *Challenger*, vol. 14. Tunicata, p. 211, pl. 26, figs. 8, 9.
1909. *Aplidium fumigatum* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 622.
1909. *Aplidium fumigatum* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1469.

Zebu, Philippines. (Herdman, 1886.)

ATOPOGASTER TROPICA Sluiter, 1909.

1909. *Atopogaster tropicum* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 107, pl. 5, fig. 10; pl. 7, fig. 15.
1909. *Atopogaster tropica* HERDMAN, Bronn's Tier-reich, vol. 3, suppl., p. 1465.

Kapul Island, Sulu Archipelago, 13 meters (Sluiter, 1909).

SYNOICUM INTERCEDENS (Sluiter), 1909.

1909. *Morchellium intercedens* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 108, pl. 5, fig. 11.
1909. *Synoicum intercedens* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1476.

Sulu Archipelago (Sluiter, 1909).

Although a majority of the Malayan ascidians are probably widely distributed in that region and may sooner or later be found to occur in Philippine waters, at least in the Sulu Archipelago, the following additional species (13 in number) were obtained by the *Siboga* Expedition at points such a short distance south of the Philippine group that there is little doubt that they will eventually be found within its limits.

Botryllus separatus Sluiter, 1909, Muaras Reef (off the east coast of Borneo).
Corella aequabilis Sluiter, 1904, Karkaralong Group and Karekelang Island.
Sluiteria rubricollis (Sluiter), 1904, Karkaralong Group.
Ectcinascidia nexa Sluiter, 1904, Karkaralong Group.
Polycitor violaceus Sluiter, 1909, Karekelang Island.
Polycitor multiperforatus Sluiter, 1909, Muaras Reef.
Trididemnum planum Sluiter, 1909, Muaras Reef.
Didemnum tabulatum Sluiter, 1909, Karkaralong Group.
Didemnum fragile, Sluiter, 1909, Karkaralong Group.
Didemnum reticulatum Sluiter, 1909, Karkaralong Group.
Didemnum maeandrium Sluiter, 1909, Karekelang Island.
Leptoclinum multifidum Sluiter, 1909, Muaras Reef.
Diplosomoides tropicum Sluiter, 1909, Karkaralong Group and Muaras Reef.

DISTRIBUTION OF THE SPECIES IN DEPTH AND GEOGRAPHICAL AREA.

Ascidians were obtained by the *Albatross* Expedition at 53 stations in the Philippine region and at 3 outside (to the south) of it. The total number of numbered dredging stations of the expedition was 576, but collecting was done also at many other stations not numbered. Although much dredging in deep and moderately deep water was done by the expedition, it is worthy of note that few ascidians were obtained at greater depths than about 30 fathoms. The eight stations where ascidians were obtained at depths of over 40 fathoms and the species collected (10 in all) are as follows:

D5153,[1] 49 fathoms:
Ciallusia longa, new species.
D5166, 97 fathoms:
Pyura inflata, new species.
D5168, 80 fathoms:
Rhopalopsis crassa (Herdman).
Polycitor torosus Sluiter.
D5432, 51 fathoms:
Ciallusia longa, new species.
D5518, 200 fathoms:
Clavelina mollucccnsis (Sluiter).
D5536, 279 fathoms:
Molgula vitrea (Sluiter).
Ctenyura intermedia, new species.
Pyura pallida (Sluiter).
Pandocia quadrata (Herdman).
D5608, 1,089 fathoms:
Molgula vitrea (Sluiter).
D5623, 272 fathoms:
Culeolus herdmani Sluiter.

Of these 10 species the only ones not also obtained at stations in depths of less than 50 fathoms are:

Molgula vitrea (Sluiter).
Ctenyura intermedia, new species.
Pyura inflata, new species.
Culeolus herdmani Sluiter.
Pandocia quadrata (Herdman).

The geographical distribution of the ascidians in the different parts of the Philippines must be very unequal if the results of this expedition are conclusive. To what extent this may be due to the circumstances, methods, and accidents of collecting, rather than to uneven distribution of the animals, is difficult to say, but there can be little doubt that both of these factors must be taken into account.

Of all the stations where ascidians were collected only five lie to the northward of the twelfth parallel of latitude, which crosses near the middle of the Philippine group. The most favorable localities were in the Sulu Archipelago, especially about Jolo Island, and among the Tawi Tawi group. The stations in the vicinity of Jolo Light yielded the greatest number of species, no less than 30 being obtained within a small radius of the light. The most favorable stations were as follows:

D5145, 14 species.
D5174, 12 species.
D5139, D5144, D5149, 8 species each.

[1] See list of stations pp. 61–67.

All these five stations were in shallow water in the Sulu Archipelago, the first four of them near Jolo. The great abundance and variety of ascidians in the Sulu Archipelago is also proved by the results of the *Siboga* Expedition, which found several localities there where a number of forms were collected, although the collecting stations of that expedition in the archipelago were few in number. This does not of course prove that equally favorable localities may not exist in the more northern parts of the Philippine group, but if so they have not yet been found.

A list of stations where ascidians were obtained by the *Albatross* expedition with the species collected at each is here given. Full details in regard to these stations are given in the Dredging and Hydrographic Records of the U. S. Fisheries steamer *Albatross* during the Philippine expedition, 1907–1910 (Bureau of Fisheries Document, No. 741, Washington, D. C., 1910).

CHINA SEA OFF SOUTHERN LUZON.

D5108, Corregidor Light N. 39° E., 22.50 miles (14° 05′ 5″ N.; 120° 19′ 45″ E.), January 15, 1908, 13 fathoms, coral.
Rhopalopsis crassa (Herdman).
Cystodites philippinensis Herdman.

D5109, Corregidor Light N. 42° E., 25.80 miles (14° 03′ 45″ N.; 120° 16′ 30″ E.), January 15, 1908, 10 fathoms, coral.
Polysyncraton dubium Sluiter (doubtful specimen).
Aplidium depressum Sluiter.

SULU SEA, VICINITY SOUTHERN PANAY.

D5128, Nogas Island (W. tangent) N. 6° E., 32.50 miles (9° 52′ 10″ N.; 121° 49′ 35″ E.), February 4, 1908, surf.
Didemnum grande (Herdman).

SULU ARCHIPELAGO NEAR BASILAN ISLAND.

D5134, Balukbaluk Island (N. tangent) S. 59° W., 6.25 miles (6° 44′ 45″ N.; 121° 48′ E.), February 7, 1908, 25 fathoms, fine sand.
Stolonica stycliformis, new species.

VICINITY OF JOLO.

(See also stations D5174, D5555, and D5557, in the near vicinity of this island.)

Marongas Island, S. side, February 10, 1908, 4–8 feet, coral.
Didemnum ternatanum (Gottschaldt).
Leptoclinum calificiforme Sluiter.

Jolo, Jolo Island, February 11, 1908 (no further data).
Eusynstyela latericius (Sluiter).
Cystodites philippinensis Herdman.
Didemnum ternatanum (Gottschaldt).
Amaroucium crateriferum Sluiter.

D5136, Jolo Light S. 37° E., 0.70 mile (6° 04′ 20″ N.; 120° 59′ 20″ E.), February 14, 1908, 22 fathoms, sand and shells.

Microcosmus exasperatus Heller.
Stolonica styeliformis, new species.
Nephtheis thompsoni (Herdman). Doubtful specimen.
Didemnum grande (Herdman).
Didemnum ternatanum (Gottschaldt).
Polysyncraton dubium Sluiter.

D5137, Jolo Light S. 61° E., 1.30 miles (6° 04′ 25″ N.; 120° 58′ 50″ E.), February 14, 1908, 10 fathoms, sand and coral.

Rhodosoma papillosum (Stimpson).
Didemnopsis jolense, new species.

D5139 Jolo Light S. 51° W., 3.60 miles (6° 06′ N.; 121° 02′ 30″ E.), February 14, 1908, 20 fathoms, coral sand.

Rhodosoma papillosum (Stimpson).
Clavelina detorta (Sluiter).
Polycitor ianthinus Sluiter.
Holozoa vallii (Herdman).
Nephtheis thompsoni (Herdman).
Didemnum grande (Herdman).
Didemnum ternatanum (Gottschaldt).
Polysyncraton dubium Sluiter.

D5141, Jolo Light S. 17° E., 5.50 miles (6° 09′ N.; 120° 58′ E.), February 15, 1908, 29 fathoms, coral sand.

Polyandrocarpa maxima (Sluiter).
Phallusia depressiuscula (Heller).
Rhopalopsis crassa (Herdman).
Cystodites philippinensis Herdman.
Holozoa vallii (Herdman).
Amaroucium multiplicatum (Sluiter).

D 5144, Jolo Light S. 50° W., 3.40 miles (6° 05′ 50″ N.; 121° 02′ 15″ E.), February 15, 1908, 19 fathoms, coral sand.

Styela macandria Sluiter.
Pandocia circumarata (Sluiter).
Pandocia ovata (Pizon).
Botrylloides tyreum Herdman.
Phallusia depressiuscula (Heller).
Clavelina molluccensis (Sluiter).
Didemnum ternatanum (Gottschaldt).
Amaroucium crateriferum Sluiter.

D5145, Jolo Light S. 16° E., 0.85 mile (6° 04′ 30″ N.; 120° 59′ 30″ E.), February 15, 1908, 23 fathoms, coral sand and shells.

Microcosmus exasperatus Heller.
Styela tinaktae, new species.
Stolonica vesicularis, new species.
Rhodosoma papillosum (Stimpson).
Clavelina molluccensis (Sluiter).
Clavelina detorta (Sluiter).
Polycitor ianthinus Sluiter.
Nephtheis thompsoni (Herdman).
Didemnum grande (Herdman).
Didemnum moseleyi (Herdman).
Polysyncraton dubium Sluiter.

Leptoclinum macdonaldi (Herdman).
Amaroucium crateriferum Sluiter.
Amaroucium multiplicatum (Sluiter).

SULU ARCHIPELAGO, VICINITY OF SIASI.

D5146, Sulade Island (E. tangent) N. 18° W., 3.40 miles (5° 46′ 40″ N.; 120° 48′ 50″ E.), February 16, 1908, 24 fathoms, coral sand and shells.
Pandocia pedata (Herdman).
Botrylloides tyreum Herdman.

D5147, Sulade Island (E. tangent) N. 30° E., 8.40 miles (5° 41′ 40″ N.; 120° 47′ 10″ E.), February 16, 1908, 21 fathoms, coral sand and shells.
Pyura pallida (Heller).
Microcosmus exasperatus Heller.
Styela areolata Heller.
Phallusia depressiuscula (Heller).
Phallusia aperta Sluiter.
Holozoa vallii (Herdman).
Didemnum grande (Herdman).

D5148, Sirun Island (N. tangent) S. 80° W., 3.90 miles (5° 41′ 40″ N.; 120° 47′ 30″ E.), 17 fathoms, coral sand.
Holozoa vallii Herdman.
Didemnum grande (Herdman).
Leptoclinum macdonaldi (Herdman).

D5149, Sirun Island (W. tangent) N. 39° E., 2.40 miles (5° 33′ N.; 120° 42′ 10″ E.), February 18, 1908, 10 fathoms, coral and shells.
Pyura pallida (Heller).
Pandocia ovata (Pizon).
Cystodites philippinensis Herdman.
Holozoa vallii (Herdman).
Sycozoa pulchra (Herdman).
Nephtheis thompsoni (Herdman).
Didemnum grande (Herdman).
Didemnum ternatanum (Gottschaldt).

D5150, Sirun Island (W. tangent) N. 34° E., 11.7 miles (5° 23′ 20″ N.; 120° 35′ 45″ E.), February 18, 1908, 21 fathoms, coral sand and shells.
Didemnum grande (Herdman).
Polysyncraton dubium Sluiter.

SULU ARCHIPELAGO, TAWI TAWI GROUP.

D5151, Sirun Island (C.) N. 58° E., 19.3 miles (5° 24′ 40″ N.; 120° 27′ 15″ E.), February 18, 1908, 34 fathoms, white sand.
Pyura pallida (Heller).

D5153, Tocanni Point S. 27° E., 2.10 miles (5° 18′ 10″ N.; 120° 02′ 55″ E.), February 19, 1908, 49 fathoms, coral sand and shells.
Ciallusia longa, new species.

D5154, Bakun Point S. 11° W., 0.70 mile (5° 14′ 50″ N.; 119° 58′ 45″ E.), February 19, 1908, 12 fathoms, coral sand.
Didemnum grande (Herdman).
Didemnum ternatanum (Gottschaldt).

D5156, Tinakta Island (N. tangent) S. 77° W., 3.40 miles (5° 12′ 50″ N.; 119° 55′ 55″ E.), February 21, 1908, 18 fathoms, fine sand and shells.
Pandocia aurata (Quoy and Gaimard).

D5158, Tinakta Island (N. tangent) N. 89° W., 1.90 miles (5° 12′ N.; 119° 54′ 30″ E.), February 21, 1908, 12 fathoms, coarse sand and shells.
Pandocia pedata (Herdman).

D5159, Tinakta Island (N. tangent) N. 82° W., 1.40 miles (5° 11′ 50″ N.; 119° 54′ E.), February 21, 1908, 10 fathoms, coral sand.
Styela tinaktae, new species.
Rhopalopsis crassa (Herdman).

D5160, Tinakta Island (N. tangent) S. 72° W., 2.75 miles (5° 12′ 40″ N.; 119° 55′ 10″ E.), February 22, 1908, 12 fathoms, sand.
Polycitor ianthinus Sluiter.

D5163, Observation Island N. 79° W., 6.70 miles (4° 59′ 10″ N.; 119° 51′ E.), February 24, 1908, 28 fathoms, coral sand.
Pyura pallida (Heller).
Styela areolata Heller.
Rhodosoma papillosum (Stimpson).
Phallusia depressiuscula (Heller).
Polycitor torosus Sluiter.

D5164, Observation Island S. 82° W., 8 miles (5° 01′ 40″ N.; 119° 52′ 20″ E.), February 24, 1908, 18 fathoms, green mud.
Pandocia pedata (Herdman).
Clavelina molluccensis (Sluiter).

D5165, Observation Island N. 70° W., 6.40 miles (4° 58′ 20″ N.; 119° 50′ 30″ E.), February 24, 1908, 9 fathoms, coral.
Nephtheis thompsoni (Herdman).
Didemnum ternatanum (Gottschaldt).

D5166, Observation Island N. 20° W., 4.60 miles (4° 56′ 10″ N.; 119° 46′ E.), February 24, 1908, 97 fathoms, coral sand.
Pyura inflata, new species.

D5168, Observation Island N. 17° W., 4.20 miles (4° 56′ 30″ N.; 119° 45′ 40″ E.), February 25, 1908, 80 fathoms, coral sand.
Rhopalopsis crassa (Herdman).
Polycitor torosus Sluiter.

SULU ARCHIPELAGO, VICINITY OF SIBUTU ISLAND.

Tumindao Reef, S. end February 26, 1908, 9–15 feet (dynamite).
Pandocia aurata (Quoy and Gaimard).
Pandocia pedata (Herdman).

VICINITY OF JOLO.

(See also stations at Marongas Island, Jolo, D5136, D5137, D5139, D5143, D5145, D5555, and D5557 in the vicinity of Jolo.)

D5174, Jolo Light E. 2.60 miles (6° 03′ 45″ N.; 120° 51′ E.), March 5, 1908, 20 fathoms, coarse sand.
Pyura pallida (Heller).
Pandocia circumarata (Sluiter).
Stolonica styeliformis, new species.
Phallusia depressiuscula (Heller).
Rhopalopsis crassa (Herdman).
Clavelina molluccensis (Sluiter).
Cystodites philippinensis Herdman.
Didemnum moseleyi (Herdman).
Polysyncraton dubium Sluiter.

Polyclinum festum Hartmeyer.
Amaroucium crateriferum Sluiter.
Amaroucium constrictum Sluiter.

VICINITY OF WESTERN BOHOL.

Mantacao Island, S. side (reef), April 8, 1908, 10–30 feet (dynamite).
Didemnum ternatanum (Gottchaldt).

OFF WESTERN SAMAR.

Catbalogan (Pamuntangan Reef), April 14, 1908, 12–15 feet (dynamite).
Pyura pallida Heller.
Catbalogan (reef), April 15, 1908 (dynamite).
Phallusia depressiuicula (Heller).
Catbalogan (reef), April 16, 1908 (dynamite).
Pyura pallida (Heller).
Pyura duplicata, new species.
Phallusia depressiuscula (Heller).

BETWEEN BURIAS AND LUZON.

D5218, Anima Sola Island (E. tangent) N. 10° W., 2 miles (13° 11′ 15″ N.; 123° 02′ 45″ E.), April 22, 1908, 20 fathoms, coarse sand.
Pandocia pedata (Herdman).
Didemnum ternatanum (Gottschaldt).

PACIFIC OCEAN, EAST COAST MINDANAO.

Surigao (reef above Bilan Bilan), May 8, 1908, 6 to 15 feet (dynamite).
Pandocia aurata (Quoy and Gaimard).
Didemnum ternatanum (Gottschaldt).

GULF OF DAVAO.

D5250, Linao Point N. 22° E., 1.1 miles (7° 05′ 07″ N.; 125° 39′ 45″ E.), May 18, 1908, 23 fathoms, coral sand.
Pandocia pedata (Herdman).
Rhodosoma papillosum (Stimpson).
Didemnopsis jolense, new species.
D5251, Linao Point N. 32° E., 1.1 miles (7° 05′ 12″ N.; 125° 39′ 35″ E.), May 18, 1908, 20 fathoms, coral.
Pandocia pedata (Herdman).
D5253, Linao Point N. 22° E.; 1.5 miles (7° 04′ 48″ N.; 125° 39′ 38″ E.), May 18, 1908, 28 fathoms, coral.
Pandocia pedata (Herdman).
D5254, Linao Point N. 44° E., 0.7 mile (7° 05′ 42″ N.; 125° 39′ 42″ E.), May 18, 1908, 21 fathoms, sand and coral.
Pandocia aurata (Quoy and Gaimard).
Phallusia depressiuscula (Heller).

OFF SOUTHEASTERN MINDORO.

Mansalay, Mindoro (reef), June 4, 1908, 5–15 feet (dynamite).
Pandocia aurata (Quoy and Gaimard).

MALAMPAYA SOUND, PALAWAN ISLAND.

Endeavor Point, December 24, 1908.
Phallusia depressiuscula (Heller).

ULUGAN BAY, PALAWAN ISLAND.

Ulugan Bay, December 29, 1908.
Phallusia depressiuscula (Heller).
Didemnum ternatanum (Gottschaldt).

MANILA BAY.

D5360, Corregidor Light S. 74° W., 6.9 miles (14° 21′ N.; 120° 41′ E.), February 7, 1909, 12 fathoms.
Phallusia depressiuscula (Heller).

NORTH OF CEBU.

D5401, Tanguingui Island Light N. 79° W., 23 miles (11° 24′ 45″ N.; 124° 06′ E., March 16, 1909, 30 fathoms, fine sand.
Clavelina molluccensis (Sluiter).

EASTERN PALAWAN AND VICINITY.

D5432, Corandagos Island (NW. tangent) N. 28° E., 4.8 miles (10° 38′ 45″ N.; 120° 12′ 45″ E.), April 8, 1909, 51 fathoms, sand.
Ciallusia longa, new species.

NORTHERN MINDANAO AND VICINITY.

D5518, Point Tagolo Light (Mindanao) S. 64° W., 8.7 miles (8° 48′ N.; 123° 31′ E.), August 9, 1909, 200 fathoms, gray mud and Globigerina.
Clavelina molluccensis (Sluiter).

BETWEEN NEGROS AND SIQUIJOR.

D5536, Apo Island (C.) S. 26° W., 11.8 miles (9° 15′ 45″ N.; 123° 22′ E.), August 19, 1909, 279 fathoms, green mud and sand.
Molgula vitrea Sluiter.
Ctenyura intermedia, new species.
Pyura pallida (Herdman).

JOLO ISLAND AND VICINITY.

(See also stations at Marongas Island, Jolo, D5136, D5137, D5139, D5141, D5143, D5145, D5174, all in the vicinity of this island.)
D5555 Cabalian Point (Jolo) N. 50° W., 3.3 miles (5° 51′ 15″ N.; 129° 58′ 35″ E.), September 18, 1909, 34 fathoms, coarse sand.
Pyura pallida (Heller).
Stolonica styeliformis, new species.
Phallusia depressiuscula (Heller).
Rhopalopsis crassa (Herdman).
Polysyncraton dubium Sluiter.
Aplidium depressum Sluiter.
D5557, Cabalian Point (Jolo) N. 70° W., 5.2 miles (5° 51′ 30″ N.; 121° 01′ E.), September 18, 1908, 13 fathoms, sand and coral.
Eusynstyela latericius (Sluiter).

OFF ZAMBOANGA, MINDANAO.

D5597, Zamboanga Light N. 31° W., 0.1 mile (6° 54′ N.; 122° 04′ 30″ E.), October 12, 1909, 9 fathoms.
Perophora hutchisoni MacDonald.
Didemnum ternatanum (Gottschaldt).

The following three stations lie outside the limits of the Philippine region:

GULF OF TOMINI, CELEBES.

D5608, Binang Unang Island peak S. 87° E., 19 miles (0° 08′ S.; 121° 19′ E.), November 18, 1908, 1,089 fathoms, gray mud.
Molgula vitrea Sluiter.

BETWEEN GILLOLO AND MAKYAN ISLAND.

D5623, Makyan Island (S. tangent) S. 88° W., 7.5 miles (0° 16′ 30″ N.; 19′ E.), November 18, 1909, 1,089 fathoms, gray mud.
Molgula vitrea Sluiter.

BUTON STRAIT.

D5640, Labuan Blanda Island N. 88° E., 1 mile (4° 27′ S.; 122° 55′ 40″ E.), December 13, 1909, 24 fathoms, sand and broken shells.
Pandocia pedata (Herdman).

DESCRIPTIONS OF SPECIES.

The attention of the reader is called to the following notes of general application to the descriptions that follow:

If not otherwise stated the colors and appearance described are those of alcoholic specimens, and must naturally differ more or less from those of living or fresh examples, but no notes on the latter were given to the writer, and probably none were made.

Except when but one specimen was obtained the descriptions and anatomical figures must be understood as composites based on the study of different individuals, since it is only rarely that all the important details can be distinguished in one and the same individual owing to the contracted and fragile condition of the delicate structures and organs. Type-specimens have been designated for the new species. In order to avoid any possible misunderstanding it may be worth while to state that where specimens have been referred to species previously described, the descriptions and figures here given have in no case been based partly on the descriptions of the other authors, and partly on the *Albatross* specimens, but wholly on the latter.

As the system of classification and nomenclature used and fully explained by Hartmeyer (1909) in Bronn's Tier-reich, vol. 3, Supplement, has been quite closely followed (adopting, however, the modifications shown to be necessary in the work of Huntsman, 1912), it has not seemed necessary to give family and generic diagnoses in the present paper. For these the reader is referred to the above work of Hartmeyer. Any material deviations from his system are explained.

In giving the number of internal longitudinal vessels in the branchial sac of simple ascidians the total number, including those on both sides of the folds, has been given, not the number on the exposed side only, as some writers have done.

The illustrations are from photographs and drawings by the writer. The drawings have been made more or less diagrammatic.

Abbreviations used in the text figures.

at, atrial aperture.
br, branchial aperture.
c, caecum.
fp, faecal pellet.
g, gonad.
i, intestine.
inc, incubatory pouch.
k, kidney.
l, liver.
mp, muscular process.
od, oviduct.
r, rectum.
sd, sperm duct.
st, stomach.

Family MOLGULIDAE Lacaze-Duthiers, 1877.

[=CAESIRIDAE Hartmeyer, 1908.]

Genus MOLGULA Forbes and Hanley 1848. [=CAESIRA Fleming, 1822.]

MOLGULA VITREA Sluiter, 1904.

1904. *Molgula vitrea* Sluiter, Tunicaten der *Siboga*-Expedition, pt. 1. p. 119, pl. 14, figs. 17–19.

1909. *Caesira vitrea* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1324.

Body oval, somewhat compressed laterally, anchored or lightly attached at the smaller end by a tuft of rootlike hairs; apertures at or near the opposite (or free) end, the branchial only moderately prominent in the contracted specimens, the atrial on a rather large tube of moderate length. The apertures are well separated, the branchial with 6, the atrial with 4 small pointed lobes. Test only moderately thick, transparent, gelatinous and colorless in formalin specimens, its surface much wrinkled and sparingly and unevenly covered with short stout crooked somewhat branched hairs to which mud adheres. A greater development of these hairs on the ventral region forms the tuft already mentioned by which the animal is attached. In the soft collapsed condition of the specimens accurate measurements are impossible. Size of largest individual about 20 mm. by 12 mm.

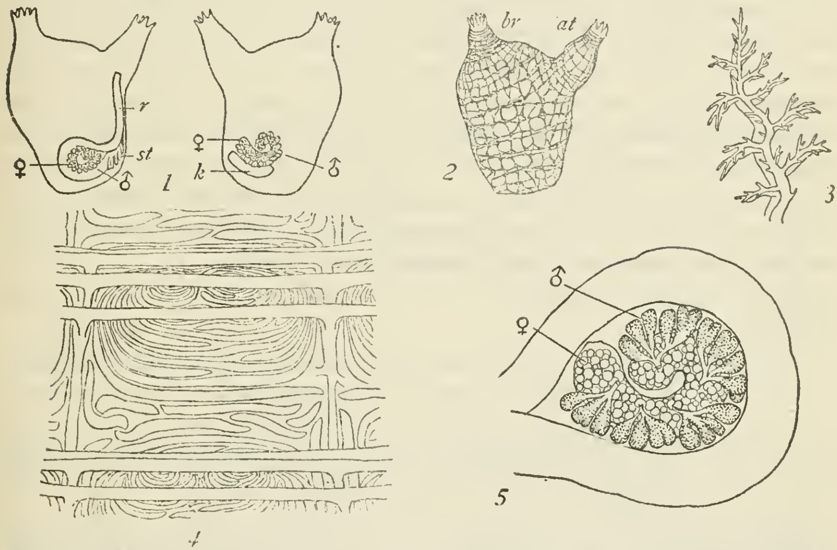
Mantle musculature of characteristic and conspicuous type, consisting of broad rather crooked bands, longitudinal and transverse ones predominating, but these anastomose, branch, and are accompanied by so many oblique and irregular ones that a conspicuous network with coarse squarish or oval meshes is formed.

There are about 20 tentacles of the first and second orders, with a few additional third-order tentacles. The large ones are two or three times compound; small branches few and rather slender, with tapering ends. Membranes borne on tentacles rather narrow.

Dorsal tubercle (seen in one specimen only) spindle shaped, with a large longitudinally elongated oval orifice.

Dorsal lamina plain-edged, at least on the anterior part.

Only six branchial folds were certainly demonstrated on each side, but owing to the poor preservation of the sac there may be seven (the number given by Sluiter for this species). On most parts of the sac at least, there is a single large infundibulum on each fold



FIGS. 1–5.—MOLGULA VITREA SLUITER. 1, LEFT AND RIGHT SIDES OF BODY. × 2. 2, NETWORK OF MUSCLE BANDS ON MANTLE. ×2. 3, TENTACLE. × 15. 4, PART OF BRANCHIAL SAC. × 20. 5, LEFT GONAD AND OUTLINE OF INTESTINAL LOOP. SEEN FROM SIDE NEXT TO BRANCHIAL SAC. × 10. (FOR LETTERING SEE PAGE 68.)

in the space between adjacent transverse vessels. It would perhaps better describe the condition to say that the folds each consist of a row of such infundibula. Stigmata long and narrow, arranged on these infundibula in quite regular spirals. Sometimes at least they form double spirals approaching the condition found in the genus *Eugyra*, but less regular, and occasionally interrupted. Some of the infundibula show a tendency to divide into an anterior and a posterior apex. On the intervals between folds the stigmata are also long and often form curves, hooks, and occasionally incipient spirals. A few delicate radial vessels cross the stigmata. Internal longitudinal vessels rather broad and quite thin. They are confined to the folds; eight or nine on a fold were counted in some cases, but this number is probably exceeded on the higher folds.

Digestive tract forming a small, short, but proportionately broad loop. Stomach elongated, of small diameter; a part of its wall is thrown into somewhat irregular glandular folds of a greenish color. Rectum long; margin of anus thin, not distinctly lobed.

Kidney small, sausage-shaped, and considerably curved with the concavity dorsal; attached to the mantle on the posterior ventral part of the right side.

A gonad is present on each side, that on the left side within the intestinal loop, that on the right just dorsal to the kidney. Gonads each consisting of an elongate ovary which is curved in a spiral of more than a complete turn, bordered and overlapped along its outer margin by the numerous small testes, the latter often cleft into two or three lobes. The free end of the ovary is not produced into an oviduct. The sperm ducts extend from the testes toward the center of the spiral formed by the ovary; they lie upon the free surface of the latter. The individual ducts end near the center of the gonad, often after uniting with the ducts of several adjacent testes. The structure of the gonad evidently resembles that described as characteristic of the genus *Gamaster* Pizon, 1896, but in that genus the branchial folds and the left gonad are wanting.

This is a deep-water form collected only at the two following stations:

No. 54.[1] Station D5536 (between Negros and Siquijor, N. lat. 9° 15′ 45″; E. long. 123° 22′, 279 fathoms, green mud, August 19, 1909). Two specimens. (Cat. No. 5921, U.S.N.M.)

No. 60. Station D5608 (Gulf of Tomini, Celebes, S. lat. 0° 08′; E. long. 121° 19′; 1,089 fathoms, gray mud, November 16, 1909). Three specimens. (Cat. No. 5920, U.S.N.M.)

The writer feels no hesitation in identifying these specimens with Sluiter's species, described from latitude 5° 26′ 36″ S.; longitude 132° 32′ 30″ E., 397 meters. *Molgula pellucida* MacDonald (1859*c*, p. 369, pl. 64, div. III, figs. 1–4) from Shark Bay, Australia, agrees with the present species in many characters external and internal, but, judging from his figures, the ovaries have a stout, flask-shaped outline instead of the tubular spirally curved form of the present species. *Molgula japonica* Hartmeyer, 1906, from Japan also agrees with the present species in many characters, including the position of the left gonad, but the gonads are described as long and club-shaped, and the intestine forms a long open loop.

Family TETHYIDAE Huntsman, 1912.

[CYNTHIIDAE, HALOCYNTHIIDAE, s. PYURIDAE Authors.]

Not Tethyidae Hartmeyer, 1908 and 1909 (=Styelidae of this paper).

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[1] Number of the specimen or lot.

For the reasons rendering necessary shifting of the names *Tethyum* and Tethyidae see Huntsman, 1912.

The definition of the family as given by Hartmeyer will need to be made somewhat broader to accommodate the following genus.

CTENYURA, new genus.

Differs from *Pyura* Molina, 1810, in having reproductive organs on the right side only. These consist of small oval masses containing both eggs and testes arranged along a common oviduct (probably accompanied by a common sperm duct) with which they communicate by short branches. Along the summit of each fold the wall of the branchial sac is raised to small infundibula upon which the stigmata exhibit a spiral arrangement. This last character is unique in this family with the single exception of the Japanese species *Pyura comma* (Hartmeyer), 1906, in which the branchial sac is similar to that of the present genus. *P. comma*, however, has gonads on both sides of the body, as is characteristic of *Pyura*.

A branchial sac with infundibula and spiral stigmata closely resembling those of the Molgulidae combined with the general characters of the genus *Pyura* would seem to indicate a connecting form between the families Molgulidae and Tethyidae [Cynthiidae], from which the Molgulidae are in all probability directly descended, and would seem also at first sight to break down much of the distinction between the two families and justify uniting them. There is, however, the possibility that the resemblances in the branchial sac are due to convergence rather than common descent; in support of this it may be urged that neither the present genus nor Hartmeyer's species appear to approach the Molgulidae in their remaining characters any more closely than their allies which have no infundibula.

The name given this genus is, in accordance with its intermediate characters, a compound of parts of the names *Ctenicella*, a genus of Molgulidae, and *Pyura*, of the present family.

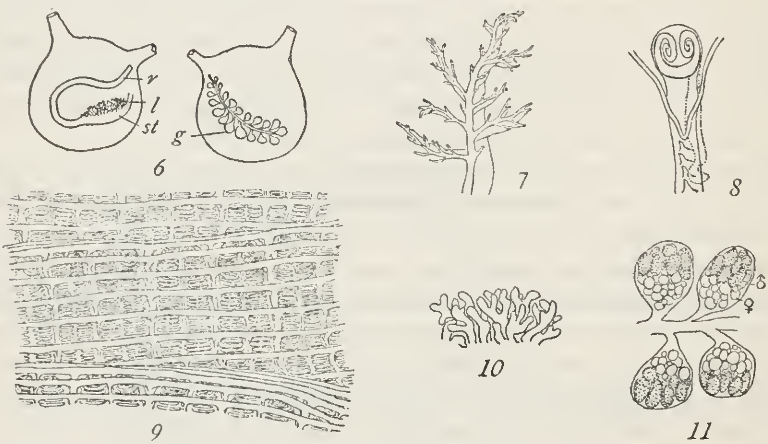
Type of the genus.—Ctenyura intermedia, new species.

CTENYURA INTERMEDIA, new species.

Plate 32, fig. 42.

Body of irregularly rounded form, attached by a wide area on the ventral surface, with widely separated, diverging retractile tubes, which, though capable of considerable extension, may not project much beyond the surface when retracted. This is partly owing to the great thickness of the test. Lobes of the apertures not readily counted in the contracted state. Several individuals sometimes adhere together. Test very thick, semicartilaginous, rather translucent, of a dirty white color; the external surface, which is rough and coarsely wrinkled, being stained with mud but without much adherent foreign matter. Diameters of one of the largest specimens, antero-posterior 18 mm., dorso-ventral 16 mm., transverse 16 mm.

When removed from the test the lobation of the branchial aperture is still obscure; the atrial aperture is square. Mantle musculature strong on dorsal part of body; sphincters of the tubes strong and thick. Numerous closely placed circular muscle bands surround the bases of the tubes. Fairly numerous and stout radial bands also extend from each tube nearly or quite to the ventral region, and are crossed by narrow and more numerous transverse or circular bands, forming a network very dense on the dorsal part of the body, but more open as the ventral region is approached.



Figs. 6–11.—Ctenyura intermedia, new species. 6, Left and right sides of body. × 1.5. 7, Tentacle. × 15. 8, Dorsal tubercle and part of dorsal lamina. × 5. 9, Part of branchial sac. × 15. 10, Hepatic tubules. × 5. 11, Part of gonad. × 6.

Tentacles only moderately numerous, of several sizes, somewhat irregularly distributed. The largest ones apparently number about 6 and are 2 or 3 times compound with rather few and irregular branches, but they bear broad membranes. Tips of smallest branches blunt and rounded though scarcely if at all enlarged.

Dorsal tubercle very large and prominent, horseshoe-shaped with strongly in-rolled horns; open interval forward (observed in a number of specimens).

Dorsal lamina represented by a series of small closely placed languets.

Branchial sac with seven very prominent folds on each side, separated by comparatively narrow intervals. Three orders of transverse vessels regularly arranged; additional still smaller vessels cross the stigmata in some places. Along the summit of each fold the sac is raised into a row of small infundibula, separated from each other by transverse vessels of the first or second order. The infundibula mostly divide near the summit into an anterior and a posterior apex, separated (when the division is sufficiently well marked) by a third order transverse vessel. Stigmata in most places merely short longitudinally placed slits arranged as usual in the family Tethyiidae, but as the upper part of an infundibulum is approached they become curved, assuming a spiral arrangement on the apex. Internal longitudinal vessels numerous (over 20 on a fold in large individuals), separated on the lower part of the folds by from three to five stigmata but by six or eight on the intervals between folds. Assuming that two internal longitudinal vessels are to be regarded as belonging to each interval between folds, their distribution in a medium-sized specimen was about as follows:

dorsal 1 (15) 2 (17) 2 (19) 2 (18) 2 (15) 2 (12) 2 (10) 2 *ventral.*

Digestive tract forming a broad, open loop; stomach elongated, not well differentiated from the other parts of the tract except by bearing on its dorsal surface numerous short crooked branching hepatic tubules of a green color. Rectum short, margin of anus thin and irregular but not deeply lobed.

No kidney was found.

A gonad is present on the right side only. It consists of a long curved obliquely placed oviduct (probably accompanied by a sperm duct) ending close to the base of the atrial tube and bearing along each side small pear-shaped or irregularly rounded sacs (a dozen or 20 in all) connected with it by short side ducts. Each sac contains eggs in the proximal part and a number of small testes of oval form in the distal part.

Collected only at station D5536 (between Negros and Siquijor, 279 fathoms, green mud, Aug. 19, 1909). Over a dozen specimens (No. 140; Cat. No. 6036 type and 6035 paratypes, U.S.N.M.).

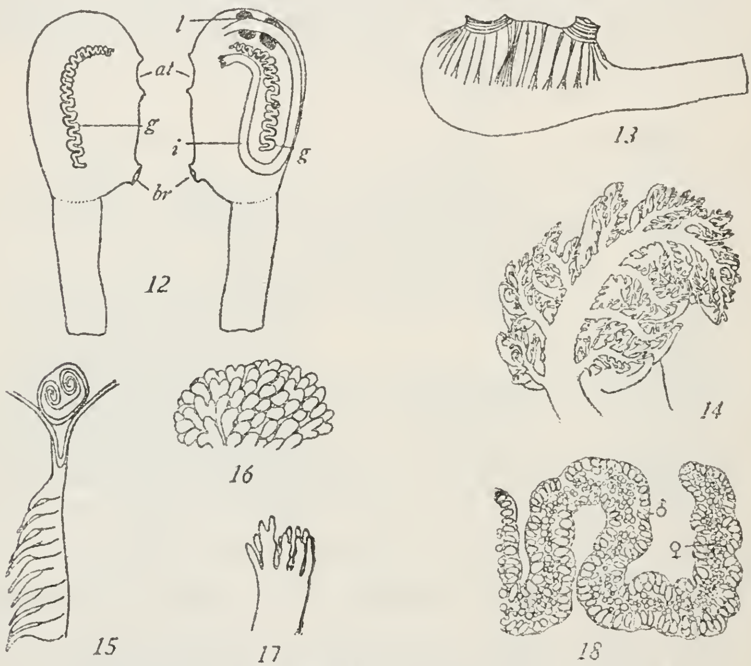
Genus PYURA Molina, 1810.

[*Cynthia* s. *Halocynthia* Authors, part.]

In the present paper the writer adopts Huntsman's (1912) limitation of the genus *Tethyum* to *T. papillosum* (Linnaeus) and its near allies having a number of small bottle-shaped gonads (often more or less fused together by their closed ends) on each side of the body, leaving the name *Pyura* Molina still available for the majority of the members of the old genus *Cynthia* Savigny, 1816. These have the dorsal lamina replaced by a series of languets, the intestine forming a widely open loop, and one or two elongate gonads (sometimes consisting of small separate glands arranged along a common duct) on each side of the body.

PYURA INFLATA, new species.

Body of the only specimen egg-shaped, larger and more rounded at the posterior end. From the anterior end, somewhat toward the ventral side, there arises a stout cylindrical pedicel of almost uniform diameter throughout its length, which does not equal that of the body. Branchial aperture of moderate size, square, raised on a very short tubular prominence arising from the anterior dorsal region. Atrial aperture very large, rounded, but little raised above the surface of the body and situated in the posterior dorsal region. Test



FIGS. 12–18.—PYURA INFLATA, NEW SPECIES. 12, RIGHT AND LEFT SIDES OF BODY. ONE-HALF NATURAL SIZE 13, OUTLINE OF BODY SHOWING MUSCLE BANDS ON MANTLE. ONE-HALF NATURAL SIZE. 14, MEDIUM-SIZED TENTACLE. × 12.5. 15, DORSAL TUBERCLE AND PART OF DORSAL LAMINA. × 12.5. 16, PART OF LIVER. × 35. 17, END OF RECTUM SHOWING ANAL LOBES. × 8. 18, PART OF GONAD. × 12.

thin, tough, and parchmentlike, nearly smooth externally and of a yellowish white color. Outer layer of pedicel similar to the test covering the body; internally the pedicel is partly hollow, the remainder being filled with test substance of rather soft consistency.

Mantle thin, very strongly adherent to the test. Conspicuous muscle bands are few, comprising only a few circular bands about the apertures (especially about the branchial aperture), and some rather short straight bands running in a dorso-ventral direction on each side of the body, but ending abruptly after extending about halfway down the sides. They are mostly gathered into groups of three to five bands; the bands composing these groups diverge more or less at the ventral and dorsal ends of the groups, and do not generally extend across the middorsal line of the body. Needle-like calcareous spicules quite similar to those found in *Pyura pallida* (Heller) (see p. 77) occur sparingly in some of the tissues of the body, especially in the larger transverse vessels of the branchial sac. Length of body, 50 mm.; of pedicel, 35 mm.; greatest diameter (dorso-ventral) of body, 31 mm.; of pedicel, 13 mm.

Tentacles large, numerous, and extensively though rather irregularly branched, and provided with very well-developed membranes. The small branches end in blunt rounded tips. Largest tentacles, four in number, several times compound; at least two or three orders of smaller tentacles, also more or less extensively branched and quite regularly arranged according to the usual scheme.

Dorsal tubercle rather small; orifice C-shaped with inrolled horns; open interval directed obliquely forward and to the right.

Dorsal lamina broken up into a series of rather long pointed languets placed close together; their bases are wide in a transverse direction.

Branchial sac with at least 11 folds on the right and 10 on the left side. Additional rudimentary folds may be present in the anterior part of the sac, which is too tangled to admit of satisfactory examination. Folds high in proportion to the width of the intervals between them. Transverse vessels of about three orders are fairly regularly arranged, the smallest crossing the stigmata in some places without interrupting them; in others they divide the stigmata. Stigmata narrow, placed with their long diameter parallel to the body axis; the interstigmatic longitudinal vessels are generally broad and flat, often much exceeding the narrow slit-like stigmata in width. Internal longitudinal vessels generally separated by only four or five stigmata on the intervals between folds. Approximate distribution of the internal longitudinal vessels:

d. 2 (20) 2 (23) 2 (26) 3 (24) 2 (21) 3 (18) 2 (15) 2 (13) 2 (10) 1 (8) 1 *v.*

Digestive tract forming a long horizontal loop whose branches lie well apart throughout their length. Stomach elongated and not well differentiated from the other parts of the tract except by bearing two large masses of small, short, closely placed, and only slightly branched hepatic tubules on the aspect toward the branchial sac. Rectum rather short, directed dorsally; the margin of its aperture produced into a number of long irregular lobes.

One elongated gonad on each side. It is thrown into numerous sinuous curves, but has a general antero-posterior direction except that it is turned up dorsally at the posterior end. On the left side the gonad lies within the intestinal loop. Apparently each gonad has a central elongated ovary bordered by the numerous small simple testes.

The type and only specimen (No. 118) (Cat. No. 603F, U.S.N.M.) was taken at station D5166, (near Observation Island, Sulu Archipelago, 97 fathoms, coral sand, February 24, 1908).

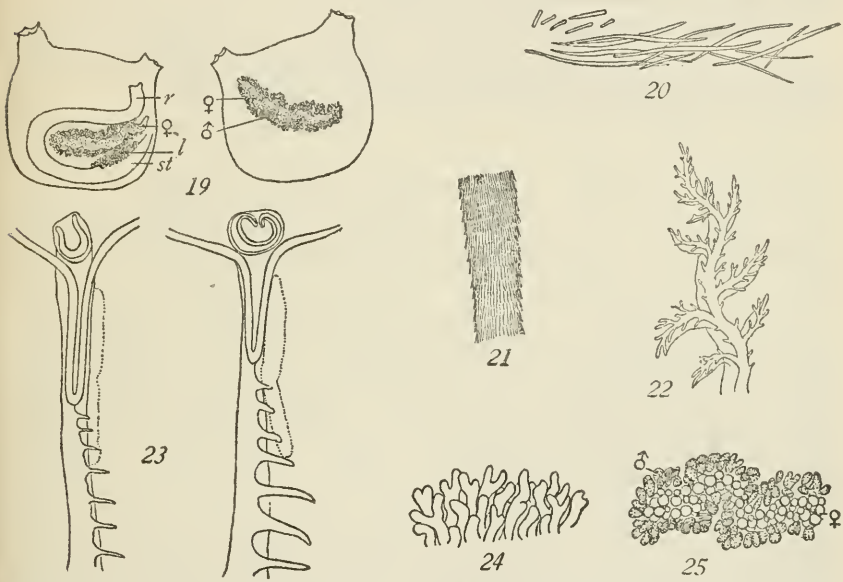
PYURA PALLIDA (Heller), 1878.

Plate 32, figs. 36–38.

1878. *Cynthia pallida* HELLER, Sitz.-Ber. Akad. Wiss. Wien, vol. 77, p. 96, pl. 3, figs. 17–18.
1881. *Cynthia pallida* HERDMAN, Proc. Roy. Soc. Edinburgh, vol. 11, p. 60.
1882. *Cynthia pallida* HERDMAN, Rep. Voy. *Challenger*, vol. 6, Tunicata, p. 143, pl. 17, figs. 17–21.
1883. *Cynthia pallida* TRAUSTEDT, Vidensk. Meddel. Natur. For. Kjobenhavn, ann. 1881, p. 119.
1885. *Cynthia pallida*, var. *billitonensis* SLUITER, Natuurk. Tijdschr. Neder. Ind., vol. 45, p. 183, pl. 1, fig. 6; pl. 2, figs. 1–11.
1885. *Cynthia pallida* TRAUSTEDT, Vidensk. Meddel. Natur. For. Kjobenhavn, ann. 1884, p. 35.
1886. *Cynthia pallida*+*C. pallida*, var. *billitonensis* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, App. A, p. 405.
1890. *Cynthia pallida*, var. *billitonensis* SLUITER, Natuur. Tijdschr. Neder. Ind., vol. 50, p. 331.
1891. *Rhabdocynthia pallida*+*R. pallida*, var. *billitonensis* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 575.
1897. *Rhabdocynthia pallida* SLUITER, Zool. Jahrbücher, Syst., vol. 11, p. 7.
1904. *Rhabdocynthia pallida* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 54.
1905. *Halocynthia pallida* HARTMEYER, Zool. Jahrbücher, Syst., suppl. vol. 8, p. 384.
1905. *Rhabdocynthia pallida* SLUITER, Bull. Mus. Nat. Hist. Paris, 1905, p. 102.
1905. *Halocynthia pallida* MICHAELSEN, Zool. Jahrbücher, Syst., suppl. vol. 8, p. 83.
1905. *Rhabdocynthia pallida* SLUITER, Mem. Soc. Zool. France, vol. 18, p. 14.
1906. *Rhabdocynthia pallida* HERDMAN, Ceylon Pearl Oyster Fisheries, Supplementary Report, No. 39, p. 308, pl. 2, figs. 36–39.
1906. *Halocynthia pallida* HARTMEYER, Zool. Anzeiger, vol. 31, p. 4, text-fig. 2.
1908. *Pyura pallida* (form *typica*) MICHAELSEN, Mitth. Mus. Hamburg, vol. 25, p. 270.
1909. *Pyura pallida* (form *typica*) HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1340.
1912. (*Pyura*) *pallida* HARTMEYER, Denkschr. Akad. Wiss. Wien, vol. 88, math.-nat. Kl., p. 17.
1912. *Pyura pallida* HARTMEYER, Deutsche Tiefsee-Exped., vol. 16, pp. 361, 363.
1913. *Pyura pallida* HARTMEYER, Zool. u. anthr. Ergeb. Forsch. Südafrica, vol. 5, p. 128.

Body as seen from one side generally irregularly rounded or quadrate and more or less compressed laterally; the attachment by a rather small area on the ventral surface or more or less on one side.

Apertures (both 4 lobed) wide apart on dorsal side, the branchial generally the most prominent, though in the contracted preserved specimen neither aperture may project much. As would be expected, there is in the considerable series of specimens collected much variation in external characters. Test moderately thick, of an opaque white color; tough and leathery in alcoholic specimens, but softer and more translucent in formalin specimens. Outer surface uneven, with wrinkles and irregular depressions and elevations, yet in places moderately smooth, and only occasionally much incrusted with foreign matter. Inner surface of test white and glistening. The



Figs. 19–25.—Pyura pallida (Heller). 19, Left and right sides of body. × .75. 20, Spicules. The long ones are from the mantle, the short ones from the test. × 15. 21, Part of a spicule. × 225. 22, Tentacle. × 15. 23, Dorsal tubercle and part of dorsal lamina of two individuals. × 9. 24, Hepatic tubules. × 20. 25, Part of gonad. × 4.

dorso-ventral diameter may be less than, or may exceed, the length. Size of one of the largest specimens: Length, 45 mm.; dorso-ventral (inclusive of elevation bearing branchial orifice), 52 mm.; lateral diameter, about 15 mm. Apertures nearly 30 mm. apart.

Tissues of the mantle (and to a less extent those of some of the other internal structures of the body) containing slender, slightly curved needlelike calcareous spicules, which taper toward one or both ends. They are densely covered with minute appressed spines arranged in rings (fig. 21). All the spines point toward one end of the spicules; this end is not so sharp as the other. The spicules are mostly between 0.75 mm. and 2 mm. in length, but larger and smaller ones also occur. Similar, but much smaller, and proportionately much shorter and stouter spicules occur in the test. These are often very blunt at both ends, and one end may be somewhat enlarged, forming a rounded head studded with minute projections. Spicules with such an enlarged end (the so-called "scepter-shaped" spicules) may have the opposite end either blunt or tapering to a point.

Tentacles of unequal sizes irregularly arranged; 11 large ones (not all of one size) and as many smaller ones of various sizes were counted in a fairly large individual. The largest are two or to some extent three times compound, but the branches are not numerous. They bear broad membranes. The tips of the small branches are often, but not always, slightly swollen.

Dorsal tubercle horseshoe-shaped with the open interval forward. The horns are generally incurved or more or less inrolled in large specimens, but in one individual they turn slightly out.

Dorsal lamina broken up into a series of long, narrow, pointed processes.

Branchial sac, with well-developed folds separated by rather narrow intervals. The number of folds varies in different individuals and will probably be found to average greater in old and large ones. In medium sized, yet fully adult, individuals there are 9 on each side, or often only 8 on the left side, while in one large specimen as many as 12 (the last two very rudimentary) were found on the right side. They could not be accurately counted on the left side of this specimen. Transverse vessels of four or five orders, often quite regularly arranged; the small ones cross the stigmata. Stigmata of moderate length and usually quite narrow. Internal longitudinal vessels numerous, rather slender, placed fairly close together on the sides of the folds, but separated by from 6 to 10 (or even 12) stigmata on the intervals between folds. The following was their approximate distribution in one of the larger specimens:

d. 4 (16) 3 (20) 2 (22) 2 (23) 2 (22) 3 (18) 2 (14) 2 (10) 1 (5) 0 *v.*

Digestive tract curved in a simple broad loop. Stomach elongated, having on its dorsal and mesial aspects a large and dense mass of small, short hepatic tubules of a greenish color, which are crooked and often slightly branched. Rectum very short, margin of anus with two lips, or somewhat sinuous, but not conspicuously lobed in the individuals examined.

One elongated slightly curved horizontally or obliquely placed gonad on each side. Each gonad consists of a long sinuously curved ovary bordered by the numerous small irregularly shaped testes. On the left side the gonad lies in the intestinal loop, though the intestine may overlap it a little at one or more points where the ovary forms wide sinuous curves.

This is evidently a common and widely distributed species in the Philippines. The stations for it listed below are all in shallow water (34 fathoms or less), except one in 279 fathoms:

No. 132. Catbalogan, Samar, April 14, 1908 (Cat. No. 599B U.S.N.M.).

No. 147. Catbalogan, Samar, April 16, 1908 (Cat. No. 599F U.S.N.M.).

No. 44. Station D5555 (off Caballan Point, Jolo Island, 34 fathoms, coarse sand, September 18, 1909). Two specimens. (Cat. No. 6004, U.S.N.M.)

No. 72. Station D5174 (off Jolo Light, 20 fathoms, coarse sand, March 5, 1908). One small specimen. (Cat. No. 5910, U.S.N.M.)

No. 133. Station D5536 (near Apo Island, 279 fathoms, green mud, August 19, 1909). Four specimens. (Cat. No. 6003, U.S.N.M.)

Nos. 138, 144. Station D5147 (off Sulade Island, Sulu Archipelago, 21 fathoms, coral sand and shells, February 16, 1908). Three specimens. (Cat. No. 6000 U.S.N.M.)

No. 71. Station D5149 (off Sirum Island, Sulu Archipelago, 10 fathoms, coral and shells, February 18, 1908). One small specimen. Cat. No. 5912 U.S.N.M.)

No. 141. Station D5151 (off Sirum Island, Sulu Archipelago, 24 fathoms, coral sand and shells, February 18, 1908). One specimen. (Cat. No. 6001 U.S.N.M.)

No. 139. Station D5168 (off Observation Island, Sulu Archipelago, 28 fathoms, coral sand, February 24, 1908). One specimen. (Cat. No. 6002, U.S.N.M.)

It is widely distributed in warm seas and a number of geographical races, treated as allied distinct species, or as subspecies of *Pyura pallida*, have been distinguished.[1] A majority of the Philippine specimens would find place in the typical form of the species, which is recorded from Tahiti, Palau, Ceylon, the western Indian Ocean, the Cape of Good Hope, and the West Indies, as they have eight or nine branchial folds on one side. Those with a larger number of folds would agree better with either the Japanese form, or with the Australian form, *grandis*. The writer does not however see sufficient reason to believe that more than one subspecies occurs in the Philippines, and is inclined to question the necessity of dividing the species into as many races as Michaelsen (1908) accepts.

PYURA DUPLICATA, new species.

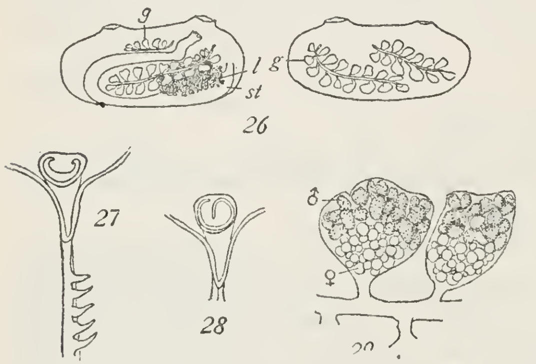
Plate 31, fig. 32.

One of the two specimens in the collection was attached by the greater part of the ventral region, and is flattened in an obliquely dorso-ventral direction; the apertures are on low rough elevations on the dorsal surface. The branchial and atrial apertures are about equally distant from the anterior and posterior ends of the body, respectively; the atrial aperture is distinctly 4-lobed, the branchial is

[1] See especially Michaelsen, 1908, p. 270, and 1912, p. 178.

too much contracted to show the lobes. Though preserved in formalin, the test is tough and cartilagenous, rather thick, with numerous fine sharply defined wrinkles on the surface, becoming especially rough about the apertures. Color (retained even a long time after transferring to alcohol) bright crimson on the exposed surface; more or less of the red color pervades also the substance of the test but not the mantle or internal organs. Size 22 mm. long, 19 mm. wide, and 15 mm. in extreme dorso-ventral diameter. Apertures 10 mm. apart.

The other specimen evidently grew on some slender object, perhaps a branch of an alcyonarian, and though also attached by the whole length of the ventral surface, the body is more cylindrical, and the apertures are nearer together, the branchial aperture being terminal and in this case clearly 4-lobed. The surface is smoother than in the first specimen, and the test white, only slightly tinged with red. The size is slightly larger (26 mm. long).



Figs. 26–29.—Pyura duplicata, new species. 26, Left and right sides of body. × 1.5. 27, Dorsal tubercle and part of dorsal lamina. × 10. 28, Dorsal tubercle of another individual. × 10. 29, Part of gonad. × 5.

The following description of the anatomy is based on the first-mentioned specimen, the other being in poor condition internally and not having the gonads developed.

Mantle muscles well developed, strongest on the dorsal region and right side. Narrow but numerous and very closely placed bands radiate from the bases of the siphons and extend far down on the sides of the body. They are overlaid by closely placed circular bands on the dorsal region. Ventrally the musculature becomes thinner and more diffuse, narrow groups of fibers crossing each other in various directions.

For some reason not clearly apparent the tentacles were in a poor state of preservation. Apparently they are scantily branched, though provided with very broad membranes.

Dorsal tubercle rather large, but not prominent, its orifice crescent-shaped with the horns strongly turned in and the concavity forward. (In the other specimen the orifice forms nearly a circle, the short open interval being forward. One horn only is strongly bent inward.)

Dorsal lamina broken up into a series of moderately long, closely placed languets.

Branchial sac with seven folds on each side, the last fold much lower than any of the others. Transverse vessels numerous, mostly of two sizes placed alternately; additional slender vessels crossing the stigmata also occur in some places. Internal longitudinal vessels narrow but rather numerous, generally separated on the intervals between folds by five or six stigmata. Their distribution is about as follows:

dorsal 1 (16) 2 (18) 2 (21) 3 (20) 3 (18) 3 (13) 3 (9) 1 *ventral.*

Digestive tract forming a rather long narrow loop. Stomach elongate, bearing on its dorsal aspect an extremely large mass (or several closely adjacent masses) of rather long slender branching hepatic tubules. Rectum short; margin of anus with a number of rounded lobes.

Two gonads on each side; on the left side a large one consisting of small irregularly shaped sacs arranged along each side of a common oviduct lying within the intestinal loop, and a small one dorsal to the loop consisting of a single row of a few sacs along only one side of a short common oviduct. On the right side the two gonads are more nearly of the same size.

Both of the two specimens were taken at Catabalogan, Samar.

Type.—Cat. No. 6038, U.S.N.M.

Genus MICROCOSMUS Heller, 1877.

MICROCOSMUS EXASPERATUS Heller, 1878.

Plate 32, fig. 39.

1878. *Microcosmus exasperatus* + *M. variegatus* + *M. distans* + ? *M. affinis* Heller, Sitzungsber. Akad. Wiss. Wien, Math.-nat. class., vol. 77, pp. 98–100, pl. 1, fig. 6; pl. 3, figs. 19–20; pl. 5, fig. 27.

1882. *Microcosmus variegatus* Traustedt, Vidensk. Meddel. Nat. For. Kjobenhavn, ann. 1882, p. 47, pl. 5, figs. 10–11; pl. 6, fig. 17.

?1883. *Microcosmus claudicans* Traustedt, Mitth. Zool. Stat. Neapel, vol. 4, p. 476, pl. 36, fig. 11; pl. 37, fig. 7.

1885. *Microcosmus variegatus* Traustedt, Vidensk. Meddel. Nat. For. Kjobenhavn, ann. 1884, p. 42.

1891. *Microcosmus exasperatus* +*M. variegatus* +*M. distans* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, pp. 514–515.

1900. *Microcosmus miniatus* Verrill, Trans. Connecticut Acad. Sci., vol. 10, p. 590.

1902. *Microcosmus miniatus* Van Name, Trans. Connecticut Acad. Sci., vol. 11, p. 396, pl. 56, fig. 79; pl. 57, figs. 91–95; pl. 62, figs. 129–130; pl. 64, fig. 148.

1908. *Microcosmus exasperatus*, subspecies *typicus* Michaelsen, Mitth. Naturhist. Mus. Hamburg, No. 25, pp. 271–278, pl. 2, fig. 11.

1909. *Microcosmus exasperatus*, subspecies *typicus* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl. p. 1345.

1912. *Microcosmus exasperatus* Hartmeyer, Denkschr. Acad. Wiss. Wien, Math.-Nat. Class., vol. 88, pp. 8–9.

Body irregularly oblong, laterally compressed, especially in the dorsal region, the tubes arising from the dorsal part of the body far apart and pointing almost forward and backward respectively; the branchial tube is the larger and longer of the two. Attachment by the ventral region. Both apertures four-lobed. Test moderately thick, tough and opaque, of a dirty whitish color. Surface of body rough and uneven, and more or less overgrown with other organisms except in the smallest specimens. Size of largest specimen, 60 mm. long and 38 mm. in dorso-ventral diameter.

Mantle thin and somewhat transparent, with numerous regularly disposed, rather broad, but not very compact muscle bands, which radiate from the bases of the tubes and extend down on the sides to the ventral region. On the sides they cross each other, forming an open network with nearly square meshes.

Figs. 30–32.—Microcosmus exasperatus Heller. 30, Left and right sides of body. × .75. 31, Tentacle. × 10. 32, Dorsal tubercles of two individuals. × 3.5.

Tentacles of several sizes, the large ones consisting of a stout tapering stem bearing a wide membrane and very short tapering lateral branches, which in turn bear a few lateral projections or more or less rudimentary branches. The tentacles of the first two orders number together about a dozen; small tentacles are few.

Dorsal tubercle large, irregularly C-shaped with the open interval to the left (nearly forward in the largest specimen) and the horns inrolled.

Dorsal lamina a plain-edged rather wide membrane.

Branchial sac with 9 folds on the left and 10 on the right side, the last one incomplete or rudimentary, and the one next to it also reduced. Transverse vessels of about four orders, the smallest crossing the stigmata. They exhibit considerable irregularity in arrangement in some parts of the sac, especially as far as the smaller vessels are concerned. Five to eight stigmata generally intervene between internal longitudinal vessels on the intervals between folds. Distribution of internal longitudinal vessels on the right side of body in two specimens is about as follows:

Smaller specimen:

d. 4 (21) 4 (22) 4 (22) 5 (25) 5 (25) 6 (19) 5 (17) 4 (14) 2 (10) 2 (3) 1 *v.*

Larger specimen:

d. 4 (26) 5 (30) 6 (36) 6 (34) 5 (30) 5 (26) 5 (24) 5 (20) 4 (16) 3 (5) 1 *v.*

Digestive tract forming a narrow loop quite abruptly curved up dorsally at the reflected end and opened out there for a short distance. Farther back the stomach and intestine lie nearly in contact for a long distance. Stomach elongate, tapering into the intestine. It bears on the side next to the branchial sac two hepatic glands (the posterior the larger), each formed of many lobes composed of thin platelike glandular folds of a greenish color. Rectum short; margin of anus plain.

One gonad on each side; in each a long obliquely placed oviduct bears along its course several large, somewhat square or irregularly shaped bodies, each containing a central mass of eggs surrounded more or less completely by the small and very numerous testes. On the left side the most anterior one of the masses lies in the intestinal loop; the others lie dorsal to the intestine, which is crossed by the oviduct.

The specimens collected are from the following localities:

No. 155. Station D5136 (off Jolo Light, 22 fathoms, sand and shells, February 14, 1908.) Two specimens, adhering together. (Cat. No. 5979, U.S.N.M.)

No. 135. Station D5145 (off Jolo Light, 23 fathoms, coral sand and shells, February 14, 1908). One specimen. (Cat. No. 6034, U. S. N. M.)

No. 76. Station D5147 (off Sulade Island, Sulu Archipelago, 21 fathoms, coral sand and shells, February 16, 1908). One small specimen. (Cat. No. 5904, U.S.N.M.)

This is a very widely distributed species in tropical seas. Michaelsen, 1908, who discusses at length its characters, relationships, and synonyms, records the typical form from the West Indies, Bermuda, coast of East Africa, and Formosa. The writer can himself testify to the close correspondence in the internal structure of specimens from Bermuda with those from the Philippines.

Genus CULEOLUS Herdman, 1881.

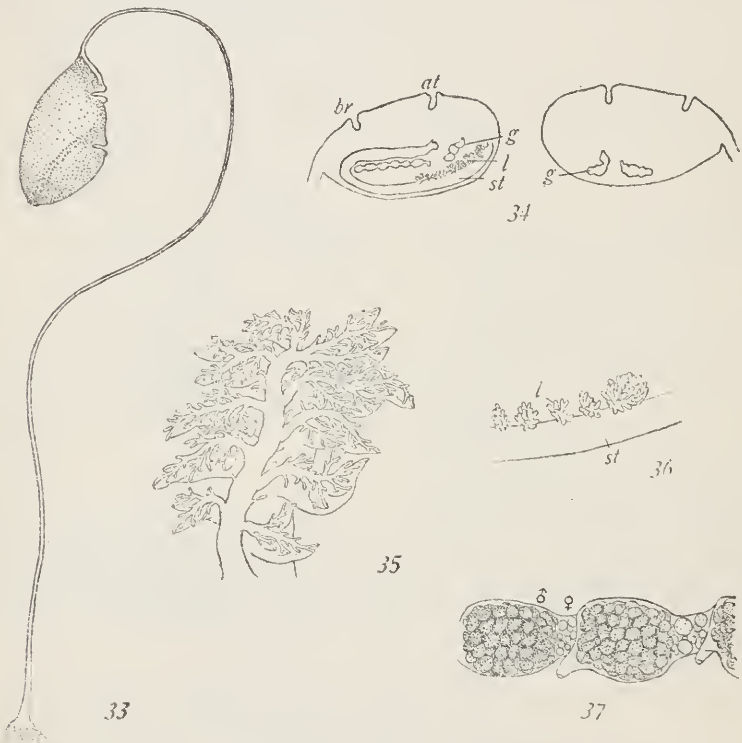
CULEOLUS HERDMANI Sluiter.

1904. *Culeolus herdmani* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 105, pl. 12, figs. 4–9.

1909. *Culeolus herdmani* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1347.

Body of rather elongate ovate form, or more or less cuneate; greatest diameter posterior to the middle; the apertures (which both have the form of rather large transverse straight or somewhat crescent-shaped clefts) widely separated on the dorsal surface; the branchial a little way from the anterior end; the atrial posterior to the middle of the body. The stalk, which is slender and of nearly uniform diameter (though increasing slightly toward the base) joins the anterior dorsal part of the body and is continued as a ridge on the dorsal surface of the body nearly to the branchial aperture. It is more or less incrusted with sand. At its basal end the stalk breaks up into a bunch of rootlike filaments by means of which the animal is anchored in the mud.

Test brownish white, tough and parchmentlike though thin; its surface slightly wrinkled, mostly free from incrusting material though some sand adheres, especially on a triangular area near and anterior to the branchial aperture. Under the microscope minute conical papillae can be seen scattered at wide intervals over the body surface; they are generally better developed around the



Figs. 33–37.—Culeolus herdmani Sluiter. 33, External view. × about .60. 34, Left and right sides of body. × .75. 35, Large tentacle. × 9. 36, Part of stomach and hepatic tubules. × 12. 37, Part of a gonad seen from the side next to the branchial sac. ×20.

apertures, sometimes also on an oblique line, extending ventrally and posteriorly from near the atrial aperture on each side, but this line is not always conspicuous. No spicules were found either in the test or in the internal organs. Owing to wrinkling and distortion incident to preservation the body diameters can only be roughly estimated, but they are approximately as follows in the two largest examples:

Length of stalk.	Length of body.	Greatest transverse diameter.	Distance between apertures.
224 mm.	36 mm.	20 mm.	15 mm.
163 mm.	34 mm.	16 mm.	16 mm.

Mantle thin, firmly adherent to the test, its musculature composed chiefly of narrow and widely separated bands. The more conspicuous ones cross the dorsal region or radiate from the apertures, extending down on the sides. These are crossed by circular bands and fibers surrounding the apertures, or extending longitudinally on the body.

Number and arrangement of tentacles very variable. Each individual studied had one very large tentacle, and several others also large enough to leave no doubt that they should be considered as of the first order. Smaller and less extensively branched tentacles are present in the intervals; but only in a few parts of the circle was any regular arrangement recognizable. The largest tentacles, though of great size in proportion to the body of the animal, are not very complex in their branching, and are not more than three (or to a small extent four) times compound. The branching is quite irregular and the tips of the small branches are blunt and slightly enlarged. The tentacles bear broad membranes.

Dorsal tubercle small, the form of its orifice difficult to make out in the specimens examined, but apparently very simple, perhaps oval or crescent-shaped.

Dorsal lamina represented by a series of rather large triangular languets corresponding in number and position to the origins of the transverse vessels. Their broad diameter is transverse to the median dorsal vessel.

Branchial sac very delicate, the large meshes formed by the transverse and internal longitudinal vessels are generally not crossed by any smaller vessels, except that in a few places a small intermediate transverse vessel may extend across one or two successive meshes, rarely more. Only four distinct folds were positively demonstrated on each side; the rudiment of a fifth fold, indicated by two closely placed internal longitudinal vessels, was present on each side in one individual at least. The distribution of internal longitudinal vessels in that specimen was about as follows:

Left side: *dorsal* 0 (4) 2 (8) 1 (5) 1 (3) 1 (2) 0 *ventral.*
Right side: *dorsal* 0 (4) 1 (9) 2 (5) 2 (4) 0 (2) 0 *ventral.*

These vessels are spaced so as to form, with the transverse vessels, large square or oblong meshes on the intervals between folds; toward the summits of the folds they become more closely placed.

Alimentary loop horizontally placed, U-shaped, the dorsal branch (formed by the intestine) being the shorter of the two. Stomach long and narrow, tapering gradually into the intestine, and bearing on its dorsal aspect a row of tufts composed of somewhat branched hepatic tubules.

Gonads present on both sides of the body; on the left between the branches of the intestinal loop; on the right rather far back on the side. The individual figured has two gonads on each side, but the number varies; the largest specimen has three on the left and two on the right side. The gonads themselves vary greatly in shape; when much elongated they are generally conspicuously constricted at one or more points; the ovaries alone extending through the constricted parts, while in the enlarged intervening segments small testes are also contained. Though the state of the specimens renders the study of the finer points of structure difficult, it seems not unlikely that the ovary discharges by an orifice at the posterior end of the entire gonad, while the testes in each segment probably discharge through an orifice on a papilla on that segment.

Collected by the *Albatross* expedition only at station D5623 (off Makyan Island, 272 fathoms, fine sand and mud, Nov. 29, 1909), where eight specimens (No. 102, Cat. No. 5978 U.S.N.M.) were taken. These agree fairly well in most character with Sluiter's specimens from several stations in the Malay region from depths ranging between 204 and 472 meters. The *Albatross* specimens have more vessels on some of the larger folds of the branchial sac, and the writer could find at most five instead of six folds on a side. However, considerable allowance must be made for individual variation in species of this genus, and the localities and depths lend support to the belief that no mistake is made in including them in the same species. As Sluiter (1904) has already pointed out, *C. herdmani* is very closely allied to *C. recumbens* Herdman, 1881,[1] although the latter is from a distant locality (between the Cape of Good Hope and Kerguelen Island) and much deeper water, 1,375 fathoms; but in this connection it is worthy of mention that Wood-Mason and Alcock (1891) record specimens which are very close to *C. recumbens*, "if not identical with it," from the Indian Ocean (station 110 of the Indian Marine Survey steamer *Investigator*, 1,999 fathoms), indicating a wide distribution for Herdman's species. With the information available it would, however, seem premature to conclude that the two species are identical.

Family STYELIDAE Sluiter, 1895.

[=TETHYIDAE Hartmeyer, 1908–1909, and Van Name, 1912, not Huntsman, 1912.]

Genus STYELA Fleming, 1822.

[=*Tethyum* Hartmeyer, 1908–1909, not Huntsman, 1912.]

STYELA AREOLATA Heller.

Plate 31, fig. 27.

?1823. *Ascidia plicata* LESUEUR, Journ. Acad. Nat. Sci. Philadelphia, vol. 3, p. 5, pl. 3, fig. 6.

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[1] See Herdman, 1882, p. 107, pl. 11, figs. 1–7; pl. 12, figs. 1–7.

?1883. *Styela plicata* TRAUSTEDT, Vidensk. Meddel. Naturh. For. Kjobenhavn, ann. 1882, p. 123, pl. 5, figs. 6, 16.

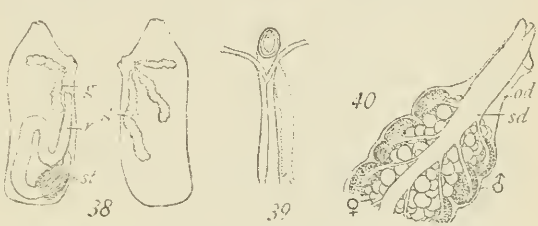
1878. *Styela areolata* HELLER, Sitz.-Ber. Akad. Wiss. Wien, vol. 77, p. 108, pl. 2, fig. 14.

1906. *Styela areolata* HERDMAN, Ceylon Pearl Oyster Fisheries. Special Rep. No. 39, p. 316, pl. 4, figs. 24–33.

1909. *Tethyum areolatum* HARTMEYER, Broon's Tier-reich, vol. 3, suppl., p. 1358.

The following description has been prepared from the specimen from station D5147 (Cat. No. 5930, U.S.N.M.) (see below), as it is the only one having the reproductive organs developed.

Body irregularly oblong or roughly cylindrical slightly curved, tapering abruptly at the anterior end and attached obliquely by the posterior part. Branchial aperture four-lobed, nearly terminal; atrial aperture probably also four-lobed, situated only a little way back on the dorsal side. Test rather thick and soft though tough, whitish externally with a slightly pearly lining; outer surface raised into irregularly rounded elevations of different sizes near the apertures, but smoother though not shiny on the posterior and ventral portions. Length 26m.; greatest dorso-ventral diameter, about 14m.; lateral diameter about the same.



FIGS 38–40.—STYELA AREOLATA HELLER. 38, LEFT AND RIGHT SIDES OF BODY. NATURAL SIZE. 39, DORSAL TUBERCLE. × 9. 40, DORSAL END OF A GONAD. × 12.5.

Mantle muscles fairly well developed; the superficial layer, consisting chiefly of circular and transverse fibers, forms a practically continuous sheet, especially on the dorsal and anterior parts; the deeper layer, consisting largely of muscles radiating from the apertures and extending down the sides, is gathered into bands.

Tentacles not very numerous; apparently about 16 large ones representing two orders and, in addition, smaller ones in some of the intervals.

Dorsal tubercle oval; its orifice horseshoe-shaped, with the open interval (which is so narrow as to easily escape notice) directed forward.

Dorsal lamina plain.

Branchial sac with four well-developed folds on each side. Four or five orders of transverse vessels quite regularly arranged in some places, the smallest crossing the stigmata. Internal longitudinal vessels broad and flat, not very numerous; generally separated by from five or six to eight or nine stigmata on the intervals between folds. (Next to the endostyle there are often 12 or more stigmata before the last internal longitudinal vessel is reached). The following is their arrangement on the right side:

dorsal 4 (11) 3 (10) 4 (13) 3 (6) 4 *ventral.*

The stigmata are mostly quite long and narrow.

Stomach short and broad, with 20 or more distinct longitudinal folds. The intestine forms a narrow strong bent loop bending and extending forward after leaving the stomach, then doubling back so as to pass along close to the border of the stomach and turning abruptly forward to form the rectum, which is long and has a deeply lobed aperture.

Two gonads on the left and three on the right side. They have the form of stout, somewhat crooked tubes and are placed with their dorsal ends (where the orifice is situated) pointing toward the base of the atrial tube. They are well distended with eggs, which occupy the unattached side of the gonad (that next to the branchial sac), the testes, which are small and of simple or somewhat lobed form, being crowded to the part next to the mantle. The individual sperm ducts extend around on to the free side of the ovary and unite there in the usual manner to form the common sperm duct, which opens with a two-lipped orifice on a papilla beside the neck of the ovary.

Collected at two localities:

No. 88. Station D5147 (off Sirun Island, Sulu Archipelago, 21 fathoms, coral sand and shells, February 16, 1908). One large individual with a very small and immature one attached to its base. (Cat. No. 5930, U.S.N.M.)

No. 80. Station D5163 (off Observation Island, Tawi Tawi Group, Sulu Archipelago. February 24, 1908, 28 fathoms, coral sand). A fairly large (22 mm. long) specimen, apparently adult, but without gonads (Cat. No. 5929 U.S.N.M.).

There can hardly be a doubt of the identity of these specimens with those from Ceylon (greatest depth 20 fathoms) referred by Herdman (1906) to Heller's species. The Philippine specimen on which the description here given is based has fewer gonads on the right side; the usual number of gonads, according to Herdman, being 1 or 2 on the left and 4 to 6 on the right side. Heller's (1878) type was also from Ceylon. This species is doubtfully distinct from *Styela plicata* Lesueur, 1823, a large species widely distributed in the warmer parts of the world. See Traustedt, 1883.

STYELA TINAKTAE, new species.

Plate 32, fig. 40.

Body rather elongate and somewhat curved, considerably flattened from side to side, and attached in an oblique position by the left posterior part. Apertures slightly prominent, small, both 4-lobed;

the branchial terminal, the atrial a short distance back on the dorsal side. Test moderately tough and opaque, its substance whitish with a somewhat pearly lining, the outer surface of a brassy yellow color, rough with elevations separated by narrow but sharply defined furrows which cross each other in various directions. The elevations are largest and most irregular in form and size on the anterior and antero-dorsal parts of the body, becoming smaller and more numerous and more uniform in size on the posterior parts. Surface free from incrusting material. Largest specimen, 40 mm. long, 16 mm. in dorso-ventral diameter.

Mantle thick, adherent to the test, its muscular layers forming thick sheets.

Tentacles few, probably about 16, comprising two sizes or orders. No atrial tentacles found.

Dorsal tubercle elliptical, its orifice horseshoe shaped (nearly a complete oval) with the open interval forward.

Dorsal lamina plain-edged in some parts, somewhat notched or denticulate in others.

Branchial sac with four well-developed folds on each side separated by broad intervals. Transverse vessels of three or four sizes, not everywhere regularly arranged, the smallest sometimes crossing, sometimes separating stigmata. Internal longitudinal vessels numerous on the intervals as well as on the folds. The specimens were not in condition to permit of an accurate count; the following is no more than a rough approximation to the scheme of their distribution:

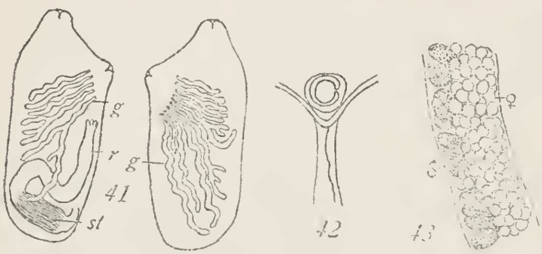
Right side: *dorsal* 10 (22) 9 (22) 9 (20) 7 (14) 5 *ventral.*
Left side: *dorsal* 4 (26) 8 (20) 8 (20) 7 (12) 6 *ventral.*

These vessels are separated on the intervals between folds by an average of five to seven stigmata. The latter are mostly rather long and narrow.

Stomach rather elongate, with over 20 not very distinct or regular longitudinal folds in its wall. Intestinal loop rather narrow in an antero-posterior direction; margin of anus irregularly lobed and plicated.

Gonads rather numerous on each side, especially on the right, long and tubular, always more or less sinuous, and sometimes very irregularly curved. Some are divided into two or more branches toward the closed (ventral) end. The dorsal ends of the gonads are directed toward the base of the atrial tube; on each side of the body the gonads lie nearly parallel to each other and quite close together, covering a considerable part of the side of the body. The ovary in each extends the whole length of the tube and fills all of it except the space occupied by the testes, which are rather large, pear-shaped or cleft into two or more lobes. They are rather irregulaly distibuted in the gonad, lying against the side which is attached to the mantle. The individual figured (fig. 41) has 5 gonads on the left and 10 on the right side; another has about 6 on the left and 8 on the right side.

There are two specimens (No. 136) (Cat. No. 6041, U.S.N.M.) of this species from station D5159 (off Tinakta Island, Sulu Archipelago, 10 fathoms, coral sand, Feb. 21, 1908), both of nearly the same size and form. The stouter one is the type. There is also, in a bottle with no locality, a broader and more flattened specimen (No. 151) (Cat. No. 5991, U.S.N.M.), with an irregular laterally extending pedicel-like process of the test arising from the posterior part of the body, which evidently assisted in attaching the animal. The orifice of the dorsal tubercle is irregularly U-shaped instead of horseshoe shaped, but, as in the other specimens, the open interval is forward. Though the individual has no reproductive organs developed, it is probably of this species, which is apparently most closely allied to *Styela clara* Hartmeyer (1906, p. 13, text-fig. 7), from Hakodato, Japan. That form, however, has but four gonads on each side, fewer internal longitudinal vessels, atrial tentacles present, and a differently shaped body.



FIGS. 41–43.—STYELA TINAKTAE, NEW SPECIES. 41, LEFT AND RIGHT SIDES OF BODY. × .75. 42, DORSAL TUBERCLE. × 8. 43, PART OF A GONAD. (THE SIDE OCCUPIED BY THE TESTES IS ATTACHED TO THE MANTLE.) × 12.

A small specimen (No. 20) (Cat. No. 5932, U.S.N.M.) from station D5145 (near Jolo Light, February 15, 1908, 23 fathoms, coral and shells) may also belong to this species, but is so immature that this is uncertain. It has the body about 19 mm. long and is attached obliquely by the posterior end, which is produced into a pedicel-like extension that evidently assisted in attaching the body as in the case of the last-described specimen. The body surface is smoother than in the specimens described, though somewhat wrinkled, and the color is nearly white. In its internal structure it apparently corresponds sufficiently well with the present species if allowance is made for its immature condition.

Tentacles apparently about 16 in number.

Dorsal tubercle with a horseshoe-shaped orifice, the open interval forward.

Dorsal lamina plain-edged.

Four well-developed branchial folds on each side the internal longitudinal vessels distributed about as follows:

dorsal 3 (14) 5 (12) 4 (13) 4 (9) 4 *ventral.*

Three sizes of transverse vessels, the smallest of which may either cross or divide the stigmata. Five to seven stigmata usually intervene between internal longitudinal vessels on the intervals between folds.

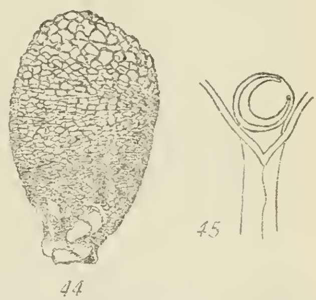
Margin of anus lobed.

Ovaries long and tubular with the testes arranged along their sides. The gonads are however very immature and their number was not determined.

STYELA MAEANDRIA Sluiter, 1904.

1904. *Styela maeandria* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 77, pl. 9, figs. 18–20.
1909. *Tethyum maeandrium* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1359.

The single specimen which the writer has identified provisionally with this species is quite regularly egg-shaped, attached by the small end, and has the apertures very near together at the other end, the branchial being almost exactly terminal. Both are 4-lobed and only slightly prominent in the preserved specimen. Test thin and tough, the outside yellow, becoming browner anteriorly; the inner surface is yellowish and slightly pearly; the substance on section yellowish white. The outer surface is minutely wrinkled, the wrinkles being mainly transverse and very close together, especially in the posterior parts of the body. The rides between these wrinkles are broken up into minute elevations which are coarser and more prominent near the apertures. Height of specimen 31 mm.; greatest transverse diameter 18 mm.



FIGS. 44, 45.—STYELA MAEANDRIA SLUITER. 44, EXTERNAL VIEW. × 1.1. 45. DORSAL TUBERCLE. × 12.5.

Mantle rather thin but with its transverse and longitudinal muscular layers forming fairly continuous sheets.

The tentacles could not be satisfactorily counted.

Dorsal tubercle of circular outline, its orifice simply C-shaped with the open interval to the left and somewhat forward. Horns not incurved.

Dorsal lamina irregularly notched along the posterior part.

Branchial sac with four folds on each side separated by wide intervals. Transverse vessels numerous, of several sizes rather irregularly arranged in some parts of the sac, but in other parts more regularly; even the smallest generally separate rows of stigmata. Internal longitudinal vessels very numerous, closely placed on the intervals as well as on the folds. Even on the intervals they are generally separated by from two to four stigmata only. Stigmata mostly very short and of oval outline. Approximate distribution of the internal longitudinal vessels.

> Right side: *dorsal* 10 (34) 11 (28) 8 (30) 9 (14) 7 *ventral.*
> Left side: *dorsal* 6 (36) 10 (20) 10 (23) 10 (11) 8 *ventral.*

Digestive and reproductive organs much as in *Styela tinaktae* just described. Stomach elongate, with numerous rather irregular plications in its wall. Rectum rather long; margin of anus with numerous long lobes.

On the right side six tubular more or less sinuous gonads were distinguished, placed in an oblique position more or less parallel to each other. On the left side the gonads were too much broken and displaced to satisfactorily determine their number and arrangement. They were evidently fewer than on the right side and were very crooked, irregular in their distribution and more or less branched.

The specimen (No. 48) (Cat. No. 5931, U.S.N.M.), is from station D5144 (off Jolo Light, 19 fathoms, coral sand, Feb. 15, 1908). The writer refers the specimen to Sluiter's species in spite of some discrepancies, believing that as Sluiter had but one specimen, and the writer also but one, considerable allowance may reasonably be made for individual variation; and that the combination of a branchial sac with such closely placed vessels and several long tubular gonads on each side of the body is a sufficiently unusual one to justify regarding various minor differences that exist as probably due to age or individual variation. Sluiter's specimen was from latitude 8° 23′ 30″ S., longitude 119° 4′ 36″ E., 69 meters.

Genus PANDOCIA Fleming, 1882 [POLYCARPA Authors].

PANDOCIA CIRCUMARATA (Sluiter), 1904.

Plate 26, figs. 7 and 8.

1904. *Styela circumarata* SLUITER. *Siboga*-Exped., vol. 56*a*, p. 70, pl. 1, fig. 4; pl. 9, fig. 1.

1909. *Pandocia circumarata* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1363.

Body rather elongated, tapering anteriorly, flattened from side to side and extended at the posterior end in the case of both of the two specimens into a short broad laterally flattened pedicel by which the animal is attached. Apertures small, obscurely 4-lobed, the branchial terminal, the atrial some distance back on the dorsal side. Test moderately thick, tough, opaque, of a yellowish white color with a pearly luster within and yellowish brown externally; external surface very rough and having a few deep furrows, longitudinal ones predominating, in addition to smaller wrinkles and rough depressions and elevations. It is not much incrusted with foreign material, except on the pedicel. Dimensions of the two specimens:

	Station D5174. mm.	Station D5144. mm.
Total length	114	100
Length of pedicel	44	18
Dorso-ventral diameter	33	42
Lateral diameter (average)	16	19
Distance apart of apertures	24	38

Mantle thick and opaque owing to the great development of the muscular layers, which form thick sheets. Mantle and internal tissues and organs light colored.

Large tentacles about 16, probably representing two orders; a few small ones irregularly distributed in the intervals.

Dorsal tubercle large, longitudinally elongate, with a C-shaped aperture; open interval to the left, horns inrolled.

Dorsal lamina rather narrow, but wider posteriorly, plain edged.

Branchial sac with four well-developed folds on each side. They rise abruptly and are separated by wide intervals. The larger vessels are very stout and muscular. Transverse vessels of about five orders, the smallest crossing the stigmata. Internal longitudinal vessels very numerous, separated on the intervals between folds by not more than five to seven stigmata on most parts of the sac and very closely crowded on the upper part of the folds. The following is an approximation to their distribution:

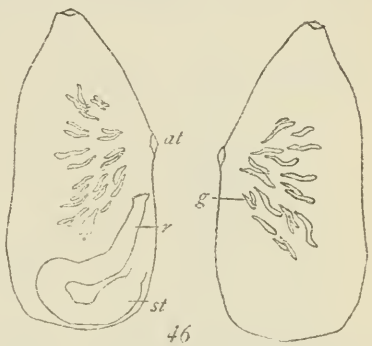


Fig. 46.—Pandocia circumarata (Sluiter). Left and right sides of body. × .75.

Right side: *dorsal* 6 (42) 9 (33) 9 (37) 9 (28) 6 *ventral.*
Left side: *dorsal* 8 (40) 10 (30) 9 (35) 8 (22) 8 *ventral.*

Esophagus short, stomach rather short oval, its walls not much plicated externally; no pyloric caecum. Intestine large but forming a rather narrow loop. No abrupt bend at the beginning of the rectum, which is rather short. Margin of anus with many minute lobes.

Gonads small and numerous, irregularly distributed on both sides of the body, but so buried in the tissues of the body wall as to be difficult to distinguish. They are elongate or phial-shaped, often irregularly curved, and sometimes forked or branched. The numerous small testes contained in them commonly lie in the part next to the mantle, crowding the eggs to the part next to the branchial sac, as in many other related species.

The two specimens in the collection are from these localities:

No. 116. Station D5174 (off Jolo Light, 20 fathoms, coarse sand, Mar. 5, 1908), (Cat. No. 6020, U.S.N.M.).

No. 112. Station D5144 (off Jolo Light, 19 fathoms, coral sand, Feb. 14, 1908), (Cat. No. 6019, U.S.N.M.).

Sluiter's type of this species, with the description and figures of which these specimens agree well in most characters, was also from the Philippine region (latitude, 6° 7′ 30″ N.; longitude, 120° 26′ E., 16–23 meters).

PANDOCIA AURATA (Quoy and Gaimard), 1834.

Plate 25, figs. 5 and 6.

1834. *Ascidia aurata* Quoy and Gaimard, Voyage Decouv. *Astrolabe*, Zool., vol. 3, p. 559, pl. 3.

1881. *Polycarpa sulcata* Herdman, Proc. Roy. Soc. Edinburgh, vol. 11, p. 73.

1882. *Polycarpa sulcata* Herdman, Rep. Voy. *Challenger*, Tunicata, vol. 6, p. 159, pl. 23, figs. 9–13.

1884. *Polycarpa sulcata* v. Drasche, Denk. Akad. Wiss. Wien, vol. 48, p. 379, pl. 6, fig. 12; pl. 7, figs. 1, 2, and 2*a*.

1885. *Polycarpa sulcata* Traustedt, Vidensk. Meddel. Nat. For. Kjobenhavn, ann. 1884, p. 48.

1890. *Styela psoloessa* Sluiter, Natuurk. Tijdschr. Neder. Ind., vol. 50, p. 339.

1891. *Styela psoloessa*+*Polycarpa sulcata* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, pp. 583, 585.

1895. *Styela* (*Polycarpa*) *pneumonodes* Sluiter, Denkschr. med.-nat. Gesell. Jena, vol. 8, p. 179, pl. 10, figs. 1–3.

1898. *Polycarpa aurata* Herdman, Ann Mag. Nat. Hist., ser. 7, vol. 1, p. 445.

1899. *Polycarpa aurata* Herdman, Catalogue Australian Museum, Sydney, No. 17, pp. 51, 110.

1902. *Ascidia aurata* Willey, Zool. Results on Material from New Britain, New Guinea, etc., p. 712.

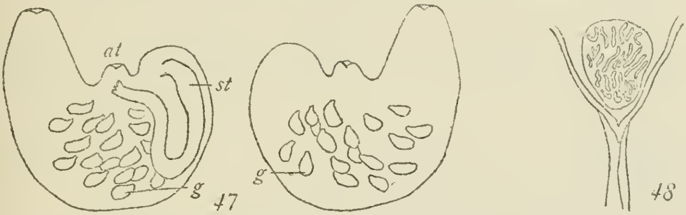
1904. *Styela aurata* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 57, pl. 7, fig. 16.

1906. *Polycarpa aurata* Herdman, Ceylon Pearl Oyster Fisheries, Supplementary Rep., No. 39, p. 318, pl. 5, figs. 1–6.

1908. *Polycarpa pedunculata* Pizon (not Heller, 1878). Rev. Suisse Zoologique, vol. 16, p. 216, pl. 12, figs. 21–24.

1909. *Pandocia aurata* +*P. pizoni* (new name for *P. pedunculata*) Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., pp. 1368 and 1484.

Body normally of peculiar and characteristic form, tapering at the anterior end, broad and rounded at the posterior end; usually but not always much compressed from side to side, and usually having the longitudinal body axis curved in about half a circle, so that the anterior end, having the branchial aperture at its tip, points directly upward, and the posterior end also more or less upward, the dorsal border of the body being deeply concave and the ventral very convex and very much longer than the dorsal. Atrial aperture on a papilla on the concave part of the dorsal border, near or behind the middle of the body. Both apertures 4-lobed. Attachment of the body by a small area on the convex ventral surface; this area being produced a little, sometimes to an extent making it proper to call it a thick short pedicel. Test thick, opaque, of the consistency of soft leather, smooth but not shining externally, and rather dark colored in the alcoholic specimens (some shade of brown or purple brown); not pearly within. The external surface has generally a few deep sharply defined but widely spaced furrows, mainly longitudinal in direction, but connected here and there by short cross furrows. The test contains branching vessels which end in rounded bulbs containing brown pigment. Many of them are large enough to appear as small spots conspicuous to the naked eye in sections of the test. Size



Figs. 47, 48.—Pandocia aurata (Quoy and Gaimard). 47, Left and right sides of body. One-half natural size. 48, Dorsal tubercle. × 5.

of the largest specimen 90 mm. in greatest diameter and 25 mm. in maximum thickness.

Mantle thick, opaque, and adherent to the test, its muscles forming fairly continuous sheets. It is dark colored (brown), as are also the branchial sac and other internal organs.

Tentacles few (about 18 or 20) nearly all large, small ones being developed in few of the intervals.

Dorsal tubercle large and flattened, more or less triangular in outline; it has in place of a single orifice, a variable and often rather large number of minute straight or curved slits or oval openings distributed over its surface.

Dorsal lamina plain edged.

Branchial sac with four well-developed folds on each side, separated by wide intervals. The course of these folds is greatly curved, owing to the above-mentioned curvature of the body axis. In most parts of the sac the smaller transverse vessels are generally of fairly uniform size; at varying intervals larger ones occur, some being very large and stout. Small vessels crossing the stigmata are not present in most places. Internal longitudinal vessels fairly numerous, both on the intervals and on the folds. In a fairly large specimen a count of them resulted as follows:

dorsal 4 (23) 5 (19) 6 (21) 4 (12) 5 *ventral.*

Stigmata numerous and narrow; 7 or 8 intervene between internal longitudinal vessels on the intervals between folds in the dorsal part of the sac; in the ventral part often 10 to 12, or more; next to the endostyle the fields often contain about 20 stigmata.

Intestine of large diameter, but forming a rather narrow loop in the posterior part of the body. Stomach inconspicuous, being neither of large diameter nor showing very distinct plications on the external surface. Rectum moderately long, making a fairly sharp bend at its origin. Margin of anus with many lobes.

Owing to the condition of the specimens, and to the fact that these organs are deeply buried in the thick opaque tissues of the mantle, the gonads are not easily distinguished. Apparently they are rather small short sacs containing eggs and small pyriform testes, and are distributed in moderate numbers on each side of the body (on the left side anterior to the intestinal loop only). No evidence was found of their becoming confluent with each other as in the next following species.

This species is represented by specimens from 5 stations; 21 fathoms being the greatest depth recorded.

No. 128. Mansalay, Mindoro (reef). June 4, 1908. One specimen, attached to a piece of coral. (Cat. No. 6014, U.S.N.M.)

No. 107. Surigao, east coast of Mindanao (reef). May 8, 1908. One specimen. (Cat. No. 6015, U.S.N.M.)

No. 161. Station D5254, off Linao Point, Gulf of Davao, 21 fathoms, sand and coral, May 18, 1908. One specimen. (Cat. No. 6018, U.S.N.M.)

No. 159. Station D5156, off Tinakta Island, Sulu Archipelago, 18 fathoms, fine sand and shells, February 21, 1908. One specimen. (Cat. No. 6017, U.S.N.M.)

No. 131. Tumindao Reef, south end, near Sibutu Island, Sulu Archipelago, February 26, 1908. Two specimens. (Cat. No. 6016 U.S.N.M.)

There are specimens in the United States National Museum from Porta Galera Bay, Mindoro, collected by S. F. Light, who reports it common also at Culion Apo, and at Tatay, Palawan.

This large and conspicuous form is common and widely distributed in the Malayan region, and was collected by the *Siboga* expedition at many stations, 74 meters being the greatest depth of any of them. Herdman, 1899, has described a variety (*plana*) from Port Jackson, Australia. In life *P. aurata* is said to be yellow or orange in color (Willey, 1902, p. 712). *Pandocia botryllifera* Michaelsen, 1912, from Samoa is evidently a very closely allied form.

PANDOCIA PEDATA (Herdman), 1881.

Plate 23, figs. 1-3.

1881. *Polycarpa pedata* HERDMAN, Proc. Roy. Soc. Edinburgh, vol. 11, p. 71.
1882. *Polycarpa pedata* HERDMAN, Rep. Voy. *Challenger*, vol. 6, Tunicata, p. 180, pl. 24, figs. 1 and 2.
1885. *Polycarpa pedata* TRAUSTEDT, Vidensk. Meddel. Nat. For. Kjobenhavn, ann. 1884, p. 48.
1891. *Polycarpa pedata* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 583.
1898. *Styela whiteleggei* HERDMAN, Ann. Mag. Nat. Hist., ser. 7, vol. 1, p. 445. (*Nomen nudum.*)
1899. *Styela whiteleggei* HERDMAN, Catalogue Australian Museum, Sydney, No. 17, pp. 40 and 110, pl. Cyn. II, figs. 6 and 7; pl. Cyn. XIV, figs. 1-6.
1904. *Styela pedata* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 126. (Listed as not found by expedition.)
1908. *Polycarpa pedata* PIZON, Rev. Suisse Zoologique, vol. 16, p. 218.
1909. *Pandocia pedata*+*Tethyum whiteleggei* HARTMEYER, Bronn's Tierreich, vol. 3, suppl., pp. 1360 and 1364.

Body usually somewhat elongated, tapering toward the anterior end, where the branchial aperture is situated, and broader and rounded at the posterior end; it may be either somewhat compressed laterally or nearly round in cross section. Usually it is attached in a nearly horizontal position (assuming the ventral to be the lower side) by means of an irregular but often long and narrow pedicel arising from the ventral region posterior to the middle of the body. One or more accessory pedicels arising near the main one may assist in the attachment, or a whole group of root-like processes may replace the single pedicel, which in any case often breaks up at its foot into root-like processes for attachment. Usually the body axis is curved so that the anterior end, and often the posterior also, is turned up (dorsally) to a greater or less extent, but this curvature is generally less pronounced than in *P. aurata*. Atrial aperture on a more or less conspicuous conical elevation on the dorsal surface posterior to the middle of the body, sometimes very far back. Both apertures 4-lobed. The above description will apply more or less satisfactorily to most of the specimens in the collection, but variations in the shape of the body, the extent of curvature of the body axis, length and character of the pedicel or processes for attachment, etc., are very great. Test usually light colored, hard, tough, and opaque, not pearly within.

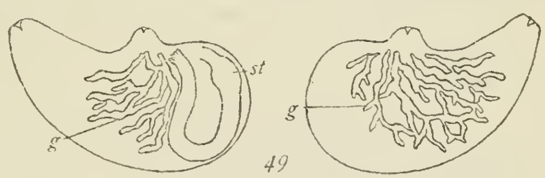


FIG. 49.—PANDOCIA PEDATA (HERDMAN). LEFT AND RIGHT SIDES OF BODY. × .6.

Outer surface very variable in character, often merely deeply and irregularly wrinkled and furrowed, but in most of the specimens a greater or less part of the body, especially in the dorsal and anterior regions, is covered with low flattened rounded elevations separated by narrow shallow furrows, giving the surface more or less the appearance of a cobblestone pavement. One large specimen (from station D5218), which is very irregular in form with a deeply and irregularly wrinkled surface, but is apparently of this species, measured about 78 mm. long by 44 mm. in height, exclusive of the processes for attachment. The other specimens are all considerably smaller, the largest 55 mm. long by 28 mm. high, exclusive of the pedicel and the papilla bearing the atrial orifice.

The mantle and internal tissues have a dark brown color, as in *P. aurata* described above, and the internal structure is so similar to that species that a separate description, other than a mention of certain small differences, will be needless.

The dorsal tubercle, though of similar structure, usually has more numerous and more minute apertures, giving its surface a spongy appearance.

Internal longitudinal vessels more numerous. In one of the large specimens their distribution is about as follows on the right side of the body:

dorsal 9 (24) 8 (22) 8 (25) 6 (19) 6 *ventral.*

They are separated by narrower intervals and fewer stigmata, only 3 or 4 on the intervals between folds in the dorsal region, and usually not over 5 or 6 in most parts of the ventral region except close to the endostyle.

Intestinal loop proportionately broad; there is usually practically no forwardly extending terminal section or rectum, the intestine making only a slight forward bend just before its termination, which is in a many-lobed orifice.

Gonads elongated branching tubes more or less confluent to an irregular network covering a large area on the right side and a smaller area (anterior to the intestinal loop) on the left side. Their branches often appear to anastomose so as to form meshes inclosed on all sides.

Localities of the specimens (one specimen from each):

No. 97. Station D5218 (between Burias and Luzon, near Anima, Sola Island, 20 fathoms, coarse sand, Apr. 22, 1908). Very large, irregularly shaped specimen (Cat. No. 6019, U.S.N.M.).

No. 149. Station D5251 (off Linao Point, Gulf of Davao, 20 fathoms, coral, May 18, 1908.) (Cat. No. 6011, U.S.N.M.)

No. 158. Station D5250 (near the last, 23 fathoms, coral sand, May 18, 1908). (Cat. No. 6010, U.S.N.M.)

No. 110. Station D5253 (near the last, 28 fathoms, coral, May 18, 1908). (Cat. No. 6012, U.S.N.M.)

No. 148. Station D5146 (off Sulade Island, Sulu Archipelago, 24 fathoms, coral sand and shells, Feb. 16, 1908), (Cat. No. 6006, U.S.N.M.).

No. 117. Station D5158 (off Tinakta Island, Sulu Archipelago, 12 fathoms, coarse sand and shells, Feb. 21, 1908), (Cat. No. 6007, U.S.N.M.).

No. 157. Station D5164 (off Observation Island, Sulu Archipelago, 18 fathoms, green mud, Feb. 24, 1908), (Cat. No. 6008, U.S.N.M.).

No. 123. Station D5640 (off Labuan Blanda Island, Buton Strait, 24 fathoms, sand and broken shells, Dec. 13, 1909), (Cat. No. 6013, U.S.N.M.).

No. 160. Tumindao Reef, south end, near Sibutu Island, Sulu Archipelago, Feb. 26, 1908. One small, irregularly shaped and doubtful specimen (Cat. No. 6005, U.S.N.M.).

The above considerable series of specimens well illustrates the variability in external form and appearance of this species and leaves no doubt in the writer's mind that *P. pedata* and *Styela whiteleggei* Herdman, 1899, must be considered identical. *P. pedata* was described by Herdman from a single specimen collected by the *Challenger* among the Philippine Islands, latitude 6° 55′ N.; longitude 122° 15′ E., 10 to 20 fathoms, sand. *Styela whiteleggei* was described by the same author (1899) from specimens from Port Jackson, Australia. The indications are that the species is widely distributed and that other forms described as distinct may eventually have to be united with it. Except for the fact that it has but nine openings in the dorsal tubercle, Herdman's description of *P. irregularis*, also from the Philippines, latitude 11° 37′ N.; longitude 123° 32′ E., 18 fathoms, mud (see Herdman, 1882, p. 178, pl. 23, figs. 7 and 8), does not seem to differ too greatly from the present species to be regarded as possibly identical, but if this conjecture be correct the name *pedata* will still have priority.

The close relationship between *P. pedata* and *P. aurata* (Quoy and Gaimard) is very evident from their curved body axis, peculiar dorsal tubercle, pigmented internal tissues, and other characters, but in the former species the gonads do not appear to fuse to form a complex network as in the present one.

PANDOCIA QUADRATA (Herdman), 1881.

Plate 31, fig. 34.

1881. *Polycarpa quadrata* Herdman, Proc. Roy. Soc. Edinburgh, vol. 11, p. 78.

1882. *Polycarpa quadrata* Herdman. Rep. Voy, *Challenger*, vol 6, Tunicata, p. 173, pl. 22, figs. 8–10.

1885. *Polycarpa quadrata* Traustedt, Vidensk. Meddel. Nat. For. Kjobenhavn. ann. 1884, p. 48.

1885. *Styela quadrata* Sluiter, Natuur. Tijdschr. Neder. Ind., vol. 45, p. 228.

1891. *Polycarpa quadrata* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 583.

1904. *Styela quadrata* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 126.

1904. *Pandocia quadrata* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1364.

Body oblong or oval, more or less compressed laterally, attached by an area at or near the posterior end. Apertures both 4-lobed, quite widely separated, the branchial larger and nearly terminal, the atrial well back on the dorsal side, both but slightly if at all prominent in the preserved specimens. Test rather thin, dirty whitish in color; in the specimens preserved in formalin rather soft and flexible, but with a tough external layer. Surface wrinkled, bearing considerable adherent sand and mud; inner surface slightly pearly. Largest specimen 25 mm. long, 20 mm. in dorso-ventral diameter, and 12 mm. (estimated) from side to side.

Mantle musculature only moderately developed, very diffuse, consisting of separate fibers which cross each other in various directions, forming on most parts of the body a fairly continuous layer without being gathered into conspicuous bands. Even the muscle fibers radiating from the base of the tubes remain separate, or form only very small groups. They are overlaid by circular fibers.

FIGS. 50–52.—PANDOCIA QUADRATA (HERDMAN). 50, LEFT AND RIGHT SIDES OF BODY. NATURAL SIZE. 51, DORSAL TUBERCLE. × 10. 52, GONAD. SIDE ATTACHED TO MANTLE. × 10.

Tentacles of several sizes but arranged with little regularity. Over 20 of them are fairly large; some small ones are also present.

Dorsal tubercle small, its orifice elongated, forming a slightly S-shaped curve.

Dorsal lamina fairly wide; plain edged.

Branchial sac with four well-developed folds on each side, the fourth lower than any of the others. Transverse vessels numerous, somewhat variable in size, but in most parts of the sac little regularity of arrangement other than an alternation of larger and smaller ones is noticeable; the latter generally only cross the stigmata in some parts of their course; in other parts they become stouter and divide them. Internal longitudinal vessels very delicate, narrow, and inconspicuous. The following is an approximation to their arrangement on the left side of one specimen:

dorsal 7 (20) 6 (13) 5 (16) 5 (10) 6 *ventral.*

On the intervals between folds about 4 stigmata intervene between the internal longitudinal vessels in the dorsal region, and about 6 in the ventral region. On the right side of the above specimen a wide interval (in some places with 12 to 14 stigmata) intervenes between the median dorsal vessel and the first internal longitudinal vessel, and there are but three or four of those vessels dorsal to the base of the first fold. Along each side of the endostyle 10 or 12 stigmata intervene before the last internal longitudinal vessel is reached.

Intestinal loop small but broad and rounded; stomach small and rounded with about 20 rather inconspicuous longitudinal folds in its walls; practically no rectum; margin of anus with many small lobes.

Gonads about a dozen on each side, attached to the mantle in an irregular row near the endostyle. Each gonad is a small oblong sac whose dorsal end is only slightly produced into a neck. The ovary in each is central and elongated and bordered (on the side toward the mantle also overlapped and covered) the rounded or pear-shaped testes. Though the sperm ducts were not traced, a small papilla on the side of the neck of the gonad probably bears the aperture of a duct common to all the testes in the gonad.

Only two specimens (No. 30) (Cat. No. 5933, U.S.N.M.) in the collection, both from station D5536 (off Apo Island, latitude 99° 15′ 45″ N.; longitude 123° 22′ E., 279 fathoms, green mud, Aug. 19, 1909).

In referring these specimens to Herdman's species (three specimens of which were obtained off Ki Island, 129 fathoms, mud) the writer does not overlook two important discrepancies, for Herdman designates the branchial folds as "slight," though the internal longitudinal vessels are numerous and slender, as in the Philippine specimens. Herdman likewise states that there are "apparently" only three or four gonads on each side. This is, of course, subject to individual variation, and as most of the characters and the deep water habitat favor the probability that the two forms are identical, the writer will not undertake to establish a new species for these two small specimens.

PANDOCIA OVATA (Pizon), 1908.

Plate 31, fig. 31.

1908. *Polycarpa ovata* Pizon, Rev. Suisse Zoologique, vol. 16, p. 211, pl. 11, figs. 15–20.

1909. *Pandocia ovata* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1484.

Body oval in outline, strongly compressed from side to side, attached by one end; the apertures (both 4-lobed) on low elevations near together at the other end. Test only moderately thick, opaque, leathery, somewhat pearly inside and of a dirty brown color externally; its outer surface very uneven with coarse elevations and prominences whose surfaces are themselves roughened with minute closely placed wrinkles, but are practically free from incrusting foreign matter. Height of largest specimen from place of attachment to branchial orifice, 45 mm.; greatest diameter at right angles to the above, 33 mm.; lateral diameter (estimated), 12 mm. or less.

Mantle dark colored, its muscles composed chiefly of separate fibers or small irregular groups of fibers, the deeper and best-developed layer consisting of those radiating from the bases of the siphons or having a similar direction, the less complete superficial muscles crossing them at right angles or obliquely.

Tentacles few: 12 to 16 large ones probably represent two orders, but are not very regularly arranged. Additional smaller ones occur in only a few of the intervals.

Dorsal tubercle large but not prominent; its orifice C-shaped with the open interval forward; horns not inrolled or incurved.

Dorsal lamina plain-edged, broader in the posterior part.

Branchial sac with four well-developed folds on each side separated by rather wide intervals. Transverse vessels of four, in some places

FIGS. 53–55.—PANDOCIA OVATA (PIZON). 53, LEFT AND RIGHT SIDES OF BODY. × .65. 54, DORSAL TUBERCLE. × 8. 55, GONAD. SIDE NEXT TO BRANCHIAL SAC. × 25.

five, orders quite regularly arranged, the smallest generally crossing the stigmata. Internal longitudinal vessels stout; their distribution in the largest specimen is about as follows:

Right side: *dorsal* 4 (11) 5 (14) 6 (19) 5 (14) 4 *ventral.*
Left side: *dorsal* 4 (10) 5 (15) 5 (18) 5 (13) 4 *ventral.*

They are rather irregularly spaced; in general there are 8 or 10, sometimes 12, stigmata between them on the intervals between folds, but along the median dorsal vessel and endostyle 15 or more.

Intestine of large diameter but forming a rather compact rounded loop within which a very large endocarp is situated. Stomach short and rounded, without conspicuous plications and with a poorly developed pyloric caecum. Rectum abruptly bent forward; rather short; margin of anus with only very rudimentary yet numerous lobes.

Gonads of the typical *Pandocia* type. Each a very small oval or rounded sac with a very short neck, containing a central mass of eggs bordered by a varying but not very large number of pyriform male glands whose ducts converge on the unattached side of the gonad toward the base of a papilla situated beside the neck of the gonad. They unite and discharge by a common orifice at the summit of this papilla. The gonads are exceedingly numerous (100 or more on a side), are distributed singly or in regular rows or groups over the inner surface of the mantle on most of the right side and the part of the left side not occupied by the digestive tract.

This species was obtained at the following two stations only:

No. 24. Station D5144 (off Jolo Light, 19 fathoms, coral sand, Feb. 15, 1908). One specimen (Cat. No. 5935, U.S.N.M.), to which a very immature ascidian, perhaps a young individual of this species, was attached.

No. 150. Station D5149 (off Sirun Island, Sulu Archipelago, 10 fathoms, coral and shells, Feb. 18, 1908). One specimen. (Cat. No. 602 F, U.S.N.M.)

This is a very typical species of the genus *Pandocia.* It was described by Pizon (1908) from Amboina and is very closely allied to, if distinct from, *Pandocia stephenensis* Herdman, 1899, from Port Jackson, Australia. It is also allied to *P. obtecta* (Traustedt), 1883 (syn. *Polycarpa multiphiala* Verrill, 1901) of the West Indies and Bermuda (see Van Name, 1902), but is distinguished from the last by fewer internal longitudinal vessels on the folds and especially by the very much more numerous and smaller and more rounded gonads, which contain fewer eggs and fewer testes than in those of the West Indian form.

A specimen of *Pandocia pedata* from station D5640 (off Labuan Blanda Island, Buton Strait, Dec. 13, 1909, 24 fathoms, sand and broken shells) has several very young ascidians (No. 73) attached to its surface. They are of flattened form attached by the whole ventral surface, and have four well-developed branchial folds on each side, rather numerous internal longitudinal vessels, and a longitudinally plicated stomach with a rudimentary caecum. Immature gonads of the usual *Pandocia* type were distinguished in the largest individual, which was only about 2.5 mm. long. The specimens, though perhaps of the present species, are too immature for satisfactory identification in the present state of our knowledge of the ascidians of this region.

Genus POLYANDROCARPA Michaelsen, 1904.

POLYANDROCARPA MAXIMA (Sluiter), 1904.

Plate 31, fig. 33.

1904. *Gynandrocarpa maxima* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 93, pl. 15, figs. 5–7.

1909. *Polyandrocarpa maxima* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1370.

The only specimen consists of a compact cluster of about nine individuals growing one upon the other and so completely fused into an irregular oval mass that it would be taken for a single large ascidian were it not for the many apertures (which are 4-lobed and each raised on small, rough, sharply defined papilla) that are scattered over the surface. Test tough, yellowish white, opaque, and moderately thick in some places, but in the interior only thin laminae generally separate adjacent individuals. The surface, though with some wrinkles, is in many places fairly smooth, but never shiny, and is nearly free from incrusting materials. Size of entire cluster 28 mm. by 21 mm. The individuals are of different sizes, the largest 17 mm. long, but it is not unlikely that they are all somewhat immature. The following details were made out in the larger individuals:

Apertures widely separated. Mantle thin and delicate, its musculature slight.

Tentacles of 3 sizes quite regularly arranged; normal total number probably 32.

Dorsal tubercle oval, broader than long, with a transversely elongate aperture which forms a complete oval except for a very small open interval on the forward side.

Dorsal lamina plain-edged.

FIGS. 56, 57.—POLYANDROCARPA MAXIMA (SLUITER). 56, LEFT AND RIGHT SIDES OF BODY OF ZOOID. × 1.5. 57, GONAD. SIDE NEXT TO BRANCHIAL SAC. × 36.

Branchial sac with four well developed folds on each side, which are separated by wide intervals. Transverse vessels of three orders fairly regularly arranged, the smallest crossing the stigmata. Internal longitudinal vessels distributed about as follows on the right side of a large individual.

dorsal 4 (13) 5 (16) 5 (16) 4 (11) 6 *ventral.*

They are generally separated by from four to six stigmata on the intervals between folds.

Stomach short and rounded with a varying number (about 15 to 20) of longitudinal folds, but no caecum worthy of a name, though a slight protuberance exists in its place. Intestinal loop forming a more or less rounded curve of varying width, then bending abruptly forward to the rather short rectum. Margin of anus two-lipped.

Immature reproductive organs were found in two of the larger individuals, and consisted of a few (not over five or six) oval or flask-shaped gonads on the inner surface of the mantle on each side of the body. They each contain an ovary in the part lying against the branchial sac and a double row of testes in the part next to the mantle, the sperm ducts embracing the ovary and uniting to form a common duct which lies upon the free surface of the ovary and ends on a papilla beside the ovarian opening in the usual manner.

Locality of the only specimen, No. 46 (Cat. No. 5959, U.S.N.M.): Station D5141 (off Jolo Light, 29 fathoms, coral sand, Feb. 15, 1908).

The type and only specimen of Sluiter's species was from Salibabu Island (reef). According to his description the internal longitudinal vessels are considerably less numerous than in the Philippine specimen; possibly he may have made the count on a smaller and less mature zooid.

Genus EUSYNSTYELA Michaelsen, 1904.

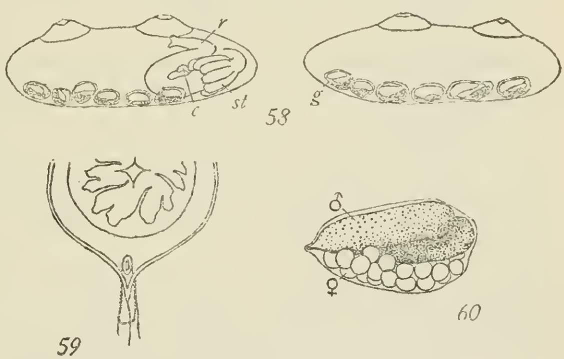
EUSYNSTYELA LATERICIUS (Sluiter), 1904.

Plate 26, fig. 9.

1904. *Gynandrocarpa latericius* Sluiter, *Siboga*-Exped., vol. 56*a*. p. 94, pl. 15, figs. 8–11.

1909. *Polyandrocarpa latericius* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1370.

Colony flat and expanded, averaging about 3 mm. thick, the upper surface fairly smooth and free from adhering material, but raised into low, distinctly bordered, rounded elevations of elliptical outline when seen from above. Each of these elevations, which are usually quite close together, is caused by the body of a zooid and bears upon its surface the two apertures of the zooid, which are raised on low flattened conical papillae, the branchial near the anterior end of the zooid, the atrial far back on the dorsal surface. The branchial aperture is distinctly square, the atrial is more nearly round.



Figs. 58–60.—Eusynstyela latericius (Sluiter). 58, Left and right sides of body of zooid. × 6. 59, Part of the circle of tentacles and dorsal tubercle. × 15. 60, Gonad. × 19.

Dimensions of the largest colony 108 mm. by 51 mm.; length of body of largest zooids 6.5 mm., width 3.5 mm.

Test very tough and leathery; yellowish white, thick between and beneath the zooids, but thin over them. Under magnification minute furrows are visible on the portion over the zooids, some radiating from the apertures, others having a elliptical course parallel and concentric with the outline of the body. Owing to the tough character of the test, vascular connections between the zooids, though doubtless present, were not successfully traced.

Mantle moderately thick; its muscles are not gathered into conspicuous bands.

Tentacles apparently normally 16, of two sizes placed alternately. At their bases an annular membrane extending around the whole circle unites them all together. Atrial tentacles are present, but are so minute and slender as to easily escape notice. They are arranged in a large circle. Peculiar thread-like appendages of the inner wall of the mantle in the atrial region have been described by Sluiter (1914) in this species, and are present in the Philippine specimens also.

Dorsal tubercle elliptical, with the long diameter placed longitudinally; its orifice of similar outline, also with its long diameter longitudinal.

Dorsal lamina plain-edged.

Branchial sac with four distinct folds on each side and numerous internal longitudinal vessels. Their distribution in a large zooid was found about as follows:

Right side: *dorsal* 2 (14) 4 (8) 4 (13) 3 (6) 2 *ventral.*
Left side: *dorsal* 2 (13) 4 (9) 3 (12) 4 (7) 2 *ventral.*

Transverse vessels of nearly uniform size. Only 2 to 3 stigmata generally intervene between internal longitudinal vessels on the intervals between folds, but a larger number occur between the endostyle and last vessel, and 8 or 10 stigmata are often present between the median dorsal vessel and the first internal longitudinal vessel, especially on the right side of the body. Stigmata oblong or elliptical, often rather wide.

Esophagus short and curved; stomach short with few (about 19) longitudinal folds and a small curved pyloric caecum. Intestine large, running forward from the stomach, then bending back along its side. The rectum is only moderately long, and begins with a sharp forward bend of the intestine. Its orifice is two-lipped.

Gonads rounded or oval sacs, each normally containing a considerable number of eggs and two large oval or sausage-shaped testes. These gonads may number a dozen or more on each side of the body and are placed in an irregular row each side of the mid-ventral line, attached to the inner surface of the mantle.

The larger of the two colonies (No. 124), (Cat. No. 5977, U.S.N.M.), is from station D5557 (near Cabalian Point, Jolo Island, 13 fathoms, sand and coral. September 18, 1909). The other (No. 137) (Cat. No. 5976, U.S.N.M.), nearly as large, is also from Jolo Island, February 11, 1908. The Philippine specimens have the longitudinal vessels more numerous and have somewhat smaller zooids than Sluiter's type, which was from Sarassa Island, 36 meters. The writer has in no case found more than two testes in a gonad and therefore places the species in the genus *Eusynstyela* Michaelsen, 1904, instead of *Polyandocarpa*. *Eusynstyela imthurni* (Hardman), from Ceylon (Herdman, 1906, p. 330, pl. 7, figs. 1–9; pl. 9, fig. 4), is evidently a very closely allied form.

Genus STOLONICA Lacaze-Duthiers and Delage, 1892.

While the following species does not conform strictly to the generic diagnosis given by Hartmeyer (1909) in respect to the arrangement of its gonads, the difference does not seem to warrant separating it from that genus.

STOLONICA STYELIFORMIS, new species.

Plate 29, figs. 17–19.

Zooids oblong or somewhat cylindrical, tapering rather abruptly at the anterior end, attached by the posterior end, the apertures (both four-lobed) on rather prominent papillæ, the branchial at the an-

FIGS. 61–63.—STOLONICA STYELIFORMIS, NEW SPECIES. 61, LEFT AND RIGHT SIDES OF BODY OF ZOOID. × 1.5. 62, DORSAL TUBERCLE × 15. 63, GONADS. × 12.5.

terior end and the atrial a little way back on the dorsal side. Colony consisting of a more or less dense cluster of zooids, which, though attached to the object on which they grow by the posterior end only, are often so crowded together that the posterior parts of their bodies are in close contact and adhere together, but they do not fuse, and can be torn apart without injuring the test. The anterior part at least of the body of each zooid is free and separate from adjacent zooids. The largest specimen (No. 130), (Cat. No. 5995, U.S.N.M.), though evidently only a part of a colony, completely surrounds a section of the stem of an alcyonarian for a length of about 60 mm. and consists of about 100 closely placed zooids, mostly of fairly uniform size (14 mm. to 16 mm. long and 6 mm. to 7 mm. in dorso-ventral diameter). Another colony (No. 113) is similar but more irregular, and has zooids of less uniform size. In neither of these colonies are the zooids mature. In specimens from stations D5174 and D5555 the zooids are larger, sometimes reaching 23 mm. or more in length, and are fully adult. They are generally less closely crowded, their bodies being separate for the whole length; the posterior end is often narrowed into a short pedicel-like extension whose expanded base is continuous with that of adjacent zooids. Connection between the zooids of the colony is by vascular processes from the posterior end of the body and appears to persist under normal conditions in fully adult zooids.

Test not thick but tough and opaque, of a brownish color externally, becoming purplish brown about the apertures. In the zooids from station D5174 this purplish color is distributed in about four broad stripes radiating from the branchial aperture and extending some distance back. External surface rather rough, somewhat wrinkled and slightly incrusted with foreign material; internal surface with a thin whitish, slightly pearly layer.

Mantle moderately thick, adherent to the test; its muscles fairly well developed but not gathered into conspicuous bands. Individual fibers or slender groups of a few fibers form a network with small more or less rectangular meshes.

Tentacles about 32; of three sizes arranged with some regularity.

Dorsal tubercle much elongated longitudinally, with a slitlike or long oval orifice.

Dorsal lamina plain-edged.

Branchial sac with but two folds on each side separated by rather wide intervals. The grouping of the internal longitudinal vessels does not appear to indicate other rudimentary folds. The branchial sac is not symmetrical, being more expanded and with more numerous internal longitudinal vessels on the right than on the left side. Transverse vessels rather widely spaced, of 2 sizes placed alternately, the smaller crossing the stigmata which are rather long. Internal longitudinal vessels numerous and slender, separated by about three or four stigmata on the intervals between folds. In a large zooid their distribution was found as follows:

Right side: *dorsal* 9 (16) 9 (14) 9 *ventral.*
Left side: *dorsal* 6 (15) 9 (12) 7 *ventral.*

In another individual:

Right side: *dorsal* 5 (17) 8 (14) 9 *ventral.*
Left side: *dorsal* 3 (14) 7 (12) 9 *ventral.*

Stomach short and rounded, with 20 to 25 longitudinal plications but no caecum. Intestine of large diameter, but forming a rather small loop. Rectum long. Margin of anus smooth or nearly so.

Reproductive organs were found only in the specimens from stations D5174 and D5555. These also contain large tailed larve in the peribranchial cavity. Only the ovaries form compact gonads, each gonad consisting of a group of a very few eggs (but one of which appears to become very large at a given time) inclosed in a small sac having a large irregularly lobed opening produced into a papilla or very short oviduct. These female gonads, which average

20 to 30 in total number in large zooids, are distributed in the two rows, one on each side of the mid-ventral line. The row on the right side is the longest, not only extending nearly to the posterior end of the body, but at that point curving dorsally and extending a little way forward in the dorsal region of the right side. The row on the left side does not, ordinarily at least, reach near to the posterior end of the body. The testes are not grouped into distant gonads; they are small rounded or pear-shaped glands, not cleft into lobes, and are very numerous, being distributed in groups, irregular rows, or singly on the inner surface of the mantle. They are most abundant on the posterior dorsal region, chiefly but not entirely to the right of the mid-dorsal line. They are also very abundant in the ventral region, among or alongside of the female gonads. A few are scattered in other places, especially on the right side of the body, and in continuation forward or backward of the rows of female gonads. The sperm ducts are difficult to trace, but it is evident that those of testes lying near together in a group often join to form common ducts.

The specimens are from the following localities:

No. 130. Station 5134 (off Balukbaluk Island. Sulu Archipelago, 25 fathoms, fine sand, Feb. 7, 1908). Large colony; no reproductive organs found in zooids. (Cat. No. 5995, U.S.N.M.).

No. 113. Station D5136 (near Jolo Light, 20 fathoms, sand and shells, Feb. 14, 1908). Large colony; no reproductive organs found in zooids. (Cat. No. 5994, U.S.N.M.).

No. 121. Station D5174 (off Jolo Light, 29 fathoms, coarse sand. Mar. 5, 1908). Type colony. (Cat. No. 6042, U.S.N.M.)

No. 17. Station D5555 (off Capalian Point. Jolo, 34 fathoms, coarse sand, Sept. 18, 1909). (Cat. No. 5996, U.S.N.M.).

In the distribution of the gonads this species differs somewhat from those thus far included in the genus *Stolonica*. It might be placed in the genus *Heterocarpa* Lacaze-Duthiers and Dalage (1892) as modified and defined by Michaelsen (1911) with but little alteration of his diagnosis except that the existence of budding and the formation of true colonies is uncertain in the species thus far placed in *Heterocarpa*. The writer can not feel any doubt of it in the case of the present species; moreover if compound species are admitted to *Heterocarpa* the chief reason for maintaining it as a distinct genus disappears.

STOLONICA VESICULARIS, new species.

Plate 32, fig. 39.

The colony or colonies in the only specimen almost entirely cover the surface of the body of a large simple ascidian (*Microcosmus exasperatus* Heller). The zooids are rounded and sac-like, sometimes higher than wide, and attached by the posterior end, but only slightly, so that they are easily broken away. The two small 4-lobed or square apertures are near together on the part of the body opposite the area of attachment and are slightly prominent. The colony contains individuals of various sizes and ages; from very immature and minute ones up to those having a diameter of 3 mm. to 4 mm. In some parts of the colonies the individuals are quite crowded, so that their form is more or less modified by the pressure of the adjacent ones, but the connection between them, especially in the case of the larger ones, is but slight and is by means of slender root-like processes of the ventral region in which small vessels run. Test thin, parchment-like and slightly translucent, its surface somewhat rough and thinly incrusted with sand in the larger individuals. Its color is yellowish, sometimes tinged with purplish brown about the apertures.

Mantle thin, adherent to the test, its musculature not greatly developed. Transverse and longitudinal fibers are numerous but are not for the most part gathered into bands.

Tentacles apparently normally 16, of two sizes placed alternately.

Dorsal tubercle small; oval with its long diameter transverse to the body axis. Its orifice is a straight or slightly curved slit likewise transverse to the body axis.

Dorsal lamina plain-edged.

First fold of the branchial sac well developed on each side of the body, especially on the right side. On the left side it is more prominent in the posterior region. One or two additional rudimentary or vestigial folds, indicated chiefly or entirely by a somewhat closer grouping of the internal longitudinal vessels, are recognizable in large zooids, showing more distinctly on the right than on the left side of the body. The scheme of the internal longitudinal vessels was found as follows in a large zooid:

Right side: *dorsal* 5 (25) 4 (5) 6 (7) 8 *ventral.*
Left side: *dorsal* 4 (23) 5 (4) 10 *ventral.*

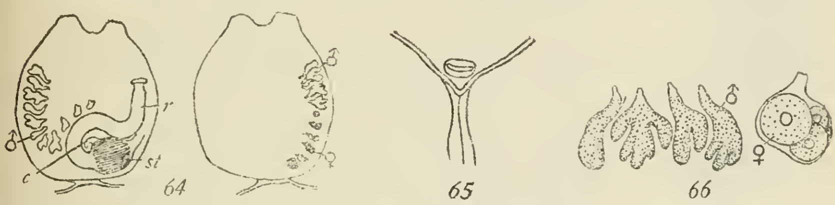
Internal longitudinal vessels closely placed especially on the large folds; even on the intervals they are separated only by the width of two stigmata or even less. The stigmata are rather wide. Transverse vessels of two (in some places three) sizes, the smallest crossing without interrupting the stigmata.

Stomach short and wide with numerous (in large zooids about 30) narrow longitudinal folds in its walls, and a rather long but slender curved pyloric caecum. Intestine forming a rather compact rounded loop; rectum moderately long, the intestine making a considerable bend where the rectum commences. Margin of anus smooth with a thickened border.

Ovaries few (about five to seven) situated on the right side along and close to the posterior part of the endostyle. They are small sacs, each containing a few eggs which are apparently discharged by an orifice on a neck too short to be termed an oviduct. Testes more numerous (15 to 20) than the ovaries; they are rather large and are generally cleft into several lobes, sometimes of quite irregular outline. They are mostly arranged in a row on the left ventral region; just anterior to the intestinal loop this row bends dorsally and forward for a little distance. A few of the testes are situated on the right side along the endostyle, continuing forward the row of female gonads. In a few cases hermaphroditic gonads, each containing a testis and a small group of eggs, were found replacing one or two of the female gonads.

The type and only specimen (No. 135) (Cat. No. 6034 U.S.N.M.) is from station D5145, off Jolo Light, 23 fathoms, coral sand and shells, February 14, 1908.

This species is closely allied to *S. socialis* Hartmeyer, 1903 (see also Michaelsen, 1904), of the northwestern European coasts. In



FIGS. 64–66.—STOLONICA VESICULARIS, NEW SPECIES. 64, LEFT AND RIGHT SIDES OF BODY OF ZOOID. × 6. 65, DORSAL TUBERCLE. × 20. 66, GONADS. × 20.

that species, however, gonads with ovaries only do not occur, and the posterior part of the row of gonads on the right side is composed entirely of hermaphroditic gonads. Other minor differences also, as well as the geographical separation and different climatic conditions of the localities of the two forms make it appear necessary to regard this as a new species.

Family BOTRYLLIDAE Verrill, 1871.

Genus BOTRYLLOIDES Milne-Edwards, 1841.

BOTRYLLOIDES TYREUM Herdman, 1886.

1886. *Botrylloides purpureum* HERDMAN (not v. Drasche, 1883), Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 41. Name changed in same work (pp. 344 and 381) to *B. tyreum;* pl. 1, figs. 1–3; pl. 2, figs. 1–11. Not *Sarcobotrylloides purpureum* Herdman, 1891 (see Herdman, 1889, p. 104).

1891. *Botrylloides tyreum* HERDMAN, Journ. Linn. Soc. London. Zool., vol. 23, p. 608.

1898. *Botrylloides tyreum* GOTTSCHALDT, Abhandl. Senckenb. Gesell., vol. 24, p. 642.

1904. *Botrylloides tyreum* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 101.

1909. *Botrylloides tyreum* HARTMEYER, Bronn's Tier-reich. vol. 3, suppl., p. 1380.

In the only well-preserved specimen in the collection the colony is thin and expanded, surrounding a piece of branching coral for a length of about 40 mm. The coral polyps protrude through openings piercing the colony, which does not appear to exceed 3 mm. in thickness at any point. Test translucent and pale purplish in color; the zooids, which are arranged in complex branching systems, are darker purple.

Zooids rather elongate, attaining a length of about 2 mm. to 2.5 mm. when moderately contracted. Branchial aperture with 6 bifid lobes. Atrial aperture large and commonly produced into a short tube of large diameter, the anterior margin of which is often extended to form a languet of considerable length, but there is great individual variation in this respect.

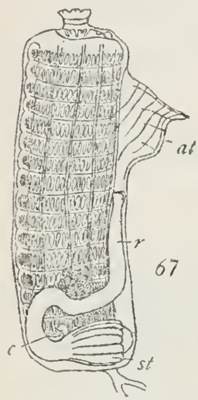


Fig. 67.—Botrylloides tyreum Herdman. Zooid. × 20.

Eight tentacles (four large and four small, placed alternately) are readily distinguishable; the existence of additional third order tentacles is probable.

Branchial sac long, with 15 to 16 rows of stigmata in some zooids, in others somewhat fewer; about 23 stigmata in a row on each side. Three internal longitudinal vessels on each side, spaced apart about the width of five stigmata. Eight or nine stigmata, however, intervene between the last internal longitudinal vessel and the endostyle.

Stomach with about 10 or 11 rather narrow longitudinal folds and a small caecum. (No caecum is mentioned or figured by Herdman, 1886.) Anus slightly 2-cleft.

Testes few in the zooids examined. Some of the zooids contain a single large egg on one or both sides of the body anterior to the testes.

The well-preserved colony (No. 127) (Cat. No. 6031, U.S.N.M.) mentioned above is from station D5144 (off Jolo Light, Feb. 7, 1908, 19 fathoms, coral sand). A small, poorly preserved specimen (No. 67) (Cat. No. 5907, U.S.N.M.), apparently of the same species, is from station D5146 (near Sulade Island, Sulu Archipelago, Feb. 16, 1908, 24 fathoms, coral sand and shells).

The type of this species was obtained by the *Challenger* Expedition in latitude 11° 37′ N.; longitude 123° 31′ E., 18 fathoms. Gottschaldt (1898) records a small colony from Ternate, and the *Siboga* Expedition (see Sluiter, 1904, p. 101) obtained it at several other localities on reefs in the Malay region.

Family RHODOSOMATIDAE Hartmeyer, 1908.

In addition to the two genera of this family at present known from the Philippine region, *Corella* Alder and Hancock, 1870, will doubtless eventually be found there, as it occurs elsewhere in the Malay Archipelago and in Japan.

Genus RHODOSOMA Ehrenberg, 1828.

RHODOSOMA PAPILLOSUM (Stimpson), 1855.

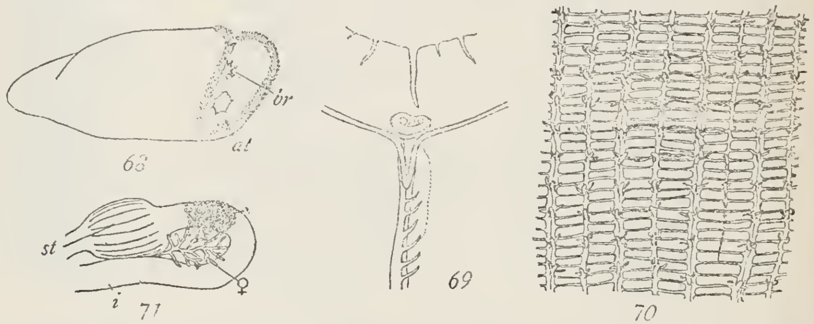
1855. *Schizascus papillosus* Stimpson, Proc. Philadelphia Acad. Sci., vol. 8, p. 377.
1885. *Rhodosoma papillosum* Traustedt, Vidensk. Meddel. Nat. For. Kobenhavn, ann. 1884, p. 9.
1891. *Rhodosoma papillosum* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 598.
1901. *Rhodosoma papillosum* Hartmeyer, Archiv. f. Natur-geschichte, vol. 67, suppl., pp. 158 and 161, pl. 4. figs. 2, 9–11.
1904. *Rhodosoma papillosum* Sluiter, *Siboga* Exped., vol. 56*a*, p. 26, pl. 1, fig. 2; pl. 4, figs. 4–6.
1906. *Rhodosoma papillosum* Hartmeyer, Zool. Anzeiger, vol. 31, p. 25.
1906. *Rhodosoma papillosum* Herdman, Ceylon Pearl Oyster Fisheries, Supplementary Report No. 39, p. 302.
1907. (*Rhodosoma*) *papillosum* Seeliger, Bronn's Tier-reich, vol. 3, suppl., p. 1077.
1909. *Rhodosoma papillosum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1390.

Body rounded at one end, broader and obliquely truncated at the other, and attached by a large part of the right side. The truncated end of the body is formed into a valve or cover hinged at the attached side and separated from the main portion of the body by a deep mouth-like cleft lined with thin flexible test; the test elsewhere is thicker and more rigid. The two apertures are situated in the flexible test in the cleft and the valve or cover can close tightly against the main part of the body, shutting off the apertures from the exterior and entirely concealing them. Branchial aperture with 7 to 9 lobes; atrial aperture with 6 less conspicuous lobes. Test on body and cover tough and fairly rigid, colorless and transparent, with a smooth clean external surface in most of the specimens, except that the margins or lips of the mouth-like cleft are studded with numerous minute conical elevations, each bearing a short spine. The spines are sometimes provided with one or more short lateral projections. One specimen, however (that from station D5139), had the body surface somewhat incrusted with foreign material. Dimensions of two largest specimens (valve closed), 42 mm. by 29 mm. and 32 mm. by 22 mm., respectively.

Mantle thin, not adherent to the test in preserved specimens except in the region of the apertures. Musculature very slight or almost wanting on most parts of the body, but slender bands radiate from the apertures and generally unite in groups to form larger bands. These, however, do not extend far from the apertures except those near the two angles of the mouth-like cleft. There the bands are long and stout and closely grouped, and serve to move the valve or cover.

Tentacles simple, rather small and widely spaced, about 32 in number of 3 orders rather regularly arranged; in addition there are a few fourth-order tentacles in some parts of the circle. (This count was made in one of the largest specimens.)

Dorsal tubercle C-shaped with strongly incurved horns; the open interval directed forward.



FIGS. 68–71.—RHODOSOMA PAPILLOSUM (STIMPSON). 68, EXTERNAL VIEW. × 1.25. 69, DORSAL TUBERCLE, PART OF DORSAL LAMINA, AND PART OF THE CIRCLE OF TENTACLES. × 16. 70, PART OF BRANCHIAL SAC. × 15. 71, STOMACH, PART OF INTESTINE, AND GONADS AS SEEN THROUGH MANTLE. × 2.5.

Dorsal lamina represented by a series of small, rather slender languets.

Branchial sac without folds or minute plications. Transverse vessels very numerous, of two sizes placed alternately in most parts of the sac, but in some places nearly uniform in size. The intervals between the transverse vessels are divided by very numerous slender longitudinal vessels into rather narrow stigmata. At intervals of 3 or 4 stigmata small curved papillae arise from the transverse vessels and support slender internal longitudinal vessels. They project a trifle beyond their point of union with the internal longitudinal vessels. The latter in large and old individuals are mostly incomplete and interrupted between the supporting papillae so that they form merely lateral branches of these papillae. (See fig. 70.) In one of the smaller and doubtless much younger individuals the internal longitudinal vessels were found to be much less reduced and were practically complete over considerable areas in some parts of the sac. Here and there one of the transverse vessels tapers off and ends, first becoming very slender and merely crossing without terminating the stigmata; the supporting papillae that bear it become correspondingly reduced, and finally disappear as the vessel terminates.

Digestive tract on right side of body. Stomach rather short and rounded, with conspicuous longitudinal folds in its walls. Intestine having the peculiar course characteristic of the family, passing ventral instead of dorsal to the stomach. Margin of anus with small inconspicuous lobes.

Reproductive organs present on the right side of the body only. The ovary is a many-branched organ lying within the intestinal loop, its branches spreading out to a slight extent on the surface of the loop next to the mantle. Testis not developed in specimens examined. In this genus it is of ramified form, spreading over the surface of the intestinal loop.

The localities of the specimens in the collection are:

No. 77. Station D5250 (off Linao Point, Gulf of Davao, May 18, 1908, 23 fathoms, coral sand) (Cat. No. 5964, U.S.N.M.).

No. 69. Station D5139 (near Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand). Large individual somewhat incrusted with foreign material (Cat. No. 5963, U.S.N.M.).

No. 93. Station D5145 (near Jolo Light, Feb. 14, 1908, 22 fathoms, sand and shells (Cat. No. 5963, U.S.N.M.).

No. 195. Station D5137 (near Jolo Light, Feb. 14, 1908, 20 fathoms, sand and shells), (Cat. No. 5993, U.S.N.M.).

No. 88. Station D5147 (Sulu Archipelago, near Siasi, Feb. 16, 1908, 21 fathoms, coral sand and shells). Very small and immature individual (Cat. No. 5930, U.S.N.M.).

This species, originally described from Chinese waters (Stimpson, 1885), appears to be widely distributed in the warmer parts of the western Pacific and in the Malay Region, and probably ranges still more widely, for *Rh. ceylonicum* Herdman (1906) from Ceylon, and *Rh. huxleyi* MacDonald (1862) from Australia,[1] do not appear to be separated from it by any characters of importance. It was obtained at many stations in the Malay Region by the *Siboga* Expedition, 118 meters being the greatest depth. The reader is referred to the article by Hartmeyer (1901) for a discussion of the species of this genus up to that date; also to Herdman, 1906, pages 302 and 303. The writer follows in the present paper all recent authors in employing the name *papillosum* for this species, but does not lose sight of the fact that Stimpson's *Rh. pellucidum*, also from China, which as Hartmeyer (1901, p. 161) suggests, is very probably identical with *papillosum*, is described as species No. 19 of Stimpson's article (1855) while *papillosum* is described as No. 20 of the same article. In case the identity of the two forms can be proved

[1] See Willey, 1902, p. 711, fig. 11.

the name *pellucidum* will have priority. The settlement of this question will probably have to wait until future collecting shall determine whether one or two species of this genus occur in Chinese waters.

Family PHALLUSIIDAE Traustedt, 1882.

[=ASCIDIIDAE Authors.]

Genus PHALLUSIA Savigny, 1816. [=ASCIDIA Authors.]

PHALLUSIA DEPRESSIUSCULA (Heller), 1878.

Plate 27, figs. 10-13.

1878. *Ascidia depressiuscula* Heller, Sitzungsber. d. k. Akad. Wiss. Wien, vol. 77, p. 87, pl. 1, fig. 7.

1891. *Ascidia depressiuscula* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 594.

1906. *Ascidia depressiuscula* Herdman, Rep. Ceylon Pearl Oyster Fisheries, pt. 5, suppl. rep. No. 39, p. 305, pl. 2, figs. 10–22.

1909. *Phallusia depressiuscula* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1402.

Body usually much flattened from side to side, attached by an area on the posterior part of the left side or by a large part of that side, but the area of attachment is subject to some variation in position. Body as seen from the side generally more or less elongate, sometimes nearly oval in outline, but more often narrowed anteriorly, or tapering in such a manner that the branchial aperture appears to be borne on a rather long tube or siphon, though in reality this is the narrowed anterior part of the branchial sac. Branchial aperture terminal; atrial aperture on a tube of varying length arising a considerable distance back on the dorsal border of the body, and pointing dorsally or more or less forward, occasionally almost directly forward and parallel to the narrow anterior part of the body.

Dimensions of largest specimens:

No. 114 (Cat. No. 6025, U.S.N.M.), Station D5555, length 110 mm., dorso-ventral diameter 47 mm.

No. 154 (Cat. No. 6021, U.S.N.M.), Endeavor Point. Length 102 mm., dorso-ventral diameter, 52 mm.; thickness from side to side about 14 mm.

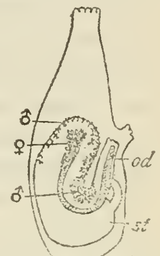
Test usually moderately thick on most parts of the body, of a cartilaginous appearance and rather firm consistency. Sometimes it is almost colorless and fairly clear with a glassy luster, in other individuals suffused with a smoky brown color over most of the body or near the apertures only. The test is easily torn or broken. Its external surface is usually fairly smooth and free from foreign matter; it may be very even, or have a few irregular furrows or depressions and elevations.

Mantle thin, but with numerous muscle fibers disposed singly or in narrow bands or loose groups. On the anterior part of the body the deeper ones are mostly transverse and overlaid with longitudinal ones, these also being separate or only gathered into very narrow bands. The transverse fibers become more widely spaced and less regularly disposed (running in various oblique directions) on the middle and posterior regions of the body, and the musculature practically disappears on the posterior part of the left side.

In one of the largest specimens about 48 tentacles were counted; they are of three orders, not very regularly arranged.

Dorsal tubercle simple, its orifice **C**-shaped, **U**-shaped, or **V**-shaped in most specimens, with the open interval forward or to the right and the horns curved inward (rarely outward), but not spirally coiled. Ganglion a considerable distance back from the dorsal tubercle.

Dorsal lamina with lateral ribs, narrow and plain-edged in the anterior part, wider and provided with small but not very regular slender teeth farther back. It passes to the left of the esophageal orifice, becoming much lower after passing the orifice, though in some specimens it can be traced a considerable distance farther back. Another membrane, also more or less denticulate, arises from the space just anterior to the esophageal orifice and is continued parallel to the dorsal lamina past the orifice on the right side and for some distance back. The papillæ along the right side of the area surrounding the esophageal opening (described by Heller, 1878, p. 87), were also observed in the *Albatross* specimens. They represent the supporting papillae of the most dorsal internal longitudinal vessel of the right side; this vessel is, however, rudimentary or wanting, and the papillae are larger and longer than usual.



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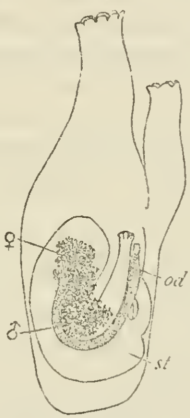

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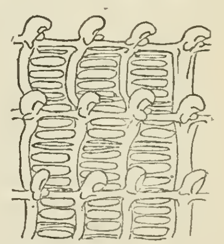
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FIGS. 72–74.—PHALLUSIA DEPRESSIUSCULA (HELLER). 72, LEFT SIDE OF BODY. ONE-HALF NATURAL SIZE. 73, LEFT SIDE OF BODY OF ANOTHER INDIVIDUAL. × .75. 74, PART OF BRANCHIAL SAC. × 15.

Branchial sac extending far back beyond the mouth of the esophagus. Transverse vessels numerous; in some individuals three or four orders arranged with considerable regularity may be recognized on most parts of the sac; in others, though large vessels occur at intervals, the vessels of the smaller orders are in most places nearly of uniform size. The minute plication of the wall of the sac characteristic of most members of the genus is fairly well developed, but the large transverse vessels take no part in it. The plications vary from about half as numerous to nearly as numerous as the internal longitudinal vessels. Internal longitudinal vessels numerous, separated in one of the largest specimens by five or six stigmata in the narrow anterior part of the sac, but farther back where the sac becomes wider by a larger number, often 10 or 11. In smaller individuals the average number of stigmata intervening between such vessels is generally somewhat less. At the intersection with transverse vessels, but not at intermediate points, the internal longitudinal vessels bear curved papillæ, which have a membrane along the concave border and generally a pair of small rounded projections at the base. The internal longitudinal vessels are often incomplete or interrupted between some of the transverse vessels.

Digestive tract large and covering an extensive area on the left side of the body, though its parts are compactly disposed, the rectum ascending quite close along the descending or posteriorly extending part of the intestinal loop. Margin of anus more or less distinctly plicated.

Ovary composed of a mass of rather stout convoluted tubules. It is partly visible through the mantle, lying in the bend of the anterior part of the intestinal loop, a few of the tubules usually spreading out upon that surface of the intestine which lies next to the mantle. From the ovary the large stout oviduct (usually closely packed with eggs) accompanies the terminal portion of the intestine lying upon it (as seen through the mantle) or along its dorsal border and terminates near the anus.

The male organ consists of an immense number of small irregularly distributed glands of simple though irregular shape, connected by a system of branching ducts leading to a common sperm duct accompanying the oviduct. Though the organ lies largely between the digestive tract and branchial sac, parts of it come out upon that surface of the stomach and intestine lying next to the mantle through the interval within the curves of the digestive tract, and generally also by reaching around the outer border of the anterior part of the intestinal loop.

Judging from its representation in the collection, this is one of the commonest and most widely distributed ascidians in the Philippine region. The specimens were collected on the reefs and in shallow water (greatest depth 34 fathoms). They agree well with Heller's (1878) original description and figure based on a specimen from Ceylon, but there is considerable variation, especially in external form and appearance, between different specimens of the series collected by the *Albatross* Expedition, as would indeed be expected, since they are of various sizes and ages, and come from different localities. With Herdman's (1906) description of specimens from Ceylon there are some discrepancies, notably in the more numerous tentacles, the spirally coiled horns of the dorsal tubercle and in the occasional presence of intermediate papillae on the internal longitudinal vessels which he mentions. The first two differences may easily be attributed to individual variation, but no intermediate papillae were found in the Philippine specimens and would hardly be expected to occur as an individual peculiarity. Herdman mentions the presence of "intermediate horizontal membranes crossing the meshes in places." These can be nothing but rudimentary transverse vessels, and the small papillae may have belonged to such vessels. In most specimens some of the transverse vessels do not extend entirely across the sac, but taper off and become rudimentary and finally disappear without extending the entire distance.

The localities of the Philippine specimens are:

No. 125. Station D5360 (off Corregidor Light, Feb. 7, 1909, 12 fathoms, hard bottom). One specimen (Cat. No. 6024, U.S.N.M.).

Nos. 89, 94, 122. Catbalogan, Samar, April 15 and 16, 1908. Nine specimens in all. (Cat. Nos. U.S.N.M., 5947, 5943, and 6026, respectively.)

No. 154. Endeavor Point, December 24, 1908. One large specimen (Cat. No. 6021, U.S.N.M.).

No. 99. Station D5254 (off Linao Point, Gulf of Davao, May 18, 1908, 21 fathoms, sand and coral). One specimen (Cat. No. 6023, U.S.N.M.).

No. 70. Station D5141 (off Jolo Light, Feb. 15, 1908, 29 fathoms, coral sand). One specimen (Cat. No. 5944, U.S.N.M.).

No. 55. Jolo, Jolo Island, Feb. 11, 1908. One specimen (Cat. No. 5942, U.S.N.M.).

No. 64. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand). One specimen (Cat. No. 5949, U.S.N.M.).

No. 114. Station D5555 (off Cabalian Point, Jolo, Sept. 18, 1909, 34 fathoms, coarse sand). Two large specimens (Cat. No. 6025, U.S.N.M.)

No. 82. Station D5147 (off Sulade Island, Sulu Archipelago, Feb. 16, 1908, 21 fathoms, coral sand and shells). One specimen (Cat. No. 5946, U.S.N.M.).

No. 90. Station D5163 (off Observation Island, Sulu Archipelago, Feb. 24, 1908, 28 fathoms). One specimen (Cat. No. 5948, U.S.N.M.).

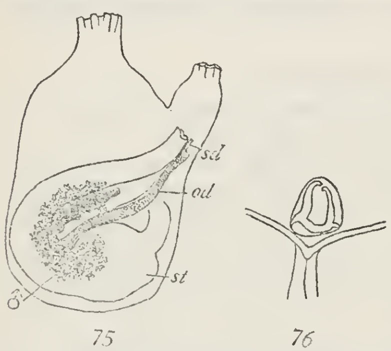
PHALLUSIA APERTA (Sluiter), 1904.

1904. *Ascidia aperta* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 38, pl. 2, fig. 4; pl. 6, figs. 1–5.

1909. *Phallusia aperta* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1401.

In the only specimen in the collection the body is short, broad dorsoventrally, and decidedly compressed from side to side. Posterior border rounded, anterior portion of body somewhat produced, bearing the branchial aperture at the end. Atrial aperture but slightly prominent, situated some distance back on the dorsal border. Attachment by a large part of the left side. Test yellowish, very smooth and shiny externally (much more so than in *Phallusia depressiuscula*, just described), and of a glassy transparency and fairly firm consistency. Apertures lobed, but in their contracted state the lobes can not readily be counted. Length, 38 mm.; dorsoventral diameter, 25 mm.; thickness from side to side, about 10 mm.

Mantle thin and transparent, its musculature slight, comprising slender radiating and circular bands on and near the tubes, and scattered transverse bands on the right side in the ventral region, but over most parts of the body no bands are noticeable. After removal from the test a few minute bright red ocelli are visible around the margin of the apertures. Eleven were counted about the branchial aperture; the number about the atrial aperture was not determined.



Figs. 75, 76.—Phallusia aperta (Sluiter). 75, Left side of body. × 1.25. 76, Dorsal tubercle. × 7.

Tentacles of three sizes arranged with some approach to regularity; a few additional fourth-order tentacles are also present, and the total number can hardly be less than 50.

Dorsal tubercle with an orifice of irregular horseshoe form; its open interval directed forward.

Dorsal lamina nearly or quite plain-edged in the anterior part; but in the posterior part cleft into numerous long narrow teeth, some of them dividing into two or three slender points.

Branchial sac in structure and appearance much like that of *Phallusia depressiuscula* just described. (See fig. 74.) Transverse vessels of two (in some parts three) orders fairly regularly arranged. with occasional much larger vessels at intervals which are not always in accord with the usual scheme of arrangement. Minute plications of the sac well developed; they are less numerous than (in some places only half as numerous as) the internal longitudinal vessels. Internal longitudinal vessels well developed and complete, though slender. They are separated by a varying number of stigmata (usually from 9 to 13), the number being influenced by the development and position of the minute plications already mentioned. At the crossing of the transverse and internal longitudinal vessels, but not at intermediate points, the latter vessels bear rather small curved papillae. These are provided with a membrane along their concave side and usually have one or two small blunt projections at their base.

Alimentary loop of very simple form. Stomach comparatively small and short, extending nearly dorsoventrally across the posterior left side of the body. From the pyloric end of the stomach the intestine curves forward and extends obliquely dorsally, ending near the base of the atrial tube. Anus not distinctly lobed.

Ovary an irregular, elongated, sinuously convoluted body with a few small lateral branches extending along the inner border of the intestinal loop, its closed end situated where the ascending part of the intestine crosses the middle of the body, the other end near where the intestine leaves the stomach. At this point the ovary opens into the large oviduct, which at first runs along the anterior border of the stomach, and then leaves it and runs directly toward the terminal part of the intestine, which it accompanies nearly to the end of the rectum. The small irregularly lobed testes are not very numerous compared with their numbers in most other species of the genus. They are irregularly distributed over those parts of the intestine and stomach which are adjacent to the ovary and oviduct. The common sperm duct apparently accompanies the oviduct.

The only specimen (No. 15) (Cat. No. 6022, U.S.N.M.), of this well-marked species, readily distinguishable by the simple open loop formed by the alimentary tract, is from station D5147 (off Sulade Island, Sulu Archipelago, Feb. 16, 1908, 21 fathoms, coral sand and shells). Sluiter's (1904) specimens were from latitude 5° 36′ 30″ S.; longitude 132° 55′ 12″ E., 90 meters, and latitude 8° 19′ S.; longitude 117° 41′ E., 274 meters.

Family PEROPHORIDAE Giard, 1872.

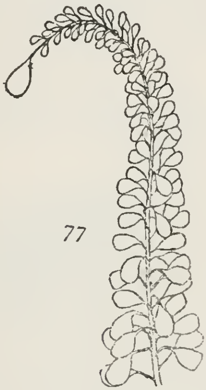
Genus PEROPHORA Wiegmann, 1835.

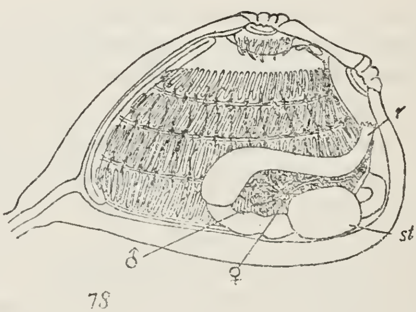
PEROPHORA HUTCHISONI MacDonald, 1859.

1859. *Perophora hutchisoni* MacDonald, Trans, Linn. Soc. London, vol. 22, p. 377, pl. 65, div. II, figs. 1–3.
1891. *Perophora hutchinsoni* Herdman, Journ. Linn. Soc. London, vol. 23, p. 602.
1893–1909. *Perophora hutchisoni* Seeliger, Bronn's Tier-reich, vol. 3, suppl., pl. 37, fig. 9.
1898. *Perophora hutchisoni* Herdman, Ann. Mag. Nat. Hist., ser 7, vol. 1, p. 446.
1899. *Perophora hutchisoni* Herdman, Cat. Australian Museum, Sydney, pp. 8 and 112.
1909. *Perophora hutchisoni* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1487 (*P. hutchinsoni*, p. 1410.)

The only specimen, evidently but a part of a colony, consists of a slender stolon, about 50 mm. long, bearing nearly 100 zooids, each on a separate lateral branch of the stolon. These lateral branches, the individual pedicels of the zooids, arise at rather close but not very regular intervals all around the stolon and are somewhat less in length than the body of the zooid they bear. The largest zooid (about 4 mm. in greatest diameter) is borne on the extreme tip of the stolon, but with this exception, the zooids become regularly larger and more mature as the base of the stolon is approached.

Zooids somewhat egg-shaped, slightly compressed laterally, the pedicel arising from the small end, which is the posterior ventral part of the body. Apertures but slightly prominent, the branchial near the dorsal side of the large end of the body; the atrial nearly opposite the origin of the pedicel. Both are lobed, but the lobes are not readily counted in the contracted preserved specimen. Nine





FIGS. 77, 78.—PEROPHORA HUTCHISONI MACDONALD. 77, PART OF A COLONY. × 1.25. 78, ZOOID. × 13.

branchial and seven atrial lobes were demonstrated in one individual. Stolon, pedicels, and zooids are insheathed in a layer of clear colorless test substance, which becomes thicker on that part of the body of the zooid where the pedicel arises so that the outline of the zooid tapers off into that of the pedicel. Yellowish brown corpuscles occur in branching vessels in the mantel, digestive organs, and to some extent in other parts of the body.

Mantle musculature slight, composed of delicate, widely spaced bands. Some of these surround the apertures, others extend posteriorly on the sides from about the branchial aperture, or obliquely backward from the region of the endostyle.

Tentacles about 30 in number. Three orders can be recognized, but there is often considerable inequality in their arrangement, especially as far as the smaller tentacles are concerned. These are inserted a little nearer the aperture than the large ones.

Dorsal languets small, inserted on the median dorsal vessel.

Owing to the peculiar form of the body the anterior part of the branchial sac is much narrower than the posterior part. Four rows of long narrow stigmata are present; about 35 stigmata on each side in the anterior row, the number increasing gradually to nearly 50 in the posterior row. The three transverse vessels on each side; each bear about 15 or 16 papillae distributed fairly evenly along their length. These support slender longitudinal vessels, which (except those borne on papillae near the endostyle and median dorsal vessel) are mostly complete between the first and third transverse vessels but elsewhere are represented only by anteriorly or posteriorly extending branches of the papillae. Because of the increase in the number of stigmata in the posterior rows the internal longitudinal vessels are separated by only about two stigmata in the anterior part and by three or more in the posterior part of the sac.

Intestinal loop rather long dorso-ventrally and narrow in an antero-posterior direction. It is situated in the left posterior dorsal part of the body. The esophagus, which is much curved, begins at the posterior dorsal part of the sac; the stomach is small, oval, and smooth-walled; the intestine has a very marked valvelike constriction some distance beyond the stomach and is of larger diameter beyond the valve, tapering gradually from this point to the anus, which has a lobed margin.

Reproductive organs small and poorly developed in most of the individuals. In some a small number of pear-shaped testes entirely distinct from each other and each borne on a slender duct can readily be distinguished. They lie in the intestinal loop. Their ducts converge in a radial manner to form a stout common sperm duct which accompanies the terminal part of the intestine. In some zooids the ovary is visible as a group of small eggs lying beside the commencement of the common sperm duct.

The only specimen (No. 43) (Cat. No. 5926, U.S.N.M.) is from station D5597 (near Zamboanga Light, Mindadao, Oct. 12, 1909, 9 fathoms). MacDonald's type was from Australia.

Family CIONIDAE Lahille, 1887.

As restricted by Hartmeyer, this family has consisted only of the well-known and nearly cosmopolitan genus *Ciona*, which, though found in the Malay Archipelago, has not yet been collected in the Philippines. The family is separated from the Phallusiidae chiefly by having the continuous dorsal lamina replaced by separate languets, but is also characterized by its elongate body, and the powerful longitudinal muscle bands in the mantle, and by the position and course of the intestine, which lies partly behind and partly beside the branchial sac.

The *Albatross* collection contains, however, a new genus, which is in many respects intermediate between *Ciona* and *Phallusia*, to which the writer has given the name *Ciallusia*, a compound of parts of these two well-known generic names. If the families Cionidae and Phallusiidae require to be kept separate, which the new genus seems to render somewhat doubtful, *Ciallusia* appears to belong in the Cionidae on account of having the dorsal lamina replaced by languets.

CIALLUSIA, new genus.

Body elongated, tapering (pediceled in the only species); both apertures near together at the anterior end, the atrial aperture distinctly 6-lobed. Test gelatinous, transparent.

Mantle with a few transverse but no strong longitudinal muscle bands.

Tentacles simple.

Median dorsal vessel broad and flat; the dorsal lamina represented by separate languets. Internal longitudinal vessels are present, but bear no papillae.

Course of digestive tract very straight, only the esophagus and part in the vicinity of the stomach being curved, the remaining portion running directly forward. It lies beside the branchial sac.

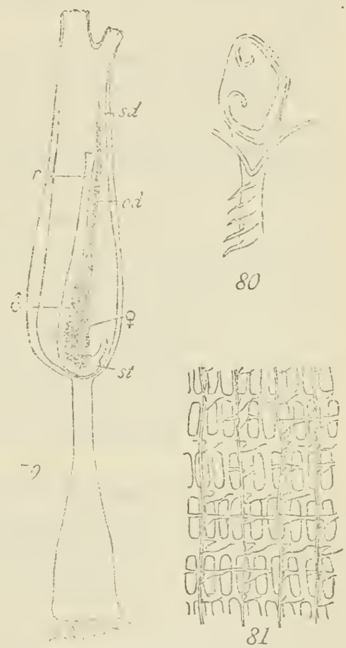
Ovary beside the proximal part of the intestine. Male organs ramifying upon the surface of the stomach and intestine.

Type of the genus.—*Ciallusia longa*, new species.

CIALLUSIA LONGA, new species.

Body greatly elongated, laterally flattened, largest at the posterior end and tapering gradually toward the anterior end. Branchial aperture terminal, indistinctly lobed; atrial aperture smaller, 6-lobed, situated on a very short tube close beside the branchial aperture but not extending forward so far. Body attached by the posterior end by means of a long pedicel. (The pedicel is complete only in one of the specimens. In this it is between two-thirds and three-fourths of the length of the body proper, narrow where it joins the body but wide at the other end where it gives off a number of rootlike branches which anchored the animal in the sand or gravel in which it grew. In the other specimens the pedicel appears to have been similar, but it is broken off.) Dimensions of largest specimen: body length (including pedicel) 93 mm.; greatest dorso-ventral diameter (near posterior end of body proper), 24 mm.; length of pedicel about 67 mm.; greatest diameter of pedicel (at end farther from body), 17 mm.; smallest diameter of pedicel (near point of origin from body), 4 to 5 mm. Test transparent and nearly colorless in the alcoholic specimens, moderately tough, with a smooth clean surface. Pedicel of substance similar to the test covering the body proper.

Mantle musculature slight, the sphincters of the apertures weak, being composed of narrow bands. The most conspicuous body muscles are short widely spaced transverse bands crossing the mid-dorsal and mid-ventral regions (about 20 to 30 on each region) but ending abruptly without extending far onto the sides of the body. In this respect it differs greatly from the genus *Ciona*, which has strong longitudinal body muscles arranged in wide bands.



Figs. 79–81.—Ciallusia longa, new species. 79, Left side of body. One-half natural size. 80, Dorsal tubercle and part of dorsal lamina. × 9. 81, Part of branchial sac. × 21.

Tentacles of several sizes, not very regularly arranged. A total of about 40 were counted in one of the smaller specimens.

Dorsal tubercle large but not prominent, its orifice irregularly C-shaped with the open interval to the right or somewhat forward. In the largest specimen the horns are somewhat inrolled.

Median dorsal vessel broad and flat, the dorsal lamina represented by a series of narrow, sharp-pointed languets inserted with the broad diameter of the base transverse to the median dorsal vessel.

In some parts of the sac three or four orders of transverse vessels quite regularly arranged can be recognized; in other parts the regularity is less. The smallest of the vessels usually cross without interrupting the stigmata and are interrupted and incomplete at many points. Well-developed though very slender internal longitudinal vessels are present and are separated by the width of only two or three stigmata. The latter are of rather short, broad oblong form in most parts of the sac, and are separated by rather wide interstigmatic vessels. The internal longitudinal vessels are borne on the ends of tapering supporting papillæ which rise from the transverse vessels (even from the small incomplete ones, those parts of the vessel which give rise to supporting papillæ being usually well developed even when intermediate parts are atrophied). No papillæ are borne on the internal longitudinal vessels.

Esophagus short and curved, stomach small and inconspicuous, of short oval form, and situated beside, or extending a trifle posterior to, the posterior end of the branchial sac. From the stomach the intestine bends forward and extends straight forward toward the anterior end of the body, ending at about one-third the body length from the anterior end in an orifice whose border has many small lobes.

Ovary elongate, tapering gradually into the stout oviduct. Ovary and oviduct lie along the dorsal side of the intestine, the oviduct extending farther toward the anterior end of the body than the intestine.

The male organs consist of many small glands connected by branching ducts which ramify over the surface of the stomach and posterior part of the intestine. They discharge by a common duct which lies along the ovary and oviduct (for the most part upon that side of the latter which is toward the branchial sac) and which extends still nearer the anterior end of the body than the oviduct.

Represented in the collection by three specimens, all rather large, from two localities, which are as follows:

No. 103. Station D5432 (off Corandagos Island, Apr. 8, 1909, 51 fathoms, sand). One specimen. (Cat. No. 5980, U.S.N.M.)

No. 152. Station D5153 (off Tocanhi Point, Sulu Archipelago, Feb. 19, 1908, 49 fathoms, coral sand and shells). Two specimens. (Large one is type, Cat. No. 6039, U.S.N.M.)

Family DIAZONIDAE Garstang, 1891.

Genus RHOPALOPSIS Herdman, 1890.

RHOPALOPSIS CRASSA (Herdman), 1880.

Plate 28, fig. 14.

1880. *Ecteinascidia crassa* Herdman, Proc. Roy. Soc. Edinburgh, vol. 10, p. 723.

1882. *Ecteinascidia crassa* Herdman, Rep. Voy. *Challenger*, vol. 6, Tunicata, p. 241, pl. 36, figs. 12–14.

1890. *Rhopalopsis crassa* Herdman, Proc. Liverpool Biol. Soc., vol. 5, p. 160.

1891. *Rhopalopsis crassa* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 601.

1898. *Rhopalopsis crassa* Herdman, Ann. Mag. Nat. Hist., ser. 7, vol. 1, p. 447.

1899. *Rhopalopsis crassa* Herdman, Cat. Australian Mus. Sydney, No. 17, pp. 8 and 112.

1904. *Rhopalopsis crassa* Sluiter, *Siboga*-Expedition, vol. 56*a*, p. 126.

1909. *Rhopalopsis crassa* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1418.

As explained below, the writer feels little doubt that *Rhopalopsis fusca* Herdman (1880) is identical with the above species. As it was described on the same page of Herdman's article as *R. crassa*, but following the latter, the name *crassa* has priority if the identity of the two forms is admitted. The references to *R. fusca* are as follows:

1880. *Ecteinascidia fusca* HERDMAN, Proc. Roy. Soc. Edinburgh, vol. 10, p. 723.
1882. *Ecteinascidia fusca* HERDMAN, Rep. Voy. *Challenger*, vol. 6, Tunicata, p. 241, pl. 36, figs. 7–11.
1890. *Rhopalopsis fusca* HERDMAN, Proc. Liverpool Biol. Soc., vol. 5, p. 160.
1891. *Rhopalopsis fusca* HERDMAN, Journ. Linn. Soc. London Zool., vol. 23, p. 601.
1893–1907. *Rhopalopsis fusca* SEELIGER, Bronn's Tier-reich, vol. 3, suppl., pl. 37, fig. 8.
1898. *Rhopalopsis fusca* HERDMAN, Ann. Mag. Nat. Hist., ser. 7, vol. 1, p. 447.
1899. *Rhopalopsis fusca* HERDMAN, Cat. Australian Mus., Sydney, No. 17, pp. 8 and 112.
1904. *Rhopalopsis fusca* SLUITER, *Siboga*-Exped., vol. 56*a*, p. 13, pl. 2, fig. 6.
1909. *Rhopalopsis fusca* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1418.
1912. *Rhopalopsis fusca* HARTMEYER, Deutsche Tiefsee-Exped., vol. 16, p. 373.

All the specimens except one consist of a single isolated zooid, giving no indication of forming buds or of having developed by budding. The remaining specimen (pl. 28, fig. 14), consists of 3 zooids of different sizes growing with their basal (posterior) ends near together and united by a continuous connection of test substance, although the writer did not succeed in demonstrating a stolon connecting the zooids.

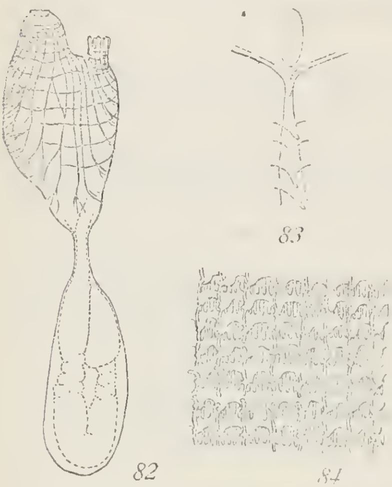
Whether growing singly or united, each zooid is inclosed in its own covering of test, which is of a yellowish or brownish yellow color (greenish yellow in a formaldehyde specimen) and of a tough, somewhat cartilagenous consistency, only slightly transparent or merely translucent. The test is very thick, the cavity occupied by the zooid's body often appearing very small in comparison; the inner layer immediately ensheathing the abdomen of the zooid is much tougher and more rigid than elsewhere. Ordinarily the animal is attached by the posterior end or more or less obliquely by that end and a part of one side, sometimes by a large part of one side. The test being of very irregular thickness, the external form is very variable, but in the more regular specimens it is somewhat club-shaped, the anterior end being often much swollen into a large rounded knob-like head. The apertures are not prominent externally. Length of the largest specimen 45 mm., maximum width about 19 mm., but some smaller ones are proportionally wider.

When removed from the test the zooid has the typical form of a compound ascidian, consisting of a thorax connected by a narrow constricted region or neck with an abdomen of the usual oval form containing the stomach, intestinal loop, and reproductive glands.

Owing to the contractions incident to preservation the neck or constricted part of the body was found broken in nearly every specimen. Length of the largest zooids when removed from the test in their partly contracted condition 30 to 35 mm. The thorax when expanded forms considerably over half the length, but in the contracted state only about one-half or less. Branchial aperture plain or only obscurely lobed; atrial aperture prominent, anteriorly directed and provided with 6 distinct lobes.

Mantle thin, provided with a very variable number of conspicuous muscle bands which on the sides of the thorax are rather irregularly distributed and longitudinal in direction, but curve and assume a transverse direction at their posterior ends, so that they approach either the endostyle or the median dorsal line. At the same time they divide or spread out into a number of narrow bands.

Other transverse muscles (except about the apertures) are few and weak. No conspicuous muscle bands on the abdomen.



Figs. 82–84.—Rhopalopsis crassa (Herdman). 82, Outline of zooid (removed from test) showing course of muscle bands on mantle and outline of intestinal loop. × 2. 83, Dorsal tubercle and part of dorsal lamina. × 20. 84, Part of branchial sac. × 20.

In one specimen seven large tentacles were counted, additional smaller ones of at least two orders are somewhat irregularly distributed in the intervals. Small papilla-like prominences farther forward within the branchial tube may represent rudimentary tentacles of higher orders.

Dorsal tubercle large, elongate oval, with an elongate oval orifice.

Dorsal lamina represented by a series of triangular languets expanded in a direction transverse to the median dorsal vessel from which they arise.

Branchial sac with numerous (sometimes 100) transverse vessels which are of nearly uniform size and bear attached along their length a membrane raised into triangular supporting papillæ that carry slender internal longitudinal vessels. These are attached almost but not quite at the tips of the supporting papillae (that is, the latter project a very little above the internal longitudinal vessels). In some places the latter vessels are incomplete and interrupted, so that they appear only as short lateral branches of the supporting papillae, but over considerable areas of the sac the internal longitudinal vessels are perfect, at least in most specimens. These vessels are separated by from three to four stigmata, and number 40 to 50 on each side of the body in fair-sized specimens.

Stomach oval, perhaps with longitudinally corrugated walls, but this is uncertain. Intestine of large diameter and forming a long loop.

Reproductive organs situated beside the intestinal loop. Ovary large, sac-like, containing a vast number of small eggs. Testes very numerous. They are minute pear-shaped glands discharging by a stout sinuous common sperm duct which accompanies the ascending branch of the intestine.

The above-mentioned group or colony of individuals (No. 38) is from station D5168 (off Observation Island, Tawi Tawi Group, Sulu Archipelago, Feb. 25, 1908, 80 fathoms, coral sand).

The single zooids are from:

No. 93. Station L5108 (off Corregidor Light, Jan. 15, 1908, 13 fathoms, coral) (Cat. No. 5936, U.S.N.M.).

No. 83. Station D5141 (off Jolo Light, Feb. 15, 1908, 29 fathoms, coral sand) (Cat. No. 5937, U.S.N.M.).

No. 37. Station D5174 (off Jolo Light, Mar. 15, 1908, 20 fathoms, coarse sand) (Cat. No. 5940, U.S.N.M.).

No. 34. Station 5555 (off Cabalian Point, Jolo Island, Sept. 18, 1909, 34 fathoms, coarse sand) (Cat. No. 5941, U.S.N.M.).

No. 53. Station D5159 (off Tinakta Island, Feb. 21, 1908, 10 fathoms, coral sand). Two specimens (Cat. No. 5938, U.S.N.M.)

The Philippine specimens are clearly of the species which has commonly been known as *R. fusca* Herdman. It is common and widely distributed in the Malay region and occurs on various kinds of bottom and at various depths. The *Siboga* Expedition obtained it from coral reefs and at depths down to 521 meters. According to Sluiter (1904) its color when living is dark blue.

The great variability exhibited by the Philippine specimens and the apparent absence of any important structural differences between the species lead the writer to the conclusion that the two species *R. crassa* from the Ki Islands, 129 fathoms, and *R. fusca* from Banda, Moluccas, 17 fathoms, collected by the *Challenger* Expedition and described in Herdman's reports are identical, and that for the reason above noted the name *crassa* should replace *fusca*. Herdman (1906, p. 299, pl. 1, figs. 15–17) has described a species from Ceylon under the name *Ecteinascidia* (? *Rhopalopsis*) *solida*, which appears to be also so closely related to *R. crassa* that it may eventually require to be united with it.

Family CLAVELINIDAE Forbes, 1848.

[=CLAVELINIDAE+POLYCITORIDAE s. DISTOMIDAE Authors.]

The propriety of uniting these closely allied families has already been suggested by several writers, including Hartmeyer, though he failed to adopt the plan in his classification.

The group thus enlarged comprises compound ascidians forming colonies either of the social type with separate zooids connected by stolons, or having the zooids completely buried in a common mass of test and discharging into common cloacal cavities, or exhibiting any of various intermediate types. Zooids without any trace of internal longitudinal vessels.

Genus CLAVELINA Savigny, 1816.

[=*Clavelina* Savigny, 1816+*Podoclavella* Herdman, 1890+*Chondrostachys* MacDonald, 1858+*Rhodozona* Van Name, 1902.]

These genera are united on the ground that the characters distinguishing them are entirely superficial ones (chiefly the degree of separation of the zooids in the colony), which are variable not only in different colonies of one species but often in the same colony at different stages of growth.

CLAVELINA MOLLUCCENSIS (Sluiter), 1895.

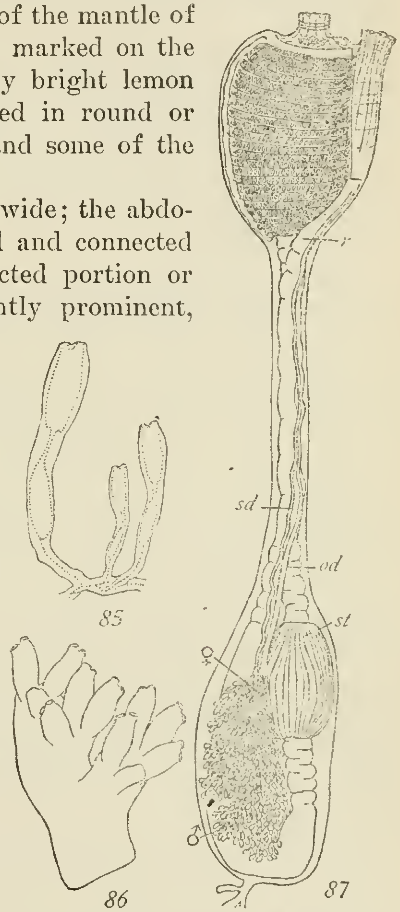
1895. *Podoclavella meridionalis* Sluiter, Denschr. Med.-Nat. Ges. Jena, vol. 8, p. 165, pl. 6, figs. 1–4.
1899. *Podoclavella meridionalis* (part) Herdman, Cat. Australian Mus., Sydney, No. 17, pp. 5 and 112.
1904. *Podoclavella molluccensis* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 5.
1908. *Podoclavella meridionalis* Pizon, Rev. Suisse Zoologique, vol. 16, p. 197, pl. 9, figs. 1–4.
1909. *Podoclavella moluccensis* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1426.

If the writer is correct in referring all the colonies listed below to this species, it is a very variable one, its characters being greatly influenced by the age or stage of development of the colony and perhaps also by the conditions under which it grows. Each zooid may have its own separate sheath of test inclosing the body for its entire length, or only the anterior parts of the zooids may be separately ensheathed, their posterior parts being embedded in a mass of test common to several or all of them. In the best-developed and most fully adult specimens in the collection, however, each zooid is inclosed in a separate club-shaped sheath of transparent pale yellowish gray or nearly colorless test, which becomes tough and horny on the basal part of the zooid, where it is extended into a pedicel, the several zooids constituting the specimen being connected only by a basal stolon which is also sheathed in tough horny test. The largest zooid measures 70 mm. high and 10 mm. in greatest width, inclusive of its covering of test and pedicel, but only 45 mm. high when removed from the test in the preserved partially contracted condition. The other zooids of the specimen are considerably smaller though apparently equally mature. Color of the mantle of the zooids deep purple, irregularly marked on the anterior part with an area of very bright lemon yellow, these colors being contained in round or oval pigment cells in the mantle and some of the internal tissues.

Zooids having the thorax rather wide; the abdomen is narrow and more elongated and connected with the thorax by a long contracted portion or neck. Apertures often only slightly prominent, near together; the branchial terminal, 6-lobed; the atrial on a very short forwardly or somewhat dorsally directed tube, also more or less distinctly lobed, at least in some individuals. A stout vascular process at the posterior end of the abdomen extends down through the pedicel and connects the zooid with the common stolon.

Musculature of mantle well developed, comprising a very variable number of fairly stout, chiefly longitudinal bands underlaid by slender closely placed transverse muscles on the thorax, but on the posterior parts of the body only longitudinal muscles of a more diffuse character are visible.

Tentacles numerous, of several sizes, the small ones inserted nearer the branchial aperture than the larger ones.



Figs. 85–87.—Clavelina molluccensis (Sluiter). 85, Diagram of part of a colony based on specimens from Station D5401. One-half natural size. 86, Colony with basal parts of zooids united. × 1.25. 87, Zooid. × 3.

Dorsal languets arising from the median dorsal vessel itself, though to the left of the middle line of the same. Their bases are continuous with membranes borne on the transverse vessels of the sac.

Stigmata in about 25 rows, with at least 40 in a row on each side (in large zooids probably considerably more). Transverse vessels provided with a rather broad membrane along the side toward the interior of the branchial sac. These membranes became continuous with the bases of the dorsal languets at the median dorsal vessel.

Intestinal loop long; stomach oval. Generally it is smooth-walled, but numerous narrow longitudinal streaks of dark pigment, which the writer believes indicate slight plications, can be made out in some zooids.

Reproductive organs beside the intestinal loop, their ducts accompanying the ascending part of the intestine. Ovary a small sac containing a large number of small eggs. Testes exceedingly numerous, small oval bodies covering up much of the ovary and adjacent portions of the intestinal loop. In some zooids small tailed larvae are present in the atrial cavity, which is more or less expanded to contain them.

Colonies not mature and those which appear to have grown under less favorable conditions differ from the above description in many respects. The zooids are always much smaller, not often over half or one-third the above size, and among the specimens in the collection none are so conspicuously pigmented as the large ones above described. Some show no pigment cells at all; the zooids have, however, more or less of a reddish or pale purplish gray tinge due to diffused color. The test has a similar but paler color and is semitransparent. The zooids are not so completely separate as in the colony above described, the anterior part of the zooid only has its own sheath of test, the posterior part being imbedded in a common mass of test. Several such common masses, each containing a group of zooids, may be united into a single colony, all arising as lobes or branches of a still larger trunk-like mass of test (fig. 86).

In very immature colonies, perhaps also in those that have passed through a stage of degeneration and shrinkage and are starting to grow again, the zooids, which are small and numerous and have the branchial sac and other internal organs as yet only imperfectly developed, are completely and often quite deeply buried in a common mass of test, as in ordinary compound ascidians, the colony having a short, thick cylindrical form, attached by one end, or in other cases dividing into several lobes or thick branches. The zooids are connected by branching vessels in the basal part of the colonies. Some of the specimens in this undeveloped condition are quite large (one from station D5164 is about 65 mm. high and nearly 20 mm. in transverse diameter), and would, if all the zooids which are developing in them should attain the full size, make very extensive colonies.

The specimens assigned to this species are all from shallow water (not over 30 fathoms), except one from station D5518, from a depth of 200 fathoms.

Specimens with adult or nearly adult zooids are from:

No. 146. Station D5401 (off Tanguingi Island, north of Cebu, Mar. 16, 1909, 30 fathoms, fine sand). A few large, completely separate, deeply pigmented zooids, probably all forming one colony as described above (Cat. No. 5967, U.S.N.M.).

No. 153. Station D5513 (off Point Tagolo Light, northern Mindanao, Aug. 7, 1909, 505 fathoms, gray mud and Globigerina). Small colony with only one large fully developed zooid and a few immature or degenerate ones. Not pigmented. (Cat. No. 5968, U.S.N.M.)

No. 42. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells). Small colony, zooids stunted and imperfectly separated, somewhat pigmented (Cat. No. 5919, U.S.N.M.).

Immature or degenerate colonies, probably of this species, are from:

No. 47. Station D5144 (off Jolo Light, Feb. 15, 1908, 19 fathoms, coral sand). Small colony (Cat. No. 5918, U.S.N.M.).

No. 95. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand). Small colony (Cat. No. 5917, U.S.N.M.).

No. 143. Station D5164 (off Observation Island, Tawi Tawi Group, Sulu Archipelago, Feb. 24, 1908, 18 fathoms, green mud). Several colonies, all containing only immature zooids deeply buried in the common test (Cat. No. 5970, U.S.N.M.).

