

BULLETIN OF THE
VANDERBILT MARINE MUSEUM

VOLUME IV

Scientific Results of the Cruises of the Yachts
"Eagle" and "Ara", 1921-1928,
William K. Vanderbilt,
Commanding.

COELENTERATA, ECHINODERMATA
AND MOLLUSCA

By LEE BOONE

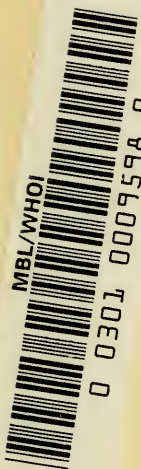
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Announcement

THE Vanderbilt Marine Museum is the privately owned depository of the marine collections of William K. Vanderbilt, Esquire, and is located on his country estate, "Eagle's Nest," Huntington, Long Island, New York. It contains extensive collections of natural history and ethnological specimens, all of which were personally collected by Mr. Vanderbilt, in various parts of the world during the past thirty-odd years.

The scientific publications of the museum consist of a series of Bulletins, designed to disseminate results of research based on the marine zoölogical collections, every specimen of which was personally collected by Mr. Vanderbilt, during a series of cruises in his yachts "Eagle" and "Ara." Volume I of the Bulletin series consists of reports on the fishes collected during these cruises, by Dr. N. A. Borodin. Volumes II and III consist of reports on the Crustacea of the cruises of the yachts "Eagle" and "Ara," 1921-1928, by Lee Boone. Volume IV, the present report, consists of a report on the Coelenterates, Echinoderms and Mollusks of the cruises of the yachts "Eagle" and "Ara," 1921-1928, by Lee Boone.

These Bulletins are available for distribution to scientific establishments by purchase or by exchange for equivalent research reports in related subjects. They may be obtained by addressing Mr. Vanderbilt, at the Vanderbilt Marine Museum, Huntington, Long Island, New York.

Other bulletins will be issued from time to time, as made desirable by the results of research on the Vanderbilt collections.

1788

BULLETIN OF THE VANDERBILT MARINE MUSEUM.

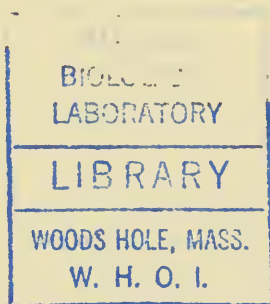
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VOLUME IV

Scientific Results of Cruises of the Yachts "Eagle" and
"Ara", 1921-1928, William K. Vanderbilt, Commanding.

COELENTERATA, ECHINODERMATA
AND MOLLUSCA.

By LEE BOONE



Huntington, L. I., New York, U.S.A.

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*“They move and have their being in the vast
Ocean that teemed before the land was green;
They keep the secret of the farthest past,
Children of the water, silent and serene.”*

—Sara Teasdale.

To Mrs. Earl E. T. Smith

TO dive into the deep Secrets of the Waters to take a view of all the excellent Creatures sporting themselves therein, and observe the vertues and occult qualities wherewith they are endow'd, is a work might be expected from that Wisdom which was communicated to *Solomon*, who treated of Trees, from the Cedar in *Libanon* to the Hyssop growing on the Wall : For the watery Element is furnished with such a miraculous plenty, that it abundantly produces not only Fishes of several kinds fit for the sustenance of man, and those of extraordinary bulk and monstrous figures, as hath been shewn in the precedent Chapters, but also such a multitude of precious Shells, and other Rarities, that we may well acknowledg that the Divine Wisdom hath display'd all these rich beauties of its inexhaustible Treasures, to shew its Omnipotency in the midst of the Waves, and gently to win us into an admiration of his Goodness and adorable Providence, which humbles it self to descend into the Abysses of the Sea to people them with some excellent Creatures not to be seen elsewhere, and an infinite number of others bearing the Characters and Idæas of the most considerable Bodies that either adorn the Heavens, flye in the Air, or embellish the Earth. Hence it comes, that there are found in the Waters, Stars, Cornets, Trumpets, Purcelains, Trees, Apples, Chest-nuts, and all the delightful curiosities which are so highly esteemed among men.

Quoted from an ancient natural history of the Caribby Isles, originated in Paris, by several authors who benefitted by Father Raymond's long residence in the Carribies; translated into English by John Davies of Kidwell and published in London, 1666.

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COELENTERATA, ECHINODERMATA AND MOLLUSCA,
CRUISES OF THE "EAGLE" AND "ARA," 1921-1928,
WILLIAM K. VANDERBILT, COMMANDING.

By LEE BOONE.

INTRODUCTION.

The present Bulletin of the Vanderbilt Marine Museum, fourth in the scientific series, contains three separate reports, on the Coelenterate, Echinoderm and Mollusk collections obtained by Mr. William K. Vanderbilt, on a series of cruises conducted in his yachts, "*Eagle*" and "*Ara*," during parts of the years 1921 to 1928, inclusive.

Four distinctly separate faunal regions are involved in these explorations: (a) The West Indian region, from which the greater percentage of species was obtained. Separate cruises during the years 1921, 1922, 1923, 1924 and 1925 were conducted by Mr. Vanderbilt in this region. Additional material was obtained in the West Indies in 1926 and also in 1928, supplementing the Galapagan expeditions of these years.

(b) The Labrador-New England region is represented by material collected in the waters of Newfoundland, Nova Scotia, eastern Canada, the coast of Maine and of New York, including Long Island Sound, in 1921, 1922, 1924 and 1926.

(c) The tropical American Pacific fauna is represented by explorations in the Galapagos Islands, Cocos Island, the west coast of Costa Rica and of Panama, including the Pearl Islands, also several deep-sea stations in this region, during the expeditions of 1926 and 1928.

(d) The Mediterranean fauna, with especial reference to the north coasts of Morocco, deep-sea dredgings off the coasts of southern France, off Sardinia and off Monaco, and explorations of the littoral fauna of the Adriatic Sea.

The bathymetric occurrence of the species taken in each of these major regions ranges from littoral to true deep-sea forms, the deep-sea stations ranging in depth from 100 fathoms to 900 fathoms.

The annotated discussion of the collections is presented with reference to their systematic classification. A list of the species found in each major faunal region is given also.

The principal value of these collections lies in the surprising percentage of rare species they possess and in the related extension of our knowledge of the geographic and bathymetric distribution of these forms, and of their anatomy, as presented in the systematic discussion. Much hitherto unpublished data on the colors of the various species were made in field sketches by Mr. Vanderbilt, during all of the cruises, except those to the Galapagos Islands, on which, his staff artist, Mr. W. E. Belanske, continued this work under Mr. Vanderbilt's direction. A few of these color plates have been published in Mr. Vanderbilt's "To the Galapagos on the 'Ara'"; a great many more are in the study collections of the Vanderbilt Marine Museum. This volume also contains complete maps of the cruises of 1926 and 1928.

ACKNOWLEDGEMENTS.

As during the preparation of the preceding Volumes II and III, Mr. Vanderbilt has generously placed unexcelled facilities at my disposal during the preparation of the present reports. His splendid generosity and unfailing patience and helpful criticisms have been most valuable.

I am also indebted to Miss Ida Richardson Hood, curator of the Library of the American Museum of Natural History, and her assistants, the Misses Hazel Gay, and Ida Sledge, for many courtesies. The line drawings of the Echinoderms and many of the Cephalopoda were made by Mrs. Helen Ziska; those of the remainder of the Cephalopoda and Tectibranchiata, also all of the Coelenterata, were done by Mrs. Else Bostelmann, all under my supervision. The photographic illustrations were made by Mr. Julius Kirschner of the photographic laboratory of the American Museum, except that of *Stylaster roseus* (Pallas), which was kindly supplied by Mr. W. E. Belanske.

GEOGRAPHICAL DISTRIBUTION OF SPECIES OF COELENTERATA.

WEST INDIAN FAUNA.

Millepora alcicornis Linné.

Several specimens in various stages of development, from the south coast of Cuba, February 19, 1923.

Stylaster roseus (Pallas).

Several fine colonies dredged in 150 fms., seven miles off Alligator Reef, Florida, March 30, 1926.

Olindias tenuis (Fewkes).

One specimen, Turtle Harbor, Florida, November 28, 1923.

Physalia physalis (Linné) Schneider.

Two, pelagic, taken at Sombrero Light, Florida, March 4, 1923.

Tamoya haplonema F. Muller.

One young specimen, Bahamas, field tag 128. One young specimen, Matanzas, Cuba, February 28, 1928. Nine specimens, all young, taken with marine light at night, Hawk's Nest, Cat Island, Bahamas, January 15, 1928.

Cassiopea xamachana H. B. Bigelow.

One unusually large specimen, taken in six fms., Dry Tortugas, Florida, November 26, 1923, field tag 315.

Cassiopea frondosa (Pallas).

One specimen taken on the south coast of Cuba, February 19, 1923, field tag 97, lot E.

Stomolophus meleagris L. Agassiz.

Eleven, collected off Miami Beach, Florida.

Corallium vanderbilti, new species, one four-branched colony, taken in over 100 fms., Casilda, south coast of Cuba, February 15, 1924.

Plexaura fusca Duchassaing and Michelotti.

One large colony, south coast of Cuba, February 19, 1923.

Rhipidogorgia flabellum (Linné).

Several fine specimens, from Nassau, Bahamas. Several from Port Tanamo, Cuba, 1923.

Pterogorgia acerosa forma typica Biel.

Two very fine colonies from Nassau, Bahamas, 1924.

Stenogorgia casta Verrill.

One very fine colony of this rare species, dredged in 150 fms., seven miles off of Alligator Reef, Florida.