Sluiter (1895) at first considered this species identical with Herdman's (1890, 1899) *Podoclavella meridionalis* from Port Jackson, Australia. Afterwards (1904) he concluded it was distinct and gave it the name *molluccensis*, which is here adopted, though from the great variability of the specimens in the *Albatross* collection, the writer is inclined to question the importance and constancy of the characters separating Sluiter's species from Herdman's.

This ascidian is widely distributed in the Malay Archipelago (see Sluiter, 1904), ranging, according to that author, from shallow water to 113 meters. Pizon's (1908) *Podoclavella meridionalis* from Amboina is undoubtedly this species.

CLAVELINA DETORTA (Sluiter), 1904.

Plate 31, fig. 29.

1904. *Podoclavella detorta* Sluiter, *Siboga*-Exped., vol. 56*a*, p. 6, pl. 3, figs. 18–22.

1909. *Podoclavella detorta* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1426.

The larger of the two specimens consists of a dense group of 40 or 50 zooids arising from a common base composed of a compacted mass of branching stolons, each zooid being inclosed in an entirely separate covering of test substance and capable of being easily separated from its neighbors without injury, though in the natural condition of the colony it is in close contact with them and is connected with them through vascular processes arising from the posterior end of the abdomen and joining the common stolons. The smaller specimen is a looser group of a few zooids connected by stolons.

The largest zooids are in the preserved condition about 23 mm. long. Each consists of a long, very narrow abdomen inclosed in a tubular sheath of tough test which extends posteriorly into a more or less elongate pedicel and at the anterior end enlarges (expanding more toward the ventral than toward the dorsal side) into a rounded or oval mass inclosing the thorax. The thorax is short, wide in a dorso-ventral direction, and narrow from side to side. Branchial aperture slightly lobed or almost plain, atrial aperture larger, and plain edged. Neither is greatly produced. The abdomen joins the thorax at the extreme posterior dorsal part of the latter, and an abrupt bend in the proximal part of the abdomen is generally present, so that the main axis of the thorax assumes a direction nearly at right angles to the long axis of the abdomen and pedicel.

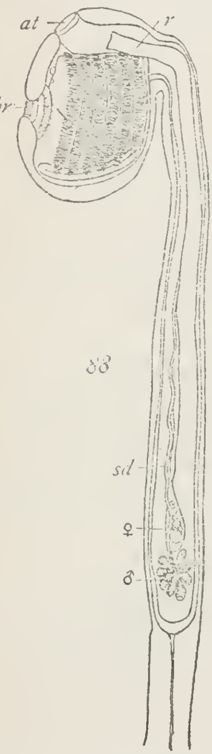


Fig. 88.—Clavelina detorta (Sluiter). Left side of body of zooid. × 4.

Mantle thin; about the apertures there are slender circular fibers, but no strong sphincters. On each side of the thorax about 15 narrow widely separated muscle bands extend posteriorly from the region about and between the apertures, each being generally formed by the union of two or more slender bands. Transverse muscles are but little developed, though a few slender circular bands cross the longitudinal ones on the anterior part of the thorax.

Tentacles 16; 8 large and 8 smaller ones alternating.

Dorsal tubercle prominent; cup-shaped with a rounded orifice.

Dorsal lamina replaced by a series of large triangular languets borne transversely upon the wide median dorsal vessel. They are continuous at their lateral angles with broad membranes borne along the whole length of the transverse vessels of the sac.

Stigmata long and narrow, separated by very slender interstigmatic vessels. Number of rows apparently 6, with about 40 in a row on each side.

Intestinal loop very long. Stomach long and narrow, not noticeably wider than some parts of the intestine. Apparently it is smooth walled.

Some individuals contained embryos or tailed larvae in the dorsal part of the thorax or proximal part of the abdomen. The reproductive organs lie beside the intestinal loop in the posterior part of the abdomen. The testes are rather few in number and form a rounded group from the middle of which the common sperm duct has its origin. The ovary is small and sac-like and lies chiefly anterior to the group of testes. It contained but few eggs in the specimens studied.

The large colony (No. 142) (Cat No. 5969, U.S.N.M.). above described is from station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand). The smaller one (No. 12) (Cat. No. 5885, U.S.N.M.), from station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells).

Sluiter (1904) described this species from two specimens dredged in lat. 70° 55.5′ S.; long. 114° 26′ E., 15 fathoms, coral and stones.

Genus POLYCITOR Renier, 1804.

[=*Distoma* Authors.]

The Philippine species belong to the subgenus *Eudistoma* Caullery, 1909.

POLYCITOR IANTHINUS Sluiter, 1909.

Plate 31, fig. 28.

1909. *Polycitor ianthinus* Sluiter, *Siboga*-Exped., vol. 56*b*, p. 20. pl. 2, fig. 2; pl. 8, fig. 3.

1909. *Eudistoma ianthinum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

Colony a thick flattened mass rounded at the edges, and if any general statement can be based on the few specimens in the collection, usually of oval or elongate outline, one end broader than the other, the attachment being by the narrower end. One specimen much narrower than the others may well be described as club shaped, though it is also somewhat flattened in one direction. Test rather opaque, grayish brown and moderately tough. It contains numerous large oval cells containing brown pigment; these cells are abundant in the deeper portions of the test as well as in the superficial layers and are a very conspicuous feature, giving the colony as a whole, a very dark-brown color. Tissues of the zooids also brown. Surface of colony rather uneven, small pits or depressions indicating the positions of the zooids. Largest colony 65 mm. long, 42 mm. in greatest width, and about 15 mm. thick.

Zooids rather large, often 5 mm. long even when somewhat contracted. Thorax rather small, oblong, the 6-lobed branchial aperture on a very short tube at the anterior end; the atrial aperture also 6-lobed but smaller, situated on a tapering tube nearly or quite as long as the thorax, which arises from the posterior part of the dorsal side of the thorax, and in most zooids is directed forward (fig. 89), but it occasionally extends out at right angles to the length of the body. A long narrow neck which often becomes much bent and contracted in preservation connects the thorax and the abdomen. Vascular processes of the abdomen were not noted.

Mantle musculature consisting of a superficial layer of narrow, rather widely spaced bands underlaid by slender groups of transverse fibers so closely placed as to form a nearly continuous sheet, which also covers the atrial and branchial tubes. Posterior to the thorax the transverse muscles practically disappear, though the longitudinal muscles are conspicuous even on the abdomen; the bands, however, spread out and unite with each other to form a practically continuous sheet.

FIG. 89.—POLYCITOR IANTHINUS SLUITER. ZOOID. × 18.

Tentacles apparently few; only two sizes were certainly demonstrated.

Dorsal languets small, arising from the transverse vessels of the left side the width of about four stigmata from the median dorsal vessel.

Branchial sac with only three rows of rather long narrow stigmata, with at least 18 or 20 stigmata in a row on each side. Near each end of each row the last few stigmata become successively shorter.

Stomach short and rounded, smooth-walled; margin of anus somewhat two lipped.

The reproductive organs lie beside the intestinal loop and are of the type usual in this family. The male glands numbered 15 to 20 in zooids of the specimen from Bantayan mentioned below. Reproductive organs not developed in the *Albatross* specimens.

The only colonies containing well-developed zooids are two (No. 126) (Cat. No. 6029, U.S.N.M.), from station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand).

Large colonies, containing very few zooids, except some in a degenerate condition, were obtained (No. 111) (Cat. No. 6030, U.S.N.M.), at station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells) and (No. 119) (Cat. No. 6028, U.S.N.M.), at station D5160 (off Tinakta Island, Sulu Archipelago, Feb. 22, 1908, 12 fathoms, sand). One colony at each place.

The United States National Museum has also a colony received from the University of the Philippines collected at Bantayan by Dr. L. E. Griffin and Mr. L. D. Wharton.

Sluiter (1909) describes the species to which these specimens appear to belong from reefs at Nusa Laut and Banda. He describes his specimens as a dark brownish violet, a variation in color from the Philippine specimens, though not too great to render the identification improbable.

POLYCITOR TOROSUS Sluiter, 1909.

Plate 32, fig. 41.

1909. *Polycitor torosus* Sluiter, *Siboga*-Exped., vol. 56*b*, p. 18, pl. 1, fig. 19; pl. 6, fig. 3.

1909. *Eudistoma torosum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1488.

The few specimens in the collection indicate a tendency of the colony to assume a capitate form, the upper surface being somewhat flattened and the sides nearly vertical, though converging a little toward the base, which is not very much less in diameter than the upper part. The largest specimen is evidently not an entire colony; its greatest diameter is about 38 mm.; its height appears to have been less than this.

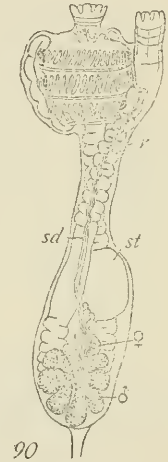


Fig. 90.—Polycitor torosus Sluiter. Zooid. × 25.

Test gelatinous, yellowish with a tinge of olive, semitransparent with a smooth shining surface on the upper part of the colony, though this may be slightly depressed and darker colored over the position of each zooid. The lower part of the sides of the colony may be somewhat wrinkled transversely, and discolored or roughened with some adherent mud or sand.

Zooids rather small, often only 2 mm. or less in length in the violently contracted and distorted state in which they occur in preservation, the long constricted pedicel or neck connecting the thorax and abdomen being so shortened that the abdomen comes against the thorax. When even moderately extended they are, however, two or three times the above length.

Branchial and atrial apertures on fairly prominent forwardly directed tubes, both 6-lobed. One or more vascular processes arise from the posterior end of the body.

Mantle with numerous strong longitudinal bands on the thorax. These muscles continue back on the abdomen, but become more diffuse and less conspicuous.

Tentacles not very numerous, apparently of three sizes, the smallest inserted somewhat nearer the aperture than the rest.

Dorsal languets not demonstrated.

Stigmata apparently in three rows (possibly four); probably 18 or 20 in a row on each side.

Stomach rounded, smooth-walled. Intestinal loop twisted so as to bring the stomach to the posterior side.

Many of the zooids contain large embryos in the ventral region of the thorax and anterior part of the abdomen and large eggs farther back in the ventral region. The ovary itself, containing a small group of eggs of different sizes, is situated beside the intestinal loop, where the testes are also situated; the latter are few in number, pear-shaped, and placed radially in a group. The sperm duct arises from the center of the group of testes and passes to the intestine, extending along it into the thorax. An oviduct was not demonstrated.

Localities for this species:

No. 63. Station D5163 (off Observation Island, Tawi Tawi Group, Sulu Archipelago, Feb. 24, 1908, 28 fathoms, coral sand). One colony.

No. 62. Station D5168 (off Observation Island, Feb. 25, 1908, 80 fathoms, coral sand). Several colonies (Cat. No. 5960, U.S.N.M.).

Sluiter (1909) described the species from a reef at Haingsisi.

Genus CYSTODITES von Drasche, 1883.

CYSTODITES PHILIPPINENSIS Herdman, 1886.

Plate 28, fig. 15.

1886. *Cystodytes philippinensis* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 140, pl. 20, figs. 1 and 2.

1891. *Cystodytes philippinensis* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 615.

1893–1907. *Cystodites philippinensis* SEELIGER, Bronn's Tier-reich, vol. 3, suppl., pl. 14, fig. 14.

1906. *Cystodites philippinensis* HERDMAN, Rep. Ceylon Pearl Oyster Fisheries, pt. 5, p. 334.

1909. *Cystodites philippinensis* SLUITER, *Siboga*-Exped., vol. 56*b*, pp. 28, 30. 28, 30.

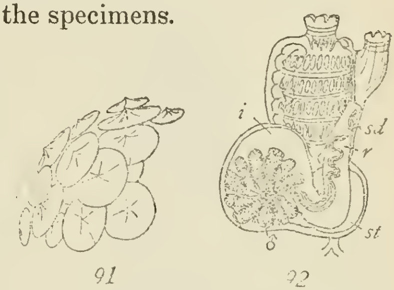
1909. *Cystodites philippinensis* CAULLERY, Bull. Sci. France Belgique, vol. 42, p. 45.

1909. *Cystodites philippinensis* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1434.

Colony flat and rather thin, generally quite uniform in thickness, with the zooids evenly but not very thickly distributed, each zooid when contracted being surrounded by a calcareous capsule. This capsule is very dense and firm and is formed of overlapping shield-shaped calcareous spicules which mostly measure from 0.20 to 0.38 mm. in diameter. These capsules show more or less plainly through the semitransparent test; the latter is of a light brown color, due in part to diffused color and in part to brown pigment cells distributed chiefly in the upper layers. There are also deposits of irregular grains of calcareous matter, broken spicules, etc., among the spicules of the capsules and in the basal parts of most of the colonies. Size of largest colony 70 by 38 mm. across and about 4 mm. thick.

The constricted part of the body connecting the thorax and abdomen of the zooid is very short, and when contracted the thorax is drawn down so that it lies partly beside the abdomen and is received within the calcareous capsule; the entire zooid then does not occupy a length of much over 1 mm. There are strong longitudinal muscles in the mantle to bring about this contraction; on the sides of the thorax they form a number of separate bands, but at the posterior end of the thorax they converge to a single broad band on each side and this spreads out again to a thin sheet on the side of the abdomen. Apertures on tubes (that for the atrial aperture the longer), both with six lobes.

Tentacles rather numerous, apparently of three orders. Their arrangement is difficult to determine in the specimens.



Figs. 91, 92.—Cystodites philippinensis Herdman. 91, Spicules. × 20. 92, Zooid. × 25.

Dorsal languets not demonstrated.

Stigmata only moderately numerous. Four rows have been represented in figure 92 as the most probable number, but the contracted state of the sac prevented counting them.

There are about a dozen male glands; they are oblong or cuneate bodies placed radially in a circle, the common sperm duct proceeding from the center of the group. The ovaries were not made out in the specimens studied, but some of the zooids have large eggs or embryos beneath the mantle.

This appears to be a common and widely distributed species in shallow water, as it is represented by the following specimens.

No. 87. Station D5108 (off Corregidor Light, Jan. 15, 1908, 13 fathoms, coral). Several colonies (Cat. No. 5924, U.S.N.M.).

No. 40. Station D5141 (off Jolo Light, Feb. 15, 1908, 29 fathoms, coral and sand). Several small colonies (Cat. No. 5923, U.S.N.M.).

No. 33. Jolo, Jolo Island, February 11, 1908. One colony (Cat. No. 5922, U.S.N.M.).

No. 22. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms coarse sand). One large colony (Cat. No. 5971, U.S.N.M.).

No. 106. Station D5149 (off Sirun Island, Sulu Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). Several colonies (Cat. No. 5972, U.S.N.M.).

This species was obtained by the *Challenger* expedition at Zamboanga, Philippines, in 10 fathoms. The genus *Cystodites* consists of a number of very similar forms, many of which will probably eventually prove to be identical. *C. ceylonensis* Herdman (1906, p. 334, pl. 8, figs. 23–25) from Ceylon is one of those which appear to be very closely allied to the present form.

Genus HOLOZOA Lesson, 1830.

[=*Distaplia* Della Valle, 1881.]

HOLOZOA VALLII (Herdman), 1886.

Plate 33, figs. 47 and 48.

1886. *Distaplia vallii* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, p. 128, pl. 18, figs. 1–6.
1891. *Distaplia vallii* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 613.
1893–1907. *Distaplia vallei* SEELIGER, Bronn's Tier-reich, vol. 3, suppl., pl. 38, fig. 4.
1909. *Distaplia vallii* CAULLERY, Bull. Sci. France Belgique, vol. 42, p. 45.
1909. *Holozoa vallei* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1437.
1912. *Holozoa vallii* HARTMEYER, Deutsche Südpolar-Expedition, vol. 12, Zool., pt. 4, p. 486.

The numerous specimens in the collection exhibit great variation in the form of the colony, ranging from distinctly capitate colonies, raised on a short but more or less distinct neck, to irregular rounded masses and even flattened incrusting forms. The most symmetrical and one of the largest colonies is nearly egg-shaped, though flattened in one direction, 55 mm. high by 37 mm. in greatest transverse diameter, and was attached by a very short thick neck arising at the large end. A majority of the specimens are, however, quite irregular in form, though a tendency to approach the capitate type prevails. Test, in the alcoholic specimens at least, of a rather soft, somewhat fibrous or sponge-like texture, very opaque, the surface generally not very smooth and often indicating by rough, slightly depressed areas the positions of the groups of zooids. In those cases where the limits of the systems appear to be distinguishable, the systems, though varying in form and extent and often irregular in outline, seem to be mostly rather small and simple. Color of the colonies very variable; the ground color is yellowish, greenish, or brownish, this being more or less extensively mottled or marbled in the superficial parts with areas of some other color; greenish yellow, dark green, dull purple or purplish red (the color varying in different colonies), these colored areas being due to collections of rounded or oval pigment cells, green cells predominating or occurring exclusively in some colonies, while in others red cells are present in sufficient number to give the red or purple coloration, though green ones are also present.

When exceptionally well preserved and considerably expanded, the zooids may be 4 to 5 mm. long, but in some specimens they are so contracted as to hardly average half the above length. Branchial apertures usually not conspicuously lobed. Atrial aperture very variable in size and form in different zooids; sometimes it is merely a large opening whose edges are neither lobed nor produced; in other cases it is smaller and situated at the end of a tubular siphon; in others again the anterior edge is produced into a languet of more or less conspicuous size and length (fig. 93).

Mantle musculature delicate, composed mainly of slender transverse and oblique bands, and circular bands surrounding the apertures.

Tentacles 8 in number; of two sizes, placed alternately.

Dorsal languets arising from the transverse vessels of the left side at some distance from the median dorsal vessel.

Stigmata in 4 rows, about 25 in a row on each side. A narrow intermediate transverse vessel crosses without interrupting the stigmata of each row midway between the larger vessels. The two or three stigmata of each row nearest the endostyle become successively shorter as that organ is approached.

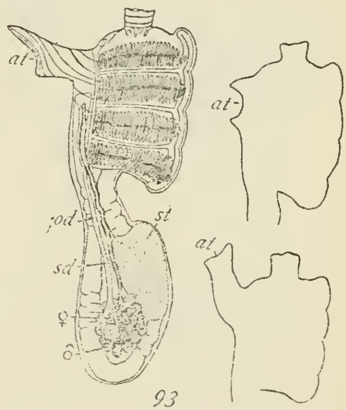


Fig. 93.—Holozoa vallii (Herdman). Zooid. × 20. Also outline of thorax of two other zooids showing variation in form of atrial orifice.

Stomach rather elongate oval, tapering toward the pyloric end. In most colonies it is smooth-walled, but in some colonies more or less distinct longitudinal ridges on the inner surface can be detected.

Intestinal loop generally not twisted, and the reproductive organs in consequence lie in the right side of the abdomen. The male organs consist of a group of about a dozen small pyriform or rounded testes arranged in a circle or hemispherical group, the stout thick-walled common sperm duct accompanying the ascending part of the intestine and rectum. The ovary is a small sac containing a few eggs, lying beside, or more or less surrounded by, the group of testes; the oviduct accompanies the sperm duct and ascending branch of the intestine. No brood pouches were found, though some large larvae were present in the test in one of the colonies. Probably brood pouches are formed in the usual manner, and the larvae observed had made their escape by the rupture or degeneration of the wall of the pouch.

This species was obtained at five stations, all in shallow water, in the Sulu Archipelago, where it appears to be common.

No. 49. Station D5141 (off Jolo Light, Feb. 15, 1908, 29 fathoms, coral sand). One colony. (Cat. No. 5905, U.S.N.M.)

No. 39. Station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand). Several colonies. (Cat. No. 5907, U.S.N.M.)

No. 36. Station D5147 (off Sulade Island, Sulu Archipelago, Feb. 16, 1908, 21 fathoms, coral sand and shells). One small colony. (Cat. No. 5925, U.S.N.M.)

No. 115. Station D5148 (off Sirun Island, Sulu Archipelago, Feb. 16, 1908, 17 fathoms, coral sand). Two large colonies. (Cat. No. 5975, U.S.N.M.)

Nos. 58, 65, 134. Station D5149 (off Sirum Island, Sulu Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). Five colonies. (Cat. Nos. 5906, 5908, and 5974, U.S.N.M., respectively.)

Herdman (1886) describes this species (which he himself suggests is none too well distinguished from the previously described Mediterranean forms *H. pileata*, O. Schmidt, 1862, and *H. rosea* Della Valle, 1881), from latitude 6° 54′ N.; longitude 122° 18′ E., 10–20 fathoms. He also reports it from Tangier Bay, Morocco, 35 fathoms.

Genus SYCOZOA Lesson, 1830.

[=*Colella* Herdman, 1886, part.]

SYCOZOA PULCHRA (Herdman), 1886.

1886. *Colella pulchra* Herdman, Rep. Voy. *Challenger*, vol. 14, Tuniacta, p. 106, pl. 15, figs. 1–3.

1891. *Colella pulchra* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 611.

1893–1907. *Colella pulchra* Seeliger, Bronn's Tier-reich, vol. 3, suppl., pl. 38, fig. 2.

1898. *Colella pulchra* Herdman, Ann. Mag. Nat. Hist., ser. 7, vol. 1, p. 447.

1899. *Colella pulchra* Herdman, Cat. Australian Mus., Sydney, No. 17, pp. 70 and 112.

1909. *Colella pulchra* Caullery, Bull. Sci. France Belgique, vol. 42, pp. 38, 41.

1909. *Sycozoa pulchra* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1438.

1909. *Sycozoa pulchra* Sluiter, *Siboga*-Exped., vol. 56*b*, p. 33.

1912. *Sycozoa pulchra* Hartmeyer, Deutsche Südpolar Exped., vol. 12 Zool., pt. 4, p. 499.

In the only specimen the colony is of inverted conical form, measuring about 14 mm. across the top, which is only slightly convex, and 17 mm. in height, exclusive of the pedicel on which it is borne. The pedicel is 3 to 4 mm. in diameter and about 34 mm. long in its present condition, but the base has evidently been broken off.

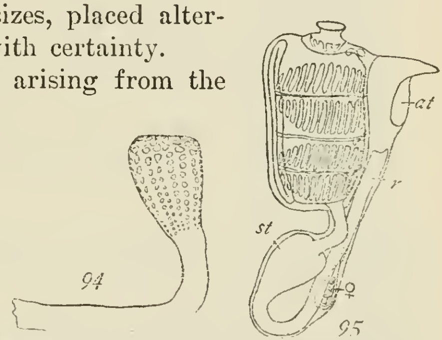
Test opaque yellowish gray in color and somewhat fibrous in consistency. Zooids numerous, arranged in vertical parallel rows on the sides of the colony, but with less obvious regularity on the top. The common cloacal ducts run vertically between every second row of zooids and probably all converge to one common cloacal aperture on the top of the colony.

Zooids small (not usually over 1.25 mm. long in the preserved state); the largest and oldest are in the upper part of the colony. Branchial aperture small, often only slightly prominent; unlobed. Atrial aperture a large opening whose anterior border may be produced into a short languet.

Mantle thin and transparent. Its musculature is only slightly developed and is mostly confined to the thorax, being composed chiefly of very delicate bands having a transverse or oblique direction or encircling the apertures, but these bands are few and very slender.

Only eight tentacles of two sizes, placed alternately, could be demonstrated with certainty.

Dorsal languets rather small, arising from the transverse vessels a little to the left of the median dorsal vessel. Branchial sac large, with four rows of stigmata. The rows are arranged in pairs, the first and second separated only by a narrow transverse vessel, and the third and fourth rows also, while between the second and third rows a wider vessel intervenes. There are 14 or 15 stigmata in a row on each side in the two anterior rows and one or two less in the posterior ones.



FIGS. 94, 95.—SYCOZOA PULCHRA (HERDMAN). 94, COLONY. × .75. 95, ZOOID. × 30.

Intestinal loop small; generally not twisted. Stomach small, pear shaped, tapering toward the pyloric end, and smooth walled. Margin of anus slightly two lipped.

Only female reproductive organs were found, though many zooids were examined, and these were not greatly developed. They consist of a saclike ovary containing a few eggs lying in the dorsal region of the abdomen close against the ascending part of the intestinal loop. The largest eggs are in the posterior part of the ovary; the anterior end of the latter appears to be continuous with an oviduct accompanying the intestine. No incubatory pouch was found, but its absence may have been due to immaturity of the colony as a whole and of the individual zooids.

The only specimen (No. 25) (Cat. No. 5926, U.S.N.M.) is from station D5149 (off Sirun Island, Sulu Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). The *Challenger* Expedition obtained the types in latitude 10° 36′ S.; longitude 141° 55′ E., 6 fathoms. The *Siboga* Expedition (Sluiter, 1909) obtained it at several stations in the vicinity of latitude 6° S.; longitude 114° E., 80 meters.

Genus NEPHTHEIS Gould, 1856.

[=*Oxycorynia* von Drasche, 1883.]

NEPHTHEIS THOMPSONI (Herdman), 1886.

Plate 24, fig. 4.

1856. *Nephtheis* (?), Gould, Mollusca and Shells (U. S. Exploring Exped., under Wilkes), Atlas, p. 16, figs. 621–621*b*.

1886. *Colella thompsoni* Herdman, Rep. Voy. *Challenger*, vol. 14, Tuniacta, p. 94, pls. 10–13.

1891. *Colella thompsoni* Herdman, Journ. Linn. Soc. London, Zool., vol. 23, p. 611.

1907. *Oxycorynia thompsoni* Michaelsen, Hamburg Magalhaenisch. Sammelreise, vol. 1, p. 8.

1908. *Nephtheis*, sp. Hartmeyer, Zool. Annalen, Würzburg, vol. 3, p. 51.

1909. *Oxycorynia thompsoni* Caullery, Bull. Sci. France Belgique, vol. 42, pp. 46, 38, 40.

1909. *Nephtheis thompsoni* Sluiter, *Siboga*-Exped., vol. 56*b*, p. 36.

1909. *Nephtheis thompsoni* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1440.

Colony consisting of one or more heads each raised on a long narrow pedicel and somewhat suggesting in its shape and appearance an elongated pine cone. When composed of more than one head the several pedicels may arise from a common basal mass of test, or one or more smaller heads may be borne on branches arising at different points from the pedicel of the principal head. Zooids present only in the heads, the largest and most mature being in the upper part of the colony. The thorax of each well-developed zooid projects somewhat above the general surface of the common test even in the contracted preserved specimens, and doubtless does so much more in the living state, especially when the zooids are expanded. The pedicels are not of uniform diameter throughout their length. In general they become larger toward the lower end, expanding somewhat abruptly into a basal mass of test, by which the colony is attached. Surface of the pedicel fairly smooth or slightly wrinkled, free from incrusting material.

Dimensions of three large colonies (each consisting of only a single head with pedicel):

Locality.	Station D5139.	Station D5139.	Station D5145.
	mm.	*mm.*	*mm.*
Total height of colony	182	190	97
Height of head	72	90	40
Length of pedicel	110	100	57
Transverse diameter of head	21	25	20
Average diameter of pedicel, about	11	11	7

Test in the heads more or less transparent, free from pigment in some specimens; in others there is more or less greenish and brownish pigment in rounded cells, these occurring also in the mantles of the zooids. In some of the colonies most of the zooids have four small dark spots on the anterior part of the thorax. In the pedicels the test is tougher and less transparent, but free from pigment cells.

Zooids very variable in size, not only in different specimens and in different states of contraction but also in different parts of the same colony. Some of them are 14 mm. or more long in the preserved and only moderately expanded condition, but in small, and especially in immature colonies they are all much smaller, not exceeding one-third or one-half this length. A constricted neck of moderate length separates the abdomen from the large and considerably elongated thorax, and a large vascular process extends from the posterior end of the abdomen. The vascular processes of the zooids form an anastomosing network in the pedicel. The buds appear to form from the extreme upper branches of this network. Anterior end of the body obliquely truncated so that the dorsal side of the thorax is longer than the ventral side; the anterodorsal region is produced into a large atrial siphon of variable length bearing the small round atrial aperture close to or at its end. The branchial aperture is situated on the oblique anterior end of the thorax and is scarcely at all prominent, but is of larger diameter than the atrial. Neither aperture lobed. When the zooids are in position in the colony the atrial siphon of each zooid extends above the general surface of the colony toward the apex of the latter.

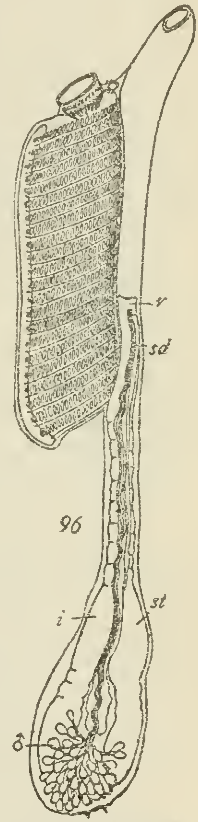


Fig. 96.—Nephtheis thompsoni (Herdman). Zooid. × 25.

Mantle thin, provided with many narrow rather regularly spaced transverse muscle bands in the thorax. These bands are generally quite conspicuous.

Tentacles numerous, of 3 sizes. The largest and medium sized ones alternate in one circle; the numerous small ones form another circle nearer the branchial aperture.

Dorsal languets triangular, continuous laterally with rather broad membranes which are borne on the transverse vessels of the branchial sac. The languets arise directly from the medium dorsal vessel.

Branchial sac with 20 or more rows of stigmata with about 25 stigmata in a row on each side.

Stomach narrow and not very conspicuous; its walls not plicated. Intestine forming a rather long loop of large diameter.

Nearly all the zooids examined, including those from different colonies, had the male reproductive organs well developed. They consist of numerous (often 30 to 50) small pear-shaped testes lying beside the posterior part of the intestinal loop and often extending beyond it to the extreme posterior end of the body. They discharge into a stout common sperm duct (which accompanies the intestine) by means of small ducts. The ovary was not satisfactorily made out in any case, unless it is represented by a saclike structure almost empty in most of the zooids studied, situated beside the intestinal loop just anterior to the group of testes. This sac appears to extend into a tube, presumably the oviduct, which accompanies the ascending branch of the intestine.

Many of the zooids possess a small hernialike incubatory pouch containing a few (usually 4 to 6) developing embryos. The pouch is situated at or near where the thorax and the constricted neck attaching the abdomen join, and it contains an enlarged loop of the oviduct within which the embryos remain and undergo part of their development. One or more large tailed larvæ are often also present in the atrial cavity of the same zooid.

The localities of the specimens are:

No. 104. Station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand). Four large colonies. (Cat. No. 5992, U.S.N.M.)

Nos. 28, 52. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells). Four colonies. (Cat. Nos. 5973 and 5915, U.S.N.M., respectively.)

No. 50. Station D5149 (off Sirun Island, Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). One small colony. (Cat. No. 5914, U.S.N.M.)

No. 35. Station D5165 (off Observation Island, Tawi Tawi Group, Sulu Archipelago, Feb. 24, 1908, 9 fathoms, coral). One specimen comprising a number of heads, all small. (Cat. No. 5913, U.S.N.M.)

No. 79. Some small degenerate fragments from station D5136 (near Jolo Light, Feb. 14, 1908, 22 fathoms, sand and shells) are also probably of this species. (Cat. No. 5916, U.S.N.M.)

This species was figured by Gould (1856) from a specimen from the "Sooloo Sea." He gave it a generic name (*Nephtheis*) but no specific name. A closely related species was afterwards described by von Drasche (1882) from the Caroline Islands under the name *Oxycorynia fascicularis.* The writer follows Hartmeyer (1909) in adopting Gould's generic name. The *Challenger* Expedition collected it in latitude 6° 54′ N.; longitude 122° 18′ E., 10 fathoms, and it was described and figured in great detail by Herdman (1886).

It was also obtained by the *Siboga* Expedition in latitude 8° 23.5′ S.; longitude 119° 4.6′ E., 64 meters. (Sluiter, 1909.) Caullery (1909, p. 46) evidently inadvertently attributes the above species *N. fascicularis* of von Drasche to the Philippines. It has not been found there, unless *N. thompsoni* should eventually prove to be identical with von Drasche's *fascicularis*.

Family DIDEMNIDAE Verrill, 1871.

Genus DIDEMNOPSIS Hartmeyer, 1903.

DIDEMNOPSIS JOLENSE, new species.

Colony of elongate outline and rather thin flattened form in the only good specimen. Length, 24 mm.; greatest width, 10 mm.; thickness, 4 to 5 mm. Test rather easily torn, translucent, of a light, smoky brown color, due both to pigment cells in the test and thoracic region of the mantle, and to diffused color in the test and tissues of the zooids. No spicules; zooids arranged in curved rows probably constituting only a few systems, or perhaps only one.

Zooids rather large, up to 3 mm. long in the partially contracted preserved state. Body strongly constricted between the thorax and abdomen; a very long strong tapering muscular process extends obliquely ventrally and posteriorly out into the test from this constricted region; club-shaped vascular processes also extend into the test from some zooids. Branchial aperture 6-lobed, and provided with a strong sphincter; atrial aperture plain or very obscurely lobed; situated at the end of a very short tubular extension of the middle dorsal region of the thorax, or in some cases scarcely produced at all. No atrial languet.

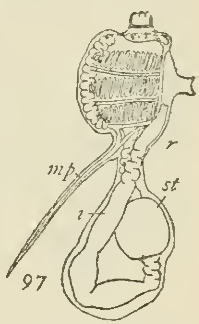


Fig. 97.—Didemnopsis jolense, new species. × 17.5.

Mantle muscles composed chiefly of longitudinal fibers on the thorax; not conspicuous on the abdomen.

Tentacles apparently of three sizes. The writer was not successful in counting them, on account of the strongly contracted state of the throax in all the zooids examined.

Dorsal languets not demonstrated for the same cause, though there is no reason to doubt their presence.

Only three rows of stigmata could be discovered; there are probably at least 15 in a row on each side.

Stomach rounded-oblong, intestinal loop rather large, with several valvelike constrictions in the proximal region of the intestine.

No reproductive organs found in any of the numerous zooids examined. The colony, however, contains some larvae.

The type and only certain specimen (No. 27) (Cat. No. 6040, U.S.N.M) is from station D5137 (near Jolo Light, Feb. 14, 1908, 20 fathoms, sand and shells). Another small colony (No. 68) (Cat. No. 5926, U.S.N.M.) in the collection may be of this species, though the specimen is insufficient to be the basis of a certain conclusion. The differences which it exhibits may be due to age or different conditions of growth or different degree and manner of contraction in preservation. The colony co sists of several minute lobes. This is, however, perhaps due to growing on a branching hydroid or bryozoan instead of on a broad surface. The test is not pigmented, but the tissues of the zooids are dark colored. As compared with the specimen just described the zooids have the branchial orifice with shorter (sometimes scarcely noticable) lobes, the atrial tube longer, and the long muscular process wanting, or at least not conspicuously developed. This latter difference may be more or less dependent on the small and lobed condition of the colony, no such large firm mass of test being present for muscular attachment as in the last-described specimen. Club-shaped vascular processes of the middle region of the zooids are, however, well developed. No reproductive organs could be demonstrated. The specimen is from station D5250 (near Linao Point, Gulf of Davao, May 18, 1908, 23 fathoms, coral and sand).

Genus DIDEMNUM Savigny, 1816.

[=*Leptoclinum* Authors.]

DIDEMNUM GRANDE (Herdman), 1886.

Plate 30, figs. 20–23.

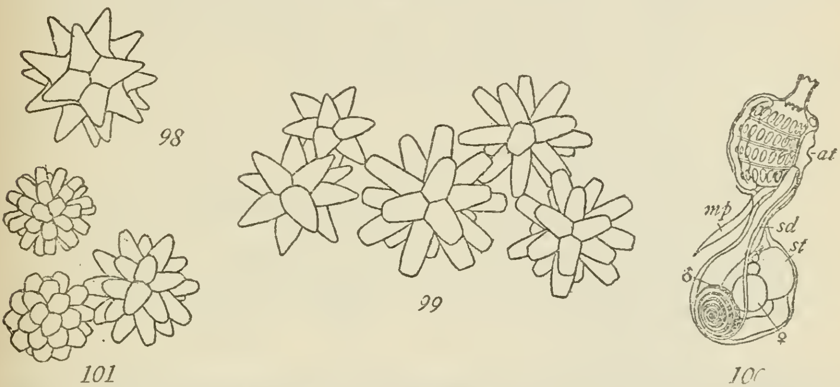
1886. *Leptoclinum albidum*, var. *grande* Herdman, Rep. Voy *Challenger*, vol. 14, Tunicata, p. 291, pl. 35, figs. 11–14.

1909. *Didemnum albidum*, var. *grande* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1449.

1910. *Leptoclinum albidum*, var. *grande* Van Name, Proc. Boston Soc. Nat. Hist., vol. 34, p. 374.

Colony of comparatively thin incrusting form, its shape depending largely on the object on which it grows. Though rarely much exceeding an average thickness of 3 mm., it forms colonies of considerable extent, some of the specimens measuring 50 to 60 mm. in greatest diameter. There is also one large colony or group of confluent colonies from station D5148 which grew upon a slender branching hydroid, enveloping and binding together its branches in such a way that the ascidian colony has taken the form of a sponge-like mass perforated by canals, clefts, and passages, which must, when entire, have been at least 120 mm. in greatest diameter. It is probable that the peculiarities of this colony are due to the form of the object on which it grew, not to any difference of species. Color usually chalky or yellowish white. In specimens from two stations (D5139 and D5154) the upper or free surface of the colony is somewhat mottled with a blackish pigment. The branchial apertures of the zooids appear in the contracted preserved specimens as minute depressions, and in some specimens are quite conspicuous. Common cloacal apertures are only occasionally recognizable, but are apparently generally rather numerously distributed over the surface. Spicules are abundant in most parts of the colonies, often to an extent rendering the test hard and brittle.

The spicules are mostly considerably larger than in *Didemnum ternatanum*, well developed ones averaging 0.027 to 0.038 mm. in diameter, or in some colonies larger (0.04 to 0.05 mm.). They are stellate; their rays rather few and long, regularly tapering in some



Figs. 98–101.—Didemnum grande (Herdman). 98, Typical spicule. × 700. 99, Common forms of spicules. × 700. 100, Zooid. × 32. 101, Spicules from colony from Station D5145. × 700.

colonies, in others usually more nearly cylindrical and truncated at the tip (figs. 98 and 99).

Zooids greatly contracted in nearly all the specimens so that the determination of their structure is difficult. In their contracted and preserved state they often do not exceed 1 mm. in length; they are numerous and closely placed in the colony. Branchial aperture with 6 small lobes; atrial aperture neither produced into a tube nor provided with a languet.

Mantle musculature mainly longitudinal, forming distinct bands on the thorax. A muscular process extending into the test from the constricted middle portion of the body is present.

Dorsal languets apparently arising from the transverse vessels a little way to the left of the median dorsal vessel.

Stigmata in four rows, rather few in number; in one zooid 9 or 10 in a row on each side were demonstrated in the three anterior rows, and 8 in the last or posterior row.

No deviations from the type usual in this genus were observed in the digestive or reproductive organs. The latter were not developed in most of the zooids examined, and none were found in which it could be determined whether the testis is single or composed of two glands, as is the case in many closely related forms. The vas deferens makes several spiral turns about the testis.

This species is sufficiently well represented in the collection to indicate that it is common in the southern part of the Philippine region if the writer is correct in including all the following specimens in this species.

No. 8. Station D5128 (off Nogas Island, Feb. 4, 1908, reef). One colony (Cat. No. 5883, U.S.N.M.).

No. 100. Station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand). Many large colonies (Cat. No. 5989, U.S.N.M.)

Nos. 11 and 12. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms coral sand and shells). Three very small colonies (Cat. Nos. 5885 and 5888, U.S.N.M., respectively).

Nos. 9 and 13. Station D5136 (near Jolo Light, Feb. 14, 1908, 22 fathoms, sand and shells). Several small colonies (Cat. Nos. 5887 and 5990, U.S.N.M., respectively).

No. 6. Station D5148 (off Sirun Island, Sulu Archipelago, Feb. 16, 1908, 17 fathoms coral sand). Parts of one, or perhaps of several very large colonies (Cat. No. 5985 U.S.N.M.).

Station D5149 (off Sirun Island, Sulu Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). Small colonies.

No. 13. Station D5150 (off Sirun Island, Sulu Archipelago, Feb. 18, 1908, 21 fathoms, coral sand and shells). One colony (Cat. No. 5884, U.S.N.M.).

No. 10. Station D5154 (near Bakun Point, Tawi Tawi Group, Sulu Archipelago, Feb. 19, 1908, 12 fathoms, coral sand). Two colonies (Cat. No. 5886 (U.S.N.M.).

Herdman's type was a large colony obtained by the *Challenger* expedition off Zebu, Philippines, in 95 fathoms. The writer has made it clear in a previous article (1910, p. 374) that the present form has nothing to do with *Leptoclinum albidum* Verrill, 1871. It seems best therefore to give the form the rank of a species, though it must be admitted that it is very close to Savigny's original type of the genus, *Didemnum candidum* (Savigny, 1816, pp. 14 and 194, pl. 4, fig. 3; pl. 20, fig. 1) from the Gulf of Suez, and it seems not unlikely that this and a number of other species of this genus from tropical and subtropical seas will eventually have to be united with Savigny's species.

There are two other colonies in the *Albatross* collection both of a chalky white color and densely crowded with spicules; that the writer also refers to this species, though the spicules lack the regularity in the form of the points or rays which is so characteristic of the specimens just described. The rays are numerous, sometimes sharp, sometimes irregularly blunted; the spicules resembling, in fact, those of *Didemnum ternatanum* except for their larger size. (See fig. 101.) These colonies are from:

No. 7. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral, sand, and shell). Rather large colony (pl. 30, fig. 23) (Cat. No. 5882, U.S.N.M.).

No. 15. Station D5147 (off Sulade Island, Sulu Archipelago, Feb. 16. 1908, 21 fathoms, coral, sand, and shells). (Cat. No. 6022, U.S.N.M.)

A rather large colony received from the University of the Philippines and collected by Dr. L. E. Griffin and Mr. L. D. Wharton at Bantayan has similar spicules.

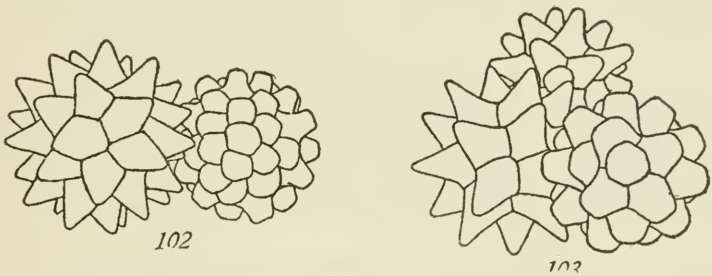
DIDEMNUM MOSELEYI (Herdman), 1886.

1886. *Leptoclinum moseleyi* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicats, p. 272, pl. 37, fig. 9–14.

1898. *Leptoclinum moseleyi* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 631.

1909. *Didemnum moseleyi* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 45.

1909. *Didemnum moseleyi* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1450.



FIGS. 102, 103.—DIDEMNUM MOSELEYI (HERDMAN). 102, SPICULES FROM COLONY FROM STATION D4145. × 700. 103, SPICULES FROM COLONY FROM STATION D5145. × 700.

Specimens from two localities appear to belong to this species of Herdman's, although they are proportionately thicker and less densely crowded with spicules than those on which his description was based. From station D5145 there is in addition to a very small colony, one apparently originally at least 30 mm. in diameter growing upon a branching coral. It is of a light brownish color becoming paler at the margin. From station D5174 there is a larger colony of a uniform buff color surrounding a calcareous worm tube for a length of 75 mm. and attaining a thickness of 5 mm. or 6 mm. in some places. Spicules very abundant in the superficial layer of the colonies, but much fewer in the interior portions. The small 6-lobed branchial apertures of the numerous and closely placed zooids are quite conspicuous, especially in the largest colony. Common cloacal apertures, when distinguishable, small and irregularly lobed. They are probably quite numerous. Surface of colonies fairly smooth and even, but not shiny. Spicules mostly between 0.024 mm. and 0.032 mm. in diameter, spherical with very numerous short points, which may be sharp and conical or more or less truncated or rounded off.

Zooids closely resembling those of *D. grande.* They are small (about 1 mm. long in their contracted state) and have a tapering muscular process extending out into the test from the constricted neck connecting the thorax and abdomen. Branchial siphon rather large, with six short triangular lobes. It is lined with test substance which may contain spicules.

Tentacles of three sizes.

Branchial sac with four rows of stigmata, eight on each side in the anterior rows and 7 in the last row.

Dorsal languets arising from the transverse vessels a little way to the left of the median dorsal vessel.

No pecularities noted in the digestive organs.

No reproductive organs found in the zooids examined.

The above-described specimens are from:

No. 16. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells). Two colonies (Cat. No. 5880, U.S.N.M.).

No. 18. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand). One large colony (Cat. No. 5881, U.S.N.M.).

Herdman (1886) described the species from Zamboanga, Mindanao, 10 fathoms. Sluiter (1909) records it from one station in the Sulu Archipelago (latitude 6° 7.5′ N.; longitude 120° 26′ E., 16–23 fathoms) and from other localities in the Malay Archipelago.

DIDEMNUM TERNATANUM (Gottschaldt), 1898.

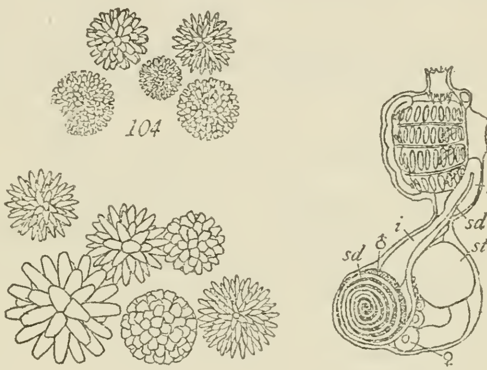
Plate 28, fig. 16; plate 29, fig. 17; plate 30, figs. 24 and 25; plate 33, fig. 44.

1898. *Didemnum ternatanum* Gottschaldt, Abh. Senckenburg. Gesell., vol. 24, p. 648, pl. 35, fig. 1.

1909. *Didemnum ternatanum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1451.

Though subject to much modification in shape, due to the position in which it grows and the form of the object to which it is attached, this species is generally recognizable by the thick, fleshy, cushionlike, dome-shaped, or obtusely conical colony with a single large common cloacal aperture at the highest point. The zooids of such a colony, even when it is large, therefore form a single very complex system. This makes necessary large branching cloacal canals in the superficial parts of the colony, and these, together with the rather soft, weak character of the test substance, render the colonies more fragile and more easily torn (especially in the superficial parts) than those of related species described in this paper. When a colony has a base of irregular or elongated form there may be two or three common cloacal apertures, and these are then commonly on distinct elevations or prominences. In some colonies, the courses of the common cloacal canals can be traced by slight furrows or darker lines on the surface, in others there are no such indications of them.

Spicules noteworthy for their smallness in most specimens, generally ranging from 0.008 to 0.028 mm. in diameter. In some colonies the larger spicules will scarcely average over 0.01 mm. in diameter; in others they may average 0.02 mm. or even more. In some colonies from station D5136 the spicules are unusually large, many of them measuring 0.03 mm. or over. In form they are usually better described as burr-like rather than stellate, on account of the large number of points or rays with which they are provided, or, more strictly speaking, of which they are composed, but in some colonies the prevailing type of spicules has fewer rays. The points are often narrow and sharp (though they never exhibit the regularity and perfect conical form that is frequent in some members of this genus), but in most colonies they are mostly irregularly blunted at the tips and often so short that the spicule has nearly a spherical form (see fig. 105). Spicules generally very numerous in the surface layer of the test, becoming less numerous and disappearing entirely in the deep portions of the colony, where (beneath the zooids and the cloacal canals) the test is solid and translucent though rather soft and easily torn. Some colonies, however, have few spicules, even in the superficial parts.



105 106

FIGS. 104–106.—DIDEMNUM TERNATANUM (GOTTSCHALDT). 104, SPICULES FROM A COLONY FROM ULUGAN BAY. × 700. 105, SPICULES FROM A COLONY FROM STATION D5136. × 700. 106, ZOOID. × 25.

Color of the alcoholic specimens generally buff, often with a purplish tinge or some shade of purplish brown or light brown, but many of the specimens have the superficial layer of the upper surface darker, due to the presence of rather large pigment cells in this layer. These are occasionally so numerous and deeply pigmented as to give the upper surface a dark-brown color (very dark in two colonies from station D5144). In some conspicuously pigmented colonies the edges of the colony and the border of the large common cloacal aperture or apertures are practically free from pigment and are light colored, in more or less conspicuous contrast to the rest of the upper surface. The minute closely placed branchial apertures of the zooids are usually quite conspicuous on the surface. Large elongated and irregularly shaped colonies measure as much as 50 to 60 mm. in diameter at the base in one direction and may attain a maximum thickness perpendicular to the base of about 30 mm. in the part where the common cloacal aperture is situated. When young the colonies are comparatively thin and flattened.

Zooids of moderate size, the individual figured (fig. 106), which was moderately well expanded, measured about 1.5 mm. long in the preserved condition. The body is strongly constricted between the thorax and abdomen, but a muscular process extending out into the test is apparently not developed, perhaps because, owing to the extensive development of the common cloacal canals, the test is much reduced in amount in that layer of the colony where the zooids are situated, most of the zooids being only separated from the adjacent canals by a thin septum of test substance. Branchial aperture with six small lobes; atrial aperture with a thin margin which invariably becomes torn in dissecting out the zooids, so that its shape is difficult to determine, but a careful examination of many zooids failed to disclose the existence of any atrial languet.

Mantle musculature very slight.

Tentacles of three orders regularly arranged.

Dorsal languets arising from the transverse vessels of the left side, but rather near the median dorsal vessel.

Stigmata in four rows; the number in a row on each side in several fully developed zooids was found to be as follows:

Row	1	2	3	4
Number of stigmata	11	11	10 or 11	8 or 9

No peculiarities were noted in the digestive or reproductive organs except that the testes appeared in some specimens to be partially divided by obscurely indicated radial clefts or furrows into four lobes. In most of the zooids the proximal part of the sperm duct makes many spiral turns (6 to 8) about the testis.

If the number of localities, as well as the quantity of material collected at many of them can be taken as a safe indication, this is the most abundant and generally distributed ascidian in the Philippine region. It was obtained at the stations and places listed below, and in addition there is one lot (No. 156) (Cat. No. 5982, U.S.N.M.) not labeled with a locality. It grows on coral, shells, eel grass, other ascidians, etc., in shallow water.

No. 97. Station D5218 (off Anima Sola Island, Apr. 22, 1908, 20 fathoms, coarse sand.) One very small colony.

No. 120. Ulugan Bay, Palawan, December 29, 1908. Two large colonies (Cat. No. 5981, U.S.N.M.).

No. 66. Surigao, Mindanao, May 8, 1908. One large colony (Cat. No. 5889, U.S.N.M.).

No. 129. Mantacao Island, coast of Bohol, April 8, 1908, reef. Large colony (Cat. No. 5983, U.S.N.M.).

No. 85. Marongas Island, Jolo, February 10, 1908. Two small colonies (Cat. No. 5892, U.S.N.M.).

No. 101. Jolo, Jolo Island, February 11, 1908. ("From interior of a pearl oyster.") One colony (Cat. No. 5984, U.S.N.M.).

Nos. 69, 81, 98 (doubtful specimen), and 198. Station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand.) Many colonies, some large (Cat. Nos. 5862, 5891, 5986, and 5987, respectively, U.S.N.M.).

Nos. 59 and 61. Station D5144 (off Jolo Light, Feb. 15, 1908, 19 fathoms, coral sand). Two deeply pigmented colonies (Cat. Nos. 5894 and 5896, respectively, U.S.N.M.).

Nos. 113 and 155. Station D5136 (near Jolo Light, Feb. 14, 1908, 22 fathoms, sand and shells). Many colonies, some large (Cat. Nos. 5994 and 5979, respectively, U.S.N.M.).

No. 56. Station D5149 (off Sirun Island, Sulu Archipelago, Feb. 18, 1908, 10 fathoms, coral and shells). One deeply pigmented colony (Cat. No. 5890, U.S.N.M.).

No. 109. Station D5154 (near Bakun Point, Tawi Tawi Group, Sulu Archipelago, Feb. 19, 1908, 12 fathoms, coral sand). Two large colonies (Cat. No. 5988, U.S.N.M.).

No. 32. Station D5557 (off Cabalian Point, Jolo Island, Sept. 18, 1909, 13 fathoms, sand and coral). One colony (Cat. 5895, U.S.N.M.).

Nos. 41 and 74. Station D5165 (off Observation Island, Sulu Archipelago, Feb. 24, 1908, 9 fathoms, coral). Small colonies (Cat. Nos. 5897 and 5893, respectively, U.S.N.M.).

There are also specimens of this species in the United States National Museum collected at Porta Galera Bay, Mindoro, by S. F. Light, and at Bantayan by Dr. L. E. Griffin and Mr. L. D. Wharton. The latter, though of the usual brown shades in preservation, are recorded as "soft green" in color when fresh. Perhaps this is the usual color of fresh specimens.

Gottschaldt (1898) described this species from numerous specimens taken at Ternate.

Genus POLYSYNCRATON Nott, 1892.

As already noted by Sluiter (1909), the propriety of including the following species in this genus seems doubtful, as it has the atrial aperture produced into a tube and lacks an atrial languet. In Nott's (1893) original species the atrial aperture is not produced, and a languet is present. In common with Nott's species, however, it has the testis cleft into a number of entirely distinct glands, a spirally coiled sperm duct, and four rows of stigmata.

POLYSYNCRATON DUBIUM Sluiter, 1909.

Plate 31, fig. 30; plate 32, fig. 43; plate 33, fig. 49.

?1856. *Eucoelium erubescens* Gould, U. S. Exploring Exped., Mollusca and Shells, Atlas, pl. 53, fig. 615.

?1906. *Leptoclinum margaritiferae* Herdman, Rep. Ceylon Pearl Oyster Fisheries. Suppl. Rep. No. 39, p. 337, pl. 8, figs. 19–22; pl. 9, fig. 7.

? 1909. *Didemnum margaritiferae* HARTMEYER, Bronn's Tier-reich, vol. 3. suppl., p. 1450.

1909. *Polysyncraton dubium* SLUITER, *Siboga*-Exped., vol. 56*b*, p. 69, pl. 4, figs. 3 and 3*a*; pl. 7, fig. 10.

1912. *Polysyncraion dubium* HARTMEYER, Deutche Tiefsee Exped., vol. 16, p. 325.

Colony flat and incrusting, but rather thick and fleshy. Surface fairly smooth and even except in a specimen from station D5136, in which it has deep convoluted furrows, and in one from station D5555, in which it is raised into low rounded elevations separated by furrows. Exterior of the colony varying from smooth and shiny to minutely granular, according to the abundance of spicules in the superficial part. Branchial orifices of the zooids conspicuous where the spicules are abundant, but less noticeable where they are scarce. Common cloacal orifices when distinguishable large and few in number, sometimes apparently only one or two for the entire colony. Color a pale, slightly reddish buff, except in the case of one specimen from station D5150, which is blackish, owing to the abundant presence of bluish-black pigment, contained chiefly in irregular elongated branching cells in the test. Greatest diameter of largest colony, 59 mm. Thickness usually ranging from 3 mm. to 8 mm., but in some places it may be less or greater than these measurements. One specimen (from station D5145) grew on the shell of a small living crab, arching over and inclosing the carapace so as to leave only the limbs and mouth parts uncovered.

Test yellowish, gelatinous, but moderately tough; its cells free from conspicuous pigment except in the specimen above mentioned. Bladder cells abundant. Spicules few in the interior and lower portions of the colonies, but often very thickly distributed in the superficial layer. They are usually mostly moderately large, 0.25 to 0.04 mm. in diameter, and the typical form appears to be regularly stellate, with a moderate number of smoothly tapering conical points ending in fairly sharp extremities. Such spicules are the chief kind occurring in the colonies from stations D5150 and D5139. In the colony from station D5145 they are accompanied in some parts of the test by spicules with more or less blunted or truncated rays, while in the colonies from stations D5174 and D5555 none of the spicules have the regular conical points, the points being in all cases more or less truncated, or at least not of regularly tapering conical form. In the last two cases the rays of the spicules are very much more numerous than in the others. The spicules in the colony from station D5174 average smaller than the usual dimensions; in that from station D5555 they average larger, many reaching 0.05 mm. in diameter. These different forms of spicules are shown in figure 107.

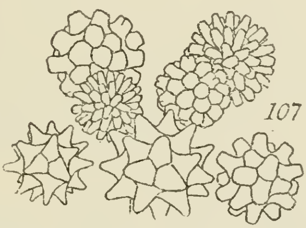
Zooids over 2 mm. long when fully expanded, but in the preserved specimens generally less. Branchial siphon usually quite long, with six more or less evident lobes. Atrial orifice round, on a short tube or siphon arising from the posterior dorsal part of the thorax, and usually directed dorsally or dorsally and posteriorly. Muscular or vascular processes extending out into the test were not demonstrated.

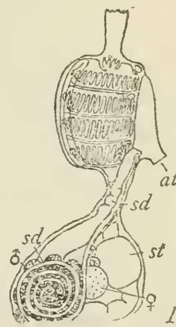
Mantle musculature rather delicate; a moderate number of slender longitudinal bands are present on the thorax.

Four large tentacles in addition to two orders of smaller ones, probably about 16 in all, are present.

Dorsal languets arising from the transverse vessels of the left side, the width of two or three stigmata to the left of the median dorsal vessel.

Four rows of stigmata; 15 in the two anterior rows, 14 in the third, and 12 or 13 in the posterior row on each side.





Figs. 107, 108.—Polysyncraton dubium Sluiter. 107, Spicules showing variations in form. × 500. 108, Zooid. × 21.

No peculiarities noticed in the digestive or female reproductive organs. Male reproductive organs were found in all except one of the colonies. There are from 9 to 12 separate pear-shaped testes communicating with the origin of the common sperm duct or vas deferens by very short connecting ducts. In the specimens from stations D5159, D5555, and D5139 the testes have a regular radial arrangement about the origin of the common sperm duct as a center, the duct making at least four or five spiral turns about the entire group of testes. In the specimen from station D5145 and D5174 the testes were evidently in an actively functional state and more or less distended and enlarged, so that they are crowded out of their radial arrangement and form a compact more or less hemispherical group, about which the sperm duct (also much distended with spermatozoa) makes only about two irregular turns. As it is evident that such a displacement of the testes and partial straightening of the sperm duct would be the natural result of dilation of these organs, the writer can not consider this peculiarity important in classification.

The above description shows that the writer has assigned to this species specimens differing among themselves a good deal in some of the minor characters. Possibly he has gone too far in this, and should have recognized more than one species, but the limited material available does not seem to afford a secure basis for the latter course. The *Albatross* specimens were from the following stations, all in the Sulu Archipelago—one colony from each:

No. 4. Station D5139 (off Jolo Light, Feb. 14, 1908, 20 fathoms, coral sand (Cat. No. 6033, U.S.N.M.).

No. 5. Station D5145 (off Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells). Growing on the shell of a small living crab (Cat. No. 5900, U.S.N.M.).

No. 1. Station D5136 (off Jolo Light, Feb. 14, 1908, 22 fathoms, sand and shells).

No. 3. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand) (Cat. No. 5901, U.S.N.M.).

No. 17. Station D5555 (off Cabalian Point, Jolo Island, Sept. 18, 1909, 34 fathoms, coarse sand) (Cat. No. 5996, U.S.N.M.).

No. 2. Station D5150 (off Sirun Island, Feb. 18, 1908, 21 fathoms, coral sand and shells). Colony differing from the remaining specimens in containing bluish-black pigment in the test (Cat. No. 6032, U.S.N.M.).

Sluiter (1909) described *P. dubium* from colonies obtained by the *Siboga* Expedition at Muaras Reef off Borneo, and at Kaniungan Ketjil (reef). As already indicated in the list of synonyms this species may perhaps be *Leptoclinum margaritiferæ* Herdman (1906) from Ceylon, but Herdman's description and figures are not sufficiently complete to settle the question. Another possibility is that it is *Eucoelium erubescens* Gould, 1856.

From station D5109 (25.8 miles off Corregidor Light, Jan. 15, 1908, 10 fathoms, coral) there is a small colony (No. 19) (Cat. No. 5899, U.S.N.M.), apparently closely related to the present species or possibly to be regarded as an abnormal example of it, which has undergone degeneration or has suffered by the oncoming of conditions unfavorable to its growth after it had attained a moderate size. It is about 20 mm. in greatest diameter and 4 mm. in thickness; its upper surface has very deep convoluted furrows separated by rounded ridges which contain few spicules and no zooids, and are practically colorless, while the basal part of the colony is densely crowded with spicules giving it a chalky-white color. The spicules are fairly large (0.03 to 0.04 mm. in diameter) and have a spherical form, the numerous blunt points or rays of which they are built up scarcely projecting above the surface of the sphere. Whether or not this condition may have resulted from the absorption of the projecting points of a type of spicule similar to those in the other specimens described above the writer will not attempt to decide; but it seems not unlikely that if abnormal conditions have affected the colony they may also have influenced the development of the spicules. The zooids measure about 1.2 mm. in length in a considerably contracted state. They are neither numerous nor are they present in all parts of the colony. Their poor preservation prevents the demonstration of many of the important points of their structure, but three orders of tentacles (probably 16 in all) could be distinguished as in *P. dubium*, and the number and arrangement of the stigmata is evidently the same or nearly the same as in that species. An atrial siphon could not be demonstrated, but, on the other hand, there was no evidence against its presence. There are a number of separate testes which, though of fair size, are so poorly preserved and in such a soft condition that their exact number could not be determined. The vas deferens makes only a few turns about the compact group or mass which they form.

Genus LEPTOCLINUM Milne-Edwards, 1842.

[=*Diplosoma* Authors.]

LEPTOCLINUM MACDONALDI (Herdman).

1886. *Diplosoma macdonaldi* HERDMAN, Rep. Voy. *Challenger*, vol. 14, Tunicata, pt. 2, p. 315.
1891. *Diplosoma macdonaldi* HERDMAN, Journ. Linn. Soc. London, Zool., vol. 23, p. 633.
1898. *Diplosoma macdonaldi* GOTTSCHALDT, Abh. Senckenb. Ges., vol. 24, p. 657.
1902. *Diplosoma macdonaldi* VAN NAME, Trans. Connecticut Acad. Sci., vol. 11, p. 368, pl. 53, fig. 60; pl. 60, fig. 124.
1909. *Leptoclinum macdonaldi* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl. p. 1455.

The only satisfactory specimens in the collection are two small colonies from station D5145, each about 10 mm. in greatest diameter and of a thickness of 2 to 3 mm. Each of them grew upon the carapace of a small living crab, arching over it so as to cover all but the lower parts and the appendages of the crustacean. Apparently the ascidians did not interfere with the life of the crabs, and though they must have inconvenienced them in locomotion, they doubtless afforded considerable protection and concealment. In addition to these specimens several very minute colonies (containing, however, adult zooids), certainly of this genus and presumably of this species, were found growing upon and among *Didemnum* colonies from station D5148.

Test nearly colorless and more or less transparent. It is fairly firm in consistency and does not contain very extensive common cloacal cavities or ducts.

Zooids 1.5 mm. long or less when moderately expanded; the intestinal loop, as well as the abdomen as a whole, are almost always, if not always, strongly bent to one side, so that an exact estimate of the length is difficult. Body only moderately constricted between the thorax and abdomen. Branchial aperture 6-lobed; atrial aperture neither produced into a tube nor provided with a languet.

Tentacles of three sizes, quite regularly arranged.

Much time and labor was expended in an attempt to demonstrate the dorsal languets, and it is believed that they were distinctly seen in several cases. The difficulty in distinguishing them is apparently due to their being long and slender and not greatly different in thickness from the interstigmatic vessels. Apparently they arise as usual from the transverse vessels of the left side, but quite near the median dorsal vessel.

Branchial sac with four rows of long narrow sigmata, apparently about 12 or 14 in a row on each side.

Esophagus long; stomach oval, somewhat larger at the cardiac end. Intestinal loop rather large, bent to one side, and more or less twisted. It has several valvelike constrictions.

Testes beside the intestinal loop; two in number, of oval form, connected with the origin of the common sperm duct (which is not spirally coiled) by very short branch ducts. Ovary situated along the initial part of the common sperm duct. Eggs mostly in a single series; the largest and most advanced in the posterior part.

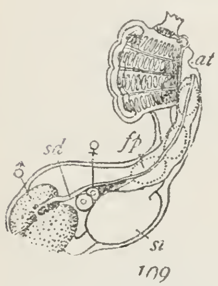


FIG. 109.—LEPTOCLINUM MACDONALDI (HERDMAN). ZOOID. × 42.

Localities of the specimens above mentioned:

No. 78. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells), (Cat. No. 5957, U.S.N.M.)

No. 162. Station D5148 (off Sirun Island, Sulu Archipelago, Feb. 16, 1908, 17 fathoms, coral sand).

Leptoclinum macdonaldi was described by Herdman (1886) from a specimen obtained by the *Challenger* expedition at Bahia, Brazil, in shallow water, and what appears to be the same species has also been found at Bermuda (Van Name, 1902). Gottschaldt (1898) records a colony from Ternate agreeing with Herdman's species. The widely separated localities are, of course, against the probability of their identity and naturally lead to the suspicion that with more abundant and better material specific differences might be discovered. A number of ascidians common to the West Indies and Malay region are, however, already known, and in this case the resemblance between specimens from Bermuda and those from the Philippines is certainly very close.

LEPTOCLINUM CALIFICIFORME Sluiter, 1909.

Plate 31, fig. 35.

1909. *Leptoclinum calificiforme* SLUITER *Siboga*-Exped., vol. 56*b*, p. 82, pl. 4, fig. 10. (Called *L. caliciforme* on p. 112.)

Colony flattened, slightly depressed in the central portion, and of irregular outline; the margins slightly elevated. Largest specimen about 22 mm. in greatest diameter and hardly over 2 mm. thick on an average. Attachment only by a small area on the central part of the lower surface, the marginal portions of the colony being free. The general form of the colony is thus that of a flattened saucer of irregular outline. Surface of colony smooth and clean; test firm and tough, of a greenish white color; the tissues of the zooids are of a deeper greenish color, so that they show through the test quite distinctively. Superficial and marginal parts of colony translucent, free from zooids, but the marginal parts penetrated by vascular processes arising from the zooids and ending in bulbs, probably incipient buds. The zooids lie somewhat below the surface in a single layer rather closely placed, but between them are extensive common cloacal ducts or canals. Each colony probably contains only a single complex system with a centrally placed common cloacal aperture. The basal portions of the colony are of solid translucent test substance containing closely packed bladder cells, small irregularly shaped cells, and also larger round cells, which may be symbiotic algæ. These are, in the preserved specimens, almost colorless.

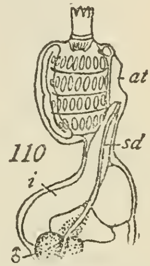


FIG. 110.—LEPTOCLINUM CALIFICIFORME SLUITER. ZOOID. × 50.

Zooids smaller than those of the last-described species, being generally considerably under 1 mm. long in the contracted state, and as noted below they have fewer tentacles and fewer stigmata in a row. They resemble them, however, in most characters, including, as far as could be detected, the absence of an atrial languet or atrial siphon. The branchial apertures are not always distinctly lobed.

Mantle musculature insignificant; a few slender longitudinal bands are present on the thorax.

Tentacles of two sizes, arranged in alternation.

Dorsal languets not demonstrated.

Branchial sac with 4 rows of stigmata; 8 or 9 on each side in the anterior rows, but apparently only 7 in the last row.

Stomach elliptical, somewhat elongated.

Reproductive organs were found only in a few of the zooids examined. The male organs resemble those of the species just described. The two testes were in all cases small and were apparently not fully developed.

Two colonies (No. 14) (Cat. No. 5956, U.S.N.M.), in the collection, both from Marongas Island, near Jolo, February 10, 1908.

Four small colonies in the United States National Museum, collected by Dr. L. E. Griffin and Mr. L. D. Wharton at Bantayan, may also belong here but are too immature and present too few distinctive characters for certain identification.

Sluiter (1909) described this species from a single small colony from the Sulu Archipelago (latitude 6° 7.5′ N.; longitude 120° 26′ E., 16–23 meters). He describes the colony as basin shaped, produced below into a short pedicel. The latter is not present in the *Albatross* specimens, but the colonies are basin or saucer shaped and attached only by a very small area of the lower surface. A colony of this form is very unusual in this genus or family.

Family SYNOICIDAE Hartmeyer, 1908.

[=POLYCLINIDAE Authors.]

Genus POLYCLINUM Savigny, 1816.

POLYCLINUM FESTUM Hartmeyer, 1905.

1905. *Polyclinum festum* Hartmeyer, Zool. Jahrbücher, Syst., suppl. vol. 8, p. 401, pl. 13, figs. 6 and 7.
1909. *Polyclinum festum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1461.

Owing to mutilation and distortion, the specimens give little indication of the original form and mode of attachment of the colonies. The largest and best of them is an elongated flattened mass about 60 mm. long and nowhere much over 5 mm. thick. The area of attachment seems to have been small and much of the lower surface as well as the upper to have been free.

Test tough, brownish from diffused color; the tissues of the zooids are still browner though no distinct pigment cells were observed. Zooids apparently arranged in systems, but the form and limit of these are difficult to make out on account of the condition of the specimens.

Zooids large, when straightened out and not much contracted some measure 6 to 7 mm. long or even more. Thorax long and rather narrow, broad at the anterior end. Branchial aperture with six slightly bifid lobes; atrial aperture a plain round orifice, generally directed forward; between it and the base of the short branchial tube a long atrial languet arises. A narrow, constricted neck of varying length connects the thorax and abdomen, which is broad and of moderate length. A still narrower neck connects the abdomen with the small oval post-abdomen.

Mantle musculature slight. Slender, rather irregular longitudinal muscles are present on the thorax, some of them extending out on the atrial languet.

The tentacles appear to be of more than one size. They were not counted, but do not seem to be very numerous.

Dorsal languets, though probably present, were not demonstrated.

Branchial sac long and narrow, with at least 16 or 17 rows of stigmata in adult zooids, but the number in a row does not appear to be large (perhaps about 14). Those near the endostyle become successively shorter. Esophagus long and narrow. Stomach oval, the esophageal end with a slight and the pyloric end with an extensive reentrant depression where the esophagus and intestine join the stomach. Stomach walls smooth and only moderately thick. Intestinal loop having the peculiar twisted course characteristic of the genus (see fig. 111) and provided with several valvelike constrictions. Anus two-lipped.

A dense group of 20 or 40 small oval testes occupy the anterior part of the post-abdomen. Posterior to, or somewhat to one side of these, is the ovary, consisting of a group of eggs of different sizes, one or two of them often quite large. A large egg or young embryo is often present in the peribranchial cavity of the thorax. What appears to be the heart occupies the extreme posterior part of the abdomen.

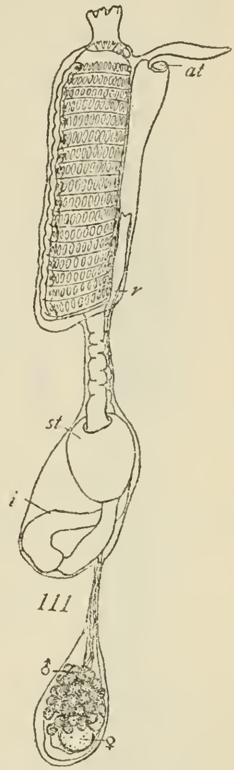


Fig. 111.—Polyclinum festum Hartmeyer. Zooid. × 14.

The only specimens (No. 57, three colonies or fragments) (Cat. No. 5958, U.S.N.M.) are from station D5174 (off Jolo Light. Mar. 5, 1908, 20 fathoms, coarse sand). In most respects they agree well with Hartmeyer's type from Mauritius, the most striking difference being that he describes the test as transparent and the zooids showing through it plainly, giving the colony a yellow-brown color. Such a character would, however, be greatly affected by the methods and circumstances of the preservation of the specimen.

Genus AMAROUCIUM Milne-Edwards, 1841.

AMAROUCIUM CRATERIFERUM Sluiter, 1909.

Plate 33, figs. 45 and 46.

1909. *Amaroucium crateriferum* Sluiter. *Siboga*-Exped., vol. 56*b*, p. 103, pl. 5, fig. 7; pl. 8, fig. 11.

1909. *Amaroucium crateriferum* Hartmeyer. Bronn's Tier-reich, vol. 3, suppl., p. 1467.

Colony so irregular and variable in form in the different specimens that a general description is difficult. It is an irregular ovoid or convex mass whose shape is best described as a modification of the flattened capitate form, and is attached by an area variable in extent and position. The surface is very uneven, with deep irregular folds and shallow depressions, and is usually quite thickly incrusted with sand, small fragments of shells, etc. These also occur to a considerable extent in the deeper parts of the colony. Dimensions of two of the largest specimens: 67 mm. long by 42 mm. wide, and 76 mm. long, 25 mm. high, and 18 mm. in greatest width. Test brownish, opaque, of a somewhat fibrous appearance, quite hard in the alcoholic specimens, though not very tough.

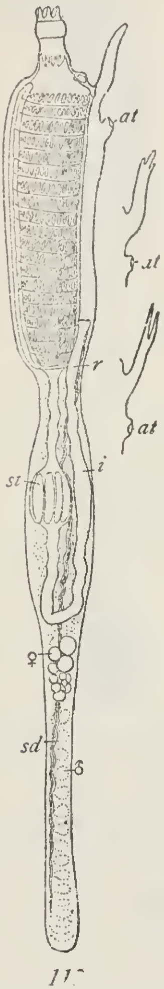


FIG. 112.—AMAROUCIUM CRATERIFERUM SLUITER. ZOOID. × 17.5. THE SMALL FIGURES SHOW VARIATIONS IN THE FORM OF THE ATRIAL LANGUET.

Zooids irregularly distributed, not very numerous in proportion to the amount of test substance. They are slender, the post-abdomen (which is very narrow) constituting over half their total length when well developed. Such zooids, even in the contracted state, may reach 8 or 9 mm. in length. Branchial aperture with six rather long lobes; atrial aperture on a low papilla on the anterior dorsal part of the thorax; ordinarily it is not lobed. Both apertures with strong sphincter muscles. A long, narrow atrial languet arises a little distance anterior to the atrial papilla. The languet may or may not be cleft into two or three lobes at its tip. (See different forms shown in fig. 112.)

Mantle musculature forming slender but distinct longitudinal bands on the thorax; on the ventral portion of the latter a deeper layer of transverse fibers can also be distinguished.

Tentacles rather few, of two sizes placed alternately.

Dorsal languets rather small, borne on the transverse vessels of the left side at a distance from the median dorsal vessel equal to the width of about four stigmata.

Branchial sac long and narrow, the transverse vessels conspicuously muscular. About 20 rows of stigmata, with 11 to 14 in a row on each side. In several zooids the writer found the lesser number to prevail on the right and the greater on the left side. The stigmata do not commence very close to the endostyle, and those near that organ are successively shorter in their dorso-ventral diameter; those near the median dorsal vessel are also slightly shortened. Variations and irregularities in their width occur in some individuals (perhaps largely because of irregular contraction of the walls of the sac); in others they are quite regular.

Intestinal loop rather long. Stomach with about 10 deep longitudinal plications in its wall. Ovary in the anterior part of the post-abdomen. The small pear-shaped testes are arranged along the common sperm duct throughout most of the length of the post-abdomen posterior to the ovary.

The specimens are all from the vicinity of Jolo and are from shallow water.

No. 31. Station D5144 (off Jolo Light, Feb. 15, 1908, 19 fathoms, coral sand.) (Cat. No. 5898, U.S.N.M.)

No. 23. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells.) Cat. No. 5951, U.S.N.M.)

No. 26. Station D5145? (Locally indicated as doubtful.) (Cat. No. 5950, U.S.N.M.)

No. 145. Station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand). (Cat. No. 5966, U.S.N.M.)

No. 45. Jolo, Jolo Island, February 11, 1908 (Cat. No. 5952, U.S.N.M.).

Sluiter (1909) described this species from a single colony, which, like the *Albatross* specimens, was also from Jolo, 14 meters.

AMAROUCIUM MULTIPLICATUM (Sluiter), 1909.

Plate 31, fig. 26.

1909. *Aplidium multiplicatum* Sluiter, *Siboga*-Exped., vol. 56*b*, p. 101, pl. 5, fig. 3.

1909. *Aplidium multiplicatum* Hartmeyer, Bronn's Tier-reich, vol. 3, suppl., p. 1469.

Small colonies usually rounded or more or less flattened, and sessile by a broad base; larger ones may be lobed or elongate and attached near one end. Largest colony 73 mm. long by 26 mm. in greatest width. Surface of colony smooth and shiny, the test more or less transparent so as to allow the zooids to show through in the best preserved specimens, but in those in poorer condition the surface may be furrowed and the test more or less opaque. Color light brown or yellowish brown, varying to yellowish white. Zooids arranged in more or less complex systems; common cloacal apertures rather few. Well expanded zooids may measure 7 mm. to 8 mm. long when the post-abdomen is well developed, but in the usual contracted state found in preserved material they are often only half the above length.

Branchial aperture 6-lobed; atrial aperture varying from distinctly lobed to nearly plain. An atrial languet of simple form arises slightly in front of the atrial aperture.

Thorax with numerous strong longitudinal muscle bands and less well-developed transverse muscles underlying them. Abdominal muscles mainly longitudinal and gathered into less definite bands than on the thorax.

Tentacles eight in number, of two orders placed alternately. Additional smaller ones were not certainly demonstrated.

Dorsal languets removed about the width of three stigmata to the left of the median dorsal vessel.

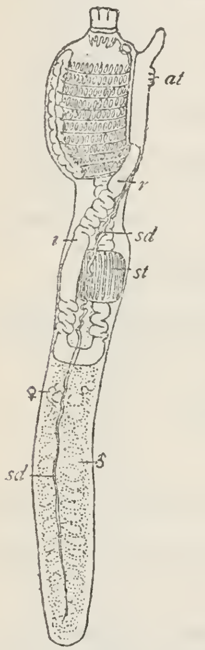


FIG. 113.—AMAROUCIUM MULTIPLICATUM (SLUITER). ZOOID. × 20.

Branchial sac with 9 or 10 rows of stigmata; about 16 in a row on each side in the anterior part, but one or two less in the most posterior rows.

Stomach wall with a considerably larger number (18 or 20) of longitudinal plications in its walls than in the case of *Amaroucium crateriferum*. The plications are narrow and some of them are often, if not usually, more or less irregular in length and arrangement.

No peculiarities of the reproductive organs were noted. Ovaries poorly developed in the specimens examined; situated in the anterior part of the abdomen. The testes form a double series along the common sperm duct in the part of the post-abdomen behind the ovaries.

Localities of the *Albatross* specimens:

No. 84. Station (off Jolo Light, Feb. 15, 1908, 29 fathoms, coral sand). One colony (Cat. No. 5954, U.S.N.M.).

Nos. 86, 163. Station D5145 (near Jolo Light, Feb. 15, 1908, 23 fathoms, coral sand and shells). Several colonies (Cat. Nos. 5953 and 5965, respectively, U.S.N.M.).

Several additional colonies in the United States National Museum were collected by Mr. S. F. Light on eel grass in Porta Galera Bay, Mindoro.

Sluiter (1909) describes this ascidian from colonies from reefs at Tial, Ki Island, and Haingsisi, Saman Island. Except that they appear to have several more rows of stigmata (a character perhaps subject to variation with age as well as individually), the *Albatross* specimens agree accurately with Sluiter's description.

AMAROUCIUM CONSTRICTUM Sluiter, 1900.

1900. *Amaroucium constrictum* SLUITER, Zool. Jahrbücher, Syst., vol. 13, p. 17. pl. 1, fig. 8*a*.
1909. *Amaroucium constrictum* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1466.

Colony in the only specimen irregularly capitate, attached by a narrowed base. Test yellowish white, translucent, moderately firm, the brownish zooids visible through it indistinctly. Height about 12 mm.; greatest diameter of head, about 8 mm.

Zooids small; in none of them is the post-abdomen equal to the rest of the body in length. The individual figured was about 3 mm. long. Branchial aperture with 8 lobes; atrial aperture only indistinctly lobed, and not at all produced into a tube.

A well-developed atrial languet is present; it has a large middle lobe and small pointed lobe on each side.

Thorax with numerous longitudinal muscle bands.

Tentacles and dorsal languets not clearly made out.

Eight or nine rows of stigmata with apparently about 15 in a row on each side.

Stomach wall with 10 or 12 deep longitudinal plications.

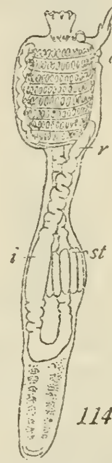


FIG. 114.—AMAROUCIUM COSTRICTUM SLUITER. ZOOID. × 20.

The only specimen (No. 29) (Cat. No. 5955, U.S.N.M.) is from station D5174 (off Jolo Light, Mar. 5, 1908, 20 fathoms, coarse sand). The species with which the writer identifies this specimen was described by Sluiter (1909) from the Chatham Islands.

Genus APLIDIUM Savigny, 1816.

APLIDIUM DEPRESSUM Sluiter, 1909.

1909. *Aplidium depressum* SLUITER *Siboga*-Exped., vol. 56*b*, p. 102, pl. 5, fig. 6.
1909. *Aplidium depressum* HARTMEYER, Bronn's Tier-reich, vol. 3, suppl., p. 1469.

Largest colony of rather thin flattened form and irregular in outline, the upper surface fairly smooth. Dimensions 26 mm. by 15 mm. across and not over 3 mm. thick at any point. Test fairly transparent, not pigmented, of only moderately firm consistency. The two smaller colonies are of rounded outline, much flattened, but attached by a somewhat narrowed base.

Zooids easily visible through the test, very small (only 1.25 to 1.5 mm. long in the greatly contracted preserved state). Post-abdomen rather short in all the individuals. Branchial aperture 6-lobed, atrial on a more or less produced tubular projection arising about the middle of the dorsal part of the thorax. It is sometimes obscurely 6-lobed, in other cases not lobed at all. No atrial languet.

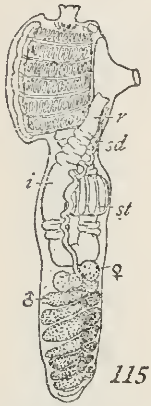


Fig. 115.—Aplidium depressum Sluiter. Zooid. × 34.

Mantle with distinct but rather widely spaced longitudinal muscle bands which are most conspicuous on the thorax. Numerous transverse fibers, quite near together but not gathered into bands, underlie the longitudinal bands on the thorax.

Tentacles, apparently about a dozen, of two sizes, placed alternately.

Dorsal languets not demonstrated.

Branchial sac rather short with comparatively few (probably about 6 or 7 rows of stigmata, with about 14 in a row on each side.

Stomach with about a dozen deep longitudinal plications.

Ovary consisting of a group of a few eggs of different sizes in the anterior part of the post-abdomen. Posterior to it the large pear-shaped or cuneate testes form a double series along the common sperm duct.

Localities:

No. 21. Station D5109 (off Corrigidor Light, Jan. 15, 1908, 10 fathoms, coral). One colony (Cat. No. 5903, U.S.N.M.)

No. 75. Station D5555 (off Cabalian Point, Jolo, Sept. 18, 1909, 34 fathoms, coarse sand). Two small colonies (Cat. No. 5902, U.S.N.M.).

The above-described specimens agree so nearly with Sluiter's (1909) description of *A. depressum* from latitude 7° 35′ S., longitude 117° 28.6′ E., that there seems to be no reason for regarding them as distinct, though Sluiter's specimen was from much deeper water (521 meters).

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EXPLANATION OF PLATES.

PLATE 23.

FIG. 1. *Pandocia pedata* (Herdman). No. 97. Station D5218. Nat. size.
2. *Pandocia pedata* (Herdman). No. 157. Station D5164. Nat. size.
3. *Pandocia pedata* (Herdman). No. 158. Station D5250. Nat. size.

PLATE 24.

FIG. 4. *Nephtheis thompsoni* (Herdman). No. 104. Station D5139. Two colonies. About seven-eights nat size.

PLATE 25.

FIGS. 5, 6. *Pandocia aurata* (Quoy and Gaimard). No. 131. Locality, South Toumindao. Two individuals, nat. size.

PLATE 26.

FIG. 7. *Pandocia circumarata* (Sluiter). No. 112. Station D5144. Nat. size.
8. *Pandocia circumarata* (Sluiter). No. 116. Station D5174. Nat. size.
9. *Eusynstyela latericius* (Sluiter). No. 124. Station D5557. Nat. size.

PLATE 27.

Fig. 10. *Phallusia depressiuscula* (Heller). No. 154. Locality, Endeavor Point. × 1.1.
11, 12. *Phallusia depressiuscula* (Heller). No. 122. Locality, Catbalogan Samar. Two individuals. × 1.1.
13. *Phallusia depressiuscula* (Heller). No. 55. Locality, Jolo, Jolo Island. × 1.1.

PLATE 28.

Fig. 14. *Rhopalopsis crassa* (Herdman). No. 38. Station D5165. Colony of three zooids. × 1.15.

15. *Cystodites philippinensis* (Herdman). No. 22. Station D5174. × 1.15.

16. *Didemnum ternatanum* (Gottschaldt). No. 156. No locality recorded. Colonies on eelgrass. ×1.15.

PLATE 29.

Fig. 17. *Stolonica styeliformis*, new species. No. 113. Station D5136. Colony incrusting a gorgonian and overgrown with colonies of *Didemnum ternatanum* (Gottschaldt) and a few small colonies of *Didemnum grande* (Herdman). Nat. size.

18. *Stolonica styeliformis*, new species. No. 130. Station D5134. Nat. size.

19. *Stolonica styeliformis*, new species. No. 121 (Type). Station D5174. Nat. size.

PLATE 30.

Figs. 20, 21, and 22. *Didemnum grande* (Herdman). No. 100. Station D5139. Three colonies, color white marbled with blackish. Nat. size.

23. *Didemnum grande* (Herdman). No. 7. Station D5145. Pure white colony. Nat. size.

24–25. *Didemnum ternatanum* (Gottschaldt). No. 109. Station D5154. Two colonies. Nat. size.

PLATE 31.

Fig. 26. *Amaroucium multiplicatum* (Sluiter). No. 86. Station D5145. Very slightly enlarged.

27. *Styela areolata* (Heller). No. 88. Station D5147. Very slightly enlarged.

28. *Polycitor ianthinus* (Sluiter). No. 126. Station D5139. × 1.15.

29. *Clavelina detorta* (Sluiter). No. 142. Station D5139. Very slightly enlarged.

30. *Polysyncraton dubium* (Sluiter). No. 2. Station D5150. Very slightly enlarged.

31. *Pandocia ovata* (Pizon). No. 150. Station D5149. × 1.15.

32. *Pyura duplicata*, new species. No. 51 (Type). Locality, Catbalogan, Samar. Specimen seen from dorsal side. Very slightly enlarged.

33. *Polyandrocarpa maxima* (Sluiter). No. 46. Station D5141. Colony very slightly enlarged.

34. *Pandocia quadrata* (Herdman). No. 30. Station D5536. Very slightly enlarged.

35. *Leptoclinum calificiforme* Sluiter. No. 14. Locality, Marongas Island. Colony seen from the concave upper surface. Very slightly enlarged.

PLATE 32.

Fig. 36. *Pyura pallida* (Heller). No. 138. Station D5147. × 0.9.

37. *Pyura pallida* (Heller). No. 139. D5163. × 0.9.

38. *Pyura pallida* (Heller). No. 132. Locality, Catbalogan, Samar. × 0.9.

Fig. 39. *Microcosmus exasperatus* Heller, overgrown with a colony of *Stolonica vesicularis*, new species. No. 135. (Type of latter species.) Station D5145. × 0.9.

40. *Styela tinaktae*, new species. No. 136. Station D5159. Two individuals. × 0.9.

41. *Polycitor torosus* Sluiter. No. 62. Station D5148. Colony seen from one side. Very slightly enlarged.

42. *Ctenyura intermedia*, new species, new genus. No. 140. Station D5536. Two individuals (cotypes) seen from the dorsal side. Very slightly enlarged.

43. *Polysyncraton dubium* Sluiter. No. 4. Station D5139. Very slightly enlarged.

Plate 33.

Fig. 44. *Didemnum ternatanum* (Gottschaldt). No. 129. Locality, Mantacao Island. Colony seen from one side. Slightly reduced.

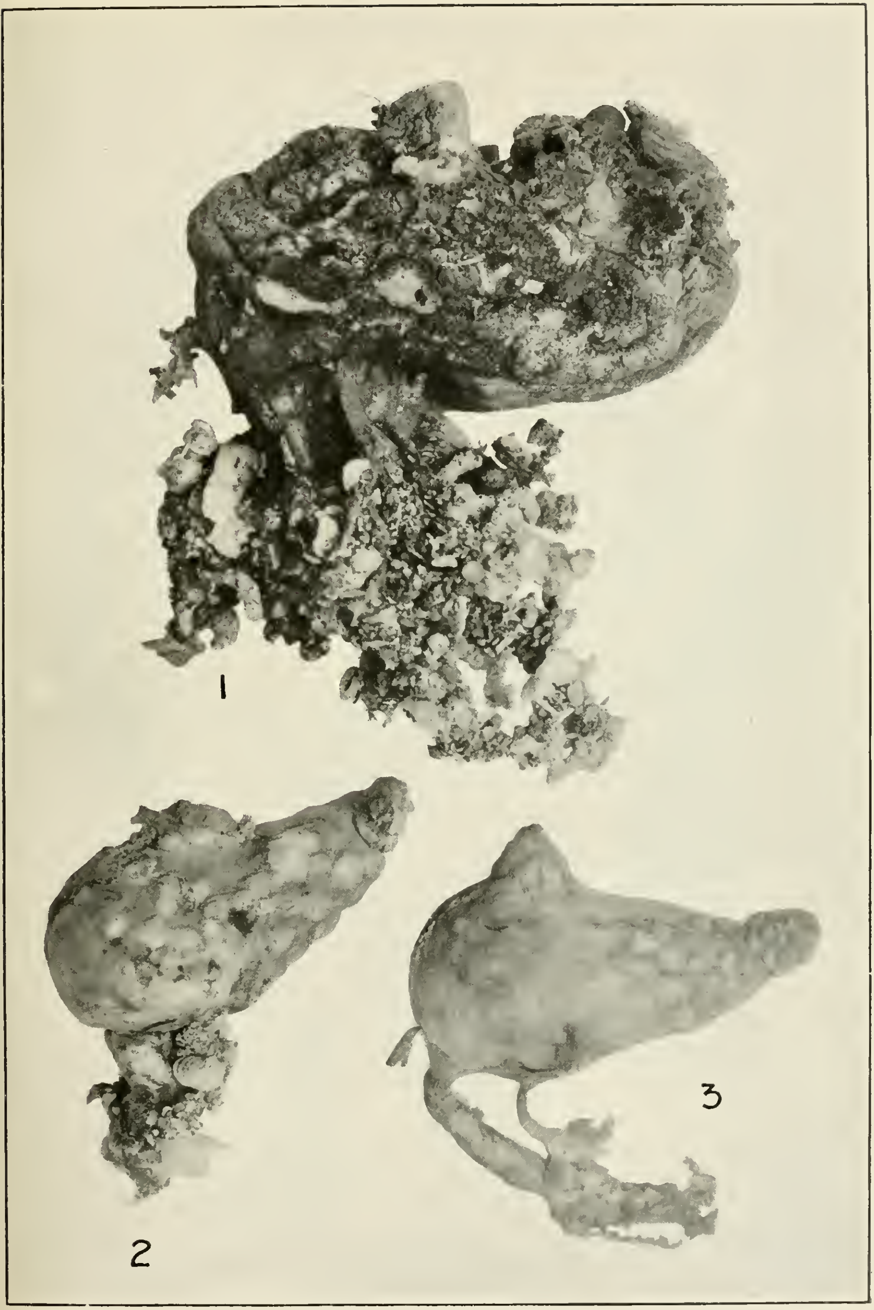
45. *Amaroucium crateriferum* Sluiter. No. 145. Station D5174. Slightly reduced.

46. *Amaroucium crateriferum* Sluiter. No. 45. Locality, Jolo, Jolo Island. Slightly reduced.

47. *Holozoa vallii* (Herdman). No. 115. Station D5148. Colony seen from one side. Slightly reduced.

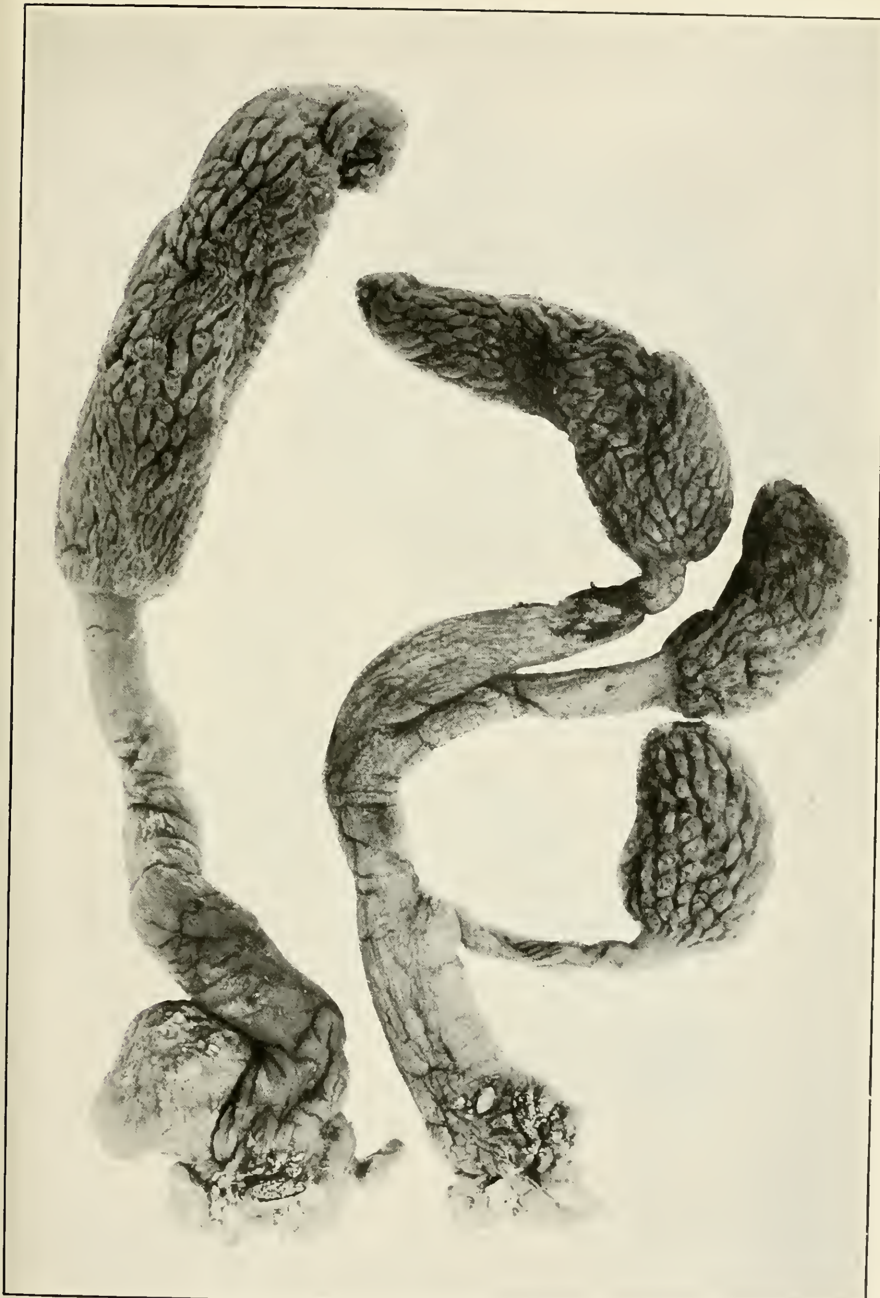
48. *Holozoa vallii* (Herdman). No. 65. Station D5149. Slightly reduced.

49. *Polysyncraton dubium* Sluiter. No. 5. Station D5145. Colony growing upon and nearly enveloping a small crab. Showing the lower surface of the crab, the upper being entirely covered by the ascidian. Slightly reduced.



PHILIPPINE ASCIDIANS.

FOR EXPLANATION OF PLATE SEE PAGE 172.



PHILIPPINE ASCIDIANS.

FOR EXPLANATION OF PLATE SEE PAGE 172

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PHILIPPINE ASCIDIANS.

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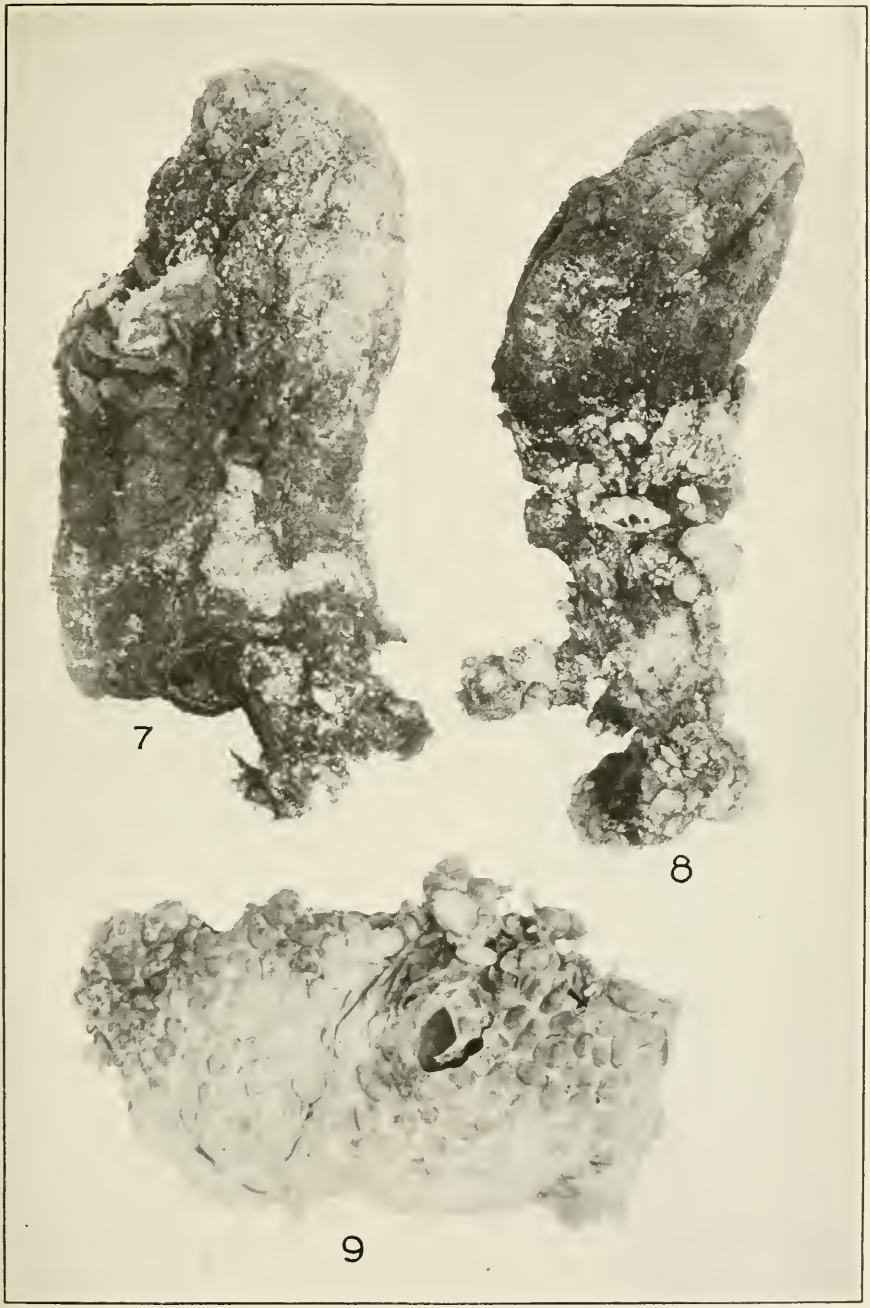

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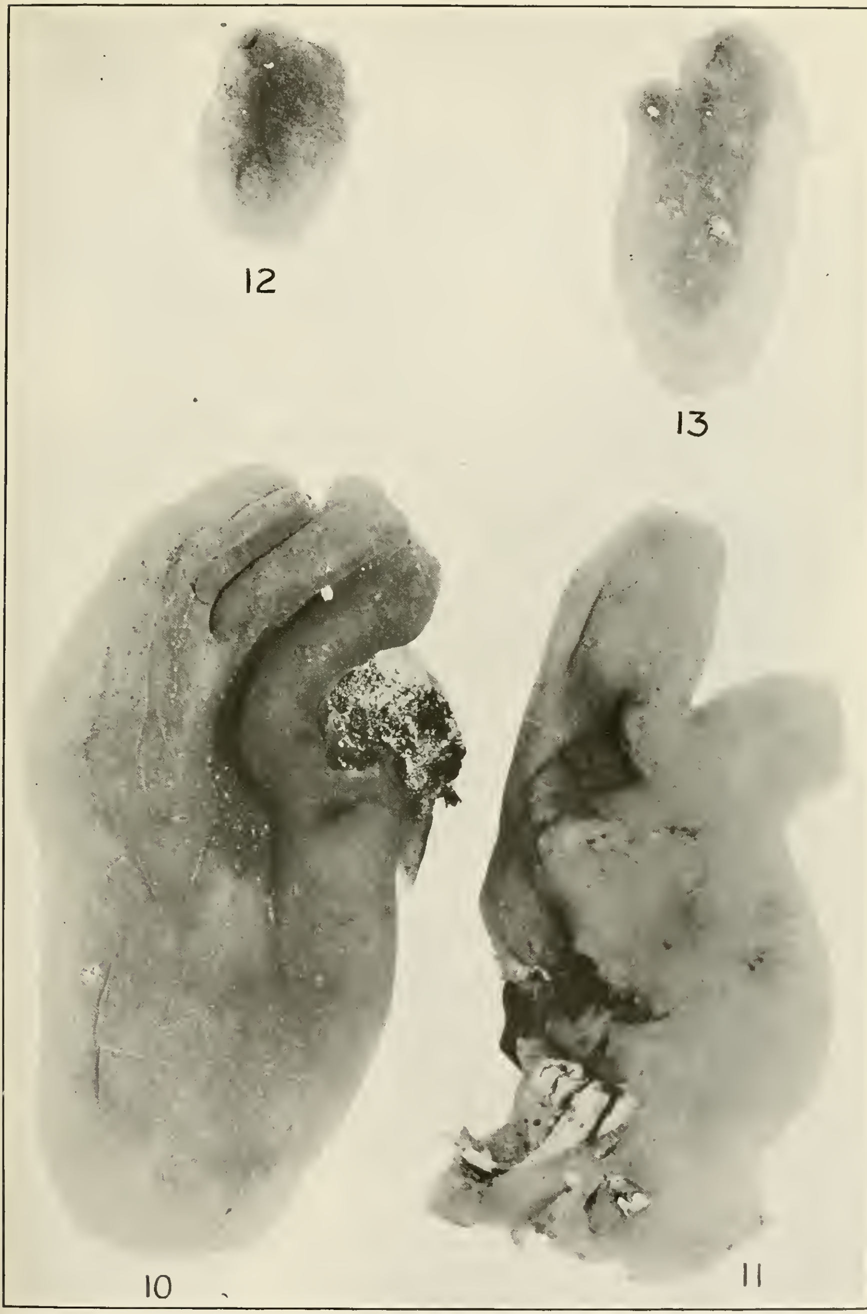

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FOR EXPLANATION OF PLATE SEE PAGE 172.

PHILIPPINE ASCIDIANS.

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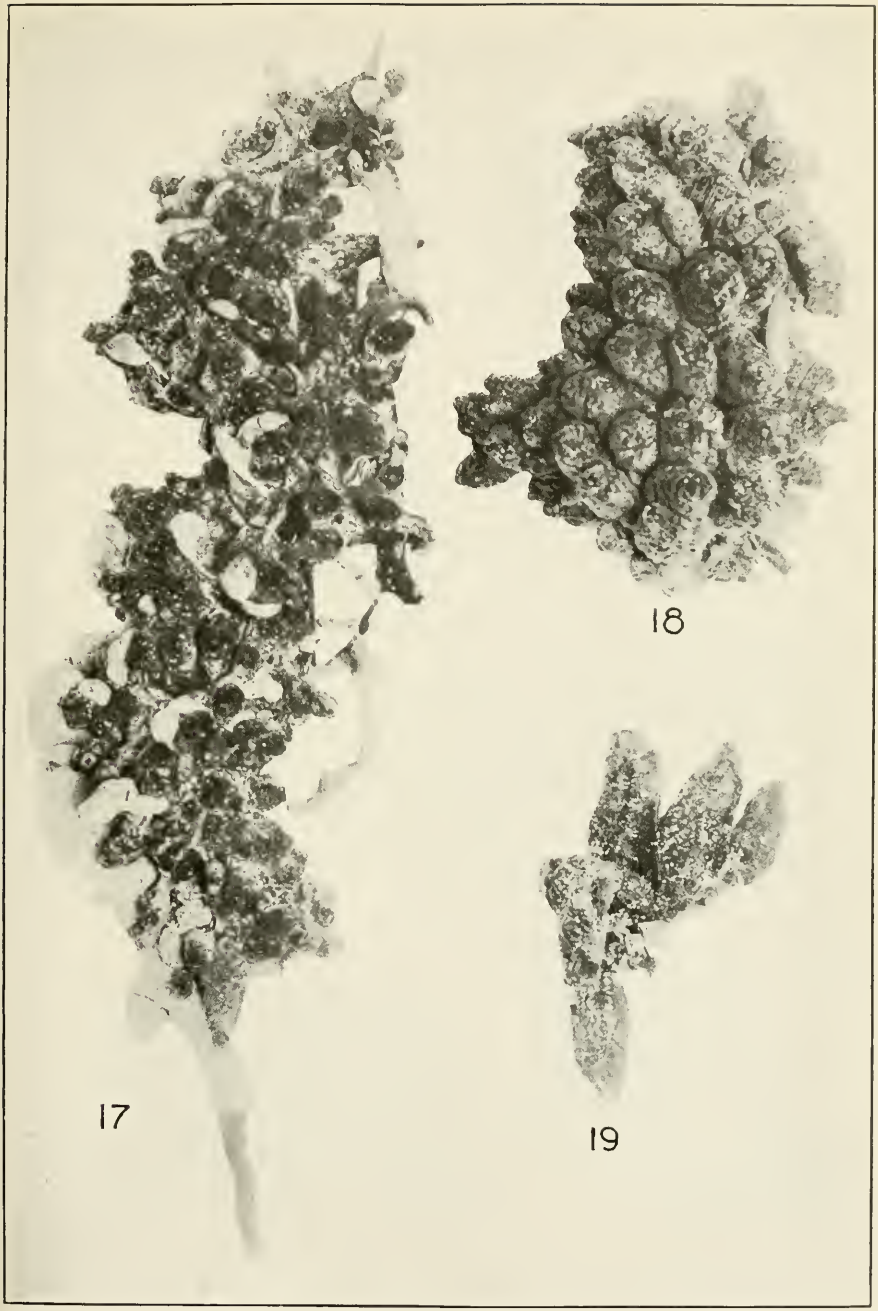
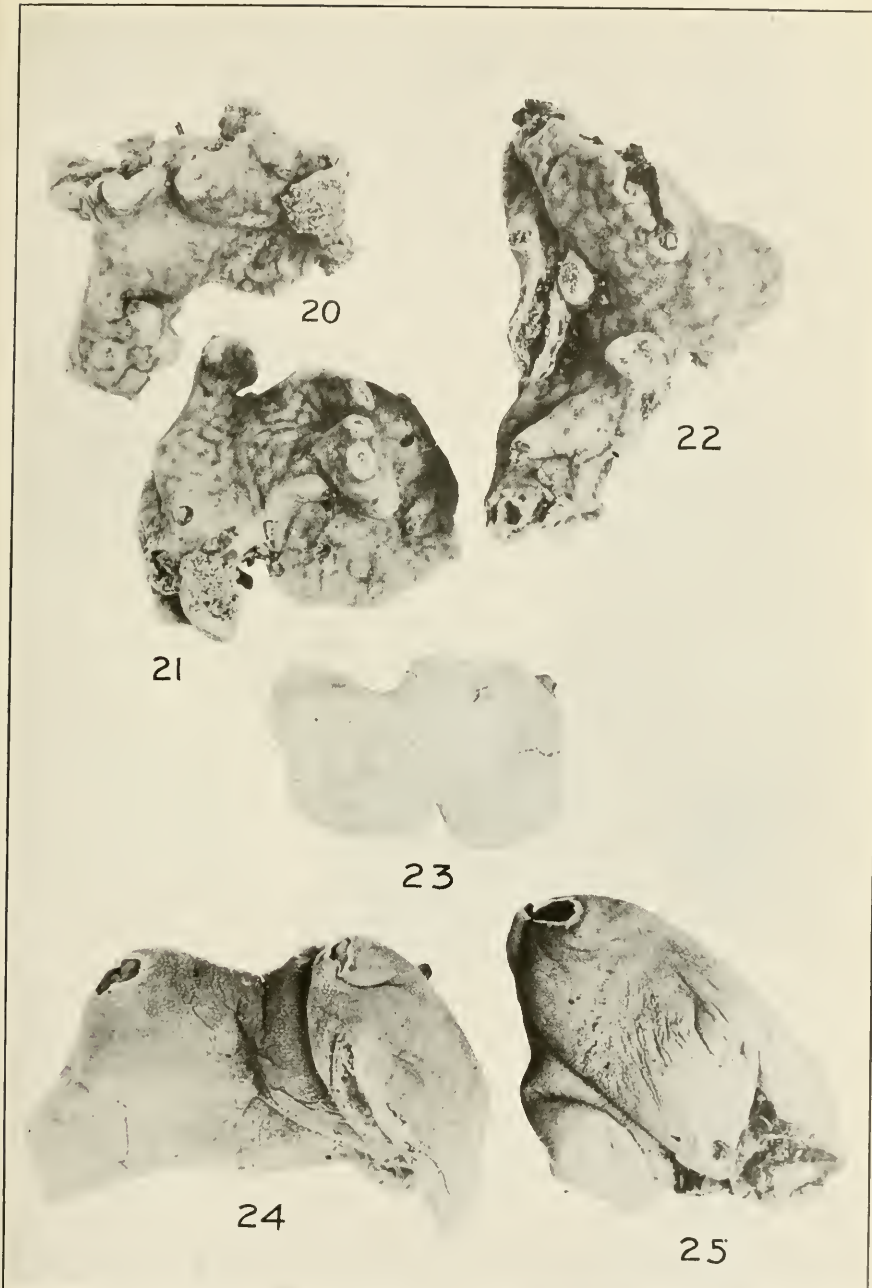


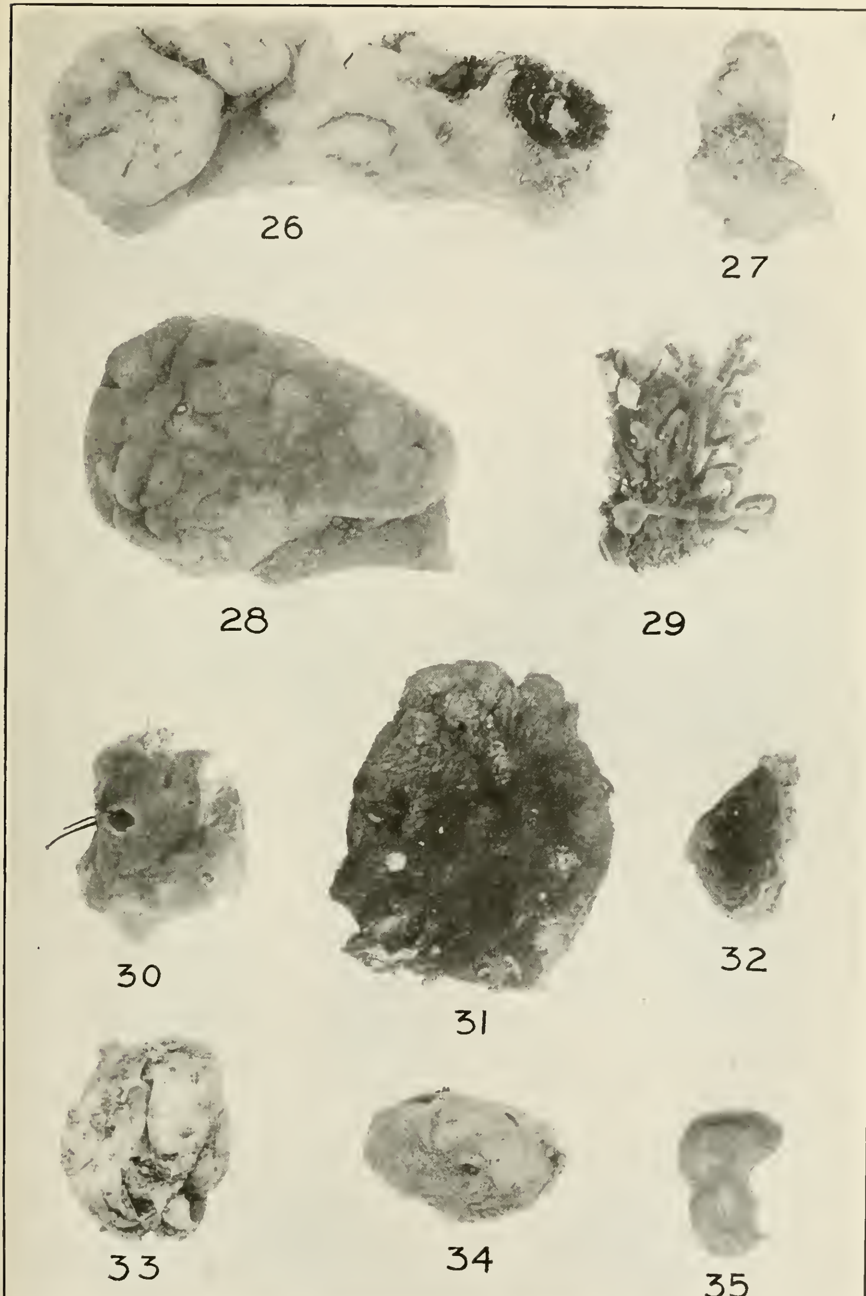
Philippine Ascidians.

For explanation of plate see page 173.



PHILIPPINE ASCIDIANS.

FOR EXPLANATION OF PLATE SEE PAGE 173



PHILIPPINE ASCIDIANS.

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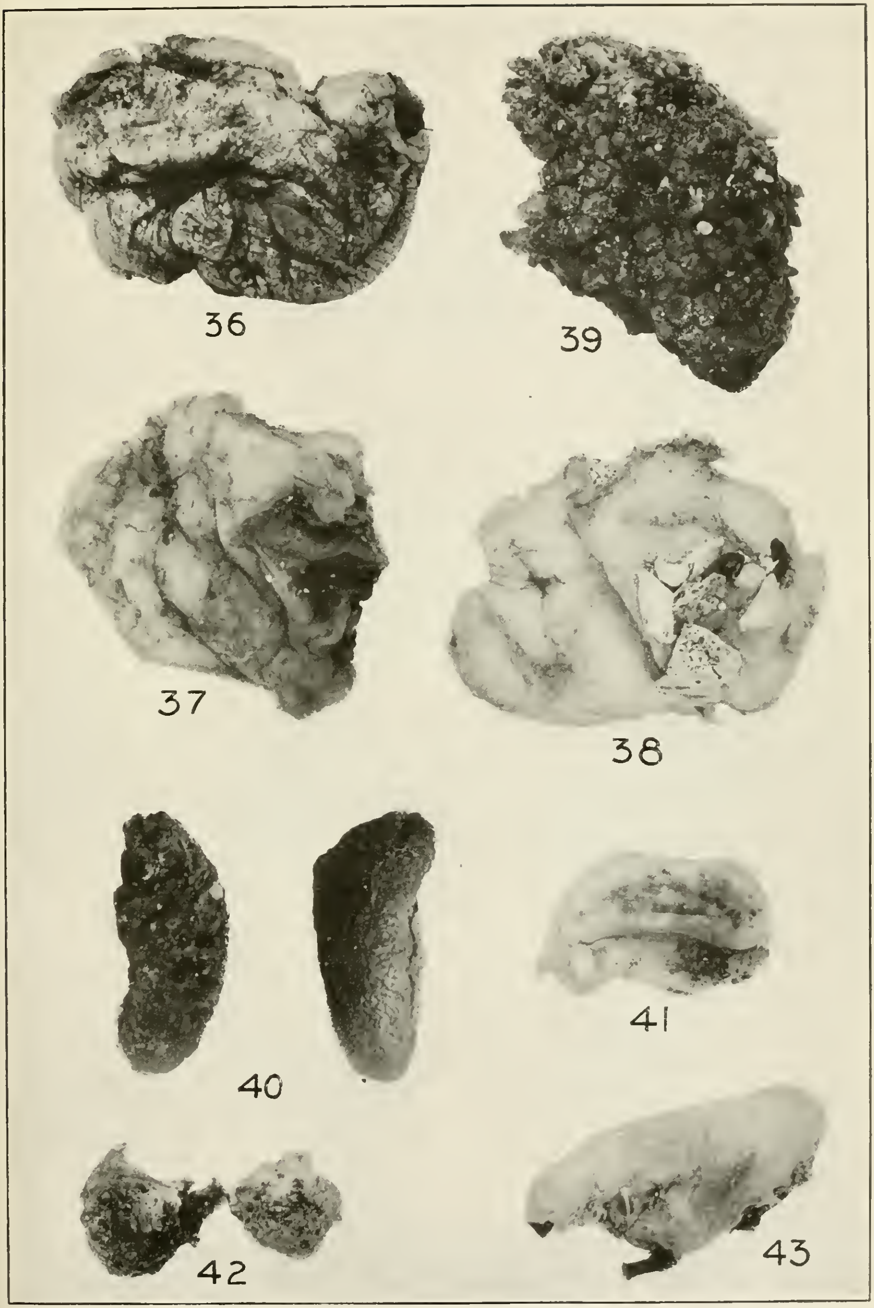
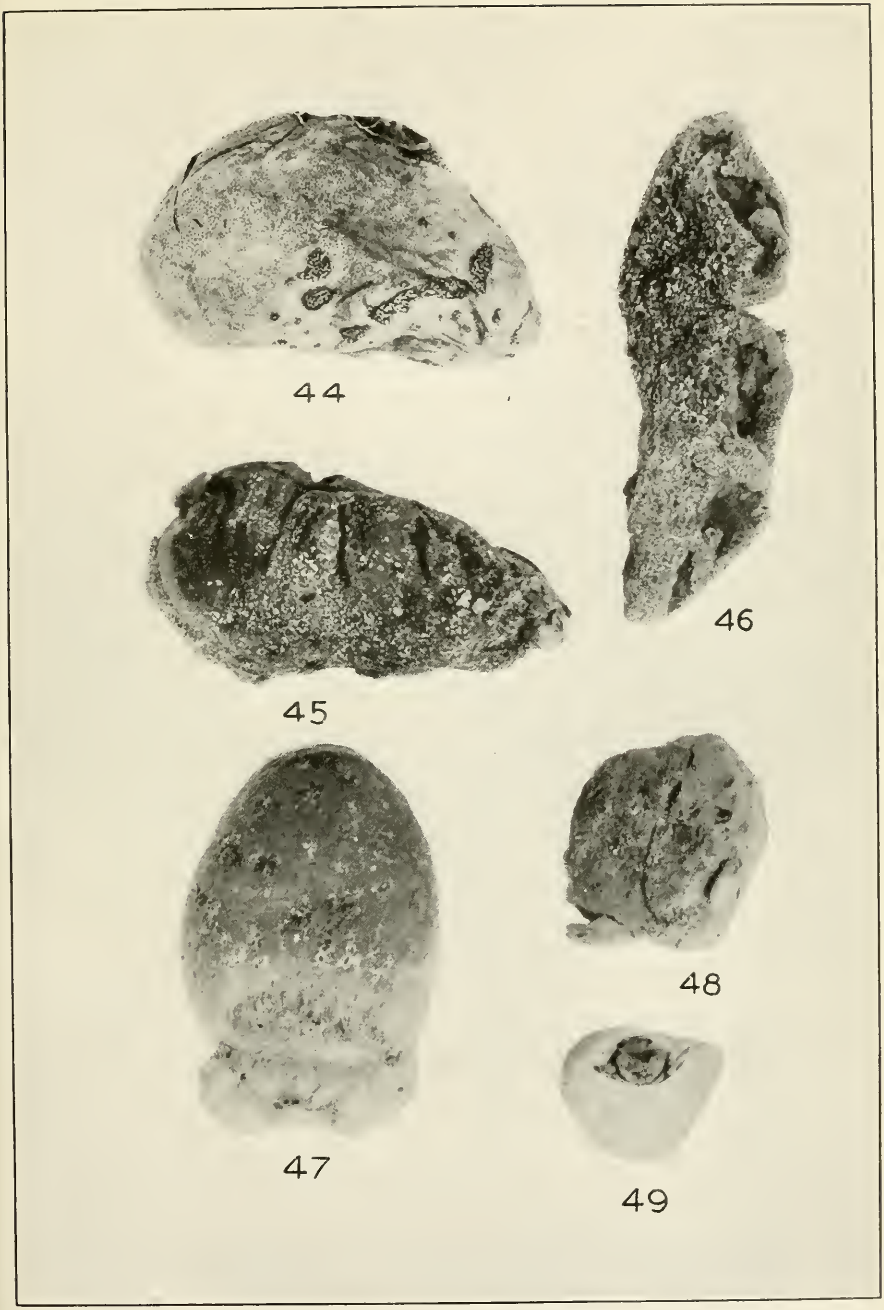


PHILIPPINE ASCIDIANS.

FOR EXPLANATION OF PLATE SEE PAGES 173 AND 174.



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REPORT UPON THE SCYPHOMEDUSAE COLLECTED BY THE UNITED STATES BUREAU OF FISHERIES STEAMER "ALBATROSS" IN THE PHILIPPINE ISLANDS AND MALAY ARCHIPELAGO.

By Alfred Goldsborough Mayer,

Director of the Department of Marine Biology of the Carnegie Institution of Washington.

INTRODUCTION.

In 1909 Dr. Hugh M. Smith, the then Acting United States Commissioner of Fisheries (now Commissioner), gave to the author for study a part of the collection of medusae now under consideration in this article, and the authorities of the Smithsonian Institution kindly permitted the use of a table in the building in Washington while engaged upon this work. In 1910 the remainder of the collection was sent to Princeton University, where the author occupied a research room in Guyot Hall. Thus the collection was studied under the most advantageous conditions, and it is a pleasure to express my sense of indebtedness to the authorities of the United States Bureau of Fisheries, the Smithsonian Institution, and Princeton University for the opportunities I have enjoyed.

Previous reports upon this collection were published by the Carnegie Institution of Washington in Publications 109 and 212.

Thirty-one Scyphomedusae were obtained by the *Albatross* in the Philippines and adjacent regions, of which 10 were new to science, the list of species being as follows:

CARYBEIDAE.

Carybdea rastonii Haacke.
Carybdea alata, var. *grandis* Agassiz and Mayer.
Chiropsalmus quadrigatus Haeckel.

CORONATAE.

Periphylla hyacinthina Steenstrup.
Linuche unguiculata, var. *aquila* Mayer.
Atolla bairdii forma *wyvillei* Haeckel.
Atolla bairdii forma *gigantea* Maas.
Atolla bairdii forma *valdiviae* Vanhöffen.

RHIZOSTOMATA.

Cassiopea andromeda, var. *baduensis* Mayer.
Cephea octostyla (Forskål).
Cephea cephea, var. *coerulea* Vanhöffen.
Cotylorhiza pacifica Mayer.
Catostylus purpurus Mayer.
Catostylus townsendi Mayer.
Catostylus mosaicus (Quoy and Gaimard).
Lychnorhiza bartschi Mayer.
Lychnorhiza bornensis Mayer.
Mastigias papua (Lesson).
Mastigias occellata (Modeer).

SEMAEOSTOMAE.

Pelagia panopyra Péron and Lesueur.
Chrysaora melanaster Brandt.
Dactylometra africana Vanhöffen.
Sanderia malayensis Goette.
Discomedusa philippina Mayer.
Aurellia aurita (Linnaeus).
Aurellia labiata Chamisso and Eysenhardt.

RHINOSTOMATA—Continued.

Phyllorhiza luzoni Mayer.
Versura maasi Mayer.
Lobonema smithii Mayer.
Thysanostoma thysanura Haeckel.
Lorifera lorifera, var. *pacifica* (Schultze).

Also in 1914 S. F. Light[1] describes 7 species from the Philippines other than those obtained by the *Albatross*. Mr. Light's additional species are: *Dactylometra quinquecirrha; Cassiopea polypoides; Cassiopea medusa*, new species; *Acromitus maculosus*, new species; *Lobonema mayeri*, new species; *Lobonemoides gracilis*, new species; and *Rhopilema visayana*, new species.

Thus 38 Scyphomedusae are already known from the Philippines, which is thus one of the richest regions of the world for Scyphomedusae, and stands in marked contrast with the tropical Pacific coast of Queensland, Australia, of which only 10 species have been described.

This appears to be another illustration of the influence of a great ocean current, the rich region of the Philippines being in the sweep of the Japan Stream, whereas there is no well-defined current along the southern shore of Papua or off the Barrier Reef of Queensland. As is well known, H. B. Bigelow, in his report upon the Siphonophorae of the *Albatross*, shows how abundant these forms are in the Humboldt current off the coast of South America and how poor the region is in the mid-Pacific to the westward of this great current. My studies, made while assistant upon Dr. Alexander Agassiz's expeditions to the tropical Pacific, in 1899, as well as upon the Carnegie Institution of Washington expedition of 1913 to Torres Straits and Papua, show that the whole great belt of the South Tropical Pacific, from the western edge of the Humboldt current to the shores of Australia, is poor in pelagic life. A number of local medusae appear in some of the large island groups, as in Fiji, but the region as a whole is poor in forms peculiar to itself, and even those of wide distribution are, generally speaking, found only occasionally over this great desert of ocean.

STRUCTURE, PHYSIOLOGY, HABITS, AND DEVELOPMENT OF THE SCYPHOMEDUSAE.

The Scyphomedusae are the large jellyfishes, commonly called the sea blubbers, in which the body is umbrella shaped, the mouth parts

[1] Philippine Journal of Science, vol. 9, Section D, No. 3.

occupying the position of the handle of the umbrella. The animal swims by means of periodic expansions and contractions of the margin of the umbrella. If we look carefully, we will see that this margin is notched at regular intervals, forming a series of lappets, and that 8, or sometimes 16, of these notches are deeper than the others and contain each a minute finger-shaped or club-shaped sense organ which may be provided with an eye, but which always contains a mass of crystals or concretions concentrated at its outer end. These little sense organs are so small that they appear to the naked eye as mere pigmented specks set within the niches at regular intervals around the margin; but though small they are of vital importance to the jellyfish, constituting its principal nerve centers; and if we cut them off, the animal commonly becomes paralyzed and is no longer able to pulsate spontaneously. Mayer believes that the crystals or concretions within the sense clubs consist largely of calcium uric oxalate, and this makes it appear probable that sodium oxalate is constantly forming in the sense club and that the calcium chloride of the sea water, when it enters the sense clubs, is precipitated, forming calcium oxalate, and in this manner setting free sodium chloride (common salt), which is a powerful stimulant for the nerves, thus causing the pulsating reaction.

Thus in these animals it is found that a stimulus which is constantly present causes periodic contractions followed by periods of rest which are perhaps due to fatigue. In the case of the scyphomedusa *Cassiopea* this stimulus is internal, for the sea water itself neither stimulates nor inhibits the sense organs of the animal, the stimulating effect of the interaction of its sodium, potassium, and calcium being offset by the inhibiting effect of its magnesium upon the motor centers.

But the marginal sense organs do more than merely produce the pulsation stimulus, for Dr. L. R. Cary finds that if they be removed and the medusa be then wounded in any manner the first stages in regeneration are delayed, but if even a single sense organ be present regeneration proceeds at once and with normal rapidity.

In general, if the area of tissue enervated by a sense organ be large it pulsates more rapidly than if the area be small, and although the ratio is not strictly proportional to the area of tissue, for according to Dr. L. R. Cary (1917), the rate is reduced one-half when the area is reduced to one-sixteenth. But young, small jellyfishes pulsate more rapidly than large, old ones; yet if we graft two jellyfishes together the small active one will force the large one to pulsate at its own rate, which will be even more rapid than the normal rate of the small one, due to the large area of tissue the sense organs now control.

Eimer and Romanes found that if the marginal sense organs be removed the jellyfish is paralyzed and responds only by single contractions to external stimuli. Later, in 1906, Mayer found that if the sense organs be removed and we cut a ring-shaped or circuit-shaped strip of tissue from the concave part of the bell, we may then start a contraction wave proceeding in one direction through the circuit through which it travels continuously, being, indeed, entrapped by the circuit of tissue from which it can not escape. This movement is almost machinelike in its regularity, its rate being about 440 cm. a second, and in 1917 McClenden showed that this note remained practically unchanged even though the nerves were artificially stretched.

It is interesting to see that the pulsation stimulus in jellyfishes is conducted by the nerves, whereas in the vertebrate heart it is conducted by the muscles. There is, however, as Parker showed, a fundamental likeness between nervous and muscular activity, for in most essential features, such as the compensating pause following an extra pulsation and the refractory stage during systole, latent period, reaction to temperature, etc., the jellyfishes behave as does the vertebrate heart. In Europe Romanes, Bethe, and von Uexkull, and in America Loeb, Harvey, Cary, McClenden, and Mayer have been most active in these studies.

Recently Mayer finds that nerve conduction in *Cassiopea* is a chemical reaction in which the cations of sodium, calcium, and potassium take the active part, while magnesium is nonessential. Thus if we dilute the sea water with 0.4 molecular magnesium chloride the rate of pulsation declines only very slightly more than if we diluted it with distilled water, thus demonstrating the inert nature of magnesium in respect to the rate of nerve conduction. It is also interesting to see that this decline in rate is proportional to the decline in the concentration of the cations of sodium, calcium, and potassium which surround the nerves and not to the electrical conductivity of the sea water as a whole. Thus if we dilute with distilled water we decrease the electrical conductivity in nearly the same ratio as the dilution, while if we dilute with 0.4 molecular magnesium chloride the electrical conductivity remains nearly constant while we simply reduce the concentration of the sodium, calcium, and potassium cations. It is therefore these cations which are alone essential to the maintenance of the rate of nerve conduction.

The previous work of Mayer, 1906, Meltzer and Auer, 1908, and especially Osterhout, 1916, make it appear that sodium and calcium together combine with some proteid element forming a sodium-calcium-ion proteid, and this compound takes an essential part in nerve conduction. Mayer in 1916 showed that the rate of nerve conduction in the medusa *Cassiopea* has a temperature coefficient 2.5 times as great as that of the electrical conductivity of the sea water, and this suggests that the sodium-calcium-ion proteid may have a high temperature coefficient of ionization; for if the rate of nerve conduction is proportional to the concentration of the reacting cations, this would account for the high temperature coefficient of the rate of nerve conduction.

Also the sodium-calcium-ion proteid is probably colloidal in character and being in an alkaline medium it is doubtless negative electrically. Thus, under the influence of the decided negative potential which accompanies the reaction of nerve conduction, the surface tension on the particles of this colloid must be augmented and this may reduce the size of the particles in the manner stated by Mayer, Schaeffer, and Terroine, 1907.

Granted this were the case, the solubility of the particles would be augmented; for the surface decreases only as the square, while the volume declines as the cube of the radius. Thus more ions of sodium and calcium would pass into solution in a given time from the many small than from the few large particles; the mass remaining constant.

Nerve conduction is therefore probably a very complex chemical reaction, in which also an enzyme action may possibly be involved as postulated by Harvey, 1911.

Goldfarb showed that *Cassiopea* regenerates more rapidly in 90 per cent of sea water (90 parts of sea water mixed with 10 parts of distilled water) than it does in normal sea water. Nerve condition is, however, most rapid in slightly concentrated sea water.

In all Scyphomedusae, excepting the Rhizostomae, tentacles are found at the bell-margin, and usually grow out from between the notches of the rim. These tentacles are hollow, the stomach cavity being continued into them as it is also into the sense-clubs; indeed, the sense organs are only highly modified tentacles.

Powerfully developed circular, or a combination of circular and radial, muscles are found in the under, concave part of the umbrella (the subumbrella), and here also there is a network of nerve fibers connecting the muscles with the sense clubs. Curiously, there are no muscles, and probably no nerves, over the outer convex part of the umbrella (the exumbrella).

Those who have handled jellyfishes know that they are capable of inflicting a sharp sting, the tentacles being especially active in this respect. Closely clustered over the surface of the tentacles and other parts of the jellyfish there are minute cells, each containing a hollow tube coiled rope-like within the cell. Upon excitation these little tubes are turned inside out and shot forward, and being more or less barbed they penertate the skin, causing a sharp sting due in part, it appears, to formic acid. Thus it is that these large jellyfishes are among the most persistent enemies of the fishes, for many an incautious victim is ensnared among their deadly tentacles only to be paralyzed and finally drawn upward into the mouth of the jellyfish. It is, however, a poor rule which does not work in both directions, and certain kinds of small fishes often accompany jellyfishes, swimming in and out among the dangerous tentacles, even biting off small pieces of the jellyfish itself and occasionally themselves falling a prey to the stings, but in general enjoying a peculiar protection from the attacks of larger fishes who dare not venture too near the jellyfish.

The mouth, or mouths, of the jellyfish may be surrounded by veil-like lips or, if the mouths are numerous, as in the so-called Rizostomae (root-mouthed) jellyfishes, by complex frills lined by minute tentacles which at intervals bend to and fro and sweep, as it were, for food, for the jellyfishes are all carnivorous. In the higher animals the intestine is a tube which lies suspended within the body cavity, but Huxley showed that the jellyfishes have no body cavity, and consist simply of a stomach and an outside with a mere structureless lamella, or a solid mass of jelly, between the stomach wall and the outer skin layer of the animal.

This gelatinous substance, which according to S. Hatai may be allied in composition to chitin or cartilage, may serve as a store of food for the animal in case of starvation, and *Cassiopea* can live at least 42 days without food, the weight of the jellyfish declining to less than one-hundredth of its original magnitude. The loss of weight after the first day of starvation, and thus after all undigested food has been discharged through the mouths of the jellyfish, follows a simple law which shows that the loss of weight each day is proportional to the weight of the animal at the beginning of that day and thus the lighter it becomes the less weight lost.

Thus, if W be the original weight of the jellyfish and y its weight after x days of starving, then $y = W(1-a)^x$; where a is a constant, less than unity. This shows that the source of energy during starvation is chiefly the very large and simply organized gelatinous substance which, being very voluminous and heavy, is far more important than the mere thin layer of cellular elements possessed by the jellyfish. For, as is well known, vertebrates in starving first consume glycogen, then mainly fats and lypoids, and finally proteid elements. Due, however, to the large volume of its gelatinous substance, the jellyfish chiefly consumes this during starvation, although, as Doctor Hatai showed, the starvation is in other respects similar to that of vertebrates. However, jellyfishes have on hand a constantly ready source of sustenance, and can, so to speak, feed upon their own bodies if deprived of prey. Mayer, 1914, carried out some work upon this subject, but the more recent study of S. Hatai is far more elaborate and convincing, and should be consulted by all students of the subject.

Indeed the rate of growth, and the ultimate size that an individual jellyfish attains before becoming mature, is a measure of its success in obtaining food, and it is interesting to see that the largest jellyfishes are those of the cold seas where the floating animal life is more abundant than in the Tropics. In common with the Corals, Sea-anemones, Alcyonaria, Siphonophores, and Hydromedusae the Scyphomedusae are, so far as is known, exclusively carnivorous and do not feed upon plant life. Thus it is possible that the more rapid growth rate of Pacific corals in comparison with those of the Atlantic may be due to the better food supply derived from the deep lagoons of the Pacific, whereas in the Atlantic the lagoons are shallow and the water is charged over these vast flats with a precipitate of calcium carbonate which collects upon all floating animals and tends to smother them; whereas in the Pacific this does not appear to be the case.

Jellyfishes are, then, all carnivorous, and, while few devour others of their own species, they often greedily feed upon other sorts of medusae. These animals are, indeed, an important factor in destroying the eggs of cod and other fishes whose spawn floats in the sea.

The prey is seized by the mouth, and after being held and partially digested in the stomach, the remnant is ejected through the mouth.

The central stomach is a space in the middle of the umbrella, but this always gives rise to an outwardly radiating system of pouches or tubes which may form a complex network of vessels under the muscular layer of the concave side of the umbrella. As this system of pouches is connected with the stomach, and nutrient fluids derived from the food circulate through it, it is often called the gastrovascular system, for it is both a sort of "chymiferous system" as well as a digestive and circulatory space.

In all the larger jellyfishes, or Scyphomedusae, we find within the stomach four clusters of tentacle-shaped organs of unknown function, placed at the broad sides of the cruciform mouth. The smaller jellyfishes, or Hydromedusae, lack these stomach-tentacles or gastric cirri, as they are often called; and in still another structural detail do they differ from the Scyphomedusae, for the Hydromedusae have a diaphragm-like membrane (velum) extending inward from the bell-margin and partially closing the opening of the umbrella, but the larger jellyfishes (Scyphomedusae) do not have a diaphragm of this sort, although it is true that the Carybeidae, or sea-wasps, appear to have such a diaphragm, but it is not strictly comparable with that of the Hydromedusae.

The sexual organs of the larger jellyfishes (Scyphomedusae) are entodermal and are found in the stomach, peripheral to, and closely associated with, the four clusters of gastric cirri. The sexes are usually separate, the animals being either male or female, although, in rare instances, as in *Chrysaora*, they are hermaphroditic, or male when young and female when old. When mature at the breeding season the males and females usually come to the surface in great numbers and may congregate in vast swarms many square miles in area. The larvae or eggs may then be cast out into the water by the breaking down of the stomach wall, or the larvae may undergo a part of their development within the stomach, or mouth parts, of the mother, finally to be cast out through the mouth, or set free from the disintegrating bodies of the dying parents.

In any event the larvae soon develop into minute pear-shaped creatures about as large as a pin's head, their bodies being covered with vibrating cilia, which enable them to spin and progress through the water. For a few days, or even weeks, they may remain thus swimming near the surface and may be drifted hundreds of miles by tide and ocean current. Soon, however, the little pear-shaped planula, as it is called, settles down head first upon the bottom and fastens itself to some fixed object. Then for the first time the mouth develops at that which was the posterior end of the planula, and tentacles grow out so that the mouth is soon surrounded by 16 or more of these organs which serve to capture the minute crustacea and other organisms upon which the little polyp feeds. Thus it remains sedentary for a long period, growing all the time and superficially resembling a small sea-anemone. Finally a series of constrictions develop at regular intervals around the sides, and the creature appears as if it were composed of a series of disks set one upon the other. The margin of each disk soon develops eight cleft lobes, and eight sense-clubs appear in the clefts. Then the uppermost disk, containing the mouth and the crown of tentacles, is cast off and perishes, while the others are set free in succession and swim away as minute jellyfishes, soon to develop tentacles and finally to become mature and repeat this peculiar process of development. After the last disk has been cast off, only the stump of the strobila, as it is called, remains, but this may regenerate a new ring of tentacles and continue to grow, and possibly to develop more jellyfishes at the succeeding season.

There are many interesting variations of this typical process of development. Often the strobila, instead of giving off a series of disks, develops only a single constriction, and every alternate tentacle changes into a sense-club, while the other tentacles may be wholly absorbed, so that they disappear. In this case only a single ephyra or larval jellyfish is set free. This form of development is especially characteristic of the Rhizostomae or multi-mouthed jellyfishes, such as *Cassiopea.* In the free-floating *Pelagia*, however, the planula larva never becomes attached, but remains swimming through the water until it develops directly into a jellyfish. Thus it is that these jellyfishes are quite independent of the land and are widely distributed over the tropical and warm oceans; but this is exceptional, for most of the Scyphomedusae must spend their early days attached to some fixed object and usually in relatively shallow water near some coast.

Some of these coastal medusae are, however, widely distributed over the world, one of these being the large semi-transparent *Aurellia aurita* of our own bays and harbors, which appears so commonly during the summer, and may be recognized by its four horseshoe-shaped, milky or pink-colored genital organs. This form occurs from pole to pole.

Such adaptability to wide range of temperature is very rare among jellyfishes, and is known only in *Aurellia aurita* and according to Vanhöffen in *Nausithoë puncata* among the scyphomedusae, and *Solmundella* among hydromedusae; these forms occurring in seas of all temperatures.

Nevertheless, even tropical medusae are much more injuriously affected by a slight rise in temperature than are the jellyfishes of the temperate regions, and we may say that most tropical forms live within 12° C. of their heat-death-temperature, and even tropical forms can withstand cooling better than they can resist heat. To use an engineering expression we might say that the medusae of temperate regions have a larger "factor of safety" in respect to temperature. Harvey showed that, upon heating, the rate of conduction of the nervous stimulus which causes pulsation increases in an arithmetical ratio, so that its "curve" is a straight line. At from 34° to 39°, however, the curve makes a sudden bend downward and the rate declines sharply. This decline may, in part, be due to the formation of carbon dioxide (CO_2) in the tissues, for Winterstein showed that the rate of oxygen consumption in jellyfishes is 3½ times more rapid at 30° to 35° than it is at about 12° C. Indeed, experiments made by the author in 1917 support the idea that high temperature causes acid to accumulate in the tissues and this causes death through acidosis.

The large, rich rosin-brown colored cyaneas of our New England coast are not found in the Tropics, but closely allied species reappear in the South Temperate Zone, so that somehow they have managed, perhaps in the glacial epoch, to cross the warm zone of the Tropics, or they may have succeeded in crossing the Equator in the cold, deep, underlying drift that moves toward the warm regions over the sea bottom from both the northern and southern polar seas.

The following table shows the range of the 174 species of Scyphomedusae, not counting varieties, described in Mayer's Medusae of the World.

Confined to the Tropics	77
Ranging from Tropics to Temperate regions	16
Ranging from Tropical to Polar regions	2
Confined to the North Temperate region	32
Confined to the South Temperate region	11
Ranging from Temperate to Polar seas	6
Confined to the Arctic Ocean	7
Confined to the Antarctic Ocean	7
Deep sea medusae all of wide range	16
Total	174

In this table the Mediterranean is designated "North Temperate" and the Red Sea "Tropical." In the "Tropics" the surface temperature in summer is above 70° F. (21° C.). The summer temperature of "Temperate Region" ranges from 70° F. to 50° (21° to 18° C.), and that of the "Polar Seas" below 50° F. (10° C.).

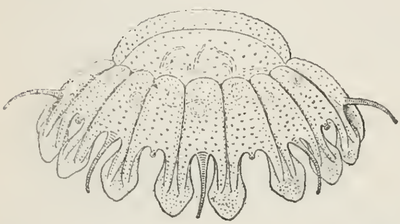

Fig. 1.—Nausithoë punctata from life, by the author. Naples Zoological Station.

As is shown, 44 per cent of the known Scyphomedusae appear to be confined to tropical waters and only two species, *Aurellia aurita* and possibly *Nausithoë punctata* (fig. 1) range from Tropical to Polar Seas. Indeed most of the scyphomedusae are confined within rather narrow temperature ranges, the only considerable number of widely ranging forms being the deep sea species whose habitat has about the same temperature whether under the Equator or in the Polar regions. Incidentally the table seems to indicate our deficiency of knowledge of the South Temperate regions for it is probable that the numbers of species in the North Temperate are more nearly equal to those found in the South Temperate Zone.

We may distinguish five main divisions or orders of the larger jelly fishes of scyphomedusae.

1. The Carybdeidae or Cubomedusae, with bell almost rectangular and with flexible tentacles mounted upon the ends of gelatinous wing-shaped expansions. They have four knob-shaped sense-clubs, which are very large and set within niches on the sides of the bell, with the eyes all directed inward, apparently to command a view of the mouth. These medusae have a marginal diaphragm which partially closes the opening to the umbrella cavity. The Carybdeidae are confined to tropical and warm seas and usually remain upon or near the bot-

tom until they become mature, when they often swim to the surface to cast out their eggs and sperm. They are dull milky-yellow, or livid in color, and their tentacles sting so sharply that they are commonly called "sea-wasps." None are known north of Cape Cod, but they are well represented in the Tropics throughout the world.

2. The Stauromedusae are attached forms which do not pulsate. The body is pear-shaped or pyramidal and the jellyfish fastens itself to seaweed or rocks by means of a stalk at the aboral end of the body. There are usually 8 clusters of knobbed tentacles which are developed at the pointed ends of eight marginal lobes, and 8 large "anchors" or suckerlike clubs upon the margin may alternate with the tentacles. These forms are confined to cold and temperate seas, and are known from the Arctic and Antarctic Oceans, although they have never been found in the Tropics.

3. The Coronatae are usually deep-sea forms distinguished by their peculiar dark purple or reddish-brown color, which is very characteristic of the invertebrate animals of the deep sea, due possibly to the fact that the red rays from the sun are rapidly absorbed as they penetrate into the ocean, so that at depths greater that 1,000 fathoms there is practically no red light, and here red-colored animals must appear black and be well concealed in the general darkness of their abysmal realm. The Coronatae are characterized by having a deep ringlike furrow cutting into the thick gelatinous wall of the sides of the umbrella; and peripheral to this are gelatinous thickenings in the radii of the tentacles and sense-organs. The gelatinous wall of the bell is much reduced in thickness at the ring-furrow, the thin part acting as a hinge to permit the creature to close its bell during contraction. These forms are common in the deep waters of the Philippines, as indeed they are upon the bottom of all seas 500 fathoms or more in depth. Most of the species, such as *Atolla* and *Periphylla*, do not normally come to the surface, but a closely allied form, the little *Nausithoë*, is one of the most universally present surface forms of all warm seas, while the mature *Linuche* occur in vast numbers, all rapidly pulsating and resembling little brown thimbles, the swarm often covering square miles of ocean in tropical regions.

4. The Semaeostomata are the common large jellyfishes of our coasts, such as *Aurellia*, *Cyanea*, and *Dactylometra*. They have tentacles and a single cruciform mouth provided with veillike lips, and there is no ring-furrow cutting into the surface of the umbrella, such as is seen in the Coronatae. They are common in bays and brackish estuaries, and are the largest and most conspicuous of all jellyfishes in temperate regions.

5. The Rhizostomae are the large jellyfishes of the East Indian and tropical seas, where they are commonly as conspicuous as are the

Semaeostomeae in our cold northern waters. They have numerous mouths and no marginal tentacles, and their gelatinous substance is often as rigid as newly-formed cartilage. Often they occur in swarms in the harbors, swimming strongly against the tide, and after a storm great numbers are found stranded upon the shore. The rigid gelatinous substance of these jellyfishes is very characteristic and was seen in fossil forms found in the Jurassic lithographic slates of Steinheim in Bavaria, showing that in the age of the Reptiles these most highly differentiated jellyfishes existed. Indeed, so old are the jellyfishes that their relationship to the echinoderms, sponges, and ctenophores remains unknown; all intergrading forms, if such ever existed, having died out long ago, as is often the case in very ancient orders.

In an early stage of development the higher animals commonly pass through a condition in which they have only an outer cell layer and a cavity lined by cells destined to form the intestine. Theoretically speaking, they are simply little 2-layered sacks, the outer layer being the external skin with its nervous and sensory organs, and the inner layer being the stomach; and thus the name gastrula is applied to this stage. Jellyfishes are essentially in the gastrula stage, even when adult. Yet so extraordinary are the foldings, outgrowths, and adaptations that have arisen in their two body layers during the vast time they have existed upon the earth that, ultimately, simple as they are, no class of the animal kingdom exhibits a more surprising variety of forms than do the jellyfishes and their close allies the Siphonophorae.

It is interesting to observe that the large jellyfishes, Scyphomedusae, which have gastric cirri and no marginal diaphragm or velum, are probably only very remotely related to the small jellyfishes, the hydromedusae, which have a velum and lack gastric cirri. Indeed, we have good reason to believe that the jellyfish-shape and peculiar locomotion through pulsation have been derived independently in the two groups. The Scyphomedusae are probably allied to the actinians or sea-anemones, while the hydromedusae have probably been derived from hydroids. In fact a jellyfish shape and pulsating body have been acquired independently in widely different kinds of animals, such as *Pelagothuria*, a holothurian which bears a wonderfully close resemblance to a jellyfish and swims actively through the water in the tropical Pacific; and in *Craspedotella*, a minute unicellular marine animal, which would certainly have been mistaken for a jellyfish had it not been of microsopic size.

Indeed, there is reason to lead us to believe that the bell of the Narcomedusae is a mere outgrowth from the sides of the pyriform larva, and has thus been acquired in a manner quite different from that of the other hydromedusae. Thus the umbrellalike bodies of jellyfishes have probably been acquired in at least three different ways within the group itself. Although nearly one-half of the known forms of Scyphomedusae are confined to the Tropics, yet many of these are rare, although, curiously, when found they usually appear in swarms. Thus one may explore the Florida Reef for 20 years and not find a single *Pelagia* or *Stomolophus*, yet if an individual be found there are almost certainly dozens or even thousands in the neighborhood. It is as if they had all remained floating side by side throughout their lives, or at least throughout the period when they come to the surface from some well-defined region of the bottom wherein they have spent their early days.

Apart from the harbors and semibrackish estuaries one rarely finds in the Tropics great swarms of medusae of a few species such as characterize the coastal waters of the temperate regions.

There are, however, exceptions to this rule, such as the enormous number of *Linuche*, which when mature rise suddenly and simultaneously to the surface to cast out their genital products and then to sink and die. For areas of square miles the tropical ocean is besprinkled with these little brown thimbles, darting in a rapid jerking movement.

Similarly the pale milky Cubomedusae with their long pink tentacles rise, when mature, from the depths to congregate along tropical shores for the few days or weeks of the breeding season.

Metschnikoff observed that many medusae cast out their eggs only at certain definite times of the day or night. One of his Mediterranean species, for example, laid its eggs always at about 3.30 o'clock in the afternoon, and Conklin observed that *Linuche* casts its eggs only at about 8 o'clock in the morning, but other Scyphomedusae are not so regular, and indeed may retain the developing young in their mouth folds for days or weeks before they escape into the ocean.

DESCRIPTION OF GENERA AND SPECIES.

Genus CARYBDEA Péron and Lesueur, 1809.

Carybdea Péron and Lesueur, 1809, Ann. Mus. Hist. Nat., Paris, vol. 14, p. 332.—Mayer, 1910, Medusae of the World, vol. 3, p. 506.

Generic Characters.—Carybdeidae, with 4 simple, interradial tentacles and pedalia. Velarium supported by 4 bracket-like frenulae. Velar canals present. Stomach small and 4-sided.

CARYBDEA RASTONII Haacke.

Carybdea rastonii Haacke, 1887, Jena, Zeitsch. für Naturwissen, vol. 20, p. 591, pl. 35, figs. 1–15.—Mayer, 1910, Medusae of the World, vol. 3, p. 508.

There are two specimens of this medusa in the *Albatross* collection from the Philippines. They are apparently mature and their dimensions in millimeters are as follows:

	Subig Bay, Luzon, surface, Jan. 6, 1908. Cat. No. 27937, U.S.N.M.	Taal Anchorage, Balayan Bay, Luzon, surface, Feb. 20, 1909. Cat. No. 28714, U.S.N.M.
Height of bell	34	33
Width of bell	20	23.5
Length of pedalia	11	9.5
Width of pedalia at base	....	4
Width of pedalia at widest part	6.5	5.5
Height of sensory niche above velar margin	6	6
Length of flexible shafts of tentacles	30	66

Two other specimens (Cat. No. 27935, U.S.N.M.) were taken by the *Albatross* at Nasugbu, Luzon, January 15, 1908, and still another (Cat. No. 27936, U.S.N.M.) at Mansalay, Mindoro.

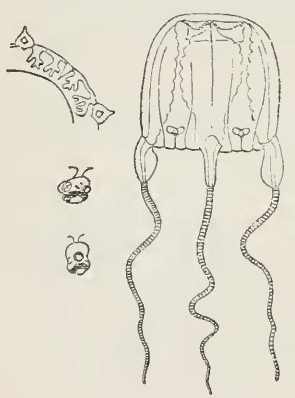

Fig. 2.—Carybdea rastonii from the Hawaiian Islands. Two views of its sense-clubs and a quadrant of the velarium, showing the branched velar canals.

This is the commonest Cubomedusa of the tropical Pacific, being widely distributed from South Australia to the Hawaiian Islands. It can be recognized by its prismatic, 4-sided bell, the 4 pedalia being about one-fourth to one-third as long as the bell-height, flat and spatula-shaped and about three-fifths as wide as long. The sense-clubs have each 2 large median eyes and 4 small lateral ocelli. There are 4 short, branched, non-anastomosing velar canals in each quadrant of the velarium, 16 in all. Four very small branched tufts of gastric cirri. This medusa is very closely allied to *Carybdea marsupialis* of the Mediterranean, but is distinguished by having only 16 instead of 24 to 30 velar canals, and by its somewhat more slender pedalia. In both forms the bell is dull milky yellow and the flexible parts of the tentacles are pink. In common with other Cubomedusae it comes to the surface when mature and is then abundant in harbors. The young usually remain in deep water at or near the bottom.

CARYBDEA ALATA, var. GRANDIS Agassiz and Mayer.

Charybdea grandis Agassiz and Mayer, 1902, Mem. Museum Comp. Zoöl. at Harvard College, vol. 26, p. 153, pl. 6, figs. 26–31.

Carybdea alata, var. *grandis* Mayer, 1910, Medusae of the World, vol. 3, p. 511, fig. 329.

The bell of this medusa becomes 230 mm. high, but the largest specimen of this cruise was obtained by the *Albatross* in Borneo and is only 166 mm. high. This tropical Pacific form may be distinguished by its short, wide-flaring pedalia and by having only 1 or 2 median eyes upon each sense-club and no lateral eyes. When young, however, there are 2 large median and 2 small lateral eyes, but the latter appear to fuse later with the median eyes. There are 24 velar canals which are short, branched, and non-anastomosing. *C. moseri* Mayer is only a half-grown stage of this medusa. In *C. alata* there are 6 eyes in each sense-club, and the pedalia are longer and narrower than in the large variety grandis.

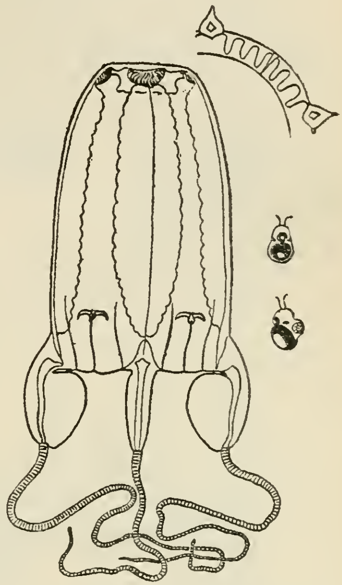

Fig. 3.—Carybdea alata, half-grown medusa from the Hawaiian Islands. Two views of its sense-clubs and a quadrant of the velarium, showing the straight simple velar canals.

The dimensions and characters of the two largest of the three specimens found by the *Albatross* are as follows:

	Station 5361, Feb. 9, 1909, Manila Bay, Luzon, 12 fathoms, 2 specimens. Cat. No. 28713 U.S.N.M.	D. 5594, Sept. 30, 1909, off Mount Putri, Borneo.
Height of bell	120	166.
Width of bell	88	144.
Length of pedalia	38 along inner side	77 along outer side. 36 along inner side.
Width of pedalia at widest part	16.5	29.
Width of pedalia at base	14	
Height of sensory niche above velar margin	16	31.
Number of eyes in each sense-club	2 median, no lateral eyes	2 median, no lateral eyes.
Gonads	Small, immature	Small.

Genus CHIROPSALMUS L. Agassiz, 1862.

Chiropsalmus L. AGASSIZ, 1862, Contr. Nat. Hist. U. S., vol. 4, p. 174.—MAYER, 1910, Medusae of the World, vol. 3, p. 515.

Generic characters.—Carybdeidae with four interradial, branching pedalia which give rise to a number of tentacles. Four wide perradially situated stomach pockets in the subumbrella, each of which gives rise to finger-shaped, unbranched, hernialike pouches, which project into the bell cavity. Wide, marginal pouches and numerous canals in the velarium. Eight leaf-shaped gonads.

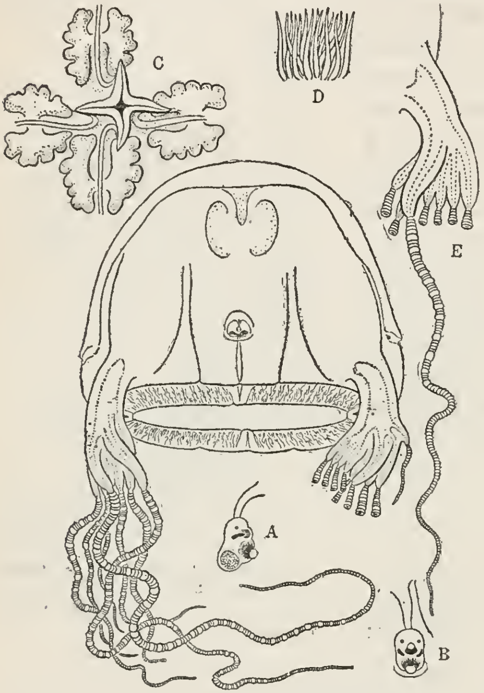

FIG. 4.—CHIROPSALMUS QUADRIGATUS FROM THE PHILIPPINE ISLANDS. *A, B,* VIEWS OF SENSE-CLUB. *C,* VIEW LOOKING DOWN ON THE CRUCIFORM MOUTH. *D,* GASTRIC CIRRI. *E,* BRANCHED PEDALIUM WITH SEVERED TENTACLES.

CHIROPSALMUS QUADRIGATUS Haeckel.

Chiropsalmus quadrigatus HAECKEL, 1880, Syst. der Medusen, p. 447.—MAYER, 1910, Medusae of the World, vol. 3, p. 516, fig. 331.—LIGHT, 1914, Philippine Journ. Science, vol. 9, p. 197.

The 44 specimens of this medusa were collected by the *Albatross* from the Philippines, but not one seems to be mature.

Light (1914) found this medusa at Culion Bay, Culion, and at Palawan, and thus it ranges widely in the Philippines. Light's specimens were larger than those found by the *Albatross*, being at least 200 mm. in diameter and usually with seven tentacles to each padalium. The tentacles are 1.5 meters or more in length and have lavander-colored bands of nematocysts. Light reports that the sting of this medusa is very severe and may even be fatal to man. The *Dactylometra* of the Philippines is also a dangerous form, but *Lobonema*, which some of the members of the *Albatross* expedition believed to be virulent, is not capable of inflicting a very severe sting.[1]

[1] Light, 1914, Philippine Journal of Science, vol. 9, pp. 291–295.

The following is a record of specimens of *Chiropsalmus quadrigatus* obtained by the *Albatross* in the Philippine Islands:

Locality.	Date.	Height of bell in mm.	Width of bell in mm.	Number of tentacles upon each pedalium.	Remarks.
Subig Bay, Luzon, caught in a seine. Cat. No. 27911, U.S.N.M.	1908 Jan. 7	18	20	4, 4, 4, 4	No gastric saccules and no gonads.
Subig Bay, Luzon, caught in a seine. Cat. No. 27915, U.S.N.M.	...do....	70	80	9, 5, 8, 8	With well-developed but immature gonads; large cockscomb-shaped gastric saccules.
Cataingan Bay, Masbate, near shore. Cat. No. 27913, U.S.N.M.	Apr. 18	49	55	6, 6, 7, 7	Immature. The 8 gastric saccules only beginning to appear.
Do.	...do....	51	51	8, 6, 7, 5	Do.
Do.	...do....	40	20	6, 5, 6, 6	Do.
Mansalay, Mindoro. Cat. No. 27917, U.S.N.M.	June 4	97	100	8, 8, 8, 8	Apparently mature.
Point Jamelo, Southern Luzon, one specimen. Cat. No. 28700, U.S.N.M.	July 13	....	....	....	Immature. Caught in a seine at a depth of 150 feet.
Tilig Bay, Southern Luzon, one specimen. Cat. No. 28698, U.S.N.M.	July 14	....	....	....	Immature. Caught in a seine at a depth of 130 feet.
Malcochim Harbor, Linapacan Island, 7 specimens, Cat. No. 28696 U.S.N.M.	Dec. 18	86	95	6, 7, 8, 8	Cockscomb-shaped saccules. Gonads small.
Malcochim Harbor, Linapacan Island, 7 specimens. Cat. No. 28692, U.S.N.M.	Dec. 19	25.5	25	5, 6, 6, 6	No saccules. No gonads.
Beach near mouth of Malampaya River, Palawan Island, 2 specimens. Cat. No. 28699, U.S.N.M.	Dec. 26	75	83	8, 8, 8, 8	Cockscomb-shaped saccules. Gonads small.
Ulugan Bay, Palawan Island, near mouth of Baheli River, 6 specimens. Cat. No. 28691, U.S.N.M.	Dec. 28	....	....	....	All small. Caught in seines.
San Miguel Bay, east coast of Luzon, 8 specimens. Cat. No. 28695, U.S.N.M.	1909 June 14	76	74	7, 7, 7, 7	Immature. Cockscomb-shaped saccules.
		81	89	7, 7, 5, 5	Do.
		73	80	5, 7, 4 [1]	Do.
Bolinao Bay, west coast of Luzon, seine 130 feet, 13 specimens. Cat. No. 28694, U.S.N.M.	May 10	69	76	6, 7, 7, 7 [2]	Cockscomb-shaped saccules well developed. Immature gonads, very small. Height of sensory niche above margin, 11.5 mm.
		22	26	6, 6, 6, 5	No gastric saccules and no gonads. Bell more transparent than in adult. Sensory niche 3 mm. above margin.

[1] Lost. [2] Largest specimen.

Three other unmeasured specimens were obtained as follows: Two (Cat. No. 27914 U.S.N.M.) at Mati, Pujada Bay, Mindanao, May 15, 1908; and one (Cat. No. 27916 U.S.N.M) at Panabutan Bay, Mindanao, February 6, 1908.

Genus PERIPHYLLA Steenstrup, 1837.

Periphylla Steenstrup, 1837, Acta et Cat. Mus. Hafniensis.—Mayer, 1910, Medusae of the World, vol. 3, p. 543.—Browne, 1910, National Antarctic Expedition, vol. 5, Medusae, p. 42.

Generic characters.—Coronatae with 4 interradial rhopalia and 12 tentacles, 4 perridial and 8 adradial, 16 marginal lappets grouped into 4 pairs of rhopalar, and 4 pairs of tentacular lappets. A deep annular furrow separates the dome-like apex of the exumbrella from marginal zone of bell. Between this ring-furrow and the lappets is a zone of 16 pedalia, 12 in the tentacular and 4 in the rhopalar radii, and these are separated one from another by 16 deep, radiating clefts which extend down the mid-axial lines of the lappets. There are four deep, interradial subgenital pits in the floor of the subumbrella, lined above their edges by rows of internal gastric cirri. The large central stomach extends peripherally outward into the subumbrella in the four perradii. These four openings lead into a wide ring-sinus in the subumbrella, which in turn sends out a radiating vessel in the radius of each tentacle and rhopalium, 16 in all. These vessels fork before reaching the tentacles or rhopalia, and their diverging ends curve around the edges of the lappets and form a marginal ring-canal.

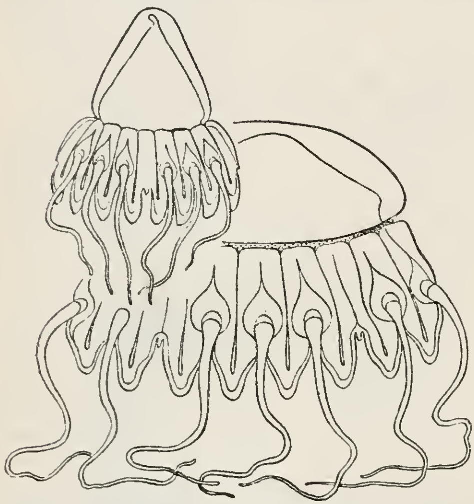

Fig. 5.—Periphylla hyacinthina from the Hawaiian Islands, showing range in slope of the bell.

I believe that *Periphylla hyacinthina* can not be separated specifically from *P. dodecabostrycha*. The shape of the bell is quite variable, and when large the medusa usually becomes relatively flat and domelike, whereas it is relatively high and conical when young. *P. hyacinthina* is said to be densely pigmented with purple-brown so that the gonads can not be seen through the bell walls, whereas *P. dodecabostrycha* is said to be less densely colored and semitranslucent. This distinction does not always apply, and certainly the degree of pigmentation appears to be quite independent of the shape of the bell, whether flat and domelike or high and pointed. Browne (1910), in his study of the Scyphomedusae of the National Antarctic Expedition, concludes that *P. dodecabostrycha* is probably only a large-growth phase of *P. hyacinthina*, and with this opinion I am heartily in accord.

PERIPHYLLA HYACINTHINA Steenstrup.

Periphylla hyacinthina Steenstrup, 1837, Act. Mus. Hafniensis.—Mayer, 1910, Medusae of the World, vol. 3, p. 543, figs. 342 and 343.

Periphylla hyacinthina forma *dodecabostrycha* Mayer, 1910, Medusae of the World, vol. 3, p. 546.

The *Albatross* obtained 21 specimens of this common deep-sea medusa among the Philippine Islands between depths of 338 and 1,291 fathoms, as follows:

Station.	Date.	Depth.	Character of bottom.	Size and number of specimens.	Variety.
D 5201 and D 5203, Cat. No. 28704, U.S.N.M., off Limasaua Island.	1908. Apr. 10	*Fathoms.* 554-775	Gray sand and mud and green mud.	2 large, 190 mm. wide, 105 high.	*Dodecabostrycha.*
D 5373, near Marinduque Island, about 15 miles off shore. Cat. No. 28705, U.S.N.M.	1909. Mar. 2	338	Soft sand	2 large	Do.
D 5379, about 37 miles off Mompog Island, near Marinduque Island. Cat. No. 28706, U.S.N.M.	Mar. 4	920		4 medium	Do.
D 5471, from about 15 miles off Point, Light, east coast of Luzon. Cat. No. 28738, U.S.N.M.	June 19	568			*Hyacinthina.*
D 5486, from 6 miles off Batobobo Point, Panaon Island.	July 31	585		7 large and medium.	*Dodecabostrycha.*
D 5497, about 10 miles off Bantigui Island.	Aug. 3	960	Green mud and fine sand.	1 large	Do.
D 5507, off northern Mindanao. Cat. No. 28703, U.S.N.M.	Aug. 5	425	do	2 medium	Do.
D 5628, Pariente Strait, about 7 miles from St. Lamo Island. Cat. No. 28707, U.S.N.M.	Nov. 30	1,291	Gray mud	1 medium	*Hyacinthina.*
D 5647, Buton Strait	Dec. 16	519	Green mud	do	Do.
D 5652, Gulf of Boni	Dec. 17	525		do	Do.

Genus LINUCHE Eschscholtz, 1829.

Linuche Eschscholtz, 1829, Syst. der Acalephen, p. 91.—Mayer, 1910, Medusae of the World, vol. 3, p. 557.

Generic characters.—Coronatae with 8 rhopalia, 4 perridial, and 4 interradial. Eight tentacles, 16 marginal lappets; with hernia-like sacs of the gastrovascular cavity protruding from the floor of the subumbrella. Eight gonads grouped in four pairs close to the four perradii. The central stomach opens by four perradial ostia into a ring-sinus, which in turn breaks up into 16 branching, radiating pouches in the lappets. A marginal ring canal is present in the Pacific *L. aquila*, and according to Vanhöffen also in *L. unguiculata* of the Atlantic, but I believe it is not always present in the Atlantic form, for I am unable to demonstrate it by inflation of the pouches with air in the living or recently preserved specimens.

LINUCHE UNGUICULATA, var. AQUILA Mayer.

Linerges aquila Haeckel, 1880, Syst. der Medusen, p. 496.
Linuche aquila Mayer, 1910, Medusae of the World, vol. 3, p. 560, figs. 356 B and C.
Linuche unguiculata Vanhöffen, 1913, Zoologischen Jahrbüchern, Suppl. 11, Heft 3, p. 429.
Linuche ungiculata forma *aquila* Mayer, 1915, Publication No. 212, Carnegie Institution of Washington, p. 174, fig. 1, B and C.

This variety is widely distributed over the tropical Pacific and is closely related to the tropical Atlantic *L. unguiculata*, with which it is identical in form and dimensions, being about 13 mm. high and 16 mm. wide. It has 48 wartlike protuberances upon the subumbrella arranged in two rows instead of in three, as is commonly the case in the Atlantic medusa. Eight of the subumbrella sacs in the variety *aquila* alternate with the gonads and eight arise from the sides of the gonads themselves. Thus, in the Pacific medusa we have two zones of protuberances — an inner zone of 16 large sacs and an outer of 32 small subumbrella saccules. The 16 large sacs lie in the midregions of the gonads, while the 32 small saccules lie at the zone of the outer ends of the gonads. In the Atlantic form the areas of brown cells are commonly developed only centrifugal to the zone of gonad, while in the Pacific variety they occur between the gonads as well as beyond them. A marginal ring canal is present. The Pacific variety is, however, found also in the Atlantic.

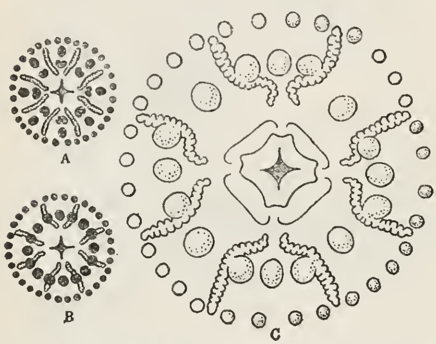

Fig. 6.—Linuche unguiculata. *A*, The usual arrangement of the subumbrella warts in the Tropical Atlantic form. *B*, The usual arrangement of the subumbrella warts in the Pacific form. *C*, Enlarged view of lips, gonads, and subumbrella saccules in the Pacific form from the Philippines.

Vast swarms of these Medusae are found among the Samoan, Fiji, and Paumotos Islands, and they extend to the coasts of Africa and to Queensland, Australia. They abound in Queensland in the spring months, in Fiji in December, and at Singapore in April. I have studied a large collection of these medusae taken in the Philippine Islands at Mactan, near Cebu, on April 6, 1908, Cat. No. 27944, U.S.N.M., by the United States Bureau of Fisheries steamer *Albatross*. All were mature.

Vanhöffen (1913) reported that he succeeded in demonstrating that a marginal ring canal is present in the Atlantic *L. unguiculata*, although after many tests I have been unable to detect its presence in living or freshly preserved animals, and am inclined to believe that the delicate membrane separating adjacent pouches was broken in Vanhöffen's specimens, which had been preserved for a long time in formalin. Moreover, Vanhöffen found that in some of the Atlantic medusae from the Bahama-Florida region the subumbrella warts are arranged as in *L. aquila* of the Pacific. It thus appears that the Pacific form is at best only a variety of the Atlantic species, and both should be called *Linuche unguiculata.*

Prof. E. G. Conklin in 1908[1] described the swarming habits, structure of the egg, and the segmentation in this medusa. The eggs are laid at 8 o'clock in the morning, after which the medusa sinks and soon dies. The segmentation is nearly equal and synchronous. The peripheral layer of oöplasm of the egg becomes the peripheral layer of the gastrula and gives rise to the cilia of the ectoderm. The intermediate layer gives rise to the principal part of all the cells of the gastrula, while the central part of the egg is the precursor of the cleavage cavity and serves as a kind of a fluid yolk for the nourishment of the surrounding cells.

Genus ATOLLA Haeckel, 1880, sensu Fewkes.

Atolla Haeckel, 1880, Syst. der Medusen, p. 488.—Fewkes, 1886, Report Commissioner of Fish and Fisheries of U. S. for 1884, p. 934.—Mayer, 1910, Medusae of the World, vol. 3, p. 561.—Browne, 1910, National Antarctic Expedition, Nat. Hist., vol. 5, Coelenterata, V. Medusae, p. 47.

Generic characters.—Coronatae with numerous (nine or more) tentacles and equally numerous marginal sense organs. Twice as many marginal lappets as sense organs. Eight adradial gonads and four interradial subgenital ostia. Four lips. The tentacles and marginal sense organs alternate regularly, but the insertions of the tentacles and their pedalia are higher up on the sides of the exumbrella than are the insertions of the pedalia of the sense organs.

The *Albatross* collection serves to show that *A. wyvillei* and *A. bairdii* are closely related if not mere extremes of an intergrading series of one and the same species. For example, two specimens from station D. 5652 in the Gulf of Boni, depth of 525 fathoms, have the margin of the central lens distinctly notched with radial furrows as in the typical *A. wyvillei;* but there is an annular ridge on the outer side of the ring-furrow with a plain peripheral margin as in *A. bairdii.* Also several other specimens show such very slight notches in the margin of the central lens that if one were not looking carefully for this feature it would surely pass unobserved and the medusa would be called *A. alexandri.* A large specimen of *A. gigantea*, from a depth of 519 fathoms in Buton Strait, shows affini-

[1] Papers from the Tortugas Laboratory of the Carnegie Institution of Washington, vol. 2, p. 155.

ties with *A. wyvillei*, *A. bairdii*, and *A. verrillii*. Thus the margin of its central lens is irregularly notched as in *A. wyvillei*, but without radial furrows. There is an annular ridge upon the outer side of the ring-furrow, and the outer edge of this ridge is simple and entire, as in *A. bairdii*, in about two-thirds of its circumference, and notched as in the typical *A. gigantea* in the remaining one-third. The central lens is more than half as wide as the medusa, as in *A. bairdii*, *A. verrilli*, and *A. valdiviae*.

It is evident that intergrading conditions prevail to a hopeless degree among many of the so-called "species" of *Atolla*. In fact, I think there are but two well-distinguished species: *A. bairdii* with smooth exumbrella and *A. chuni* with well-developed and quite regularly arranged papillae upon the exumbrella sides of the lappets. As a matter of convenience, however, we may distinguish *A. bairdii* var. *wyvillei* by the notched margin of its central lens, and the absence of a well-marked annular ridge on the outer side of its coronal furrow; for while there is often an annular ridge on the outer side of the ring-furrow, the margin of the central lens usually projects over it, overarching and concealing it from view. *A. bairdii* is a case where this ridge is so well developed that it projects beyond the margin of the central lens.

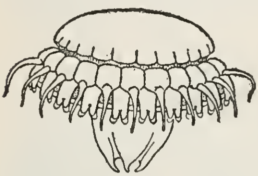

Fig. 7.—Atolla bairdii, var. wyvillei from the Philippines, Gulf of Boni; depth, 492 fathoms.

Some 35 specimens of *Atolla* were found by the *Albatross* among the Philippine Islands; and of these 18 are more or less typical *A. wyvillei*, 4 are intermediate in condition between *A. wyvillei* and *A. alexandri*, 3 are intermediate between *A wyvillei* and *A. bairdii*, 1 combines the characters of *A. bairdii* with the forma *valdiviae*.

The specimen of *Atolla gigantea*, Cat. No. 28690, U.S.N.M., which shows affinities with *A. bairdii* and *A. verrillii*, was dredged at Station D. 5647, from Buton Strait, about 11.6 miles off North Island, depth 519 fathoms, bottom green mud. This medusa is a large one, being 130 mm. wide and with 29 tentacles. The diameter of the central lens is 94 mm. and the thickness of its gelatinous substance 21 mm. The margin of the central lens is irregularly notched, but is without distinct radial furrows. Its margin overarches the ring-furrow, which is 15 mm. deep. The outer edge of the ring-furrow exhibits an annular ridge, which is, however, overarched and hidden under the projecting margin of the central lens. Two-thirds of the circumference of the peripheral edge of this annular ridge is entire and plain, as in *A. bairdii*, but about one-third of it is notched, the notches tending to lie in the radii of the tentacular pedalia, as in the typical *A. gigantea*.

Other dimensions of this medusa (given in millimeters) are as follows: Tentacular pedalia, 11.5 long, 10.5 wide; rhopalar pedalia, 11.5 long, 8.5 wide; diameter across subumbrella to outer edge of ring-muscle, about 126; width of ring-muscle, 77.5; diameter across zone of gonads, about 96 (each gonad is circular, disk shaped, and about 15 in diameter, the medusa being a female and apparently nearly mature); diameter across central stomach, about 66; length of manubrium, 46.

It thus appears that in this specimen the central lens is more than half as wide as the medusa, as in *A. bairdii* and *A. verrillii*, its outer margin being slightly notched as in *A. bairdii* and *A. valdivae.* The annular ridge is probably concealed under the overarching edge of the central lens, as in *A. wyvillei* and *A. verrillii.* Part of the outer edge of the annular ridge is entire and even, as in *A. bairdii* and *A. valdiviae*, and part of it is notched and furrowed, as in the typical *A. gigantea.*

It is probable that most of the so-called specific distinctions between the various *Atollas* are mere individual peculiarities of no greater specific value than the difference between blue eyes and brown in man.

List of stations among the Philippines from which specimens of Atollas allied to A. wyvillei were obtained.

D 5201, April 10, 1908, from Sogod Bay, Southern Leyte Island, depth 554 fathoms, bottom gray sand and mud. One typical *A. wyvillei* with 23 tentacles. Dimensions given in table. Cat. No. 28231, U.S.N.M.

D 5285, July 20, 1908, about 17.5 miles off Malavatuan Island in the China Sea, depth 272 fathoms, bottom soft mud. Eleven specimens of medium size, not well preserved, but all are probably *A. wyvillei.* Cat. No. 28685, U.S.N.M.

D 5348, December 27, 1908, in Palawan Passage. about 33.5 miles from Point Tabonan, depth 375 fathoms, bottom coarse sand. One specimen too imperfect for accurate specific determination. Cat. No. 28681, U.S.N.M.

D 5471, June 19, 1909, about 15 miles off Sialat Point Light on the east coast of Luzon, depth 568 fathoms. Two specimens closely allied to *A. alexandri*, one with 29 and the other with 26 tentacles. The dimensions of both are given in the table. Cat. No. 28686, U.S.N.M.

D 5486, July 31, 1909, about 6 miles off Batobolo Point, between Leyte and Mindanao, depth 585 fathoms. Four badly preserved specimens, too imperfect for specific determination. Cat. No. 28708, U.S.N.M.

D 5493, August 2, 1909, about 5.5 miles off Diuata Point, between Leyte and Mindanao, depth 478 fathoms, bottom green mud. Four specimens of *A. wyvillei.* The largest was 60 mm. wide, central lens 44 mm. wide with indented margin, 22 tentacles each 21 mm. long. Another medusa was 50 mm. in diameter, central lens 29.5, with indented margin and 23 tentacles. Another medusa was 42 mm. in diameter, central lens 33 mm. wide with distinct radial furrows and notched margin, 24 tentacles. The smallest medusa was 31 mm. wide, central lens 21 mm. wide with radial furrows and notched margin, 23 tentacles. Cat. No. 28689, U.S.N.M.

D 5533, August 19, 1909, between Cebu and Siquijor, about 9.5 miles off Balicasag Island, depth 432 fathoms, bottom green mud and sand. One specimen of *A. wyvillei*. Cat. No. 28684, U.S.N.M.

D 5631, December 2, 1909, south of Patiente Strait, about 4.5 miles off Doworra Island, depth 809 fathoms, bottom green mud. One specimen approaching condition of *A. alexandri* in having no distinct indentations or furrows at the margin of the central lens. The dimensions of this specimen are given in the table. Cat. No. 28682, U.S.N.M.

D 5650, December 17, 1909, in the Gulf of Boni, about 12.5 miles off Lamulu Point, depth 540 fathoms, bottom green mud. One specimen distorted by pressing upon the bottom of the bottle in which it was preserved, so that its specific affinities can not be determined with accuracy. The medusa was 60 mm. wide, central lens 42 mm. wide, with a few faint indentations in its margin. Twenty-four tentacles. Cat. No. 28683, U.S.N.M.

D 5652, December 17, 1909, in the Gulf of Boni about 7.5 miles off Lamulu, depth 525 fathoms, bottom green mud. Four specimens, one of which is 89 mm. wide with 31 tentacles and is an *A. wyvillei* approaching the condition of *A. alexandri*. Its dimensions are stated in the table. Another specimen has five furrows in the margin of its central lens, but there is a plain-edged, projecting annular ridge on outer side of ring furrow, as in *A. bairdii*. It thus combines characters of *A. wyvillei* with those of *A. bairdii*. This medusa is 51 mm. wide and has 29 tentacles. Two other specimens, one 33 and the 37 mm. in diameter, have each 20 tentacles, with the margins of their central lenses notched as in *A. wyvillei*, while they have well-developed annular ridges which project beyond the margin of the ring furrow, resembling *A. bairdii* in this respect. Cat. No. 28687, U.S.N.M.

D 5657, December 19, 1909, in the Gulf of Boni, about 15.5 miles off Oland Point, depth 492 fathoms, bottom gray mud. One specimen of *A. wyvillei* 54 mm. wide, central lens 41 mm. wide, 25 tentacles. Cat. No. 28688, U.S.N.M.

Dimensions (in mm.) of some specimens of nontypical and typical A. wyvillei, collected by the "Albatross" in the Philippine Islands.

	Forma *A. wyvillei* approaching the condition of *A. alexandri*.[1]	Typical *A. wyvillei*.[2]	*A. wyvillei* approaching *A. alexandri*.[3]	*A. wyvillei* approaching *A. alexandri*.[4]	
Diameter of entire medusa	89	55	68	91	44
Thickness of bell	15	26	....	19	8
Number of tentacles	31	23	23	29	25
Diameter of central lens of exumbrella	51	40	45.5	54	25
Condition of margin of central lens of exumbrella	(5)	(6)	(7)		(8)
Depth of coronal furrow	13	3	....	9.5	4
Length of tentacular pedalia	7	6.5	5.75	8.25	6
Width of tentacular pedalia	6.5	6	6.75	7.5	4.5
Length of rhopalar pedalia	6.5	6.5	6.75	6.25	3.5
Width of rhopalar pedalia	5	5	5.25	5.75	3
Length of marginal lappets	8	....	....	....	....
Length of tentacles	19	13	14	....	....
Diameter to outer edge of ring-muscle of subumbrella	73	48	56.5	75	39
Width of subumbrella ring-muscle	5.5	3	4	4.5	2.75
Diameter across zone of gonads	47	28.5	38	50.5	25.5
Dimensions of each gonad (circumferential×radial)	....	7×5	(9)	....	....
Diameter of central stomach	37	21	24	37	18
Length of manubrium	22	22	....	42	

[1] D 5652, Dec. 17, 1909, Gulf of Boni, depth 525 fathoms, near Lamulu.
[2] D. 4201, Apr. 10, 1908, south end of Leyte Island, depth 554 fathoms.
[3] D. 5631, Dec. 2, 1909, south of Pariente Strait, depth 809 fathoms.
[4] D 5471, June 19, 1909, off Sialet Point Light, east coast of Luzon, 568 fathoms.
[5] Notched with about 5 more or less distinct radial furrows.
[6] Notched with 22 radial furrows.
[7] Only slightly wavy in places, no distinct notches.
[8] Faintly wavy in outline, no furrows.
[9] Spherical.

ATOLLA BAIRDII forma VALDIVIAE Vanhöffen.

Atolla valdiviae VANHÖFFEN, 1902, Wissen. Ergeb. deutsch. Tiefsee Expedition, Dampfer *Valdivia*, vol. 3, Lief. 1, p. 13, pl. 1, fig. 3; pl. 6, figs. 41–46.—MAAS, 1903, Schphomedusen der *Siboga* Expedition, Monog. 11, p. 17, pl. 1, figs. 3, 4; pl. 3, fig. 23; pl. 12, fig. 108.—MAYER, 1910, Medusae of the World, vol. 3, p. 565, fig. 358.

This form is very closely related to *A. bairdii*, but the central disk is only half as wide as the medusa, and the four septal nodes are wider than in *A. bairdii.*

The *Albatross* obtained three specimens (Cat. No. 27927, U.S.N.M.) of this medusa in the Philippine Island on April 10, 1908, at dredging station No. 5202, in Gogod Bay, depth 502 fathoms, bottom green mud. The characters and dimensions of these specimens are given by Mayer.[1]

Genus PELAGIA Péron and Lesueur, 1809.

Pelagia PÉRON and LESUEUR, 1809, Annal. du Mus. Hist. Nat. Paris, vol. 14, p. 349.—MAYER, 1910, Medusae of the World, vol. 3, p. 570.

Generic Characters.—Semaeostomata of the family Pelagidae, in which the central stomach gives rise to 16 completely separated radiating pouches, 8 in the radii of the tentacles and 8 in the radii of the sense-organs. There are 8 adradial tentacles, 8 rhopalia, and 16 partially cleft marginal lappets. Each of the 16 stomach pouches is cleft at its distal end, where it enters the marginal lappets. There is no ring-canal.

PELAGIA PANOPYRA Péron and Lesueur.

Medusa panopyra PÉRON and LESUEUR 1807, Voyage aux terres Australes, pl. 31, fig. 2.

Pelagia panopyra MAYER, 1910, Medusae of the World, vol. 3, p. 575.

This widely distributed tropical Pacific species is distinguished by its small, low, rounded exumbrella warts, which are elliptical in outline and have a longitudinal furrow with cross-foldings. The bell becomes about 50 mm. wide, and the esophagus is about as long as the bell-diameter, the mouth-arms being somewhat longer. In common with other species of *Pelagia*, the color is highly variable, but the bell is usually rose-colored or violet, and the nettling-warts are violet. The gonads are usually purple and the mouth-arms violet.

There are 21 specimens of this medusa in the collection of the *Albatross* from the Philippines; 10 (Cat. No. 28719, U.S.N.M. are from Station 5422, March 30, 1909, from a tow made at a depth of 15 feet below the surface, about 10 miles off Lusaran Point Light, between Panay and Guimaras; the largest specimen is 33 mm. wide and with large gonads, while another 28 mm. wide has only small gonads. Eleven young specimens (Cat. No. 28716, U.S.N.M.) were

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[1] Medusae of the World, vol. 3, p. 565.

obtained at Station D5220, April 24, 1908, on the surface between Luzon and Marinduque at 12.57 p. m. These are all small and about 10 mm. in diameter, evidently being taken from a swarm of immature individuals.

Genus CHRYSAORA Péron and Lesueur, 1809.

Chrysaora Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat., Paris, vol. 14, p. 364.—Mayer, 1910, Medusae of the World, vol. 3, p. 577.

Generic Characters.—Pelagidae with 8 marginal sense-organs, 24 (3×8) tentacles, and typically 32 (4×8) marginal lappets; although in *C. malanaster* the lobes may still further divide, giving 48 (6×8) marginal lappets.

CHRYSAORA MELANASTER Brandt.

Chrysaora melanaster Brandt, 1838, Mém. Acad. Sci. St. Petersburg, Sci. Nat., sér. 6, vol. 4, p. 385, pls. 16, 17.—Mayer, 1910, Medusae of the World, vol. 3, p. 582.

There is a well-preserved specimen of this medusa from station D5461, June 14, 1909, San Miguel Bay, east coast of Luzon, depth 11 fathoms (Cat. No. 28712, U.S.N.M.). The bell is about 130 mm. in diameter and slightly flatter than a hemisphere. There are 16 radiating spoke-like streaks of faint umber color extending from near the apex of the exumbrella to the bell-margin in the radii of the 16 cleft velar lobes. These 16 streaks occupy depressed radial areas sunken below the general level of the contour of the exumbrella, and they are besprinkled coarsely with wart-like nematocyst clusters of cinnamon-brown color.

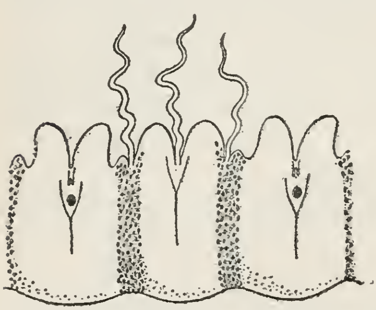

Fig. 8.—Chrysaora melanaster. An octant of the bell margin. San Miguel Bay, east coast of Luzon.

There are 8 rhopalia, 3×8 tentacles, and 6×8 marginal lobes. The velar lobes are cleft as in Brandt's figures and are nearly similar in shape and size to the ocular lappets. They are, however, not narrower at the base than outwardly, as in Brandt's figures, but are oval and taper quite regularly from base to tip.

The tentacles are short and slender, the longest being not over 60 mm.

The mouth-arms are long and slender, folded complexly, and about 170 mm. long. The gonads are well developed, apparently mature, and protrude through the subgenital ostia, the subgenital ostia being fully twice as wide as the perradial columns between them. Thus each ostium is 28 mm. long (circumferentially) and 15 mm. wide (radially), while the perradial columns of the mouth-arms are only 13 mm. wide.

In formalin the general color of the medusa is milky custard-yellow, the gonads being lighter. The apex of the exumbrella is besprinkled with cinnamon-colored nematocyst warts, and the 16 radial streaks of light umber color are also besprinkled with brown-colored clusters of nematocysts. This medusa is widely distributed over the north Pacific from Kamtschatka to California, but this Philippine Island specimen is the first which has been obtained in the tropics.

Genus DACTYLOMETRA L. Agassiz, 1862.

Dactylometra L. Agassiz, 1862, Contributions to Nat. Hist. U. S., vol. 4, p. 166.—Mayer, 1910, Medusae of the World, vol. 3, p. 583.

Generic Characters.—Pelagidae with 8 rhopalia. 5×8 tentacles and 6×8 marginal lappets.

DACTYLOMETRA AFRICANA Vanhöffen.

Dactylometra africana Vanhöffen, 1902, Wissen. Ergeb. deutsch. Tiefsee Expedition, Dampfer *Valdivia*, vol. 3, Lief. 1, p. 40, pl. 4, fig. 20.—Mayer, 1910, Medusae of the World, p. 588.

Disk 100 to 130 mm. wide with exumbrella thickly covered with wart-like clusters of nettling cells. Six well-developed marginal lappets and five long tentacles in each octant. Lappets and tentacles red. Red radial streaks over exumbrella. Esophagus, palps, and gonads not highly colored. Colors of large specimens duller and more brownish than those of small medusae and not unlike the coloration of *D. quinquecirrha.* Distinguished by its lappets being deeply pigmented near the margin on the exumbrella side.

Vanhöffen's specimens came from the Great Fish Bay, coast of German southwest Africa, in October, 1898. Five specimens (Cat. No. 28679, U.S.N.M.), all imperfect, the largest about 105 mm. in diameter and with only 3×8 tentacles and 4×8 marginal lappets, were found by the *Albatross* at station D5461, June 14, 1909, at a depth of 12 fathoms, about 7.2 miles off Corregidor Light, Manila Bay, Luzon. The bells are pinkish in hue, and thickly and uniformly besprinkled over the exumbrella with red-brown mematocyst warts. The lappets are edged on the exumbrella side with reddish brown. The tentacles have been lost and the mouth parts are imperfect.

Another specimen (Cat. No. 28680, U.S.N.M.), 166 mm. in diameter and with mouth-arms 280 mm. long, was found at Kowloon, China, on August 14, 1908. It was 3×8 tentacles, and 6×8 marginal lappets, the lappets being edged on their exumbrella margins with russet brown.

Light[1] records a *Dactylometra* from the Philippines which he believes is identical with *D. quinquecirrha*. The bell is white, translucent, and covered on the exumbrella with minute white spots.

Light's specimens were all in the *Chrysaora* stage with 24 tentacles and 32 marginal lappets. The sting which this medusa inflicts is apparently far more severe than that given by the *Dactylometra* of our American coast.

Genus SANDERIA Goette, 1886.

Sanderia GOETTE, 1886, Sitzungsber. Akad. Wissen. Berlin, Jahrg. 1886, p. 835.—VANHÖFFEN, 1902, Wissen. Ergeb. deutsch. Tiefsee Expedition, Dampfer *Valdivia*, vol. 3, Lief. 1, p. 37.—MAYER, 1910, Medusae of the World, vol. 3, p. 580.

Generic Characters.—Pelagidae with 16 marginal sense-organs, 16 tentacles, and 32 cleft marginal lappets. Four lips, 4 interradial

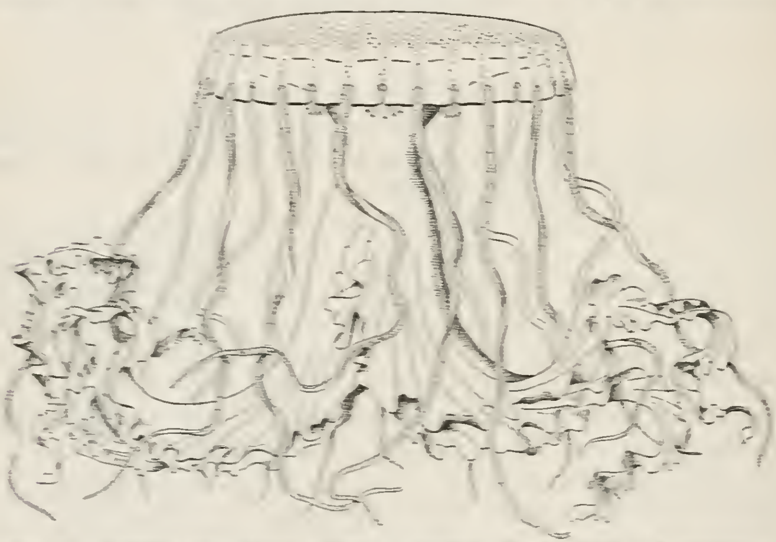

FIG. 9.—SANDERIA MALAYENSIS, AFTER VANHÖFFEN IN "VALDIVIA" EXPEDITION.

gonads, and 32 peripheral stomach-pouches in the radii of the tentacles and sense-organs. No marginal ring-canal.

SANDERIA MALAYENSIS Goette.

Sanderia malayensis GOETTE, 1886, Sitzungsber. Akad. Wissen. Berlin, Jahrg. 1886, p. 835.—VANHÖFFEN, 1902, Wissen. Ergeb. deutsch. Tiefsee Expedition, Dampfer *Valdivia*, vol. 3, Lief. 1, p. 38, pl. 3, fig. 12; pl. 5, figs. 69–74.—MAYER, 1910, Medusae of the World, vol. 3, p. 580.

Found in the Indian Ocean, Gulf of Aden, at Singapore, and off the east coast of Africa. Some specimens of this medusa were found by the United States Fisheries Bureau steamer *Albatross* in the Philippine Islands between March and June, 1908.

[1] 1914, Philippine Journal of Science, vol. 9, p. 195.

A perfect specimen (Cat. No. 27947, U.S.N.M.), found by the *Albatross* on March 8, 1908, at station D5175, in the Sulu Sea, southeast of Cagayanes Islands, Philippine Islands, had a bell 75 mm. wide, palps 46 long, central stomach 35 wide, contracted tentacles 65 long, and with 25 to 30 finger-shaped projections upon each gonad.

One large imperfect specimen about 97 mm. in diameter is from station D5291, July 23, 1908, depth of 173 fathoms, about 2.2 miles off Escarceo Light, southern Luzon. Only 3 gonads are left. These have between 14 to 26 papillæ.

Eight other specimens of medium size are from station D5386, March 9, 1909 (Cat. No. 28727, U.S.N.M.). Depth 287 fathoms, about 25.3 miles off Arena Point, Ragay Gulf, Luzon.

One imperfect specimen (Cat. No. 28731, U.S.N.M.) is from station D5532, August 13, 1909, from between Masbate and Leyte. Bell about 73 mm. wide and with 26 to 29 finger-shaped processes on the gonads.

FIG. 10.—DISCOMEDUSA PHILIPPINA FROM CATAINGAN BAY, PHILIPPINE ISLANDS, APRIL 20, 1908.

One perfect specimen (Cat. No. 28726, U.S.N.M.) is from station D5456, June 7, 1909, east coast of Luzon, about 6.7 miles off Legaspe Light.

Genus DISCOMEDUSA Claus, 1877.

Discomedusa CLAUS, 1877, Denkschrift, Wien Acad., vol. 38, p. 42.
Ulmaris—*Umbrosa* HAECKEL, 1880, Syst. der Medusen, p. 545.
Umbrosa MAAS, 1908, Expédition Antarctique Française, Meduses, p. 9.
Discomedusa MAYER, 1910, Medusae of the World, vol. 3, p. 606.

Generic Characters.—Ulmaridae with 24 (3×8) tentacles, 32 (4×8) lappets, and 8 sense-organs. The tentacles arise from the clefts between the marginal lappets. There are 8 simple, unbranched, adradial canal, 8 branched, 4 perradial, and 4 interradial canals, and a marginal ring-canal.

DISCOMEDUSA PHILIPPINA Mayer.

Discomedusa philippina MAYER, 1910, Medusae of the World, vol. 3, p. 607, fig. 388.

This medusa bears a close resemblance to *Parumbrosa polylobata* Kishinouye (1910, Journal College of Science, Tokyo, Japan, vol. 27, art. 9, p. 19, pl. 4, figs. 20–23); but in Kishinouye's medusa the marginal lobes are still further divided, being 64 instead of 32 as in *D. philippina.* Moreover, the canal system appears to be less complex in its branching in *P. polylobata*, so that it seems probable that the two are distinct species, not mere growth-stages one of the other. Should this view prove erroneous, however, the medusa should be called *Parumbrosa polylobata* Kishinouye.

Six specimens were collected by Fisheries steamer *Albatross*, station 5213, Masbate Island, Philippine Islands, April 20, 1908. (Cat. No. 27948, U.S.N.M. Type.)

Genus AURELLIA Péron and Lesueur, 1809.

Aurellia Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat., Paris. vol. 14, p. 357.
Aurelia Lamarck, 1817, Syst. Anim. sans Vertebrés, vol. 2, p. 512.
Aurellia Mayer, 1910, Medusae of the World, vol. 3, p. 619.

Generic Characters.—Semaeostomata with a simple central mouth-opening, which is surrounded by four well-developed, perradially situated, unbranched mouth-arms or palps. Eight marginal sense-organs. The tentacles are small and alternate with an equal number of short lappets. Both tentacles and lappets arise from the sides of the exumbrella a short distance above bell-margin. The bell-margin is divided into 8 or 16 broad velar lobes. The central stomach gives rise to a number of branched, radiating canals which anastomose and are connected by a marginal ring-canal. There are four interradial gonads and four well-developed subgenital pits.

AURELLIA AURITA (Linnaeus).

Medusa aurita Linnaeus, 1758, Systema Naturae, ed. 10, vol. 1, p. 660.
Aurellia flavidula Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat., Paris, vol. 14, p. 369.
Aurellia aurita Lamarck, 1817, Hist. Anim. sans Vert., vol. 2, p. 513.—Mayer, 1910, Medusae of the World, vol. 3, p. 623.

Some 13 specimens of this universally distributed medusa were found by the *Albatross* among the Philippine Islands. Of these, 11 half-grown specimens (Cat. No. 28718, U.S.N.M.) are from station D 5663, December 28, 1909, in Macassar Strait, depth 11 fathoms, about 1.7 miles off Kapoposang Island, 7h. 20m. p. m., while 2 larger but still immature are from Station D 5662, December 21, 1909, Flores Sea, near Tana Keke Island, 5h. 40m. to 6h. 12m. a. m. There are only 8 notches in the bell margin corresponding to the 8 rhopalia, instead of 16 notches, 8 rhopalar and 8 inter-rhopalar as in *Aurellia labiata.*

Aurellia aurita is found in all seas from the Polar regions to the Tropics. In the Tropics it lives very close to its heat death-temperature, and thus it is barely able to survive in the surface waters of the warmer seas in summer. Romanes found that specimens of this medusa from the British seas can withstand being frozen solidly into ice, and I find this to be true also of this medusa from Halifax, Nova Scotia. At Halifax, on the other hand, the medusa ceases to pulsate at 29.4° C., at which temperature it is most active at Tortugas, Florida. On the other hand, the Florida medusa is killed by being frozen into the ice. Thus the medusa becomes somewhat acclimated to the temperature of the waters in which it lives, and if accustomed to warm water it loses its resistance to cold and the opposite.

AURELLIA LABIATA Chamisso and Eysenhardt.

Aurelia labiata Chamisso and Eysenhardt, 1820, Nova Acta Phys. med. Leop. Car., vol. 10, p. 358, pl. 28, figs. 1 A. B.

Aurellia labiata Mayer, 1910, Medusae of the World, vol. 3, p. 628, fig. 398.—Light, 1914, Philippine Journal of Science, vol. 9, p. 200.

Light (1914) records a specimen from the Philippines, the bell of which was 225 mm. in diameter.

Aurellia labiata differs from *A. aurita* by having 16 notches in its bell-margin, by its peculiar velum-like, interrhopalar, subumbrella membranes representing the true bell-margin, and by the very small size of its subgenital ostia. The mouth-arms are also shorter than one commonly observes them to be in *A. aurita*, and the terminal branches of the radial-canals anastomose to a greater degree than in *A. aurita*.

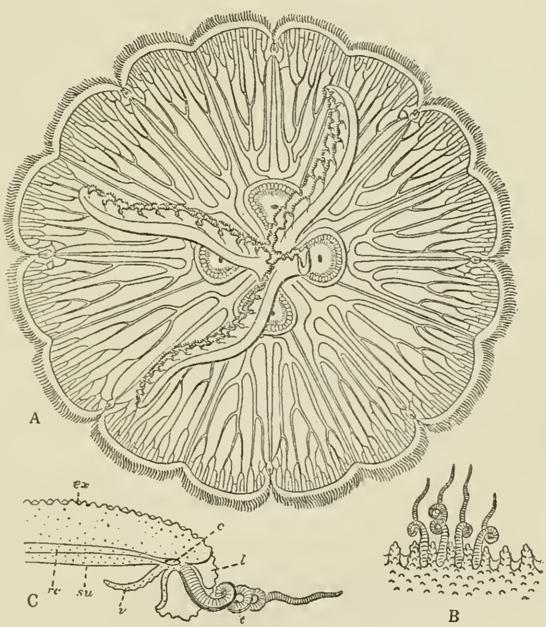

Fig. 11.—Aurellia labiata from the Philippines. *A*, Oral view showing the 16 notches in the bell margin. *B*, Aboral view of tentacles and lappets. *C*, Diagrammatic cross section of bell margin. *c*, ring canal; *ex*, exumbrella; *l*, lappets; *rc*, radial canal; *su*, subumbrella; *t*, tentacle; *v*, velarium.

The dimensions of three specimens, Cat. No. 27923, U.S.N.M., obtained by the United States Fisheries Bureau steamer *Albatross* at

Masbate Anchorage, Philippine Islands, on April 21, 1908, are as follows:

	mm.	*mm.*	*mm.*
Diameter of umbrella	174	189	128
Diameter across zone of gonads	57	53	42
Length of each mouth-arm	74	75	52

Four other specimens (Cat. No. 27979, U.S.N.M.) were caught at night upon the surface under the electric light at Jolo Anchorage, on February 8, 1908; while seven more (Cat. No. 27924, U.S.N.M.) were taken at *Albatross* station D 5230, between Bohol and Leyte, May 7, 1908.

An abnormal but perfect specimen of *Aurellia aurita* was found at Tortugas, Florida, on July 27, 1914. This aberration closely resembled the normal *A. labiata* of the Pacific. There were 16 deep notches in the bell-margin, 8 perradial and 8 interradial, and the velumlike marginal membrane was like that of *A. labiata.* The small subgenital ostia and simple mouth-arms also recalled *A. labiata;* but the terminal branches of the adradial-canal system did not anastomose and in this resembled *A. aurita* rather than *A. labiata.* The case is interesting, as it leads one to suspect that *A. labiata* of the Pacific has been derived as a mutation from the universally distributed *A. aurita.* The bell of this Tortugas medusa was 270 mm. in diameter; diameter of genital cross, 78 mm. Palps simple and each about one-eighth longer than the bell-radius. Eight sense organs, 8 interradial notches in the bell-margin. Eight straight, simple, non-pigmented perradial-canals, 8 straight pink-colored interradial-canals. The sparingly branched adradial-canals reach the bell-margin without anastomosing, and in this respect resemble those of *A. aurita.* The male gonads were pink, the tentacles rich purple, the velarium creamy white, the palps purple-pink, and the gelatinous substance pink.

Order RHIZOSTOMAE.

Scyphomedusae without marginal tentacles and with numerous mouths borne upon four dichotonously branched (eight) mouth-arms. Most of these forms are tropical and none are found in Arctic seas. They are the conspicuous large jellyfishes of harbors and coastal waters in the East Indies, although usually rare and represented by but few species in the West Indies.

Genus CASSIOPEA Péron and Lesueur, 1809.

Cassiopea Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat. Paris, vol. 14, genre 24, p. 356.—Mayer, 1910, Medusae of the World, vol. 3, p. 636.

Generic Characters.—Rhizostomata pinnata with eight (four pairs of) adradial, complexly branched mouth-arms, the lower or ventral surfaces of which bear numerous mouth-openings and vesicles. There are four gonads and four separate subgenital cavities. There are more than eight marginal sense-organs and twice as many radial-canals as sense-organs. The radial-canals are placed in communication one with another by means of an anastomosing network of vessels. A well-defined ring-canal may or may not be present, but is commonly absent.

CASSIOPEA ANDROMEDA, var. BADUENSIS Mayer.

Medusa andromeda FORSKÅL, 1775, Descript. que in Itinere Orientali Observait, Hauniae, p. 107, pl. 31.

Cassiopea andromeda ESCHSCHOLTZ, 1829, Syst. der Acalephen, p. 43.

Cassiopea andromeda, var. *baduensis* MAYER, 1915, Publication No. 212, Carnegie Institution of Washington, p. 183.

A specimen of this medusa (Cat. No. 28730, U.S.N.M.) is from Endeavour Strait, between Australia and New Guinea, and was found by the *Albatross* on December 23, 1908. The bell is 101 mm. in diameter, flat without an aboral depression, and with 18 rhopalia. There are four to eight, usually six, lappets between successive rhopalia. The arm-disk is octagonal, 36 mm. wide, and the eight mouth-arms are each 34 mm. long and definitely bifurcated, the forks being 16 mm. long, thus nearly half as long as the total length of the mouth-arms. There are no appendages among the mouth-arms, but these may have been lost. The color has wholly faded in formalin.

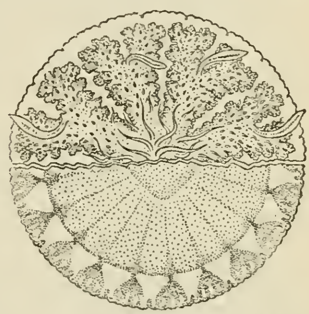

FIG. 12.—CASSIOPEA ANDROMEDA, VAR. BADUENSIS, FROM TORRES STRAIT, BADU ISLAND. ORAL VIEW ON THE RIGHT; ABORAL VIEW OF BELL ON THE LEFT.

Another specimen of this medusa was found at Badu Island, Torres Straits, Australia, within a few miles of Endeavour Strait, by the expedition of the Carnegie Institution of Washington, on November 5, 1913, and was studied alive, and is herewith figured.

The bell is 61 mm. in diameter. There are 22 marginal sense-organs and (5×22) 110 bluntly rounded, barely perceptible, evenly spaced marginal lappets all similar each to each. The arm-disk is about one-third as wide as the bell-diameter and the mouth-arms are compressed dorso-ventrally and when fully expanded extend slightly beyond the bell-margin, but in their ordinary state of contraction they do not quite reach the bell-margin. The side branches of these mouth-arms are short, but each arm is bifurcated at its outer end, the forked part being about one-third as long as the entire arm. There are about 20 slender, flat, tapering, central arm-disk appendages of various lengths, the longest of which is at the center of the oral side and is about as long as the bell-radius. There is also a spatula-shaped appendage at the crotch of bifurcation of each mouth-arm. These are somewhat stouter than the central appendages, about half as long as the bell-radius, and their entoderm is bluish. There are numerous, minute, spatulate appendages among the mouth-arms.

The general color of the bell of the medusa is olive-brown. There are 22 large, triangular white spots with forked outer ends near the bell-margin in the radii of the sense-organs, and also (3×22) 66 short white streaks near the margin in the radii of the velar lappets. There are 22 interradial, dull bluish streaks in the subumbrella alternating with the rhopalia in position.

This variety is distinguished by its bifurcated mouth-arms. Its nearest ally appears to be *Cassiopea andromeda*, var. *acycloblia* Schultze, from Amboina, but it differs in its color pattern, in the absence of a central dome, and in its simple bifurcated mouth-arms, those of the Amboina medusa branching dichotomously.

Cassiopea andromeda is the common species of the Indian Ocean, Red Sea, and Malay Archipelago, and Kellar records its having wandered into the Suez Canal. It gives rise to numerous local varieties.

There are evidently a number of other varieties of *Cassiopea* in the Philippines, for Light[1] describes *Cassiopea polypoides*, var. *culionensis*, *C. polypoides?*, and *C. medusa*, new species. The last named is distinguished by its very large mouth-arm appendages, which in a medusa whose bell is 260 mm. in diameter are 110 mm. long and 7.5 mm. in diameter, being cylindrical near the base and flattened at their outer ends. *C. medusa* is described from Culion Bay, Culion, Philippine Islands.

Genus CEPHEA Péron and Lesueur, 1809.

Cephea Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat., Paris, vol. 14, p. 360.—Mayer, 1910, Medusae of the World, vol. 3, p. 651.

Generic Characters.—Rhizostomata dichotoma in which the eight mouth-arms fork once dichotomously and each fork gives rise to short dichotomous or dendritic branches. Solid, wart-shaped tubercles at the center of the exumbrella. The central stomach gives rise to eight rhopalar and numerous inter-rhopalar radial-canals, all of which connect with a network of anastomsing vessels in a wide zone near the margin. Rhopala without ocelli and without sensory pits on the exumbrella. There is no definite ring-canal. Development unknown.

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[1] 1914, Philippine Journal of Science, vol. 9, p. 201.

CEPHEA OCTOSTYLA (Forskål).

Medusa octostyla FORSKÅL, 1775, Descript. Anim. Itin. Orient., p. 106, No. 18, Icon., pl. 29.

Cephea octostyla MAYER, 1910, Medusae of the world, vol. 3, p. 652, fig. 405.

A number of well-preserved specimens of *Cephea octostyla* were obtained by the following localities:

Jolo, Philippine Islands, February 8, 1908, 1 specimen. Cat. No. 27906, U.S.N.M.

Jolo Anchorage, Philippine Islands, February 13, 1908, 3 specimens. Cat. No. 27908, U.S.N.M.

Jolo Anchorage, Philippine Islands, March 5, 1908, 1 specimen. Cat. No. 27907, U.S.N.M.

Station 5173, Jolo, Philippine Islands, March 5, 1908, 9 specimens. Cat. No. 27910, U.S.N.M.

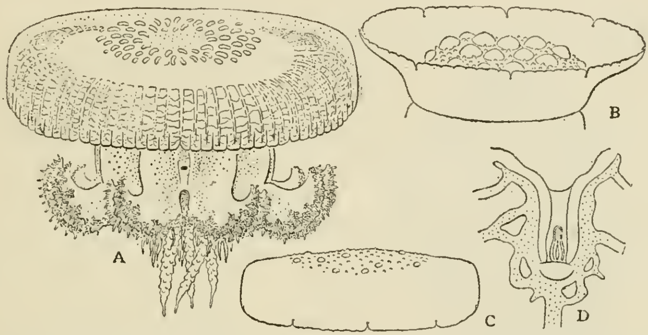

FIG. 13.—CEPHEA OCTOSTYLA FROM JOLO ANCHORAGE, PHILIPPINE ISLANDS. *A, B,* AND *C,* VARIATIONS IN THE DEVELOPMENT OF THE CENTRAL WARTS OF THE EXUMBRELLA. *D,* RHOPALIUM FROM THE SUBUMBRELLA SIDE.

Bell 90 mm. wide, exumbrella flat, rim vertical, 20 mm. high. Near the center of the exumbrella there is a zone of numerous low wart-like protuberances, leaving the exact center smooth. Eight rhopalia without ocelli and without sensory pits. Seven velar and two ocular lappets in each octant, all similar each to each and indistinct rectangular in outline and separated by very slight indentations spanned by a web. Fairly deep grooves extend up the vertical rim of the exumbrella surface of the bell between the lappets.

Arm disk as wide as the bell radius. At its center 4 to 12 or more tapering, somewhat flattened, wart-covered filaments about one-fourth as long as the bell diameter. Each filament terminates in a simple, slender, pointed end. There are also numerous simple short filaments ranging from 15 to 5 mm. in length near the center of the arm disk, and in addition many still shorter arms between the numerous frilled mouths of the mouth arms.

Four small subgenital ostia and a unitary genital cavity. Ring muscles of subumbrella entire, but weakly developed. Eight rhopalar and (8×7) somewhat narrower radial canals all connected by anastomosing side branches. The eight rhopalar canals lead straight out to the rhopalia, but the 56 inter-rhopalar canals tend to lose themselves in the network of vessels. No distinct ring canal. Numerous small yellowish spots over the exumbrella and reddish brown dots over the outer surface of the arm disk and reddish-brown streaks around the warts of the exumbrella.

CEPHEA CEPHEA, var. COERULEA, atypical.

Cephea coerulea VANHÖFFEN, 1902, Wissen. Ergeb. deutsch. Tiefsee Expedition *Valdivia*, vol. 3, Lief. 1, p. 45, fig. 13, 14.—MAYER, 1910, Medusae of the World, vol. 3, p. 657.

One well-preserved specimen of this medusa was found by the *Albatross* at Station D 5457, June 8, 1909, 5 miles off Legaspi Light, east coast of Luzon. Cat. No. 28715, U.S.N.M.

The bell is flat, 109 mm. wide, with a low dome-like apex 34 mm. wide, which is completely covered with long, conical, wart-shaped protuberances. There are two small ocular and eight completely fused velar lappets in each octant, forming mere thickenings on the exumbrella side of the bell wall and bridged over on the subumbrella side by a web of tissue. The arm disk is 50 mm. wide and the mouth arms are laterally flattened, 29 mm. wide in the radial direction, and 44 mm. long. There are three to six slender filaments among the mouths of each mouth arm. These taper to pointed ends and the longest are only 13 mm. long. There are no filaments upon the central parts of the arm disk, but there are some at the bases of the mouth arms. The filaments are thus much smaller and less numerous than in Vanhöffen's *C. coerulea* from the east coast of Africa.

There are eight rhopalar radial canals which extend straight to the sense organs, and in addition there are from five to seven inter-rhopalar canals in each actant, which anastomose and lose their identity in a wide network of vessels which send branches to the rhopalar canals. The subgenital porticus is unitary. A color note states that the mouth arms were pale hyaline blue and raw umber.

CEPHEA, species.

Five specimens of *Cephea*, too poorly preserved to be determined specifically, were collected at the following stations:

April 25, 1909, from Manila Bay, surface.

April 29, 1909, from Manila Bay, behind the breakwater.

D 5452, June 7, 1909, off Legaspi Island, east coast of Luzon.

D 5453 June 7, 1909, off Legaspi Island, east coast of Luzon.

D 5461, June 14, 1909, Carino Island, east coast of Luzon.

Light (1914) records *Cephea cephea* from Manila Bay in January, 1912.

Genus COTYLORHIZA L. Agassiz, 1862.

Cotylorhiza Agassiz, L., 1862, Contr. Nat. Hist. U. S., vol. 4, p. 152.—Mayer, 1910, Medusae of the World, vol. 3, p. 658.

Generic Characters.—Rhizostomata dichotoma with eight simple, bifurcated mouth-arms, the ends of which branch pinnately. The four subgenital ostia are simple and funnel-shaped, and there is a single subgenital porticus. The appendages upon the mouth-arms are mounted upon pedunculated filaments. There are eight marginal sense-organs and numerous radial-canals which anastomose laterally without any definite ring-canal in the adult. The sense-clubs have no ocelli and no exumbrella sensory pit. There is a unitary peripheral zone of circular muscles and an inner zone of radial-muscles in the subumbrella. The exumbrella is smooth and without an aboral "sucker-like" depression, but with a prominent central dome without wart-shaped elevations upon it.

COTYLORHIZA PACIFICA Mayer.

Cotylorhiza pacifica Mayer, 1915, Publication No. 212. Carnegie Institution of Washington, p. 185.

A single specimen of this interesting medusa was obtained at the launch landing in Manila Bay, Luzon, Philippine Islands, on January 24, 1908 (Cat. No. 28729, U.S.N.M. type). Unfortunately it was cut into several pieces before being preserved, and this renders an attempt to study it unsatisfactory in many respects. The bell appears to have been about 200 mm. wide, exumbrella finely granular, with a central dome as in the Mediterranean *Cotylorhiza tuberculata.*

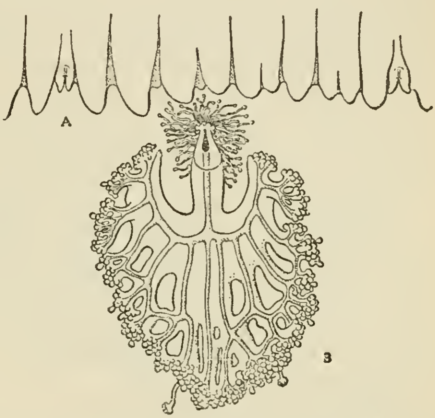

Fig. 14.—Cotylorhiza pacifica from Manila Bay, Luzon. *A*, An octant of the bell margin. *B*, Abaxial view of one of the mouth-arms.

There are 8 rhopalia without ocelli (in formalin), and without exumbrella pits, being similar in essential respects to those of *Cotylorhiza, tuberculata.* The rhopalar lappets are short and pointed. There are about eight irregularly spaced, bluntly pointed, large velar lappets in each octant, and deep furrows between them extend radially inward over the exumbrella, as in *C. tuberculata.* The velar lappets vary in length, but the largest are about twice as long and twice as wide as the ocular lappets.

The circular muscles occupy the entire zone of the subumbrella beyond the arm-disk. They are broken in the eight principal radii, and unlike *C. tuberculata* there are no radial muscles.

The arm-disk is about 100 mm. wide, the perradial columns being each 36 mm. wide. The subgenital ostia are much larger than in *C. tuberculata*, but they were so mutilated that one can not state their exact size, which appears, however, to be nearly that of the perradial columns themselves. The specimen having been cut into pieces, we can make no statement concerning the condition of the subgenital porticus.

The eight mouth-arms resemble those of *C. tuberculata*, but there are windowlike openings in the lateral membranes, as in *Lobonema smithii.* The total length of each arm is 81 mm., the upper arm being one-fourth as long as the lower arm. At their widest part the arms are about three-fourths as wide as they are long. The center of the arm disk is thickly covered with slender filamentous appendages which terminate in nematocyst-bearing, swollen, knoblike ends, as do the appendages of the mouth-arms of *C. tuberculata.* In this Philippine Island medusa the appendages of the outer parts of the mouth-arms much less numerous and smaller than in *C. tuberculata*, but are similar in general form to those of the Mediterranean medusa. The longest are about 15 to 20 mm. long.

The cruciform central stomach gives rise to about 140 radial-canals, the eight rhopalar canals being about twice as wide as the others, instead of being of the same caliber, as in *C. tuberculata.* All these canals anastomose in a network under the zone of the circular muscles. There is no distinct ring-canal. In formalin the specimen is dull uniform yellowish brown.

It differs from *Cotylorhiza tuberculata* in having no radial-muscles, and in the circular muscles being interrupted in the eight principal radii. The subgenital ostia and arm-disk are larger and the appendages of the mouth-arms smaller and fewer than in *C. tuberculata.* Moreover, the peculiar perforations in its mouth-arm membranes at once distinguish this species.

These distinctions are indeed of such nature that if one felt so inclined a new genus could be established to receive this medusa. I believe, however, that its relationships will be more clearly indicated by placing it in the genus *Cotylorhiza*, within which it forms a well-marked species.

Genus CATOSTYLUS L. Agassiz, 1862.

Catostylus (part) Agassiz, L., 1862, Contr. Nat. Hist. U. S., vol. 4, pp. 152, 153.

Generic Characters.—Rhizostomata triptera, in which the mouth-arms bear neither clubs, filaments, nor other appendages. Sixteen radial-canals, 8 rhopalar, and 8 adradial. The rhopalar-canals extend to the bell-margin, but the adradial-canals end in the ring-canal. On both its inner and outer sides the ring-canal gives off anastomosing vessels, which may join with the radial-canals, but which do not connect directly with the central stomach. Among characters of minor importance, the marginal zone of circular muscles in the subumbrella is only partially interrupted in the eight principal radii. There is an exumbrella pit with radiating furrows above each sense-organ.

CATOSTYLUS PURPURUS Mayer.

Catostylus purpurus Mayer, 1910, Medusae of the World, vol. 3, p. 671, fig. 412.—Light, 1914, Philippine Journ. of Science, vol. 9, p. 207.

This form is closely related to *Catostylus stiphropeterus*, from Ternate, but differs in the number and arrangement of its marginal lappets and in its deep uniform purple-brown color. Light (1914) describes this medusa from life, whereas Mayer had only preserved material. In life the bell is higher than a hemisphere, whereas in its contracted state in preservative fluids, as in our figure, it is flatter

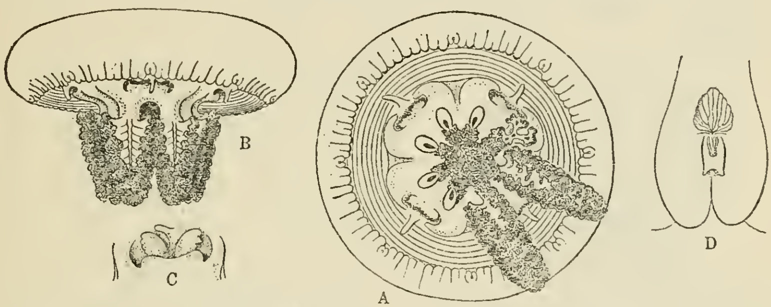

Fig. 15.—Catostylus purpurus, Manila Bay, Luzon. *A*, Oral view, six mouth-arms cut off. *B*, Side view, bell contracted. In life it is nearly hemispherical. *C*, Genital ostium. *D*, Exumbrella view of rhopalium.

than a hemisphere. When mature it is deep purplish brown, and the sense-organs have brillant silver ocellus-like spots which are larger in small than in full-grown medusae. When young the medusa may be plum-colored, or even translucent white. Small cyclops-like crustacea were found by Light to be commensal with this medusa, the crustaceans lying upon the rhopalar canals close to the sense-organs.

Light finds that this medusa is not a bottom form, but swims in shallow water near the surface.

Seven specimens (Cat. No. 27934, U.S.N.M.) found in Manila Bay on December 9, 1907, are in the collection made by the United States Fisheries Bureau steamer *Albatross*, and a larger one (Cat. No. 27980, U.S.N.M.) found on March 11, 1908. This largest specimen serves as the type of the species in the United States National Museum at Washington. Its dimensions in millimeters are as follows: Bell 115 wide, evenly rounded, 35 high; arm-disk 75 wide where it arises from the subumbrella, 52 wide at level of origin of mouth-arms; mouth-arms 58 long, upper arm 7 long, lower arm 51 long and 30 wide.

Another specimen (Cat. No. 28723, U.S.N.M.) of medium size, nearly mature, was found at Cavite Anchorage, Manila Bay, Luzon, on July 2, 1909.

Light (1914) states that this is the commonest medusa in Manila Bay in November and December.

CATOSTYLUS TOWNSENDI Mayer.

Catostylus townsendi MAYER, 1915, Publication No. 212, Carnegie Institution of Washington, p. 183.

This species is named in honor of the author's friend, Dr. Charles H. Townsend, the distinguished director of the New York Aquarium.

FIG. 16.—CATOSTYLUS TOWNSENDI FROM OFF POINT PUTRI, BORNEO.

Six specimens were found at Station D5594, September 30, 1909, about 6 miles off Mount Putri, Borneo, in 11 fathoms. Type, Cat. No. 28722, U.S.N.M.; paratypes 28721, U.S.N.M. This medusa is closely allied to *Catostylus purpurus* of Manila Bay, Philippine Islands, but in formalin its exumbrella is milky in color and bespeckled irregularly with numerous conspicuous purple-brown spots. The mouth-arms are more pointed than in *C. purpurus*. In some octants of the bell-margin the velar lappets are arranged as in *C. purpurus*, but they are usually more numerous and more irregularly arranged than in *C. purpurus*.

The dimensions of the largest specimen of *C. townsendi*, stated in millimeters, are as follows: Bell 97 wide, flatter than a hemisphere, exumbrella finely granular, gelatinous substance of horny rigidity. Shape and consistency of the bell as in *C. purpurus*. Eight rhopalia without ocelli, in formalin, and with a deep dark-colored, furrowed, exumbrella pit.

The rhopalar lappets are small and oval, but the velar lappets are about twice as wide as long. Deep clefts between the lappets extend a short distance up the sides of the exumbrella. The velar lappets are very irregular in arrangement, although they tend to conform to that seen in *C. purpurus* of Manila Bay, Luzon, yet in most of the octants the subdivisions of the principal lappets are more pronounced and irregular than in *C. purpurus*, so that there are usually 7 or 8 main velar lappets with 10 to 14 marginal lobes in each octant.

The arm-disk is similar in shape to that of *C. purpurus*. It is 61 mm. in perradial and 45 mm. in interradial diameter. The perradial columns are 17 mm. and the subgenital ostia 20 mm. wide. The projections and papillae of the subgenital ostia are similar to those of *C. purpurus*. The subgenital cavity is unitary.

The eight mouth-arms are each about 64 mm. long, the upper, naked outer part of each arm being 14 mm. and the 3-winged lower part 50 mm. long. The arms are widest at the proximal parts of the 3-winged expansions which, when spread out, have a span of about 31 mm. They taper to pointed distal ends and have no appendages among the mouth-frills.

There is a powerful unbroken zone of circular muscles in the subumbrella, 27 mm. wide, from the outer edge of the arm-disk to the bell margin. There are also radial muscle fibers on the abaxial sides of the four perradial columns of the arm disk, as in *C. purpurus*.

Sixteen radial canals arise from the cruciform central stomach. The eight rhopalar canals extend straight to the rhopalia, but the eight adradial canals end in the ring canal, which is beneath an annular furrow or bend in the subumbrella 13 mm. inward from the bell margin. On its inner side the ring canal gives rise to from 4 to 7, usually 5, centripetal canals betwen each successive pair of radial canals. These centripetal vessels anastomose with one another and with the 16 radial canals, and end blindly before reaching the stomach margin. On its outer side the ring canal gives off a network of vessels which ramify through the lappets. In formalin the medusa is opaque milky white with irregularly clustered brown spots over the exumbrella.

This medusa is closely related to *Acromitus maculosus* Light,[1] but it has no filaments upon its mouth arms. It is possible, however, that these were lost, but this seems improbable among six well-preserved specimens.

Moreover, in *Catostylus townsendi* the centripetal vessels anastomose with the 16 radial canals, whereas in *Acromitus*, according to Light, they join only with the eight rhopalar canals. It seems probable, therefore, that *Catostylus townsendi* is a distinct species, separate from *Acromitus maculosus* Light, and that *Acromitus* is a genus derived by mutation from *Catostylus*.

CATOSTYLUS MOSAICUS (Quoy and Gaimard).

Cephea mosaica Quoy and Gaimard, 1824, Voyage de *l'Uranie*, Zoologie, p. 569, pl. 85, fig. 3.

Catostylus mosaicus Agassiz, 1862, Contr. Nat. Hist. U. S., vol. 4, p. 152.—Mayer, 1910, Medusae of the World, vol. 3, p. 666.

A single immature medusa (Cat. No. 28720, U.S.N.M.) which may possibly be the young of *C. mosaicus*, was taken by the *Albatross* in a seine off the beach near the mouth of Malampaya River, Palawan Island, Philippine Islands, on December 26, 1908. It differs

[1] 1914, Philippine Journal of Science. vol. 9, No. 3, sec. D, p. 212, figs. 4–6.

from *C. mosaicus* in having only 10 marginal lappets in each octant instead of about 16, as in *C. mosaicus.* Moreover, in *C. mosaicus* the lappets are all long, pointed, and similar in size and shape each to each, whereas in the Philippine medusa there are eight long, pointed velar and two much shorter, oval, occular lappets in each octant. The Philippine medusa is, however, quite small, being only 86 mm. in diameter, whereas *C. mosaicus* becomes fully 350 mm. wide. These differences may therefore be due to immaturity. In the Philippine medusa the bell is 86 mm. wide, mouth arms 63 mm. long, the upper arms being 11 mm. and the lower 52 mm. The interradial subgenital ostia are 18 mm. wide, with a large oval or nearly spherical papilla on the subumbrella. The perradial columns of the arm disk are only 12 mm. wide, thus the ostia are 1.5 times as wide as the columns. The perradial diameter of the arm disk is 52 mm. and its interradial diameter 44 mm. The powerful ring muscles of the subumbrella are only partially interrupted in the eight chief radii. The exumbrella is coarsely granular and besprinkled thickly with numerous minute cinnamon-brown flecks. Other parts of the medusa are pale milky pink. The gelatinous substance is tough and rigid.

If this be not *C. mosaicus* it is certainly very closely related to this well-known Australian medusa. *C. mosaicus* is abundant in bays and estuaries along the Australian coast from Melbourne to the mouth of the Brisbane River in Queensland.

In Sydney Harbor all specimens of this medusa are dull creamy brown or yellowish in color, but in Moreton Bay, Queensland, most of them are cobalt blue. It is interesting to see that H. B. Bigelow[1] finds that *Stomolophus meleagris* in San Diego Bay, California, is prussian blue instead of being dull yellow, as in the Atlantic.

Catostylus mosaicus appears to breed throughout the year in Moreton Bay, Queensland, but in the temperate regions of Australia it is said to become mature only in summer and autumn.

Genus LYCHNORHIZA Haeckel, 1880.

Lychnorkiza+Cramborhiza HAECKEL, 1880, Syst. der Medusen, pp. 587, 633.—MAYER, 1910, Medusae of the World, vol. 3, p. 672.

Generic Characters.—Rhizostomata triptera with filaments, but without clubs, upon the 3-winged mouth-arms. No axial terminal club at end of each arm, and no club-shaped appendages between the mouths. The stomach gives rise to 16 radial-canals—8 rhopalar and 8 adradial. The rhopalar-canals extend to the bell-margin, but the adradial ones end in the ring-canal. Blindly ending, centripetal vessels arise from the inner side of the ring-canal and may anastomose to some extent. On its outer side the ring-canal gives off a network of anastomosing vessels which extend into the lappets.

[1] 1914, University of California Publications in Zoology, vol. 13, p. 239.

LYCHNORHIZA BARTSCHI Mayer.

Lychnorhiza bartschi MAYER, 1910, Medusae of the World, vol. 3, p. 674, figs. 413, 414.

Named in honor of Dr. Paul Bartsch, of the United States National Museum, to whom we owe the excellent preservation of all specimens of medusae which passed through his hands.

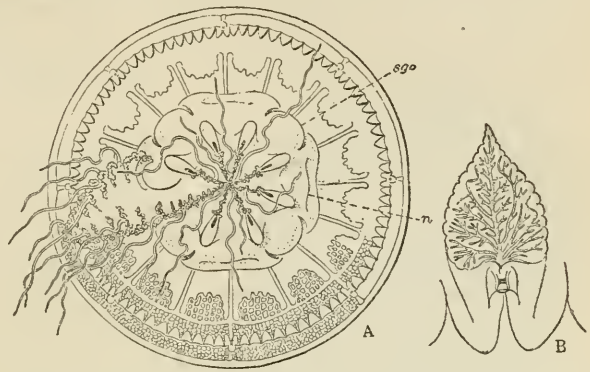

FIG. 17.—LYCHNORHIZA BARTSCHI FROM JOLO ANCHORAGE, PHILIPPINE ISLANDS. *A*, ORAL VIEW; *n*, NOTCH IN THE PERRADIAL COLUMN OF THE ARM DISK; *sgo*, SUBGENITAL OSTIUM. *B*, RHOPALIUM FROM THE EXUMBRELLA SIDE.

Bell 84 mm. wide, flatter than a hemisphere and with smooth exumbrella surface. Gelatinous substance thick but not very rigid. Eight rhopalia, each with an ocellus, and an exumbrella sensory pit with dendritic furrows over its floor. About 96 (8×12) lappets, 10 bluntly pointed velar lappets between 2 somewhat smaller ocular lappets in each octant. Arm-disk 51 mm. wide where it arises from the subumbrella, but only 47 mm. wide at the level of origin of the 8 mouth-arms. The 4 subgenital ostia are crescent-shaped and each is covered above by a gelatinous flap. They are only half as wide as the perradial columns between them. Each perradial column exhibits a niche on its outer side which bears a superficial resemblance to the subgenital ostia. The subgenital cavity is unitary.

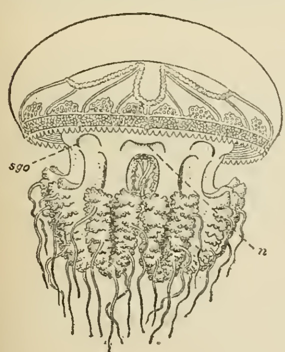

FIG. 18.—LYCHNORHIZA BARTSCHI. SIDE VIEW. LETTERING AS IN FIGURE 17.

The 8 mouth-arms are laterally compressed and 36 mm. long, the lower 3-winged parts of the arms being 24 mm. long and 23 mm. wide. Numerous simple, laterally flattened, tapering filaments arise from between the frilled mouths on all sides of the mouth-arms and from the arm-disk. The filaments upon the arm-disk are about 30 mm. long, but those from the outer parts of the mouth-arms are shorter.

The central stomach is cruciform and about 46 mm. wide. Sixteen simple radial-canals, 8 rhopalar and 8 adradial. These are all put into intercommunication with a wide ring-canal which is at some distance inward from the margin. The adradial-canals terminate in this ring-canal, but the rhopalar-canals extend outward to the sense-organs. On its inner side the ring-canal gives rise to 16 blindly ending networks of vessels which do not connect either with the stomach or with the radial-canals. On its outer side a fine-meshed network of vessels arises from the ring-canal and fuses with the rhopalar vessels. Around the margin at the bases of the lappets is a marginal ring-canal of fine caliber. There is a unitary uninterrupted system of ring-muscles in the marginal zone of the subumbrella, but no radial-muscles.

The gelatinous substance is translucent and milky in formalin, and the gonads, mouth-frills, and canal-system are milky yellow. Doctor Bartsch states that these colors in the living animal were nearly as they appear in the specimen preserved in formalin.

The type-specimen, Cat. No. 27942, U.S.N.M., was found by the United States Fisheries Bureau steamer *Albatross* at Jolo Anchorage, Philippine Islands, on February 13, 1908, and three others (Cat. no. 28737, U.S.N.M.) were taken in Limbé Strait, Celebes, in December, 1909. The dimensions given above are those of the largest specimen from the Celebes, this being somewhat larger than the type-species previously described.[1]

LYCHNORHIZA BORNENSIS Mayer.

Lychnorhiza bornensis MAYER, 1915, Publication No. 212, Carnegie Institution of Washington, p. 191, fig. 6.

A single specimen of this medusa was found at Tawao, Borneo, on September 30, 1909, at 9h. 30m. a. m. Cat. No. 28736, U.S.N.M. Type.

Bell 89 mm. wide, exumbrella smooth, somewhat flatter than a hemisphere. Eight rhopalia, each with an ocellus and a furrowed exumbrella pit. The rhopalar lappets are very short and lanceolate. In each octant there are usually seven, occasionally eight, velar lappets. The lappets adjacent to the rhopalar lappets are about twice as wide as the remaining velar lappets. All are oval and bluntly rounded.

The arm disk is half as wide as the bell, and the subgenital porticus is unitary. The external faces of the perradial columns have each a slight concavity, not a deep niche, as in *Lychnorhiza bartschi*. The subgenital ostia are twice as wide as the perradial columns and each is arched over by a flap-like projection. There are also four interradial papillae upon the subumbrella, one opposite the opening of each subgenital ostium.

The eight mouth-arms are not quite two-thirds as long as the bell-diameter, the upper arms being not quite half as long as the lower arms. Each mouth-arm terminates in a single, slender, tapering,

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[1] Medusae of the World, p. 674.

thread-like filament about 50 mm. long. There are also a few shorter, more slender filaments which arise from the sides of the mouth-arms between the mouths. There are no filaments upon the arm-disk.

There is a wide zone of circular muscles in the subumbrella, and these are only partially interrupted in the eight rhopalar radii.

The central stomach gives rise to 16 radial canals, 8 of which extend to the rhopalia and the 8 others end in the ring canal. On its inner side the ring canal gives rise to 16×4 radial vessels, which do not reach the margin of the stomach but anastomose one with another and with the 16 chief radial canals. On its outer side the ring canal gives rise to about 100 radiating vessels, all of which anastomose by side branches, forming a reticulum in the outer zone of the subumbrella.

In formalin the gelatinous substance is translucent and milky, and the gonads and mouth frills are milky yellow.

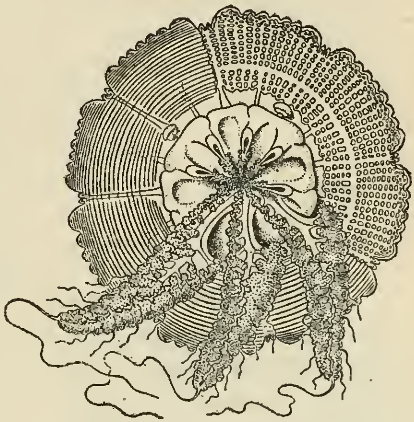

Fig. 19.—Lychnorhiza bornensis from Tawao, Borneo.

The following table will serve to indicate the distinctions between *Lychnorhiza bornensis* and *Lychnorhiza bartschi* of the Philippines:

	L. bartschi.	*L. bornensis.*
Velar lappets	(8×12) all oval and similar each to each.	(8×7) those adjacent to rhopalar lappets being twice as wide as the others.
Interradial papillae on the subumbrella.	None	4.
Perradial niches in the arm-disk	Four deep clefts	Four wide, shallow grooves.
Mouth-arms	Less than half as long as bell-diameter.	About two-thirds as long as bell-diameter.
Filaments	Numerous. Lateral filaments as long as those at outer tips of mouth-arms. Longest filaments are upon arm-disk.	A single slender filament at outer end of each arm. Other arm-filaments are very short and slender. No filaments upon arm-disk.
Circular muscles	Entire	Almost interrupted in 8 principa radii.
Canal system	Network on inner side of ring-canal does not fuse with 16 radial-canals.	Network on inner side of ring-cana fuses with 16 radial-canals.
Central stomach	Narrow and cruciform	Wide and cruciform.

Genus MASTIGIAS L. Agassiz, 1862.

Mastigias L. Agassiz, 1862, Contr. Nat. Hist. U. S., vol. 4, p. 152.—Mayer, 1910, Medusae of the World, vol. 3, p. 677.

Generic Characters.—Rhizostomata triptera with 3-winged mouth-arms, which terminate in a naked, club-shaped extremity. There are also smaller clubs and filaments between the frilled mouths.

The mouths are developed not only along the edges of the three leaf-like wings of the lower parts of the mouth-arms, but also over parts of their flat, expanded sides. The central stomach gives rise to eight rhopalar-canals and numerous, interocular radial-canals, all of which anastomose and finally connect with the ring-canal. The rhopalar-canals extend straight to the sense-clubs, but the inter-rhopalar-canals end in the ring-canal. On its outer side the ring-canal gives off a network of vessels which extend into the lappet-zone and fuse with the outer ends of the rhopalar-canals. The ring-muscles of the subumbrella are interrupted in the eight rhopalar radii. There is a unitary subgenital porticus.

MASTIGIAS PAPUA (Lesson).

Cephea papua Lesson, 1829, Voyage de la *Coquille*, Zooph., p. 122, pl. 11, figs. 2, 3.

Mastigias papua Agassiz, L., 1862, Cont. Nat. Hist. U. S., vol. 4, p. 162.—Mayer, 1910, Medusae of the World, vol. 3, p. 678, fig. 415.—Light, 1914, Philippine Journ. of Science, vol. 9, p. 209.

This common medusa is widely distributed over the Malay Archipelago, Indian Ocean, and China Sea to Japan, and outward over the Pacific to the Fiji Islands. It gives rise to a number of varieties. Eight specimens, the largest 59 mm. in diameter, were found by the *Albatross* in the Philippines. Two specimens are from Santiago River, Pagapas Bay, Luzon, February 20, 1909; two, Cat. No. 28735, U.S.N.M., are from Pandanon Island, between Cebu and Bohol, March 24, 1909, and four, Cat. No. 28732, U.S.N.M., were taken on the surface off Cebu on September 5, 1909. It was abundant in shallow water among the mangroves in Port Moresby, Papua, in November, 1913.

MASTIGIAS OCELLATA (Modeer).

Medusa ocellata Modeer, 1791, Nova. Acta. Phys. Med., N. C., vol. 8, Append., p. 27.

Cephea ocellata Péron and Lesueur, 1809, Annal. du Mus. Hist. Nat., Paris, vol. 14, p. 361.

Mastigias ocellata Haeckel, 1880, Syst. der Medusen, p. 623.—Mayer, 1910, Medusae of the World, vol. 3, p. 680.

The *Albatross* found small medusæ of this variety in March and April, and a mature one, Cat. No. 27919, U.S.N.M., in January in the Philippines, in 1908. It is distributed over the eastern parts of the Indian Ocean and in the China Sea.

Genus PHYLLORHIZA L. Agassiz, 1862.

Phyllorhiza Agassiz, L., 1862, Cont. Nat. Hist. U. S., vol. 4, p. 158.—Mayer, 1910, Medusae of the World, vol. 3, p. 684.

Generic Characters.—Similar to the closely allied *Lychnorhiza*, but the centripetal vessels which arise from the inner side of the ring-canal join with the central stomach, as in *Mastigias*, instead of ending blindly as in *Lychnorhiza*. The canal-system resembles that of *Mastigias*, but the mouth-arms have no terminal clubs.

PHYLLORHIZA LUZONI Mayer.

Phyllorhiza luzoni Mayer, 1915, Publication No. 212, Carnegie Institution of Washington, p. 194, fig. 7.

Two specimens of this medusa were captured at a depth of 150 feet in Varadero Bay, Southern Luzon, Philippine Islands, on July 23, 1908. Cat. No. 28728, U.S.N.M. Unfortunately both became somewhat macerated in the preservative fluid.

The bell of the larger and more perfect specimen is 60 mm. wide, flat, and with finely granular exumbrella. Eight rhopalia without ocelli in formalin and without exumbrella pits. Sixteen scimeter-shaped rhopalar lappets, and (9×8) 72 rounded velar lappets which are somewhat wider but not longer than the rhopalar lappets, so that the general contour of the bell-margin is circular, without deep niches in the rhopalar radii.

Fig. 20.—Phyllorhiza luzoni from Varadero Bay, Luzon.

The arm-disk is cruciform, 32 mm. in perradial and 20 mm. in interradial diameter. The subgenital ostia are 14 mm. and the perradial columns 8 mm. wide, and the subgenital porticus is wide and unitary.

The eight mouth-arms are slender and strongly compressed laterally, their lower parts being 3-winged with deeply incised lateral membranes. The naked outer part of each upper arm is 13 mm. and the 3-winged lower part only 11 mm. long. Any appendages which may have existed among the mouth-frills have disappeared in the preservative fluid, owing to the maceration of the specimens.

The muscular system of the subumbrella consists of a broad, uninterrupted zone of weakly developed circular muscles. In other hitherto known species of *Phyllorhiza* the muscles are interrupted in the eight principal radii.

The central stomach is cruciform, 32 mm. in perradial and 16 mm. in interradial diameter. Eight radial-canals arise from the stomach and extend straight to the eight rhopalia; these main canals are connected one with another by a ring-canal which is 6 mm. inward from the margin of the bell. In each octant six to nine radiating vessels arise from the cruciform stomach anastomosing in an irregular network with one another and with the eight main canals. On its outer side the ring-canal gives rise to a fine-meshed network of vessels which ramify through the lappets.

A color note states that the medusa was light green with grayish white spots.

Genus VERSURA Haeckel, 1880.

Crossostoma preoccupied for mollusks by Norris and Lycett, 1850.
Crossostoma Agassiz, L., 1862, Contr. Nat. Hist. U. S., vol. 4, p. 155.
Versura+*Crossostoma* Haeckel, 1880, Syst. der Medusen, pp. 606, 607.
Versura Mayer, 1910, Medusae of the World, vol. 3, p. 685.

Generic Characters.—Rhizostomata triptera with clubs and filaments upon the mouth-arms. The 4 perradial canals arise directly from the stomach, but the 4 interradial canals result from the fusion of a number of anastomosing vessels which arise from the interradial sides of the stomach. There is no definite ring-canal, but merely a marginal network of vessels. There are no radial-muscles in the subumbrella, but the ring-muscles are well developed. Among the characters of minor importance, the subgenital ostia are wide openings, wider than the columns between them, and the sense-organs have a simple, exumbrella pit without radiating furrows. At the center of the arm-disk is a prominent, raised cluster of frilled mouths having filaments between them.

VERSURA MAASI Mayer.

Versura maasi Mayer, 1910, Medusae of the World, vol. 3, p. 687, fig. 416.

Named in honor of Prof. Dr. Otto Maas, in recognition of his notable researches upon Medusae. A single perfect specimen (Cat. No. 27943, U.S.N.M. Type) was obtained by the United States Fisheries Bureau steamer *Albatross* on April 8, 1908, along the shore at Mantacao Island, west coast of Bohol, Philippine Islands.

Bell 90 mm. wide, flatter than a hemisphere and evenly rounded. Exumbrella finely granular without furrows. Gelatinous substance fairly thick but not very rigid. Eight rhopalia each with a pigment spot and an exumbrella pit with smooth floor. Usually 12 marginal lappets in each octant, with outer edges bluntly rounded. The 16 rhopalar lappets are slightly narrower than the velar lappets. Arm disks five-ninths as wide as bell-diameter at the level of the origin of the eight mouth-arms. The four interradial subgenital ostia are two times as wide as the perradial columns of the arm-disk. Eight mouth-arms each one-third as wide as the bell-diameter. The three-winged lower part of each arm is somewhat more than two times as long as the unbranched upper part of the arm. The two lateral outer wings of each arm are deeply cleft. (See fig. 21, *C*.) There are a large number of laterally flattened clubs at the center of the arm-disk. These are besprinkled with small nettle-warts which are most prominent at the broad outer end of the club. In addition there are a few very small appendages among the mouths of the mouth-arms. The mouth-arms are strongly compressed laterally. A single duct extends down each mouth-arm and gives rise to four terminal branches, two to the lateral wings and two to the triangular extremity of the arm.

There are eight wide rhopalar radial canals, of which the four perradial ones rise directly from the stomach; but each of the 4 interradial arise from the confluence of a Y-shaped fork. Seven to nine narrow radial vessels arise in each inter rhopalar octant and extend outward anastomosing profusely with each other and with the eight rhopalar canals. There is no definite ring-canal.

A wide, entire, annulus of circular muscles is found in the subumbrella, but there are no radial muscle strands. This muscular zone

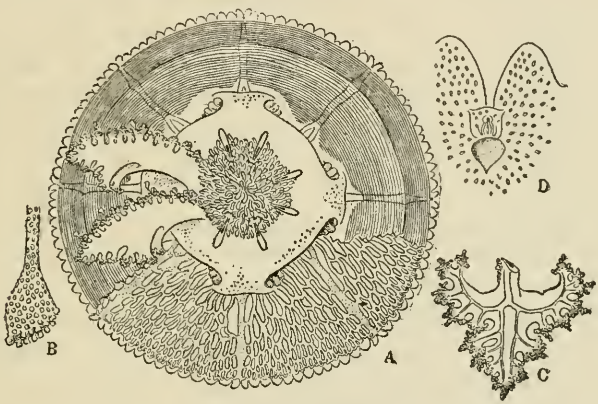

FIG. 21.—VERSURA MAASI FROM MANTACAO ISLAND, WEST COAST OF BOHOL. *A*, ORAL VIEW. *B*, A CLUB FROM THE MOUTH-ARMS, MUCH MAGNIFIED. *C*, A MOUTH-ARM SEEN FROM THE OUTER (ABAXIAL) SIDE. *D*, EXUMBRELLA VIEW OF ONE OF THE MARGINAL SENSE ORGANS.

is wider in the interradii than in the perradii, and is somewhat thinned but still unbroken in the eight rhopalar radii.

In formalin the rhopalar canals, and all vessels near the stomach, are bluish purple. The mouth-frills are brownish to brownish purple. The bell is milky and the gonads dull brownish yellow.

Genus LOBONEMA Mayer, 1910; sensu Light, 1914.

Lobonema MAYER, 1910, Medusae of the World, vol. 3, p. 688.—LIGHT. 1914, Philippine Journ. of Science, vol. 9, p. 216.

Generic Characters.—Rhizostomata triptera in which the marginal lappets are greatly extended, tapering to pointed ends. These lappets are noncontractile and lack muscles. Mouth-arms with numerous filaments. Mouth-arm membranes perforated by windowlike openings. Eight to sixteen rhopalia and twice as many radial-canals, and a ring-canal which gives off anastomosing vessels on both its inner and outer sides. The inner network does not connect with the stomach. All of the radial-canals extend beyond the ring-canal. The subumbrella exhibits a well-developed system of ring-muscles. There are numerous, prominent, tapering papillae upon the exumbrella. There is a sensory pit on the exumbrella side above each rhopalium, and the floor of the pit exhibits radiating, dendritic furrows.

Lobonema smithii, the first-known species and type of the genus, was obtained by the *Albatross* in Manila Bay, Philippine Islands, late in April, 1908. It is named in honor of Dr. Hugh M. Smith, Commissioner of Fisheries of the United States. Another species from Palawan was described by Light [1] under the name *Lobonema mayeri*.

Lobonema smithii has only eight marginal sense-organs, and the subumbrella ring muscles are entire; while in *L. mayeri* there are 12 to 16 marginal sense organs, and the circular muscles are completely interrupted in the ocular radii. Light, who studied the medusae in life, states that the colors of *Lobonema mayeri* are an exquisite scheme of purple, violet, and rose pink. The gonads are, as a rule, pink, the general color is violet, and the fringe of tapering marginal lappets purple. Doctor Light tells me that in *Lobonema smithii* these colors are not so brilliant, and the bell of the medusa may be white. Light finds that the sting of this medusa is not very severe, and that the cases of poisoning reported by Old were probably due to *Dactylometra* and not to *Lobonema*.

Light describes *Lobonemoides gracilis*, an immature medusa which may possibly be a young stage of *Lobonema mayeri*. The marginal lappets are pointed but are not very long, and there are no window-like openings in the mouth-arm membranes.

LOBONEMA SMITHII Mayer.

Lobonema smithii Mayer, A. G., 1910, Medusae of the World, vol. 3, p. 689, figs. 417, 418.

The *Albatross* found this medusa in Manila Bay, Luzon, at the ship's anchorage on April 25, 1908, and again (Cat. No. 28725, U.S.N.M. Type) on the surface at station D. 5222, between Marinduque and Luzon, 9 miles off San Andreas Island.

This species is named in honor of Dr. Hugh M. Smith, now United States Fish Commissioner, who found it in Manila Bay, Philippine Islands. The *Albatross* found a perfect specimen of this medusa, and a quadrant of its disk and all of its mouth arms were preserved. There were also two other imperfect specimens, so that all three taken together afford data for a partial description of the medusa.

Bell flatter than a hemisphere, 236 mm. across from each sense club to the one 180° from it. Gelatinous substance thick, tough, and rigid. Exumbrella regularly besprinkled with erect, gelatinous papillae

[1] 1914, Philippine Journal of Science, vol. 9, p. 217, figs. 7–9.

which are largest and most abundant at the center of the exumbrella but disappear near the margin and are not seen over the lappets. Near the center of the exumbrella these papillae are about 6 to 10 mm. apart and each is about 35 to 40 mm. long and 3 to 5 mm. wide at the base; they are conical, usually more or less curved, and taper to pointed ends. Their surfaces are thickly covered with nematocysts, which give a bristling appearance to the disk of the medusa. Eight rhopalia which lack ocelli in specimens preserved in formalin or alcohol. On the exumbrella side above each sense club there is a shallow, heart-shaped, sensory pit with dendritic ridges over its floor. The rhopalia are flanked by very small, oval, ocular lappets only 3 mm. long and 2.5 mm. wide. There are 32 (4×8) velar lappets, which are most extraordinary, each being 90 to 100 mm. long and tapering gradually from base to tip. They are modified so as to resemble superficially tentacles of semaeostomous Scyphomedusæ. They trail downward from bell margin, waving flexibly to and fro, as do veritable tentacles. I can find no muscles in these lappets, however, and Light confirms the statement that they can neither contract nor elongate. They are deep clefts in the exumbrella surface between the lappets, but these clefts are bridged over by a thin subum-

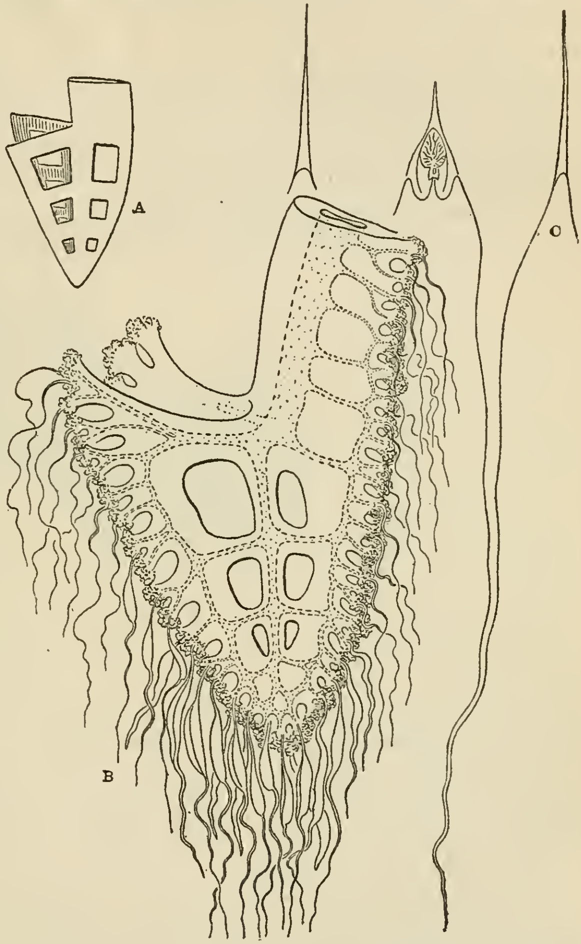

Fig. 22.—Lobonema smithii. *A*, Diagram showing the plan of structure of the mouth-arms. *B*, Side view of one of the mouth-arms. *C*, Rhopalium and one of the long, tapering marginal lobes.

brella membrane spanning between the lappets. The eight inter-rhopalar grooves are 35 mm., the 8 rhopalar 16 mm., and the 16 intermediate clefts 31 mm. long. The eight rhopalar clefts are U-shaped and the exumbrella sensory pit is at the middle of the crotch of the Y with the divided groove on either side of it (see fig. 22, C). The grooves between the velar lappets are simple, undivided, linear clefts.

Sixteen radial canals, eight rhopalar and eight inter-rhopalar leave the central stomach, and all extend to the bell margin. There is a fairly distinct ring canal about 30 mm. inward from the sense clubs, and this ring canal gives rise on both its inner and outer sides to an anastomosing network of vessels which connect with the 16 radial canals but not directly with the stomach. This network of

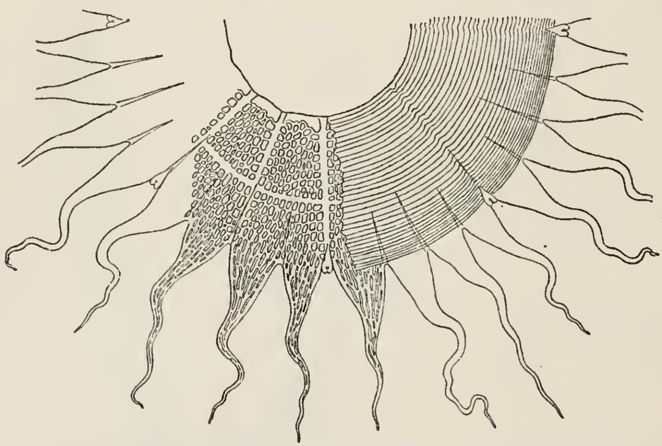

FIG. 23.—LOBONEMA SMITHII FROM MANILA BAY. PART OF THE OUTER ZONE OF THE SUBUMBRELLA, SHOWING CANAL SYSTEM AND MUSCLE STRANDS.

vessels extends downward throughout the length of the tapering lappets trending mainly longitudinally but with frequent anastomoses.

The muscular system forms an annulus about 68 mm. wide in the subumbrella from the margin of the arm disk to the zone of the rhopalia. The circular muscles are powerfully developed and are only thinned but not broken in the rhopalar radii. There are no radial muscles and no muscles in the lappets (fig. 23).

The arm-disk is 100 mm. wide, but as it was cut off I can make no statements in reference to the size or form of the subgenital ostia or of the gonads.

The eight mouth-arms are separate, 150 mm. long, and each is 3-winged below. The upper shaft of each arm is 60 mm. and the 3-winged lower part 90 mm. long. It is remarkable that each of the three lateral membranes is perforated by three windows or openings (see diagram *A*, fig. 22). The axial duct of the arm extends down the center and gives off side branches in the tissue between the windows to the mouths. These side branches are joined one to another by longitudinal canals near the frilled mouth (see fig. 22, *B*).

There are numerous appendages upon the mouth-arms arising between the mouths. Those near the lower pointed ends of the mouth-arms are large, spindle-shaped, more or less triangular in cross-section and taper to pointed ends. Those arising higher up are more slender, and above these there are mere threadlike filaments. The appendages are usually 70 to 100 mm. long, and the large ones contain an axial duct. The general color of the medusa in formalin is milky-gray, the mouths and gonads being darker than other parts.

Genus THYSANOSTOMA L. Agassiz, 1862.

Thysanostoma Agassiz, 1862, Contr. Nat. Hist. U. S., vol. 4, p. 153.—Mayer, 1910, Medusae of the World, vol. 3, p. 691.

Generic Characters.—Rhizostomata lorifera having mouth-arms bearing three rows of frilled mouths from base to lower end, without a terminal club. Among characters of minor importance, the four interradial, subgenital ostia are wider than the perradial columns between them. There are eight rhopalar canals and a ring canal which gives off a network of vessels on both its inner and outer sides. This network connects with all the radial canals and also at numerous points with the central stomach. The well-developed circular muscles are only partially interrupted in the eight principal radii. There is a small, shallow, exumbrella pit above each sense organ, and there are no furrows in the floor of the pit. The only difference between this genus and the closely allied *Lorifera* is that the frilled mouths are developed even to the tips of the lower ends of the mouth-arm and there is no terminal club, whereas *Lorifera* has a naked terminal club.

THYSANOSTOMA THYSANURA Haeckel.

(?) *Rhizostoma brachyura* Lesson, R. P., 1829, Voyage de la *Coquille*, Zoophyt., vol. 2, p. 153; 1830, Centurie Zoologique, p. 227, pl. 80.
Thysanostoma Agassiz, 1862, Contr. Nat. Hist. U. S., vol. 4, p. 153, figs. 1–9.—Mayer, 1910, Medusae of the World, vol. 3, p. 692, fig. 420.

The dimensions, in millimeters, of a specimen (Cat. No. 27929, U.S.N.M.) obtained at Mindanao, Philippine Islands, by the United States Bureau of Fisheries steamer *Albatross* are as follows: Bell, 100 wide; perradial diameter of arm-disk, 74; diameter of arm-disk at level of origin of mouth-arms, 48; genital ostium, 40 wide; mouth-arms, 220 long, 24 wide at widest part, 12 wide at their blunt tips; 8 to 12 velar lappets in each octant; filamentary appendages on the arm-disk, 10 to 15 long; exumbrella finely granular.

In another large medusa (Cat. No. 27930, U.S.N.M.) from Mansalay, Mindoro, Philippine Islands, taken by the *Albatross* on June 4, 1908, from a depth of 150 feet, the bell is 120 mm. wide and the mouth-arms 190 mm. long. In a half-grown medusa (Cat. No. 27928, U.S.N.M.) obtained on the surface at the same time and place the bell is 59 mm. wide with finely granular exumbrella; mouth-arms, 67 mm. long; arm-disk, 41 mm. wide at its origin from the subumbrella and 33 mm. wide at the level of the origins of the mouth-arms.

Two specimens (Cat. No. 28710, U.S.N.M.) are from Atulayan Bay, east coast of Luzon, June 17, 1909. Of these the larger one was cut into two pieces when viewed by me, but the bell appears to have been about 106 mm. in diameter, the mouth-arms being 167 mm. long, the upper arm 20 mm., and the lower arm 147 mm. long.

Fig. 24.—Thysanostoma thysanura from Panabutan Bay. *A*, Oral view of the 8 mouth-arms being removed. *B*, Cross section of mouth-arm near the base. *C*, Cross section of mouth-arm near the outer end of the arm. *D*, Oral view of rhopalar lappets. *E*, Rhopalar lappets from the exumbrella side.

A color note leads one to infer that in life the bell was translucent with a slightly brownish margin, and with the frilled mouths dark burnt-umber. The smaller specimen when alive had a translucent bell with some whitish spots and with eight indigo streaks along the eight principal radii. The frilled mouths and bell-margin were pale brown. One specimen (Cat. No. 28711, U.S.N.M.) 91 mm. in diameter with mouth-arms 155 mm. long, is from Station D2268, September 21, 1909, depth 13 fathoms off Singaan Island north of Tawi Tawi. In this the arm-disk is 59 mm. in perradial diameter, and the upper arms are 13 and the lower 142 mm. long.

Genus LORIFERA Haeckel, 1880.

Himanostoma preoccupied for Diptera by Loew, 1853.

Himanostoma Agassiz, L., 1862, Contr. Nat. Hist. U. S., vol. 4, p. 152.

Lorifera Haeckel, 1880, Syst. der Medusen, p. 628.—Mayer, 1910, Medusae of the World, vol. 3, p. 693.

Generic Characters.—Rhizostomata lorifera in which the eight mouth-arms bear rows of frilled mouths throughout their lengths but terminate each in a naked knob. Among characters of minor importance the subgenital ostia are usually wider than the perradial disk-columns. The circular muscles of the subumbrella are practically entire. The sense clubs have each an occellus and a well-developed exumbrella pit with radiating furrows. This genus is distinguished from the closely allied *Thysanostoma* only by the naked, club-shaped extremities of its mouth-arms.

LORIFERA LORIFERA, var. PACIFICA (Schultze).

Himanostoma loriferum, var. *pacifica* SCHULTZE, L. S., 1897, Abhandlung, Senckenberg, Naturf. Gesell., vol. 24, Heft 2, p. 153, pl. 15, figs. 1, 1*a*, 6; 1898, Denkschr. Med. Nat. Gesell. Jena, vol. 8, p. 446, pl. 34, fig. 9 (young medusa).

Lorifera lorifera, var. *pacifica* MAYER, 1910, Medusae of the World, vol. 3, p. 695.

A single half-grown specimen of this medusa, Cat. No. 28709, U.S.N.M., was found at Port Palapag, Luzon, by the United States Fisheries Bureau steamer *Albatross* on June 2, 1909, being captured through the use of dynamite. Its bell is 98 mm. wide, exumbrella finely granular, flatter than a hemisphere. The bell margin is badly damaged but there appear to be six to eight cleft or subdivided velar lappets in each octant. Their general contours are rounded, and interlobular clefts extend radially a short distance up the exumbrella surface.

The eight rhopalia have each an ocellus, but no exumbrella pit. Perradial diameter of arm disk, 55 mm.; width of subgenial ostia, 34 mm.; width of perradial columns of arm disk, 12 mm.; subgenital porticus wide and unitary; naked upper arm, 20 mm. long; length of the abaxial side of the mouth-bearing part of each arm, 35 mm.; length of the terminal naked axial filament of each arm at least 40 mm., but all are broken at their ends.

There is a thick felting of short filaments upon the arm disk.

The circular muscles are unitary, being only partially interrupted in the eight principal radii.

The eight radial canals are each about 3.5 mm. wide, and in addition there are about 8×10 slender radial canals, all of which anastomose with one another and with the eight chief radial canals, forming a wide network in the subumbrella.

In formalin the eight chief radial canals are violet.

Schultze describes this medusa from Ternate and from Amboina, Malay Archipelago.

TABULAR DESCRIPTIONS.

Table showing the chief characteristics of Philippine Scypho medusae. This table is designed to enable one to recognize each species from its most conspicuous features, but it must be used with caution, and is worthless for the medusae of regions other than the Philippines.

Family CARYBDEIDAE.

Bell high, pale milky colored, more or less rectangular. Four small niches on the sides of the bell alternating with the tentacles. A minute club, bearing several eyes, is set within each niche. The tapering flexible, *pale pink* sharply stinging tentacles arise from the ends of stiff, spatula-shaped projections from the rim of the bell.

1. Bell about 1½ inches high, only slightly higher than it is wide. Four tentacles——*Carybdea rastonii.*
2. Bell about 9 inches high, about twice as high as wide. Four tentacles. *Carybdea alata*, var. *grandis.*
3. About 28 tentacles arising from the ends of four stiff finger-shaped clusters of projections from the rim of the bell——*Chiropsalmus quadrigatus.*

Family CORONATE.

These medusae have a deep constriction, or ring-furrow, cutting into the sides of the bell.

1. A deep-sea medusa, purple-brown or claret colored. Usually about 2 to 6 inches high. Sixteen marginal lobes, 12 tentacles. Bell conical or dome-like with a deep ring-furrow extending around about one-third the way up the side of the bell——*Periphylla hyacinthina.*
2. Bell *thimble-shaped*, ½ an inch high, brown with darker colored warts on the concave side. Swims very actively, with an incessant pulsation, near the surface in great swarms——*Linuche unguiculata.*
3. A deep-sea medusa with flat, thick lenticular bell usually about 1½ to 4 inches wide; the central part separated by a deep constriction from the numerous lappets. Numerous short tentacles alternate with the equally numerous cleft lappets. Deep brownish red lappets and mouth parts. *Atolla bairdii*, etc.

Family SEMAEOSTOMAE.

Usually large medusae, with *marginal tentacles.* Without a ring-furrow in the bell. With a single cross-shaped mouth at the middle of the concave side of the umbrella. Often seen in harbors.

1. Animal blue-violet with purple streaks on the outer side of the bell, eight long, tapering tentacles, and four long, flexible curtain-like lips. Bell about 2 inches wide, and lips 3 inches long——*Pelagia panopyra.*
2. Sixteen areas of reddish-rosin colored dots radiate outward in a spokelike manner from the center to the bell margin. *Twenty-four tentacles* and 48 marginal lobes (16 *small* and 32 *large*). Bell about 5 inches wide. *Chrysaora melanaster.*

(3 and 4.) Resemble *Chrysaora melanaster*, but there are 40 tentacles.

3. Marginal lobes *not* highly colored............*Dactylometra quinquecirrha.*[1]
4. Marginal lobes *red*.................................*Dactylometra africana.*
5. Resembles *Dactylometra* (3) in general appearance, but the color is more yellowish, and there are only *16 tentacles.* Bell about 4 inches wide. Thirty-two *cleft* marginal lobes.....................*Sanderia malayensis.*
6. Bell only about ½ inch wide, translucent, 24 tentacles, 32 marginal lobes, 8 simple radial canals, alternating with 8 complexly branching canals on the concave side of the bell..........................*Discomedusa philippina.*

7 and 8. Bell genatinous, about 10 inches wide or larger, hyaline or slightly milky, with 4 whitish or pinkish *horseshoe-shaped* genital organs near the center of the bell. 4 long, fleshy lips. More than 100 short tentacles. 8 simple and many branched and anastomosing canals all of which are conspicuous, due to their milky color.

7. 8 clefts in the bell-margin..................................*Aurellia aurita.*
8. 16 clefts in the bell-margin................................*Aurellia labiata.*

Family RHIZOSTOMAE.

Usually large medusae *without* marginal tentacles. With *numerous* minute mouths, the frilled tentacle-bearing lips which superficially resemble sea weed. Mouths born on 8 more or less branched projections (mouth-arms) arising from the center of the concave side of the bell. Common in harbors in the East Indies. The *gelatinous* substance of the bell is often remarkably rigid. The branched, frilled, and tentacle-bearing mouth-arms are often greenish or reddish in color, thus giving the appearance of some sort of vegetable growth arising from the center of the concavity of the bell.

Living *on the bottom*, slowly pulsating, "lying on its back," with the concave side of the bell, and its 8 mouth-arms, and mouths uppermost; remaining for hours, or days, fixed at one place and rarely swimming through the water..........................*Cassiopea.*

1. Bell flat, about 4 inches wide, without a concavity where it lies upon the ground. Olive-brown in color with about 18–22 triangular *large whitish spots* in the radii of the marginal sense organs. 3 small white streaks near the bell margin between the large triangular spots. 8 bifurcated mouth-arms.............................*Cassiopea andromeda*, var. *baduensis.*
2. Bell olive green about 6 inches wide with a suckerlike concavity where it touches the ground. Dull inconspicuous, white bands radiate outward in the radii of the 16 or more marginal sense organs. The leaflike appendages of the mouth-arms are opaque white.
Cassiopea polypoides, var. *culionenus.*[2]
3. Bell about 11 inches wide. Numerous *large* ribbonlike *appendages* on the mouth-arms, 4½ inches long............................*Cassiopea medusa.*[3]

Large free swimming medusae a foot or more wide with a more or less conspicuous dome covered with *wart-like* projections at the center

[1] See S. F. Light, 1914, Philippine Journal of Science, vol. 9, section D, p. 198.
[2] Idem, p. 201.
[3] Idem, p. 204.

of the convexity of the bell. The dome may be sky blue, rose-colored, or amber colored and the bell blue with reddish spots and markings. Mouth-arms fused forming an eight-sided prism, flaring outward below. Gelatinous substance tough---------------*Cephea.*

1. Dome low, warts small--------------------------------*Cephea octostyla.*
2. Dome high, warts conspicuous-----------------------------*Cephea cephea.*

Bell amber colored, about 9 inches wide, with a *smooth* central dome without wartlike projections. Clusters of grapelike appendages on the eight leaflike mouth arms. Windowlike openings in the membranes of the mouth arms. Marginal lappets of the bell short and oval---------------------------------*Cotylorhiza pacifica.*

Bell smooth, hemispherical, about 8 inches wide when full grown. Deep uniform, *purple-brown.* The commonest medusa in brackish water canals in shallow water along shore in Manila Bay in November and December------------------------*Catostylus purpurus.*

Similar to the above but with *irregular purple brown spots* over the convex side of the bell. No filaments on the mouth arms.
Catostylus townsendi.

Similar to *Catostylus townsendi* but with *numerous long filaments* on the mouth arms. The longest ones being near the outer ends of the mouth arms--------------------------*Acromitus maculosus.*[1]

Bell high, domelike, 4½ to possibly 12 or more inches wide, slightly granular on the convex surface. Yellowish-white or cobalt blue. Eight tapering mouth arms without filaments or other appendages. Common in the mouth of Brisbane River, Queensland, Australia, but widely distributed over this general region-----*Catostylus mosaicus.*

Bell about 3½ inches wide, smooth, evenly rounded, flatter than a hemisphere, milky-yellow, with smooth convex surface. Slender tapering filaments in the eight mouth arms. No prominent spots in the convex surface of the bell------------------------*Lychnorhiza.*

1. A single long filament at the pointed end of each mouth arm. All other filaments very short--------------------------------*Lychnorhiza bornensis.*
2. With numerous long filaments on the mouth arms-----*Lychnorhiza bartschi.*

Bell smooth, about 2½ to 3½ inches wide. With eight mouth arms, each tapering to end in a long naked more or less club-shaped filament. This small medusa pulsates and swims rapidly, is usually greenish or reddish brown, and is common in harbors in the East Indies.

1. Bell blue, greenish, olive, or brown with *solid* white, brown or yellowish, spots. The eight terminal clubs on the mouth arms each as long as the diameter of the bell------------------------------------*Mastigias papua.*
2. Bell reddish brown, with ringlike spots of white and brown. Eight terminal clubs only about half as long as the diameter of the bell---*Mastigias ocellata.*

[1] See S. F. Light, 1914, Philippine Journal of Science, vol. 9, section D, p. 212, fig. 4.

Bell *flat*, about $2\frac{1}{2}$ inches wide, light green with grayish white spots. Eight laterally flattened mouth arms, each ending in three expansions, eight simple radial canals in the radii of the eight marginal sense organs and a network of vessels between these canals and on both sides of the ring canal. No appendages on the mouth arms.--*Phyllorhiza luzoni.*

Similar to *Phyllorhiza luzoni* in general shape, but there is no ring canal and there are numerous small clubs upon the eight mouth arms, especially at the center of the disk------------*Versura maasi.*

Bell 15–20 inches wide, flat topped and thickly covered above with *flexible tapering projections*, the largest near the center. The marginal lobes are greatly extended, forming *tapering filaments.* The mouth arms are perforated with windowlike openings and bear numerous long filaments. Common in Harbors, Manila, and west coast of Palawan in April and May·

1. Twelve to 16 marginal sense organs and 70–80 *long tapering marginal lobes.* Purple, violet, and rose pink are the prevailing colors of the animal. *Lobonema mayeri.*[1]
2. Only eight marginal sense organs and 32 marginal lobes. Colors not so bright as in *L. mayeri*, and the bell may even be white---------*Lobonema smithii.*

Bell 4 or 5 inches wide. Eight very long, "snakelike," mouth arms with frilled "seaweedlike" mouths all down their sides *even to the tips of the arms*--------------------------*Thysanostoma thysanura.*

Similar to *Thysanostoma thysanura*, but the eight arms end each in a *naked* club------------------------------------*Lorifera lorifera.*

[1] See S. F. Light, 1914, Philippine Journal of Science, section D, vol. 9, p. 217, figs. 7–9.

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REPORT ON THE CHAETOGNATHA COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION, 1907–1910.

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INTRODUCTION.

This paper is based upon the chaetognatha collected by the United States Bureau of Fisheries steamer *Albatross* during the Philippine expedition of 1907–1910. Chaetognatha were taken at 46 stations scattered between the parallels of 21° 31′ north and 5° 36′ south latitude, and between the meridians of 117° 53′ east and 127° 44′ east longitude. The collection is represented by 12 species of *Sagitta,* of which one, *Sagitta philippini,* is apparently new; one of *Pterosagitta;* two of *Eukrohnia;* and one of *Krohnitta.* The species of *Sagitta,* in order of the number of specimens obtained, are: *S. enflata,* (2,800); *S. hexaptera,* (700); *S. ferox,* (600); *S. pulchra,* (550); *S. neglecta,* (425); *S. bedoti,* (350); *S. decipiens,* (160); *S. serratodentata,* (100); *S. planktonis,* (85); *S. minima,* (2); and one each of *S. macrocephala* and *S. philippini. Pterosagitta* is represented by 32 specimens of *P. draco; Eukrohnia* by 6 specimens of *E. hamata* and 5 of *E. richardi;* and *Krohnitta* by 3 specimens of *K. subtilis.*

Most of the material was preserved in formalin and is in excellent condition. In some cases, however, alcohol was used. Specimens preserved with it are distorted and the tannin extracted from the corks of the containers has turned most of them quite black, rendering identification uncertain and, in some cases, impossible. But, in so far as the collection permits, tables of diagnostic measurements are given for each species, enough measurements being made on each individual to enable reconstruction of its outline. Otherwise, the species are not further described except for those concerning which need of description is indicated by the literature. In lieu of descriptions, however, references are given to those published in other reports, particularly to Ritter-Záhony's (1911) revision of the group, which, with two or three exceptions, is adopted as my basis of classification.

In order to make the report as serviceable as possible, keys are supplied for identifying not only those species obtained during the Philippine expedition but all the species in the group. Several new species and five new genera have been described since my last (1911) report. In addition, Ritter-Záhony (1911) has called attention to and admirably illustrated specificities in the presence and absence of rays in the lateral fins. In devising the keys these specificities are used and, except for *Sagitta maxima* (Conant), which I still find impossible to separate from *S. lyra*, every species recognized as valid by Ritter-Záhony (1911) and several others described subsequent to his report are included. There is great need of keys for identifying poorly preserved material, but the minute structure of seizing jaws and other skeletal parts of the head, upon which such identification depends, is still undescribed in nearly half the species. The keys included in this report are therefore adapted only to the identification of well-preserved specimens.

The area covered by the expedition is too large and the hauls were too scattered to yield definite information concerning the distribution of the various species obtained. As pointed out elsewhere (1916, p. XVIII), variability in plankton distribution is enormous, and hydrobiological relations are too complex to be revealed without frequently repeated collections in very restricted areas and searching hydrographic observations corresponding in time and place to each net haul. Even though thousands of individuals of one species and none of another be obtained by a single haul, no conclusion is justified other than that the former species was obtained and that the latter was not obtained. Such data afford no adequate evidence for concluding that the former species is more abundant in or more typical of that particular locality than is the latter. Had 20 or 30 hauls been made at each station with nets of similar filtering capacities, sufficient evidence for such conclusions might have been obtained. But rarely more than one haul was made at each station, so the data yield little else than records of occurrence. These records are given for each species.

In comparing the species occurring in the Philippine region with those obtained from the vicinity of San Diego (the only coastal region of the Pacific off either of the American continents from which chaetognaths have been described), two interesting and suggestive facts come to light: First, those species obtained in largest numbers from the Philippines are those which, as a rule, occur rarely, if at all, in the San Diego region, and the opposite. Second, of those species common to both regions, the number of teeth is greater in Philippine specimens.

This is contrary to what might have been expected. For, judging from the fact that chaetognatha collected under the auspices of the Scripps Institution from as far south as 23° north, off Lower California, are essentially like those within the San Diego region proper, and, realizing that this is but two degrees north of the northern boundary of the Philippine area from which chaetognatha were obtained, one would naturally infer a close relationship between the Philippine and San Diego faunas. To find it quite the reverse is therefore suggestive of a fundamental and far-reaching difference in the other faunas, and so of the whole economic and fisheries situations of the coastal waters on opposite sides of the Pacific at corresponding latitudes. Extensive exploration of the Pacific, particularly of the coastal waters of Central and South America, is needed, however, to discover the full significance of what is here so clearly indicated, and it is regretted that no chaetognatha are described from these regions. But, in spite of this, it seems probable, from the meager data at hand, that conclusions reached through explorations in the western Pacific are largely inapplicable to the waters of the eastern Pacific, and the opposite. Some space is therefore taken at the close of the paper in briefly comparing the Philippine and San Diego chaetognatha. It is hoped this will emphasize the need of more extensive explorations, and that it may add its mite toward a better understanding of the fishery problems of the Pacific Ocean.

KEYS FOR THE IDENTIFICATION OF THE CHAETOGNATHA.

Ritter-Záhony (1911) has been the last investigator to thoroughly revise the chaetognatha. He recognizes six genera—*Sagitta, Pterosagitta, Spadella, Eukrohnia, Heterokrohnia,* and *Krohnitta.* Subsequently Germain and Joubin (1912) added two more—*Pseudosagitta* and *Krohnitella.* All are probably valid with the possible exception of *Spadella* and *Pseudosagitta,* the status of which is baffling. Most of the differences given by Ritter-Záhony (1911) between *Pterosagitta draco* and *Spadella cephaloptera* are certainly no greater than that between those species of *Sagitta* in which the skeletal part of the vestibular ridge is present and those in which it is absent, and this difference is clearly of subgeneric rather than generic value. On the other hand, Conant's (1895) description of *Spadella schizoptera,* although fragmentary and wholly unsatisfactory, reveals a close affinity between that species and *S. cephaloptera* and at the same time makes the genus to which it belongs unmistakably distinct from *Pterosagitta.* Furthermore I have seen specimens of neither *S. cephaloptera* nor *S. schizoptera,* and it seems best, therefore, to tentatively recognize *Spadella* as valid in spite of the fact that the characteristics by which its one well known species, *S. cephaloptera,* differs from *P. draco* seem of subgeneric value.

The validity of *Pseudosagitta* is ably discussed by Baldasseroni (1915, p. 101), who holds its single new species *P. grimaldi* to be synonymous with *Sagitta lyra.* The differential characters described by Germain and Joubin (1912, p. 6) are certainly such as to suggest this synonymy and I find myself in agreement with Baldasseroni.

In the following keys seven genera are therefore recognized, of which *Sagitta* is represented by 23 species, *Eukrohnia* by three, *Spadella* by two, and each of the others by one: *Pterosagitta draco* (see p. 264), *Heterokrohnia mirabilis* (Ritter-Záhony, 1911, p. 42), *Krohnitta subtilis* (see p. 269), and *Krohnitella boureei* (Germain and Joubin, 1912, p. 133).

KEY TO GENERA.

1. Two pairs of rows of teeth.. 2
1. Teeth entirely absent, or only one pair of rows present..................... 4
2. Two pairs of lateral fins, the posterior pair being partly on body and partly on tail. Fins completely or incompletely rayed; anterior and posterior pairs sometimes connected by narrow membrane........................*Sagitta.*
2. One pair of lateral fins, or two pairs of which the posterior one is entirely confined to the tail-segment. Fins completely rayed..................... 3
3. One pair of lateral fins confined entirely to tail-segment. Collarette massive, extending to tail-septum and spreading out over fins. Greatest width slightly anterior to tail-septum, and exceeding half that of the body. Ventral transverse muscles absent. Anterior and posterior teeth both exceed six in number..*Pterosagitta.*
3. One pair of lateral fins confined entirely to tail-segment, or two pairs the posterior one of which is confined to tail-segment. Collarette present but not massive. Greatest width slightly behind head, less than half that of body. Ventral transverse muscles present in body-segment only. Neither anterior or posterior teeth exceed five in number......................*Spadella.*
3. One pair of lateral fins partly on body and tail. Collarette absent. Ventral transverse muscles present in both body and tail..................*Heterokrohnia.*
4. Lateral fin begins at or in front of ventral ganglion and extends onto tail but never to seminal vesicles. Ventral transverse muscles present in anterior third of body. One pair of rows of teeth...........................*Eukrohnia.*
4. Lateral fin begins about half-way between ventral ganglion and tail-septum, and extends fully to seminal vesicles. Ventral transverse muscles absent.. 5
5. Head small but wider than body. Less than 50 per cent of fin in front of tail-septum. Width of body less than 8 per cent of total length. One pair of rows of teeth. Seizing jaws delicate, but not filliform.........*Krohnitta*
5. Head small, narrower than body. More than 60 per cent of fin in front of tail-septum. Width of body exceeds 9 per cent of total length. Teeth absent. Seizing jaws filliform...................................*Krohnittella.*

KEY TO SPECIES OF SAGITTA.

1. Collarette absent.. 2
1. Collarette present... 13
2. Shaft of seizing jaw serrated ....*S. serratodentata.*
2. Shaft of seizing jaw not serrated.. 3
3. Anterior and posterior fins confluent.. 4
3. Anterior and posterior fins separated.. 5
4. Both pairs of fins entirely rayless throughout at least their anterior thirds; tail usually exceeds 15 per cent of total length...........................*S. lyra.*
4. Fins only rayless adjacent to body but not along outer margins; tail usually less than 15 per cent of total length.................................*S. gazelle.*
5. Anterior fins longer than posterior fins.............................*S. philippini.*
5. Posterior fins longer than anterior fins..................................... 6
6. Anterior fins entirely rayless; rays of posterior fin perpendicular to body. *S. minima.*
6. Anterior fins not entirely rayless; rays of posterior fin directed obliquely to body.. 7
7. Anterior fins extend nearly if not quite to ventral ganglion............... 8
7. Anterior fins never extend within half their length of ventral ganglion.... 9
8. Both pairs of fins with rays throughout; mature ovary short and thick, not reaching anterior limit of posterior fins...............................*S. setosa.*

8. Anterior extremities of both pairs of fins rayless; anterior fin also rayless throughout a narrow strip adjacent to body; mature ovary long and narrow, extending nearly if not quite to ventral ganglion....... *S. serratodentata*
9. Tail 28–40 per cent of total length; posterior teeth 20–38, rarely as few as 17. *S. macrocephala.*
9. Tail less than 28 per cent of total length; posterior teeth rarely exceed 16.. 10
10. Posterior fins extend nearly if not quite to seminal vesicles; both pairs of fins rayed throughout.. 11
10. Posterior fins never extend more than $\frac{2}{3}$ distance from tail-septum to seminal vesicles; both pairs of fins rayless throughout a narrow strip adjacent to body.. 12
11. Body very transparent; interval between anterior and posterior fins always less than half the length of posterior fin............................... *S. setosa.*
11. Body semi-translucent but never transparent; interval between anterior and posterior fins usually greater than half the length of posterior fins..... *S. elegans*
12. Vestibular ridge composed entirely of papillae; anterior teeth 0–4, rarely 5; posterior teeth 0–6.. *S. hexaptera.*
12. Vestibular ridge provided with usual skeletal parts; anterior teeth 5–12, rarely less than 6; posterior teeth 7–18, rarely less than 10........... *S. enflata.*
13. Collarette short, not extending over half-way from neck to ventral ganglion. 14
13. Collarette long, extending more than $\frac{3}{4}$ distance from neck to ventral ganglion.. 22
14. Anterior fins longer than posterior fins.................................. 15
14. Posterior fins longer than anterior fins.................................. 18
15. Posterior fins never extend nearly to seminal vesicles................ *S. decipiens.*
15. Posterior fins extend nearly if not quite to seminal vesicles............... 16
16. Body transparent; anterior fins exceed 30 per cent of total length of animal. *S. pulchra.*
16. Body opaque or semi-translucent, but never transparent; anterior fins less than 30 per cent of total length of animal.......................... 17
17. Both pairs of fins rayed throughout................................ *S. neglecta.*
17. Anterior extremities of both pairs of fins rayless .... *S. bedoti.*
18. Interval between anterior fins and ventral ganglion exceeds one-fifth length of fins.. *S. bipunctata.*
18. Anterior fins extend nearly if not quite to ventral ganglion............... 19
19. Collarette inconspicuous, extending less than one-fourth distance from neck to ventral ganglion.. 20
19. Collarette well developed, extending between one-fourth and one-half distance from neck to ventral ganglion................................ 21
20. Pronounced constriction at tail-septum; sexually mature at a length of 5–6 mm.. *S. tenuis*
20. No constriction at tail-septum; never sexually mature under 9–10 mm. *S. friderici.*
21. Anterior teeth 10–18; exceeding number of posterior teeth............. *S. helenae.*
21. Anterior teeth 4–9; less than number of posterior teeth............... *S. hispida.*
22. Collarette never extending to ventral ganglion....................... *S. neglecta.*
22. Collarette extending from neck to seminal vesicles................. *S. californica.*
22. Collarette extending fully to ventral ganglion, frequently onto anterior fins, but never beyond anterior quarter..................................... 23
23. Posterior fins longer than anterior fins............................ *S. regularis.*
23. Anterior fins longer than posterior fins................................ 24
24. Less than 50 per cent of posterior fin in front of tail-septum............. *S. ferox.*
24. More than 50 per cent of posterior fin in front of tail-septum........ *S. planktonis.*

KEY TO SPECIES OF SPADELLA.

1. One pair of lateral fins entirely on tail-segment. Ventral transverse muscles present throughout entire body-segment....................... *S. cephaloptera.*

1. Two pairs of lateral fins, the posterior pair much larger and confined entirely to tail-segment, beginning directly behind seminal receptacle. Anterior pair extends throughout posterior third of body, beginning directly in front of seminal receptacles. Ventral transverse muscles present only in anterior half of body.......................................*S. schizoptera*.

KEY TO SPECIES OF EUKROHNIA.

1. Anterior two-thirds of lateral fins rayless. Posterior extremity of fins less than half-way from tail-septum to seminal vesicles. Width of body less than 8 per cent of total length of animal. Seizing jaws delicate; sometimes serrated.. 2
1. Lateral fins delicately rayed throughout. Posterior extremity of fins at least three-fourths way from tail-septum to seminal vesicles. Width of body exceeds 12 per cent of total length of animal. Seizing jaws massive; not serrated..*E. richardi*.
2. Eyes without pigment. Seizing jaws 8–10, gently curved throughout. Points sickle-shaped..*E. hamata*.
2. Eye with pigment. Seizing jaws 11–13, sharply curved in anterior quarter. Point slightly curved toward edge of jaw, but not sickle-shaped ....*E. fowleri*.

SPECIES OBTAINED DURING THE PHILIPPINE EXPEDITION.

Genus SAGITTA Quoy and Gaimard.

SAGITTA PHILIPPINI, new species.

Plate 34, figs. 1–4.

General appearance.—To the naked eye *S. philippini*, when placed in formalin upon a white background, appears white in color, scarcely distinguishable from the background. Its head and tail, and in less degree its ovaries, assume a brownish-yellow color in marked contrast to the body proper. On a black background the head, ventral ganglion, ovaries, tail, seminal vesicles, and to a less extent the intestine appear much more opaque than the body, which resembles ground glass. The lateral fins and tail fin are so transparent as to be invisible to the naked eye. In degree of opacity *S. philippini* resembles *S. decipiens* more than any other species, although it is perhaps less transparent.

Characters.—Collarette absent. Neck conspicuous. Lateral fields prominent. Body flabby, not retaining its form well; widest behind center, tapering gradually forward toward head and backward toward tail. No constriction at tail-septum. Ovaries, even when immature (pl. 34, fig. 1), extend beyond posterior end of anterior fin. Corona ciliata not observed.

Anterior fins (pl. 34, fig. 1) rayless throughout anterior half of fin. They are longer and narrower than posterior fins, and extend anteriorly beyond posterior end of ventral ganglion. Form triangular, the position of greatest width being in the caudal quarter of fin. Interval from anterior to posterior fins slightly greater than maximum width of body.

Posterior fins do not extend caudally to seminal vesicles. More than 50 per cent of fin in front of tail-septum. Form triangular, the position of greatest width being at or just behind tail-septum.

Vestibular ridge (pl. 34, fig. 3) well developed with large papillae. Wing of ridge covers all but the first two or three teeth, the notch extending to the fourth or fifth. External process long and blunt.

Anterior teeth (pl. 34, fig. 2), nine in number. They are short, broad, closely set, and diverge but little distally.

Posterior teeth (pl. 34, fig. 3), 20 in number. They are long, narrow, closely set, and diverge even less than do the anterior teeth.

Seizing jaws (pl. 34, fig. 4), six in number. Point with an oval base imbedded between 20 and 25 per cent of its height into shaft. Top of shaft and base of point converge toward edge of jaw. Edge of shaft provided with narrow crest. Pulp canal central and slightly swollen at base of point. Pulp evenly distributed.

Only a single specimen was obtained. Its measurements follow:

Length	13 mm.
Width	5. 5 per cent of length.
Length of tail	23 per cent of length.
Tip of tail to posterior end of ventral ganglion	70. 5 per cent of length.
Length of ventral ganglion	6. 5 per cent of length.
Length of posterior fin	22 per cent of length.
Width of posterior fin	4. 5 per cent of length.
Interval from anterior to posterior fins	6 per cent of length.
Per cent of posterior fin in front of tail-septum	60 per cent.
Length of anterior fin	30 per cent of length.
Width of anterior fin	2. 5 per cent of length.
Anterior fin extends beyond posterior end of ventral ganglion by	2 per cent of length.
Ovary extends beyond posterior end of posterior fin by	14 per cent of length.
Anterior teeth	9–9
Posterior teeth	20–(?)
Seizing jaws	6–6

The single specimen (Cat. No. 17801, U.S.N.M.) was taken from the surface May 14, 1908, off Uanivan Island, at station D 5240, latitude 6° 49.5′ north and longitude 126° 15′ east. The same haul also yielded 130 *S. enflata*, 10 *S. ferox*, 6 *S. hexaptera*, 1 *P. draco*, and 75 *S. decipiens*.

S. philippini bears a strong resemblance to the latter species, but differs from it in several important details: In the first place, it has no trace of a collarette, although this structure, while not pronounced in *S. decipiens*, is conspicuous. Again, the ovaries of *S. philippini*, though not fully mature, extend nearly to the middle of the anterior fin, while in *S. decipiens* they do not, when mature, extend beyond the anterior limit of the posterior fin. Further, the posterior fin of *S. philippini* is rayed throughout, while in *S. decipiens* (pl. 35, fig. 8) the anterior fourth or fifth of the fin is rayless. Lastly, the seizing jaws of the two species are quite different (pl. 34, fig. 4, and pl. 37, fig. 22), the jaw in *S. philippini* being provided with a narrow but conspicuous crest, which is missing in *S. decipiens*.

Altogether, these differences would seem to justify the description of a new species, even though it may later prove to be synonymous with *S. decipiens*. Had more than one individual been obtained, I should feel certain of the validity of *S. philippini*, but as the matter stands this single specimen might with as much justification be regarded as an abnormal *S. decipiens*.

SAGITTA ENFLATA Grassi.

Plate 38, fig. 28.

Sagitta enflata GRASSI (1883), p. 13.—FOWLER (1906), p. 8.—RITTER-ZÁHONY (1911), p. 13.—MICHAEL (1911), p. 28.

This species is represented in the Philippine collection by approximately 2,800 individuals. They usually exceed 20 mm. in length, and the largest taken measures 31.5 mm. In the San Diego region, on the other hand, the specimens rarely exceed 18 mm. in length, the largest recorded (Michael (1911, p. 29)) measuring only 21 mm. Again, the anterior teeth number 6 to 11, typically 7 or 8, in the Philippine specimens, while they number 4 to 8, typically 6 or 7, in San Diego specimens. Similarly, the posterior teeth number 9 to 15 in the Philippine specimens, the usual number being 14, while they number 6 to 12 in San Diego specimens, the usual number being 10 or 11. In all other respects, however, specimens from the two localities are in agreement, and the Philippine specimens agree in size and number of teeth with specimens described by Fowler (1906 p. 8) from the *Siboga* region.

One puzzling fact is revealed by the Philippine collection. The ovaries in most of the larger specimens are barely approaching maturity, only one case of complete maturity having been discovered in individuals exceeding 20 mm. in length; but among individuals under 16 mm. in length many have mature ovaries (pl. 38, fig. 28). In my San Diego report (1911, p. 56) a table is given of specimens of *S. enflata* arranged in three groups according as their ovaries were mature, approaching maturity, or remote from maturity. In the first group the specimens varied in length between 12.5 and 19.5 mm., in the second between 15 and 17.5 mm., and in the third between 8 and 15.5 mm. Obviously, these facts are open to two interpretations: First, the ovaries in San Diego specimens attain maturity only once and that after a length of 12 mm. is reached; and, second, the ovaries in the same individual become mature periodically, first when the individual is not less than 12 mm. in length, and subsequently after it has grown larger. If the second interpretation is eliminated, how is the relation between length of individual and stage of maturity of the ovary in the Philippine specimens to be accounted for? It could, of course, be readily explained on the assumption that two species had been confused, but I am unable to discover any other differences even remotely indicative of more than one species. In Table 1, for example, No. 9 alone had mature ovaries, but its measurements agree with the other larger and immature specimens.

TABLE 1.—*Measurements of Sagitta enflata.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To anterior fin.	To seminal vesicles.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.			
1	25.2	10.7	15.5	74.5	3.9	14.3	3.8	7.2	4.1	66.7	11.8	2.5	16	?-8	?-14	8-8
2	23.7	10.7	19.2	74	3.7	17.2	3.9	8.3	4.3	62.5	12.2	(?)	16	11-11	15-14	8-8
3	23.6	8.7	19.8	69.5	4	17.5	3.1	8.8	4.3	60.3	14.9	2.3	15.4	9-10	14-14	9-9
4	23.2	10.4	20	73	3.8	16.9	4.4	11.2	4.4	62	13.4	2.3	16.9	10-7	14-14	?-8
5	21.1	9.9	20.8	74.8	3.9	18.1	4.7	8.3	4.6	64.1	15.8	2.6	18.3	8-7	15-15	8-8
6	20.6	12.4	19.1	71.6	4.2	19.1	3.7	7.8	4	64.8	16.6	2.6	15.6	9-11	15-14	8-8
7	18.8	12.8	19.9	70.4	4.6	19.3	3.3	(?)	4.8	65	15.6	2.2	17.6	7- 7	14-15	8-7
8	18.4	11.8	20	73.6	3.7	18.8	5.1	9.3	4.9	63.4	17.7	2.3	14.8	8- 9	13-13	9-8
9	15.9	12.5	18.6	71	4.6	15.8	4.4	9.6	4.8	63.6	11.6	2.1	21.2	8- 7	13- ?	9-9
10	13.6	9.7	18.9	71.7	4.7	18.4	3.9	9.7	3.4	70	16.2	2.4	14.1	7- 7	12-12	8-9
11	10.2	7.7	23	72.3	5.7	17.3	4.6	8.4	4.8	59.9	10.7	2.1	18.2	7- 6	10- 9	7-8

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

Distribution.—*S. enflata* was collected from 39 stations, or 85 per cent of the 46 stations at which chaetognaths were taken, a total of approximately 2,800 specimens having been obtained. Of the 39 stations 8, or 21 per cent, were mesoplanktonic, while 31, or 79 per cent, were epiplanktonic, and 22, or 56 per cent, were surface stations. From the 8 mesoplanktonic stations a total of 247 specimens was obtained, or an average of 31 per station, while from the 31 epiplanktonic stations a total of 2,559 specimens, or an average of 83 per station, was obtained, and from the 22 surface stations a total of 1,476 specimens, or an average of 67 per station, was obtained. These data, together with the fact that all subsurface hauls were made with open nets, make it clear that *S. enflata* occurs typically in the upper epiplankton of the Philippine region.

The northernmost record of its capture during the Philippine expedition is 14° 21′.5 north and 120° 23′.3 east in the China Sea near southern Luzon. The southernmost record is 5° 36′.1 south and 127° 7′.6 east in Buton Strait. The easternmost and westernmost records are 127° 44′.0 east and 1° 3′.0 south, south of Patiente Strait, and 117° 53′ east and 21° 31′ north in the China Sea off Hongkong. The largest number (950) was taken February 7, 1908, at 8.05 in the morning from 25 fathoms by an open 0000 grit-gauze net towed horizontally 9 fathoms above the bottom of the Sulu Archipelago, near Basilan Island, at 6° 44′.2 north and 121° 47′ east. Other species taken in the same haul are: 318 *S. bedoti*, 217 *S ferox,* 116 *S. pulchra*, 2 *S. hexaptera*, and 19 *P. draco*. The complete records of its capture are given in table 2:

TABLE 2.—*Philippine records of occurrence of Sagitta enflata.*

Station.[1]	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms.		Number of specimens.	Cat. No. U.S.N.M.
						Haul.	Bottom.		
	° ′	° ′							
D. 5101	14 24.5 N.	120 23.3 E.	China Sea, near southern Luzon	Jan. 6, 1908	1.16 p. m.	37	43	17	17802
D. 5128	9 52.1 N.	121 49.8 E.	Sulu Sea, near southern Panay	Feb. 4, 1908	7.05 p. m.	Surf.	(?)	7	17803
D. 5129	7 41.5 N.	122 1.8 E.	Sulu Sea, off western Mindanao	Feb. 5, 1908	2.23 p. m.	100	(?)	47	17817
D. 5134	6 44.2 N.	121 47 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	950	17805
....	....	....	Sandakan	Feb. 29, 1908	8.15 p. m.	Surf.	7	2	....
D. 5176	13 35.3 N.	120 53.3 E.	Verde Island Passage	Mar. 24, 1908	7.01 p. m.	Surf.	260	11	....
D. 5177	13 35 N.	120 54.6 E.	....do	....do	7.33 p. m.	25	260	8	....
D. 5186	9 53.5 N.	122 15.5 E.	Between Panay and Negros	Mar. 30, 1908	8.01 p. m.	Surf.	(?)	51	17804
D. 5190	10 8.3 N.	123 16.8 E.	Tanon Strait, east of Negros	Mar. 31, 1908	4.39 p. m.	250	295	(?)	....
D. 5195	10 47 N.	124 6.5 E.	Off northern Cebu Island	Apr. 3, 1908	7.03 p. m.	Surf.	(?)	53	17806
D. 5196	10 44.5 N.	124 7.5 E.	....do	....do	7.42 p. m.	Surf.	(?)	3	....
D. 5223	13 36 N.	121 25.5 E.	Between Marinduque and Luzon	Apr. 24, 1908	7.47 p. m.	Surf.	(?)	44	17807
D. 5224	13 34.8 N.	121 21.8 E.	....do	....do	8.24 p. m.	Surf.	(?)	11	17808
D. 5226	14 12.3 N.	120 32.4 E.	China Sea, south of Corregidor	May 4, 1908	7.45 p. m.	Surf.	(?)	10	....
D. 5227	12 53.8 N.	121 52.5 E.	East of Mindoro	May 5, 1908	1.30 p. m.	290	322	6	....
D. 5233	10 0.4 N.	124 45.1 E.	Between Bohol and Leyte	May 7, 1908	9.00 p. m.	100	(?)	46	17809
D. 5234	10 0.0 N.	124 46.1 E.	....do	....do	9.42 p. m.	15	(?)	1	17810
D. 5240	6 49.6 N.	126 46.1 E.	Pujada Bay	May 14, 1908	1.33 p. m.	115	145	130	17811
D. 5262	12 37.5 N.	121 37.5 E.	East of Mindoro	June 4, 1908	7.40 p. m.	Surf.	(?)	1	....
D. 5263	12 38.5 N.	121 37.5 E.	....do	....do	8.17 p. m.	65	(?)	4	....
D. 5288	13 43.5 N.	121 0.0 E.	East of Matocot Point, Luzon	July 22, 1908	8.14 a. m.	115	140	6	17814
D. 5319	21 31 N.	117 53 E.	China Sea, off Hongkong	Nov. 5, 1908	7.23 p. m.	20	(?)	54	17815
D. 5320	20 58 N.	120 3 E.	....do	Nov. 6, 1908	3.18 p. m.	500	1,804	22	17816
D. 5340	10 55.8 N.	119 14.2 E.	Malampaya Sound, Palawan Island	Dec. 22, 1908	8.22 a. m.	20	25	3+	....
....	....	....	Endeavor Strait	Dec. 23, 1908	8.00 p. m.	Surf.	(?)	31	17827
D. 5436	14 22.6 N.	120 29.0 E.	East of Corregidor	May 7, 1909	7.03 p. m.	Surf.	32	451	17812
D. 5456	13 11.2 N.	123 51.9 E.	Southeast of Luzon	June 7, 1909	12.55 p. m.	120	142	66	17813
D. 5500	8 37.8 N.	124 36.8 E.	East of Macabalan Point, Mindanao	Aug. 4, 1909	11.25 a. m.	200	267	16	17822
D. 5530	9 26.8 N.	123 38.5 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.14 p. m.	Surf.	(?)	49	17818
D. 5531	9 27.5 N.	123 38.0 E.	....do	....do	7.49 p. m.	Surf.	(?)	169	17819
D. 5539	9 3.2 N.	123 24.8 E.	Between Siquijor and Negros Islands	Aug. 19, 1909	7.11 p. m.	Surf.	(?)	9	17820
D. 5540	9 3.0 N.	123 24.5 E.	....do	....do	7.42 p. m.	Surf.	(?)	42	17821
D. 5553	5 51.0 N.	120 46.5 E.	Near Jolo Island	Nov. 17, 1909	7.28 p. m.	Surf.	25	55	17880
D. 5611	0 40.5 S.	121 50.0 E.	Tomini Bay, Celebes Island	Nov. 19, 1909	7.41 p. m.	Surf.	(?)	33	17823
D. 5615	0 32.5 S.	126 31.5 E.	Molucca Passage	Nov. 22, 1909	2.37 p. m.	Surf.	1,021	1	....
D. 5633	1 3.0 S.	127 41.0 E.	South of Patiente Strait	Dec. 2, 1909	7.14 p. m.	Surf.	(?)	111	17936
D. 5649	5 36.1 S.	122 7.6 E.	Buton Strait	Dec. 16, 1909	7.23 p. m.	Surf.	(?)	122	17824
D. 5669	2 19.5 S.	118 50.0 E.	Mamuju Island, in Macassar Strait	Dec. 29, 1909	7.25 p. m.	Surf.	(?)	84	17825
D. 5672	0 29.0 S.	118 51.0 E.	Macassar Strait	Dec. 30, 1909	7.26 p. m.	Surf.	(?)	80	17826

[1] Reference to these stations in Dredging and Hydrographic Records of the Philippine Expedition (Bureau of Fisheries Doc. No. 741, in Commissioner's Report, 1910) will reveal details concerning collecting apparatus used, duration of hauls, distance of drift, etc., which are here omitted.

SAGITTA HEXAPTERA d'Orbigny.

Sagitta hexaptera D'ORBIGNY (1843), p. 140.—FOWLER (1906), p. 11.—RITTER-ZÁHONY (1911), p. 7.—MICHAEL (1911), p. 30.

This species is the second most abundant and frequent obtained during the Philippine expedition, being represented by approximately 700 specimens. Most are large though immature, the largest specimen measuring 45 mm. in length. Curiously, both anterior and posterior teeth in many specimens are entirely missing. My first impression was that although not seen they must be present, but careful dissection of several heads has made it certain that the teeth are actually missing. This was not noticed in San Diego specimens, two being the smallest number of either anterior or posterior teeth recorded in my (1911) report. Again, Fowler (1906, p. 13) lists the number of teeth in 42 specimens, one being the smallest number of either anterior or posterior teeth recorded. Ritter-Záhony (1908, p. 10), however, while recording three as the smallest number of anterior teeth, gives four instances in which the posterior teeth in individuals 33, 34, 36, and 38 mm. in length were missing. In attempting to account for the peculiar variability in number of teeth, Fowler (1906, p. 14) explains their absence in the Philippine specimens. He says:

> I believe the explanation to lie mainly (perhaps not entirely) in the length and slenderness of the teeth; many of them are probably torn out by the roots; certainly many are broken off short, for their bases may be seen still in place. As an additional weakness, the posterior teeth in older specimens often appear not to be attached to the bony bar with which they are united in other species, but to lie at some distance from it in a superficial plate of chitinous material.

TABLE 3.—*Measurements of Sagitta hexaptera.*[1]

Number.	Length.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Ovaries.			Anterior teeth.	Posterior teeth.	Seizing jaws.
						Length.	Width.	To seminal vesicles.	Tail-septum.[2]	To anterior fin.	Length.	Width.	To ventral ganglion.	Length.	Width.	To ventral ganglion.[3]			
1	42.1	.....	17.0	65.1	2.8	20.9	5.7	3.5	66.0	10.8	13.3	(?)	10.0	41.0	0.33	− 7.1	2–2	0–0	5–5
2	39.4	10.1	19.1	65.8	3	20.2	4.3	3.7	65	8.6	11.8	2.6	13.3	36.4	.89	−10.3	4–2	0–2	5–5
3	38.6	9.9	19.1	72	3.4	21.9	4.6	6	69	10.6	14.5	3	12.7	49.6	1.54	− 3.4	0–0	1–0	4–4
4	38.5	.....	20.2	72.5	2.8	23	5.7	4	66.5	9.6	15.5	3.3	12.1	42.3	.45	−10.1	0–0	0–0	4–4
5	36.4	.....	22.2	71.1	3.3	18.5	6.1	4.9	59.4	11.8	11.2	2.3	14.9	33	.77	−15.8	0–0	2–1	4–5
6	34.4	.....	21.4	70.9	3.5	24.5	5.4	5.1	69	7.2	14.3	2	11.1	58.4	1.32	+ 5.4	0–0	0–0	5–4
7	33.7	.....	22.3	67	3	19	5.7	4.9	57.5	14.1	15.2	2.1	14.9	39.2	.62	−16	0–0	0–0	5–5
8	32.4	10.2	19.6	67.6	3.2	20	5.2	3.7	64.8	6.9	13.6	3	14.6	55.5	2.16	+ 4.2	1–1	1–0	4–4
9	32	9.3	21.6	65.5	3.5	21.2	5.1	2.8	61.8	8.5	10.5	2.3	11.8	19.7	1.09	−23.2	1–0	4–0	7–6
10	31.4	9	23.1	66.7	3.2	21.4	5	5.5	64	6.1	12.3	3.2	11.4	24.5	1.12	−19.1	0–2	2–2	4–4
11	30.8	7.5	20.8	69.5	3.1	20.3	4.3	5.4	63.7	9.9	11.6	2.7	11.7	24.7	.91	−21.6	1–1	4–3	5–4
12	30.5	8.6	21.7	71.5	3	20.8	5	4.2	55.5	10.4	13.5	....	14.5	16.8	.46	−32.3	0–0	2–1	5–5
13	30.2	6.4	19.6	63.7	3.5	20.3	4.8	4.9	64.5	6.6	13.3	2.1	9.9	13.7	.46	−30.4	2–2	3–2	5–5
14	29.5	9.4	19.5	72.5	3.6	26.4	4.7	4.6	70.5	8.8	12.1	2.8	13.6	26.1	.71	−27	3–2	2–3	5–5
15	29.3	10.2	17.8	66.4	3.6	22.8	5.5	4.1	72.3	7.9	13.2	3.1	11	36.2	1.31	−12.4	2–3	2–1	4–4

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.
[3] The + signifies extension beyond anterior end of ganglion; the − signifies distance from posterior end of ganglion.

Distribution.—*S. hexaptera* was collected from 26, or 57 per cent, of those stations at which chaetognaths were captured. Of these, 8 were mesoplanktonic, while 13, or one-half, were surface stations. From the 8 mesoplanktonic stations a total of only 70, or an average of 9 to each station, was obtained, while the 18 epiplanktonic stations yielded 642, or an average of 36 per station, and the 13 surface stations yielded 491, or an average of 38 per station. It is evident, therefore, that *S. hexaptera* occurs typically in the upper epiplankton of the Philippine region.

S. hexaptera, often confused with *S. elegans* and with the large variety (*S. maxima*) of *S. lyra*, is a eurythermal, nearly cosmopolitan species found typically in the lower epiplankton and mesoplankton of the arctic, sub-arctic, north temperate, tropical, and south tropical Atlantic, the south temperate and tropical Indo-Australian, and the north temperate and sub-antarctic Pacific oceans. Its northern and southern limits of distribution are 74° north and 28° south, while the extremes of temperature recorded in connection with its capture are 29° C. and 6° C. A statement frequently encountered in the literature is that surface Chaetognatha of the arctic seas would be found, if at all, in the mesoplankton of temperate and tropical regions, the implication being that temperature plays the all-important part in delimiting the vertical distribution of a species. Obviously, the typical occurrence of *S. hexaptera* in the upper epiplankton during the Philippine expedition contradicts this statement, which contradiction is further supported by Ritter-Záhony (1911, p. 54), who says: "Es gibt keinen einzigen verbürgten Fundort der *S. hexaptera* aus dem Epiplankton der Meere nördlich von 40° N." Rather do the facts point in quite the opposite direction, that is that surface *S. hexaptera* of tropical and sub-tropical regions are found, if at all, in the lower epiplankton and mesoplankton of arctic and sub-arctic regions. However, until consistency of identification of the species obtained during the various expeditions is attained, and until the vertical distribution of the species in diversified regions is critically studied, no conclusion as to the part played by temperature or any other environmental influence, in controlling its distribution throughout the world, is justified.

The northernmost and westernmost record of its capture during the Philippine expedition is 21° 31′ north and 117° 53′ east in the China Sea, off Hongkong. Its southernmost record is 5° 36′.1 south and 122° 7′.6 east, in Buton Strait; and its easternmost record is 127° 44′ east and 1° 3′ south, south of Patiente Strait. The largest number (153 +) was taken August 11, 1909, at 7.49 in the evening, from the surface between Siquijor and Bohol Islands, at 9° 27′.5 north and 123° 38′ east. Other species obtained at the same station are: 169 *S. enflata*, 128 *S. pulchra*, 50 *S. ferox*, and 14 *S. bedoti*.

TABLE 4.—*Philippine records of occurrence of Sagitta hexaptera.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms.		Number of specimens.	Cat. No. U.S.N.M.
						Haul.	Bottom.		
	° ′	° ′							
D. 5120	13 45.5 N.	120 30.3 E.	Verde Island Passage	Jan. 21, 1908	3.10 p. m.	350	393	2	17833
D. 5128	9 52.1 N.	121 49.8 E.	Sulu Sea, near southern Panay	Feb. 4, 1908	7.05 p. m.	Surf.	(?)	2	17835
D. 5129	7 41.5 N.	122 1.8 E.	Sulu Sea, off western Mindanao	Feb. 5, 1908	2.23 p. m.	100	(?)	127	17836
D. 5134	6 44.2 N.	121 47 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	2	17837
D. 5177	13 35 N.	120 54.6 E.	Verde Island Passage	Mar. 24, 1908	7.33 p. m.	25	260	2	17838
D. 5185	10 5.8 N.	122 18.5 E.	Between Panay and Negros	Mar. 30, 1908	5.26 p. m.	550	638	28	17839
D. 5186	9 53.5 N.	122 15.5 E.	....do	....do	8.01 p. m.	Surf.	(?)	4	17935
D. 5195	10 47 N.	124 6.5 E.	Off northern Cebu Island	Apr. 3, 1908	7.03 p. m.	Surf.	(?)	48	17840
D. 5224	13 34.8 N.	121 21.8 E.	Between Marinduque and Luzon	Apr. 24, 1908	8.24 p. m.	Surf.	(?)	12	17834
D. 5234	10 0.0 N.	124 46.1 E.	Between Bohol and Leyte	May 7, 1908	9.42 p. m.	15	(?)	8	17841
D. 5240	6 49.6 N.	126 46.1 E.	Pujada Bay	May 14, 1908	1.33 p. m.	115	145	6	17842
D. 5263	12 38.5 N.	121 37.5 E.	East of Mindoro	June 4, 1908	7.40 p. m.	Surf.	(?)	6	17843
D. 5288	13 43.5 N.	121 0.0 E.	East of Matocot Point, Luzon	July 22, 1908	8.14 a. m.	115	140	2	17844
D. 5319	21 31 N.	117 53 E.	China Sea, off Hongkong	Nov. 5, 1908	7.23 p. m.	20	(?)	12	17845
D. 5320	20 58 N.	120 3 E.	....do	Nov. 6, 1908	3.18 p. m.	500	1,804	4	17846
D. 5437	15 45.9 N.	119 42.7 E.	West of Luzon	May 8, 1909	12.07 p. m.	450	(?)	9	17847
D. 5456	13 11.2 N.	123 51.9 E.	Southeast of Luzon	June 7, 1909	12.55 p. m.	120	142	1	17848
D. 5500	8 37.8 N.	124 36.8 E.	East of Macabalan Point, Mindanao	Aug. 4, 1909	11.25 a. m.	200	267	18	17853
D. 5530	9 26.8 N.	123 38.5 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.14 p. m.	Surf.	(?)	45	17849
D. 5531	9 27.5 N.	123 38 E.	....do	....do	7.49 p. m.	Surf.	(?)	153+	17850
D. 5539	9 3.2 N.	123 24.8 E.	....do	Aug. 19, 1909	7.11 p. m.	Surf.	(?)	32	17851
D. 5540	9 3 N.	123 24.5 E.	....do	....do	7.42 p. m.	Surf.	(?)	135	17852
D. 5633	1 3 S.	127 44 E.	South of Patiente Strait	Dec. 2, 1909	7.14 p. m.	Surf.	(?)	14	17854
D. 5649	5 36.1 S.	122 7.6 E.	Buton Strait	Dec. 16, 1909	7.23 p. m.	Surf.	(?)	30	17855
D. 5669	2 19.5 S.	118 50 E.	Mamuju Island, in Macassar Strait	Dec. 29, 1909	7.25 p. m.	Surf.	(?)	8+	17856
D. 5672	0 29 S.	118 51 E.	Macassar Strait	Dec. 30, 1909	7.26 p. m.	Surf.	(?)	2	....

SAGITTA MINIMA Grassi.

Plate 37, figs. 16–17; plate 38, fig. 29.

Sagitta minima Grassi (1881), p. 213; (1883), p. 15.—Krumbach (1903), p. 637.—Ritter-Záhony (1911), p. 25.

This species is represented by only two specimens (Cat. No. 17925, U.S.N.M.), both of which are apparently sexually mature. Both were obtained on April 3, 1908, from the surface at station D. 5195, off northern Cebu Island, 10° 47′ north and 124° 6′.5 east. Except for the mature ovaries they are almost inseparable to the naked eye from small *S. enflata.* Microscopic examination, however, reveals several marked differences. The species is redescribed on the basis of these two specimens.

Collarette absent. Body flabby and widest on a level with anterior end of posterior fins, tapering gradually toward head and tail. Constriction at tail-septum slight or absent. Ovary (pl. 38, fig. 29) short, not extending to anterior end of posterior fins. Ova large and arranged *in a single row* within the ovary. Corona ciliata not observed.

Anterior fins shorter and narrower than posterior fins and entirely rayless. They fall short of reaching the posterior end of ventral ganglion by nearly two-thirds the length of fins. Interval from anterior to posterior fins approximately equal to half the length of anterior fins.

Posterior fins (pl. 38, fig. 29) with rays arranged perpendicular to the body. Interval from fins to seminal vesicles 3 to 5 per cent of total length. More than 50 per cent of fins in front of tail-septum. Position of greatest width behind tail-septum.

Vestibular ridge (pl. 37, fig. 16) provided with low, regular papillæ, one for each tooth. Wing covers all except the first tooth, the second being just barely covered. Notch extends to fourth tooth. External process apparently missing.

Anterior teeth, 4 to 5 in number (2 to 5 according to Ritter-Záhony, 1911, p. 26). They are very closely set and not diverging much distally. *Posterior teeth* (pl. 37, fig. 16), 10 or 11 in number (6 to 14 according to Ritter-Záhony). They are not so closely set as the anterior teeth, but are more divergent distally.

Seizing jaws (pl. 37, fig. 17), 8 or 9 in number (7 to 8 according to Ritter-Záhony). Point with an oval base, inserted into shaft by less than one-fifth its height. Tip of point curved toward its edge. Base of point and top of shaft parallel. Pulp-canal central, with a swollen place below base of point. Pulp evenly distributed throughout canal.

Aside from the number of teeth and seizing jaws and length of tail, only one of the two specimens is well enough preserved to permit accurate measurements.

Length in mm	9.5.
Tail:	
Length	20.8 per cent of length.
To ventral ganglion	68.5 per cent of length.
Posterior fin:	
Length	17.6 per cent of length.
To seminal vesicles	3.2 per cent of length.
To anterior fin	9.1 per cent of length.
Proportion in front of tail-septum	59.1 per cent.
Anterior fin:	
Length	16.5 per cent of length.
To ventral ganglion	11.7 per cent of length.
Number of anterior teeth	5–4.
Number of posterior teeth	11–(?)
Number of seizing jaws	8–9.

The other specimen measured 8.9 mm.; its tail measured 20.7 per cent; the number of anterior teeth are 4–5; the number of posterior teeth, 10–10; and the number of seizing jaws, 9–8.

SAGITTA SERRATODENTATA Krohn.

Sagitta serratodentata Krohn (1853), p. 272.—Fowler (1905), p. 58.—Ritter Záhony (1911), p. 22.—Michael (1911), p. 39.

Approximately 100 specimens were obtained, none of which is sexually mature. The number of anterior and posterior teeth is greater than recorded by Fowler (1905, p. 58) in specimens taken from the Bay of Biscay, or by myself (1911, p. 40) in specimens taken from the San Diego region. In specimens between 7 and 11 mm. in length Fowler records 3 to 6 anterior and 2 to 10 posterior teeth, while in Philippine specimens between the same lengths, the anterior teeth number 8 to 11 and the posterior teeth 13 to 24. The San Diego specimens are considerably larger, those recorded varying in length between 10 and 17 mm.; but the number of teeth is intermediate, the anterior teeth numbering 6 to 9 and the posterior teeth 13 to 19. The species appears to be unusually variable.

Table 5.—*Measurements of Sagitta serratodentata.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To anterior fin.	To seminal vesicles.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.			
1	10.6	4.5	26.0	62.0	7.5	26.0	3.0	......	4.5	51.5	22.0	2.0	0.5	10–10	23–22	6–5
2	10.5	6	24	67	7	28	4	......	2.5	51.5	24	3	2	11–11	24–23	6–6
3	10.3	5	25	65	7	27	1.5	......	7	55	18.5	1.5	1	11–10	20–18	6–6
4	10.2	5	26	68	7	25	3.5	0.5	6.5	52	22.5	2	......	8–9	20–?	6–6
5	9.3	4.5	24.5	68.6	7.5	28	4.5	1	5	52	21	2.5	0.5	9–8	?–19	6–6
6	9	5	25	68	8	29.5	4.5	......	4	50.5	23	3	......	9–9	17–16	7–7
7	8.6	5	25.5	68.5	8.5	27.5	4	1.5	5.5	50	22.5	2.5	......	9–8	15–14	6–6
8	8.4	5	27	72.5	8	31	4.5	0.5	3.5	[illegible].5	26	3	......	9–9	18–19	6–7
9	7.6	4.5	25.5	68	7	28	4.5	1.5	4.5	[illegible]	22	2.5	......	9–?	15–?	6–6
10	7.5	5	25	69	8	28.5	4.5	1.5	[illegible]	[illegible]	21.5	2.5	......	9–9	14–13	7–7

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

TABLE 6.—*Philippine records of occurrence of Sagitta serratodentata.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms. Haul.	Depth in fathoms. Bottom.	Number of specimens.	Cat. No. U.S.N.M.
	° ′	° ′							
D. 5120	13 45.5 N.	120 30.2 E.	Between Balayan Bay and Verde Island	Jan. 21, 1908	2.41 p. m.	350	393	1	17932
D. 5129	7 41.5 N.	122 1.8 E.	Sulu Sea, off western Mindanao	Feb. 5, 1908	2.23 p. m.	100	(?)	1	17828
D. 5185	10 5.8 N.	122 18.5 E.	Between Panay and Negros	Mar. 30, 1908	5.26 p. m.	550	638	2	17829
D. 5190	10 8.3 N.	123 16.8 E.	Tanon Strait, east of Negros	Mar. 31, 1908	4.39 p. m.	250	295	(?)	....
D. 5319	21 31 N.	117 53 E.	China Sea, off Hongkong	Nov. 5, 1908	7.23 p. m.	20	(?)	19	17830
D. 5320	20 58 N.	120 3 E.	....do....	Nov. 6, 1908	3.18 p. m.	500	1,804	5	17831
D. 5540	9 3 N.	123 24.5 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.49 p. m.	Surf.	(?)	1	....
D. 5615	0 32.5 S.	126 31.5 E.	Molucca Passage	Nov. 22, 1909	2.37 p. m.	Surf.	1,021	73	17832

Distribution.—*S. serratodentata* was collected from only eight stations. All except three were mesoplanktonic, but the largest number of specimens (73) were taken from the surface. The records are given in Table 6:

SAGITTA MACROCEPHALA Fowler.

Sagitta macrocephala FOWLER (1905), p. 65.—RITTER-ZÁHONY (1911), p. 31.

A single distorted specimen was obtained. Its measurements follow:

Length in mm	7.8 mm.
Width in per cent of length	14.4 per cent.
Tail in per cent of length	37.4 per cent.
Length of posterior fin	24.8 per cent.
Per cent of fin in frontof tail-septum	45.5 per cent.
Width of posterior fin	7.7 per cent.
Interval from anterior to posterior fin	5.5 per cent.
Length of anterior fin	15.0 per cent.
Width of anterior fin	2.7 per cent.
Number of anterior teeth	7–7
Number of posterior teeth	25–26
Number of seizing jaws	11–11

Ventral ganglion, corona ciliata, and ovaries not observed.

The specimen differs conspicuously in width from those drawn by Fowler (1905, pl. 5, fig. 16) and Ritter-Záhony (1911, fig. 37). In width the Philippine specimen measures 14.4 per cent of the length, while Fowler draws it 7.8 per cent, and Ritter-Záhony 5 per cent. However, the Philippine specimen is clearly immature, neither ovaries nor seminal vesicles being visible. Moreover, it is poorly preserved, some portions of the body being distorted and others torn away. These facts are probably responsible for the excessive width. Unfortunately the points of all seizing jaws were broken off, so that their structure could not be determined.

The single specimen (Cat. No. 17926, U.S.N.M.) was obtained November 6, 1908, in the China Sea, in the vicinity of Formosa, at station D. 5320, 20° 58′ north and 120° 3′ east by an open 0000 grit gauze net towed at 3.18 in the afternoon in 500 fathoms for twenty minutes.

SAGITTA PULCHRA Doncaster.

Plate 35, fig. 5; plate 37, figs. 19, 23.

Sagitta pulchra Doncaster (1902), p. 213.—Fowler (1906), p. 17.—Ritter-Záhony (1911), p. 21.

Approximately 500 individuals were obtained, and few, if any, are sexually mature. In body length and number of teeth they agree remarkably well with specimens described by Fowler (1906) from the *Siboga* region. He records 5 to 10 anterior and 9 to 15 posterior teeth in specimens between 9 and 22 mm. in length, and in Philippine specimens between 9 and 30 mm. in length, the anterior teeth number 5 to 9, and the posterior teeth 10 to 13. The Philippine specimens are, on the whole, so well preserved that the species is redescribed.

Collarette (pl. 35, fig. 5) conspicuous but short, varying in length from one-twentieth to one-tenth the length of the animal. Its length is less than twice the body width and it extends between one-fourth and one-half the distance from neck to ventral ganglion Neck pronounced but rendered inconspicuous by the collarette. Muscles thin but strong. Lateral fields large. More transparent than any other species having a collarette, and similar in transparency to *S. enflata*. Its body, however, is firmer than that of *S. enflata* and is approximately half as wide. Width greatest between one-half and three-quarters the distance from head to tail-septum, tapering gradually forward and more rapidly backward. Slight constriction at tail-septum. Tail 18 to 25 per cent of total length of animal. Corona ciliata not observed.

Anterior fins (pl. 35, fig. 5) longer and narrower than posterior fins extending anteriorly beyond posterior end of ventral ganglion, frequently beyond its middle, and rarely beyond its anterior end. No rays except in posterior quarter of fin. Interval from anterior to posterior fins usually less than two-thirds width of body, varying from slightly less than one-half to slightly more than the width.

Posterior fins (pl. 35, fig. 5) rayless anteriorly. They extend posteriorly nearly if not quite to seminal vesicles, the interval never exceeding 2.5 per cent of total length of animal. More than 50 per cent of fin in front of tail-septum, varying from 50.5 to 64 per cent. Broadly triangular in form, and widest at or slightly behind tail-septum.

Vestibular ridge (pl. 37, fig. 19) provided with large regular papillae, the apices of which usually terminate in two minute spines. Wing of ridge covers all except first two or three teeth. Notch extends to fourth or fifth tooth. External process one-third to one-half length of ridge and approximately four times longer than broad.

Anterior teeth 5 to 9, closely set and diverging distally. *Posterior teeth* (pl. 37, fig. 19) 10 to 13, not so closely set nor so divergent distally as anterior teeth.

Seizing jaws (pl. 37, fig. 23) 5 to 6 in number. Point with oval base inserted little more than one-tenth its height into shaft. Base of point and top of shaft parallel. Edge of shaft provided with broad thin crest. Pulp-canal central, with pulp evenly distributed throughout.

TABLE 7.—*Measurements of Sagitta pulchra.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Collarette.		Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To seminal vesicle.	To anterior fin.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.	Length.	To ventral ganglion.			
1	29.3	5.5	18	70.5	4	25	5.5	1	2.5	64	37.5	3	+4.5	5	16	6–7	10–10	5–5
2	27.3	7	17.5	70	3.5	23	4	1.5	3.5	56	37.5	2.5	+1	7.5	16	5–6	11–12	5–6
3	21	6	19.5	72	4	24.5	5.5	1.5	2.5	63.5	36	2.5	+1.5	6	13.5	6–6	12–13	5–5
4	20.5	5.5	19.5	69	4	22	5	1	2	58.5	36	3	+1.5	7.5	14.5	7–6	10–11	5–6
5	20.2	6	20	71	4	24	5	1	3	59.5	32	2	+ .5	9.5	11.5	7–8	10–11	5–6
6	19.5	5.5	21	70.5	4.5	26.5	5.5	0	1.5	56.5	35	3.5	+2	8	13	6–6	?–12	6–6
7	19.4	6	19.5	70	4	23.5	5	1	4.5	59.5	33.5	3.5	+1.5	8.5	13.5	8–8	13–13	5–5
8	18.7	5.5	21	72	4.5	22.5	4	1	7	54	32.5	2.5	+ .5	7	12.5	7–6	12–12	5–6
9	18.4	6	20	71	4.5	23	5.5	1	3	58.5	36	3	+1.5	8	12.5	8–9	12–13	6–5
10	16.2	4.5	21	70.5	4.5	24	3.5	(?)	4.5	55.5	33	2	+1.5	8	12.5	7–7	11–?	6–6
11	15.2	5	20	67	5	22	4	2	3.5	60	32	3	+2.5	9.5	10.5	8–7	11–?	6–6
12	14.1	6	23.5	69	5	27	5.5	0	3	56	32	3.5	+1.5	8.5	13.5	5–6	12–11	6–6
13	10.5	7	27	68.5	6.5	28.5	5.5	(?)	3	62	32	3	+3.5	8.5	16.5	7–8	11–12	6–6
14	10.3	6	23	68.5	5	23.5	4.5	2	3.5	51.1	31.5	3	+2	7.5	12.5	7–6	10– 9	6–6
15	9.6	5	25	69.5	6	27.5	5	(?)	1	50.5	32	3	+2	6	13	7–6	?–10	6–6

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

Distribution.—*S. pulchra* was collected from 23 stations, or from exactly 50 per cent of those at which chaetognaths were taken. Of these only 5 were mesoplanktonic stations, and 14 of the remaining 18 were surface stations. There can be no question, therefore, that the species is typical of the upper epiplankton in the Philippine region. Its northernmost record of capture during the Philippine expedition is in the China Sea, near Hongkong, 20° 58′ north and 120° 3′ east; its southernmost record is in Buton Strait, 5° 36.1′ south and 122° 7.6′ east; its easternmost record is in the Gulf of Tomini, Celebes, 125° 17.1′ east and 1° 13.2′ north; and its westernmost record is in Macassar Strait, 118° 50′ east and 2° 19.5′ south. The largest number (128+) was taken August 11, 1909, at 7.49 in the afternoon by a 0000 grit-gauze net towed on the surface between Siquijor and Bohol Islands, at 9° 27.5′ north and 123° 38′ east. Other species taken at the same station are *S. enflata* (169), *S. lyra* (85), *S. ferox* (50), and *S. bedoti* (14).

TABLE 8.—*Philippine records of occurrence of Sagitta pulchra.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms. Haul.	Depth in fathoms. Bottom.	Number of specimens.	Cat. No. U.S.N.M.
	° ′	° ′							
D. 5101	14 24.5 N.	120 23.3 E.	China Sea, off southern Luzon	Jan. 6, 1908	1.16 p. m.	37	43	1	17857
D. 5129	7 41.5 N.	122 1.8 E.	Sulu Sea, off western Mindanao	Feb. 5, 1908	2.23 p. m.	100	(?)	21	17858
D. 5134	6 44.2 N.	121 47 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	116	17859
D. 5195	10 47 N.	124 6.5 E.	Off northern Cebu Island	Apr. 3, 1908	7.03 p. m.	Surf.	(?)	29	17860
D. 5223	13 36 N.	121 25.5 E.	Between Matinduque and Luzon	Apr. 24, 1908	7.47 p. m.	Surf.	(?)	3	17861
D. 5224	13 34.8 N.	121 21.8 E.	.....do	.....do	8.24 p. m.	Surf.	(?)	1	....
D. 5226	14 12.3 N.	120 32.4 E.	China Sea, south of Corregidor	May 4, 1908	7.45 p. m.	Surf.	(?)	1	....
D. 5258	10 27.8 N.	122 12.5 E.	Off southern Panay	June 2, 1908	7.08 p. m.	Surf.	(?)	1	....
D. 5263	12 38.5 N.	121 37.5 E.	East of Mindoro	June 4, 1908	7.40 p. m.	Surf.	(?)	1	....
D. 5288	13 43.5 N.	121 0.0 E.	East of Matocot Point, Luzon	July 22, 1908	8.14 a. m.	115	140	63	17862
D. 5320	20 58 N.	120 3 E.	China Sea, off Hongkong	Nov. 6, 1908	3.18 p. m.	500	1,804	29	17863
D. 5340	10 55.8 N.	119 14.2 E.	Malampaya Sound, Palowan Island	Dec. 22, 1908	8.22 a. m.	20	25	(?)	....
....	....	....	Endeavor Strait	Dec. 23, 1908	8.00 p. m.	Surf.	(?)	2	17874
D. 5436	14 22.6 N.	120 29 E.	East of Corregidor	May 7, 1909	7.03 p. m.	Surf.	32	8	17864
D. 5456	13 11.2 N.	123 51.9 E.	Southeast of Luzon	June 7, 1909	12.55 p. m.	120	142	45	17865
D. 5500	8 37.8 N.	124 36.8 E.	East of Macabalan Point, Mindanao	Aug. 4, 1909	11.25 a. m.	200	267	21	17866
D. 5530	9 26.8 N.	123 38.5 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.14 p. m.	Surf.	(?)	8	17867
D. 5531	9 27.5 N.	123 38 E.	.....do	.....do	7.49 p. m.	Surf.	(?)	128	17868
D. 5539	9 3.2 N.	123 24.8 E.	.....do	Aug. 19, 1909	7.11 p. m.	Surf.	(?)	5	17869
D. 5540	9 3.0 N.	123 24.5 E.	.....do	.....do	7.42 p. m.	Surf.	(?)	22	17870
D. 5601	1 13.2 N.	125 17.1 E.	Gulf of Tomini, Celebes	Nov. 13, 1909	2.18 p. m.	765	765	8	17871
D. 5649	5 36.1 S.	122 7.6 E.	Buton Strait	Dec. 16, 1909	7.23 p. m.	Surf.	(?)	29	17872
D. 5669	2 19.5 S.	118 50 E.	Mamuju Island, in Macassar Strait	Dec. 29, 1909	7.25 p. m.	Surf.	(?)	10	17873

SAGITTA DECIPIENS Fowler.

Plate 35, fig. 8; plate 37, figs. 18, 22.

Sagitta decipiens FOWLER (1905), p. 70.—RITTER-ZÁHONY (1911), p. 27.
Sagitta sibogae FOWLER (1906), p. 21.—RITTER-ZÁHONY (1909*a*), p. 5.—MICHAEL (1911), p. 74.

According to Ritter-Záhony (1911, p. 29), there is "keine spezifischen Unterschiede in Fowler's Diagnosen und Abbildungen der beiden Arten [*S. decipiens* und *S. sibogae*] und *S. sibogae* weist danach—als älteres Stadium!—gegenüber *S. decipiens* eigentlich nur bedeutendre Dimensionen und höhere Zahlen für die Vorder- und Hinterzähne auf."

Although the species is represented in the Philippine collection by more than 100 specimens, few are well enough preserved to permit accurate measurements and their identification is therefore not certain. They have more anterior and posterior teeth than recorded by Fowler (1905, p. 70) in his original description, 8 to 11 anterior and 19 to 22 posterior teeth against his records of 5 to 10 anterior and 12 to 18 posterior teeth. They agree, however, with his (1906, p. 21) records for *S. sibogae*, in which the anterior teeth number 7 to 10 and the posterior teeth 13 to 23. They also agree, not so well perhaps, with Ritter-Záhony's (1911, p. 28) records. He gives the number of anterior teeth as 7 to 9 and the number of posterior teeth as 12 to 20. The species is redescribed on the basis of the Philippine material.

Collarette (pl. 35, fig. 8) inconspicuous, varying in length from slightly less than one-quarter to slightly more than half the body width. Body flabby, seldom retaining its form well, and widest on level with posterior end of anterior fins, tapering gradually toward head and tail. No constriction at tail-septum. Ovary short, not extending beyond anterior limit of posterior fins. Corona ciliata not observed.

Anterior fins (pl. 35, fig. 8) rayless throughout anterior half, longer and narrower than posterior fins, and extending slightly beyond posterior end of ventral ganglion. Interval from anterior to posterior fins about equal to maximum width of body.

Posterior fins (pl. 35, fig. 8) rayless in anterior extremity. They never extend posteriorly to seminal vesicles, the interval varying in length from about 25 to 110 per cent of the maximum body width. More than 50 per cent of fin in front of tail-septum, varying from 54 to 65 per cent. Form irregular, the position of greatest width being at or just behind tail-septum.

Vestibular ridge (pl. 37, fig. 18) concealed by a thick cuticle. It is characterized by large fairly regular papillae extending internally beyond the teeth and terminating near the mouth. Wing covers all except the first one or two teeth, the notch extending to the third or fourth. External process not observed. According to

Fowler (1905, p. 70) it is "a very strong process; sometimes forked at the external edge."

Anterior teeth 8 to 11, short, broad, and diverging distally. *Posterior teeth* 19 to 22, longer, and more closely set than anterior teeth.

Seizing jaws (pl. 37, fig. 22), 5 to 7. Point inserted slightly less than one-third its height into shaft, with an irregular triangular projection at the middle of its base. Base of point and top of shaft converge toward edge of jaw. Edge of point and edge of shaft on a line with each other, but back of point and back of shaft intersect each other, forming an obtuse angle. Tip of point slightly bent toward edge of jaw. Pulp-canal displaced slightly toward back of shaft, with a swollen place below base of point. Pulp evenly distributed throughout canal.

TABLE 9.—*Measurements of Sagitta decipiens.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Collarette.		Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To seminal vesicle.	To anterior fin.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.	Length.	To ventral ganglion.			
1	12.4	5.0	23.5	70.5	7.0	20.0	4.0	5.5	7.5	64.5	27.0	1.5	+1.0	3.0	15.5	9–8	19–20	6–6
2	12.2	5.5	24	67	9.5	20.5	5	4.5	6	65	25	2.5	+1.5	3	15.5	9–9	21–20	6–6
3	11	5.5	25	72.5	8.5	21.5	4.5	1.5	4	58.5	29	2	+1.5	1.5	13	10–11	22–22	5–5
4	9.1	(?)	25.5	70	8.5	24	5	2.5	4.5	55	27	2.5	+1.5	1.5	14	11–10	19–21	7–7
5	8.8	5	24	69.5	8	22.5	(?)	2.5	3	58	28	2	+2	1.5	15.5	9–8	20–21	5–6

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

Distribution.—*S. decipiens* was collected from only six stations, four of which were mesoplanktonic and two surface stations. According to the literature the species is typically mesoplanktonic, only the very young having been taken above 100 fathoms. Its records of occurrence during the Philippine expedition are given in Table 10.

SAGITTA BEDOTI Béraneck.

Plate 35, fig. 6; plate 37, figs. 20, 24; plate 38, fig. 30.

Sagitta bedoti BÉRANECK (1895), p. 137.—FOWLER (1906), pp. 6–8.—RITTER-ZÁHONY (1911), p. 20.—MICHAEL (1911), p. 75.

According to Fowler (1906, p. 6) *S. bedoti* has "a very slight thickening of the epidermis at the neck, but no real collarette." In my 1911 report those species not taken from the San Diego region were briefly described and, not having seen *S. bedoti,* I assumed Fowler's statement to be correct and placed this species among those in which the collarette was absent. Subsequently, however, Ritter-Záhony's (1911) report appeared in which he (p. 20)

TABLE 10.—*Philippine records of occurrence of Sagitta decipiens.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms.		Number of specimens.	Cat. No. U.S.N.M.
						Haul.	Bottom.		
	° ′	° ′							
D. 5224	13 34.8 N.	121 21.8 E.	Between Marinduque and Luzon	Apr. 24, 1908	8.24 p. m.	Surf.	(?)	2	17875
D. 5240	6 49.6 N.	126 15 E.	Near Uanivan Island	May 14, 1908	1.49 p. m.	115	145	75	17876
D. 5288	13 43.5 N.	121 0.0 E.	East of Matocot Point, Luzon	July 22, 1908	8.14 a. m.	115	140	13	17877
D. 5436	14 22.6 N.	120 29 E.	East of Corregidor	May 7, 1909	7.03 p. m.	Surf.	32	3	......
D. 5456	13 11.2 N.	123 51.9 E.	Southeast of Luzon	June 7, 1909	12.55 p. m.	120	142	6	17878
D. 5500	8 37.8 N.	124 35.8 E.	East of Macabalan Point, Mindanao	Aug. 4, 1909	11.25 a. m.	200	267	50	17879

says: "Collerette relativ kurz, nur bis etwa zur halben Corona reichend." The specimens collected during the Philippine expedition agree with Ritter-Záhony's statement. Every specimen has a collarette which, while narrow and short, is broader and longer than that of *S. bipunctata*. Owing to this confusion in the literature, *S. bedoti* is redescribed from the Philippine specimens:

Collarette (pl. 38, fig. 30) conspicuous but short, extending caudally a distance nearly equal to greatest width of body. Head small. Lateral fields large. Muscles strong, but narrow. Body firm, retaining its form well, widest slightly behind its middle, and tapering gradually toward head and more rapidly toward tail. No constriction at tail-septum. Tail 20 to 30 per cent of total length of animal. Corona ciliata not observed.

Anterior fins (pl. 35, fig. 6) longer and narrower than posterior fins, without rays in the anterior half or two-thirds. Fins extend nearly if not quite to posterior end of ventral ganglion, the exact limit being difficult to determine owing to absence of rays. In some individuals the fins may extend beyond posterior end of ganglion, but never to its anterior end. Form acutely triangular, the position of greatest width being in posterior quarter of fins.

Posterior fins (pl. 35, fig. 6) extend caudally to seminal vesicles. Rays absent in anterior extremity. Usually, but not always, less than 50 per cent of fin in front of tail-septum, the extremes being 40 and 52 per cent. Triangular in form, the position of greatest width being behind tail-septum. Interval from anterior to posterior fins varies from half to twice the maximum width of body.

Vestibular ridge (pl. 37, fig. 20) prominent and provided with regular and unusually acute papillae. Number of papillae less than number of teeth. Wing of ridge covers all except the first and occasionally the second tooth. Notch extends to the fourth or fifth tooth. External process short and blunt, not, as described by Fowler (1906, p. 6), "terminating externally in a well-marked, rather sharp process." Its length is about two-sevenths that of entire ridge.

Anterior teeth 8 to 10 and *posterior teeth* (pl. 37, fig. 20) 20 to 28 in number in individuals 10 to 15 mm. long. Anterior teeth are closely set and diverging distally, while the posterior teeth are more closely set and only slightly divergent distally.

Seizing jaws (pl. 37, fig. 24) 5 to 7 in number. Points with curved tip, oval bases, and embedded about 25 per cent of their heights into shaft. Base of point and top of shaft parallel. Pulp-canal central, extending into point about 75 per cent of its height and converging markedly toward edge of point. Pulp evenly distributed throughout canal.

TABLE 11.—*Measurements of Sagitta bedoti.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.					Anterior fin.			Collarette.		Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To seminal vesicle.	To anterior fin.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.	Length.	To ventral ganglion.			
1	14.5	6.4	29.6	74.0	5.0	24.7	4.0	0	3.0	49.2	28.4	2.5	0+	3.4	14.4	9–10	24–22	7–7
2	14.5	5	25	70.5	6	24	4.5	0	6.5	43.5	28.5	2	0–	3	16	9–9	24–23	7–6
3	14.5	4.5	25	71.5	6.5	27	3	0	4	52.5	27.5	2	0–	5	14.5	9–10	27–28	7–6
4	14	4	25.5	70.5	5.5	23.5	4	0	7	42.5	28	1.5	0–	4	15	8–9	22–21	6–6
5	14	5	25	72	5.5	26	3.5	0	4.5	47.5	28.5	2.5	0–	4	14	8–8	24–25	6–6
6	13.5	5.5	26	75	6.5	29	4	0	4.5	50	29.5	2	0–	4	16	8–8	25–24	6–6
7	13	5	25.5	71	6	24	4	0	6	42.5	29	2	0–	4	15.5	9–8	22–21	6–6
8	12.5	6	26	73.5	6.5	27	4.5	0	5	51	28	2.5	0–	5	16.5	9–9	24–25	6–6
9	11.5	5	29	66	6.5	29	4.5	0	8	45.5	32	2	0–	7	16.5	8–9	23–22	6–6
10	10	5	26	70.5	6.5	27	3	0	3	49	28.5	2.5	0–	2.5	15.5	9–10	20–21	6–6

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

Distribution.—*S. bedoti* was collected from only four stations, 352 specimens having been obtained. As shown by the following table all specimens were taken from the upper epiplankton. This indication that the species typically occurs near the surface is supported by other expeditions and collections. It has been taken near the surface in the region of Port Natal by the Gauss expedition; in the Maldive and Laccadive Archipelagoes by Doncaster (1902) under the name *S. polyodon;* in the Malay Archipelago by Béraneck (1895); in the *Siboga* region by Fowler (1906); in Misaki Harbor, Japan, by Aida (1897) under the name *S. bipunctata;* and in Sharks Bay, Australia, by Ritter-Záhony (1910). Altogether, the evidence warrants concluding that *S. bedoti* is characteristic of the upper epiplankton of the tropical Indo-Pacific region.

TABLE 12.—*Philippine records of occurrence of Sagitta bedoti.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms. Haul.	Depth in fathoms. Bottom.	Number of specimens.	Cat. No. U.S.N.M.
	° ′	° ′							
D. 5128	9 52.2 N.	121 49.6 E.	Sulu Sea, in vicinity of southern Panay	Feb. 4, 1908	7.05 p. m.	Surf.	(?)	4	17885
D. 5134	6 44.2 N.	121 47 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	318	17886
D. 5185	10 5.7 N.	122 18.5 E.	Between Panay and Negros	Mar. 30, 1908	8.01 p. m.	Surf.	(?)	16	17887
D. 5531	9 27.5 N.	123 38 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.49 p. m.	Surf.	(?)	14	17888

SAGITTA NEGLECTA Aida.

Plate 35, fig. 9.

Sagitta neglecta AIDA (1897), p. 16.—FOWLER (1906), p. 15.—RITTER-ZÁHONY (1911), p. 23.—MICHAEL (1911), p. 46.

This species is represented by approximately 425 specimens (Cat. No. 17927, U.S.N.M.), many of which are mature. Curiously enough, all were taken by a single surface haul on November 22, 1909, in Molucca Passage at station D. 5615, 0° 32.5′ south and 126° 31.5′ east. Certain specimens obtained from five or six other stations were at first thought to be *S. neglecta*, but closer examinations proved them to be either young *S. serratodentata* or *S. bedoti*.

As in so many other cases, the Philippine specimens have more anterior and posterior teeth than those described from the San Diego region. In my former (1911, p. 48) report, the number of anterior teeth is given as 3 to 5 and the posterior teeth as 8 to 11 in individuals between 8 and 13 mm. in length. The Philippine specimens, however, are smaller, ranging as a rule between 6.5 and 8 mm. and the number of anterior and posterior teeth are 4 to 8 and 12 to 16, respectively. This agrees better with Fowler's (1906, p. 16) records for specimens from the *Siboga* region. He records 3 to 7 anterior and 7 to 15 posterior teeth in individuals between 5 and 10 mm. in length. Similarly, Ritter-Záhony (1911, p. 24) records 5 to 7 anterior and 11 to 18 posterior teeth in individuals from Port Natal between 6 and 7.5 mm. in length.

TABLE 13.—*Measurements of Sagitta neglecta.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin. Length.	Posterior fin. Width.	Posterior fin. To seminal vesicle.	Posterior fin. To anterior fin.	Posterior fin. Tail-septum.[2]	Anterior fin. Length.	Anterior fin. Width.	Anterior fin. To ventral ganglion.	Collarette. Length.	Collarette. To ventral ganglion.	Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
1	8	6	30.5	68	8	25	4.5	0	5.5	40	21.5	3	0	12	6	6–5	15–14	6–6
2	8	5.5	30	69	7.5	28.5	3	0	6	46	21	2.5	0	13.5	4.5	6–5	?–?	7–6
3	7.5	5.5	31	68.5	7	26	3	0	4	39.5	23.5	2	0	14.5	3	6–5	15–14	7–6
4	7	6	32	75	7.5	26.5	5	0	6.5	42	25	2.5	0	14.5	4.5	?–?	14–13	6–5
5	7	5.5	31.5	67.5	8	25.5	4	0	6	37	23.5	2	0	15.5	3.5	5–5	13–13	7–7
6	7	5.5	32	66.5	8.5	26.5	4	0	7.5	40	22.5	2.5	−1.5	13	5.5	8–8	16–15	7–7
7	7	5.5	31	68.5	8	26	3.5	0	4.5	40	22	2	−1.0	12	6.5	6–5	13–12	6–6
8	7	5.5	32	67.5	8	25	4	0	5.5	37.5	20.5	2	0	13.5	6	5–6	14–13	6–6
9	6.5	5.5	33.5	73.5	8	26	4	0	6	39	24	2.5	−1.0	15	5	6–5	?–14	7–7
10	6.5	5.5	33	74	7.5	31	3	0	5	38	24	2.5	0	15	5	4–5	12–?	7–7

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.

SAGITTA FEROX Doncaster.

Plate 35, fig. 7; plate 37, figs. 21, 25.

Sagitta ferox DONCASTER (1902), p. 212.—FOWLER (1906), p. 10.—MICHAEL (1911), p. 74.

Sagitta robusta (part) RITTER-ZÁHONY (1909*a*), p. 49; (1911), p. 16.

Ritter-Záhony (1909*a*, 1911) synonymises this species to *S. robusta* Doncaster and says (1909*a*, p. 49): "Ich glaube daher nicht fehlzugehen, wenn ich mich für die schon von Doncaster (1902, p. 212) als möglich hingestellte Identität dieser beiden Arten ausspreche und *S. ferox* nur eine ältere *S. robusta* auffasse." Yet, although the two species closely resemble each other, the Philippine specimens do not indicate the slightest convergence with age in three important differential characters (see Table 14):

1. The collarette is much wider in *S. ferox* and nearly always extends beyond the anterior end of the ventral ganglion, while in *S. robusta* it never extends much over halfway from neck to ventral ganglion.

2. Anterior fins always extend beyond posterior end of ventral ganglion in *S. ferox*, while in *S. robusta* there is an interval between the fins and ganglion.

3. Anterior fins are longer than posterior fins in *S. ferox*, while the posterior fins are the longer in *S. robusta*.

These three persistent differences justify considering *S. ferox* valid until critical study of variations in these particulars can be made. The species is therefore redescribed from the Philippine specimens in hopes that this description may aid in establishing its valid or synonymical position:

Collarette (pl. 35, fig. 7) long and broad, extending past anterior end of ventral ganglion onto anterior fins. Head large. Lateral fields small. Body firm, opaque, and nearly of uniform width from in front of ventral ganglion to tail-septum. Tail 25 to 30 per cent of total length of animal. Corona ciliata not observed.

Anterior fins (pl. 35, fig. 7) longer and slightly narrower than posterior fins, always extending anteriorly beyond posterior end of ventral ganglion, frequently past its middle and occasionally to its anterior end. Form acutely triangular, the position of greatest width being in posterior quarter of fin.

Posterior fins (pl. 35, fig. 7) extend caudally to seminal vesicles. Interval from anterior to posterior fins 3 to 7, usually about 5 per cent of total length of animal. Less than 50 per cent (41 to 44) of fin in front of tail-septum. Triangular in form, the position of greatest width being about midway between tail-septum and seminal vesicles.

Vestibular ridge (pl. 37, fig. 21) strongly mamillated, the number of papillae corresponding to the number of teeth. Wing of ridge covers all except the first two teeth, the notch extending beyond the fourth or fifth. External process short, broad, and blunt.

Anterior teeth 5 to 9 in number. They are closely set, provided with broad bases, and diverging distally.

Posterior teeth (pl. 37, fig. 21) 10 to 14 in number. They are long, broad, closely set, and diverging distally.

Seizing jaws (pl. 37, fig. 25) 4 to 6 in number. Point with an oval base inserted into shaft between 15 and 20 per cent of its height. Base of point and top of shaft converge toward back of shaft. Edge of shaft provided with narrow crest. Pulp-canal central, and extending into point about 80 per cent of its height. Pulp evenly distributed throughout canal.

TABLE 14.—*Measurements of Sagitta ferox.*[1]

Number.	Length in mm.	Width.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Posterior fin.				Anterior fin.			Collarette.		Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
						Length.	Width.	To anterior fin.	Tail-septum.[2]	Length.	Width.	To ventral ganglion.[3]	Length.	To ventral ganglion.[4]			
1	15.6	7.5	27	70.5	6	25.5	2.5	5.5	43	32.5	2.5	+5	20	+2.5	5–5	10–11	5–5
2	15.4	6.5	26	70	6	15.5	1.5	5	44	30.5	2	+3.5	18.5	+4	7–8	?–12	5–5
3	15.2	7	29.5	71	6	26.5	3	5.5	41.5	31	2.5	+5	20	+4.5	?–?	?–?	5–5
4	15	6	29	70	6	26	2.5	7	40	27.5	2	+3	......	......	7–7	13–13	5–5
5	14.9	5.5	29	72	5.5	26.5	2.5	6	43	27	2.5	+3.5	20	+3	7–7	12–11	5–5
6	14.9	5.5	28	69	5.5	25	3.5	4.5	42.5	31	2.5	+4	19	+2	8–9	13–13	6–5
7	14.7	7.5	29.5	71	5	26	3	5.5	41.5	29	2.5	+3.5	18.5	+1	8–8	13–12	5–5
8	14.5	8.5	27.5	71.5	5	24.5	3	6.5	40.5	32	2	+4	19.5	+2	9–8	13–14	5–4
9	14.1	8	29	71	6.5	27	3	6	42.5	29	2	+4	21	+3.5	8–8	15–12	5–6
10	13.5	7	31	71.5	5	26.5	3	5.5	41	32.5	1.5	+5.5	20	+4	9–8	12–12	5–4
11	13.3	7	28	70	5.5	26.5	3	5.5	42.5	19	2.5	+4.5	19.5	+3	7–8	12–12	5–5
12	13.2	6.5	30	70	6.5	25	3	3	43	30	2.5	+6	17.5	+1.5	7–7	12–12	5–4
13	12.9	8.5	19.5	68	6	25	3	4.5	42.5	26	2.5	+2.5	21.5	+3	8–7	12–12	5–5
14	11	7	27	69	7	25	3	6.5	43	26.5	1.5	+2.5	......	......	7–6	12–?	5–5
15	10.9	6.5	29	68.5	6.5	26.5	3.5	5	42	27.5	2.5	+6.5	20	+3.5	5–6	10–12	5–5

[1] All measurements made in per cent of total length of animal.
[2] Per cent of posterior fin in front of tail-septum.
[3] The + indicates that the fin extends beyond posterior end of ganglion.
[4] The + indicates that the collarette extends beyond anterior end of ganglion.

Distribution.—*S. ferox* was collected from 22 of the 46 stations from which chaetognaths were taken, 598 specimens being obtained. It is difficult to decide whether the species is typically epiplanktonic or mesoplanktonic in the Philippine region. At 15 stations it was taken from above 100 fathoms. Five, or 33 per cent of the epiplanktonic hauls, and two, or 29 per cent of the mesoplanktonic hauls, obtained more than the average number of specimens (27). Again, the median number of those taken above 100 fathoms is nine, but nine is also the median number of those taken below 100 fathoms. Finally, the greatest number was taken from 25 fathoms, the second, fhird, and fourth greatest from the surface, and the fifth greatest trom 500 fathoms.

All subsurface hauls, however, were made by various types of open nets. It is well to remember that such hauls, whether horizontal or vertical, afford no certain evidence of the depth from which specimens were collected. This is true even when every haul is made with the same net, and when various types of nets are used the data are worse than useless for this purpose. For these reasons it may well be that, as indicated by other reports, *S. ferox* is typically epiplanktonic in the Philippine region. It was taken in abundance during the Siboga expedition from the surface, but only rarely from the mesoplankton.

Indeed the species appears to be restricted to the epiplankton of the Indo-Australian region, although, owing to its questionable synonymy with *S. robusta* Doncaster, this statement is made with some reservations. But, even assuming the two species to be synonymical, it is still restricted in distribution to the surface and upper epiplankton of tropical and subtropical regions. Thus, according to Ritter-Záhony (1911, p. 58), it is found "im Atlantischen Ozean zwischen 0° and 20° N., im Indischen zwischen 20° and 30° S. in Vertikalfängen und an der Oberfläsche. . . ." He continues: "Auf der Westseite des Atlantischen Ozeans wird sie zwar durch den Floridastrom wohl bis in die Gegend des 40° N. gebracht, auf der Ostseite gelangt sie jedoch kaum bis zum 35°. Breitegrad, da sie ja schon im Mittelmeer fehlt. Im Süden dürfte sie gerade noch um die Südspitze Afrikas herumkommen. Im Stillen Ozean ist sie bisher nur funf Fundorten, die samtlich auf seiner Westseite liegen, bekannt geworden. . . . Ich glaube jedoch, dass die Verbreitung der *S. robusta* im Stillen Ozean der im Atlantischen völlig analog ist, d. h. das tropisch-subtropische Gebeit umfasst und nur auf der Westseite etwas weiter nach Norden reicht, wobei der Kuro-Siwo die Rolle des Floridastroms übernimmt." Clearly *S. ferox* is a warm water species, but is its absence in the eastern Pacific not more likely attributable to the abnormally cold water there due to upwelling? (see p. 271).

The northernmost and westernmost record of its capture in the Philippine region is 21° 31′ north and 117° 53′ east, or in the south China Sea, approximately halfway between the city of Hongkong and the island of Formosa. The southernmost record is 5° 36′ south at 122° 7.6′ east off the south end of the island of Celebes in Buton Strait. The easternmost record is 0° 32.5′ south and 126° 31.5′ east, or, less accurately, at the southern end of Molucca Passage east of Tomini Bay. The largest number of specimens (217) was taken February 7, 1908, at 8.05 in the morning, from 25 fathoms by an open 0000 grit-gauze net towed horizontally 9 fathoms above the bottom of the Sulu Archipelago, near Basilan Island, at 6° 44.2′ north and 121° 47′ east. The other records are given in the table following.

TABLE 15.—*Philippine records of occurrence of Sagitta ferox.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms.		Number of specimens.	Cat. No. U.S.N.M.
						Haul.	Bottom.		
	° ′	° ′							
D. 5101	14 24.5 N.	120 23.3 E.	China Sea, vicinity of southern Luzon	Jan. 6, 1908	1.16 p. m.	37	43	3	17889
D. 5120	13 45.5 N.	120 30.2 E.	Balayan Bay and Verde Island Passage	Jan. 21, 1908	2.41 p. m.	350	393	3	17890
D. 5128	9 52.1 N.	121 49.5 E.	Sulu Sea, near southern Panay	Feb. 4, 1908	7.05 p. m.	Surf.	(?)	9	17891
D. 5134	6 44.2 N.	121 48 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	217	17892
D. 5195	10 47 N.	124 6.5 E.	Off northern Cebu Island	Apr. 3, 1908	7.03 p. m.	Surf.	(?)	1	17893
D. 5223	13 36 N.	121 25.5 E.	Between Marinduque and Luzon	Apr. 24, 1908	7.47 p. m.	Surf.	(?)	1	17894
D. 5233	10 0.4 N.	124 45.1 E.	Between Bohol and Leyte	May 7, 1908	9.00 p. m.	100	(?)	19	17895
D. 5234	10 0.0 N.	124 46.1 E.	....do	....do	9.12 p. m.	15	(?)	18	17896
D. 5240	6 49.6 N.	126 46.1 E.	Pujada Bay	May 14, 1908	1.33 p. m.	115	145	9	17897
D. 5288	13 43.5 N.	121 0.0 E.	China Sea, vicinity of southern Luzon	July 22, 1908	6.00 a. m.	115	140	6	17898
D. 5319	21 31 N.	117 53 E.	China Sea, off Hongkong	Nov. 5, 1908	7.23 p. m.	20	(?)	24	17899
D. 5320	20 58 N.	120 3 E.	....do	Nov. 6, 1908	3.18 p. m.	500	1,804	29	17900
....	....	....	Endeavor Strait	Dec. 23, 1908	8.00 p. m.	Surf.	(?)	75	17909
D. 5530	9 26.8 N.	123 38.5 E.	Between Siquijor and Bohol Islands	Aug. 11, 1909	7.14 p. m.	Surf.	(?)	9	17901
D. 5531	9 27.5 N.	123 38 E.	....do	....do	7.49 p. m.	Surf.	(?)	50	17902
D. 5539	9 3.2 N.	123 24.8 E.	Between Negros and Siquijor Islands	Aug. 19, 1909	7.11 p. m.	Surf.	(?)	8	17903
D. 5540	9 3.0 N.	123 24.5 E.	....do	....do	7.42 p. m.	Surf.	(?)	6	17904
D. 5553	5 51.0 N.	120 46.5 E.	Jolo Island and vicinity	Sept. 17, 1909	7.28 p. m.	Surf.	25	19	17905
D. 5601	1 13.2 N.	125 17.1 E.	Tomini Bay, Celebes	Nov. 13, 1909	2.18 p. m.	765	765	5	17906
D. 5611	0 40.5 S.	121 50 E.	....do	Nov. 19, 1909	7.14 p. m.	Surf.	(?)	6	17907
D. 5615	0 32.5 S.	126 31.5 E.	Molucca Passage	Nov. 22, 1909	2.37 p. m.	Surf.	1,021	79	17908
D. 5649	5 36.0 S.	122 7.6 E.	Buton Strait	Dec. 16, 1909	7.23 p. m.	Surf.	(?)	2	17919

SAGITTA PLANKTONIS Steinhaus.

Sagitta planktonis STEINHAUS (1896), p. 39.—RITTER-ZÁHONY (1911), p. 29.—MICHAEL, (1911), p. 44.
Sagitta zetesios FOWLER (1905), p. 67; (1906), p. 22.

Eighty-seven specimens were obtained, but unfortunately all except one were preserved in alcohol, with the result that they are so badly distorted as to prevent certain identification. Measurements of the single well-preserved specimen are:

Length	27 mm.
Width	8. 5 per cent of length.
Tail:	
Length	24. 5 per cent of length.
To central ganglion	68. 0 per cent of length.
Ventral ganglion (length)	4. 0 per cent of length.
Posterior fin:	
Length	20. 5 per cent of length.
Width	4. 5 per cent of length.
To anterior fin	4. 5 per cent of length.
Proportion in front of tail-septum	77. 0 per cent.
Anterior fin:	
Length	23. 0 per cent of length.
Width	2. 5 per cent of length.
To ventral ganglion	0. 0 per cent of length.
Collarette:	
Length	25. 0 per cent of length.
To ventral ganglion	0. 0 per cent of length.
Number of anterior teeth	8–7
Number of posterior teeth	17–18
Number of seizing jaws	8–8

The length, number of anterior and posterior teeth, and number of seizing jaws of a few other individuals are:

Length in mm.	Anterior teeth.	Posterior teeth.	Seizing jaws.
11.5	7–6	13–12	9–8
13	9–9	16–?	7–8
16.5	9–10	16–15	9–9
17	10–9	17–18	8–8
21	8–8	16–17	8–8
25	9–8	18–17	8–9

The number of teeth is greater than in specimens from the San Diego region (Michael, 1911, p. 45). San Diego specimens, ranging in length between 15 and 26 mm., have 4 to 7 anterior, and 11 to 15 posterior teeth. In the Biscayan report, however, Fowler (1905, p. 68) records a variation in number of anterior teeth from 5 to 9 and of posterior teeth from 11 to 19 in individuals between 11 and 21 mm. in length.

Distribution.—*S. planktonis* was collected from only seven stations. Of the 84 specimens obtained, 53 were taken from below 100 fathoms by open nets towed horizontally at four stations for approximately

TABLE 16.—*Philippine records of occurrence of Sagitta planktonis.*

Station.	Latitude.	Longitude.	General location.	Date.	Time.	Depth in fathoms.		Number of specimens.	Cat. No. U.S.N.M.
						Haul.	Bottom.		
	° ′	° ′							
D. 5120	13 45.5 N.	120 30.3 E.	Off Sombrero Island, Balayan Bay	Jan. 20, 1908	3.10 p. m.	350	393	13	17910
D. 5129	7 41.5 N.	122 1.8 E.	Sulu Sea, off western Mindanao	Feb. 5, 1908	2.23 p. m.	100	(?)	1	17911
D. 5185	10 5.7 N.	122 18.5 E.	Between Panay and Negros	Mar. 30, 1908	8.01 p. m.	550	638	33	17912
D. 5232	10 0.8 N.	124 44.1 E.	Between Bohol and Leyte	May 7, 1908	8.25 p. m.	Surf.	(?)	11	17913
D. 5233	10 0.4 N.	124 45.1 E.	....do	....do	9.00 p. m.	100	(?)	25	17914
D. 5234	10 0.0 N.	124 46.1 E.	....do	....do	9.42 p. m.	15	(?)	15	17915
D. 5288	13 43.5 N.	121 0.0 E.	East of Matocot Point, Luzon	July 22, 1908	8.14 a. m.	115	140	1	17916
D. 5500	8 37.8 N.	124 36.8 E.	East of Macabalan Point, Mindanao	Aug. 4, 1909	11.25 a. m.	200	267	6	17917
D. 5672	0 29.0 S.	118 51.0 E.	Macassar Strait	Dec. 30, 1909	7.26 p. m.	Surf.	(?)	8	17918

20 minutes at each. The 35 remaining specimens were taken from above 15 fathoms at the three remaining stations by 20-minute tows. These facts indicate that the species is typically mesoplanktonic in the Philippine region, which indication is supported by the results of many other expeditions. In the regions covered by the *Biscayan*, *Siboga*, and *Plankton* expeditions, as well as off the California coast, the species occurs abundantly below 100 fathoms, but is rarely found above that depth. It is common between 500 and 1,000 fathoms, and, as Ritter-Záhony (1911, p. 62) says: "*S. planktonis* ist unter allen Arten der Tiefsee am häufigsten in der Literatur erwähnt."