Zoanthus pulchellus (Duchassaing and Michelotti).

Four colonies, Limon Bay, Panama, January 21, 1928.

LABRADOR-NEW ENGLAND FAUNA.

Zygodactyla groenlandica (Peron and Lesueur).

One very large specimen, Eastport, Maine, collected by the "Eagle."

Metridium dianthus (Ellis).

One large specimen, Bay of Islands, Newfoundland, September 3, 1926. Another, York Harbor, Newfoundland, September 12, 1923.

Actinauge rugosa Verrill.

Twelve specimens, dredged in 180 fms., Bay of Islands, Newfoundland, September 3, 1926. Four larger specimens taken from the same locality, attached to stones and various species of mollusks, September 3, 1926.

Bolocera longicornis Carlgren.

Five specimens, dredged in 200 fms., 9 miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926.

Stomphia carneola (Stimpson).

One, taken by the "*Eagle*" at Eastport, Maine.

TROPICAL AMERICAN PACIFIC FAUNA.

Stomotica divisa Maas.

One specimen, dredged in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926.

Nectrodroma reticulata Bigelow.

One unusually fine colony and two not quite perfect nectophores of this rare animal were taken in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926.

Abylopsis eschscholtzii (Huxley).

Several bracts, dredged in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926.

Periphylla hyacinthina (Steenstrup).

One taken in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926.

Ptilosarcus gurneyi Gray.

One very fine specimen, Wafer Bay, Cocos Island, Pacific Ocean, in shallow water, March, 1926.

Pavonaria californica Moroff.

Eleven colonies, dredged in 100 fms., Punta Arenas, Costa Rica, February, 1928.

Beroe forskalii H. Milne Edwards.

Four taken in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926. One, Jicarón Island, Panama, January, 1928. One specimen, taken at 1090 fms., Pacific Ocean, Lat. 1° 14' N.; Long. 90° W., January 30, 1928.

MEDITERRANEAN FAUNA.

Solmissus albescens Gegenbaur.

One specimen, taken 10 miles S. by E. of Monaco Harbor, April 19, 1923.

Abylopsis tetragona (Otto).

Free Eudoxid stage taken in 400 fms., off St. Raphael, bearing S. S. E. distance 9 miles S. of France, Mediterranean Sea, March 23, 1927.

Verella velella (Linné).

Two, pelagic, 10 miles S. by E. of Monaco Harbor, April 19, 1927.

Cotylorhiza tuberculata (Macri).

One very fine specimen, Monaco, Mediterranean Sea, April 19, 1927.

Alcyonium palmatum Pallas.

Two, dredged in 35 fms., 5 miles N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea, July 21, 1927. One small specimen from 325 fms., Cape Spartivento, Sardinia, 1927.

GEOGRAPHICAL DISTRIBUTION OF SPECIES OF ECHINODERMATA.

WEST INDIAN FAUNA.

Neocomatella pulchella (Pourtales).

One very fine specimen dredged in 150 fms., 7 miles S. W. off Alligator Reef, Florida, March 30, 1926.

Astropecten antillensis Lutken.

Two specimens, Porto Padre, Cuba, March, 1928, collected by the "Ara."

Luidia marcgravi Lutken.

Two very fine specimens, south of Catalina Creek, Cuba, February 11, 1924. Another large specimen, Guantanamo Bay, Cuba, February 8, 1924. Another fine specimen, Port Segua la Grande, Cuba, February 13, 1925.

Oreaster reticulatus (Linné) Muller and Troschel.

Three large dry specimens from Bury Island Flats, B. W. I., January 19, 1925. Five younger specimens of various sizes, in spirit, from the same locality.

Peltaster planus Verrill.

One, dredged in 150 fms., 7 miles off Alligator Reef, Florida, March 30, 1926.

Echinaster echinophorus (Lamarck) Perrier.

Two specimens, from the Florida Reefs, January, 1923. One larger specimen, from the south of Catalina Creek, Cuba, dredged in 5 fms., February 11, 1924.

Asteronyx loveni Muller and Troschel.

One specimen, dredged in 150 fms., 7 miles S. W. off Alligator Reef, Florida, March 30, 1926.

Astrophyton muricatum (Lamarck).

One large specimen, taken on the Florida Reefs, 1923. One large dry specimen, dredged off the south coast of Cuba, in deep water, February, 1924.

Hemipholis elongata (Say).

One specimen, taken in Turtle Harbor, Florida, April 14, 1923.

Ophiothrix angulata (Say).

One specimen, Thompson Key, Florida, January 27, 1923. Two, dredged in 150 fms., 7 miles S. W. off Alligator Reef, Florida, March 30, 1926.

Ophiothrix suensonii Lutken.

Two dry specimens, Pigeon Key, Florida, April 17, 1926, collected by the "Ara." Two young specimens, Turtle Harbor, Florida, 2 fms., April 19, 1922. One from south of Catalina Creek, Cuba, February 14, 1923. Two specimens from Barnett Harbor, Bahamas, January 13, field tag 12.

Ophioderma appressum (Say).

Two specimens from Porto Padre, Cuba, 2 fms., March, 1923.

Ophioderma cinereum Muller and Troschel.

Two, dredged in 70 fms., south of Marquesas Keys, Florida, March 2, 1924.

Ophiolepis elegans Lutken.

One specimen, Porto Padre, Cuba, March, 1928.

Stichopus badionotus Selenka.

Three specimens, Egg Island Harbor, Bahamas, B. W. I., January 19, 1925. One specimen, Port Tanamo, Cuba, February 23, 1924, taken in 2 fms.; another much younger specimen, from the same locality, also taken in 2 fms.

Holothuria arenicola Brandt.

One specimen, Dry Tortugas, Florida, March, 1925.

Cidaris affinis (Philippi).

Four specimens, seined, Porto Padre, Cuba, 3 fms., March, 1928.

Eucidaris tribuloides (Lamarck).

Six specimens, dredged in shallow water, Egg Island, Bahamas, B. W. I., January, 1925. Another specimen, from the same locality, figured in plate. Two specimens, taken in 3 fms., south of Catalina Creek, Cuba, February 1, 1924.

Diadema setosum (Leske).

One large specimen, Port Tanamo, Cuba, 2 fms., January 23, 1924. Two young ones from the same locality. One large specimen, Dry Tortugas, Florida.

Lytechinus variegatus (Leske).

Eight beached tests from the West Indies. One specimen, Dry Tortugas, Florida.

Tripneustes esculentus (Leske).

Ten very young specimens, Bury Island Flats, B. W. I., January 19, 1925. Two small specimens, Porto Padre, Cuba, March, 1928.

Echinometra lucunter (Linné).

Two small specimens, Dry Tortugas, Florida.

Clypeaster ravenelii Agassiz.

Two specimens, dredged in 70 fms., S. of Marquesas Keys, Florida, March 2, 1924.

Clypeaster rosaceus Linné.

Two beach worn tests from Dry Tortugas, Florida.

Moiria atropus (Lamarck).

Three dredged in 3 fms., Cape Cruz, Cuba, field tag 410 A, February 11, 1924. Five young specimens, Porto Padre, Cuba, seined in 2 fms., March, 1928.

Meoma ventricosa (Lamarck).

One large specimen, dredged at Egg Island, British West Indies, January 19, 1925.

LABRADOR-NEW ENGLAND FAUNA.

Ctenodiscus crispatus (Retzius).

Seven specimens, dredged in the middle of St. George's Bay, Newfoundland, September 2, 1926.

Peltaster planus Verrill.

One larger than the type, dredged in 200 fms., 9 miles S. W. by W. of Port Basque, Newfoundland.

Solaster papposus (Linné).

Three young specimens, dredged in the middle of St. George's Bay, Newfoundland, September 2, 1926.

Solaster endeca (Retzius).

Three specimens, from the coast of Maine, collected by the "*Eagle*."

Henricia sanguinolentus (O. F. Muller).

One specimen, off Cuttyhunk, Vineyard Sound, Mass., June 16, 1922. Two small specimens, without label, but probably from Vineyard Sound, June, 1922. One young and two somewhat larger specimens, dredged in 200 fms., 9 miles S. W. of Port Basque, Newfoundland, September 2, 1926. One larger specimen, dredged in Long Island Sound, off Northport, N. Y., summer of 1929.

Asterias vulgaris Verrill.

Three specimens, from the coast of Maine, taken by the "*Eagle*." Another large dry specimen, from the coast of Maine. One young specimen, dredged off Eastport, Maine, August 22, 1923.

Gorgonocephalus arcticus (Leach).

One large specimen, in spirit, dredged in 200 fms., 9 miles S. by S. W. off Port Basque, Newfoundland, September 1, 1926. One dry specimen, from the coast of Maine, collected by the "*Eagle*."

Ophiopholis aculeatus (Linné).

One specimen, dredged in 200 fms., 9 miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926.

Ophiura sarsii Lutken.

One, collected at Eastport, Maine, by the "*Eagle*."

Echinarachinus parma (Lamarek).

Three, collected at Eastport, Maine, August 24, 1924. Four, from the W. K. Vanderbilt estate shores, Northport Harbor, Long Island, N. Y.

Cucumaria frondosa (Gunnerus).

Two, from the Bay of Islands, Newfoundland, September 10, 1923.

Psolus phantapus (Strussenflet).

One specimen, dredged in the middle of St. George's Bay, Newfoundland, September 2, 1926.

TROPICAL AMERICAN PACIFIC FAUNA.

Nidorellia armata Gray.

One specimen, taken at Webb Cove, Albemarle Island, Galapagos Islands, March, 1928.

Luidia columbia (J. E. Gray).