Genus PTEROSAGITTA Costa.

Syn. *Spadella* LANGERHANS (part 1).

PTEROSAGITTA DRACO (Krohn).

Plate 36, figs. 11, 12, 13.

Sagitta draco KROHN (1853), p. 273.
Pterosagitta mediterranea COSTA (1869), p. 55.
Spadella draco FOWLER (1906), p. 25.—MICHAEL (1911), p. 54.
Pterosagitta draco RITTER-ZÁHONY (1911), p. 33.

Thirty-two specimens were obtained, of which only one has mature ovaries. These completely fill the body cavity (pl. 36, fig. 13), extending from tail-septum to neck. All other specimens are clearly immature, and in nearly one-half there is no trace of ovaries, and the seminal vesicles are barely visible (pl. 36, fig. 12). Fowler (1906, p. 26) records the tail as 41 to 57 per cent of total length in specimens between 6 and 9 mm. The Philippine specimens, however, vary only between 39.5 and 44.3 per cent. Otherwise Fowler's records agree exceptionally well with the Philippine material. He records 7 to 9 seizing jaws, 7 to

10 anterior teeth, and 11 to 16 posterior teeth; the Philippine specimens show 7 to 9 seizing jaws, 6 to 10 anterior teeth, and 10 to 16 posterior teeth.

Nearly half the Philippine specimens are devoid of the collarette, except for a narrow strip behind the head. This caused considerable trouble in identification until others were discovered in which the structure was partly missing. These (pl. 36, figs. 12 and 13) indicate that for some unknown reason the collarette has been torn off. Immature specimens in this condition bear a striking superficial resemblance to young *S. ferox*.

TABLE 17.—*Measurements of Pterosagitta draco.*[1]

Number.	Length in mm.	Width with collarette.	Width without collarette.	Length of tail.	Tail to ventral ganglion.	Length of ventral ganglion.	Lateral fin.			Ovary.		Number of anterior teeth.	Number of posterior teeth.	Number of seizing jaws.
							Length.	Width.	To seminal vesicles.	Length.	Width.			
1	7.7	....	7.8	43.3	66.6	9.1	22.8	......	0	24.6	2.3	9-8	13-13	8-7
2	7.6	16.0	6.9	44	66.5	8.7	23.4	6.4	0	24.8	2.7	9-8	(?)-14	8-8
3	7.4	15.2	7.1	42.8	65.6	9.1	22.4	5.7	0	25.7	1.9	9-8	15-16	8-9
4	7.2	....	10.7	39.5	59.6	7.8	20	6.8	0	47.8	5.9	5-6	11-12	8-8
5	7	....	8	44	66.9	8.5	23	5	0	21	4.5	8-7	14-13	8-9
6	6.9	....	7.6	40.3	65.2	9.2	23	......	0	10.7	.5	7-6	14-(?)	8-9
7	6.9	....	6.6	43.1	66.5	8.1	22.3	4.6	0	20.8	1.5	8-8	13-13	8-8
8	6.7	16.2	6.8	41.4	65	10	23.1	6.3	0	9.5	1	8-7	13-14	8-8
9	6.7	13	7.8	40.5	64	9.9	21.3	5.7	0	....	......	10-9	15-(?)	8-8
10	6.6	13.3	8.5	40.9	62.7	10.6	21.8	5.3	0	....	......	7-7	14-15	8-8
11	6.6	....	7.4	42	65	9.6	19.1	4.8	0	....	......	6-6	11-12	9-9
12	6.3	15.1	7.3	41.3	64.8	9.5	22.9	6.1	0	6.8	1.1	9-8	14-(?)	8-8
13	5.8	....	7.9	40	63.6	9.7	21.8	5.5	0	....	......	6-7	11-11	9-9
14	5.8	....	7.9	42.3	66.7	6.7	18.8	4.8	0	....	......	9-8	14-14	8-9
15	5.6	....	9.3	41.6	66.5	8.7	16.8	5.6	0	18	5	8-7	12-11	9-8
16	5.4	15	7.2	42.5	65.5	9.8	20.2	6.5	0	....	......	8-7	14-15	8-9
17	5.4	....	7.8	40.8	64.2	9.7	20.8	5.8	0	....	......	7-7	(?)-11	7-7
18	5.3	16	6.7	41.3	64.5	10.7	22.7	5.3	0	....	......	7-7	10-11	8-8
19	5.1	10.4	6.2	41.4	64.9	11	20.7	4.8	0	....	......	6-6	11-12	(?)-8
20	4.9	....	7.1	44.3	68.5	10.7	21.4	......	0	....	......	7-6	13-13	7-7

[1] All measurements made in per cent of total length of animal.

Distribution.—*P. draco* was obtained from only five stations, all of which were subsurface ones. Two were mesoplanktonic, but they only yielded four specimens. The remaining 28 were obtained from between the surface and 25 fathoms, indicating that in so far as the species occurs in the Philippine region it is typical of the upper epiplankton. This accords with what is known of its distribution generally. Although nowhere abundant it is apparently restricted to the upper epiplankton of tropical and subtropical regions. Says Ritter-Záhony (1911, p. 63): "Ihre Verbreitung dürfte sich mit der von *S. enflata* und *bipunctata* decken, doch ist die Art in den gemässigten Zonen, soweit sie überhaupt noch darin vorkommt, schon seltener als jene beiden. . . ." Its northernmost and southernmost records of occurrence are 42° north, 56° west; and 42° south, 36° east. Its records of capture during the Philippine expedition are given in the table following:

TABLE 18.—*Philippine records of occurrence of Pterosagitta draco.*

Station.	Latitude.	Longitude.	General locality.	Date.	Time.	Depth in fathoms. Haul.	Depth in fathoms. Bottom.	Number of specimens.	Cat. No. U.S.N.M.
	° ′	° ′							
D. 5134	6 44.2 N.	121 47 E.	Sulu Archipelago, near Basilan Island	Feb. 7, 1908	8.05 a. m.	25	34	19	17920
D. 5185	10 5.8 N.	122 18.5 E.	Between Panay and Negros	Mar. 30, 1908	5.26 p. m.	550	638	1	17921
D. 5240	6 49.6 N.	126 46.1 E.	Pujada Bay	May 14, 1908	1.33 p. m.	15	(?)	1	17922
D. 5319	21 31 N.	117 53 E.	China Sea, off Hongkong	Nov. 5, 1908	7.23 p. m.	20	(?)	8	17923
D. 5320	20 58 N.	120 3 E.	....do	Nov. 6, 1908	3.18 p. m.	500	1,804	3	17924

Genus EUKROHNIA Ritter-Záhony.

Syn. *Krohnia* LANGERHANS (part).

EUKROHNIA HAMATA (Möbius).

Plate 37, figs. 14, 27.

Sagitta hamata MÖBIUS (1875), p. 158.
Krohnia hamata KRUMBACH (1903), p. 639.—FOWLER (1905), p. 74; (1906), p. 23.
Eukrohnia hamata RITTER-ZÁHONY (1911), p. 39.—MICHAEL (1911), p. 51.

This species is represented by six poorly preserved and badly damaged specimens (Cat. No. 17928, U.S.N.M.). The heads of all but two are missing and in one of those it is torn away from the body. It is impossible, therefore, to accurately determine the length or to count the teeth and seizing jaws in four of the six specimens. The other two are 16 and 16.3 mm. in length; their tails are 28.3 and 30.2 per cent of their lengths; the number of teeth are 21–21 and 24–25, and the number of seizing jaws are 9–10 and 9–9.

The number of teeth (pl. 37, fig. 14) greatly exceed that recorded by Ritter-Záhony (1911, p. 39) for specimens taken from the Antarctic Ocean, as well as that recorded by me (1911, p. 52) for specimens from the San Diego region. Although Ritter-Záhony records a variation in number of teeth from 4 to 23, he gives 12 as the upper limit for specimens under 18 mm. in length. Similarly, in specimens from the San Diego region between 13 and 17.5 mm. in length, I have never found more than 13 teeth. Fowler (1906, p. 23), however, records 22 in specimens from the *Siboga* area that are only 13 mm. in length. It is evident, therefore, that the number of teeth vary according to the region in which the species occurs.

The points of the seizing jaws (pl. 37, fig. 27) are curved to an unusual extent, and the jaws are not serrated as described by Krumbach (1903). Otherwise, however, the structure of the jaws agree with his description.

The six specimens were all obtained November 6, 1908, in the China Sea in the vicinity of Formosa, at station D. 5320, 20° 58′ north and 120° 3′ east by an open 0000 grit-gauze net towed at 3.18 p. m. in 500 fathoms for 20 minutes.

EUKROHNIA RICHARDI Germain and Joubin.

Plate 36, fig. 10; plate 37, figs. 15, 26.

Eukrohnia richardi GERMAIN and JOUBIN (1912), p. 2.

This species (pl. 36, fig. 10) is represented by five specimens, only two of which are well enough preserved to permit certain identification. Measurements of these two (*a* and *b*), and, for comparison, those taken from Germain and Joubin's drawing (*c*), are as follows:

	a.	*b.*	*c.*
Length in mm	27.7	27.8	27.8
Width in per cent of length	12.9	13.3	12.2
Tail:			
Length in per cent of total length	27.2	26.2	25.2
To ventral ganglion in per cent of total length	70.7	74.2	67.6
Length of ventral ganglion in per cent of total length	6.6	5.2	2.9
Lateral fin:			
Length in per cent of total length	73.1	69.3	68.4
Width in per cent of total length	4.9	6.5	6.5
Extends beyond anterior end of ventral ganglion, in per cent of total length	10.4	6.5	10.8
Proportion in front of tail-septum (per cent)	82.7	86.4	74.4
Ovary:			
Length in per cent of total length	4.8	6.5	10.8
Width in per cent of total length	1.26	2.64	2.88
Number of teeth	22–21	25–24	24
Number of seizing jaws	10–11	10–10	8

It is questionable whether this species is valid or not. It closely resembles *E. hamata,* but according to Germain and Joubin (1912, p. 5), "il s'en distingue facilement, en dehors de sa coloration verte caractéristique et jusqu'a présent absolument unique chez tous les Chétognathes, par la forme très différente de sa tête, beaucoup plus nettement triangulaire allongée, par ses crochets plus étroitement allongés et par ses dents, au nombre de 24, alors qu'on en compte seulement de 20 à 22 chez *l'Eukrohnia hamata.*" Of these distinctive features it is evident that differences in the number of teeth and shape of head are of no specific value, and it seems probable that the color, which is described (p. 2) as "d'un vert d'eau plus foncé à la région antérieure et s'atténuant régulièrement vers la queue," is also highly variable. In the Philippine material at least, specimens of *E. hamata* agree quite as well with this description as those of *E. richardi.* Both, although considerably faded by action of the formalin, are dark green and more so anteriorly than posteriorly.

Again, the various dimensions of the body recorded by Germain and Joubin (p. 4) do not agree with those taken from the drawing. The drawing measures 139 mm. in length. Assuming the recorded length of 27 mm. to be accurate, the magnification of the drawing is 5.15. This makes the length of tail 6.8 mm., or 25.2 per cent of total length, but it is given as 6.5 mm., or 24 per cent of the total length. It is stated that the ovaries are 2.25 mm. in length, or 8.3 per cent of the length of animal, but in the drawing they measure 10.8 per cent, which is equivalent to 2.92 mm. The maximum width of body ("y compris la largeur des nageoires") is given as 2.5 mm., or 9.3 per cent of the length of animal, but in the drawing it measures 11.5 per cent, which is equivalent to 3.1 mm. Finally, it is stated that the lateral fin occupies "17/27 [63 per cent] de la longeur totale de l'animal," that it extends 5.5 mm. anterior to the ventral ganglion or "à environ 3 millimètres de l'extrémité du corps," but in the drawing it measures 68.4 per cent of the total length of animal and extends only 10.8 per cent, or 2.92 mm., anterior to the ventral ganglion.

Although these discrepancies are, for the most part, small, they make it impossible to depend with certainty upon either the descriptions or the drawing, and whether *E. richardi* is or is not synonymous with *E. hamata* must remain undecided until the type is more accurately described. In spite of this uncertainty there are several points that indicate its validity:

1. The seizing jaws (pl. 37, fig. 26) are more massive than those of *E. hamata* and their points are quite dissimilar. In *E. hamata* the points are always sickle-shaped (pl. 37, fig. 27), although they are not usually curved so much as in the Philippine material; the top of shaft and base of point converge upon approaching the edge of the jaw; the point has an oval base; and the pulp-canal is central and sparsely filled with pulp. In *E. richardi,* on the other hand, the points are not sickle-shaped; the top of shaft and base of point are parallel; the point has an irregular rather than an oval base; the pulp-canal is irregular in outline and is displaced toward the back of shaft; and the pulp is evenly distributed.

2. The body of *E. richardi* is between two and three times wider in proportion to the length of animal than is the case with *E. hamata.*

3. Lateral fins extend to, but rarely beyond, anterior end of ventral ganglion in *E. hamata,* while in *E. richardi* they extend beyond the anterior end of ganglion by 6 to 11 per cent of the length of animal.

4. Lateral fins in *E. hamata* with "fin-rays extending about as far in front of the septum as the fin does behind it, but the fin continued forwards as an expansion of the epidermis up to or to the middle of the ventral ganglion." [Fowler (1905, p. 74).] In *E. richardi* the fin, according to Germain and Joubin, is delicately rayed throughout, the rays making an acute angle with the body as illustrated by their drawing. This seems to be true of the Philippine specimens (pl. 36, fig. 10), although the rays are fewer and much finer toward the anterior end.

5. Lateral fins never extend more than halfway from tail-septum to seminal vesicles in *E. hamata*, while they extend three-quarters of the distance, according to Germain and Joubin's drawing, and quite to the anterior end of the vesicles in the Philippine specimens.

The Philippine specimens apparently differ from the type in two points:

(1) Germain and Joubin state that the ventral neck muscles are composed of longitudinal fibers, together with very fine transverse ones. The transverse fibers are absent in the Philippine specimens.

(2) The seminal vesicles are figured and described as very small disks lying within the anterior end of the caudal fin. In the Philippine specimens this is not the case, although the vesicles in all specimens were very immature. Their appearance, however, suggests that when mature their posterior extremities may touch the caudal fin.

The five specimens (Cat. No. 17929, U.S.N.M.) were all obtained at 12.07 in the afternoon, May 8, 1909, station D. 5437, off the west coast of Luzon, 15° 45.′9 north and 119° 42.′8 east, by an open 0000 grit-gauze net towed for 27 minutes in 450 fathoms.

Genus KROHNITTA Ritter-Záhony.

Syn. *Krohnia* Langerhans (part).
Spadella Grassi (part).
Krohnia Strodtman (part).

KROHNITTA SUBTILIS (Grassi).

Spadella subtilis Grassi (1883), p. 23.
Krohnia subtilis Strodtman (1892), p. 22.—Fowler (1905), p. 78; (1906), p. 25.
Krohnia pacifica Fowler (1906), p. 24.
Eukrohnia subtilis Michael (1911), p. 52.
Krohnitta subtilis Ritter-Záhony (1911), p. 44.

Only three specimens were obtained, all of which are immature. Only one is sufficiently well preserved to permit accurate measurements:

Length in mm	9.8.
Length of tail	35.9 per cent of total length.
Tail to ventral ganglion	63.5 per cent of total length.
Length of ventral ganglion	7.5 per cent of total length.
Length of fin	35.1 per cent of total length.
Width of fin	6.4 per cent of total length.
Proportion of fin in front of tail-septum	32.7 per cent.
Length of ovary	8.6 per cent of total length.
Width of ovary	2.1 per cent of total length.
Number of seizing jaws	8–8.

The teeth could not be counted, but in the two other specimens, which were about the same length, the number of teeth on the right and left sides are 11–10 in one and 12–13 in the other specimen. Similarly, the number of seizing jaws are 8–7 in the first specimen and (?)–7 in the second.

Two of the specimens (Cat. No. 17931, U.S.N.M.) were obtained between Panay and Negros at station D. 5185, 10° 5.′8 north and 122° 18.′5 east, on March 30, 1908, at 5.26 in the afternoon, by an open 0000 grit-gauze net towed horizontally for 20 minutes in 550 fathoms. The third specimen (Cat. No. 17930, U.S.N.M.) was obtained in the China Sea in the vicinity of Formosa, at station D. 5319, 21° 31′ north and 117° 53′ east, on November 5, 1908, at 7.23 in the afternoon, by the same net towed for 27 minutes in 20 fathoms.

COMPARISON OF PHILIPPINE CHAETOGNATHA WITH THOSE FROM THE SAN DIEGO REGION.

Aida (1897) describes 10 species from Misaki Harbor, Japan, of which all except *S. regularis* and *S. hispida* (=*S. robusta* Doncaster) are represented in the Philippine collection. Again, Doncaster (1902) records 10 species from the Maldive Archipelago, of which all save *S. regularis* and *S. hispida* are present in the Philippine material. Likewise, Fowler (1906) describes 14 species from the "*Siboga*" area, of which all save *S. regularis* and *S. hispida* have been taken from the Philippines. Lastly, Ritter-Záhony (1910) lists 10 species from Sharks Bay, Australia, of which all except *S. regularis* and *S. bipunctata* are represented in the Philippine collection. The only species obtained from the Philippines which are not recorded from any of these regions are *S. philippini* and *E. richardi*, the former a new species represented by a single individual, and the latter a rare species represented by only five specimens. Obviously these facts strongly point toward a uniformity in the chaetognath fauna, especially the epiplankton, over the Indo-Pacific Ocean, notwithstanding the curious absence of *S. regularis* and *S. hispida* in the Philippine collection.

The situation is quite otherwise when the Philippine chaetognatha are compared with those from the San Diego region, for those species most characteristic of the Philippines are those that are either absent or least characteristic of the San Diego region, and the opposite. Thus, *S. enflata*, by far the most typical and abundant species about the Philippines, has been obtained in the San Diego region by less than 20 out of nearly 4,000 hauls. Conversely, *S. bipunctata* is by far the most typical and abundant species in the San Diego region, but not a single individual was obtained from the Philippines. Again, *Sagitta ferox*, *S. pulchra*, *S. bedoti*, *S. decipiens*, *S. minima*, *S. macrocephala*, and *Eukrohnia richardi* have not been taken from the San Diego region, although the first three are third, fourth, and sixth in order of abundance in the Philippine region. On the other hand, *Sagitta lyra* and *S. californica*, in addition to *S. bipunctata*, were not taken from the Philippine region, although the former is the most characteristic mesoplanktonic species in California waters. Again, of those species common to both regions, *Sagitta hexaptera* and *S. serratodentata* are second and eighth in order of abundance in the Philippines and tenth and second in the San Diego region. Finally, aside from *S. neglecta*, which is rare in the San Diego region and obtained by only one haul from the Philippines, the order of abundance of the remaining species common to both regions is as follows: *S. planktonis*, *P. draco*, *E. hamata*, and *K. subtilis* in the Philippine region; and *E. hamata*, *K. subtilis*, *S. planktonis*, and *P. draco* in the San Diego region.

Taken in connection with what is known of the distribution of chaetognatha throughout the world, the above comparisons show that the Philippine species are characteristic of the Tropics and warm water, while those of the San Diego region are, on the other hand, more characteristic of the Arctics or sub-Arctics and cold water. As a matter of fact there is less difference between the California chaetognatha and those of the region about Spitzbergen than there is between the California and Philippine faunas.

Furthermore, this sub-Arctic nature of the California chaetognatha is not peculiar to that group. *Calanus finmarchicus*, the commonest copepod of the California coast is, according to Cleve (1900, p. 47), a "characteristic inhabitant of the Arctic regions, along the coast banks of Greenland, Iceland, etc." Similarly, *Eucalanus elongatus*, the second most typical copepod of California waters, is "noted from 60° north, 7° west in August and the Skagerak in February." [Cleve (1900, p. 63.)] Likewise *Acartia clausii*, obtained in abundance off the pier of the Scripps Institution, is typical of the North Sea "and follows the coast of Norway to about 70° or 74° north." [Cleve (1900, p. 42).] Again, the most prevalent ctenophore of the California region, *Pleurobrachia bachei*, "is found in vast swarms in the cold water of Maine and Nova Scotia." [Esterly (1914, p. 28).] Lastly, among the diatomaceae, *Chaetoceros criophilum* is the commonest diatom in San Diego waters, although Cleve (1900, p. 295) states that it is a "decidedly Arctic, pelagic species." Another common San Diego *Chaetoceros* is *C. debile*, but Cleve (1900, p. 296) says that it is abundant along the south coast of Iceland and at the Faroes." Similarly with *Nitzschia seriata*; its "principal area of distribution is between Scotland, Iceland, and Greenland" [Cleve (1900, p. 336)], although it is among the common diatoms of the San Diego region.

So the list might be continued. To be sure, there are many tropical and semitropical species occurring in California waters, but they are not the characteristic and prevalent ones. These have their nearest allies, not in other parts of the world at corresponding latitudes, but in the Arctic and sub-Arctic regions. May this not be attributable in part to the marked upwelling of cold bottom waters along the western coast of America? To establish this would require an extensive series of collections off the coast of Central and South America, and comparisons of the faunas at the same latitudes on the two sides of the Pacific. But, if it is true, it emphasizes the necessity of recognizing this fact in fisheries investigations and demonstrates an essential difference between the problems, economic and otherwise, of the coastal waters of the eastern and western Pacific.

That the chaetognath faunas of the two regions are fundamentally different is made more certain by the fact that in four of the five *Sagitta*[1] common to both Philippine and San Diego regions, the Philippine specimens have a greater number of both anterior and posterior teeth. The same is true with respect to *P. draco*, and in *E. hamata* the Philippine specimens have nearly twice as many teeth (21 to 25) as do the San Diego specimens (10 to 13). These differences are mentioned in the preceding pages in connection with the account of each species, but are better revealed, perhaps, in the following list:

Species.	Anterior teeth.		Posterior teeth.	
	Philippines.	San Diego.	Philippines.	San Diego.
S. enflata	6–11	4–8	9–15	7–12
S. neglecta	4–8	3–5	12–16	8–11
S. serratodentata	8–11	6–9	13–24	13–19
S. planktonis	6–10	4–7	12–18	11–15
P. draco	6–10	4–4	10–16	8–9

In the case of *P. draco* the differences may mean little, owing to the fact that only a single very immature specimen is recorded from the San Diego region. It is interesting, however, to note that it was 7 millimeters in length, whereas 15 of the 20 from the Philippine region recorded in Table 17 are smaller and quite as immature, the smallest being less than 5 millimeters in length, although it has 6 to 7 anterior teeth and 13 posterior teeth.

To demonstrate that the differences in number of teeth given for the four species of *Sagitta* are significant, from 10 to 30 or more individuals of each species were selected at random from the two collections, the number of teeth counted, and the mean number and corresponding probable errors computed. The results are entered in Table 19:

TABLE 19.—*Comparison of mean number of teeth in specimens from the Philippines and from the San Diego region.*

Species.	Anterior teeth.			Posterior teeth.		
	Philippines (P).	San Diego (S).	Difference (P–S).	Philippines (P).	San Diego (S).	Difference (P–S).
S. enflata	8.29 ± 0.256	6.27 ± 0.035	2.02 ± 0.258	13.45 ± 0.241	10.18 ± 0.133	3.27 ± 0.275
S. neglecta	5.61 ± 0.160	3.80 ± 0.243	1.81 ± 0.291	13.75 ± 0.184	8.96 ± 0.135	4.79 ± 0.228
S. serratodentata	9.32 ± 0.133	7.22 ± 0.114	2.10 ± 0.175	18.24 ± 0.536	15.44 ± 0.203	2.80 ± 0.573
S. planktonis	8.36 ± 0.200	5.94 ± 0.335	2.42 ± 0.390	16.15 ± 0.145	12.60 ± 0.218	3.55 ± 0.262

[1] *S. hexaptera* is not considered owing to loss of teeth. See p. 245.

Table 19 shows (1) that in every case the mean number of both anterior and posterior teeth in Philippine specimens exceeds that in San Diego specimens, and (2) that the magnitude of the excess is between 5 and 20 times the corresponding probable error. That this excess is not merely an expression of the larger size of the Philippine specimens is evident, for the counts were made on specimens of Philippine *Sagitta enflata* between 10 and 21 mm. in length and on San Diego specimens between 10 and 25 mm.; on Philippine *S. neglecta* between 6 and 8 mm., and on San Diego specimens between 8 and 13 mm.; on Philippine *S. serratodentata* between 7 and 11 mm., and on San Diego specimens between 10 and 17 mm.; and on Philippine *S. planktonis* between 13 and 27 mm., and on San Diego specimens between 17 and 26 mm. Obviously, some differential influence is at work in the two regions causing an excess of teeth in the Philippine fauna, or a deficiency in the San Diego fauna.

Unfortunately, a similar comparison of Philippine chaetognatha with those from other regions of the Pacific is impossible, owing to the fact that no one except Fowler (1906) has published a series of tooth counts, and he has not kept the individual counts distinct. The range of variation, however, in the *Siboga* material is much the same as that in Philippine specimens. This is pointed out in the foregoing pages for every species common to the two regions, but these data are brought together and amplified in Table 20:

TABLE 20.—*Comparison of number of anterior and posterior teeth in Philippine species and those from the Siboga region.*

SAGITTA ENFLATA.

Length of specimens in mm.	Anterior teeth.		Posterior teeth.	
	Philippines.	*Siboga.*	Philippines.	*Siboga.*
10–15	6– 7	7– 9	9–12	9–14
15–20	7– 9	8– 9	13–15	12–17
20–25	7–11	8–10	14–15	12–16
25–30	8	7–10	14	14–17

SAGITTA NEGLECTA.

6.5	4– 6	4– 5	12–14	9–10
7	5– 8	4– 6	12–16	9–12
7.5	5– 6	4– 5	14–15	10–13
8	5– 6	4– 6	14–15	9–14

SAGITTA SERRATODENTATA.

7– 8	9	5– 9	13–15	9–16
8– 9	8– 9	6– 9	14–18	13–18
9–10	8– 9	6– 9	16–19	13–19
10–11	8–11	8– 9	18–24	15–19

TABLE 20.—*Comparison of number of anterior and posterior teeth in Philippine species and those from the Siboga region*—Continued.

SAGITTA PLANKTONIS.

Length of specimens in mm.	Anterior teeth.		Posterior teeth.	
	Philippines.	*Siboga.*	Philippines.	*Siboga.*
11-13	7- 9	5- 8	12-16	13-16
13-15	9	5- 9	16	14-18
15-17	9-10	8- 9	15-18	17-18
17-19	9-10	7- 9	17-18	16-18
19-21	8	7-11	16-17	16-20
21-23	8	8-11	16-17	17-20
23-25	8- 9	8-10	17-18	18
25-27	7- 9	8- 9	17-18	18-19

SAGITTA PULCHRA.

10-15	5- 8	6-10	9-12	10-14
15-20	6- 9	6-10	11-13	10-15
20-25	6- 8	7-10	10-13	12-15

SAGITTA DECIPIENS.

9.0	9-11	8	19-21	16
11	10-11	7	22	16
12	9	8	20-21	15-17
12.5	8- 9	8- 9	19-20	15-18

SAGITTA BEDOTI.

10-12	8-10	9-11	20-23	18-27
12-14	8- 9	9-13	21-25	20-32
14-16	8-10	9-10	22-28	21-29

SAGITTA FEROX.

10-12	5- 7	4- 8	10-12	9-13
12-14	7- 9	7- 9	12-15	10-14
14-16	5- 9	6- 9	10-14	10-14

PTEROSAGITTA DRACO.

6.0	7- 9	8	11-14	12
7	5-10	7-10	11-15	11-15
7.5	8- 9	8- 9	13-16	12-16

Inspection of this table reveals a pronounced similarity in number of both anterior and posterior teeth between Philippine and *Siboga* specimens of *Sagitta enflata, S. planktonis, S. pulchra, S. bedoti, S. ferox,* and *Pterosagitta draco*. In *S. neglecta, S. serratodentata,* and *S. decipiens* specimens from the two regions agree in number of anterior teeth, but those from the Philippines have a greater number of posterior teeth. Even in these instances the differences are slight and probably insignificant except for *S. decipiens*. In this species there seems to be no doubt that the Philippine specimens have more posterior teeth than *Siboga* specimens of the same length, although, as pointed out on page 254, where the length of animal was neglected, Fowler's records show a range of 13 to 23 posterior teeth as against that of 19 to 22 for Philippine specimens.

On the whole there is close agreement in number of teeth between specimens of species common to the Philippines and the *Siboga* region, while the same species are represented in the San Diego region, if at all, by specimens having markedly fewer teeth. In the face of this fact it is evident that, as formerly (1911, p. 68) stated, "variation in number of both anterior and posterior teeth in many species is not referable to specific differences, but probably to some distribution factor." When it is recalled that a subnormal ocean temperature characterizes the region adjacent to the western coast of America, due to pronounced upwelling of bottom water, and that the chaetognath fauna off southern and Lower California is representative of more northern latitudes, it suggests that one of these distribution factors is temperature. I believe the small number of teeth in San Diego specimens is an expression of the slower rate of metabolism due to a lower ocean temperature. This is not a new suggestion, but it is one that merits thorough investigation. Fowler (1906, p. 29), after stating that specimens of *Siboga Sagitta serratodentata* have nearly twice as many posterior teeth as specimens of the same length from the Bay of Biscay, says: "It is possible that this may be correlated with the respective temperatures at which the specimens live, but a long series of similar observations from different latitudes would be necessary before this could be regarded as even probable."

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EXPLANATION OF PLATES.

[All figures drawn with camera lucida.]

Plate 34.

Fig. 1. *Sagitta philippini*, new species. × 18.
2. Anterior teeth and few of posterior teeth of *S. philippini*. × 250.
3. Vestibular ridge of *S. philippini*. × 250.
4. Seizing jaws of *S. philippini*. × 800.

Plate 35.

Fig. 5. *Sagitta pulchra* Doncaster. × 8.
6. *Sagitta bedoti* Béraneck. × 8.
7. *Sagitta ferox* Doncaster. × 8.
8. *Sagitta decipiens* Fowler. × 18.
9. *Sagitta neglecta* Aida. × 18.

Plate 36.

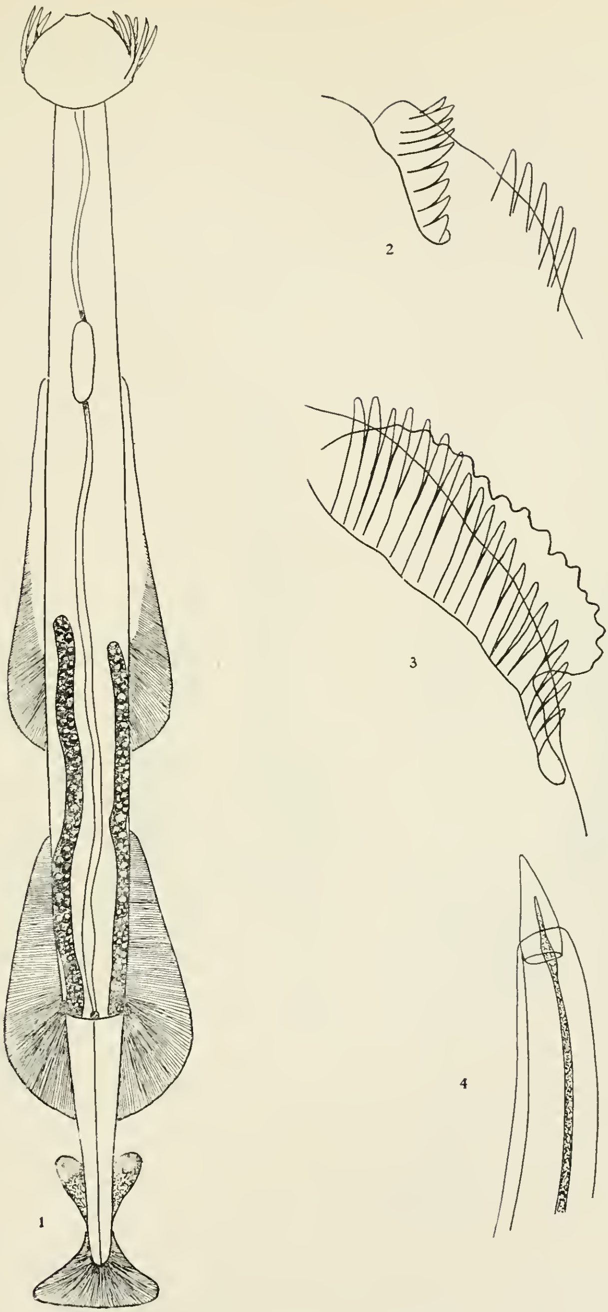
Fig. 10. *Eukrohnia richardi* Germain and Joubin. × 6.
11. *Pterosagitta draco* (Krohn). × 25.
12. *Pterosagitta draco* with collarette partly torn away and with no vestige of ovary or seminal vesicle. × 25.
13. *Pterosagitta draco* with fully mature ovaries and with collarette almost entirely missing. × 25.

Plate 37.

Fig. 14. Teeth of *Eukrohnia hamata* (Möbius). × 100.
15. Teeth of *Eukrohnia richardi* Germain and Joubin. × 100.
16. Vestibular ridge of *Sagitta minima* Grassi. × 400.
17. Seizing jaw of *Sagitta minima*. × 800.
18. Portion of vestibular ridge and posterior teeth of *Sagitta decipiens* Fowler. × 400.
19. Vestibular ridge of *Sagitta pulchra* Doncaster. × 400.
20. Vestibular ridge of *Sagitta bedoti* Béraneck. × 400.
21. Vestibular ridge of *Sagitta ferox* Doncaster. × 400.
22. Seizing jaw of *Sagitta decipiens* Fowler. × 800.
23. Seizing jaw of *Sagitta pulchra* Doncaster. × 800.
24. Seizing jaw of *Sagitta bedoti* Béraneck. × 800.
25. Seizing jaw of *Sagitta ferox* Doncaster. × 800.
26. Seizing jaw of *Eukrohnia richardi* Germain and Joubin. × 800.
27. Seizing jaw of *Eukrohnia hamata* (Möbius). × 800.

Plate 38.

Fig. 28. Posterior extremity of a small mature *Sagitta enflata* Grassi. × 25.
29. Posterior extremity of a mature *Sagitta minima* Grassi. × 25.
30. Ventral view of anterior extremity of *Sagitta bedoti* Béraneck. × 50.



CHAETOGNATHA COLLECTED IN PHILIPPINE ISLANDS.

FOR EXPLANATION OF PLATE SEE PAGE 277.

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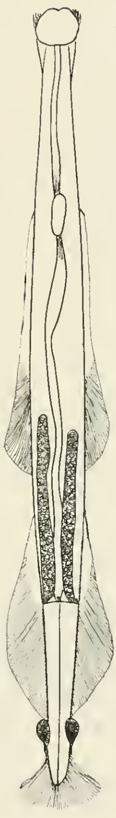

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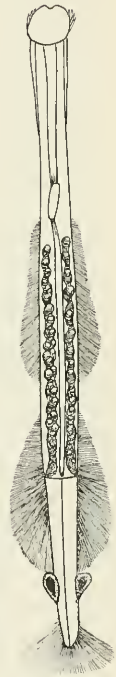

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CHAETOGNATHA COLLECTED IN PHILIPPINE WATERS.

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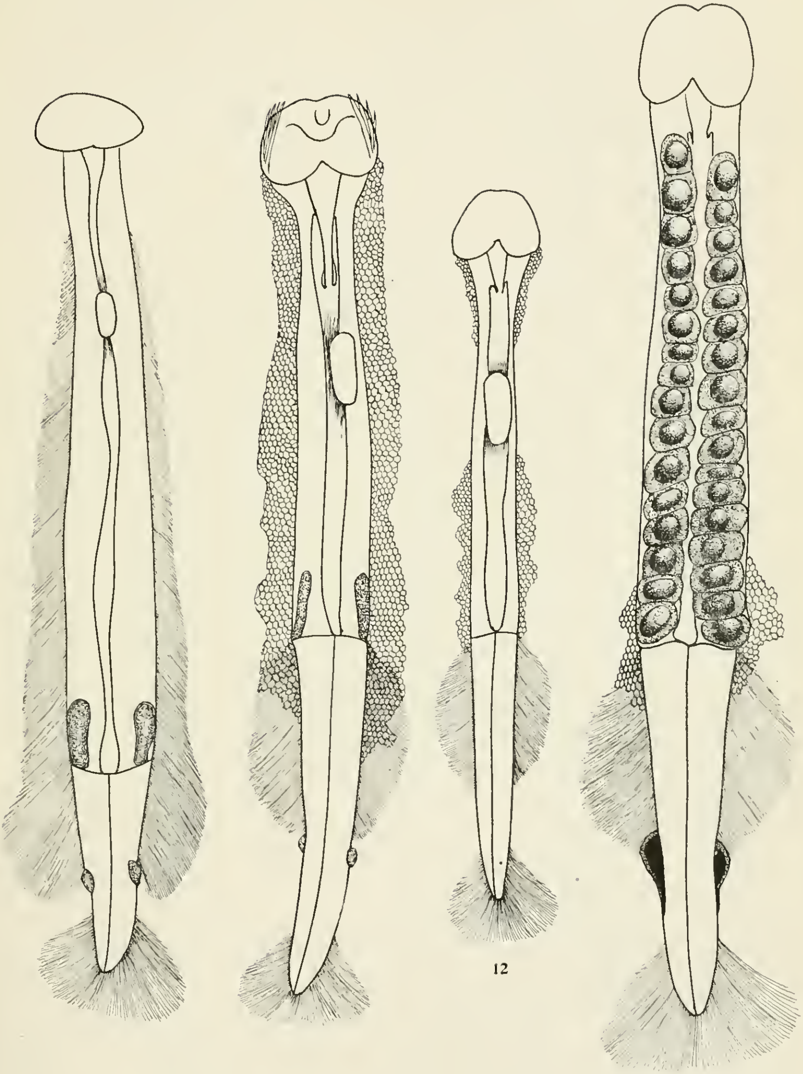

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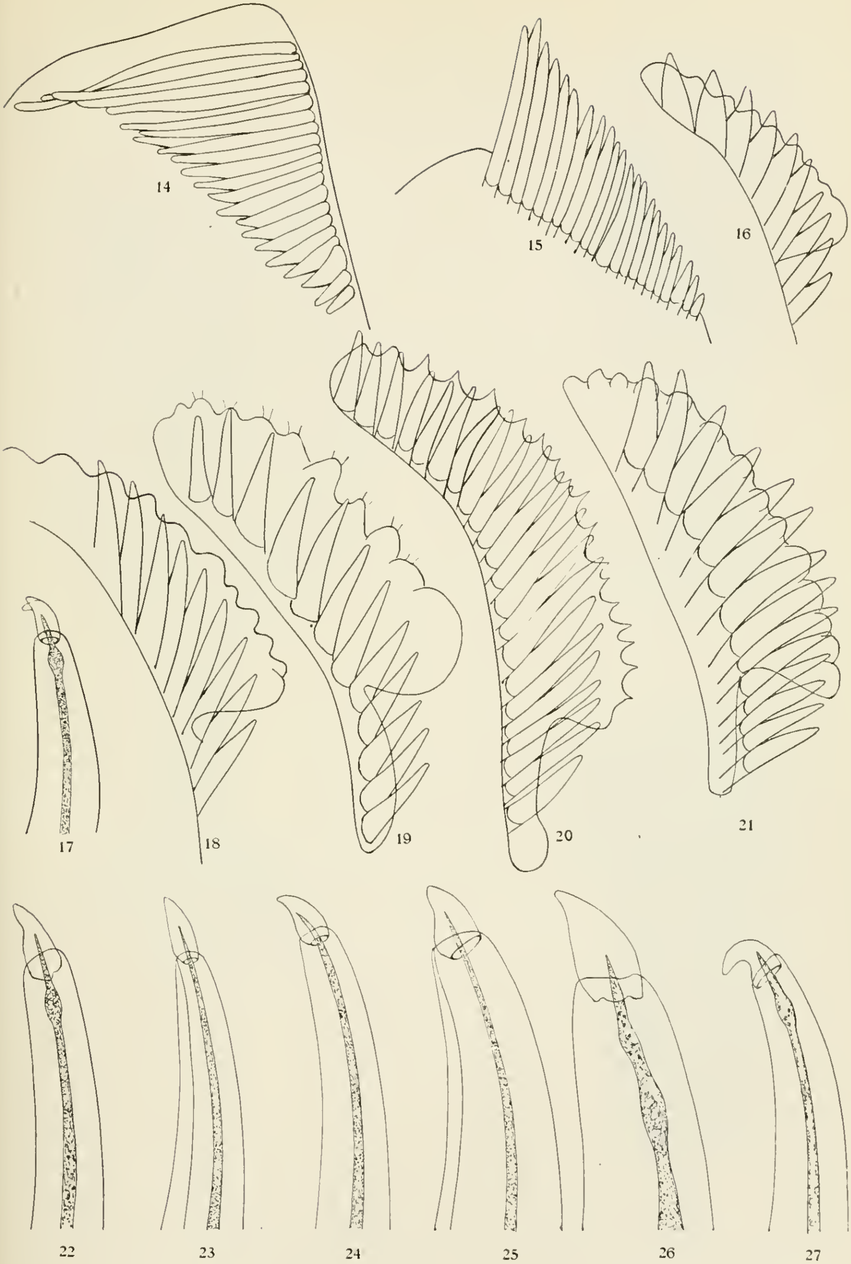

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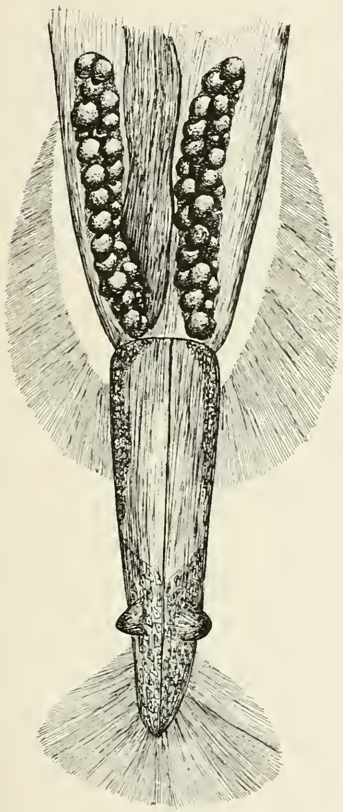

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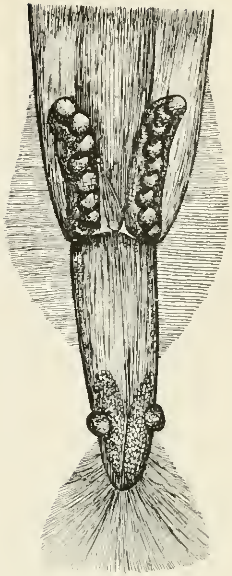

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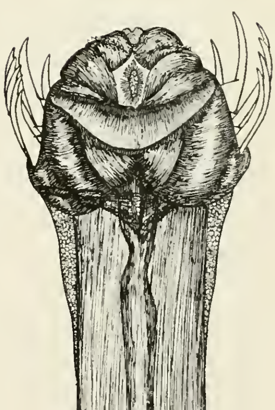

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CHAETOGNATHA COLLECTED IN PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGE 277.

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O

HYDROMEDUSAE, SIPHONOPHORES, AND CTENOPHORES OF THE "ALBATROSS" PHILIPPINE EXPEDITION.

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INTRODUCTION.

The medusae, siphonophores, and ctenophores described in the following pages were collected among the Philippines by the United States Fisheries steamer *Albatross* during 1907–1910. The material submitted to me consisted in part of specimens picked out on the spot and separately preserved, in part of a very large amount of unsorted plankton. The former were uniformly in good condition, but such medusae as I was able to separate from the mass of crustaceans, sagittae, salpae, pteropods, etc., were all damaged, many of them past recognition. For this reason and because time has allowed only a superficial examination of the unsorted plankton, it is by no means certain that the list includes all species which were taken. The labels give no information as to the depths of capture of any of the specimens; these have been obtained from the published data of the expedition.[1]

As points of special interest I may point out the discovery of a new *Protiara* (1912, p. 253), a new representative of Haeckel's genus *Zygocanna* (1912, p. 255), a genus not recorded since 1879; and a new genus of Petasidae of unusual morphological interest (1912, p. 258). The collection as a whole affords the opportunity for a discussion of the geographic affinities of the medusa-fauna of the Malay-Philippine region.

[1] Dredging and Hydrographic records of the U. S. Fisheries steamer *Albatross* during the Philippine Expedition, 1907–1910, U. S. Bureau of Fisheries, document 741, 1910.

DESCRIPTIONS OF GENERA AND SPECIES.

Class HYDROMEDUSAE.

Order ANTHOMEDUSAE.

Family BOUGAINVILLEIDAE Gegenbaur, 1856.

Genus BOUGAINVILLEA, Lesson, 1843.

BOUGAINVILLEA FULVA Agassiz and Mayer.

Bougainvillea fulva Agassiz and Mayer, 1899, p. 162, pl. 2, fig. 6. Synonymy, Mayer, 1910, pp. 160, 492.

Bougainvillea fulva—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40418	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	12
1617	M.C.Z	1	5129	....do	6
40419	U.S.N.M	1	5224	Between Marinduque and Luzon	9
29298	U.S.N.M	1	5451	Off east coast of Luzon	15
40420	U.S.N.M	2	5456	....do	8,11
1670	M.C.Z	2	5456	....do	6, 8
29299	U.S.N.M	2	5500	Off northern Mindanao	7,14
3051	M.C.Z	1	5500	....do	7
29297	U.S.N.M	1	5649	Buton Strait	7

This species has been studied so fully by previous students that a detailed account is unnecessary here. The most advanced stage yet observed is described by Maas (1905, 1906); slightly younger specimens by me (1909*a*). The account by Hartlaub (1909), and his comparison between *fulva* and the various Atlantic Bougainvilleas, is especially noteworthy. I need merely note that the present series contains two color phases, otherwise indistinguishable, one with manubrium yellowish, the other with a brown stripe in each interradius. The difference is not a sexual one, because both males and females were found in each phase. Perhaps it is evidence of differences in nutrition.

The range of *B. fulva* extends over the whole breadth of the tropical Indo-Pacific from the coast of Mexico in the east (Bigelow, 1909*a*) to the Gulf of Aden on the west (Djibuti, Hartlaub 1909).

Family PANDEIDAE, Haeckel, 1879 (sens. em.). TIARIDAE, Hartlaub, 1913.

Genus PROTIARA, Haeckel, 1879.

As I have previously pointed out (1913, p. 12) "Tiaridae" can not be used as the name of a medusan family, *Tiara* being preoccupied for a mollusk. *Protiara* was defined by Haeckel as having gonads in the form of single longitudinal swellings, and it is so limited by

Hartlaub (1913), whom I follow here, though Mayer (1910) has expanded it to include forms with solid marginal cirri as well as tentacles, as *Halitiara formosa* Fewkes. The descriptions of the various species which have been credited by different authors (Haeckel 1879, Mayer 1910, Hargitt 1905) to this genus are so insufficient that it is not worth while to add anything here to the discussion of them given by Hartlaub (1913, p. 251). As he points out, some of them are really Sarsiids, only two, *tetranema* (Péron and Lesueur) Haeckel, and *haeckeli* Hargitt, being undoubted Pandiids. That *Halitiara formosa* is likewise a true Pandiid is proved not only by its general structure, but by cross sections of its gonads which I have myself examined. But in this species there are solid cirri on the bell margin, as well as the four tentacles, and it therefore deserves a separate genus.

PROTIARA TROPICA Bigelow.

Plate 39, figs. 1–4.

Protiara tropica Bigelow, 1912, p. 253.

Protiara tropica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29380.....	U.S.N.M.......	1	5,500	Off northern Mindanao...	9 by 9 high.

I have already (1912) described this specimen in such detail that I need merely call attention to the figure showing the interradial gonads in transverse section (pl. 39, fig. 2), the location of these organs being the reason for classing the specimen as a pandiid rather than a sarsiid.

Genus LEUCKARTIARA Hartlaub 1913.

Tiara[1] Lesson, 1843 (part).
Turris[1] Mayer, 1910 (part).
Clavula Mayer, 1910 (part).

Hartlaub's recent (1913) discussion of this genus leaves little to add—I follow him in referring to it all Pandiids with eight or more tentacles, in one series, with "mesenteries" and with gonads primarily horseshoe-shaped, their concavities directed distally, their arms transversely folded. The chief distinction between *Leuckartiara*, *Neoturris*, and *Pandea* is the structure of the gonads (1909*a*, Hartlaub, 1913). I may refer the reader to Hartlaub's discussion of the complicated synonymy, only pointing out that he is undoubtedly correct in using the species name *octona* Fleming for the medusa which most authors have called "*Tiara pileata*," the *Medusa pileata* of Forksål being a *Neoturris* (p. 284).

[1] Preoccupied for a mollusk.

LEUCKARTIARA OCTONA (Fleming) Hartlaub.

Plate 39, figs. 5, 6.

Geryonia octona FLEMING, 1823, p. 299. Synonymy, Hartlaub 1913, p. 285.

Leuckartiara octona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29303	U.S.N.M.	5	5,195	Off northern Cebu	4–6 hgh.
1672	M. C. Z.	2	5,129		Do.
29304	U.S.N.M	1	5,649	Buton Strait	6 high.

I formerly (1909*a*) believed that the Pacific *Leuckartiara* described by Maas (1909) and by me (1909*a*) as *Tiara papua* Lesson, but probably incorrectly, as Hartlaub (1913, p. 334) points out,[1] could be distinguished from the Atlantic *L. octona* by the presence of fewer tentacles. But Vanhöffen has recently (1912) recorded Pacific specimens of the characteristic "*octona*" type; hence it can no longer be maintained that the final number of tentacles is always smaller in the Pacific than in the Atlantic form. But most of the Pacific specimens recently recorded have only eight or fewer tentacles, irrespective of size, as shown in the following table:

Authority.	Locality.	Size.	Large tentacles.	Gonads.	Small tentacles and bulbs.
Maas, 3 specimens	Malay Archipelago	(?)	8	Large present.	8.
Agassiz & Mayer	600 miles north of the Marquesas.	5 mm. high	8	Present	8 small,+16 bulbs.
Bigelow	East Pacific	5 diam	8	Small	8 bulbs.
Do	do	7 high	9	Present	11 bulbs.
Do	do	6 high	9	do	8 bulbs and small tentacles.
Do	do	3 high	4	None	4 bulbs.
Maas	Japan	15 high	8	Large	8 small.
Do	do	15 high	8	do	8 small.

The present collection gives the following data:

	Locality.	Size (mm.).	Large tentacles.	Gonads.	Small tentacles and bulbs.
	Philippines	6 high	4	Present	4 small and 8 knobs.
	do	6 high	8	Present, large.	8 knobs.
	do	6 high	8	Present	8 knobs.
	do	5 high	4	do	3 small and 8 knobs.
	do	4 high	2	do	6 small and 7 knobs.
	do	4 high	2	do	6 small and 7 knobs.
	do	5 high	4	do	4 small and 8 knobs.
	do	5 high	8	do	9 knobs.

[1] Hartlaub, 1913, p. 334, shows that the *Turris papua* of Lesson and of Eydoux and Souleyet is a *Neoturris*.

The bases of the tentacles are laterally flattened, and on the outer surface there is a more or less pronounced spur clasping the exumbrella (pl. 39, fig. 6). This character, however, varies both individually and with contraction. It is not shown in Maas's figure of his Japanese specimens, nor was it noticeable in either the *Siboga* or the *Albatross* eastern Pacific series. There is usually but not always an abaxial ocellus on the base of each tentacle, and of each marginal bulb. But this is not an invariable rule, for an ocellus may be lacking, or there may be two in conjunction with a single tentacle. Thus in one specimen 7 of the 8 large tentacles and 7 of the 9 knobs have 1 ocellus, while 2 knobs have 2 ocelli each; in another, the 8 tentacles and 3 of the 7 knobs have 1 ocellus, while 4 knobs have 2 ocelli each; in a third 5 tentacles have 1 ocellus; 1 has a diffused pigment spot and 2 have no ocelli, and of the 8 knobs 4 have one and 4 have 2 ocelli each.

The gonads are of the characteristic type, as a comparison of the photograph (pl. 39, fig. 5) with any of the numerous figures of *L. octona* (Maas 1904*b*, pl. 1, fig. 9; Hartlaub, 1913) will show. The edges of the radial canals are irregularly fluted, especially in the distal one-third of their course (pl. 39, fig. 6); but the lobing varies from canal to canal, or even on opposite sides of any given canal. Some canals hardly show it at all. It is not present in young specimens, and first appears as a jagged outline (Bigelow 1909*a*). It is never as pronounced here as in *Catablema* or in *Neoturris.*

Color.—In the preserved specimens the gonads and lips are violet or purple; the tentacles opaque and yellowish, their bases brownish yellow. The ocelli are dark brown. In the large Japanese examples described by Maas (1909, pl. 1, fig. 3) the colors are similar. *L. octona* is very generally distributed over the warmer parts of the Indo-Pacific region, but is not yet known from the northwest Pacific north of Japan.

Genus NEOTURRIS Hartlaub, 1913.

Neoturris Hartlaub, 1913.
Tiara Lesson, 1837 (part).
Turris Lesson, 1837 (part).
Clavula Bigelow, 1909*a*.—Mayer, 1910 (part).

The discovery by Browne (1910) and Hartlaub (1913) that the *Turris neglecta* of Forbes (of which *Clavula* is probably the hydroid) is not a Pandiid forbids the use of *Clavula* as the name for the present genus.

Neoturris is undoubtedly very closely allied to *Leuckartiara;* indeed, it has often been united with it, as, for instance, by Vanhöffen (1912). But as previously pointed out (1909*a*), I agree with

Hartlaub (1892, 1913) that the gonads are sufficiently different to separate it. In *Leuckartiara* these are fundamentally horseshoe shaped; the arms, it is true, are transversely folded, but the folds are permanently connected next the interradius. In *Neoturris*, on the contrary, the vertical series of transverse gonad folds are not connected with one another at the inner (interradial) ends, while the interradial surface of the manubrium is occupied by an irregular network of sexual thickenings. The figures by Maas (1904*b*) and Hartlaub (1913) show the two gonad types very clearly. (For further discussion see Hartlaub, 1913, p. 325.)

So far three species of *Neoturris* have been recorded from the Indo Pacific—the *Turris papua* of Lesson (if it be actually a *Neoturris*), *T. pelagica* Agassiz and Mayer, and *T. fontata* Bigelow [*Turris brevicornis* Murbach and Shearer (1903) is probably a *Leuckartiara*, as Hartlaub, 1913, p. 335, points out].

There is nothing in the original account and rather diagrammatic figure of *pelagica* (Agassiz and Mayer, 1902) to separate it from the Atlantic *N. pileata*. And two specimens in the present collection also agree with *N. pileata* in general form, structure of the gonads and tentacles, degree of lobation of radial canals, and absence of ocelli, though they have more tentacles than have ever been recorded for the Atlantic form. But the number of tentacles is so variable (Hartlaub, 1913) and the discontinuity between the two forms so small (up to 90 for Atlantic, 100–120 for Phillipine specimens) that it does not justify separating the Pacific form specifically. And the Philippine specimens are apparently only an older stage of *pelagica* Agassiz and Mayer; at least, the only important difference—larger size and greater number of tentacles—can be readily explained as concomitants of growth. In short, it appears that in *Neoturris*, as in *Leuckartiara*, one species ranges over both the Atlantic and the Pacific. And comparison of the accompanying photographs (pl. 39, figs. 7–8) with Hartlaub's (1913) figures will show how closely specimens from the two oceans agree in all essential features.

It is possible that the *Turris papua* of Eydoux and Souleyet (1841) also belongs to this compound form, for its gonads are clearly of the *Neoturris* type. But it differs from *pileata* in having very few tentacles (10–11), and this is also true of Lesson's (1830) *Aequorea mitra*, later called by him *Turris papua*.

N. fontata is distinguished from all other members of the genus by the presence of ocelli, of exumbral sense pits, and of tentacular ostia, together with a small number (20±) of tentacles, and of many permanently rudimentary tentacular knobs.

NEOTURRIS PILEATA (Forskål) Hartlaub.

Plate 39, figs. 7, 8; plate 40, fig. 1.

Medusa pileata Forskål 1775, p. 110.
Neoturris pileata Hartlaub, 1913, p. 326. To the synonymy given by Hartlaub, 1913, p. 326, add *Turris pelagica;* Agassiz and Mayer, 1902, p. 142, pl. 1, fig. 2.—Mayer, 1910, p. 127.

Neoturris pileata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29305.....	U.S.N.M........	1	5127	Sulu Sea, vicinity southern Panay.	17; about 120 tentacles.
40421.....	.....do...........	1	5129	Sulu Sea, off western Mindanao.	14 by 21 high; about 92 tentacles.

Both the examples are in good condition, though somewhat contracted. But in each a small portion of the margin is so damaged that it is impossible to determine the total number of tentacles within two or three. The specimens are described here in detail, as no account of adult Pacific examples has appeared.

The tentacles seem at first sight to be arranged in two alternating rows, an inner and an outer. But this appearance is merely superficial, for all the tentacles arise at the same level, close to the circular canal, and the apparent outer row is merely the older tentacles, whose bases are broader and reach outward farther than those of the younger ones. A side view of the margin (pl. 39, fig. 8) shows the actual relation of the tentacles of different ages more clearly than a verbal description. The tentacle bases are laterally flattened and triangular. There are openings on the outer face of several of the bulbs near the base, but these are apparently accidental mutilations, not true ostia such as occur in *N. fontata.*

In the smaller specimen there are six rudimentary knobs, but there are none in the larger. Evidently, then, the number of tentacles present is nearly, if not quite, the final one. There are no ocelli; nor are ectodermal sensory pits, so important a feature of *N. fontata*, present. But there is a shallow furrow in the exumbrella just above the base of each of the larger tentacles. I was not able to study the histology of the ectoderm in this region because of the condition of the specimens.

Manubrium and gonads.—The manubrium occupies but little more than one-half the depth of the bell cavity; the lips are thrown into numerous small complex folds (pl. 39, fig. 7).

The gonads (pl. 39, fig. 7), which closely resemble the figures of *N. pileata* given by Maas (1905, pl. 1, fig. 5) and Hartlaub (1913), are entirely discontinuous in the perradii, but connected in the upper half of the interradii by an irregular network.

Canals.—The margins of the radial canals are lobed in their mid-region, but their outer ends and the circular canal are smooth.

Color.—In the preserved specimens the tentacles, manubrium, and gonads are pale yellow.

Family BYTHOTIARIDAE Maas, 1905. Sens. em. Bigelow (1909*a*, 1918), Maas (1910).

Tribe *Bythotiaridi* (part)+Tribe *Calycopsidi* MAYER, 1910. "Gruppe" *Calycopsiden* HARTLAUB, 1913.

Hartlaub (1913, p. 349) substitutes the name "Calycopsiden" for "Bythotiaridae," both because the former is derived from the oldest and largest genus, and because he finds the latter "unbequem." But neither of these reasons seems to me to justify abandoning a generally accepted family name.

Maas (1910) has recently given us so satisfactory a discussion of this family that I need add little here beyond the statement that I am still in thorough accord with his union of *Bythotiara*, *Heterotiara*, *Sibogita*, and *Calycopsis* in a single family, distinct on the one hand from the Williadae, on the other from the Pandeidae. Mayer (1910), on the contrary, has referred *Bythotiara* and *Sibogita* to the Williadae, *Heterotiara* to the Pandeidae ("Tiarinae"). Vanhöffen (1911), who has examined more specimens of the three genera than any other student, has classed them all among the Pandeidae ("Tiaridae"), but without any discussion of their relationships. And Hartlaub (1913) in his recent revision of the Pandeidae ["Tiaridae"] classes them as "Gruppe Calycopsiden" of that family. But although, as I have previously pointed out (1909*a*, p. 213), "the closest relationship of the Bythotiaridae is undoubtedly with the Tiaridae [Pandeidae]," they are so easily distinguishable from the members of that family by the greater development of the manubrium, which, as in most Leptomedusae, is distinguishable into basal, gastric, and oral regions; by the structure of the gonads, which are permanently interradial instead of having this primitive location masked with growth as is the case in most Pandeidae; by the structure of the bell margin and by the fact that the tentacles have no distinct bulbs; and they are so uniform, among themselves in these respects, that I still believe they are best grouped in a separate family. But here, as so often among Medusae, it is perhaps impossible to draw a hard and fast line; for, as Hartlaub (1913) points out, the genus *Meator*, recently described by me from the northwest Pacific (1913) has some characters in common with the Pandeids, some with the Bythotiarids.

A feature of special importance emphasized by Maas is the absence of any swelling at the base of the tentacles.

Niobia is included by Mayer in his "tribe Bythotiaridi," but its swollen tentacle bases argue against this view. Maas (1910, p. 7) suspects that it is a Leptomedusa.

Genus HETEROTIARA Maas 1905.

The genus was proposed by Maas (1905) for two immature specimens named by him *H. anonyma*. It has since been recorded by me (1909*a*) for two more examples of *anonyma* from the eastern Pacific, for large series of that species from the northwest Pacific (1913) and from the Western Atlantic (1918), and by Vanhöffen (1911) for one *anonyma* and four specimens of a new species, *minor*, from the "Valdivia" collection. The present collection contains eight examples of *minor*, which are in such good condition that they allow me to amplify the original account of that species somewhat.

Vanhöffen (1911) has questioned whether the eastern Pacific specimens which I referred to *anonyma* really belonged to that species, on the ground that his examples, as well as those of the *Siboga*, 19 mm. high, had only eight tentacles and no sign of others in process of formation, whereas mine, only slightly larger (22 mm.) had eleven or twelve. But the northwest Pacific specimens (1913, p. 26) showed that the number of tentacles varies (7–10) independent of size (13–21 mm. high), besides varying in number from quadrant to quadrant of the bell margin. Hence, as I have pointed out (1913), there is no real separation between the eastern Pacific and the other recorded specimens of *anonyma*. And this same conclusion has been reached by Hartlaub (1913, p. 351).

H. minor is distinguished from *H. anonyma* by its small size and by having about twice as many tentacles. Data are now available from enough specimens to establish the constancy of the difference, and consequently the validity of Vanhöffen's species. It is possible that the *Tiara prismatica* of Maas (1893) belongs to one or other of these two species. But in the absence of any figure of the entire Medusa, this must remain doubtful (Hartlaub, 1913, p. 349).

HETEROTIARA MINOR Vanhöffen.

Plate 39, fig. 9; plate 40, figs. 2–4.

Heterotiara minor VANHÖFFEN, 1911, p. 212, figs. 8*a*, 8*b*.

Heterotiara minor—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40422	U.S.N.M.	1	5224	Between Marinduque and Luzon	8
1676	M.C.Z.	1	5224	do	6
29351	U.S.N.M.	2	5320	China Sea, vicinity Hongkong	8, 9
29350	U.S.N.M.	3	5456	Off east coast of Luzon	7
1667	M.C.Z.	1	5456	do	7

The general structure of the genus is now so well known that all that is needed here is a discussion of characters which may be expected to be of specific importance. The series, arranged according to size, gives the following data:

Locality (station).	Diameter (mm.).	Height (mm.).	Interradial tentacles per quadrant.	Total tentacles.
5224	6	6	4-3-4-3	18
5456	7	7	3-3-3-3	16
5456	7	7	3-4-3-3	17
5320	8	9	5-3-4-4	20
5224	8	10	4-4-4-4	20
5320	9	11	6-3-4-5	22
5456	[1]	[1]	3-3-4-3	17

[1] Too crumpled to measure.

Vanhöffen (1911) has recorded the following data for the *Valdivia* specimens:

Locality (station).	Diameter.	Height.	Interradial tentacles per quadrant.	Total tentacles.
Near Nias Island	6	6	4-2-3-3	12
Do	7	7	4-2-3-3	12
Between New Amsterdam and Cocos Islands	11	10	6 tentacles per quadrant.	24
Do	12	12	.....do	24

If we consider the specimens not only as individuals, but quadrant by quadrant, we shall obtain a fairly complete survey, because 3 of the *Albatross* series are sexually mature. The number of tentacles increases somewhat irregularly with growth, six interradials being the observed maximum. If this number were present in all four quadrants of any one individual the total would be 28, radial and interradial. But since this number is not reached in either of the large *Valdivia* specimens, it is doubtful whether it is normally attained. Only in three quadrants did I find young tentacles—one in each. And these, as it happened, were not in the smaller, but in the two largest individuals. All the large tentacles, as noted by Vanhöffen (1911) end in oval terminal nematocyst swellings.

Manubrium and gonads.—The gonads are purely interradial. In the smaller specimens the manubrium is very short; in the two largest, which are apparently mature, it is one-third as long as the bell cavity. One is a female, with large eggs, which drop from the sexual masses at a touch. In one specimen the manubrium is torn off; in another, 7 by 7 mm., there are no gonads; in all the others its walls are thrown into transverse folds (pl. 40, fig. 4). These, however, are not definite plications, such as are seen in *Calycopsis*, but are so irregular and vary so in number on different sides of a given manubrium that it is a question whether they are anything but evidence of contraction of the manubrium as a whole. The fact that the perradii, as well as the interradii, are more or less folded, though there is no sexual tissue there, is evidence in this direction.

In at least one adult specimen of *anonyma* (Bigelow, 1909*a*) the walls of the manubrium were smooth; but in others which I have examined it was more or less folded (1913, p. 26).

In two of the smaller specimens the manubrium is sunken into the gelatinous substance (pl. 40, figs. 2, 3) in the peculiar manner already described by Vanhöffen. But this is merely an evidence of a remarkable contraction of the upper part of the bell cavity. There is no longitudinal connection in these cases between the manubrium and the subumbrella or radial canals.

In the third small example, as in all the larger ones, the manubrium hangs in its usual position in the bell cavity. It would be interesting to study this peculiar contraction phase on living material. At any rate, as Vanhöffen (1911) has pointed out, it can have no significance in classification.

There are no centripetal canals in any of the specimens.

Color.—On the preserved specimens the manubrium is pale yellow; otherwise they are colorless. In the *Valdivia* examples the terminal tentacular knobs are red, and the manubrium (in life?) had four interradial dark brown-violet stripes.

The genus *Heterotiara* has previously been taken only in intermediate hauls, but two of the Philippine specimens are from the surface.

Genus CALYCOPSIS Fewkes, 1882.

Sibogita Maas, 1905.

It is no longer an open question whether *Sibogita* can be distinguished generically from *Calycopsis*, separated by Vanhöffen (1911) on the assumption that in the former some of the canals are centrifugal branches from preexisting canals, whereas all the inter- and adradial canals of the latter are centripetal. If this were true, the distinction would be a valid one; but I have recently (1918) described a species bridging the gap, in that some of its centripetal canals join the radial canals, some the manubrium; and there discussed the genus as a whole.

The present collection contains two specimens, one belonging to *C. geometrica*, the other without question specifically identical with the Medusae from the eastern Pacific, which I described under the name *Sibogita simulans*, representing a stage in development intermediate between the extremes which I then recorded. Vanhöffen (1911) has united *simulans* with the Gulf Stream species *typa*. But though the differences between the two are trivial they seem sufficiently constant to distinguish *simulans*, at least as a variety. It is clear that in the *simulans* form many, or all, of the centripetal canals finally unite with the cruciform base of the manubrium, a union taking place in specimens in which only 12 canals (radial and subradial), are developed, as the present example shows. But should new canals be later interpolated in such a way that they alternate more or less regularly with the preexisting ones, the condition observed by Vanhöffen in the *Valdivia* specimen credited by him to *typa* but christened *valdiviae* by Hartlaub (1913)—namely, 24 canals which unite with the stomach and 36 blind ones alternating somewhat irregularly with them—might result. In my Gulf Stream specimens (1909*b*), on the other hand, all the canals were blind even in a specimen with mature ova, 37 mm. high, with 21 canals in all. In Fewkes's type specimen, which I have recently examined (1913, p. 21), every centripetal canal which is well enough preserved to show its termination is blind. Moreover, as I have pointed out (1913), his specimen and all of mine from the Gulf Stream, including two series collected by the *Grampus* (1909*b*, 1915*a*), though taken more than 30 years apart, show the apical depression of the subumbrella which I have described and figured elsewhere (Bigelow 1909*b*). But no such character has been observed in the *simulans* form.

If it were the *Grampus* series alone which showed it, it might well be credited to individual or to swarm variation. But when we find it present in all examples from the Gulf Stream, though taken so many years apart, it is a reasonable conclusion that we have here evidence of a distinct local race. And if this be true, it deserves recognition in nomenclature, at least as a geographic variety.

Large series may show that the centripetal canals in the Atlantic form are not permanently blind, as they now seem to be, and that the apical depression is not of importance. But for the present it is wisest to refer the Philippine specimen to var. *simulans* of *typa*.

CALYCOPSIS GEOMETRICA (Maas) Bigelow.

Plate 40, figs. 5–7; plate 41, fig. 2.

Sibogita geometrical Maas, 1905, p. 17, pl. 3, figs. 16–18.
Calycopsis geometrica Bigelow, 1918, p. 377.

Calycopsis geometrica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29383	U.S.N.M.	1	5125	Sulu Sea, vicinity southern Panay.	20

Station 5125, off Nogas Island, Sulu Sea, vicinity of southern Panay, 411 fathoms; 1 specimen, 20 mm. in diameter, very well preserved. The height of the specimen is only 12 mm., but it is obviously so much flattened that the measurement represents much less than the normal proportion to the breadth.

Maas has given an excellent account of the general organization of *C. geometrica.* The reasons for hesitancy in identifying this specimen as *geometrica* are the relative numbers and succession of tentacles and canals and, more important, the presence of ocelli at the base of the tentacles.

The relation of the canals to each other and to the stomach, of the same general type as Maas has described it for *geometrica*, is as follows: each of the four primary radial canals, after leaving the stomach, from which it is not sharply defined, gives off "branches" (the word being used in a descriptive, not an ontogenetic sense), alternatively right and left (pl. 40, fig. 5). In the present series the numbers in each of the four groups are 5, 6, 5, 6. All of these, a total of 22 canals, run to the margin. In each group one canal joins the radial trunk so very close to its juncture with the stomach that it might be spoken of as running to the stomach. But as there is no definite morphologic limit to the stomach this point is not a very important one. There are no blind canals, centripetal or centrifugal. At the margin every canal is connected with a tentacle. Of the 22 seventeen are large, evidently fully developed; five, in every case associated with one of the two outer members of a group of canals, are small and spurlike (pl. 41, fig. 2). There are also three small tentacles unconnected with any canals. At the base of every large tentacle, on the outer side, there is a dense group of red pigment granules (pl. 40, fig. 7) or "ocellus."

Manubrium and gonads.—These structures agree very well with Maas's account. The mouth is surrounded by a simple quadrate lip. The gonads are purely interradial; each consists of a double series of about 19 regular transverse folds (pl. 40, fig. 6). These folds are opaque and brownish-yellow in the preserved condition.

On comparing the specimen with Maas's description we find the following differences: in his one specimen there were 32 canals; but though all of these run to the bell margin there were only 16 tentacles. When we compare this with the condition in the Philippine specimen it is difficult to derive either one from the other by assuming progressive development, because the evidence afforded by the margin—that is, the presence of young tentacles without corresponding canals—shows that the order of succession is tentacle-canal, just as it is in *Calycopsis typa* (Bigelow, 1909*b*). On the other hand, the fact that half the canals have no corresponding tentacles in the *Siboga* specimen of *geometrica* showed that in that form the order of succession is first canal, then tentacle.

A second feature of difference is the presence of pigment spots or ocelli in the Philippine specimen. No such structures were observed by Maas in *geometrica*. With future research it may prove that either tentacles or canals may appear first, and that ocelli may be either present or absent; perhaps they were obscured by preservation in the *Siboga* material. The question can not be settled until more specimens are available, and therefore the identity of the present example remains in doubt.

CALYCOPSIS TYPA Fewkes, var. SIMULANS Bigelow.

Plate 40, fig. 8; plate 41, fig. 1.

Sibogita simulans Bigelow, 1909*a*, p. 213, pl. 5, figs. 4, 5; pl. 41, figs. 8, 9; pl. 43, figs. 1, 2.—Mayer, 1910, p. 187.
Calycopsis typa Vanhoffen, 1911, p. 214, pl. 22, fig. 6 (not Fewkes).

Calycopsis typa variety *simulans—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29300.....	U.S.N.M.......	1	5125	Sulu Sea, vicinity southern Panay.	16, but obviously much contracted.

The advanced condition of the gonads and canals shows that it is nearer maturity than the small size, after preservation, would suggest.

Canals and tentacles.—There are 12 canals—4 radial, 8 adradial. Of the adradials, one ends blindly, the other seven join the cruciform base of the manubrium (pl. 40, fig. 8). Each of the radial canals and six of the adradials are connected with large tentacles. Two of the adradials, one being the blind one, are connected with small tentacles. Obviously these two canals are the youngest ones. There are likewise eight small tentacles in connection with which no canals have yet been developed. The tips of the large tentacles are all so much damaged that the terminal knobs are entirely lost. In each of the two eastern Pacific specimens there were 8 adradial canals, all blind.

Manubrium and gonads.—The mouth is surrounded by a simple cruciform lip without any trace of marginal folds or crenulations (pl. 41, fig. 1). The gonads (pl. 41, fig. 1) are of the usual type, consisting of double series of regular transverse folds in each interradius, about 15 folds in each, the sexual development occupying nearly the entire length of the manubrium.

Color.—In the preserved condition the gonads are pale brownish-yellow. There are no ocelli.

Order LEPTOMEDUSAE.

Family EUCOPIDAE Gegenbaur, 1856.

Genus PHIALUCIUM Maas 1905.

I formerly defined this genus (proposed by Maas as a subgenus) as "Eucopidae with numerous tentacles and otocysts (number indeterminate), with rudimentary as well as large tentacles; with or without cirri" (1909*a*). Almost simultaneously Torrey (1909) separated forms with cirri and instituted for them his new genus *Phialopsis.* This division has subsequently been adopted by both Mayer (1910) and Vanhöffen (1911) and is followed here.

Tables of the characters of the various described forms which fall in *Phialucium* (*sensu strictu*) have recently been published by them.

These authors agree in recognizing two well-defined species, *carolinae* and *mbengha* (Mayer lists both *mbengha* Agassiz and Mayer, and *virens* Bigelow, but says that they are probably identical), and I myself have maintained the same position (1909*a*). But Vanhöffen separates the two species on quite different grounds from those employed by Mayer or by me, and hence arrives at a different conclusion as to their relative geographic distribution. According to Vanhöffen the two species are separated in the main by the number of tentacles, *mbengha* having comparatively many, *carolinae* few; and a second character is the number of otoliths to the otocyst, the former having 5 to 6, the latter only 2. But if we examine the number of tentacles in the specimens which have been described, as given in Vanhöffen's own table, adding thereto the present specimens, we find that there is no discontinuity, but rather a continuous series. The numbers in natural order of sequence are:

	Tentacles.		Total.	Otocysts.
	Large.	Rudimentary.		
virens Bigelow	16–20	30–40	46–60	32
carolinae Mayer	16	48	64	64
virens, Maas	16	50	66	32
Philippine specimen	20	55	75	38
mbengha Agassiz and Mayer	16	80	96	32
mbengha Vanhöffen	20	80	100	48
Do	15	87	102	(?)

Phialidium tenue Browne was referred by me (1909*a*) *to Phialucium;* Browne (1905), however, believes that it was an abnormal *Irenopsis.*

This table, I think, makes it evident that any division based either on the number of tentacles as a whole, or on either class of tentacular structures taken separately, would be purely arbitrary.

Nor are the relative numerical proportions of the two classes to each other any more significant. With the evidence at his command Vanhöffen had every reason to use the number of otoliths to each otocyst as a systematic character. But facts afforded by the present specimens show that it can not be given so much weight. Thus in the larger Philippine example I have found otocysts with 1, 2, 3, and 4 otoliths, usually two large and the others small; and in the smaller one, instances with 1, 2, and 3. The only character which stands the test of critical examination, as I have previously pointed out, but which Vanhöffen (1911) has not employed at all, is the relation between the number of otocysts and that of tentacular organs, both large and rudimentary. The recorded numbers are as follows:

	Tentacles of both kinds, large and small.	Otocysts.
virens Bigelow	46–60	32
virens Maas	66	32
Philippine specimen	75	38
mbengha Agassiz and Mayer	96	32
mbengha Vanhöffen	100	48
carolinae Mayer	64	64

We have every reason to assume that the numerical conditions in the Atlantic *carolinae* described by Mayer (1910) are fairly constant in the adult, for he has found it very abundant on two occasions at Charleston, South Carolina, and has also taken it at the Tortugas. The table, then, shows that in all the Indo-Pacific specimens, irrespective of locality or of exact stage of development, there are many more tentacular structures than otocysts, often twice as many. On the other hand, in all the Atlantic examples of which we have any account the number of otocysts is as great as that of the tentacular structures. We have here something tangible.

It is, of course, possible that further studies may reveal specimens connecting the two types; but the same possibility is present in the case of every difference which could be used us a specific character. We have no right to assume that this will happen. On the contrary, when we find that all the evidence yet available points to discontinuity of the two forms, and when we find that the Atlantic—that is "*carolinae*" type has never been found in the Indo-Pacific, although the genus has been recorded there from several widely separated localities, there is nothing to do but to make it the basis for specific diagnosis.

PHIALUCIUM MBENGHA (Agassiz and Mayer) Maas.

Mitrocoma mbengha Agassiz and Mayer, 1899, p. 168, pl. 8, figs. 24, 25.
Oceania virens Bigelow, 1904, p. 252, pl. 1, figs. 3, 4.
Phialucium virens Maas, 1905, p. 32, pl. 4, figs. 36, 37; 1906, p. 93.—Bigelow, 1909*a*, p. 157.—Mayer, 1910, p. 276.
Phialucium mbengha Maas, 1905, p. 32.—Mayer, 1910, p. 276.—Vanhöffen, 1911, p. 225.
? *Phialidium* species? Hartlaub, 1909, p. 455, pl. 20, figs. 8–10 [=18–20].

This species has been described in detail by Maas (1905).

The typical form of *P. mbengha* is represented in the collection by 2 specimens, respectively, 10 (Cat. No. 29374, U.S.N.M.), and 15 mm. (Cat. No. 1689, M.C.Z.) in diameter, from Manila Bay, Jan. 5, 1909.

In the smaller specimen the arrangement of marginal organs, as shown by the graphic method of Vanhöffen (1911), is as follows:

Tentacles, series 1	I	II	III	IV	Totals, 4.
Tentacles, series 2	4	5	4	3	16
Rudimentary tentacles	2, 2, 3, 6, 2	3, 2, 1, 3, 3, 0	3, 3, 3, 4, 4	3, 4, 4, ?	55±
Otocysts	2, 2, 3, 3, 1	3, 1, 1, 2, 1, 4	1, 2, 2, 2, 1	3, 1, 2, 1	38

In the larger specimen the numbers in the only quadrant which is still preserved intact are:

Tentacles, series 1	I II	Totals, 2.
Tentacles, series 2	6	6
Rudimentary tentacles	5, 4, 6, 4, 3, 4, 6	32
Otocysts	2, 2, 3, 0, 2, 2, 2	13

These tables show how very variable the number of marginal organs is. Indeed, no two quadrants of either the Philippine or the *Valdivia* specimens are precisely alike. With growth the increase in number of bulbs far outstrips the increase of large tentacles.

I have noted above the variation observed in the number of otoliths to each otocyst.

Color.—In the preserved specimens the gonads, manubrium, and tentacular bases are yellowish; in living specimens from the Maldives they were pale green; in the *Valdivia* specimens these regions were light red.

The localities from which *P. mbengha* has previously been recorded are Fiji, the Maldive Islands, Amboina, Ceram, Ternate, and other localities in the Malay Archipelago, the Indian Ocean north of Sumatra, and possibly the Gulf of Aden (Hartlaub, 1909). Its occurrence in the Philippines was therefore to be expected.

PHIALUCIUM MBENGHA var. POLYNEMA, new variety.

Plate 41, fig. 8.

Octocanna polynema BROWNE, 1905, p. 144, pl. 2, fig. 8–10.
Octocanna polynema MAAS, 1905, p. 38, pl. 6, figs. 41, 42.
Phialidium heptactis VANHÖFFEN, 1911, p. 225, fig. 15, pl. 22, fig. 11.
Phialidium phosphoricum, forma *polynema* VANHÖFFEN, 1912, p. 19.

Phialucium mbengha variety *polynema—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40423	U.S.N.M.......	1	5101	Corregidor light, west coast of Luzon.	About 12.
1690	M.C.Z..........	1	5101	.....do...............................	

The specimens listed above are apparently an octoradial race of *Phialucium mbengha*, which they resemble in all particulars except the number of canals, slightly larger size, and proportionally shorter gonads. And the differences in size and gonad length are so slight that of themselves they would be no obstacle to locating the specimens in *P. mbengha.* The only question is whether we are dealing here with a sport, or with a race which has more or less crystallized, so to speak, in the octoradial condition. And the records of variation in the number of canals among Eucopidae have so multiplied within the last few years (Mayer, 1910, Vanhöffen, 1912, 1913) that the first alternative may be correct. But inasmuch as similar sports of this species have been recorded previously, as shown by the synonymy given above, it is wisest to dignify it with a varietal name.

Genus EUTIMA McCrady 1857.

It is now generally agreed that Haeckel's (1879) subdivision of this genus, according to the number of gonads, was artificial. But since Apstein (1913) and Neppi and Stiasny (1913) have recently revived the genus *Octorchis* Haeckel, I may point out that McCrady (1857) in his original account of *Eutima* noted the fact that in both species some specimens had four gonads (*i. e.*, on subumbrella only); others eight (on both subumbrella and peduncle). These observations having been substantiated by more recent studies (notably by Brooks 1886, Maas 1905, and Mayer 1910), there is no longer any warrant for distinguishing *Octorchis* with eight from *Eutima* with four gonads; it is not even a specific difference. Apart from the number of gonads, Maas (1905) and Mayer (1910) limit the genus *Eutima* in different ways. And Hartlaub (1909) does not recognize it at all, but believes that it must be subdivided into various genera. In my paper on the Eastern Pacific Medusae (1909*a*) I followed Maas, defining *Eutima* as "Eucopidae with long peduncle; with only eight otocysts; with only a small number of tentacles (4, 8, or 12); gonads on subumbrella, on peduncle, or on both." But the present collection shows that we can not limit the genus to specimens with 12 tentacles or less because to do so would make certain individuals of *levuka* fall into one genus, others into another. And inasmuch as number of tentacles, being an intergrading character, is seldom a satisfactory limit to Hydromedusan genera, it is wiser to follow Mayer (1910) and to include in *Eutima* all eucopids with long peduncle, eight otocysts, and with marginal warts and cirri as well as tentacles, as opposed to *Eutimium* in which there are neither warts nor cirri.

As pointed out below, the characters on which Hartlaub subdivides the genus *Eutima* (that is, number and arrangement of marginal organs and extent of gonads on radial canals) are very variable, the latter, at least, almost worthless even as a specific character. To use them as generic limits would throw some individuals of a given species into one genus, others into another.

The numerous described "species" of *Eutima* (Mayer 1910, lists 12, not counting synonyms) have recently been revised by Vanhöffen (1912), who reduces the number to 3, as follows: With 4 tentacles only, *E. mira* McCrady; with 8 or more tentacles and peduncular gonads limited to the mid-region of peduncle, *gegenbauri* Haeckel; 8 or more tentacles, with peduncular gonads (if present) long, *E. gentiana* Haeckel. Considering how very variable, in all characters, the genus *Eutima* is, this reduction is warranted, in the main, and it is a question whether there is any real distinction between *gegenbauri* and *gentiana*.

The following Eutimas have been recorded from the Indo-Pacific: *levuka* Agassiz and Mayer, *lactea* Bigelow, *curva* Browne, *orientalis* (Browne), *gentiana* Haeckel as recorded by Vanhöffen, *australis* Mayer (1915), *orientalis* Hartlaub, and *modesta* Hartlaub. *Levuka*, *lactea*, and Hartlaub's *orientalis* are undoubtedly a single species, the chief difference between them are the cirri, whether flanking the tentacles, or the rudimentary knobs, or both; thus *levuka* has cirri flanking the knobs alone (Maas 1909) or both knobs and tentacles (Bigelow 1909*a*); *lactea* has them in connection with the tentacles but not the knobs, and in adult *orientalis* there are none (Hartlaub 1909, p. 457). But two specimens in the present collection show that the arrangement of cirri is not a sound character for diagnosis, because in a given quadrant some of the knobs have them, while others lack them, and the same, as described more fully below, is true of the tentacles. And it has long been known that cirri are very variable in their occurrence in the Atlantic *E. mira*, even more so than in *levuka*. All these agree in having eight or more tentacles. *Modesta* Hartlaub is probably also a variety of *levuka;* but the single specimen was immature. Vanhöffen (1912, p. 21), it is true, states that it does not even belong to the genus *Eutima*. But I can find nothing in Hartlaub's account (14 tentacles, many marginal bulbs flanked by cirri, 8 otocysts; peduncle present; gonads on subumbrella) to warrant this view.

Curva and *orientalis* Browne have only four tentacles and differ from each other only in the number of gonads. *Australis* Mayer is not separable from *curva*, the two agreeing in the number of tentacles and form of the tentacular bulbs, extent of gonads, and general form. In short, all three probably belong to one species. According to Vanhöffen (1912) they are indistinguishable from the Atlantic *E. mira*. He also classes as *mira* the small specimens, with four tentacles from the west coast of Mexico described by me (1909*a*) as *levuka*. But as they were very young, and since *levuka* must also pass through a four-tentacle stage, it is equally possible that they belonged to that species.

Vanhöffen classes *levuka* as a synonym of the Atlantic *gentiana* on the strength of its numerous tentacles and long peduncular gonads, and records specimens of this type from Amoy and Hongkong under the latter name. But although, as I have pointed out (1909*a*), *levuka* and *gentiana* are closely allied, it is by no means certain that their true relationship would be best represented by uniting the two, and maintaining the combined species as distinct from *gegenbauri*, because it is not unlikely that Haeckel's original *gentiana* was an abnormal *gegenbauri* (Vanhöffen 1912, p. 23). At any rate, it had no subumbrellar gonads, which is seldom the case in adults either of *gegenbauri* or of *levuka*.

The only thing separating *levuka* from *gegenbauri* is its long peduncular gonads. But so far as the various published accounts of the latter go (Haeckel, 1879; Vanhöffen, 1913; Apstein, 1913; Neppi and Stiasny, 1913), this difference seems to be constant. Furthermore, as Vanhöffen points out, no *Eutima* of the *gentiana* (or *levuka*) type has been recorded from the Atlantic since 1879. It is true that *E. variabilis* McCrady (1857), figured by Brooks (1886), resembles it in having 12 to 16 tentacles and long peduncular gonads. But it differs in general form (short peduncle), and in the large number (10 to 12) of otoliths in each otocyst, from all other *Eutimas*, though the number of otocysts (eight) places it in that genus.

Until the range of variation of *gegenbauri* and *levuka* is better known, it is wisest to retain the latter as a distinct species, though with the reservation that the two may finally be united.

EUTIMA LEVUKA (Agassiz and Mayer) Maas.

Eutimeta levuka Agassiz and Mayer, 1899. p. 163, pl. 9, figs. 30, 31.
Eutimeta lactea Bigelow, 1904, p. 253, pl. 2, figs. 7, 8.
Eutima lactea Mayer, 1910, p. 300.
Eutima levuka var. *ocellata* Maas, 1905, p. 35, pl. 7, figs. 43, 44.
? *Eutima levuka* Bigelow, 1909*a*, p. 165, pl. 5, figs. 2, 3; pl. 35, figs. 1, 2. — Mayer 1910, p. 301.
? *Octorchandra orientalis* Hartlaub, 1909, p. 456, pl. 20, figs. 1–5.

Eutima levuka—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29342	U.S.N.M.	1	5101	Off Corregidor Light, west coast of Luzon.	10
40424	U.S.N.M.	1	5224	Between Marinduque and Luzon	9

The number and arrangement of tentacular structures is as follows:

SPECIMEN 9 MM. IN DIAMETER.

Tentacles, series 1	I	II	III	IV	I
Tentacles, series 2	1	1	1	1	
Tentacular knobs	10, 14	14, 11	12, 11	13, 14	

SPECIMEN 10 MM. IN DIAMETER.

Tentacles, series 1	I	II	III	IV	I
Tentacles, series 2	2	2	2	1	
Tentacular knobs	7, 5, 12	12, 6, 7	11, 3, 11	11, 12	

Thus the smaller specimen has 8, the larger 11 tentacles, and 99 and 97 knobs, respectively.

Maas (1905, p. 35) has pointed out that the tentacles do not increase regularly in number with development. My small specimens from Acapulco had only four (Bigelow, 1909*a*), while Maas records large specimens with 4 to 6, and believes that the normal number is 8—4 peradial and 4 interradial. The large Philippine example shows that 8 is not necessarily the final number, any more than it is in specimens from the Atlantic (Apstein, 1913, records 4 to 21); indeed, Maas has himself recorded small examples with more than 8. But not enough specimens have yet been studied to show how great the normal variation in number of tentacles may be in the Indo-Pacific race. Various records have shown that the number of marginal bulbs to the quadrant is variable. The present specimens have from 23 to 27.

The records of pigment in the tentacular bulbs for Indo-Pacific specimens are as follows: Agassiz and Mayer do not mention any; none was to be seen in the Maldive specimens (Bigelow, 1904). On the other hand the *Siboga* series, and both the Philippine representatives of the species have definite pigment spots. But in the latter, though they occur on most of the knobs, there are several knobs in each specimen which lack them.

Cirri.—The irregularity of occurrence of the cirri has been noted above. I may point out, however, that there is some evidence that the tentacles in *levuka*, as in *mira*, lose their flanking cirri with advancing age. Thus in the youngest known specimens (Bigelow, 1909*a*) there were 3 to 5 pairs of cirri flanking each of the tentacles, whereas Mass found none in connection with the tentacles of nearly mature specimens. Furthermore, in one of the present specimens one of the interradial—that is, youngest—tentacles is flanked by cirri, though none of the radial tentacles have any.

Gonads.—We have here an excellent example of how much the development of the gonads may vary relative to that of the marginal organs, for the specimen with the most tentacles has the smallest gonads. In this case the subumbral gonads are restricted to the outer half of the canals, the peduncular ones to the extreme distal end of the peduncle. In the other specimen the subumbral swellings reach from the base of the peduncle almost to the circular canal, and the peduncular ones occupy fully two-thirds of the length of that organ. It would require only slightly more growth for the gonads to become continuous from one end of the canals to the other. The condition of the gonads in the earlier described Indo-Pacific specimens is as follows: in the Maldive specimens ("*lactea*," Bigelow, 1904), they were limited to the peduncle, occupying about two-thirds of its length. On the other hand, Agassiz and Mayer (1899) describe them as limited to the subumbrella in their specimens from Fiji. But Maas has recorded specimens with distal subumbrellar gonads, and others, otherwise indistinguishable, in which there are sexual swellings on both subumbrella and peduncle. And, similarly, the two Philippine specimens show two distinct sexual masses on each radial canal. Great variation is found in the location of the gonads in *E. mira* also.

The evidence here outlined shows that the gonads develop independently in two locations; either the peduncular (Bigelow 1909*a*) or the subumbrellar (Maas, 1905) may appear first; or either one may be lacking, and peduncular or subumbrellar ripen alone. And this same thing has long been known to be true of *mira*, in which both subumbrellar, or peduncular gonads, or both, may be developed (Brooks, 1886). No one of these conditions is restricted to a given geographic locality, so far as we know.

Gonads continuous from bell margin to extremity of peduncle have not been described for *levuka*, though one of the Philippine examples approaches this condition. There is such an example, it is true, in the present collection, but cirri being absent, I hesitate to credit it to that species.

? EUTIMA LEVUKA.

? Eutima levuka—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29343	U.S.N.M........	1	5195	Off northern Cebu.........	11, much contracted with large gonads.

There are 23 large tentacles, 5, 5, 5, and 4 interradials, respectively, to each quadrant. In the one well-preserved quadrant, with 4 interradials, there are 26 knobs, 5, 4, 6, 6, and 5, between successive pairs of tentacles. If we assume that this number is continued all around the margin we would have a total of 104 knobs. There are no cirri flanking either tentacles or knobs, nor is there any pigment in the knobs.

The peduncle is narrow and hangs well below the bell opening. The gonads are stout and extend in unbroken ridges over the entire length of the peduncle, and extend over the subumbrella almost to the circular canal.

The only characters separating this specimen from *levuka* are the large number of tentacles, absence of cirri and of pigment, and the length of gonads. The first and last of these might naturally be expected to be the end condition of the Philippine specimens described above did development along these lines progress far enough. And we must remember that Brooks (1886) long ago described examples of *E. mira* with the subumbrellar and peduncular gonads practically continuous. As pointed out above (page 300), pigment is sometimes absent even in young specimens of *levuka;* and there is some evidence that the cirri flanking the tentacles are progressively lost with growth. All this points to a probable identity with *levuka.* But to prove it will require the discovery of stages connecting the two.

Genus PHORTIS McCrady, 1857. Sensu Mayer 1910.

The genus *Eirene*, as recognized by Haeckel (1879), has been divided by Mayer (1910) into *Eirene* and *Phortis*, the former with, the latter without, cirri on the bell margin. And his diagnosis is accepted by Vanhöffen (1912).

I have already maintained that the subfamily Eireninae, adopted by Mayer, can not be sharply defined from the Eucopidae *sensu strictu;* because one of the latter, *Phialopsis comata*, may show the rudiments of a peduncle at maturity. There is good reason to believe that *Eirene*, *Phortis*, *Eirenopsis*, and *Tima* form a natural group. And though the phylogenetic relationships between them are not yet altogether clear we can fairly assume that *Eirenopsis* is an offshoot, through radial reduplication, of some *Eirene* or *Phortis.*

Inasmuch as the character which separates *Eirene* and *Phortis*, presence or absence of cirri, separates two groups, each composed of several closely allied species, there is every reason to follow Mayer (1910) and Vanhöffen (1912), and recognize both genera.

The following described species belong to *Phortis: gibbosa* McCrady, *pyramidalis* L. Agassiz, *lactea* Mayer, *palkensis* Browne, *ceylonensis* Browne, *kambara* Agassiz and Mayer, *elliceana* Agassiz and Mayer, and *pellucida* Will. The latter has had a checkered history. By Haeckel, by Maas and by me (1909*a*) it was classed as a probable synonym of *Eirene viridula*, while Mayer (1910) classed it as the young of Tima. But recent studies by Hartlaub (1909), Vanhöffen (1911, 1912), and by Neppi and Stiasny (1913) show that neither of these views was correct, as is gracefully acknowledged by Mayer (1910), but that the *pellucida* described by Claus (1881), which lacks cirri, is a perfectly distinct species of *Phortis*, while the *pellucida* of Haeckel, which had cirri, is probably a synonym of *Eirene viridula.* According to Vanhöffen (1912) the genus *Irenopsis* of Goette, with six canals, is merely a sport of *Phortis pellucida.*

Unfortunately no figure of the adult *P. gibbosa* has ever appeared. But this species is very closely allied to *pyramidalis*, which is well described and figured by Mayer (1910), and of which I myself studied a large series including a wide range of developmental stages. According to Mayer (1910, p. 300) *gibbosa* is "distinguished from *pyramidalis* by its high bell, few tentacles, reddish color, and large stomach." But the difference in form is very slight, for I have myself seen *pyramidalis* as high as broad; the difference in tentacle number is apparent rather than real, for I have counted from 60 to 70 tentacles in *pyramidalis* 25 mm. in diameter—that is, the same number as is recorded for *gibbosa* of the same size. In large specimens of *pyramidalis*, of 30 to 35 mm., there are often upwards of 100 tentacles.

Without any figure it is impossible to tell whether the stomach is really much larger in *gibbosa* than in *pyramidalis*, but judging from analogy with other species it is unlikely that its size is important as a specific character. And the difference in color, greenish gonads in *pyramidalis*, reddish in *gibbosa*, is one which has often been found to occur among Eucopidae, as in *Phialucium mbengha.* The evidence as yet available shows no valid distinction between the two, but to determine this point requires a fresh study of specimens from Charleston, South Carolina, the type-locality of *gibbosa.* I may point out here that Mayer's statement that in *pyramidalis* tentacles and otocysts alternate regularly is not altogether correct, for in every example which I have seen there are some young tentacles in process of development, and a certain amount of irregularity in the arrangement of otocysts. Thus I have seen three between two tentacles, and, on the other hand, two tentacles without any intervening otocyst. On the whole, moreover, the number of otocysts is always greater than that of mature tentacles, at least in large specimens. Excretory pores are present and easily distinguished.

Phortis lactea may be a young *pyramidalis* in which the gonads have appeared a little sooner than usual. A comparison of the figures of the two by Mayer (1910) will show how closely they agree. But not having seen any specimen of the *lactea* type I am not prepared to make definite location of it.

P. pellucida and the *gibbosa-pyramidalis* group agree in the thick bell and broad, comparatively short, peduncle. I have not seen any specimens of *pellucida* myself.

P. palkensis, *ceylonsis*, *kambara* and *elliceana* all agree with each other, and differ from the preceding, in having a long narrow peduncle. *P. kambara* was based on a single specimen, 8 mm. in diameter, so young that no trace of gonads is yet to be seen (Agassiz and Mayer, 1899, pl. 8, fig. 29). The absence of tentacular knobs suggests that it may be a stage in the development of *ceylonensis.*

Palkensis and *ceylonensis*, the latter recently recorded by Vanhöffen (1911–1912), are separated by the marginal organs; the former having few (48 or less) tentacles and a large number of permanently rudimentary bulbs, the latter a large number of tentacles and few or no rudimentary bulbs. There is also a difference in the structure of the otocysts (Browne 1905). *Ceylonesis* is represented in the present collection.

Elliceana was described by Agassiz and Mayer (1902) from a single immature specimen, 16 mm. in diameter; it has not been recorded since. There are several specimens in the present collection which apparently belong to it, and which are easily distinguished by the structural characters noted below (p. 305), from all other members of the genus.

PHORTIS CEYLONENSIS (Browne) Mayer.

Eirene ceylonensis BROWNE, 1905, p. 140, pl. 3, figs. 9–11.—ANNANDALE, 1907, p. 79, pl. 2, fig. 7.

Phortis ceylonensis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29371	U.S.N.M.	1	5195	Off northern Cebu	About 15
1736	M.C.Z.	1	5195	.....do	Do.

In the preserved condition the gelatinous substance is thin, the bell very flat, and the long, narrow peduncle hangs far below its opening much as Browne described it. But Annandale has found that in life the bell is higher and more arched, its cavity deeper. Neither of the specimens shows the complete number of tentacles in any quadrant. But so far as I can judge by the portion of the margin still intact there must have been between 90 and 100 large ones; that is, just about the number recorded by Browne. There are also a few young tentacles in various stages in development. There is every reason to believe that ultimately they would all attain the adult condition. There are no cirri.

Otocysts.—According to Browne there is one otocyst between every two tentacles, and this is the general rule in the present examples. But there are some variations, there being sometimes two otocysts, sometimes none, between two adjacent tentacles. On the whole, however, there are about as many otocysts as there are tentacles. In every otocyst which I have examined there is a single large otolith, as Browne found was usually the case. But both he and Annandale have observed cases with two otoliths, due probably to "twinning," as the otocysts in such instances are abnormally large. In *palkensis* there are from 1 to 4 otoliths to each otocyst.

Color.—Color, if any was present, has entirely faded in the preserved specimens.

We owe to Annandale (1907) an account of the hydroid of this species. This is closely aliled to that of *P. gibbosa*, so far as I can judge from the descriptions by Brooks (1883) and Annandale (1907), but separable from it by differences in the form of hydrotheca and gonotheca.

The known range of *ceylonensis* extends from Ceylon to Lower Bengal and to the Philippines. Annandale found it in fresh water. *P. palkensis* is recorded from Ceylon and from the Nicobar Islands.

PHORTIS ELLICEANA Agassiz and Mayer.

Plate 41, figs. 3–7.

Phortis ellieeana Agassiz and Mayer, 1902, p. 146, pl. 2, figs. 5–7.—Mayer, 1910, p. 309, fig. 170.

Phortis ellieeana—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40425	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	13, with 5 radial canals and gonads.
40426	U.S.N.M	2	5456	Off east coast of Luzon	14, 23
29378	U.S.N.M	2	5500	Off northern Mindanao	27, 30
1666	M.C.Z	2	5500	.....do	18 and 8

In the preserved condition the bell is flat and its cavity very shallow, though the gelatinous substance is rather thick. The peduncle is thick, cylindrical, stiff, and as long as or longer than the diameter of the bell. Its stoutness, solidity, and nearly uniform diameter throughout its unusual length are excellent field marks. A shallow bell, very long, though slightly narrower peduncle, is shown in the figure of *elliceana*, by Agassiz and Mayer.

Marginal organs.—No one of the specimens was in good enough condition to allow a survey of its entire margin, but individual quadrants could be studied in several.

(*a*) In a quadrant in a specimen 8 mm. in diameter there was one interradial tentacle, 7 tentacular knobs, and about that number of otocysts.

(*b*) 13 mm. in diameter; one-fifth (there are 5 canals in this specimen), 3 interradial tentacles, 11 knobs, 14 otocysts.

(*c*) 23 mm. in diameter, 1 quadrant, 2 interradial tentacles, 22 knobs, 27 otocysts. In the next quadrant there are four interradial tentacles.

(*d*) 30 mm. in diameter, 5 interradial tentacles, 27 knobs, 30 otocysts. In this specimen there were about 25 tentacles, both radial and interradial, and upward of 90 knobs.

In the specimen described by Agassiz and Mayer, 16 mm. in diameter, there were four large radial tentacles, 12 interradial ones, 3 per quadrant, about 40 knobs, and 56 otocysts. So far as the specimens show there are always about as many or a few more otocysts than tentacles and knobs combined. They usually alternate with the tentacular structures, but I have seen two between two knobs, and in one instance 4 knobs with no intervening otocysts. Some of the knobs have threadlike filaments; others do not, probably as the result of contraction.

The series of stages outlined above shows that the number of large tentacles remains permanently small; that is, that the great majority of the knobs never develop into tentacles, but remain rudimentary, just as they do in *P. palkensis.* Both tentacles and knobs bear excretory papillae (pl. 41, fig. 5).

Manubrium and gonads.—The manubrium is short, perhaps through contraction; the lips complexly folded (pl. 41, fig. 4). The gonads extend from the base of the peduncle nearly to the margin.

Budding.—One of the most interesting finds of the collection is the specimen of this species, 13 mm. in diameter and abnormal in having five radial canals, with hydroid blastostyles budding from the gonads, exactly as they do in *Phialidum mccradyi* Brooks. This is the second known instance among Leptomedusae of this method of asexual reproduction. The process has been described in detail for *Phialidium* by Sigerfoos (1893), who corrects some errors in the original account by Brooks (1888), and figures of the fully formed blastostyles have been given by the latter and by Mayer (1900, 1910). The photographs of the gonad of *P. elliceana* (pl. 41, figs. 6, 7) will show how closely the type of budding agrees in the two genera.

Color.—In the preserved condition the gonads are pale yellowish.

The present specimens agree so closely with the original specimen of *elliceana* in the structure and arrangement of marginal organs, as well as in general form, as noted above, that I have no hesitation in uniting them with it. The combination of comparatively few large tentacles with many permanently rudimentary knobs separates it from all species of *Phortis* except *palkensis*. *Palkensis*, when of the same size, has many more tentacles according to the account by Browne (1905); according to Vanhöffen (1911) at least twice as many. So long as we have only the data afforded by so few specimens both species may be retained. Should future investigation prove that the two extremes be within the range of normal variation of a single species, which is possible, though I think not probable, the name *elliceana* would prevail on the ground of priority.

Genus OCTOCANNA Haeckel, 1879.

EUCOPIDAE with eight radial canals.

Vanhöffen (1912) has recently maintained that the various octoradial eucopids ("*Octocanna*") described by recent authors (Browne 1905, Maas 1905, 1911; Bigelow 1909*a*, Vanhöffen 1911) are really mere variants of the tetraradial type. This is probably true in the case of the octoradial variety of *Phialucium mbengha.* But there are at least two "*octocannas*" which can not yet be referred to any known eucopid with four canals. One of these is the globular form, from the west coast of Mexico, described by me as *O. polynema* Haeckel, but which Mayer (1910) thinks is a new species; the other *O. polynema* of Maas (1906) from Amboina, characterized by very numerous tentacles. The last of these, it is true, much resembles *Philidium globosum* Mayer (1910, p. 272, pl. 34, fig. 4) in general appearance; but, apart from the difference in the number of canals, is separated from it by having nearly four times as many tentacles (upward of 100) and otocysts, the only species which approaches it in this respect, *P. gregaria* (of which I have studied a large series) having at most only about half as many tentacles (up to about 60). And of course the absence of peduncle separates it from the many-tentacled species of *Eirene* or *Phortis*. For this same reason it can not be united with Haeckel's *O. polynema;* and as it must be called something for the present, even if later united with some Philidium, it may be named *aphrodite.*

OCTOCANNA APHRODITE, new name.

Plate 42, figs. 1, 2.

Octocanna polynema Maas, 1906, p. 95, pl. 3, fig. 10 (not *Octocanna polynema* Haeckel, 1879, Maas, 1905, Browne, 1905, Bigelow 1909*a*).

Octocanna aphrodite—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40428	U. S. N. M.....	1	5128	Sulu Sea, vicinity southern Panay.	16, with 7 radial canals, about 100 tentacles.
9366	.....do..........	1	5581	Vicinity Darvel Bay, Borneo.	17, 9 radial canals, 80 tentacles in three-fourths of the margin.

The three specimens from Amboina described by Maas (1906) all had 8 canals; it is remarkable that the two from the Philippines should show variation one in one direction, the other in the other, from this number. And it is fortunate that there are now enough records to show that here as in *Irenopsis* the number is not fixed.[1]

Marginal organs.—The very numerous tentacles, with large basal bulbs, are closely crowded on the bell margin. Here and there there are to be seen younger onces in process of interpolation, at various stages in development (pl. 42, fig. 2). There are no permanent rudimentary knobs, neither are there any cirri. The bases of the tentacles bear well-developed excretory papillae.

The number of tentacles to the segment of the margin is variable, corresponding to variation in the distance between radial canals.

[1] In *Irenopsis hexanemalis* in which the usual number of canals is 6, Browne (1905) has recorded specimens with 4, 7, 8, 9, and 11 canals.

Thus in one segment of the 9-radial example there are 16 interradial tentacles; in another segment only 6. In the 7-radial specimen there are 9 tentacles in one segment; 11 large and 4 small in a second; and 7 large and 3 small in a third.

There are one or two otocysts between every two tentacles; that is, many more otocysts than tentacles. I was not able to count the entire number in either specimen, because part of the margin was damaged in each.

The gonads are spindle-shaped, thickest distally, and are restricted to the outer one-half or one-third of the radial canals. They do not quite reach to the circular canal.

Color.—In one specimen the gonads are brownish-yellow; in the other pale pinkish. There are no notes available as to their color in life.

Comparison between these examples and Maas's Amboina specimens shows that they agree even to minor details.

Family AEQUORIDAE Eschscholtz, 1829.

LEPTOMEDUSAE with very numerous radial canals and with closed otocysts.

These are the family limits which have been adopted by Maas, by Browne, and the writer, for the presence of more than eight canals can not be used as the dividing line between eucopid and aequorid, as I formerly proposed, because occasional specimens of eucopids may have as many as 11 (p. 307, Browne, 1905).

Mayer (1910) extends the family to all Leptomedusae with eight canals, irrespective of whether the otocysts are open or closed; that is, he includes *Octocanna*, *Octogonade*, and *Halopsis*. But the former (p. 306, Maas, 1905) certainly belongs to the Eucopidae; indeed, it is a question whether its "species" are anything but variant tetranemal eucopids. *Octogonade* and *Halopsis* have open sense pits, with ocelli as well as otoliths, hence belong to the Mitrocomidae. Browne (1910), it is true, says that reinvestigation of the sense organs of *Halopsis* is necessary to show whether they are really open. But I have recently been able to establish, in fresh material, that they are open (1914, p. 102).

No family corresponding to the Mitrocomidae of Torrey (1909) and Browne (1910) is recognized by Mayer, the genera listed above being distributed between Eucopidae and Aequoridae, according to the number of their canals. But the structure of the sense organs shows that the Mitrocomidae are a natural group.

The Aequoridae are still perhaps the most puzzling family of Leptomedusae to the systematist; no division into genera which has yet been proposed covers the ground adequately, nor are the normal limits of variation yet known for a single species. Yet the family is one of the longest known and most widely distributed geographically of medusan groups. The difficulty facing us is the extreme variability of its members—the inconstancy of almost every character which might be expected to serve as the basis for classification.

I have already argued, from a study of living as well as preserved material (1909*a*, p. 171), that the size and structure of the mouth as used by Haeckel (1879) and recently by Maas (1909) and Browne (1904, 1905) is misleading as a generic character. Torrey (1909, pp. 28, 29) has simultaneously come to the same decision from his study of living examples. Our view has been accepted by Mayer (1910) and Vanhöffen (1911). Neppi and Stiasny (1913) have recently corroborated it on large series of living specimens. But while I recognized only one genus, *Aequorea*, to include the whole family, exclusive of Haeckel's problematical genera *Zygocanna* and *Zygocannula*, Mayer retains *Stomobrachium* for species with 12 canals and *Zygodactyla* for forms with subumbral gelatinous papillae.

I have recently studied excellent series of the latter (1915*a*), finding the papillae as Mayer describes them. But in a group where it is so difficult to separate even species it is better to use their occurrence as a specific, not a generic, character. And, at any rate, if the papillate forms be recognized as a separate genus, the international code of nomenclature forbids the use of the name *Zygodactyla* for them, because its type species, *Z. coerulescens* Brandt, does not have papillae (Bigelow, 1909*a*); hence, as Mayer himself points out, it is an *Aequorea*.

Stomobrachium may as well be left out of this discussion, for neither the early descriptions (Brandt, 1838; A. Agassiz, 1865) nor the recent account by Le Danois (1913) tells anything about its otocysts or even whether it has any.

Vanhöffen (1911) distinguishes two genera of "Vielsträhligen Aequoriden," *Aequorea* and *Mesonema*, separating them solely on the proportional number of tentacles and radial canals. But this diagnosis is unsatisfactory, because it leaves no place for species (or specimens) with slightly fewer tentacles than canals, whereas such proportional numbers have often been recorded. In short, I believe that in the present stage of our knowledge all aequorids with the canals normally simple (unbranched) must be grouped in one genus, *Aequorea*, as distinguished from the forms with branched canals, *Zygocanna*.

The present collection contains an excellently preserved series of the latter, one of its most interesting finds.

As I have pointed out (1913, p. 36), the separation of distinct species in the genus *Aequorea* is very difficult, except for *groenlandica*, characterized by subumbral papillae; and *tenuis* (+*flori-*

dana) by very small stomach. The Aequoreas in the present collection all have smooth subumbrella, a broad stomach, and many more canals than tentacles; but they are separable into two groups by the following structural characteristics:

a. Specimens with triangular basal bulbs, which do not clasp the exumbrella; without excretory papillae, with about 11 or 12 times as many canals as tentacles; with a good deal of anastomosis of the canals near their tips.

b. Specimens with basal bulbs clasping the exumbrella more or less; with excretory papillae, with from 4 to 6 times as many canals as tentacles, with little if any anastomosis of canals.

I have already attempted a temporary revision of the Indo-Pacific Aequoreas (1909*a*, 1913), and these two forms agree very well with two species there recognized, namely, *pensile* and *macrodactylum.* Both of these have likewise been studied by Maas (1905), while Browne (1904), writing almost simultaneously, recognizes both, though he used a new name, *maldivensis*, instead of *macrodactylum.* They are united by Vanhöffen (1911) as *pensile.* But the presence or absence of excretory papillae is significant. These have never been recorded for *pensile*, though Browne (1905) made a special search for them, and of course I have looked for them carefully in the present series. *A. pensile* is further distinguished by the extraordinarily thick biconvex disk, an excellent "field mark." On the other hand, the wing-like lateral extensions of its tentacular bulbs prove to be less constant than earlier studies suggested. The characters of a series of each are given below (pp. 312, 314).

Macrodactylum is very closely allied to the widely distributed *Aequorea aequorea.* As a rule, the numbers of tentacles and canals are more nearly equal in *aequorea* than in *macrodactylum*, as I have pointed out (1913, p. 37); but there is no discontinuity between the two in this respect, nor is there anything in the structure of stomach and mouth, of gonads nor in general form to separate them.

The shape of the tentacular bases, clasping the exumbrella, is the most distinctive feature of *macrodactylum.* But it is not possible to draw a sharp line between it and *aequorea* in this respect, for, as I have already pointed out (1913, p. 37), the specimens show all stages from clasps "as pronounced as figured by Maas (1905) for *macrodactylum*, to a condition where it is doubtful if they are present or not." Conversely, some of the tentacle bases in a specimen of *aequorea* from Naples have distinct clasps. And in an excellent specimen from Puget Sound, 40 mm. in diameter, with 77 canals and about 66 tentacles (a few are lost), some of the tentacular bases are of the "*aequorea*," others of the "*macrodactylum*" type. Thus there is no discontinuity in this respect, any more than in the number of tentacles relative to canals. In short, we have here, as so often, a bimorphic Medusa with two fairly distinct types, with the great majority of specimens belonging to one or the other. However, since intermediates seem to be rare, the species *macrodactylum* may be retained (1913, p. 37), until the normal range of variation is better understood.

Genus AEQUOREA Péron and Lesueur, 1809.

AEQUOREA PENSILE (Haeckel) Mayer.

Plate 42, figs. 3, 4.

Mesonema pensile HAECKEL, 1879, p. 226. Synonymy, Mayer, 1910, p. 333.

Aequorea pensile—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40429	U.S.N.M.	1	5231	Between Bohol and Leyte	50
40430	U.S.N.M.	1		Port Dupon, Leyte	22
29391	U.S.N.M.	8		Limbones Cove, China Sea, off southern Luzon.	Up to 40
1732	M.C.Z.	2		do	Do.
1683	M.C.Z.	1	5195		30

The decision as to whether this species should be called *pensile* or *coelum-pensile* (accepting Browne's idntification of it as Modeer's *Medusa coelum pensile*) raises a nice question in nomenclature. Most students, myself included, have called it *pensile* or *pensilis* Modeer. But this position is untenable, because Modeer's name (*coelum pensile*, adopted by Eschscholtz, 1829), was either a polynomial, in which case, of course, it has no standing, or if he meant it for a binomial, the two words *coelum* and *pensile* should be compounded, as Vanhöffen (1913) has recently done.

I have not had access to Modeer's papers. Least confusion will result by following Browne and Mayer, and using *pensile*, but referring it to Haeckel on the ground that Modeer's name was a polynomial.

The specimens listed above agree with each other in having a very large number of canals, in the entire absence of excretory papillae, and in the fact that the tentacular bulbs never clasp the exumbrella. Lateral extensions of these organs along the bell-margin, however, are variable. In all the specimens from Limbones they are very long, much as Browne (1905) has figured them; but in the example 50 mm. in diameter from station 5231 they are but slightly developed. The latter, however, is much contracted. Browne (1905) has made a careful study of the margin. He finds, from serial sections, that excretory pores or slits are present, though the papillae so characteristic of other aequorids are absent; and the absence of papillae has now been established in so many specimens that it may be assumed to be constant.

Unfortunately only two of the specimens have the entire margin intact; on them only was it possible to make certain of the entire number of tentacles. But judging from the number of canals in the damaged specimens and their relation to the remaining tentacles, the proportional numbers listed below can not be far from the truth for the entire series. In the following table the numbers of tentacles and canals are given for all recorded specimens which are described as having no excretory papillae. I previously referred *Polycanna purpurostoma* of Agassiz and Mayer to *pensile.* But fresh examination of their type specimen revealed papillae, as well as that the tentacle bulbs clasp the exumbrella.

Locality.	Diameter.	Diameter of stomach.	Tentacles.	Tentacular bulbs.	Canals of all sizes and ages.	Proportional numbers.	
						Canals—tentacles.	Bulbs—tentacles.
Philippines	50	34	13	210	162	12–1	16–1
Do	22	16	11	85	124	11–1	8–1
Maldives, Brown	45	26	10	....	120	12–1	....
Do	60	....	10	....	[1] 100	10–1	....
Do	60	....	15	....	[1] 150	10–1	....
Do	60	43	13	....	148	11–1	....
Tahiti, "*Rhegmatodes lacteus*" Agassiz and Mayer	50	....	10	250	105	10–1	25–1
"*Siboga*" Maas	100	50–60	16?	....	[1] 200	12.5–1	....
Do	90	50	10?	....	[1] 250	25–1	....

[1] About.

Vanhöffen (1911, 1912, 1913) has given tables for much larger series, all characterized by many more canals than tentacles. But as he does not state whether his specimens had or lacked excretory papillae, it is a question whether they belong to *pensile* as here defined or whether some of them may not have been *macrodactylum*, or even *Ae. aequorea.*

As far as our knowledge yet goes, there are usually at least 10 times as many canals as tentacles in large specimens of *pensile*, and seldom over 12 times as many. But it is quite possible that *pensile* may, in development, pass through what we may call a "*macrodactylum*" stage with respect to the proportional numbers of these organs.

Browne (1904) has already called attention to the prevalence of anastomosis among the canals of *pensile.* It is a prominent feature in the present series, especially near the distal extremities of the canals.

The otocysts are very numerous; about as much so as tentacles and bulbs combined in the one specimen in which they seemed to be intact in about the normal condition.

All the records which can be safely referred to *pensile*, that is, the examples in which we know that excretory papillae are lacking, are from the Indo-Pacific; that is, the Maldives, the Philippines, the Malay Archipelago, Tahiti, and Japan.

AEQUOREA MACRODACTYLUM (Brandt) Bigelow.

Plate 43, fig. 7.

Mesonema macrodactylum BRANDT, 1835, p. 21; 1838, p. 359, pl. 4. Synonymy, Bigelow 1909*a*, p. 174; Mayer 1910, p. 333. To the list given there must be added the *Polycanna purpurostoma* of Agassiz and Mayer (1899), which I formerly referred to *pensile*, for the reasons given above (p. 312); likewise some of the specimens recorded by Vanhöffen (1911) as *pensile*.

Aequorea macrodactylum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
....	....	1	5101	Off Corregidor Light, west coast of Luzon.	20–55
29281	U. S. N. M.........	1	5129	Sulu Sea, off western Mindanao..........	
....	....	1	5231	Between Bohol and Leyte..............	
29394	U. S. N. M.........	2	5233	.....do..............................	
40431	U. S. N. M.........	2	5240	Vicinity Pujada Bay, Mindanao.........	
1736	M. C. Z.............	1	5240	.....do..............................	
....	....	1	5649	Buton Strait.........................	
29280	U. S. N. M.........	1	....	Off Rojas Point, Banay................	
40432	U. S. N. M.........	1	....	Port Dupon, Leyte.....................	

The general features of this species have been described in detail by Maas (1905) and by me (1909*a*), and as its relationship to *Aequorea aequorea* is discussed above (p. 310), we need only consider here the constancy of the characters on which I base the separation of *macrodactylum* from *pensile* and *aequorea*.

The following table contains the statistics of all entire specimens of *macrodactylum* yet recorded with the information that they have excretory papillae. It is to be observed that the identification of the specimens here listed rests on the presence of papillae and of the "*macrodactylum*" type of tentacular bulbs. Number of tentacles or canals was not considered in making up the table. By following this plan we can find out whether or not it is correlated with the two structural characters, which are more important.

Vanhöffen's figure (1911, fig. 21) shows that the specimen from which it was drawn belonged to *macrodactylum* as here defined; and his statement that the tentacle-bulbs usually have more or less noticeable clasps (1911, p. 233) shows that the same was true of most of his series. Unfortunately he gives no data as to absence or presence of papillae, or of the structure of the bulbs in individual specimens. Had he done so his data on the numbers of canals and tentacles in so large a series would have been most valuable, to check the systematic value of the numerical differences between *pensile* and *macrodactylum* which appear from the present tables.

Locality.	Diameter.	Diameter of stomach.	Tentacles.	Tentacle bulbs.	Canals of all ages.	Approximate proportional numbers.	
						Canals—tentacles.	Bulbs—tentacles.
Philippines	33	22	13	106	71	5 -1	8 -1
Do	23	15	9	87	59	6 -1	10 -1
	55	37	22	[1] 130	94	4 -1	6 -1
Do	34	19	16	[2] 128	71	4 -1	8 -1
Do	40	21	15	[2] 120	63	4 -1	8.5-1
Do	41	23	17	(?)	93	5.5-1	....
Do	34	20	12	[2] 96	73	6 -1	8 -1
Siboga Maas	45	20	28	....	86	3 -1	....
Do	38	17	30	....	94	3 -1	....
Do	28	13	29	....	95	3 -1	....
Do	17	9	18	....	77	4 -1	....
Do	19	9	22	....	72	3.5-1	....
Do	24	13	20	....	62	3 -1	....
Do	18	9	20	....	80	4 -1	....
Do	12	7	16	....	56	3.5-1	....
Do	26	12	26	....	103	4 -1	....
Fiji, M. C. Z. coll	24	16	18	....	79	4.5-1	....
"Maldivensis," Browne	35	20	21	....	52	2.5-1	....
Do	45	....	34	....	69	2 -1	....
Do	75	....	50	....	54	1 -1	....
East Pacific, Bigelow	8	....	16	....	29	2 -1	....
Fiji	22	....	18	....	42	2.5-1	....

[1] About 6 between 2 tentacles. [2] About 8 between 2 tentacles.

The last specimen is the type of *Polycanna purpurostoma* Agassiz and Mayer, which has papillae.

I have not included Chun's (1896) specimen from Zanzibar because of lack of information as to excretory papillae and of the forms of the tentacular bulbs. It had 84 canals and 10 tentacles—that is, 8.4–1.

The table shows a variation in proportional numbers of canals and tentacles of from 1–1 to 6–1. Thus there are invariably considerably more tentacles in proportion to canals than there are in *pensile*. Another minor feature helping to separate the two is the fact that anastomosis of the canals seldom or never occurs in *macrodactylum*, while it is usually more or less evident in large specimens of *pensile* (p. 312).

In the specimens from the Philippines the bases of the tentacles usually clasp the exumbrella more or less (pl. 43, fig. 7), but the precise conformation varies as noted above.

The records for *macrodactylum* as here defined are chiefly from the Indo-Pacific, where it is widely distributed in warm regions. I have examined a typical specimen from the Gulf Stream.

Genus ZYGOCANNA Haeckel, 1879.

Zygocanna Haeckel+*Zygocannota* Haeckel+*Zygocannula* Haeckel.

Mayer (1910) has summarized our vague knowledge of this, up till now, problematical genus. Its distinguishing feature among aequorids is the fact that its canals bifurcate. Haeckel's accounts, taken from alcoholic material, are incomplete, and the condition of his specimens precluded accuracy. Probably his three "species" and the *pleuronota* of Péron and Lesueur are identical.

The Philippine specimens can be described as having branched canals, and it is for this reason that I refer them to *Zygocanna*, but the branching takes place at the margin of the stomach instead of distal to it, as Haeckel describes it; and the canals can be traced inward over the roof of the gastric cavity to its center, a feature not previously described for any aequorid. The branching, moreover, is much less regular than Haeckel deemed it, and the subumbrella surface is studded with gelatinous papillae so prominent, even in alcoholic specimens, that Haeckel could hardly have overlooked them had they been present in his material. Furthermore, there is no peduncle, which separates them from his *Zygocannula diploconus*, and there are many more tentacles than in his *pleuronota*. It is not worth while discussing the *Aequorea purpurea* of Péron and Lesueur (1809), which is also placed by Haeckel in "*Zygocannota*," because the structure of the gonads is so remarkable as to need confirmation. These facts combined are sufficient grounds for the institution of a new species. The only known Medusa with which it may be identical is a young unnamed aequorid figured and described from the collection of the *Siboga* by Maas (1905).

ZYGOCANNA VAGANS Bigelow.

Plate 42, figs. 5–7; plate 43, fig. 6.

Zygocanna vagans Bigelow, 1912, p. 255.
aequoride juv. gen? sp? Maas, 1905, p. 44, pl, 4, figs. 22, 23.

Zygocanna vagans—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40434	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	36
1718	M.C.Z	1	5129		
29388	U.S.N.M	1 (type).	5190	Tanon Strait, east coast of Negros	39
29418	U.S.N.M	9	5190	do	28–30
1716	M.C.Z	2	5190	do	Frag.
29416	U.S.N.M	1	5216	Between Burias and Luzon	76
3049	M.C.Z	1	5216	do	68

There is little to add to my original description (1912), except the accompanying illustrations, the most important being those showing the structure of the stomach and the method of branching of the canals. The important fact is that the branching takes place at the margin of the stomach. And the cruciform figure formed by inward prolongation of the canal stripes over the roof of the stomach shows that with growth there have been successive divisions for the four primary canals, the last one being obscured by the lips. In the type specimen there are 38 canals resulting from the bifurcation of the four primary ones (pl. 42, fig. 5).

As a result of this method of branching the canals are in groups, the number of which varies according to the number of branchings which each main stem has undergone, and the number of canals varies from group to group. In the type the "cross" is so irregular that it is hard to determine which trunks are the four primary ones. But in another specimen, in which the figure is more regular, there are 10, 5, 7, and 7 canals, originating from each of the four primary trunks, respectively. In another there are 9, 12, 5, and 8. In the two young aequorids described by Maas, which probably belonged to this species, the central cross is quite regular, and in each specimen there are 32 definitive canals.

The canal stripes within the limits of the stomach are the visible evidence of lines along which the upper (outer) wall of the manubrium is now attached to the subumbrella. Between these lines it hangs loose, leaving spaces into which a probe can be inserted or an air bubble injected. Consequently it is easily stripped off, and all the specimens show more or less damage of this sort.

The manubrium itself broadens as so many sinuses along the successively formed canals; evidently the outgrowth of new centrifugally formed canals takes place from the margin of the manubrium. A still further specialization would be branching of canals outside the margin of the manubrium, such as Haeckel has described.

Marginal organs.—The tentacles vary in number from about 30 to about 70; the canals from 29 to 46, in specimens 29 to 76 mm. in diameter (1912). Tentacular knobs are numerous; about 110 in a specimen with 29 tentacles. There are usually 1 to 3 otocysts between every 2 tentacular organs; i. e., upward of 200 [they are so small that the photographs do not show them; but they are easily seen on the specimens].

The tentacular bulbs are cylindrical and stout (pl. 42, fig. 6), and do not clasp the exumbrella, though they are truncate basally. In the type some tentacles are opposite canals, some between them (pl. 42, fig. 6); but in the specimen 36 mm. in diameter, they are all opposite canals.

I have already (1912) called attention to the great length of the excretory papillae borne by both tentacles and knobs (pl. 42, fig. 6).

Gonads.—The sexual glands are of the usual aequorid type.

Subumbrella sculpture.—One of the most characteristic features of the species is the presence of conical gelatinous subumbral papillae (pl. 43, fig. 6) described in detail elsewhere (1912, p. 257). These are restricted to the central two-thirds of the disk, arranged in rows alternating with the radial canals; 4 to 15 papillae in each row. In the region of the manubrium they are represented by low rounded knobs; 16 in one specimen.

Haeckel's (1879) records for the genus (+*Zygocannota*+*Zygocannula*) are from New Guinea, and straits of Sunda; the "Siboga" specimens (Maas, 1905) from Malayan waters.

Order TRACHOMEDUSAE.

Family PETASIDAE Haeckel, 1879. Sens. Em. Browne (1904); Bigelow (1909*a*, 1915*b*).

This family corresponds to the Olindiadae+subfamily Petasinae of Mayer (1910). Mayer leaves the relationships between his two groups open; and he adds to the latter Craspedacusta, both Goto (1903) and Browne (1904) having maintained that the affinities of the latter are with such genera as *Olindias* and *Gonionemus*.

I follow Browne (1904) in dividing this family into two subfamilies, Olindiinae with the otocysts in capsules, Petasinae in which they are free clubs (1909*a*, 1915*b*).

Subfamily OLINDIINAE.

Genus OLINDIAS F. Müller, 1861.

The genus *Olindias* is known from the Indo-Pacific, by two forms races or species, *O. phosphorica* var. *malayensis* Maas, and *O. singularis* Browne (1904). In my memoir on the "Albatross" Eastern Pacific Medusae (Bigelow 1909*a*, p. 109) and in Mayer's (1910) Monograph, the characters of members of the genus from various parts of the world will be found tabulated. The general conclusion, as Mayer points out, is that the various Atlantic representatives are at most geographic races of one species, *phosphorica*. The case of the two Indo-Pacific forms is still obscure. With the evidence available at the time, I recognized both, *singularis* with usually one, *phosphorica* with usually or always 2 otocysts at the base of each primary tentacle. The Mangareva specimens had one otocyst at the base of most, two at the bases of a few, primary tentacles. Hence they were associated with *singularis*. In the Philippine specimens also single otocysts predominate largely over paired. As pointed out elsewhere (Bigelow, 1909*a*) single antedates paired otocyst in ontogeny in *Olindias*. In the Atlantic specimens of the genus paired otocysts are developed at the base of a primary tentacle very soon after the latter is formed. In Indo-Pacific representatives single otocysts may persist, or at some of the tentacles a second one may develop. When this takes place it is at a very early stage, as in the Atlantic *phosphorica*. The only record of specimens from the Indo-Pacific with paired otocysts prevailing is that by Maas (1905). That is to say, we find here a tendency, not completely effective, to retain permanently a condition which is only evanescent in their Atlantic relatives. Or, in other words, Indo-Pacific specimens show a tendency to advance in their development to the degree of specialization exemplified by the Atlantic form, but seldom attain it. On the other hand, there is no record of the Indo-Pacific type from the Atlantic, though many Atlantic specimens have been studied by various authors; most recently by Neppi and Stiasny (1913).

The *singularis* type is now known to be widely distributed over the warmer parts of the central Indo-Pacific. In the Malaysian region the *phosphorica* type also occurs (Maas, 1905), though it is not recorded from elsewhere in that great oceanic division.

The evidence is still too scanty to explain the meaning of this state of things; to tell how far the variation is hereditary, how far physiological. Just such cases often meet the student of Medusae; and they offer constant difficulties in classification.

Although *singularis* seldom, if ever, lacks paired otocysts entirely, yet the two types, *singularis* and *phosphorica* approach discontinuity because no true intermediates between an overwhelming preponderance of one or other sort of otocyst, paired or single, are known. For this reason, I have recognized *singularis* as a valid species; and it is sufficient ground to do so still. But we must recognize that studies of larger series may show that the two forms can not be so sharply separated as the evidence now available suggests. Perhaps *singularis* may finally be reduced to a variety of *phosphorica*. An open mind is necessary if we are to mask neither the facts which we know, nor the gaps which separate them.

OLINDIAS SINGULARIS Browne.

Olindias singularis Browne, 1904, p. 737, pl. 56, fig. 2; pl. 57, fig. 1.—Bigelow, 1909*a*, p. 109, pl. 4, fig. 1; pl. 31, figs. 1–10; pl. 32, fig. 8.

Olindias singularis—material examined.

Catalogue No.	Collection of—	Number of species.	Station.	Locality.	Diameter in mm.
29424	U.S.N.M.	2	5097	Off Corregidor Light, west coast of Luzon.	
29370	U.S.N.M.	1	5169	Off Sibutu Island, Tawi Tawi	
40435	U.S.N.M.	3	5533	Between Cebu and Siquijor	one=32
1734	M.C.Z.	2	5533	do	
3050	M.C.Z.	1	5595		
40436	U.S.N.M.	1	5649	Buton Strait	
1680	M.C.Z.	1	5649	do	15
29369	U.S.N.M.	1	5669	Macassar Strait	21
40531	U.S.N.M.	1		Tilig Lubang, off west coast of Luzon	22

The numbers of tentacles and of otocysts in four specimens of different sizes are as follows:

Station.	Diameter.	Primary tentacles.	Secondary tentacles.	Bulbs.	Numbet of primary tentacles with one otocyst.	Tentacles with two otocysts.	Tentacles without otocysts.	Canals per quadrant.
5669	21	37	36	38	22	10	5	7,5,5,6
Tilig	22	44?	41	52	26	6	2	6,7,7,7
5649	15	39	19?	43	31	8	1	2,9,6,6
5553	32	52	38	57	42	2	1	....

In the last two specimens a small portion of the margin was damaged, so that at several tentacles the otocysts could not be determined.

It is of interest that when paired otocysts are developed, they are both distinguishable when the tentacle is very small. There is no evidence that tentacles which have one otocyst during the greater part of their history ever acquire a second one at a late stage. Single otocysts are usually much larger than either of the components of a pair.

In the smallest specimen one of the quadrants is very narrow and another disproportionately broad; the numbers of blind canals per quadrant show a corresponding irregularity. Abnormalities are common in Olindias (Bigelow, 1909*a*).

Subfamily Petasinae.

Genus NAUARCHUS Bigelow, 1912.

Petasidae with six radial canals, but without centripetal canals; manubrium short and flat, without distinct gastral portion; mouth surrounded by a simple circular lip; gonads leaflike; tentacles of one kind only, corresponding to the primary tentacles of *Olindias*, their basal ends lying in furrows of the gelatinous substance so that they appear to emerge from the exumbrella; with terminal nematocyst swelling; otocysts are free clubs. At first sight the shallow manubrium with its simple, circular lip (pl. 43, fig. 1), suggests an Halicreid, the presence of six radial canals,[1] and the flat oval leaflike gonads, a geryonid, such as *Geryonia*. But the absence of any trace of peduncle separates *Nauarchus* from the latter, the structure of otocysts from the former, its sense organs with spherical capsule and inclosed sensory stalk, being entirely different from the large sense clubs with series of columnar entoderm cells which characterize all known Halicreids. And in the structure of the tentacles there is an equally important difference, for in all Halicreids in which these organs have been described they consist of soft proximal and stiff, spinelike distal portions (1909*a*), besides arising free from the mar-

[1] One of the specimens is abnormal, there being only four canals at the margin of the stomach. One of these, however, soon divides into three, though only two of the latter reach the circular canal.

gin. The leaflike gonads, too, are unknown among Halicreids, and the radial canals are much broader in that family than in *Nauarchus*. The resemblance between the two in the flat stomach and simple lip, is certainly far less significant, phylogenetically, than the structure of the marginal organs; in short, it is merely superficial. The only Trachomedusae with which it shares its leaflike gonads are the Geryonids, but here again we find essential differences; that is, absense of peduncle, free sense clubs, structure of tentacles. And the structure of tentacles and gonads separate it from the Trachynemidae.

The location of *Nauarchus* in the Petasidae is based chiefly on the structure of the tentacles, which agree very closely with those of *Eperetmus* (Bigelow 1915*b*), both anatomically and in their relation to the bell margin. And, except for the replacement of sucking disk by nematocyst knob and in the details of the nematocyst rings, they agree with those of *Gonionemus* and the primary tentacles of *Olindias*.

The otocysts, too, are easily reducible to the ordinary Olindiid type.

According to the subdivision of the family proposed by Browne (1904) and followed here (p. 317, 1909*a*, 1912, 1915*b*), *Nauarchus* belongs to the Petasinae. [For a tabular view of the Olindiinae, see Bigelow, 1915*b*, p. 400.] But its leaflike gonads and the presence of six radial canals separate it from the only other Medusae which fall into the Petasinae as here defined, namely, *Petasus*, *Dipetasus*, *Petasata*, and *Petachnum* of Haeckel. All these are united by Mayer (1910) as *Petasus*, but until specimens agreeing with Haeckel's account are again discovered discussion of them is idle.

NAUARCHUS HALIUS Bigelow.

Plate 43, figs. 1–5.

Nauarchus halius Bigelow, 1912, p. 258.

Nauarchus halius—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29365	U.S.N.M.	2	5456	Off east coast of Luzon.	Largest 12 mm. in diameter, the other two smaller, but too contracted for measurement.
1727	M.C.Z.	1	5456	.....do	

All three were so badly crumpled that it was impossible to make a photograph of the general habitus. But all were well preserved anatomically.

The species having been described elsewhere (1912) in detail, the present account is limited to the features most important for their bearing on the relationships of this remarkable genus.

There are 12 solid tentacles—6 radial, 6 interradial—arising, of course, from the margin, but curving upward against the bell, in open furrows of the exumbrella, to emerge a slight distance above the margin. The two (both interradials) which are intact in the type-specimen are smooth walled for the inner four-fifths of their length, but the ends are ringed with about 20 nematocyst ridges, with a large nematocyst knob at the tip.

There is an otocyst close beside each tentacle root, within the exumbral furrow (pl. 43, fig. 5), but standing free, not inclosed by the gelatinous substance. The organs themselves are naked, spherical in form, consisting of an ectodermic covering layer, inclosing an entodermic core with about four large spherical cells, each containing a central mass, the high index of refraction of which shows that it is an otolith (pl. 43, fig. 3).

The discovery of free sense-clubs in *Nauarchus* is especially interesting because up to this time the only records for sense-organs of this type in the Petasidae are Haeckel's accounts of his problematic genera *Petasus*, *Dipetasus*, *Petasata*, and *Petachnum*. In all the other genera of the family, as *Gonionemus*, *Olindias*, *Eperetmus*, *Aglauropsis*, *Cubaia*, *Vallentinia*, *Olindioides*, *Craspedacusta*, and probably in *Gossea*, the sense-organs lie in vesicles, which themselves are usually inclosed in the mesogloea.

The otoliths of *Nauarchus* are clearly entodermal, just as in the Trachynemidae; and, according to Perkins and Murbach, this is also true of *Gonionemus*, as it apparently is of *Eperetmus* (1915*b*, pl. 59, fig. 8). That is to say, the sense-club of *Nauarchus*, or indeed that of any Trachomedusa in which this type of sense-organ occurs, corresponds essentially to the strand of cells with terminal concretion, which lies within the vesicle of *Gonionemus*. Both are modified tentacles. And although Goto (1903) believed the otocysts of *Olindias* to be of ectodermal origin, it is not likely that they are fundamentally different in that genus from in its allies. *Rhopalonema*, in which the club, at first free, is later enclosed by the upgrowth of a crater-like vesicle, may epitomize the relationship here outlined.

Family TRACHYNEMIDAE Gegenbaur, 1856.

Genus COLOBONEMA Vanhöffen, 1902.

Colobonema Maas (1905), Browne and Fowler (1906), Bigelow (1909*a*).
Homoeonema Part Mayer (1910).

Trachynemidae, with tentacles all of one kind, 32 in number, of which the 8 perradial, the 16 adradial, and finally the 8 interradial develop in succession.

One species of this genus, *sericeum* Vanhöffen, now well known (except for tentacles and otocysts), has been taken in the Bay of Biscay (Browne and Fowler, 1906), off the west coast of Africa from Sierra Leone to 42° S. (Vanhöffen, 1902), in the Malaysian region (Maas, 1905), and in the eastern tropical Pacific (Bigelow, 1909*a*). Whether or not the *Homoeonema typicum* of Maas (1897), from off the Pacific coast of Central America, is identical with it, has been the subject of a good deal of discussion. Mayer (1910), following Maas (1905), believes that it is. As I have previously pointed out, Maas, in his original description of *typicum*, writes that there are more than four times as many tentacles as canals—that is, more than 32—and his figure shows 41. Now, all recent studies, and the present series as well, show that in *sericeum* the number of tentacles is determinate, invariably 32 in adults. This number is present in moderate-sized individuals, and is not overstepped even in very large ones However, the material on which Maas based his early account was not of the best, and he himself suggests (1905) that it was its poor condition which led to his crediting it with so many tentacles. Unfortunately Maas's original specimen is apparently no longer in existence, so the question can never be settled absolutely. For the sake of uniformity I follow Mayer and use the name *typicum* (1913, p. 46) instead of *sericeum*, as I formerly did. But Vanhöffen deserves credit for first giving us an adequate account of this interesting genus.

COLOBONEMA TYPICUM (Maas).

Homoeonema typicum MAAS, 1897, p. 22, pl. 3, figs. 1–3. Synonymy, Mayer, 1910, p. 385.

Colobonema typicum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
1720	M.C.Z.	1	5120	Verde Island Passage.
40437	U.S.N.M.	2	5120	Do.
1662	M.C.Z.	1	5125	
40438	U.S.N.M.	1	5227	Off east coast of Mindoro.
1662	M.C.Z.	1	5227	Do.
....		2	5227	Do.
29307	U.S.N.M.	2	5287	Verde Island Passage.
3046	M.C.Z.	2	5287	Do.
40439	U.S.N.M.	1	5293	Do.
1661	M.C.Z.	1	5293	Do.
29402	U.S.N.M.	4	5295	Do.
1685	M.C.Z.	2	5295	Do.
29308	U.S.N.M.	1	5320	China Sea, vicinity Hongkong.
3047	M.C.Z.	1	5320	Do.
29306	U.S.N.M.	1	5438	Off west coast of Luzon.

The specimens range from 16 to 33 mm. in height; they are all more or less fragmentary. Only in two particulars will they add to the previous accounts of this species, i. e., as regards otocysts and length of the manubrium. Previously no otocysts had been found in *Colobonema*, although a good many specimens had been examined—

a fact that led to the suggestion that they might be lacking in this genus (Bigelow, 1909*a*). But I have found one, in one of the present examples, a particularly fragmentary example, as it happens. The sense organ is a free club, much like that of *Aglantha*, standing free on the margin, midway between two tentacles. Its structure is not remarkable, there being an entodermal core with a terminal mass of concretions. It is not in very good condition. It stands on a slight elevation of the margin, and though I could find no other otocysts in any of the specimens, several of them showed the elevations, alternating with the tentacles.

The present series supports the view that the length of the manubrium is so variable as to be quite worthless as a specific criterion. The extremes illustrated here are a specimen 26 mm. high, in which it is only 1 mm. long; and two of 27 mm. and 29 mm., respectively, in which it hangs to the bell opening; and as there is a series of intermediates between these two, the differences are merely evidences of contraction and expansion. In specimens not too much contracted, and in good condition, the mouth is surrounded by four prominent lips. But under extreme contraction, or in very limp specimens, these may be masked.

I examined all the specimens without finding any variation, in any octant, from the normal number of tentacles, i. e. two adradials and one interradial. In the smaller examples the latter is much the smallest, but in the larger ones all are of nearly the same size.

Genus RHOPALONEMA Gegenbaur, 1856. Sens. em. Vanhöffen, 1902.

The studies of Maas (1893) and especially of Vanhöffen (1902) have given us an excellent concept of the structure and limits of *Rhopalonema*. I have previously (1909*a*) discussed this genus at some length, and given my reasons for concluding that all species referable to *Rhopalonema* which have yet been described belong either to *velatum* or to the species from the mid depths variously known as *funerarium* or *coeruleum*—a view which I share with Vanhöffen (1902) and with Maas (1905).

RHOPALONEMA VELATUM Gegenbaur.

Rhopalonema velatum GEGENBAUR, 1856, p. 251, pl. 9, figs. 1–5. Synonymy, Bigelow 1909*a*, p. 129, and Mayer 1910, p. 378.

Rhopalonema velatum—material examined.

Catologue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29381	U.S.N.M.	4	5190	Tanon Strait, east coast of Negros	3–5
3052	M.C.Z.	2	5190	do.	3–5
40440	U.S.N.M.	8	5530	Between Siguijor and Boho	3–5
1682	M.C.Z.	3	5530		3–5

All the specimens are much battered—but all show an apical thickening of the gelatinous substance, either as a circumscribed "top-knot" or as a more gradual swelling. This was true likewise of the eastern Pacific specimens, of those recorded by Browne and Fowler (1906) from the Bay of Biscay (as "*coeruleum*"), and of the Japanese series recently described by Maas (1909). But the specimens from Trieste studied by Neppi and Stiasny (1913) had none.

R. velatum was known to occur in the Malaysian region (Maas, 1905), and it is widely distributed over the tropical Pacific; therefore it was to be expected in the Philippines. The only surprising thing about the records is that it was taken at two stations only.

Family HALICREASIDAE Fewkes, 1886. HALICREIDAE Vanhöffen (1902) sens, em.

Trachomedusae with eight very broad radial canals; with numerous tentacles of different sizes, but all structurally alike and arranged in a single series; each tentacle divisible into a soft flexible proximal, and a stiff spine-like distal region: with free sensory clubs; with neither peduncle nor proboscis.

The general structure of these remarkable Medusae is now well known, thanks to Vanhöffen (1902), Maas (1905), Browne (1908), and to the excellent series from the eastern Pacific (Bigelow, 1909*a*).

Mayer (1910) classes the genera here included among the Trachynemidae, uniting them with *Rhopalonema* and allied forms, as the subfamily Rhopaloneminae, because of the absence of peduncle. But they are separated from *Rhopalonema*, etc., by their very broad radial canals; by the structure of the tentacles, which is extremely characteristic; by the large otocyst clubs; and especially by the rudimentary, flattened manubrium. On the other hand, they are a very homogeneous group among themselves. I need make no apology for retaining them as a separate family, when in so doing I agree with every recent student who has actually examined any of them.

Genus HALICREAS Fewkes 1882.

HALICREAS PAPILLOSUM, Vanhöffen.

Halicreas papillosum VANHÖFFEN, 1902, p. 68, pl. 9, figs. 7, 8; pl. 11, fig. 30.—MAAS, 1905, p. 57, pl. 10, fig. 70; pl. 11, fig. 71.—BIGELOW, 1909*a*, p. 138, pl. 3, fig. 3; pl. 33, figs. 8, 9; pl. 34, figs. 1–3, 5, 8, 10, 11.

Halicreas papillosum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29349	U.S.N.M.	1	5120	Verde Island Passage	21

The single example is in such poor condition that I can add nothing to my previous account of the species, taken from the excellent series collected by the *Albatross* in the eastern Pacific. *H. papillosum* is already known from the Malaysian region (Maas, 1905). Considering how regularly it occurred in the eastern Pacific, it is surprising that only one of the Philippine hauls captured it.

Family GERYONIDAE Eschscholtz, 1829.

Genus GERYONIA Péron and Lesueur, 1809.

GERYONIA PROBOSCIDALIS (Forskål) Eschscholtz.

Medusa proboscidalis Forskål, 1775, p. 108, 1776, pl. 36, fig. 1. Synonymy, Bigelow, 1909*a*, p. 116, and Mayer, 1910, p. 425. (To the latter, add *Geryones elephas* Haeckel, 1879, p. 294, pl. 18, fig. 7.

Geryonia proboscidalis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29405	U.S.N.M.	1	5177	Verde Island Passage	35, with 5 canals.

Mayer (1910) has given an excellent account and beautiful figures of this species. Its ova have formed the foundation of a recent investigation by Maas (1908) on the composition of the egg and on the early development, both normal, and when the blastomeres are separated.

Variations from the normal hexamerous condition are very common; thus each of the specimens in the *Albatross* eastern Pacific collection had seven radial canals.

Geryonia proboscidalis is widely distributed over the warmer parts of all oceans.

Genus LIRIOPE Lesson, 1843.

I have recently (1909*a*, 1913) discussed this puzzling genus and given my reasons for uniting, under the name *tetraphylla*, all *Liriope* with angular or heart-shaped gonads. All the specimens of the present collection belong to that form.

LIRIOPE TETRAPHYLLA (Chamisso and Eysenhardt) Gegenbaur.

Geryonia tetraphylla, Chamisso and Eysenhardt, 1821, p. 357, pl. 27, fig. 2. To the synonymy already given by me (Bigelow, 1909*a*, p. 112), add:

Liriope haeckeli Goette, 1886, p. 833.—Hartlaub, 1909, p. 464, pl. 22, figs. 29, 30, 33.

Liriope rosacea Hartlaub, 1909, p. 466, pl. 22, figs. 28, 31, 32.—Maas, 1909, p. 31.—Mayer, 1910, p. 417.

Lirope tetraphylla Mayer, 1910, p. 418.

Liriope tetraphylla—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
....	....	2	5128	Sulu Sea, vicinity southern Panay.
29362	U.S.N.M..........................	1	5155	Off Bakum Point, Tawi Tawi.
40441	U.S.N.M..........................	1	5175	Sulu Sea, between Palawan and Negros.
40442	U.S.N.M..........................	1	5177	Verde Island Passage.
29364	U.S.N.M..........................	1	5186	Between Panay and Negros.
....	....	1	5190	Tanon Strait, east coast of Negros.
29361	U. S. N.M........................	2	5195	Off northern Cebu.
....	....	3	5195	Do.
....	....	3	5530	Between Siguijor and Bohol.
40443	U. S. N.M........................	13	5649	Buton Strait.
1675	M.C.Z............................	9	5649	Do.
....	....	9	5649	Do.
29363	U.S.N.M..........................	2	5663	Macassar Strait.
29360	U.S.N.M..........................	10	5669	Do.
3048	M.C.Z............................	5	5669	Do.
40444	U.S.N.M..........................	5	5672	Do.
1681	M.C.Z............................	3	5672	Do.
....	....	3	5672	Do.

The specimens range from 8 to 16 mm. in diameter, and are all in what I have called the "rosacea" stage (1909*a*), as were all but the smallest (less than 5 mm. in diameter) described by Maas (1909) from Japan. It has been described so fully by him (1905), by Hartlaub (1909), and by the writer (1909*a*) that a brief statement of the growth condition of the present series will suffice here.

Maas found that the first trace of gonads appears in specimens 3 to 4 mm. in diameter, and that at first they are oval, just as I described them from the eastern Pacific series. This outline, however, is transitory, the triangular form being attained in specimens 5 to 6 mm. in diameter. This, of course, explains the fact that it was only the very smallest specimens of *tetraphylla* from the eastern Pacific, 7 mm. or less, that had oval or squarish gonads. Therefore it is not surprising that the triangular outline is universal in the Philippine series, all of which are 8 mm. or larger.

The gonads are not in contact in any of the specimens, nor were they in the Japanese examples of about the same size (12 to 14 mm.; Maas, 1909, p. 31). In the eastern Pacific collection it was only in specimens 18 mm. or larger that they were large enough to touch each other, while in none smaller than about 20 mm. did they show the pentagonal form typical of the "compacta" stage (Bigelow, 1909*a*). But in one specimen from the northwest Pacific only 12 mm. in diameter one gonad was pentagonal (Bigelow 1913, p. 55).

Most of the specimens have three blind canals in each quadrant, but one 16 mm. in diameter has four in one, three in each of the others. The other specimens of this size, of which there are four, are badly damaged. Maas (1905, 1909) found more than three canals only in specimens 18 mm. in diameter and upward.

Order NARCOMEDUSAE.

In previous paper (1909*a*) I have discussed at length the structure and apparent relationships of the Narcomedusae and given my reasons for adopting, in the main, the classification proposed by Maas. Mayer (1910) has likewise accepted the main principle laid down by Maas and me—namely, that the presence or absence of gastric pockets is of prime importance; the presence or absence of a peripheral canal system of little significance in classification.

A very different scheme has been outlined by Vanhöffen (1908). I have already (1909*a*, 1918) criticised his preliminary statement, and Maas (1909) and Mayer (1910), with whom I entirely agree in their general conclusions, have discussed his final account of the *Valdivia* Narcomedusae.

The only important difference between the scheme adopted by Maas and by me on the one hand and the classification used by Mayer on the other is that in the former Aeginidae and Cunanthidae are distinct families; in the latter they are reduced to the rank of two subfamilies of a single family.

Family CUNANTHIDAE Haeckel, 1879.

Genus SOLMISSUS Haeckel 1879.

Sens. em. MAAS (1904*a*–1904*b*).—BIGELOW (1909*a*).—MAYER (1910).
Solmaris (part) VANHÖFFEN (1908).

No part of Vanhöffen's classification of the Narcomedusae is further from representing what I believe to be the natural relationships of the forms involved than his treatment of *Solmissus*.

Vanhöffen's definition of his genus *Solmaris* is based upon the statement (1908, p. 58) that "alle Solmariden auch mit Magentaschen ausgestattet sind. Dass Magentaschen fehlen sollen, beruht auf Beobachtung an jungen noch nicht genügend entwickelten Tieren oder an mangelhaft erhaltenen Exemplaren." But we have the word of Maas (1909, p. 34), of Mayer (1910), and of Neppi and Stiasny (1913), that there are solmarids—that is, forms with neither otoporpae nor peripheral canals—which do lack any trace of true gastric pockets when adult, the gastric margin running direct or on the arc of a circle from tentacle base to tentacle base. And these students made their observations not only on young or on fragmentary material, but on living specimens in various stages of development, including sexually mature adults. I can substantiate their statements for an excellent adult specimen of *Solmaris flavescens* Kölliker from the Mediterranean, a species recently redescribed by Mayer. The margin of the stomach is entire; there are no gelatinous septa in the interradii.

The condition of the margin of the stomach in this species is precisely what it would be in a *Pegantha* did the sexual products develop irregularly and sparsely near the outer edge of the lower gastric wall instead of being localized in regions where the lower walls grow downward, as pockets, to accommodate them. Apparently Vanhöffen had not seen this species, for he has given the name *flavescens* to a form with gastric pockets; that is, a *Solmissus.* I must confess that I can not understand Vanhöffen's statement (1908, p. 69) that all species of his genus *Solmaris* have interradial gelatinous septa horizontal to the plane of the stomach, instead of vertical to it, as in Aeginidae. Inasmuch as the gastric pockets in *Solmissus marshalli* and *S. albescens* (Bigelow, 1909*a;* Mayer, 1910) are structurally precisely similar to the corresponding pockets in *Cunina* and *Cunoctantha*, it is in such forms as *Solmaris flavescens* Kölliker (not *S. flavescens* Vanhöffen) that we must seek horizontal septa if they exist anywhere. By a horizontal septum must be understood one which, by growing centrad, leaves the lower gastric wall reaching outward beyond, and thus overlapping its line of union with the oral surface of the disk; in other words, forming a horizontal pouch. But there is nothing of this sort in *S. flavescens* any more than there is in *Pegantha*, as is clearly shown in Mayer's figure of a section through the interradius (1910, fig. 286). The only thing which might possibly suggest such a septum is the fact that the sexual mass in the male may overlap the subumbrella slightly, beyond the gastric margin. But this is purely a secondary phenomenon, caused by the rapid proliferation of the sexual cells themselves; that is, it is directly comparable to the secondarily formed genital pouches of *Pegantha*, and has nothing to do with the gastric pockets of *Solmissus* or *Cunina*, which develop long before the sexual products begin to appear.

The genus *Solmaris* of Vanhöffen includes two distinct groups of species—one with, the other without, gastric pockets. According to the classification proposed by Maas, and here adopted, they not only belong to different genera, *Solmaris* and *Solmissus* but to different families.

Two of Vanhöffen's species of *Solmaris*, his *S. flavescens*, which, as noted above, is not the *Solmaris flavescens* of Kölliker, Gegenbaur, and latterly of Mayer (1910), and probably three specimens identified by him as *S. rhodoloma* Brandt belong to *Solmissus*, as here defined.

The present collection contains a considerable series of *Solmissus marshalli*, a species separable from the well-known Mediterranean *S. albescens* Gegenbaur only by the lack of exumbrellar sculpture (Mayer 1910), large number of otocysts, and square instead of slightly pentagonal gastric pockets.

Vanhöffen's *Solmaris flavescens* is apparently identical with *Solmissus marshalli*, as he himself points out (Vanhöffen 1912, p. 395). But the name *marshalli* must be used because *flavescens*, as applied to a *Solmissus* (not being the *Solmaris flavescens* of Kölliker), dates only from 1908; *marshalli* from 1902.

SOLMISSUS MARSHALLI Agassiz and Mayer.

Solmissus marshalli Agassiz and Mayer, 1902, p. 151, pl. 5, figs. 23–25.—Bigelow, 1909*a*, p. 64, pl. 16, figs. 5, 6, pl. 21, figs. 4, 6–8.—Mayer, 1910, p. 484.

Solmissus marshalli—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29415	U.S.N.M.	12	5227	Off east coast of Mindoro	22–53
1684	M.C.Z.	4	5227	do.	
29385	U.S.N.M.	1	5320	China Sea, vicinity Hongkong	
29386	U.S.N.M.	1	5320	do.	
		1	5500	Off northern Mindanao	

All the specimens are so battered that I can add nothing to my account of the much better preserved series from the eastern Pacific (1909*a*), except a few notes on the numbers of tentacles and of otocysts. Out of the total of 22 specimens, two have 11, two 12, five have 14, six 15, and five have 16 tentacles and gastric pockets. In the eastern Pacific series of 11 specimens, 8 was represented once, 11 once, 12 twice, 13 once, 14 once, and 16 five times. The number of tentacles varies irrespective of size. Thus the two largest examples of 52 and 53 mm. have 16 and 15 tentacles, respectively; the two smallest, of 19 and 22 mm., 14 and 15. The specimens with the fewest tentacles—that is, with 11 and 12—are of medium size, 36, 34, 28, and 30 mm. in diameter. The smallest with 16 tentacles, is only 30 mm.

The largest number of otocysts in any one lappet in the eastern Pacific series was 15. But in one of the Philippine collection, 48 mm. in diameter, with 14 tentacles, there are 15 and 21 in two successive lappets. In another of 45 mm., with 15 tentacles, there are 11 and 19 in two lappets. In one of 46 mm., 16 tentacles, 11 and 14 in two lappets. The margins are all so damaged that I could not count the otocysts on more than two lappets in any one specimen.

S. marshalli, or the variety *marshalli* of *albescens*, which ever its final fate, is widely distributed over the tropical Pacific, as far north as the Hawaiian Islands, and so far east as off the coast of Peru; and Vanhöffen's (1908, 1912) records from the tropical Atlantic and Indian Oceans probably belong to it also.

Family AEGINIDAE Gegenbaur, 1856.

Genus AEGINA Eschscholtz, 1829.

Sens em. MAAS (1904*a*, 1905).—BIGELOW (1909*a*, 1913).

AEGINA CITREA Eschscholtz.

Aegina citrea ESCHSCHOLTZ, 1829, p. 113, pl. 11, fig. 4. Synonymy, Mayer, 1910, p. 451.

Aegina citrea—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29277	U.S.N.M..................	1	5120	Verde Island Passage...	17

The specimen is in fair condition, except for the margin, which is so damaged that I have not been able to count the otocysts, nor to make any observations on the peripheral canal system.

The gastric pouches are of the typical *citrea* type, each of the eight pouches is subdivided at its margin by a shallow indentation, just as in the larger specimens in the eastern Pacific and northwestern Pacific series (Bigelow 1909*a*, 1913) and as figured by Maas (1905) for the *Siboga* examples.

Color.—In the preserved specimens stomach and gonads are pale yellowish; tentacles colorless.

AEGINA ROSEA Eschscholtz.

Aegina rosea ESCHSCHOLTZ, 1829, p. 115, pl. 11, fig. 4.—HAECKEL, 1879, p. 338.—VANHÖFFEN, 1908, p. 48, pl. 7, figs. 1, 2; pl. 9, figs. 16–19.—MAAS, 1909, p. 35. For further synonymy see Mayer, 1910, p. 452, "*A. rhodina*."

Aegina rosea—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29278	U.S.N.M..................	1	5659	Gulf of Boni, Celebes...	24

The single example is in rather poor condition; the margin very much damaged, and the large gonads torn. No study of the otocysts or peripheral canals was possible. Its identity with *rosea* is shown by the fact that, in spite of its large size, the eight gastric pouches are not subdivided, and by the reddish color of stomach and gonads. It is too poorly preserved to add anything to the previous accounts.

Genus SOLMUNDELLA Haeckel 1879.

Sens. em. MAAS, (1904, 1905), BROWNE (1905).

This genus has recently been discussed by Maas (1909), Browne (1905), Mayer (1910), Vanhöffen (1908), and by the writer (1909*a*).

SOLMUNDELLA BITENTACULATA (Quoy and Gaimard) Browne.

Charybdea bitentaculata Quoy and Gaimard, 1834, p. 295, pl. 25, figs. 4, 5. Synonymy, Bigelow 1909*a*, p. 77, Mayer 1910, p. 455.

Solmundella bitentaculata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29384	U.S.N.M.	1	5456	Off east coast of Luzon.
....	....	24	5456	Do.
40445	U.S.N.M.	1	5581	Vicinity Darvel Bay, Borneo.

Order SIPHONOPHORES.

All but two of the present list are recorded by Lens and Van Riemsdijk (1908) from the Malayan region collection, or from Amboina by Bedot (1896), and these two were taken by the *Albatross* in the eastern Pacific (1911*b*). Most of them are well-known forms, which have been described and figured by other authors; and the status and synonymy of all have been discussed in detail elsewhere (Bigelow, 1911*b*).

The two most interesting captures are the remarkable eudoxid *Archisoma natans* Bigelow, and *Chuniphyes multidentata* Lens and Van Riemsdijk.

Geographically the collection is not particularly instructive, for all the species were to be expected among the Philippines. Unfortunately the labels give no information as to the depths from which any of the specimens came.

Suborder CALYCOPHORAE.

Family SPHAERONECTIDAE Huxley, 1859.

Genus CUBOIDES Quoy and Gaimard, 1827.

CUBOIDES VITREUS Quoy and Gaimard.

Cuboides vitreus Quoy and Gaimard, 1827, p. 19, pl. 2E, figs. 1–3. Synonymy, Bigelow, 1911*b*, p. 190.

Cuboides vitreus—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40446	U.S.N.M.	1	5436	Off Corregidor Lt., west coast of Luzon.
29311	U.S.N.M.	2 eudoxids	5436	Do.
29310	U.S.N.M.	1 eudoxid	5436	Do.
29312	U.S.N.M.	15	5500	Northern Mindanao.
29309	U.S.N.M.	20 eudoxids	5500	Do.
1654	M.C.Z.	19	5500	Do.

This species is usually known as *Halopyramis adamantina* Chun. But as Chun (1892) himself says that its eudoxid is the *Cuboides vitreus* of Quoy and Gaimard—a statement which is undoubtedly correct—no choice is left but to use the older name for the species as a whole.

Like Bedot (1896) and Lens and Van Riemsdijk (1908), I have been unable to find any differences to separate the Philippine or Eastern Pacific from Atlantic specimens. Chun's beautiful figure (1892) might have been taken from any one of the larger Philippine specimens. *Cuboides vitreus*, like so many other siphonophores, occurs in the warmer parts of all great oceans.

The present specimens, in excellent condition, are larger than any Indo-Pacific examples yet recorded, the nectophores measuring 9 to 14 mm., the bract of the eudoxid from 4 to 10 mm. in height.

Family PRAYIDAE Kölliker, 1853.

AMPHICARYON ACAULE Chun.

Amphicaryon acaule Chun, 1888, p. 1162. Synonymy Bigelow, 1911*b*, p. 195, pl. 4, fig. 1–8.

Amphicaryon acaule—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29289	U.S.N.M	1	5451	Off east coast of Luzon	About 9.
1608	M.C.Z	1	5451	do	Do.

Each of the specimens has lost the older bractlike nectophore, besides the stem and appendages. But the outlines and proportions of the nectosac of the remaining nectophores are so characteristic that the identification is justified.

The specimens are interesting chiefly because they extend the range of genus and species to Philippine waters. It was known previously only from the Atlantic and from the eastern tropical Pacific.

PRAYA CYMBIFORMIS (Delle Chiaje) Leuckart.

Physalia cymbiformis Delle Chiaje, 1842, pl. 33. Synonymy, Bigelow, 1911*b*, p. 200.

Praya cymbiformis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29413	U.S.N.M	15 nectophores	5,500	Off northern Mindanao.
1660	M.C.Z	5 nectophores	5,500	Do.
29379	U.S.N.M.	1 detached nectophore	5,659	Gulf of Boni, Celebes.

In these specimens the stems and appendages are entirely lost, and the nectophores themselves are so crumpled and torn that the most that can be said about them is that they are certainly prayids. And since the hydroecium (when distinguishable) reaches from one end of the nectophore to the other, they probably belong to *P. cymbiformis*.

Family HIPPOPODIIDAE Kölliker, 1853.

Genus HIPPOPODIUS Quoy and Gaimard, 1827.

HIPPOPODIUS HIPPOPUS (Forskål) Schneider.

Gleba hippopus Forskål, 1775, p. 14, 1776, pl. 43, fig. E. Synonomy, Bigelow, 1911*b*, p. 208.

Hippopodius hippopus—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29353	U.S.N.M.	6 detached nectophores	5129	Sulu Sea, off western Mindanao
1620	M.C.Z.	1 detached nectophore	5129	Do.
		63	5129	Do.
29352	U.S.N.M.	1, with 2 large and 2 very small nectophores and 1 detached nectophore	5240	Vicinity Pujada Bay, Mindanao.
29357	U.S.N.M.	2 nectophores	5451	Off east coast of Luzon.
1751	M.C.Z.	8 nectophores	5497	Between Leyte and Mindanao.
29358, 29355	U.S.N.M.	2, with 2 and 3 nectophores and 38 detached nectophores.	5500	Off northern Mindanao.
29356	U.S.N.M.	1, with 2 nectophores	5530	Between Siquijor and Bohol.
29354	U.S.N.M.	3 detached nectophores	5616	Molucca Passage.
40447	U.S.N.M.	8	5647	Buton Strait.
1659	M.C.Z.	4	5647	Do.

Family DIPHYIDAE Eschscholtz, 1829.

Genus ABYLA Quoy and Gaimard, 1827.

ABYLA LEUCKARTII Huxley.

Abyla leuckartii Huxley, 1859, p. 49, pl. 3, fig. 2. Synonymy, Bigelow, 1911*b*, p. 216.

Abyla leuckartii—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40448	U.S.N.M.	1 eudoxid	5451	Off east coast of Luzon.
29262	U.S.N.M.	2 superior nectophores	5601	Gulf of Tomini, Celebes.
3055	M.C.Z.	1 nectophore	5601	Do.
40449	U.S.N.M.	3 nectophores	5672	Macassar Strait.
1634	M.C.Z.	....do	5672	Do.

The inferior nectophore of this species was discovered very recently, and is so far known only from small examples (Bigelow, 1911*b*). Unfortunately the present specimen is so crumpled that I can add nothing to my previous account.

The eastern Pacific series (Bigelow, 1911*b*) showed that the remarkable eudoxid *Ceratocymba asymmetrica* Lens and Van Riemsdijk is the free eudoxid of *A. leuckartii.* *Ceratocymba sagittata* Quoy and Gaimard is the eudoxid of *Diphyabyla hubrechti* Lens and Van Riemsdijk (Bigelow, 1918; Moser, 1911, 1912).

Though the superior nectophore of *A. leuckartii* is so characteristic that it is not likely to be mistaken for any other species, it has seldom been recorded. The *Siboga* took it at five stations; the *Albatross* at seven in the eastern Pacific. Agassiz and Mayer (1902) describe it from the Marquesas and from near the Paumotas. Huxley's original specimen was taken off the east coast of Australia. I have recently recorded it from the West Indies (Bigelow 1911*b*, 1918); Moser (1913) from the Atlantic.

ABYLA TRIGONA Quoy and Gaimard.

Abyla trigona Quoy and Gaimard, 1827, p. 14, pl. 2B, figs. 1–8. Synonymy, Bigelow, 1911*b*, p. 221.

Abyla trigona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40450	U.S.N.M.	1 superior nectophore	5120	Verde Island Passage.
29266	U.S.N.M.	do	5451	Off east coast of Luzon.
40451	U.S.N.M.	do	5581	Vicinity Darvel Bay, Borneo.
29264	U.S.N.M.	4 nectophores	5601	Gulf of Tomini, Celebes.
1658	M.C.Z.	1 superior nectophore	5601	Do.
		1 eudoxid bract only	5320	China Sea, vicinity of Formosa
29267	U.S.N.M.	8	5672	Macassar Strait.
3074	M.C.Z.	4	5672	Do.

The superior nectophores are all in fair condition, but only two of the five inferior ones (station 5672) preserve their normal outlines.

All of the specimens show the conformation of facets and ridges characteristic of *trigona*, as opposed to the closely related *haeckeli* Lens and Van Riemsdijk. The difference has been discussed elsewhere (Bigelow, 1911b). Briefly stated, it consists in the presence of a transverse ridge in the superior nectophore of *haeckeli*, which divides the single dorsal facet, such as is seen in *trigona*, into two facets. A very detailed description has been given by Lens and Van Riemsdijk.

A. trigona or its eudoxid was taken at 18 stations by the *Siboga*, and it is also known from the Indian Ocean, so it was to be expected in Philippine waters.

ABYLOPSIS TETRAGONA (Otto) Bigelow.

Pyramis tetragona Otto, 1823, p. 306, pl. 42, figs. 2*a*–2*e*. Synonymy, Bigelow, 1911b, p. 224.

This species has usually been known as *Abyla pentagona* Quoy and Gaimard. The use of the name *tetragona* rests on Chun's statement

(1897, p. 31) that Otto's type-specimen, preserved at Breslau, was undoubtedly *A. pentagona.* The necessity of the change was pointed out by Schneider (1898).

Abylopsis tetragona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29271	U.S.N.M.	2	5177	Verde Island passage.
1614	M.C.Z.	2	5177	Do.
40453	U.S.N.M.	1	5224	Between Marinduque and Luzon.
40454	U.S.N.M.	1 superior and 1 inferior nectophore.	5436	Off Corregidor Light, west coast of Luzon.
29270	U.S.N.M.	1	5451	Off east coast of Luzon.
....	....	35, and 61 inferior nectophores.	5451	Do.
29389	U.S.N.M.	20 nectophores	5456	Do.
1622	M.C.Z.	10 nectophores	5456	Do.
29275	U.S.N.M.	1	5500	Off northern Mindanao.
40455	U.S.N.M.	1	5581	Vicinity Darvel Bay, Borneo.
1615	M.C.Z.	1	5581	Do.
29272	U.S.N.M.	2	5601	Gulf of Tomini, Celebes.
1638	M.C.Z.	1	5601	Do.
29273	U.S.N.M.	2	5616	Molucca passage.
3062	M.C.Z.	2	5616	Do.
40456	U.S.N.M.	1	5663	Macassar Strait.
29274	U.S.N.M.	2	5669	Do.
1633	M.C.Z.	1	5669	Do.

ABYLOPSIS ESCHSCHOLTZII (Huxley) Bigelow.

Aglaismoides eschcholtzii HUXLEY, 1859, p. 60, pl. 4, fig. 2 (eudoxid).
Abylopsis quincunx CHUN, 1888, p. 20. Synonymy, Bigelow, 1911*b*, p. 226.

Abylopsis eschscholtzii—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29268	U.S.N.M.	1	5436	Off Corregidor Light, west coast of Luzon.
....	....	1 inferior nectophore	5500	Off northern Mindanao.
29269	U.S.N.M.	18 nectophores and euxodids	5616	Molucca Passage.
1632	M.C.Z.	10 nectophores and eudoxids	5616	Do.

The eudoxid (*Aglaismoides eschscholtzii* Huxley) was taken at Station 5616, 19 specimens.

This small series, not in very good condition, does not add anything of importance to the previous descriptions of the species. It, or its eudoxid, was taken at 33 stations by the *Siboga*, and 22 by the *Albatross* in the eastern Pacific. Lens and Van Riemsdijk (1908) and the writer (1911*b*) have discussed its relationship to *tetragona*, and the characters which distinguish its nectophores and eudoxid from that species.

Genus BASSIA L. Agassiz.

BASSIA BASSENSIS (Quoy and Gaimard) Bigelow.

Diphyes bassensis QUOY and GAIMARD, 1834, p. 91, pl. 7, figs. 18–20. Synonymy, Bigelow, 1911*b*, p. 229.

Bassia bassensis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29293	U.S.N.M.	1 inferior nectophore	5120	Verde Island Passage.
29294	U.S.N.M.	1 superior and 1 inferior nectophore.	5436	Off Corregidor Light, west coast of Luzon.
3072	M.C.Z.	.....do	5436	Do.
40457	U.S.N.M.	5 nectophores	5649	Buton Strait.
40458	U.S.N.M.	4 eudoxids	5649	Do.
1618	M.C.Z.	4 nectophores and 9 eudoxids	5649	Do.
....	....	8 nectophores	5649	Do.
40459	U.S.N.M.	1 inferior nectophore	5672	Macassar Strait.
29292	U.S.N.M.	2 inferior nectophores	5663	Do.
1619	M.C.Z.	.....do	5663	Do.

All of the specimens were very much battered, but owing to its characteristic form, and especially to the opacity of its ridges, which appear white against a black background after preservation in formalin, *bassensis* is easily recognized. It was taken by the *Siboga* in considerable numbers in Malayan waters.

Genus GALEOLARIA Blainville.

GALEOLARIA QUADRIVALIS Blainville.

Sulculeolaria quadrivalvis BLAINVILLE, 1830, p. 126. Synonymy, Bigelow, 1911*b*, p. 137, pl. 5, figs. 1–7, 1918, p. 416.

Galeolaria quadrivalvis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40460	U.S.N.M.	1 inferior nectophore	5320	China Sea, vicinity of Hongkong.
40461	U.S.N.M.	2 nectophores	5649	Buton Strait.
1639	M.C.Z.	1 nectophore	5649	Do.
....	....	11 inferior nectophores	5669	Macassar Strait.

None of the specimens are in good condition: all have lost the entire stem.

It is somewhat surprising that no superior nectophores were found among the numerous Galeolarias from station 5669, especially since the long somatocyst is a good field mark for *quadrivalvis*, even when the margin is so contracted that it is hard to distinguish the two narrow dorsal teeth. The inferior nectophores all show the characteristic conditions of the nectosac.

G. quadrivalvis was taken by the *Siboga* at 8 stations. It is widely distributed over the eastern tropical Pacific, as well as in the Atlantic.

GALEOLARIA AUSTRALIS Quoy and Gaimard.

Galeolaria australis Quoy and Gaimard, 1834, p. 42, pl. 5. Synonymy, Bigelow, 1911*b*, p. 238, 1918, p. 419.

Galeolaria australis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29346	U. S. N. M.	2 nectophores	5500	Off northern Mindanao.
3063	M. C. Z.	1 nectophore	5500	Do.
40532	U. S. N. M.	2 nectophores	5610	Gulf of Tomini, Celebes.
29345	U. S. N. M.	10 nectophores	5669	Macassar Strait.
29347	U. S. N. M.	7 nectophores	5669	Do.
3064	M. C. Z.	10 nectophores	5669	Do.
29404	U. S. N. M.	100 nectophores	5672	Do.
1649	M.C.Z.	About 100 nectophores	5672	Do.

The question of the possible identity of the tropical Indo-Pacific *australis* with the boreal Atlantic *biloba* Sars has been discussed fully in my report on the eastern tropical Pacific collection (1911*b*). According to Moser (1913) the two are identical. The present specimens agree very well with the eastern Pacific representatives. The length of the somatocyst varies a good deal—it is always short, reduced to a mere bubble in some, and in a few of the most fragmentary ones none is to be seen. But in these its absence is only the result of mutilation.

I was in hopes that this large series would throw some light on the question of the identity of *G. chuni* of Lens and Van Riemsdijk, resembling *australis*, except for a much longer somatocyst, which I referred provisionally to the synonymy of the latter. But none of the specimens approach the *chuni* type. According to Moser (1913) *chuni* is distinct, but she does not state the difference.

GALEOLARIA MONOICA Chun.

Epibulia monoica Chun, 1888, p. 17.

Galeolaria monoica Chun, 1897, p. 17.—Lens and Van Riemsdijk, 1908, p. 60, pl. 9, figs. 76, 77.—Bigelow, 1911*b*, p. 239, pl. 6, figs. 4–9, 1918, p. 418.

Galeolaria monoica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29348	U.S.N.M.	1 nectophore	5669	Macassar Strait.
3054	M.C.Z.	1 nectophore	5669	Do.

These two nectophores are in fair condition and show the complex basal structure which I have described elsewhere (Bigelow, 1911*b*, p. 239). The small somatocyst in conjunction with a prominent dorsal and two lateral teeth and two ventral wings distinguishes the superior nectophore, while the inferior one is characterized by similar teeth and a single undivided ventrobasal wing.

Genus DIPHYES Cuvier.

DIPHYES APPENDICULATA Eschscholtz.

Diphyes appendiculata Eschscholtz, 1829, p. 138, pl. 12, fig. 7. Synonymy, Bigelow, 1911*b*, p. 248, pl. 7, figs. 5, 6; pl. 8, figs. 7, 8; pl. 9, fig. 6; pl. 11, fig. 1.

Diphyes appendiculata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
1650	M.C.Z.	4 superior nectophores	5320	
40462	U.S.N.M.	2 superior nectophores	5320	China Sea, vicinity of Hongkong.
1613	M.C.Z.	1 superior nectophore	5320	Do.
29316	U.S.N.M.	1 superior and 1 inferior nectophore.	5437	Off west coast of Luzon.
29317	U.S.N.M.	5 superior nectophores	5530	Between Siquijor and Bohol.
3060	M.C.Z.	2 superior nectophores	5530	Do.
29314	U.S.N.M.	1 superior nectophore	5581	Vicinity Darvel Bay, Borneo.
29313	U.S.N.M.	3 superior nectophores	5601	Gulf of Tomini, Celebes.
....	M.C.Z.	1 superior nectophore	5601	Do.
29315	U.S.N.M.	4 superior nectophores	5616	Molucca Passage.
3058	M.C.Z.	2 superior nectophores	5616	Do.
40463	U.S.N.M.	2 superior nectophores	5643	Buton Strait.
1612	M.C.Z.	1	5643	Do.

The present series shows that in the Philippine, as in the Biscayan and Pacific specimens, the number of ridges at the apex, 3, is constant; nor is there any variation from the rule that the fourth, which arises some distance below the apex, invariably becomes the left lateral.

D. appendiculata is very generally distributed over the tropical Pacific, as well as the Atlantic.

DIPHYES CONTORTA, Lens and Van Riemsdijk.

Diphyes contorta Lens and Van Riemsdijk, 1908, p. 39, pl. 6, figs. 48–50.—Bigelow, 1911*b*, p. 254, pl. 7, fig. 8; pl. 8, fig. 3; pl. 11, fig. 2.

Diphyes contorta—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
....	....	2 superior nectophores	5320	China Sea, vicinity of Hongkong.
29342	U.S.N.M.	6 superior nectophores	5436	Off Corregidor Lt., west coast of Luzon.
3057	M.C.Z.	4 superior nectophores	5436	Do.
29325	U.S.N.M.	1 superior nectophore	5581	Vicinity Darvel Bay, Borneo.
29323	U.S.N.M.	4 superior nectophores	5601	Gulf of Tomini, Celebes.
3056	M.C.Z.	1 superior nectophore	5601	Do.
40468	U.S.N.M.	2 superior nectophores	5611	Do.
1867	M.C.Z.	1 superior nectophore	5611	Do.
1641	M.C.Z.	5 superior nectophores	5616	Molucca Passage.
....	....	7 superior nectophores	5616	Do.
40469	U.S.N.M.	1 superior nectophore	5649	Buton Strait.

The specimens are all 5 to 6 mm. long.

The general structure of the superior nectophore of *D. contorta* has been described in detail by its discoverers; the present series agrees very well with their account except for one point already noted in my discussion of the eastern Pacific collection (1911*b*). Instead of there being five ridges at the apex, as Lens and Van Riemsdijk state, there are only four, for the right ventral invariably arises a short distance below the apex. I have seen no variation from this in either Pacific or Philippine specimens.

The series is especially interesting because three specimens have buds for inferior nectophores so far developed that there is no doubt of their future fate. This discovery shows that *contorta* is unquestionably a diphyid, not a monophyid: the absence of special nectophores in the groups of appendages (Lens and Van Riemsdijk, 1908) places it in *Diphyes* rather than in *Diphyopsis*.

The peculiar asymetry of *contorta* and the form of the somatocyst are so characteristic that it is not likely to be confused with any other species. The species is so far known from the Malay Archipelago, the eastern tropical Pacific, Japan (Bigelow, 1913), the Philippines, the Seychelles (Moser, 1913), and has recently been recorded by Moser (1913) from the Atlantic.

Genus DIPHYOPSIS Haeckel.

DIPHYOPSIS BOJANI (Eschscholtz) Bigelow.

Eudoxia bojani ESCHSCHOLTZ, 1825, p. 743, pl. 5, fig. 15.

Diphyes bojani BIGELOW, 1911*b*, p. 251, pl. 7, fig. 2, 3; pl. 8, fig. 6; pl. 9, figs. 1, 2; pl. 10, figs. 2, 3; pl. 11, fig. 5; pl. 12, fig. 1, 1918, p. 424, [full synonymy].

Diphyopsis bojani—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29321	U.S.N.M.	1 superior nectophore	5320	China Sea, vicinity of Hongkong.
29320	U.S.N.M.	1 superior nectophore	5340	Malampaya Sound, Palawan.
1609	M.C.Z.	1	5340	Do.
40464	U.S.N.M.	1 superior nectophore	5436	Off Corregidor Light, west coast of Luzon.
1611	M.C.Z.	1	5436	Do.
29319	U.S.N.M.	1	5456	Off east coast of Luzon.
40465	U.S.N.M.	1 superior nectophore	5530	Between Siquijor and Bohol.
40466	U.S.N.M.	1 superior nectophore	5539	Between Negros and Siquijor.
40467	U.S.N.M.	1 superior nectophore	5669	Macassar Strait.

According to Moser (1911, 1913) *Ersaea bojani* Eschscholtz, which I was unable (1911*b*) to connect definitely with any Diphyid, belongs to this species; and she also unites *D. bojani* with the Atlantic *D. steenstrupi* Gegenbaur. This I can myself confirm (1918) from Atlantic specimens recently studied. *D. serrata* Chun probably belongs here also.

These few examples add little to the account of the eastern Pacific and "*Bache*" series (1911*b*, 1918).

In *D. bojani* the number of ridges at the apex of the superior nectophore is variable, the specimens with 3, 4, and 5, in a series of 50 from the eastern Pacific, being in the proportions of about 1, 5, and 10.

In the present small series there are six specimens with five ridges at the apex, two with four. Individuals with four ridges at the apex fall into two main classes; there may be a dorsal, one lateral and two ventral, the second lateral arising from a division of one of the ventrals a short distance below the apex, or there may be a dorsal, two laterals and one ventral, the latter dividing into two. The two Philippine specimens in question belong to class 1. In each the right lateral ridge arises through a bifurcation of the right ventral. Various intermediates occur, and in some specimens the apex is not a point, but a flat area of appreciable size, from the top of which the ridges originate; or, again, it may be represented by a short transverse dorso-ventral ridge. In short, the five ridges of *bojani* show very wide individual variability, but they always arise, by whatever method, close to the apex; and, so far as my observations go, the dorsal ridge never branches, and always arises at the apex. It is the proved variability of the ridges that has led to my uniting the *D. indica*, *D. malayana*, and *D. gegenbauri* of Lens and Van Riemsdijk as synonyms of *bojani*.

The only diphyiids with which *bojani* might be confused are young specimens of *Diphyopsis dispar;* but the presence of minute teeth on the dorsal hydroecial wall in *bojani* separates it from *dispar* (1918, p. 424, pl. 8, figs. 3, 4). I had overlooked these teeth until Doctor Moser called my attention to them in a letter. But they are shown by Gegenbaur (1860, pl. 29, fig. 27); and the narrow outline of *bojani* separates it at the first glance from adult *dispar*.

D. bojani is widely distributed over the warmer parts of the Pacific and Atlantic; it was therefore to be expected in Philippine waters.

DIPHYOPSIS DISPAR (Chamisso and Eysenhardt) Chun.

Diphyes dispar Chamisso and Eysenhardt, 1821, p. 365, pl. 33, fig. 4.
Diphyes campanulifera Eschscholtz, 1829, p. 137, pl. 12, fig. 6. Synonymy Bigelow, 1911*b*, p. 257.

Diphyopsis dispar—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40470	U.S.N.M.	3 superior nectophores	5320	China Sea, vicinity of Hongkong.
1629	M.C.Z.	2 superior nectophores	5320	Do.
29337	U.S.N.M.	20+ nectophores	5436	Off Corregidor Lt., west coast of Luzon.
3064	M.C.Z.	5 nectophores	5436	Do.
29332	U.S.N.M.	2 nectophores	5500	Off Northern Mindanao.
3063	M.C.Z.	1 nectophore	5500	Do.
40471	U.S.N.M.	2 nectophores	5530	Between Siquijor and Bohol.
1630	M.C.Z.	1 nectophore	5530	Do.

Diphyopsis dispar—material examined—Continued.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29329	U.S.N.M.	12+ superior nectophores	5581	Vicinity Darvel Bay, Borneo.
3062	M.C.Z.	3 nectophores	5581	Do.
29333	U.S.N.M.	2 nectophores	5601	Gulf of Tomini, Celebes.
1647	M.C.Z.	4 nectophores	5611	Do.
29335	U.S.N.M.	15 nectophores	5616	Molucca Passage.
1627	M.C.Z.	5 nectophores	5616	Do.
40472	U.S.N.M.	15+ nectophores	5649	Buton Strait.
1628	M.C.Z.	7+ nectophores	5649	Do.
29403	U.S.N.M.	30+ nectophores	5663	Macassar Strait.
1652	M.C.Z.	12 nectophores	5663	Do.
29330	U.S.N.M.	3 nectophores	5669	Do.
1646	M.C.Z.	1 nectophore	5669	Do.
29336	U.S.N.M.	6 nectophores	5672	Do.
3061	M.C.Z.	3 nectophores	5672	Do.

I have given elsewhere (1911*b*) my reasons for uniting the Indo-Pacific *dispar* with the Atlantic *campanulifera*.

The general form of the superior nectophore is so characteristic that it is not likely to be confused with any other diphyid.

The proportions between length and breadth in 25 specimens, ranging from 9 to 22 mm. in length, are given in the following table:

Length.	Breadth.	Proportion, length, breadth.	Length.	Breadth.	Proportion, length, breadth.
9	4	2.25–1	13	6	2.1 –1
9	3	3 –1	13	6	2.1 –1
9	3	3 –1	14	6.5	2.1 –1
10	4.5	2.2 –1	14	6.5	2.1 –1
10	4	2.5 –1	15	7	2.1 –1
10	4	2.5 –1	15	7+	2.1 –1
10	4	2.5 –1	16	8.5	1.8 –1
10	4.5	2.2 –1	17	10	1.7 –1
12	5	2.4 –1	18	10	1.8+–1
12	6	2 –1	18	9	2 –1
12	4.5	2.6 –1	21	10.5	2 –1
13	6	2.1 –1	22	12	1.8 –1
13	6	2.1 –1			

This table shows that proportional length decreases very slightly on the average with growth. The ratio is approximately slightly more than 2 to 1 in small specimens, 10 mm. high or less, about 2 to 1 in moderate sized, and slightly less than 2 to 1 in the largest.

DIPHYOPSIS MITRA (Huxley) Bigelow.

Diphyes mitra Huxley, 1859, p. 36, pl. 1, fig. 4.

Diphyopsis diphyoides Lens and Van Riemsdijk, 1908, p. 51, pl. 8, figs. 65, 66. For synonymy and description, Bigelow, 1911*b*, p. 258, pl. 7, fig. 9; pl. 9, fig. 4; pl. 10, figs. 4, 15; pl. 11, fig. 6; pl. 12, fig. 5.

Diphyopsis mitra—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40473	U.S.N.M	6 superior nectophores	5436	Off Corregidor Light, west coast of Luzon.
1635	M.C.Z	1 superior nectophore	5436	Do.
29338	U.S.N.M	5 superior nectophores	5500	Off northern Mindanao.
29341	U.S.N.M	1 superior nectophore	5500	Do.
1625	M.C.Z	1 superior nectophore	5500	Do.
29340	U.S.N.M	3 superior nectophores	5530	Between Siquijor and Bohol.
1616	M.C.Z	2 superior nectophores	5530	Do.
40474	U.S.N.M	1 superior nectophore	5611	Gulf of Tomini, Celebes.
29339	U.S.N.M	3 superior nectophores	5616	Molucca Passage.
40475	U.S.N.M	1 superior nectophore	5649	Buton Strait.

The specimens range in length from 3 to 9 mm. They agree so well with the account by Lens and Van Riemsdijk (1908) and with the *Albatross* eastern Pacific series (Bigelow, 1911*b*) that no description of them is necessary here, further than to note that they show no noticeable variation in the distinctive specific characters, that is, 5 ridges at the apex, short hydroecium almost wholly below the bell opening; short pear-shaped somatosyst; total absence of basolateral teeth, and baso-dorsal tooth hardly distinguishable. None of the specimens have inferior nectophores attached, nor were any found loose.

D. mitra is widely distributed over the eastern tropical Pacific, as well as in the Malaysian region. I have myself studied typical specimens of it from the West Indies and western Atlantic (Bigelow, 1918).

DIPHYOPSIS CHAMISSONIS (Huxley) Bigelow.

Diphyes chamissonis Huxley, 1859, p. 36, pl. 1, fig. 3.

Diphyopsis weberi Lens and Van Riemsdijk, 1908, p. 53, pl. 8, figs. 67, 68.

Diphyopsis chamissonis [Synonymy], Bigelow, 1911*b*, p. 347.

Diphyopsis chamissonis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29328	U.S.N.M	3 superior nectophores	5436	Off Corregidor Light, west coast of Luzon.
3071	M.C.Z	1 superior nectophore	5436	Do.
29326	U.S.N.M	1 superior nectophore	5500	Off northern Mindanao.
40528	U.S.N.M	18 superior nectophores	5649	Buton Strait.
3069	M.C.Z	17 superior nectophores	5649	Do.
40529	U.S.N.M	13 superior nectophores	5663	Macassar Strait.
1648	M.C.Z	10 superior nectophores	5663	Do.
29327	U.S.N.M	2 superior nectophores	5669	Do.
3070	M.C.Z	1 superior nectophore	5669	Do.

I have already (1911*b*) pointed out that the *Diphyopsis weberi* of Lens and Van Riemsdijk was identical with the form long ago recorded by Huxley as *Diphyes chamissonis* and recently redescribed by Browne (1904); and the present series supports this view.

Huxley's figure (1859, pl. 1, fig. 3) shows that the superior nectophore of his specimens had all the important external characters which distinguish *weberi;* that is, prominent dorso-basal and lateral-basal teeth; hydroecium deep, reaching to one-third or one-half the length of the nectosac, and extending well below the bell-mouth; short fusiform somatocyst; and nectosac not constricted apically. The only noticeable difference is that in Huxley's figure the apex of the nectophore is rather blunter than it is shown by Lens and Van Riemsdijk. But we must remember that Huxley drew his figure from living or at least fresh material, whereas the *Siboga* specimens were studied after preservation. Furthermore the present series shows that there is a considerable range of variation in the acuteness of the apex as well as in the proportion between the breadth of the nectophore and its length. Therefore this slight difference is merely individual, perhaps the result of contraction. The number of ridges at the apex (five) is constant, as are the other distinguishing characters noted above.

The present specimens agree very well with the accounts by Browne (1904, p. 742, pl. 54, fig. 6) and by Lens and Van Riemsdijk (1908). The stems are invariably broken off, only 2 to 4 of the most proximal and youngest groups of appendages being intact. They are not sufficiently advanced to show the buds for special nectophores discovered by Lens and Van Riemsdijk.

The largest specimen is 12 mm. long, rather larger than the *Siboga* examples, which averaged 7 mm. long, but about the same size as Huxley's and Browne's. The inferior nectophore of this species is unknown, but Lens and Van Riemsdijk saw the bud for this structure. The detached inferior nectophores which they thought might belong to this species (1908, p. 55) have since proved to be *D. mitra* (Bigelow, 1911*b*).

D. chamissonis is so far known only from the Indo-Pacific—*i. e.*, east coast of Australia and Louisiade Archipelago (Huxley), Malay Archipelago (*Siboga*), Ceylon, and the Maldives (Browne, 1904, 1905), Japan, Sumatra, New Guinea, the Seychelles (Moser 1913), and the Philippines. There are no Atlantic records.

Genus CHUNIPHYES Lens and Van Riemsdijk.

CHUNIPHYES MULTIDENTATA, Lens and Van Riemsdijk.

Chuniphyes multidentata Lens and Van Riemsdijk, 1908, p. 13, pl. 1, figs. 9–11; pl. 2, figs. 12–15.—Bigelow, 1911*a*, p. 348; 1911*b*, p. 262; pl. 8, fig. 9; pl. 10, fig. 7; pl. 12, fig. 6; 1913, p. 73; 1918, p. 425.

Chuniphyes multidentata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29302	U.S.N.M.	1 superior and 1 inferior nectophore.	5320	China Sea, vicinity of Hongkong.
1607	M.C.Z.	1 superior nectophore	5320	Do.

This interesting species is now fairly well known, thanks to the collections made by the *Siboga*, by the *Albatross* in the eastern Pacific, and by Doctor Fowler in the Bay of Biscay. One of the present superior nectophores is hopelessly crumpled, but the other is in good enough condition to show that it is a perfectly typical example. The median dilation of the somatocyst, which is apparently so constant that it may fairly be called characteristic of the species, is crescentic—that is, prolonged transversely on each side as a horn, just as it was in four of the Biscayan specimens (Bigelow, 1911*a*).

The occurrence of an example of this type in the Philippines is especially interesting, because it shows that, as I supposed, the difference between crescentic, and spherical as seen in one Pacific example, is merely a case of individual variation, or the result of contraction, not evidence of two local races.

The much crumpled inferior nectophore agrees very well with the corresponding one described from the eastern Pacific (Bigelow, 1911*b*).

All previous records of *Chuniphyes* are from intermediate or closing-net hauls. It has never been taken on the surface. Unfortunately no information is available as to the level from which the Philippine specimens came.

Family UNCERTAIN.

ARCHISOMA NATANS Bigelow.

Archisoma natans Bigelow, 1911*b*, p. 266, pl. 20, fig. 6.

Station 5659 Gulf of Boni, Celebes; 1 specimen in very good condition except for the tentilla, which are all fragmentary; bract, 43 mm. long; special nectophore, 24 mm. with three very young gonophores, and one older but damaged one (Cat. No. 29396, U.S.N.M.).

The capture of an excellent example of this remarkable eudoxid was timely, for it allows me to substantiate the main features of my previous account and to add to it in some particulars.

In the eastern Pacific specimen the canal system of both bract and nectophore was damaged, consequently the figure (1911*b*, pl. 20, fig. 6) was incomplete in this respect. In the present representative the canals are well preserved and follow the same general plan. The ascending branch of the bracteal somatocyst has a transverse branch running to the dorsal surface (represented in the earlier figure by dotted lines). The two descending (hydroecial) trunks are separate from the beginning, all three arising at the same point, descending over the two faces of the hydroecium, on the right and left, respectively, to unite near the tip of the bract. In the present specimen their point of union is slightly nearer the extremity of the bract than it was in the eastern Pacific one.

The canal system of the special nectophore is especially interesting because it gives us our only clue to the identity of this eudoxid. There is a single main trunk running along the dorsal face of the hydroecium, forming its pedicular canal at its upper end, and reaching the extremity of the basal prolongation of the bell. It gives off four chief branches as follows: one opposite the upper, one opposite the lower face, of the nectosac: the other two together, opposite the center of the nectosac. These four join the nectosac at its widest level—that is, some distance below its apex—to form the subumbral canals. The basal ends of these four trunks could be seen in the eastern Pacific specimen, but their courses could not be traced.

Now, this same type of subumbral canals is to be seen in the monophyid *Nectopyramis thetis* Bigelow (1911*a*), and, so far as I am aware, in no other siphonophore. The implication, of course, is that *Archisoma* is the free eudoxid of *N. thetis*. This, of course, is proposed only tentatively; the gaps in the chain of evidence are much more extensive than its links. One objection is that the only record of *N. thetis* is from the Atlantic. But, judging from what we know of the distribution of other siphonophores, this is not serious. If my suggestion should prove correct it would be of great importance systematically, because the only other species yet referred to *Nectopyramis*, *N. albatrossi*, lacks the special nectophore, and likewise has subumbral canals of the ordinary type.

Suborder PHYSOPHORAE.

Family FORSKALIIDAE Haeckel, 1888.

Genus FORSKALIA Kölliker, 1853.

FORSKALIA, species ?.

Jolo. One very fragmentary specimen (Cat. No. 29344, U.S.N. M.) minus all the older nectophores and all the bracts, and much contracted.

The single example of *Forskalia* is in such poor condition that it is hopeless to try to identify it specifically. But the younger nectophores are of the characteristic *Forskalia* outline, as are the siphons.

Family AGALMIDAE Brandt, 1835.

Genus AGALMA Eschscholtz, 1825.

AGALMA OKENI Eschscholtz.

Agalma okeni ESCHSCHOLTZ, 1825, p. 744, pl. 5, fig. 17; 1829, p. 151, pl. 13, figs. 1*a*–1*d*. Synonymy, Bigelow, 1911*b*, p. 277.

Agalma okeni—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29283	U.S.N.M.	2 nectophores	5340	Malapaya Sound, Palawan.
3065	M.C.Z.	2 nectophores	5340	Do.
40530	U.S.N.M.	3 nectophores	5456	Off east coast of Luzon.
29288	U.S.N.M.	4 nectophores	5500	Off northern Mindanao.
29382	U.S.N.M.	4 nectophores	5500	Do.
3066	M.C.Z.	3 nectophores	5500	Do.
29390	U.S.N.M.	7 nectophores	5530	Between Siquijor and Bohol.
3067	M.C.Z.	3 nectophores	5530	Do.
29287	U.S.N.M.	4 nectophores	5601	Gulf of Tomini, Celebes.
29395	U.S.N.M.	4 nectophores	5601	Do.
3068	M.C.Z.	2 nectophores	5601	Do.
29285	U.S.N.M.	1	5669	Macassar Strait.
1656	M.C.Z.	Fragments	5669	Do.

Also many fragments from station 5489 [M.C.Z., Cat. No. 1757, and U.S.N.M., Cat. No. 29421].

This widely distributed species, usually known either as *Crystallomia polygonata* Dana, or as *Crystallodes vitreus* Haeckel, has been described in detail by Haeckel (1869, 1888), by Lens and Van Riemsdijk (1908), and by me in a previous paper (1911*b*).

The present series consists of fragments. Most of the records are from detached nectophores and bracts. But these have such characteristic forms that they are not likely to be misidentified.

A. okeni is already known from Malayan waters (Lens and Van Riemsdijk, 1908; Bedot, 1896); and is common and generally distributed in the tropical parts of the Pacific, as well as in the Atlantic and Indian Oceans. And Moser (1915) now reports it from the Mediterranean.

Family PHYSOPHORIDAE Eschscholtz, 1829.

Genus PHYSOPHORA Forskål, 1775.

PHYSOPHORA HYDROSTATICA Forskål.

Physophora hydrostatica FORSKÅL, 1775, p. 114; 1776, pl. 33, fig. *e*. Synonymy, Bigelow, 1911*b*, p. 293, pl. 16.

Station 5175: Sulu Sea between Palawan and Negros; 1 specimen, 8 mm. long, (Cat. No. 29376, U.S.N. M.). The stem is denuded, but there are a few palpons and nectophores in the bottle.

The characteristic dilation of the siphosome identifies this fragmentary specimen.

Suborder RHIZOPHYSALIAE.

Family PHYSALIIDAE Brandt, 1835.

Genus PHYSALIA Lamark, 1801.

PHYSALIA UTRICULUS (La Martinière) Eschscholtz.

Medusa utriculus La Martinière, 1787, p. 365, pl. 2, figs. 13, 14. Synonymy, Bigelow, 1911*b*, p. 323.

Locality.—Latitude 25° 10′ N.; longitude 166° 20′ W., between Oahu and Midway Island; 3 specimens (Cat. No. 29411, U.S.N.M.), with pneumatophore 22 to 30 mm. long. It is somewhat surprising that during so long a cruise only three small specimens of a species so common and generally distributed over the warmer parts of the Indo-Pacific were collected.

Suborder CHONDROPHORAE.

Family PORPITIDAE Brandt, 1835.

Genus PORPITA, Lamark, 1801.

PORPITA, species?

Locality.—Latitude 25° 10′ N.; longitude 166° 20′ W., between Oahu and Midway Island; 5 specimens (Cat. No. 32994, U.S.N.M., 4 specimens; Cat. No. 1606, M.C.Z., 1 specimen), 7 to 10 mm. in diameter.

These specimens are so young that I hesitate to identify them specifically. From the standpoint of the zoogeophrapher an incorrect identification would be much worse than none, because the question whether the Porpitas of Philippine, Malayan and Indian waters belong to the smooth Atlantic *umbella*, or to the papillated Pacific *pacifica* is an open one (Bigelow, 1911*b*.) The upper surface of the disk is smooth in these Philippine specimens; but it is probable that the papillae which occur in this region in large *pacifica* are formations which appear late in development. The same is true of the complex branching of the limbar canals of *pacifica* which passes, in growth, through what may be called an "umbella" stage. The present specimens might develop either into *umbella* or into *pacifica*.

Class CTENOPHORES.

Order BEROIDA.

Family BEROIDAE Eschscholtz, 1829.

Genus BEROE Fabricius, 1780.

The genus name *Beroe* has usually been credited to its author, P. Browne (1756), but according to the international rules of zoological nomenclature, it should date from its earliest post Linnean employer, Fabricius (1780).

The Beroes in the Philippine collection are all of the *ovata* type, which, as Mortensen (1912) has conclusively shown, is merely a variety of *Beroe cucumis*.

BEROE CUCUMIS Fabricius, variety OVATA Bosc.

Plate 38, figs. 8–10.

Beroe ovatus Bosc, 1892, p. 149, pl. 18, fig. 1. Synonymy, Mortensen, 1912, p. 83.

Beroe cucumis variety *ovata—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Length in mm.
....	....	6 (none sexually mature).	5128	Sulu Sea, vicinity southern Panay.	20–45
29919	U.S.N.M........	3........................	5214	Off east coast of Masbate.	60–80
1725	M. C. Z.........	1........................	5214	.....do..................	60–80
....	....	5........................	5258	Off southern Panay......	90–95
....	....	Fragments of 3 specimens.	5180	Off Romblon Light, Romblon.	About 65.
29400	U.S.N.M........	Fragments................	5186	Between Panay and Negros.	....
....	....	2 fragmentary specimens.	5195	Off northern Cebu........	....
....	....	1 fragmentary specimen..	5261	Off Southern Mindoro....	About 50.
29419	U.S.N.M........	.....do..................	5293	China Sea, vicinity southern Luzon.	....
29295	.....do..........	Fragments................	5295	.....do..................	....

All the Beroes in the present series show the canal structure typical of *ovata*. The photographs show that the canals derived from the meridional system do not form a network (pl. 43, fig. 8); that there are numerous transverse stolons uniting with the gastric system (pl. 43, fig. 9); and that the latter anastomose in a loose and irregular net. The gonads are in the form of bands without lateral lobes (pl. 43, fig. 10).

The preserved specimens range in outline from the example photographed to egg-shaped; and a drawing made on board the Bureau of Fisheries steamer *Albatross* from life is of the typical *ovata* form. Their chief interest lies in the fact that, so far as I can learn, the *ovata* form is not recorded from the Indo-Pacific, although *cucumis* and *B. forskalii* both have been.

GEOGRAPHICAL DISTRIBUTION.

The list of Medusae from the Philippines lacks several which might have been expected; for instance, I could not find a single example of *Aglaura hemistoma* in the considerable quantity of unsorted Plankton submitted to me. But since this species is not only known from Maylayan waters, but is recorded very generally from the warmer parts of all oceans, it is hardly conceivable that it can be absent from the Philippines. The same is true of the species of *Liriope* with round or oval gonads. *Proboscidactyla ornata*, too, placed in the oceanic group by its budding phase, has been taken on both sides of the Philippines, and so have *Slabberia brownei* and *Gonionemus suvaensis*. These instances merely show how far from adequate, as a survey of the Medusa fauna of any region, a single collection is likely to be.

Medusae were collected at only 57 of the 571 stations occupied, and few species were taken at more than 3 or 4 stations each. They do not suffice for an attempt to plot their occurrence among the Philippine Islands. But when we add to them the records of the recent collections from Malayan waters (*Siboga* Maas, 1905; Bedot, 1906) and from the west coast of Sumatra (*Valdivia* Vanhöffen, 1902, 1908, 1911), and Mayer's (1915) list from Torres Straits, we have sufficient data for a tentative discussion of the relationship of the Medusa fauna of the Philippine-Malayan region to that of other parts of the Indo-Pacific.

The most obvious comparison is between the Philippines and the Malay Archipelago *sensu strictu.* Out of the total of 26 Philippine species, 15 were taken by the *Siboga*, by Bedot at Amboina, or by the *Valdivia* off the west coast of Sumatra. Three are new, and all of those which remain have been recorded either from the tropical Pacific, from the Indian Ocean, or from both. Furthermore, all recorded Malayan forms not collected in the Philippines are recorded from the Pacific or from the Indian Oceans, or both, except five, which are known from only a single record each, and five known from the Atlantic or represented there by hardly distinguishable allies.

There would be no reason on geographic grounds to expect any separation between Philippine and Malayan waters, so far as their medusae are concerned, and the data outlined above shows that there is none. Indeed, it is surprising that the apparent unity is as great as it is, when we remember how little work has been done in either region, the difference being no greater than would naturally be expected for any two different collections made several years apart. There is no conclusive evidence that either has any medusae peculiar to it, for a *single* record can not be given that weight, even if the form in question has never been taken elsewhere.

In the following pages the surface species and those belonging to the intermediate depths are treated separately, because the two groups are subject to very different environments.

1. Surface Species.

Under this term are included all species known from the surface, except for *Halicreas papillosum*, a typical "intermediate" form which has been taken sporadically at the surface (Bigelow, 1909*a*). I have also included two species, *Protiara tropica* and *Phortis elliceana*, for which we can not yet assign a definite habitat, but which probably are epiplanktonic. In the accompanying table (p. 350) the records of the Philippine-Malayan surface species is plotted, for various parts of the Indo-Pacific region, from east to west, only well-authenticated records and species the validity of which seems reasonably assured being included.

There are three general directions along which the species in question can be followed—westward, northward, and eastward. We can not trace them to the south because our knowledge of the Medusa fauna of the northern shores of Australia and of the neighboring islands is almost *nil.* But not one of our Philippine species appears in Von Lendenfeld's (1887) list of medusae from Port Jackson, New South Wales (34° south latitude.)

DISTRIBUTION OF MALAYAN-PHILIPPINE SURFACE HYDROMEDUSAE.

Octocanna polynema Haeckel is omitted because the specimens so named may have been *Phialidium* (p. 306).

	Alguhlas Stream.	Western Indian Ocean.	Zanzibar.	Red Sea.	Maldives and Chagos.	Ceylon.	Bay of Bengal.	W. Sumatra.	Malaysian.	Philippines.	Central Tropical Pacific.	Hong Kong-Amoy.	Japan.	West Coast of America.	Atlantic.
Euphysora bigelowi		×			×			×	×			×			
Euphysora valdiviae								×							
Pennaria disticha									×						×
Pennaria armata								×							
Cytaeis tetrastyla		×			×	×			×	×	×		×	×	×
Dendroclava dohrnii									×						×
Bougainvillea fulva		×		×	×				×	×	×			×	
Rathkea octonemalis									×						
Amphinema turrida [1]									×					×	×
Protiara tropica										×					
Leuckartiara octona		×							×	×	×		×	×	×
Neoturris pelagica										×				×	
Heterotiara minor			×		×				×	×					
Proboscydactyla ornata		×			×	×			×				×	×	×
Laodice fijiana						×			×		×				
Melicertidium malayicum									×						
Cannota dodecantha [2]									×		×				—
Toxorchis thalassina [2]									×						—
Tiaropsis rosea		×							×		×				—
Mitrocoma minervae	×							×						—	—
Phialidium discoida					×				×				×	×	×
Phialidium heptactis								×							
Phialucium mbengha				?	×			×	×	×	×	?			
Phortis elliceana										×	×				
Phortis ceylonensis						×	×			×	?				
Phortis palkensis						×	×					×			
Irenopsis hexanenalis			×		×	×	×		×						
Eutima levuka				×	×	×			×	×	×	?		×	
Eutima mira [1]						×			×			×		?	×
Octocanna aphrodite									×	×					
Aequorea aequorea var. *macrodactylum*			×		×				×	×	×	×		×	×
Aequorea pensile	×	×			×	×			×	×	×	×	×		
Aequorea globosa									×		?				
Zygocanna vagans									×	×					
Olindias phosphorica									×						×
Olindias singularis					×	?				×	×				
Nauarchus halius										×					
Liriope tetraphylla		×		×	×	×			×	×	×	×	×	×	×
Liriope sp									×		×			×	—
Geryonia proboscidalis		×								×	×			×	×
Aglaura hemistoma		×		×	×				×		×	×	×	×	×
Rhopalonema velatum		×			×				×	×	×		×	×	×
Cunoctantha octonaria									×		×			×	×
Solmissus marshalli		—		—						×	×				
Aegina citrea					×				×	×	×		×	×	×
Aegina rosea									×	×			×		×
Solmundella bitentaculata		×			×	×			×	×	×	×	×	×	×
Hydroctena salenskyi									×						
Pegantha pantheon									×						

[1] Torres Straits. [2] New Guinea.

× Definite record.
— indicates that the species is represented by a form so closely allied that it may prove identical.

Out of the total of 48 Philippine-Malayan species no less than 21 are definitely known from some part of the western half of the tropical Pacific, chiefly from Polynesia; that is to say, about as large a proportion as is common to Malayan and Philippine waters. And the agreement is the more striking in view of the fact that nearly all our modern knowledge of the medusa-fauna of the central tropical Pacific is based on the three collections made by Agassiz on his expeditions to Fiji (Agassiz and Mayer, 1899), through Polynesia (Agassiz and Mayer, 1902) and to the eastern Pacific (Bigelow, 1909*a*). It is evident, then, that a very uniform medusa-fauna extends from the Malay region eastward at least as far as the Paumotos. But while about 17 of the Malaysian species are known from the western coast of America, most of these, as *Aglaura*, the two species of *Liriope*, *Geryonia*, *Rhopalonema*, *Solmundella*, *Aegina*, *Proboscydactyla*, and *Cytaeis*, are typically oceanic, or "holoplanktonic," forms; either without hydroid stage, or placed in the oceanic class, so far as dispersal is concerned, by their asexual budding. Of the remaining species which are common to Malaysia and West America, three, *Bougainvillea fulva*, *Eutima levuka*, and *Leuckartiara octona*, extend from one side of the Indo-Pacific to the other; the latter being practically cosmopolitan in the Atlantic as well; and *Philalidium discoida* and *Slabberia brownei*[1] are probably also distributed over the entire breadth of the Pacific. In short, very few leptoline forms, and those few very widespread, are common to the two sides of the tropical Pacific, which supports the view, already advanced by me (1909*a*) that the broad uninterrupted oceanic area of the eastern half of the tropical Pacific has been an effective barrier to dispersal of such forms. Conversely, there is a considerable fauna peculiar to the west coast of America, only a small proportion of which extends westward to the islands of the central Pacific, or to its western part; while, on the other hand, there is an unmistakable resemblance between the leptoline forms of the west coast of America and of the tropical Atlantic, to which I have called attention elsewhere (1909*a*).

The collections from Hongkong and from Japan, recently recorded by Maas (1909), by Kishinouye (1910), by Vanhöffen (1912), and by me (1913), give some slight but welcome data on the northern extension of the tropical species of the central part of the Indo-Pacific area.

The small list from Hongkong (Vanhöffen, 1912) is typically tropical; that is *Euphysora bigelowi*, *Irenopsis hexanemalis*, *Phortis palkensis*, *Eutima levuka*, *Aequorea pensile*, *Aglaura hemistoma*, *Liriope tetraphylla* and *Solmundella bitentaculata*. But only 11 of

[1] Not included in table because not known from the Philippines or Malaysia (1909*a*).

the Malay-Philippine species are known to reach Japan, and all of these are widely distributed throughout the warm waters of the Pacific and Indian oceans; nine of them are also known in the Atlantic. That is to say, none of the characteristic tropical leptoline forms (1913, p. 109) penetrate to Japan, though the oceanic Medusae are carried thither by the Kuro Shiro current.

As I have pointed out (1913, p. 109), the probable explanation for the absence of the tropical leptoline species from Japan is that they, or their hydroids, can not survive the cooling of the water in winter; and this working hypothesis is supported by the fact that the tropical *Gonionemus suvaensis* is replaced there by *G. vertens* var. *depressum;* a variety of the species found on the temperate west coast of America, and closely allied to the one known from the corresponding zone on the coast of New England. The subtropical genus Olindias, too, is replaced in Japanese waters by Olindioides, and *Rathkea octonemalis* by *R. blumenbachii.*

Rhopalonema, *Aglaura*, and *Liriope*, and the other holoplanktonic medusae of warm waters are, on the contrary, limited in their extreme dispersal by the summer, not by the winter temperature. And though Japan is within the range of *Rhopalonema*, *Aglaura*, and *Liriope* in summer, it is doubtful whether they would be found there in winter.

In tracing the Malay-Philippine species westward we are met by the difficulty that while the combined data from the Maldives (Bigelow, 1904, Browne, 1904) and from Ceylon (Browne, 1905), (which can no longer be looked on as having separate medusa-faunae), and from the Chagos Archipelago (Brown, 1916), give a preliminary survey of the central portion of the Indian Ocean, our knowledge of the medusae of its western side is very scanty.

About 19 Malayan species are so far known from the Maldives or Ceylon, while of the 23 hydromedusae recorded by Browne (1916), from the Chagos Islands, 16 at least have already been recorded from Malaysia. And several other species from the central part of the Indian Ocean, as for example, *Slabberia brownei*, *Gonionemus suvaensis*, and *Turritopsis nutricula*, probably occur in the Philippine region as well, since they have been taken in the tropical Pacific, or in Japanese waters. In short, there is no evident separation between Malaysia and the Ceylon-Maldive-Chagos region, so far as their medusae are concerned.

Since a continuous coast line, with tropical sea temperatures, connects the two sides of the Indian Ocean, there would be no reason to expect to find their medusa-faunae different. And so far as they go, the few records available suggest uniformity. Thus *Proboscydac-*

tyla ornata, *Euphysora bigelowi*, and *Bougainvillea fulva* extend to the neighborhood of Madagascar (Browne, 1916), *Eutima levuka* and *Phialucium mbengha* to the Red Sea. And *Rhopalonema velatum*, *Aglaura hemistoma*, and *Liriope tetraphylla* are known to be as widespread in the surface waters of the tropical Indian Ocean as they are in the Atlantic (Vanhöffen, 1902; Browne, 1916), or Pacific.

These facts suggest no break in the leptoline fauna of tropical waters from the east coast of Africa to a longitude of about 130° W., that is, including the most easterly of the Paumotos; but they do show that the broad oceanic belt which separates the South Sea Islands from America marks a decided division.

2. Species from the Intermediate Depths.

Only four members of the Philippine collection can be credited to the intermediate fauna—*Calycopsis geometrica*, *Calycopsis typa* var. *simulans*, *Colobonema typicum*, and *Halicreas papillosum;* but the following have been taken in the Malaysian region by the *Siboga:* *Heterotiara anonyma*, *Pantachogon rubrum*, *Rhopalonema funerarium*, and *Aeginura grimaldii*. The only one of these not known to be widely distributed over the Indo-Pacific is *Calycopsis geometrica;* a species which may perhaps be peculiar to the Malaysian region. as *Ptychogena erythrogonon* probably is to the intermediate water layers off the west coast of tropical America. But as yet it is known from only two records. *Heterotiara anonyma* has recently been recorded from the Atlantic (Bigelow, 1918, p. 382), *Calycopsis typa* var. *simulans* has a very close ally in the Atlantic (p. 289), and the other species are all widely distributed throughout all three great oceans.

The data on the bathymetric occurrence are too scanty to be of much value, except in the cases of *Heterotiara minor* and *Colobonema typicum*. The former was taken by the *Valdivia* in two intermediate hauls; the present records show that it occurs on the surface. The records of *Colobonema* are interesting, because so shallow; they range from 350–0 to 231–0 fathoms. And the latter is particularly valuable because it is from a trawl haul, and the condition of the specimens is so good that we can hardly suppose that this instrument brought them up through a long column of water. The *Siboga* took *Colobonema* twice in comparatively shallow hauls (about 230 fathoms and 300 fathoms), and in the eastern Pacific it was taken in seven hauls between 300 fathoms and the surface (1909*a*), while Browne (1906) records it from between 250 fathoms and the surface. On the other hand, the *Valdivia* took it in a closing-net between 810 and 485 fathoms. The other records of the *Siboga* and *Valdivia* are almost all from depths greater than 500 fathoms. But, as I have pointed out elsewhere (1909*a*, p. 232) very few comparatively shallow hauls were made by either of these two expeditions, with nets fitted for capturing large organisms, except at such trivial depths as 20 or 30 fathoms. The positive evidence from the Philippines, from Malayan waters, and from the Bay of Biscay, shows that *Colobonema* is rather common in depths of 300 fathoms, or less though it undoubtedly occurs much deeper as well.

LOCATION OF STATIONS AT WHICH MEDUSAE AND CTENOPHORES WERE COLLECTED.

[Abridged from Document 741, United States Bureau of Fisheries.]

Station.	Locality.	Depth fathoms.
5097	Off Corregidor Light, China Sea off southern Luzon	30
5101	do	43–0
5120	Off Sombrero Island, Verde Island Passage	393–0
5124	Off Point Origon, east coast of Mindoro	281–0
5125	Off Nogas Island, Sulu Sea vicinity of southern Panay	411–0
5127	do	958–0
5128	do	Surface.
5129	Off Dulunguin Point, Sulu Sea off western Mindanao	100–0
5155	Off Bacun Point, Sulu Archipelago, Tawi Tawi group	
5159	Off Tinakta Island, Sulu Archipelago, Tawi Tawi group	
5169	Off Sibutu Island, Sulu Archipelago, Tawi Tawi group	10–0
5175	Off Manucan Island, Sulu Sea, southeast of Cagayanes Island	70?–0
5177	Off Escarceo Light, Verde Island Passage	260–0
5180	Off Romblon Light, Romblon	Surface.
5185	Off Lusaran Light between Panay and Negros	638–0
5186	do	Surface.
5190	Off Pescador Island, Tanon Strait, east coast of Negros	295–0
5195	Off Capitancillo Island Light, off northern Cebu Island	Surface.
5214	Off Palanog Light, east of Masabate Island	218–0
5216	Off Anima Sola Island, between Burias and Luzon	215–0
5224	Off Malabrigo Light, between Marinduque and Luzon	Surface.
5226	China Sea south of Corregidor Light	Surface.
5227	Off Point Origon, east of Mindoro	322–0
5231	Off Limasaua Island, between Bohol and Leyte	
5233	do	
5240	Off Uanivan Island, Pujada Bay	145–0
5258	Off Juraojuras Island, off south Panay	Surface.
5261	Off Balanja Point, southeast Mindanao	234–0
5374	Off Malavatuan Island, China Sea, near southern Luzon	525–0
5281	do	201–0
5293	Near Escarceo Light, China Sea vicinity of southern Luzon	180–0
5295	do	231–0
5320	China Sea near Formosa (20° 58′ N., 120° 03′ E.)	1804–0
5340	Off Cone Island, Malampaya Sound, Palawan Island	19–24
5436	Off Corregidor Light, Manila Bay, west coast Luzon	32
5437	Off Hermana Mayor Light, west coast Luzon, Manila Bay to Lengayen Gulf	
5438	do	297–0
5451	Off east point Batan Island, east coast Luzon	380–0
5456	Off Legaspi Light, east coast of Luzon	142–0
5500	Off Macabalan Light, northern Mindanao	200–0
5530	Near Balicasag Island (9° 26′ N., 123° 38′ E.)	Surface.
5533	Near Balicasag Island, between Cebu and Bohol Islands	432
5539	Near Apo Island, between Negros and Siquijor	Surface.
5553	Near Sulade Island, off Jolo Island	Surface.
5581	Off Bumbum Island, vicinity of Darvel Bay, Borneo	Surface.
5601	Off Libme Island, Gulf of Tomini, Celebes	765–0
5610	Off Batu Daka Island, Gulf of Tomini, Celebes	678
5611	Off Buka-Buka Island, Gulf of Tomini, Celebes	
5616	Off Tifore Island, Molucca Passage	
5643	Near Pendek Island, Buton Strait	215–0
5644	Near Makasser Island, Buton Strait	22–0
5649	Off North Island, Buton Strait	
5659	Off Cape Lassa, Gulf of Boni, Celebes	702–0
5663	Off Kapoposang Island, Strait of Macassar	
5669	Off Mamuju Island, Strait of Macassar	
5672	Off Dongala Light, Strait of Macassar	
	Between Oahu and Midway Island, 25° 10′ N., 166° 20′ W	

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EXPLANATION OF PLATES.

All figures are from photographs of preserved specimens.

Plate 39.

Protiara tropica.

Fig. 1. Side view of type. × about 5.

2. Transverse section of upper part of manubrium showing gonads discontinuous in perradii (*Per*) and interradii (*Int*). × 25.
3. A tentacle, with part of the radial canal.
4. Aboral view of manubrium, showing its cruciform outline, and the radial canals (*C. Ra*).

Leuckartiara octona.

5. A specimen 6 mm. high, with part of the bell-wall dissected away to show the gonads (*Go*) and lips (*L*).
6. Outer view of one tentacle of another specimen, a small tentacle (T^2), a knob (T^3), and part of a radial canal. (*C. Ra*). × 15.

Neoturris pilcata.

7. Manubrium and gonads (*Go*) of specimen 21 mm. high, (*C. Ra*) radial canal; (*L*) lip. × 5.
8. Portion of margin, to show radial canal, (*C. Ra*) and tentacles (*C. C.*), circular canal.

Heterotiara minor.

9. Specimen 8 mm. high.

Plate 40.

Fig. 1. *Neoturris pileata.* Part of margin with two tentacles (*C. C.*), circular canal.

Heterotiara minor.

2. A specimen 6 mm. high, showing contraction of the upper part of the subumbrella.
3. Upper part of the subumbrella of another similarly contracted example, with the manubrium, (*C. Ra*), radial canal. × 20.
4. Manubrium of specimen shown in plate 34, figure 9, showing folds.

Calycopsis geometrica.

5. Oblique side view showing canal system. × 3.5.
6. Manubrium of same, showing gonads (*Go*) and simple quadrate lips. The canals which appear to end blind have been broken in dissection.
7. A portion of the margin showing the pigment masses (*O*) at the bases of the tentacles.

Calycopsis typa var. *simulans.*

8. Part of the bell wall, to show canal system. One canal ends blind and 2 pairs are connected by transverse trunks. × 3.

Plate 41.

Calycopsis typa var. *simulans.*

Fig. 1. Side view of specimen with part of the bell wall cut away to show the manubrium. × 2.5.

Calycopsis geometrica.

2. Margin, with large (T^1) and small (T^2) tentacles.

Phortis elliceana.

Fig. 3. Specimen 23 mm in diameter.
4. Manubrium of another large specimen. × 8.
5. Margin, T^1, large and T^2, small tentacle; *P. Ex.*, excretory papilla; *Otc*, otocyst.
6. Pentamerous specimen 13 mm. in diameter with hydroid blastostyles borne on the gonads.
7. Portion of one of the gonads of the same.

Phialucium mbengha var. *polynema.*

8. Specimen 12 mm. in diameter.

PLATE 42.

Octocanna aphrodite.

Fig. 1. Oral view of type-specimen. × about 4.
2. Part of margin of same, showing young and old tentacles, and otocysts (*Otc*).

Aequorea pensile.

3. Specimen 50 mm. in diameter.
4. Margin of same.

Zygocanna vagans.

5. Oral view of type-specimen.
6. Margin of same, showing tentacles (T^1, T^2), knobs, and excretory papillae (*P. Ex.*).
7. Manubrium of same to show canals and lips.

PLATE 43.

Nauarchus halius.

Fig. 1. Oral view of a portion of the bell of the type-specimen, showing manubrium. one radial canal (*C. Ra*) with its gonad (*Go*), and the bases of the five others, *T. Ra*, radial tentacle. × about 6.
2. One sextant of the margin of the same, *C. Ra*, radial canal.
3. An otocyst of same.
4. Terminal portion of one of the interradial tentacles.
5. Base of a radial tentacle, showing the position of the otocyst (*Otc*).

Zygocanna vagans.

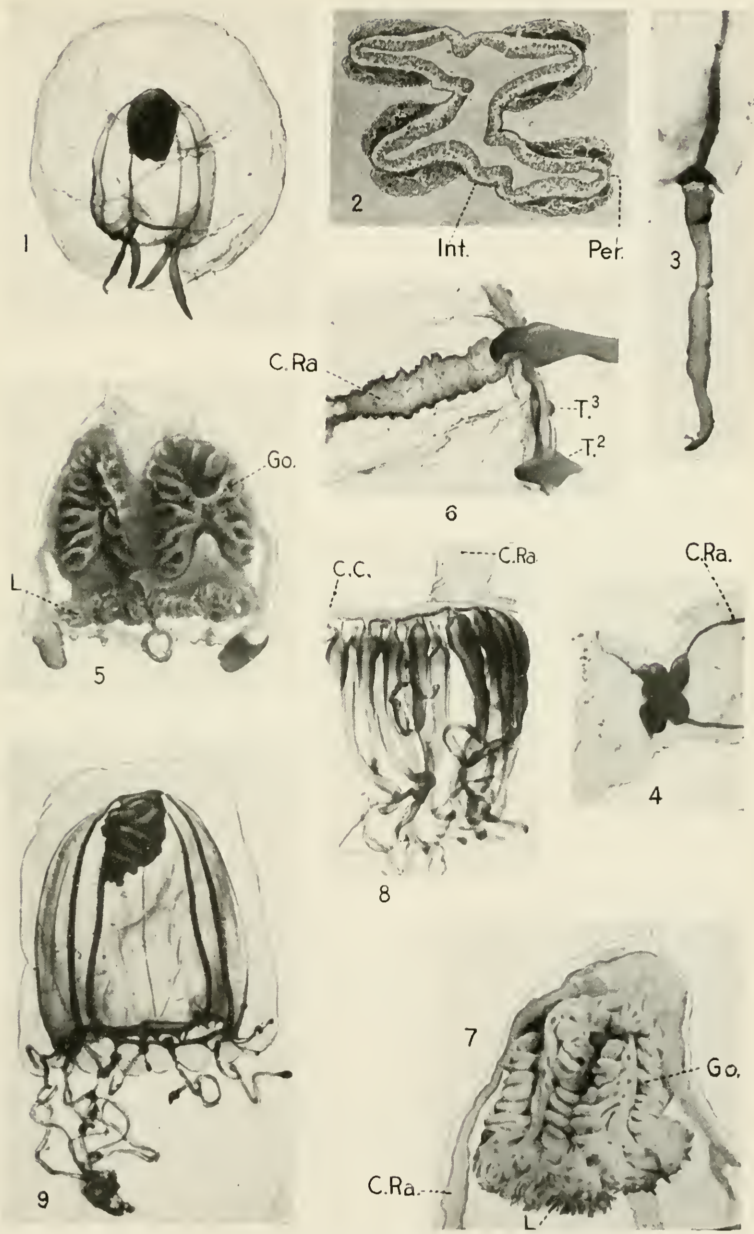
6. A segment of the subumbrella showing gonads, and gelatinous papillae (*G. P.*).

Aequorea macrodactylum.

7. Side view of base of tentacle.

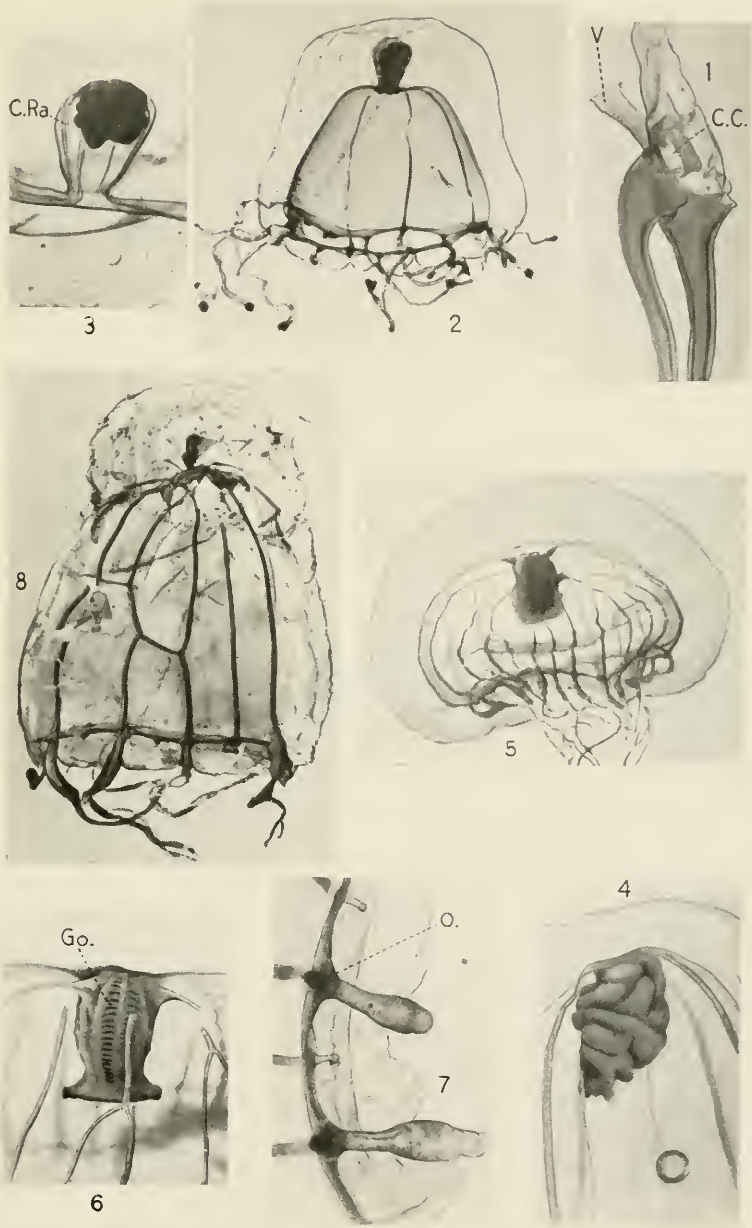
Beroe cucumis var. *ovata.*

8. General view of specimen 90 mm. high, to show ramifications of the meridional canals.
9. Section of the body wall of same, showing transverse stolons which connect meridional (*C. M.*) with gastric canals (*C. G.*).
10. Portion of one of the meridional canals, with the paddle-plates stripped off, to show the gonads.



ANTHOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGE 361.



ANTHOMEDUSAE.

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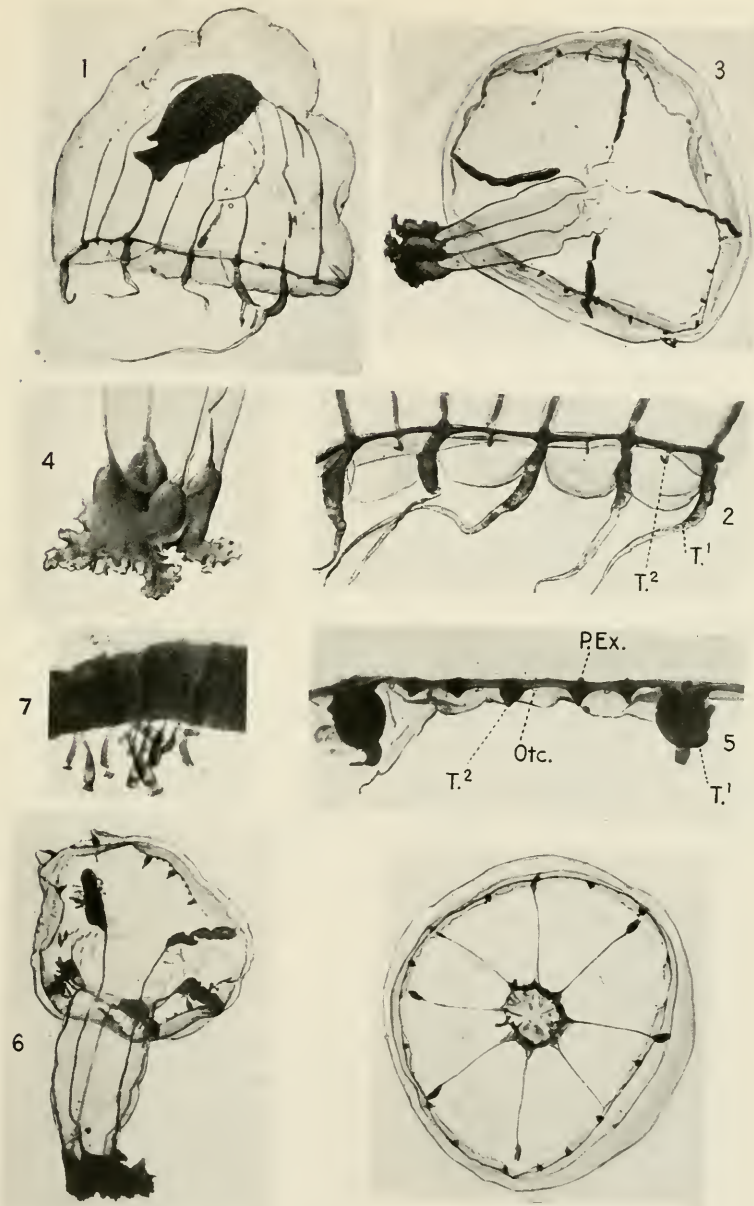
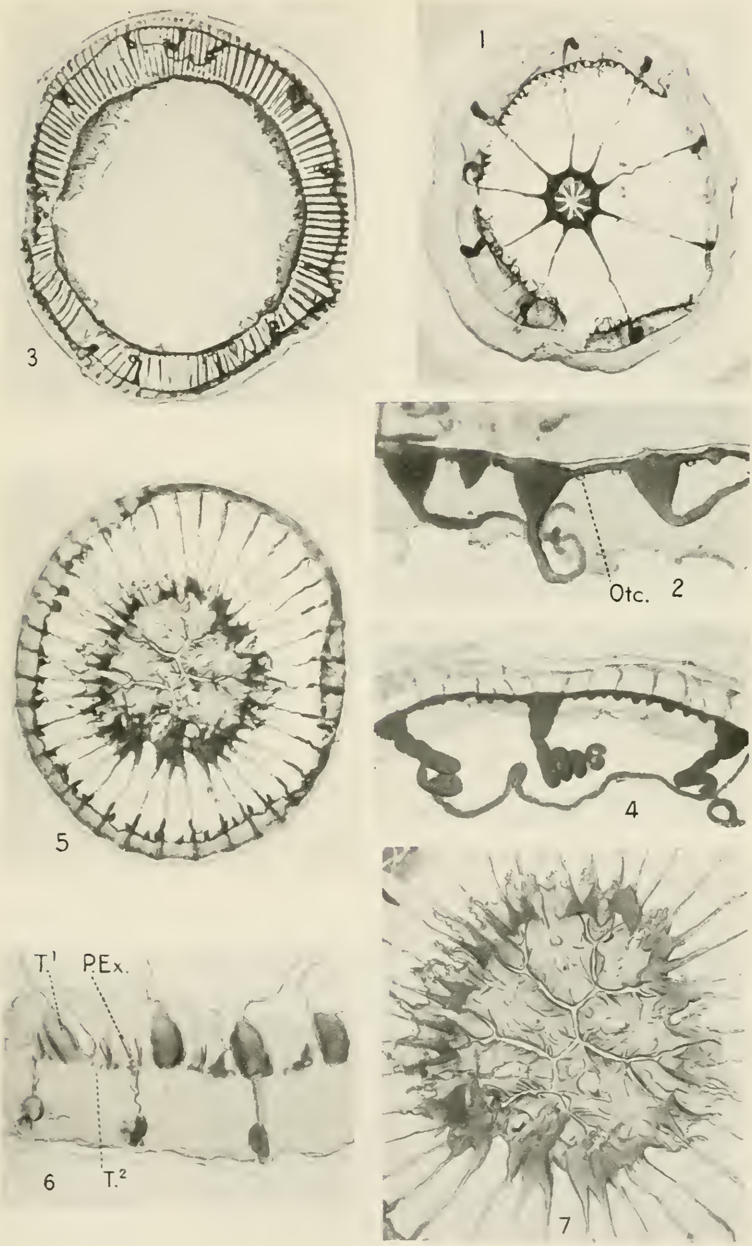


ANTHOMEDUSAE AND LEPTOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGES 361, 362.



LEPTOMEDUSAE.

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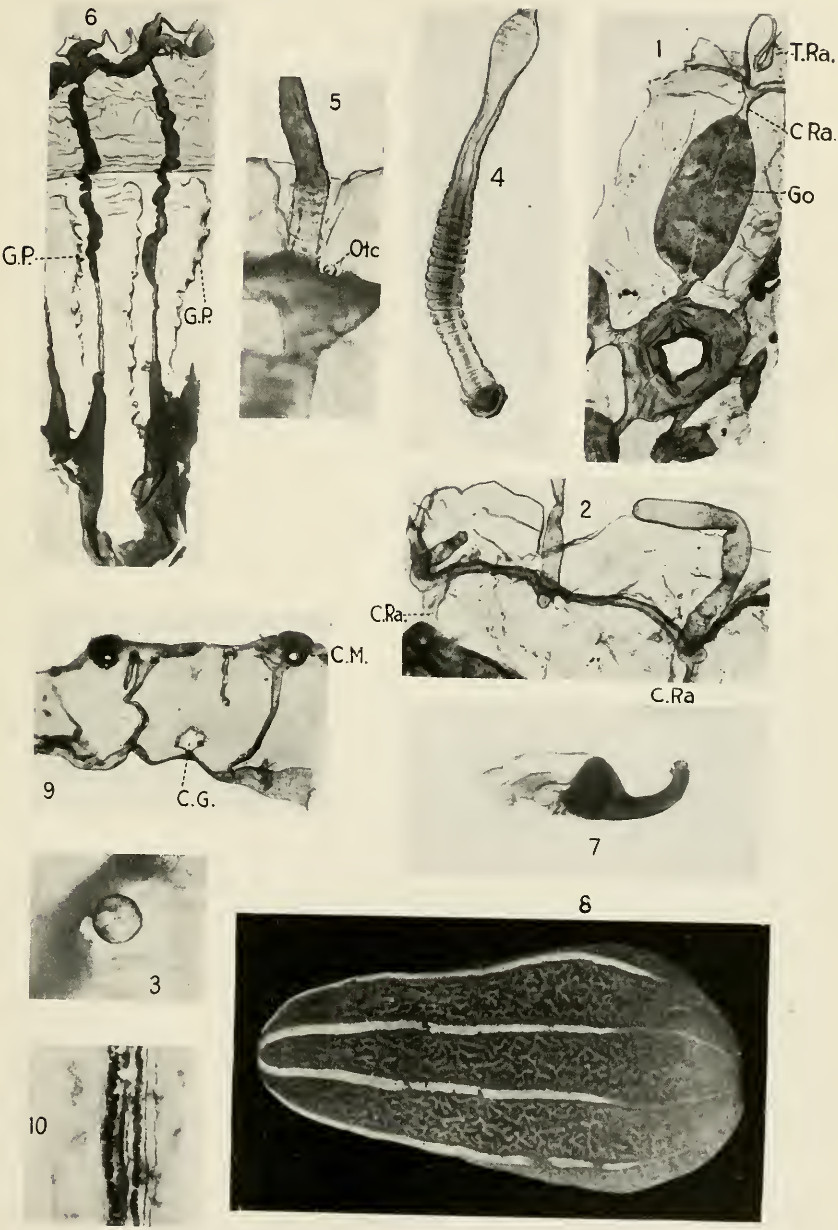

LEPTOMEDUSAE, TRACHOMEDUSAE, AND CTENOPHORES.

FOR EXPLANATION OF PLATE SEE PAGE 362.

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THE RELATIONSHIPS OF THE GENERA CALCARINA, TINOPORUS, AND BACULOGYPSINA AS INDICATED BY RECENT PHILIPPINE MATERIAL.

By Joseph A. Cushman,

Of the Boston Society of Natural History.

During the *Albatross* Philippine Expedition of the United States Bureau of Fisheries great numbers of shallow-water foraminifera were collected. Those belonging to *Calcarina* and *Tinoporus*, as those genera are usually understood, form a considerable amount of material from many stations and hundreds of specimens. The problem of identifying the species represented has not been a simple problem and has involved a review of much of the earlier literature. Much of the difficulty of the problem has centered about the question which other workers have had as to the exact identity of Montfort's genus *Tinoporus*.

An indication first of the various species involved and later their generic position will perhaps be the easiest way to present the results. The earliest species is the *Nautilus spengleri* Gmelin, not Linnaeus, as usually given, as this first appears in the thirteenth edition, 1788, which is Gmelin's, based on the figure given by Spengler in 1781 as "Ammonshorn." This species is now apparently well defined. D'Orbigny in 1826 referred to it under his genus *Calcarina spengleri* Gmelin and gives as synonymous *Tinoporus baculatus* Montfort and *Siderolites calcitrapoides* Lamarck. No figures are given, but those in the "Planches inedites," published by Fornasini, include all of d'Orbigny's species of the 1826 paper. The figures given in the *Challenger* Report, H. B. Brady, 1884, give a good idea of the species. It is a lenticular test, biconvex, made up of numerous chambers in a close coiled trochoid spire, developing a secondary skeleton and with a series of blunt spinose processes about the margin of the test taking their origin early in the development of the test and gradually increasing in size. The surface is generally smooth or somewhat tuberculate, especially in the center of the disk at either side, and the spiral condition continues throughout the life history. The spines are smooth except for the channels of the supplementary canals, and are bluntly rounded at the extremities, usually from three to six or more with five or six the usual number.

Such tests (pl. 44, fig. 1) are fairly common in the Philippine material, at some of the stations being very common, and there seems little question as to what *spengleri* Gmelin really is.

Of the synonyms given by d'Orbigny, *Siderolites calcitrapoides* Lamarck is based upon a chalk fossil from Maestricht and I have been able to study material from Maestricht kindly sent me from the United States National Museum, and this is not the same, as will be shown later.

The next problem is *Tinoporus baculatus* Montfort. This has been the cause of much dissension. Montfort refers to an earlier figure of Fichtel and Moll of 1803 (pl. 15, figs. *i. k.*), Montfort also figures the species. This figure shows a rounded test with three truncate spinose projections at three of four equidistant points of the circumference, the exterior of the test black with white points on both the body and spines. The interior is shown as spiral [?] and composed of numerous chambers with an indication that they are several deep in the convex area.

In the Philippine material especially from *Albatross* Station D5134 (Sulu Archipelago, near Basilian Island—Latitude 6° 44′ 45″ N.; longitude 121° 48′ E.—25 fathoms), there are numerous specimens of a black form with four equidistant spines and numerous raised tubercles over the surface, all corresponding very well with the crude figure given by Montfort. The short generic description is as follows:

"Coquille libre, univalve, cloisonnée et cellulée, spirée et lenticulaire, têt granulé extérieurement; bouche sémi-lunaire, placée vers la circonférence et sur un des côtes; dos caréné, armé de quatre points au plus; les deux centres bombés et relevés."

The specimens from D5134 and elsewhere (pl. 44, fig. 3) are very clearly the same as those Montfort had. It is a test very similar in shape to *spengleri* Gmelin but has a greater amount of secondary skeleton, the spines covered with spinose projections (indicated by the white dots of Montfort's figure) and the whole test spinose except the centers of each side, which have high, conical tuberculations, and on the ventral side the last formed chambers of the outer whorl often more or less obscured by the surface ornamentation. There are usually four spines at equidistant points on the periphery, sometimes five. This seems to be the adult of this particular species, which, as has been said, is very common at certain stations. Montfort's specimens were from the East Indies, also from the Arabian Sea and the Adriatic. The sections of the Philippine specimens show them to be spiral throughout, with a certain amount of piling up of chambers in the central portions in late growth. If, then, the *baculatus* Montfort is taken as this species, a second definite species is segregated.

D'Orbigny in 1826 figures *Calcarina defrancii* d'Orbigny (pl. 13, figs. 5–7). These show a fairly smooth test in a low trochoid spire with elongate spines, one from each chamber, and those of the earlier whorl persisting above those of the last formed whorl. Brady figures similar specimens in the *Challenger* report. Fornasini in figuring the tracings of the "planches inedites" gives more bizarre forms, in one with spines having forked tips. Such specimens were figured by Carpenter (Introd. Foram., 1862). These are caused, at least in some cases, by the spines of the earlier and later whorls fusing, and being at different angles the points of the two or more continue their original lines and diverge. Specimens of this species are smooth except for the spire, and the spines are also relatively smooth. Specimens are fairly common at some stations, usually in comparatively shallow water (pl. 44, fig. 2).

A fourth species is described by Brady in 1876 and figured in the *Challenger* Report (pl. 107, figs. 8, 9) as *Calcarina hispida* H. B. Brady. This again is a well-known species, flattened and the entire surface hispid with short blunt spines, these extending out into the numerous flattened spines of the periphery. This spinose condition is part of the supplementary skelton and the newly added chambers of the spire are added directly on top of this hispid surface. The chambers themselves at their inception are very thin walled and punctate, but quickly add the thickened layer of spinose skeleton. Occasionally there are a few tubercles developed in the center of the surface (pl. 44, fig. 4). From the evidence of the "planches inedites" this is the same as d'Orbigny's *Calcarina quoyi*, which becomes a synonym of *C. hispida*, as it was not recognizable until the publication of the figures by Fornasini in 1907.

Associated with the other species already noted were specimens with usually three rather pointed spines, very hispid, the center of the body surface with a group of large tubercles and a very definitely trochoid spire. It was noted that these occurred only in association with a larger form of what has been generally known as *Tinoporus*. A series of these studied showed that all were but developmental stages of one species, some of the stages of which are shown in plate 45, figure 1, shows the general appearance of the young, with a regular spire, the elongate spines and central tubercles. Figure 2 shows a slightly later stage, where the newly added chambers now begin to appear around the periphery of the test and even on the dorsal side (2*b*). Figure 3 shows a later stage where the development of the chambers has become greater and both sides are beginning to be covered with the hemispherical, thin walled, punctate chambers covering the hispid surface and extending out onto the spines. In the adult this continues until the spines are completely covered, as in figure 5. In figure 4 is shown a specimen with an eroded test the spines large and blunt, and at *x* the remains of some of the tubercles of the test which grow outward and help support the test which is otherwise very fragile. This gives a large globular test in the adult (pl. 44, fig. 5), from which usually project three spine tips, still hispid if not covered by the hemispherical chambers, the chambers large and rather coarsely punctate. This species seems to be undescribed and will be referred to later.

Another species (pl. 44, fig. 6), not common in the Philippine material but very abundant in the Murray Island region of the Great Barrier Reef of Australia and elsewhere, is that which is figured by Brady and others as *Tinoporus baculatus*. This species, as shown by Carpenter in 1860, has a spiral young, but the spire is continued for but a single whorl when the several spines are produced, and later growth is on the order of *Gypsina*, covering the test with concentric layers of small chambers, interspersed with which are bosses of clair solid shell material regularly placed and connected radially with each other. The spines are not hispid but smooth or channeled and are usually four to eight or nine in number. The chambers are much smaller than those of the preceding species, and not so obviously punctate, while the reticulate pattern caused by the bosses and their radial connections is always a conspicuous feature. With these six species in hand their generic position becomes a second problem.

The first name—that of *Nautilus*—is of course used in mollusca. The next available name—*Siderolites* Lamarck—is, according to various authors, the same as *Calcarina*, and if so would have to be used by rules of priority instead of *Calcarina* d'Orbigny. It is based, however, upon a fossil species from the chalk of Maestricht, and a study of its structure is necessary to determine its true relations. However, a study of the material from Maestricht shows that *Siderolites calcitrapoides* is the same generically as the species figured (pl. 45). Sections of the fossil material also show that the characters of the two are very similar. This, therefore, is not the same as *Calcarina* d'Orbigny, and is not the same as Gmelin's *Nautilus spengleri;* therefore this name is not available as a generic name for the latter species. *Tinoporus* Montfort is evidently largely based as far as figure and generic descriptions show on a species of *Calcarina*, although the specific descriptions in places as noted by Carpenter and others seems more like the last of our species mentioned here. His remarks on the color (p. 148), "blanche, flambée et teintée de jaune" would seem more like the last, as this is often yellow or even orange colored. It is evident therefore that the genus *Tinoporus* is in a seriously mixed condition. As has been shown the figure and generic description evidently refer to a species of *Calcarina* but whether sufficiently clear to be used is a question.

Calcarina d'Orbigny is clearly understood and is the first of the names that can be used without question.

In 1893 Sacco erected the Genus *Baculogysina* on account of the uncertainty of identifying Montfort's *Tinoporus*. Sacco referred to his genius *Orbitolina sphaerulata* Parker and Jones, 1860, which is abundant in the white calcareous muds of Australia. This is the reticulately marked species and this gives a definite genus and species for that which may be known as *Baculogypsina sphaerulata* (Parker and Jones).

Gümbel in 1862 describes *Calcarina tetraedra* from the Eocene and this is used as a synonym of *Baculogypsina sphaerulata* by various authors. However, a reference to his figure shows the close relation between this and our species on plate 45, figures 1–5. A study of the fossil material of *Siderolites calcitrapoides* shows that the fossil species and the recent one from the Philippines are apparently generically the same. They represent different species, however, and probably our recent Philippine species is the same, or very close, to that described by Gümbel from the Eocene. If this is correct, the following key may be used for our six species. The occurrence of *Siderolites* as a recent Philippine genus is in line with that of other groups of animals which have now living in this region species of genera elsewhere extinct.

A. Test rotaliform throughout; with peripheral spines, and a supplementary skeleton ---------- *Calcarina* d'Orbigny.
- *a*¹. Test fairly smooth, spines smooth or channeled.
  - *b*¹. With few spines ---------- *C. spengleri* (Gmelin).
  - *b*². With numerous spines ---------- *C. defrancii* d'Orbigny.
- *a*². Test hispid, spines hispid.
  - *b*¹. Flattened, very hispid, spines numerous ---------- *C. hispida* H. B. Brady.
  - *b*². Biconvex, hispid, centrally tuberculate, spines four or five, distinct ---------- *C. baculatus* (Montfort)?

B. Test with rotaliform young, hispid, later irregular with numerous large chambers, coarsely punctuate, usually three or four blunt spines, hispid in the young, reticulations not distinct ---------- *Siderolites* Lamarck. / *Siderolites tetraedra* Gümbel.

C. Test with very young rotaliform, not hispid, later irregular with numerous small finely punctate chambers, 4–8 or more sharp spines, not hispid, bosses with reticulations very distinct ---------- *Baculogypsina* Sacco. / *Baculogypsina sphaerulata* (Parker and Jones).

A comparison of the distribution of *Baculogypsina sphaerulatus* (Parker and Jones) and *Siderolites tetraedra* Gümbel shows very striking evidence of a distinct distribution for each. In the Philippine region *Siderolites tetraedra* is widely distributed, and at some stations very abundant, while *Baculogypsina sphaerulatus* has been noted at but three stations in the area, and then as of rare occurrences. In material from the Murray Island region of the Great Barrier Reef of Australia there is a great development of *Baculogypsina sphaerulatus* as shown in the series of samples collected by Dr. Alfred G. Mayor on the Carnegie Expedition to Murray Island. This species makes up a large proportion of the material and *Siderolites* is entirely lacking. *Baculogypsina sphaerulatus* is abundant at the Atoll in Funafuti according to Chapman, but no figures or mention is made of the other. The more detailed distribution of these two genera and their relations to the Eocene would be interesting.

From their development, *Calcarina*, with its close-coiled test, represents the simplest form, and in its geological history apparently goes back to the Cretaceous. *Siderolites* is the next in order, the close-coiled spiral development being continued for sometime in the young before the later method of growth is attained. This goes back geologically to the *Cretaceous*. *Baculogypsina* as applied here has a very short-coiled stage in the very young and then assumes the generic character. Thus a much more accelerated development is shown and a higher position in the scale. The supplementary skeleton of bosses and radial connections is also carried to a high development, making a firm test, whereas *Siderolites* is fragile as far as the chambers are concerned (pl. 45, fig. 4).

EXPLANATION OF PLATES.

Plate 44.

Fig. 1. *Calcarina spengleri* (Gmelin) ventral view. X 20.
2. *Calcarina defrancii* d'Orbigny ventral view X 20.
3. *Calcarina baculatus* (?) (Montfort) ventral view. X 20.
4. *Calcarina hispida* H. B. Brady ventral view. X 20.
5. *Siderolites tetraedra* (Gümbel). X 15.
6. *Baculogypsina sphaerulatus* (Parker and Jones). X 20.

Plate 45.

Figs. 1–5. *Siderolites* (?) *tetraedra* (Gümbel).
1. Young, ventral view. X 45.
2. Later stage, chambers invading dorsal side. X 40.
a, ventral side; *b*, dorsal side.
3. Still later stage where dorsal side is partly covered by the invading chambers. X 35.
a, ventral side; *b*, dorsal side.
4. Old eroded specimen, in which the chambers are largely broken away leaving the raised bosses (x) as projections from the center. X 18.
5. Specimens in which the chambers now cover even the spines. X 15.

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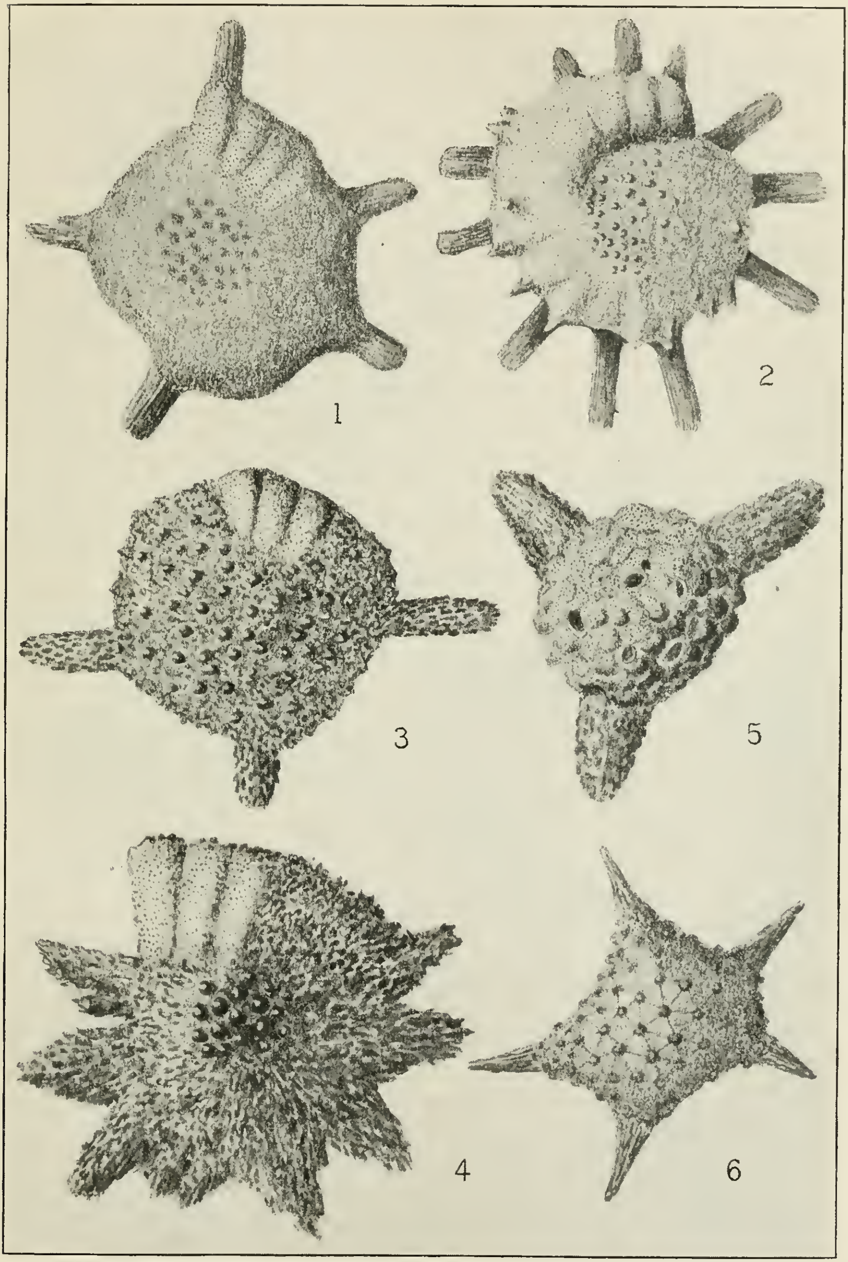
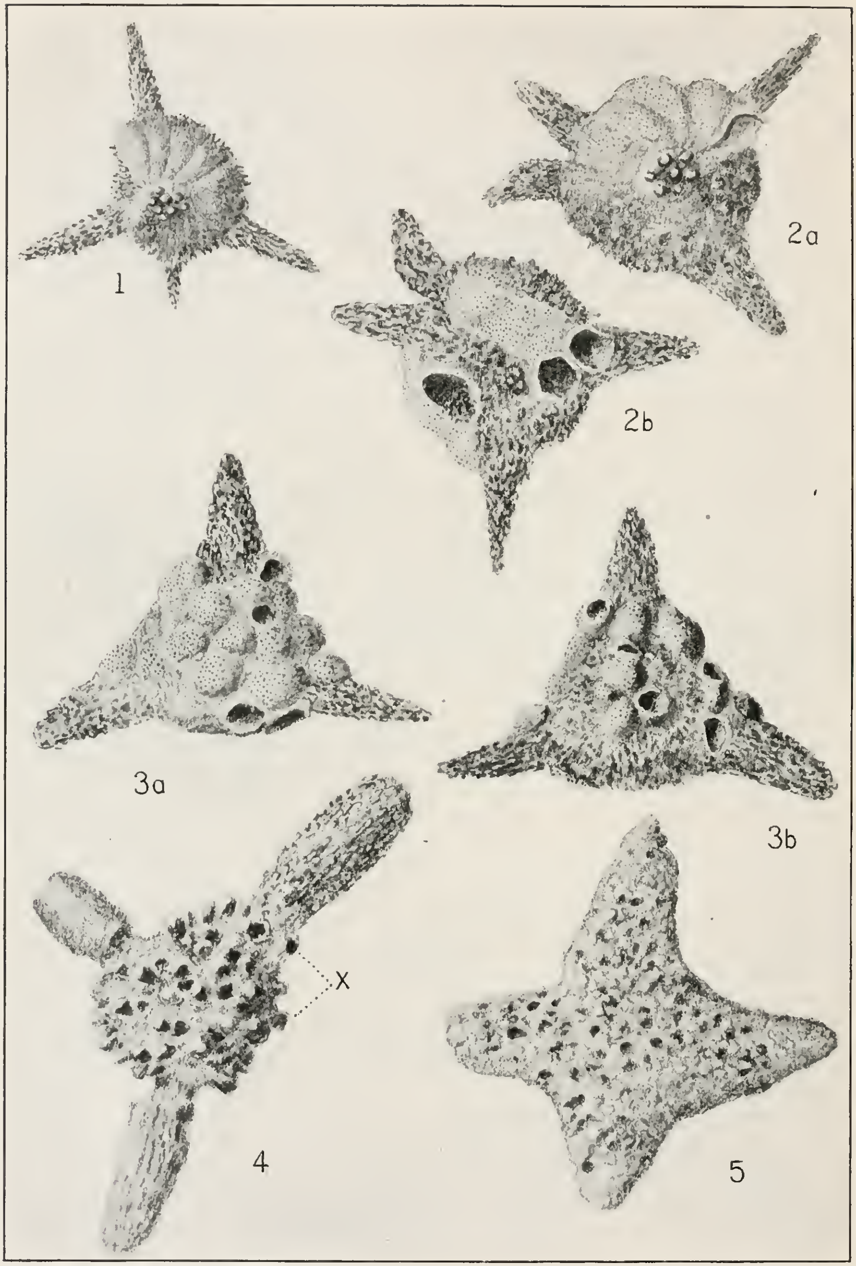


THE RELATIONSHIPS OF CALCARINA, TINOPORUS, AND BACULOGYPSINA.

FOR EXPLANATION OF PLATE SEE PAGE 368.



THE RELATIONSHIPS OF CALCARINA, TINOPORUS, AND BACULOGYPSINA.

FOR EXPLANATION OF PLATE SEE PAGE 368

THE MACROUROID FISHES OF THE PHILIPPINE ISLANDS AND THE EAST INDIES.

By Charles Henry Gilbert,
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I. INTRODUCTION.

Twenty-seven of the new species of the Coryphaenoididae obtained during the Philippine cruise of the fisheries steamer *Albatross* have been described in a paper by Lewis Radcliffe.[1] The entire collection, through the kindness of Dr. Hugh M. Smith, was placed in the hands of the present writers that they might test the constancy of the characters used by them in a revision of the genera.[2] It soon became apparent, however, that the collection contained many additional undescribed forms, and the authors undertook to prepare this detailed report on the entire material, which contains nearly 1,500 specimens.

The following genus, subgenera (8), species (30), and subspecies (1) are described as new to science:

Bathygadus spongiceps, new species.
Bathygadus entomelas, new species.
Gadomus denticulatus, new species.
Gadomus magnifilis, new species.
Gadomus introniger, new species.
Coryphaenoides semiscaber, new species.
Ilyomacrurus, new subgenus.
(Genus *Coelorhynchus* Giorno.)
Quincuncia, new subgenus.
C. quincunciatus, new species.
C. thompsoni, new species.
(Subgenus *Paramacrurus* Bleeker.)
C. maculatus, new species.
C. velifer, new species.
C. sexradiatus, new species.
C. triocellatus, new species.

[1] Proc. U. S. Nat. Mus., vol. 43, 1913 (Sept. 27, 1912), pp. 105–140.
[2] Published by the writers in their Report on the Japanese Macrouroid Fishes (Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 135–214).

C. dorsalis, new species.
C. macrolepis, new species.
C. cingulatus, new species.
(Subgenus *Oxymacrurus* Bleeker.)
C. acantholepis, new species.
C. carinifer, new species.
C. smithi, new species.
C. radcliffei, new species.
C. weberi, new species.
Oxygadus, new subgenus.
C. spinifer, new species.
(Genus *Hymenocephalus* Giglioli.)
Hymenogadus, new subgenus.
H. gracilis, new species.
(Subgenus *Hymenocephalus*.)
H. striatissimus aeger, new subspecies.
H. nascens, new species.
Papyrocephalus, new subgenus.
H. barbatulus, new species.
Malacocephalus luzonensis, new species.
Ventrifossa, new genus.
Atherodus, new subgenus.
Lucigadella, new subgenus.
Lucigadus, new subgenus.
Subgenus *Ventrifossa*.
V. nigrodorsalis, new species.
V. divergens, new species.
Lionurus infranudis, new species.
Lionurus evides, new species.
Lionurus decimalis, new species.

In addition to the systematic descriptions, we have prepared analytical keys to the species of several of the larger genera, each key being the result of a study of the relationships throughout the world of all the known species in the given genus.

Methods of measuring and counting.—In order to insure greater accuracy we have made large numbers of counts and measurements, following generally the methods explained in our Japanese report,[1] but with certain minor alterations which are of quite evident nature.

II. SOME RESULTS OF GENERAL BIOLOGICAL INTEREST.

The present work has thrown some light on the biology of the Coryphaenoididae, the family of fishes represented most abundantly in the depths of the sea.

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 147–148.

Sexual dimorphism.—We have been able to demonstrate the existence of sexual dimorphism in this family for the first time. In certain species of *Coelorhynchus* (*C. velifer* and its allies, *q. v.*) the first dorsal, pectoral, and ventral fins are decidedly longer in the adult males than in the females or the young males. The wide variation[1] in the length of the outer ventral ray in the subarctic *Coryphaenoides cinereus* upon reinvestigation is shown to be due likewise to sexual dimorphism: the ray is produced into a long strengthened filament in the male. In most species of the family no marked sexual variation in the length of the fins is evident.

Age determinations.—We have made a short study of the scales of the species of *Gadomus*, as presented in more detail under the head of the four species of that genus here reported on. The scales of *G. denticulatus* especially show certain marks which greatly resemble the so-called "annuli" of certain littoral fishes, and are probably indications of a yearly check in the growth of the fish. These marks are very obscure or entirely absent in the species inhabiting the greater depths.

Subspecific intergradation.—The intergrading of the geographical subspecies of *Hymenocephalus striatissimus* has been worked out in detail. So far as known to us this is the first demonstration of its kind among the bathybial fishes.

Distribution correlated with temperature and depth.—The region of the Jolo or Sulu Sea forms a partly inclosed basin connected with open waters by narrow and comparatively shallow channels; the water of the sea is consequently rendered warm, retaining a temperature of more than 49° F. to depths of over 1,000 fathoms. Though of comparatively small size, the Philippine faunal subregion, comprising these waters of unusually high temperatures at great depths, contains a large proportion of peculiar and frequently very distinct species, which have probably been evolved in this region of peculiar environmental conditions. The process of their evolution has doubtless been aided or hastened by their isolation, more or less complete, in this partly inclosed sea.[2]

III. THE GEOGRAPHICAL DISTRIBUTION OF THE MACROUROID FISHES OF THE PHILIPPINE AND ADJACENT ISLANDS.

There are now known about the East Indian and the Philippine Islands no fewer than 75 or 76 species[3] of the Coryphaenoididae. In no other area of similar size is there known a fauna comprising such a numerous and varied assemblage of these fishes.

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[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 107.

[2] Some of the species range northward to southwestern Luzon.

[3] Including the three subspecies of *Hymenocephalus striatissimus*; 69 of these species were obtained by the *Albatross*.

1. COMPARISON WITH OTHER FAUNAS.

For the purpose of our faunal analysis there are three other regions suitable for comparative study in this family; these comparable faunas are the Indian, the Japanese, and the Hawaiian. As might be expected, these four faunas are more closely related to each other than they are to the fauna of the eastern and northern Pacific, or to that of the northern Atlantic, the other regions where an extensive exploration of the continental shelf has been made.

But few of the many species of Macrouroid fishes belonging to the East Indian-Philippine fauna are known in other regions. Careful comparison has led us to conclude that not one of these species is known about the Hawaiian Islands. Four of the species are identified by us with Indian forms, without actual comparison of material in any case. These are: *Bathygadus furvescens*, *Bathygadus multifilis* (?), *Ventrifossa petersonii* (?), and *Lionurus pumiliceps*.[1] Eight species are identified as also Japanese: *Gadomus multifilis*, **Coelorhynchus parallelus*, **Hymenocephalus s. striatissimus*, **Ventrifossa misakia*, *Lionurus proximus*, **L. spinosus*, *Trachonurus villosus*, and *Cetonurus robustus;* but those above starred are known in the Philippines only from a few young specimens taken in eastern Luzon, and the material was too inadequate, except in the case of the *Hymenocephalus*, to make their identification certain.

Although so few of the species are identified with those of other faunas, many are represented in the three other regions by very closely allied or geminate species, as listed in the following tables (from which all notably distinct species are excluded).

1. *Table indicating the geminate species occurring in the East Indian-Philippine region and about the Hawaiian Islands.*

East Indian-Philippine species.	Hawaiian species.
Bathygadus spongiceps [2]	*B. bowersi.*
Gadomus multifilis [3]	*G. melanopterus.*
Hymenocephalus gracilis	*H. tenuis.*
Hymenocephalus nascens	*H. striatulus.*
Lionurus pumiliceps [4]	*L. gibber.*
Malacocephalus nigrescens [5]	*M. acipenserinus.*
Trachonurus villosus [6]	*T. sentipellis.*

[1] It is possible that *Coelorhynchus parallelus* and *Malacocephalus laevis*, or allied forms of these, should be included.
[2] Very close also to *B. cottoides* from near New Zealand and the Kermadec Islands.
[3] Occurs also in Japan and probably in the Indian Ocean.
[4] Occurs also in the Indian Ocean.
[5] Very close also to *M. tenuicauda* of the Panama fauna.
[6] Occurs also in Japan; close also to Atlantic species.

2. *Table indicating the geminate species occurring in the East Indian-Philippine region and in the Indian fauna.*

East Indian-Philippine species.	Indian species.
Coryphaenoides asprellus	*C. hoskynii.*
Coryphaenoides semiscaber *Coryphaenoides tydemani*	*C. macrolophus.*
Coelorhynchus smithi	*C. flabellispinis.*
Lionurus proximus	*L. brevirostris.*
Mataeocephalus adustus	*M. microstomus.*

3. *Table indicating the geminate species occurring in the East Indian-Philippine region and the Japanese fauna.*

East Indian-Philippine species.	Japanese species.
Gadomus denticulatus	*G. colletti.*
Coryphaenoides microps	*C. marginatus.*
Coelorhynchus weberi	*C. anatirostris.* *C. productus.*
Coelorhynchus commutabilis	*C. japonicus.*
Hymenocephalus s. striatissimus [1] *Hymenocephalus s. torvus* *Hymenocephalus s. aeger*	*H. s. striatissimus.*
Hymenocephalus nascens	*H. lethonemus.*
Hymenocephalus barbatulus	*H. papyraceus.*
Ventrifossa divergens	*V. garmani.*
Lionurus evides	*L. condylura.*
Lionurus parvipes	*L. cetonuropsis.*

[1] Each of the three subspecies of distinct distribution.

It is thus apparent that the Macrouroid fauna most nearly related to that of the East Indies and the Philippine Islands is the fauna of Japan, which is probably largely derived from the southward.[1] These two faunas contain the largest number of species common to both, and they contain the largest number of geminate species; but this is not the only reason for considering them more closely related to each other than either is to any other known fauna. As corroborative evidence we may note that the *Coelorhynchus notatus* group of species from the Philippines and East Indies finds its only close relatives in *C. jordani* and *C. kishinouyei* of Japan, and that the remarkable subfamily Macrouroidinae is represented by but two species: *Macrouroides inflaticeps* of eastern Luzon and *Squalogadus modificatus* of Japan. In addition to *Macrouroides* and *Squalogadus*, there is but one genus not common to both regions, no representative of *Mataeocephalus* being yet known from Japan.

2. ANALYSIS OF THE EAST INDIAN-PHILIPPINE FAUNA.

The fauna of Macrouroid fishes in the East Indian and Philippine Islands has been compared with the faunas of other regions, and found to resemble that of Japan most closely. In order to determine the subdivisions of the fauna of the Philippines a distributional

[1] Excluding, of course, the three subarctic species reaching northern Japan (*Coryphaenoides pectoralis*, *C. acrolepis*, and *C. cinereus*).

table has been drawn up, in which the number of specimens of each species dredged by the *Albatross* is given for eight different regions; in addition the six or seven species [1] dredged in the East Indies only by the *Siboga* are marked by a cross (×) in the column for that region. No attempt is made to define the subdivisions in the East Indies for the Macrouroid fauna.

Ten columns are used, corresponding to the following regions:

1. Known also from the Indian fauna.
2. East Indian subregion.
3. Tawi Tawi (or Sulu) Archipelago, and the Gulf of Davao, southern Mindanao.
4. Philippine subregion (*q. v.*).
5. Eastern Mindanao.
6. Eastern Luzon.
7. Northern and northwestern Luzon.
8. Formosa.
9. Off Hongkong, China.
10. Known also from Japan.

Distributional lists of the species.

Species.	Regions.									
	1	2	3	4	5	6	7	8	9	10
Bathygadus spongiceps		2		2		3				
Bathygadus filamentosus		4								
Bathygadus entomelas		1								
Bathygadus furvescens	×	1		3		1				
Bathygadus sulcatus				15						
Gadomus denticulatus		3		7		1				
Gadomus magnifilis				3						
Gadomus introniger		12		1		1				
Gadomus multifilis	?×	2				1				×
Macrouroides inflaticeps						1				
Coryphaenoides paradoxus				[1] 1						
Coryphaenoides dubius				1						
Coryphaenoides asprellus		[2] 1								
Coryphaenoides semiscaber				4						
Coryphaenoides tydemani		4								
Coryphaenoides microps						1	4			
Coryphaenoides hyostomus		3		4						
Coryphaenoides heyningeni		×								
Coryphaenoides aequatoris		[2] 2								
Coryphaenoides orthogrammus		[2] 1								
Coryphaenoides camurus				[2] 1						
Coryphaenoides sp. Weber		×								
Coelorhynchus argentatus		×	13	7						
Coelorhynchus quincunciatus				13		1				
Coelorhynchus thompsoni				5						
Coelorhynchus maculatus		10		2						
Coelorhynchus velifer				107						
Coelorhynchus sexradiatus			7							
Coelorhynchus notatus			1							
Coelorhynchus triocellatus			1							
Coelorhynchus dorsalis							2			
Coelorhynchus argus		×	9	15						
Coelorhynchus macrolepis				57						
Coelorhynchus cingulatus							1	1		
Coelorhynchus platorhynchus		7				1				
Coelorhynchus acantholepis		4								
Coelorhynchus carinifer				1						

[1] Possibly one or two others should be included.

[2] Known only from depths greater than 700 fathoms; owing to the paucity of dredge hauls at such depths these records may have little significance; the same is true, to a somewhat lesser degree, of the distribution of *Malacocephalus adustus* and *Cetonurus robustus*.

Distributional lists of the species—Continued.

Species.	Regions.									
	1	2	3	4	5	6	7	8	9	10
Coelorhynchus smithi		3		16						
Coelorhynchus radcliffei		2		13						
Coelorhynchus weberi							1			
Coelorhynchus commutabilis		8	1	1		2				
Coelorhynchus macrorhynchus		1	2	7						
Coelorhynchus acutirostris				4						
Coelorhynchus parallelus	??)×	(?)×				3				×
Coelorhynchus spinifer		[1] 1								
Hymenocephalus gracilis				1						
Hymenocephalus longiceps		7	2	39		12	2	1	1	
Hymenocephalus longipes				25						
Hymenocephalus striatissimus		×	×	×		×	×	×	×	×
Hymenocephalus s. striatissimus						19		5	8	×
Hymenocephalus s. intergrades							25			
Hymenocephalus s. torvus				159+						
Hymenocephalus s. intergrades, nearest *s. aeger*			103							
Hymenocephalus s. aeger		72								
Hymenocephalus grimaldii		×								
Hymenocephalus nascens		39		14		1			1	
Hymenocephalus barbatulus					2					
Malacocephalus ?laevis		×								
Malacocephalus luzonensis					4		1			
Ventrifossa macronemus				3						
Ventrifossa misakia						1				×
Ventrifossa petersonii	×	(?)×								
Ventrifossa nigrodorsalis		30	2	134		4		1		
Ventrifossa divergens		14		40		2	3		1	
Ventrifossa nigromarginata		2	9	35						
Ventrifossa lucifer				14						
Lionurus proximus				3						×
Lionurus spinosus						4				×
Lionurus infranudis		1								
Lionurus evides		8								
Lionurus vittatus		×								
Lionurus richardi		×								
Lionurus pumiliceps	×	18		[2] 1		3				
Lionurus decimalis				[3] 2						
Lionurus parvipes		[1] 6								
Mataeocephalus adustus		5								
Mataeocephalus nigrescens		2		10						
Trachonurus villosus		6		38						×
Cetonurus robustus		8								×

[1] Known only from depths greater than 700 fathoms; owing to the paucity of dredge hauls at such depths these records may have little significance; the same is true, to a somewhat lesser degree, of the distribution of *Mataeocephalus adustus* and *Cetonurus robustus*.
[2] From western Luzon.
[3] From Palawan Passage.

A. THE EAST INDIAN SUBREGION.

The East Indian subregion alone contains species supposed to be identical with those of the Indian Ocean. Many of its species occur also in the Philippine subregion, and three are found in Japan—namely, *Gadomus multifilis*, *Trachonurus villosus*, and *Cetonurus robustus;* in addition to these there occurs in the East Indian subregion a species identical or closely allied with *Coelorhynchus parallelus* of eastern Luzon and Japan. *Gadomus multifilis* was also dredged off eastern Luzon, but *Cetonurus robustus* was not obtained in intermediate localities. Of these four species *Trachonurus villosus* is the only one known from the Philippine subregion; the other three East Indian forms, found also in Japan, if now connected with the Japanese population of their species, are probably so connected along eastern Luzon. The East Indian species *Lionurus evides* is closely related only to *L. condylura* of Japan.

Only 11 species were obtained about the Sulu or Tawi Tawi Archipelago, which separates the East Indian and the Philippine subregions: 7 are found in the subregions on both sides, while 3 species [1] were not dredged elsewhere; the *Hymenocephalus striatissimus* of the Tawi Tawi region is intermediate between the East Indian *H. s. aeger* and the Philippine *H. s. torvus*, but nearest *H. s. aeger*.

B. THE PHILIPPINE SUBREGION.

This subregion includes the waters about the central Philippine Islands, north of the Tawi Tawi group, and south of west-central Luzon, and exclusive of the Pacific Ocean along the east coast of Luzon. While sharing many of its species with the East Indies, this subregion is inhabited by a number of peculiar and often singular forms: *Bathygadus sulcatus; Gadomus magnifilis; Coryphaenoides semiscaber* (representing the East Indian *C. tydemani*) ; three species of *Coryphaenoides*, each known only from its type dredged in the depths of the Jolo (Sulu) Sea—namely, *C. paradoxus*, *C. dubius*, and *C. camarus; Coelorhynchus quincunciatus* [2] and *thompsoni*, *C. velifer*, *C. macrolepis*, *C. carinifer*, *C. acutirostris; Hymenocephalus gracilis* (closely related to the Hawaiian *H. tenuis*) ; *H. longiceps; H. s. torvus* (representing *H. s. striatissimus* of Japan, Formosa, and eastern Luzon, and *H. s. aeger* of the East Indies; intergrading with *striatissimus* off northern and northwestern Luzon, and with *aeger* about the Tawi Tawi group) ; *Malacocephalus luzonensis* [2]; *Ventrifossa macronemus* (most nearly related to *V. misakia* of Japan and eastern Luzon) ; *Ventrifossa lucifer; Lionurus decimalis.*

The Philippine subregion appears to lack certain species of the East Indies, as the *Albatross* failed to obtain them during months of intensive dredging within the limits of the subregion. These species follow: *Bathygadus filamentosus*, *B. entomelas*, *Gadomus multifilis*, *Coryphaenoides asprellus*, *C. tydemani*, *C. heyningeni*, *C. aequatoris*, *C. orthogrammus*, *C.* sp. Weber, *Coelorhynchus platorhynchus* and *acantholepis*, *Hymenocephalus s. aeger*, *H. grimaldii*, *Malacocephalus ? laevis*, *Lionurus infranudis*, *L. evides*, *L. vittatus*, *L. richardi*, and *L. parvipes*, *Mataeocephalus adustus*, *Cetonurus robustus*.

In contemplating such a peculiar fauna occupying a comparatively restricted area, one is led to examine the hydrographic data of the region to determine whether the physical conditions of life may be obviously unusual. Such an examination does, in fact, indicate that the basic conditions of depth and temperature throughout this subregion are in peculiar relationship to each other. Briefly stated, the

[1] The closely related *Coelorhynchus sexradiatus*, *C. notatus*, *C. triocellatus*.

[2] One specimen also dredged off eastern Luzon.

region consists largely of a partially inclosed cup, broken up by islands to the northward, and communicating with more open bodies of water only by narrow channels, much shallower than the depths of the Jolo (Sulu) Sea, which in consequence are rendered peculiarly warm. The temperature records of depths greater than 400 fathoms vary little from 50° F., and nowhere was the temperature found to fall as low as 49°, although depths of over 1,000 fathoms were investigated.[1]

At the northern end of the Philippine subregion, in the China Sea off southern Luzon, it was found that the temperatures do not remain warm at greater depths. Here the fauna resembles, in general, that of the moderate depths to the southward, and as it contains no additional northern elements we consider it a derived portion of the Philippine fauna. It is characterized particularly by the exclusive or nearly exclusive occurrence of *Coelorhynchus velifer*, *C. macrolepis*, and *C. carinifer*.[2] Of the other species peculiar to the Philippine subregion, this northern district shares with the south only *Coelorhynchus thompsoni*, *Hymenocephalus striatissimus torvus*, and *Ventrifossa lucifer* (one specimen), fishes inhabiting the moderate depths. The remaining fishes inhabiting the China Sea off southern Luzon are not among those peculiar to the Philippine subregion.[3]

To the westward of Japan there lies a sea (Sea of Japan) which is surrounded by a rim which is not at any point depressed as much as 100 fathoms below the sea level. The straits which connect the Sea of Japan with the Pacific are thus above the normal bathymetric range of Macrouroid fishes. This Sea of Japan is geographically somewhat analogous to the area of the Philippine subregion just discussed, but faunally it differs strikingly in the fact that Macrouroid fishes " were not to be discovered in the Sea of Japan nor the Gulf of Tartary, although numerous and successful hauls of the trawl were made at the appropriate depths"; but "they were found in the Okhotsk Sea and everywhere to the eastward of the islands." [4]

C. THE EAST COAST OF MINDANAO.

The only species obtained in the Pacific Ocean off eastern Mindanao is *Hymenocephalus barbatulus*, unknown elsewhere, but closely related to *H. papyraceus* of Japan.

[1] An unusually heavy degree of parasitism noted among these fishes is probably to be correlated with the lack of currents in this comparatively warm inclosed sea.

[2] The distribution of *Malacocephalus luzonensis* differs from any of the others: it is known from three specimens from southern Luzon, one from western Luzon (taken with intergrades between *Hymenocephalus s. striatissimus* and *H. s. aeger*), and one from eastern Luzon.

[3] Two species, known also from the East Indies and from off eastern Luzon, are known from the Philippine subregion by a single specimen: A specimen of *Gadomus introniger* was dredged off southern Luzon, and one of *Lionurus pumiliceps* off western Luzon.

[4] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 135.

D. THE EAST COAST OF LUZON.

In the Philippine subregion, already discussed, we find among 40 species present only two species which occur also in Japan. On the east coast of Luzon, however, out of a total of but 20 species known to inhabit that region 5 species are also found in Japan. Of these five species but one or two[1] occur in the East Indies and none belong to the fauna of the Philippine subregion. The typical Japanese subspecies of *Hymenocephalus striatissimus* ranges southward to eastern Luzon, but is exclusively represented in the Philippine subregion by *H. s. torvus*. The most remarkable of all Macrouroid fishes, *Macrouroides inflaticeps*, which is known only from the type dredged off eastern Luzon, finds its sole ally in *Squalogadus modificatus* of Japan. The four species which range from the East Indies as far north as northern Luzon occur on both coasts of that island. Of the 10 remaining species of eastern Luzon, 6 are found also both in the Philippine and the East Indian subregions, while one specimen each of 4 species were obtained, two of which are characteristic of the Philippine subregion, one is characteristic of the East Indian subregion, and a fourth is known elsewhere only from northern Luzon.

E. NORTHERN AND NORTHWESTERN LUZON.

The seven species known from this region show the following relationships:

1. *Coryphaenoides microps*, known also from southeastern Luzon.

2. *Coelorhynchus dorsalis*, unknown elsewhere, but representing the *C. notatus* group of the Philippine and East Indian subregions.

3. *Coelorhynchus cingulatus*, a very distinct species known also from Formosa.

4. *Coelorhynchus weberi*, more closely related to *C. productus* and *C. anatirostris* of Japan than to any of the numerous species occurring to the southward.

5. *Hymenocephalus striatissimus*, intergrades between *H. s. striatissimus* of Japan, Formosa, and eastern Luzon, and *H. s. torvus* of the Philippine subregion.[2]

6 and 7. *Hymenocephalus longiceps* and *Ventrifossa divergens*, known throughout the region both to the northward and the southward.

F. FORMOSA.

In addition to *Coelorhynchus cingulatus* and to *Hymenocephalus s. striatissimus*, discussed in the preceding section, there are known from about Formosa but two species, *Hymenocephalus longiceps* and *Ventrifossa nigrodorsalis*, species of wide range to the southward.

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[1] *Bathygadus multifilis* and perhaps *Coelorhynchus parallelus*.

[2] One specimen of *Malacocephalus luzonensis* was obtained off western Luzon within the range of these intergrades.

G. CHINA SEA IN THE VICINITY OF HONGKONG.

Three of the species obtained here—namely *Hymenocephalus longiceps*, *H. nascens* and *Ventrifossa nigrodorsalis*, occur throughout the East Indian-Philippine region, while the fourth, *Hymenocephalus striatissimus*, belongs to the typical subspecies found also off Japan, Formosa, and eastern Luzon.

IV. SYSTEMATIC DESCRIPTIONS.

Family CORYPHAENOIDIDAE.

Subfamily BATHYGADINAE.

Genus BATHYGADUS Günther.

A detailed study of the various species of *Bathygadus* has led us to conclude that all of the described species are valid,[1] and further, that, in so far as known, they are of localized distribution. In addition to the two species we are now describing, we have examined all of the twelve species hitherto known with the exception of two: *B. cottoides* and *B. melanobranchus.*

The species of *Bathygadus* form a well-graded series, by which those with excessively wide and cavernous heads are connected with those having comparatively firm heads. At the two extremes of this series stand *B. bowersi* and *B. macrops.* These two species are of very dissimilar appearance, but their reference to the same genus can be justified by the existence of such intermediate species as *B. filamentosus.*

An attempt has been made in the construction of the following key to indicate the mutual relationships of the species.

KEY TO THE KNOWN SPECIES OF THE GENUS BATHYGADUS.

a^1. Orbit[2] decidedly less than two-thirds the interorbital width; head excessively wide and cavernous; scales on mandible in a single series[3]; no barbel.......................................(BATHYGADUS).

b^1. First dorsal, pectoral and ventral fins without long filamentous rays, all being shorter than the head.

c^1. Interorbital width contained less than 3 times in length of head; color blackish ....*bowersi.*

c^2. Interorbital width contained more than 3 times in length of head.

d^1. Ventral fins inserted in advance of pectorals; the distance from anus to base of ventrals greater than postorbital length of head:[4] color blackish brown.

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[1] With the single exception of *B. dubiosus* Weber, which seems to be identical with *B. filamentosus*

[2] Extreme length between orbital rim on each side as distinguished from diameter of eye.

[3] Not verified in *B. cottoides*.

[4] Verified in *B. cottoides* from Günther's figure.

e^1. Gill-rakers 6+17; eye half length of snout or of interorbital space .... *cottoides.*

e^2. Gill-rakers 5 or 6+19 to 22; eye more than half length of snout or of interorbital space .... *spongiceps.*

d^2. Insertion of ventral fins below that of pectorals; distance from anus to base of ventral equal to the postorbital length of the head; color light .... *favosus.*

b^2. First dorsal, pectoral and ventral fins each with a filamentous ray longer than the head; color lighter than in *B. bowersi* or *B. cottoides* .... *antrodes.*

a^2. Orbit more than two-thirds interorbital width (orbit 1.4 to 1.6 in interorbital in *B. filamentosus*); head only moderately wide and cavernous; scales on mandible in 1½ or 2 series .... (MELANOBRANCHUS).

f^1. First dorsal, pectoral and ventral fins each with a filamentous ray longer than the head.

g^1. Barbel not present; orbit 1.4 to 1.6 in interorbital width; about 20 gill-rakers on lower limb of outer arch ... *filamentosus.*

g^2. Barbel small, but evident; orbit 1.0 in interorbital width; 35 gill-rakers on lower limb of outer arch .... *micronema.*

f^2. Fins without long filaments.

h^1. Barbel absent.

i^1. Ventral with 10 rays; 19 gill-rakers on lower limb of outer arch; pseudobranchiae present; interorbital little wider than orbit, 3.7 in head; snout scarcely longer than orbit; branchial cavity wholly black .... *entomelas.*

i^2. Ventral with 8 or 9 rays.

j^1. Orbit shorter than snout.

k^1. 19 to 21 gill-rakers on lower limb of outer arch; pseudobranchiae present in adult; interorbital 4 in head; branchial cavity wholly black .... *furvescens.*

k^2. 16 gill-rakers on lower limb of outer arch; pseudobranchiae absent in adult; interorbital 3.43 in head; color much lighter, the posterior margins of the opercular and gill membranes irregularly lighter or whitish .... *nipponicus.*

j^2. Orbit decidedly longer than snout, about equal to interorbital width .... *melanobranchus.*

h^2. A small barbel present.

l^1. Interorbital wider than eye .... *garretti.*

l^2. Interorbital much narrower than eye.

m^1. Inner shagreen-like portion of premaxillary band of teeth forming only a narrow border to the band; orbit 4 in head; ground color chocolate; iris dark; ventrals with 9 rays; barbel tubercular .... *sulcatus.*

m^2. Inner shagreen-like portion of premaxillary band of teeth about half as wide as the entire band; orbit very large, 2¾ to 3 in head; ground color silvery or gray, including iris; ventrals with 8 rays; barbel slender .... *macrops* [1]

[1] Among the species of *Bathygadus*, *B. macrops* most closely approaches the genus *Gadomus* as defined by us.

Subgenus BATHYGADUS Günther.

1. BATHYGADUS SPONGICEPS, new species.

Type-specimen.—Cat. No. 78210, U.S.N.M.: 390 mm. in total length, 105 mm. long to anus; dredged at *Albatross* station 5582 in the vicinity of Darvel Bay, Borneo.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5274	China Sea, off southern Luzon	525	41.3	2
[1] 5460	Off southeast coast of Luzon	565	....	2
5467	.....do	480	....	1
5582	Off northeastern Borneo	890	38.3	1
5648	Buton Strait, near Celebes	559	39.2	1

[1] *B. furvescens* was also dredged at this station.

The body is deep and sharply compressed, thin posteriorly; the width of the body across the pectoral bases is two-fifths its greatest depth. The head is broad and cavernous; its membrane-bones are thin and papery. The dorsal contour is arched behind the occiput, but concave from the occiput forward to the tip of the premaxillary spine, which enters conspicuously into the profile; the ventral contour is angulated more sharply than usual at the posterior end of the mandible. The sides of the head are subvertical. The orbit is rather small, its length being contained five times in the head, or 1.8 (1.7 to 1.8 in paratypes) times in the least interorbital width, which is as great as, or slightly greater than, the length of the snout, and is contained slightly more than three times in the head. The least width of the suborbital space is contained 1.3 (1.3 to 1.5) times in the length of the orbit. The opercle, as usual, divides posteriorly into two branches, the upper of which ends in a flat and weak spine; the lower branch, also weak, extends across the subopercle to an acute tip. The lower margin of the interopercle is arched upward more strongly than in the related Japanese species, *B. antrodes*. The posterior angle of the interopercle is produced backward in the form of an acutely rounded lobe, which is longer and narrower than that of *B. antrodes;* the tip of this flap is visible behind the rounded angle of the preopercle.

The mouth is oblique and large; the upper jaw extends to the vertical from the hind margin of the orbit, and is contained 1.8 (to 1.9) times in the head. The teeth are rather coarse and irregularly placed in the premaxillary band, which is margined within by a definite, narrow, parrallel-sided area of shagreen-like teeth, extending forward almost to the front of the premaxillaries. No trace of a mandibular barbel can be detected on any of the specimens. Small inclosed pseudobranchiae are present on all specimens, and are located, as in the other species, beside a deep conic pit. The gill-rakers are always denticulate along their inner edges, but are variable in width and in length; the longest one, near the angle of the first gill arch, is contained 1.8 (1.2 to 1.6) times in the orbit; the number of gill-rakers is 6+20 on the left, and 6+22 on the right side of the type (6 or 5+19 to 21 in paratypes). Four full gills are present, the last of which is short, and followed by a slit about half as wide as the interorbital space. The branchial aperture is continued forward almost to the vertical from the anterior orbital margin. Seven branchiostegals. As in *B. antrodes*, the scapular

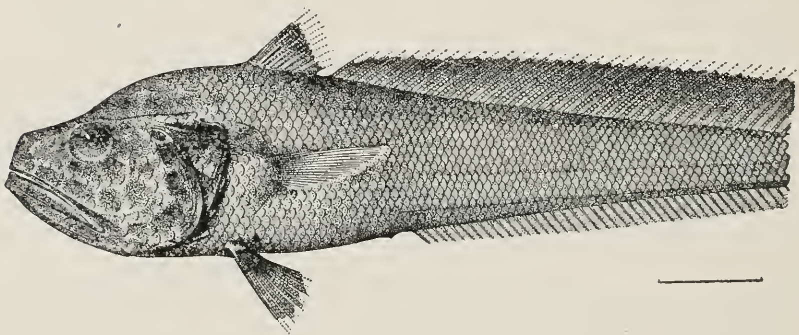

FIG. 1.—BATHYGADUS SPONGICEPS. TYPE.

foramen, though encroaching entirely upon the substance of the hypercoracoid, is in contact with the suture separating that bone from the hypocoracoid.

The scales which separate the lateral line series from the front of the second dorsal fin are arranged in six horizontal series. Several much enlarged scales or scale-like bones are present in the sensory canal above the gill openings. The shoulder girdle is scaleless beneath the opercles.

The first dorsal spine is soft and concealed, but is slender, sharp, and about one-fifth as long as the orbit; the smooth second dorsal spine is contained 1.6 times in the head; the second pectoral and the outermost ventral rays are likewise scarcely strengthened or produced. In this respect *B. spongiceps* differs notably from *B. antrodes*, in which the three rays are strengthened and greatly lengthened. The base of the ventral fin is anterior to the base of the pectoral, which is nearly in line with the origin of the first dorsal. The distance from the center of the anus to the base of the outer ventral ray is contained 1.6 (to 1.8) times in the head.

The pyloric caeca were counted in three paratypes. In one there were 21, longer than the orbit, but shorter than the interorbital; in another, 16, about as long as the orbit; in a third specimen, 17, only two-thirds as long as the orbit.

The color is very dark, the head, belly, and fins being blackish. The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities wholly black. The wall of the stomach and the mesenteries are black, while the intestines and pyloric caeca are without pigment.

B. spongiceps differs widely from *B. filamentosus*, *B. micronema*,[1] *B. nipponicus*,[2] *B. entomelas*, *B. furvescens*, *B. melanobranchus*,[3] *B. garretti*,[4] *B. sulcatus*, and *B. macrops*,[5] in the much wider and more cavernous head, correlated with a smaller size of eye, and other characters. It may readily be distinguished from *B. antrodes*[6] by the lack of filamentous rays, by the different form of the interopercular margin, and by the decidedly blacker coloration. From *B. favosus*[7] of the western Atlantic, it differs in the coarser dentition, in the more advanced position of the ventral fins, and in the very much darker color. It seems to differ from *B. cottoides*,[8] described by Günther from near New Zealand and the Kermadec Islands (a species insufficiently described) in the more numerous gill-rakers (5 or 6+19 to 22, instead of 6+17), and in the larger eye, the length of which is constantly somewhat more than half the length of the snout or the width of the interorbital space. *B. spongiceps* is closely related also to *B. bowersi*,[9] an Hawaiian species, from which it differs in the lesser width of the interorbital space, which is contained more, instead of less, than three times in the head; in the lower position of the scapular foramen, and in dentition, the inner shagreen-like portion of the premaxillary band not being expanded posteriorly, but forming throughout only a narrow margin to the main outer portion of the band.

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[1] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 661, fig. 258.

[2] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 605, text fig.

[3] Vaillant, Exp. Sci. *Trav. Talisman,* 1888, p. 206, pl. 18, fig. 1; Collett, Poissons de *L'Hirondelle,* 1896, p. 88.

[4] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 151, pl. 8, fig. 1.

[5] Goode and Bean, Oceanic Ichthyology, 1895, p. 423.

[6] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 606, pl. 4, fig. 1; Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 149.

[7] Goode and Bean, Bull. Mus. Comp. Zool., vol. 12, pt. 5, 1886, p. 160; Oceanic Ichthyology, 1895, p. 420, fig. 352.

[8] Günther, Ann. Mag. Nat. Hist., vol. 2, 1878, p. 23; *Challenger* Reports, vol. 22, 1887, p. 154.

[9] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659, fig. 257.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5582	5648	5467	5274
Total length in mm	390	307+	285+	232
Length to anus in mm	105	90	93	66
Length of head	61	66	....	68
Length of orbit	12	12.5	....	13
Width of interorbital	21	22	....	23
Width of suborbital	8	9	....	10
Orbit to preopercle	31	33	30.5	34
Length of snout	20	20.5	....	20
Length of upper jaw	34.5	37	....	38
Depth of body	44	[1] 50	....	[1] 50
Width of body	21	20	20.5	20
Anus to ventral	38	39	41	37
Ventral to end of pectoral arch	28	29	29	....
Height of second dorsal spine	39	....	41	....
Length of first dorsal base	20.5	20.5	18	20
Length of first pectoral ray	11.5	10.5	11	11
Length of second pectoral ray	....	31.5	....	....
Scales, above lateral line	6	([2])	([2])	([2])
Soft rays, first dorsal	9	8	8	8
Ventral rays	9-9	9-9	9-9	9-8
Pectoral rays	19-17	18-17	15-15	....
Gill-rakers, outer arch (left)	6+20	6+20	6+19	5+21
Gill-rakers, outer arch (right)	6+22	6+19	6+19	6+20
Length, gill-rakers	7	8	8	9.5

[1] Approximate. [2] Probably 6.

(*spongiceps*, in reference to the spongy nature of the head.)

Subgenus MELANOBRANCHUS Regan.

2. BATHYGADUS FILAMENTOSUS (Smith and Radcliffe).

Regania filamentosa SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 107, pl. 22, fig. 2.

Bathygadus dubiosus WEBER, Die Fische der *Siboga*-Expedition, May, 1913, p. 173, pl. 5, fig. 5.

Bathygadus filamentosus WEBER, Die Fische der *Siboga*-Expedition, p. 672.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			F°.	
5587	Off east[1] coast of British North Borneo	415	42.3	2
5619	Molucca Passage	435	....	1
5650	Gulf of Boni, East Indies	540	40.1	1

[1] The type station was wrongly located in the original description; it is off the east, not the west, coast of Borneo.

In form, in the breadth and softness of the head, in the size of the eye, in the development of the sensory canal system, and in the strength of the opercular spines, this species occupies a position intermediate between the species of the *B. cottoides* type, on the one hand, and those species with comparatively firm heads and large eyes on the other hand.

Our measurement of the interorbital differs a little from that given in the original description. As we measure, the orbit is contained 1.5 times in the least interorbital width, which is contained three times in the head.

The lower margin of the interopercle is but slightly concave. The flap at its posteroventral angle is short and blunt, only its tip being visible behind the semicircular margin of the preopercle.

The inner shagreen-like portion of the premaxillary band of teeth extends only along the posterior half of the band. The teeth in the narrow mandibular band are of unequal size.

Seven branchiostegal rays. The small pseudobranchial filaments are concealed beneath the skin.

A single main series of oval, imbricate scales extends along each mandibular ramus, but this series is flanked along its outer side by a few small scales. The lateral line on the tail runs below the middle of the depth, as in other species.

The pyloric caeca, 30 in number, are about two-thirds as long as the orbit.

Lining of the buccal, branchial, and abdominal cavities wholly black.

B. filamentosus is perhaps most closely related to *B. antrodes* of Japan, differing from that species, however, in the narrower, firmer head, larger eye, longer fin filaments, more numerous pyloric caeca, etc. It is probably related also to *B. micronema*, an Hawaiian species, but differs, in addition to the characteristics mentioned by Radcliffe, in the fewer gill-rakers.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5587	5587	5650	5619
Total length in mm	[1] 242	[1] 173	230	[1] 181
Length to anus in mm	72	48		54
Length of head	63	70		
Length of orbit	15	15		
Width of interorbital	22	24		
Width of suborbital	10	10		
Orbit to preopercle	31	33		
Length of snout	20	22		
Length of upper jaw	39	40		
Depth of body	43			
Anus to anal	7.5	10		
Anus to ventral	36.5			
Ventral to end of pectoral girdle	30			
Length of first dorsal base	16	17		
Length of first pectoral ray	11			
Length of second pectoral ray	121			
Length of third pectoral ray	43			
Length of outer ventral ray	119+			
Length of second ventral ray	31			
Scales above lateral line	7		7	7
Soft rays, first dorsal	8	9	8	
Ventral rays	8	8	8	8
Pectoral rays	15	15		
Gill-rakers, left side	6+20	6+19		6+20
Gill-rakers, right side		6+20		

[1] A pseudocaudal developed.

(*filamentosus*, in reference to the long filaments.)

3. BATHYGADUS ENTOMELAS, new species.

Type-specimen.—Cat. No. 78211, U.S.N.M., a female specimen, 220 mm. long (a pseudocaudal developed), from *Albatross* station 5619, in Molucca Passage, East Indies; depth, 435 fathoms; dredged with a specimen of *B. filamentosus.*

The body is more slender and less compressed than in *B. spongiceps*, the width over the pectoral being more than half the greatest depth.

The head, though wide and cavernous, is much narrower and less spongy than in the species of the subgenus *Bathygadus.* The dorsal contour, not strongly arched behind the occiput, is straight from that point forward to the tip of the premaxillary spine; the evenly curved

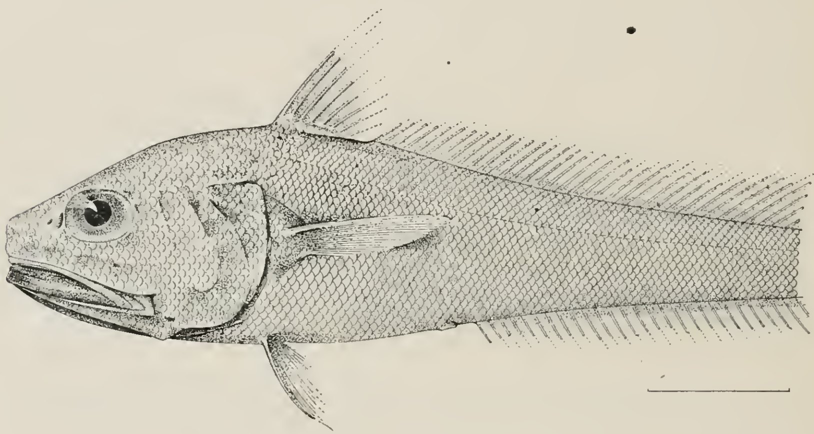

FIG. 2.—BATHYGADUS ENTOMELAS. TYPE.

ventral contour is less strongly angulated than in the species of the *B. cottoides* type. The orbit is larger than in the preceding species; its length is contained 4 times in the head, or 1.1 times in the least interorbital width, which is equal to the length of the snout; interorbital 3.7 in head. The least suborbital width is contained 2.4 in the interorbital. The two limbs of the opercle end in very weak spines, the upper of which is flat; the lower, slender. The interopercle is formed much as in *B. antrodes*, having the lower margin concave, and the bluntly rounded posterior flap just visible behind the preopercular margin. The mouth is only moderately oblique, more nearly horizontal than that of *B. cottoides* and its allies. The upper jaw extends slightly beyond the vertical from the hind orbital margin, its length being contained 1.8 times in the head. The teeth, similar to those of *B. spongiceps*, are coarser than those of *B. furvescens;* the mandibular band, which is about one-third as wide as the premaxillary band, is composed of but two or three irregular rows of teeth; the premaxillary band as usual consists of two portions—an outer one, with rather small teeth, which become decidedly smaller posteriorly; and an inner, shagreen-like portion, which extends along the entire inner length of the band, becoming widest below the front half of the eye, where its width is 0.03 of the length to the anus; the band narrows abruptly on its posterior third. No trace can be detected of a mandibular barbel. The pseudobranchiae, which form a series one-fourth as long as the orbit, are located beside the usual conic pit. The slit behind the fourth gill-arch is only half as long as the orbit. Branchiostegals, 7; gill-rakers, 5+20 (left) or 5+21 (right), denticulate on their inner margins; the longest gill-raker is half as long as the orbit. The branchial aperture is continued forward ventrally to a vertical crossing the orbit before the pupil. The scapular foramen lies wholly within the hypercoracoid, but is in contact with the suture between that bone and the hypocoracoid.

The scales are in eight series from the origin of the second dorsal to but not including the lateral line series; the scales are thin and cycloid; they are in two series on the mandible. The shoulder girdle is covered by a naked membrane beneath the opercles.

Fin-rays—first dorsal, II, 8; ventrals, 10; pectorals, 17 and 18. The first dorsal spine is slender and concealed; neither the second dorsal spine nor any of the pectoral rays are strengthened or produced. The outer ventral ray probably failed to reach the anus. The base of the ventral is but little anterior to the origin of the dorsal and the insertion of the pectoral.

Pyloric caeca, thirty-five, shorter than the orbit.

The color in alcohol is light brown, becoming blackish on the belly and on the jaws and the gular and branchiostegal membranes. The ventral fins are blackish; all the other fins are dusky. The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities wholly black; the walls of the stomach are black, but the intestines and the pyloric caeca are pale.

The relationships of this species are indicated in the preceding key. It is apparently related, though not very closely, to the two Japanese species of this subgenus—*B. nipponicus* and *B. garretti.* It differs from the Atlantic *B. melanobranchus* in the more numerous ventral rays, smaller eye, and other characters. It is closely related also to *B. furvescens*, but differs from that species in numerous details: the ventral rays are more numerous (10, instead of 8 or 9); 8 instead of 7 series of scales separate the front of the second dorsal from the lateral line; the color is much lighter, especially on the fins; the walls of the intestines are not pigmented; the body is less strongly compressed, the width of the pectoral bases being contained less than, instead of more than, twice in the depth;

the head is of firmer texture; the distance between the head and the anus in *B. entomelas* is equal to the length of the head behind the anterior nostril, but in *B. furvescens* is equal to the length of the head behind the middle of the eye; the teeth are coarser and in narrower bands on the jaws; the scapular foramen pierces the shoulder girdle at a lower point, being in contact with the suture between the hypercoracoid and the hypocoracoid; and, finally, the orbit is noticeably larger, although the type has been compared, in the preparation of the following table, with both smaller and larger Philippine specimens of *B. furvescens*.

Table showing size of orbit in Bathygadus entomelas and B. furvescens.

	entomelas.	*furvescens.*
Orbit in head	4.0	4.5 to 5.0
Orbit in snout	1.1	1.2 to 1.35
Orbit in interorbital	1.1	1.2
Orbit in postorbital	1.9	2.2 to 2.6

Measurements in hundredths of length to anus (84 mm.).—Length of head, 59; length of orbit, 16; least distance between orbits, 17; least suborbital width, 7; distance between orbit and preopercle, 29; length of snout, 18; length of upper jaw, 34; depth of body, 41; width of body over pectoral bases, 26; distance from origin of anal to center of anus, 7; from anus to base of outer ray, 39; from ventral fin to anteroventral end of pectoral girdle, 27; length of first dorsal base, 17; length of longest gill-rakers, 8.

Only the type-specimen is known to us.

(*entomelas*, in reference to the wholly black branchial cavity.)

4. BATHYGADUS FURVESCENS Alcock.

Bathygadus furvescens Alcock, Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 128; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 16, fig. 1, 1895; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 121.

Bathygadus melanobranchus Brauer, Die Tiefsee-Fische, 1906, p. 272.—Weber, Die Fische der *Siboga*-Expedition, May, 1913, p. 112.

Contrary to the suggestion of Alcock and to the opinion of Brauer, this species appears to be distinct from the Atlantic *B. melanobranchus* Vaillant,[1] having a decidedly smaller eye, according to the measurements of Vaillant, Collett, Alcock, and Brauer. Our study of the material which is here referred to *B. furvescens* strongly confirms the view that the two species are quite distinct.

For the purpose of more accurate comparison we present a description of our Philippine specimens, which were collected at the following stations:

[1] Vaillant, Exp. Sci. *Trav. Talisman,* 1888, p. 206, pl. 18, fig. 1; Collett, Poissons de *L'Hirondelle,* 1896, p. 88.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
[1] 5460	East coast of Luzon	565	....	1
5495	Between Leyte and Mindanao	976	52.3	1
5515	Off northern Mindanao	(2)	....	1
5526	Between Siquijor and Bohol Islands	805	52.3	1
5601	Gulf of Tomini, Celebes	765	....	1

[1] *B. spongiceps* was also dredged at this station. [2] About 700.

In the form and the texture of the head this species occupies a position intermediate between *B. entomelas* and *B. filamentosus.* The body is compressed more strongly than in *B. entomelas*, but less strongly than in *B. filamentosus*, the width across the pectoral bases being contained about $2\frac{1}{4}$ times in the greatest depth of the body. The length of the orbit is contained from 4.5 to 5.0 [1] times in the head; 2.2 to 2.6 times in the length of the head behind the orbit; 1.2 to 1.35 times in the snout; and 1.2 times in the interorbital width. The length of the snout and the least interorbital width are each contained from 3.6 to 3.8 times in the head. The least suborbital width enters 2.2 to 2.3 times into the interorbital. The opercle ends posteriorly in two weak spines, only the tips of which are exposed. The form of the interopercle is like that of *B. entomelas;* its posterior flap is just visible behind the preopercle. Length of upper jaw, 1.8. The teeth are finer than usual in *Bathygadus;* the premaxillary band is 0.2 as wide as the orbit; its inner shagreen-like portion is narrow and not strongly differentiated from the outer portion; the villiform teeth of the mandible form a band nearly half as wide as the premaxillary band (the dentition is quite different in *B. entomelas*). The barbel is absent. Pseudobranchial filaments are constantly present; the slit behind the fourth gill-arch is shorter than the orbit. The scapular foramen pierces the hypercoracoid about its own diameter above the suture between that bone and the hypocoracoid (determined in three specimens; both sides examined in one).

Seven series of thin and deciduous scales occupy the space between the origin of the second dorsal and the lateral line series. There are two series on the mandible, but none on the face of the shoulder girdle beneath the opercles.

None of the fins are greatly produced or strengthened. The ventral fin is inserted but little before the base of the pectoral or the origin of the dorsal.

Twenty pyloric caeca, two-thirds as long as the orbit, were counted in one specimen.

The coloration is darker than in *B. entomelas.* The fins are blackish; the buccal, branchial, and abdominal cavities are wholly lined

[1] In the largest specimen.

with black; the walls of the stomach are black, and those of the intestines are also pigmented.

Table of measurements in hundredths of length to anus.

Albatross station	5460	5515	5526	5495	5601
Total length in mm	....	271	235	203	85+
Length to anus in mm	145	72	62	51	30
Length of head	....	63	64	65	66
Length of orbit	12	15	15	16	15
Width of interorbital	16	18	18	19	20
Width of suborbital	....	8	8	9	....
Orbit to preopercle	28	31	32.5	31	....
Length of snout	18	17	18	19	....
Length of upper jaw	33.5	36	37	37	36
Depth of body	....	45	47	46	....
Width of body	....	24	23	21	....
Anus to anal	7.5	9	11	11	9
Anus to ventral	42	38	37	39	33
Ventral to anteroventral end, pectoral girdle	23.5	29	28	29	31
Height of second dorsal spine	....	31	....	....	....
Length of first dorsal base	19	18	19	21	....
Length of first pectoral ray	10	....	....	....	....
Length of second pectoral ray	35+	40+	....	40+	....
Length of outer ventral ray	....	42+	....	40	....
Length of gill-rakers	8.5	9	10	....	....
Number of gill-rakers, left	x+19	6+20	6+20	....	....
Number of gill-rakers, right	6+19	6+19	6+20	....	....
Soft rays, first dorsal	8	8	7	9	....
Pectoral rays	20	15	16	....	....
Ventral rays (both sides)	9-9	9-9	9-9	9-9	....

(*furvescens*, in reference to the dark color).

5. BATHYGADUS SULCATUS (Smith and Radcliffe).

Regania sulcata Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 108, text fig. 1 and pl. 22, fig. 3.

List of stations.

Albatross station	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5423[1]	Near Cagayan Island, Jolo Sea	508	49.8	1
5219	Between Marinduque and Luzon	530	50.8	1
5423	Near Cagayan Island, Jolo Sea	508	49.8	4
5424	.....do	340	50.4	2
5510	Off northern Mindanao	423	53.0	2
5527	Between Siquijor and Bohol	392	53.3	2
5528	.....do	439	53.3	1
5529	.....do	441	53.0	2
Lost	....	....	....	1

[1] Type.

A few additions to the original description have been compiled.

Pseudobranchiae are present, but concealed beneath the skin.

The inner shagreen-like portion of the premaxillary band of teeth is very definite, and forms a narrow margin along the entire band in the smaller specimens, but disappears anteriorly in the larger type; both portions of the band are widest at the end of the second third of its length; the teeth forming the outer portion are rather coarse, and expanded distally ("arrow-shaped"), but they become much smaller and more crowded posteriorly.

The form of the interopercle distinguishes *B. sulcatus* from the other Philippine species of the genus; the lower margin of that bone, along its posterior half, even along the posterior flap, is almost straight. The branchial aperture extends forward to below the middle of the eye, where the gill-membranes form a narrow fold across the isthmus.

The scales are in two series along the mandible.

Thirty-five pyloric caeca were counted in one specimen; they are very short, being only two-fifths as long as the orbit.

The parietal peritoneum is black.

The three most anterior gill-rakers are unusually small, and were not included in the count in the type-description: there are 6+18 or 19 in the type-specimen, instead of 5+16, as given by Radcliffe.

Table of measurements in hundredths of length to anus.

	Type.				
Albatross station	5423	5424	(*unknown*)	5510	5513
Total length in mm	440	[1]323	300	[1]172	[2]108+
Length to anus in mm	156	98	93	54	35
Length of head	58	58	58	63	62
Length of orbit	15.5	16.5	17	18	17.5
Width of interorbital	12.5	14	13	17	16.5
Width of suborbital	6	7	7	8	8
Orbit to preopercle	27	28	28	29	....
Length of snout	16	16.5	16	18	....
Length of upper jaw	32.5	32.5	33	38	37
Depth of body	38	41	38	42	....
Width of body	25	26	21	22	....
Anus to anal	9	7	8	9	10
Anus to ventral	39.5	39.5	39.5	37	....
Ventral to end of pectoral arch	27.5	28	28.5	27	27
Height of second dorsal spine	....	....	19	....	....
Length of first dorsal base	17	16	17	19	18
Length of first pectoral ray	7	9	8	....	....
Length of second pectoral ray	....	54.5	....	57	....
Length of third pectoral ray	....	40	....	....	....
Length of outer ventral ray	....	51	45	....	....
Length of gill-rakers	8	9	9	11	....
Scales:					
Above lateral line	9	9	9	....	8
Below lateral line	20	21	21	....	....
Soft rays, first dorsal	10	8	9	9	9
Ventral rays (both sides)	9-10	9-9	9-9	10-9	10-10
Pectoral rays	17	16	15	....	....
Gill-rakers:					
Left	5+19	6+18	....	5+18	....
Right	5+18	5+18	5+18	5+19	....

[1] A small pseudocaudal developed. [2] The smallest specimen procured.

(*sulcatus*, furrowed.)

Genus GADOMUS Regan.

This group, as recently defined by us,[1] contains about 10 species which have been greatly confused. The seven described species are probably all valid, and they appear to follow the species of *Bathygadus* and other Macrouroid genera in their localized distribution. The western Atlantic species, *G. longifilis*, has been recorded from the eastern Atlantic by Vaillant[2] and Collett,[3] but the descriptions

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 139, 148.

[2] Vaillant, Exp. Sci. *Travailleur et Talisman*, Poiss., 1888, p. 218, pl. 23, fig. 1.

[3] Collett, Poissons de *L'Hirondelle*, 1896, p. 91.

of these authors indicate that they have had another species, in which the interorbital is nearly as wide as the orbit. In addition Vaillant counted 9 ventral rays ("I, 8") and Collett 7+27 gill-rakers on the outer arch, while *G. longifilis* has but 8 ventral rays, and 30 to 35 gill-rakers below the angle of the outer arch. Alcock's,[1] Brauer's[2] and Weber's[3] records of this species from the Indian Ocean and East Indian Islands seem to be all erroneous. The species of these authors are distinguished from the true *longifilis* by their wider interorbital space and more numerous pyloric caeca.

The number of pyloric caeca in the species of Gadomus[4], with the number of specimens counted.

G. longifilis (Goode and Bean)	8	(one).
G. sp. (Hawaiian Islands)[5]	12	(one).
G. melanopterus	15	(one).
G. multifilis (Philippine Islands)	12	(one).
G. multifilis (Japan)	16	(one).
"*Bathygadus longifilis*" of Alcock	20	(one?)
"*Bathygadus longifilis*" of Brauer	15 to 22	(two).
G. magnifilis	24 to 29	(two)
G. introniger	35 to 52	(several).
G. denticulatus	61 to 75	(three).
G. colletti	95	(one).

The number of pyloric caeca occurring in the different species of *Gadomus* thus form a very striking series, in which the number gradually becomes smaller as one passes from the species with the firmest, narrowest heads and the fewest gill-rakers, to those of the more bathybial types, with contrasting characters.

ANALYTICAL KEY TO THE SPECIES OF GADOMUS.

a^1. Fins without long filaments; pectoral broad, with 25 rays; teeth excessively minute; interorbital much narrower than orbit.
arcuatus (western Atlantic).

a^2. Fins with long filamentous rays; pectoral narrower, with 15 to 22 rays.

b^1. Gill-rakers on lower limb of outer arch, 17 to 25, blunt at their tips (undescribed in *G. dispar*, a species not closely related to those of groups b^2 and b^3).

c^1. Interorbital 2 in "eye" *dispar* (Eastern Atlantic).

c^2. Interorbital 1.57 to 1.8 in orbit; gill-cavity with a whitish band on opercular margin; gular membrane light brown.

d^1. Teeth so excessively minute and crowded as to form an even shagreen-like surface, on which the individual teeth cannot be distinguished by the unaided eye; filamentous rays shorter, the dorsal spine less than twice as long as head; pyloric caeca 61 to 95.

e^1. Band of teeth in upper jaw little expanded posteriorly, its greatest width half that of bony suborbital region; color lighter; head firmer; pyloric caeca 95 *colletti* (Japan).

[1] Alcock, Ann. Mag. Nat. Hist., ser. 6, vol. 6, 1890, p. 302; and ser. 6, vol. 8, 1891, p. 123; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 120.

[2] Brauer, Die Tiefsee-fische, 1906, p. 270, pl. 12, fig. 7.

[3] Weber, Die Fische der *Siboga*-Expedition, 1913, p. 172.

[4] All of the counts were made by us, excepting those credited to Alcock and Brauer.

[5] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659.

c^2. Band of teeth in upper jaw expanded posteriorly, its greatest width being contained from $1\frac{1}{4}$ to $1\frac{3}{8}$ times in the least width of bony suborbital region; color darker; head more cavernous; pyloric caeca 61 to 75............*denticulatus* (East Indies).

d^2. Teeth small, but readily distinguishable by the unaided eye; band of teeth in the upper jaw narrow, its greatest width 2.0 to 2.4 in bony suborbital region; filamentous rays longer, the dorsal spine being more than twice as long as the head; pyloric caeca 24 to 29..........................*magnifilis* (Jolo Sea, Philippines).

e^3. Interorbital 1.0 to 1.23 in orbit; gill-cavity wholly black, as in the following species; gular membrane black; ventral fin with 8 rays. *introniger* (East Indies).

b^2. Gill-rakers on lower limb of outer arch 26 or 27, long and pointed; pectoral rays 17 to 20; interorbital space nearly as wide as the orbit; pyloric caeca 12 or more; gular membrane black; teeth readily distinguished by unaided eye.

f^1. Ventral rays constantly 8; pseudobranchiae present in specimens nearly as large as the type of *melanopterus;* scapular foramen on suture between hypercoracoid and hypocoracoid. *multifilis* (East Indies to Japan).

f^2. Ventrals 9-rayed in type;[1] no pseudobranchiae in type; scapular foramen wholly within the hypercoracoid. *melanopterus* (Hawaiian Islands).

b^3. Gill-rakers on lower limb of outer arch 30 to 35 (30 to 33 counted by us, 35 given in original description); gill-rakers long and slender, sharply pointed; pectoral rays 15 (13 given in original description); interorbital space decidely narrower than the orbit; teeth relatively coarse, approaching those of *Bathygadus;* pyloric caeca 8; gular membrane black..................................*longifilis* (Western Atlantic).

6. GADOMUS DENTICULATUS, new species.

Bathygadus longifilis Weber, Fische der *Siboga*-Expedition, 1913, p. 171.

Type-specimen.—Cat. No. 78207, U.S.N.M., 307 mm. long to end of regenerated pseudocaudal, 112 mm. long to anus, dredged by the *Albatross* off northern Mindanao, at a depth of 220 fathoms, at station 5505.

At each of the following stations a single paratype was dredged, with the exception of station 5198, where two were obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° *F.*
5123	East coast of Mindoro	108	....
5198	Vicinity of western Bohol	220	53.9
5406	Vicinity of Leyte	298	....
5410	Between Cebu and Leyte	385	....
5445	East coast of Luzon	383	44.3
5505	Vicinity of northern Mindanao	220	....
5587	Off east coast of British North Borneo	415	42.3
5589	....do	260	45.7
5624	Between Gillolo and Makyan Islands	288	....

[1] Ventral 8-rayed in a small Hawaiian specimen perhaps distinct from *B. melanopterus,* having also a wider interorbital space, etc. (See Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659.)

The general outlines of the body and head agree closely with those of other species. The greatest depth of body is equal to the distance from the tip of the snout to the angle of the preopercle; the greatest width, over the pectoral bases, is contained 2.3 times in the head and about twice in the depth of the body.

The head is rather firmer and less cavernous than in such species as *G. multifilis*, *G. introniger*, and *G. longifilis;* the greatest width of the head is about equal to the length of the snout plus the eye. The orbit is nearly round; its length is contained 1.15 (to 1.05)[1] times in length of snout, 4.3 (to 4.2)[1] times in length of head. The interorbital is narrow and flat, with clearly concave sides; its least width is contained 1.7 (1.5 to 1.8)[1] times in the greatest orbital

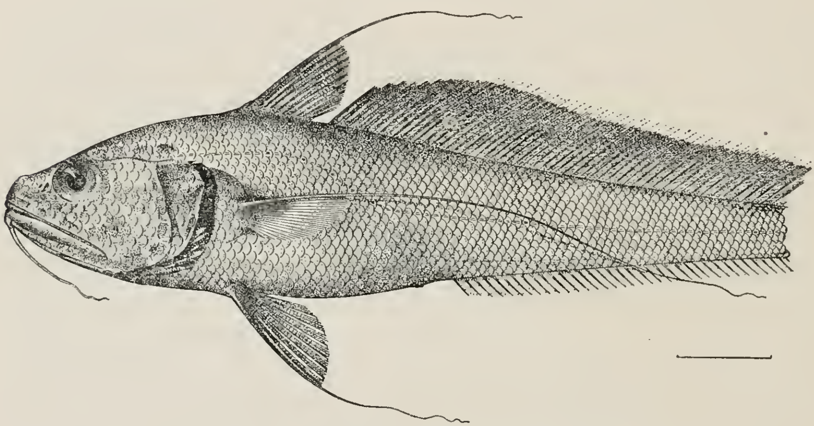

FIG. 3.—GADOMUS DENTICULATUS. TYPE.

length, and is about one-half as great as the length of the snout. The least width of the bony suborbital is about two-thirds that of the interorbital. The two limbs of the opercle do not end in spines; the lower margin of the interopercle is arched upward a little before its evenly rounded angle. The mouth, as in the other species, is large and moderately oblique; the upper jaw, the length of which is contained 1.85 (1.8 to 1.9)[1] times in the length of the head, extends but slightly beyond the vertical passing through the posterior margin of the orbit. The teeth are so excessively fine and crowded that they can not be individually distinguished by the unaided eye; they form an even surface on the two jaws, as also in *G. colletti*, the Japanese representative of *G. denticulatus*, and in *G. arcuatus*, an Atlantic species; the bands of teeth are strongly convex in cross section, the mandibular band being only one-third as wide as

[1] These measurements are of the three paratypes more than 100 mm. long to anus. Measurements of smaller specimens are given in the following table.

the premaxillary band, which is flattened and greatly expanded in width at the middle of the length of the maxillary; the greatest width of the band is contained 1.25 (to 1.65) times in the least width of the bony suborbital.

The length and strength of the barbel are too variable to serve as good specific characters, as can be understood by an examination of the tables of measurements following the descriptions of each species. Pseudobranchial filaments are developed, but are exposed only in our smallest specimens, having become covered in the large specimens by the fold of membrane which precedes the first gill-arch, and lines the deep pit opposite the upper angles of the arches. The gill-rakers are blunt at their tips, rather robust, smooth, rather widely spaced, and short, their length in the larger specimens being less than least width of the bony suborbital; they number 5+17 and 5+19, on the left and right sides, respectively, of the type, and vary from 4 to 5+19 to 21 in the nine paratypes counted. The branchial aperture curves forward to below the middle of the eye. A narrow slit is present behind the fourth gill-arch. Seven branchiostegals. As in our specimens of all four Philippine species of this genus, as well as in the specimen of *G. colletti* of Japan which we examined, the scapular foramen is in contact with the suture separating the hypercoracoid from the hypocoracoid.

The scales are thin, deciduous, and cycloid. When examined under the compound microscope, the numerous striae are seen to be finely denticulate; on the exposed portion of the scale the striae are arranged concentrically, but on the basal portion, which is the larger, they form an extremely irregular zigzag pattern, and are perpendicular (or nearly so) to the basal margin of the scale; these striae are connected by numerous cross ridges. Certain marks or narrow zones may be annular rings, as they bear a striking similarity to certain marks so interpreted in other marine fishes.[1] Several scales from the type specimen, 112 mm. long to anus, show three such rings; those from the paratype 111 mm. long, from *Albatross* station 5624, show two rings. A region of closely approximated circuli, occurring just outside the focus of the scale, suggests a similar area in salmonoid and other fishes, which in those forms is regarded as the winter zone of the first full year's growth. A similar area is more clearly marked off on the scales from *G. colletti* of Japan, and is also indicated on the scales of *G. longifilis* and the other species reported on in this paper. Those species inhabiting deeper water, however, do not show more than traces, if anything, of those marks which resemble annular rings. That fact is in harmony with the view that

[1] Such as *Cynoscion* (Taylor, Bull. U. S. Bur. Fish., No. 34, 1914 (Sept. 23, 1916), pp. 295–330; numerous figures).

these marks are seasonally made. If these zones are season indicators, then the type specimen was in its fourth or fifth year.

Eight series of scales separate the front of the second dorsal from the lateral line series in the type and in seven paratypes, but there are seven series in two paratypes. The scales on the mandible, in a single row anteriorly, become biserial posteriorly.

The lateral line below the anterior end of the second dorsal suddenly dips downward, as in other species, to its position below the middle of the tail.

The first dorsal spine is concealed; the second is three-fourths as long as the length to anus, but varies from a little less than two-thirds to 1.05 times that distance. The second pectoral ray is lengthened into a slender filament 1.4 times the length to anus (varying to slightly shorter than that distance in the paratypes). The outer ventral ray is always less than twice as long as the head and is always shorter than the length to anus, being 0.7 of that length in the type. The origin of the first dorsal is almost on a vertical with the insertions of the paired fins. The distance between the anus and the ventral is more than two-thirds the length of the head.

The pyloric caeca are short and numerous, 61, 69, and 75 in the three specimens counted.

Color, in alcohol, deep brown, lighter below and with silvery reflections on the lateral and ventral surfaces of the head and trunk; the branchiostegal membranes are dark brown, the gular membranes light; the lower lip is white. The walls of the buccal cavity are light near the mouth; the branchial cavity is lined with purplish black, with a wide whitish area along the opercular and branchiostegal margins. Parietal portions of peritoneum and the visceral portions over all the organs except the pyloric caeca, deep purplish black. Dorsal black, a little lighter on basal part of fin; anal light anteriorly, but shading into black posteriorly. Pectoral and ventral dark, with lighter filaments and a lighter area near their lower or inner basal portions. Other specimens are very much lighter in color; in these only the first dorsal is blackish, and it is lighter near its base, and dusky posteriorly; only those rays of the paired fins next to the filaments are dark; the dark portion of the branchial cavity is brown with lighter clouding, while the peritoneum shows much silvery through the dusky purplish color.

The distinguishing characters of this species are given in the key. It is probably most closely related to *G. colletti*, its Japanese representative, though allied with *G. magnifilis*, the next species to be described.

Table of measurements in hundredths of length to anus.

	G. colletti.			*G. denticulatus.*				
	Topotypes.			Type.	Paratypes.			
Albatross station	5062	5065	5067	5505	5624	5587	5505	5589
Total length in mm	302	[1] 190	68	[1] 307	[1] 306	[1] 277	[1] 230	[1] 214
Length to anus in mm	99.5	60	22.5	112	111	104	109	81.5
Length of head	56	60	61	53	54	55	56	54
Length of orbit	14.3	17	22	12.5	13.3	14	14.5	14.5
Width of interorbital	9	10.5	13	8	9	8.5	8	9
Width of suborbital	7	6	....	5.5	5.3	6	5.3	6
Orbit to preopercle	25	26	....	23	24	25	24	25
Length of snout	15	16	14	14	15.5	15	15.3	14
Length of upper jaw	29.6	32	37	28.5	29.5	30	29.5	30
Width of band of teeth in upper jaw	....	3	....	4.3	4.3	4	4.3	4
Length of barbel	47	56	57	33.5	35	51	32	44
Depth of body, about	45	48.5	....	44	41	44	41	42
Width of body, about	26.5	27	....	....	26.5	29	....	29
Anus to ventral	38	37	36	45	42.5	43	40	43
Ventral to end of pectoral girdle	....	26	26	27	28.5	26.5	....	27.5
Height of second dorsal spine	91	71	41	75	81	58	79.5	105
Height of third dorsal ray	31	36	....	26	32	34	31.5	36.5
Length of base of first dorsal	18	19	20	18	18.6	18	19	17
Length of first pectoral ray	10	11	....	6.5	8.5	12.3	10	14
Length of second pectoral ray	100	84	43	141	131	105.5	111+	134
Length of third pectoral ray	33	36	....	28	34	33.5	33	41.5
Length of outer ventral ray	41	55	72	70	57	52	81	....
Length of second ventral ray	31.6	36	33	29.5	30.5	33	32.5	Short.
Length of gill-rakers	5.5	8	....	4	4	5.3	5	6
Scales above lateral line	9	9	....	8	8	8	8	8
Soft rays, first dorsal	10	10	10	10	11	11	10	10
Ventral rays (both sides)	8	8	8	8	8	8	8	8
Pectoral rays (left side)	20	18	....	18	19	19	18	19
Outer gill-rakers:[2]								
Left side	5+22	6+21	....	5+17	×+19	5+19	....	4+19
Right side	....	5+20	....	5+19	5+19	4+20	6+20	5+20

	G. denticulatus.				
	Paratypes.				
Albatross station	5589	5410	5198	5445	5198
Total length in mm	[3] 263	[4] 226	[4] 203	[4] 183	[4] 197
Length to anus in mm	95	78	66	71	66
Length of head	55	57	57	59	55
Length of orbit	14	14	16	16.5	15
Width of interorbital	9.3	9.2	9.5	9.3	9
Width of suborbital	6	5.5	6	6	5.5
Orbit to preopercle	24	24	25	25.5	24
Length of snout	14	15	16	15	14
Length of upper jaw	30	31.5	32	32	31
Width of band of teeth in upper jaw	4	4	3.8	4	3.8
Length of barbel	40	50	53	56	52
Depth of body, about	46	41	47	45	43
Width of body, about	27	23	28	....	....
Anus to ventral	47	39	38	41	47
Ventral to end of pectoral girdle	28.5	....	27.5	27	....
Height of second dorsal spine	90	84	87	....	102
Height of third dorsal ray	....	30	....	....	....
Length of base of first dorsal	18.5	17	17	17	17
Length of first pectoral ray	10	13	12	11	13
Length of second pectoral ray	134	139	139	93	140
Length of third pectoral ray	46	29	32	36	31
Length of outer ventral ray	65	74	83	51	86
Length of second ventral ray	35	33	33	32.5	34
Length of gill-rakers	5	7	7.5	6.5	8
Scales above lateral line	8	7	7	8	8
Soft rays, first dorsal	11	10	10	10	10
Ventral rays (both sides)	8	8	8	8	8
Pectoral rays (left side)	18	18	19	22	18
Outer gill-rakers:[5]					
Left side	4+20	5+21	5+21	5+21	5+20
Right side	4+21	5+21	5+21	5+21	5+20

[1] To end of large or small pseudocaudal.
[2] Including anterior rudiments.
[3] A female with mature eggs; pseudocaudal moderate.
[4] A pseudocaudal developed.
[5] Including anterior rudimentary gill-rakers.

Only two specimens were not measured, owing to their poor state of preservation. They are about 52 and 76 mm. long, respectively, to the anus, and agree with the other specimens in the diagnostic characters.

(*denticulatus*, in reference to the fine teeth.)

7. GADOMUS MAGNIFILIS, new species.

Type-specimen.—Cat. No. 78208, U.S.N.M.; 337 mm. long to the end of a very small pseudocaudal, 103 mm. long to the anus; dredged at *Albatross* station 5515, off northern Mindanao, in "about 700" fathoms, near the type locality of *G. denticulatus*, but in deeper water.

Two smaller paratypes were also obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			°*F.*
5201	Sogod Bay, southern Leyte Island	554	52.8
5423	Near Cagayan Island, Jolo Sea	508	49.8

The form of the body is similar to that of related species; the greatest depth is equal to the greatest length of the head to the preopercular margin; the greatest width across the pectoral bases is about half the depth, and is contained 2.35 times in the head. The head is somewhat more cavernous and angular in outline than in *G. denticulatus*, as correlated with its living at greater depths; the outline of the snout at the tip of the premaxillary forms little more than a right angle. The width of the head is almost equal to the length of the snout plus that of the orbit. The orbit, as deep as long, is contained 4.65 (4.4)[1] times in the length of the head, 1.3 (1.2)[1] times in the length of the snout. Least width of interorbital, 1.37 (1.5)[1] in orbit. The least width of the bony suborbital region is nearly two-thirds that of the interorbital. The maxillary reaches a little beyond the vertical from the posterior orbital margin; length of the upper jaw, 1.8 in head. The teeth, though minute, are of sufficient size and spacing to be readily distinguished from one another by the unaided eye. The bands of teeth in the jaws are rather narrow, and are somewhat rounded in cross-section; the premaxillary band is widened posteriorly, but lacks the flat process, extending inward, which is found in *G. denticulatus;* the greatest width of the premaxillary band is contained only 2.0 (to 2.4)[1] times in the least bony suborbital width. The teeth in the bands are aligned in lengthwise series. The barbel is long and slender, being over half as long as the head in the type-specimen; but its length may be expected to

[1] In the paratype from station 5201 (70 mm. long to anus).

vary widely, as it does in the related species. The pseudobranchiae are covered by membrane in the three specimens at hand. The rather widely spaced gill-rakers are smooth on their inner edge, and are bluntly tipped; they are about half as long as the orbit. Gill-rakers 5+23 and 5+24 in the type, 5+22 and 5+21 in the larger paratype. The branchial aperture extends forward to below the front of the pupil; a slit is present behind the last gill; seven branchiostegals. In the paratype examined the scapular foramen is in contact with both the hypercoracoid and the hypocoracoid.

The scales closely resemble those of *G. denticulatus* in their finer structure, but differ remarkably in one point: the marks which were considered as possible season-indicators are much less pronounced, and consist chiefly of a sudden bending of the striae along a line

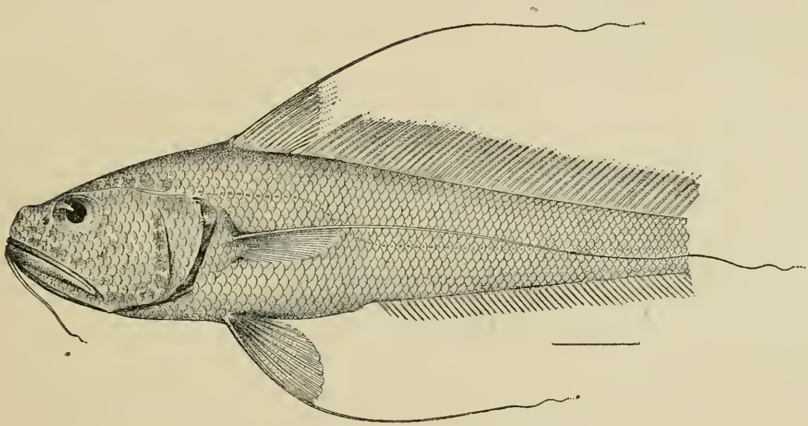

FIG. 4.—GADOMUS MAGNIFILIS. TYPE.

parallel with the margin of the scale (as seen on a scale from the type, 103 mm. long to the anus, and also in one from the paratype, 70 mm. long to anus.) In each of these a slight suggestion of a "check" occurs outside of the better defined one. A light streak was observed beneath this line in the substance of the scale. A marked approximation of the rings a short distance out from the center gives much the appearance of the first winter check in the salmon scale. The less pronounced marks on the scales of this species lends some support to the assumption that they are season marks, as the seasons would be expected to leave a lesser trace on a fish inhabiting greater depths.

Seven scales were counted, in each of the three specimens, in a series between the origin of the second dorsal and the lateral line, not including the lateral line scale. The mandibular scales are in a single series, with a few lateral scales posteriorly. The lateral line is elevated on the trunk.

The first dorsal spine is concealed; the second spine is produced into a long filament, and is about 1.2 times as long as the distance between the tip of snout and anus in the type (more than 1.4 times that distance in a paratype). The second pectoral ray is similarly elongate, varying from one and three-fourths to almost two times the length to anus. The outer ventral ray, likewise produced, is 1.1 times the length to anus in the type and one paratype, and but little shorter than the length of anus in the other paratype. The first dorsal and the paired fins all originate on about the same vertical. The distance from the anus to the ventral base is a little more than half the length of the head.

Pyloric caeca in two specimens, 24 and 29.

The color of the preserved specimens, from which nearly all of the scales have been lost, is light brown, with silvery reflections on the abdomen and the sides of the head. The exposed portion of the mandible is dusky. The branchiostegal membranes are brownish black, the gular membranes light. The buccal, branchial, and abdominal cavities are lined with brownish black membranes; the branchial cavity has a light margin on its outer wall, along the edge of the opercle and branchiostegal membranes; the walls of the buccal cavity are not light near the gape. The dorsal fins, including the produced spine, are blackish, except on a narrow lighter basal streak; the anal fin is light anteriorly, becoming wholly dark, like the dorsal, posteriorly. The basal region of the paired fins is dark.

Summary of the differences between Gadomus magnifilis and G. denticulatus.

	G. magnifilis.	*G. denticulatus.*
Length of head[1]	[2] 0.61	[2] 0.53 to 0.56
Length of orbit in head	[2] 4.65	[2] 4.2 to 4.3
Length of orbit in snout	[2] 1.3	[2] 1.05 to 1.15
Width of interorbital in orbit	[2] 1.37	[2] 1.5 to 1.8
Length of upper jaw[1]	[2] 0.335	[2] 0.285 to 0.30
Teeth[3]	([4])	([5])
Width of premaxillary band in suborbital	2.0 to 2.4	[3] 1.25 to 1.65
Distance from anus to base of ventral[1]	0.38 to 0.47	[3] 0.33 to 0.36
Gill-rakers on lower limb of first arch	[3] 21 to 24	[3] 17 to 21
Height of second dorsal spine[1]	[3] 1.185 to 1.40	[3] 0.58 to 1.05
Length of second pectoral ray[1]	[3] 1.70+ to 1.95	[3] 0.93 to 1.41
Length of outer ventral ray[1]	[3] .97 to 1.11	[3] .51 to .86
Buccal cavity color[3]	([6])	([7])
Number of pyloric caeca	[3] 24 to 29	[3] 61 to 75

[1] Expressed in hundredths of length from tip of snout to anus.
[2] In specimens over 100 mm. long to anus.
[3] Including smaller specimens.
[4] Distinguishable to unaided eye.
[5] Not distinguishable to unaided eye.
[6] Wholly dark.
[7] Lighter anteriorly.

Although the preceding table indicates the marked differences between *G. magnifilis* and its nearest relative, *G. denticulatus*, it is quite probable that it has been derived from that form. The three stations at which this species were dredged are all in the Jolo (Sulu)

Sea, and it is not improbable that it is confined to the peculiarly warm depths of that body of water.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5515	5201	5423
Total length in mm	[1] 337	[1] 235	[2] 220
Length to anus in mm	103	70	63
Length of head	61	61.5	....
Length of orbit	13	15	[2] 17
Width of interorbital	9.5	10	[2] 10.5
Width of suborbital	6	6	....
Orbit to preopercle	27	27	[2] 28
Length of snout	16	17	....
Length of upper jaw	33.5	34	[2] 36
Width of band of teeth in upper jaw	2.9	2.5	[2] 3.0
Length of barbel	37	44	[2] 42
Depth of body, about	48	49	....
Width of body, about	27	28	....
Anus to ventral	36.5	33	[2] 36
Ventral to end of pectoral girdle	30.5	28.5	....
Height of second dorsal spine	118.5	....	[2] 140+
Height of third dorsal ray	25	....	[2] 25
Length of base of first dorsal	17.5	18	....
Length of first pectoral ray	9	10	....
Length of second pectoral ray	177	170+	[2] 195
Length of third pectoral ray	33	31.5	....
Length of outer ventral ray	110	97	111
Length of second ventral ray	33.5	36	....
Length of gill-rakers	7	9	9
Scales above lateral line	7	7	7
Soft rays, first dorsal	10	9	10
Ventral rays (both sides)	8	8	8
Pectoral rays (left side)	18	17	17
Outer gill-rakers:			
Left side	5+24	5+22	....
Right side	5+23	5+21	....

[1] A small pseudocaudal developed.
[2] The measurements on this specimen are to be regarded as approximate only, owing to its very poor condition.

(*magnifilis*, in reference to the large fin-filaments.)

8. GADOMUS INTRONIGER, new species.

Gadomus multifilis, Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 106, text fig. 1 (in part).

Type-specimen.—Cat. No. 78209, U.S.N.M., 329 mm. long to the end of a large regenerated pseudocaudal, 119 mm. long to anus. Collected by the steamer *Albatross* at station 5648, at which six paratypes also were obtained. Locality, Buton Strait, near Celebes; depth, 559 fathoms; bottom temperature, 39.2° F.

A single paratype is in the collection from each of the following stations:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° F.
5274	China Sea, off southern Luzon	525	41.5
5460	Lagonoy Gulf, eastern Luzon	300	....
5585	East Coast, British North Borneo	476	41.1
5586	.....do	347	44.0
5647	Buton Strait, near Celebes	519	....
5651	Gulf of Boni	700	38.7
5656	.....do	484	41.2

The body contours are less strongly curved than in the two preceding species, *G. denticulatus* and *G. magnifilis;* the greatest depth, below the origin of the first dorsal, does not equal the length of the head to the margin of the preopercle at its angle as it does in those species, but is about equal to the distance from the tip of the snout to the preopercular ridge at its angle. The greatest width of the body across the bases of the pectoral fins is contained 2.35 times in the length of the head, and is more than half the greatest depth; the greatest width of the head is a little less than the length of the snout plus that of the orbit. The head is about as cavernous as in *G. magnifilis;* not so firm as in *G. colletti* or *G. denticulatus*, but firmer than in *G. multifilis.* The angle of the snout at the tip of

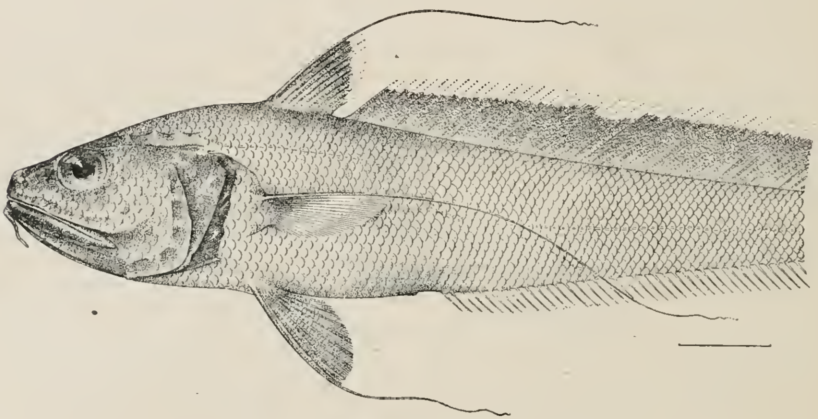

FIG. 5.—GADOMUS INTRONIGER. TYPE.

the premaxillary spines is quite obtuse. The horizontal length of the orbit, greater than the vertical, is contained 4.7 (to 4.5)[1] times in the length of the head, and 1.25 (to 1.15)[1] times in the length of the snout. The interorbital is almost as wide as the orbit, and about twice as wide as the suborbital. The upper jaw, which is contained 1.8 (to 1.7)[1] times in the head, extends well beyond the eye. The teeth, like those of *G. multifilis*, as distinguished from those of *G. denticulatus*, though minute, are of sufficient size to be readily differentiated from one another without a lens. The bands of teeth, occurring on the jaws only, are rather narrow and are not strongly convex in cross section. The teeth forming the bands are aligned in a single series separated by narrow toothless streaks. The greatest width of the premaxillary band is contained 2.4 (2.2 to 3.0) times in the least width of the suborbital. The mental barbel is long and slender, but of extreme variability, its length ranging from

[1] In paratypes more than 100 mm. long to anus.

half that of the eye to two-thirds that of the head (1.25 in eye in type); it is probably a healed stub when extremely short. The pseudobranchial filaments are covered by a membrane, which is ruptured in the type-specimen.

The gill-rakers are slightly roughened on their inner edge; are bluntly tipped, rather widely spaced, and are short, being about as long as the least suborbital width in the adults, but relatively a little longer in the young. Number of gill-rakers 6+23 and 6+24 on the two sides of the type, varying from 5+20 to 6+24 in the paratypes; other gill-structures as in related species. The scapular foramen is in contact with both the hypercoracoid and the hypocoracoid.

The scales in their finer structure are very similar to those of the other species. Toward the margin of the scale in the type-specimen there appears a break in the rings like the breaks which appeared more strongly in *G. denticulatus*. There is also that approximation of striae which, occurring near the center of the scale, may represent a check in the first year's growth. This approximation of the rings occurs in all of the species examined.

There are constantly seven scales in a series between the origin of the second dorsal fin and the lateral line scales. The scales on the mandible are in two series except at the anterior end of the rami. The lateral line, high on the trunk, runs below the middle of the tail.

The first spine of the dorsal fin is concealed; the second is greatly produced, but less so than in *G. multifilis*, *G. longifilis*, or *G. magnifilis;* its length is a half greater than that of the head, or 0.85 of the length to the anus in the type, varying in the paratypes from shorter than the head to considerably less than twice the head, and varies from half the length to anus to a little more than that length. The length of the second pectoral ray varies greatly, from less than three-fourths to one and a half times the length to anus. The length of the outer ventral ray never approaches twice that of the head, but is always longer than the head; it is four-fifths (0.65 to 0.93) as great as the length to anus. The first dorsal, pectoral and ventral fins begin on about the same vertical. The distance between the anus and the base of the outer ventral ray is contained about 1.5 times in the head.

Pyloric caeca (in several specimens), 35 to 52.

The color was apparently dark brown, a little darker on the belly, and blackish on the snout, mandible, and sides of the head. The silvery reflections on the abdominal region and on the sides of the head are probably less marked than in the preceding species. The buccal, branchial, and peritoneal cavities are wholly lined with black, being without light margins. The first dorsal fin is light throughout; the second dorsal has a narrow light streak near its base, but the main part of the fin is dusky, shading into black anteriorly; the anal is dusky throughout. The dusky pectoral fin becomes lighter toward the tip of the filamentous ray and blackish near the base of the fin. The blackish ventral fin becomes lighter toward the inner margin of its base.

This species, together with *G. multifilis*, is readily distinguishable from *denticulatus*, *colletti*, and *magnifilis*, differing from all in the wider interorbital space and the wholly dark branchial cavity, from *denticulatus* and *colletti* also in the coarser dentition, and from *magnifilis* also in the shorter fin filaments. The number of pyloric caeca seems also to be characteristic of the species; there are 24 to 29 in *magnifilis*, 35 to 52 in *introniger*, 61 to 75 in *denticulatus*, and 95 in *colletti*.

From *G. multifilis*, *G. introniger* differs in a number of diagnostic characters: the gill-rakers are shorter, more widely spaced and bluntly, instead of sharply, tipped, and they are fewer in number, there being 20 to 24 instead of 26 below the angle of the outer arch; the head is much firmer, the sensory channels being less developed; the teeth are considerably finer, and in wider bands, the premaxillary band being contained 2.2 to 3.0 in the suborbital width, rather than 3.3 to 3.8 times; the body is a little more robust, the depth in *G. multifilis* not equaling the length of the head to the angle of the preopercular ridge; the distance between the anus and the base of the ventral is decidedly longer, being two-thirds instead of half as long as the head; there are 7 instead of 6 scales above the lateral line; the fin filaments are shorter, the dorsal spine and the outer ventral ray being shorter, instead of longer, than twice the length of the head. *G. introniger* differs in similar details from *G. melanopterus* of Hawaii, and from *G. longifilis* in the wider interorbital, wider bands of teeth, and especially in the fewer gill-rakers (see measurements and counts of *G. longifilis* in the table of measurements and counts of the next species, *G. multifilis*). The number of pyloric caeca proves valuable in distinguishing these species also; 35 to 52 were counted in *G. introniger*, 12 to 16 in *G. multifilis*, 15 in *G. melanopterus*, and but 8 in *G. longifilis*.

This species lives in water probably deeper, on the average, than that inhabited by *G. denticulatus*. Its general appearance and structure is in harmony with such a difference in distribution. *G. introniger* inhabits depths as great as those from which *G. magnifilis* was dredged, but in much colder water.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.					
Albatross station	5648	5648	5648	5648	5585	5648	5648
Total length in mm	[1] 329	375	[1] 296	[1] 334	323	[1] 301	[1] 310
Length to anus in mm	119	118	111	110	100	97.5	95
Length of head	57	57	57	57	56	57	56
Length of orbit	13	13	13	13	13	12.5	13
Width of interorbital	12.5	11.5	11.5	13	12	11.3	12.3
Width of suborbital	6	6	6	6	6	7	5.5
Orbit to preopercle	26	27	26	27	27	27	26.5
Length of snout	16	15	16	16	15.5	15	16
Length of upper jaw	31	32.5	32	33	32	33	32
Width of band of teeth in upper jaw	2.5	2.4	2.3	2.4	2.7	2.3	2.2
Length of barbel	10.5	6.5	34.5	33	15.5	16	33
Depth of body, about	41	....	42	42	38	39	43
Width of body, about	....	....	....	....	24	24	....
Anus to ventral	40	39	....	45	45	40	40
Ventral to end of pectoral girdle	28	....	....	....	27	30	29
Height of second dorsal spine	85	84	95	98	92+	84	100.5
Height of third dorsal ray	....	....	....	....	25	24	26
Length of base of first dorsal	16	16.5	17	16.5	15	17	18.5
Length of first pectoral ray	11	6.5	10.5	6	7.5	8	....
Length of second pectoral ray	128+	129+	113	128	152	133+	....
Length of third pectoral ray	30	28	28.5	30	28	29	....
Length of outer ventral ray	79.5	67	68	68	91	86	65
Length of inner ventral ray	32	....	....	....	31	31	29
Length of gill-rakers	5.5	6	6	5	6.5	7	5.5
Scales above lateral line	7	7	7	7	7	7	....
Soft rays, first dorsal	10	10	10	10	9	10	10
Ventral rays (both sides)	8	8	8	8	8	8	8
Pectoral rays (left side)	18	19	17	20	18	17	....
Outer gill-rakers: [2]							
Left side	6+23	....	....	6+24	....	....	4+23
Right side	6+24	6+22	....	6+24	5+23	....	4+23

Albatross station	5274	5463	5586	5651	5648	5647
Total length in mm	[1] 236	[1] 216	240	[1] 213	[1] 205	163+
Length to anus in mm	78	75	75	64	62	51
Length of head	59	57	58	59	59	62
Length of orbit	14	14	14	14.5	15	16
Width of interorbital	12	12.5	12	12.5	13	13
Width of suborbital	6	6	6	6.5	6	7
Orbit to preopercle	27	28	26	28	27	27
Length of snout	16	16	16	16	16.5	17
Length of upper jaw	34	33	33	33.5	35	36
Width of band of teeth in upper jaw	2.4	2.2	2.5	2.6	2.3	2.5
Length of barbel	32	39	39	22	24	31
Depth of body, about	45	45	43	41	39	41
Width of body, about	....	24	24	21	23	20
Anus to ventral	39	43	41	39	38	39
Ventral to end of pectoral girdle	26	28	30	30	27	31
Height of second dorsal spine	....	....	103	96	....	51
Height of third dorsal ray	....	....	27	....	....	27
Height of base of first dorsal	16	16.5	16	15	15	16.5
Length of first pectoral ray	8	6	9	9	7	8
Length of second pectoral ray	72	....	122	134	....	121
Length of third pectoral ray	....	....	31	....	....	27
Length of outer ventral ray	....	....	77	74	82+	93
Length of inner ventral ray	....	31	33	....	31	32
Length of gill-rakers	7	7	7	7	8	9
Scales above lateral line	7	....	7	7	7	7
Soft rays, first dorsal	10	9	9	9	10	9
Ventral rays (both sides)	8	8	8	8	8	8
Pectoral rays (left side)	19	19	18	17	19	20
Outer gill-rakers: [2]						
Left side	6+25	5+22	5+20	5+24	5+22	6+22
Right side	6+23	4+24	5+20	....	....	....

[1] To end of small or large pseudocaudal. [2] Including anterior rudiments.

(*introniger*, in reference to the wholly dark buccal and branchial cavities.)

9. GADOMUS MULTIFILIS (Günther).

Bathygadus multifilis GÜNTHER, Report on the Deep-Sea Fishes, *Challenger* Expedition, 1887, p. 155, pl. 42, fig. B (near Philippine Islands).

Gadomus species GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 153 (Japan).

?*Bathygadus longifilis* ALCOCK, Ann. Mag. Nat. Hist., ser. 6, vol. 6. 1890, p. 302, and ser. 6, vol. 8, 1891, p. 123; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 120 (Arabian Sea and Bay of Bengal).—CHUN, Aus den Tiefen des Weltmeeres, 1900, p. 504, fig. East Coast of Africa).—BRAUER, Die Tiefsee-Fische, 1906, p. 270, pl. 12, fig. 7.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° *F.*
5467	Lagonoy Gulf, east coast of Luzon	480	
5582	Vicinity of Darvel Bay, Borneo	890	38.3
5607	Gulf of Tomini, Celebes	671	

We refer with some doubt the three specimens with the above data to Günther's species. The only character given in his original description accurately serving to distinguish between the species at hand and *G. introniger* is the distance between the anus and the base of the ventral. Our three specimens agree with Günther's description in that character, the distance being half as long as the head, while it is two-thirds as long as the head in *G. introniger*. One difficulty is that Günther's figure does not agree with his description in this regard. Assuming, then, that this species is *G. multifilis*, we find that Alcock, Brauer, and other European naturalists err in identifying it with *G. longifilis*—a species differing in the more numerous gill-rakers (30 to 35 instead of 26 on lower limb of outer arch); in the narrow band of premaxillary teeth, which is contained 4.8 instead of 3.0 to 3.8 times in the least bony suborbital width; in the much narrower interorbital; and in certain details brought out in the following table of measurements, which includes one of the types of the Atlantic species. *G. longifilis* should no longer be confused with distinct species inhabiting distant seas.

From the Hawaiian species (*G. melanopterus*), *G. multifilis* is less readily distinguished, and it is possible that the two species are identical. There are nine ventral rays in the type of *G. melanopterus* and but eight in *G. multifilis*. The scapular foramen in *G. melanopterus* was described as being "wholly within the hypercoracoid," while in *G. multifilis* it is on the suture between the hypercoracoid and the hypocoracoid.

A brief description of our three specimens (61 to 72 mm. long to anus) is appended:

The head is soft and spongy, due to the spaciousness of the sensory canals, which appear to be more highly developed than in any other species of the genus, thus rendering the appearance of the fish most similar to that typical of *Bathygadus*, in which genus these canals are usually enlarged. The outlines of the body are less curved than in *G. colletti*, *denticulatus*, or *magnifilis*, and the depth is less, not being equal to the length of the head to the angle of the preopercular ridge. Length of orbit, 1.2 in snout, 4.2 or 4.3 in head. The interorbital is almost as wide as the eye, and is over twice the least width of the bony suborbital; length of upper jaw, 1.6 to 1.7 in head, extending well beyond orbit; the teeth are coarser than in the other Philippine species and are confined to very narrow bands, the greatest width of the premaxillary series being contained from 3.3 to 3.8 times in the least suborbital width. Gill-rakers long, sharp, crowded, strongly compressed, and rough on their inner edge, 6+26 on the outer arch. The scapular foramen lies in the suture between the hypercoracoid and the hypocoracoid. Small pseudobranchiae are developed.

Six scales, exclusive of the lateral line scale, in a series between lateral line and origin of second dorsal. In their finer structure the scales seem to offer good specific characters. In *G. colletti*, *G. denticulatus*, and *G. magnifilis* the rings from the first, second, or third, extend forward on the scale to meet their fellow at an acute angle. The "circuli" thus soon become perpendicular to the basal margin of the scale. In *G. introniger* and in *G. multifilis* the first four rings are subcircular, and even after these, the "circuli" do not run so far from the circular course as do those of the other three species. In all of these five species the circuli are first well spaced, but soon become more closely approximated, the number of striae out to the end of this crowded area being 6 to 10. In the true *G. longifilis* this area of approximated circuli, very decidedly shown, occurs at the very center of the scale, and includes the first five circuli (determined in one of the type-lot). In *longifilis* the "circuli," even more than in *G. multifilis*, retain their circular character. However, the general character of the scales is the same in all the species. The "circuli" posteriorly are nearly concentric, while anteriorly they are more or less nearly perpendicular to the scale margin. They are finely denticulate, and are connected by numerous cross ridges.

On the trunk the lateral line runs above the middle of the sides, but descends on the tail to a position below the middle of the depth.

The fin filaments are very long, the second dorsal spine and the outer ventral ray being each twice as long as the head.

Pyloric caeca in a Philippine specimen, 12; in the Japanese specimen referred to *G. multifilis*, 16. Brauer counted 15 and 22 in two specimens, Alcock counted 20 in one of the Indian specimens. Whether Brauer's and Alcock's specimens are referable to *G. multi-*

filis is open to doubt, owing to their failure to describe in detail those characters which we find of highest value in the discrimination of the species.

The color is dark brown, becoming blackish on the belly and about the nostrils; the jaws, the branchiostegal and gular membranes, as well as the entire linings of the buccal, branchial, and peritoneal cavities, are black. The fins are mostly blackish, but the second dorsal is lighter anteriorly, especially near its base; the anal is dusky.

Table of measurements in hundredths of length to anus.

	Philippine Islands.			Japan.	(1)
Albatross station	5582	5607	5467	4973	2385
Total length in mm	172+	224+	252+	106+	250
Length to anus in mm	61	61	72	35	68
Length of head	61	63	62	62	61
Length of orbit	16	15.5	14	16	17
Width of interorbital	15	14.5	14	14	12.5
Width of suborbital	6	6.5	6.5	8	6
Orbit to preopercle	28	29	29	28	27
Length of snout	17	18	16.5	19	17
Length of upper jaw	38	37	38	....	37
Width of band of teeth in upper jaw	1.8	1.7	1.8	....	1.3
Length of barbel	36	40.5	36	....	24
Depth of body, about	44	47	47	....	44
Width of body, about	26	26	....	....	22.5
Anus to ventral	32	32	32	38	35
Ventral to end of pectoral girdle	28	....	....	27	31
Height of second dorsal spine	128	120+	127	....	130
Height of third dorsal ray	....	....	24	....	27
Length of base of first dorsal	16	20	19	19	19
Length of first pectoral ray	5.5	10	9	....	9
Length of second pectoral ray	150	....	....	107	124
Length of third pectoral ray	....	....	27	....	28
Length of outer ventral ray	122+	....	130+	....	139+
Length of inner ventral ray	31	....	....	....	37
Length of gill-rakers	9	10.5	9.5	13	9
Scales above lateral line	6	6	6	....	5
Soft rays, first dorsal	8	9	9	9	9
Ventral rays (both sides)	8	8	8	8	8
Pectoral rays (left side)	17	18	19	17	15–15
Outer gill-rakers [2] (left side)	6+26	6+26	....	6+27	7+30

[1] One of the types of *Bathygadus longifilis*. [2] Including anterior rudiments.

(*multifilis*, in reference to the numerous fin filaments.)

Subfamily MACROUROIDINAE.

Genus MACROUROIDES Smith and Radcliffe.

10. MACROUROIDES INFLATICEPS Smith and Radcliffe.

Macrouroides inflaticeps RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 139, pl. 31, fig. 2.

Type-specimen collected in 408 fathoms at *Albatross* station 5450, in Lagonoy Gulf, eastern Luzon; bottom temperature 42.3° F.

The relationships of this remarkably aberrant fish are discussed[1] in our paper on Japanese Macrouroids, in connection with the description of the related *Squalogadus modificatus*.

(*inflaticeps*, in reference to the immense head.)

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 138, 140, 156.

Subfamily CORYPHAENOIDINAE.

Genus CORYPHAENOIDES Gunner.

11. CORYPHAENOIDES PARADOXUS (Smith and Radcliffe).

Macrourus paradoxus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 115, pl. 25, fig. 1.

This very distinct species was dredged by the *Albatross* at a depth of 1,105 fathoms, at station 5428 off eastern Palawan, at a bottom temperature of 49.7° F. It is known from the type-specimen only.

(*paradoxus*, in allusion to its supposed doubtful position, in reference to the group "*Chalinura*").

12. CORYPHAENOIDES DUBIUS (Smith and Radcliffe).

Macrourus dubius SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 117, pl. 25, fig. 3.

This species is apparently closely related only to *C. wood-masoni* (Alcock),[1] an Indian species. The interdorsal space and the outer ventral ray do not differ in length in the type of *C. dubius* and in Brauer's[2] specimens of *C. wood-masoni*.

According to the system of measurements outlined previously by us,[3] the orbit in the type and only known specimen is contained 1.4 times in the snout; 1.05 in interorbital width, 5 in head; the least interorbital width is contained 3 times in the head. The maxillary extends beyond the vertical from middle of eye. The basal fourth of the second dorsal spine is smooth. The angle of the preopercular ridge is bluntly pointed. There are six branchiostegal rays.

Measurements in hundredths of length to anus (150 mm.; total length to end of pseudocaudal, 425 mm.); length of head, 64; length of orbit, 13; least interorbital width, 13.5; least suborbital width, 9; distance between orbit and preopercular margin, 31.5; length of snout, 18; length of upper jaw, 21.5; depth of body, 45; width of body over pectoral bases, 30; distance between the center of anus and the base of outer ventral ray, 29; distance from base of outer ventral ray to isthmus, 29; height of second dorsal spine, 41; length of pectoral fin from base of second ray, 34; length of first pectoral ray, 4; length of second pectoral ray, 27.5; length of outer ventral ray, 44; length of second ventral ray, 23.

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[1] *Macrurus wood-masoni* Alcock, Ann. Mag. Nat. Hist., Oct. 1890, p. 301; Nov. 1892, p. 353; Jour. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 13, fig. 1, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 114.

[2] Brauer, Die Tiefsee-Fische, p. 267.

[3] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 147.

Known only from the type taken at *Albatross* station 5511, in Iligan Bay, Mindanao, at a depth of 410 fathoms, where the bottom temperature was recorded at 53° F.

(*dubius*, apparently in reference to its supposed doubtful status or relationships.)

13. CORYPHAENOIDES ASPRELLUS (Smith and Radcliffe).

Macrourus asprellus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 118, pl. 26, fig. 1.

C. asprellus is related to *C. nasutus*,[1] a common Japanese species, but differs chiefly in the number and character of the scales. There are 5 or 6 instead of 6 or 7 between the origin of the second dorsal and the lateral line, excluding the lateral line scale. The spinules on the scales are coarser and longer; the rostral tubercles are much weaker and smaller, the terminal one bearing only six radiating spinous carinae; the scales on the preopercle have strongly divergent spinous carinae, while those of the same region in *C. nasutus* bear spinules in quincunx order as elsewhere on the body. Several additional differences are apparent: the dentition is stronger; the suborbital ridge is less pronounced; and the color is much darker. Certain proportions of the head differ: the snout is larger and its preoral projection greater; the interorbital is much wider; the maxillaries are much longer (3.1 in head).

It is perhaps more closely related to *C. hoskynii*,[2] from the Bay of Bengal (1,310 fathoms), differing chiefly from Alcock's description in not having "the last spinelet of the middle series greatly enlarged above the others."

The spinules of the scales are in quincunx order, and not in rows as originally described.

Known only from the type, collected at *Albatross* station 5632, southeast of Bachian Island, Dutch East Indies, at a depth of 845 fathoms.

(*asprellus*, diminutive of *asper*, a Japanese species.)

14. CORYPHAENOIDES SEMISCABER, new species.

Type-specimen.—Cat. No. 83625, U.S.N.M.; 251 mm. in total length, 74 mm. to anus; from *Albatross* station 5215, in 604 fathoms, east of Masbate Island, Philippine Islands; bottom temperature, 50.5° F.

Three smaller paratypes were also obtained: one at station 5124, in 218 fathoms, off the east coast of Mindoro; another at station

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[1] For description and references see Gilbert and Hubbs, Proc. U. S. Nat Mus., vol. 51, 1916, p. 168.

[2] *Macrurus hoskynii* Alcock, Ann. Mag. Nat. Hist., Sept., 1890, p. 214; Jour. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126. Illustrations of the Zoology of the *Investigator*. Fishes, pl. 9, fig. 4, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 116.

5215, at which the type was also dredged; the third at station 5534, between Cebu and Siquijor, in 333 fathoms, and at a bottom temperature of 53.3° F.