One specimen, Webb Cove, Albemarle Island, Galapagos Islands, February 3, 1926.

Linckia columbiae Gray.

One, Webb Cove, Albemarle Island, Galapagos Islands, February 3, 1928.

Heliaster multiradiatus (Gray).

One young specimen, Webb Cove, Albemarle Island, Galapagos Islands, February 3, 1928.

Amphiura diomedae Lutken and Mortensen.

Two disks with broken arms and 50 to 100 arms minus the disks, dredged in 100 fms., Punta Arenas, Costa Rica, February, 1928.

Ophiocoma aethiops Lutken.

Five very large specimens, collected in Webb Cove, Albemarle Island, Galapagos Islands, tide-pool, February, 1928.

Ophioderma variegatum Lutken.

Eight specimens, from Punta Arenas, Costa Rica, February, 1928.

Eucidaris thouarsii (Valentin).

Three large specimens, Hood Island, Galapagos, March, 1928.

Strongylocentrotus gibbosus Agassiz and DeSor.

Six specimens, shallow water, Webb Cove, Albemarle Island, Galapagos Islands, March, 1928.

Pegalothuria natatrix Ludwig.

Three specimens, in very good condition, dredged in 300 fms., 50 miles S. W. off Cape Mala, Panama, Pacific Ocean, March 16, 1926, by the "Ara."

Holothuria impatiens (Forsk.).

Two, Gardner Bay, Hood Island, Galapagos Islands, February, 1928.

Holothuria kefersteinii (Selenka).

Ten specimens, tide-pool, Hood Island, Galapagos Islands, February, 1928.

MEDITERRANEAN FAUNA.

Antedon adriatica A. H. Clark.

One specimen, dredged in 65 fms., 11 miles S. W. of Lissa Island, Dalmatia, Adriatic Sea. Ten specimens, dredged in 100 fms., 9½ miles E. by S. ½ S. off Cape Bon Tunis, N. Africa, July 21, 1927.

Echinaster sagenus (Retzius).

One young specimen, dredged in 19 fms., 10 miles S. of Cagliari, Sardinia, July 23, 1927.

Brisinga mediterranea Perrier.

Six rays without the central disk, taken in dredge, 102 fms., mud bottom, St. Andrea Island, off Dalmatian coast, Adriatic Sea.

Ophiomyxa pentagona (Lamarek).

One dredged in 35 fms., 5 miles N. E. by N. of Cape Carthage, Gulf of Tunis, North Africa, July 19, 1927.

Ophioderma longicauda (Linek).

Eight specimens, dredged in 19 fms., 10 miles south of Cagliari, Sardinia, July 23, 1927.

Ophura texturata Lamarek.

One large specimen, 35 fms., N. E. by N. of Cape Carthage, Gulf of Tunis, North Africa, July 21, 1927.

Sphaerichinus granularis (Lamarek).

Eleven young specimens, dredged in 19 fms., grassy bottom, 10 miles S. of Cagliari, Sardinia, Mediterranean Sea, July 23, 1927.

Stichopus regalis (Cuvier).

Three specimens, dredged in 100 fms., 9½ miles S. by E., ½ S. off Cape Bon Tunis, North Africa, Mediterranean Sea, July 19, 1927.

Holothuria tubulosa Gmelin.

Three specimens, from grassy bottom, 19 fms., 10 miles south of Cagliari, Sardinia, Mediterranean Sea, July 23, 1927.

Cucumaria planci von Marenzeller.

One, taken in 35 fms., 5 miles N. E. by N. of Cape Carthage, Gulf of Tunis, North Africa, July 21, 1927.

GEOGRAPHICAL DISTRIBUTION OF SPECIES OF MOLLUSCA.

WEST INDIAN FAUNA.

Onychoteuthis banksii Leach.

Two very young specimens, from Bimini, British West Indies, January 19, 1923.

Rossia tenera (Verrill).

One, dredged in 100 fms., Marquesas Keys, Florida, 1924.

Loligo brevis Blainville.

One specimen, Hogsty Island, San Salvador, B. W. I., February 13, 1926. One specimen, Limon Bay, Panama, caught in dragnet, 1½ fms., January 21, 1928.

Loligo pealeii (Leseuer).

Three specimens, Thompson Key, Florida, January 26, 1926. One specimen, caught at night with marine electric light, Hawk's Nest,

Cat Island, Bahamas; January 15, 1923. Three specimens, caught on the south coast of Cuba, February 14, 1923.

Sepioteuthis sloanii Leach.

Two specimens, caught in Turtle Harbor, Florida.

Octopus verrilli Hoyle.

Three specimens, dredged in 200 fms., off Miami, March 31, 1926.

Octopus vulgaris Lamarck.

One specimen, Bimini, Bahamas Islands, March, 1924. One, taken at Miami, Florida. The cut-off arm of a specimen which resisted capture and attacked one of the sailors on the schooner "Sonia" while the boat was crossing from Bimini to Miami Beach, Florida. This specimen was probably between seven and eight feet umbrella diameter. The naturalist of the "Sonia," Mr. L. L. Mowbray, reported that the octopus was basking in the sunlight close to the surface, as if asleep, when first sighted. A mother octopus, with umbrella diameter of about ten inches, and her brood of 522 young, seven of which are not fully escaped from the egg-capsule; taken from loggerhead sponge, Knight's Key, Florida, dredging 2 fms., March 6, 1925. Two young specimens, Le Mole, Carenge Bay, Haiti, February 5, 1924. One very minute young specimen, taken in 34 fms., off Fowey Rock Light, Florida, April 26, 1922. One large specimen, Bimini, British West Indies. Another large specimen, Miami, Florida, 1923. One very young specimen, Cualeo Reales Channel, Cuba, February 18, 1923. One large octopus, caught by hand in rock crevice, Miami, Florida, no. 10, lot B.

Ischnochiton (Stenoplax) limaciformis Sowerby.

One specimen, dredged in 5 fms., American Shoal Light, Florida.

Tethys dactylomela (Rang).

One specimen, off American Shoal Light, Florida, 6 fms., March 23, 1924.

Dolabrifera virens Verrill.

One, taken at the surface, 15 miles east of Casilda, Cuba, February 14, 1923.

TROPICAL AMERICAN PACIFIC MOLLUSCAN FAUNA.

Onychoteuthis banksii Leach.

One young specimen, taken 17 miles S. W. of Pinta Island, Galapagos, January 31, 1928.

Pyrgopsis schneehageni (Pfeffer).

Two specimens, dredged in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926. Very rare.

Dosidicus gigas (D'Orbigny).

One, taken 17 miles S. W. of Pinta Island, Galapagos, January 31, 1928.

Loligo diomedea Hoyle.

One fairly large adult, dredged in 300 fms., 50 miles S. W. off Cape Mala, Panama, March 16, 1926. Seven very young specimens, in the post-embryonic stage, just from the capsule, dredged in 100 fms., Punta Arenas, Costa Rica, 1928.

Argonauta argo Linné.

One egg-laden female and shell, from 50 miles off Cape Mala, Panama, pelagic at surface, March 16, 1926.

Octopus bimaculatus (Verrill).

One large specimen, taken by blasting rocks, at Eden Island, Indefatigable group, Galapagos Islands, March 12, 1926. One smaller specimen, taken in drag-net, Coiba Island, Panama, Pacific side, February, 1928.

Chiton (Chiton) latus Sowerby.

One large specimen, collected on the rocks at Gardner Bay, Hood Island, Galapagos Islands, February 4, 1928.

Chiton (Chiton) goodallii Broderip.

Six specimens, Wafer Bay, Cocos Island, Pacific Ocean, March 5, 1926. Seven very large specimens, Wafer Bay, Cocos Island, February 4, 1928.

Chiton (Radsia) sulcatus Wood.

One very large specimen, on the rocks, Gardner Bay, Hood Island, Galapagos Islands, February 4, 1928.

LABRADOR-NEW ENGLAND MOLLUSCAN FAUNA.

Illex illecebrosus illecebrosus (Leseuer).

One specimen, taken in 200 fms., 9 miles S. W. of Port Basque, Newfoundland, September 1, 1926. One specimen, Halifax, Nova Scotia, August 3, 1923.

MEDITERRANEAN MOLLUSCAN FAUNA.

Onychoteuthis banksii Leach.

One specimen about six inches long, taken in storm, washed up on the upper deck of the yacht "Ara" between Madeira and Casa Blanca, Morocco, August 4, 1924.

Sepiola rondeletii (Gesner).

One, dredged in 100 fms., 9 miles E. by S. $\frac{1}{2}$ S. off Cape Bon Tunis, North Africa, July 19, 1927.

Rossia macrosoma (Delle Chiaje).

One, dredged in 100 fms., 9 miles E. by S. $\frac{1}{2}$ S. off Cape Bon Tunis, North Africa, July 19, 1927.

Loligo vulgaris Lamarck.

Two specimens, dredged in 11 fms., Casa Blanca, Morocco, August 20, 1924.

Octopus (Octopus) vulgaris Lamarck.

One large specimen, taken in Monaco Harbor, Mediterranean Sea.

Scaevurgus uniccrrhus (Delle Chiaje) D'Orbigny.

One taken in 100 fms., 9 miles E. by S. $\frac{1}{2}$ S. off Cape Bon Tunis, North Africa, July 19, 1927.

Eledone moschatus (Lamarck).

One, from rock crevices, Monaco Harbor, Mediterranean Sea, 1927.

Cymbulia peronii Blainville.

Four specimens, pelagic, in the Mediterranean Sea, 10 miles S. by E. of Monaco Harbor, April 19, 1927, 900 fms. Two, from 400 fms., St. Raphael, bearing S. S. E., 9 miles S. of France, March 27, 1927.