Fin-rays—first dorsal, II, 10 (or 9); pectoral, 22 (20 or 21); ventrals, 8.

The body is deep and strongly compressed, the width over the pectoral bases being somewhat less than half the greatest depth (two-fifths depth in a paratype); greatest depth, 1.3 (to 1.15) in head; depth over anus, 1.5 (to 1.3) in head; depth, at a distance behind the head equal to twice its length, 1.7 (to 1.3) in head; at that point the width of the body is contained 4.8 (to 4.3) times in its depth. The dorsal edge of the tail is rounded, but the ventral

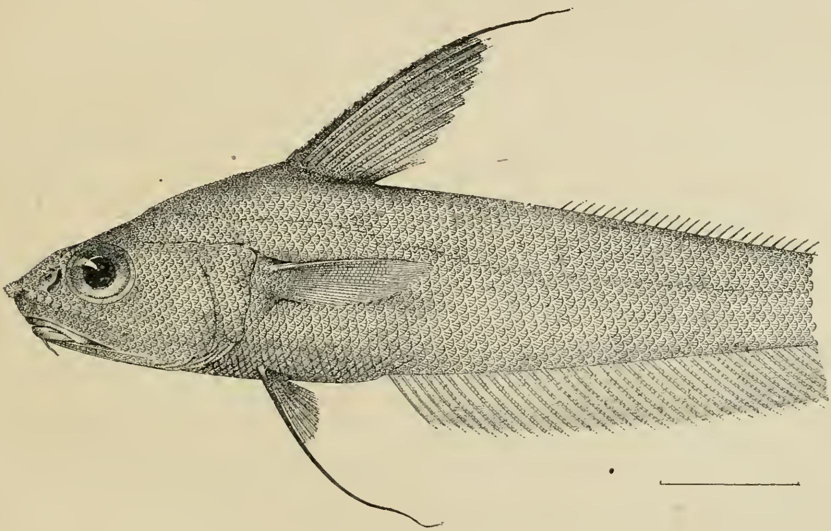

FIG. 6.—CORYPHAENOIDES SEMISCABER. TYPE.

edge is sharp. The dorsal contour is a little concave above the eyes, but slightly convex behind the occiput, oblique along the first dorsal base, and thence horizontal along the anterior half of the second dorsal. The ventral contour is a gentle curve from the mouth to the end of the second third of the total length, behind which the two contours converge to the end of the slender tail. The snout projects only moderately beyond the mouth, the preoral projection being about equal to the suborbital width, and less than the distance between the tip of snout and the front of the premaxillaries. The head is about half as wide as long; the width of the snout, across the suborbital ridges at the front of the orbits is contained 2.6 (to 2.8) times in the length of head; the distance between the lateral tubercles is equal to the length of the orbit (0.9 orbit in a paratype). The supranarial ridges are rather strongly arched inward; the preopercular margin is arched evenly forward above the rounded angle; the oblique suborbital ridge is little curved downward; it extends from below the anterior nostril to below the hind margin of the orbit. The snout is equal in length to that of the round orbit, each being contained 3.7 times in the head (in all three specimens). The interorbital width is narrow, being contained 5.0 (4.65 to 6.0) times in the head; the least suborbital width is slightly less than half the orbital length. The moderately oblique upper jaw extends from below the lateral rostral tubercle to below the front edge of the pupil (to past vertical from center of eye in the smaller paratypes); its length is contained 3.4 (3.2 to 3.5) times in the head, being greater than the length of the snout. The outer series of teeth in the premaxillary band are stouter and more widely spaced than the others. The barbel is variable; it is slender in the type, in which it is contained 2.6 times in the orbit; slender in the paratype from station 5215, 2.4 in orbit; very thick and much longer in the other paratype, from station 5124, 1.6 in orbit. The gill-membranes are united without a free fold. Six branchiostegal rays. The slit before the first gill-arch is reduced, 3.5 in orbit; the gill-rakers are rudimentary.

Eight (or nine in a paratype) rows of scales separate the front of the second dorsal fin from the lateral line series (six below last ray of first dorsal fin); 18 rows of scales were counted from the lateral line downward and backward to the origin of the anal. The scales are reduced in size on the belly and on the head exclusive of the opercular region. The gular and branchiostegal membranes are wholly naked. The spinules on the scales are definitely arranged in parallel or subparallel series, and no definite quincunx order can be made out except on some of the scales on the head and on the back before the dorsal fin; each scale of the body bears about 15 (11 to 16) of these series. There are no carinae, as each spinule rises independently from the surface of the scale. The individual spinules are of subequal size and of conic form; the last one of each series projects a little beyond the margin of the scale. The conspicuous terminal rostral tubercle, of semispherical form, is armed with about eight radiating rows of strong spinules; the smaller lateral tubercles are of oval outline, with a less definite arrangement of the smaller spinules.

Six pyloric caeca were counted in one paratype, and eight in the other; they are shorter than the orbit in both cases. The anus is placed immediately before the anal fin; its center is located behind the base of the outer ventral ray a distance slightly less than the postorbital length of the head, and equal to the distance between the ventral base and the isthmus (somewhat longer in a paratype).

The first dorsal spine is sharp but short, the length of its external portion being one-seventh that of the orbit; its root is composed of two posterior condyles separated anteriorly by a socket, from which a foramen passes backward between the condyles; the exposed portion is of pyramidal form, with grooves between the four sharp angles. The first dorsal spine appears to be more than a rudiment: it probably serves as a support for the strong denticulated second spine. The heavy basal half of the second spine is triangular in cross-section, with the sides grooved; the sharp anterior keel bears 24 (20 or 30) strong spinules, becoming longer and more slender upwards, and confined to the basal 0.6 of the spine. The spine becomes very slender distally, and exceeds the length of the head by a distance contained 5.2 (2.4, 2.9) times in the head; the third ray is contained 1.1 (to 1.5) times in the head; all the soft rays of the first dorsal except the last two are branched in their distal half. The rays of the second dorsal are rudimentary anteriorly, and can not be traced so far forward in the type as in the paratype, the interdorsal space being 2.3 times the base of the first dorsal in the type, and 1.3 times that distance in the two paratypes. The pectoral fin is not produced, its length being contained 1.7 times in the head (1.4 times in a paratype); its fifth ray is longest. Ventral with 8 rays, the outer one filamentous and nearly as long as the head, reaching backward to the ninth anal ray; ventral inserted slightly behind the pectoral, but anterior to the dorsal.

The ground color is dusky brownish, becoming darker on the belly and on the head, particularly toward the snout; the sides of the belly and of the head are underlain with a silvery pigment; the lips, nasal fossa, and upper half of branchiostegal membranes are blackish. The fins are all blackish, with a little grayish pigment basally, overlying the darker shade. The base of the anal has a narrow whitish, punctulate streak. Lining of buccal cavity bluish black; of branchial cavity, brown, shading into black toward branchial aperture; parietal peritoneum dusky brown.

C. semiscaber belongs to a rather well-marked group of species which agree in possessing a produced dorsal spine, a deep and sharply compressed body, and a dorsal contour horizontal behind the first dorsal fin. It differs from all the other species of the group in the lower dorsal spine, and in numerous other details: from *C. marginatus*,[1] the Japanese representative, in the much darker color, less regular arrangement of the spinules on the scales, blunter head, more numerous serrations of the dorsal spine, etc.; from *C. microps*, in the more numerous ventral rays; much darker color; more numer-

[1] For description and synonomy see Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 164.

ous serrations on the dorsal spine; much larger eye, and blunter head; and from *C. macrolophus*,[1] in the larger eye, which is equal to the length of the blunter snout, instead of being much smaller, as in both adult (*C. macrolophus*) and young (*C. lophotes*), of the Indian Ocean species.

C. awae, of Japan, a member of the same group, appears to be a very distinct species, although the large type of that species probably differs widely from smaller specimens, judging from the known changes in *C. marginatus* and *C. microps*. It is possible that *awae* is based on a very large example of *marginatus*.

C. semiscaber is also closely related to the following species, *C. tydemani*, another member of the same group.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5215	5215	5534
Total length in mm	251	213	[1] 110
Length to anus in mm	74	65	28
Length of head	66	66	69
Length of orbit	18.5	18	19
Width of interorbital	13	14	15
Width of suborbital	8	7	8
Orbit of preopercle	23	24	31
Length of snout	18.5	18.5	....
Length of upper jaw	20	20	21
Length of barbel	6	7	9
Depth of body	49	55	46
Width of body	27	27	30
Anus to ventral	29	30	31
Ventral to isthmus	29	27	27
Height of second dorsal spine	78	88	....
Height of third dorsal ray	52.5	....	....
Length of base of first dorsal	20	21.5	19
Length of pectoral	39	40.5	....
Length of outer ventral ray	62	63	51
Length of second ventral ray	26	26	....

[1] A small pseudocaudal developed.

(*semiscaber*, in reference to the basal armature of the dorsal spine.)

15. CORYPHAENOIDES TYDEMANI (Weber).

Macrurus tydemani WEBER, Fische der *Siboga*-Expedition, 1913, p. 158. pl. 1, fig. 6.

Four specimens of this fine species were dredged at *Albatross* station 5648, in Buton Strait, near Celebes, at a depth of 559 fathoms; bottom temperature, 39.2° F.

There is included a complete description of our material for comparison with *C. semiscaber* and other related species.

Fin-rays—first dorsal, II, 9 or 10; pectorals, 20 to 22; ventrals, 8 (8—9 in one).

The shape of the body and the course of the contours being similar in all respects to those of *C. semiscaber*, a repetition of the description seems unnecessary.

[1] See the note after the description of the next species.

Snout, 3.4 to 3.5 in head, longer than the orbit, the greatest length of which is contained from 4.0 to 4.2 times in the head. The interorbital is subject to considerable variation, as in *C. semiscaber*, its least width being contained 4.1 to 5.5 times in the head. The least suborbital width is half the length of the orbit. The mouth is somewhat oblique; the maxillary extends from below the lateral rostral tubercle to the vertical passing through the center of the orbit; length of upper jaw, 3.3 to 3.4. The teeth in both jaws are in moderate villiform bands; the teeth in the outer premaxillary series are somewhat heavier and more widely spaced than those in the remainder of the band. Barbel variable in strength, 2.4 to 3.9 in orbit. The gill-membranes are united, without a free fold. Six branchiostegals. The slit before the first gill-arch is greatly reduced, being contained only 4.0 to 4.5 times in the orbit. Eight rows of scales separate the origin of second dorsal from the lateral line scales; somewhat farther back a ninth row is inserted along the dorsal base; there are six or seven rows between the last ray of the first dorsal and the lateral line. The scales are smaller on the belly, and on the head with the exception of the opercular region. The gular and branchiostegal membranes, and the shoulder girdle beneath the opercles, are wholly devoid of scales. The spinules on the scales are not so definite in their arrangement as in *C. semiscaber;* a quincunx order can be made out on most of them; the spinules are aligned in about 15 series which converge more or less rapidly toward the apex of the scale; the spinules are of subequal size and conic form; the last one projects beyond the margin of the scale. The terminal rostral tubercle is rather small, and is armed with conic spinules of moderate strength, and not definitely arranged in series; the lateral tubercles are weak but distinct.

Ten pyloric caeca, about as long as the orbit, were counted in one specimen. The anus lies immediately in advance of the anal fin. The distance between the base of the outer ventral ray and the center of the anus is equal to, or greater than, the postorbital length of the head; the distance between the ventral fin and the isthmus is only 0.7 to 0.8 the postorbital length of the head.

The first dorsal spine is short and slender; the second spine is produced into a strong, compressed, and exceedingly long filament; the entire length of the spine is much greater than the length to the anus, being considerably more than half the length of the fish (except in the largest specimen); the anterior keel of the spine bears only 11 or 12 denticulations of moderate strength, confined to a basal portion of the spine contained 7.4 times in its entire length, and 2.5 to 3.0 times in the head; the length of the head is contained 2.82 to 3.05 times in the spine (only 2.0 times in the largest specimen). The third ray of the first dorsal is contained from 1.05 to 1.25 times in the head. The base of the first dorsal fin contains the length of the snout from 1.0 to 1.2 times, and itself is contained from 1.0 to 1.25 times in the interval between the end of the first dorsal and the first of the small anterior rays of the second dorsal. The length of the pectoral fin is contained 1.5 times in the head; it is not produced, but somewhat pointed, the fifth ray being longest. The filamentous outer ventral ray, reaching at most to the fifth anal ray, is contained 1.35 to 1.6 times in the head; its insertion is slightly behind the vertical from the origin of the first dorsal.

The ground color in alcohol is light yellowish brown, becoming duller on the belly and head, darker on the snout and opercle. The margins of the mouth, the edges of the nostrils, the eye, and the branchiostegal membranes opposite the opercle, are blackish. The sides of the head and the belly are underlain with silvery. The fins are blackish, becoming lighter basally. The lining of the buccal and branchial cavities is blackish; the parietal peritoneum is brownish.

C. tydemani differs from the other species of the same group (as defined after the description of the last species) as follows: from *C. marginatus*, in the smaller eye, darker color, and arrangement of spinules on the scales; from *C. microps*, in the larger eye, more numerous ventral rays, darker color, and in the arrangement of the spinules on the scales; and from specimens of *C. macrolophus* (Alcock)[1] of similar size, in the much longer dorsal spine, with fewer serrations, and in the smaller scales; both Alcock and Brauer counted 5 or 6 scales from the end of the first dorsal to the lateral line, including the lateral line scale; while *C. tydemani* has 7, exclusive of the lateral line scale. *C. tydemani* is closely related also to *C. semiscaber*, from which species it differs as follows:

Snout longer than orbit, instead of being equal to it, and contained 3.4 to 3.5 instead of 3.7 times in the length of the head.

2. Orbit shorter, 4.0 to 4.2 (to 5; Weber) instead of 3.7.

3. Spinules on scales less regularly arranged in parallel series, it being possible to align them in quincunx order.

4. The rostral tubercles smaller; the spinules on the terminal tubercle weaker and not arranged in definite radiating series.

5. The distance is greater between the anus and the base of the ventrals, and shorter between the base of the ventrals and the isthmus.

6. The second dorsal spine is stronger and very much longer, and is armed with fewer serrations, which are confined much more closely to the basal portion of the spine.

[1] See note on *C. macrolophus*, after the description of this species.

7. The interdorsal space appears to be shorter, 1.0 to 1.25, instead of 1.3 to 2.3, times as long as the first dorsal base.
8. The ventral filament is weaker, and shorter.
9. The color, especially of the fins, is a little lighter.

The slight difference in size between our specimens of the two species renders wholly improbable any assumption that these differences may be due to age variation. Furthermore, the dorsal spine usually decreases in length with age in the species of this long-spined group, and such appears to be the case with *C. tydemani*, but *C. semiscaber*, though represented by smaller specimens, has a much shorter spine.

Table of measurements in hundreths of length to anus.

Albatross station	5648	5648	5648	5648
Total length in mm	288+	369	[1] 268	258+
Length to anus in mm	94	87	85	80
Length of head	63	64	58	66
Length of orbit	16	15.5	16	15
Width of interorbital	15	12	14.5	12
Length of suborbital	8	8.5	8	9
Orbit to preopercle	25	27	23	28
Length of snout	18.5	19.5	17.5	18
Length of upper jaw	19	19	17.5	20.5
Length of barbel	5	6	4	6
Depth of body	54	51	52	....
Width of body	31	25	27	30
Anus to ventral	33	32	38.5	32
Ventral to isthmus	23	24.5	23	25
Height of second dorsal spine	127	182	....	198
Height of third dorsal ray	52	52.5	52	63
Length of first dorsal base	19	19.5	20	21.5
Length of pectoral	39	41	41	43
Length of outer ventral ray	45	47	45	42
Length of second ventral ray	21	23	22	23

[1] A small pseudocaudal developed.

Note on CORYPHAENOIDES MACROLOPHUS (Alcock).

Macrurus macrolophus Alcock, Ann. Mag. Nat. Hist., Nov. 1889, p. 394; August, 1891, p. 121; Nov., 1892, pp. 351, 352, fig. 1; Journ. Asiatic Soc. Bengal, vol. 63, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 12, fig. 1, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 115.

Macrurus macrolophus Brauer, Die Tiefsee-Fische, 1906, p. 266.

Macrurus lophotes Alcock, Ann. Mag. Nat. Hist., Nov., 1889, p. 385; Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 3, fig. 2, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 116.

Brauer considers *C. lophotes* to be the young of *C. macrolophus*, a conclusion which is apparently justified. But inasmuch as Brauer states that most of his specimens have seven branchiostegal rays, it is highly probable that he had, in part at least, a species of another genus, as all specimens of *Coryphaenoides* examined by us have constantly six branchiostegal rays.

C. macrolophus is not represented in the Philippine collection. Radcliffe's[1] reference to Philippine specimens should apply to *C. semiscaber* and to *C. tydemani.*

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, p. 117.

16. CORYPHAENOIDES MICROPS (Smith and Radcliffe).

Macrourus microps SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 116, pl. 25, fig. 2.

List of stations.

Albatross station.	Locality.	Depth, in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5325	Off northern Luzon	224	53.2	4
5470	Lagonoy Gulf, southeastern Luzon	560	....	Type.

A series of eight or nine scales separates the origin of the second dorsal fin from the lateral-line series.

Measurements of the large type follow: Length of orbit, 6.0 in head, 1.7 in snout, 1.15 in interorbital width, 5.2 in head; length of snout, 3.7.

The small specimens, four in number, differ in several respects so widely from the type-specimen that one might be led to separate them as a distinct form. On the basis of the limited material, and especially because the variations are partly paralleled in the growth of *C. marginatus*,[1] we regard the differences between them as being due to age variations. The differences in proportion are well indicated in the table of measurements. Further differences are listed below:

1. The number of parallel rows of spinules on the scales is fewer in the smaller specimens (a very similar variation occurs in *C. marginatus*, the closely related Japanese species).[1]

Length to anus in mm.	Number of rows of spinules.
33	3
53	6 to 8
66	8 to 11
150 (type).	13 to 21

2. The number and strength of the serrations on the second dorsal spine apparently decrease with the age of the fish, as in *C. marginatus*.[1] They are very weak in the type-specimen.

Length to anus in mm.	Number of serrations, mm.
33	16
ca. 37	12
53	11
66	11
150 (type).	4

3. The first dorsal spine is comparatively strong and sharp in the smallest specimen, becoming progressively weaker in the larger specimens, being rudimentary in the large type. This variation is normal.

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 165.

4. The second dorsal spine, as in *C. marginatus*, seems to be the longest in the medium-sized specimens (see the following table of measurements).

5. The terminal rostral tubercle is relatively much smaller in the large type than in the smaller specimens.

6. The coloration of the smaller specimens, perhaps to be correlated with their capture at a lesser depth, is much lighter, especially on the fins, than in the larger type. The fact that the largest of the paratypes is much lighter than the other three renders less significant the color difference between the type and the paratypes. In this lightest specimen the fins are white, with the exception of the following parts: the ventral filament, the tips of the anterior anal rays, the second dorsal spine, and the distal portions of the first few rays of the anterior dorsal.

The buccal cavity is lined with dusky; the branchial cavity with blackish; the peritoneal cavity with brownish.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.			
Albatross station	5470	5325	5325	5325	5325
Total length in mm	[1] 430	[1] 183	[2] 172	....	....
Length to anus in mm	150	66	53	ca. 37	33
Length of head	57	62	63	....	....
Length of orbit	10	13	14	....	14
Width of interorbital	11.5	12	12	....	13
Width of suborbital	8	8	9	....	....
Orbit to preopercle	25	28	29	....	....
Length of snout	16	18	19	....	....
Width of snout	19.5	23	26	....	22
Length of upper jaw	17	20	20	....	20
Length of barbel	5	6	6	....	....
Depth of body	53	47	49	....	45
Width of body	23	28	28	....	26
Anus to ventral	....	29	27	....	....
Ventral to isthmus	27	26	26	....	....
Height of second dorsal spine	122.5	177.5+	....	ca. 250	152
Height of third dorsal ray	45	59	....	....	....
Length of first dorsal base	18	19	19	....	....
Interdorsal space	[3] 35	10	21	....	....
Length of pectoral	36	38	39	....	33
Length of outer ventral ray	29	37	39	....	38
Length of second ventral ray	19	24	26	....	....
Soft rays, first dorsal	9	10	9	9	9
Pectoral rays:					
Left	20	20	21	....	....
Right	....	20	21	....	....
Ventral rays:					
Left	7	8	7	7	7
Right	7	8	7	7	8

[1] A large pseudocaudal developed around the truncated end of tail (see type-figure).
[2] A small pseudocaudal developed.
[3] The rudimentary rays of the second dorsal can be traced farther forward by dissection.

(*microps*, in reference to the very small eye.)

17. CORYPHAENOIDES AEQUATORIS (Smith and Radcliffe).

Macrourus aequatoris Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 120, pl. 26, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
[1] 5608	Gulf of Tomini, Celebes	1,089	36.3	1
5609	.....do	1,092	36.3	1

[1] Type.

The head, as usual, is deeper than wide, the erroneous statement to the contrary in the type description being due to the abnormal inflation of the sides of the head. A few proportions follow: length of orbit, 3.8 in head; length of snout, 3.6 (3.8); least interorbital distance, 4.1; length of upper jaw, 3.3; length of barbel, 0.6 length of orbit (in specimen from station 5609). A triangular portion of the interopercle is visible above and behind the rounded, denticulate margin of the preopercle; the ridge of the preopercle is produced backward as a rounded lobe. Number of branchiostegal rays, 6. Five rows of scales occupy the region between the lateral line series and the front of the second dorsal.

The ventral fins are inserted well behind the pectorals, directly below the origin of the first dorsal. The distance between the insertion of the ventrals and the center of the anus is very short, being about equal to the length of the snout, and shorter than the distance between the ventral base and the isthmus.

The buccal cavity is lined with dusky, but is lighter behind the corners of the mouth; the branchial and abdominal cavities are lined with bluish black.

The type-figure, referred to above, is rather inaccurately drawn; the snout is represented too long, and the ventral fins are inserted too far forward.

This aberrant species is certainly not closely related, as Radcliffe was led to believe, to *Macrurus petersonii* Alcock, a species which inhabits comparatively shallow water and belongs to a genus quite distinct, namely *Ventrifossa.*

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5608	5609
Total length in mm	[1] 188	166+
Length to anus in mm	62	55
Length of head	70	70
Length of orbit	18	19
Width of interorbital	17	18
Width of suborbital	11	11
Orbit to preopercle	31.5	32
Length of snout	20	20
Length of upper jaw	22	22
Length of barbel	11	13
Depth of body	51	57
Width of body	53	....
Anus to ventral	22	21
Ventral to isthmus	27.5	30
Length of first dorsal base	18	18
Length of pectoral	34	30
Length of outer ventral ray	62	63
Length of second ventral ray	25	....

[1] A small pseudocaudal developed.

(*aequatoris*, in reference to the type locality, which is nearly under the equator.)

18. CORYPHAENOIDES ORTHOGRAMMUS (Smith and Radcliffe).

Macrourus orthogrammus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 123, pl. 27, fig. 3.

This species is a very distinct one, having no close allies. It differs generically from *Lionurus parvipes* and *Mataeocephalus*, with which its describers compared it, in the number of branchiostegal rays, of which there are 6 instead of 7.

C. orthogrammus is known only from the type-specimen dredged from 1,262 fathoms, by the *Albatross*, at station 5636 near Gomomo Island, in Pitt Passage, Dutch East Indies.

The width over the pectoral bases is but half the greatest depth of the body. The length of the orbit is contained 4.2 times in the head; the width of the wide, flat interorbital space, 3.4 times. The prominent supranarial ridges are arched inward. The sides of the head are parallel, not diverging posteriorly; the distance between the lateral terminal tubercles is equal to the interorbital width. Length of the upper jaw, 3.3. The denticulate margin of the preopercle is produced backward in a wide curve, which nearly covers the posterior lobe of the interopercle. The preopercular ridge is sharply produced backward.

The scales are in five series between the origin of the second dorsal and the lateral line series.

The ventral fin is inserted directly below the origin of the first dorsal and the base of the pectoral, at a distance from the center of the anus equal to the interorbital width, and at a distance from the isthmus equal to the length of the snout.

The lining of the buccal cavity is dusky; of the branchial cavity, bluish black; of the abdominal cavity, brownish black.

Measurements in hundredths of length to anus (48 mm.)—Length of head, 74; length of orbit, 17; width of interorbital, 22; width of suborbital, 10; orbit to preopercle, 33; length of snout, 25; length of upper jaw, 24; length of barbel, 2.5; depth of body, 49; width of body, 26; length from anus to ventral, 22; from ventral to isthmus, 26; length of first dorsal base, 19; length of outer ventral ray, 50.

(*orthogrammus*, perhaps in reference to the strongly marked line formed by the suborbital ridge.)

19. CORYPHAENOIDES CAMURUS (Smith and Radcliffe).

Macrourus camurus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 122, pl. 27, fig. 2.

This remarkably peculiar species is known only from the small type, dredged at *Albatross* station 5428, off eastern Palawan, at a depth of 1,105 fathoms and at a bottom temperature of 49.7° F.

The width across the pectoral bases is distinctly less than half the depth of the body below the origin of the first dorsal. Orbit, 3.2 in length of head; interorbital width, 3.3; snout, 3.9; length of upper jaw, 2.6. The preopercular ridge is produced backward at its angle more strongly than is the preopercular margin; only the tip of the rather acute posterior lobe of the interopercle is visible behind the preopercular margin. Six branchiostegal rays.

The lateral line is indicated on the sides by the presence of several scales with pores at a distance below the origin of the first dorsal less than one-fourth that to the ventral surface. The type-description indicates that its position was interpreted too low. There are about eight scales in a series from the origin of the second dorsal to, but exclusive of, the lateral line scales.

The ventral fin is inserted below the pectoral base, slightly anterior to the origin of the first dorsal; its distance from the anus is equal to the length of the upper jaw, and is less than its distance from the isthmus.

The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities, black.

Measurements in hundredths of length to anus (29.5 mm.).—Length of head, 68; length of orbit, 21; width of interorbital, 22; width of suborbital, 11; orbit to preopercle, 34; length of snout, 19; length of upper jaw, 27; length of barbel, 20; depth of body, 63; width of body, 29; length from anus to ventral, 29; from ventral to isthmus, 30; length of first dorsal base, 18.

(*camurus*, crooked; in reference to the peculiar physiognomy.)

A. CORYPHAENOIDES, species.

Coryphaenoides, species, Weber, Fische der *Siboga*-Expedition, 1913, p. 154.

There is little doubt that the species of *Coryphaenoides* thus noted by Weber is an undescribed form; it certainly is not included in the collections of the *Albatross*.

Hyomacrurus, new subgenus.

Type-species.—*Macrourus hyostomus* Smith and Radcliffe.

Distinguished by the anterior position of the anus.

20. CORYPHAENOIDES HYOSTOMUS (Smith and Radcliffe).

Macrourus hyostomus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 121, pl. 27, fig. 1.

The collection contains six specimens of this interesting species, in addition to the type described by Radcliffe.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5460	Off east coast of Luzon	565	....	1
5467	.....do	480	....	2
5470	.....do	560	....	Type.
5587	Near Sibuko Bay, Borneo	415	43.3	1
5648	Buton Strait, near Celebes	559	39.2	2

This remarkable species strikingly differs from all others referred by us to *Coryphaenoides* in the anterior position of the anus, which is located well in advance of the anal fin. But it has six branchiostegal rays, and its reference to *Coryphaenoides* is corroborated by the entire appearance of the fish. *Macrurus heyningeni* Weber,[1] a species recently described from the East Indies, is described as having six branchiostegal rays and the anus remote from the anal fin. It probably is a species of *Coryphaenoides*, but certainly is not *C. hyostomus*.

The orbit of the type-specimen is contained 4.3 times in the head, 1.3 times in the snout, and 1.0 times in the interorbital space. In the other specimens the orbit is contained 4.05 to 4.4 times in the head, 1.2 to 1.4 times in the snout, and in some slightly exceeds in length the least interorbital width. The large flap which covers the anterior nostril in the type is not constantly enlarged. The mouth, as usual in the genus, is U-shaped, and longer than broad; the statement to the contrary, in the type description, is due to the frequent distortion of the head, which throws outward the walls of the branchial cavity. The suborbital ridge is especially well developed, extending backward beyond the orbit, but not to the preopercle; the total length of the ridge is equal to that of the mandible. The tip of the snout is armed with short but robust spinules which display no definite order in their arrangement; the lateral rostral tubercles are indistinct. The slit before the first gill-arch is 0.3 as long as the orbit. There are 5 or 6 rows of scales between the origin of the second dorsal and the lateral line, excluding the scale perforated by the lateral line.

The dorsal spine bears 3 to 5 indistinct or small serrations on its anterior edge, confined to a basal portion containing the length of the orbit 1 to 1.8 times. The head is contained 1.88 times in the dorsal spine in the type, 2.02, 2.08, 2.17, 2.63+, and 2.83 times in five of the other specimens. First dorsal, II, 9 in all specimens but one, which has 8 soft rays; ventral fin with 8 rays in all cases; pectoral rays, 17 to 20.

[1] Die Fische der *Siboga*-Expedition, 1913, p. 156. pl. 5, fig. 3.

The lining of the buccal and branchial cavities is blackish, except along the margin of the mouth; the peritoneum is blackish brown, underlaid with silvery.

Table of measurements in hundredths of length to anus.

Albatross station	5202	5648	5467
Total length in mm	280+	[1] 273	[1] 259
Length to anus in mm	82	82	71
Length of head	73	72	74
Length of orbit	18	18	18
Width of interorbital	17	18	16.5
Width of suborbital	11	11	11
Orbit to preopercle	29	30	29
Length of snout	24	23	25
Width of snout	29	27	28
Length of upper jaw	22	20	21
Length of barbel	7	5	6
Depth of body	46	46	47
Width of body	31	34	29
Anal to anus	13	13.5	15
Anus to ventral	18	21	20
Ventral to isthmus	22	23	23
Height of second dorsal spine	139	146.5	163
Height of third dorsal ray	56.5	57	....
Length of first dorsal base	18	17	17
Length of interdorsal space	13.5	16	14
Length of pectoral	38	22.5	....
Length of outer ventral ray	43	40	31
Length of second ventral ray	26	27	22

[1] A pseudocaudal developed.

(*hyostomus*, meaning hog-mouth.)

Genus COELORHYNCHUS Giorna.

The fauna of the Philippine Islands and the adjacent region to the southward has proved to be exceptionally rich in the species of *Coelorhynchus*. The region appears to be the center of their distribution, for in no other similar area in any of the seas is there known anything like the variety of species which occurs there. Of special note are the numerous species of the *C. notatus* and the *C. japonicus* groups. The subgenus *Quincuncia* is unknown elsewhere. In this region there are now known 23 species, or 45 per cent, of the total number in the world.[1] Despite the occurrence of this large number of species, none of them, with the exception of *C. parallelus*, has been discovered in other faunal regions, although some of them have close representatives in the Indian, Japanese, and Hawaiian faunas. These facts of distribution have already been discussed in the introduction.

The following analytical key has been arranged, as far as possible, to indicate the mutual relationships of the subgenera and species, each one being most closely related to the group or species preceding and following it.

[1] The authors have examined 42 of the 51 known species.

ANALYTICAL KEY TO THE SUBGENERA AND SPECIES OF COELORHYNCHUS.[1]

A[1]. Teeth in the lower jaw biserial or nearly so, at least on the sides; scales little strengthened on the weak ridges of the head; subopercle angulated at posteroventral angle, but without a distinct flap.

B[1]. Teeth biserial in both jaws; anus remote from anal, and preceded by a single large naked fossa covering a glandular body not supported by a rod of cartilage; scales well imbricate, armed with spinules on strong divergent carinae; anterior portion of eyeball scaled; one Japanese species ---------- ABYSSICOLA *macrochir.*

B[2]. Teeth in a cardiform band in upper jaw; anus posterior in position, immediately in advance of anal; anus preceded by a long cylindrical organ with a dilation immediately before the anus, and another, before the ventral fins, supported by an arched rod of cartilage connected with the pubic bone; scales poorly imbricate, armed with spinules arranged in quincunx order; eyeball wholly naked; three East-Indian species ---------- QUINCUNCIA.

a[1]. Underside of head naked; five or six series of scales between lateral line and origin of second dorsal; distance from anus to base of ventral in head, 1.8 to 2.3; distance from anus to isthmus in head, 1.15 to 1.32 ---------- *argentatus.*

a[2]. Underside of head scaled; four series of scales between lateral line and and origin of second dorsal; distance from anus to base of ventral in head, 2.4 to 3.5.

b[1]. Rami of mandibles scaled; front of premaxillaries below middle of nasal fossa; distance from anus to isthmus in head, 1.32 to 1.6; numerous proportions of fins and of parts of head generally like those of *C. argentatus* (see p. 445) ---------- *quincunciatus.*

b[2] Rami of mandibles nearly scaleless; front of premaxillaries below posterior nostril; distance from anus to isthmus in head, 1.6 to 2.0; numerous proportions of fins and of parts of head different from those of *C. argentatus* and *C. quincunciatus* (see p. 445) *thompsoni.*

A[2]. Teeth of both jaws in villiform bands (sometimes reduced in the lower jaw to scarcely more than three series in the subgenus *Oxygadus*).

B[1]. Subopercle with posteroventral angle rounded; snout little produced; physiognomy much as in *Quincuncia*, the ridges of head weakly armed; anus never in advance of normal position just before anal fin; height of first dorsal fin less than postrostral length of head; a closely related group of six species known only from the Atlantic Ocean and the Eastern Pacific ---------- COELORHYNCHUS.

a[1]. Spinules on scales arranged in quincunx order, without a median series; no prominent median occipital scaly ridge; species of the North Atlantic.

b[1]. Median scale of terminal rostral tubercles not so strong as the lateral pair; scaleless ventral fossa elongate, one-third as wide as long.

c[1]. Scales with smaller spinules; no prominent spot on first dorsal; no dark barks on body; a species of the eastern Atlantic ---------- *coelorhynchus.*

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[1] We include all of the known species with the exception of *C. labiatus* (Koehler), the original description of which is not available to us.

c^2. Scales rougher; first dorsal with a blackish median spot; a dark bar above the lateral line below origin of second dorsal (sometimes indistinct); a species of the western Atlantic ---------- *carminatus.*

b^2. Median scale of terminal rostral tubercles much more produced than the lateral pair; scaleless ventral fossa shield-shaped, two-thirds as wide as long; a species of the western Atlantic -------- *caribbaeus.*

a^2. Spinules on scales arranged in definite series; a median occipital scaly ridge present; species of the eastern Pacific and Patagonia.

b^1. Spinules on scales in subparallel series; species of the eastern Pacific.

c^1. Spinules weak, the median series not enlarged; five rows of scales between lateral line and origin of second dorsal; a species from Panama ---------- *canus.*

c^2. Spinules strong, with an enlarged median series; six rows of scales between lateral line and origin of second dorsal; a species from the Gulf of California ---------- *scaphopsis.*

b^2. Spinules on scales in an enlarged median series and divergent lateral series; four rows of scales between lateral line and origin of second dorsal; a species from Patagonia ---------- *patagoniae.*

B^2. Subopercle with a conspicuous acute flap on its posterior margin; snout variable, but usually very long; ridges of the head strong, and armed with thickened, highly specialized scales.

C^1. Spinules on scales on parallel or subparallel carinae of equal strength; anus usually in advance of normal position just before anal fin; height of second dorsal equal to, or greater than, postrostral length of head;[1] body with definite dark markings;[2] an apparently natural group of small species of the south and west Pacific[3] -- PARAMACRURUS.

a^1. Under side of head completely scaled; Australian species.

b^1. Eye longer than snout; occipital ridges very weak; boundaries of scales on head indistinct; 8 rows of scales above lateral line; interdorsal space one-third as long as base of first dorsal; dark bars extending obliquely forward ----------[4] *asperocephalus.*

b^2. Eye shorter than snout; occipital ridges stronger; boundaries of scales on head distinct; 5 rows of scales above lateral line; interdorsal space equal to length of first dorsal base; dark bars extending obliquely backward ---------- *australis.*

a^2. Under side of head completely scaleless;[5] species of the Japanese, Hawaiian, and Philippine faunas (with the exception of *C. fasciatus* and *C. innotabilis*).

c^1. Snout much shorter than the very large orbit; a subantarctic species ---------- *fasciatus.*

c^2. Snout scarcely if any shorter than the orbit, usually longer.

d^1. A round blackish spot always present just above and behind pectoral fin; second dorsal fin much lower anteriorly than anal.

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[1] Except in *C. innotabilis*, known only from young type; character unknown in *C. cingulatus*.

[2] Except in *C. innotabilis*.

[3] *C. fasciatus* has been recorded from South Africa.

[4] We are uncertain as to the relationships of this peculiar species. It possibly does not belong to this genus.

[5] This statement has been verified by examination of all the species included in group a^2, with the exception of *C. innotabilis*, which is not closely related to either *C. asperocephalus* of *C. australis*.

e^1. Snout less than twice as long as orbit; 4 to 6½ scales in a series from origin of second dorsal to lateral line; first dorsal not black distally; species of the Japanese and East Indian faunas.

f^1. Snout about as long as orbit; species of the Japanese fauna.

g^1. A scaleless ventral fossa present, between ventrals, separated by a scaly bridge from the peritroct; pyloric caeca 19 to 23; pectoral longer and stronger, with 17 rays; orbit longer than postorbital length of head; body with a large round spot above and behind pectoral, and another below anterior part of second dorsal---------*kishinouyei*.

g^2. No scaleless ventral fossa; pyloric caeca 25 to 31; pectoral shorter and weaker, with 14 to 15 rays; orbit shorter than postorbital length of head; body with a smaller anterior spot and no posterior spot----------------*jordani*.

f^2. Snout decidedly longer than orbit; species of the East Indian fauna.[1]

h^1. A scaleless ventral fossa extending from between ventrals to the peritroct, widest anteriorly; dorsal spine produced into a long filament.

i^1. Dorsal contour of snout straight; sides of snout strongly and evenly convex, without prominent anterolateral angles; color darker, the two posterior saddle-like markings rather indistinct, not ocellated; ventral rays, 7; distance from anus to anal, 2.0 to 4.0 in distance from anus to ventral.

j^1. Five or fewer very strongly spinous carinae on scales; snout longer, its preocular length 2.3 to 2.7 in head; anterolateral region of snout naked; interorbital broader, its least width 1.3 to 1.6 in postorbital; body more slender, its greatest depth 1.8 to 1.95 in head; color darker, rays of first dorsal light near base----------------------------------*maculatus*.

j^2. Five to 11 much smoother carinae on scales; snout shorter, its preocular length 2.75 to 2.95; anterolateral region of snout largely prickly; interorbital narrower, 1.55 to 1.85 in postorbital; body more robust, its greatest depth 1.6 to 1.7 in head; color lighter; rays of first dorsal dark near base--*velifer*.

i^2. Dorsal contour of snout concave; sides of snout not strongly convex, with prominent anterolateral angles; 7 to 12 carinae on scales; least interorbital width 1.55 to 1.85 in postorbital; greatest depth of body 1.7 to 1.9 in head; color lighter; first dorsal whitish proximally.

k^1. Tho two posterior saddle-like markings rather indistinct, not ocellated; pectoral rays, 14 or 15; ventral rays, 6; anterolateral portion of snout with a few scales posteriorly; scaleless ventral fossa longer, extending forward to between front of ventral bases; preocular length of snout 2.48 to 2.6 in head; preoral

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[1] Many diagnostic details, especially in characters of the head scales, the coloration, etc., are not included in the key, but may be found in the body of the descriptions.

length, 2.9 to 3.05; orbit, 3.5 to 3.9 in head, 1.3 to 1.55 in snout; maxillary, 3.7 to 4.05 in head; distance from anus to anal, 2.9 to 3.7 in distance from anus to base of outer ventral ray__________ *sexradiatus.*

k^2. Two posterior saddle-like markings very distinct, strikingly ocellated; pectoral rays, 16 or 17; ventral rays, 7; anterolateral portion of snout largely prickly; scaleless ventral fossa shorter, extending forward only to opposite posterior end of ventral bases.

l^1. Snout shorter and blunter, its preocular length 2.71 in head; its preoral length 3.0; orbit, 3.4 in head; 1.28 in snout; maxillary, 3.75 in head; distance from anus to anal, 1.6 in distance from anus to base of outer ventral ray______________ *notatus.*

l^2. Snout much longer and sharper, its preocular length 2.32, its preoral length 2.45, in head; orbit, 3.6 in head, 1.6 in snout; maxillary, 4.5 in head; distance from anus to anal, 2.6 in distance from anus to base of outer ventral ray__________ *triocellatus.*

h^2. No scaleless ventral fossa in region anterior to peritroct; dorsal spine produced into a long filament in only one species (*C. dorsalis*).

m^1. Dorsal contour of snout convex; orbit smaller, 3.3 to 3.8 in head, shorter than postorbital; snout narrower, its width at base 2.7 to 3.05 in head; interorbital narrower, 1.5 to 1.8 in postorbital; suborbital narrower, 2.6 to 2.7 in postorbital; 5½ or 6½ scales above lateral line; carinae on scales well developed; anterolateral region of snout largely prickly.

n^1. Second dorsal spine produced into a filament, about as long as head; 6½ scales in series above lateral line; snout more strongly convex laterally, the distance between the prominent anterolateral angles greater than distance anterior to them____________________ *dorsalis.*

n^2. Second dorsal spine without filament, much shorter than head; 5½ scales in a series above lateral line; snout less strongly convex laterally; the distance between anterolateral angles less than the distance anterior to them_____ *argus.*

m^2. Dorsal contour of snout straight; orbit larger, 3.05 to 3.3 in head, longer than postorbital; interorbital, 1.3 to 1.5 in postorbital; suborbital, 2.0 to 2.3 in postorbital; 4½ scales in a row above lateral line series; carinae on scales obsolescent; anterolateral region of snout largely scaleless; dorsal spine not filamentous_________ *macrolepis.*

e^2. Snout more than twice as long as orbit; 7½ scales in a series between origin of second dorsal and the lateral line scales; first dorsal fin black distally; second dorsal fin as high anteriorly as the anal; one Hawaiian species__________ *gladius.*

d^2. No round blackish spot above and behind the pectoral fin; second dorsal fin as high anteriorly as the anal.

o^1. Snout, 2.2 in head; orbit, 3.7; least interorbital width, 1.2 in orbit; interdorsal space two-thirds as long as the first dorsal base; body conspicuously mottled anteriorly, barred posteriorly; one species from northern Luzon and Formosa. *cingulatus.*

o^2. Snout, 2.4 in head; eye, almost 3 in head; interorbital width 1.8 in orbit; interdorsal space one-third as long as base of first dorsal; body without dark markings; one Australian species ________ *innotabilis.*

C^2. Spinules on scales on strongly divergent carinae, the lateral ones of which are often weaker than the median; anus always immediately before anal fin; second dorsal spine equal to, or less than, the postrostral length of head; body usually without definite dark markings; an apparently natural group of species, with its center of distribution in the East Indies ________ OXYMACRURUS.

a^1. Orbit very large, longer than the postorbital length of head; 3 to 5 spinous ridges on scales; distance from anus to ventral greater than length of orbit; snout comparatively short; one Chilean species ________ *chilensis.*

a^2. Orbit moderate, shorter than postorbital length of head; Indo-Asiatic species.

b^1. Snout less than twice as long as orbit in adult.

c^1. Snout without an acuminate tip; sides of snout very convex, the width between its anterolateral angles 0.75 or 0.8[1] in length before that point; scales on ridges of head, especially on infraorbital ridge, enlarged and strengthened much more than usual in this subgenus; flesh soft (*platorhynchus* group).

d^1. Underside of head and lower part of nasal fossa scaled; 5 to 7 strong spinous carinae on scales of body; scales from top of head usually with a single strong median keel; 4½ rows of scales in a series between lateral line and origin of second dorsal; infraorbital ridge scales in a double series on suborbital and preopercular regions, that is, behind middle of eye; area between ridge and orbit covered by small scales; orbit 1.2 to 1.25 in postorbital length of head; least interorbital width shorter than length of orbit, 1.5 to 1.7 in postorbital; preoral length of snout, 2.9 to 3.3 in head; length of maxillary, 3.8 to 4.1 ________ *platorhynchus.*

d^2. Underside of head and nasal fossa completely naked; scales from top of head usually with several carinae.

e^1. Four to seven strong spinous carinae on scales of body; 4½ rows of scales between lateral line and origin of second dorsal; infraorbital ridge scales in a double series on preopercular, suborbital, and posterior part of preorbital regions, that is, behind front of eye; area between ridge and orbit naked; orbit, 1.15 in postorbital length of head; least interorbital width decidedly shorter than length of orbit, 1.5 to 1.6 in postorbital; preoral length of snout, 2.9 to 3.05 in head; length of maxillary, 3.9. *acantholepis.*

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[1] 0.85 in a young specimen of *C. acantholepis* 60 mm. long to anus.

e^2. Seven to ten weakly spinous carinae on scales of body; scales of head with lower and more numerous carinae; 5½ rows of scales between origin of second dorsal and lateral line, excluding lateral line series; infraorbital ridge scales in a double series only on preopercular region of ridge; area between ridge and orbit with scales of reduced size; orbit, 1.33 in postorbital length of head, equal to least width of interorbital, which is contained 1.3 times in postorbital; preoral length of snout, 3.5 in head; length of maxillary, 3.55 ________ *carinifer.*

c^2. Snout with its tip more or less acuminate; sides of snout less convex, sometimes nearly straight; the width between its anterolateral angles less than 0.85 in length before that point, usually much less; scales on ridges of head less strengthened than in *platorhynchus* group; flesh firmer (*japonicus* group).

f^1. Four or four and one-half rows of scales in a series from origin of second dorsal to, but excluding, the lateral line series.

g^1. Underside of head completely scaled.

h^1. Three to seven strong spinous carinae on scales of body; orbit, 1.0 to 1.3 in postorbital length of head; pectorals longer than postorbital portion of head; pyloric caeca about 20; color of peritoneum blackish ________ *smithi.*

h^2. Eight or nine weak spinous carinae on scales; orbit, 1.8 in postorbital length (as measured on Alcock's figure); pectorals shorter than postorbital portion of head; pyloric caeca about 40; color of peritoneum "silvery grey" ________ *flabellispinis.*

g^2. Underside of head scaleless.

i^1. Distance from center of anus to base of outer ventral ray equal to, or less than, length of orbit; a scaleless anterolateral groove on snout; nasal fossa naked; scales of median rostral ridge with carinae radiating in all directions from center of scale; median series of scales between occipital and postorbital ridges little enlarged; orbit, 1.2 to 1.7 in snout, 1.05 to 1.25 in postorbital length of head; spinous carinae on scales of body weak, 6 to 11 in number ________ *radcliffei.*

i^2. Distance from anus to base of outer ventral ray decidedly longer than length of orbit; anterolateral region of snout and lower half of nasal fossa scaled; scales of median rostral ridge with carinae diverging outward and backward from front of scale; median series of scales between occipital and postorbital ridges much enlarged;[1] spinous carinae on scales of body stronger, 3 to 9 in number.

j^1. Orbit almost as long as postorbital length of head.

k^1. Three to five spinous carinae on scales; snout longer, with outlines weakly convex; orbit, 1.8 in snout; barbel, 6 in orbit ________ *productus.*

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[1] These characters derived from the squamation of the head have not been verified in *C. anatirostris*, but probably will not be found different in that species.

k^2. Six to nine spinous carinae on scales; snout "shaped like a duck's bill," its outlines strongly convex; orbit, 1.5 in snout; barbel, about 2 in orbit.
anatirostris.

j^2. Orbit much smaller, 1.35 in postorbital length of head, 1.9 in snout; 5 to 7 spinous carinae on scales; compared with *C. productus*, the snout is longer and broader, and much more convex toward tip; barbel, 3.5 in orbit---------------------------------*weberi.*

f^2. Five and one-half to seven rows of scales in a series from origin of second dorsal to, but excluding, the lateral line series; under side of head completely scaled; distance from center of anus to base of ventral longer than the orbit.

l^1. Sides of snout moderately convex; scales on top of head similar to those on body, with about 5 spinous carinae.
commutabilis.

l^2. Sides of snout nearly straight; scales on top of head with usually but a single median keel, being thus very dissimilar to the scales of the body---------------*japonicus.*

b^2. Snout more than twice as long as orbit.

m^1. Tip of snout without a long spine; spinous carinae on scales of head radiating backward.

n^1. Underside of head naked, excepting a small oval patch below preopercular angle; body marked with cross bars both above and below lateral line-----------*tokiensis.*

n^2. Underside of head completely scaled.

o^1. Interdorsal space scarcely half as long as base of first dorsal; dark cross bars above, but not below, lateral line--------------------------------*quadricristatus.*

o^2. Interdorsal space much longer than base of first dorsal; no dark markings------------*macrorhynchus.*

m^2. Tip of snout with an excessively long spine; spinules on scales of head arranged mostly in quincunx order.
acutirostris.[1]

C^3. Spinules on scales on a very strong median keel, with others in parallel rows; anus always immediately before anal fin; second dorsal spine shorter than postrostral length of head; body without definite dark markings; a natural group of species inhabiting the Atlantic, Indian, and western Pacific Oceans--------------------------------OXYGADUS.

a^1. Under surface of head completely scaled.

b^1. Orbit larger, more than half length of snout, its length decidedly greater than the interorbital width; spinules on scales of head moderately rough, several in number on each scute along the ridges; sides of snout nearly straight.

c^1. Spinous ridges on scales, 3 to 5, usually 3; scales on top of head mostly with a single keel; interdorsal space about equal to base of first dorsal--------------------------------*parallelus.*

c^2. Spinous ridges on scales, 5 to 7; scales on top of head with "stellate" ridges; interdorsal space figured as about twice length of first dorsal base---------------------*kermadecus.*

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[1] The systematic position of this species is questionable; an additional subgenus perhaps should be erected for it.

c^3. Spinous ridges on scales, 7 to 9, usually 9.
parallelus (Brauer, *nec* Günther).[1]

b^2. Orbit smaller, about half length of snout, equal to interorbital width; spinules on scales of head excessively rough, 1 to 3 only on each scute along the ridges; sides of snout convex____*spinifer.*

a^2 Under surface of the head wholly devoid of scales.

d^1. Lateral spinules on scales about three-fourths as large as those on the median keel; first dorsal fin black at base, becoming silvery distally____*aratrum.*

d^2. Lateral spinules on scales much smaller than those on the median keel; first dorsal fin uniformly colored.

e^1. Orbit smaller, 2.0 in snout, two-thirds postorbital length of head.

f^1. Spination of scales weaker, the lateral rows very weak, with many small spinules; total number of series, 3 to 13 on each scale____*doryssus.*

f^2. Spination of scales much stronger than in *C. doryssus*, the lateral series especially with fewer and stronger spinules; total number of series, 3 to 5 on each scale____________*occa.*

e^2. Orbit larger, 1.5 to 1.8 in snout, about equal to postorbital length of head____*talismani.*[2]

QUINCUNCIA, new subgenus.

Type-species.—*Coelorhynchus argentatus* Smith and Radcliffe.

This group includes, in addition to the type-species, two others described in this report—*C. quincunciatus* and *C. thompsoni*. These three species belong to the fauna of the Philippine Islands and the adjacent region to the southward; they are closely related to each other, and may be readily distinguished from all other members of the genus by the arrangement of the spinules on the scales in quincunx order (:·:) (not rising as serrulations along parallel or divergent carinae). The cardiform teeth of the upper jaw form a narrow band; the mandibular teeth are in two series, irregular anteriorly, in the type species, while in the two other species the two series become so irregular toward the symphysis that they form a narrow band. The anus is located far behind the head, immediately before the anal fin, and is not preceded by a naked fossa. The gland-like organ in the abdominal body wall is dilated at both ends —posteriorly just in advance of the anus, anteriorly in advance of the ventrals; this anterior lobe is supported, in the cavity that surrounds it, by a slender rod of cartilage connected with the posterior arm of the pubic bone.

The relationships of this natural group and of its species are indicated in the preceding analytical key. There now follows a detailed description of each form.

[1] The validity and position of this form are open to question.

[2] *Coelorhynchus vaillanti* Roule (1916) is a synonym of *C. talismani.*

21. COELORHYNCHUS ARGENTATUS Smith and Radcliffe.

Coelorhynchus argentatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, Sept. 27, 1912, p. 137, pl. 31, fig. 1.

Coelorhynchus acus WEBER, Fische der *Siboga*-Expedition, May, 1913, p. 160.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5279	China Sea, off southern Luzon	117	....	1
5291	.....do	173	51.5	1
5516	Off northern Mindanao	175	54.3	3
5517	.....do	169	54.3	1
5518	.....do	200	54	1
5255	Gulf of Davao, Mindanao	100	....	1
5135	Vicinity of Jolo	161	57.4	5
[1] 5172	.....do	318	....	[1] 2
5545	.....do	144	....	3
5550	.....do	200	54	1
5566	Between Jolo and Tawi Tawi	244	52.5	1

[1] The type specimen is one of the two from station 5172.

Inasmuch as both the description and figure given by Weber agree exactly with this species, it is evident that Weber's reference[1] of his *C. acus* to *C. commutabilis* Smith and Radcliffe, a wholly different species, can not be confirmed.

For the purpose of close comparison with the next two species, a detailed description has been prepared of *C. argentatus.* It is based upon the type-specimen, 143 mm. long to the anus, but is supplemented by measurements and counts of 13 other specimens ranging from 61 to 120 mm. long to anus.

Fin-rays—first dorsal, II, 9 (8 to 10); pectorals, 15–14 (14 to 20); ventrals, 7.

The dorsal contour is scarcely elevated at the origin of the first dorsal; before that point the outline is evenly convex; the ventral contour is gently curved. The body varies from robust to slender, the greatest depth being contained 1.68 (1.7 to 2.4) times in the head; the greatest width of the body, across the pectoral bases, 2.55 (2.4 to 3.0) times.

The tip of the snout is comparatively rather blunt. The dorsal margin of the snout is nearly straight; the lateral margins are slightly concave immediately behind the tip, but thence nearly straight to the more or less prominent anterolateral angles. The tip of the snout is on a horizontal passing slightly below (sometimes through) the lower orbital margin. Preocular length of snout in head, 2.8 (2.4 to 2.7); preoral length, 3.8 (2.9 to 3.6); width of snout opposite front of orbits, 3.66 (3.3 to 3.7); width at anterolateral angles, 1.0 (to 1.3) in the distance anterior to that point. The occipital ridges converge from both ends toward their middle,

[1] Fische der *Siboga*–Expedition, May, 1913, p. 671.

where the least distance between them is contained 3.1 (2.6 to 3.4) times in the interorbital width; posteriorly the ridges grade "into a shallow, scaleless groove which is continuous with the lateral line"—a condition indicated in Weber's figure of his *C. acus*. The postorbital ridge is curved slightly downward behind the ridge of the preopercle. The infraorbital ridge is less prominent than in any other species examined, with the single exception of *C.* (*Abyssicola*) *macrochir*. The lower angle of the subopercle is obtusely angulated, but without the prominent sharp flap diagnostic of the subgenera *Paramacrurus*, *Oxymacrurus*, and *Oxygadus*. The length of the orbit is contained 4.2 (3.7 to 4.25) times in the head, 1.4 (1.4 to 1.75) times in the snout, 1.7 (1.3 to 1.6) times in the postorbital. The interorbital width, least above the front of the pupil, is about equal to the orbital length, being contained 1.7 (1.4 to 1.6) times in the postorbital. The maxillary extends from below the middle of the large nasal fossa backward to beyond the vertical from the hind margin of the orbit; the length of the upper jaw is contained 2.8 times in the head in the type, from 2.9 to 3.3 times in the smaller specimens. Length of the slender barbel, 3.75 (2.6 to 4.2) in postorbital.

The premaxillary teeth are cardiform and are disposed in a narrow band. The mandibular teeth are in two series, which become a little irregular in large specimens; the inner of the two series is enlarged.

The sensory canal system of the head is well developed. Between the occipital and the postorbital ridges there is a spacious cavity, on the bottom of which large sense organs are located. Each of these organs lies on a scale-like neuromastic bone, the two ends of which rise upward and outward as slender curved rods, arching toward each other, and supporting the skin which forms the roof of the sensory cavity. Where the cavity becomes shallow posteriorly, behind the ridge of the pectoral girdle, its floor is covered by two scales or scale-like bones similar to those described by us in *Bathygadus* and *Hymenocephalus*.[1] Their similarity to the structure just described is greatly increased by the presence in each of slender rods passing outward to the skin. These two scales or scale-like bones are of irregular outline, being convex behind; the anterior of the two is imbricate over the second, which in turn is imbricate over the normal scales. The skin lying over these plates is covered with small scales, which are separated by a narrow scaleless groove from the adjacent scales of the body, over which the posterior plate just described is imbricate. The cavity in which these neuromastic bones lie is connected by a foramen with the cavity immediately behind the orbit, and with the

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 149, 186.

superior rostral sensory canal by means of a foramen, which is roofed over by a bony arch forming the anterior part of the occipital ridge. From the upper edge of the high median rostral crest of each side there branches off a slender horizontal rod, which supports the skin over a large sense organ.

The position of the anus is more posterior than in other species; its distance from the base of the ventral fin, 1.95 (1.8 to 2.3) in head; its distance from the isthmus, 1.16 (1.15 to 1.32). The distance between the base of the outer ventral ray and the isthmus is contained 2.7 (to 3.0) times in the head.

A highly differentiated organ, of problematic function, lies in the body wall on the midabdominal line. It is probably homologous to, but more complicated than, similar structures which we have described in *Coelorhynchus* and in other genera. As we have found this organ with skeletal support only in this subgenus (*Quincuncia*), its structure is probably diagnostic of the group. A description of this organ follows. A black superficial streak extends forward from the anus, at each end dilated into an area in which the scales are much reduced in size. The distance between the anterior end of this black streak and the isthmus is a little greater than half the orbital length. Immediately above this streak, between the ventral ends of the lateral muscles, there is located the organ being described. It consists of a stand of soft tissue, more or less pigmented on its ventral (or outer) surface, firmly united with the peritoneum, and expanded at each end into a depressed dilation. The posterior one is bilobed, being divided by the anus. The thick anterior dilation is roughly triangular in outline, with a convex anterior edge. It lies within a cavity, and is supported in a strikingly peculiar manner by a cartilaginous rod in close connection with the pelvic girdle. The posterior arm of this bone is a poorly ossified plate, which by meeting its fellow at the median line, forms a brace directly between the ventral bases. From the anteromedian angle of each of these posterior limbs a cylindrical rod of cartilaginous tissue extends forward to the sides of the anterior dilation, from which it extends dorsad, meeting its fellow in a wide arch, the apex of which is bound to the well ossified anterior arms of the public bone, where these meet at the median line.

Nine pyloric caeca, much shorter than the orbit, were counted in one specimen.

Shrimp-like crustaceans were found in the stomachs of two specimens.

The lateral line gently rises anteriorly to form a long, low curve, the chord of which is about as long as the distance between the anus and the isthmus. The thin scales are armed with short, stout, suberect spinules, which are arranged in quincunx order (occasionally showing a tendency to align themselves to form parallel or divergent series). There are five or six rows of scales between the origin of the second dorsal fin and the lateral line series.

The scales on the head are in general quite similar to those of the body, but the spinules on them are stronger and more nearly erect. The spinules along the weak ridges of the head are often arranged in strongly divergent series, and are comparatively little strengthened. The dorsoterminal rostral plate is poorly developed, being scarcely produced in the larger specimens. The scales along the infraorbital ridge are flat; only along the ventral margins of these scales are the spinules strengthened; these ridge scales are in a single series before the middle of the eye, but are in two series posteriorly. The median rostral ridge is covered by quadrate scales in a series continued backward almost to the median occipital scute; this median series is flanked on each side by a single series of scales. The occipital scute is preceded by a partly scaled area, and is immediately followed by a similarly strengthened scale. The large and irregular scales between the occipital and the postorbital ridges cover the sensory canal already described; this area is well defined, and is continued backward to below the origin of the first dorsal fin, being confined to the region below the scaleless groove continuous with the lateral line (the scales in the posterior portion of the area are of decreased size). Only a few weakly spinous or smooth scales are present on the lower part of the nasal fossa, and between the orbit and the infraorbital ridge; the anterolateral region of the snout is largely naked; the underside of the head is wholly scaleless, including the branchiostegal membranes, but excluding a well-defined and highly diagnostic crescent-shaped area just below and within the anterolateral margins of the snout.

The base of the first dorsal fin is contained 1.4 (to 1.05) times in the interval between the two dorsals, and 2.0 (to 1.6) times in the postorbital length of the head. The anterior rays of the second dorsal fin are very short. The origin of the anal fin is behind that of the second dorsal, and also (with few exceptions) behind the end of the pectoral. The ventral fin never reaches the anus except in very young individuals. Length of the fin rays in the head (in specimens exclusive of the type)—second dorsal spine, 1.95 to 2.5; pectoral fin, 2.2 to 2.9; outer ventral ray, 2.6 to 3.3; inner ventral rays, 3.3 to 4.2.

Coloration in alcohol.—The body, especially in the young, is marked by dark mottling on the trunk and by numerous dark vertical bars on the tail. The ventral portion of the branchiostegal membrane is jet black; the gular membrane is crossed by numerous fine black lines on minute ridges, between which the silvery ground color is prominent. This type of coloration is not to be confused with the true striations of *Hymenocephalus*, for in that genus both types are sometimes found together on the gular membrane (see descriptions of the species of *Hymenocephalus*). The surface over the pectoral girdle, where covered by the gill covers, is largely silvery, but is dark in front of the pectoral fin. The lining of the buccal cavity, in strong contrast to its color in most species, is whitish; the lining of the branchial cavity is whitish over the hyoid arch, but brown elsewhere, shading to black just within the abrupt and narrow white margin along the branchiostegal and opercular membranes. The parietal peritoneum is for the most part dark purplish brown, underlain with silvery, but is whitish along each side of the ridge formed by the organ already described. The opercles show silvery and bronzy reflections. The region of the occiput is blackish. The eye-ball is blackish dorsally, silvery ventrally; the pupil is surrounded by a very narrow silvery ring; the iris is more or less yellowish, but without a well-defined yellow ring as in *C.* (*Abyssicola*) *macrochir*. The bases of the first dorsal and the paired fins are blackish, as are also the tips of the ventral rays.

In the larger specimens the striking silvery color of the sides is bounded above by a dark streak along the tail.

In a young specimen, measuring only 24 mm. to the anus, the abdomen is whitish, excepting the dark streak along the mid-ventral line; the branchiostegal membranes are light, with dark specks; the gular membrane is light brown, without the dark transverse streaks (these are already apparent in a specimen 32 mm. long to the anus); and the fins lack their blackish bases. Small specimens differ also in their proportions from larger ones, as the following table shows.

Table of measurements in hundredths of length to anus.

	Type.				
Albatross station	5172	5172	5118	5135	5545
Total length in mm	365	[1] 281	334	....	....
Length to anus in mm	143	120	92	66.6	24
Length of head	65.5	65	67.5	67	71
Length of orbit	16.3	16	17	17.3	22
Length of postorbital	27	25.3	24.5	23	24
Width of interorbital	15.8	16.5	17	16	20
Width of suborbital	7.5	7.5	8	7.3	9
Orbit to preopercle	26.7	27.3	27	28	27
Length of snout	23.5	25	27.2	27.2	27.5
Length of maxillary	24	21.6	21	20.6	22
Depth of body	39.5	35	37	32	33
Width of body	26	24.4	26	23.3	23
Anus to ventral	34	33	34	34	32
Ventral to isthmus	24	24	23.3	23	24
Length of first dorsal base	13.3	14	13.3	13	14
Length of interdorsal space	28.4	38	18	18.6	17
Length of pectoral fin	....	....	26	26	29
Length of outer ventral ray	....	23.5	22	26	....
Length of second ventral ray	....	17.6	17	18	....

[1] A pseudocaudal developed.

(*argentatus*, in reference to the silvery coloration.)

22. COELORHYNCHUS QUINCUNCIATUS, new species

Type-specimen.—Cat. No. 78213, U.S.N.M., a mature female 237 mm. long to end of a pseudocaudal of 7 rays, or 93.3 mm. to anus; from *Albatross* station 5392, between Samar and Masbate, in 135 fathoms.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5121	Off east coast of Mindoro	108	....	2
5392	Between Samar and Masbate	135	....	6
5396	.....do	137	....	1
5397	.....do	134	....	2
5412	Between Cebu and Bohol	162	54.8	1
5451	Off southeastern Luzon	153	....	1 yg.

This species is not recorded at depths so great as are *C. argentatus* (318 fathoms) and *C. thompsoni* (200 fathoms).

In the description which follows, those measurements and counts included in the parentheses after each measurement or count of the type, were taken on paratypes 60 to 77 mm. long to anus. When markedly different, there are added, separately, the measurements of three smaller specimens, 50 to 57 mm. long to anus.

Fin-rays—first dorsal, II, 9 (or II, 10); pectorals, 16 (to 18); ventrals, 7.

The greatest depth of the body is contained 2.1 (1.85 to 2.3) times in the head; the greatest width, across the pectoral bases, 3.0 (2.5 to 3.3) times. The dorsal contour is slightly concave on the snout and weakly convex between the snout and the first dorsal. The snout closely resembles that of *C. argentatus;* it has a slightly acuminate tip, which is on a horizontal passing below (or through) the lower margin of the pupil. The proportions of the snout follow: preocular length, 2.4 (2.3 to 2.55) in head; preoral length, 3.15 (2.8 to 3.3); width of snout at front of orbits, 3.5 (3.33 to 3.5); width across snout at anterolateral angles, 1.2 (1.1 to 1.3) in the distance anterior to the angle. The occipital ridges diverge strongly toward both ends; the least distance between them is contained 3.0 (2.9 to 3.3) times in the interorbital; the ridge is followed by a naked groove which bounds above that area of scales which covers the large sensory canal anterior to the origin of the lateral line. The postorbital ridge curves slightly downward behind the preopercular angle. Length of the orbit in the type-specimen (93.3 mm. to anus), 4.65 in head, 1.9 in snout, 1.7 in postorbital; orbit in specimens 60 to 77 mm. to anus, 4.0 to 4.15 in head, 1.65 to 1.75 in snout, 1.35 to 1.5 in postorbital; orbit in paratypes from 50 to 57 mm. to anus, 3.9 in head, 1.6 in snout, 1.3 in postorbital. The least interorbital width (anterior to the front of the pupil) is about equal to the orbital diameter, being contained 1.6 (1.3 to 1.5) times in the postorbital. The least suborbital width is contained 3.1 times in the postorbital (2.9 to 3.2 times in paratypes from 60 to 77 mm. to anus; 2.7 to 2.85 times in paratypes from 50 to 57 mm. to anus). The upper jaw extends from below the middle of the nasal fossa backward nearly to the vertical from the posterior margin of the orbit; length of upper jaw, 3.3 (3.4 to 3.7) in head. The barbel is slender; its free length is contained 2.6 (2.3 to 3.3) times in the postorbital.

The cardiform teeth of the upper jaw form a band, the outer series of which is sometimes enlarged. The mandibular teeth form two series laterally, of which the outer series is irregular; anteriorly, near the symphysis, the teeth are so irregularly arranged as to form a narrow band.

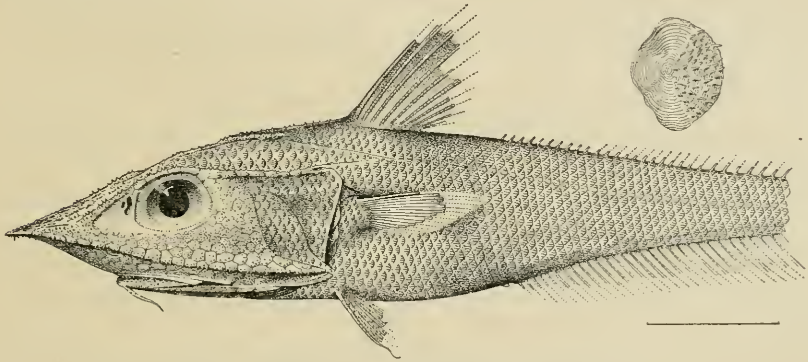

Fig. 7.—Coelorhynchus quincunciatus. Type.

The characters of the sensory canals and of the structures connected with them, are essentially similar to those described for *C. argentatus*.

The anus is located immediately before the anal fin; the distance from its center to the base of the outer ventral ray is contained 2.4 (2.5 to 3.2) times in the head; its distance from the isthmus, 1.32 (1.4 to 1.6) times. The distance between the base of the ventral and the isthmus is contained 2.8 (2.85 to 3.27) times in the head.

The gland-like body lying in the body wall, along the midventral line, has the peculiar structure that it also possesses in the last species—the anterior dilation is supported by a slender rod connected with the pubic bone.

Pyloric caeca, 8 to 11 (4 specimens).

Several specimens contained crustacea of various groups in their stomachs, but one contained a Myctophid fish, probably *Myctophum*, belonging to the silvery pigmented or surface-pelagic type.

The lateral line rises anteriorly to form a long, even curve. The scales are relatively large, in but four rows between the lateral line series and the front of the second dorsal. The scales are rather thin, and are thickly beset with short slender spinules, which are directed outward and backward, and are arranged in definite quincunx order, except on and near the head, where they fall into very widely divergent rows. The scales of the head bear weak spinules, which are smaller than those of *C. argentatus;* those on the ridges of the head are little strengthened. Instead of being followed by a single median scute, as in *C. argentatus*, the occipital scute is preceded on each side by a similar scale. The squamation of the head is more complete than in *C. argentatus:* the anterolateral region of the snout is largely scaled, leaving only a narrow scaleless groove adjoining the series of scales which bounds the median rostral series on each side; the under surface of the head is wholly scaled, including the rami of the mandibles, and excluding only the lips and the gular and branchiostegal membranes. In other respects the squamation of the head is the same as in *C. argentatus.*

The length of the first dorsal base is contained 1.2 (0.75 to 1.3) times in the interdorsal space, 1.8 (1.5 to 1.9) times in the postorbital. The anterior rays of the second dorsal fin are very short. The origin of the anal is slightly behind (or slightly before) the vertical from the origin of the second dorsal. Length of fin-rays in the head (in paratypes): second dorsal spine, 2.1; pectoral fin, 2.4 to 2.65; outer ventral ray, 3.0 (3.2 in type), sometimes reaching anus; inner ventral rays, 3.75 to 4.2.

Coloration in alcohol.—The dark markings of the body consist anteriorly of weakly ocellated dorsal saddles, and posteriorly of dark bars; a dark blotch is located on the lateral line below the first dorsal. The sides of the body and head are silvery, but there is a dark blotch on the opercles. The gular membrane is punctulate, with but traces of the cross striae or black ridges characteristic of this region in *C. argentatus;* the branchiostegal membrane is black ventrally, and blackish or dusky laterally. The skin over the pectoral girdle is mostly silvery, but becomes abruptly dark brown over the anterior face of the girdle before the pectoral fin. The buccal cavity is lined with whitish; the walls of the branchial cavity are dusky (except over the hyoid arches, where they are whitish), becoming blackish posteriorly, but with an abrupt whitish margin along the edge of the opercular and branchiostegal membranes. The parietal peritoneum is brownish black, underlain with silvery; it is sometimes whitish over the posterior portion of that organ which lies in the body wall before the anus. This organ is superficially covered by a black streak, with an anterior dilation between the ventral fins and the isthmus and a posterior dilation in front of the anus. From each side of these dilations a diffused darker area spreads out. The region immediately around the base of the first dorsal, the axillary region of the pectoral, and the dorsal spine, are all black; the ventrals are sometimes blackish near their bases, and near the tips of their rays; elsewhere the fins are light dusky.

C. quincunciatus differs quite widely from *C. argentatus*, although the two species obviously belong to the same group. The scales are larger in *quincunciatus*, being in but four, instead of five or six, rows between the lateral line series and the origin of the second dorsal fin; the underside of the head is completely scaled, instead of being wholly scaleless, except for a definite small anterolateral patch; the anterolateral region of the snout above is almost wholly scaled, instead of being mostly naked; the spinules on the scales of the head are weaker; the gular membrane is punctate, rather than transversely striate; the anus is located farther forward, its distance from the ventral fin being contained 2.4 to 3.2 times in the head (rather than from 1.8 to 2.3 times); its distance from the isthmus is contained from 1.32 to 1.6 times in the head (rather than from 1.15 to 1.32 times); the barbel is usually longer, being contained from 2.3 to 3.0, instead of from 2.6 to 4.2 times in the postorbital; the snout is usually longer, its preoral length being contained 2.3 to 2.55 times in the length of the head, instead of from 2.4 to 2.8 times. *C. quincunciatus* appears to be intermediate in its relationships between the preceding species, *C. argentatus*, and the one next to be described, *C. thompsoni*. An analysis of the three species is given in the key, and another after the description of *C. thompsoni*. Of the three forms, *C. argentatus* apparently attains the largest size.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
Albatross station	5392	5121	5121	5396	5412	5497
Total length in mm	[1] 237	225	194	[1] 182	[1] 188	147
Length to anus in mm	93.3	77	68	72	70.5	50
Length of head	71	71	68	72	73	76.5
Length of orbit	16	17	18	19	18	21
Postorbital length of head	26.5	24	24	26	26.5	26
Width of interorbital	16.5	18	18.5	18	17.5	20
Width of suborbital	8	9	8	8	9.5	9.5
Orbit to preopercle	28	27	26	28	28	29
Length of snout	30	30.5	31	29	31	32
Length of upper jaw	21.5	22	20.5	21	20	21.5
Depth of body	34	37	38	35	34	37
Width of body	24	27	29	....	23	20
Anus to ventral	30	28	28	24	26	26
Ventral to isthmus	25	26	23	26	25	26
Length of first dorsal base	15	14	14	13.5	13.5	15
Length of interdorsal space	18	15	16	15	18	12.5
Length of second dorsal spine	....	....	....	34	....	33
Length of pectoral fin	....	27	....	....	28	31
Length of outer ventral ray	23	....	....	....	....	....

[1] A pseudocaudal developed.

(*quincunciatus*, in reference to the quincunx arrangement of the spinules on the scales.)

23. COELORHYNCHUS THOMPSONI, new species.

Type-specimen.—Cat. No. 78214, U.S.N.M., a mature female 106 mm. long to anus, dredged at *Albatross* station 5363, at a depth of 180 fathoms, in Balayan Bay, on the southwest coast of Luzon.

Four other specimens were obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5110	China Sea, off southern Luzon	135	59.0	
5118	Verde Island Passage, Luzon	159	....	
5518	Off northern Mindanao	200	54.0	

The two specimens from station 5518 show certain differences from the typical specimens, and are referred with some doubt to the same species. It is of interest to note in this connection that all of the 14 specimens of the preceding species, *C. quincunciatus*, were dredged at six stations among the islands between the localities at which typical and aberrant specimens of *C. thompsoni* were obtained. The aberrant specimens differ in the rougher spination of the scales, in the fewer pyloric caeca (14 instead of 22), and in the slightly narrower interorbital and suborbital.

Fin-rays—first dorsal, II, 9; pectorals, 15–16 (17 or 18); ventrals, 7.

Greatest depth of body, 2.2 (2.3 to 2.4) in head; width across pectoral bases, 3.3 (3.3 to 3.7). The sides of the snout gradually converge forward toward the very sharply acuminate tip, which, higher than in *C. argentatus* or *C. quincunciatus*, lies on a horizontal passing through the eye above the lower margin of the pupil. The greater convexity of the dorsal outline of the snout, together with other characters, renders the physiognomy of this species very different from that of *C. argentatus* and *C. quincunciatus*, which are quite similar in their general appearance. The preocular length of the snout is contained 2.2 (2.1 to 2.15) times in the head; preoral length, 2.35 (2.23 to 2.3); width of snout at front of orbits, 3.5 (3.3 to 3.6); width of snout at anterolateral angles (a point below the front of the nasal fossa), 1.5 (1.4 to 1.55) in the distance anterior to that point (in other words, in the ethmoid region of the infraorbital ridge). The occipital ridges diverge strongly anteriorly, but weakly posteriorly; the least distance between them is contained 2.4 (2.5 to 2.65) times in the interorbital width; from their terminations on each side a scaleless groove extends backward to the lateral line. The sharp postorbital ridge curves slightly downward behind the preopercular ridge; the subopercular angle is obtusely pointed. The orbit is conspicuously larger than in *C. argentatus* or *C. quincunciatus;* its length is contained 3.9 (3.85 to 4.15) times in the head, 1.8 (1.8 to 1.95) times in the snout, 1.15 (1.05 to 1.2) times in the postorbital. The least interorbital width is greater than in the other species of the subgenus, it is a little less than the orbital length, and is contained 1.3 (1.23 to 1.4) times in the postorbital. The suborbital also averages wider, being contained 2.6 (2.5 to 3.0) times in the postorbital. The short upper jaw extends backward from below the posterior nostril not so far as the vertical from hind margin of the orbit; its length is contained 4.05 (4.2 to 4.35) times in the head. The barbel is short, being contained 4.4 (3.4 to 4.6) times in the postorbital. The cardiform teeth of the premaxillary are in a narrow band; those of the lower

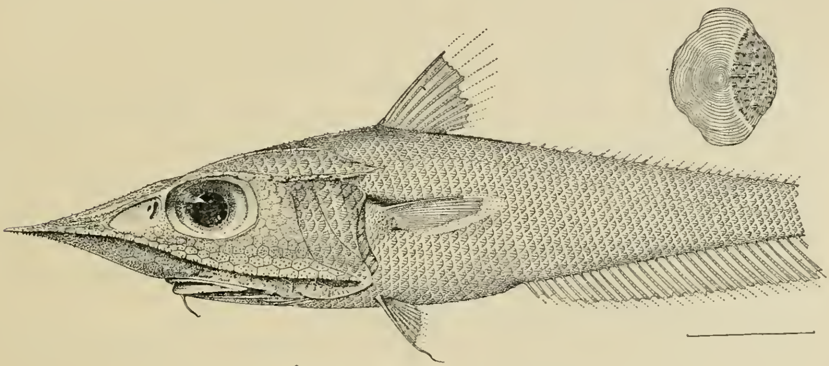

FIG. 8.—COELORHYNCHUS THOMPSONI. TYPE.

jaw, in two irregular series on the sides posteriorly, become so crowded near the symphysis as to form a narrow band.

The anus is located immediately in advance of the origin of the anal fin, somewhat farther forward than in *C. quincunciatus*, and much farther forward than in *argentatus;* it lies below the posterior half of the interdorsal space; the distance from the center of the anus to the base of the outer ventral ray is contained 2.7 (2.9 to 3.5) times in the head; the distance between the ventral fin and the isthmus (at the front of the scaled area), is contained 3.3 (3.6 to 3.85) times in the head; the total distance, from the anus to the isthmus, 1.6 (1.65 to 2.0) times. As in *argentatus* and *quincunciatus*, the anterior lobe of the gland-like body in the abdominal wall is supported by a slender rod connected with the joined ends of the two pairs of arms of the pubic bones.

Pyloric caeca—14 in 2 specimens (stations 5110 and 5118); 22 in 2 specimens (station 5518); 9 were counted in a specimen of *argentatus*, and 8 to 11 were counted in 4 specimens of *quincunciatus*.

One of the specimens from station 5518 contained in its stomach one of the horny jaws (1 cm. long) of some cephalopod.

The lateral line courses along a low curve anteriorly. The large scales are in but four series between the lateral line and the origin of the second dorsal fin; they are covered with small suberect spinules, arranged in quincunx over most of the body, but aligned, more or less definitely, into strongly divergent series anteriorly, especially on the head. The scale characters of the species agree with those of *quincunciatus* in contrast with those of *argentatus;* the median occipital scute is preceded by a similar scale on each side; a narrow scaleless groove extends backward along the upper surface of the snout just outside the series of scales bounding the median rostral series. The under surface of the head is completely scaled, with the exception of the gular and branchiostegal membranes, and of the rami of the mandibles, which have only a few scales posteriorly (the rami are completely scaled in *C. quincunciatus*).

Fin measurements of specimens from southern Luzon—length of first dorsal base 1.2 (1.0 to 1.35) in the interval between the dorsal fins, 1.8 (1.65 to 1.9) in the length of the head behind the orbit; length of pectoral fin, 3.05 and 3.3 in the head (two specimens); outer ventral rays, 4.3 (one specimen); second ventral ray, 5.1 (one).

Fin measurements of specimens from station 5518—first dorsal base, 0.9 and 1.2 interdorsal, 1.65 and 2.0 in postorbital; outer ventral ray, 3.6 (one specimen); second ventral ray, 4.65 (one).

The origin of the anal fin is slightly before (or directly below) that of the second dorsal.

The dark markings of the young become indistinct in the adult. In the specimen 150 mm. long there are several dark dorsal saddles anteriorly—one just before the first dorsal fin, another below that fin, a third below the posterior part of the interdorsal space and the anterior end of the second dorsal fin, and two posterior to these; of these saddles the penultimate and the one under the first dorsal extend a short distance below the lateral line. Posteriorly the tail is crossed by dark vertical bars about as wide as the interspaces between them. The occipital region is dusky. The silvery area covers the sides of the head, the trunk below the lateral line, and the median third of the sides of the tail. The belly is dusky between the ventral fins and the isthmus and about the anus, from which region a black streak extends forward to an anterior elliptical dilation covering the gland-like organ in the body wall. The axil of the pectoral is black. The snout is dark along its margins and mid-dorsal line, and dusky below. The concealed region about the tip of the premaxillaries is dark; the inner wall of the sensory cavity just above the ventral margin of the suborbital region, is dark, showing through the thin outer wall of the cavity; the rami of the mandibles are dark. The gular membrane has a ground color of silvery white, especially on the sides where covered by the mandibular rami, but is darkened by punctulations or a diffused dark expansion of the chromatophores. The branchiostegal membranes are dusky ventrally, but, together with the opercular membranes, are margined with light on their sides, just behind the submarginal blackish area of the branchial cavity, which shows through the opercles to the exterior; the roof of the branchial cavity is dark; the walls of the buccal cavity are light; the parietal peritoneum is blackish, underlain with silvery. The vertical fins and the pectoral are dusky; the dorsal spine is blackish; the ventral fin rays are light, with dusky tips and dusky bases in some specimens.

C. thompsoni differs from *C. argentatus* in much the same manner that *C. quincunciatus* does; the scales are larger, being in but four series, instead of five or six, between the lateral line and the origin of the second dorsal fin; the underside of the head,[1] and the anterolateral region of the snout above, are scaled, instead of being mostly naked; and the gular membrane is punctate, rather than transversely striate. From both of the other species *C. thompsoni* differs in the more posterior position of the front of the premaxillaries, which lie below the posterior nostril, instead of below the middle of the large nasal fossa. Further differences between *C. thompsoni* and *C. quincunciatus* consist chiefly in the various proportions. These differences are tabulated in the following comparison; further differences between *thompsoni* and *argentatus* are also indicated.

Comparative table showing the differences in certain proportions between the species of the subgenus Quincuncia.

	C. argentatus.	*C. quincunciatus.*	*C. thompsoni.*
Anus to base of ventral in head	1.8 to 2.3	2.4 to 3.2	2.7 to 3.5
Anus to isthmus in head	1.15 to 1.32	1.32 to 1.6	1.6 to 2.0
Preocular length of snout in head	2.4 to 2.8	2.3 to 2.55	2.1 to 2.2
Preoral length of snout in head	2.9 to 3.8	2.8 to 3.3	2.22 to 2.35
Width of snout at anterolateral angles in distance anterior thereto	1.0 to 1.3	1.1 to 1.3	1.4 to 1.55
Orbit in snout	1.4 to 1.75	1.6 to 1.9	1.8 to 1.95
Orbit in postorbital	1.3 to 1.7	1.3 to 1.7	1.05 to 1.2
Interorbital in postorbital	1.4 to 1.7	1.3 to 1.5	1.23 to 1.4
Suborbital in postorbital	2.9 to 3.4	2.7 to 3.1	2.5 to 3.0
Distance between occipital ridges in interorbital	2.6 to 3.4	2.9 to 3.3	2.4 to 2.65
Maxillary in head	2.8 to 3.3	3.3 to 3.7	4.05 to 4.35
Pectoral fin in head	2.2 to 2.9	2.4 to 2.65	3.05 to 3.3
Outer ventral ray	2.6 to 3.3	3.0 to 3.2	3.6 to 4.3
Second ventral ray	3.3 to 4.2	3.75 to 4.2	4.65 to 5.1
Barbel in postorbital	2.6 to 4.2	2.3 to 3.0	3.4 to 4.6

[1] With the exception of the mandibular rami, which are nearly naked in *thompsoni*, but scaled in *quincunciatus*.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5363	5118	5110
Total length in mm	206+	[1] 176	150
Length to anus in mm	106	77	57
Length of head	72	75	80
Length of orbit	19	18.5	20.5
Postorbital length of head	21.5	22	21.5
Width of interorbital	16	18	18
Width of suborbital	8	8	9
Orbit to preopercle	25	26	26
Length of snout	33.3	36.5	38
Length of upper jaw	18.5	17.6	18
Depth of body	33	32	32
Width of body	22	23	22
Anus to ventral fin	26.5	26.5	21.5
Ventral to isthmus	22.5	21	19
Length of first dorsal base	11.5	11.3	13
Length of interdorsal space	14.7	15	12.5
Length of pectoral	....	25	....
Length of outer ventral ray	....	....	19
Length of second ventral ray	....	16	....

[1] A pseudocaudal developed.

(*thompsoni*, named for Mr. Will F. Thompson, in recognition of his ichthyological investigations.)

Subgenus PARAMACRURUS Bleeker.

The richness[1] of the fauna of the East Indian and Phillipine Islands in the species of this subgenus has already been mentioned. Most of these species are closely related to the two which have already been described; namely, *C. notatus* and *C. argus*.

24. COELORHYNCHUS MACULATUS, new species.

Type-specimen.—Cat. No. 78215, U.S.N.M.: 191 mm. total in length to broken tip of tail, 66 mm. to anus; a female, with ripe ova; type locality, *Albatross* station 5621, between Gillolo and Makyan Islands.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Number of specimens.
[1] 5290	China Sea, off southern Luzon	214	[1] 1
5366	Batangas Bay, off Southern Luzon	240	1
5621	Between Gillolo and Makyan Islands	298	6
5623	Between Gillolo and Makyan Islands (latitude 0° 16′ 30″ N.)	272	4

[1] Specimen being in poor condition, not designated as a paratype.

These 12 specimens represent a small species which markedly differs from the others of the same group in the extreme roughness of the scales, both on the head and body.

Fin-rays—first dorsal, II, 9; pectorals, 16 (15 to 17); ventrals, 7 (6 on one side in one paratype).

[1] Nine of the 16 known species belong solely to this region.

The slender body is not strongly compressed, the width being equal to the depth below the origin of the lateral line; the greatest depth is contained 1.8 (to 1.95) times in the head. The dorsal contour of the snout in this species is straight, and is more oblique than the postrostral outline, which is nearly straight; the ventral contour is gently convex behind the mouth. The snout is broad and deep, with sides evenly and strongly convex to the bluntish tip, which is not produced in the type, and but little produced in the

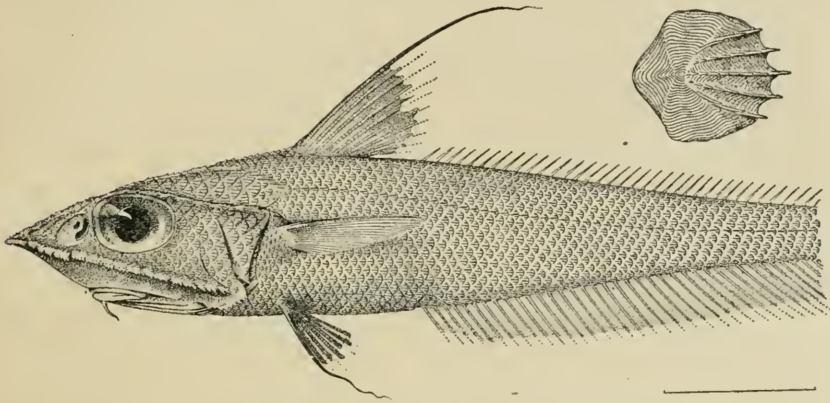

FIG. 9.—COELORHYNCHUS MACULATUS. TYPE.

smaller paratypes; the extreme tip of the snout, through the terminal plates, is not depressed. The dimensions of the snout follow.

Table of measurements of the snout at different sizes.

	Type.	Paratypes.						
Length of head, in mm	46.5	41	40	39	38	37.5	36.5	35.5
Proportions in head:								
Preocular length	2.7	2.65	2.4	2.6	2.4	2.6	2.4	2.3
Preoral length	3.1	3.00	2.9	2.9	2.75	3.0	2.7	2.45
Width, at front of orbits	3.3	3.35	2.6	2.55	2.45	....	2.4	2.6

This table seems to indicate that the relative length of the snout decreases with increased size, as it does also in *C. jordani* and in other species of this subgenus, while the reverse condition obtains in certain species of the subgenera *Oxymacrurus* and *Oxygadus*.[1] The middle of the length of the head in the largest specimen, the type, is at the center of the pupil, while it is at the front margin of the pupil in the smallest specimen, in which the head is 35.5 mm. long. The scaly ridges of the head are strongly developed, the occipital

[1] We find the same condition, however, true in *C. aratrum*, an Hawaiian species of the subgenus *Oxygadus*.

ridges in particular forming a crest unusually high for a species of the subgenus *Paramacrurus*. The posteroventral angle of the subopercle is produced backward and slightly downward into a pointed flap. The length of the rounded-oblong orbit is contained 3.25 times in the head, 1.2 in the snout, 1.15 in the postorbital length of the head (measurements of orbit in smallest paratype: 3.4 in head, 1.35 in snout, 1.0 in postorbital). The least interorbital width, which is contained 1.5 (1.3 to 1.6) times in the postorbital, lies above the front of the pupil; behind this point the slightly convex sides of the interorbital diverge strongly; least interorbital width, 2.2 (to 2.25) in postorbital. The mouth is rather small, the length of the upper jaw, which extends backward to below the hind margin of the pupil, is contained 4.0 times in the head (3.9 to 4.3 times in the paratypes). The outer series of the villiform teeth forming the premaxillary band is scarcely enlarged. Length of the free portion of the barbel, 6 (3.5 to 5.5) in postorbital. Branchiostegal rays, six; the gill-membranes are attached to the isthmus, leaving a narrow free fold.

The distance from the center of the anus to the base of the outer ventral ray varies from about two-fifths (in the type) to one-fourth the distance from the anus to the base of the outer ventral ray, the latter distance is slightly shorter, or slightly longer than, the postorbital length of the head, and is usually, but not constantly, a little longer than the distance from the ventral to the isthmus.

A well-marked, narrow, scaleless ventral fossa, widest anteriorly, extends forward from the peritroct to between the ventral fins. An ovoid gland-like body lies imbedded in the body wall above the front part of this fossa, and is connected by a strand of tissue with the peritroct; it is without apparent skeletal support. The "gland" is pigmented with black on its ventral and posterodorsal surfaces, while the posterior stand of tissue is pigmented on its lower side only. We have described similar structures in other groups of *Coelorhynchus*, as well as in species of *Hymenocephalus* and *Lionurus*.

The pyloric caeca are rather short and slender, 28 to 32 in number (counted in four paratypes).

Scales in 6 or 5½ series from the origin of the second dorsal fin to, but excluding, the lateral line scale. There are at most 5, and often fewer, spinous carinae on the scales, but they are much stronger and somewhat more divergent than in related species. The median ridge on the scales of the body bears as many as 9, but usually fewer, strong retrorse spinules, imbricate on one another, and increasing in size posteriorly; the last one projects well beyond the margin of the scale. The scales become reduced in size and armature on the belly, especially toward the isthmus. The scales of the body appear to be more deciduous than in related species, but their more frequent loss may be in part due to their greater roughness.

The nasal fossa and the under surface of the head are wholly scaleless; elsewhere on the head the scales are strong, and bear spinules which differ from those of the related Philippine species in their greater strength, and differ from those of *C. kishinouyei* of Japan in the fact that they are not arranged in series radiating from the center of the scale. The dorsoterminal plate of the snout is not especially strengthened, and does not project beyond the anterolateral margin of the snout; the length of the plate is contained 5 to 6 (3.3 in smallest specimen) times in the postorbital; it is armed by one median and two marginal pairs of series of spinules (subject to some variation); the spinules of the plate, as on the other ridge scales, are less numerous and less regularly arranged in small specimens. The terminal plate is followed on each side of the snout by a series of eight or nine scales, increasing in size posteriorly, and covering the bony ridge formed by the ethmoid; the spinules on these scales form irregularly radiating series; a short interspace then separates the ethmoid series from the following preorbital series, which consists of 10 (to 7) subquadrate scales, small in front, but decidedly larger below the posterior nostril; the spinules form series radiating upward and backward from the anteroventral angle of each scale in the preorbital series; the two following portions of the infraorbital ridge—namely, the suborbital and the preopercular, are covered by a double row of scales, strongest below the posterior third of the orbit. The median superior rostral ridge bears 10 oblong scales, all of which, except the small last one, are of subequal size.; the spinous carinae on these scales diverge outward and backward from the front margin of each scale. The supranarial ridge is arched upward and inward; it is armed by small scales, which become larger posteriorly, where the supranarial ridge meets two others: one, the supraorbital, extending backward; the other, the antorbital ridge, which bears a series of three strong scales, extending along the front margin of the orbit and the hind margin of the nasal fossa downward to opposite the middle of the posterior nostril.

The supraorbital series of scales forms the margin of the interorbital area; in small specimens all of the narrow scales of this series are rough with spinules, while in the larger specimens most of them, except at the two extremes of the ridge, retain spinules only on a median keel. The postorbital ridge extends from the end of the supraorbital ridge series to the upper angle of the gill-cleft; it curves slightly downward, and bears a series of strengthened scales armed with a single keel, along which eight or fewer rather strong spinules project outward and backward. The occipital ridges are subparallel anteriorly, but diverge posteriorly; the least distance between them is contained 1.8 (1.5 to 1.9) times in the interorbital width; the scales on the occipital ridges bear from one to three (usually one) spinous carinae, but are rougher in small specimens. The median occipital scute bears a single keel in the type and in the larger paratypes, but three ridges in the small paratypes; a similar scute is situated at the origin of the lateral line. A row of enlarged scales, the largest of all, is located midway between the occipital and postorbital ridges; these large scales have seven or fewer divergent carinae; the remaining scales between those ridges are small or minute. The space between the front half of the occipital ridges is covered by five series of scales; the scales of the median series are the largest, and bear 3 (2 to 4) divergent carinae; those of the outermost series on each side are smaller, and bear 2 or 3 carinae; those of the intervening series are minute. The two series of sparsely spinulate scales bounding the median rostral series on each side become narrow anteriorly, so that their lateral margins converge forward and meet the median series just behind the terminal plate. A conspicuous scaleless groove separates these series from the single series bounding the supranarial ridge. An area of scales like those of the body is located behind the upper half of the orbit.

The first dorsal spine is sharp, but very short; the second spine is produced into a filament, and is almost as long as the head in the type. The base of the first dorsal is slightly longer than the length of the interdorsal space in the type, and is contained from 0.9 to 1.2 times in that distance in the paratypes. The anterior rays of the second dorsal fin are comparatively well developed, being 0.3 as long as the orbit. The origin of the anal fin is directly below that of the second dorsal.

The length of the fin rays forms a notable sexually dimorphic character. They are decidedly longer in the males than in the females, as is indicated in the following table:

Table of measurements of length of fins in each sex.[1]

	Males (Paratypes).	Females.	
		Paratypes.	Type.
Second dorsal spine	0.8 to 0.9	1.17 to 1.55	1.02
Pectoral fin	1.15 to 1.50	1.60 to 2.15	1.80
Outer ventral ray	1.3 to 1.4	1.7 to 3.0	1.95
Second ventral ray	Ca. 2.4 to 2.7	2.9 to 3.7	3.27

[1] Expressed in the number of times the length of each ray or fin is contained in the head.

Coloration in alcohol.—The body is dark brown, becoming lighter ventrally, but blackish on the belly. A rounded blackish spot, ocellated by a whitish ring, extends from the lower end of the pectoral base upward and backward to and including the first row of scales above the lateral line; the spot is nearly as long as the orbit and covers about eight rows of scales (counting downward and backward). A less regular and less distinct squarish spot has its four corners at the front of the first dorsal fin, at the origin of the lateral line on each side, and at a point on the top of the head above the posterior orbital margin. Another indistinct blotch lies below the posterior end of the first dorsal and the anterior part of the interdorsal space. A dark bar, half the head's length behind the spot near the pectoral, covers three scale rows extending downward and backward from the dorsal fin to the lateral line. Behind this region the tail is indistinctly barred. The sides of the abdomen and of the head show silvery reflections. The upper end of the branchiostegal membrane, the opercle, and the posterior border of the preopercle are dull blackish. Elsewhere the head is light, being pale and punctate on the under surface, whitish on the mandibular rami, and on the gular and branchiostegal membranes. The buccal and branchial cavities are lined with blackish, except along their light margins. The blackish brown color of the parietal peritoneum, easily rubbed off, is underlain by a bright silvery pigment. The fins are mostly blackish, but are light on the base of the first dorsal, on the entire second dorsal, and on the filament of the outer ventral ray.

This interesting species has been sufficiently compared with related forms in the preceding analytical key.

Table of measurements in hundredths of length to anus.

	Type (female).	Paratype (male).
Albatross station	5621	5621
Total length in mm	[1] 191	169
Length to anus in mm	66	51
Length of head	71	73
Length of orbit	22	22
Postorbital length of head	24	24
Width of interorbital	16	17
Width of suborbital	11	11
Orbit to preopercle	29	28
Length of snout	27	28
Length of barbel	4	6
Length of upper jaw	18	18
Depth of body	41	....
Width of body	31	33
Anal to anus	10	7
Anus to ventral	23	27
Ventral to isthmus	21	20
Height of second dorsal spine	69	84
Height of third dorsal ray	....	....
Length of first dorsal base	17	18
Length of interdorsal space	15	16
Length of pectoral	38	50
Length of outer ventral ray	37	46
Length of second ventral ray	22	29

[1] A pseudocaudal developed.

(*maculatus*, in reference to the large blackish spot which is located just above and behind the pectoral fin in the series of species led by *C. maculatus.*)

25. COELORHYNCHUS VELIFER, new species.

Type-specimen.—Cat. No. 78216, U.S.N.M.; 251 mm. in total length (tail almost entire), 72 mm. to the anus. The type is an adult male, and was dredged at *Albatross* station 5294 (data below).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5265	Off southwestern Luzon, in the China Sea and adjacent waters.	135		1
5268	do	170		6
5269	do	220		1
5289	do	172		52
5291	do	173	51.5	13
5292	do	162	52.4	1
5293	do	180	57.4	21
5294	do	244	48.4	2
5296	do	210		2
5297	do	198		3
5523	Mindanao Sea			5
	Total			107

This species, so abundantly dredged off southwestern Luzon, was not collected so far south as were *C. notatus* and *triocellatus*, and but one or two of the specimens of *maculatus* were obtained within its known range. The species just named are obviously closely allied, and are mutually characterized by the presence and the form of the ventral fossa, a scaleless strip extending forward from the peritroct to between the ventrals.

The evidence at hand points to the possible conclusion that the young of this species inhabit shallower water than the adults do, although their vertical ranges overlap; only the young were obtained at stations 5265 (135 fathoms), 5268 (170 fathoms), and 5292 (162 fathoms); both the young and adult specimens were dredged at stations 5289 (172 fathoms), 5291 (173) and 5293 (180); only adults were collected at the following stations: 5297 (198 fathoms), 5296 (210), 5269 (220), and 5294 (244).

This species, *C. velifer*, apparently attains a larger size than does *C. maculatus.*

Fin-rays—first dorsal, II, 9 (8 to 10); pectorals, 15 (15 to 17); ventrals, 7.

The body is slender, but more robust than in *C. maculatus*, the greatest depth being contained 1.6 (1.6 to 1.7) times in the head in the adults (the young, as usual, are more slender); the width of the body across the pectoral bases is nearly equal to the depth of the body below the lateral line (only half the depth in very small specimens). In trimness of form, and in firmness of texture, this species presents an appearance intermediate between *C. maculatus* and *C. notatus*, confirming other intermediate characters, such as the spinulation of the scales and the color. As further evidence of its intermediate position, this species in certain of its characters most clearly resembles each of the other two.

The dorsal contour of the snout, as in *C. maculatus* and *C. macrolepis*, is straight, and the outline behind the snout is nearly straight; the ventral contour is evenly and slightly curved downward behind the mouth. The short, broad, deep, snout, with its widely convex sides, closely resembles that of *C. platorhynchus*, *C. acantholepis*, and *C. carinifer*, which are species of another subgenus. The tip of the snout is blunt, the dorsoterminal plate being little or not at all produced beyond the line of the following scales on the infraorbital ridge; the depth and width of the snout through the terminal plates are about equal.

Table of proportions of parts of head.

	Length of head (mm.).								
	17 to 45.				45.5 to 54.7.				53.5.
	Maximum.	Minimum.	Average.	Number.[1]	Maximum.	Minimum.	Average.	Number.[1]	Type.
Orbit in head	3.05	3.33	3.21	15	3.20	3.50	3.34	17	3.36
Orbit in postorbital	1.00	1.20	1.10	15	1.10	1.30	1.19	17	1.20
Orbit in snout	1.05	1.35	1.18	15	1.15	1.23	1.185	17	1.17
Interorbital in postorbital	1.40	1.70	1.57	15	1.55	1.85	1.68	17	1.67
Maxillary in head	3.55	4.00	3.82	14	3.40	4.00	3.68	13	3.60
Barbel in postorbital	4.90	5.30	....	3	4.00	5.00	....	3	....
Preocular length of snout	2.70	3.00	2.76	15	2.75	2.95	2.84	17	2.82
Preoral length of snout	2.80	3.10	3.00	9	3.00	3.50	3.22	10	3.50
Width of snout	2.50	2.75	2.58	7	2.40	2.95	2.59	10	2.48

[1] The number of specimens on which the given average was based.

The preceding table of measurements clearly shows certain variations of the relative proportions which are correlated with the size of the individual: the orbit becomes smaller in larger specimens, the interorbital narrower, the maxillary longer, and the snout shorter.

A comparison of these measurements with those of *C. maculatus* shows three of the differences which distinguish the two species; the snout is shorter in *C. velifer*, the interorbital narrower, and the mouth larger.

The posteroventral angle of the subopercle is produced backward and downward into a pointed flap. The orbit is of rounded-oblong outline. The interorbital space is narrowest above the front margin of the pupil, behind which point the slightly convex sides rapidly diverge; the least width of the suborbital is less than in *C. maculatus*, being contained 2.5 (2.3 to 2.7) times in the postorbital length of the head. The maxillary extends slightly beyond the hind margin of the pupil. The outer premaxillary series of teeth are scarcely enlarged. There are six branchiostegals: a narrow free fold is formed behind the attachment of the gill-membranes.

The location of the anus is subject to variation, its distance from the origin of the anal being contained 3.0 (2.0 to 3.7) times in the distance from the anus to base of outer ventral ray, a distance about equal to that from the ventral to the isthmus, and contained 1.15 times (1.0 to 1.2) in the postorbital length of the head.

The ventral fossa in this species is a scaleless strip extending forward from the peritroct. Its shape is variable; in some specimens it is narrow and rectangular, of variable width, but is usually widest anteriorly, as in the type; in one specimen it has an obovate form; its surface is punctate. Above the fossa a peculiar organ is imbedded, resembling that of *C. maculatus*, but apparently differing from it in certain details: it is an elongate, flat body, darkly pigmented on its ventral surface, but wholly silvery on its dorsal surface; a strand of tissue, about as long as the organ, connects it with the peritroct. The organ has no skeletal support.

Table of scale and ridge characters.

Albatross station.	Length of head, mm.	Number of rows of scales above lateral line.	Number of carinae on scales of body.	Number of scales on superior rostral ridge.	Length of dorso-terminal tubercle in postorbital length of head.	Number of scales on ethmoid portion of infraorbital ridge, excluding the terminal tubercle.	Number of scales on preorbital portion of the infraorbital ridge.	Least distance between occipital ridges in least interorbital width.
5292	17	5½	...	...	...	...	...	...
5291	20.5	5½	3	9	6.0	6—6	...	...
5291	28	5½	5	9	5.5	7—6	10—9	1.7
5291	32	5½	5	9	4.5	6	8—9	1.6
5297	40	5½	6 to 8	8	5.4	...	9	1.9
5289	41	5½	5 to 7	9	4.4	6—6	8—10	1.8
5294	42	5½	5 to 7	9	5.0	6—7	8—9	1.6
5523	42.5	5½	5 to 7	9	7.3	6—6	8—9	1.7
5823	44	5	6 to 8	9	5.0	6—6	10—10	1.8
5297	44.5	5½	7 to 10	8	6.0	6—6	8—8	1.7
5297	45	5½	7	8	5.2	7	8—9	1.7
5523	46	5½	7 to 8	10	5.9	6—6	9—10	1.8
5523	47	5½	6 to 8	10	6.0	7	8—9	1.75
5289	47.5	5½	5 to 9	10	5.5	7—7	9—9	1.8
5523	49	5	6 to 8	9	5.6	6—6	9—9	1.7
5289	51	5½	6 to 9	9	6.0	7—7	10—8	2.0
5291	52	6	7 to 10	...	...	...	...	1.7
5294[1]	53.5	5½	7 to 10	10	7.0	7—6	9—8	1.8
5269	51.7	5½	7 to 9	8	6.5	7-7	9—8	1.7
5289	55	5½	7 to 11	10	6.5	6—7	10—9	1.85
5289	63	5½	6 to 10	8	8.0	6—7	9—8	1.85

[1] Type.

The spinous carinae of the scales do not approach, either in size or strength, those of *C. maculatus*, but are stronger than those of *C. notatus*. The rather weak spinules on the scales of the body are imbricate upon one another; the last spinule in each series projects but little beyond the margin of the scale; the 11 or fewer spinules on each of the carinae increase but little in strength posteriorly on the carina. The spinules on the scales of the head are finer and fewer than in *maculatus*. The dorsoterminal plate resembles that of *maculatus*, not being greatly strengthened and modified as it is in *notatus*, *sexradiatus*, and *triocellatus;* it barely projects beyond the marginal line of the following scales. Both the dorsoterminal and the ventroterminal plates are armed by a median and a submarginal series of stout, erect, conic spinules in the type, while in certain paratypes either the median or lateral series (or both) of the upper plate may be irregularly doubled. In the young the spinules of the terminal plates, as those of the other scales, are stronger relatively and fewer in number, but the same arrangement holds true as in the

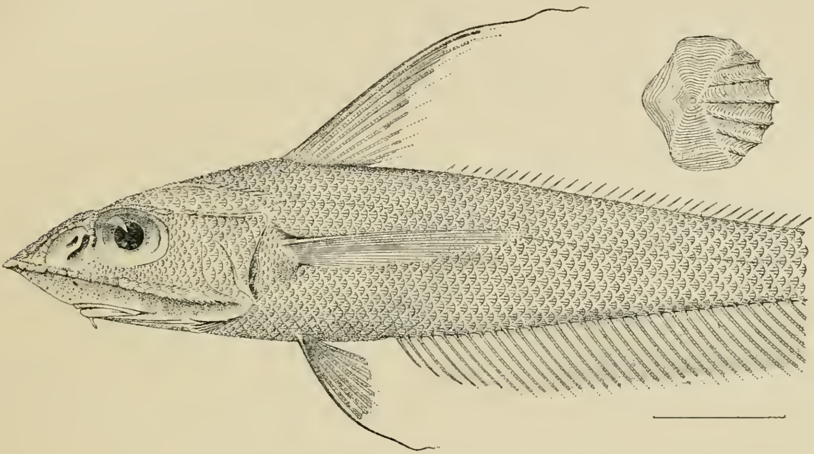

FIG. 10.—COELORHYNCHUS VELIFER. TYPE.

adult. The number of scales on the ethmoid region of the infraorbital ridge averages fewer than in *maculatus;* they bear spinules arranged in irregular radiating series. The scales of the median superior rostral series are fewer than in *maculatus*, there being 8 to 10, instead of constantly 10; these scales are also armed with more numerous carinae (as many as 10)—the carinae of the last scale, which is not reduced in size, are subparallel, but those on the other scales are arranged in series which radiate or diverge strongly—on the posterior scales, from the middle of the front margin of each scale; on the anterior scales, from a point near the front margin of each scale. The supraorbital series is composed of scales which are largest in front, and are wider and weaker than in *C. maculatus*, all bearing several series of spinules which radiate from near the front margin of the first scales, but from the anteroventral angle of the posterior scales. The scales along the postorbital ridge bear spinules in one to several series, usually in but one.

The occipital ridges, which are nearly parallel anteriorly, but diverge posteriorly, bear scales rather sturdily armed; the anterior ones usually with several divergent ridges, the posterior ones with but the single median keel persistent in the larger specimens. The median occipital scute is armed by a rather strong median keel, and from one (as in the type) to three lateral divergent series. A similar but smaller scute, located near the origin of the lateral line, is less strongly developed than in *C. maculatus*. The area between the occipital and postorbital ridges is largely covered by three longitudinal series of scales, similar to those on the body; those in the median series, although the largest, are not so much enlarged as in *C. maculatus*. As in *C. maculatus*, five series of scales occupy the area between the occipital ridges; the scales of the median series are the largest, and bear seven or fewer carinae (in the type). The scales bounding the superior rostral ridge form an area similar to that of *C. maculatus*, but are in other respects quite dissimilar: they are arranged in a single series on each side; they are of subquadrate outline, and they are armed in a peculiar and diagnostic fashion: each scale is sharply divided into two regions by that diagonal which extends from the anterolateral angle across the scale to the inner posterior angle; the posterolateral triangular area, thus outlined, is armed by several (four to six in type) parallel or subparallel spinous carinae, while the inner-anterior triangular area bears but one or two spinous ridges coursing inward and backward. The area within the anterolateral margins of the snout, mostly scaleless in *C. maculatus*, is largely covered with prickles in *C. velifer*. The under side of the head, including the branchiostegal membrane, and also the nasal fossa, are wholly naked.

The first dorsal spine is short but sharp, the second is long and filamentous, with a base grooved on its three sides; the anterior edge of the spine is rounded, and is constantly wholly spineless. The base of the first dorsal is a little shorter than the interval between the dorsals. The second dorsal is not so rudimentary anteriorly as it often is, the first ray being contained 4.5 times in the orbit. The anal fin is inserted a little in advance of the vertical from the origin of the second dorsal. The second ventral ray in the type reaches to between the anus and the anal fin.

Table of measurements of length of fins [1] in the males, young males, and females.

Nature of specimen.	Type.	Paratypes.		
	Male.	Large males.	Young males.	Females.
Length of head, mm	53.5	42.5 to 55	40 and 42	41 to 63
Second dorsal spine	.805	.80 to 1.05	1.08	1.15 to 1.46
Third dorsal ray	....	1.08 to 1.16	1.23	1.36 to 1.61
Pectoral fin	1.10	1.10 to 1.39	1.55 to 1.60	1.58 to 2.46
Outer ventral ray	1.38	1.24 to 1.64	1.55 to 1.74	1.71 to 2.22
Second ventral ray	2.45	2.25 to 2.68	2.70 to 2.85	2.72 to 3.60

[1] Expressed in the number of times each ray or fin is contained in the head. The table is summarized from measurements on 30 specimens.

The fin-rays in this species are longer in the male than in the female. As usual in cases of sexual dimorphism, the exaggerated character of the male is less marked in the young than in the adult. The sexual dimorphism of the fin rays shown to occur in several species with elongated dorsal spines (*C. maculatus*, *C. velifer*, *C. sexradiatus*, and probably *C. dorsalis*) is good evidence of their close relationships. It was not noted in those related species in which the dorsal spine is not produced, although there is a wide individual variation in this regard among those species.

The color is somewhat lighter than in *C. maculatus*, but of similar pattern. The body is lighter below, but blackish on the belly. The characteristic brownish black spot of this group of species, located above and behind the pectoral fin, is large and round in *C. velifer;* it includes the first row of scales above the lateral line, and covers 8 or 9 rows counting downward and backward (restricted to 7 or even 6 rows in some paratypes) ; this spot is ocellated by a lighter band, which includes a whitish spot just below the front end of the lateral line, and a whitish bar just behind the spot. A less distinct spot, square in outline, is irregularly bounded by lines joining the first dorsal spine, the origin of the lateral line on each side, and the median occipital scute. The remainder of the diagnostic color pattern is indistinct in the adult, but is well marked in the young. A broad triangular dark area with its apex ventral, and with its base along the posterior half of the first dorsal fin and the whole interdorsal space, is rather indefinitely ocellated below with a broad lighter band, which is followed by a blotch darkest just above the lateral line. An oblique bar, directed downward and backward to the anal base, and covering 6 to 8 scale rows, is located behind the head a distance nearly or quite equal to the length of the head. Similar but less distinct broad bars cross the tail posteriorly. The sides of the abdomen and of the head show silvery reflections. The upper part of the branchiostegal membranes are blackish, with the exception of the lighter margin to the branchial cavity. The color of the head is light, punctate below. The buccal and branchial cavities are lined with bluish black everywhere except on their margins; the parietal peritoneum is brownish black, underlain with silvery. The fins are dusky, including the base of the first dorsal fin rays, which are light in *maculatus*, but excluding the black filament of the dorsal spine, the light second dorsal fin, and the white outer ventral ray. The intensity of the color on the fins varies widely; the ventral fin is usually blackish, but the entire outer ventral ray and the tips of the other rays are whitish in the lightest specimens.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
	Male.	Female.	Male.	Female.	Female.	Young.
Albatross station.	5294	5523	5523	5289	5291	5292
Total length in mm	251	[1] 193	[1] 202	[1] 147	133+	74
Length to anus in mm	72	66	63	54.5	42	21
Length of head	74	75	73.5	76.5	78	84
Length of orbit	22.5	23	23.3	24	26	30
Postorbital length of head	28	27	27	25.5	27	28
Width of interorbital	17	17	17.5	16	17	20
Width of suborbital	11.5	10	10	10.5	11	11
Orbit to preoperele	30	29	28	29	28	31
Length of snout	27	27.5	27	29	29.5	31
Width of snout	31	28	28	30	30	......
Length of upper jaw	21.5	19	19	20	19	21.5
Length of barbel	......	4.1	4.7	4.7	4	......
Depth of body	47	44	45	......	41	41
Width of body	33.5	32	31.5	33	30	28
Anus to anal	8	10.5	11	11	7	8
Anus to ventral	24	23.7	23	23	21	16
Ventral to isthmus	25	24	24.5	21	22	22
Height of second dorsal spine	92	68	68	65+	64	42
Height of third dorsal ray	......	54.5	63	57.5	......	......
Length of first dorsal base	20.5	16	18	17	17	19
Length of interdorsal space	22	22	19	18	20	......
Length of pectoral	67	42.5	61	48	36	36
Length of outer ventral ray	54	40.5	53	48	45	42
Length of second ventral ray	30.5	24.7	31	25	26	......

[1] A pseudocaudal developed.

(*velifer*, in reference to the high dorsal.)

26. COELORHYNCHUS SEXRADIATUS, new species.

Type-specimen.—Cat. No. 78217, U.S.N.M.: a male 205 mm. in total length (a small pseudocaudal developed), 66 mm. to anus, dredged at *Albatross* station 5172.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5172	Vicinity of Jolo	318	......	Type+1
5565	Between Jolo and Tawi Tawi	243	52.3	6

Fin-rays—first dorsal, II, 8 (or II, 9); pectoral, 14 (or 15); ventral, 6—6 (as also in 6 paratypes, but 6—7 in the only other one). Pectoral and ventral rays fewer than in *C. notatus.*

Greatest depth of body, 1.78 (to 1.72) in head; width over pectoral bases, 2.30 (2.25 to 2.50), being a little less than the depth of the body below the origin of the lateral line. In a smaller specimen, 55 mm. long to anus, the depth is 1.85 and the width 2.64 in the head.

The dorsal contour of the snout is concave; the snout is broadest at its base, its lateral contours converging forward in a curve less convex than in *C. maculatus* and *C. velifer*, but rather more convex than in *C. notatus* or *triocellatus.* The tip of the snout is sharp, as the terminal plate projects beyond the margin of the following scales.

Summarized table of proportions of parts of head.

	Type.	Maximum.	Minimum.	Average.[1]	Young.
Length of head in mm	49.5	57	....	....	43
Orbit in head	3.50	3.50	3.90	3.68	3.55
Orbit in postorbital	1.15	1.15	1.34	1.27	1.15
Orbit in snout	1.33	1.30	1.55	1.40	1.40
Interorbital in postorbital	1.55	1.55	1.85	1.72	1.65
Maxillary in head	4.05	3.70	4.05	3.86	4.10
Barbel in postorbital	....	3.40	4.60	4.07	4.00
Preocular length of snout	2.50	2.48	2.60	2.56	2.48
Preoral length of snout	2.95	2.90	3.05	2.98	3.10
Width of snout	2.50	2.50	2.85	2.67	2.70

[1] Based upon 5 to 7 specimens in each case (type included).

The preceding table indicates certain of those differences which distinguish *C. sexradiatus* from *C. notatus*, the snout being longer and the orbit smaller.

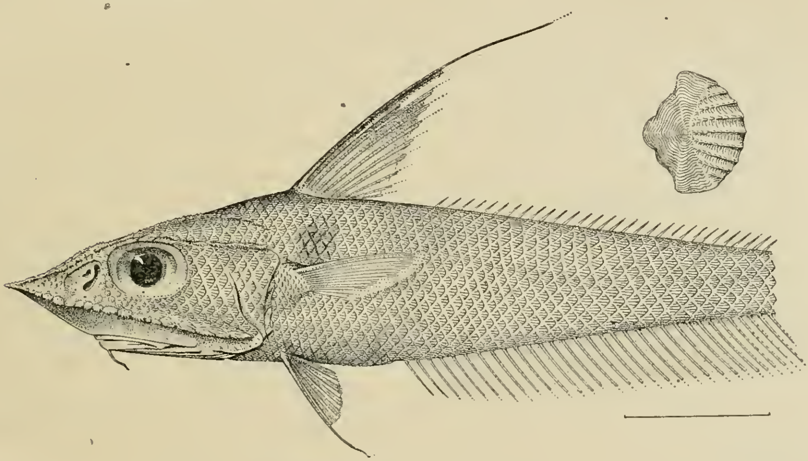

FIG. 11.—COELORHYNCHUS SEXRADIATUS. TYPE.

The posteroventral angle of the subopercle is sharply produced backward (and slightly downward). The interorbital width is least above front of pupil; least suborbital width, 2.5 (to 2.7) in postorbital. The maxillary subtends the anterior two-thirds of the orbital length. Bands of fine teeth occur on the jaws; the outer premaxillary series is not enlarged. Six branchiostegals. The gill-membranes form a narrow free fold across the isthmus.

The anus is located near the origin of the anal fin, the interspace being contained 3.7 (to 2.9) times in the distance between the anus and the base of the outer ventral ray, which is contained 1.05 (to 1.4) times in the postorbital length of the head. The distance between the outer ventral ray and the isthmus is slightly shorter than the distance between the anus and the ventral fin (slightly longer in one paratype).

A narrow, darkly pigmented, naked fossa, widening anteriorly, extends forward from the anus to between the front of the ventral bases.

The lateral line series of scales is separated by 5½ (5 or even 4½) rows from the origin of the second dorsal fin. There are 8 to 12 parallel spinous carinae on the scales of the body in the type and large paratypes, but fewer on the smaller specimens. These carinae are less rugose than in the preceding two species; each is armed with as many as 14 rather weak retrorse imbricate spinules, which increase somewhat in size posteriorly, so that the last one projects a little beyond the margin of the scale. The scales of the head are much smoother and more prefectly imbricate than in *maculatus* or *velifer*, but less so than in *notatus*. The highly specialized ridge scales of the head are so similar to those of *notatus* that only the following diagnostic characters need be described. The dorsoterminal plate is more prominent, its length being contained 4.2 (4.4 to 5.2) times in the postorbital. There are but 5 to 7 scales on the ethmoid portion of the infraorbital ridge. The median occipital scute is armed by a single strong keel in the type, while in some of the paratypes a smaller pair of divergent lateral carinae are added; in all the specimens except one paratype, an additional scute, not so strongly modified, is located on the mid-dorsal line at the end of the first third of the distance between the first scute and the origin of the dorsal fin. The median of the three series of scales between the occipital and postorbital ridges is markedly enlarged. A few small scales posteriorly partially replace the prickles which in *C. notatus* largely cover the fossa within the anterolateral margins of the snout; this region is consequently naked to a wider extent. The carinae on the opercular scales are mostly subparallel. The under surface of the head, the gill-membranes, and the nasal fossa are completely scaleless.

The fins are essentially like those of related species. The similarity apparently includes the sexual dimorphism as regards the length of the fins, but the data for this species are meager, as in many cases the fins are broken.

Table showing length of fin-rays in the two sexes.

	Male.		Female.
	Type.	Paratypes.	Paratypes.
Length of second dorsal spine	0.94	0.093 to 0.096	
Length of third dorsal ray	1.55	1.4	
Length of pectoral fin	1.9	1.75 to 2.0	2.1 to 2.15
Length of outer ventral ray	1.67	1.6 to 1.9	2.0 to 2.05
Length of second ventral ray	3.0	2.95 to 3.32	3.5 to 3.6

Base of the first dorsal contained 1.25 (1.0 to 1.4) times in the interdorsal space, and 1.5 (1.4 to 1.8) times in the postorbital length of the head. The origin of the anal lies below either the middle or the posterior part of the interdorsal space.

Coloration in alcohol.—The ground color is lighter than in *C. notatus*, *velifer*, or *maculatus;* the belly is dark, becoming blackish between the ventral fins. An ocellated blackish spot extends upward and backward from the pectoral onto the first row of scales above the lateral line, covering 6 (5 to 7) rows of scales extending downward and backward. There is a dusky blotch between the first dorsal fin and the occiput, and only faint traces of a dusky saddle representing the well-defined marking in *C. notatus.* The dark lining of the buccal cavity becomes light near the gape; the light margin along the outer edge of the branchiostegal membranes widens ventrally; the parietal peritoneum is pale purplish brown, punctulate, and underlain with silvery. The whitish proximal color of the first dorsal shades into black distally. The second dorsal and the anal fins are light, the anal becoming uniformly dark anteriorly. The ventral fin is dark except on the distal and larger portion of its first ray; the pectoral fin, otherwise light, is darkened on its uppermost two rays.

C. sexradiatus differs from the nearest relative, *C. notatus*, in many points: the fewer rays in the paired fins; the more convex margins of the snout; the longer and more prominent dorsoterminal plate; the more posterior position of the anus; the longer ventral fossa; the somewhat smoother carinae on the scales; many details, as outlined heretofore, in the squamation of the head; the lighter color, with but traces of the dark saddles so characteristic of *notatus.*

Table or measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5172	5565
Total length in mm	[1] 205	[1] 153
Length to anus in mm	66	53
Length of head	75	81
Length of orbit	22	22.5
Postorbital length of head	27	27
Width of interorbital	16.5	17
Width of suborbital	11	10
Orbit to preopercle	31	30
Length of snout	30	33
Length of upper jaw	19	19
Length of barbel	5	7
Depth of body	42	44
Width of body	33	31
Anus to anal	7	7
Anus to ventral	25	19
Ventral to isthmus	22	23.5
Height of second dorsal spine	91	....
Height of third dorsal ray	51	....
Length of first dorsal base	16.5	18
Length of interdorsal space	21	20
Length of pectoral	42	40
Length of outer ventral ray	43	42
Length of second ventral ray	24	23

[1] A small pseudocaudal developed.

(*sexradiatus*, in reference to the number of ventral rays, which appears to be characteristic to this species.)

27. COELORHYNCHUS NOTATUS Smith and Radcliffe.

Coelorhynchus notatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 136 (type-specimen only), pl. 30, fig. 3.

For the purpose of presenting a full comparison with the several closely related species which we are now describing, we have prepared a detailed description of this species.

Type-specimen.—Cat. No. 72948, U.S.N.M., is the only representative of this species in the collection. It is a mature female, measuring 268 mm. in total length to the broken tip of the tail, and 84 mm. to the center of the anus. These measurements indicate that *C. notatus* is probably a larger species than any of the closely related forms with the exception of *C. velifer.* The type was dredged at *Albatross* station 5162, in Alice Channel, which connects Sulu Sea with Celebes Sea; depth, 230 fathoms; bottom temperature, 52.9° F.

Dorsal rays, II, 9; pectoral, 17 (including the uppermost spine); ventral, 7.

Greatest depth of the body, 1.7 in head; width over pectoral bases, 2.25 in head, less than the depth below the origin of the lateral line. The concavity of the dorsal contour of the snout is well shown in the type figure; the lateral margins of the snout are much less strongly convex than in *maculatus* or *velifer;* they converge rather rapidly forward. The tip of the snout is sharper than in *C. maculatus* or *velifer*, but somewhat blunter than in the other closely related species; the snout near its tip is wider than deep; the terminal plate projects but little beyond the general contour of the snout. The preocular length of the snout is contained 2.71 times in the length of the head (63 mm.); the preoral length, 3.00 times; width of snout opposite front of orbits, 2.70 times. The posteroventral angle of the subopercle is produced backward as a rather bluntly pointed flap. Length of the orbit, 3.40 in head, 1.15 in postorbital length of the head, 1.28 in snout. The least interorbital width, above the front of the pupils, is contained 1.75 times in the postorbital; least suborbital width, 2.60 times. The length of the upper jaw is contained 3.75 times in the head; the maxillary subtends the anterior two-thirds of the orbital length. The outer premaxillary series of teeth is scarcely enlarged. Length of the barbel, 3.40 in postorbital. Branchiostegal rays, 6. A narrow free fold is formed on the median line behind the attachment of the gill-membranes.

The anus is remote from the anal fin, the interspace being contained 1.6 times in the distance from the anus to the base of the outer ventral ray, a distance which is slightly shorter than the orbit. The interval between the isthmus and the base of the ventral fin is contained 1.07 times in the postorbital, and is 1.1 times as long as the distance from the ventral base to the isthmus.

A darkly pigmented and narrow ventral fossa extends forward, with increasing width, to a line joining the posterior ends of the ventral bases; the length of the fossa, measured from the center of the anus, is equal to the distance between the anus and the anal origin.

There are 5½ scales in a series from the origin of the second dorsal to, but excluding, the lateral line scale. The spinous carinae on the scales of the body, 7 to 9 in number, are of moderate strength, being much smoother than in *maculatus*, a little smoother than in *velifer*, and slightly rougher than in *sexradiatus*. These carinae are armed with as many as 11 slender spinules, which are directed backward, and are imbricate on one another; the last spinule projects beyond the margin of the scale; the spinules increase but little in size posteriorly on each carina. The scales are more completely imbricate than in *C. maculatus* or *velifer*. The length of the dorsoterminal plate is contained 5.2 times in the postorbital; it is armed by 5 double series of spinules; the ventroterminal plate bears 5 single series. Following the terminal plate, on the ethmoid portion of the infraorbital ridge, are 7 scales, which become larger posteriorly, and are armed with radiating rows of spinules; the first scale in this series, bounding the terminal plate, is somewhat modified and enlarged. No interspace separates the ethmoid from the preorbital series, which is composed of 9 or 10 subquadrate scales armed with spinules radiating upward on the first scales from near the middle of their lower margins, but on the last scales from near their anteroventral angles. The scales on the two following regions of the ridge—namely, the suborbital and the preopercular—are arranged in two series, and bear carinae diverging strongly upward and backward. The median superior rostral ridge is covered by 10 oblong scales, which are armed with numerous tubercular spinules aligned in 12 or fewer series radiating from near the anterior margin of each, the point of radiation being nearest the margin on the anterior scales. The supranarial ridge is covered by rough scales increasing in size posteriorly, and armed with spinous carinae diverging strongly from the anteroventral angle of the scale; four scales cover the ridge which separates the upper half of the nasal fossa from the orbit.

The seven strong scales along the supraorbital ridge are flat anteriorly, but convex and narrower posteriorly; they are armed with series of spinules diverging widely backward. The supraorbital ridge scales are bounded within by a narrow naked groove, which is not developed in *C. velifer*. After an interspace as long as a scale, the supraorbital series is followed by the postorbital series of scales, which are narrow, and bear either a single spinous keel, or three divergent carinae. The occipital ridges, from their origin opposite the third and largest scale of the supraorbital series, extend backward, nearly parallel with one another, to the occiput, behind which point they diverge; the least distance between the center of the ridges is contained 1.7 times in the least interorbital width; the scales on the occipital ridges are armed with 2 to 5 divergent spinous carinae. The median occipital scute bears two long spinous ridges, parallel anteriorly, divergent posteriorly. The scute at the origin of the lateral line, weaker than in *C. maculatus*, is armed with a median spinous keel, and a weaker spinous ridge below. Three series of scales occupy the region between the occipital and postorbital ridges; these differ from those of *C. velifer* and especially from those of *C. maculatus* in the fact that the scales of the median series are scarcely enlarged. Five series of the scales cover the area between the occipital ridges. The outer pair of series and the median series are of subequal size, somewhat smaller than the scales of the body, and differing from them chiefly in the greater divergence of their carinae; the scales of the inner pair of series are reduced in size. As in *C. velifer*, the scales bounding the median rostral ridge are in a single series, the margins of which rapidly converge anteriorly, meeting the rostral ridge just behind the terminal tubercle; these scales are armed on the outer and posterior portion by about six long and slightly divergent carinae bearing suberect spinules, but on the inner portion by a few carinae extending obliquely inward and backward; the scales of these series are rounded, and the peculiar arrangement of carinae is much less strongly developed than in *C. velifer*. A series of rather small scales, continuous with the occipital ridge, becoming irregular above the front margin of the orbit, bounds the inner margin of the supraorbital and supranarial series, and abruptly terminates opposite the front of the nasal fossa. Between this series and that bounding the median rostral series there extends a naked groove, which, after continuing forward with increased width to the terminal plate, abruptly turns back and bounds within the scales along the anterolateral margin of the snout. The remaining portion of the snout above is covered with prickles. The scales on the opercles are not reduced in size and bear as many as 12 divergent carinae. The scales below the orbit, extending from the nasal fossa to the preopercular ridge, are small. The underside of the head and the nasal fossa are wholly scaleless.

The short but sharp first dorsal spine is two-thirds as long as the terminal tubercle; the filamentous second spine is contained 1.21 times into the head.[1] The base of the first dorsal fin is contained 1.2 times in the interdorsal space, or 1.4 times in the postorbital length

[1] The statement of Radcliffe (p. 136) that the dorsal spine is "frequently longer than head in smaller specimens" is not pertinent, inasmuch as none of those smaller specimens are true *notatus*.

of the head. The second dorsal is lower anteriorly than in *C. maculatus* or *velifer*, its first ray being contained 7.5 times in the orbit. The anal fin originates in advance of the second dorsal a distance one-third as great as the interval between the dorsals. The pectoral fin is short; the outer ventral ray is contained 1.95 times in the head; the second ray, 3.15 times.

Coloration in alcohol.—Ground color, light brown, with silvery reflections on the sides of the head and trunk; the color is lighter than in *maculatus* or *velifer*. The belly is blackish only in advance of the ventrals (no such restriction of the black area occurs in *maculatus*, *velifer*, nor *triocellatus*). A large blackish brown imperfectly ocellated spot, extending from the pectoral fin to the lateral line, covers six scale rows counting downward and backward: it is thus smaller than in *C. maculatus* or *C. velifer*. A dark area, not well defined, extends from the first dorsal fin to the occiput; a dark spot of irregular outline (too sharply emphasized in the type figure), is located before the origin of the lateral line. An ocellated saddle of dark brown color, covering six scale rows, extends across the back downward to the lateral line; it is separated from the pectoral spot by a distance enterring twice into the head; a saddle of similar width, but not ocellated, is separated from the anterior saddle by a distance contained 1.75 times in the head; the tail is indistinctly barred behind these saddles. The opercles are dusky, becoming blackish toward the opercular angle. The buccal cavity is lined with light around the mouth and with dark dusky blue within; the branchial cavity is lined with purplish black except along the light margin of the outer wall; the abdominal cavity is lined with pale purplish brown, punctulate with darker, and underlain by silvery pigment. "Basal sixth of second dorsal spine light brownish yellow, distal portion dusky black, the dark markings of the spine extending onto distal portion of soft rays; second dorsal light; basal portion of anal light, distal portion of fin anteriorly almost black; ventrals dusky black, filament of outer ray whitish; pectoral dusky white," its uppermost two rays dark.

Measurements in hundredths of length to anus (84 mm.).—Length of head, 75; length of orbit, 22; postorbital length of head, 25; least width of interorbital, 15; least suborbital width, 10.5; distance from orbit to preopercle, 28; length of snout, 28; width of snout, 29; length of upper jaw, 20; length of barbel, 7; depth of body, 46.5; width of body across pectorals, 31.5; distance from center of anus to origin of anal, 15; distance from anus to base of outer ventral ray, 20.5; distance between ventral and isthmus, 23; length of first dorsal base, 18; interdorsal space, 22.5; length of outer ventral ray, 40.

Only the type-specimen is known.

(*notatus*, designated by a mark.)

28. COELORHYNCHUS TRIOCELLATUS, new species.

Type-specimen.—Cat. No. 78218, U.S.N.M.; a male 190 mm. long to the end of a pseudocaudal, 65 mm. to the anus; dredged at *Albatross* station 5575, north of Tawi Tawi, at a depth of 315 fathoms, where the bottom temperature was recorded as 52.3° F.

This species, quite handsomely marked for a bathybial type, is closely related to both *C. notatus* and *sexradiatus*, but resembles *notatus* most. Comparison between these forms has already been given in the analytical key to the species of *Coelorhynchus*, and will be repeated in some detail in the course of the following description. *C. triocellatus* is also related to the following species, which, however, lacks the ventral fossa.

Fin-rays—first dorsal, II, 9; pectorals, 17–16; ventrals, 7–7.

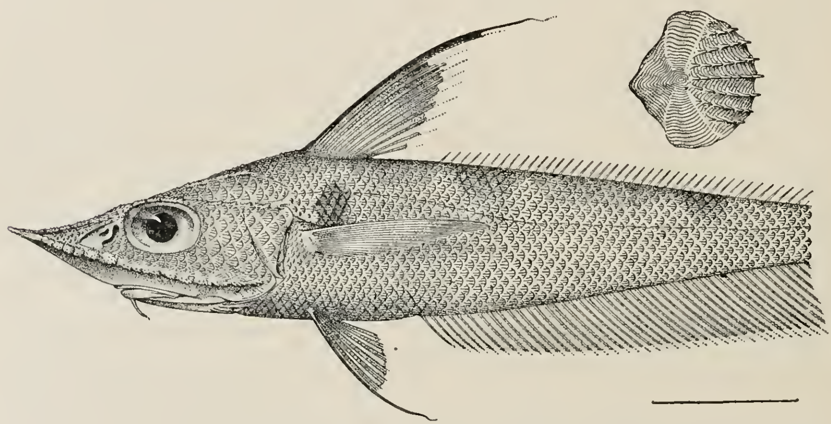

Fig. 12.—Coelorhynchus triocellatus. Type.

The body is slender and comparatively strongly compressed; its greatest depth is contained 1.9 times in the head; its width across the pectoral bases, 2.5 times, being equal to the depth of the body below the origin of the lateral line, or to the total depth of the body at a point twice the head's length behind the tip of the snout; at that point the width of the body is contained 3.4 times in the depth. The dorsal contour is concave on the snout, but straight on the postorbital portion of the head, and horizontal on the tail behind the first dorsal fin. The snout in this species is diagnostically long, slender, and sharply pointed, with sides but little convex. Its preocular length is contained 2.32 times in the head; the preoral length, 2.45 times; its width opposite front of the orbits, 3.0 times. The posteroventral angle of the subopercle is produced backward into a pointed flap. Length of the orbit, 3.6 in head, 1.05 in postorbital, 1.6 in snout; least interorbital width, 1.6 in postorbital; least suborbital width, 2.5. The maxillary subtends the anterior two-thirds of the orbit; the length of the upper jaw is contained 4.5 times into the head. The villiform teeth, as usual, are in bands on the jaws; the outer premaxillary series is scarcely enlarged. The short barbel is contained 5.7 times in the postorbital. Six branchiostegals; gill-membranes with a free fold.

In the location of the anus this species occupies a position intermediate between that of *C. notatus* and that of *C. sexradiatus*, the distance from the center of the anus to the origin of the anal being contained 2.6 times in the distance between the anus and the base of the outer ventral ray; the latter distance is contained 1.1 times in either the postorbital or the distance from the ventral fin to the isthmus.

A darkly pigmented and very narrow ventral fossa extends forward from the peritroct only to opposite the posterior ends of the ventral bases.

The scales are in 5½ series from the origin of the second dorsal to but excluding the lateral line scales. The spinous carinae on the scales of the body, 7 to 10 in number, are similar in strength to those of *notatus*, but bear 9 or fewer longer, sharper, and more curved spinules; these spinules are much longer, sharper, more slender, and more widely spaced than those of *C. sexradiatus*. The squamation of the head is so similar to that of *C. notatus* that only the features apparently diagnostic need be described. The scales as a whole differ in bearing fewer carinae and fewer spinules. The acute dorsoterminal plate is much longer than in any of the preceding species, its length being contained only 2.9 times in the postorbital; its spinules are arranged in three series radiating from its tip, being much reduced in size along the double median series. There are 6 scales on the ethmoid, 7 or 8 on the preorbital, series of the infraorbital ridge, and 9 on the mediorostral ridge. The median of the three spinous ridges on the occipital scute is the strongest; a scale nearly half the distance from the scute to the dorsal fin is enlarged and strengthened after a somewhat similar fashion. The median of the three series of scales between the occipital and postorbital ridges is enlarged. The anterolateral region of the snout is largely covered with prickles, leaving only a narrow naked groove lateral to the single series of scales bounding the median rostral row. In addition to these prickles, and to the longer dorsoterminal plate, the scales on the head of *triocellatus* differ from those of *sexradiatus* chiefly in bearing fewer and more divergent carinae. The underside of the head and the nasal fossa are completely scaleless.

The first dorsal spine is very short, stout, and sharp; the second is long and filamentous,[1] being contained 1.12 times in the head (the

[1] The fin-rays are probably shorter in the female.

spine is broken at its extreme tip); the third ray is longer than in *C. sexradiatus*, being contained 1.21 times in the length of head. The base of the first dorsal fin is contained 1.2 times in the interdorsal space, or 1.4 times in the postorbital length of head. The second dorsal fin is rather low anteriorly, the first ray being contained 6.3 times in the postorbital. The origin of the anal is anterior to the vertical from the middle of the interdorsal space. Pectoral fin, 1.6 in head; outer ventral ray, 1.75; second ventral ray, 2.85, reaching a little beyond the origin of the anal.

The ground color is a little lighter than in *sexradiatus* or *notatus*, and much lighter than in *maculatus* or *velifer*. The dark shade of the belly extends from the anus to the isthmus and on the sides to above the ventrals. The blackish brown spot above the pectoral extends upward to the lateral line and covers six scale rows. A dusky region, of squarish outline, extends from the first dorsal forward to the occiput, and downward on each side to the origin of the lateral line; it bounds the upper anterior margin of the light area about the suprapectoral spot. A dusky area which extends downward and backward to the lateral line is separated from the spot by an interval shorter than in *notatus* (being but two-fifths as long as the head); a similar but smaller, and only faintly ocellated saddle, is separated from the first by an interval half as long as the head. A black spot, located on the sides of the branchiostegal membranes, is separated from the free edge by a narrow whitish line. The opercle is dusky, with a small blackish spot near its angle. The first dorsal fin is dusky black only on the spine and on the distal portion of the anterior soft rays; it is whitish elsewhere. The second dorsal fin is light; the anal is dark anteriorly, especially toward the tips of the rays. The ventral fin is chiefly dusky, becoming darker distally, blackish near its base, and whitish on the filament of the outer ray. The pectoral rays, with the exception of the uppermost two, are light.

The differences between *C. triocellatus* and *notatus* may be summed up as follows: the body is more strongly compressed; the snout is much longer, narrower, and more acute; the dorsoterminal plate is much longer; the anus is more posterior in position; the spinules on the scales of the body are longer; other differences exist in the squamation of the head and in the coloration. *C. triocellatus* differs from *sexradiatus* in several characters: the body is more compressed; the snout is longer, narrower, more acute; the anus is located farther forward; the ventral fossa is shorter; the pectoral and ventral rays are more numerous; the coloration is more variegated; additional differences in squamation have been noted in the description.

Measurements in hundredths of length to anus (65 mm).—Length of head, 78; length of orbit, 22; postorbital length of head, 23; least interorbital width, 14; least suborbital width, 9; distance between orbit and margin of preopercle, 25; length of snout, 34; width of snout, 27; length of upper jaw, 18; length of barbel, 4; depth of body, 43; width of body across pectorals, 31.5; distance from origin of anal to center of anus, 9; distance from anus to base of outer ventral ray, 20; distance between ventral and isthmus, 24; length of second dorsal spine, 69+; length of third dorsal ray, 66; length of first dorsal base, 16; length of interdorsal space, 18; length of pectoral, 49; length of outer ventral ray, 44; length of second ventral ray, 28.

(*triocellatus*, in reference to the three ocellated marks.)

29. COELORHYNCHUS DORSALIS, new species.

Type-specimen.—Cat. No. 78219, U.S.N.M.; a male, 200 mm. long (extreme tip of tail broken off), 59 mm. to anus, dredged by the steamer *Albatross* at station 5329, in 212 fathoms, off northern Luzon, where the bottom temperature was recorded at 51.4° F.

A single paratype, 155 mm. long to the end of its pseudocaudal, about 47 mm. to anus, was taken near the type-locality, at station 5326; depth, 230 fathoms; bottom temperature, 55.4° F.

This species is the only one of the *C. notatus* group known from off northern Luzon, and was not taken off southern Luzon, where *C. velifer* and *macrolepis* were dredged in abundance.

Fin-rays—first dorsal, II, 8; pectorals, 17—17 (17—16 in paratype); ventrals, 7—7.

In its form this species is somewhat more slender than usual, its greatest depth being contained 1.95 times in the head (1.88 times in the paratype); width of body across pectoral bases, 2.75 (2.6) times; at a point twice the length of the head behind the rostral tip the width of the body is just one-third of the depth. The dorsal contour of the snout is somewhat concave; that of the postrostral portion of the head is nearly straight, not being elevated at the occiput. The snout is long and diagnostically broad anteriorly, being especially wide between the comparatively prominent anterolateral angles, where the width is a little greater than either the orbital length or the length anterior to the angle on either side. The preocular length of the snout is contained 2.37 times in the head; preoral length, 2.7; width opposite front of orbits, 2.9 (2.8). The subopercle is produced backward and downward, from its lower angle, as a pointed flap. Length of orbit, 3.6 in head (3.7 in paratype); 1.1 (1.15) in postorbital; 1.5 (1.6) in snout. Least interorbital width, 1.7 (1.6) in postorbital; least suborbital width, 2.6 (2.7). The upper jaw, contained

4.15 (4.2) times in the head, extends backward almost to below the hinder margin of the pupil. The outer series of premaxillary teeth are scarcely enlarged. The free portion of the small barbel is contained but 7.2 (6.2) times in the postorbital. The gill-membranes cross the isthmus with a narrow free fold; six branchiostegals.

The center of the anus is distant from the anal, the interspace being half the distance from the anus to the base of the outer ventral ray, a distance which is contained 1.2 times in that between the ventral and the isthmus, or 1.3 (1.4) times in the postorbital. There is no trace of a ventral fossa in front of the anus nor between the ventrals.

The scales are smaller and more closely imbricate than in the following species, there being 6½ in a series from the origin of the second dorsal fin to the lateral line series. The scales are less strongly

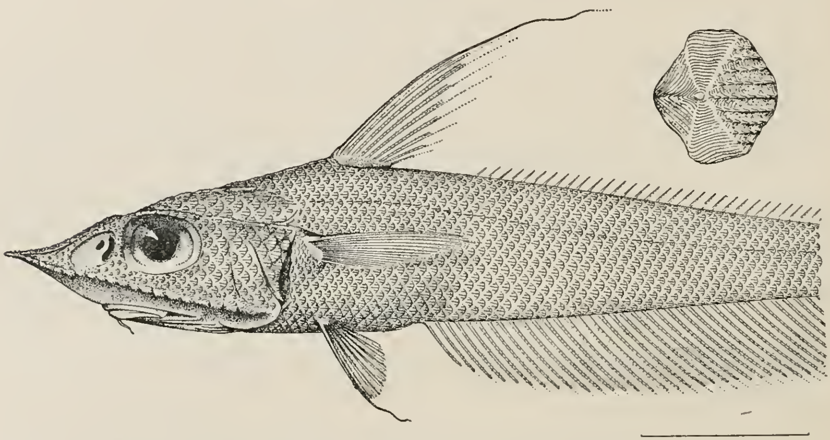

FIG. 13.—COELORHYNCHUS DORSALIS. TYPE.

spinous than in *argus* and *macrolepis*, but their carinae are more distinctly developed, numbering 8 to 11 on each scale (5 to 7 in the smaller paratype). Each of the carinae bears 12 or fewer short, sharp, close-set spinules directed backward, the last one projecting slightly beyond the margin of the scale. In general the squamation of the head is similar to that of *notatus*, *sexradiatus*, and *triocellatus*, but a few differences are apparent: the carinae on most of the scales of the head are similar to those of the body; they are usually more divergent, weaker, and smoother than in the preceding species. The dorsoterminal plate is shorter than in *triocellatus* but more prominent than in *notatus* and *sexradiatus;* its dorsal length is contained 3.3 times in the postorbital (4.1 times in the paratype). Seven scales cover the ethmoid portion, and 10 or 11 (9) the preorbital portion of the infraorbital ridge. Over the mediorostral ridge there are but 8 narrow scales, each more oval than in the preceding three species, and armed with spinous carinae radiating from near the center of the scale. Between the occipital ridges the scales, in five series, are mostly little modified, but become reduced in size near the median occipital scute; this scute bears a strong median and a weak lateral keel; there is no second scute between this one and the dorsal fin; a scute near the origin of the lateral line bears a strong spinous crest, with a weaker ventral carina. The scales in the median of the five series between the occipital and the postrostral ridge series are markedly enlarged, some bearing as many as 13 divergent carinae. As in *notatus* and *triocellatus*, as distinguished from *sexradiatus*, the fossa within the anterolateral margin of the snout is largely covered by prickles, leaving only a narrow groove along the outer side of those series of scales which bound on each side the median rostral ridge scales; the scales of these series are similar to those of preceding species, bearing an outer subparallel and an inner oblique group of carinae; posteriorly, small scales are inserted between the main series and the median rostral series. The underside of the head bears no scales.

The first dorsal spine is short and strong; the second is long, and it terminates in a long filament; the third ray is as long as the snout plus the orbit. The base of the first dorsal is contained 1.3 times in the interval between the dorsals, and 1.5 times in the postorbital length of the head; the second dorsal fin is rather low anteriorly. The origin of the anal fin lies below the anterior portion of the interdorsal space. The pectoral is contained twice in the head; the second ventral ray reaches the anal origin.

As a wide sexual dimorphism was demonstrated in *C. maculatus*, *velifer*, and *sexradiatus* as regards the length of the fin-rays, a comparison of these characters is added, based upon the type, a male, and the paratype, a smaller female. Although the difference is less striking, it is probable that in this species, too, the fin-rays are longer in the male than in the female.

Table of fin-ray measurements.

	Type (a male).	Paratype (a female).
Dorsal spine into head	0.9	1.2
Pectoral fin into head	2.0	2.0
Outer ventral ray into head	1.95	2.2
Second ventral ray into head	3.15	3.3

The ground color is light, about as in *C. triocellatus*. The dusky shade of the belly extends forward to, or nearly to, the isthmus, and on the sides to above the ventrals, thus distinguishing this species from *notatus* and *sexradiatus*. The markings of the two specimens are not strong. The large spot above and behind the pectoral includes the first row and a half of scales above the lateral line, and covers eight oblique rows (six in paratype); this spot is ocellated by a wide lighter band, which is immediately preceded and followed by rather indistinct saddles, similar to those of related species. After an interspace three-fourths as long as the head, the dark spot is followed by the usual dark saddle, which in this species is quite indistinct. The head is lightly colored, with silvery reflections as on the sides of the body; the opercle is dusky; the margin of the branchiostegal membranes laterally is whitish. The buccal cavity and the upper two-thirds of the branchial cavity are lined with a dusky membrane; the parietal peritoneum is light purplish brown, blotched with darker and underlain with silvery. The first dorsal is mostly dark, but lighter near its base, and near the tip of the spine; the second dorsal is light; the anal fin has a dark margin, which is widest anteriorly. The pectoral fin is almost whitish, except on its upper margin; the ventral is dusky, with a blackish base.

This interesting species is similar to the last one described, *C. triocellatus*, but differs notably in lacking the ventral fossa, in its plainer coloration, etc. It is also closely related to the next species, *C. argus*, from which it differs in the produced dorsal spine, in the broader snout with more convex sides, and in details in the squamation of the head. From both of these species, *C. dorsalis* differs also in its finer scales, there being 6½ instead of 5½ scales in a row between the origin of the second dorsal and the lateral line series.

Measurements of type in hundredths of length to anus.—Length of head, 76; length of orbit, 21; postorbital length of head, 24; width of interorbital, 17; width of suborbital, 9; distance from orbit to preopercular margin at angle, 28; length of snout, 32; length of upper jaw, 18; length of barbel, 3.7; depth of body, 39; width of body, 26; distance from center of anus to origin of anal, 9; distance from anus to base of outer ventral ray, 18.5; distance from base of outer ventral ray to isthmus, 22; height of second dorsal spine, 84; height of third dorsal ray, 51; length of first dorsal base, 16; length of interspace between dorsals, 20.5; length of pectoral fin, 40; length of outer ventral ray, 39; length of second ventral ray, 25.

(*dorsalis* in reference to high dorsal fin.)

30. COELORHYNCHUS ARGUS Weber.

Coelorhynchus argus Weber, Fische der *Siboga*-Expedition, 1913, p. 161, pl. 4, fig. 4 and 4*a*.

We hesitate to refer our specimens to *C. argus*, as certain discrepancies between them and Weber's description are difficult to explain. The orbit is never quite as long as the postorbital length of the head, as we measure these parts, either in our specimens or in Weber's figure, but his measurements indicate the reverse. The interorbital in our material is always less than half the length of the snout, but to a variable degree. Weber[1] finds only 2 specimens out of 19 in which the snout is more than twice as long as the least interorbital space. These differences may, however, be due to different methods of measurement. The methods which we follow are clearly given in the introduction to our paper on Japanese Macrouroids.[2] *C. argus* can not be identified with any other of the seven species of the *C. notatus* group, all of which are described in these pages.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			F.°	
5387	Between Burias and Luzon	209	52.4	1
5112	China Sea, off southern Luzon	177	52.4	1
5118	.....do	159	....	1
5265	.....do	135	....	1
5291	.....do	173	....	8
5298	.....do	140	....	2
5421	Between Panay and Guimaras Islands	159	....	1
5247	Gulf of Davao, southern Mindanao	135	....	2
5549	Near Jolo Islands	232	53.5	4
5135	.....do	161	57.4	3

We have prepared a detailed description of our material:

Fin-rays—first dorsal, II, 7 to 9; pectoral, 14 to 17; ventral, 7.

The dorsal contour varies somewhat, that of the snout being more or less concave, while that behind the snout is more or less convex. Greatest depth of body, 1.85 to 2.0 in head; width across pectoral bases, 2.6 to 2.9, equal to, or somewhat less than, the depth of the body below the origin of the lateral line. The dorsal contour is not elevated at the occiput. The snout is narrow anteriorly as in *notatus*, *sexradiatus*, and *triocellatus*, its sides being quite evenly convex forward to just behind the produced dorsoterminal plate, the length of which is contained from 2.9 to 3.9 times in the postorbital. In some specimens the anterolateral angles of the snout are fairly prominent, while in others they are scarcely apparent. Preocular length of snout, 2.2 to 2.5[3] in head; preoral length, 2.4 to 2.9; width of snout opposite front of orbits, 2.7 to 3.05. The width of the snout at the posterior end of the ethmoid region of the infraorbital ridge is about equal to the length of the orbit, and is contained from 1.0 to 1.25 times in the distance from that point to the tip of the snout. The subopercle has the usual pointed flap. The orbit is of rounded-oblong outline, its length being contained from 3.4 to 3.8 times in the head: 1.0 to 1.1 times in the postorbital length to the edge of the

[1] Doctor Weber has kindly reexamined his material as regards this and other points which were of interest to us.

[2] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 147.

[3] These measurements of the parts of the head were made on each of about 12 specimens, in which the heads measured from 41 to 53 mm.

membrane at the opercular margin; 1.4 to 1.7 times in the snout. The least interorbital width is located above the front of the pupil, and is contained 1.5 to 1.8 times in the postorbital; the least suborbital width, 2.6 to 2.7. The upper jaw extends backward almost or quite to the vertical below the hind margin of the pupil, and is contained from 3.95 to 4.8 times in the head. Bands of fine teeth occur in the jaws; the outermost premaxillary series is somewhat enlarged. Barbel, 4.0 to 7.0 in postorbital length of head. Six branchiostegals; the gill-membranes have a free fold of variable width.

The center of the anus lies in advance of the origin of the anal fin a distance half to two-thirds that between the anus and the base of the outer ventral ray; the distance from anus to ventral is contained 1.25 to 1.5 times in the distance from the ventral to the isthmus, or in the postorbital length of the head. No trace of a scaleless ventral fossa can be found in specimens in which no scales are lost, but the scales are often fallen in an area before the anus. A gland-like body extends forward from the peritroct to between the ventrals, above the position occupied by the ventral fossa in those species in which the fossa is present; this organ is slender posteriorly, but widens anteriorly to an ellipsoidal form; its ventral surface is black, in strong contrast to its silvery dorsal face.

The scales are less closely imbricate than in *C. dorsalis;* they are constantly in 5½ rows between the lateral line and the origin of the second dorsal. The scales of the body are moderately rough, being more strongly spinose than in *C. dorsalis.* Each scale is armed with 5 to 10 well-formed, slightly divergent spinous carinae. The spinules are fewer than nine on each carina; they increase in size posteriorly on each carina, the last one projecting beyond the scale margin. The ridges of the head are rendered quite rough by scales armed with several carinae. Six or seven scales cover the ethmoid, and 9 to 11 the preorbital portion of the infraorbital ridge. The dorsoterminal plate is of variable length and breadth, and is nearly smooth medially; the ventroterminal plate is rough with conic spines.

The median rostral ridge is covered by seven to nine oblong-elliptical scales, on which the carinae radiate in all directions from a point near the center of the anterior scales, but from a point near the front margin of the posterior ones. The inner oblique group of carinae are obsolescent on those scales which form the series bounding the median rostral series. The character of the squamation between the occipital ridges in diagnostic of the species: from the end of the median rostral ridge backward for a distance equal to the vertical diameter of the orbit, the scales are similar to those of the body, but are rather smaller, and are arranged in five irregular rows; behind these there abruptly follows an area in which the scales are much reduced in size and armature; this area is followed by a crescent-shaped naked region, with the convex side just in front of the occipital scute. This scute is less modified than in related species; it bears five to seven carinae not much stronger than those on the scales of the body; behind this scute the scales are rather small; a similar scute, even less modified, occurs in some specimens on the mid-dorsal line between the main scute and the origin of the first dorsal; a scute with a strong median keel is sometimes developed at the anterior end of the lateral line. The squamation of the region between the occipital and postorbital ridges also differs conspicuously from that of the other species: the lower two-thirds of this area is covered by two or three subequal rows of scales, bearing as many as 11 divergent carinae, while the upper third is covered by scales mostly of greatly reduced size. The region below the orbit and the larger part of the anterolateral region of the upper surface of the snout are covered by prickle-like scales. The under side of the head is wholly naked.

The first dorsal spine is sharp; the second spine in some specimens ends in a short, fine filament; its length is variable, about equal to the postrostral length of the head. The base of the first dorsal is contained 1.3 to 1.7 times in the interdorsal space, and 1.4 to 1.8 times in the postorbital length of head. The second dorsal fin is low anteriorly, its first rays being contained from 4 to 6 times in the length of the orbit. The origin of the anal fin lies below the middle or the anterior half of the interdorsal space. The outer ventral ray ends in a filament, which, like that of the dorsal spine, is sometimes compressed distally. The second ventral ray reaches almost to the origin of the anal fin. The wide variation existing in the length of the fin-rays is apparently not sexual, as was demonstrated in those species with elevated dorsals (as *C. velifer*).

Table to show variation of fin-rays in male and female specimens.[1]

	Males.	Females.
Second dorsal spine in head	1.5 to 1.85	1.6 to 2.0
Third dorsal ray in head	1.7 to 1.9	1.8 to 2.2.
Pectoral fin in head	2.2 to 2.5	2.1 to 2.65.
Outer ventral ray in head	2.1 to 2.8	2.25 to 2.7.
Second ventral ray in head	3.45 to 4.0	3.4 to 4.25.

[1] Five males and four females were measured, including both sexes from southern Luzon and from off Jolo Island.

The color of *C. argus* is more variable than that of any other species of the group examined. The ground color varies from light yellowish to dark brown. The region between the anus, ventrals, and isthmus is blackish. The dark specimens are from China Sea, while the lighter ones were dredged in the vicinity of Jolo Island, and in Davao Gulf, off the southern coast of Mindanao (other differences are not evident between the northern and the southern specimens). The dark markings are very indistinct in certain specimens, both of the light and dark types, while in others they are very strongly marked. The spot behind and above the pectoral fin covers seven to nine oblique rows of scales, and extends upward to include one or two rows above the lateral line. This spot in some specimens, most notably in the young, is ocellated by a white ring, which separates the spot from the dark squarish blotches extending forward and backward from the first dorsal fin. After an interspace about as long as the snout plus the orbit, the pectoral spot is followed by a dark bar extending from the dorsal downward and backward to the anal, and covering five to seven rows of scales. The sides of the head and body show silvery reflections. The branchiostegal membranes are mainly dark, but are margined with whitish. The linings of the buccal cavity, except about the mouth, and of the upper half of the branchial cavity, are dusky. The parietal peritoneum is light purplish brown, punctulate with black, and underlain by silvery; the peritoneum is little darkened in young specimens. The color of the fins, like that of the body, is widely variable; the first dorsal is whitish or dusky, with the larger and distal part of its spine, and the smaller and distal portion of its soft rays, blackish; the second dorsal is constantly light, but the anal varies from dusky to blackish anteriorly, and from whitish to dusky posteriorly; the pectoral is whitish or dusky, the ventral dusky or blackish, with the filament of its outer ray whitish.

This species probably never reaches a large size. Our largest specimen among 25 is a male, and measures only 65 mm. to the anus, while females measuring 54 to 64 mm. to the anus have their ovaries filled with ripening ova. *C. argus* is most closely related to *C. dorsalis* from northern Luzon, from which it differs in the larger scales, lower dorsal, narrower snout, and in details in the form and in the squamation of the head.

Table of measurements in hundredths of length to anus.

Albatross station	....	5549	5549	5135	5112	5549
Total length, in mm	196	186	171	[1] 167	[1] 187	117
Length to anus in mm	64	59	53.5	54	65	35
Length of head	80	87	81	78	81.5	78
Length of orbit	24	21	22	23	23	24
Postorbital length of head	24	23	24.5	25	23	24
Width of interorbital	16	14	16	15.5	16	15
Width of suborbital	10	8.5	9	9	9	9
Orbit to preopercle	28	25	26	28	25	26
Length of snout	33	33.5	34	31	37	33
Length of upper jaw	20.3	18	19	20	18	19.5
Depth of body	46	39	43	42	41	40
Width of body	31	30	32	31	31	28
Anus to anal	11.3	8.5	13	9	10.5	8
Anus to ventral	19	17.5	18	16	17	16
Ventral to isthmus	24	22	24	23	21	22
Height of second dorsal spine	46	52.5	52	49	44	42
Height of third dorsal ray	....	46	48	....	42.5	41
Length of first dorsal base	17	15	14	16	14	16
Length of interdorsal space	22	26	22	21	22.5	21
Length of pectoral	36	36	38	36	32	34
Length of outer ventral ray	36	36	38	37	30	36
Length of second ventral ray	20	21	22	21	21	19

[1] A small pseudocaudal developed.

(*argus*, in reference to the eyelike spots.)

31. COELORHYNCHUS MACROLEPIS, new species.

Type-specimen.—Cat. No. 78220, U.S.N.M.; collected by the *Albatross* in 236 fathoms at station 5111 in China Sea off southwestern Luzon. It is 143 mm. long to the end of a large pseudocaudal of 10 rays, and 55.5 mm. to the anus.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F*.	
5111	China Sea, vicinity of southern Luzon	236		35
5280	.....do	193	49.6	1
5281	.....do	201	50.4	1
5365	Balayan Bay, southern Luzon	214		20
Lost.				1

This small and fragile species is represented in the collection by 58 specimens, varying in length from 27 to 70 mm. to the anus; 18 females, in which the heads measure from 41 to 52 mm., have ripe or ripening ova. It is one of the most distinct species of the *notatus* group, being distinguished from all of the others by its larger scales, and from those species without a ventral fossa in numerous other characters; the orbit is larger, the snout of different form, and the squamation different in many details.

Fin-rays—first dorsal, II, 9 (8 to 19 in paratypes); pectorals, 17 (or 16); ventrals, 7 (constant).

This is a slender form, with an arched dorsal contour more notably elevated than usual at the origin of the first dorsal fin. The greatest depth is contained 1.8 (to 2.0) times in the head; the width across the bases of the pectoral fins, 2.5 (2.4 to 3.00) times, being a little less than the depth of the body below the origin of the lateral line. In distinction from all other species of the *notatus* group, with the exception of *maculatus* and *velifer*, the dorsal contour of the snout is almost straight. The suborbital and preorbital portions of the infraorbital ridge are straight in outline; the ethmoid region is evenly convex. The width of the snout across its anterolateral angles is greater than the length of the snout before the angle. The dorsoterminal plate varies widely in its length, which is contained from 3.0 to 4.3 times in the postorbital (3.7 times in the type). The subopercle ends below and behind in the usual pointed flap. The interorbital space is wider than in *dorsalis* or *argus*, and the suborbital is markedly broader. The maxillary extends backward a little beyond the vertical from the middle of the orbit. The teeth are villiform on the jaws; the outer premaxillary series is scarcely enlarged; the barbel is short and slender. Six branchiostegals; gill-membranes with a free fold. The center of the anus is in advance of its normal position before the origin of the anal fin, the interspace being contained 1.4 (1.0 to 2.0) times in the distance between the anus and the base of the outer ventral ray; the latter distance is contained 1.4 (1.3 to 2.0) times in the interval between the ventral fin and the isthmus, or 1.4 (1.3 to 1.8) times in the postorbital length of the head.

Summarized table of proportion of parts of the head.[1]

	Variation.	Type-specimen.
Orbit in head	3.05 to 3.3	3.05
Orbit in postorbital	0.8 to 1.0	0.8
Orbit in snout	1.2 to 1.4	1.25
Interorbital in postorbital	1.3 to 1.5	1.5
Suborbital in postorbital	2.0 to 2.25	2.0
Upper jaw in head	4.1 to 4.65	4.2
Barbel in postorbital	3.6 to 5.5	5.0
Length of snout in head:		
Preocular	2.25 to 2.6	2.5
Preoral	2.4 to 2.9	2.9
Width of snout in head	2.4 to 2.7	2.55
Width of snout at end of ethmoid region of infraorbital ridge, measured into length of snout before that point	0.8 to 1.0	0.85

[1] Measured in each case on 22 specimens, varying in length of head from 30 to 47.5 mm. (excepting case of barbel, measured in 16 specimens). Length of head in type-specimen, 44 mm.

The scales, especially those on the head, are loosely imbricate; they are larger than in any other species of the *notatus* group, there being constantly but 4 or 4½ in a series from the origin of the second dorsal to but excluding the scales of the lateral line. The scales of the body are about as rough as in *argus* or *velifer*, but those on the head, especially along the ridges, bear longer and stronger spinules. On each scale of the body there are from 9 to 11 parallel rows of slender and usually long spinules, the arrangement of which is slightly irregular as a result of the obsolescent character of the ridges along which the spinules are usually borne. The last spinule of each series often projects well beyond the margin of the scale. Six to 8 scales, studded with strong conic spinules, bound the ethmoid region of the infraorbital ridge; there are 8 to 11 scales on the preorbital section of the ridge. There are 8 (6 to 9) scales in a series along the superior rostral ridge; from near the anterior margin of each of these elongate scales there radiate backward several series of fine spinules. This median rostral series is bounded on each side by a single series of rather large scales bearing spinules in several series directed chiefly backward and inward, but not differentiated into two groups as usual in related species. The squamation of the region between the occipital ridges offers diagnostic characters: along the region vertically above the orbit there are three very regular and parallel rows of scales similar to those of the body (in paratypes smaller scales are sometimes interpolated between these series, rendering the arrangement less regular); between the abrupt termination of these series of scales and the occipital scute there is an area covered by prickles anteriorly but naked posteriorly. The occipital scute, often double or even triple,[1] is armed by a strong median spinous keel and by a few weaker lateral carinae variously developed; no scute is present on the mid-dorsal line between the occipital scute and the dorsal fin, but there is a small scute just above the origin of the lateral line. The median of the 3 irregular series of scales between the occipital and postorbital ridges is enlarged only anteriorly. Except for the presence of a few scales posteriorly, the anterolateral region of the snout is wholly naked. There are no scales on the under side of the head.

The first dorsal spine is stout and very short; the second spine is about as long as the first soft ray, and when unbroken at its tip

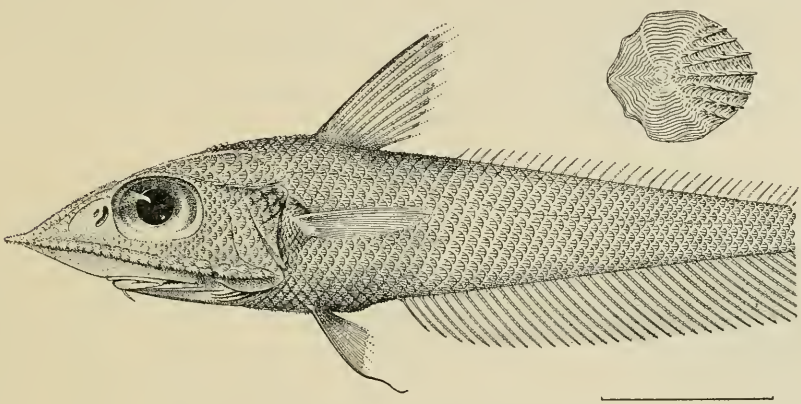

FIG. 14.—COELORHYNCHUS MACROLEPIS. TYPE.

is about equal to the postrostral length of the head (often somewhat longer, sometimes slightly shorter). The base of the first dorsal is contained 1.6 (1.25 to 1.6) times in the interdorsal space, and 1.5 (1.3 to 1.6) times in the postorbital. The origin of the anal lies behind the vertical from the middle of the interdorsal space. Length of pectoral, 2.15 (to 2.8) in the head. As in the case of *C. argus*, this wide variation in the length of the fin-rays appears not to be correlated with sex. The outer ventral ray is constantly shorter than in related species except *argus*, being contained 2.4 times in the head in the type and in most of the paratypes of either sex, but varying from 2.25 to 2.6. The short second ventral ray fails to reach the anal, and is contained 3.9 to 4.4 times in the head.

Coloration in alcohol.—The ground color is light, with more or less evident markings as in related forms. The abdomen between the

[1] This degree of variation is apparently characteristic of this species.

anus and the ventral fins is blackish, but the region anterior to the ventrals is usually dark brown (or light brown). The usual roundish spot above and behind the pectoral fin covers about seven oblique scale rows, and is ocellated with a lighter ring, which is preceded by an indistinctly darker squarish saddle just before the first dorsal fin, and followed by a similar saddle extending below the interdorsal space. Silvery reflections are seen on the sides of the head and body. The coloration of the head in general is light, becoming dark brown near the anterolateral angles of the snout, and blackish on the opercle. The buccal cavity is lined with purplish brown, without light margins about the gape; the branchial cavity is lined with brownish black, with a narrow light margin along the free edge of the opercular and branchiostegal membranes. The vertical fins are blackish, varying to light dusky; pectorals, light dusky; ventrals blackish, with a white filament. In the young the first dorsal may be whitish proximally, but black on the tips of the spine and the front rays. The tail of the young is crossed by bars which are wider than the light interspaces between them.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.			
Albatross station	5111	5365	5111	5111	5111
Total length in mm	[1] 143	164	152+	....	[1] 104
Length to anus in mm	55.5	53	55	53	36
Length of head	80	82	81	82	81
Length of orbit	27	26.5	26	25	26
Postorbital length of head	23	21.5	23	22	22
Width of interorbital	16	17	17	16	16
Width of suborbital	11	11.5	10	11.5	11
Orbit to preopercle	25	26	26	26	27
Length of snout	32	36	35	36	36
Length of upper jaw	19	18	18.5	18.5	19
Depth of body	44	43	43	43	39
Width of body	32	29	31	30	27
Anus to anal	12.5	9	....	11	8
Anus to ventral	17	14	....	13	14
Ventral to isthmus	23	22	26	22	23
Height of second dorsal spine	....	49	48	47	45
Height of third dorsal ray	....	....	46	....	....
Length of first dorsal base	16	14	16	15	16
Length of interdorsal space	22.5	21.5	26	23	21
Length of pectoral	38	34	39	33	33
Length of outer ventral ray	35	38	34	33	37
Length of second ventral ray	19	23	....	20	21

[1] A pseudocaudal developed.

(*macrolepis*, in reference to the large scales characteristic of this species.)

32. COELORHYNCHUS CINGULATUS, new species.

Type-specimen.—Cat. No. 78221, U.S.N.M., a male, 136 mm. long to the end of a broken pseudocaudal, 56.5 mm. to the anus (about 0.5 mm. of tip of snout estimated as broken off). The type was dredged by the steamer *Albatross* at station 5317, in the China Sea near Formosa; depth, 230 fathoms; bottom temperature, 50.6° F.

A single paratype was obtained: length, 148 mm. to end of injured pseudocaudal, 60 mm. to anus; *Albatross* station, 5325; locality, China Sea off northern Luzon; depth, 224 fathoms; bottom temperature, 53.2° F; sex, female, with unripe ova in an elongate ovary.

Fin-rays—first dorsal, II, 8 (II, 9 in paratype); pectorals, 17 (18); ventrals, 7.

The dorsal and ventral contours of the slender body are long, even curves; the greatest depth is contained 2.2 times in length of head; the greatest width across pectoral bases is about equal to the depth below origin of lateral line, and is contained 2.8 times in length of head. The dorsal contour of the head above and behind the orbit is gently convex, while that of the snout is concave. The sides

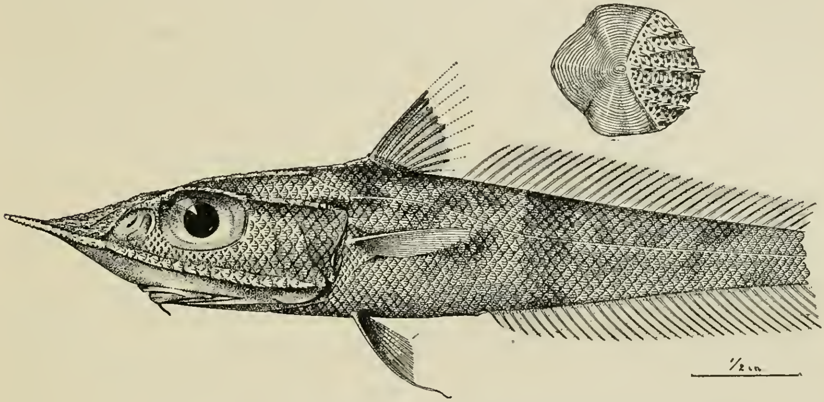

FIG. 15.—COELORHYNCHUS CINGULATUS. TYPE.

of the head are straight medially along the preorbital and suborbital portions of the infraorbital ridge, but the contour of the ethmoid portion of the ridge is doubly curved, being convex posteriorly, and concave anteriorly just behind the sharp, long, and slender terminal spine; the length of the dorsoterminal plate is contained 2.3 times in the postorbital (in paratype). The width of snout at front of orbits is equal to the length of the ethmoid region of the infraorbital ridge, and is contained 2.7 (2.85) times in the head. Preocular length of snout, 2.2 in head; preoral length, 2.4 (2.3). The occipital ridges are subparallel anteriorly, but divergent posteriorly; the least distance between them is contained 1.3 (1.4) times in the distance between their terminations, and is equal to the least suborbital width, each being contained 1.6 to 1.7 times in the interorbital. The postorbital ridge is curved slightly upward anteriorly, slightly downward posteriorly. The lower subopercular angle is produced downward and backward into a long, blunt flap, in contrast with the more slender, pointed flap of the preceding series of species. The orbit is small: 3.8 (4.1) in the head; 1.75 (1.85) in snout; 1.15 (1.25) in postorbital. The least interorbital width is contained 1.4 (1.5) times in the postorbital; least suborbital width, 2.2 (2.4) times. The upper jaw (4.5 and 4.8 in head) extends just a little beyond the vertical from the hinder margin of the pupil; the teeth of the premaxillary are somewhat enlarged in an outer series. The barbel is short and very slender, 6 (5) in the postorbital; 6 branchiostegals; fold of gill-membrane very narrow.

The anus is located immediately before the anal fin, well behind the vertical from the origin of the second dorsal. Its distance from the base of the outer ventral ray is notably longer than either the distance between the ventral and the isthmus or the postorbital length of the head, and is contained 2.6 times in the head; the distance between the ventral fin and the isthmus is equal to the length of the orbit. The anus is preceded by a small scaleless black area, from which a black line extends forward to the oval ventral fossa, which is covered by very thin, smooth scales, and is located just anterior to the ventral fins; the fossa is one-third as long as the postorbital; the distance from the center of anus to the front of the fossa is half as great as the length of the head. Distance between outer ventral ray and isthmus, 1.25 in postorbital.

Twenty-one pyloric caeca, shorter than the orbit (in paratype).

The scales are well imbricate and of medium size; 5 (or $5\frac{1}{2}$) in a series between the front of the second dorsal base and the lateral line (excluding the lateral line scales). Each scale of the body bears 5 to 7 poorly developed, slightly divergent carinae, which are armed with six (or fewer) spinules near the middle of the scale, where they are strongest and most numerous; these spinules are sharp and slender, and are directed backward; the last ones project beyond the margin of the scale. The spinules on the scales of the head are in general similar to those of the body, but are strengthened moderately on the supraorbital, postorbital, and occipital ridges; those on the snout and on the infraorbital ridge are characteristically small and suberect. The long, sharp dorsoterminal plate is armed by scattered spinules above, and by a marginal series (the strongest) on each side; the ventroterminal plate is armed by five series of spinules; the bases of the terminal plates are bounded by the first two scales of the 9 to 11 which cover the ethmoid region of the infraorbital ridge; the preorbital region of the ridge is covered by 14 to 17 scales in a single series, while the preopercular and suborbital regions, behind the posterior margin of the pupil, are covered by a double series; from this double series there extends forward, between the scales of the ridge and the eye, a diagnostic row of modified scales bearing two strong series of spinules. The median rostral series consists of 9 (6) scales with strongly divergent, but not radiating, series of erect spinules; it is bounded on each side by one or two series of scales, which decrease in size anteriorly, and are armed with six or fewer subparallel series of spinules; these series of scales are separated by a narrow scaleless groove from the lateral regions of the snout, which are covered by small prickly scales. The scales along the occipital ridges bear a median spinous keel and a few lateral carinae, well developed anteriorly, but obsolescent posteriorly; the region between the occipital ridges is covered by 5 irregular rows of scales, which are similar to those of the body posteriorly, but are smaller anteriorly.

The occipital scute, barely apparent, is preceded by a small prickly area; a narrow scute, located just above the origin of the lateral line, bears a strong median spinous crest and one weaker ventral carina. A series of enlarged scales extends forward from the lateral line, each bearing 10 or fewer divergent spinous carinae, of which the median is the strongest; this series is separated from the postorbital ridge by a series of scales like those of the body, and from the occipital ridge by two irregular rows of small scales. The scales on the opercles are like those of the body; those below the orbit are reduced in size.

The under side of the head is wholly naked; the nasal fossa and the concealed portion of the skin over the shoulder girdle are almost completely scaleless.

The interval between the dorsals is very short, only two-thirds the length of the first dorsal base, which is contained 1.8 times in the postorbital. Length of pectoral, 2.7 in the head (in paratype). The length of the filamentous outer ventral ray, which reaches to the origin of the anal, is contained 2.7 (2.65) times into the head; the inner ventral rays, which do not nearly reach the anus, are contained 3.7 times in the head.

The ground color in alcohol is light brown, replaced by silvery white over the entire region of the body cavity, with the exception of a dark bar joining the ventral bases, and crossing the black streak described in connection with the anus and the ventral fossa. The under side of the head is light and punctuate; sides and top of head, grayish brown, shading to darker on the snout, especially toward its anterolateral margins, on the median rostral ridge, and on the anterior and posterior margins of the nasal fossa. Two dark brown streaks radiate backward from the eye, the lower one extending to the angle of the preopercular ridge, while the upper one, more conspicuous, extends horizontally backward, just below the postorbital scaly ridge, to the upper angle of the branchial aperture, where it is continuous with the dusky opercular blotch. The area around the occipital scute is dark brown; a squarish dark blotch surrounds a small light median patch between the ends of the occipital ridges. The character of the highly variegated markings is similar in the two specimens, and is sufficiently well shown in the figure. The posterior portion of the tail is marked by a series of dorsal and anal blotches, extending from the fin bases almost to the lateral line. The first dorsal and pectoral fins are light dusky; the second dorsal and the anal are light except near their anterior ends; the ventral fin is dark, with a white filament. The buccal cavity is lined with dusky except near the gape; the upper walls of the branchial cavity are brownish black; the opercular and branchiostegal membranes are bordered along their free edge by a light streak; the parietal peritoneum is purplish brown underlain with silvery.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5317	5325
Total length in mm	[1] 136	[1] 148
Length to anus in mm	56.5	60
Length of head	72.5	70
Length of orbit	19	15
Postorbital length of head	22	21.5
Width of interorbital	15	14.5
Width of suborbital	10	9
Orbit to preopercle	22	21.5
Length of snout	33	33
Length of upper jaw	17	16
Depth of body	32	....
Width of body	26	....
Anus to ventral	28	27
Ventral to isthmus	18	17
Length of first dorsal base	12	12
Length of interdorsal space	8	7
Length of pectoral	....	27
Length of outer ventral ray	29	26
Length of second ventral ray	18	....

[1] A pseudocaudal developed.

C. cingulatus is a species not closely related to others found in the same or adjoining waters. It is probably most closely related to *innotabilis*, an Australian species with which it is compared in the preceding key to the species of the genus. It also bears some resemblance to *gladius*, an Hawaiian species.

(*cingulatus*, banded.)

Subgenus OXYMACRURUS Bleeker.

33. COELORHYNCHUS PLATORHYNCHUS Smith and Radcliffe.

Coelorhynchus platorhynchus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 133, text fig. 8, pl. 30, fig. 1.

In order to present a thorough comparison with the two following species, we have prepared a supplementary description of this species, based upon the following material:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5460	East coast of Luzon	565	....	1
5585	Vicinity Sibuko Bay, Borneo	476	41.1	[1] 1
5657	Gulf of Boni	492	41.3	3
5658	.....do	510	41.2	3

[1] Type.

Type-specimen.—387 mm. in total length; 150 mm. to anus; dredged at *Albatross* station 5585.

Fin-rays [1]—first dorsal, II, 9; pectorals, 18 (to 16); ventrals, 7.

The general form of the body is correctly indicated in the two type figures; the greatest depth of the body, at the posterior end of head, is contained 1.9 (to 2.1) times in the length of head to end of opercular membrane. The greatest width of the body is contained 2.5 (to 3.0) times in the head; the greatest width of the head is equal to its depth through the hind margin of the eye. Preocular length of snout, 2.7 (2.5 to 2.9); preoral length, 3.05 (2.9 to 3.3); width of snout across its base, 2.7 (to 2.5); width of snout at end of ethmoid region of the infraorbital ridge, into the distance from that point to the tip of snout, 0.75 (to 0.8). The occipital ridges diverge rather widely posteriorly; the least distance between them is contained 1.7 (to 2.0) times in interorbital. Length of the orbit: 3.4 (3.35 to 3.6) in head; 1.25 (1.2 to 1.4) in snout; 1.2 (to 1.25) in postorbital. Least interorbital width, 1.6 (1.5 to 1.7) in postorbital; least suborbital width, 2.5 (2.4 to 3.0). Length of upper jaw into head, 3.85 (3.8 to 4.1); the upper jaw extends from below the hind margin of the anterior nostril backward to a vertical passing across the eye between its hind margin and the pupil. Branchiostegal rays, 6; the gill-membranes form a free fold across the isthmus. The free length of the barbel enters 4.9 (4.2 to 5.2) times into the postorbital length of the head. The lower subopercular angle is produced backward as a long narrow flap, which is curved slightly downward distally.

Distance from center of anus to base of outer ventral ray, 2.15 (to 2.9) in head; distance from ventral fin to isthmus, 3.2 (to 3.6); distance from anus to isthmus, 1.3 (to 1.6). The anus is immediately preceded by a naked space about as long as the peritroct; above it, between the muscles of the body wall, there lies a flattened gland-like body which probably represents the structure described in some detail in other species; in color this organ is black below, and dusky above.

Thirty-two pyloric caeca about as long as the orbit were counted in a paratype.

[1] Counted in all eight specimens.

The scales are large, in but 4½ series from the origin of the second dorsal to but excluding the lateral line series; an additional series is inserted shortly behind the origin of the second dorsal. The 5 to 7 widely divergent carinae on each scale of the body are armed with about 6 very strong, broad spinules, imbricate, and increasing in strength posteriorly, the last one often projecting a little beyond the margin of its scale; the spinules of the median series are often much larger than those on the lateral carinae. The scales on the spinous ridges of the head are greatly strengthened. The dorsoterminal and ventroterminal plates are armed by 3 to 5 divergent carinae, and are scarcely produced beyond the lateral contour of the head. There are 7 to 9 scales along the ethmoid portion of the infraorbital ridge on each side; the 9 to 11 scales on the preorbital portion of the ridge are largest below the front margin of the orbit,

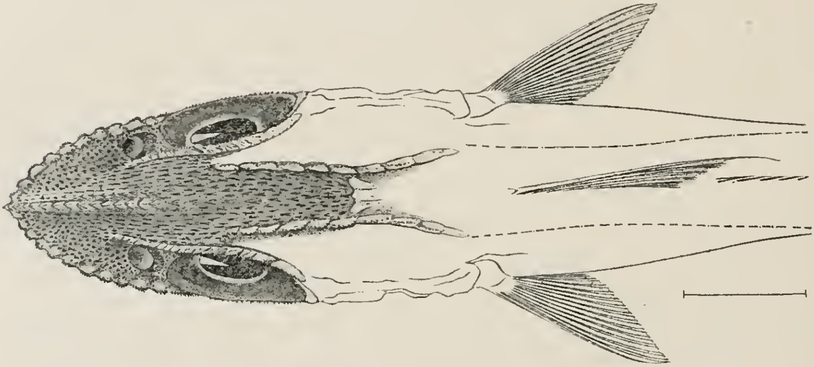

FIG. 16.—COELORHYNCHUS PLATORHYNCHUS. TYPE. AFTER RADCLIFFE.

and bear spinules mostly confined to their lower margins and to a single vertical series; the scales of the suborbital and preopercular portions of the ridge—that is, behind the vertical through the middle of the eye—are arranged in two series; the distance between the end of the infraorbital ridge and the preopercular margin is contained 4 (3.5 to 5) times in the postorbital length. The scales between the orbit and the infraorbital ridge are small; those from the nasal fossa to below the middle of eye are irregular in position and somewhat strengthened, while those below the posterior half of the orbit, and backward to the preopercular ridge, are regularly arranged, and bear mostly a single spinous ridge directed backward and downward. A series of 10 to 12 scales covers the median superior rostral ridge, extending backward to between the verticals from the front of orbit and the front of pupil; each of these quadrate scales is armed by 3 to 7 spinous carinae radiating outward and backward from the middle of its front margin.

The occipital ridges are covered by modified scales in the form of elongate tubercles bearing one or two keels, which are armed by strong spinules; the median occipital scute is also a strong tubercle, bearing a single spinous keel (three in one specimen); the scute may or may not be preceded on each side by a similar scale, or by a short naked region; from near the front of the scute five rows of scales diverge forward, confined posteriorly between the occipital ridges, but curving outward on the snout to bound the median series; these scales are mostly armed by a single, but sometimes by 2, 3, or even 4 trenchant spinuous keels. The anterolateral region of the snout, within the infraorbital ridge, together with the lower portion of the nasal fossa, is covered by small scales with a single (more rarely several) spinous ridge, the height of which may exceed the length of the scale. The series of scales on the postorbital and the posterior half of the supraorbital ridges are similar to those of the occipital ridges; between the postorbital and occipital ridges the scales are little modified, usually bearing several carinae; those bounding the ridges are reduced in size, while those forming the median series are somewhat enlarged. The scales on the opercles and on the upper half of the cheeks in general are similar to those of the body. The underside of the head, excluding only the lips and the gular and branchiostegal membranes, is wholly covered by small scales, each of which bears a high spiny keel.

In one paratype the outer ventral ray, reaching a little past the origin of the anal, is 0.53 of the length of the head (0.45 in type). Length of the pectoral fin, 2.0 to 2.4 in head.

The color becomes darker on the belly and opercles. The linings of the buccal, branchial, and peritoneal cavities are wholly dark brown, with the exception of an indistinct light margin along the free edge of the opercular and branchiostegal membranes.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5585	5658	5657	5658
Length to anus in mm	150	144	130	122
Length of head	66	68	69	69
Length of orbit	20.5	19	21.5	20.5
Postorbital length of head	23.5	23.5	25	24
Width of interorbital	15	....	17	15.5
Width of suborbital	9.5	8	....	10
Orbit to preopercle	26	25.5	28	27
Length of snout	25	27	24	27
Length of upper jaw	18	18	18	17
Depth of body	35	36	37	35
Width of body	27	23	26	26
Anus to ventral	31.5	30.5	28	26.5
Ventral to isthmus	22	23	22	20.5
Length of first dorsal base	14	13.5	14.5	12

(*platorhynchus*, in reference to the form of the snout.)

34. COELORHYNCHUS ACANTHOLEPIS, new species.

Coelorhynchus platorhynchus form *alpha* Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134, text fig. 9 (exclusive of the specimen from *Albatross* station 5111).

Coelorhynchus japonicus Weber, Die Fische der *Siboga*-Expedition, 1913, p. 163 (not *Macrurus japonicus* Temminck and Schlegel).

Type-specimen.—Cat. No. 78222, U.S.N.M.; 316 mm. long, 118 mm. to anus, from *Albatross* station 5587, off Borneo; figured by Radcliffe.[1]

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Length to anus.
			° *F.*	
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	113
5586	.....do	347	44	59
5586	.....do	347	44	[1] 32

[1] About.

In the following description comparison is made with *C. platorhynchus;* certain details alike in the two species are omitted. After the various measurements and counts of the type, two additional measurements or counts, if different, are given in parentheses: first, of the paratype 113 mm. long to anus; second, of the specimen 59 mm. long to anus; the smallest one, being in poor condition, is not included in the description.

Fin-rays—first dorsal, II, 9; pectorals, 17 (18, 18); ventrals, 7.

The form of the head as seen from above is well figured by Radcliffe (see fig. 17). The depth of the body, 1.8 (1.9, 2.4) in head, is slightly greater below the origin of the first dorsal fin than at any other vertical; greatest width of body, 2.4 (2.3, 2.75). Measurements of snout into head—preocular length, 2.6 (2.55, 2.4); preoral length, 3.05 (2.9, 2.85); width across base of snout, 2.6 (2.6, 2.5); width across snout, at end of ethmoid portion of infraorbital ridge, 0.8 (0.8, 0.85) in length of snout before that point. Least distance between divergent occipital ridges, 1.8 (1.6, 1.85) in interorbital. Length of orbit—into head, 3.4 (3.6, 3.4); into snout, 1.33 (1.35, 1.35); into postorbital, 1.15 (1.15, 1.05). Least interorbital width, 1.5 (1.6, 1.4); least suborbital width, 2.3 (2.25, 2.2). Length of upper jaw, 3.9 (3.9, 4.0); the upper jaw extends from below the anterior nostril to behind the pupil. Length of barbel, 4.8 in postorbital (in largest paratype).

Distance from center of anus to base of outer ventral ray, 2.65 (2.8, 2.7) into head; distance between ventral and isthmus, 3.05 (3.4, 3.4); distance from anus to isthmus, 1.5 (1.7, 1.6).

[1] Proc. U. S. Nat. Mus., vol. 43, p. 134, text fig. 9.

The scales are in 4½ rows between the origin of the second dorsal and the lateral line series; an additional series is inserted shortly behind that point (the first rays of the second dorsal are broken off in the type). The spinules on the body scales are set along 4 to 7 carinae[1]; these spinules are similar to those of *C. platorhynchus*, being strong, but somewhat weaker than in that species. The scales on the front half of the infraorbital ridge often have about three series of spinules directed upward and backward; there are 8 scales on each side of the ethmoid region of the infraorbital ridge, and 9 (8, 8) on the preorbital region, which is bounded above by a smaller but similar series subtending the front half of the orbit; the suborbital and preopercular portions of the ridge are covered by two series of similar scales; the distance between the end of the infraorbital ridge and the preopercular margin is contained 4.6 (4.6, 4.0)

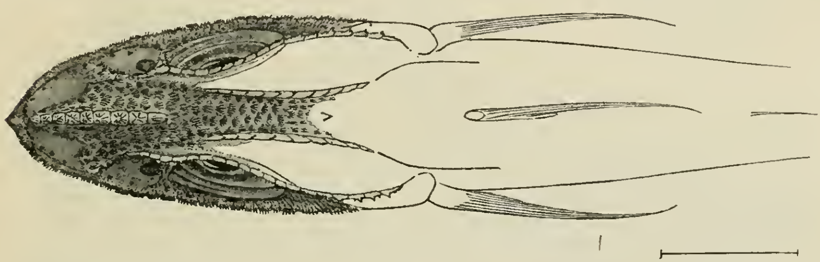

FIG. 17.—COELORHYNCHUS ACANTHOLEPIS. TYPE. AFTER RADCLIFFE ("COELORHYNCHUS PLATORHYNCHUS, FORM ALPHA").

times in the postorbital. The median rostral ridge is covered by 11 (10, 9) subquadrate scales with 5 to 7 carinae radiating from near the front margin of the scale. The scales of the occipital and postorbital series, like those of *C. platorhynchus*, bear but a single keel. The occipital scute has only a median spinous keel; it is preceded in the two larger specimens by a short naked area, but in the smaller paratype by two similar scutes, one on either side. The scales along the supraorbital ridge are armed by numerous close-set spinules. The other scales on top of head are arranged as in *C. platorhynchus*, but are armed with 1 to 7 (usually several) carinae. The scales in the region between the occipital and the infraorbital ridges are in general similar to those on the body, but rather smaller; a median series between the occipital and postorbital ridges is enlarged; the scales on the lower half of the cheeks, downward and backward from the eye, and those between the preopercular and infraorbital ridges, are reduced in size and are usually armed only by a single keel. The anterolateral region of the snout, the nasal

[1] In the two larger specimens; the scales are mostly lost in the smaller two.

fossa, the area between the orbit and the infraorbital ridge, and the underside of the head *are completely naked.*

Length of first dorsal base, 1.6 (1.6, 1.9) in postorbital length of head; length of interdorsal space (1.3, 1.6) in postorbital Length of fin-rays in head—second dorsal spine 2.0+[1] (1.7+[1]); pectoral fin, 2.1+[1] (2.0+[1]); length of outer ventral ray, 2.4 (1.75, 2.5); length of inner ventral rays, 3.1 (in largest paratype).

Coloration in alcohol.—Dark brown (as in *platorhynchus*), becoming blackish on the fins, belly, underside of head, and the opercle. The buccal, branchial, and visceral cavities are lined by dark brownish membranes; the light margin along the free edge of the branchiostegal membrane is indistinct. The color is lighter in the young, being grayish on the head.

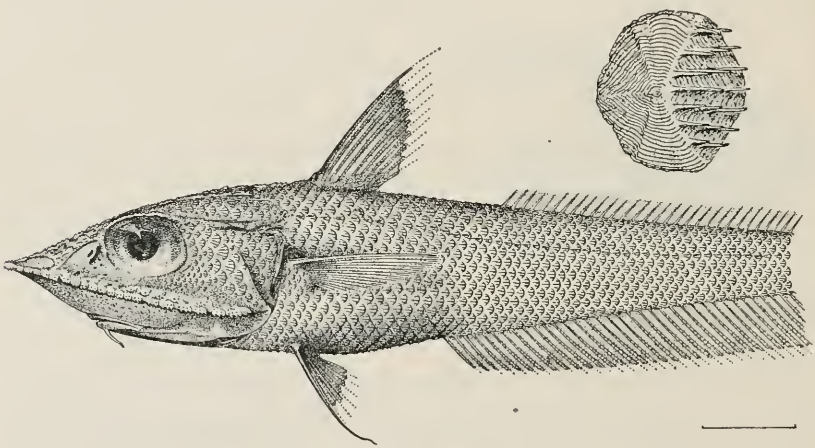

FIG. 18.—COELORHYNCHUS ACANTHOLEPIS. TYPE.

Measurements of type in hundredths of length to anus (113 mm.).—Length of head, 71; length of orbit, 21; postorbital length of head, 24.5; least interorbital width, 16.5; least suborbital width, 10.5; distance between orbit and preopercular margin, 26; preocular length of snout, 28; length of upper jaw, 19; greatest depth of body, 39; greatest width of body (across pectoral bases), 28; distance between center of anus and base of outer ventral ray, 26; distance between ventral and isthmus, 24.5; length of first dorsal base, 15; length of outer ventral ray, 30.

35. COELORHYNCHUS CARINIFER, new species.

Coelorhynchus platorhynchus form *alpha* RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134 (specimen from *Albatross* station 5111 only, the type of *C. carinifer*).

Type-specimen.—Cat. No. 78223, U.S.N.M.; 332 mm. long to end of broken pseudocaudal, 128 mm. long to anus; dredged at *Alba-*

[1] Indicating a broken tip.

tross station 5111 at a depth of 236 fathoms, in the China Sea off southern Luzon.

Fin-rays—first dorsal, II, 9; pectorals, 16; ventrals, 7.

The form and outline of the body are like those of *C. platorhynchus;* greatest depth, about 1.8 in head; greatest width, across pectoral bases, 2.6; the greatest width of head is about equal to the depth of head at the vertical through the hind margin of the orbit. Preocular length of snout, 2.65 in head; preoral length, 3.5, less than in *C. platorhynchus* or *C. acantholepis;* width of snout across base, 2.6; width of snout at end of ethmoid portion of infraorbital ridge, three-fourths the length of snout before that point. Length of orbit, 3.7 in head, 1.4 in snout, 1.33 in postorbital; the orbit is thus

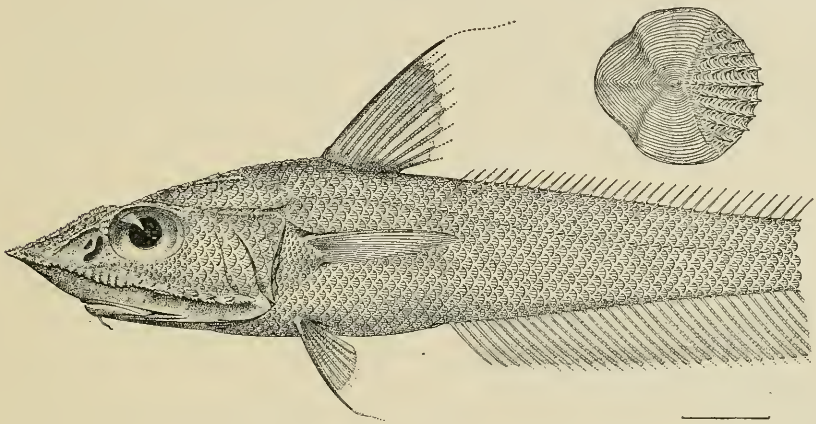

Fig. 19.—Coelorhynchus carinifer. Type.

somewhat smaller than in the two preceding species. The interorbital is markedly wider than in related species; its least width is equal to length of orbit, is contained 1.3 times in postorbital length of head, and contains the least distance between the divergent occipital ridges 2.2 times; least suborbital width, 2.4 in postorbital. The upper jaw is longer and placed farther forward than in *C. platorhynchus* and *C. acantholepis*, being contained 3.55 times in length of head, and extending from before nostrils to just behind the pupil; length of barbel, 4.3 in postorbital. A triangular flap, shorter than in *C. platorhynchus*, extends downward and backward from the lower angle of the subopercle.

Distance from center of anus to base of outer ventral ray, 2.3 in head; distance between ventral and isthmus, 2.8; distance between anus and isthmus, 1.3. A naked space extends forward a short distance from the anus, as in *C. platorhynchus.*

Scales large, in 5½ series between origin of second dorsal and lateral line (exclusive). The scales are not smaller than in *C. plator-*

hynchus and *C. acantholepis*, in which but 4½ series occupy the space between origin of second dorsal and lateral line, the different count being due to the course of the lateral line, which in those two species rises on the trunk to the next horizontal scale row above the one it occupies on the tail. The carinae, numbering 7 to 10 on each scale of the body, are low, divergent ridges, bearing comparatively very weak spinules. The dorsoterminal plate is not prominent and is armed by about 8 rows of spinules; there follows, on the ethmoid portion of the infraorbital ridge, 7 scales on one side, 6 on the other; then 9 (8) greatly strengthened scales with one or a few rows of spinules on the preorbital portion (in a single series); 6 (5) scales, still in a single series, cover the suborbital region of the ridge, and it is only upon the preopercular portion that the scales are in two series; the ridge ends in a sharp point located in front of preopercular margin a distance contained 4.7 (6.0 on right side) times in postorbital. The area between the orbit and the infraorbital ridge is scaled; the portion below the anterior half of orbit with small scales bearing only a few spinules; the portion below posterior half of orbit and extending backward to the preopercular ridge, with scales small but much better developed than in the preceding two species; each one bears 2 to 6 divergent spinous carinae. Nine subquadrate scales, with several carinae directed outward and backward, cover the superior rostral ridge; these scales are bounded by a single series of scales with numerous carinae, outward from which a narrow groove runs forward to the naked anterolateral region of snout, as in *C. acantholepis*. The scales on the occipital ridge are rather weaker than in *C. platorhynchus*, but are otherwise similar; most of them bear a single spinous keel; the postorbital and the posterior half of the supraorbital ridges are covered by scales quite similar to those on the occipital ridges. All of the spinules of the occipital scute but one are arranged along the median keel. The scales between the occipital ridges are armed by three to seven carinae, and are arranged in about five rows. The scales between occipital and postorbital ridges bear numerous carinae; these scales are enlarged in a median series; the scales on the exposed part of opercular bones and on the cheek behind the eye are similar to those on the body. The nasal fossa and the underside of the head are completely naked.

Length of first dorsal base, contained 1.2 times in the interdorsal space and 1.6 times in the postorbital length of head. The first dorsal spine is short, the second almost as long as the postrostral length of head (contained 1.7 times in head); length of pectoral, 1.9 in head; inner ventral rays, 3.6.

Color, brownish, much lighter than in *C. platorhynchus* and *C. acantholepis;* under side of head light brown (instead of blackish), the rami of mandibles, and the gular and branchiostegal membranes, whitish. The fins are all dusky. The buccal cavity is lined with bluish black, becoming decidedly lighter near mouth; branchial cavity lined with brownish black, except on a narrow but abrupt whitish margin along the opercular and branchiostegal membranes; the peritoneum is dusky-purplish, underlain by silvery.

The lighter color and firmer flesh of this species are characters correlated with the lesser depth probably inhabited by it (as compared with *C. platorhynchus* and *C. acantholepis*). Other distinguishing characters are given in the key to the species.

Measurements in hundredths of length to anus (128 mm.).—Length of head, 67.5; length of orbit, 18; postorbital length of head, 24.5; least interorbital width, 18; least suborbital width, 10.5; distance between orbit and preopercular margin, 27.5; preocular length of snout, 26; length of upper jaw, 19.5; distance from center of anus to base of outer ventral ray, 30.5; distance between ventral and isthmus, 24.5; length of first dorsal base, 15; length of interdorsal space, 17.5; length of second dorsal space, 38; length of pectoral fin, 34.

Only the type is known.

36. COELORHYNCHUS SMITHI, new species.

Coelorhynchus commutabilis Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 192, p. 128 (part).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5122	Off east coast of Mindoro	220	....	1
5123	.....do	283	....	3
5124	.....do	281	....	2
5198	Near western Bohol	220	53.9	1
5424	Near Cagayan Island, Sulu Sea	340	50.4	2
5503	Vicinity of northern Mindanao	226	53.3	1
5505	.....do	220	....	1
5535	Between Cebu and Siquijor	310	53.3	1
5536	Between Negros and Siquijor	279	53.5	3
5538	.....do	256	53.3	1
5590	Near Sibuko Bay, Borneo	310	44.3	1
5621	Between Gillolo and Makyan Islands	298	....	2

Type-specimen.—Cat. No. 78212, U.S.N.M.,—263 mm. in total length, 102 mm. to anus; dredged at *Albatross* station 5621 on November 28, 1909; 15′ N., 127° 24′ 35″ E.; 298 fathoms.

The specimens vary in length from 37 to 162 mm. to anus.

Fin-rays—first dorsal, II, 9 (8 to 10);[1] pectorals, 17–18 (15 to 19); ventrals, 7.

The greatest depth of body, contained 2.15 (1.8 to 2.3) times in length of the head to the angle of the opercular membrane, is located

[1] The counts and measurements in parentheses are of paratypes.

on the vertical passing through the origin of the first dorsal fin, from which point the contours of the body extend forward and backward in convex curves (more convex in some specimens than in the type, the larger specimens being decidedly more robust than the smaller ones). The ventral contour is gently curved. The greatest width of the body is contained 2.8 (2.4 to 2.9) times in the head; the greatest width of the head is equal to its depth through the hind margin of the orbits, except in very large specimens. The lateral outlines of the head are as figured for specimens of *C. commutabilis* with long snouts.[1] The dorsal contour of the snout is slightly concave. Measurements of snout in head: preocular length, 2.28 (2.05 to 2.4); preoral length, 2.45 (2.25 to 2.9); width of base, at verticals from front of orbits, 3.1 (2.95 to 3.35); width at end of ethmoid portion of infraorbital ridge, 1.25 (1.1 to 1.33) in length of snout anterior to that point. The figures of *C. commutabilis* given by Radcliffe show the course taken by each of the spinous ridges of the head for this species as well; the occipital ridges diverge both anteriorly and posteriorly; the least distance between them is contained 2.05 (1.6 to 1.9) times in the interorbital space. Length of orbit: 3.6 (3.4 to 3.9) in head; 1.6 (1.5 to 1.9) in snout; 1.05 (1.0 to 1.3) in postorbital. Least interorbital width, 1.25 (1.3 to 1.6) in postorbital; least suborbital width, 2.35 (2.33 to 2.6). The upper jaw extends from below the posterior nostril to the vertical passing through the eye behind the pupils (to below the posterior orbital margin in the largest specimen); the length of the upper jaw is contained 4.05 (3.3 to 4.7) times in the head, being decidedly greatest in the largest specimens. Length of barbel, 3.6 (3.6 to 5.6) in postorbital. Six branchiostegals; gill-membranes with a narrow free fold. The lower angle of the subopercle is produced downward and backward into a pointed flap, lying just above the angle of the preopercle.

The distance between the center of the anus and the base of the outer ventral ray is contained 4.0 (3.6 to 5.8) times in the head, 3.0 times in the very large specimens; the distance is only a little shorter than the orbit in the type, but varies from decidedly shorter to about one-third longer than the orbit, being longest in the largest specimens. The distance between the ventral fin and the isthmus is contained 3.75 (2.7 to 4.0) times in the head; the distance from the anus to the isthmus, 2.05 (1.5 to 2.35) times. An oval or linear naked ventral fossa extends forward from the anus for a distance only as long as the peritroct. In the body wall between this fossa and the peritoneum there lies a gland-like body,[2] truncate anteriorly, black on its ventral surface and anterior edge, but silvery dorsally.

[1] Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, text figure 2 (p. 129); reprinted in this report as text figure 27.

[2] Dissected out in a paratype.

Pyloric caeca 21 in two paratypes of medium size, 19 in the largest specimen.

The scales are relatively large, being in 4½ (to 5) rows from the origin of the second dorsal fin to, but excluding, the lateral line series, in 5½ series between the second dorsal and the end of the anterior curve of the lateral line, which is located behind the opercular angle a distance two-thirds as long as the head; behind this point the number of scale rows dorsal to the lateral line again decreases. The scales of the body are armed with from 4 to 6 (3 to 7) strongly spinous carinae, the median one of which is strongest, being armed by about 4 spinules (6 in the largest specimen).

Examined under the microscope, the structure of the scale is seen to be similar to that of other species in the genus. The small focus

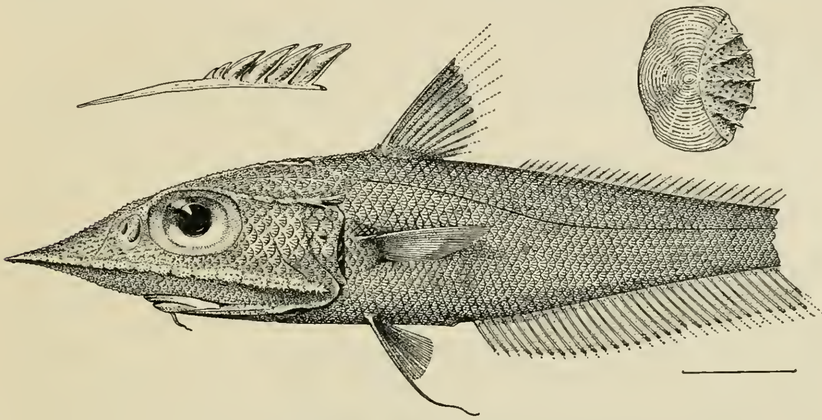

FIG. 20.—COELORHYNCHUS SMITHI. TYPE. UPPER LEFT HAND FIGURE REPRESENTS A LONGITUDINAL SECTION OF SCALE, TO SHOW STRUCTURE OF SPINULES.

is surronded by fine, close-set circuli, which soon give place to coarser circuli, which are evenly spaced to the margin of the scale on all fields; they are parallel with the scale margin on the lateral fields, but may terminate on the basal margin at an obtuse angle, in which case the basal field is divided by a line along which the circuli of each side meet at an acute angle; the circuli on the apical field are perpendicular to lines drawn midway between the carinae. The structure of the spinules is indicated in the figures above. Their anterior and lateral edges appear as ridges, while the surfaces between these ridges are concave. In certain rather definite areas on the tail of a large specimen there occur scales which differ in certain features from normal ones; they are notably thinner, bearing rows of spinules which are more numerous and subparallel instead of divergent; their striae (circuli) are absent except near their margins. These scales are evidently abnormal and in all probability have been regenerated on an area where the scales had previously been lost by injury. In a former paper the authors described[1] in detail the occurrence, in *Coryphaenoides* (*Nematonurus*) *pectoralis*, of areas of scales bearing an increased number of parallel rows of spinules. On reexamination we find that these scales, too, are thinner than the normal ones and that they lack striae, except near their margins; it is evident, then, that these scales also are regenerated; this explanation accounts for the peculiarly inconstant location of the groups of such scales.

The terminal rostral plate ends in a long, sharply acuminate, spine-like tip, behind which the plate is covered by several long, straight rows of small spinules; the following scales of the infraorbital ridge are closely set with rather strong spinules; these scales are in two series behind middle of eye—that is, on the suborbital and preopercular portions of the ridge; the infraorbital ridge ends sharply a short distance before the preopercular margin, the interspace enterring about 8 (7 to 9) times into the length of the postorbital region of head. The scales below the orbit, in an area extending forward to the nasal fossa and backward to the preopercular ridge, although small, are armed by several series of spinules directed downward and backward. The 8 (to 11) subquadrate scales covering the median superior rostral ridge bear numerous series of spinules radiating from near the center of each; similar scales cover the supranarial and the anterior half of the supraorbital ridges; the posterior half of the supraorbital ridge and the occipital and postorbital ridges are prominent, bearing elongate scales strongly armed by a single (or a few) series of strong spinules directed backward. The scales on the top of the head and on its posterior sides are little reduced in size, bearing several series of high, trenchant spinules; about five series occupy the space between the occipital ridges; a median enlarged series lies between the occipital and postorbital ridges, in advance of the lateral line. The median occipital scute bears 3 (to 5 in large specimens) spinous carinae; it is usually preceded on each side by a similar scute; a scute with a strong median keel is located just above the origin of the lateral line. The scales on the anterolateral region of the snout are small, bear a few trenchant carinae, and are separated by a narrow groove from the series of scales bounding the median rostral series. The lower half of the nasal fossa is scaled. The under side of the head, including the rami of the mandibles, is covered with very small scales, most of which bear a few spinous carinae directed backward.

Length of first dorsal base, 1.7 (to 1.4) in interdorsal space and 1.9 (1.8 to 2.25) in postorbital length of head. Length of fin-rays

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 161–162.

in head—second dorsal spine, 2.6 (2.63 to 2.7); pectoral fin, 2.75 (2.45 to 2.95), not notably shorter in large specimens; outer ventral ray, 2.65 (2.4 to 3.35), varying without apparent relation to the length of the fish; second ventral ray, 5.25 (4.4 to 5.3).

Color, brown, usually darker than in *C. commutabilis;* it is darker above than below; the belly is sometimes dark; opercle with a dark blotch. The young have darker bars on the tail, the first being located below the front of second dorsal, the second being separated from the first by an interspace about as long as the orbit; these markings are very faint in larger specimens. The fins are all dark. The lining of the buccal cavity is bluish black; that of the branchial cavity, brownish black, with an abrupt whitish margin on the opercular and branchiostegal membranes; the parietal peritoneum is dark purplish.

C. smithi is closely related to *C. flabellispinis* (Alcock),[1] known from a specimen dredged by the *Investigator* at a depth of 719 fathoms in the Arabian Sea. Certain differences, however, make the separation of the two imperative, as may be seen from the following table:

	C. flabellispinis.	*C. smithi.*
Spinous carinae on scales	8 or 9	3 to 7.
Pyloric caeca	About 40	19, 20.
Pectorals	Decidedly shorter than postorbital.	Longer than postorbital.
Color of body	Stone-gray	Brown.
Color of peritoneum	Silvery-gray	Purplish-black.
Spines on scales	Judging from figure, much weaker; occasionally the last spine of one rib or more projects beyond the edge of the scale.	Stronger; last spine or carinae usually projects beyond margin of scale.
Barbel	Not much more than half eye	About one-third orbit or less.
Orbit	1.8 in postorbital (measured on Alcock's figure).	1.0 to 1.3 in postorbital.
Double scale row of infraorbital ridge beginning	Behind front of orbit (figure)	Behind middle of orbit.

We are far less certain as to Brauer's[2] *Macrurus* (*Coelorhynchus*) *flabellispinis.* Most of his measurements and counts agree with those of *C. smithi*, and it is not unlikely that his specimens from the west coast of Sumatra are referable to that species. But Brauer has failed, as in other cases, to designate the locality from which his described and measured specimens came. He had other specimens from southern and northeastern Africa.

The relationships of *C. smithi* with *C. commutabilis* are less intimate. *C. smithi* has constantly larger scales; several carinae instead of a median keel on the scales of occipital ridges; browner and

[1] Alcock, Journ. Asiatic Soc. Bengal, vol. 63, pt. 2, 1894, pp. 123, 126; Illustrations of the Zoology of the *Investigator,* pl. 16, figs. 2 and 2*a*; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 107.

[2] Brauer, Die Tiefsee-Fische. 1906, p. 258.

darker color; more strongly curved body contours; a lesser distance between the anus and the base of ventral fin (except in largest specimens), etc.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
Albatross station	5621	5424	5424	5123	5621	5536
Total length in mm	263	....	....	290+	[2] 201	84+
Length to anus in mm	102	[1] 162	151	126	83	37
Length of head	80	72.5	73	77	81	83
Length of orbit	22.5	18.5	19	20	21.5	22
Postorbital length of head	23	24.5	23.5	23.7	21.7	24
Width of interorbital	19	15.5	14.3	16	17.5	18
Width of suborbital	9.5	9.5	9	9.3	9.5	....
Orbit to preopercle	25.5	27	25	26	26	....
Length of snout	36	[1] 30	31.5	33	39	38
Length of upper jaw	19.5	21.7	19.7	20.5	20	18
Depth of body	38	43	ca. 40	39	37	....
Width of body	28	29	28	28	30	....
Anus to ventral	19	24	25	21.5	19	15
Ventral to isthmus	23.5	28	25	24	21	....
Height of second dorsal spine	31	....	....	....	30	....
Length of first dorsal base	12.5	....	11.5	11.5	13	....
Length of interdorsal space	20.5	....	....	18	18	....
Length of pectoral	28.5	27.5	25	26	27	26
Length of outer ventral ray	30.5	22	24	20	30.5	....
Length of second ventral ray	16	16	14	....	15	....

[1] Approximate, owing to broken tip of snout. [2] To end of large pseudocaudal.

(*smithi*, named in honor of Dr. Hugh M. Smith, United States Commissioner of Fisheries.)

37. COELORHYNCHUS RADCLIFFEI, new species.

Coelorhynchus commutabilis form *beta* Smith and Radcliffe (the type of form *beta* is chosen as the type of *radcliffei*), Proc. U. S. Nat. Mus., vol. 43, 1912, p. 131, text fig. 4.

Coelorhynchus commutabilis form *gamma* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 131, text fig. 5.

List of stations.

Albatross station.	"Form."	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
				°F.	
5122	*beta*	Off eastern Mindoro	220	....	1
5221	*beta*	Between Marinduque and Luzon	193	52.4	1
5260	....	Off southeastern Mindoro	234	51.4	1
5374	....	Near Marinduque Island	190	....	2
5502 [1]	*gamma*	Off northern Mindanao	214	....	[1] 2
5503 [2]	*beta*	....do	226	53.3	[2] Type.
5505	*gamma*	....do	220	....	1
5535	*beta*	Between Cebu and Siquijor	310	53.3	1
5536	*beta* *gamma*	Between Negros and Siquijor	279	53.5	2
5537	....	Between Negros and Siquijor	254	53.5	1
5624	....	Between Gillolo and Makyan Islands	288	....	1
5626	*beta*	Between Gillolo and Kayoa Islands	265	....	1

[1] One of these specimens is the type of form *gamma*. [2] This specimen also the type of form *beta*.

Type-specimen.—Cat. No. 78224, U.S.N.M., 268 mm. in total length; 101 mm. to anus; from *Albatross* station 5503.

The form called *gamma* was apparently distinguished from *beta* by its shorter, blunter snout. In the three specimens of *gamma* other than the type this difference is to be accounted for chiefly by the fact that the terminal spine has been broken off. We are not sure that the tip of the snout is broken in the type of *gamma*, which is the largest specimen known; it may be that the snout becomes blunter in very old individuals, or perhaps the spine in that specimen had been broken off and had since healed over. The measurements are taken on this specimen with the assumption that the tip has not been broken off, and when different from others are given separately.

The following description is based upon all of the specimens which vary in length to anus from 46.5 to 134.5 mm.; those characters which vary with age are so noted.

Fin-rays—first dorsal, II, 8 (rarely 7, sometimes 9); pectorals, 17 (15 to 18); ventrals, 7.

This species resembles *C. smithi* in its arched contours; the snout is slightly concave along its dorsal margin; the base of the first dorsal fin is oblique; the greatest depth of the body lies below the origin of the first dorsal fin, and is contained 2.0 (1.9 to 2.3; 2.6 in young) times in the length of head; the greatest width across the pectoral bases, 2.7 times (2.5 to 2.7; much narrower in young, 4.0).

The snout is much longer in the young than in very large specimens, as indicated in the figures and in the following:

Table showing variation of length of snout[1] with size.

	Paratypes.					Type.	Paratypes.				
Length to anus in mm. (approximate in some).	46.5	89	92	95	98	101	102	104	104	123	134.5
Preocular length	2.1	2.25	2.35	2.5	2.6	2.4	2.5	2.4	2.5	2.7	2.75
Preoral length	2.35	2.6	3.0	3.1	3.3	3.1	3.35	3.1	......	3.5	4.1
Width at base	3.2	2.95	3.1	3.1	3.2	3.25	2.85	3.15	......	3.2	3.05
Width at anterolateral angles in length anterior thereto	1.3	1.2	1.2	1.2	1.0	1.2	1.0	1.2	1.05	1.0	0.85

[1] Parts measured into head, except width at anterolateral angles.

The form of the snout as seen from above is indicated by text figures 23 and 24. The same figures also show the courses of the strong spinous ridges of the head; the least distance between the occipital ridges, which diverge a little in both directions, is contained 1.95 times (to 2.1, 1.8 times in specimen 46.5 mm. long to anus) in the postorbital length of the head. The subopercular flap is rather obtusely pointed; its lower margin is nearly horizontal. The orbit is large, as in *C. smithi* and other species, being contained 3.7 (3.4 to 3.75) times in the length of head, 1.4 (1.2 to 1.7) times in the snout, 1.2 (1.05 to 1.25) times in the postorbital. Least interorbital width, 1.45 (1.35 to 1.55) in postorbital; least suborbital width, 2.65 (2.5 to

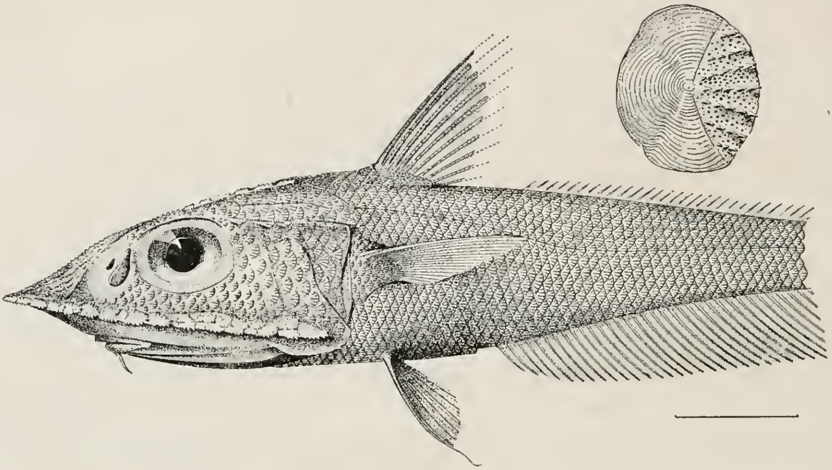

FIG. 21.—COELORHYNCHUS RADCLIFFEI. PARATYPE. ADULT.

2.85). The size of the mouth is proportionately much greater in large specimens; the upper jaw extends backward from below (or in front of) the anterior nostril to below the hind margin of the pupil in the smallest specimens, but to below the hind margin of the orbit in the largest; its length is contained in the head from 4.4 times in

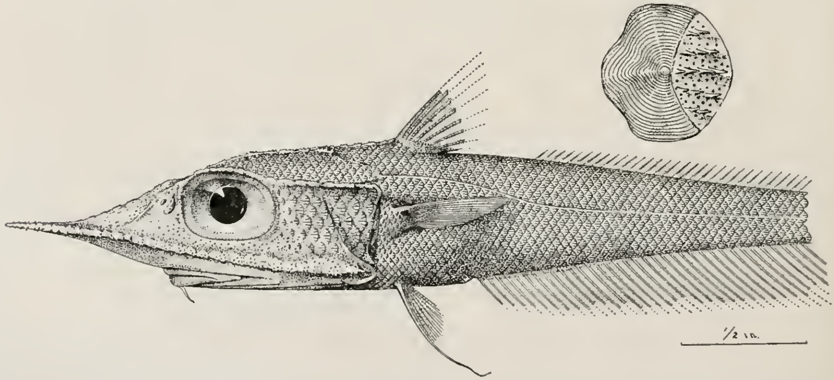

FIG. 22.—COELORHYNCHUS RADCLIFFEI. PARATYPE. YOUNG.

the smallest, to 3.3 times in the largest, specimens; 3.8 times in the type, from 3.55 to 3.8 times in specimens from 90 to 110 mm. long to anus. Length of barbel, 3.4 (to 4.7) in postorbital. The teeth are villiform on the jaws. Six branchiostegals; gill-membranes with a very narrow free fold.

The anus is located immediately before the origin of the anal fin; its distance from the base of the outer ventral ray is less than the distance between the ventral fin and the isthmus, and is equal to, or less than, the length of the orbit, being contained 3.7 (3.4 to 4.65) times in the length of the head; distance between ventral fin and isthmus, 3.1 (2.7 to 4.0); distance between anus and isthmus, 1.85

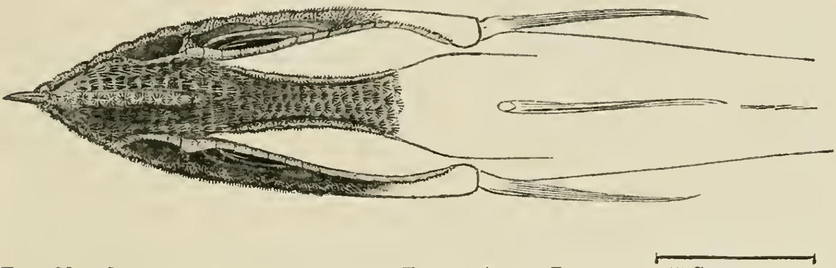

Fig. 23.—Coelorhynchus radcliffei. Type. After Radcliffe ("Coelorhynchus commutabilis, form beta").

(1.65 to 2.4). As in the foregoing species of the subgenus *Oxymacrurus*, the anus is preceded by a short naked area, which lies just below the gland-like organ in the body wall.

Pyloric caeca, 39 (in one paratype), shorter than the orbit.

Scales large, in but 4½ (or 4) rows from the origin of the second dorsal fin to but excluding the lateral line series. The numerous carinae, bearing many comparatively weak spinules, are highly diagnostic of the species. There are from 6 to 11 carinae on the scales

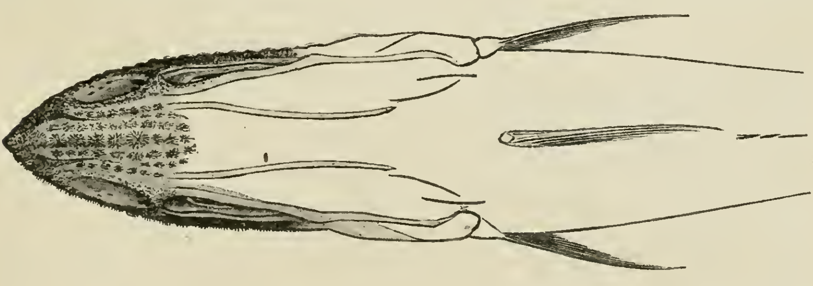

Fig. 24.—Coelorhynchus radcliffei. Paratype. After Radcliffe ("Coelorhynchus commutabilis, from gamma").

of specimens more than 95 mm. long to anus, and from 5 to 8 in smaller specimens. The short and slender spinules lack the prominent ridges and concave surfaces as described for *C. smithi;* the spinules, furthermore, are more numerous than in that species, there being about 8 on each carina, as many as 6 in the specimen only 46.5 mm. long to the anus (7 is the largest number of spinules in any series in the *adult* of *C. smithi*). The terminal rostral plates are each armed by about four long rows of spinules, which become obsolete distally; the bases of the plates are bounded on each side by one or two scales. The infraorbital ridge is covered by two series of scales behind the middle of orbit. The ridges of the head are covered by rather strong scales, mostly close-set with spinules; the occipital and postorbital ridges, together with the posterior half of the supraorbital ridge, are covered by strong scales bearing a few spinous keels directed backward; the scales on the median rostral ridge are oval or subquadrate in outline, and are armed by several series of spinules radiating in all directions from near the *center* of each scale. The occipital scute is provided with a strong median keel, and with two (one to several) carinae on each side; the median scute is preceded on each side by a weaker one; a similar scute is located just above the origin of the lateral line. The three to five rows of scales covering the region between the occipital ridges are armed by several high, divergent, serrated ridges. The supranarial and medial rostral ridge scales are each bounded by scales in single series, separated from each other by a narrow groove; this groove widens forward and merges into a rather wide anterolateral groove, which, though parallel with the infraorbital ridge, is separated from it by a series of prickly scales; this naked area in the young occupies most of the anterolateral region of the snout, but in the largest specimens is reduced to a narrow groove. Below the orbit and in areas extending backward thence to the preopercular ridge, and forward to the nasal fossa, the scales are reduced in size and spination; the scales between the occipital and infraorbital ridges are otherwise similar to those of the body; the median of the three main series of scales between the occipital and postorbital ridges is slightly enlarged. The nasal fossa and the underside of the head are completely naked in all specimens.

Base of first dorsal, 1.9 (1.3 to 2.2) in interdorsal space, about half postorbital length of the head; the second dorsal fin is weak anteriorly. The outer ventral ray is filamentous; it enters 2.85 (2.4 to 3.2) times into the head; the second ventral ray extends to the anus. The anal fin is inserted a little in advance of the second dorsal.

Color in alcohol, light brown, with silvery reflections on the lower sides; the head is lighter in general, but dusky on the opercles. Other specimens are very pale brownish on the trunk and tail and whitish on the head. The second dorsal fin is light; the filament of the outer ventral ray is whitish; the other fins are dusky, quite light in the more faintly colored specimens. The lining of the buccal cavity is dark, becoming lighter toward the gape in some specimens; that of the branchial cavity is blackish, with an abrupt whitish margin along the opercular and branchiostegal membranes; the parietal peritoneum is purplish or brownish black.

C. radcliffei is apparently related, on the one hand, to *C. smithi* and *flabellispinis*, and, on the other hand, to *productus*, *anatirostris*, and *weberi*. In addition to the characters given in the key, *radcliffei* differs from *productus* and *weberi* in the naked nasal fossa. Its relationships with *commutabilis* are more remote.

Table of measurements in hundredths of length to anus.

Albatross station	5502	[1] 5505	[2] 5503	5536	[4] 5537
Total length in mm	347	[3] 253	268	....	137
Length to anus in mm	134.5	[3] 102	101	95	46.5
Length of head	72	[2] 76	77.5	76.5	81
Length of orbit	22	22.3	22	22	22
Postorbital length of head	26.5	26	25.5	25	22.5
Width of interorbital	17.5	17	17	16.5	16
Width of suborbital	9.7	10.5	9	10	9
Orbit to preopercle	30.5	[3] 29	27	27	26
Length of snout	27	31	32	31	39
Length of upper jaw	23	22	21	20	18
Depth of body	38	40	39	34	32
Width of body	30	29	29	30	22
Anus to ventral	22	20.5	20	20	16
Ventral to isthmus	27	27.5	26	25.5	....
Height of second dorsal spine	....	33	33	34	....
Length of first dorsal base	14	14	13	12	11
Length of interdorsal space	....	18	25	22	16
Length of pectoral	28.5	34.6	30.5	30	....
Length of outer ventral ray	24.5	30	27	27.5	34
Length of second ventral ray	17	20.5	18.5	19	....

[1] See fig.
[2] Type.
[3] Two mm. added as an estimate of the length of spine broken from tip of snout.
[4] See fig.

(*radcliffei*, named for Mr. Lewis Radcliffe, scientific assistant, United States Bureau of Fisheries, in recognition of his work on Philippine Macrouroids).

38. COELORHYNCHUS WEBERI, new species

Coelorhynchus commutabilis form *eta* Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text figure 7 (including only the type-specimen, which is figured; the two other specimens are typical of *C. commutabilis*, the scales having been lost from underside of head).

Type-specimen.—Cat. No. 78225 U.S.N.M.; from *Albatross* station 5325, off northern Luzon, at a depth of 224 fathoms and a bottom temperature of 53.2° F.; length, 315 mm. to end of pseudocaudal of 8 rays, 127 mm. to anus.

Fin-rays—first dorsal, II, 8; pectorals, 18, ventrals, 7.

The contours of the body are long, even curves; the base of the first dorsal is scarcely oblique. The greatest depth of the head is equal to its width; the greatest depth of the body is contained about 2.3 times in the length of the head to the opercular angle; the greatest width, scarcely less, is contained 2.4 times in head; the tail is less strongly compressed than usual, its width being contained just twice in its depth at a point twice the head length behind tip of snout. The form of the head is well shown in figure 25, except that the posterior sides of the head are drawn as somewhat distended. The snout is very broad, and by maintaining its width forward more strikingly than usually, renders the sides of the snout much more convex distally than in other species with a similarly long snout; its preocular length is contained 2.25 times in head; its preoral length, 2.6 times; its width at base, 2.75 times in head, 1.2 times in preocular length; the width of snout at the end of the ethmoid region of the infraorbital ridge is equal to the length of snout anterior to that point. The ridges of the head are prominent; the occipital ridges are but little divergent forward and backward; the least distance between them is contained 1.2 times in the distance between either their anterior or posterior ends, and is just half the least interorbital width. The preopercular margin is denticulate; the subopercle is produced backward into a sharply pointed flap. The orbit is smaller than usual in this group, its length being contained 4.25 times in head, 1.9 times in snout, 1.35 times in postorbital. Least interorbital width,

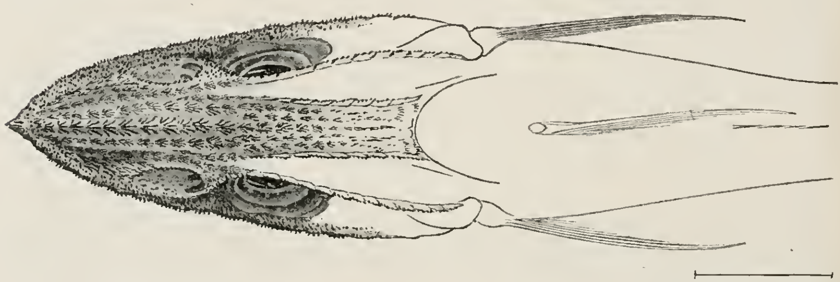

FIG. 25.—COELORHYNCHUS WEBERI. TYPE. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM ETA").

1.45 in postorbital; least suborbital width, 2.35. The upper jaw extends from below the middle of anterior nostril backward to below the hind margin of orbit; its length is contained 4.05 times in the head; barbel, 4.2 in postorbital. Teeth villiform, in bands on jaws. Six branchiostegals; gill-membranes with a narrow free fold across isthmus.

Distance from anus to base of outer ventral ray, two-fifths longer than orbit, contained 3.0 times in length of head; distance between ventral and isthmus, nearly one-third longer than orbit, contained 3.35 times in length of head; distance between anus and isthmus, 1.62 in head.

Scales large: in $4\frac{1}{2}$ series between the lateral line and the origin of the second dorsal (excluding the lateral line series), in $5\frac{1}{2}$ series a short distance behind that point; the number then decreases posteriorly. Each scale of the body is well armed by from 5 to 7 strongly spinous carinae. The spinules are long and strong, but not grooved and widened basally as in *C. smithi* (fig. 20); their number is 5 to 7 on the median carina, which is slightly stronger than the lateral ones; the spinules increase in strength and height posteriorly and are imbricate upon one another; the last one scarcely projects beyond the margin of the scale. The terminal rostral plates do not project strongly; they are rather bluntly pointed, and the series of spinules (6 dorsal, 4 ventral), by which they are armed, are extended forward to their tips; the length of the dorsoterminal plate is contained 4.6 times in the postorbital length of head; the plates are bounded on each side by an elongate scale, the first of the eight covering the ethmoid region of the infraorbital ridge on each side; these scales of the ethmoid region increase in size posteriorly, and bear 6 or fewer strong carinae directed upward and backward; 9 scales, similarly armed, follow on the preorbital portion of the ridge, which then becomes covered by a double series of scales on the

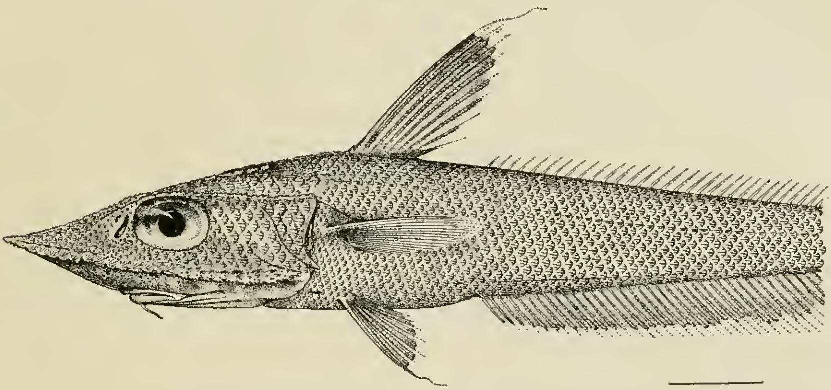

Fig. 26.—Coelorhynchus weberi. Type.

suborbital and preopercular portions, behind the vertical from the middle of eye.

The median superior rostral ridge is covered by 10 shield-shaped scales bearing at most 8 spinous ridges diverging backward and outward from the front of each; this median series is bounded on each side by a single row of well-armed scales; a series of smaller scales bounds the supranarial ridge scales, but the entire remaining anterolateral region of the snout is completely covered by small, crowded scales, like those covering the lower half of the nasal fossa and the region below the orbit extending backward to the preopercular ridge. The anterior half of the area between the occipital ridges is covered by five series of scales which decrease in size posteriorly and converge toward the median occipital scute, which, like the smaller scute preceding it on each side, is armed by a strong median keel. The supranarial and antorbital ridges, and the anterior half of the supraorbital ridge, are covered by scales bearing several divergent spinous crests; the occipital, posterior half of supraorbital, and postorbital ridges, bear scales armed wholly or for the most part by a single strong spinous keel; a similar scale forms a detached scute at the origin of the lateral line. The scales on the opercles and on the upper half of the cheeks are similar to those on the body; the median series between the occipital and postorbital ridges is much enlarged. The under side of the head is completely naked, with the exception of a few scales below the preopercular angle, as described also for *C. anatirostris*, and as now noted by us in paratypes of *C. productus;* this detail of similarity confirms the other characters which indicate the close relationship between the three species.

The first dorsal fin is high, the second spine being almost as long as the postrostral length of head; the first soft rays are a little shorter; the base of the first dorsal is contained 1.4 times in the interdorsal space, 1.8 times in the postorbital length of head; the first rays of the second dorsal are shorter than the pupil. The pectoral fin is decidedly longer than the postorbital length of head, and is contained 2.2 times in the head (tips of rays broken off). The outer ventral ray is filamentous, being about as long as the pectoral, and extending about to the anal fin; the second ventral ray does not reach to the anus, and is contained 4.0 times in the head.

Color brownish in alcohol, becoming lighter ventrally. Fins dusky, excepting the filament of the first ventral ray. Mouth dusky within, becoming lighter toward the lips. The buccal cavity is lined with brownish black except along the whitish margin of the opercular and branchiostegal membranes; the parietal peritoneum is brownish black.

C. weberi is closely related to two Japanese species,[1] *C. anatirostris* and *C. productus*, but is distinguished by the much smaller orbit, and by the longer, broader snout; by the armature of the scales, there being more carinae than in *C. productus*, but fewer than in *C. anatirostris*, and by a few other details.

Table of measurements in hundredths of length to anus (127 mm.).—Length of head, 70; length of orbit, 17; postorbital length of head, 22.5; least width of interorbital, 15; least suborbital width, 9.5; distance from orbit to preopercular margin, 24.5; length of snout, 31; width of snout, 25.5; length of the upper jaw, 17; length of barbel, 5.5; greatest depth of body, 30; greatest width, across bases of pectorals, 28; distance from center of anus to base of outer ventral ray, 23.5; distance between ventral fin and isthmus, 21.5; height of second dorsal base, 12.5; interdorsal length, 17.5; length of second ventral ray, 17.5.

(*weberi*, named for Dr. Max Weber, in recognition of his work on the fishes of this and other families in the East Indian region.)

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[1] See Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 175.

39. COELORHYNCHUS COMMUTABILIS Smith and Radcliffe.

Coelorhynchus commutabilis typical form SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 128, text fig. 2 (part).

Coelorhynchus commutabilis form *alpha* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 13, 1912, p. 130, text fig. 3.

Coelorhynchus commutabilis form *delta* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text fig. 6.

Coelorhynchus commutabilis form *eta* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text fig. 7 (two specimens, exclusive of type).

After having described *C. commutabilis*, Radcliffe proceeded to define certain "forms," differing from the typical specimens in the presence or absence of scales on the underside of the head, and in the form and proportions of the snout and orbit. The discovery of certain diagnostic characters, such as those we emphasize in the analytical key to the species, has led us to a different grouping of these variants. In order to indicate the relation between these "forms" of Smith and Radcliffe and the species, as we define them, the following comparative table has been prepared:

Identification by Smith and Radcliffe.	Present reference.
Coelorhynchus commutabilis:	
Typical form	*C. commutabilis.* *C. smithi.*
Form *alpha*	*C. commutabilis.*
Form *beta*	*C. radcliffei.*
Form *gamma*	*C. radcliffei.*
Form *delta*	*C. commutabilis.*
Form *eta*	*C. weberi.* *C. commutabilis.*

The statement that mutation has been demonstrated in this case[1] therefore appears to lose its significance.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.	Identification by Smith and Radcliffe.
			°F.		
5172	Vicinity of Jolo Island	318	....	1	Type, *delta*.
5348	Palawan Passage	375	56.4	1	Type, *commutabilis*.
5444	Off eastern Luzon	308	45.3	1	Form *eta*.
5445	.....do	383	44.3	1	Do.
5589	Near Sibuko Bay, Borneo	260	45.7	1	Type, *alpha*.
5589	.....do	260	45.7	4	Form *alpha*.
5590	.....do	310	44.3	1	Do.
5590	.....do	310	44.3	2	*Commutabilis*.

This species, as we recognize it, is now redescribed in some detail. The description is based upon the type-specimen, 129 mm. long to anus, and is supplemented and verified in all points by an examination of each of the other 11 specimens.

[1] See Radcliffe, p. 130.

The dorsal and ventral contours are long, even curves; the base of the first dorsal is scarcely oblique; the dorsal contour of the snout is but little (or scarcely) concave. Greatest depth of body, 2.2 (1.8 to 2.3) in length of head to end of membrane at angle of opercle; the greatest width of the body or head is about equal to the depth below the origin of the lateral line, and about equal to the depth of the head at the vertical passing through the hind margin of the orbit. The form of the head and trunk is shown in figure 27, in which the width of the body is abnormally contracted, owing to the imperfect preservation of the type-specimen. The length of the snout is unusually variable in this species, so variable that Smith and Radcliffe separated out the short-snouted specimens as a distinct "form," *alpha* (figure 29). That two distinct groups are not represented may readily be seen by an examination of the following table:

Table of measurements of snout in C. commutabilis.

Form	*Eta.*	*Typical.*		*Delta.*	*Alpha.*				
Station	5445[1]	5348[1]	5590	5590	5172[1]	5590	5589[1]	5589	5589	5589
Text figure	......	27	......	......	28	......	29	......	......	......
Preocular length[2]	2.33	2.35	2.4	2.55	2.5	2.6	2.65	2.62	2.7	2.67
Preoral length[2]	2.6	2.75	2.75	3.2	2.9	3.0	3.1	3.1	3.0	3.1
Width at base[2]	3.15	3.25	3.1	3.1	2.75	2.95	2.95	2.8	3.0	2.9
Width at anterolateral angles[3]	1.1	1.2	1.15	1.0	0.9	0.95	0.85	.09	.09	1.0
Orbit in snout	1.6	1.6	1.65	1.6	1.4	1.35	1.35	1.35	1.26	1.3

[1] Type-specimen.
[2] Measured into length of head.
[3] Measured at end of ethmoid portion of infraorbital ridge, into length anterior to that point.

The ridges of the head are covered by a single series of strong scales, excepting the infraorbital ridge behind the middle of the eye, where the scales are in two series. The occipital ridges diverge a little toward both ends; the least distance between them is contained 2.2 (1.8 to 2.2) times in the interorbital width. The rounded margin of the preopercle is scarcely denticulate; the lower ventral angle of the subopercle is produced backward into a slender flap. The orbit is large, as usual in this group of species, but widely variable in size, being contained 3.9 (3.33 to 3.95) times in entire length of head and 1.25 (1.15 to 1.3) times in postorbital length of head. The variation in the size of the orbit is not correlated with the size of the specimens; the extremes are joined together by intermediate sizes. Least interorbital width, 1.38 (1.33 to 1.6) in postorbital length of head; least suborbital width, 2.9 (2.2 to 2.8). The upper jaw extends backward from below the anterior nostril (or immediately behind that vertical) almost (or quite) to below the hind margin of the orbit; the length of the upper jaw is contained 3.75 (3.35 to 4.0) times in the head; barbel, 3.6 (3.5 to 6.0) in postorbital. Six branchiostegals; gill-membranes with a free fold across the isthmus.

Distance between center of anus and base of outer ventral ray decidedly longer than orbit, a little longer than postorbital, and contained 3.0 (2.4 to 3.0) times in length of head; distance between ventral and isthmus, also longer than the orbit, contained 3.25 (2.8 to 3.4) times in head; distance between anus and isthmus, 1.6 (1.5 to 1.65). A narrow, naked fossa, which extends forward a short distance from the peritroct, covers an elongate glandular organ.

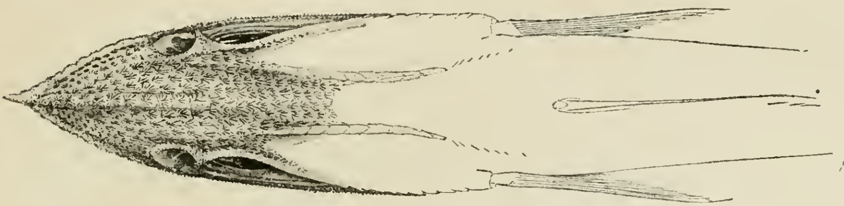

FIG. 27.—COELORHYNCHUS COMMUTABILIS. TYPE. AFTER RADCLIFFE.

Scales rather small, in 5½ rows from the front of the second dorsal fin to but excluding the lateral line series; in 6 or 6½ rows just behind the long anterior curve of the lateral line. The scales of the body bear usually 5, but varying from 3 to 7, carinae, which are armed by a series of spinules overlapping the margin of the scale; the median series is often enlarged. The spinules increase in size posteriorly on each carina, and are rather broad at their base, approaching in their structure those described and figured for *C.*

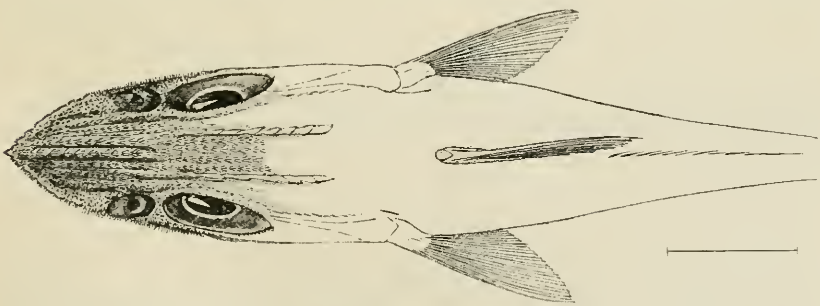

FIG. 28.—COELORHYNCHUS COMMUTABILIS. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM DELTA").

smithi (fig. 19). The terminal rostral plates vary greatly in their length, strength, and spination. The occipital and postorbital ridges are covered by scales armed chiefly by a single spinous keel (by several carinae in *C. smithi*); the scales on the remaining ridges of the head bear numerous spinous carinae; those on the median rostral ridge radiate from near the front of each scale (from near the middle of the scale in *C. radcliffei*). The scales on the top of the head are not greatly reduced in size, and bear several spinous carinae; the scales covering the anterolateral region of the snout, the lower half of the nasal fossa, and the region below the orbit, extending backward to the preopercular ridge, are reduced in size, but usually bear divergent ridges; the five series of scales between the occipital ridges converge backward toward the median occipital scute, which is variously armed by a single median keel or by several divergent ridges; a somewhat similar scute is located at the origin of the lateral line. The scales between the occipital and postorbital ridges are in about five series, and bear several carinae; those scales forming the median series are markedly enlarged, those in the next series below the median are scarcely reduced, those in the first series above the median are small, those in the two or three other series are reduced in size. In *C. japonicus* the scales of the head are quite different; they are smaller, as a rule, and even in specimens considerably larger than any known of *C. commutabilis* mostly bear only a single spinous crest, except on the scaly ridges

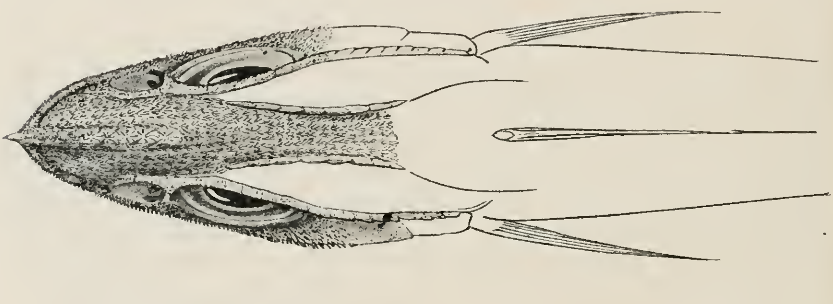

Fig. 29.—Coelorhynchus commutabilis. After Radcliffe ("Coelorhynchus commutabilis, form alpha").

and in the median series between the occipital and postorbital ridges. The underside of the head in both species is constantly covered by small scales.

Pyloric caeca, 20 in one specimen, 28 in another (50 were counted in a specimen of *C. japonicus*):

The height of the second dorsal spine in contained 2.1 (1.85 to 2.1) times in length of head; its length when laid out on the head from the opercular angle extends forward to the front of pupil (in paratypes varying forward and backward from that point a distance almost as great as the diameter of the pupil). The length of the first dorsal base is contained 1.63 (1.35 to 1.75) times in the interval between the dorsals, and 2.1 (1.7 to 2.1) times in the postorbital length of head. The outer ventral ray, ending in a slender filament, is contained 2.65 (2.1 to 3.0) times in head; the second ventral ray, 3.7 to 4.35 times, not reaching to the anus.

Color in alcohol grayish brown, of varying shade, becoming lighter below; darker and less silvery than in *C. radcliffei*, less brownish than in *C. smithi.* The fins are blackish, varying to light dusky; the outer ventral ray is dark or whitish. The buccal and branchial cavities are wholly lined with bluish black, except along the narrow margin of the opercular and branchiostegal membranes; the parietal peritoneum is brownish black.

Although certain rather wide variations are apparent, we have little doubt as to the unity of this species as we now define it.

Table of measurements in hundredths of length to anus.

	Type.	Type, *delta.*	Typical form.	Type, *alpha.*	*Alpha.*
Albatross station	5348	5172	5590	5589	5590
Total length in mm	320	300	....	289	267
Length to anus in mm	129	106	116	105	103
Length of head	74	74	73	72	71.5
Length of orbit	19	21.5	19	21	21
Postorbital length of head	25	24	25	25.5	24
Width of interorbital	17.5	16	16.5	17.5	17
Width of suborbital	8.5	11.5	9.5	9.5	9
Orbit to preopercle	26	26	27	26	26.5
Length of snout	31.5	30.5	30.5	27	28
Length of upper jaw	19.5	18.5	21	20	20.5
Depth of body	34	39	34	37	35
Width of body	....	33	27	30	30
Anus to ventral	24.5	25.5	26	27	25.5
Ventral to isthmus	23	22	23.5	22	26
Height of second dorsal spine	36	....	....	....	33.5
Length of first dorsal base	12	13	13	14	12
Length of interdorsal space	19.5	18	19	22.5	23
Length of pectoral	31	32	....	34	30
Length of outer ventral ray	28	29.5	27	34	....
Length of second ventral ray	....	19.5	16.5	22	18.5

(*commutabilis*, in reference to the supposed mutants, or "forms," which were originally confused with this species.)

40. COELORHYNCHUS MACRORHYNCHUS Smith and Radcliffe.

Coelorhynchus macrorhynchus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1812, p. 127, pl. 29, fig. 1 (not *Coelorhynchus macrorhynchus* Weber, Fische der *Siboga*-Expedition, 1913, p. 162, pl. 4, figs. 2 and 2*a;* also p. 671).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5111	China Sea, off southern Luzon	236	....	6
5367	Verde Island Passage, southern Luzon	180	....	Type.
5574	North of Tawi Tawi	340	....	1
5575	North of Tawi Tawi	315	52.3	1
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	1

We present the following notes and measurements based upon four small paratypes from *Albatross* station 5111.

Scales in 5½ series from origin of second dorsal to but excluding the series perforated by the lateral line; the series midway between the occipital and postorbital ridges is enlarged; the spinules on the scales of the median rostral ridge are in rows radiating from near front of scale; the lower half of the nasal fossa is scaled. Second dorsal, proximal part of first dorsal, and pectorals light.

Traces of vertical bars can be seen on the small specimen from station 5587.

Table of measurements of paratypes in hundredths of length to anus.

Albatross station	5111	5111	5111	5111
Total length in mm	[1] 187	[1] 213	[1] 202	[1] 150
Length to anus in mm	82	88	80	66
Length of head	82	83	83	82
Length of orbit	18	18	18	18
Postorbital length of head	23.5	24	24	23
Width of interorbital	14	14	13.5	14
Width of suborbital	7.5	8	7.5	8
Orbit to preopercle	24	26	26	24
Length of snout	41	41.5	41	41
Length of upper jaw	18.5	18.5	18	18
Depth of body	32	32	32	29
Width of body	24	27	25	25
Anus to ventral	17	18	16	17
Ventral to isthmus	20	21	20.5	18
Length of first dorsal base	10	10	10	11
Length of interdorsal space	17	17.5	17	16
Length of pectoral	23	26	25	25
Length of outer ventral ray	22	24	23	26
Length of second ventral ray	....	14	14	....

[1] Pseudocaudal developed.

(*macrorhynchus*, in reference to the long snout.)

41. COELORHYNCHUS ACUTIROSTRIS Smith and Radcliffe.

Coelorhynchus acutirostris Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134, pl. 30, fig. 2, text figure 10.

This small species is one of the most distinct in the genus; its position in the subgenera into which we have divided *Coelorhynchus* is quite uncertain. The divergence of the spinous carinae on the scales, together with other characters shared in common with the species having that type of squamation, have influenced us to place it in the subgenus *Oxymacrurus*. In the quincunx arrangement of the spinules on the scales of the head and the bluntness of the subopercular flap the species bears some resemblance to those of the subgenus *Quincuncia*. Its close resemblance to *C.* (*Paramacrurus*) *gladius* of the Hawaiian fauna may indicate a close relationship with that species, as Radcliffe has already pointed out. It resembles *C. gladius* in the excessively long, pointed snout; in the two ventral fossae, one before the anus, the other before the ventral fins, and in the squamation of the head. In addition to the details enumerated by Radcliffe, *C. acutirostris* differs from *C. gladius* in having the spinules on the scales of the head arranged in quincunx order; the spinous carinae of the body scales decidedly divergent instead of parallel; in the lower first dorsal fin; and further in certain details of proportions, as indicated in the tables of measurements, and in certain other details mentioned in the following description of this species.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5417	Between Cebu and Bohol	165	54.4	1
5418	....do	159	54.4	Type.
5516	Vicinity of northern Mindanao	175	54.3	1
5517	....do	169	54.3	1

In addition to the color marks described by Radcliffe, a dark streak extends along the anterior half of the tail immediately above the lateral line. The opercle is dusky, and a dark streak lies just below the postorbital ridge.

Scales in 5 series from origin of second dorsal fin to, but excluding, the lateral line scales; in 6 series behind anterior curve of lateral line. The 5 to 7 series of short, robust, suberect spinules on the scales of the body, moderately divergent posteriorly, become strongly divergent toward the head. The scales of the head, much as in the species of the subgenus *Quincuncia*, bear numerous suberect spinules arranged usually in quincunx order,[1] but sometimes in divergent or stellate series. The sharply acuminate tip of the snout is covered by a spinigerous plate above and below; the length of the dorsoterminal plate is about two-thirds that of the orbit (the two measurements are equal in *C. gladius*). These terminal plates are bounded on each side by a narrow scale, followed on the ethmoid region of the infraorbital ridge by six scales; the suborbital and preopercular regions of the ridge are covered more or less irregularly by two series of scales; the ridge ends sharply just before the margin of the produced preopercular lobe. The subopercle is produced backward, behind the upper margin of preopercular lobe, into a very obtuse, short flap, less prominent than in any other species of either *Paramacrurus* or *Oxymacrurus* examined. A long, narrow, scaleless groove, more prominent than in *C. gladius*, bounds along its entire length that series of scales on each side of the series on the median rostral ridge; a few scales (many in *C. gladius*) lie between this groove and the scales of the infraorbital ridge. The occipital ridges diverge toward their posterior ends, where they are separated by a distance one-third greater than the least distance between the ridges, a distance contained 1.7 to 1.9 times in the least interorbital width. From the many-spined median occipital scute there extends outward and forward a scaly ridge which meets the occipital ridge on each side above the hind margin of the orbit; this ridge is preceded on each side by series of strengthened scales; similar scales also cover the triangular area included between this short ridge and the occipital ridge on each side; another scaly ridge, formed over the supraoccipital crest.

[1] In numerous divergent rows in *C. gladius*.

extends backward from the occipital scute. The scales between the occipital and postorbital ridges are reduced in size, excepting those in the median series; a strong scute, pointed posteriorly and armed with several spinules, is present near the origin of the lateral line. The nasal fossa has a few scales in its anteroventral angle. The underside of the head is completely naked. Six branchiostegals; free fold of gill-membranes very narrow.

A ventral fossa about as long as the pupil and covered by thin and nearly smooth scales is located before the ventral fins. The usual gland-like organ which this fossa covers shows through the transparent scales. It is flat on its punctulate, yellowish outer surface, and black on its thick, rounded anterior edge and arched dorsal surface; it extends backward as a strand of glandlike substance, surrounded by a black membrane, to its black posterior dilation, which, located just before the anus, is covered by a small area in which the scales are thin.

In the sensory cavity lying in advance of the lateral line there are developed small neuromastic bones, like those described in some detail for *Coelorhynchus argentatus* (p. 434).

Eleven pyloric caeca (one specimen examined).

Table of measurements in hundredths of length to anus.

	Coelorhynchus acutirostris.		*Coelorhynchus gladius.*		
	Type.	*Paratype.*	....	....	*Paratype.*
Albatross station	5418	5417	....	....	3472
Total length in mm	205	190	[1] 237	157+	57
Length to anus in mm	87.5	81	96	65	23.5
Length of head	72	74	70	72	70
Length of orbit	16.5	17	14.5	16	22
Postorbital length of head	21.5	22	19	19	20
Width of interorbital	15	16.5	13.5	13.5	16
Width of suborbital	9	9	7.5	8	7
Orbit to preopercle	23	23	19	19	22
Length of snout:					
Preocular	35	37	36.5	39	31
Preoral	31	31	33	36	27
Width of snout:					
At base	23	25	21	22	27
At end of ethmoid portion of infraorbital ridge	17.5	19	15.5	18	24
Length of terminal rostral plate	10.5	10.5	13.5	16	7
Length of upper jaw	15	15	13.5	15	19
Length of barbel	4	4	5	4	....
Depth of body below origin of first dorsal	33	35	27	27	32
Depth of body at twice length of head behind tip of snout	12	10	16	12	15
Width of body across pectoral bases	23	22	26	22	....
Width of body at twice length of head behind tip of snout	4	3.5	10	8	7
Anus to ventral	24	21.5	26	29	27
Ventral to isthmus	23	21	17	18	19
Height of second dorsal spine	25	22	33	33	....
Length of first dorsal base	11.5	10.5	12	11	....
Length of first ray of second dorsal	4	4	9	9	....
Length of interdorsal space	10	8	8	5	....
Length of pectoral	21.5	25	26.5	26.5	....
Length of outer ventral ray	23	21	24	26	41
Length of second ventral ray	15	15	16.5	17	....
Fin rays:					
First dorsal	II, 8	[2] II, 8	II, 9	II, 9	....
Pectorals	16–15	14–13	18–17	19–19	....
Ventrals	7	7	7	7	....

[1] Pseudocaudal developed. [2] First dorsal rays II, 8 in each of the four specimens.

(*acutirostris*, in reference to the sharply acuminate snout.)

OXYGADUS, new subgenus.

We unite into a subgenus certain species of *Coelorhynchus* which are distinguished by the spination of their scales: there is a very strong median spinous keel, with smaller lateral spinules, usually not set on keels, but arranged in series parallel with the median keel. In addition to the type-species, *C. parallelus* (Günther), it includes *C. kermadecus* Jordan and Gilbert, *C. spinifer*, new species, *C. aratrum* Gilbert, *C. doryssus* Gilbert, *C. occa* (Goode and Bean), *C. talismani* (Collett), and probably additional species hitherto confused with *C. parallelus*. The group is almost surely a natural one.

42. COELORHYNCHUS PARALLELUS (Günther).

Macrurus parallelus GÜNTHER, Ann. Mag. Nat. Hist., (4) vol. 20, 1877, p. 439; *Challenger* Reports, vol. 22, 1887, p. 125, pl. 29, figs. A′ and AA″. [figs. A, A″, a″, and a‴, probably represent a distinct species called *C. kermadecus* by Jordan and Gilbert (Bull. U. S. Fish Comm., 1902 (1904), p. 619). The specimens from New Zealand perhaps represent a third species.]—Japan; Kermadec Islands; New Zealand.

Coelorhynchus parallelus JORDAN and GILBERT, in Jordan and Starks, Bull. U. S. Fish Comm., 1902 (1904), p. 618.—FRANZ, Abh. Bayer. Akad. Wiss., vol. 4, Suppl. vol. 1, 1910, p. 26.—GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 181.—Japan.

?? *Macrurus parallelus* ALCOCK, Ann. Mag. Nat. Hist. (6), vol. 4, 1889, p. 391; Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 106.—Gulf of Manar.

?? *Macrurus parallelus* BRAUER, Die Tiefsee-Fische, 1906, p. 257 (probably a distinct species, having 7 or 9, usually 9, instead of 3 to 5 rows of spinules on the scales).—off southwestern Africa.

? *Coelorhynchus parallelus* WEBER, Fische der *Siboga*-Expedition, 1913, p. 163, pl. 4, fig. 3.—East Indies.

We refer to *C. parallelus* three small specimens from *Albatross* station 5445, off the east coast of Luzon (383 fathoms; bottom temperature, 44.3° F.). The scutes along the ridges of the head bear a strong keel armed by several spinules of subequal strength. Scales mostly lost; probably originally present on under surface of head; 5 scales in a series above lateral line (to origin of second dorsal).

The measurements given by Weber indicate that his specimens have the snout shorter than in our Japanese material. Concerning the spination of the scales, Dr. Weber writes: "A specimen from station 52 of 220 mm. length shows *about* the following arrangement of spinules: 2. 3. 4. 3. 2=14. A specimen from same station of 125 mm. length shows on well-developed scales the arrangement: 2. 2. 2=6."

Although it is evident that several species have been confused with *C. parallelus*, we do not feel justified in naming or defining them on the basis of published descriptions.

We have prepared a table of measurements of our three small specimens with which are included measurements of typical *C. parallelus* from Japan. The relative lengths of the different specimens should be constantly considered when their measurements are being compared.

Table of measurements in hundredths of length to anus.

	Philippine Islands.			Japan.			
Albatross station	5445	5445	5445	4909	4909	4906	4908
Total length in mm	121	....	128	[1] 249	....	104	83
Length to anus in mm	47	47	47	99	72	32	27
Length of head	76	78	78	69.5	73	76	79
Length of orbit	23	23	22	19	21	22	22
Postorbital length of head	22	23.5	23.5	22	22.5	25	24
Width of interorbital	18	18	18	15.5	17	17	16
Width of suborbital	9	9	9	9	10	10	....
Orbit to preopercle	26	27	26	23	23	26	....
Length of snout	33	35	36	30	32	30	33
Length of upper jaw	19	19	20	16.5	16.5	....	19
Length of barbel	7	5	5	4	5	....	....
Depth of body	33	34	32	33	30	29	32
Width of body	....	24	24	28	....	25	....
Anus to ventral	20	21	22	27	25	23	24
Ventral to isthmus	20	18.5	18	17	16	16	16
Length of first dorsal base	13	14	13	11	11	10	14
Length of interdorsal space	15	14	16	13.5	12.5	....	....
Length of outer ventral ray	29	35	34	25	27	....	....
Length of second ventral ray	14	16	....	12.5	15	....	....

[1] A pseudocaudal developed.

(*parallelus*, in reference to the arrangement of the series of spinules on the scales.)

43. COELORHYNCHUS SPINIFER, new species.

? *Coelorhynchus macrorhynchus* Weber, Fische der *Siboga*-Expedition, 1913, p. 162, pl. 4, figs. 2 and 2*a* (not a synonym of *C. macrorhynchus* Smith and Radcliffe, as suggested by Weber on p. 671).

This remarkable new species is related rather remotely to *C. parallelus;* it differs from that species in having the orbit smaller; the snout longer and with more convex sides; the spinules on the scales notably longer and stronger, particularly on the ridges of the head. *C. spinifer* is probably the most strongly spined species of the genus. It was dredged at a greater depth than that inhabited by most of the other species. (A specimen of *Bathygadus multifilis* was also dredged at the type-station of this species.)

Type-specimen.—Cat. No. 78226 U.S.N.M.: 185 mm. long to the end of its whip-like tail, 66.5 mm. to the anus; *Albatross* station 5607, in the Gulf of Tomini, Celebes (0° 04′ S., 121° 36′ E.); depth, 761 fathoms.

Fin-rays—first dorsal, II, 9; pectorals, 19–18; ventrals, 7.

The dorsal and ventral contours are not strongly arched, but converge rather rapidly behind the trunk; the dorsal contour of the snout is almost straight (a little concave in *C. parallelus*); the base of first dorsal is not oblique. Greatest depth of body, below origin of first dorsal, 2.33 in length of head; greatest width, across pectoral bases, 3.0; the depth, at a distance behind snout twice the length of head, is contained only twice in the postorbital length, and is about 3 times the width of the tail at the same point. The sides of the head are convex; the snout is heavy and broad; its preocular length is contained 2.15 times in length of head; it preoral length, 2.3 times; its width at base, 2.65 times; the width of the snout at anterolateral angles is a little less than the length anterior to that point. The infraorbital, occipital, supranarial, supraorbital, and postorbital ridges are exceedingly strong and heavily spined. The preopercular ridge and margin are oblique; the sharply pointed flap of the subopercle, concealed by the produced lobe at the angle of the preopercle, is

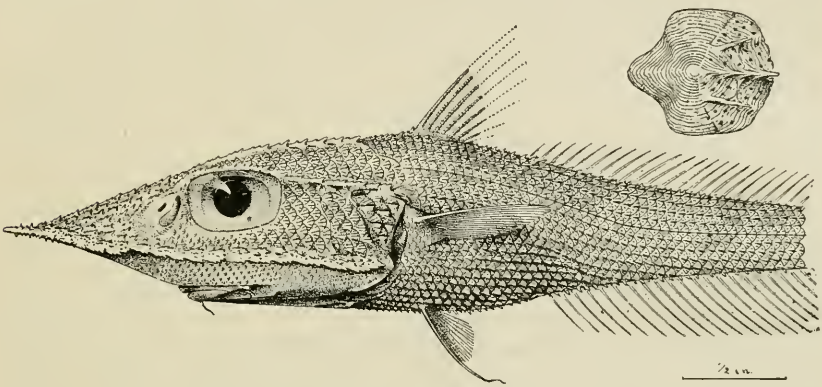

FIG. 30.—COELORHYNCHUS SPINIFER. TYPE.

directed downward and backward, and is almost as long as the pupil. The orbit is oval and small; its length is equal to the least interorbital width, and is twice the least distance between the occipital ridges; orbit 4.3 in head, 2.0 in snout, 1.3 in postorbital. Least suborbital width, 2.4 in postorbital. The upper jaw extends from below the posterior nostril backward to below the hind margin of the pupil; its length is contained 4.65 times in the head. The barbel is slender and very short, being contained 7.5 times into the postorbital. The teeth are in rather narrow bands in the jaws; there are only about three teeth in a cross section of the mandibular band laterally. Six branchiostegals.

Distance between isthmus and base of ventral, 1.4 in distance from base of ventral to center of anus, 1.5 in postorbital length. There are no naked areas on the breast.

The scales are large, being in 4½ rows from the origin of the second dorsal to but excluding the lateral line series; this number does not increase at the end of the low anterior arch in the lateral line. The scales are armed very strongly by a sharply 3-angled spine, which is about two-thirds as high as the width of the scale; this spine from its widened base is directed upward and backward at an angle of about 65°, extending to a point directly above the hind margin of the scale; this main spine is preceded by one to three smaller imbricate spinules; a single spinule is sometimes present above or below the median keel. In *C. parallelus* of comparable size there are three to five parallel rows of several spinules, which increase in strength along the median keel much less abruptly posteriorly. The scales on the infraorbital ridge before middle of eye are in a single series and bear two or three spinous keels like the main one on the scales of the body; behind middle of orbit the scales of the infraorbital ridge are armed by a single, very strong, broad keel, the main spine of which is about one-third as high as the diameter of the pupil; the ridge ends in a single, hard, strong scale, pointed posteriorly, and bearing a heavy, retrorse spine, which is preceded by a few small spinules; this spine extends backward to within its own length of the preopercular margin. The 12 scales on the median rostral ridge bear about three series of spinules, except the last one, which has only the strong median keel, composed of three spinules. The remaining scales of the head bear but a single keel, like that on the body scales; the spines on the ridges are greatly strengthened and enlarged; the height of the tip of the spines from the base of the occipital ridge is about half the diameter of the pupil, being twice as great as in *C. parallelus*. The four series of scales between the occipital ridges converge backward to the middle of a naked area lying before the two strong occipital scutes, which lie side by side, and represent the single weaker median scute of *C. parallelus*. The series of scales midway between the occipital and postorbital ridges is little enlarged; about three scales, larger than those surrounding them, extend backward from the orbital rim to the preopercular ridge (a similar series occurs in *C. parallelus*). The under surface of the head is completely covered by deciduous prickle-like scales.

The second dorsal spine is weak and smooth. The length of the first dorsal base is contained 1.2 times in the interdorsal space, 2.4 times in the postorbital length of the head. The first ray of the second dorsal fin is shorter than the pupil. The rays of the pectoral fin are slender and weak; the filamentous outer ventral ray extends to the origin of the anal fin, and is equal in length to the postorbital region of the head; the other ventral rays are weak and short, not nearly reaching to the anus.

Color pale brownish in alcohol, black over the coelom; pale greenish on head, becoming blackish on the opercles, about the mouth, and on the gular and branchiostegal membranes. Lining of buccal and branchial cavities, wholly blackish; parietal peritoneum, brownish black. Fins dusky, the pectorals and ventrals dark; outer ventral ray, light.

Measurements in hundredths of length to anus (66.5[1] mm.).—Length of head, 77; length of orbit, 18; postorbital length of head, 24; least width of interorbital, 18; least width of suborbital, 10; distance between orbit and preopercular margin, 24.5; preocular length of snout, 36; preoral length of snout, 34; width of snout at base, 29; width of snout at end of ethmoid portion of infraorbital ridge, 24; length of maxillary, 16.5; length of barbel, 3; depth of body below origin of first dorsal, including the spines on the scales, 35; width of body over pectoral bases, 28; distance from center of anus to base of outer ventral ray, 21; distance from base of ventral to front of scaly area on isthmus, 16.5; length of first dorsal base, 10.5; length of interval between dorsals, 12.5; length of outer ventral ray, 23.

(*spinifer*, in reference to the relatively immense spine borne on each scale).

Genus HYMENOCEPHALUS Giglioli.

This genus, which comprises a number of small and fragile species dwelling in the moderate depths of tropical seas, has been defined in detail by us in our Report on the Macrouroid Fishes of Japan.[2] Since the appearance of that report we have described[3] an interesting new species, *Hymenocephalus tenuis*, from the Hawaiian Islands. In the present report we are basing a new subgenus on a new Philippine species and this recently described Hawaiian form; in addition to these, another new subgenus, two other new species, and one new subspecies are now added to the list. The inclusion of these new types makes necessary certain modifications of the generic description: the dorsal spine may be weakly denticulate, and the gill-rakers may be short and tubercular, and they may be as few as 10 on the lower limb of the outer two arches, thus attaining the reduced condition which is characteristic of the other genera in the Coryphaenoidinae. Even with these modifications the genus remains a compact group, but its position in the subfamily now seems somewhat less isolated than it did before the discovery of these new facts, and its relation to *Bathygadus* is rendered much less apparent.

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[1] About 1 mm. has been added as an estimate of amount broken off from the tip of the snout.

[2] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 137, 141, 186.

[3] Idem, vol. 54, 1917, p. 173.

ANALYTICAL KEY TO THE SUBGENERA AND SPECIES OF HYMENOCEPHALUS.[1]

A[1]. Body and head slender or moderately robust; sensory canal system of head not excessively developed; bony crests of skull thin, but firmer; eye very large, being contained from 2.5 to 3.5 times in length of head; color chiefly silvery.

B[1]. Second dorsal spine weakly denticulate; body more slender; the head not compressed, its width equal to greatest depth of body or of head; gill-rakers tubercular, about 10 to 13 on the lower limb of the outer two arches; scales wholly smooth, so far as known. HYMENOGADUS.

a[1]. Lens-shaped organ before anus circular in outline; striations on sides of isthmus well developed; gill-rakers about 12 in number on lower limb of outer two arches; barbel nearly as long as orbit______*gracilis.*

a[2]. Lens-shaped organ before anus elongate; striations on sides of isthmus obsolescent; gill-rakers about 10 in number on lower limb of outer arches; barbel not quite half length of orbit________________*tenuis.*

B[2]. Second dorsal spine wholly smooth; body more robust; head compressed, its width being less than depth of body or of head; gill-rakers short but not tubercular, about 18 in number on outer arches; scales with short spinules arranged in quincunx order__________HYMENOCEPHALUS.

a[1]. Barbel much longer than the orbit; ventral fins with 8 rays.

b[1]. Pectoral rays 11; barbel two-thirds length of head_______*longibarbis.*

b[2]. Pectoral rays 15; barbel less than two-thirds length of head; snout and maxillary longer, and eye smaller than in Günther's figure of *longibarbis* ____*longiceps.*

a[2]. Barbel much shorter than orbit, often obsolete.

c[1]. Ventral rays greatly produced beyond anus, 8 in number; no barbel____*longipes.*

c[2]. Ventral rays little or not at all produced beyond anus.

d[1]. Ventral rays 7 or 8 (rarely 6 or 9); snout scarcely produced beyond the mouth.

e[1]. Barbel developed; interorbital width about equal to length of orbit, or less___________________________________*striatissimus.*

f[1]. Ventral rays 8 (rarely 7 or 9); barbel usually about as long as pupil, or longer.

g[1]. Orbit nearly circular, contained 0.9 to 1.1 times in postorbital length of head____________________________*s. striatissimus.*

g[2]. Orbit obliquely oval, its length contained 1.15 to 1.4 times in postorbital length of head________________________*s. aeger.*

f[2]. Ventral rays 7 (rarely 6, never 8); barbel usually shorter than pupil ____*s. torvus.*

e[2]. Barbel absent; interorbital space one-third wider than eye; ventral rays 8____________________________________*grimaldii.*

d[2]. Ventral rays 10 to 14.

h[1]. Orbit 2.5 to 3.25 in head; its length greater than the interorbital width.

i[1]. Snout much shorter than the interorbital width, not projecting beyond the mouth, rounded.

j[1]. Barbel small, but distinctly developed; a small, distinct, faintly striated area directly below base of pectorals, and one before base of each ventral.

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[1] The authors have examined all of the 19 species and subspecies now known, excepting *H. longibarbis* and *H. grimaldii.*

k^1. Striations behind ventral fins much finer than those above ventrals or on isthmus; form more slender______*italicus*.

k^2. Striations behind ventral fins not finer than those above ventrals or on the isthmus; form more robust_______ *cavernosus*.

j^2. Barbel minute or obsolete; no striated areas directly below pectoral bases nor in front of ventral bases; compared with *cavernosus*, the ventral lens-like bodies are smaller, the color is darker, and the bands of teeth are narrower____ *antraeus*.[1]

i^2. Snout about as long as the interorbital width, projecting beyond mouth, pointed; barbel wholly absent, or rudimentary.

l^1. Color lighter, grayish along bands of teeth in jaws.

m^1. Ventral rays usually 11, sometimes 12________*lethonemus*.

m^2. Ventral rays usually 12, sometimes 11 or 13______*nascens*.

l^2. Color darker, black along bands of teeth in jaws; ventral rays 13 to 15________________________________*striatulus*.[2]

h^2. Eye $3\frac{1}{2}$ in head, $\frac{5}{6}$ interorbital width; snout $\frac{3}{4}$ eye; barbel distinctly developed; ventral rays 10 to 12 (readily separable on account of its small orbit from *H. italicus* and *H. cavernosus*, the only species in the subgenus with which it agrees in the number of ventral rays and the development of the barbel) _________________________________ *heterolepis*.

A^2. Body deeper; sensory canals of head excessively developed, as in the typical subgenus of *Bathygadus;* bony septa of skull exceedingly thin and papery; eye small, 4 to 5 in head; color chiefly blackish.

PAPYROCEPHALUS.

a^1. Barbel present, very small.

b^1. Ventral rays 7_________________________________*barbatulus*.

b^2. Ventral rays 11________________________________*papyraceus*.

a^2. Barbel absent; ventral rays 13 or 14____________________*aterrimus*.

HYMENOGADUS, new subgenus.

Type-species.—Hymenocephalus gracilis, new species.

This subgenus is erected to include two closely related species—the type-species and *H. tenuis*[2]—which we have recently described from the Hawaiian Islands. The two species are closely related, and differ strikingly from all other known species in the denticulation of the dorsal spine, in the reduced gill-rakers, and in the cylindrical form of the head. Their reference to *Hymenocephalus* is made because of their agreement with the other species of the genus in the possession of certain diagnostic characters conservatively retained throughout the group. Among these characters the most prominent are: the forward extension of the branchial aperture;[3] the comparatively wide slit before the first gill-arch; the "striation" of the abdominal region; the presence of two lens-like bodies in constant

[1] Specimens of this Hawaiian species from *Albatross* station 3467 have never been recorded.

[2] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 54, 1917, p. 173.

[3] In this character *Hymenocephalus* is approached by two other genera, *Malacocephalus* and *Ventrifossa*.

position on the midventral line;[1] the large size and subterminal position of the mouth; the development of the sensory canal system[2] of the head, with thin bony septa connected by thin external membranes;[3] the large size and thinness of the scales; and the correlated position of the anus (immediately before the anal fin) and the number of branchiostegal rays (7).

44. HYMENOCEPHALUS GRACILIS, new species.

Type-specimen.—Cat. No. 78227, U.S.N.M., 96 mm. long to end of pseudocaudal, 29 mm. long to anus; dredged by the steamer *Albatross* at station 5292, in the China Sea off southern Luzon (lat. 13° 28′ 45″ N.; long. 121° 01′ 12″ E.); depth, 162 fathoms; bottom temperature, 52.4° F.

Fin-rays—first dorsal, II, 10; pectorals, 13; ventrals, 8.

The form of the body is entirely similar to that of *H. tenuis.* It is slender throughout, the depth gradually decreasing toward the end of tail; the width of the head, equal to the greatest depth of either head or body, is contained twice in length of head. The sides of the head are strongly convex; the head in cross section is round, instead of rectangular as in *H. striatissimus.* The snout projects forward beyond the tip of the premaxillaries a horizontal distance half as long as the pupil; preocular length of snout, 1.4 in length of orbit, 3.2 in length of head. The orbit is oval in outline; its length is contained 1.25 times in the postorbital, or 2.9 times in the entire length of head. The middle of the length of the head is at the hind margin of the pupil. The orbit encroaches medially upon the interorbital, the sides of which, in consequence, are strongly concave; the least interorbital width is contained about 5 times in the head, being not much more than half the orbital length; least suborbital width, 0.3 length of orbit. The mouth is large and a little oblique; the upper jaw, which extends backward to a vertical intersecting the eye behind the pupil, is contained 2.25 times in the head. The small teeth are arranged in narrow bands in the two jaws. The preopercular ridge, as in *tenuis*, is rounded at its angle, not being acutely produced backward as in the subspecies of *striatissimus;* the preopercular margin is widely rounded, and but little produced backward. The head, as in *tenuis*, is comparatively firm, and the sensory canals, though spacious, are much less developed than in such species as *striatissimus;* these canals are covered over by delicate membranes supported by thin bony septa.

The gill-membranes, free from the sides of the isthmus, extend forward to below end of maxillary, where they form a narrow free fold

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[1] Somewhat similar and doubtless homologous structures occur in other genera, particular in certain species of *Ventrifossa,* such as *V. nigromarginata* (q. v.).

[2] The head is firmer in *Hymenogadus* than usual in the other groups.

[3] In this character *Hymenocephalus* is approcahed by certain species of *Ventrifossa.*

across the isthmus. The short spiny gill-rakers are fewer than in any form previously described with the exception of *tenuis*, there being but 12 or 13 on the outer two arches; the first gill-arch is bound down by membrane above its angle and near its anterior end. Seven branchiostegals.

The anus is located immediately before the origin of the anal fin, its distance from the base of the outer ventral ray being equal to the distance from tip of snout to hind margin of orbit, and a little longer than the distance between the ventral base and the isthmus at the fold of the gill-membranes.

The two ventral lens-shaped bodies are present in the usual positions; both are circular in outline; the diameter of the anterior one, located in advance of the ventrals, is about two-thirds that of the posterior one, which is situated immediately before the anus. The

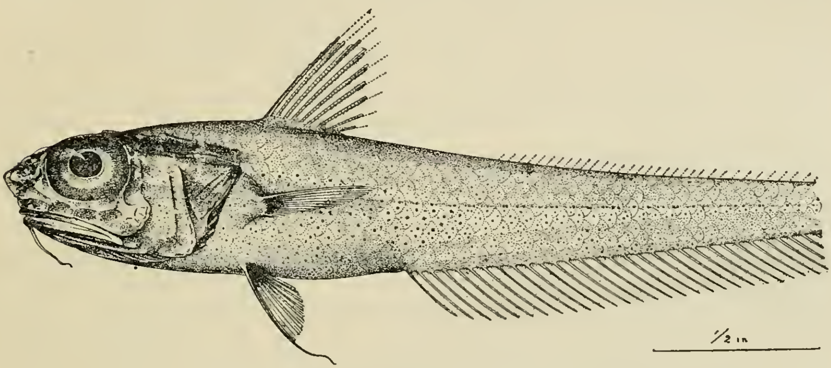

Fig. 31.—Hymenocephalus gracilis. Type.

two organs, as usual, are connected by a black-surfaced strand of tissue along the inner surface of the abdominal body wall.

The scales are almost entirely lost, but three are present near the origin of the lateral line; two are overlapped by the last of the scale-like bones flooring the sensory canal in advance of the lateral line. The scales are round and marked with concentric striae, but are wholly spineless. One, bearing a lateral line pore, is separated from the origin of the first dorsal by 2½ rows of scales.

This species is sharply distinguished from all others of the genus previously described, with the exception of *H. tenuis*, by the presence of weak denticulations on the distal portion of the dorsal spine; the spine is broken, but 5 denticulations remain on a distal portion only half as long as the orbit; the proximal smooth portion of the spine is two-thirds the postorbital length. The length of the first dorsal base is about half the interval between the dorsals, or two-thirds the postorbital. The rays of the paired fins are exceedingly slender and weak; the pectoral fin is just equal in length to the postorbital portion of the head; the outer ventral ray, with its filament, extends to the front of the peritroct, and is contained 1.9 times in the head; the inner ventral rays are not quite half as long as the orbit, and extend but halfway to the origin of the anal fin, the vertical from which passes behind the first dorsal a distance half as long as the fin itself; the height of the first anal ray and of the orbit are equal.

The trunk is silvery between the anus and the ventral bases and on an area extending thence forward along the sides of the isthmus and upward to the middle of the sides; this silvery region is continued backward as a streak occupying the middle third of the sides of the tail; the abdominal region before the ventral fins has a coppery luster; the immediate bases of the paired fins are blackish; a fine black ring surrounds each of the lens-shaped structures on the belly; the rest of the body is brownish, becoming dark below the first dorsal fin. The markings of the head consist of a dark brown region about the occiput; a dark streak along the margins of the postorbital sensory canals, and narrow black streaks along the front margin of the snout, along the inner margins of the lips, and along the sides of the central canal in each mandibular ramus. The sides of the head are bright silvery, but the black lining of the branchial cavity shows through the opercle. The membranes over the sensory canals are transparent, allowing the coloration of the walls of the canals to be visible; the vertical wall of the suborbital cavity is silvery, but its roof is dark; the floor of the interorbital cavity is blackish. The buccal and branchial cavities are lined with silvery everywhere excepting a margin about as wide as the pupil on the outer posterior sides of the branchial cavity; this dark is margined at the extreme edge of the opercular and branchiostegal membranes by a whitish line. The parietal peritoneum is silvery with some diffused brownish color and black spots.

The "striated" region of the belly consists of a strip, about as wide as the pupil, extending along the sides of the isthmus and backward to above the base of the ventral fin, from which place the striae fade out posteriorly, being traceable about halfway to the anus. The striae are similar to but more extensive than those of *tenuis;* they are finer than those of *striatissimus*, and do not occur, as in that species, on a thickened portion of the skin below the post-clavicle. The end of that bone is much nearer the base of the ventrals than the anus, the reverse of its position in *striatissimus*. The gular membrane lacks the median black streak of *striatulus*, and lacks the double striation characteristic of *striatissimus;* it is marked only by numerous black lines somewhat coarser than those on the striated region of the belly.

H. gracilis is widely separated from all other species of the genus with the exception of the recently described *H. tenuis*, from which species it differs in the circular form of the lens-shaped organ before the anus; in the better development of the striations on the sides of the isthmus; in the less reduced character of the gill-rakers, and in the greater length of the barbel.

Only the type-specimen is known.

(*gracilis*, in reference to the slender form.)

Subgenus HYMENOCEPHALUS Giglioli.

45. HYMENOCEPHALUS LONGICEPS Smith and Radcliffe.

Hymenocephalus longiceps SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 111, pl. 23, fig. 3.

Hymenocephalus striatissimus WEBER, Die Fische der *Siboga*-Expedition, 1913, p. 168 (specimen from *Siboga* station 38).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F*.	
5301	China Sea, near Hongkong	208	50.5	1
5317	China Sea, near Formosa	230	50.6	1
5440	China Sea, off western Luzon	172	53.2	1
5441	do	186	52.2	1
5117	China Sea and adjacent waters off southwestern Luzon	118		3
5118	do	159		1
5265	do	135		1
5290	do	214		1
5291	do	173	51.5	11
5292	do	162	52.4	1
5375	Vicinity of Marinduque Island	107		1
5121	Off east coast of Mindoro	108		9
5197 [1]	Vicinity of western Bohol	174	54.3	1
5411	Between Cebu and Bohol	145	55.2	7
5412	do	162	54.8	3
5453	Off southeast coast of Luzon	146		8
5454	do	153		2
5459	do	201		[2] 3
5476	do	270	48.3	1
5565	Between Jolo and Tawi Tawi	243	52.3	1
5566	do	244	52.5	1
5580	Vicinity of Darvel Bay, Borneo	162	55.8	5
5621	Between Gillolo and Makyan Islands (0° 15′ 00″ N., 127° 24′ 35″ E.).	298		2

[1] The data corresponding to the tag borne by this specimen is: station 5179, Apr. 9, 1908. As station 5179 was occupied on Mar. 25, at a depth of only 37 fathoms, it seems likely that 5179 was written for 5197 (occupied on Apr. 9).

[2] One of these specimens is the type of the species (Cat. No. 72928, U.S.N.M.).

We have a few notes to add to the original description.

The tail ends in a very long filament, the tip of which is broken off in the type; the head is contained about 6.5 times in the total length when the tail is entire.

The posterior lens-shaped body, lying just before the anus, is unusually large in this species, being about half as wide as the pupil;

its posterior margin is bilobed, being divided by the anus; the organ is raised above the surface of the body, has a clear glassy appearance, and is punctulate on its outer face; this posterior organ is connected by a median black strand of tissue with the anterior lens-like body, which is similar but much smaller, and is located before the ventrals. There can be little doubt that these structures are homologous with those described by us in other species of this genus and in species of other genera, as in *Coelorhynchus argentatus* (p. 435).

Many of the scales still remain on a few specimens. These scales are beset with short, weak spinules, as in other species of the subgenus, being similar in arrangement to those figured for *H. longipes*.[1] The midline of the belly, even over the anterior lens-like organ, is scaled, contrary to a statement in the original description; the scales themselves are usually lost, but the scale pockets can be made out. The position of the lateral line was incorrectly given in the type description; it rises anteriorly, as in *H. longipes*, so that there are 3, instead of 5, large scales from the end of the first dorsal to and including the lateral line series.

The striation of the abdominal region agrees in its wide extent with that of *H. striatissimus*, *italicus*, and *cavernosus*. The striated region includes the area encircling the base of each ventral fin, and regions extending backward about half way to the anus, upward to before the pectoral base, and forward along the entire sides of the isthmus; the gular membrane is completely covered by similar but somewhat finer striations, in addition to the cross lines of black, which are less sharply developed than in most species.

Branchiostegals 7, as in all other species examined. Günther's count of 6 in his *longibarbis* is doubtless an error, due to the small size of his type specimen.

Table of fin-ray counts.

Albatross station.	Soft rays, first dorsal.	Pectoral rays.	Ventral rays.
[1] 5459	9	14	8
5118	10	14	8
5621	9	15	8
5476	9	15	8
5565	9	16	8
5590	10	16	8
5441	10	14	8
5621	10	17	8
5566	9	16	8
5459	9	14	8

[1] Type.

(*longiceps*, in reference to the comparatively long, slender head.)

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, pl. 23, fig. 1.

46. HYMENOCEPHALUS LONGIPES Smith and Radcliffe.

Hymenocephalus longipes Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 109, pl. 23, fig. 1.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5118	Off southwestern Luzon	159	....	1
5216	Between Burias and Luzon	215	51.9	1
5222	Between Marinduque and Luzon	195	52.8	1
5372	Vicinity of Marinduque Island	150	....	1
5374	.....do	190	....	5
5387	Between Burias and Luzon	209	52.4	1
5403	Between Leyte and Cebu	182	55.7	7
5412	Between Cebu and Bohol	162	54.8	1
5417	.....do	165	54.4	1
5418	.....do	159	54.4	2
5421	Between Panay and Guimaras	137	58.4	Type
5502	Off northern Mindanao	214	....	1
5542	.....do	200	54.3	2

When the tail is entire, the head is contained six times in the total length; the greatest width of the head is contained twice in its length; the middle of the length of the head is not at the posterior margin of pupil, being nearer to the posterior rim of the orbit, varying from midway between pupil and hind margin of orbit to the hind margin of the orbit. Preocular length of snout, contained 4.2 (4.0 to 4.8 in paratypes) times in length of head to end of membrane at angle of opercle; orbit, 3.35 (2.8 to 3.4); interorbital, 5.7 (4.8 to 6.4); length of upper jaw, 1.8 (1.75 to 2.0). Branchiostegals, 7.

The posterior lens-shaped body is about half as wide as the pupil; its posterior margin is emarginate, as in *longiceps;* the anterior organ is similar but slightly smaller, and is located, as in all other species, on the mid-ventral line between the ventrals and the isthmus. The region between the pectoral and ventral fins and the anus is not naked, as originally described, but is covered with thin, spineless scales.

The striation of the belly is extensive, as in *H. striatissimus*, *italicus*, *cavernosus*, and *longiceps.* The base of each ventral fin is surrounded by this striated area, which extends thence backward nearly to the anus, leaving a median non-striated strip; the region before and below the pectoral bases, the entire sides of the isthmus, and the gular membrane are all striated; the black cross lines on the gular membranes are not strongly developed.

(*longipes*, in reference to the produced ventral fin.)

47. HYMENOCEPHALUS STRIATISSIMUS Jordan and Gilbert.

This species was dredged in large series by the *Albatross* about the Philippine Islands. The large number (472) of specimens available has made possible a detailed study of the material, which has led us to the following conclusion: *there are in the Philippine Islands, and in the adjacent regions to the northward and southward, three geographical subspecies which apparently intergrade in the two regions where their ranges meet.* The typical *striatissimus*, originally described from Japan, ranges southward to China, Formosa, and the east coast of Luzon. It intergrades off the northwest coast of Luzon with the subspecies *torvus*, which inhabits the Sulu Sea and the China Sea off southern Luzon. The form *torvus* then intergrades, along the Tawi Tawi Archipelago, with the third subspecies, *aeger*, which inhabits the East Indian Islands south of the Philippines.

The diagnostic characters, in so far as we have been able to analyze them, seem to be but three or four in number:

1. The ventral rays in *striatissimus* and *aeger* are 8 in number, while in *torvus*, which occupies a region between the other two forms, there are 7.

2. The orbit is nearly circular and very large in *striatissimus*, but smaller and more obliquely elongate in *torvus* and *aeger*.

3. The barbel is usually longer than the pupil in the southern form *aeger*, about as long as the pupil in the typical *striatissimus* and usually shorter than the pupil in the central subspecies, *torvus*.

4. The color may average darkest in *torvus*, but the character is not constant and is not very valuable in distinguishing the subspecies.

It will be noted that the intergrades between *striatissimus* and *torvus* have the eight ventral rays of the former, but usually have the small and less regular orbit and the short barbel of *torvus*. The intergrades between *torvus* and *aeger* likewise usually have eight ventral rays, and have the small irregular orbit as in both *torvus* and *aeger*. It follows from these facts that the two sets of intergrades are difficult to distinguish from one another, although the three typical forms may readily be separated. The chief average difference between the intergrades seems to be in the length of the barbel, which averages greater in the specimens from the Tawi Tawi group than in those from off northwest Luzon.

Tables showing the diagnostic characters of the subspecies of Hymenocephalus striatissimus and of the intergrades between these subspecies.

VENTRAL RAYS.[1]

Species.	6	7	8	9
striatissimus[2]			70	2
Intergrades		2	44	
torvus	4	302		
Intergrades		30	111	
aeger		2	125	

[1] Number of fins, not specimens, are enumerated; the number is often not the same on the two sides o the same fish.
[2] Japanese material included; the types, not here listed, also have 8 ventral rays.

Tables showing the diagnostic characters of the subspecies of Hymenocephalus striatissimus and of the intergrades between these subspecies—Continued.

ORBIT IN PASTORBITAL.[1]

Subspecies.	0.9 or 0.95	1.0 or 1.05	1.1 or 1.15	1.2 or 1.25	1.3 or 1.35
striatissimus	5	1			
Intergrades		3	7	4	
torvus		7	39	50	4
Intergrades		3	22	17	
aeger		5	24	12	2

BARBEL.[1]

Subspecies.	½ or ⅔ pupil.	About ¾ pupil.	About = pupil.	Longer than pupil.
striatissimus		11	12	5
Intergrades	15	3		
torvus	91	3	1	
Intergrades	18	19	4	
aeger	1	9	9	23

[1] Measurements of the orbit and barbel do not include Japanese specimens, which agree with typical *striatissimus* from China, Formosa, and the Philippines.

48. HYMENOCEPHALUS STRIATISSIMUS STRIATISSIMUS Jordan and Gilbert.

Hymenocephalus striatissimus Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 612, text figure.—Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 187.

Hymenocephalus striatissimus Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 111.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5301	China Sea near Hongkong	208	50.5	8
5317	China Sea near Formosa	230	50.6	5
5476	Off southeastern Luzon	270	48.3	19

As in the two other subspecies, *torvus* and *aeger*, the posterior lens-like organ, which is located immediately in advance of the anus, is transversely elongate and bilobed, being almost dumb-bell shaped.

The orbit in this, the typical subspecies, is large and almost exactly circular in outline, the oblique diameter being about equal to the vertical diameter.

The ventral rays are constantly 8 in number; the only varying specimens are 2 from near Formosa, which have 8 rays on one side, 9 on the other.

(*striatissimus*, in reference to the extensive development of the abdominal striation.)

INTERGRADES BETWEEN HYMENOCEPHALUS STRIATISSIMUS STRIATISSIMUS AND H. S. TORVUS.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5325	Off northern Luzon	224	53.2	15
5326	.....do	230	55.4	3
5328	.....do	150	53.9	1
5329	.....do	212	51.4	4
5331	Off western Luzon	178	54.7	1
5440	.....do	172	53.2	1

The status of these 23 specimens and their relation to the two subspecies occurring on each side of their range have already received consideration. They resemble *H. s. torvus* in the small, obliquely elongate orbit, and in the short barbel, but usually agree with *H. s. striatissimus* in the number of ventral rays: 21 specimens have 8 on each side, and 2 have 8 on one side and 7 on the other. Over 70 fins have been counted in *striatissimus*, and none were found with 7 rays; 306 fins counted in *H. torvus* include none with 8.

49. HYMENOCEPHALUS STRIATISSIMUS TORVUS Smith and Radcliffe.

Hymenocephalus torvus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 110, pl. 32, fig. 2.

The type-specimen was stated, in the original description, to have been dredged at station 5548, near Jolo. This statement is erroneous, as the specimen was dredged at *Albatross* station 5508, off northern Mindanao, at a depth of 270 fathoms.

The lateral line is on the fourth row of scales below end of first dorsal (not the sixth, as originally described). The scales are thin and deciduous, as usual in the genus; they are weakly armed with small spinules in quincunx order. The abdominal region, which is striated exactly as in typical *striatissimus*, is completely covered by spineless scales, as in the two other subspecies.

The roof of the buccal cavity is mostly silvery, but dusky just within the mouth and whitish on the tongue. The branchial cavity is brownish above, but mostly silvery below and whitish along the margin of the opercular and branchiostegal membranes. The parietal peritoneum is brownish, underlain with silvery.

The orbit is smaller in this subspecies than in typical *striatissimus*, and is not circular, as originally described; its vertical height is contained about 1.2 times in the oblique length, which is contained from 1.1 to 1.4 times in postorbital length of head (measured in 100 specimens).

List of stations.

Albatross stations.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5110	China Sea off southern Luzon	135	59.0	1
5112	.....do	177	52.4	1
5113	.....do	159	....	1
5118	.....do	159	....	2
5122	East coast of Mindoro	220	....	2
5198	Vicinity of western Bohol	220	53.9	2
5221	Between Marinduque and Luzon	193	52.4	10 plus [1] 3.
5222	.....do	195	52.8	2
5259	Off northwestern Panay	312	49.3	4
5260	Off southwestern Mindoro	234	51.4	5 plus [1] 40.
5268	Off southern Luzon	170	....	1 plus [1] 3.
5269	.....do	220	....	2
5279	.....do	117	....	1
5280	.....do	193	49.6	1 plus [1] 5.
5282	.....do	248	47.4	7 plus [1] 15.
5283	.....do	280	46.8	[1] 3
5289	.....do	172	....	1
5291	.....do	173	51.5	1
5294	.....do	244	48.4	3
5363	Balayan Bay, Luzon	180	....	12
5365	.....do	214	....	7 plus [1] 12.
5368	Near Marinduque Island	181	....	1
5371	.....do	[2] 83	....	1
5374	.....do	190	....	5
5409	Between Cebu and Leyte	189	....	6
5418	Between Cebu and Bohol	159	54.4	1
5419	.....do	175	54.5	1
5501	Northern Mindanao and vicinity	214	54.3	7
5502	.....do	214	....	24
5503	.....do	226	53.3	8
5504	.....do	200	54.3	1
5505	.....do	220	....	3
5506	.....do	262	53.3	9
5508	.....do	270	53.3	Type.
5508	.....do	270	53.3	6
5535	Between Cebu and Siquijor	310	53.3	4
5536	Between Negros and Siquijor	279	53.5	2
5537	.....do	254	53.5	11
5542	Northern Mindanao and vicinity	200	54.3	3
				159 plus [2] 81.

[1] The condition of these specimens makes them almost unrecognizable; they are assumed to be *torvus*.
[2] Depth estimated from chart; probably an error.

The diagnostic characters of this subspecies, which is confined to the west-central region of the Philippine Islands, are given under the head of *Hymenocephalus striatissimus*.

(*torvus*, staring, from the large eyes.)

50. HYMENOCEPHALUS STRIATISSIMUS AEGER, new subspecies.

Hymenocephalus striatissimus Weber,[1] Fische der *Siboga*-Expedition, 1913, p. 168 (part, includes also *H. longiceps*, q. v.).

Type-specimen.—Cat. No. 78228, U.S.N.M., 158 mm. long to end of whip-like tail, 40 mm. long to anus; dredged at *Albatross* station 5621 (0° 15′ 00″ N.; 127° 24′ 35″ E.)

The material includes typical specimens from the East Indian Islands, south of the Philippines, and, in addition to these, specimens from the Tawi Tawi Archipelago, which seem to be intergrading to-

[1] The measurements which Weber gives of two specimens and his count of 8 ventral rays indicates that he had this small eyed subspecies rather than *H. s. striatissimus* or *H. s. torvus*.

ward *H. s. torvus*. Both sets are discused under the present heading. The stations at which each were taken are given separately in the following lists:

List of typical specimens.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5626	Between Gillolo and Kayoa Islands	265	....	1
5625	.....do	230	....	5
5621	Between Gillolo and Makyan Islands	298	....	38
[1] 5593	Vicinity of Sibuko Bay, Borneo	[1] 38	....	1
5590	.....do	310	44.3	1
5589	.....do	260	45.7	26

[1] The tag borne by this specimen (No. 4540) corresponds to station 5593, but it is almost certain that an error has crept in here, as the species probably never lives in such shallow water; it is probable that the specimen was obtained at one of the deeper hauls earlier in the same day.

List of specimens varying toward H. s. torvus.

			° F.	
5172	Vicinity of Jolo Island	318	....	33
5173	.....do	186	....	1
5549	.....do	263	52.3	1
5550	.....do	258	52.3	1
5551	.....do	193	53.3	2
5563	Between Jolo and Tawi Tawi	224	52.3	7
5564	.....do	236	52.3	5
5565	.....do	243	52.3	2
5566	.....do	244	52.5	1
5576	North of Tawi Tawi	277	53.3	1

The distinctive characters of this subspecies are given under the heading of *Hymenocephalus striatissimus*. In other respects the description of this form will apply very well to either of the two other subspecies, *torvus* and *striatissimus*. The following description is based only on the typical series.

The body is robust anteriorly, becoming rather suddenly constricted and then attenuate behind into a whip-like tail; the length of the head is contained 6.32 times in the total length. The head approaches a rectangular outline, when viewed from above, before, or from the side; it is notably compressed, the greatest width being equal to its postorbital length. The snout is short and blunt, scarcely projecting beyond the mouth, 3.7 (to 4.5) in head. The middle of the length of head lies immediately behind the pupil; the same sometimes holds true in *striatissimus*. The orbit is obliquely oval; its greatest length, 2.8 in head, 1.3 in postorbital, varying from 1.15 to 1.4 (0.9 to 1.1 in typical *striatissimus*). Interorbital width about equal to length of orbit (decidedly less in *striatissimus* proper). As in *torvus* and *striatissimus*, the suborbital is somewhat narrower than the pupil (about two-thirds length of pupil in the type of *torvus*). The vertical from the hind margin of the maxillary passes through the eye behind the pupil. The barbel is shorter than the pupil in the type-specimen, but is usually longer; the variation of its length, as compared with the same measurements of the other subspecies.

has already been given. The teeth, of small size, are crowded into narrow bands on the jaws.

The fins are essentially like those of the other forms, the chief difference being in the number of ventral rays, which is 8 (7 in *torvus*); 127 fins were counted, of which 125 had 8 rays; the two fishes with 7 rays in one ventral had 8 rays in the other. The lengths of the various fins, when entire, are given in the table of proportional measurements. The base of the pectoral lies between the verticals from the origin of the dorsal and the base of the ventral.

Coloration in alcohol: brown on the trunk, becoming much darker near the front of the first dorsal fin and near the occiput; the tail is light yellowish, with traces of a median silvery streak; the middle of the sides of the trunk is silvery; the belly is underlain with darker,

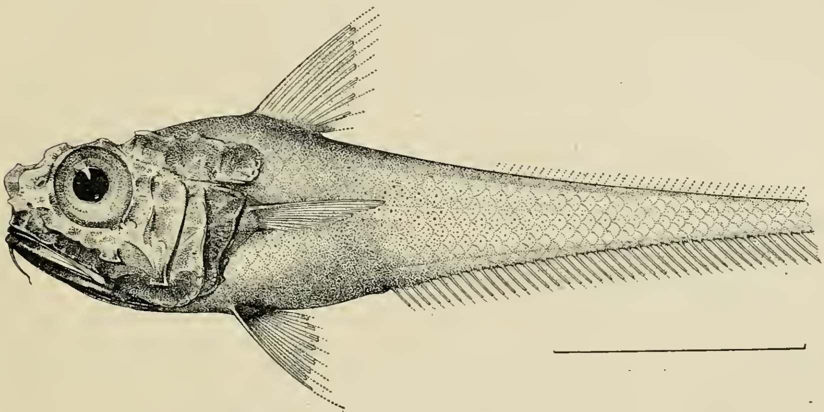

FIG. 32.—HYMENOCEPHALUS STRIATISSIMUS AEGER. TYPE.

but superficially is silvery behind the ventrals and coppery before them. The region of the belly, extensively striated, is separated from the sides by a dark line, which extends from the blackish streak at the pectoral base to the anus; this dark line lies over the postclavicle. Below this streak the skin becomes more leathery than elsewhere, and is marked by a pattern of "striae," consisting of fine parallel and alternating lines of purplish black and silvery color connected with structural modifications. The lines are vertical (or transverse below) along the sides of the isthmus and backward to the ventrals and thence upward on the face of the shoulder girdle to before the pectoral fins, and backward almost to the anus. The striae in a small patch inward and forward from the ventrals are irregularly arranged, like the papillary ridges on one's fingers. Toward the mid-ventral line behind the ventral fins the striae become longitudinal. A squarish region before the ventrals, the center of which is located at the anterior lens-shaped organ, is devoid of striae. The gular membranes, as in the other subspecies of *striatissimus* and as in *long-*

iceps and *longipes*, are marked by two types of striae: the typical striation is fine and irregular, and in addition to this there occur coarser black cross lines. The black ring about the anus, surrounding also the posterior lens-shaped organ, is continued forward to and about the smaller anterior organ.

The cheeks and the surface of the preopercular region are brilliantly silvery; the opercle is dark, but with metallic luster; the ventral half of the suborbital region and the space between the eyes show a blackish color through the delicate superficial membranes. The snout, between and before the nostrils, is translucent; the mandible is mostly dark, but whitish along the lower lip; the end of the maxillary is also whitish. The extreme whitish margin of the buccal cavity lies just behind a dark area; the roof of this cavity is silvery, but the tongue is whitish, as is also the region before it, with the exception of a median black triangle, pointed forward; the branchial cavity is dark brown on its roof, and whitish on its lower sides, but margined by a blackish band with an extreme whitish edge on the opercular and branchiostegal membranes. The parietal peritoneum is purplish brown, underlain with silvery.

The vertical fins are usually clear, with a spot at the base of each ray, but the first anal ray and the dorsal spines are sometimes blackish; the distal half of the first dorsal fin is sometimes dusky, as in the type of *torvus*.

The specimens from the Tawi Tawi Archipelago, which are regarded as intergrades between *aeger* and *torvus*, agree with the preceding description in all characters but those showing intergradation toward *torvus*, as has already been discussed.

Table of measurements in hundredths of length to anus (typical specimens of H. s. aeger).

Albatross station	5621	5621	5621	5621	5589	5589
Total length in mm	165	145	....	....	....	....
Length to anus in mm	39	36	42	36	37	39
Length of head	64	62	64	64	67	62
Length of orbit	22	23.5	22	25	25	25
Width of interorbital	21	22	21	21	22	21
Orbit to preopercle	30	30	29	27	30	29
Width of suborbital	9	9	9	7	10	9
Length of snout	18	19	14	17	19	18
Length of upper jaw	32	34	35	37	....	....
Length of barbel	11	9	9	14	13.5	9
Depth of body	49	45	48	47	....	....
Width of body	30	22	27	32	....	....
Height of second dorsal spine	....	42	....	....	....	....
Height of first dorsal base	21	22	23	23.5	....	....
Interdorsal space	55	61	52	53	....	....
Height of first anal ray	....	....	....	20	....	....
Length of first pectoral ray	2	3	....	....	....	....
Length of second pectoral ray	....	....	38	39	....	....
Length of third pectoral ray	....	....	41	41	....	....
Length of outer ventral ray	....	....	....	52	58	48
Length of second ventral ray	....	32	....	31	....	....
Soft rays, first dorsal	8	8	9	9	....	....
Ventral rays	8	8	8	8	....	....
Pectoral rays	13	15	15	13	....	....
Gill-rakers, lower limb, second arch	19	18	19	19	18	17

(*aeger*, feeble.)

51. HYMENOCEPHALUS GRIMALDII Weber.

Hymenocephalus grimaldii WEBER, Fische der *Siboga*-Expedition, 1913, p. 169, pl. 1, fig. 1.

This species seems to be a close ally of *H. striatissimus*, from which it differs in several characters: the eye is smaller, less than one-third length of head, and less than the interorbital width, which is wider, being two-fifths length of the head; the barbel is absent; there are only 10 pectoral rays.

These measurements and counts are taken from Weber's work, since the *Albatross* failed to obtain this species.

52. HYMENOCEPHALUS NASCENS, new species.

Hymenocephalus lethonemus WEBER, Fische der *Siboga*-Expedition, 1913, p. 167 (not of Jordan and Gilbert).

Type-specimen.—Cat. No. 78229, U.S.N.M., 143 mm. long to end of pseudocaudal, 47 mm. to anus; dredged at *Albatross* station 5587; depth, 415 fathoms; bottom temperature, 42.3° F.

The large number of specimens of the *lethonemus* type in the collection from the Philippine and East Indian Islands has made possible a very close comparison of them with typical *H. lethonemus* from Japan.[1] A single difference has been disclosed; namely, an increased average number of ventral rays. We regard *nascens* as a species rather than as a subspecies because there is no evidence at hand of the intergradation of the two forms. The number of ventral rays is summarized in the following table:

Number of ventral rays in Hymenocephalus lethonemus from Japan and in H. nascens from the Philippine and East Indian Islands.

	11	12	13
H. lethonemus	38	4	
H. nascens	9	103	2

The type-specimens of *H. lethonemus* also have 11 ventral rays; Weber gives 12 or 13 as the number of rays in the specimen of *nascens* which he referred to *lethonemus*. Most of the 9 fins of *nascens* with 11 rays are paired by a ventral with 12 rays.

[1] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 615, text figure; Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51 1916, p. 188.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5310	China Sea, vicinity of Hongkong	100	65.5	1
5114	China Sea and adjacent waters off southern Luzon	314		1
5115 or 5116	....do	340 or 200	? or 50.2	1
5119	....do	394	43.7	1
5282	....do	248	47.4	7
5373	Vicinity of Marinduque Island	338	51.8	2
5445	East coast of Luzon	383	44.3	1
5510	Vicinity of northern Mindanao	423	53.0	1
5586	Vicinity of Sibuko Bay, Borneo	347	44.0	11
5587	....do	415	42.3	1
5589	....do	260	45.7	28
5622	Between Gillolo and Makyan Islands	275		3
5623	....do	272		1
5624	....do	288		7
Lost				1

From the data presented above it seems probable that this species inhabits water averaging deeper and colder than any other Philippine species of the genus, with the probable exception of *H. barbatulus.* The record from near Hongkong is unusual, and possibly erroneous.

The body is robust anteriorly, its greatest depth, below origin of first dorsal, being contained but 1.25 times in length of head; the paratypes, especially smaller ones, are more slender, the depth being contained from 1.35 to 1.5 times in head (2.0 times in *H. gracilis*). The lateral outlines of the head are strongly and evenly curved anteriorly; the sides of the head posteriorly are subvertical on the middle third, but are concave above and below. The width of the head is decidedly greater than its postorbital length. The snout projects horizontally forward from the vertical through front of premaxillaries a distance half as long as the pupil; the snout is a little shorter than the interorbital, its length is contained 1.25 (1.1 to 1.4) times in the orbit, and 3.8 (3.7 to 4.1) times in the head. The orbit is of irregular outline; its oblique length, which is the greatest, is contained 1.4 (1.3 to 1.5) times in the postorbital, or 3.0 (2.9 to 3.3) times in the total, length of head. The middle of the length of the head is midway between the hind margins of the pupil and of the orbit (varying to each of these limits in the paratypes). The least width of the interorbital space, contained 3.35 (3.0 to 4.0) times in the head, lies above the front of the pupil, from which place the sides of the interorbital diverge widely posteriorly; the least suborbital width is about equal to the diameter of the pupil. The length of the long and slightly oblique upper jaw is contained 1.9 (1.8 to 1.9) times in the head. The teeth are minute, and occur in narrow bands along the jaws. No trace of a barbel is developed. The angle of the preopercular ridge is sharp, but scarcely produced backward; the crenulate margin of the preopercle is evenly rounded. In the degree to which the sensory canal system and thin bony septa of the head are developed, this species holds a position intermediate between *striatissimus* and its allies on the one hand, and *longiceps* and *longipes* on the other. The gill-membranes, which are free from the sides of the isthmus, unite, with a free fold, below the posterior margin of the orbit. The gill-rakers are arranged as in other species of the subgenus *Hymenocephalus;* there are two series of 18 on the lower limb of the outer arch; those of the outer series are decidedly more crowded and smaller than those of the inner series, as they are confined to the restricted limits of the first gill-slit, which is only about as long as the orbit. Seven branchiostegals.

The distance between the anus and the ventral base is equal to the distance from the tip of the snout to the hind margin of the orbit,

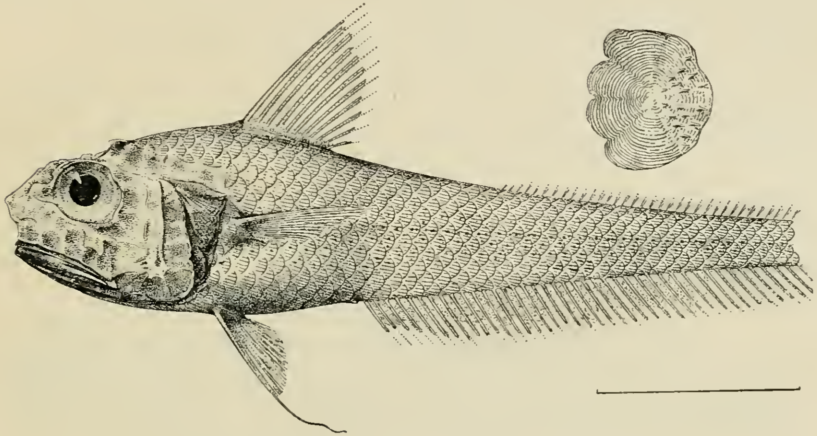

FIG. 33.—HYMENOCEPHALUS NASCENS. TYPE.

and about equal to the distance between the ventral base and the fold of the gill-membranes across the isthmus.

The ventral lens-shaped organs are both round; the diameter of the posterior of the two, although about twice that of the anterior one, is but one-fourth that of the pupil (half pupil in *longiceps* and *longipes*).

The few large scales retained on the side of the type bear 10 to 16 fine sharp spinules, directed backward, and arranged in quincunx order. The lateral line is rather poorly developed; it is separated from the first dorsal base by 2 rows of scales and from the front of the second dorsal by 4 rows.

No denticulations on the second dorsal spine are apparent. The length of the first dorsal base is contained 1.9 (1.5 to 2.1) times in the interval between the dorsal fins, and 1.2 (1.2 to 1.3) times in the postorbital length of the head. The length of the weak and slender pectoral fin is contained 1.6 (1.6 to 1.9) times in the head; the outer ventral ray, with its filament, 1.25 (1.1 to 1.3) times; the second ventral ray, 2.1 (2.0 to 2.35) times, barely reaching to the anus.

The color, darker in general than in most species of the subgenus, is purplish brown, becoming darker below the first dorsal fin; bluish black on the belly, chin, and opercles; and brownish black about the occiput. The lower sides of the trunk and the median strip of the tail are silvery, as are also the sides of the head. The upper parts of the head and the snout are translucent; the front margin of the snout is black; the inner wall of the suborbital cavity is dark ventrally. The roof of the buccal cavity is mainly silvery; the branchial cavity is lined with white, for the most part, but with black posteriorly on its outer sides (leaving the extreme rim of the branchiostegal and opercular membranes white); the parietal peritoneum is blackish, but underlain by silvery. The first dorsal fin is dusky, the anal lighter; the paired fins are light and clear, but with a black base which is preceded ventrally by an area with metallic luster; the base of each ray in the second dorsal and anal fins is marked by a black spot.

The striations are not so widely developed as in *striatissimus*, *longiceps*, *longipes*, and certain other species. The striated area extends backward from the ventral base about half way to the anus, and forward, from above the ventral base, along the sides of the isthmus. The striations are obsolete on and just below the pectoral base, immediately anterior to the ventral bases, and on the gular membrane, which, however, is crossed by the usual black lines not similar to the true "striae."

Table of measurements in hundredths of length to anus.

	H. lethonemus.				*H. nascens.*		
					Type.	Paratypes.	
Albatross station	4919	5060	4919	4919	5587	5114	5115 or 5116
Total length in mm	180+	[1] 122	[1] 182	[1] 177	[1] 143	152	160
Length to anus in mm	49.5	45	50	49	47	42	43
Length of head	67	63	67	65	63	66	64
Length of orbit	23	20	20	19	21	21	21
Width of interorbital	19	20	20	20	19	20	20
Width of suborbital	9	9	9	8.5	10	9	9
Orbit to preopercle	29	30	30	29	29	31	29
Length of snout	20	19	22	19	18	19	18
Length of upper jaw	35	33	36	34	34	38	36
Depth of body	45	40	40	43	45	45	48
Anus to ventral	....	33.5	....	....	35	....	....
Ventral to gill-membrane	....	37	....	....	36	....	....
Height of first dorsal base	23	22	26	24	26	27	27
Interdorsal space	42	37	38	47	49	42	41
Length of first pectoral ray	2	4	....	....	3	....	....
Length of second pectoral ray	40	37	35	33	33	....	36
Length of third pectoral ray	40	40	38	35	36	....	....
Length of outer ventral ray	70	....	59	....	....	59	....
Length of second ventral ray	....	30	30	28	29	....	27
Soft rays, first dorsal	10	11	11	10	11	10	11
Ventral rays	12	11	11	11	12	11	12
Pectoral rays	13	13	15	16	17	15	15
Gill-rakers on lower limb of second arch	18	19	....	....	19	19	....

[1] A pseudocaudal developed.

(*nascens*, being born, applied to this form to designate it as an incipient species.)

PAPYROCEPHALUS, new subgenus.

Type-species.—Hymenocephalus aterrimus Gilbert.

Three species of *Hymenocephalus* differs so widely from all others in certain characters that we have erected for them this new subgenus, *Papyrocephalus.* These species are *H. aterrimus* Gilbert[1] (Hawaiian), *H. papyraceus* Jordan and Gilbert[2] (Japanese), and *H. barbatulus*, new (Philippine). They are mutually characterized by their deep, sharply compressed bodies; by the excessive development of the shallow sensory canals of the head; by having the bony septa even much thinner and weaker than in typical *Hymenocephalus;* by the great width of the suborbital and preopercle; by the small eye; and by the blackish color, they being without the silvery sides characteristic of all other known forms.

53. HYMENOCEPHALUS BARBATULUS, new species.

Type-specimen.—Cat. No. 83652 U.S.N.M., 98 mm. long to end of tail, which is broken at its extreme tip, 27 mm. to anus; dredged with the single paratype 57 mm. long at *Albatross* station 5238, in

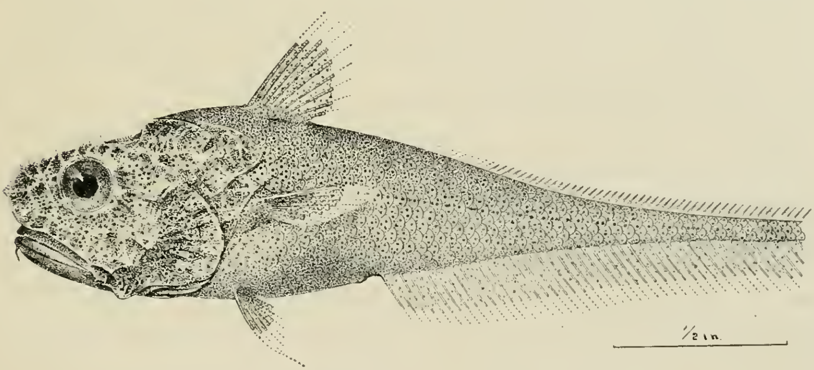

FIG. 34.—HYMENOCEPHALUS BARBATULUS. TYPE.

the Pacific Ocean, off the eastern coast of Mindanao; 380 fathoms; bottom temperature, 43.0° F.

Fin-rays—first dorsal, II, 8; pectorals, about 10; ventrals, 7 (11 in *papyraceus*, 13 or 14 in *aterrimus*).

The body is deep and compressed, tapering rather abruptly into the usual whip-like tail; greatest depth of body, 1.4 in length of head; greatest width of head, about equal to postorbital length of head. The head is bluntly rounded anteriorly, its lateral contours are subparallel. The length of the blunt snout is greater than that of the orbit, is nearly equal to the interorbital width, and is contained 3.3 times in the length of head. The orbit is small, being

[1] Gilbert, Bull U. S. Fish Comm., 1903 (1905), sec. 2, p. 666, pl. 93.
[2] Jordan and Gilbert, Bull. U. S. Fish. Comm., 1902 (1904), p. 614, text figure.

little wider than the suborbital; its length is contained two times in the postorbital, or four times in the entire length of the head. The middle of the length of the head lies between the hind margins of the pupil and of the orbit. The mouth is large, terminal, and oblique; the length of the upper jaw enters twice into the head. Fine teeth are arranged in very narrow bands on the jaws. The barbel is evident, but decidedly shorter than the pupil. The distance between the angle of the preopercular ridge and the margin of the preopercle is equal to the orbit. The sensory canals are much wider but shallower than in typical species of *Hymenocephalus;* the bones are excessively delicate and papery. The gill-membranes are free from the sides of the isthmus; the first gill-slit is less restricted than usual in this subfamily; about 13 short and spinous gill-rakers were counted on the first arch.

The anus is located immediately before the anal fin, at a distance from the ventral base contained 1.6 times in the head; this distance is decidedly longer than that from the tip of the snout to the hind margin of the orbit.

The lens-like structures on the midventral line are small; the one immediately in advance of the anus is double, consisting of two small closely connected hemispheres lying side by side, the division being more complete than in *striatissimus.*

The few scales retained are round and wholly spineless, as in *aterrimus*, *gracilis*, and *tenuis.*

Base of first dorsal fin, 1.7 in postorbital. The rays of the paired fins are weak (broken in types).

Color in alcohol: blackish on the head and trunk and on the first dorsal and the ventral fins, becoming brown on the tail, with a black spot at the base of each anal ray; the pectoral fin is dusky. The buccal cavity is black along the margins of the jaws, but light on the tongue and silvery on the roof of the cavity; the branchial cavity is lined with dusky, the peritoneal cavity with black (underlain with silvery).

The striated region is confined to the sides of the isthmus and to the area immediately above and behind the ventral fins.

This species is closely related to *H. aterrimus*[1] and to *H. papyraceus*[2] forming with them the group which we have just called *Papyrocephalus*. *H. barbatulus* agrees with *papyraceus* in the possession of a small barbel, which is lacking in *aterrimus.* The number of ventral rays serves to distinguish all three species: in *barbatulus* there are but 7; in *papyraceus*, 11; in *aterrimus*, 13 or 14.

(*barbatulus*, in reference to the short barbel.)

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[1] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 666, pl. 93 (Hawaiian Islands).

[2] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 614, text figure (Sagami Bay, Japan).

Genus MALACOCEPHALUS Günther.

For a description of this genus with a discussion of its relationships, and for a key to the four species it contains, reference may be made to our report on the macrouroid fishes in Japan.[1]

54. MALACOCEPHALUS LUZONENSIS, new species.

Malacocephalus, species, GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 189.

Type-specimen.—Cat. No. 83626 U.S.N.M., 56.5 mm. long to anus; dredged at *Albatross* station 5440.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5282	Off southern Luzon	248	47.4	2
5291	.....do	173	51.5	1
5440	Off western Luzon	172	53.2	Type.
5476	Off eastern Luzon	270	48.3	1

Fin-rays—first dorsal, II, 10; pectorals 16 or 17, ventrals, 9.

This species is characteristically blunt-headed; the greatest depth, between the vertical from front of first dorsal and that from the preopercular ridge, is contained 1.2 times in the head. The snout is unusually low and blunt, its bony tip is on a horizontal from the lower margin of pupil; preocular length of snout, 4.2 in head; preoral length, 3.7 in postorbital. The least interorbital width slightly exceeds the length of orbit. The ridge and margin of the preopercle are sharply produced backward at their angles; the least suborbital width is nearly equal to the diameter of pupil. The mouth is large and oblique; the length of the upper jaw, which extends backward well beyond the orbit, is contained 1.8 times in the head; the teeth are stronger than in the Japanese or Hawaiian species, the longest being about one-seventh as long as the orbit; the teeth are recurved, and are arranged in two series in the upper jaw, of which the outer row is enlarged, like the single series on the lower jaw. The barbel is long and slender, being contained 1.6 times in the orbit. The gill-membranes form a narrow free fold across the isthmus below the posterior margin of the orbit; this wide forward extension of the branchial aperture in *Malacocephalus* is evidence of relationships with *Hymenocephalus* and with *Ventrifossa*, the next genus to be described.

The scales are very small; about 13 series separate the prominent lateral line from the origin of the second dorsal; each scale is armed with about 10 small suberect spinules arranged in a diamond-shaped patch on each scale. The anterior curve of the lateral line is long and low. The gular membrane is naked; the branchiostegal membrane is scaled over the 7 rays.

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 136, 141, 189.

The pyloric caeca, as in the other Pacific species, are very numerous, and are branched. The center of the anus is placed well in advance of the anal origin, the interspace being about one-half of the distance between the anus and the ventral fin, or one-fifth the postorbital length of the head. There is a small naked fossa between the ventral fins.

The dorsal spine is without denticulations.

The color in alcohol is silvery gray, clearest along the middle of trunk and tail, becoming brownish on the back, dusky on the opercles and gular membranes, and blackish between the ventrals and the anus.

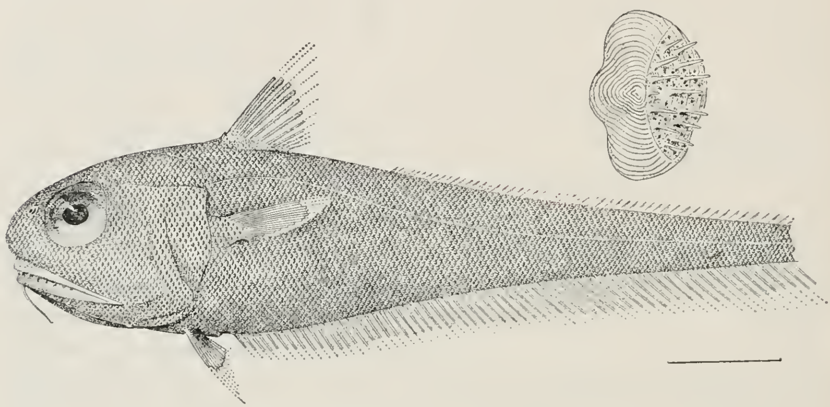

FIG. 35.—MALACOCEPHALUS LUZONENSIS. TYPE.

This species is well distinguished by its blunt, low snout, strong dentition, long barbel, uniform dusky fins, etc. In these diagnostic characters the four paratypes, which are in poor condition, agree with the holotype.

Table of measurements in hundredths of length to anus.

	Types.		Paratypes, *hawaiiensis*.		
	Luzonensis.	*Nipponensis.*			
Albatross station	5440	4967	4134	4134	4134
Total length in mm	....	[1] 406	340+	330+	285+
Length to anus in mm	56.5	77	69	66	53
Length of head	89	92	85	84.5	86+
Length of orbit	29	30.5	31	29	31
Width of interorbital	31	32	26	28	29
Width of suborbital	10	11	10	9	9
Orbit to preopercle	44	42	37	36	39
Length of snout	21	27	23	24.5	24
Postorbital length of head	42	43	35	36	36.5
Length of upper jaw	48	47	40.5	40	42
Length of barbel	18	15	13.5	16	17
Depth of body	76	....	74	71	84
Width of body	45	45	44	42.5	39
Anus to anal	9	17	7.5	10	9
Anus to ventral	15	17	17	17	16.5
Ventral to isthmus	35	34	29	30	27
Length of first dorsal base	22	26	26	24.5	28

[1] A pseudocaudal developed.

(*luzonensis*, from the type locality.)

55. ? MALACOCEPHALUS LAEVIS (Lowe).

Malacocephalus laevis WEBER, Fische der *Siboga*-Expedition, 1913, p. 166.

Doctor Weber has kindly reexamined his material for us, and has made some measurements on the head which indicate that his specimens are not referable to *M. luzonensis.* The measurements referred to are as follows:

Siboga station	38	38	314
Total length	300 mm.	321	283
Preocular length of snout	15.5 mm.	15	11
Preoral length of snout (from front of premaxillary)	12 mm.	12.5	13
Postorbital length of head	27 mm.	23.5	22

Whether these specimens are really referable to *M. laevis* is not evident. We have no specimens of that species.

VENTRIFOSSA, new genus.

Type-species.—*Coryphaenoides garmani* Jordan and Gilbert.

In the synopsis of the genera of Macrouroid fishes, which was included in our report on the fishes of this family from Japan,[1] we separated out a group of species [2] (*e*) distinguished by the number of branchiostegal rays (seven), and by the position of the anus (remote from the anal fin). The genus *Malacocephalus* was next separated from the other genera: *Lionurus*, *Mataeocephalus*, *Trachonurus*, and *Cetonurus.* But in the description of *Lionurus* [3] it was noted that nine species differed widely from the others, but closely resembled *Malacocephalus* in the large subterminal mouth and other characters. These species, together with two new ones which we are describing in this report, further agree with *Malacocephalus* in the ventrolateral extension of the gill-slit, which is continued forward to below the posterior rim of the orbit. In *Cetonurus*, *Trachonurus*, and *Mataeocephalus*, as well as in the other species which we referred to *Lionurus*, the gill-membranes unite below the ridge of the preopercle or thereabouts, except in certain aberrant species like *pumiliceps*, in which the whole ventral region of the head and trunk has migrated forward, producing a very peculiar physiognomy.[4] In all the species of *Malacocephalus* and *Ventrifossa* the length of the upper jaw is contained decidedly less than 3 times in the head, while in all other species in the group of genera under discussion, the length of the upper jaw is contained about three times (*Lionurus stelgidolepis*, *Trachonurus villosus*) or more than three times (usually much more) in the head.

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 135 to 214.

[2] In the listing of the species we erroneously referred to *V. nigromarginata* as *L. nigromaculatus.*

[3] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 192.

[4] Owing to the intermediate position of several species, we are unable to define or delimit a group based on *pumiliceps* and its nearest allies.

There can be little question as to the naturalness of this group of species, although they have been described as members of the following diverse genera: *Macrourus*, *Optonurus*, *Malacocephalus*, *Coryphaenoides*, *Chalinura*.

KEY TO THE SPECIES OF VENTRIFOSSA.

a^1. A scaleless ventral fossa, not pearly, nor lens-like, situated between the ventral fins, of variable size, and usually separated by a more or less complete scaly bridge from the peritroct; mouth little oblique; spinules on scales arranged in quincunx order.

b^1. Teeth of lower jaw in two series; canines of upper jaw arrow-shaped; denticulations of dorsal spine obsolescent; scales with a few short spinules; orbit about 3 in head__________(ATHERODUS, new subgenus.) *atherodon*.[1]

b^2. Teeth of lower jaw in three or more series, forming a narrow band; denticulations of dorsal spine numerous and sharp; scales beset with numerous spinules________________________________(Subgenus VENTRIFOSSA.)

c^1. Sides of head and body brownish, with little or no silvery; scales small.

d^1. Preopercle not produced backward at its angle; outer ventral ray filamentous; upper jaw shorter, its length $2\frac{3}{5}$ in head__*macronemus*.

d^2. Preopercle produced backward at its angle; outer ventral ray not filamentous; upper jaw longer, its length $2\frac{1}{3}$ in head_______*misakia*.

c^2. Sides of head and body bright silvery; scales of moderate size.

e^1. An area of enlarged spineless scales behind first dorsal; eye about 4 in head; 6 rows of scales from last ray of first dorsal to lateral line; first dorsal black, with a white base and tip (Alcock). *petersonii*.

e^2. No area of enlarged or spineless scales behind first dorsal fin; orbit 3.5 in head, or larger.

f^1. Preopercular ridge not sharply produced backward.

g^1. First dorsal fin with a distinct black spot; ventrals blackish.

h^1. Ventral fossa very small, as in *garmani*, its front being behind the bases of the outer ventral rays; barbel about $\frac{2}{3}$ as long as the snout________________________________*nigrodorsalis*.

h^2. Ventral fossa of moderate size, its front being in line with the outer ventral rays_______________________________*ctenomelas*.

g^2. First dorsal fin without a distinct black spot; ventrals paler; ventral fossa small; barbel longer than the snout, being contained 2.8 to 4.0 times in the head.

i^1. 7 to 9 series of scales separating the front of second dorsal from lateral line row; interorbital width less (0.20 to 0.23, usually 0.21 or 0.22 of length to anus_____________*divergens*.

i^2. 6 series of scales above lateral line; interorbital wider (0.22 to 0.29, usually 0.25 to 0.27 of length to anus)________*garmani*.

f^2. Preopercular ridge sharply produced backward at its angle. *occidentalis*.

a^2. A lens-like organ immediately before anus, and another between the ventrals, much as in *Hymenocephalus;* mouth little oblique; spinules on scales arranged along parallel series_____________LUCIGADELLA, new subgenus.) *nigromarginata*.

[1] This species approaches the genus *Malacocephalus* most closely.

a^3. A conspicuous pearly body in a sheath between the ventrals; mouth notably oblique, spinules on scales arranged in quincunx order (LUCIGADUS, new subgenus) -- *lucifer*.

Three species, *atherodon*, *nigromarginata*, and *lucifer* are sharply distinguished from the others, and may serve as the respective types of the new subgenera *Atherodus*, *Lucigadella*, and *Lucigadus*. (*Ventrifossa*, in reference to the scaleless fossa present in the typical species between the ventral fins.)

Subgenus VENTRIFOSSA Gilbert and Hubbs.

56. VENTRIFOSSA MACRONEMUS Smith and Radcliffe.

Macrourus macronemus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 115, pl. 24, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5114	Off southwestern Luzon	340	....	1
5424	Jolo Sea, near Cagayan Islands	340	50.4	Type.
5528	Between Siquijor and Bohol Islands	439	53.3	1

This species is related most closely to *V. misakia*, of Japan and the east coast of Luzon.

(*macronemus*, in reference to the produced outer ventral ray.)

57. VENTRIFOSSA MISAKIA (Jordan and Gilbert).

Coryphaenoides misakius JORDAN and GILBERT, Bull. U. S. Fish. Comm., 1902 (1904), p. 611, text fig.

Lionurus misakius GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 194.

Macrourus asper JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306, pl. 38, fig. 2 (not *Coryphaenoides asper* Günther).

A single specimen of this well-marked species, hitherto known only from Japan, was collected during the Philippine cruise; it was dredged at *Albatross station* 5445, off the southeastern coast of Luzon; depth, 383 fathoms; bottom temperature, 44.3° F.

Dorsal rays, II, 10; ventral rays, 8.

We compare this specimen in the following table with two, including the type, from Japan. Certain differences are indicated which render somewhat doubtful the reference of our specimen to *V. misakia*. The snout is longer; the barbel much longer; the distances greater between the anus and the origin of the anal fin and between the ventral base and the isthmus.

Table of measurements in hundredths of length to anus.

	Eastern Luzon.	Japan.	
Albatross station	5445	Type.	....
Total length in mm	170+	340+	113+
Length to anus in mm	36	80	30
Length of head	92	85	90
Length of orbit	36	30	41
Width of interorbital	28	28	29
Width of suborbital	13	10	12
Orbit to preopercle	39	38.5	37
Length of snout	26	21.5	....
Length of upper jaw	37	35	38
Length of barbel	10	4	4
Depth of body	62	63	62
Width of body	32	36	28
Anus to anal	17	11.5	13
Anus to ventral	12	11.5	13
Ventral to isthmus	30	28	26
Length of first dorsal base	22	22.5	22
Interdorsal space	33	37	....

(*misakius*, from the type locality.)

58. VENTRIFOSSA NIGRODORSALIS, new species.

Type-specimen.—Cat. No. 83627, U.S.N.M.; 214 mm. long, 45.5 mm. to anus; *Albatross* station 5502, off the northern coast of Mindanao; depth, 214 fathoms.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5317	China Sea, vicinity of Formosa	230	50.6	1
5113	China Sea, off southern Luzon	159	....	1
5122	East coast of Mindoro	220	....	6
5124	....do	281	....	6
5172	Vicinity of Jolo	318	....	2
5198	Vicinity of western Bohol	220	53.9	1
5221	Between Marinduque and Luzon	193	52.4	6
5222	....do	195	52.8	11
5259	Off northwestern Panay	312	49.3	1
5348	Palawan Passage	375	56.4	1
5363	Balayan Bay, southern Luzon	180	....	8
5365	....do	214	....	5
5374	Vicinity of Marinduque Island	190	....	11
5388	Between Burias and Luzon	226	51.4	6
5404	Vicinity of Dupon Bay, Leyte	190	54.4	1
5406	....do	298	....	2
5409	Between Cebu and Leyte	189	....	12
5444	East coast of Luzon	308	45.3	2
5445	....do	383	44.3	2
5501	Vicinity of northern Mindanao	214	54.3	5
5502	....do	214	....	14
5503	....do	226	53.3	8
5504	....do	200	54.3	6
5505	....do	220	....	5
5508	....do	270	53.3	6
5523	....do	....	....	1
5535	Between Cebu and Siquijor	310	53.3	2
5536	Between Negros and Siquijor	279	53.5	4
5538	....do	256	53.3	1
5542	Vicinity of northern Mindanao	200	54.3	3
5586	Vicinity of Sibuko Bay, Borneo	347	44.0	3
5587	....do	415	42.3	2
5589	....do	260	45.7	4
5590	....do	310	44.3	3
5592	....do	305	43.3	2
5622	Between Gillolo and Makyan Islands	275	....	2
5624	....do	288	....	5
5625	Between Gillolo and Kayoa Islands	230	....	7

In both its geographical and its bathymetric distribution, *V. nigrodorsalis* agrees with the following species, *V. divergens.*

Fin-rays—first dorsal, II, 10 (9 to 11); pectorals, 20 (17 to 23); ventrals, 8 (8 or 9).

The body is deeper than in *V. divergens*, the ventral contour being more strongly arched; the depth below the elevated origin of the first dorsal fin is contained 1.1 times in the head, being more than twice the greatest width of the body. The general appearance of this species in other respects strongly resembles that of *divergens.* The horizontal projection of the snout beyond the premaxillaries is equal to the length of the pupil; preocular length of snout, 3.7; pre-

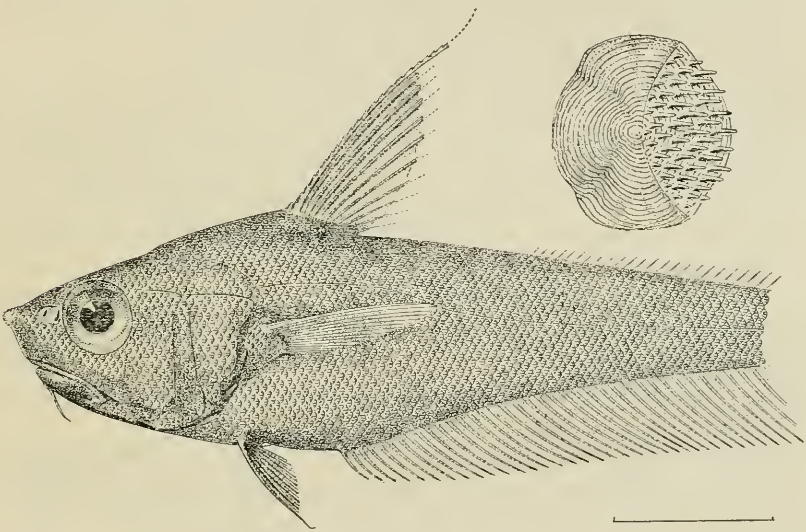

FIG. 36.—VENTRIFOSSA NIGRODORSALIS. TYPE.

oral length, 2.6 in postorbital. The orbit is almost round, 3.4 in head, 1.6 in postorbital. The interorbital is rather narrow, as in *divergens* as contrasted with *garmani;* its least width is contained 1.25 times in the orbit, 2.0 times in the postorbital. The oblique preopercular ridge is not produced backward at its angle. The suborbital width is nearly equal to the diameter of the pupil. The mouth is little oblique and large, the maxillary extending backward almost to the vertical from the posterior margin of the pupil; length of upper jaw, 2.6 in head. The teeth are apparently finer than in *divergens;* the outer premaxillary series is little enlarged. The barbel is well developed but comparatively short, being constantly shorter than in *divergens;* its length is about two-thirds that of the snout. The branchial aperture extends forward to below the hind margin of the orbit; seven branchiostegals.

The scales bear numerous fine spinules close-set in quincunx order. There are 8 (7 to 9) rows between the origin of the second dorsal and the lateral line series.

The anus is situated just behind the ventral fins. A small fossa, about 1 mm. broad, lies between the middle of the ventral bases, being much smaller than in *V. ctenomelas*.

The numerous sharp denticulations of the second dorsal spine are developed along its entire length. The ventral fin is inserted a little in advance of the pectoral. The right pectoral fin of the type-specimen is absent, apparently as the result of an early injury; its base is now completely healed over and covered by small scales.

The color in alcohol, a little darker than in *V. divergens*, is brown, becoming darker and more dusky below the first dorsal fin, and blackish on the belly; the sides shine with silvery reflections. The ridges and margins of the head are mostly dark; the jaws are whitish at the corners of the mouth. The first dorsal fin is dusky, with an intensely black median spot; the pectoral is dark dusky, becoming black on its base and axil; the ventral is blackish, but sometimes lighter either proximally or distally. The lining of the buccal cavity is whitish: that of the branchial cavity is dusky anteriorly, whitish over most of the hyoid region, and blackish within its posterior outer margin, except on the extreme white edge. The parietal peritoneum is silvery, with fine black dots.

The relationships of this species are indicated in the key which is included under the generic heading.

Weber[1] reported on some specimens of this group, referring them to *Macrurus petersoni* Alcock. He distinguished two sets of specimens; the typical ones are probably true *V. petersonii*, but his variants are more probably referable to *V. nigrodorsalis*.

Table of measurements in hundredths of length to anus.

	Paratypes.						Type.
Albatross station	5317	5586	5586	5586	5542	5330	5502
Total length in mm.	192	240	[2] 220	[2] 188	[2] 171	187	214
Length to anus in mm.	38	53	51	49	39	37.5	45.5
Length of head	85	82	84	85	82	92	90
Length of orbit	29	26	24	27.5	26	31	27
Width of interorbital	23	23	23	21	22	24	21
Width of suborbital	10	11	11	11	10	12	11
Orbit to preopercle	33	33	35	33	35	38	38
Length of snout	22	24	26	26	23	27	26
Length of upper jaw	32	34	34	33	30	37	35
Length of barbel	21	18	20	21	18	18	17
Depth of body	76	68	77	68	69	77	81
Width of body	30	34	29	35	32	35	41
Anus to anal	12.1	17.5	18	16	12.5	13	22
Anal to ventral	23	29	27	26	23	22	33
Height of second dorsal spine	73	69	....	72	65	79	....
Height of third dorsal ray	....	63	56	70	63	76	....
Length of first dorsal base	23	25	23	23	22	26	26

[1] Fische der *Siboga*-Expedition, 1913, p. 156.

[2] A pseudocaudal developed.

Table of measurements in hundredths of length to anus—Continued.

	Paratypes.						Type.
Interdorsal space	57	57	60	58	53	....	60
Height of second dorsal	....	15	13	....	....	....	....
Length of first pectoral ray	9	10	9	7	7	5	11
Length of second pectoral ray	49	49	43	48	45	....	48
Length of pectoral fin	50	51	49	54	49	53	62
Length of outer ventral ray	33	40	41	45	33	42	37
Length of second ventral ray	30	32	31	31	26	....	32
Soft rays, first dorsal	10	11	10	10	11	9	10
Ventral rays	9	9	9	9–8	8	8	8
Pectoral rays	20	23	20	20	17	18	20
Scales above lateral line	8	8	8	7	9	8	8
Denticulations of dorsal spine	36+?6	29	....	29	26	48	....
Gill-rakers, lower limb, second arch	11	13	12	12	....	11	11

(*nigrodorsalis*, in reference to the black spot on the first dorsal fin.)

59. VENTRIFOSSA DIVERGENS, new species.

Type-specimen.—Cat. No. 78230, U.S.N.M.; 270 mm. long to end of tail, 54 mm. to anus; dredged at *Albatross* station 5592, in the vicinity of Sibuko Bay, Borneo (lat. 4° 12′ 44″ N.; long. 118° 27′ 44″ E.); depth, 305 fathoms; bottom temperature 43.3° F. The largest paratypes are about 66 mm. long to anus.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5310[1]	China Sea, vicinity of Hongkong	100	65.5	1
5325	Off northern Luzon	224	53.2	2
5329	.....do	212	51.4	1
5259	Off northwestern Panay	312	49.3	1
5269	Off southwestern Luzon	220	....	2
5282	.....do	248	47.4	2
5284	.....do	422	42.3	1
5289	.....do	172	....	16
5290	.....do	214	....	7
5293	.....do	180	57.4	3
5294	.....do	244	48.4	3
5296	.....do	210	....	3
5297	.....do	198	....	2
5444	Off eastern Luzon	308	45.3	2
5590	Vicinity of Sibuko Bay, Borneo	310	44.3	1
5621	Between Gillolo and Makyan Islands	298	....	12

[1] The shallowness and warmth of the water at this station (5310) is unusual for this species, as well as for *Hymenocephalus nascens*.

Fin-rays—first dorsal, II, 9 (3 specimens), II, 10 (15), or II, 11 (8); pectorals, 23 (to 21); ventrals, 8 (11 fins) or 9 (9 fins).

The greatest depth of the body lies below the elevated origin of the first dorsal fin, and is contained 1.25 times in the head; the greatest width of the body is half its depth. The snout is broadly triangular when viewed from above; viewed from the side it is seen to project forward beyond the mouth a distance equal to the diameter of the large pupil; preocular length of snout 3.8 in head; the preoral length is one-third the postorbital. There are no enlarged median nor lateral rostral tubercles. The large orbit is slightly oval in outline; its length, greater than that of the snout, is contained 3.22 (2.9 to 3.4 in 14 paratypes) times in the head, 1.4 times in the postorbital. The least width of the flat interorbital space is contained 1.2 times in the orbit, or 1.8 times in the postorbital; the interorbital is narrower than in the closely related Japanese species, as the following figures indicate:

Table to show least width of interorbital space in hundredths of length to anus.

	20	21	22	23	24	25	26	27	28	29
V. garmani	......	......	2	2	2	4	4	8	2	1
V. divergens	1	3	4	2	......	......	......	......	......	......

The ridge and the margin of the preopercle extend downward and backward, but are not sharply produced backward behind their general courses at their angle. The suborbital width is narrower than the pupil. The mouth is very large and a little oblique; the length of the upper jaw, which extends backward a little farther than the orbit, is contained 2.3 times in the head. The rather coarse teeth are arranged in narrow bands on the jaws; the outer premaxillary series is enlarged. The barbel is long and slender, being nearly as long as the snout in the type, but usually decidedly longer in the paratypes; its free length is contained about four times[1] in the head, but varies in the paratypes as indicated in the following table:

Table showing the length of the barbel in V. divergens as measured into the head.

Length of barbel	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
Number of specimens	5	1	1	3	5	1	1	--	1	1	--	1	1

The sensory canal system of the head is well developed, much as in *Hymenocephalus*, but the membranous roofs over the canals are thicker and are covered by firm scales, and the bony septa supporting these membranes are stronger. The branchial aperture is extended forward to below the hind margin of the orbit. The 13 to 15 short, spinous gill-rakers are better developed than usual in the Coryphaenoidinae, but are not so numerous as usual in the species of *Hymenocephalus*. Seven branchiostegals.

The scales, which are beset with numerous fine spinules arranged in quincunx order, are more numerous than in *V. garmani*, which

[1] Possibly when shortest the barbel has been injured some time during the life of the individual.

has but six rows between the lateral line series and the front of the second dorsal; in *divergens* there are 7 to 9 rows (7 in 2 specimens, 8 in 13, 9 in 7). The gular and branchiostegal membranes are scaleless.

The anus is located just behind the ventral fins; it is preceded, after a scaly interspace, by a very small naked spot or fossa like that of *garmani* and *nigrodorsalis.*

The numerous and fine denticulations of the second dorsal spine are sometimes obscure proximally. The bases of the pectoral and ventral fins are on the same vertical in the type, but in some speci-

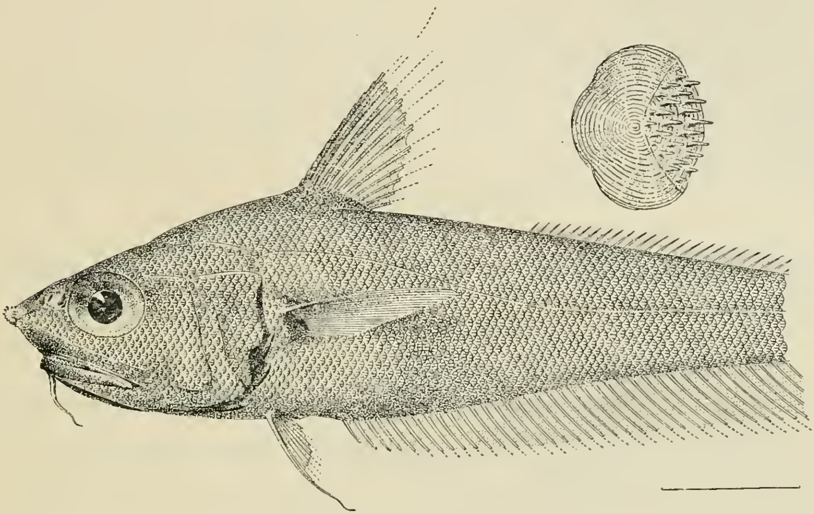

FIG. 37.—VENTRIFOSSA DIVERGENS. TYPE.

mens the ventral is inserted a little farther forward. The second ventral ray extends to the origin of the anal fin.

Color in alcohol, silvery on the sides; brown on the back, becoming darker anteriorly; blackish on the under surface of the trunk and head. and on the jaws, which, however, are whitish about the corners of the mouth. There is a dark streak along the front margin of the snout, and another at the occiput. The first dorsal fin is dusky proximally, but lacks the deep black spot of *nigrodorsalis* and *petersonii;* the base and axil of the pectoral fin are black; the ventral fin is almost black in the type and in some paratypes, but usually is dusky, becoming blackish proximally. The lining of the buccal cavity is mostly whitish; that of the branchial cavity mostly blackish brown, but whitish over most of the hyoid arch and on the extreme free edge of the branchiostegal and opercular membranes. The parietal peritoneum is silvery, with brownish spots.

Table of measurements in hundredths of length to anus.

Albatross station	5284	[2] 5592	5269	5115 or 5116	5260
Total length in mm	285	272	....	222	302
Length to anus in mm	62.5	55	52	48.5	66
Length of head	86	88	82	86	83
Length of orbit	26	27.5	27	28	27
Width of interorbital	23	21.5	21	22.5	22
Width of suborbital	11	10	11	12	10.5
Orbit to preopercle	38	40	38	39	37
Length of snout	24	25	21.5	24	21
Length of upper jaw	40	40	39	40	39
Length of barbel	30	24	28	23	27
Depth of body	76	75	....	79	73
Width of body	37	40	....	30	....
Anus to anal	19	16	....	20	14
Height of second dorsal spine	....	....	....	....	57+
Height of third dorsal ray	....	....	....	....	55+
Length of first dorsal base	25	26	24	26	25.5
Interdorsal space	48	52	51	50	45.5
Length of first pectoral ray	7	4	8	7	5.5
Length of second pectoral ray	38	49	....	....	....
Length of pectoral fin	49	58	....	....	....
Length of outer ventral ray	....	41	....	....	....
Length of second ventral ray	....	29	....	....	....
Soft rays, first dorsal	9	10	11	10	11
Ventral rays	8	8	9	8	9
Pectoral rays	21	23	20	19	19
Scales, above lateral line	7	8	8	8	9
Gill-rakers, lower limb of second arch	13	....	....	15	13

[2] Type-specimen.

(*divergens*, diverging, that is, from *V. garmani*, its representative in Japan.)

LUCIGADELLA, new subgenus.

60. VENTRIFOSSA NIGROMARGINATA (Smith and Radcliffe).

Macrourus nigromarginatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 114, pl. 24, fig. 2.

Lionurus nigromaculatus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 145, 192 (misprint).

List of stations.

Albatross. station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5135	Vicinity of Jolo	161	57.4	2
5172	....do	318	....	2
5198	Vicinity of western Bohol	220	53.9	1
5260	Off southeastern Mindoro	234	51.4	2
5261	....do	145	....	1
5265	Off southwestern Luzon	135	....	1
5388	Between Burias and Luzon	226	51.4	7
5418	Between Cebu and Bohol	159	54.4	1
5501	Vicinity of northern Mindanao	214	54.3	3
5502	....do	214	....	1
5505	....do	220	....	1
5508	....do	270	53.3	1
5516	....do	175	54.3	6
5517	....do	169	54.3	1
5518	....do	200	54.0	2
5519	....do	182	54.3	3
5523	....do	....	....	3
5527	Between Siquijor and Bohol	392	53.3	1
5551	Vicinity of Jolo Island	193	53.3	1
5565	Between Jolo and Tawi Tawi	243	52.3	1
5569	North of Tawi Tawi	303	52.3	1
5575	....do	315	52.3	1
5576	....do	277	53.3	1
5580	Vicinity of Darvel Bay, Borneo	162	55.8	1
5661	Flores Sea (5° 49′ 40″ S.; 120° 24′ 30″ E.)	180	50.5	1

In its distribution this species closely parallels *V. nigrodorsalis;* the two species were often dredged together.

Among the diagnostic characters of this species the coloration, the parallel arrangement of the spinules on the scales, and the presence of two lens-like organs may be mentioned. The lens-like structures closely resemble those of *Hymenocephalus:* the smaller one lies between the ventral fins, the larger one is situated in a naked area immediately before the anus.

(*nigromarginatus*, having a black margin along the anal fin anteriorly.)

LUCIGADUS, new subgenus.

61. VENTRIFOSSA LUCIFER (Smith and Radcliffe).

Macrourus lucifer SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 113, pl. 24, fig. 1.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5268	Off southwestern Luzon	170	....	1
5516	Off northern Mindanao	175	54.3	[1] 4
5517	.....do	169	54.3	1
5519	.....do	182	54.3	8

[1] One of these specimens (Cat. No. 72929, U. S. N. M.) is the type of the species.

This species is one of the most distinct in the entire subfamily. The conical pearly structure directed downward and forward, and ensheathed in the ventral abdominal wall, is highly diagnostic.

The possibility that this organ is phosphorescent led to the naming of this species *lucifer*.

Genus LIONURUS Günther.

Lionurus GÜNTHER, *Challenger* Reports, vol. 22, Deep-Sea Fishes, 1887, pp. 124, 141.—GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 192.

The genus *Lionurus* is here used as we have already modified and defined it,[1] exclusive of those species which are now referred to *Ventrifossa*, a genus which we have just described. As all of the Philippine species have spinous scales, they are all referred to the subgenus *Nezumia*.

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 141, 192.

Subgenus NEZUMIA Jordan.

62. LIONURUS PROXIMUS (Smith and Radcliffe).

Macrourus proximus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 119, pl. 26, fig 2.

Lionurus proximus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol 51, 1916, p. 201.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5201	Off southern end of Leyte Island	554	52.8	1
5202	....do	502	....	Type.
5527	Between Siquijor and Bohol Islands	392	53.3	1

We have already recorded this species from Japan, referred it to its proper position, and given measurements, in hundredths of length, of both the Japanese and the three Philippine specimens.

(*proximus*, from its supposed close relationship with *Coryphaenoides nasutus*.)

63. LIONURUS SPINOSUS Gilbert and Hubbs.

Lionurus spinosus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 199, pl. 10, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Number of specimens.
5463	Off the eastern coast of Luzon	300	1
5470	....do	560	3

These four specimens are probably the young of *L. spinosus*, described originally from Japan. The head is proportionally longer and the body deeper than in the larger Japanese type; the difference is wider than that which usually results from age-variation, and it is quite possible that two species are represented. The differences, however, may to a certain extent be more apparent than real, as the larger measurements of the Philippine specimens may result from the smaller base of measurements (length to anus) due to the position of the anus.

Table of measurements in hundredths of length to anus.

	Philippine Islands.				Japan.
Albatross station	5470	5463	5470	5470	4915
Total length in mm	196	[1] 165	...	[1] 150	280
Length to anus in mm	33	45	42	38	64.5
Length of head	90	91	86	91	73
Length of orbit	29	25	24	27	20
Width of interorbital	18	17	14	15	15.5
Width of suborbital	9	9	9	10	9
Orbit to preopercle	30	29	31	29	24
Length of snout	26	22	22	23	22
Length of upper jaw	26	22	...	22	22
Length of barbel	10	12	9	10	10
Depth of body	...	79	60	71	56
Anus to anal	22	17	21	18	13.5
Height of second dorsal spine	...	81	...	95	96.5
Height of third dorsal ray	...	...	...	68	68
Interdorsal space	34	...	32	32	27
Length of pectoral	47	43	41	41	37
Length of outer ventral ray	68	...	...	66	40
Length of second ventral ray	30	26	...	...	22
Soft rays, first dorsal	9	10	10	9	10
Ventral rays	8	9	8	8	8
Pectoral rays	21	20	19	22	21
Scales, series separating lateral line from origin of second dorsal	9	8	7½	8	8
Denticulations of dorsal spine	...	13	...	11	16

[1] Pseudocaudal developed.

(*spinosus*, in reference to the very spiny scales.)

64. LIONURUS INFRANUDIS, new species.

Type-specimen.—Cat. No. 82669, U.S.N.M.; 203 mm. long to end of pseudocaudal, 50 mm. to anus; dredged at *Albatross* station 5586, off Sibuko Bay, Borneo (lat. 4° 06′ 50″ N.; long. 118° 47′ 20″ E.); depth, 347 fathoms; bottom temperature, 44° F.

Fin-rays—first dorsal, II, 12; ventrals, 11; pectorals, 21.

The body is rather slender, the dorsal contour sloping forward in a gently convex curve from the elevated origin of the first dorsal fin to the subconic snout. The horizontal projection of the snout beyond the front of the premaxillaries is equal to the length of the pupil; the preocular length, about 0.2 longer than the preoral length, and equal to the height of the orbit, is contained 3.33 times in the head. The orbit is not quite round, the vertical diameter being a little greater than its horizontal length, which is contained 1.55 times in the postorbital, or 3.6 times in the entire length of the head. The margin and the ridge of the preopercle are not sharply produced backward at the angle, above which they are vertical. The least width of the narrow interorbital space is contained 1.4 times in the orbit, or 2.2 times in the postorbital; the suborbital is narrower than the pupil. The length of the upper jaw, which extends backward to below the posterior half of the pupil, is contained 3.25 times in the head. The teeth are in the usual bands, that of the upper jaw having an outer series a little enlarged. The length of the barbel is equal to the interorbital width. The gill-membranes unite in a free fold directly below the preopercular ridge; there are seven branchiostegal rays.

The scales are armed by numerous rather long spinules arranged in quincunx order; the last spinules project beyond the margin of the scale. Nine rows of scales separate the origin of the second dorsal fin from the lateral line series.

The anus is about equidistant from the origin of the anal and from the base of the outer ventral ray; it is preceded by a naked area.

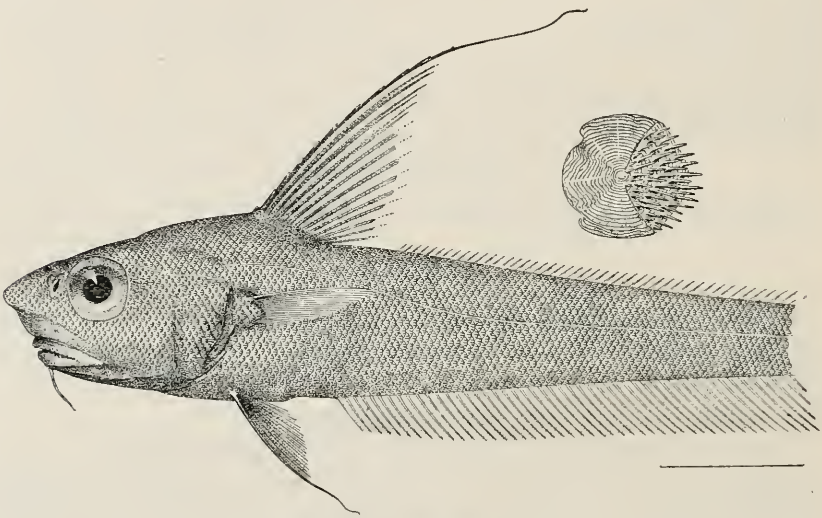

Fig. 38.—Lionurus infranudis. Type.

The second dorsal spine is longer than the distance between the tip of snout and the origin of the anal fin; the basal half of the spine is armed with 11 widely spaced denticulations. The pectoral and ventral fins are inserted on the same vertical. The inner ventral rays, when depressed, fall short of the origin of the anal.

Color in alcohol, gray-brown, becoming blackish on the belly, opercles, and nasal fossa; pale on the jaws and the underside of the snout. All of the fins, excepting the second dorsal, are black. The buccal and branchial cavities are lined with black, without light margins except along the bands of teeth and at the corners of the mouth; the parietal peritoneum is brownish black laterally, but silvery with black spots ventrally (except about the anus).

Measurements in hundredths of length to anus (50 mm.)—Length of head, 82; length of orbit, 24; width of interorbital, 17; width of suborbital, 10; orbit to preopercle, 31; length of snout, 24; length of upper jaw, 26; length of barbel, 17; anus to anal, 18; height of second dorsal spine, 128; height of third dorsal ray, 79; interdorsal space, 29; length of pectoral, 42; length of outer ventral ray, 62; length of second ventral ray, 29.

(*infranudis*, having the under surface of the head naked.)

65. LIONURUS EVIDES, new species.

Type-specimen.—Cat. No. 78231, U.S.N.M.; 157 mm. long to end of tail, 33 mm. to anus; dredged with four paratypes at *Albatross* station 5589.

List of paratypes.

Albatross station	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5589......	Vicinity of Sibuko Bay, Borneo..................................	260	45.7	4
5621......	Between Gillolo and Makyan Islands..........................	298	....	3

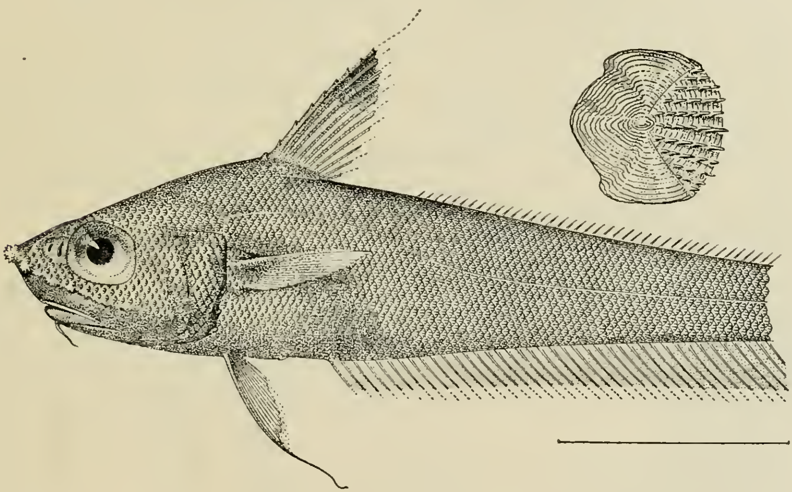

FIG. 39.—LIONURUS EVIDES. TYPE.

This pretty little species is a close representative of *Lionurus condylura*, a Japanese species,[1] from which it differs in the blacker spot on the first dorsal fin, in the longer outer ventral ray, in the fewer denticulations on the dorsal spine, and in the larger scales (see tables of measurements).

Fin-rays—first dorsal, II, 9 (11 to 13); pectoral 21 (20 to 22); ventrals, 11–14 (13 to 15).

The body is deep and elevated at the origin of the first dorsal fin, from which point the dorsal contour extends forward as a convex

[1] See Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 197.

curve to the occiput, thence straight to the subconic snout, which projects beyond the front of the premaxillaries half its horizontal projection beyond the eye. The tip of the snout bears two rather prominent spiny tubercles; preocular length of snout, 3.25 in head; preoral length, 4.0; length of orbit, 3.0. The least interorbital width is nearly equal to the length of the orbit; the suborbital is wider than the pupil. The upper jaw extends backward to below the posterior margin of the pupil; its length is contained 4.4 times in the head. The gill-membranes unite below the preopercular ridge; there are seven branchiostegal rays.

The scales are armed with about 10 slightly divergent rows of spinules. The scales are larger than in *condylura*, there being but 9 (8 to 9½) instead of 11 rows between the origin of the second dorsal fin and the lateral line series.

The center of the anus is a little nearer to the origin of the anal fin than to the insertion of the ventral.

The second dorsal spine, which is strong basally, is armed with 12 (9 to 15) rather large and well-spaced denticulations. The lengths of the various fins are given in the table of measurements.

Color in alcohol, light brown, becoming blackish, with a silvery sheen, on the opercles and over the coelomic cavity. The buccal and branchial cavities are lined wholly with blackish except near the corners of the mouth and along the edge of the opercular and branchiostegal membranes. The black color of the parietal peritoneum is underlain by silvery.

Table of measurements in hundredths of lengths to anus.

Albatross station	5621	5621	5621	5589	5589	[1] 5589	5589	5589
Total length in mm	[2] 132	131	[2] 125	[2] 117	[2] 146	164	157	107
Length to anus in mm	32.5	31	....	34	37	....	33	25
Length of head	75	79	....	80	78	....	79	81
Length of orbit	24	26	....	27	27	....	27	30
Width of interorbital	19	19	....	20	19	....	22	22
Width of suborbital	10	11	....	12	11	....	11	12
Orbit to preopercle	24	26	....	28	27	....	28	27
Length of snout	22	23	....	22	22	....	27	26
Length of upper jaw	22	25	....	25	23	....	22	25
Length of barbel	12	15	....	13	13	....	12	14
Depth of body	....	....	....	85	80	....	....	69
Height of second dorsal spine	68	78	....	70	78	....	73	82
Height of third dorsal ray	62	....	....	58	....	....	64	71
Length of first dorsal base	23	23	....	27	24	....	23	26
Interdorsal space	18	27	....	34	34	....	32	34
Length of pectoral	39	40	....	44	43	....	47	40
Length of outer ventral ray	70	61	....	....	62	....	68	68
Length of second ventral ray	29	....	....	....	27	....	....	25
Soft rays, first dorsal	12	11	12	11	11	13	9	11
Ventral rays	14	14,15	13,14	15,15	15,15	15,13	11,14	13,13
Pectoral rays	22	....	22	....	....	20	21	....
Scales (series separating lateral line from origin of second dorsal)	9	9	8	9	9	9	9	9½
Denticulations of dorsal spine	12	9	....	15	14	10	12	10
Gill-rakers, second arch	7	....	8	....	....	7	....	....
Sex	(3)	(4)	(3)	(4)	(4)	....	(3)	....

[1] Type-specimen. [2] Pseudocaudal developed. [3] Male. [4] Adult female.

(*evides*, pretty.)

66. LIONURUS VITTATUS (Weber).

Macrurus vittatus WEBER, Fische der *Siboga*-Expedition, p. 157, pl. 1, fig. 5.

This species, the most strikingly marked of any in the genus, was not obtained by the *Albatross*.

67. LIONURUS RICHARDI (Weber).

Macrurus richardi WEBER, Fische der *Siboga*-Expedition, p. 154, pl. 1, figs. 3 and 3*a*.

This species is a close ally of *L. pumiliceps* and of *L. decimalis*, differing from them in the small number (8) of rays in the ventral fins. No specimens were dredged by the *Albatross*.

68. LIONURUS PUMILICEPS (Alcock).

Macrurus pumiliceps ALCOCK, Journ. Asiat. Soc. Bengal, vol. 63, pt. 2, 1894, pp. 125, 127; Illustrations of the Zoology of the *Investigator*, Fishes, pt. 3, pl. 16, fig. 3; Descrip. Cat. Ind. Deep-sea Fishes Indian Museum, 1899, p. 113.