Tethys depilans (Linné).

One large specimen, Palermo, Italy, September 2, 1924.

Tethys fimbria (Bohascht).

One very fine specimen, Monaco, Mediterranean Sea, May 14, 1927.

Carinaria mediterranea (Peron and Leseuer).

One, taken in dip-net, Monaco, Mediterranean Sea, May 2, 1927. Another slightly smaller specimen, from the same locality, May 14, 1927.

Firola coronata Forskal.

One, dredged in 400 fms., St. Raphael, bearing S. S. E. distance 9 miles S. of France, March 23, 1927.

MEDUSA.

"I looked down into the current
And saw Medusa pass,
A delicate tinted creature,
Like languidly pulsing glass;
An exquisite filmy nothing
That has no meaning for me,
And yet she is holding the heart
Of the sea.

Why are the oceans stirring,
What makes their waters run
Cold from the inshore icebergs,
Warm from the offshore sun,
Green where the banks lie sleeping,
Blue in the deeps outside;—
All are Medusa's servants,
Hers to ride.

So in the sea of letters
Some artfully shaded word
Is drifted down the ages
Sure as a homing bird,
Unreal and without substance,
Yet meaning more to you
Than all of the hard statistics
That are true."

—J. T. NICHOLS.

COELENTERATA: SYSTEMATIC DISCUSSION.

HYDROCORALLINAE.

Family: MILLEPORIDAE.

Genus: MILLEPORA Linné.

Millepora alcicornis Linné.

NAME: Sea-Ginger.

TYPE: Linné states: "*Habitat in O. India utriusque.*"

DISTRIBUTION: Shallow water to ten fathoms; found from Florida to northern Brazil.

MATERIAL EXAMINED: Several specimens collected on the south coast of Cuba, February 19, 1923.

REMARKS: This is one of the most important and abundant of the reef-building animals of the West Indies. In life it is usually dark russet-brown, but occasionally it is orange-brown or umber-brown. When young it often encrusts shells, corals or gorgonians; when well grown it forms large clusters of finger-like fronds, the groups often being four to six feet across and one to two feet high. The shape of the fronds varies greatly. When young it forms encrustations on dead corals, shells and sea-fans, and on these latter as they shrink or swell the millepore breaks into bead-like forms. The zoöids are armed with unusually powerful stinging cells which cause it to be called "Sea-ginger." Several distinct subspecies have been described from West Indian waters. In 1858 Louis Agassiz first established the hydroid nature of the zoöids of this millepore.

REFERENCES: *Millepora alcicornis* LINNÉ, Syst. Nat. ed. 10, p. 791, 1758; ed. 12, p. 1282, 1767.—DANA, Zoöph. U. S. Explor. Exped., vol. VII, p. 543, 1846.—H. MILNE EDWARDS and HAIME, Hist. Nat. Corall., vol. III, p. 228, 1860.—POURTALES, Mem. Mus. Comp. Zoöl., vol. VII, pl. XX, figs. 1-6, 1880.—HICKSON, Proc. Zoöl. Soc. London, for 1898, p. 256.—VAUGHAN, Bull. U. S. Fish. Comm. XX, part 2, p. 318, 1901.—VERRILL, A. E., Trans. Conn. Acad. Arts and Sci., vol. XI, p. 182, 1903; *ibid*, XII, p. 37, 1904-07.

ANTHOMEDUSAE.

Family: OCEANIDAE Vanhoffen, s. s.

Genus: STOMOTICA L. Agassiz.

Stomotica divisa Maas.

TYPE: Maas' type was taken by the "*Albatross*" at Station 3383, in the Bay of Panama; depository not given.

DISTRIBUTION: A deep-sea species known from the tropical American Pacific.

MATERIAL EXAMINED: One specimen, dredged in 300 fms., 50 miles S. W. of Cape Mala, Panama, March 16, 1926, by the "Ara."

COLOR: This species, which is very closely related to the West Indian *Stomotica pterophylla* Haeckel, and possibly identical with it, is milky white, with the gonads rose-pink, the manubrium and tentacles canary yellow.

LIFE HISTORY: Unknown. The members of this genus are known to develop through Tubularian hydroids.

TECHNICAL DESCRIPTION: Consult Maas (1897), p. 11, pl. I, figs. 1-7, color plate and Bigelow (1909), p. 203.

The single specimen taken by the "Ara" has an axial diameter of 12 mm. It is somewhat broken, but corresponds in all essentials with the above cited descriptions of this species.

REFERENCES: *Stomotica divisa* MAAS, Mem. Mus. Comp. Zoöl., vol. 23, p. 11, pl. 1, figs. 1-9, 1897.—BIGELOW, H. B., Mem. Mus. Comp. Zoöl., vol. 37, p. 203, pl. 7, fig. 9, pl. 43, figs. 6, 7, 1909.—MAYER, Medusae of World, Publ. 109, Carnegie Inst. of Washington, vol. I, p. 114, fig. 61, 1910.

Order: LEPTOMEDUSAE.

Family: AEQUORIDAE.

Genus: **ZYGODACTYLA** Brandt, s. s. Agassiz.

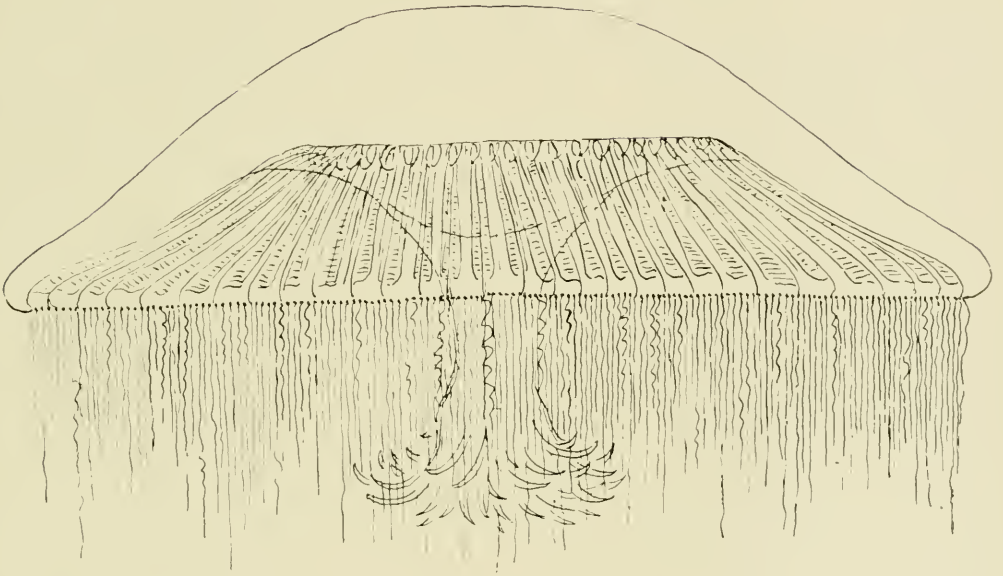
Zygodactyla groenlandica (Peron and Lesueur).

Plate 1.

TYPE: Peron and Lesueur recorded the species from "the seas of Greenland." Louis Agassiz in his "tabular classification of the hydroids" gives in addition to Greenland, the coasts of Maine, Bay of Fundy and Massachusetts Bay. Neither author cites a depository of his material.

DISTRIBUTION: The northern form of this species is larger than the southern and ranges from the coast of Greenland to Cape Cod, Mass., while the southern form is found in abundant swarms pelagic from the southern shores of Long Island to Beaufort, N. C.

MATERIAL EXAMINED: One large specimen about 21 inches in diameter, collected at Eastport, Maine, by the "Eagle."



Zygodactyla groenlandica (Peron and Lesueur), about one-third natural size.

COLOR: Louis Agassiz records that this medusa is highly phosphorescent at night and that the phosphorescence takes place in the substance of the nervous cord. The northern form varies in color from nearly colorless specimens to some that are exquisite transparent violet fringed around the margin with fine tentacles of a darker violet. The southern form is decidedly pinkish.

LIFE HISTORY: The young of this species were first described by Agassiz (1865). Mayer (1910) also described the young.

TECHNICAL DESCRIPTION: Adult: Northern form. Disk, axial diameter 10 to 15 inches; aboral surface flat or slightly concave in the middle region; gelatinous substance hyaline, rigid, about three-quarters of an inch thick in the middle of umbrella, abruptly quite thin near the margin; velum rudimentary. Eighty to one hundred chymiferous tubes present, with three to four very long, retractile tentacles with hollow bulb-like ends between each two chymiferous tubes. The excretion papillæ are near the bases of the tentacles and some occur between them. There are eight to ten very minute lithocysts, each containing two spherical concretions, situated between each successive pair of tentacles. There is also a single row of six to fifteen solid, rounded papillæ on the subumbrella, between each successive pair of radial canals. The stomach is sac-like, broad proximally, tapering to an elongated, cylindrical throat-tube, margined by long oral tentacles which equal or slightly exceed in number the radial canals.

REFERENCES: *Medusa aequorea* FABRICIUS, Fauna Gronlandica, no. 357, 1780.

Medusa globularis MODEER, Nova Acta Phys. Med. Bd. 8, p. 33, 1791.

Aequorea gronlandica PERON and LESUEUR, Ann. Mus. Hist. Nat. Paris, tome 14, p. 339, 1809.—LESSON, Zoöph. Acal., p. 313, 1843.

Aequorea globularis MORCH, Beskriv. af Groenland., p. 96, 1857.

Rhacostoma atlanticum AGASSIZ, L., Proc. Boston Soc. Nat. Hist., vol. III, p. 342, 1850.