This species is one of that group of *Lionurus* in which the whole ventral region of the head and trunk has migrated forward from its normal position, the snout is blunt in profile, and projects but little beyond the mouth; the gill-membranes are united below the orbit; the ventral fins are inserted below the middle of opercle; the anus lies before the vertical from the origin of the first dorsal, and is followed by the anal fin after an interval unusually short for a species of the *Lionurus* type of genera.

The reference of our material to the Indian *L. pumiliceps* is made without comparison of specimens. No differences of importance are apparent between our material and Alcock's descriptions, which, however, are not sufficiently complete to render the identification entirely certain.

We present a short description of our specimens, which were obtained at the following stations:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F*.	
5439	Off western Luzon	900	36.7	1
5467	Off eastern Luzon	480	....	2
5469	.....do	500	....	1
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	2
5605	Gulf of Tomini, Celebes	647	....	2
5607	.....do	761	....	2
5647	Buton Strait	519	....	1
5648	.....do	559	39.2	2
5650	Gulf of Boni	540	40.1	1
5651	.....do	700	38.7	1
5654	.....do	805	38.3	1
5655	.....do	608	39.2	2
5657	.....do	492	41.3	1
5658	.....do	510	41.2	1
5660	Flores Sea	692	39.2	1
5664	Macassar Strait	400	43.3	1

Fin-rays—first dorsal II, 11 or 12; pectorals, 20 to 23; ventrals (39 fins counted), 11 to 13.

The body is very deep, and sharply compressed posteriorly; in some specimens the depth is constricted behind the trunk much more than in others. The origin of the dorsal fin is at the apex of a triangular elevation of the dorsal contour. The horizontal projection of the snout is half as long as the pupil. The least width of the oblique suborbital is a little more than half the orbital length. The barbel is decidedly more than half as long as the orbit. The preopercular ridge is separated above from the orbit by a distance equal to the diameter of the pupil; the ridge is arched backward a little at the angle. There are seven branchiostegals and about eight rudimentary gill-rakers.

The scales are rather small, being in eight or nine series from the origin of the second dorsal to but excluding the lateral line. The scales are reduced in size on the upper and under surfaces of the head; those in front of the anal fin are sometimes enlarged as though vertically fused. In the larger specimens the scales of the body bear six to eight parallel or slightly divergent rows of spinules.

The first dorsal spine is sharp and robust; the second spine may be lower or a little higher than the length of the head; it is armed by 23 to 37 denticulations in four specimens, 39 to 46 mm. long to the anus, and by 16 in one specimen of 33 mm. The interdorsal space is very much longer than the orbit.

For comparison with *L. decimalis* we include the following measurements:

Table of measurements in hundredths of length to anus.

Albatross station	5439	5654	5607	5469	5467
Total length in mm	[1] 227	233	223	207+	144
Length to anus in mm	46	42	40	39	26
Length of head	81	83	80	79	85
Length of orbit	26	29	26	27	30
Width of interorbital	20	22	20	23	22
Width of suborbital	14	14	14	15	15
Orbit to preopercle	31	33	30	32	33
Length of snout	26	29	27.5	26	26
Length of upper jaw	24	29	28.5	32	34
Length of barbel	19	17	....	16	20
Depth of body	90	84	80	80	81
Anus to anal	9	11	9	9	10
Height of second dorsal spine	91	75	76	70	....
Interdorsal space	32	37	....	41	40
Length of pectoral	....	45	46	....	....
Length of outer ventral ray	33	43+	54	62	....
Length of second ventral ray	....	....	....	33	....

[1] A pseudocaudal developed.

(*pumiliceps*, in reference to the shortened head.)

69. LIONURUS DECIMALIS, new species.

Type-specimen.—Cat. No. 82668, U.S.N.M.: 155 mm. long, 38.5 mm. to anus; dredged with a single paratype of about the same size at *Albatross* station 5348 in Palawan Passage; 375 fathoms; 56.4° F., bottom temperature.

Fin-rays—first dorsal II, 11 (both specimens): pectoral, 18 (22); ventral, 10 (both sides of both specimens).

This species belongs to that peculiarly formed group typified by *L. pumiliceps*, the last species. The depth of the body, greatest below the highly elevated origin of the first dorsal fin, is one orbital length longer than the head. In the type the ventral contour behind the anus is markedly concave, but is quite straight in the paratype; this variation is paralleled in *pumiliceps*. The head is short and blunt, vertical between the tip of the snout and the mouth. Length of snout in head, 3.6 (3.4); oblique length of orbit, 2.65 (2.7); least interorbital width in postorbital, 1.4 (1.3); least suborbital width less than half the orbital length; barbel much less

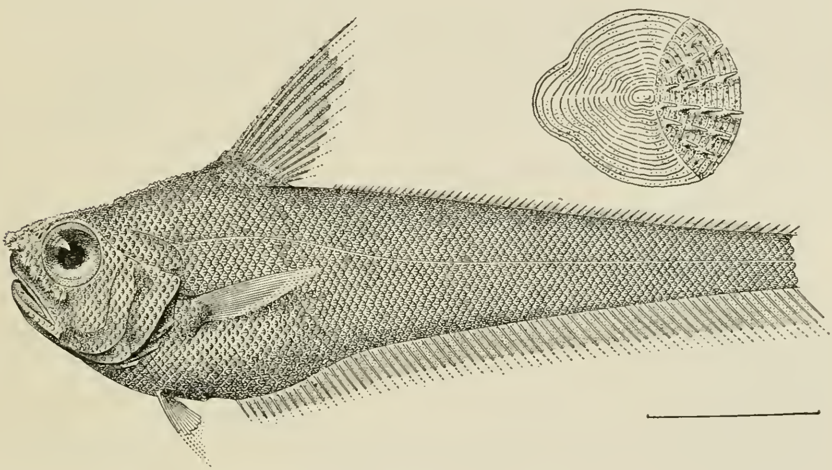

FIG. 40.—LIONURUS DECIMALIS. TYPE.

than half as long as the orbit. The small mouth stands at an angle of about 45° with the horizontal, paralleling the sharp suborbital ridge. The vertical preopercular ridge, separated above by the diameter of the pupil from the eye, is only slightly produced backward at its rounded angle. There are 7 rudimentary gill-rakers on the lower limb of the first arch; branchiostegals, 7. The gill-membranes are free forward to below the orbit.

The anus lies a little in advance of the origin of the anal fin, which is almost directly below the origin of the first dorsal. The scaleless peritroct is as wide as the pupil.

Eight rows of scales separate the lateral line series from the origin of the second dorsal fin. Each scale of the body is armed with five to seven parallel rows of spinules. The scales are reduced in size on the cheeks, the under surface of the head and in a strip extending forward from the first dorsal fin and including the top of the head; those along the suborbital ridge are strengthened and angular; both the terminal and lateral rostral tubercles are studded with stronger spinules.

The interdorsal space is much shorter than the orbit. The second dorsal spine is armed with 34 denticulations.

The coloration in alcohol is mostly blackish-brown, but is much lighter on the upper half of the trunk and head and black over the coelom. The fins are all black, the ventral and anal black. The buccal and branchial cavities are blackish, becoming abruptly light around the inner margin of the upper jaw. The silvery peritoneum is punctate with black and thinly coated with purplish brown.

L. decimalis is sharply distinguished from its close ally, *L. pumiliceps*, in the number of ventral rays, 10 instead of 11 to 13, in the even blunter head, and in certain proportions quite strikingly shown by comparison of the tables of measurements we have prepared for each species. In *decimalis* the following measurements are decidedly shorter: the suborbital width, the distance between the orbit and the preopercular margin, the length of the snout and of the barbel, and the interdorsal space.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5348	5348
Total length in mm	[1] 155	[1] 142
Length to anus in mm	38.5	40
Length of head	81	79
Length of orbit	27	25
Width of interorbital	23	24
Width of suborbital	12	11.5
Orbit to preopercle	27	27
Length of snout	21	22
Length of upper jaw	24	22
Length of barbel	9	7.5
Depth of body	90	85
Interdorsal space	19	11
Length of pectoral	47	....

[1] Pseudocaudal developed.

(*decimalis*, in reference to the number of ventral rays.)

70. LIONURUS PARVIPES (Smith and Radcliffe).

Macrourus parvipes Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43 1912, p. 124, pl. 28, fig. 1.

Lionurus parvipes Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 202, 205.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5608	Gulf of Tomini, Celebes	1089	36.3	1
5609	do	1092	36.3	2
5636	Pitt Passage	1262	....	[1] 2
5670	Macassar Strait	1181	38.2	1

[1] One of these specimens, Cat. No. 72941, U.S.N.M., is the type of *Macrourus parvipes*.

We have tabulated the measurements of this species while comparing it with *Lionurus cetonuropsis*, its Japanese representative. (*parvipes*, in reference to the reduced ventrals.)

Genus MATAEOCEPHALUS Berg.

This genus is not intermediate between *Macrourus* and *Coelorhynchus* as Radcliffe[1] has suggested. It is really related to *Lionurus* in a manner analagous to that by which *Coelorhynchus* is related to *Coryphaenoides* (*Macrourus*). The similarity between the two genera, consisting in the production of the snout and in the correlated strengthening of the infraorbital ridge, is due to convergence rather than to common origin.

71. MATAEOCEPHALUS ADUSTUS Smith and Radcliffe.

Mataeocephalus adustus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 126, pl. 28, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5605	Gulf of Tomini, Celebes	647	....	1
5606	.....do	834	....	1
5630	South of Patiente Strait	569	....	2
5654	Gulf of Boni, Celebes	805	38.3	Type

This species seems to be distinct from *Mataeocephalus microstomus* (Regan), the only one with which it might be confused.

72. MATAEOCEPHALUS NIGRESCENS Smith and Radcliffe.

Mataeocephalus nigrescens SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 125, pl. 28, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°*F.*	
5219	Between Marinduque and Luzon	530	50.8	3
5348	Palawan Passage	375	56.4	1
5423	Jolo Sea	508	49.8	1
5424	.....do	340	50.4	1
5425	.....do	495	49.4	1
5492	Between Leyte and Mindanao	735	52.5	[2] 2
5515	Vicinity of northern Mindanao	[3]	....	1
5586	Sibuko Bay, Borneo	347	44	2

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, p. 125.
[2] One of these is the type-specimen: Cat. No. 72942, U.S.N.M.
[3] "About 700."

According to the data available, *M. nigrescens* appears to have a more northern distribution than *M. adustus*. *M. nigrescens* is a close ally of the Hawaiian *M. acipenserinus* and of the Panamaic *M. tenuicauda.*

Genus TRACHONURUS Günther.

73. TRACHONURUS VILLOSUS (Günther).

Trachonurus villosus Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 205 (description of Japanese material, with synonomy).—Weber, Fische der *Siboga*-Expedition, p. 165, pl. 5, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5123	East coast of Mindoro	283	....	4
5124	.....do	281	....	3
5348	Palawan Passage	375	56.4	2
5373	Vicinity of Marinduque Island	338	51.8	4
5407	Vicinity of Dupon Bay, Leyte	350	....	2
5410	Between Cebu and Leyte	385	....	1
5423	Jolo Sea (Sulu Sea)	508	49.8	4
5425	.....do	495	49.4	1
5492	Between Leyte and Mindanao	735	52.3	5
5494	.....do	678	53.3	6
5512	Vicinity of northern Mindanao	445	52.8	3
5513	.....do	505	52.8	1
5528	Between Siquijor and Bohol	439	53.3	1
5533	Between Cebu and Siquijor	432	53.3	1
5586	Vicinity of Sibuku Bay, Borneo	347	44	1
5587	.....do	415	42.3	2
5646	Buton Strait	456	....	2
5648	.....do	559	39.2	1

The range of depth and bottom temperature inhabited by this species is remarkably wide for a Macrouroid fish of tropical seas.

We can detect no differences of importance among these specimens nor between them and Japanese material.

Genus CETONURUS Günther.

74. CETONURUS ROBUSTUS Gilbert and Hubbs.

Cetonurus robustus Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 207, pl. 11, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F	
5601	Gulf of Tomini, Celebes	765	....	1
5631	South of Patiente Strait	809	....	1
5632	.....do	845	....	4
5651	Gulf of Boni, Celebes	700	38.7	1
5654	.....do	525	41.2	1

Between these East Indian specimens and the type material from Japan no specific differences can be detected.

COMPLETE LIST OF THE SPECIES OF MACROUROID FISHES OBTAINED AT EACH STATION.[1]

Each of the stations occupied by the *Albatross* during the Philippine cruise, from which Macrouroid fishes were preserved, are listed below, together with the number of specimens of each species. The data is offered as being valuable in presenting the associational distribution of the various forms.

Station 5110; 135 Fathoms; Bottom Temperature, 59° F.

Coelorhynchus thompsoni	1
Hymenocephalus striatissimus torvus	1

Station 5111; 236 Fathoms.

Coelorhynchus macrolepis	Type+34
Coelorhynchus carinifer	Type
Coelorhynchus macrorhynchus	6

Station 5112; 177 Fathoms; 52.4° F.

Coelorhynchus argus	1
Hymenocephalus s. torvus	1

Station 5113; 159 Fathoms.

Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis	1

Station 5114; 340 Fathoms.

Hymenocephalus nascens	1
Ventrifossa macronemus	1

"Station 5115 or 5116"; 340 or 200 Fathoms; (?) or 50.2° F.

Hymenocephalus nascens	1

Station 5117; 118 Fathoms.

Hymenocephalus longiceps	3

Station 5118; 159 Fathoms.

Coelorhynchus thompsoni	1
Coelorhynchus argus	1
Hymenocephalus longiceps	1
Hymenocephalus longipes	1
Hymenocephalus s. torvus	2

Station 5119; 394 Fathoms; 43.7° F.

Hymenocephalus nascens	1

[1] The detailed data for each station are given in Bureau of Fisheries Document No. 741, 1910.

Station 5121; 108 Fathoms.

Coelorhynchus quincunciatus	2
Hymenocephalus longiceps	9

Station 5122; 220 Fathoms.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	6

Station 5123; 283 Fathoms.

Gadomus denticulatus	1
Coelorhynchus smithi	3
Trachonurus villosus	4

Station 5124; 281 Fathoms.

Coryphaenoides semiscaber	1
Coelorhynchus smithi	2
Ventrifossa nigrodorsalis	6
Trachonurus villosus	3

Station 5135; 161 Fathoms; 57.4° F.

Coelorhynchus argentatus	5
Coelorhynchus argus	3
Ventrifossa nigromarginata	2

Station 5162; 230 Fathoms; 52.9° F.

Coelorhynchus notatus	Type

Station 5172; 318 Fathoms.

Coelorhynchus argentatus	Type+1
Coelorhynchus sexradiatus	Type+1
Coelorhynchus commutabilis	1
Hymenocephalus s. aeger varying toward *H. s. torvus*	33
Ventrifossa nigrodorsalis	2
Ventrifossa nigromarginata	2

Station 5173; 186 Fathoms.

Hymenocephalus s. aeger varying toward *H. s. torvus*	1

Station 5197;[1] 174 Fathoms; 54.° F.

Hymenocephalus longiceps	1

Station 5198; 220 Fathoms; 53.9° F.

Gadomus denticulatus	2
Coelorhynchus smithi	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	1
Ventrifossa nigromarginata	1

[1] See discussion of this station on p. 525.

STATION 5201; 554 FATHOMS; 52.8° F.

Gadomus magnifilis	1
Lionurus proximus	1

STATION 5202; 502 FATHOMS.

Lionurus proximus	Type

STATION 5215; 604 FATHOMS; 50.5° F.

Coryphaenoides semiscaber	Type+1

STATION 5216; 215 FATHOMS; 51.9° F.

Hymenocephalus longipes	1

STATION 5219; 530 FATHOMS; 50.8° F.

Bathygadus sulcatus	1
Mataeocephalus nigrescens	3

STATION 5221; 193 FATHOMS; 52.4° F.

Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	10+?3
Ventrifossa nigrodorsalis	6

STATION 5222; 195 FATHOMS; 52.8° F.

Hymenocepholus longipes	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	11

STATION 5238; 380 FATHOMS; 43.0° F.

Hymenocephalus barbatulus	Type+1

STATION 5247; 135 FATHOMS.

Coelorhynchus argus	2

STATION 5255; 100 FATHOMS.

Coelorhynchus argentatus	1+?1

STATION 5259; 312 FATHOMS; 49.3° F.

Hymenocephalus s. torvus	4
Ventrifossa nigrodorsalis	1
Ventrifossa divergens	1

STATION 5260; 234 FATHOMS; 51.4° F.

Coelorhynchus, species? (young; poor condition)	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	5+?40
Ventrifossa nigrodorsalis or *divergens* (poor condition)	2
Ventrifossa nigromarginata	2

STATION 5261; 145 FATHOMS.

Ventrifossa nigromarginata	1

STATION 5265; 135 FATHOMS.

Coelorhynchus velifer	1
Coelorhynchus argus	1
Hymenocephalus longiceps	1
Ventrifossa nigromarginata	1

STATION 5268; 170 FATHOMS.

Coelorhynchus velifer	6
Hymenocephalus s. torvus	1+?3
Ventrifossa nigrodorsalis or *divergens* (poor condition)	13
Ventrifossa lucifer	1

STATION 5269; 220 FATHOMS.

Coelorhynchus velifer	1
Hymenocephalus s. torvus	2
Ventrifossa divergens	2

STATION 5274; 525 FATHOMS; 41.3° F.

Bathygadus spongiceps	2
Gadomus introniger	1

STATION 5279; 117 FATHOMS.

Coelorhynchus argentatus	1
Hymenocephalus s. torvus	1

STATION 5280; 193 FATHOMS; 49.6° F.

Coelorhynchus macrolepis	1
Hymenocephalus, species?	3
Hymenocephalus s. torvus	1+?5

STATION 5281; 201 FATHOMS; 50.4° F.

Coelorhynchus macrolepis	1
Ventrifossa nigrodorsalis or *divergens*	3

STATION 5282; 248 FATHOMS; 47.4° F.

Coelorhynchus, species? (young; poor condition)	1
Hymenocephalus s. torvus	7+?15
Hymenocephalus nascens	7
Malacocephalus luzonensis	2
Ventrifossa divergens	2
Lionurus, species? (young)	1

STATION 5283; 280 FATHOMS; 46.8° F.

?Hymenocephalus s. torvus	3

STATION 5284; 422 FATHOMS; 42.3° F.

Ventrifossa divergens	1

STATION 5287; 379 FATHOMS; 43.4° F.

Coelorhynchus, species? (very poor condition)	4

STATION 5289; 172 FATHOMS.

Coelorhynchus velifer	52
Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis or *divergens*	5
Ventrifossa divergens	16

STATION 5290; *214 FATHOMS.

?*Coelorhynchus maculatus*	1
Hymenocephalus longiceps	1
Ventrifossa divergens	7

STATION 5291; 173 FATHOMS; 51.5° F.

Coelorhynchus argentatus	1
Coelorhynchus velifer	13
Coelorhynchus argus	8
Hymenocephalus longiceps	11
Hymenocephalus s. torvus	1
Malacocephalus luzonensis	1

STATION 5292; 162 FATHOMS; 52.4° F.

Coelorhynchus velifer	1
Hymenocephalus gracilis	Type
Hymenocephalus longiceps	1

STATION 5293; 180 FATHOMS; 57.4° F.

Coelorhynchus velifer	21
Ventrifossa divergens	3

STATION 5294; 244 FATHOMS; 48.4° F.

Coelorhynchus velifer	Type+1
Hymenocephalus s. torvus	3
Ventrifossa divergens	3

STATION 5296; *210 FATHOMS.

Coelorhynchus velifer	2
Ventrifossa divergens	3

STATION 5297; *198 FATHOMS.

Coelorhynchus velifer	3
Ventrifossa divergens	2

STATION 5298; *140 FATHOMS.

Coelorhynchus argus	2

STATION 5301; 208 FATHOMS; 50.8° F.

Coelorhynchus, species? (young; poor condition)	1
Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	8

STATION 5310; 100 FATHOMS; 65.5° F.

Hymenocephalus nascens	1
Ventrifossa divergens	1

STATION 5317; 230 FATHOMS; 50.6° F.

Coelorhynchus cingulatus	Type
Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	5
Ventrifossa nigrodorsalis	1

STATION 5325; 224 FATHOMS; 53.2° F.

Coryphaenoides microps	4
Coelorhynchus cingulatus	1
Coelorhynchus weberi	Type
Hymenocephalus s. striatissimus × *H. s. torvus*	15
Ventrifossa divergens	2

STATION 5326; 230 FATHOMS; 55.4° F.

Coelorhynchus dorsalis	1
Hymenocephalus s. striatissimus × *H. s. torvus*	3

STATION 5328; 150 FATHOMS; 53.9° F.

Hymenocephalus s. striatissimus × *H. s. torvus*	1

STATION 5329; 212 FATHOMS; 51.4° F.

Coelorhynchus dorsalis	Type
Hymenocephalus s. striatissimus × *H. s. torvus*	4
Ventrifossa divergens	1

STATION 5331; 178 FATHOMS; 54.7° F.

Hymenocephalus s. striatissimus × *H. s. torvus*	1

STATION 5348; 375 FATHOMS; 56.4 F.

Coelorhynchus commutabilis	Type
Ventrifossa nigrodorsalis	1
Lionurus decimalis	Type+1
Mataeocephalus nigrescens	1
Trachonurus villosus	2

STATION 5363; *180 FATHOMS.

Coelorhynchus thompsoni	Type
Hymenocephalus s. torvus	12
Ventrifossa nigrodorsalis	8

STATION 5365; *214 FATHOMS.

Coelorhynchus macrolepis	20
Hymenocephalus s. torvus	7+?12
Ventrifossa nigrodorsalis	5
Ventrifossa nigrodorsalis or *divergens*	2

STATION 5366; *240 FATHOMS.

Coelorhynchus maculatus	1

STATION 5367; *180 FATHOMS.

Coelorhynchus macrorhynchus	Type
Hymenocephalus, species? (poor condition)	1

STATION 5368; 181 FATHOMS.

Hymenocephalus s. torvus	1

STATION 5371; *83 FATHOMS.[1]

Hymenocephalus s. torvus	1

STATION 5372; *150 FATHOMS.

Hymenocephalus longipes	1

STATION 5373; 338 FATHOMS; 51.8° F.

Hymenocephalus nascens	2
Trachonurus villosus	4

STATION 5374; *190 FATHOMS.

Coelorhynchus radcliffei	2
Hymenocephalus longipes	5
Hymenocephalus s. torvus	5
Ventrifossa nigrodorsalis	11

STATION 5375; 107 FATHOMS.

Hymenocephalus longiceps	1

STATION 5376; *90 FATHOMS.

Hymenocephalus, species (poor condition)	1

[1] Depth probably erroneously estimated.

Station 5387; 209 Fathoms; 52.4° F.

Coelorhynchus argus	1
Hymenocephalus longipes	1

Station 5388; 266 Fathoms; 51.4° F.

Ventrifossa nigrodorsalis	6
Ventrifossa nigromarginata	7

Station 5392; 135 Fathoms.

Coelorhynchus quincunciatus	Type + 6

Station 5396; 137 Fathoms.

Coelorhynchus quincunciatus	1

Station 5397; 134 Fathoms.

Coelorhynchus quincunciatus	2

Station 5403; 182 Fathoms; 55.7° F.

Hymenocephalus longipes	7

Station 5404; 190 Fathoms; 55.4° F.

Ventrifossa nigrodorsalis	1

Station 5406; 298 Fathoms.

Gadomus denticulatus	1
Ventrifossa nigrodorsalis	2

Station 5407; 350 Fathoms.

Trachonurus villosus	2

Station 5409; 189 Fathoms.

Hymenocephalus s. torvus	6
Ventrifossa nigrodorsalis	12

Station 5410; 385 Fathoms.

Gadomus denticulatus	1
Trachonurus villosus	1

Station 5411; 145 Fathoms.

Hymenocephalus longiceps	7

Station 5412; 162 Fathoms; 54.8° F.

Coelorhynchus quincunciatus	1
Hymenocephalus longiceps	3
Hymenocephalus longipes	1

Station 5417; 165 Fathoms; 54.4° F.

Coelorhynchus acutirostris	1
Hymenocephalus longipes	1

Station 5418; 159 Fathoms; 54.4° F.

Coelorhynchus acutirostris	Type
Hymenocephalus longipes	2
Hymenocephalus s. torvus	1
Ventrifossa nigromarginata	1

Station 5419; 175 Fathoms; 54.5° F.

Hymenocephalus s. torvus	1

Station 5421; 137 Fathoms; 58.4° F.

Coelorhynchus argus	1
Hymenocephalus longipes	Type

Station 5423; 508 Fathoms; 49.8° F.

Bathygadus sulcatus	Type + 4
Gadomus magnifilis	1
Mataeocephalus nigrescens	1
Trachonurus villosus	4

Station 5424; 340 Fathoms; 50.4° F.

Bathygadus sulcatus	2
Coelorhynchus smithi	2
Ventrifossa macronemus	Type
Mataeocephalus nigrescens	1

Station 5425; 495 Fathoms; 49.4° F.

Mataeocephalus nigrescens	1
Trachonurus villosus	1

Station 5428; 1105 Fathoms; 49.7° F.

Coryphaenoides paradoxus	Type
Coryphaenoides camurus	Type

Station 5439; 900 Fathoms; 36.7° F.

Lionurus pumiliceps	1

Station 5440; 172 Fathoms; 53.2° F.

Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus × *H. s. torvus*	1
Malacocephalus luzonensis	Type

Station 5441; 186 Fathoms; 52.2° F.

Hymenocephalus longiceps	1

STATION 5444; 308 FATHOMS; 45.3° F.

Coelorhynchus commutabilis	1
Ventrifossa nigrodorsalis	2
Ventrifossa divergens	2

STATION 5445; 383 FATHOMS; 44.3° F.

Gadomus denticulatus	1
Coelorhynchus commutabilis	1
Coelorhynchus parallelus	3
Hymenocephalus nascens	1
Ventrifossa misakia	1
Ventrifossa nigrodorsalis	2

STATION 5450; 408 FATHOMS; 42.3° F.

Macrouroides inflaticeps	Type

STATION 5453; *146 FATHOMS.

Hymenocephalus longiceps	8

STATION 5454; *153 FATHOMS.

Coelorhynchus quincunciatus	1
Hymenocephalus longiceps	2

STATION 5459; *201 FATHOMS.

Hymenocephalus longiceps	Type+2

STATION 5460; 565 FATHOMS.

Bathygadus spongiceps	2
Bathygadus furvescens	1
Gadomus introniger	1
Coryphaenoides hyostomus	1
Coelorhynchus platorhynchus	1

STATION 5463; *300 FATHOMS.

Lionurus spinosus	1

STATION 5467; *480 FATHOMS.

Bathygadus spongiceps	1
Gadomus multifilis	1
Coryphaenoides hyostomus	2
Lionurus pumiliceps	2

STATION 5469; 500 FATHOMS.

Lionurus pumiliceps	1

STATION 5470; *560 FATHOMS.

Coryphaenoides microps	Type
Coryphaenoides hyostomus	Type
Lionurus spinosus	3

STATION 5476; 270 FATHOMS; 48.3° F.

Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	19
Malacocephalus luzonensis	1

STATION 5492; 735 FATHOMS; 52.3° F.

Mataeocephalus nigrescens	Type + 1
Trachonurus villosus	5

STATION 5494; 678 FATHOMS; 53.3° F.

Trachonurus villosus	6

STATION 5495; 976 FATHOMS; 52.3° F.

Bathygadus furvescens	1

STATION 5501; 214 FATHOMS; 54.3° F.

Hymenocephalus s. torvus	7
Ventrifossa nigrodorsalis	5
Ventrifossa nigromarginata	3

STATION 5502; **214 FATHOMS.

Coelorhynchus radcliffei	2
Hymenocephalus longipes	1
Hymenocephalus s. torvus	24
Ventrifossa nigrodorsalis	Type + 13
Ventrifossa nigromarginata	1

STATION 5503; 226 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	Type
Hymenocephalus s. torvus	8
Ventrifossa nigrodorsalis	8

STATION 5504; 200 FATHOMS; 54.3° F.

Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis	6

STATION 5505; *220 FATHOMS.

Gadomus denticulatus	Type + 1
Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	3
Ventrifossa nigrodorsalis	5
Ventrifossa nigromarginata	1

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STATION 5506; 262 FATHOMS; 53.3° F.

Hymenocephalus s. torvus	9

STATION 5508; 270 FATHOMS; 53.3° F.

Hymenocephalus s. torvus	Type + 6
Ventrifossa nigrodorsalis	6
Ventrifossa nigromarginata	1

STATION 5510; 423 FATHOMS; 53.0°. F.

Bathygadus sulcatus	2
Hymenocephalus nascens	1

STATION 5511; 410 FATHOMS; 53° F.

Coryphaenoides dubius	Type

STATION 5512; 445 FATHOMS; 52.8° F.

Trachonurus villosus	3

STATION 5513; 505 FATHOMS; 52.8° F.

Trachonurus villosus	1

STATION 5515; NO SOUNDING, DEPTH ABOUT 700 FATHOMS.

Bathygadus furvescens	1
Gadomus magnifilis	Type
Mataeocephalus nigrescens	1

STATION 5516; DEPTH 175; 54.3° F.

Coelorhynchus argentatus	3
Coelorhynchus acutirostris	1
Ventrifossa nigromarginata	6
Ventrifossa lucifer	Type + 3

STATION 5517; 169 FATHOMS; 54.3° F.

Coelorhynchus argentatus	1
Coelorhynchus acutirostris	1
Ventrifossa nigromarginata	1
Ventrifossa lucifer	1

STATION 5518; 200 FATHOMS; 54° F.

Coelorhynchus argentatus	1
(?) *Coelorhynchus thompsoni*	2
Ventrifossa nigromarginata	2

STATION 5519; 182 FATHOMS; 54.3° F.

Ventrifossa nigromarginata	3
Ventrifossa lucifer	8

STATION 5523; NO SOUNDING.

Coelorhynchus velifer	5
Ventrifossa nigrodorsalis	1
Ventrifossa nigromarginata	1

STATION 5526; 805 FATHOMS; 52.3° F.

Bathygadus furvescens	1

STATION 5527; 392 FATHOMS; 53.3 F.

Bathygadus sulcatus	2
Ventrifossa nigromarginata	1
Lionurus proximus	1

STATION 5528; 439 FATHOMS; 53.3° F.

Bathygadus sulcatus	1
Ventrifossa macronemus	1
Trachonurus villosus	1

STATION 5529; 441 FATHOMS; 53° F.

Bathygadus sulcatus	2

STATION 5533; 432 FATHOMS; 53.3° F.

Trachonurus villosus	1

STATION 5534; 333 FATHOMS; 53.3° F.

Coryphaenoides semiscaber	1

STATION 5535; 310 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	4
Ventrifossa nigrodorsalis	2

STATION 5536; 279 FATHOMS; 53.5° F.

Coelorhynchus smithi	3
Coelorhynchus radcliffei	2
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	4

STATION 5537; 254 FATHOMS; 53.5° F.

Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	11

STATION 5538; 256 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Ventrifossa nigrodorsalis	1

STATION 5542; 200 FATHOMS; 54.3° F.

Hymenocephalus longipes	2
Hymenocephalus s. torvus	3
Ventrifossa nigrodorsalis	3

STATION 5545; 114 FATHOMS.

Coelorhynchus argentatus	3

STATION 5549; 263 FATHOMS; 52.3° F.

Coelorhynchus argus	4
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5550; 258 FATHOMS; 52.3° F.

Coelorhynchus argentatus	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5551; 193 FATHOMS; 53.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	2
Ventrifossa nigromarginata	1

STATION 5563; 224 FATHOMS; 52.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	7

STATION 5564; 236 FATHOMS; 52.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	54

STATION 5565; 243 FATHOMS; 52.3° F.

Coelorhynchus sexradiatus	6
Hymenocephalus longiceps	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	2
Ventrifossa nigromarginata	1

STATION 5566; 244 FATHOMS; 52.5° F.

Coelorhynchus argentatus	1
Hymenocephalus longiceps	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5569; 303 FATHOMS; 52.3° F.

Ventrifossa nigromarginata	1

STATION 5574; 340 FATHOMS.

Coelorhynchus macrorhynchus	1

STATION 5575; 315 FATHOMS; 52.3° F.

Coelorhynchus triocellatus	Type
Coelorhynchus macrorhynchus	1
Ventrifossa nigromarginata	1

Station 5576; 277 Fathoms; 53.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	1
Ventrifossa nigromarginata	1

Station 5580; 162 Fathoms; 55.8° F.

Hymenocephalus longiceps	5
Ventrifossa nigromarginata	1

Station 5582; 890 Fathoms; 38.3° F.

Bathygadus spongiceps	Type
Gadomus multifilis	1

Station 5585; 476 Fathoms; 41.1° F.

Gadomus introniger	1
Coelorhynchus platorhynchus	Type

Station 5586; 347 Fathoms; 44.0° F.

Gadomus introniger	1
Coelorhynchus acantholepis	2
Hymenocephalus nascens	11
Ventrifossa nigrodorsalis	3
Lionurus infranudis	Type
Malacocephalus nigrescens	2
Trachonurus villosus	1

Station 5587; 415 Fathoms; 42.3° F.

Bathygadus filamentosus	Type+1
Gadomus denticulatus	1
Coryphaenoides hyostomus	1
Coelorhynchus acantholepis	Type
Coelorhynchus macrorhynchus	1
Hymenocephalus nascens	Type
Lionurus pumiliceps	2
Ventrifossa nigrodorsalis	2
Trachonurus villosus	2

Station 5589; 260 Fathoms; 45.7° F.

Gadomus denticulatus	1
Coelorhynchus commutabilis	5
Hymenocephalus s. aeger	26
Hymenocephalus nascens	28
Ventrifossa nigrodorsalis	4
Lionurus evides	Type+4

Station 5590; 310 Fathoms; 44.3° F.

Coelorhynchus smithi	1
Coelorhynchus commutabilis	3
Hymenocephalus s. aeger	1
Ventrifossa nigrodorsalis	3
Ventrifossa divergens	1

STATION 5592; 305 FATHOMS; 43.3° F.

Ventrifossa nigrodorsalis	2
Ventrifossa divergens	Type

STATION 5601; 765 FATHOMS.

Bathygadus furvescens	1
Cetonurus robustus	1

STATION 5605; 647 FATHOMS.

Lionurus pumiliceps	2
Mataeocephalus adustus	1

STATION 5606; 834 FATHOMS.

Mataeocephalus adustus	1

STATION 5607; 761 FATHOMS.

Gadomus multifilis	1
Coelorhynchus spinifer	Type
Lionurus pumiliceps	2

STATION 5608; 1089 FATHOMS; 36.3° F.

Coryphaenoides aequatoris	Type
Lionurus parvipes	1

STATION 5609; 1092 FATHOMS; 36.3° F.

Coryphaenoides aequatoris	1
Lionurus parvipes	2

STATION 5619; 435 FATHOMS.

Bathygadus filamentosus	1
Bathygadus entomelas	Type

STATION 5621; 298 FATHOMS.

Coelorhynchus maculatus	Type+5
Coelorhynchus smithi	Type+1
Hymenocephalus longiceps	2
Hymenocephalus s. aeger	Type+37
Ventrifossa divergens	12
Lionurus evides	1

STATION 5622; 275 FATHOMS.

Hymenocephalus nascens	3
Ventrifossa nigrodorsalis	2

STATION 5623; 272 FATHOMS.

Coelorhynchus maculatus	4
Hymenocephalus nascens	1

Station 5624; 288 Fathoms.

Gadomus denticulatus	1
Coelorhynchus radcliffei	1
Hymenocephalus nascens	7
Ventrifossa nigrodorsalis	5

Station 5625; 230 Fathoms.

Hymenocephalus s. aeger	5
Ventrifossa nigrodorsalis	7

Station 5626; 265 Fathoms.

Coelorhynchus radcliffei	1
Hymenocephalus s. aeger	1

Station 5630; 569 Fathoms.

Mataeocephalus adustus	2

Station 5631; 809 Fathoms.

Cetonurus robustus	1

Station 5632; 845 Fathoms.

Coryphaenoides asprellus	Type
Cetonurus robustus	4

Station 5636; 1262 Fathoms.

Coryphaenoides orthogrammus	Type
Lionurus parvipes	Type+1

Station 5646; 456 Fathoms.

Trachonurus villosus	2

Station 5647; 519 Fathoms.

Gadomus introniger	1
Lionurus pumiliceps	1

Station 5648; 559 Fathoms; 39.2° F.

Bathygadus spongiceps	1
Gadomus introniger	Type
Coryphaenoides tydemani	4
Coryphaenoides hyostomus	2
Lionurus pumiliceps	2
Trachonurus villosus	1

Station 5650; 540 Fathoms; 40.1° F.

Bathygadus filamentosus	1
Lionurus pumiliceps	1

STATION 5651; 700 FATHOMS; 38.70° F.

Gadomus introniger	1
Lionurus pumiliceps	1
Cetonurus robustus	1

STATION 5654; 805 FATHOMS; 38.3° F.

Lionurus pumiliceps	1
Mataeocephalus adustus	Type
Cetonurus robustus	1

STATION 5655; 608 FATHOMS; 39.2° F.

Lionurus pumiliceps	2

STATION 5656; 484 FATHOMS; 41.2° F.

Gadomus introniger	1

STATION 5657; 492 FATHOMS; 41.3° F.

Coelorhynchus platorhynchus	3
Lionurus pumiliceps	1

STATION 5658; 510 FATHOMS; 41.2° F.

Coelorhynchus platorhynchus	3
Lionurus pumiliceps	1

STATION 5660; 692 FATHOMS; 39.2° F.

Lionurus pumiliceps	1

STATION 5661; 180 FATHOMS; 50.5° F.

Ventrifossa nigromarginata	1

STATION 5664; 400 FATHOMS; 43.3° F.

Lionurus pumiliceps	1

STATION 5670; 1181 FATHOMS; 38.2° F.

Lionurus parvipes	1

(Station number lost.)

Bathygadus sulcatus	1
Coelorhynchus macrolepis	1
Hymenocephalus nascens	1
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POLYCHAETOUS ANNELIDS COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN THE WATERS ADJACENT TO THE PHILIPPINE ISLANDS IN 1907–1910.

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INTRODUCTION.

Some time ago the polychaetous annelid collections made by the United States Bureau of Fisheries Steamer *Albatross* in the Philippines were sent me for description. As a result of a preliminary study the old species were identified and sent to the United States National Museum some two years ago. Two new species were also described, but since pressure of other duties prevented my continuing the work the remainder of the collection was turned over to my assistant, Miss Ruth Hoagland, whose report follows this. A few old species which I had overlooked are included in her report. These two papers together, then, comprise the report on the polychaetous annelids of this expedition.

DESCRIPTION OF SPECIES.

Family SYLLIDAE.

Genus AUTOLYTUS Grube.

AUTOLYTUS TRIANGULIFER Grube.

Autolytus triangulifer Grube, 1878, p. 132, pl. 7, fig. 8.

The polybostricous stage was collected in considerable numbers at San Miguel Harbor, Ticao Island. Grube reported that his specimens were incomplete. One specimen in this collection had in the posterior region 31 somites similar in structure, though narrowing very noticeably toward the posterior end. These somites are largely covered by the prominent parapodia. Somites 32, 33, 34, 49, 50, and 51 of the entire body have small parapodia and are covered dorsally with a brownish pigment, an expansion of the median pigment spots occurring in the anterior somites. Behind somite 44 was a colorless region containing about six somites with very small parapodia and a pygidium carrying a pair of anal cirri. They were too poorly preserved to determine the precise number of somites involved.

Genus SYLLIS Savigny.

SYLLIS (ODONTOSYLLIS) HYALINA Grube.

Syllis (Odontosyllis) hyalina GRUBE, 1878, p. 129, pl. 7, fig. 1.

Collected at San Miguel Harbor, Ticao Island.

Family AMPHINOMIDAE.

Genus CHLOEIA Savigny.

CHLOEIA CEYLONICA Grube.

Chloeia ceylonica GRUBE, 1878, p. 10.

In this paper Grube refers to an earlier paper[1] which was not accessible to me, but the comparison which he there draws between *C. ceylonica* and *C. flava* makes it certain that this is his species.

Collected at Jolo Anchorage, Jolo.

CHLOEIA FLAVA Pallas.

Aphrodita flava PALLAS, 1766, p. 97, pl. 8, figs. 7–11.
Chloeia flava McINTOSH, 1885, p. 8, pl. 3, figs. 1 and 3, pl. 1*a*, figs. 7–9.

Collected at Port Dupon, Leyte Sound; Anchorage, Tomindos Sound; D 5561, Teomabal Island, Jolo, 10 fathoms. D 5165, Observation Island, Tawi Tawi Group, 9 fathoms, coral bottom.

Genus EURYTHOE Kinberg.

EURYTHOE PACIFICA Kinberg.

Eurythoe pacifica KINBERG, 1857, p. 14.—GRUBE, 1878, p. 6.—McINTOSH, 1885, p. 27, pl. 2, figs. 3, 4; pl. 3, fig. 3; pl. 2*a*, fig. 13; pl. 3*a*, figs. 5–9.

Collected at Nau Wau, Formosa; Batan Island; Tataan, Tawi Tawi, San Pascual, Burias Island. A fragment, probably of this species, was collected at Nasugbu, Luzon.

Family APHRODITIDAE.

Genus POLYNOE Savigny.

POLYNOE MIRABILIS McIntosh.

Polynoe mirabilis McINTOSH, 1885, p. 121, pl. 16, fig. 1; pl. 12*a*, figs. 9–11.—TREADWELL, 1906, p. 1149.

As stated in my original paper, McIntosh's specimen was undoubtedly incomplete and had originally more somites than he described. These from the Philippines were approximately 70 mm. long and 15 mm. broad at the broadest part, thus much larger than the *Chal-*

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[1] Proc. Zool. Soc., 1874, p. 10.

lenger specimens. No elytra remained and the head in each was badly preserved, so that it was impossible to be certain as to their normal form. In all cases the head had been rolled over so that the basal joint of the median antenna had been directly posteriorly. Some of the few remaining cirri showed a violet color and the inner surface of the proboscis is a dark color, as described by McIntosh.

Collected from D5122, Malabrigo Light, East coast of Mindoro, N. 46° W., 20.60 miles (13° 21′ 30″ N.; 120° 30′ 33″ E.) 220 fathoms, green mud bottom. D5114, Sombrero Island, Balayan Bay, N. 36° E., 7.2 miles (13° 36′ 11″ N.; 120° 45′ 26″ E.) 340 fathoms, fine sand bottom.

POLYNOE OCELLATA McIntosh.

Polynoe ocellata McIntosh, 1885, p. 126, pl. 12, fig. 3; pl. 12*a*.

A few were found at D5382, Arena Point, Luzon, S. 55° W., 3.8 miles (13° 15′ 20″ N.; 122° 45′ 30″ E.), 128 fathoms, mud bottom, in tubes which were apparently made by *Phyllochaetopterus claperedii*, though none of the animals were to be found, and they may have been made by some other member of this family. None of the Polynoes were well preserved, but enough remained to establish their identity.

Genus APHRODITA Linnaeus.

APHRODITA ECHIDNA Quatrefages.

Aphrodita echidna Quatrefages, 1865, p. 197.—McIntosh, 1885, p. 36, pl. 7, figs. 1–2; pl. 6*a*, figs. 2, 3.

Collected at D5123, Malabrigo Light, East coast of Mindoro, N. 44° W., 32.50 miles (13° 12′ 45″ N.; 121° 38′ 45″ E.), 283 fathoms, green mud bottom.

Genus IPHIONE Kinberg.

IPHIONE CIMEX Quatrefages.

Iphione cimex Quatrefages, 1865, p. 270.
Iphionella cimex McIntosh, 1885, p. 58, pl. 9, figs. 4–6; pl. 18, fig. 3; pl. 8*a*, figs. 7, 8.

McIntosh proposed a new generic name for this form, but did not define his generic characters. The specimen agreed with his description except that he saw no antennae. No median antenna was preserved, but there were two lateral antennae with rather long, dark-colored basal portions nearly twice as long as the head, each having a filamentous tip longer than the basal portion. On each elytrophore, underneath the elytron, is a thin translucent plate like a shadow of the elytron.

McIntosh stated that the ventral setae are more prominent than the dorsal ones. In this specimen the dense tuft of slender serrated dorsal setae entirely obscures the stouter ventral one.

Collected at Tataan, Simaluc shore, station D5250, Linao Point, Gulf of Davao, 23 fathoms, coral and sand bottom.

Genus PALMYRA Savigny.

PALMYRA AURIFERA Savigny.

Palmyra aurifera SAVIGNY, 1820, p. 17.—AUDOUIN AND MILNE EDWARDS, 1832–1834, p. 110, pl. 2*a*, figs 1–6.—GRUBE, 1878, p. 13.—McINTOSH, 1885, p. 53, pl. 9, figs. 1, 2; pl. 6*a*, figs. 8, 9.

I have doubtfully identified this species. Grube gave out no figures and the head is much larger and more distinct than Audouin and Milne Edwards's figure. It agreed in general with the description of McIntosh, though much larger, measuring about 30 mm. in length by 8 in breadth.

Collected at station D5250, Linao Point, Gulf of Davao, 23 fathoms, coral and sand bottom.

Genus EULEPETHUS Chamberlin.

EULEPETHUS HAMIFERA Grube.

Eulepis hamifera GRUBE, 1878, p. 52, pl. 3, fig. 8.

Collected at station D5235, Nagubat Island, Mindanao, 44 fathoms, soft mud bottom.

Genus PSAMMOLYCE Kinberg.

PSAMMOLYCE FIJIENSIS McIntosh.

Psammolyce fijiensis McINTOSH, 1885, p. 148, pl. 21, fig. 6; pl. 22, fig. 4; pl. 24, fig. 6; pl. 13*a*, fig. 18.

One incomplete specimen from station D5160, Tinakta Island, Tawi Tawi Group, 12 fathoms, sand bottom.

Genus STHENELAIS Kinberg.

STHENELAIS LUXURIOSA Grube.

Sthenelais luxuriosa GRUBE, 1878, p. 54.

Collected at station D5375, Tayabas Light (outer), 107 fathoms, green mud bottom; D5423, Cagayan Island, Jolo Sea, 508 fathoms, gray mud, coral sand bottom; D5397, Panalangan Point, between Samar and Masbate, 134 fathoms, green mud bottom; D5257, Utara Point, Bongo Island, eastern Illana Bay, Mindanao, 28 fathoms, mud bottom; D5183, Lusaran Light, between Panay and Negros, 96 fathoms, soft green mud bottom; and D5392, Tubig Point, Samar, 135 fathoms, green mud and sand bottom.

Fragments of members of this family were collected at stations D5297, Matcot Point, China Sea, 198 fathoms, mud and sand bottom; and D5108, Corregidor Light, China Sea, 13 fathoms, coral bottom, but were too much injured for identification.

Family PHYLLODOCIDAE.

Genus PHYLLODOCE Savigny.

PHYLLODOCE DUPLEX McIntosh.

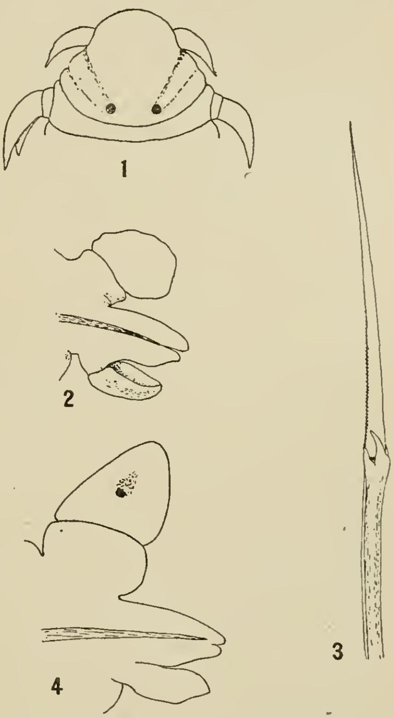
Phyllodoce duplex McIntosh, 1885, p. 167, pl. 27, fig. 8; pl. 32, fig. 9; pl. 15*a*, fig. 1.

Collected at station D5113, Sombrero Island, Balayan Bay, 159 fathoms, dark green mud bottom.

Genus MYSTA Malmgren.

MYSTA MACULATA, new species.

A single specimen, with a length of approximately 60 mm. Width of head between tentacles, 0.5 mm.; width at somite 20, 1.5 mm. There were about 146 somites present, the posterior end having been lost. Anteriorly the proportion of length of somite to breadth is as 1 to 8, and the dorsal cirri are inconspicuous. Beginning with approximately the fortieth somite there is a gradual change in the proportion of length to breadth, and toward the posterior end this proportion is about as 1 to 2. Anteriorly the dorsal cirri are very inconspicuous, and while they overlap one another to a certain extent they cover no part of the somite surface. Posteriorly these cirri become much more prominent, but still do not overlap the body. Each dorsal cirrus is marked with a median dark spot, rather faint anteriorly but very prominent posteriorly. The general body color (in alcohol) is a very light brown, marked on the dorsal surface with dark spots, which in the anterior somites show a tendency to arrange themselves in a transverse row near the anterior border of the somite. Ventrally the body has a broad median dark band, spotted with white.



Figs. 1–4.—Mysta maculata, 1, Head × 20; 2, 15th parapodium × 45; 3, Compound seta × 295; 4, Parapodium from middle region × 45.

The prostomium (fig. 1) is, roughly speaking, lens-shaped, with the long diameter transverse, this long diameter being about one-fourth longer than the antero-posterior one. About one-quarter of its length from either end the anterior border is excavated for the attachment of a tentacle. These are shorter than the head, rather thick, and taper rapidly to a sharp point. Two other tentacles are attached to the ventral surface of the head and are not visible from above. These are similar to the dorsal tentacles in form, but are heavier. One pair of small eyes lies near the anterior border. Just posterior to the right hand one of these is a dark spot which resembles an eye, but is, I think, merely a surface marking. Two tentacular cirri on either side are attached to the first somite. They are much like the tentacles in form, but about twice as large. The mouth is bounded anteriorly by the prostomium, while about one-third of the posterior border is made up of an anterior prolongation from somite 2.

The first parapodium is about two-thirds as long as the second, but is similar to it in all other respects.

A well-developed parapodium (fig. 2—an anterior view of the fifteenth) shows the setigerous portion prolonged into bifid presetal lip, behind which arises a row of about 25 compound setae with elongated basal joints. The notocirrus is broadly rounded and carried on a large cirrophore. The neurocirrus is bluntly conical in outline, with its dorsal surface next the setigerous lobe rather deeply excavated.

The compound seta (fig. 3) has the basal portion very slightly curved, the convex side apparently with a narrow transparent edge, which thickens abruptly at the apex. The apex has a sharp hook at the end of the convex surface, with a much heavier curved hook opposite it. This larger hook lies a little inside the line of the concave margin, which is continued into a much smaller spine. Apparently other smaller spines of uncertain arrangement are located around the base of the large hook. The terminal portion is broad at the base and tapers to a sharp point, the whole terminal portion being about as long as the free part of the basal portion. Near its base there are minute denticulations along its thinner edge. I was unable to determine the extent of these denticulations, but think that they do not go beyond the middle of the joint. With careful focussing, fine lines, giving it a shagreen appearance, may be seen on the surface of this terminal joint.

A later parapodium (fig. 4) shows a cirrophore larger than the cirrus, and there is a black spot in the center of the cirrus. In the preparation the whole cirrus was bent away from the observer so that the cirrus was really larger than appears in the figure. The setae in these parapodia are similar to those farther forward.

Collected at station D5146, Sulade Island, vicinity of Siasi, 24 fathoms, coral sand and shell bottom.

Type.—Cat. No. 18940, U.S.N.M.

Family NEREIDAE.

The collection contained large numbers of heteronereis stages of *Nereis.* Since during this phase the bodily changes are such as to obscure specific characters I have relied almost entirely in determining species on the characters of the jaws and paragnaths. These determinations must therefore be regarded as provisional.

Genus NEREIS Linnaeus.

NEREIS MASOLOCENSIS Grube.

Nereis masolocensis Grube, 1878, p. 75, pl. 5, fig. 4.

The *Albatross* specimens corresponded exactly with these in respect to tooth structure. Grube states that 22 anterior somites are marked with a brown stripe on either side. In these not more than 17 or 18 were so marked. A prominent feature is a brown band across the entire dorsal surface of the second setigerous somite.

Collected at Bohuao; Varadero Harbor, Mindoro; Subic; Tava Island; San Miguel Harbor; Varadero Bay, Mindoro; "Electric light, July 20, 1908," station D5403, Capitancillo Island, between Leyte and Cebu, 182 fathoms, green mud bottom.

NEREIS PECTINIFERA Grube.

Nereis pectinifera Grube, 1878, p. 66, pl. 4, fig. 5; pl. 5, fig. 5.

Collected at Labuan Blanda Island.

NEREIS TONGATABUENSIS McIntosh.

Nereis tongatabuensis McIntosh, 1885, p. 212, pl. 34, figs. 7, 8, 9; pl. 16*a*, figs. 5, 6, 7.

Collected at Nasugbu Luzon.

NEREIS (PLATYNEREIS) INTEGER, new species.

An epitokous form, characterized by an enormous development of the prostomium, so that the antennae are thrown to the ventral surface, all that is visible from above being the enormous eyes and the shovel-shaped prostomium (figs. 1 and 2).

Male.—The prostomium rounded, its margin entire, the portion anterior to the eyes being very thin and translucent. In some individuals the palps may be seen through this translucent region. The anterior eyes are the larger, and they are situated on the latero-ventral portion of the head.

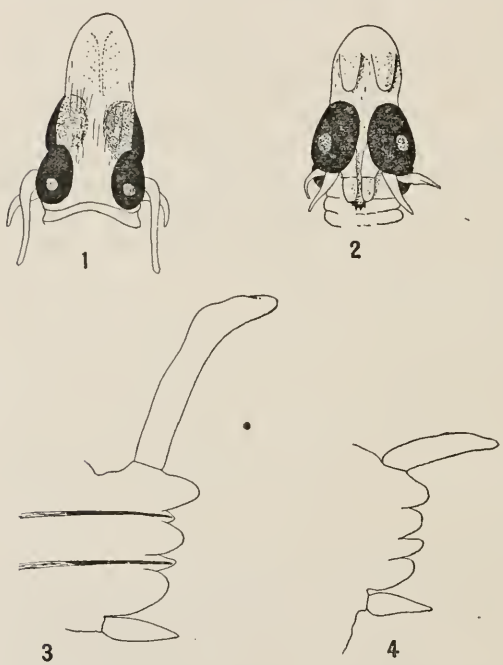
The dorsal tentacular cirrus (lost in the specimen figured) extended in other specimens to the eighth somite. The median cirri (fig. 1) are much shorter.

On the ventral surface (fig. 2) appear the flattened antennae, which normally hang at right angles to the prostomium, but are figured as if pressed against its lower surface. The large anterior eyes with their latero-ventrally directed lenses occupy a considerable part of the ventral surface. Posterior and ventral to these are the palps with their two portions nearly equal in size, hanging down so as to cover the sides of the mouth. While in the figure they are shown under slight pressure, their direction is only very slightly changed by it.

The jaws have each a large terminal and five smaller lateral teeth. I could discover no trace of paragraths.

The dorsal cirri of the first seven somites are enlarged, increasing successively in size until the seventh is reached (fig. 3 of the seventh). The notopodium has two obtuse subequal lobes, the acicula extending into a short conical lobe between them. The neuropodium has a dorsal conical lobe, into which the acicula extends, and an obtuse ventral lobe similar to that of the notopodium. Dorsal cirrus elongated, its terminal portion bent and slightly flattened as shown, somewhat foreshortened, in the figure.

Setae of notopodium with long "camerated" shafts, the terminal joint set into rather a deep socket. The terminal joint is long, slender, and very sharp pointed, with numerous very sharp teeth along the greater part of one edge. The teeth are all drawn out into fine processes, which bend apically so that each covers over several of those distal to it. In the ventral bundle are a few similar to the dorsal and others having the terminal portion short, narrow as compared with the basal joint, with one large tooth at the apex and a row of very fine teeth along one margin.



Figs. 1–4.—Nereis integer, 1, Dorsal view of head × 22; 2, Ventral view of head × 22; 3, 7th parapodium × 45; 4, 8th parapodium × 45.

The parapodia, from eighth to fourteenth inclusive, are unmodified, though the general structure of neuropodium, notopodium, ventral cirri, and setae are essentially as in the seventh. The dorsal cirrus is much shorter and tapers slowly to a blunt end.

The parapodial modifications begin on somite 15. In a modified parapodium the neuropodium has a dorsal, and the notopodium a ventral sagittal lobe, which overlap, the notopodial being anterior. Dorsal to the slender dorsal cirrus is a broad rounded lobe with ventral to it, a lanceolate one extending to nearly the end of the cirrus. The ventral cirrus is much like the dorsal in form, but relatively a little heavier. Ventrally it carries a plate shaped like that of the dorsal but larger. Dorsally, attached to its base, this cirrus carries a zigzag three-pronged outgrowth, while on the ventral surface of the neuropodium is another outgrowth very similar to this but with four prongs. The setae are of the usual type with broad terminal joint toothed along one edge.

Most individuals show traces of brown spots on the dorsal surface. When best developed these appear in the anterior unmodified portion as prominent spots on the parapodia from the eighth to the fifteenth. In the modified portion there is a median dorsal and two lateral brown spots in each somite, with a double row of smaller brown spots on the dorsal surface of each parapodium. Ventrally these markings are most prominent in the modified region, where the median row breaks up into a double row of smaller spots and the parapodial row tend to coalesce into a single one.

In the collections were a number of females in the epitokous condition, but none which resembled the above-described males sufficiently to justify one in identifying them as of this species.

Collected from Subic Bay; Santa Cruz Harbor, Marinduque; San Miguel arbor, Ticao Island, a large number of individuals being from the latter locality; Port Matalvi, Luzon, and Romblon.

Type.—Cat. No. 18939, U.S.N.M., from latter locality.

Family LEODICIDAE.

Genus LEODICE Savigny.

LEODICE APHRODITOIS Pallas.

Eunice aphroditois PALLAS, 1766.—EHLERS, 1864–1868, p. 306, pl. 15, figs. 23–29.

Collected at Batan Island.

Genus AGLAURIDES Ehlers.

AGLAURIDES FULGIDA Savigny.

Aglaurides fulgida SAVIGNY, 1820, p. 54.—GRUBE, 1878, p. 172.

Collected at station D5179.

Fragments of a Leodice were collected at station D5401, Tanguingui Island, north of Cebu, 30 fathoms, fine sand bottom.

Genus HYALINOECIA Malmgren.

Fragments of a *Hyalinoecia* and numerous tubes were collected from the following localities. No individuals were well enough preserved to enable the species to be identified. D5654, Cape Tabako, Gulf of Boni, 805 fathoms. D5439, Hermana Mayor Light, West coast of Luzon, 940 fathoms, green mud bottom. D5209, Taratara Island, off western Samar, 20 fathoms, green mud. D5619, Mareh Island, Molucca Passage, 435 fathoms, fine gray sand bottom. D5132, Island off Panabutan Point, Sulu Sea, 26 fathoms, green mud and sand bottom. D5432, Corandagos Island, Eastern Palawan, 51 fathoms, sand bottom. D5187, Apo Island, Tanon Strait, 225 fathoms, soft green mud bottom. D5365, Cape Santiago Light, Balayan Bay, 214 fathoms. D5606, Dodepo Island, Gulf of Tomini, Celebes, 834 fathoms, green mud bottom. D5670, Chenoki Point, Macassar Strait, 1,181 fathoms, gray mud bottom. D5656, Olang Point, Gulf of Boni, 484 fathoms, gray mud bottom. D5126, Nogas Island, Sulu Sea, 742 fathoms, soft green mud. D5181, Antonia Island, off eastern Panay, 26 fathoms, mud and fine sand bottom. D5582, Si Amil Island, Darvel Bay, Borneo, 890 fathoms, gray mud and fine sand bottom.

HYALINOECIA CAMIGUINA Grube.

Hyalinoecia camiguina Grube, 1878, p. 142, pl. 10, figs. 1, 1*a*, 1*b*.

While most of the specimens of this genus were represented by either the tubes alone or fragments of the animals, one lot from D5483, Cabugan Grande Island, between Samar and Leyte, 74 fathoms, sand and broken shell bottom, contained a number of well-preserved individuals of this species. These were not easily removed from the tubes without injury, but all points in their external anatomy could be seen through the transparent tube.

Family MALDANIDAE.

Genus MALDANE Grube.

MALDANE DISPARIDENTATA Moore.

Maldane disparidentata Moore, 1904, p. 494, pl. 38, figs. 28–31.

A single specimen, retaining only about 12 of the anterior somites and two from somewhere near the middle of the body, were collected at D5592, Silungan Island, Sibuko Bay, Borneo, 305 fathoms, green mud bottom. Fragments of the anterior ends of others were collected at D5207, Badian Island, Samar, 35 fathoms, green mud and sand bottom; and D5209, Taratara Island, Samar, 20 fathoms, green mud bottom. I have identified them as of this species from the form of the head and anterior somites and of the setae.

MALDANE SARSII Malmgren.

Maldane sarsii Malmgren, 1865, p. 188.—Arwidsson, 1906, p. 251, pl. 6, figs. 192–199; pl. 10, figs. 333–338.

In identifying these as *sarsii* I have followed Arwidsson's diagnosis of the species.

One entire specimen and some fragments in mud tubes taken from D5585, Sidipan Island, Sibuko Bay, Borneo, 476 fathoms, gray mud bottom. Another was from D5368, Tayabas Light, Verde Island Passage, 181 fathoms, gray mud bottom; and a fragment from 5533, Balicasag Island, between Cebu and Siquijor, 432 fathoms, green mud and sand bottom.

Family AMPHICTENIDAE.

Genus PECTINARIA Lamarck.

PECTINARIA CLAVA? Grube.

Pectinaria clava Grube, 1878, p. 212, pl. 11, fig. 3.

This I have doubtfully identified as of this species, as the specimens had dried and details of structure were difficult to make out.

Collected from station D5162, Tinagta Island, Tawi Tawi Group, 230 fathoms, coarse sand and broken shell bottom.

Part of a tube of *pectinaria*, species? was dredged at station D5206, Badian Island, Samar, 32 fathoms, green mud bottom.

Family GLYCERIDAE.

Genus GLYCERA Savigny.

GLYCERA LONGIPINNIS Grube.

Glycera longipinnis Grube, 1878, p. 182, pl. 8, fig. 9.

Station 5113, Sombrero Island, Luzon, 159 fathoms, dark green mud bottom.

Family CHAETOPTERIDAE.

Genus PHYLLOCHAETOPTERUS Grube.

PHYLLOCHAETOPTERUS CLAPEREDII McIntosh.

Phyllochaetopterus claperedii McIntosh, 1885, p. 374, pl. 45, figs. 9, 10, 10*a*, 11; pl. 26, fig. 1; pl. 24*a*, figs. 1–5.

Tubes containing portions of the anterior ends of two specimens were collected at Station D5206, Badian Island, Samar, 32 fathoms, green mud bottom. Large numbers of tubes without any of the animals were collected at station D5382, Arena Point, Ragay Gulf, Luzon, 128 fathoms, mud bottom; and they were also found at D5209, Taratara Island, Samar, 20 fathoms, green mud bottom.

Family TEREBELLIDAE.

Genus LOIMA Malmgren.

LOIMA MONTAGUI Grube.

Terebella montagui Grube, 1878, p. 224, pl. 12, fig. 3.

Collected at Station D5160, Tinakta Island, Tawi Tawi Group, 12 fathoms, sand bottom.

LOIMA ANNULIFILIS Grube.

Terebella annulifilis Grube, 1878, p. 225, pl. 13, fig. 2.

Two specimens were in the collection, one having lost all of its gills and on the other only fragments of these organs remained. Enough were present, however, to establish the diagnosis of the species, and they agreed in other respects with Grube's description.

Station 5209. Taratara Island, Samar, 20 fathoms, green mud bottom.

Genus PISTA Malmgren.

PISTA TYPHA Grube.

Pista typha Grube, 1878, p. 232, pl. 12, fig. 4.

Collected at Stations 5428, 30th of June Island, Palawan, 1,105 fathoms, gray mud bottom; and D5209, Taratara Island, Samar, 20 fathoms, green mud bottom.

Family CAPITELLIDAE.

Genus DASYBRANCHUS Grube.

DASYBRANCHUS UMBRINUS Grube.

Dasybranchus umbrinus Grube, 1878, p. 189.

Collected at D5372, Tayabas Light, Marinduque Island, green mud bottom.

Family SABELLIDAE.

Genus SABELLA Linnaeus.

SABELLA SPECTABILIS Grube.

Sabella spectabilis Grube, 1878, p. 253, pl. 14, fig. 4.

Two bottles containing this species. One was labeled A4521, F2599, and the other A4371, F.2542.

Tubes of a sabellid were collected from D5213, Destacado Island, east of Masbate Island, 80 fathoms, sand, mud, and shell bottom;

5300, 20° 31′ N.; 115° 49′ E., 265 fathoms, gray mud and sand bottom; and D5411, Lauis Point, between Cebu and Bohol, 145 fathoms, green mud bottom.

Family SERPULIDAE.

Genus SERPULA Linnaeus.

SERPULA (POMATOSTEGUS) ACTINOCERAS Mörch.

Pomatostegus actinoceras Mörch, 1863, p. 54, pl. 11, fig. 16. This reference quoted from Grube, 1878, p. 271.

Station 5205, Leyte, staghorn coral and rock bottom. Caguayan Point.

Empty serpulid tubes were collected from D5413, Lauis Point Light, Dupon Bay, 42 fathoms.

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POLYCHAETOUS ANNELIDS COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION OF 1907–1909.

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INTRODUCTION.

The collection of Annelids described here is extensive but in many cases poorly preserved. Specimens too mutilated for identification are not mentioned in the following list; also, vials containing only tubes have in some cases been discarded. In descriptions of new species I have endeavored to include drawings in sufficient numbers to supplement the verbal descriptions, thus, I believe, eliminating the errors in identification which often result from such descriptions. I am indebted to Prof. A. L. Treadwell, of Vassar College, for the use of the collection.

The following families are represented:

Syllidae.
Hesionidae.
Aphroditidae.
Nereidae.
Nephthydidae.
Amphinomidae.
Leodicidae.
Glyceridae.
Spionidae.
Cirratulidae.
Terebellidae.
Ampharetidae.
Capitellidae.
Opheliidae.
Chlorhaemidae.
Sabellidae.
Hermellidae.

DESCRIPTION OF SPECIES.

Family SYLLIDAE.

Genus MYRIANIDA Milne-Edwards.

MYRIANIDA TERESETA, new species.

Plate 46, figs. 1–3.

Type.—Cat. No. 18942, U.S.N.M. A sexually mature female of 114 somites (incomplete). Length, 17 mm.; greatest width, not quite 2 mm.

Head with width about twice length (fig. 1). No palps. Three moderately long tentacles showing no segmentation. Eyes four, reddish; the posterior pair dorsal, the anterior pair lateral, with lenses not seen from the dorsal surface. The stippling in figure 1 represents the part of the anterior eyes seen through the dorsal integument.

First somite triangularly shaped dorsally, with apex directed anteriorly. Tentacular cirri four pairs, of which the more ventrally placed are short, the dorsally placed equaling the tentacles in length. Second somite rectangular, setigerous.

Parapodia with blunt dorsal lobe (fig. 2). Dorsal cirrus heavy, not as attenuated as tentacles. Ventral cirrus lacking. Setae of two kinds. Dorsal long, slender, and tapering, extending beyond the dorsal cirrus. Ventral equally slender, shorter, and articulated. The terminal part is very minute; the basal part club-shaped and provided with fine teeth (fig. 3).

Color of alcoholic specimen brownish yellow.

Collected at San Miguel Harbor, Ticao Island.

Family HESIONIDAE.

Genus HESIONE Savigny.

HESIONE INTERTEXTA Grube.

Hesione intertexta Grube (1878), p. 102, pl. 6, fig. 5.

Collected at station D5355, Balabac Light, North Balabac Strait, 44 fathoms, coral and sand bottom.

Genus IRMA Grube.

IRMA ANGUSTIFRONS Grube.

Irma angustifrons Grube (1878), p. 108, pl. 6, fig. 7; pl. 15, fig. 12.

Collected at station D5149, Sirun Island, 10 fathoms, coral and shell bottom.

Family APHRODITIDAE.

Genus POLYNOE Savigny.

POLYNOE PLATYCIRRUS McIntosh.

Polynoe platycirrus McIntosh (1885), p. 111, pl. 3, fig. 4; pl. 16, fig. 2.

Collected at station D5518, Point Tagolo Light, Mindanao, 200 fathoms, gray mud and Globigerina bottom, temperature 54.0°.

POLYNOE POLYCHROMA Schmarda.

Polynoe polychroma Schmarda (1861), p. 153, pl. 31.

Collected at station D5355, Balabac Light, North Balabac Strait, 44 fathoms, coral and sand bottom.

Genus IPHIONE Kinberg.

IPHIONE FUSTIS, new species.

Plate 46, figs. 4–8.

Type.—Cat. No. 18941, U.S.N.M. Specimen young. Length, 5.2 mm. Greatest width, 5 mm. Body oval, narrowing anteriorly and posteriorly. Number of somites, 26. Scales, 13 pairs.

Head (fig. 4) 3 mm. longer than broad. Palps, 3.5 times as long as head, with longitudinal rows of papillae. Tentacular cirri, two on each side, extending to end of palps: borne on basal portion one-half length of palps. Tentacles, two, converging toward the median line anteriorly. Blunt anteriorly directed lobe in place of median tentacle. Eyes, two pairs, posterior pair on postero-lateral margin of the head. Anterior pair a short distance in front of these, but so placed as to be scarcely seen from the dorsal surface.

Eltyra (fig. 5) reniform, divided and subdivided by honeycomb reticulum. Postero-lateral surface of dorsal side armed with cudgel-like spines. First elytra ovate.

Parapodia (fig. 6) small, not divided. Dorsal cirrus long, provided with papillae, extending to ends of dorsal setae. Ventral cirrus extending to lateral edge of parapodium; provided with papillae. Dorsal setae bundle very thick, arising anteriorly and just medianly to ventral setae bundle.

Setae of two kinds. Dorsal (fig. 7) long and slender with naked tip. Subterminal portion provided with leaf-like appendages, gradually increasing in size just below tip, but soon becoming uniform. Ventral (fig. 8) heavy, yellow, with fine irregular serrations and naked, blunt tip.

Collected at station D5141, Jolo Light, 29 fathoms, coral sand bottom. Paratypes collected at Tanguingui Island Light, 30 fathoms, fine sand bottom; North of Cebu; Caguayan Point, off east coast Leyte Island, 8 fathoms.

Genus LAGISCA Malmgren.

LAGISCA? HEXACTINELLIDAE McIntosh.

Lagisca ? hexactinellidae McIntosh (1885), p. 94, pl. 4, fig. 5; pl. 12*a*, figs. 14–16.

Specimen 15 mm. in length. Missing parts identical with those missing in McIntosh's specimen. No data given as to habitat of form.

Collected at station D5536, Apo Island, 279 fathoms, green mud bottom.

LAGISCA OCULESCENS, new species.

Plate 47, figs. 1–7.

Type.—Cat. No. 18943, U.S.N.M. Length of specimen, 25 mm. Number of somites, 38. Number of scales, 15. Greatest width, 7 mm. Body attenuate posteriorly.

Head (fig. 1) somewhat more than twice as long as broad, prolonged anteriorly into minute lateral peaks. Median tentacle broken. Lateral tentacles attached below median, extending a short distance beyond lateral lobes of head. Palps about three times as long as head, longitudinally striped. Tentacular cirri, two pairs, reaching two-thirds of length of palps, borne on long basal portion. Eyes, two pairs, completely coalesced, forming roughly S-shaped markings on the dorsal surface of the head.

Elytra (fig. 2) roughly ovate, with ruffling edge; crowded into almost vertical position posteriorly by the pressure of the dorsal setae. Median posterior area of elytron covered with ornate golden-brown spines (fig. 3).

Parapodia (fig. 4) with noto- and neuro-podia, each drawn out into bluntly pointed processes laterally. Dorsal cirri long, sharply attenuated at end, borne on basal portion. Ventral cirri small and short.

Setae of three kinds; all light yellow. Dorsal (fig. 5) stout, with blunt naked tip and provided with minute serrations throughout remainder of length. Ventral two kinds: many (fig. 6) slender, bidentate, provided with long barb-like teeth; a few (fig. 7) bidentate, and provided with needle-like serrations.

Type either from Jolo Anchorage, Jolo, or from Kopoposang Light, Macassar Strait, 400 fathoms hard bottom.

Genus PANTHALIS Kinberg.

PANTHALIS MELANONOTUS Grube.

Panthalis melanonotus GRUBE (1878), p. 48, pl. 4, fig. 1.

One specimen of this species was found. The first seven pairs of elytra were lacking, so that it was impossible to determine to what extent they had overlapped. It agreed in all respects with Grube's description, except that it possessed small paired tentacles situated immediately beneath the ommatophores. Number of somites, 90.

Collected at station D5209, Taratara Island, 20 fathoms, green mud bottom.

PANTHALIS ADUMBRATA, new species.

Plate 46, figs. 9–14.

Type.—Cat. No. 18944, U.S.N.M. Length of specimen 48 mm., incomplete. Length of a complete paratype 63 mm. Number of somites, 53; scales, 24 pairs. Width, 12 mm.

Head (fig. 9) with length (including peduncles) about three times the width. Palps somewhat less than twice as long as entire head, tapering at end, faintly papillose. Tentacular cirri, two on each side, borne on long basal portion, extending three-fourths of length of palp. Median tentacle slender, borne on short basal portion, extending slightly beyond peduncles. Paired tentacles present, equal in length to the median tentacle, but not seen from the dorsal surface. Eyes, two pairs; anterior large, reddish, and borne on peduncles; posterior small, gray, and situated dorsally equidistant from base of peduncles and median tentacle.

Dorsal surface of first seven somites conspicuously tuberculated in type. Not tuberculated in paratype.

Eltrya (fig. 10) oval, grayish, with black edging medianly and posteriorly, giving the whole a shaded appearance.

Parapodia (fig. 11) stout, with small antero-dorsal lobe separated by a deep cleft. Dorsal cirrus stout, reaching beyond body of parapodium. Ventral cirrus small, not reaching to edge of parapodium.

Setae of three kinds. Dorsal long, slender, provided with hair-like points along the terminal portion (fig. 12); subterminal portion slightly enlarged. Middle setae (fig. 13) heavy, yellow, bluntly pointed terminally and provided with a group of fine needle-like teeth just below the termination. Ventral setae (fig. 14) like the dorsal, strongly serrated along the enlarged subterminal portion, the serrations becoming smaller toward the tip. The setae did not cover the scales dorsally in any part of the body.

Type collected at Dumurung Point, Masbate Shore, or Tinakta Island, 10 fathoms, coral sand bottom. Paratypes collected at stations D5157 and D5158, Tinakta Island, 18 fathoms, fine sand bottom.

This species resembles *Panthalis panamensis*, Chamberlin.[1] The differences between the two species are the coloration of the ommatophores or peduncles, the shape of the head, the absence in *P. adumbrata* of the finer setae in the dorsal series and the absence in *P. abumbrata* of the lash-like process in the median setae. The last may be due to breakage.

Family NEREIDAE.

Genus NEREIS Linnaeus.

NEREIS MASALACENSIS Grube.

Nereis (Lycoris) masalacensis GRUBE (1878) p. 75, pl. 5, fig. 4.

Collected at Varadero Bay and at station D5146, Sulade Island, 24 fathoms, coral sand and shell bottom.

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[1] 1919, p. 86, pl. 11, fig. 4–8; pl. 2, fig. 1–6.

NEREIS ZONATA Malmgren.

Nereis zonata MALMGREN. Fauvel (1914), p. 177, pl. 14, figs. 1–17.

Epitokous form with paragnaths coalesced.

Collected at station D5149, Sirun Island, 10 fathoms, coral and shell bottom.

NEREIS (LEPTONEREIS) INERMIS, new species.

Plate 47, figs. 8–12.

Type.—Cat. No. 18947, U.S.N.M. An incomplete specimen of 30 somites. Length, 16 mm.; greatest width, just behind head, 5 mm.

Head (fig. 8) 6-angled, with length equal to greatest width. Palps more than twice as long as head, with ends distorted and unequal because of poor preservation. Tentacles extending three-fourths of length of palps, borne on anteriorly directed lobes of head. Tentacular cirri, four pairs, the longest extending posteriorly as far as the twelfth setigerous somite. Eyes, four pairs, all provided with lenses, situated in the posterior region of the head. Anterior pair larger with lenses directed antero-laterally; posterior pair nearer the mid line, with lenses directed dorsally. Proboscis without armature of any kind.

Parapodia varying slightly, the change being gradual antero-posteriorly. Typical anterior parapodium (fig. 9) divided into noto and neuro podia. Notopodium divided into two lobes, the acicula being in the ventral one. Dorsal cirrus arising median to base of dorsal lobe and extending beyond it. Neuropodium divided into two lobes, the dorsal of which is subdivided for a short distance, and contains acicula. Ventral cirrus short, and arising medianly and ventrally to ventral lobe. Posterior parapodium (fig. 10) with same parts. Dorsal cirrus greatly elongated. Dorsal lobe of notopodium shortened. Ventral lobe greatly increased. Ventral cirrus elongated.

Setae from anterior parapodium of setose variety. First variety, setose seta (fig. 11) occurring in dorsal and ventral bundles. Blade finely serrated. Second variety, setose setae (fig. 12) occurring in ventral bundle. Blade finely but deeply serrated. Setae of posterior parapodia essentially the same as to form, but more slender.

Collected at station D5346, Cliff Island, 7 fathoms, mud bottom.

NEREIS (HETERONEREIS) CAERULEIS, new species.

Plate 47, figs. 13–16; plate 48, figs. 1–4.

Type.—Cat. No. 18948, U.S.N.M. Specimen, 90 mm. in length, incomplete posteriorly. Greatest width, 10 mm. Number of somites. 167. Color, grayish, with marine blue mid-dorsal stripe. Light refractive spot just median to dorsal lobe of parapodium on each somite; most conspicuous on heteronereid somites. Ventral surface milky white.

Head (pl. 47, fig. 13) iridescent. Length somewhat less than twice breadth. The figure shows the head in a flattened condition for purposes of comparison. In the specimen the head was bent directly ventrally along a line just in front of the posterior eyes. Palps, two, the same length as the head; provided with terminal articles not seeen in the figure. Tentacles short and bluntly pointed. Tentacular cirri, four pairs, the longest pair slightly exceeding the breadth of the peristomium. Eyes, two pairs; posterior pair small, provided with lenses and situated nearer the mid line than the anterior; anterior pair large, provided with lenses and directed laterally.

As the pharynx was not extruded it is represented diagrammatically (pl. 47, figs. 14, 15). Paragnath formula as follows: I, two small groups; II, absent; III, three groups, the central one the largest; IV, crescent-shaped group with heavier teeth anteriorly; V, three groups roughly triangular in shape with teeth in longitudinal rows and heavier teeth anteriorly; VI, single row of heavy black teeth; VII, zigzag group across ventral side; VIII, gradually decreasing continuation of VI.

First 28 pairs of parapodia in the ordinary nereid condition (pl. 47, fig. 16). Notopodium subdivided into three lobes, the dorsal cirrus situated on the most dorsal of these and extending to the limit of the notopodium laterally. Middle and ventral lobes pigmented with brown laterally. Acicula passing to base of ventral lobe. Neuropodium subdivided into three lobes, with acicula passing to base of dorsal lobe. Middle lobe shorter and pigmented; ventral lobe still shorter and bearing ventral cirrus. Setae bundle on dorsal lobe. Twenty-ninth and following parapodia in heteronereid condition (pl. 48, fig. 1). Notopodium subdivided into three lobes: the dorsal large and flat bearing a short cirrus subterminally and a large finger-like lobe ventrally; middle short and bearing setae; ventral lobe intermediate in size. Neuropodium subdivided into three lobes: the dorsal pointed and provided with acicula and seta bundle; the middle resembling the ventral lobe of the notopodium; the ventral flat and fan shaped, bearing a small ventral cirrus and provided dorsoanteriorly with a vascularized area. Extra lobe, large and faintly bordered with pink borne posteriorly by neuropodium. Margins of all lobes provided with papillae.

Setae on heteronereid parapodium of two kinds, the most abundant of the large natatory type (pl. 48, fig. 2) with one edge finely serrated. Setose type rare (pl. 48, fig. 3). Setae of thirteenth parapodium of two kinds, the most abundant of the falcate type (pl. 48, fig. 4) with short terminal portion without serrations. Setose type rare. Similar to those of heteronereid parapodium but with shorter terminal blade.

Type collected from Limbe Strait and paratypes from Leyte Sound, Port Dupon.

Family NEPHTHYDIDAE.

Genus NEPHTHYS Cuvier.

NEPHTHYS MIRASETIS, new species.

Plate 48, figs. 5–8.

Type.—Cat. No. 18950, U.S.N.M. A complete specimen, 45 mm. in length, including extruded proboscis. Width, 4 mm., not including setae. Number of somites, 79, the last nine greatly reduced in size and terminating in a single anal cirrus.

Head (fig. 5) square, with rounded corners. Posterior area faintly marked with grayish oblong spots. Tentacles conical; subtentacles similar but longer. Proboscis set with numerous rows of papillae, gradually decreasing in size posteriorly. Not more than nine in a row in type specimen. Mouth a dorso-ventral slit surrounded by distal papillae.

Parapodia (fig. 6) divided into noto- and neuro-podia. Dorsal lamella of notopodium moderate in size. Gill large and curved, borne on posterior face of notopodium. Dorsal cirrus simple, arising near base of gill. Neuropodium provided with small simple gill dorsally. Ventral cirrus conical, not reaching beyond parapodium. Ventral lamella not prominent anteriorly, gradually increasing to slightly larger dimensions posteriorly.

Setae of three kinds. Most abundant simple non-serrated setae of capillary type. Barred setae (fig. 7) present at base of setae bundle in most parapodia. Bidentate setae (fig. 8) with extra serrations present at base of setae bundle in a few parapodia.

Collected at station D5161, Tinakta Island, 16 fathoms, fine sand and black specks bottom.

Family AMPHINOMIDAE.

Genus AMPHINOME Brugière..

AMPHINOME ROSTRATA Pallas.

Amphinome rostrata Pallas, McIntosh (1885), p. 21, pl. 1, fig. 7.

Collected at station D5332, Apo Light on "driftwood at surface."

Genus CHLOEIA Savigny.

CHLOEIA FLAVA Savigny.

Chloeia flava SAVIGNY, Grube (1878), p. 10.

Two specimens, one of which is a young form previously described by Grube (1874) as *Chloeia ceylonica.*

Large specimen collected at station D5136, Jolo Light, 22 fathoms, sand and shell bottom; another from Jolo Anchorage, Jolo, electric light, March 5, 1908; and a small specimen collected at Opol, Mindanao Island.

Genus EURYTHOE Kinberg.

EURYTHOE PACIFICA Kinberg.

Eurythoe pacifica KINBERG, McIntosh (1885), p. 27, pl. 2, figs. 3–4.

Collected at station D5147, Sulade Island, 21 fathoms, coarse sand and shell bottom.

Genus EUPHROSYNE Savigny.

EUPHROSYNE TRIPARTITA, new species.

Plate 48, figs. 9–12.

Type.—Cat. No. 18951, U.S.N.M. Length, 15 mm. Elliptical in form, tapering evenly at both ends; 9 mm. in greatest width. Dorsal bare area, 3 mm. in greatest width—i. e., one-third the width of body. Number of somites, 37.

Caruncle (fig. 9) extending to middle of fifth somite, consisting of median vertical crest and horizontal portion thickened laterally, giving the whole a three-lobed appearance. Median tentacle short and thick, with posterior eye spots at its base. Antennae short and small, situated just above the anterior eye spots; not seen from the dorsal surface. Mouth bounded posteriorly by fourth somite. Palps large and ovate, their broader posterior margins reaching the fourth somite.

Parapodia with heavy setae bundle ventrally. Ventral cirrus arising immediately posterior to setae bundle, so as to appear to emerge from it. Dorsal cirrus short, not extending beyond branchiae. Lateral cirrus between second and third branchiae, extending beyond them in length. Branchiae, eight or nine on each side, all ramose with trefoil termination to each branchlet (fig. 10).

Ventral setae (fig. 11) heavy, bidentate, without serrations. Dorsal setae (fig. 12) cleft, with heavy serrations within the cleft.

Collected at station D5250, Linao Point, Gulf of Davao, 23 fathoms, coral and sand bottom.

Paratype.—Locality not recorded.

Genus HERMODICE Kinberg.

HERMODICE DISTINCTA, new species.

Plate 48, figs. 13–15.

Type.—Cat. No. 18953, U.S.N.M. Specimen large and well preserved. Length, 145 mm.; breadth, 10 mm., with gradual narrowing throughout last 10 somites. Number of somites, 91. Body rectangular in section, with dorso-ventral flattening throughout last somites. Dorsal surface dull white, irregularly streaked with bluish gray. Ventral surface dull white with median longitudinal stripe of bluish gray. Anus in last somite, dorsal, surrounded by elevated fold.

Caruncle (fig. 13) triangular in shape, with apex reaching as far as fourth somite posteriorly. Composed of a central, brownish, vertical lamella with broad anterior end between the eyes, and lateral vertical lamellae (10 on each side), paired and decreasing posteriorly. Dorsal two-thirds of lateral lamellae corrugated anteriorly and posteriorly.

Eyes (fig. 13) four pairs, large, reddish, and provided with lenses. Posterior pair directed dorso-laterally; anterior pair directed ventro-laterally. Median tentacle arising between posterior eyes; somewhat more than half as long as caruncle.

Oral lobe provided with paired superior and inferior tentacles, somewhat shorter than the median tentacle. Mouth longitudinal, extending to edge of fifth somite posteriorly.

Parapodia (fig. 14) divided into dorsal and ventral parts. Dorsal setae bundle borne on stout darkly pigmented lobe, also bearing dorsal cirrus. Gill, large and bush-like, situated just posterior to dorsal lobe. Ventral lobe pale, bearing ventral cirrus and large ventral setae bundle.

Dorsal setae of two kinds. First variety (fig. 15) rare, simple, slender, with tip finely serrated. Second variety abundant, simple, smooth, considerably longer and more slender than first variety. Ventral setae of same character. Serrated setae slightly heavier than those in dorsal bundle.

Collected at Opol, Mindanao Island.

Genus NOTOPYGOS Grube.

NOTOPYGUS HISPIDA, new species.

Plate 48, fig. 16; plate 49, figs. 1–3.

Type.—Cat. No. 18954, U.S.N.M. Length, 27 mm.; greatest width, 16 mm. Number of somites, 31. Body elliptical, with prominent white setae shading to Nile green posteriorly in paratype. Body a dull brown. Anus situated dorsally between twentieth and twenty-first somites. Terminal cirri short and stout.

Head (pl. 48, fig. 16) rounded. Tentacles three, of equal length, the median extending posteriorly for a short distance over the caruncle. Tentacular cirri two, arising at base of first somite. Eyes, two pairs; most posterior pair situated on each side of median portion of caruncle; anterior pair scarcely seen from the dorsal surface. Caruncle large, extending to anterior border of seventh somite. Composed of a middle vertical plicated crest and two horizontal plicated portions. Mouth a longitudinal slit surrounded by oral lobe and extending to anterior edge of third somite.

Parapodia (pl. 49, fig. 1) divided into dorsal and ventral lobes. Dorsal cirri two. The more lateral jointed and borne on a basal portion emerging from the dorsal lobe with the dorsal setae bundle. More median arising near base of gill and extending for short distance beyond gill. Ventral cirrus borne on ventral lobe just below setae bundle. Gills palmate in form, beginning on fifth somite and situated just median to dorsal lobe of parapodium.

Dorsal setae of two kinds—simple tapering variety (pl. 49, fig. 2) and smooth bifid variety. Ventral setae all smooth bifid (pl. 49, fig. 3).

Port Maricabau, anchorage, electric light.

Paratype obtained from station D5249, Lanang Point, Gulf of Davao, 23 fathoms, coral and sand bottom.

Family LEODICIDAE.

Genus LEODICE Savigny.

LEODICE (EUNICE) COLLARIS Ehrenberg.

Eunice collaris Ehrenberg, Grube (1878) p. 158, pl. 9, fig. 3.

Specimens collected at station D5165, Observation Island, 9 fathoms, coral bottom. Small specimens collected at station D5157, Tinakta Island, 18 fathoms, fine sand bottom.

LEODICE (EUNICE) APHRODITOIS (Pallas).

Eunice aphroditois (Pallas) Grube, 1878, p. 146.

Collected in tide pool at Batan Island and at Verde del Sur Island, Palawan 8–10 feet, coral, gravel, and sand bottom.

LEODICE (EUNICE) MAGELLANICA McIntosh.

Eunice magellanica McIntosh (1885), p. 265, pl. 37, figs. 12–15.

Specimen collected at station D5589, Mabul Island, 260 fathoms, fine gray sand and gray mud bottom, temperature 45.7°.

LEODICE (EUNICE) MICROPRION Marenzeller.

Eunice microprion MARENZELLER (1879), p. 135 (sep. p. 27), pl. 5, fig. 1.

Specimens collected at station D5149, Sirun Island, 10 fathoms, coral and shell bottom and station D5148, Sirun Island, 17 fathoms, coral sand bottom; station D5411, Lauis Point Light, 145 fathoms, green mud bottom, temperature 55.2°; station D5641, Kalono Point, 39 fathoms, sand and shell bottom; station D5280, Malavatuan Island, 193 fathoms, gray sand bottom, temperature 49.6°; station D5523, Point Tagolo Light, 182 fathoms, Globigerina and sand bottom, temperature 54.3°; station D5519, Point Tagolo Light, 230 fathoms, temperature 52.3°; station D5589, Mabul Island, 260 fathoms, fine gray sand and gray mud bottom, temperature 45.7°; and station D5536, Apo Island, 279 fathoms, green mud bottom, temperature 53.5°.

Several young specimens of this species were found, differing from Marenzeller's description of the adult worm in having a softer, paler jaw apparatus and fewer gills. Specimens collected at station D5249, Lanang Point, 23 fathoms, coral and sand bottom; station D5146, Sulade Island, 24 fathoms, coral sand and shell bottom; and station L5355, Balabao Light, 44 fathoms, coral and sand bottom.

LEODICE LEVIBRANCHIA, new species.

Plate 50, figs. 1–8.

Type.—Cat. No. 19018, U.S.N.M. Specimen, 100 mm. in length; 10 mm. in width anteriorly, gradually decreasing to 5 mm. posteriorly. Anal cirri lacking. Number of somites, about 105; about 20 in the middle covered with fragment of tube.

Head (fig. 1) provided with five tentacles, the three median ones of the same length (about as long as first three somites). Two lateral tentacles of equal length, being two-thirds as long as median tentacle. Prostomium prominent and bilobed. Eyes roughly triangular in shape, situated at base of lateral tentacles. Peristomium or first somite broad and smooth. Second somite about one-third as long as the first, and provided with short tentacular cirri. Third somite provided with parapodia.

Dental appartus (fig. 2) dark brown. Maxillae jointed posteriorly and notched for muscle attachment. Curvature moderate. Surface smooth. Dental plates large, deeply notched posteriorly for muscle attachment. Each provided with seven large teeth, with irregularity in shape of last two. Lateral accessory plates about two-thirds length of dental plates, bearing 10 teeth each. Unpaired plate of right side finely toothed. Mandibles (fig. 3) brown, with clear white dental plates ventrally.

Anterior parapodia (fig. 4) with long dorsal cirrus and large blunt ventral lobe.

No hooks; acicula ending in blunt points.

Gills beginning at about fiftieth somite. The poor preservation made this almost impossible to determine. Gill a simple three-lobed structure (fig. 5). Differentiation gradually lost until on ninetieth parapodium gill is a flattened, knob-like structure.

Setae of three kinds. Heavy, pale yellow, compound setae (fig. 6) ventrally. Simple capillary type (fig. 7) dorsally. Pectinate type (fig. 8) just below dorsal cirrus.

Type collected at station D5348, Point Tabonan, Palawan Passage, 375 fathoms, coral and sand bottom.

LEODICE ARTICULATA, new species.

Plate 50, figs. 9–12.

This is not *Eunice articulata* Ehlers (1887), which has been shown to be synonymous with *Leodice longicirrata* Webster, the latter name having precedence.

Type.—Cat. No. 18955, U.S.N.M. A young, well-preserved specimen, 57 mm. in length, 5.5 mm. wide anteriorly, tapering gradually posteriorly. Anal cirri two, consisting of five articulations. Number of somites, 107.

Head (fig. 9) provided with five tentacles, so articulated as to give a beaded appearance. Median tentacle longest, reaching back to anterior border of eighth setigerous somite. Intermediate tentacles reaching to anterior border of fifth setigerous somite. Lateral tentacles reaching fifth setigerous somite. Tentacular cirri similarly articulated, extending slightly beyond anterior edge of peristomium. Eyes round, in usual situation.

As the specimens, both type and paratype, were young, the jaw apparatus (fig. 10) was pale in color and soft in texture. Maxillae with short basal joint, grooved dorsally for muscle attachment. Terminal joint long, with slight curvature. Dental plates long and narrow, provided with eight to nine brown teeth. Lateral plates short, with nine small brown teeth. Right unpaired plate with about seven small teeth. Mandibles present, with light brown basal part and white dental plate. On account of their softness they disintegrated upon being touched, thus making it impossible to determine their structure.

Gills beginning as single filament on dorsal cirrus of fifth parapodium, gradually increasing to six and seven filaments toward middle of body (fig. 11), continuing to within seven somites of end of body, but gradually reduced to two filaments posteriorly. Dorsal cirri sharply articulated, with three or four joints terminally (fig. 11), and long, smooth base. Ventral cirri short, with cushion-like ventral portion.

Setae of two kinds. Ventral compound (fig. 12) with bidentate, terminal portion covered by wing, and shaft finely serrated distally.

Dorsal setae of simple capillary variety. Acicula light yellow in color, with blunt termination.

Type collected at station D5159, Tinakta Island, 10 fathoms, coral sand bottom, and paratype (poorly preserved), at station D5205, Caguayan Point, off Leyte Island, 8 fathoms.

LEODICE ACCRESCENS, new species.

Plate 50, figs. 13–16; plate 51, figs. 1–2.

Type.—Cat. No. 18956, U.S.N.M. A large incomplete specimen, 150 mm. in length; width, 9 mm., uniform throughout. Number of somites, 289. Anal cirri lacking.

Head (pl. 50, fig. 13) provided with five smooth tentacles, the median slightly larger than the intermediate, and intermediate slightly longer than lateral. Eyes small and irregular, situated just median to base of lateral tentacles. Prostomium deeply notched, with lobes slightly shorter than lateral tentacles. Peristomium or first somite broad and smooth. Stout tentacular cirri on second somite. Parapodia on third.

Dental apparatus (pl. 50, fig. 14) dark brown. Maxillae with comparatively long basal joint. Terminal joint sickle-shaped, with prominence for articulation with great dental plate. Right dental plate with four large round teeth; left with three similar teeth and irregular surface posteriorly. Anterior lateral plates small and finely toothed. Posterior lateral plates small and smooth. Mandibles (pl. 50, fig. 16) heavy. Posterior part light brown. Dental plates clear white and recurved dorsally on lateral side.

Anterior parapodia provided with moderately long dorsal cirrus and cushion-like ventral cirrus. No gills. Gills begin at irregular intervals in region of eightieth somite, as small knob-like processes at base of dorsal cirri (pl. 51, fig. 1). Three acicula, all ending in blunt points. Posteriorly gill increases in length (pl. 51, fig. 2), extending almost to mid-dorsal line. Dorsal cirrus greatly reduced. Third aciculum lost.

Setae of two kinds. Ventral compound (pl. 50, fig. 15), with bifid terminal portion, finely serrated shield, and serrated basal shaft. Dorsal setae of simple, capillary form.

LEODICE ACCRESCENS, new species, young.

The only differences between this form and the adult specimens are the first appearance of the gills in the neighborhood of the one-hundredth somite (a point posterior to that in the adult), and the fewer number of acicula. Here there are two acicula to a parapodium anteriorily and one posteriorly.

Collected at station D5148, Jolo Light, Jolo, 17 fathoms, coral sand bottom, and station D5142, Sirun Island, 21 fathoms, coral sand and shell bottom.

Genus LUMBRINEREIS Blainville.

LUMBRINEREIS BIFURCATA McIntosh.

Lumbrinereis (*Lumbriconereis*) *bifurcata* McIntosh (1885), p. 241, pl. 36, figs. 10, 11, 12.

Collected at station D5100, Corregidor Light, off Luzon, 35 fathoms, gray sand bottom.

LUMBRINEREIS HETEROPODA Marenzeller.

Lumbriconereis heteropoda Marenzeller (1879), p. 138, (sep. p. 30), pl. 5, fig. 4; pl. 6 (fig. 1).

Collected at Batan Island "Electric Light."

LUMBRINEREIS JAPONICA Marenzeller.

Lumbriconereis japonica Marenzeller (1879), p. 137, (sep. p. 29), pl. 5, fig. 3.

Collected at station D5536. Apo Island. 279 fathoms, green mud bottom, temperature 53.5°.

Genus ONUPHIS Audouin and Milne-Edwards.

ONUPHIS (NOTHRIA) WILLEMOESII McIntosh.

Onuphis (*Nothria*) *willemoesii* McIntosh (1885), p. 322, pl. 41, figs. 4–10.

Collected at station D5394, Panalangan Point, Talajit Island, 153 fathoms, green mud bottom.

Genus MARPHYSA Quatrefages.

MARPHYSA DIGITIBRANCHIA, new species.

Plate 49, figs. 4–14.

Type.—Cat. No. 18958, U.S.N.M. A small specimen, incomplete posteriorly. Length, 20 mm.; width, 2 mm., including parapodia. Number of somites, 80.

Head (fig. 4) with five tentacles, median unpaired and intermediate paired of equal length, reaching to edge of prostomium. Lateral pair arising anteriorly to intermediate and equal to two-thirds of their length. Eyes dark brown, small, in usual position. Peristomium of two segments, equaling in total length the greatest length of the prostomium. No tentacular cirri.

Jaws (fig. 5) light brown, touched with dark brown at certain points. Maxillae borne on long basal portion; curvature slight. Great dental plates with five and six large teeth. Median unpaired short, with five or six teeth and irregular surface posteriorly. Proximal paired, similar to unpaired. Distal paired, simple dark brown plates. Mandibles (fig. 6) frail, dark brown, with lighter dental plate marked by rows of concentric striations.

Gills beginning on twentieth parapodium as a single filament at base of large dorsal cirrus. Increasing rapidly to several filaments, the greatest number being five posteriorly (fig. 8).

Anterior parapodia (fig. 7) with large blunt ventral cirrus and large conical dorsal cirrus. Three acicula, two dark brown, one light: all with blunt terminations. Dorsal setae tuft composed of simple capillary setae (fig. 9). Ventral setae tuft composed of three types. First variety (fig. 10), compound with long pointed termination. Second variety (fig. 11), compound with shorter pointed termination. Third variety (fig. 12), compound with bidentate, protected termination.

Posterior parapodia (fig. 8) with small ventral cirrus and more slender dorsal cirrus. Gill, arising from base of dorsal cirrus, so situated as to resemble the digits of a hand. Two setae tufts, the dorsal composed of simple capillary (fig. 9), the ventral of simple capillary and compound (fig. 10). Acicula three; one dark brown with blunt ending, situated between the setae tufts (fig. 13); two bidentate (fig. 14), with shield, situated in ventral half of parapodium.

Collected from station D5301, China Sea, near Hongkong, surface temperature 84°.

Genus RHAMPHOBRACHIUM Ehlers.

RHAMPHOBRACHIUM PACIFICA, new species.

Plate 49, figs. 15–23.

Type.—Cat. No. 18959, U.S.N.M. An incomplete specimen, 40 mm. in length; width 12 mm. anteriorly, decreasing to 8 mm. posteriorly. Number of somites, 76. Color dull gray with purple head.

Head (fig. 15) provided with seven tentacles, the median anterior pair or subtentacula being globose. Antero-lateral pair 3 mm. in length, including basal joint. Postero-lateral pair 3.5 mm. including basal joint. Median unpaired tentacle broken. Tentacular cirri two, borne on anterior edge of peristomium, scarcely reaching anterior border of head.

Jaws (fig. 16) brownish lavender. Maxillae borne on basal piece; curvature moderate. Deeply notched posteriorly and ventrally for muscle attachment. Great dental plates notched in same manner. Left provided with nine teeth and irregular notch posteriorly; right with five large teeth. Unpaired plate long, with six large teeth. Lateral anterior paired plates dissimilar in shape, with seven and eight teeth. Mandibles (fig. 17) light brown, with white dental plate anteriorly.

Parapodia of first three somites lengthened and drawn forward on each side of head. Ehlers (1887) figures two long hooks to each of these parapodia. The Pacific form has an irregular number of hooks extruded. Upon dissection it was found that these parapodia contained from 18 to 20 retracted hooks. Most of them were broken. Figure 18 shows the distal end of a complete hook. Dorsal cirri long on first three parapodia, resembling tentacles in form and size. Moderately long on fourth; gradually decreasing to tenth. Gills appearing at base of dorsal cirrus on eleventh parapodium as single, heavy, brown process. Ventral cirri reduced to transversely elongated elevations on ventral surface of somite. Gills (fig. 16) rapidly increasing to four and five processes. Dorsal cirrus small and subordinated, bearing a small ventral process.

Acicula of two varieties. Two (fig. 20) light yellow with blunt termination situated in midst of setae tuft. Varying number of second type (fig. 23) with bidentate, protected termination, situated ventral to blunt variety.

Setae of two varieties. Dorsal setae (fig. 21) chisel-shaped. Middle setae (fig. 22) simple capillary, with slight indication of wing.

Type collected at station D5656, Olang Point, Basa Island, 484 fathoms, gray mud bottom, temperature 41.2°.

There is in the collection a decolorized specimen of this species, which, however, differs from the specimen described in the increased number of acicula, which may be as many as five in the anterior parapodia. The form is 44 mm. in length, incomplete. The retractor muscles of the hooks, with hooks attached, may be seen protruding for 9 mm. posteriorly, showing that the hooks are 50 mm. long.

Specimen collected at station D5348, Point Tabonan, Palawan Passage, 375 fathoms, coral and sand bottom, temperature 56.4°.

Family GLYCERIDAE.

Genus GLYCERA Savigny.

GLYCERA NANA Johnson.

Glycera nana Johnson (1901) p. 411, pl. 10, fig. 103.

Very small specimen from San Miguel Harbor, Ticao Island. Similar but poorly preserved specimen from station D5149, Sirun Island, 10 fathoms, coral and shell bottom.

Fifth setigerous somite similar in lamellae and type of setae, but with ventral setae tuft particularly large. Sixth somite similar to fifth.

Also collected at station D5209, Taratara Island, 20 fathoms, green mud bottom.

GLYCERA POSTEROBRANCHIA, new species.

Plate 51, figs. 3–8.

Type.—Cat. No. 18960, U.S.N.M. An incomplete specimen, 75 mm. in length, not including extruded proboscis. Width, 3 mm. anteriorly, gradually increasing to 5 mm. posteriorly. Length of pharynx, 8 mm. Number of somites, 90; terminal portion lost. Color of specimen, light brown. Dorsal surface marked by brown longitudinal line. Mid-ventral line, characterized by longitudinal flattened area, 0.5 mm. in width. Somites two-ringed, the rings being of equal circumference throughout.

Head (fig. 3) 2.5 mm. in length, or equal in length to first eight somites. Number of rings in head not distinguishable. Four small papillae at end. Extruded proboscis large, equaling the first 37 somites in length. Cuticle covered with two kinds of papillae. Minute sucker-like type covering whole surface. Large, blunt, conical type on proximal end. Jaws (fig. 4) with lateral appendage for muscle attachment.

Parapodia gradually increasing in size and length posteriorly. Anterior parapodia (fig. 5) with long, conical dorsal and ventral lobes. Dorsal cirrus a rounded tubercle. Ventral cirrus similar in shape to dorsal lobe of ventral division. Posterior parapodia (fig. 6) elongate, divided into one dorsal and two ventral rami, the ventral lobe of the ventral ramus equaling the dorsal ramus in length. Ventral cirrus similar in shape to dorsal lobe of ventral ramus. Dorsal cirrus a small pointed tubercle. Gills beginning on twenty-fifth somite as small knobs at dorsal base of parapodia lateral to dorsal cirrus, gradually increasing (fig. 6) until they appear as long rugose, finger-like processes.

Setae of two kinds. Dorsal (fig. 7), simple capillary with finely serrate edge. Ventral (fig. 8), compound with finely serrated blade.

Collected at station D5375, Tayabas Light, Marinduque Island, 107 fathoms, green mud bottom.

Family SPIONIDAE.

Genus AONIDES Claparède.

AONIDES DIVERAPODA, new species.

Plate 51, figs. 9–12.

Two specimens, one with tentacular cirri missing. Both well preserved anteriorly. Greatest width, 3 mm. The perfect one is the type, Cat. No. 18961, U.S.N.M.

Prostomium (fig. 9) blunt anteriorly, extending forward over mouth; prolonged posteriorly as long, sinuous nuchal ridge as far as anterior border of third setigerous somite. Nuchal or unpaired cirrus prominent, arising anterior to nuchal ridge. Peristomium forming two lateral lobes, one on each side of the mouth, reaching beyond prostomium in expansion, but not showing from the dorsal surface in contraction. Tentacular cirri attached at each side of prostomium at base of peristomial lobes; 10 mm. in length—that is, a little more than three times greatest width of body.

First setigerous somite (fig. 9) with two dorsal conical cirri and dorsal setae tuft of simple capillary setae. Ventral cirrus lamelliform. Ventral setae tuft fan-shaped, composed of single row of heavy, simple setae of two kinds—long, tapering, oar-like setae arranged alternately with shorter, cylindrical, blunt setae.

Second setigerous somite with dorsal setae tuft of pale, fine, capillary setae. Ventral tuft of very heavy, dark-brown setae (fig. 10) in a row similar to ventral tuft of first setigerous somite, but with only three or four (curved) capillary setae. Dorsal cirrus lacking. Dorsal lamella pointed, with apex directed dorsoposteriorly. Ventral lamella rounded, beneath ventral setae tuft.

Third setigerous somite with dorsal lamella similar to but less pointed than that of second setigerous somite. Ventral lamella equal in size and form to dorsal lamella. Dorsal setae tuft, composed of simple capillary setae. Ventral tuft composed of similar setae ventrally, but of heavier, spinous setae dorsally (fig. 11).

Fourth setigerous somite with dorsal and ventral lamellae similar to preceding. Dorsal setae simple capillary. Ventral setae tuft composed of simple capillary setae ventrally and curved, spinous setae (fig. 12) dorsally, differing from spinous setae in preceding somite in size and curvature.

Fifth setigerous somite similar in lamellae and type of setae, but with ventral setae tuft particularly large. Sixth somite similar to fifth.

Specimen collected at station D5209, Taratara Island, 20 fathoms, green mud bottom.

Family CIRRATULIDAE.

Genus CIRRATULUS Lamarck.

CIRRATULUS ZEBUENSIS McIntosh.

Cirratulus zebuensis McIntosh (1885), p. 384.

Capillary setae very finely serrated. Hooks absent anteriorly, present in middle and posterior regions.

Specimen collected from station D5304, China Sea near Hongkong, 34 fathoms, blue mud bottom.

Genus AUDOUINIA Quatrefages.

AUDOUINIA POLYTRICHA Schmarda.

Cirratulus polytricha SCHMARDA (1861), p. 58, pl. 27, fig. 214.
Audouinia polytricha SCHMARDA, Ehlers (1901), p. 266.—GRAVIER (1907), pl. 10.

Specimen collected at station D5760, Tinakta Island, 12 fathoms, sand bottom.

Family TEREBELLIDAE.

Genus POLYMNIA Malmgren.

POLYMNIA CONGRUENS Marenzeller.

Polymnia congruens MARENZELLER (1884), p. 207 (sep. p. 11), pl. 2, fig. 3.

A large complete specimen agreeing in character of gills, setae, and uncini with Marenzeller's specimen, but with tentacles intact, forming a large tangled mass equal to two-thirds the length of the body. Tube also present, composed of Foraminifera shells, etc., adhering to a very fragile membrane.

Collected at Nasugbu, Luzon Reef.

Genus PISTA Malmgren.

PISTA FASCIATA Marenzeller.

Pista fasciata MARENZELLER (1884), p. 202 (sep. p. 6), pl. 1, fig. 4.
Terebella (*Phyzelia*) *fasciata* EHRENBERG, Grube (1869).

Using the interpretation of *P. fasciata* as given by Marenzeller (1884) and McIntosh (1885) one specimen in the collection is referred to this species. As only one branchial process (anterior right) remained attached to the specimen, nothing can be said as to the comparative size of these organs. The form of the body and the structure of the uncini agreed with the descriptions given by Marenzeller and McIntosh.

Collected at station D5536, Apo Island, 279 fathoms, green mud bottom, temperature 53.5°.

Genus TEREBELLA Linnaeus.

TEREBELLA PARVABRANCHIATA Treadwell.

Terebella parvabranchiata TREADWELL (1906), p. 1175, fig. 71.

Using the uncini as diagnostic character, this form is referred to the above species. Although in very poor condition, the specimen possesses three pairs of gills (with manner of branching as in *T. parvabranchiata*), thus verifying Treadwell's remarks regarding the Hawaiian form. The tentacles were too badly mutilated for description.

Collected at station D5536, Apo Island, 279 fathoms, green mud bottom, temperature 53.5°.

TEREBELLA (LANICE), species.

Fragmentary. Identification based upon tube and uncini.

Collected at station D5589, Mabul Island, 260 fathoms, fine gray sand, gray mud bottom, temperature 45.7°.

TEREBELLA (LOIMIA) VARIEGATA Ehrenberg Grube.

Terebella variegata Ehrenberg, Grube (1878), p. 227, pl. 13, fig. 3.

Tentacles missing.

Collected at Makasser Island.

TEREBELLA (LOIMIA) MONTAGUI Grube.

Terebella montagui Grube (1878), p. 224, pl. 12, fig. 3.

Loimia montagui Marenzeller (1884), p. 205 (sep. p. 9), pl. 2, fig. 1.

A fragmentary specimen of this species, having no tentacles and only two abdominal somites, was found in the collection. It agreed with Grube's description of the species in having six-toothed uncini consistently throughout the body. No trace was found of the seventh small tooth described by Marenzeller. Gills as figured by Marenzeller.

Collected at station D5157, Tinakta Island, 18 fathoms, fine sand and shell bottom.

LOIMIA, species.

Large form having seven-toothed uncini. As the specimen was incomplete—that is, the tentacles were lacking—it seemed unwise to describe it as a new species.

Collected at station D5157, Tinakta Island, 18 fathoms, fine sand and shell bottom.

Family AMPHARETIDAE.

Genus AMPHICTEIS Grube.

AMPHICTEIS PHILIPPINARUM Grube.

Amphicteis philippinarum Grube (1878), p. 207, pl. 11, fig. 7.

Specimen fragmentary but possessing all four branchial processes. The longest of these is 10 mm., or equal in length to the first nine setigerous somites.

Collected at station D5609, Binang Unang Island, 1092 fathoms, green mud bottom, temperature, 36.3°.

Genus MELINNA Malmgren.

MELINNA DUBITA, new species.

Plate 51, figs. 13–16.

Type.—Cat. No. 18957, U.S.N.M. Fragmentary but possessing important diagnostic characters. Sixteen somites present. Length, exclusive of gills and tentacles, 15 mm.: greatest width (across third somite), 7 mm.

Prostomium directed anteriorly and slightly ventrally, ending in folded upper lip. Tentacles of two kinds. Posterior (figs. 13–14) six in number, arising together from the dorsal surface of the prostomium just behind the upper lip. Greatest length of a complete posterior tentacle, 15 mm. These tentacles are deeply grooved along one side—a condition not easily seen because of coiling. Anterior tentacles (fig. 13) with diameter equal to one-third that of posterior tentacles, arising in two groups of seven on each side of upper lip; varying in length from 3 to 7 mm.

"Buccal segment" or lower lip (fig. 13) largely covered by following somite, but showing as an oval pad just ventral to the mouth opening. Dorso-lateral extremities of lower lip arising immediately in front of the origin of the gills.

Next four somites forming a collar-like structure with prominently developed lateral region extending obliquely from ventral to dorsal surface. Free edge of first somite lying immediately beneath the lower lip. First two somites marked ventrally (fig. 13) by row of fine setae (fig. 16). Third somite with similar setae ventrally, and delicate tuft of similar but larger capillary setae dorsally. Fourth somite similar to third, but with prominent seta tuft dorsally (fig. 14). Third somite plainly continuous dorsally (fig. 14), forming an inconspicuous or else strongly retracted post-branchial ridge. No trace of the hooks figured by Marenzeller (1874) for *M. adriatica* was found.

Gills stout, tapering, and curved distally (two are broken in fig. 14); eight in number, arising from the second and third somites. Most anterior gills situated internally on second somite. Other gills situated externally on second and third somites.

Pinnulae beginning on fifth somite. Second and third pinnulae larger than first, gradually decreasing until on the sixteenth somite they occur as blunt, medianly directed processes. Dorsal setae simple capillary, unequal in length, borne on truncated, papillae-like processes. Uncini (fig. 15) pectinate in form, with four large teeth above the ligament process.

Tube composed of tough inner membrane and thick outer coating of fine brown mud. Total diameter, 13 mm. Lumen, 5 mm.

As only 16 setigerous somites are present, it is impossible to tell how many there would be in a complete specimen. This form is doubtfully placed in the genus *Melinna*, as the presence of two kinds of tentacles suggests that it may belong to a new but similar genus. The present interpretation is based upon the marked resemblance in form between this specimen and Marenzeller's *M. adriatica.*

Type collected at station D5513, Camp Overton Light, Mindanao, 505 fathoms, gray mud and fine sand bottom, temperature 52.8°.

Family CAPITELLIDAE.

Genus NOTOMASTUS Sars.

NOTOMASTUS LATERICEUS Sars.

Notomastus latericeus Sars. Fauvel (1914), p. 250, pl. 10, fig. 14; pl. 22, fig. 20.

Specimen incomplete posteriorly. Differing slightly from Fauvel's description in the length of the peristomium—a condition probably due to differences in preservation. Proboscis not extruded.

Collected at station D5100, Corregidor Light, off Luzon, 35 fathoms, gray sand bottom.

Family OPHELIIDAE.

Genus AMMOTRYPANE Rathke.

AMMOTRYPANE AULOGASTER Rathke.

Ammotrypane aulogaster Rathke, Fauvel (1914), p. 243, pl. 22, figs. 5–7.

Collected at station D5178, Point Origon, 73 fathoms, fine sand bottom.

Family CHLORHAEMIDAE.

Genus STYLAROIDES Delle Chiaji.

STYLAROIDES, species.

Fragmentary specimen collected at station D5207, Badian Island, 35 fathoms, green mud and sand bottom.

STYLAROIDES ATENTACULA, new species.

Plate 52, figs. 1–4.

Type.—Cat. No. 18962, U.S.N.M. Specimen, 70 mm. in length; width anteriorly, 3 mm.; greatest width (through middle region), 7 mm.; width posteriorly, 5 mm. As the post-middle region of the body is distorted by drying, it is impossible to determine how far posteriorly the broad region extends.

Intersegmental grooves indistinct anteriorly, but more conspicuous posteriorly. Cuticle covered with papillae covered with fine silt in anterior and middle regions of the body. No attempt has been made in the figure to represent this condition.

Apparently everted proboscis-like structure (fig. 1), consisting of heavy basal portion and narrower distal portion, freely open at the end, extending from the mouth opening. Distal end ragged around opening. Epidermis of entire structure thrown into fine longitudinal folds.

First six somites provided with long capillary setae (figs. 1–2). Ventral setae beginning on third somite (in this specimen). Absence of anterior ventral tufts may be due to breaking. Setae not clear in middle region. Posterior somites provided with small tufts of heavy, gold-colored dorsal setae (fig. 3) of the cross striated type. Ventral setae (fig. 4) long, slender, and attenuated, also of the cross striated type. Heavier setae appear dorsally on the thirty-first from the last somite. They are all broken off short in this specimen.

The absence of tentacles suggested the name of *S. atentacula*, but as breakage seems to have occurred in all parts of the body this may be erroneous.

Type collected at station D5140, Bagacay Point, between Cebu and Leyte, 385 fathoms, green mud bottom.

Family SABELLIDAE.

Genus HYPSICOMUS Grube.

HYPSICOMUS PHAEOTAENIA Schmarda.

Sabella phaeotaenia Schmarda (1861), p. 35, pl. 22, fig. 88.

Hypsicomus phaeotaenia Marenzeller (1884), p. 212 (sep. p. 16), pl. 3, fig. 3.

Genus SABELLA Linnaeus.

SABELLA (BRANCHIOMMA) ACROPHTHALMOS Grube, variety.

Plate 52, figs. 5–6.

Sabella acrophthalmos Grube (1878), p. 258.

Two specimens of this were taken similar to Grube's description of *S. acrophthalmos* in all respects except the number of thoracic somites. The two specimens differ somewhat with respect to the termination of the gills. One has the ends strongly rolled over, as observed by Grube, and a very delicate purplish eye spot. The other has the gills straightened out and provided with a large prominent eye spot, which is divided externally by the shaft of the rachis. [See *Branchiomma vesiculosum* Montagui as interpreted by McIntosh (1885).]

Avicula uncini with faintly serrated crest (fig. 5). Pennoned setae comparatively large (fig. 6).

Collected from reef opposite Cebu.

SABELLA SECUSOLUTUS, new species.

Plate 52, figs. 7–13.

Type.—Cat. No. 19013, U.S.N.M. Incomplete posteriorly, only four abdominal somites being present. Eight thoracic somites including collar fascicle, the eighth being, however, thoracic in character on the right side and abdominal on the left. Total length, not including gills, 11 mm. Length of gills, including basal portion, 38 mm. Width of thorax, 5 mm.

Collar low, widely separated on back (fig. 7) and split ventrolaterally (fig. 8). Ventral ends prolonged into lappets overlapping in the mid-line (fig. 8). Gills born on high basal portion, enlarging just proximad to the base of the radioles (figs. 7–8). Radioles 26 on each side joined by basal membrane 26 mm. in height. Membrane region same color as rest of body—yellowish brown. Radioles lighter and irregularly banded with reddish brown pigment. Tips of radioles naked for distance of 1.5 mm. No external appendages. No eyes. Tentacles 4 mm. in length. Distal portion attenuated and pigmented reddish brown. The ventral surface of the head bears a two-lobed prominence which has been injured. It is merely indicated in figure 8.

Capillary setae of thorax of two kinds. First variety (fig. 9) slender, without wing. Second variety (fig. 10) stout with prominent, subterminal wing. Thoracic uncini avicular with serrated crest and short basal portion. Pennoned setae (fig. 12) simple, spatulate, without attenuated point. Capillary setae of abdominal region (fig. 13) similar to second variety of the thoracic region but with narrower wing and longer point. Abdominal uncini similar to those of thorax.

Type collected at station D5113, Sombrero Island. 159 fathoms, dark green mud bottom.

Family HERMELLIDAE.

Genus TETRERES Caullery.

TETRERES TREADWELLI, new species.

Plate 52, figs. 14–23.

Type.—Cat. No. 18964, U.S.N.M. Specimen in good condition and complete anteriorly, but having only 2 mm. of the caudal region. Total length, 26 mm.; width, 4 mm.

Cephalic region greatly developed, being 7 mm. in length ventrally, sloping down to 3 mm. in length dorsally. Peristomium deeply split medianly, thus being divided into two peduncles (figs. 14–15), supporting on their anterior ends the opercular region, the latter consisting of two slightly concave elliptical areas, each surrounded by a single row of paleae. Paleae of the simple unserrated type, but of two varieties. Median paleae (fig 16), golden in color, resembling in form the simple acicula of Leodicidae. Outer paleae (fig. 17) pale in color, with termination narrow and more attenuated than that of the median paleae. Moderately long conical opercular papillae, 11 on each side, situated external to the paleae. Opercular region diverging slightly dorsally, the posterior limits being provided with large, dark brown hooks opposite each other (fig. 14). Filiform branchiae borne on median opposing faces of the peduncles, and on seven oblique ridges on the ventro-lateral surface of the peduncles (figs. 15–18). Gill filaments, seven to eight on each ridge. First four ridges on each side marked with distinct black pigment spot (fig. 18). Large median cirrus (fig. 14) deeply pigmented distally, arising dorsally between the hooks and extending dorso-ventrally between the peduncles for a distance of 4 mm. Mouth situated ventrally: bounded dorsally by a pair of deeply grooved palps, 0.5 mm. in width, laterally by two large, flat, labial processes (fig. 15), and ventrally by the lower lip. Prominent conical cirrus (fig. 15) situated on each side lateral to labial processes, provided at the base with a fascicle of simple capillary setae (fig. 19).

Somite II provided laterally with four conical cirri (fig. 18), the most dorsal being the longest and constituting the first of the dorsal branchiae. Somites III, IV, V, VI bearing ventrally papilla-like tori, having two types of setae. Largest type (fig. 20) paddle-shaped with frayed termination. Smaller type (fig. 21), simple capillary setae, alternating with the paddle-shaped setae. Somites III, IV, V, and VI bearing dorsally stout rectangular pinnulae, with setae similar to figure 20, but three times larger. Branchiae arising medianly to bases of rectangular pinnulae.

First nine abdominal somites bearing branchiae dorsally and uncinigerous ruffle-like tori laterally, the latter ending ventrally in a small free lobe overlying a ventral tubercle and small setae tuft.

Uncini (fig. 22) pectinate with double row of seven teeth each. Ventral setae of two kinds—delicate capillary and slightly heavier spinous (fig. 23).

Ventral tori decreasing gradually in size from the tenth through the seventeenth. Occurring as long stalked processes from the eighteenth through the twenty-fifth.

Tube of fine white stones, Foraminifera shells and bits of red coral cemented together.

Type collected at station D5109, Corregidor Light off Luzon, 10 fathoms, coral bottom.

This species bears a close resemblance to *T. nesiotes* Chamberlin.[1] The distinctive features are the presence of only seven branchial plates, the presence of gills on the inner surfaces of the peduncles and the pointed character of the nuchal hooks.

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EXPLANATION OF PLATES.

PLATE 46.

Myrianida tereseta.

FIG. 1. Dorsal view of head × 15.
2. Parapodium × 50.
3. Ventral seta × 475.

Iphione fustis.

4. Dorsal view of head × 30.
5. Elytron × 23.
6. Cirrus-bearing parapodium × 22.
7. Terminal fifth of dorsal seta × 350.
8. Terminal portion of ventral seta × 350.

Panthalis adumbrata.

9. Dorsal view of head × 15.
10. Elytron × 10.
11. Parapodium × 10.
12. Terminal portion of dorsal seta × 350.
13. Terminal portion of middle seta × 350.
14. Ventral seta × 350.

PLATE 47.

Lagisca oculescens.

FIG. 1. Dorsal view of head × 14.
2. Elytron × 10.
3. Spike from median edge of elytron × 350.
4. Cirrus-bearing parapodium × 15.
5. Terminal portion of dorsal seta × 350.
6. Ventral seta of first type × 350.
7. Ventral seta of second type × 350.

Nereis (Leptonereis) inermis.

8. Dorsal view of head × 20.
9. Posterior view of right seventh parapodium × 25.
10. Posterior view of right twenty-ninth parapodium × 25.
11. Setose seta of first type from seventh parapodium × 350.
12. Setose seta of second type from seventh parapodium × 350.

Nereis (Heteronereis) caeruleis.

Fig. 13. Dorsal view of head × 13.
14. Conventional dorsal view of pharynx × 10.
15. Conventional ventral view of pharynx × 10.
16. Thirteenth left parapodium × 25.

PLATE 48.

Nereis (Heteronereis) caeruleis.

Fig. 1. Anterior view of fifty-second right parapodium × 16.
2. Natatory seta from fifty-second right parapodium × 350.
3. Setose seta from fifty-second right parapodium × 350.
4. Falcate seta from thirteenth right parapodium × 350.

Nephthys mirasetis.

5. Dorsal view of head and proboscis × 13.
6. Posterior view of fifty-sixth parapodium × 26.
7. Barred seta × 350.
8. Bidentate serrated seta × 350.

Euphrosyne tripartita.

9. Dorsal view of caruncle and tentacle × 26.
10. Typical gill × 30.
11. Ventral seta × 350.
12. Dorsal seta × 350.

Hermodice distincta.

13. Dorsal view of head and caruncle × 10.
14. Anterior view of sixteenth right parapodium × 9.
15. Dorsal seta × 350.

Notopygus hispida.

16. Dorsal view of head and caruncle × 10.

PLATE 49.

Notopygus hispida.

Fig. 1. Posterior view of right eighth parapodium × 12.
2. Simple dorsal seta × 55.
3. Bifid ventral seta × 55.

Marphysa digitibranchia.

4. Dorsal view of head × 20.
5. Dorsal view of jaw apparatus × 41.
6. Ventral view of left mandible × 47.
7. Anterior view of right seventeenth parapodium × 50.
8. Posterior view of left eightieth parapodium × 50.
9. Dorsal seta × 350.
10. Ventral seta Type I × 350.
11. Ventral seta Type II × 350.
12. Ventral seta Type III × 350.
13. Blunt aciculum × 350.
14. Toothed aciculum × 350.

Rhamphobrachium pacifica.

FIG. 15. Dorsal view of head and anterior somites × 6.
16. Ventral view of jaw apparatus × 11.
17. Ventral view of right mandible × 10.
18. Distal end of hook × 270.
19. Posterior view of right thirteenth parapodium × 16.
20. End of aciculum × 350.
21. Chisel-shaped dorsal seta × 350.
22. Capillary seta × 350.
23. Ventral aciculum × 350.

PLATE 50.

Leodice levibranchia.

FIG. 1. Dorsal view of head × 5.
2. Ventral view of jaws × 7.
3. Left mandible × 7.
4. Anterior view of left ninth parapodium × 20.
5. Anterior view of left seventieth parapodium × 25.
6. Compound ventral seta × 350.
7. Simple dorsal seta × 350.
8. Pectinate seta × 350.

Leodice articulata.

9. Dorsal view of head × 15.
10. Dorsal view of jaw × 24.
11. Anterior view of left fifteenth parapodium × 35.
12. Compound ventral seta × 350.

Leodice accrescens.

13. Dorsal view of head × 9.
14. Dorsal view of jaws × 8.
15. Ventral seta × 350.
16. Ventral view of right mandible × 6.

PLATE 51.

Leodice accrescens.

FIG. 1. Anterior view of right ninetieth parapodium × 22.
2. Anterior view of right two hundred and forty-seventh parapodium × 22.

Glycera posterobranchia.

3. Dorsal view of head and proboscis × 2.3.
4. Jaw showing appendage for muscle attachment × 20.
5. Anterior view of fifth right parapodium × 35.
6. Anterior view of sixty-second left parapodium × 35.
7. Dorsal seta from sixty-second parapodium × 350.
8. Ventral seta from sixty-second parapodium × 350.

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Aonides diverapoda.

FIG. 9. Portion of anterior end × 15.
10. End of heavy seta from second setigerous somite × 350.
11. Spinous ventral seta from third setigerous somite × 350.
12. Spinous ventral seta from fourth setigerous somite × 350.

Melinna dubita.

13. Ventral view of anterior end × 5.
14. Dorsal view of anterior end × 5.
15. Uncinus from thirteenth somite × 350.
16. Seta from second somite × 350.

PLATE 52.

Stylaroides atentacula.

FIG. 1. Side view of anterior end × 5.
2. Anterior capillary seta × 350.
3. End of dorsal posterior seta × 350.
4. End of ventral posterior seta × 350.

Sabella (Branchiomma) acrophthalmos.

5. Avicular uncinus × 350.
6. Pennoned seta × 350.

Sabella secusolutus.

7. Dorsal view of anterior end ×6.
8. Ventral view of anterior end × 6.
9. Capillary seta of Type I from third setigerous somite × 350.
10. Capillary seta of Type II from third setigerous somite × 350.
11. Avicular uncinus from third setigerous somite × 350.
12. Pennoned seta from third setigerous somite × 350.
13. Abdominal seta × 350.

Tetreres treadwelli.

14. Dorsal view of anterior end × 6.
15. Ventral view of anterior end × 6.
16. Termination of median palea × 350.
17. Termination of outer palea × 350.
18. Lateral view of anterior end × 6.
19. Seta from buccal fascicle × 350.
20. Anterior ventral seta × 350.
21. Anterior ventral seta alternating with the foregoing × 350.
22. Anterior uncinus (only one row of teeth shown) × 350.
23. Spinous ventral seta from abdomen × 350.

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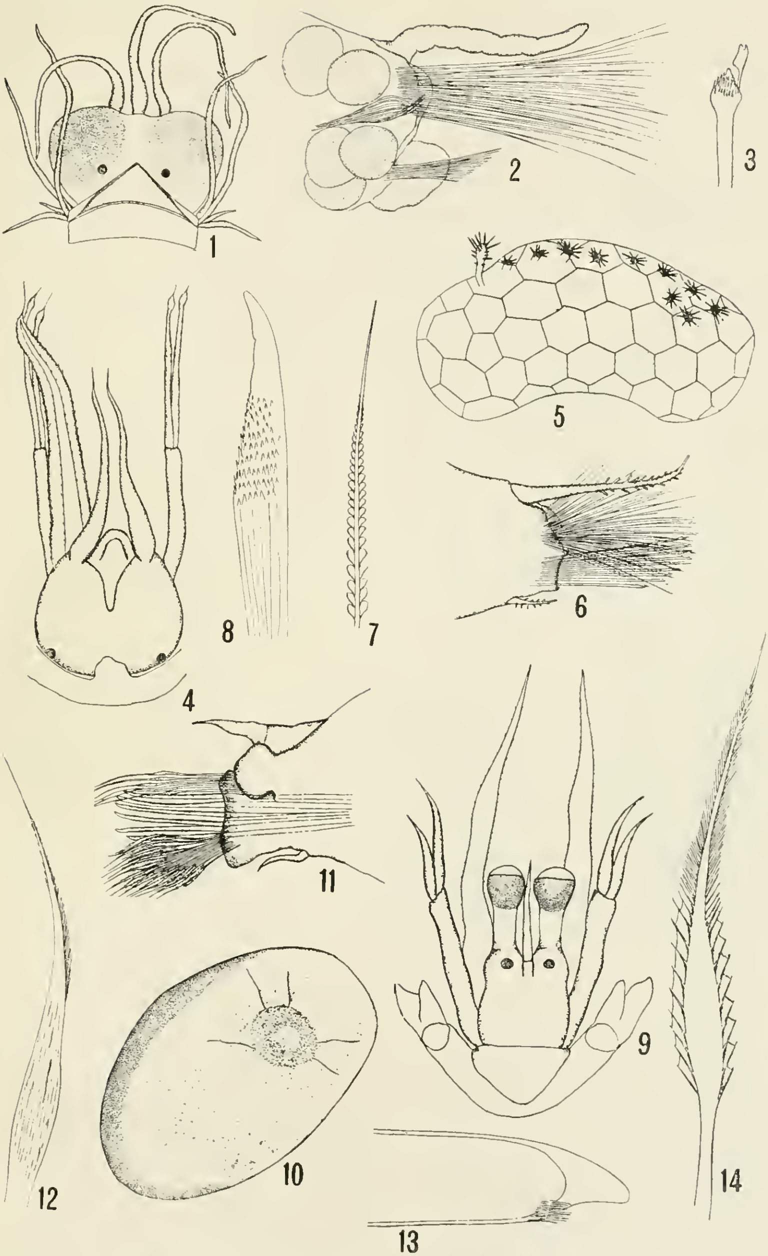
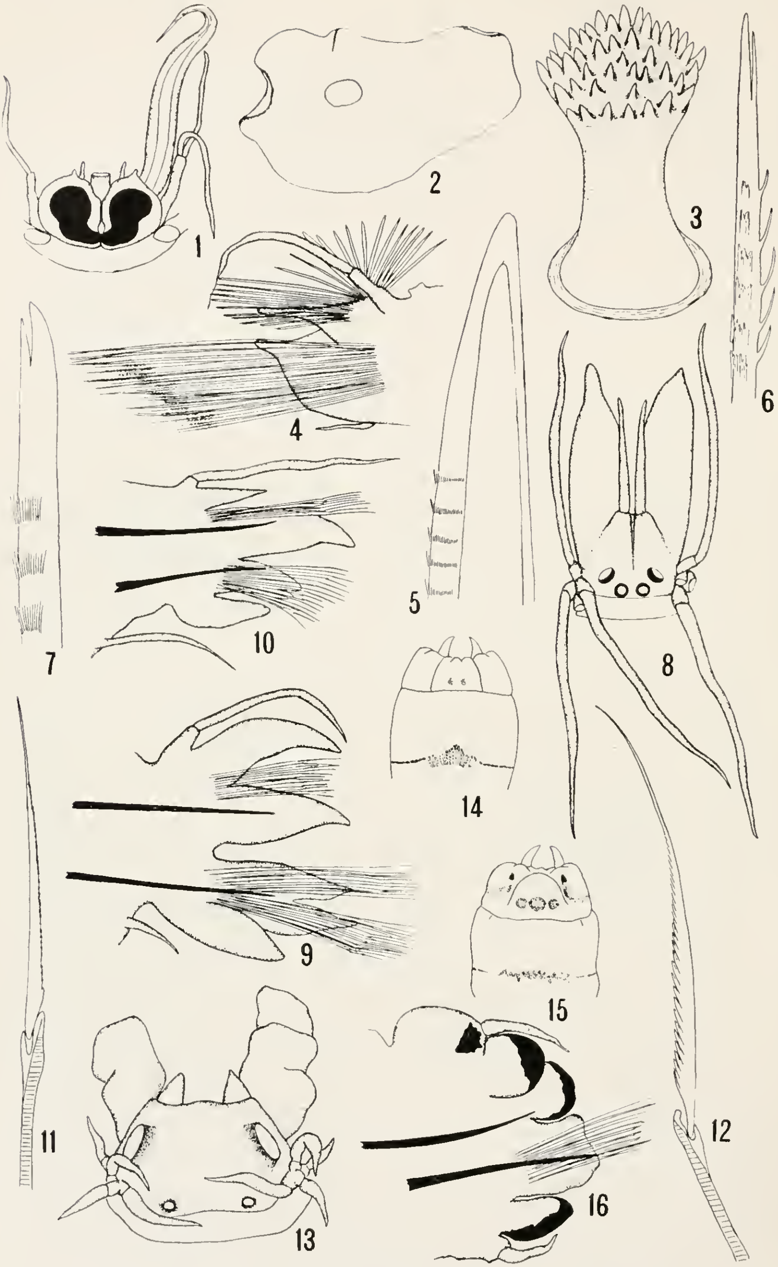


Polychaetous Annelids from Philippine Waters

For explanation of plate see page 631.

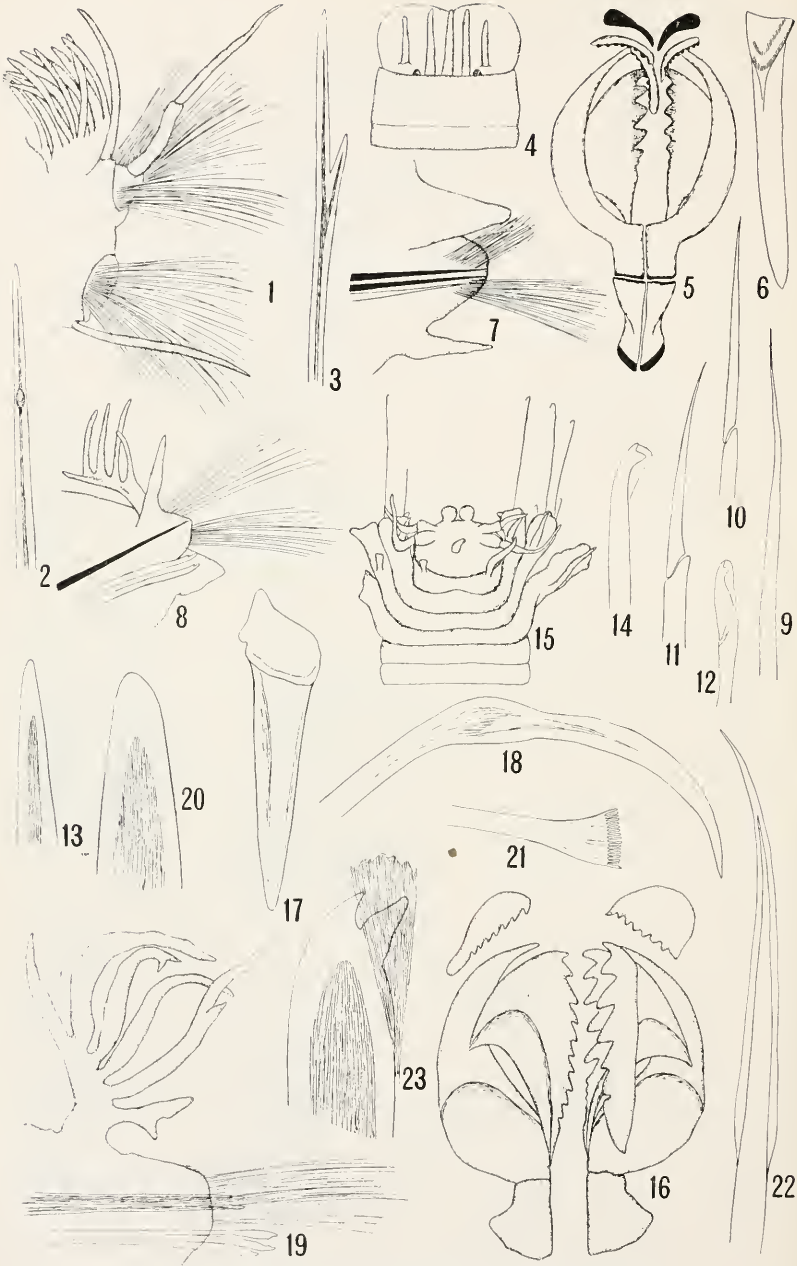


POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGES 631 AND 632.

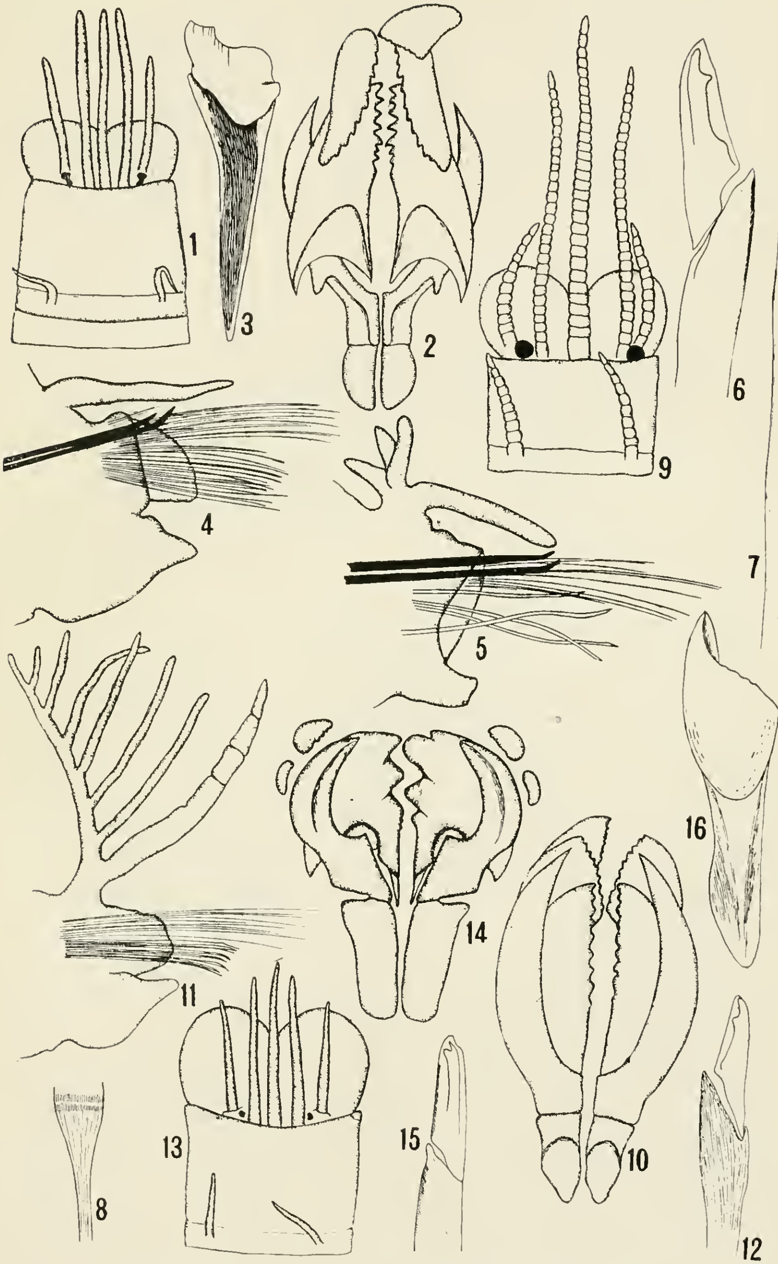
POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGE 632.



POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGES 632 AND 633.

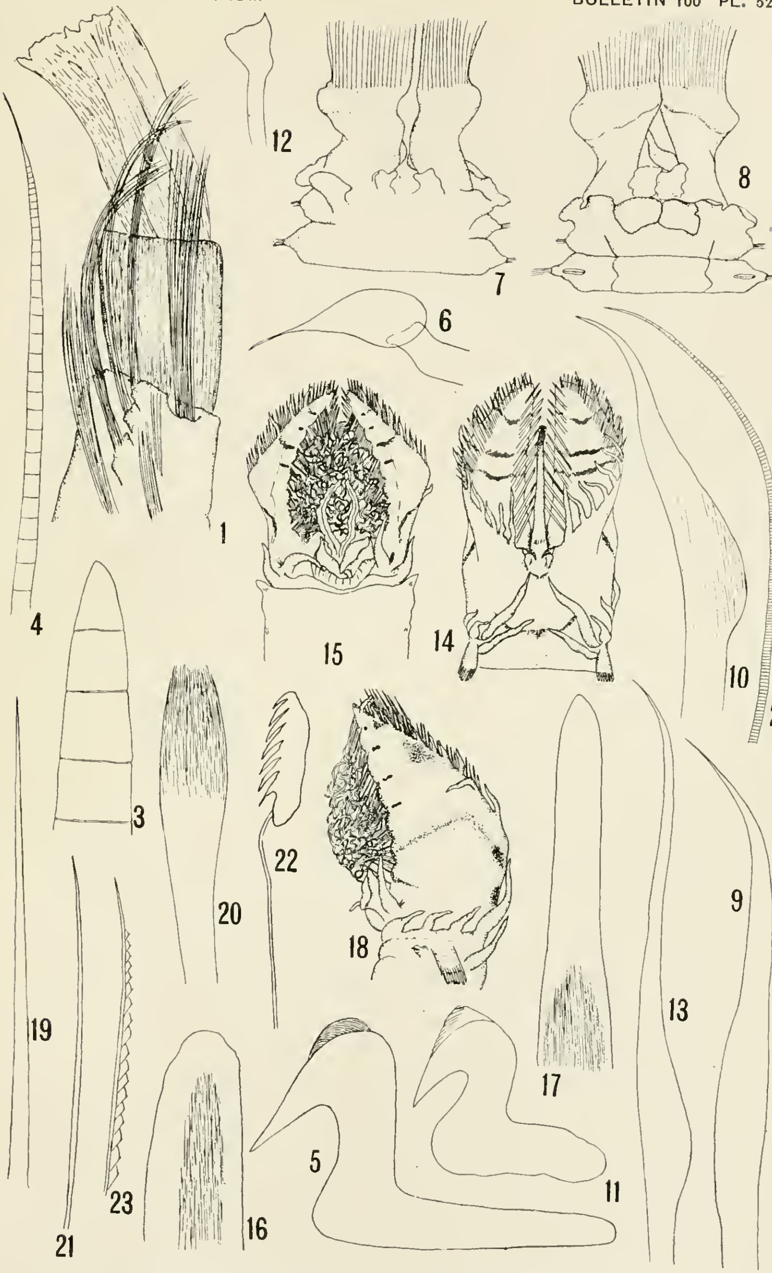


POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGE 633.

POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGES 633 AND 634.



POLYCHAETOUS ANNELIDS FROM PHILIPPINE WATERS.

FOR EXPLANATION OF PLATE SEE PAGE 634.

THE POLYCLAD TURBELLARIANS FROM THE PHILIPPINE ISLANDS.

By Tokio Kaburaki,
Of the Science College, Tokyo Imperial University.

Recently the collection of Polyclads made by Dr. Paul Bartsch of the United States National Museum during the Albatross Philippine Expedition has been entrusted to me for report. Small as the collection is, it proved to be an interesting one in that it was found to comprise in all 11 species, of which 4 appear to be new to science.

The following is a list of the species dealt with in the present paper:

ACOTYLEA.

Family STYLOCHIDAE.

1. *Cryptophallus bartschi*, new species.

COTYLEA.

Family PSEUDOCERIDAE.

2. *Thysanozoon auropunctatum* Kelaart-Collingwood.
3. *Pseudoceros hancockanus* (Collingwood).
4. *Pseudoceros litoralis* Bock.
5. *Pseudoceros buskii* (Collingwood).
6. *Pseudoceros concinnus* (Collingwood).
7. *Pseudoceros rubrotentaculatus*, new species.
8. *Pseudoceros philippinensis*, new species.

Family EURYLEPTIDAE.

9. *Prostheceraeus papilio* (Kelaart).
10. *Prostheceraeus meleagrinus* (Kelaart).

Family DIPLOPHARYNGEATIDAE.

11. *Simpliciplana marginata*, new genus and new species.

Owing to the fact that there is only a single example of each of these species, with exception of one, and also because the state of preservation does not permit a close study, I have now confined myself to such a diagnosis of each form as shall render its future identification a matter of reasonable certainty.

It is my duty to express my warmest thanks to Prof. Paul Bartsch for his aid in securing for me the privilege to examine this interesting collection and for placing at my disposal a series of notes made by him and colored drawings taken while the worms were living.

ACOTYLEA.

Family STYLOCHIDAE.

Genus CRYPTOPHALLUS Bock.

1. CRYPTOPHALLUS BARTSCHI, new species.

Plate 1, fig. 1; text figs. 1, 2.

In the collection there were five specimens which appear to represent a new species. They were found creeping on the reef in

FIG. 1.—ARRANGEMENT OF EYESPOTS IN CRYPTOPHALLUS BARTSCHI.

Tominado Island, Tawi Tawi, in February. The holotype has been given the United States National Museum Cat. No. 19102.

The body in the living state was elongate-oval in shape and moderately firm in texture. In the preserved state it is of a wavy outline and without any sign of tentacles. Judging from the presence of a group of eyespots in a certain position lateral to the cerebral group of eyes, however, the present species may be provided with a pair of very small tentacles, as is the case with *Cryptophallus wahlbergi* Bock[1]. One of the specimens in the living state had a total length of about 65 mm. and a breadth of 25 mm. in the broadest part of the body.

The dorsal surface was of a chocolate-brown color, a little darker in the median than in the marginal parts, owing to a touch of dark blue. The extreme margin was white, but the white rim was exceedingly narrow. Along the sides of the pharynx were visible the uteri

[1] Bock, 1913, Zool. Bid. f. Uppsala, vol. 2, p. 120.

to a certain degree as two somewhat lighter colored streaks. The ventral surface was a little paler than the dorsal.

Completely round the margin of the body are numerous small eyespots which form a crowded row. In addition to these there is a large number of eyespots scattered over the anterior end of the body, extending back as far as the brain, where they are thickly set. Further, some eyespots form a crowded cluster on each side of the brain which apparently represent a tentacular group of eyes.

The genital organs are constructed on the same plan as in *C. wahlbergi.* The vasa deferentia, proceeding straight backward, turn abruptly round at near the male gonopore and then pursue a directly opposite course, to enter the base of the penis, without forming any seminal vesicle, differing to that extent from *C. wahlbergi* in which the seminal vesicle is formed on either side. Within the penis bulb they unite into a common duct, the ejaculatory duct, which opens into the anterior part of the penis sheath near the tip of the penis. Embedded in the penis bulb, just posterior to the ejaculatory duct, is the prostate, which is a small pear-shaped organ and opens near the apex of the penis together with the ejaculatory duct. The penis is of conical shape and projects downward into a cavity, whose walls form the penis sheath. This cavity opens directly to the exterior by the male gonopore which lies a little behind the pharyngeal cavity.

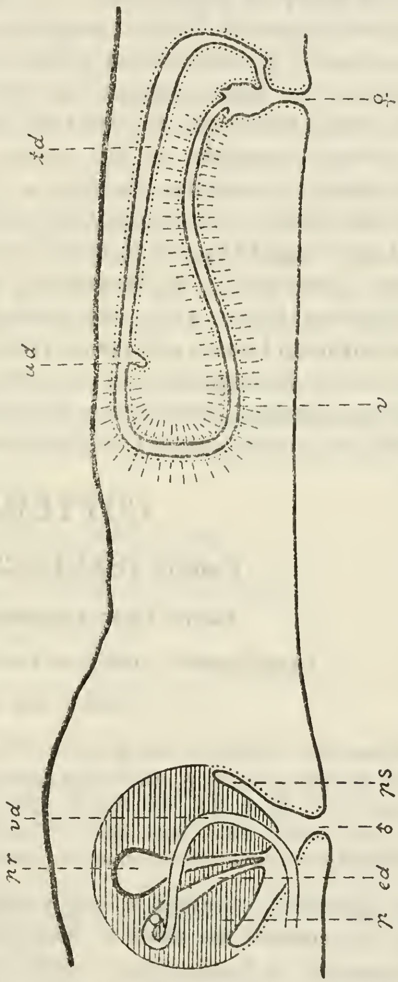


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF THE GENITAL ORGANS OF C. BARTSCHI IN SAGITTAL SECTION. *ed*, EJACULATORY DUCT; *p*, PENIS; *pr*, PROSTATE; *ps*, PENIS SHEATH; *td*, TERMINAL VAGINAL DUCT; *ud*, UNPAIRED UTERINE DUCT; *v*, VAGINA; *vd*, VAS DEFERENS; ♂, MALE GONOPORE; ♀ FEMALE GONOPORE.

The female gonopore occurs a short distance posterior to the male and leads into a narrow irregular antrum, which in turn is continuous with the vagina extensively surrounded by numerous glands. The vagina proceeds forward for some little distance, then bends abruptly upward and backward and soon receives on the ventral side a common uterine duct. Beyond this point the terminal vaginal duct runs backward and downward, describing an arcuate course, and finally opens into the antrum a little inward to the external female gonopore from behind. Thus the vagina and the terminal vaginal duct together form a complete irregular loop. There seem to be no special glands present along this terminal duct. The common uterine duct just mentioned is very short and divides anteriorly into two uteri, which run forward on either side.

The present example, so far as its external characters are concerned, closely resembles Laidlaw's *Latocestus agrus*,[2] a species from Pulau Bidan, a few miles north of Penang; but a closer examination has revealed the fact that this is only a superficial resemblance and that it represents an interesting new species referable to the genus *Cryptophallus*. Only one species, *C. wahlbergi*, of this genus has been hitherto known and comes from South America. *C. bartschi* may be easily distinguished by the different feature of the male organs, as is evidenced in the above description. Besides, the organs in *C. wahlbergi* occur ventral to, instead of behind, the pharyngeal cavity.

COTYLEA.

Family PSEUDOCERIDAE.

Genus THYSANOZOON Grube.

2. THYSANOZOON AUROPUNCTATUM Kelaart-Collingwood.

Plate 1, fig. 2.

Thysanozoon auropunctatum Kelaart-Collingwood, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 94.—Stummer-Traunfels, 1895, Zeitschr. f. wiss. Zool., vol. 60, p. 701.—Laidlaw, 1903, Proc. Zool. Soc. London, vol. 1, p. 314.—Bock, 1913, Zool. Bid. f. Uppsala, vol. 2, p. 252.
Thysanozoon verrucosum Grube in Lang's Monogr., p. 537.

The collection contained a single specimen, which was found adhering to a certain sea weed at Tacloban, Leyte, in April, and was, unfortunately, in fragments, so that a satisfactory examination was not possible. According to Professor Bartsch's note and colored drawings taken from the living form, this planarian seems to be identical with Kelaart's *Thysanozoon auropunctatum*, which is known to occur in Samoa, Arip on the west coast of Ceylon, Pulau Bidan on the west coast of Malacca, and Cape Jaubert in West Australia.

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[2] Laidlaw, 1903, Proc. Zool. Soc. London, vol. 1, p. 312.

The body in life was elongate-oval in shape and had the margin very strongly frilled. The frontal margin was folded in a pair of tentacular horns about 5 mm. apart. Irregularly distributed all over the dorsal surface were numerous slenderly conical papillae of varying size. The worm in the expanded state measured 85 mm. in length and 38 mm. in breadth at the middle of the body.

Almost completely round the extreme margin of the body, on the dorsal surface, was a pale pearl-gray stripe, just inside which was a broad band of a sooty color, gradually shading inward to plumbeous. A somewhat darker shade occurred along the median line from the tentacles to near the end of the body. Most of the dorsal papillae were generally of a white color, excepting at the tip, which was orange. Frequently some were colored orange throughout. The ventral surface presented a marginal band of pearl gray and a broad purplish sooty one within this, just as on the dorsal. The rest of the surface was of a pearl-gray color with a narrow median white streak which extended posteriorly from a short distance behind the anterior margin.

The present species is on the whole most closely allied to *Thysanozoon brocchi* (Grube) of cosmopolitan distribution, which varies in color to some extent. But it can be distinguished from this by the possession of an unpaired penis.

Genus PSEUDOCEROS Lang.

3. PSEUDOCEROS HANCOCKANUS (Collingwood).

Plate 1, fig 3.

Proceros hancockanus Collingwood, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 91.

? *Stylochopsis malayensis* Collingwood, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 94.

Prosthecerаeus hancockanus Lang, 1884, Naples Monogr., p. 567.

Pseudoceros malayensis Bock, 1913, Zool. Bid. f. Uppsala, vol. 2, p. 258.

Professor Bartsch secured but one specimen. While fishing with a submarine light in February, near Tominado Island, Tawi Tawi, it was found swimming on the surface of the water. It may be identical with *Proceros hancockanus.*

The body in the living state was of a thick, broad, leaflike shape with frilly margin. The tentacles appeared as two S-shaped lobes of the anterior margin of the body. When the worm was at rest, they were folded back on the dorsal surface. In the expanded state the body measured 46 mm. long by 24 mm. across the widest part at the middle.

The dorsal surface was of a blackish-brown color with a much darker shade along the median line, and was margined nearly all around by a narrow light-gray band; just inside this was a second one of similar width of Chinese orange. The tentacular lobes were colored like the general surface, but lacked the sub-marginal band of Chinese orange. The ventral surface was of a much lighter color than the dorsal. Along the median line was a pearl-gray streak which extended posteriorly from near the anterior margin of the body.

Numerous small eyespots, though difficult to detect owing to a poor state of preservation, appear to be distributed on the tentacular folds in two distinct clusters; and an oval elongated group of eyes, divisible into two closely approximated clusters, occurs dorsal to the brain.

Situated near the beginning of the middle third of the body is the mouth, which leads into the pharyngeal cavity with the plicated pharynx. The ventral sucker occurs slightly behind the middle of the body.

Instead of strongly folded, **S**-shaped lobes, the tentacles in Collingwood's form are in his figure shown as a pair of long prominent processes. Excepting such a difference, it is difficult to find any distinguishing character.

Laidlaw,[3] although harboring some suspicion, puts on record a form from Pulau Bidan, a little north of Penang, which is perhaps referable to the present species.

The present form is almost exactly similar in color to Stimpson's *Callioplana marginata*,[4] an Acotylid species from Japan, but is beyond doubt distinguished from it by the presence of marginal, instead of nuchal, tentacles.

4. PSEUDOCEROS LITORALIS Bock.

Plate 1, fig. 4.

Pseudoceros litoralis Bock, 1913, Zool. Bid. f. Uppsala, vol. 2, p. 259.

The collection contained one specimen, which I have identified as *Pseudoceros litoralis* Bock, a species from the Gulf of Siam. It was found on coral sand and shell bottom at a depth of 21 fathoms off Sulade Island, Sulu Archipelago.

The body in life was thin leaflike in shape and of a sinuous outline. The anterior margin was elevated and folded in two **S**-shaped loops of tentacular folds, while the posterior was evenly rounded. The fully extended animal measured 20 mm. in length and 14 mm. in breadth.

The dorsal surface was of a uniform velvety dark-brown color with a touch of purple. Just inside the extreme margin of the

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[3] Laidlaw, 1903, Proc. Zool. Soc. London, vol. 1, p. 315.

[4] Yeri and Kaburaki, 1918, Journ. Sci. Coll. Imp. Univ. Tokyo, vol. 39, art. 9, p. 32.

same color occurred a submarginal band of orpigment orange, which was interrupted at the extreme anterior end only. An elevated papilla, which was about 2 mm. high and presented a basal ring of orpigment orange and a black tip, was located a little to the left of the tentacle of the same side and just inside the submarginal orange band above mentioned. The ventral surface was of a somewhat paler color than the dorsal and presented a median line of smoky gray.

Numerous small eyespots are scattered over each tentacular fold, and they also occur over the brain in a group which is faintly divisible into two clusters.

The mouth opens nearly between the anterior and the middle third of the body, leading into the pharyngeal cavity with the pharynx plicated. The ventral sucker occurs slightly in front of the commencement of the posterior third of the body.

Unfortunately the genital organs were not developed in the specimen examined.

As with the present specimen, most of the examples examined by Bock are of a uniform brown color and are marked by two distinct narrow marginal stripes, the inner chrome yellow and the outer black, though some presenting, besides these, a narrow rim of a paler color. Under this circumstance I feel it advisable to refer the present example to Bock's *Pseudoceros litoralis*.

So far as concerns the coloration, the present specimen appears to be very closely allied to *Pseudoceros superbus* Lang which is known to occur in the Mediterranean and also in the Pacific, off the Galapagos Islands. According to Bock, however, it differs from this in having only a single penis.

5. PSEUDOCEROS BUSKII (Collingwood).

Plate 1, fig. 5.

Proceros buskii COLLINGWOOD, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 91.

Pseudoceros buskii LANG, 1884, Naples Monogr., p. 547.—LAIDLAW, 1902, Fau. & Geogr. Maldive & Laccadive Archip., vol. 1, pt. 3, p. 298.

In the collection was a single individual of a species which is perhaps identical with Collingwood's *Proceros buskii* from Singapore. It was found on the reef in Cataingan Bay, Masbate, in April.

The body in the living state was of an elongate-oval shape with the margin very strongly frilled. The tentacles appeared as two short folds of the frontal margin of the body. In the expanded state the specimen had a total length of 50 mm. and a breadth of 20 mm.

Dorsally the body was bordered all around by a narrow marginal band of citron yellow, immediately interior to which was a broad purplish-black band, gradually grading inward into a cream color with numerous fine reticulations of poppy red. Along the median line occurred a longitudinal band of a yellowish-white color. The ventral surface was almost exactly similar in color and markings to the dorsal, excepting the purplish-black band, which was more or less broad. The internal structures were discernible with more or less distinctness by tubular white markings.

The state of preservation makes it very difficult to detect the arrangement of eyespots with any degree of accuracy. The eyespots, which are exceedingly numerous, are scattered over the tentacular flaps and also occur forming a single circular cluster slightly posterior to the tentacles.

The mouth, which leads into the pharyngeal cavity with the pharynx plicated, appears to open at the hind end of the first fourth of the body, and the ventral sucker lies a little behind the center of the body.

The present specimen, though sexually mature, was unfortunately in an unfit state for close examination of the genital organs.

In his description of the species from Singapore Harbor, Collingwood gives the color of the body as a rich velvety olive green, but in his figure the body is shown rather as black. Although there exists a small difference in the ground color, as is evident from the above, I feel justified in identifying the present specimen with Collingwood's species.

The present species appears to be closely allied to *Pseudoceros flavomarginatus* Laidlaw,[5] a species from Minikoi, Laccadive Group, so that they may be identical; and it, according to Laidlaw, is also known to occur in Hulule and Minikoi.

6. PSEUDOCEROS CONCINNUS (Collingwood).

Plate 1, fig. 6.

Proceros concinnus Collingwood, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 90.—Lang, 1884, Naples Monogr., p. 593.

Only a single example, which, although showing a small difference in the feature of its tentacles, appears to be identical with Collingwood's *Proceros concinnus* from the islands of Labuan and Pulo Daak near the mainland of Borneo, was found on the head of coral in about 2 feet of water on the shore of Papahag, Tawi Tawi, in February. No specimen unfortunately came under my direct observation; and the following is based upon Professor Bartsch's note and colored drawing.

The body was of a thin leaflike shape in the living state, its lateral margin being slightly frilled. The tentacles appeared as two S-shaped, folded outgrowths of the anterior body margin, differ-

[5] Laidlaw, 1902, Fau. & Geogr. Maldive & Laccadive Archip., vol. 1, pt. 3, p. 298.

ing from Collingwood's form, in which they are pointed at the tip. When in motion the tentacular folds projected for about 4 mm. In the fully extended state the body may have reached 55 mm. in length and 18.5 mm. in breadth.

The present example bears a close resemblance to Collingwood's form in color. The entire margin of the body was marked on the dorsal surface by a narrow band of cobalt blue. Along each side of the median line occurred a narrow line of Antwerp blue, which fused with its fellow of the opposite side before reaching the anterior and posterior extremities. The space inclosed between was of the same color as the rest of the dorsal surface, which was pale cream buff with numerous small lighter hydrophanous spots of varying size and distribution. The ventral surface was uniformly cream with a border of cobalt blue just as on the dorsal. The dorsal median blue lines were faintly visible from the ventral side.

As is evident from the above, the present specimen has small folded tentacles, whereas Collingwood's form bears tentacles of a slender conical shape. *Proceros concinnus*, in fact, appears almost certainly to be an Euryleptid, as mentioned by Laidlaw,[6] who, although not having made any precise identification, has given a note on several examples of a species colored exactly like this, whilst the present example is undoubtedly a member of the genus *Pseudoceros*. In spite of such a small difference in the tentacles, it may, I think, be advisable to refer this to *Pseudoceros concinnus*, because of a close resemblance in their coloration.

7. PSEUDOCEROS RUBROTENTACULATUS, new species.

Plate 2, fig. 7; text figs. 3, 4.

Only one individual, which appears to represent a new species, was found in the crevice of coral between tide marks at Dumurug Point, in Cataingan Bay, Masbate, in April; holotype, Cat. No. 19103, U.S.N.M.

This species in the living state was of a small leaflike shape with a sinuous outline. The anterior margin gave rise to a pair of tentacular folds. In the expanded state the length of the body was 14 mm. and the breadth 10 mm.

The dorsal surface was of a cream color with a narrow marginal band of bright cobalt blue, decidedly intensified between the two tentacular folds, where the band was about twice as wide as the rest. The tentacular folds presented a bright orpigment orange-colored spot on the outer side of the tip. Extending from the tentacular region to near the posterior margin of the body were three bright

[6] Laidlaw, 1903, Proc. Zool. Soc. London, vol. 1, p. 315.

buff bands of almost similar breadth, each of which was bordered by a narrow, deep, tawny-brown stripe. One followed the median line; the other two ran parallel to it, with an interspace as broad as or broader than the buff bands. The ventral surface was of a uniform pale buff color with a bright cobalt marginal stripe, just as the dorsal.

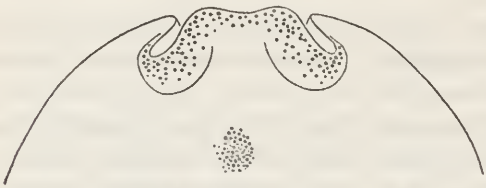

FIG. 3.—ARRANGEMENT OF EYESPOTS IN PSEUDOCEROS RUBROTENTACULATUS.

Numerous small eyespots are found irregularly arranged along the margin of the tentacular folds and also occur forming a crowded cluster over the brain.

The mouth is placed at the beginning of the middle third of the body and opens nearly into the middle of the much-folded pharynx, which is nearly one-third as long as the body. The main gut is narrow, of a considerable length, and gives rise to numerous pairs of lateral branches, the subdivisions of which do not undergo anastomosis. At the hind end the main trunk becomes somewhat dilated. The ventral sucker occurs a little anterior to the hind end of the middle third of the body.

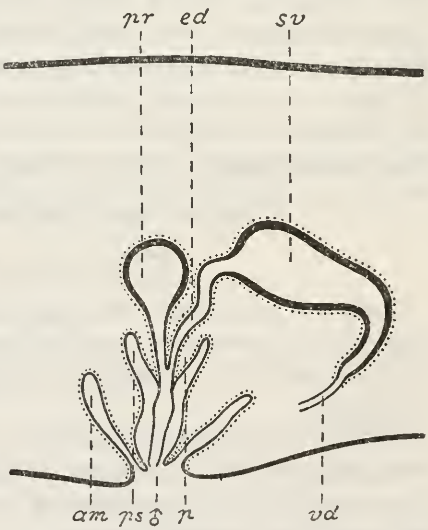

FIG. 4.—MALE GENITAL ORGANS OF P. RUBROTENTACULATUS IN SAGITTAL SECTION. *am*, ANTRUM MUSCULINUM; *sv*, SEMINAL VESICLE. OTHER LETTERS AS IN FIG 2.

The male gonopore lies in the median line slightly behind the pharyngeal cavity. The vas deferens pursues a backward course and bends inward a little behind the genital opening, finally to unite with its mate of the opposite side into a median canal, which rises upward to continue with the anteriorly directed, wide seminal vesicle having a thick muscular coating composed of two sets of fibers, circular and longitudinal. Anteriorly the vesicle gives rise to a slender duct, the ejaculatory duct, which turns abruptly downward just behind the prostate, and after receiving the duct of this organ enters the penis. The prostate is of a pyriform shape and lies just dorsal to the base of the penis, which is represented by a long chitinous stylet hanging vertically in the sheath. The antrum musculinum forms an oblique upwardly directed, annular outbulging before opening to the exterior.

In having three bands of almost similar breadth, each of which was bordered by a narrow dark pigmented stripe, the present spe-(Kelaart), which will be described later. But it stands distinctly at variance from this chiefly in the different features of the tentacles and coloration, as may be seen from the description.

8. PSEUDOCEROS PHILIPPINENSIS, new species.

Plate 2, fig. 8.

A single representative of this interesting new species was collected in Subic Bay, Luzon, in January, holotype, Cat. No. 19104, U.S.N.M.

The body in the living state was firm in texture, leaflike in shape, and had the margin strongly frilled. The frontal margin shows an aspect somewhat similar to that in *Pseudoceros bedfordi* Laidlaw [7] from Singapore Harbor, the tentacles forming two loops, as is seen in figure 8. In the resting state the body measured 40 mm. long by 10 mm. across in the broadest part. When swimming it may have reached about 75 mm. in length.

The dorsal surface was of a velvety black color with a touch of purple and was marked by a median stripe of light purple, extending through about two-thirds the length of the body posteriorly from the anterior margin. On each side of the median stripe, a short distance from it, was an ashy-gray band of twice the width of the median one. These two bands extended from the anterior margin to near the posterior. Further, the body was bordered all around by two narrow bands of almost similar breadth, the outer marginal band orange chrome and the inner submarginal white, shading to ashy at the inner border. In the anterior median parts of the ventral surface was a white shade, extending about halfway across the body. The rest of the surface was of a velvety black color, as on the dorsal. The extreme margin was orange chrome, but the rim was very thin.

The deep pigmentation makes it impossible to determine the arrangement of eyespots.

This strikingly handsome specimen was unfortunately broken in part, so that a satisfactory examination was not possible. It may, however, be provided with a pair of the male organs.

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[7] Laidlaw, 1903, Proc. Zool. Soc. London, vol. 1, p. 314.

Family EURYLEPTIDAE.

Genus PROSTHECERAEUS Schmarda.

9. PROSTHECERAEUS PAPILIO (Kelaart).

Plate 2, fig. 9.

Planaria papilionis KELAART, 1858, Journ. Ceylon Branch Roy. Asiat. Soc., 1856–1858, p. 136.

Acanthozoon papilio COLLINWOOD, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 95.

Pseudoceros? papilio LANG, 1884, Naples Monogr., p. 546.

A single specimen, which may be identical with Kelaart's *Planaria papilionis* from Ceylon, was collected in Subic Bay, Luzon, in January. Unfortunately no specimen was brought under my direct examination. The following description is based upon Professor Bartsch's careful note and colored drawing.

The body in life was oval in shape and had a frilled margin. The tentacles appeared as two short, obtusely pointed outgrowths of the anterior margin of the body. In the resting state the worm measured 22 mm. long by 15 mm. broad; when fully extended it may have reached 35 mm. in length.

The dorsal surface was of an ashy-gray color, merging to deep purplish brown on either side, and was mottled more or less uniformly all over with minute dark-brown spots. The extreme margin was marked by a narrow colorless stripe, as is seen in Collingwood's figure. A longitudinal band of an ashy-gray color with a touch of purple extended almost throughout the median line.

The present example shows a slight difference in its general coloration from Kelaart's form, which is of a yellow color. It may, however, be advisable to regard this as a variation. After some hesitation I have referred this specimen to *Planaria papilionis* and arranged it under the genus *Prostheceraeus* on account of a close resemblance of their markings and short, obtusely pointed tentacles.

This specimen seems to be closely allied to Laidlaw's *Pseudoceros collingwoodi* from Pulau Bidan, near Penang, in which the dorsal surface is of mottled dark-brown or brownish-white color and is bordered by a thin white marginal stripe. One of the distinctive characters is the presence of an equally fine black submarginal line just inside the marginal.

10. PROSTHECERAEUS MELEAGRINUS (Kelaart).

Plate 2, fig. 10; text fig. 5.

Planaria meleagrina KELAART, 1858, Journ. Ceylon Branch Roy. Asiat. Soc., 1856–1858, p. 137.—LANG, 1884, Naples Monogr., p. 613.

Stylochoplana meleagrina COLLINGWOOD, 1876, Trans. Linn. Soc., ser. 2, Zool., vol. 1, p. 98.

In the collection there is a single individual, which seems to agree with Collingwood's description and figures of *Planaria meleagrina* Kelaart from Ceylon, so far as they go. It was collected in the Bay of Lianga, Mindanao, in May. An examination has revealed that this form may be referred to the genus *Prostheceraeus.*

The body in the living state was of a leaflike shape, its margin being frilled to a certain extent. The tentacles were represented by two hornlike projections arising from the anterior margin of the body. When fully extended the animal was 17 mm. in length and 7 mm. in breadth.

The dorsal surface was light buff and margined almost completely by a narrow dark-blue stripe. In addition to this there were, as in *Pseudoceros rubrotentaculatus* already described, three bands of a dark-brown color, a median and a pair of lateral, each bordered by a much deeper color. The median band was wide and extended from behind a group of eyespots over the brain to a point some little distance from the posterior extremity. The lateral pair, which were somewhat narrower and much lighter in color, occupied a position nearly halfway between the median band and the lateral body margin and extended a little farther forward and backward. At the base of each tentacle there was a yellow spot. In the preserved state the tenacles show a black color at the tip on account of the presence of well-developed pigments. The ventral surface was, like the dorsal, of a bluish-white color with a dark brownish-blue marginal stripe. The dorsal markings were visible on the outside with more or less distinctness.

Fig. 5.—Arrangement of eyespots in Prostheceraeus meleagrinus (Kelaart).

At the base of each tentacle are numerous small eyespots, which assume an irregular group on both sides, dorsal and ventral, and they also occur in a horseshoe-shaped cluster above the brain.

The position of the mouth could not be detected, since the specimen was unfortunately in a state unfit for close examination. Lying in the anterior half of the body is the pharynx, which is of smaller size. Along the median line runs the main trunk of the intestine with numerous lateral branches, the subdivisions of which form a highly anastomosing system before reaching the margin of the body. The ventral sucker is placed at a short distance behind the middle of the body.

According to Collingwood's description and figures, Kelaart's original form is provided with a pair of linear appendages on the occipital region above the eyespots. The ground color, which is white in the central and light blue in the marginal parts of the body, is marked almost completely by a narrow black marginal stripe and also by three longitudinal broad bands of brownish red, each edged with black pigments. Though showing such differences in color and also in the feature of the tentacles, the general appearance agrees with that of the example which I have examined.

Family DIPLOPHARYNGEATIDEA.

SIMPLICIPLANA, new genus.

11. SIMPLICIPLANA MARGINATA, new species.

Plate 2, fig. 11; text fig. 6.

Only a single individual, which seems to represent a new genus and species, was collected in Tominado Island, Tawi Tawi, in February, holotype, Cat. No. 19105, U.S.N.M.

The body in life was leaflike in shape and of a strongly frilled outline. The tentacles appeared as two simple folds of the frontal body margin, so that this form seemed to be destitute of them. In the preserved state, however, they are rather distinct. The worm in the expanded state had a total length of 25 mm. and a breadth of 11 mm.

Fig. 6.—Arrangement of eyespots in Simpliciplana marginata.

The ground color of the dorsal surface was wax yellow, excepting the extreme margin marked by a narrow greenish-white stripe; just inside this was a broader band of pale olive, grading over inward to the general color. A white band ran along the median line almost throughout the entire length of the body. Slightly behind the anterior margin was located a small spot which appeared to represent the position of eyespots in a cluster. The ventral surface was similar in color to the dorsal, excepting the occurrence of an ill-defined greenish cord.

Distributed on the tentacular flap are numerous small eyespots, which form two irregular groups, as is shown in figure 6. Other eyespots, of somewhat larger size, also occur over the brain in an almost circular cluster.

So far as my observation goes, the present species appears to be devoid of any ventral sucking disk. Placed in the anterior third of the body is the unfolded pharynx, which appears to open to the exterior at the middle of its cavity. The main gut trunk gives off numerous lateral branches, the subdivisions of which form a highly anastomosing system. Some interest attaches to the presence of minute gut diverticulae, which arise from the dorsal wall of the main trunk and end blindly in the parenchyma just beneath the basement membrane.

The genital organs, though difficult to observe owing to a poor state of preparation, seem to be constructed on a plan similar to those figured by Von Plehn[8] for *Diplopharyngeata filiformis*, a species from Sumatra. Just behind the pharynx lie the male organs, in which no seminal vesicle nor prostate of any kind could be detected in the sections available.

The female gonopore is situated nearly at the middle of the body and leads into an irregular antrum, which in turn appears to connect with the vagina.

In spite of fundamental similarity in the structure of the genital organs and also of the absence of the ventral sucker, the present species appears to be somewhat related to Plehn's *D. filiformis*, just mentioned, but is distinctly at variance from this in some respects. *D. filiformis* is wholly devoid of any trace of tentacles, has the pharynx reduplicated, and presents no anastomasing system of the intestine. For the present I can not feel certain of referring the present example to any previously recorded genus.

As to its systematic position I am not in a position to make any assertion, because the specimen is too incomplete to admit of a satisfactory diagnosis. I feel, however, justified in not ranging this remarkable form either under the Pseudoceridae or under the Euryleptidae, chiefly on account of appearing devoid of prostate and sucking disk of any kind, not to speak of other points of differences. Provisionally it may be placed under the Diplopharyngeatidae.

EXPLANATION OF THE PLATES.

Plate 53.

Fig. 1. *Cryptophallus bartschi*, new species, about natural size.
2. *Thysanozoon auropunctatum* Kelaart-Collingwood, about ×2.
3. *Pseudoceros hancockanus* (Collingwood), about ×2.
4. *Pseudoceros litoralis* Bock, about ×2.
5. *Pseudoceros buskii* (Collingwood), about natural size.
6. *Pseudoceros concinnus* (Collingwood), about natural size.

Plate 54.

Fig. 7. *Pseudoceros rubrotentaculatus*, new species, ×5.
8. *Pseudoceros philippinensis*, new species, ×2.
9. *Prostheceraeus papillo* (Kelaart), ×2.
10. *Prostheceraeus meleagrinus* (Kelaart), ×5.
11. *Simpliciplana marginate*, new species, ×2

[8] Von Plehn, 1896, Jena. Zeitschr., vol. 30, p. 167, pl. 13, fig. 12.

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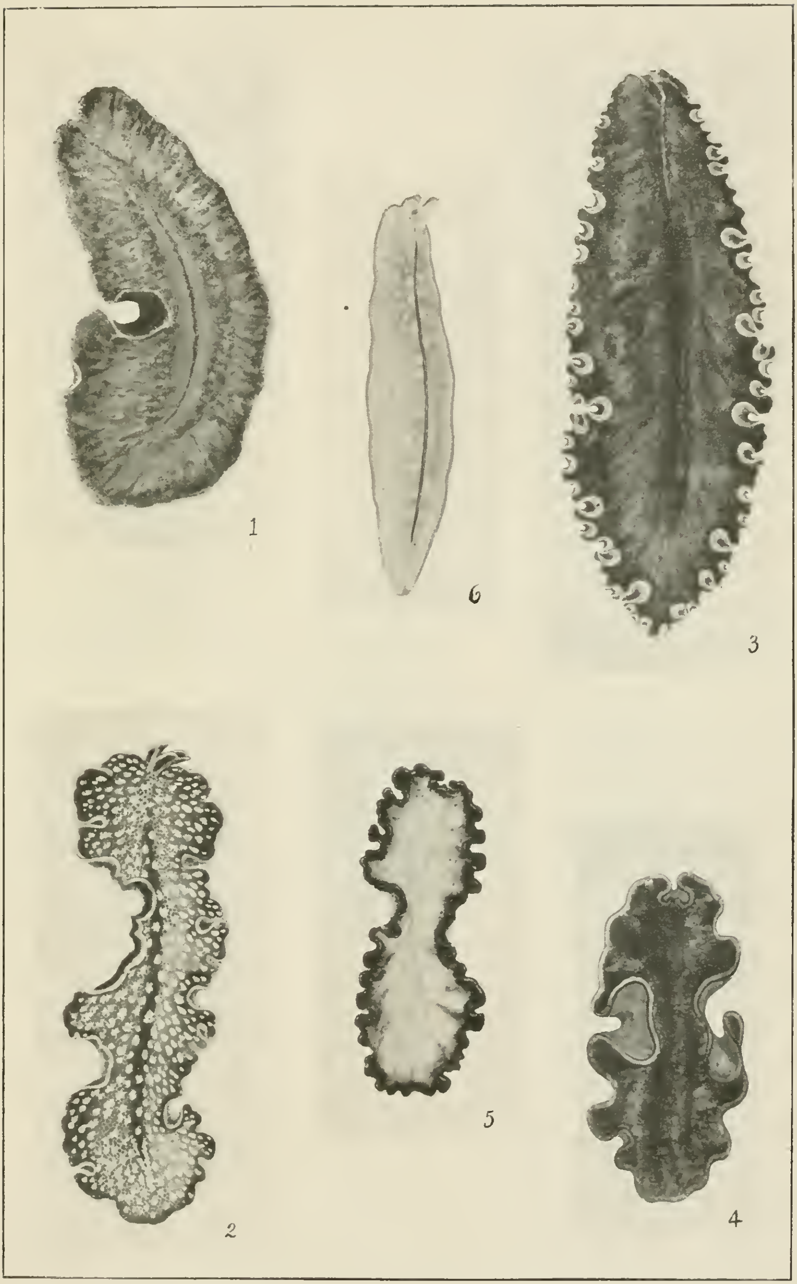
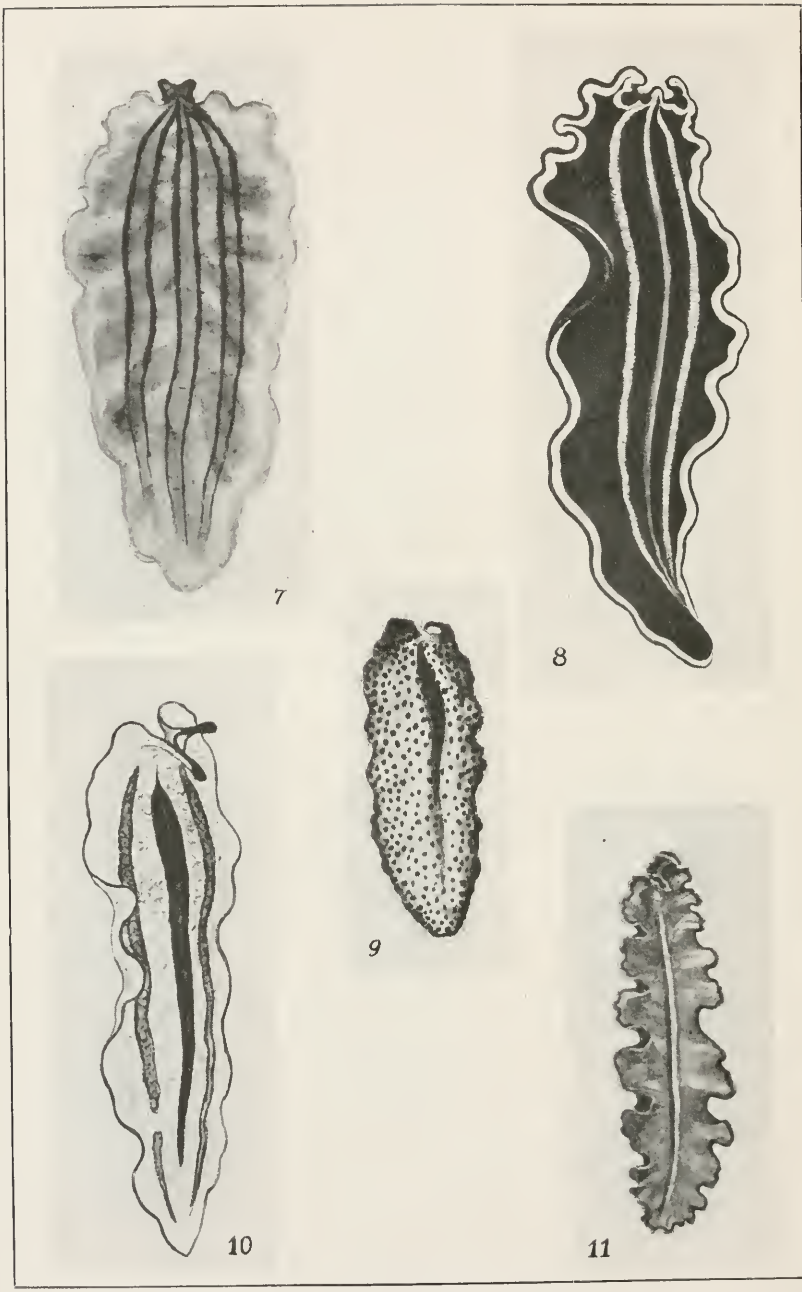


POLYCLAD TURBELLARIANS FROM PHILIPPINE ISLANDS.

FOR EXPLANATION OF PLATE SEE PAGE 649.



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