Polycanna groenlandica HAECKEL, Syst. der Medusen, p. 232, 1879.—WHITEAVES, Cat. Marine Invert. Eastern Canada, Publ. of Geol. Survey Canada, p. 22, 1901.

Zygodactyla groenlandica AGASSIZ, L., Contrib. Nat. Hist. U. S., vol. 4, p. 360, 1862.—AGASSIZ, A., N. American Acalephæ, p. 103, figs. 153-155, 1865.—VERRILL, A. E., Rept. U. S. Comm. Fish and Fisheries, 1871-72, p. 729, pl. 37, fig. 275, 187.—FEWKES, Bull. Mus.

Comp. Zoöl., vol. 8, p. 156, pl. 5, figs. 5, 6, 11, 12, 1881; Mem. Mus. Comp. Zoöl., vol. 9, pl. 5, figs. 7, 19, 1884.—HARGITT, Bull. U. S. Bur. Fish., vol. 24, p. 25, 1904.—MAYER, A. G., *Medusae of The World*, vol. II, p. 335, pl. 44, figs. 1-4, color plate, 1910; Publ. 109, Carnegie Inst. of Washington.

HYDROIDA.

Family: PLUMULARIIDAE.

Genus: CLADOCARPUS Allman.

Cladocarpus sigma (Allman).

Plate 2.

TYPE: Allman's type came from Florida and is deposited in the Museum of Comparative Zoölogy.

DISTRIBUTION: Florida and the upper West Indian region. Bathymetric occurrence: 110 to 352 fms.

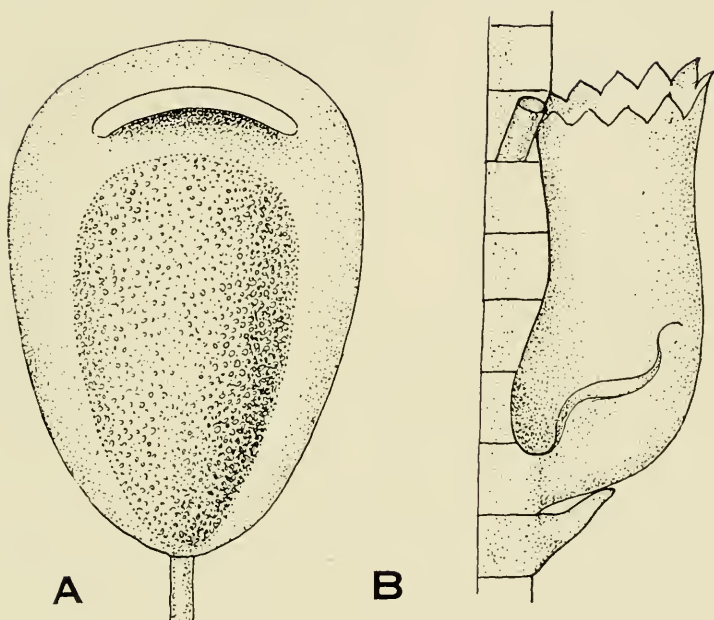
MATERIAL EXAMINED: Two small colonies taken in 150 fms., 7 miles S. W. off Alligator Reef, Florida, March 31, 1926.

COLOR: Crystalline, transparent.

TECHNICAL DESCRIPTION: According to Nutting this species attains a height of two to two and one-half feet, branching profusely and repeatedly. The "*Ara*" specimens are broken branches 80 mm. and 87 mm. high, respectively.

TROPHOSOME: Colony pinnate, stem fascicled except at the extreme tips of the branches; hydrocladia alternate, closely set, originating from the front side of stem; internodes straight, each having its axial cavity divided by about ten very strong and conspicuous septal ridges, which appear to extend entirely around the internal surface of the internode. Hydrothecae rather closely approximated for this group, deep, cylindrical, with the margins cut into about ten shallow teeth, sharp pointed with shallow arcs between; margin slightly flaring; intrathecal ridge conspicuous with a sigmoid flexure in lateral view its course being curved forward then upward then forward, downward and forward again; the supracalycine nematophores are cylindrical, reaching the margin of the hydrotheca; the mesial nematophores are small, spur-like, adnate except at the distal end; the cauline nematophores afford no specific characters.

GONOSOME: Gonangia are present on one of the specimens; they are borne on phylactogonia, springing from the proximal internode of



Cladocarpus sigma (Allman), A, Gonosome $\times 40$. B, Hydrotheca $\times 80$.



Stylaster roseus (Pallas), about one-third natural size.

the hydrocladia and are subovoid, much broader at the distal end than toward the proximal end, as shown in the figure; each has a lunate, lateroterminal aperture. Not all of the gonangia are identical in shape; some appear in profile somewhat like a bird's head, the convex distal end beyond the aperture being abruptly narrowed; these usually are the less fully developed gonangia, toward the tip of the phylactogonia. Each phylactogonium bears three to four gonangia and several protective nematophorous branchlets, one each arising at the base of each gonangium.

REFERENCES: *Aglaophenia sigma* ALLMAN, Mem. Mus. Comp. Zoöl., vol. V, no. 2, p. 45, pl. 26, 1877.

Cladocarpus sigma NUTTING, Smiths. Special Bull., part I, p. 111, pl. 26, figs. 1-2, 1900.

Order: **STYLASTERINA.**

Family: **STYLASTERIDAE.**

Genus: **STYLASTER** Gray.

Stylaster roseus (Pallas).

Plate 3.

TYPE: Pallas' type material came from the seas about St. Domingo, and was probably deposited in the Leyden or Belgium museum.

DISTRIBUTION: This is a deep water species, restricted to the West Indian region. Bathymetric occurrence: shallow water to 340 fms., but found mostly from 50 to 340 fms.

MATERIAL EXAMINED: Several very beautiful branches, some 7 to 10 inches high, dredged in 150 fms., 7 miles S. W. off Alligator Reef, Florida, March 30, 1926, by the "*Ara*."

COLOR: The branches vary from ivory in the older basal portions of the branches to deep rose toward the more fragile outer branches.

TECHNICAL DESCRIPTION: Corallum flabelliform, nonanastomosing, principal branches large, compressed cylindrical rapidly dividing and subdividing into smaller branches and branchlets, the distal branches very delicate, elegantly graceful. In cross section the proximal branches are broad, oval or subcircular, firm and hard. The cyclostems are on the lateral sides of the branches, a few are found on the surfaces also. The majority are turned towards one surface; they are slightly elevated; 0.7 to 1.2 mm. transverse diameter. The septa are delicate, usually 12, sometimes 10 to 14 distinct septa present; columella minute.

REFERENCES: *Madrepora rosea* PALLAS, Elench. Zoöph., etc., p. 312, 1766.

Stylaster roseus H. MILNE EDWARDS and HAIME, Hist. Nat. Corall. t. II, p. 130, 1857 (with early synonymy).—POURTALES, as footnote, Bull. Mus. Comp. Zoöl., vol. I, art. 7, p. 136, 1868.—VERRILL, *ibid*, vol. I, art. 3, p. 45.—HICKSON and ENGLAND, *Stylasterina* Siboga Exped., vol. VIII, p. 8, 1905.

Stylaster sanguineus VALENTIN, Mem. Mus. Comp. Zoöl., vol. II, p. 83, 1871.

Family: **OLINDIAIDAE.**

Genus: **OLINDIAS** F. Muller

Olindias tenuis (Fewkes).

Plate 4.

TYPE: Collected at Key West, Florida, 1878, by Alexander Agassiz; deposited in the Museum of Comparative Zoölogy, Cambridge, Mass.

DISTRIBUTION: Found abundantly on the muddy flats of the Florida coast, Bahamas and Bermudas. An abundant species in summer. Mayer (1910) suggests that *tenuis* may be only a small northern variety of *O. sambaquiensis*, which occurs abundantly along the Brazilian coast.

MATERIAL EXAMINED: One specimen, collected at Turtle Harbor, Florida, November 28, 1923, by the "*Ara*."

COLOR: Bell delicate translucent greenish yellow. Ectoderm of manubrium, gonads and tentacle bulbs is an opaque yellow green with the innermost parts purple-red. On the manubrium near the base of the origin of the four radial canals there are four interradiial purple red spots. The nematocyst warts on the short exumbrella tentacles are either white or deep purple, while the half-rings on the long flexible marginal tentacles are red and yellow. (Mayer.)

LIFE HISTORY: Mayer (1910) describes several growth stages of this species.

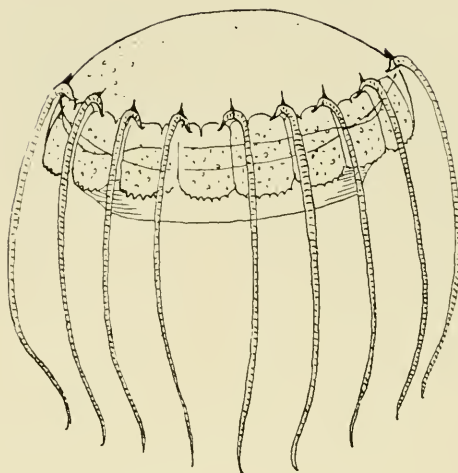
TECHNICAL DESCRIPTION: Consult Bigelow, Mem. Mus. Comp. Zoöl., vol. 37, p. 109, 1909, and Mayer, Medusae of the World, vol. II, p. 354, pl. 47, figs. 8-10, pl. 48, figs. 1-7, 1910.

The "*Ara*" specimen is 25 mm. diameter and has 34 primary tentacles; 52 secondary tentacles.

The bell is hemispherical, the gelatinous substance quite firm; the velar, short tentacles each arising from the bell in a line a little above



Olindias tenuis (Fewkes), $\times 2$.



Solmissus albescens (Gegenbaur), $\times 1.5$.

the margin. The tentacles of this series are furnished with wart-like clusters of nematocysts, and near the distal end, on the aboral side, there is an elongate, pad-like cluster of nematocyst cells, having a sucker-like appearance and serving as a strong adhesive organ, enabling the medusa to fasten itself to stones, etc. The exumbrella tentacles are 34 in number and arise from the bell margin; are about four times as long as the bell diameter, frequently retracted into corkscrew like curls and having a very powerful longitudinal muscle stripe on the inner side while the outer side is regularly banded by transverse half-rings of nematocysts. The tentacles terminate in a knob-like cluster of nematocysts and on their inner side there is a pad-like cluster of large cells which may serve as a weak adhesive organ. The exumbrella margin between the tentacles is in the form of small, rounded papillae. Above the ring-canal, on its inner side, are a series of lithocysts, a pair between the base of each velar tentacle; making a total of from 64 to 108 lithocysts. There is a spherical concretion in each lithocyst. There are four straight radial canals and twenty-eight to forty branches which extend inward from the ring canal and end blindly in the bell. The four gonads are papilliform, laterally reflected and develop on the outer halves of the radial canals. The manubrium is tubular, elongate reaching about three-fourths of the depth of the bell, and is cruciform in cross-section and has four out-curved lips.

REFERENCES: *Halicalyx tenuis* FEWKES, Bull. Mus. Comp. Zoöl., vol. 9, p. 277, pl. 7, fig. 15, 1882.—MAYER, Bull. Mus. Comp. Zoöl., vol. 37, p. 63, pls. 5, 6, figs. 12, 13, 1900.—Goto, Mark Anniversary Volume, p. 15, 1903.

Olindias tenuis BROWNE, Fauna and Geol. Maldivé Archipelagoes, vol. 2, p. 737, 1904.—MAYER, Mem. Nat. Sci. Brooklyn Inst. Mus., vol. 1, p. 23, pls. 5, 6, figs. 50-59, 1904; Medusae of the World, Publ. 109, Carnegie Inst. Wash., vol. II, p. 354, 1910.—BIGELOW, H. B., Mem. Mus. Comp. Zoöl., vol. 37, p. 109, 1909.

Order: **NARCOMEDUSAE.**

Family: **AEGINIDAE** *sens. ampl.*

Genus: **SOLMISSUS** Haeckel.

Solmissus albescens (Gegenbaur).

Plate 5.

TYPE: Collected in the Mediterranean Sea; depository not stated.

DISTRIBUTION: An abundant species in the Mediterranean Sea.

MATERIAL EXAMINED: One specimen, measuring 26 mm. bell diameter, collected 10 miles S. by E. of Monaco Harbor, Mediterranean Sea, April 19, 1923.

COLOR: The bell is transparent, colorless, except that the tentacles and gonads are milky; the concretions are garnet-red.

TECHNICAL DESCRIPTION: A small species, with bell diameter of 20 to 30 mm. The bell is flat, lenticular, with the central region a biconvex lens, thick in the center, while the bell collar is thin, flexible, contractile; over the collar region the exumbrella is beset with numerous prickle-like tubercles and flat, discoidal, wart-like nematocysts. There are 12 to 14 marginal lappets, with the same number of tentacles alternating the lappets. Each lappet is subrectangular, about one and one-half times as long as wide, the free margin a little rounded at the corners; there are five to eight sensory clubs on the margin of each lappet; each club is short, distally dilated, with a cup-like concavity within its outer end and filled with a vesicle containing a spherical concretion. There are sensory filaments on the outer half of the club. The velum is broad, with strong circular muscles. The tentacles are each nearly as long as the bell diameter, tapered distally and rather stiff, usually bending only near the base. The central stomach is large with a usually gaping circular aperture; the marginal stomach pouches are wide pentagonal, their outer angles extending under the base of the tentacles. There is no marginal canal system present. The gonads are situated over the subumbrella ectoderm of the stomach and its pouches and are somewhat milky in color.

REFERENCES: *Cunina albescens* GEGENBAUR, Zeit. fur. Wissen. Zoöl. Bd. 8, p. 260, taf. 10, figs. 3, 4, 1856.

Cunina moneta LEUCKART, Archiv. f. Naturgesch. Jahrg., vol. 22, p. 36, taf. 1, fig. 13; taf. 2, fig. 12, 1856.

Cunina solmaris HERTWIG, O. & R., Nerven. Syst. Sinnesorgane der Medusen, pp. 19, 34, taf. 1, figs. 7-10; taf. 10, fig. 6, 1879.

Solmissus albescens HAECKEL, Syst. der Medusen, p. 350, 1879.—BIGELOW, H. B., Mem. Mus. Comp. Zoöl., vol. 37, p. 63, 1909.—MAYER, Medusae of the World, Publ. 109, Carnegie Inst. Washington, vol. II, p. 482, figs. 326, 327, 1910.

Polyxenina albescens METSCHNIKOFF, Embryol. Studien an Medusen, Wien, pp. 23, 65, 1886.

Order: **CALYCOPHORAE.**

Family: **PRAYIDAE.**

Subfamily: **Prayinae.**

Genus: **NECTRODROMA** H. B. Bigelow.

Nectrodroma reticulata Bigelow.

TYPE: Collected by the "*Albatross*," station 4681, 300 fms., down, two nectophores and three bracts; deposited in the U. S. National Museum or Museum of Comparative Zoölogy.

DISTRIBUTION: Known only from three small catches in the tropical American Pacific, in the vicinity of the Galapagos Islands, Cocos Island, and Cape Mala, Panama.

MATERIAL EXAMINED: One unusually fine colony and two not quite perfect nectophores of this rare animal were caught 300 fms., down, in the Pacific Ocean, 50 miles S. W. off Cape Mala, Panama, March 16, 1926, by the "*Ara*."

COLOR: Transparent, colorless, except for the yellow oil globule in the oleocyst.

LIFE HISTORY: Not known.

TECHNICAL DESCRIPTION: The "*Ara*" specimens conform in all essentials with Dr. Bigelow's excellent description and figures of the species.

REFERENCES: *Nectodroma reticulata* H. B. BIGELOW, Mem. Mus. Comp. Zoöl., vol. 38, p. 206, pl. 1, figs. 7, 8, pl. 3, figs. 1-7, 1911.

Family: **DIPHYIDAE.**

Subfamily: **Abilinae** L. Agassiz.

Genus: **ABYLOPSIS** Chun.

Abylopsis eschscholtzii (Huxley).

TYPE: Huxley's type material was collected in all the seas traversed by H. M. S. "*Rattlesnake*," during the survey of the intricate passage within the Barrier Reef, which skirts the eastern shores of Australia and exploring the sea which lies between the northern end of this reef and New Guinea and the Louisiade Archipelago. Depository, British Museum.

DISTRIBUTION: Widely distributed over the tropic Pacific and Malaysian regions. Deep-sea.

MATERIAL EXAMINED: Several bracts were taken in the dredge down 300 fms., Pacific Ocean, 50 miles S. W. of Cape Mala, Panama, March 16, 1926, by the "*Ara*."

COLOR: Transparent, colorless, with a touch of yellow due to oil in the oleocyst.

LIFE HISTORY: Imperfectly known.

TECHNICAL DESCRIPTION: Consult Huxley, T. H., (1859), and Bigelow, H. B. (1911).

REFERENCES: *Aglaismoides eschscholtzii* HUXLEY, T. H., The Oceanic Hydrozoa, p. 60, pl. 4, fig. 2, 1859, London.

Abylopsis eschscholtzii BIGELOW, H. B., Mem. Mus. Comp. Zoöl., vol. 38, p. 226, pl. 14, figs. 1-5, pl. 15, fig. 1, 1911.

***Abylopsis tetragona* (Otto).**

TYPE: Otto's type came from the Mediterranean and is deposited in the Museum at Breslau.

DISTRIBUTION: Widely distributed in the Mediterranean, the tropical Atlantic, the West Indian region, the eastern and western tropical Pacific, the Malaysian region and the Indian Ocean. Bathypelagic.

MATERIAL EXAMINED: The Eudoxid stage of this species was taken in very good condition in the dredge down 400 fms., bottom depth 500 fms., off St. Raphael, bearing S. S. E., distance 9 miles S. of France, Mediterranean Sea, March 23, 1927, by the "Ara."

TECHNICAL DESCRIPTION: There are several excellent well illustrated descriptions of this species. It is more similar to *A. eschscholtzii* than any other members of the genus, but is readily distinguished therefrom by its very large size, its relatively much longer nectophore which is between four and five times as long as the anterior nectophore. The asymmetry of the nectophore in *tetragona* is very marked. The hydroecium is likewise diagnostic, the right wing being only slightly serrate on its transverse basal margin; the left wing being toothed throughout its length. The canals of the nectosarc are peculiarly arranged in *tetragona*, while in *eschscholtzii* they have the usual radial distribution.

The free Eudoxid stage of this species has likewise been well described. The outstanding diagnostic feature of this stage is that its dorsal facet is subrectangular in *tetragona*, but is regularly pentagonal in *eschscholtzii*; the ventral facet is straight in *tetragona*, deeply convex in *eschscholtzii*; the basolateral facets also differ in their proportions.

REFERENCES: *Pyramis tetragona* OTTO, p. 306, taf. 42, figs. 2a-2c, 1883.
Abylopsis tetragona H. B. BIGELOW, Mem. Mus. Comp. Zoöl., vol. 38, p. 224, pl. 14, figs. 6, 7, pl. 15, fig. 2, 1909-1911.

Family: **PHYSALIIDAE.**

Genus: **PHYSALIA** Bosc.

Physalia physalis (Linné) Schneider.

TYPE: Collected from the coasts of Santa Catharina, Brazil; depository not stated. Possibly St. Petersburg, Russia?

DISTRIBUTION: Pelagic in the West Indian region and Gulf Stream and the tropical Atlantic Ocean as far as the Azores and Canary Islands.

MATERIAL EXAMINED: Two specimens, pelagic at Sombrero Light, Florida, March 4, 1923 (coll. no. 140), collected by the "*Ara*."

COLOR: The float is pearly with a bright bluish tint, varying to rose color; the crest is margined with decided rose color and streaked below with rose. The appendages are opaque milky white with a bluish tinge.

DISCUSSION: *Physalia physalis* is the largest, best known, and most remarkable of the American siphonophora. The air-sac is pear-shaped with a conspicuous crenulated crest on the upper margin, which acts as a sort of sail. Pendant below the air-sac are three types of hydrae; the large, locomotive hydrae which arise from a hollow stem that communicates with the cavity between the inner and outer wall of the air-sac; outwardly the stem divides into three or four bunches of large hydrae which are placed on the windward side of the air-sac. Similar but definitely smaller clusters of hydrae occur on the lee-side. When the animal is storm driven, these larger tentacles can stretch forty to fifty feet in an effort to maintain the animal's safety. The feeding hydrae are scattered along the lee-side of the bag, and are of two kinds, large and small, clustered in bunches, each bunch arising from a common stem that communicates with the chymiferous cavity of the air-sac. The food is digested within these hydrae which have no tentacles. The third types of hydrae are very small, forming large clusters which are suspended among the feeding hydrae. The medusae buds, which arise singly either from the base of these hydrae or adjacent stems, are male or female, very similar to those of *Tubularia*.

REFERENCES: *Holothuria physalis* LINNÉ, Syst. Nat., p. 657, ed. X, 1758.

Physalia physalis SCHNEIDER, Zoöl. Anz., vol. 21, p. 190, 1898.—H. B. BIGELOW, Mem. Mus. Comp. Zoöl., vol. 38, p. 352, 1908-09 (with synonymy from Linné to date).

Family: VELELLIDAE.

Genus: **VELELLA** Lamarek.*Verella velella* (Linné).

TYPE: Linné's type came from the Mediterranean Sea; present depository unknown.

DISTRIBUTION: In American waters known from the West Indian region and in the Gulf Stream as far north occasionally as Nantucket, Rhode Island; in the tropic Atlantic eastward to the Azores; also in the Mediterranean Sea.

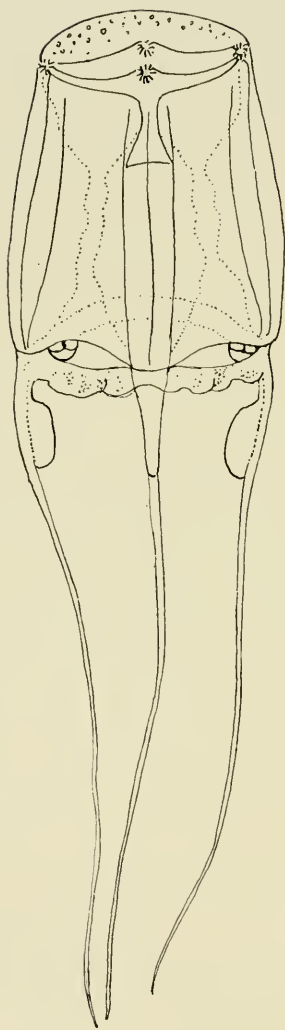
MATERIAL EXAMINED: Two specimens, 10 miles S. by E. of Monaco Harbor, April 19, 1927. One specimen, taken $4\frac{1}{2}$ miles off Monaco, March 20, 1927.

COLOR: See Prof. Agassiz's color plate, made from Florida specimens, Mem. Mus. Comp. Zoöl., vol. VIII, pl. 1, 1881-83.

The mantle is a metallic bluish green with a deep cobalt blue margin surrounding the float and a similar band forming nearly an ellipse across the float. Between these bands of color the float passes from yellowish green to the dark blue marginal bands. The entire mantle is dotted with patches of brownish liver cells. The extreme outer margin of the mantle is fringed with a light cobalt blue band, through which the lower side of the tentacles of the float show. The mantle where it covers the central part of the float is light greenish blue with metallic lustre and with few liver cells, diminishing in abundance toward the base of the keel. The greenish color forms concentric lines parallel with the chambers of the float, crossed by triangular radiating rays extending from the fixed mantle margin towards the base of the keel, dividing the float into irregular alternating sections of light colored spaces. The keel is delicate steel color, with a thickened margin of the mantle extending around it; there are dark violet patches of liver cells in the mantle margin.

LIFE HISTORY: Extensive critical work has been done upon this species (see bibliography). In 1859 T. H. Huxley reported the larval forms.

TECHNICAL DESCRIPTION: Consult Agassiz, Mem. Mus. Comp. Zoöl., vol. 8, for description of the West Indian form, and Krohn, Archiv. f. Naturg., 1848, I, p. 30, for that of the Mediterranean form. Agassiz reviews the research done on the younger stages of *Verella velella* by Kolliker, Gegenbaur, Vogt, Huxley, Stuart and other workers.



Tanoyia haplonema F. Muller, young specimen, $\times 1.5$.

REFERENCES: *Medusa velella* LINNÉ, Syst. Nat. ed. X, p. 660, 1758.
Velella velella H. B. BIGELOW, Mem. Mus. Comp. Zoöl., vol. 38, p. 353,
1909-1911, (with very complete synonymy).

SCYPHOMEDUSAE.

Order: **CHARYBDEIDA.**

Family: **CHARYBDEIDAE** Gegenbaur.

Genus: **TAMOYA** F. Muller.

Tamoya haplonema F. Muller.

Plate 6.

TYPE: Muller's type came from Desterro, Santa Catharina, coast of Brazil. The depository is not cited.

DISTRIBUTION: This species is essentially of the West Indian region, having been recorded from the northern coasts of Brazil, at many places in the West Indies; the coasts of Florida; at Beaufort, N. C., and in the autumn from Long Island Sound, New York, at Branford Harbor and Great Peconic Bay. Mayer notes that none of the Long Island Sound specimens were obtained at the surface, all being taken in dredges in depths of a fathom or more. In southern waters the species is very frequently found at the surface.

MATERIAL EXAMINED: One young specimen, Bahamas, field tag 128. One young specimen, Matanzas, Cuba, February 28, 1928. One young specimen, Bimini, B. W. I., January 19, 1923, field tag 13. Nine young specimens, Hawk's Nest, Cat Island, Bahamas, with marine light and dipnet, January 15, 1928.

COLOR: The gelatinous substance of the bell is tough but transparent milky white; the wart-like nematocysts on the pedalia and velarium are also milky white. The long tentacles are milky amber, frequently with a delicate violaceous hue. The genital organs are milky amber; the ocelli dark wood brown.

LIFE HISTORY: Apparently not studied.

TECHNICAL DESCRIPTION: Umbrella 85 to 110 mm. high, 50 to 60 mm. wide, shaped not unlike a four-sided tumbler, with the sides vertical, the top or aboral surface nearly flat; the aboral surface is thickly set with wart-like clusters of milky white nematocysts. There are four pedal lobes, each about 25 to 30 mm. long, flat, spatula shape, with thin edges. The four tentacles are each 85 to 95 mm. long, hollow, very flexible, and having regularly spaced rings of powerful nemato-

eysts. The rhopalia have two large median and four small lateral eyes, all placed on the inner side of the bulb. The large eyes have well developed, convex lenses. The velarium is thick, well developed, each quadrant having ten dendritic velar canals which terminate in many fine, non-anastomosing branches. The nerve extending from the base of each pedalum to the rhopalium is a well delineated white thread. The stomach is cruciform with four slightly recurved lips and extends approximately a third of the distance from the apex to the velarium. There are numerous short, gastric cirri. The genital organs are eight in number, attached to the four interradial septa, and extending like ribbon-like ruffles with frilled edges into the perradial gastrovascular pouches of the bell.

REFERENCES: *Tamoya haplonema* MULLER, Abhand. Naturf. Ges. Halle, Bd. 5, p. 1, taf. 1, 2, 1859.—AGASSIZ, L., Contrib. Nat. Hist. U. S., vol. IV, p. 174, 1862.—HAECKEL, Syst. der Medusen, p. 443, 1880.—BROOKS, Studies Johns Hopkins Univ. Labr., vol. II, p. 138, 1882.—VON LENDENFELD, Proc. Linn. Soc. New South Wales, vol. 9, p. 245, 1884.—MAYER, Mem. Nat. Sci. Museum Brooklyn Inst. Arts and Sci., vol. I, p. 28, pl. 7, figs. 60-64, 1904; Medusae of the World, Publ. 109, Carnegie Inst. Washington, vol. III, p. 513, pl. 57, figs. 2 to 2'', color plate, 1910.—BOONE, L., Bull. Bingham Oceanog. Coll. vol. I, no. 5, p. 1, 1928.

Tamoya prismatica HAECKEL, *ibid*, p. 443.

Carybdea (Tamoya) haplonema FEWKES, Rept. U. S. Comm. Fish. for 1886, p. 526, issued 1889.

Order: CORONATAE.

Family: PERIPHYLLIDAE.

Genus: PERIPHYLLA Steenstrup.

Periphylla hyacinthina (Steenstrup).

TYPE: Steenstrup's type was taken in 300 fms., at Cape Farewell, Greenland, and is deposited in the Copenhagen Museum.

DISTRIBUTION: This exquisite medusa is widely distributed over the floor of the great oceans, and especially in the tropical parts of the Pacific, the west coast of Mexico, coast of Chile, the Hawaiian Islands, Philippines, Indian Ocean, Malaysia; Mediterranean Sea, and Guinea Stream in the Atlantic Ocean off West Africa.

MATERIAL EXAMINED: One specimen, dredged in 300 fms., bottom depth 1400 fms., 50 miles S. W. of Cape Mala, Panama, by the "*Ara*," March 16, 1926.

COLOR: In life this jellyfish has the exoderm of the umbrella milky white, the endodermal part of the umbrella a rich red; the pedalia are reddish brown; the tentacles are an opaque milky blue.

REFERENCES: *Periphylla hyacinthina* STEENSTRUP, Acta et Catal. Musei Hafniensis, 1837, (not available for examination).—HAECKEL, System der Medus., p. 419, taf. 24, 1880.—VANHOFFEN, Deutsche Tiefsee Exped. Valdivia, 1898-99, Bd. 3, p. 29, pl. II, fig. 9, 1903, (excellent color plate).—BIGELOW, H. B., Mem. Mus. Comp. Zööl., vol. 37, p. 26, pl. 1, fig. 3, pl. 9, fig. 2, (color plate) 1909. (With full synonymy, including that of the variety *dodecabostrycha*.)—MAYER, Medusae of World, vol. III, p. 544, figs. 342, 343, 1910, (synonymy).

Family: ATOLLIDAE.

Genus: **ATOLLA** Haeckel, s. s. Fewkes.

Atolla wyvillei Haeckel.

For color plate see Bigelow, 1909.

TYPE: Haeckel's type was obtained in the Antarctic Ocean; depositary not stated.

DISTRIBUTION: A deep-sea species known first from stations in the Antarctic and sub-Antarctic, later taken by the "*Albatross*" at several stations in the eastern Pacific, including Hawaii and the coast of California.

MATERIAL EXAMINED: One small specimen, dredge down 300 fms., bottom depth 1400 fms., Pacific Ocean, 50 miles S. W. of Cape Mala, Panama; piece of a large specimen, from the same locality.

COLOR: See Dr. Bigelow's exquisite color plates of this species made from living specimens. (Mem. Mus. Comp. Zööl., vol. 37, pl. 8, pl. 9, fig. 3, 1909.) The center of the bell is deep wine-red with more delicate markings of the same color toward the margin; the lappets and tentacles are delicate amber.

LIFE HISTORY: Unknown.

TECHNICAL DESCRIPTION: Consult Haeckel (1880) for the original description, and Bigelow (1909) for critical discussion of additional knowledge of this species.

The "*Ara*" specimen has an axial diameter of 46 mm., with broad radial furrows and smooth lappets.

REFERENCES: *Atolla wyvillei* HAECKEL, Syst. der Medusen, p. 488, 1880; Rept. Voy. H. M. S. "*Challenger*," Zööl., vol. IV, p. 113,

pl. 29, figs. 1-9, 1881.—ROULE, Res. Sci. Campag. Caudan, t. I, Lyon, p. 302, 1896.—MAAS, Mem. Mus. Comp. Zoöl., vol. 23, p. 79, 1897; Exped. Antarctique Francaise, vol. VII, p. 13, 1908.—VANHOFFEN, Deutsche Tiefsee Exped. Valdivia, Bd. 3, Lfg. 1, p. 13, taf. 5, fig. 22, 1902; Deutsche Sudpolar Exped. Bd. 10, Zoöl., 2, p. 37, 1908.—BROWNE, Trans. Royal Soc. Edinburgh, vol. 46, p. 241, 1908.—BIGELOW, H. B., Mem. Mus. Comp. Zoöl., vol. 37, p. 39, pls. 8-10, 1909.—MAYER, A. G., Medusae of the World, vol. III, p. 566, fig. 359, 1910; Publ. 109, Carnegie Inst. of Washington, (with full synonymy).

Atolla alexandri MAAS, Mem. Mus. Comp. Zoöl., vol. 23, p. 81, taf. 11, fig. 2, taf. 14, figs. 4, 5, 1897.—AGASSIZ, A., and MAYER, A. G., Mem. Mus. Comp. Zoöl., vol. 26, p. 156, 1902.—MAYER, A. G., Bull. U. S. Fish Comm., vol. 23, p. 1138, pl. 2, fig. 7, pl. 3, figs. 10, 11, 1906.

Order: RHIZOSTOMAE.

Rhizostommata Pinnata Vanhoffen.

Genus: **CASSIOPEA** Peron and Lesueur.

Cassiopea xamachana H. B. Bigelow.

Plate 7.

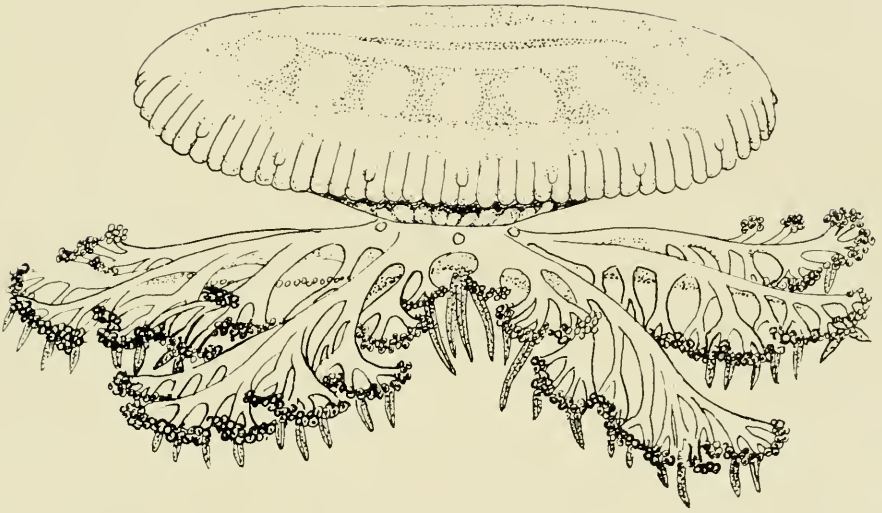
NAME: This specific name is derived from the ancient Indian name for Jamaica.

TYPE: Dr. Bigelow discovered this species in great abundance in a salt water lagoon named Great Salt Pond, near Port Henderson, Kingston Harbor, Jamaica. The type is deposited in the Museum of Comparative Zoölogy.

DISTRIBUTION: Known from the above type locality, Kingston Harbor, Jamaica, and also from the salt water lagoons along the Florida Reefs as far north as Miami.

MATERIAL EXAMINED: One specimen dredged in 6 fms., Dry Tortugas, Florida, November 26, 1923, field no. 315.

COLOR: In life the general color of this jellyfish is greenish gray-blue, the greenish color being due to the presence of clusters of commensal plant cells, algae, *Zoöthanellae*, within the gelatinous substance of the disk near the surface. Around the outer edge of the central concavity of the exumbrella is a wide, dull white circle, edged on its inner margin with delicate gray-brown. A somewhat Y-shaped radial white band extends outward from the broad ring in the radii of the



Cassiopea xamachana H. B. Bigelow, one-half of natural size.

sense organs. There is also a single radial stripe extending outward down the middle of the exumbrella side of each marginal lappet. Prominent spoke-like white stripes extend outward in the radii of the sense organs. The mouths, filaments and vesicles are olive or olive-brown; the vesicles and filaments more frequently being decidedly green. A number of color varieties of this species are known. An especially striking form is the rare one with dull white diamond-shaped markings.

LIFE HISTORY: The early stages of the development of the egg into scyphostoma are not yet studied. The formation of asexual buds by the scyphostoma has been critically studied by Bigelow and also observed by Perkins (1905). A careful résumé of this phase of the development of the species has been presented by Mayer (1910).

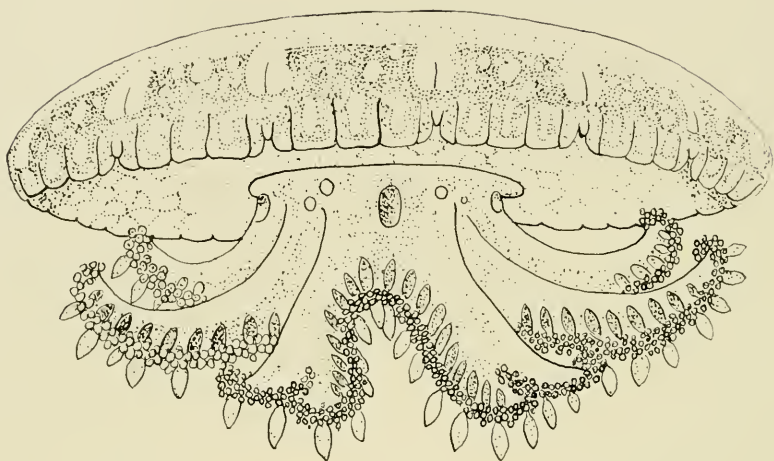
Regeneration in this species has been carefully studied by Stockard (1907) and Zeleny (1907). Histology of the muscles has been discussed by Dahlgren and Kepner (1908).

Studies of the rhythmical pulsation and its causes in the medusa have been reported by Mayer (1906, 1908).

TECHNICAL DESCRIPTION: Mayer states that the disk diameter is usually 150 mm. Bigelow has recorded a specimen from Jamaica with a disk diameter of 240 mm. The disk is flat with rounded edges, the exumbrella with a median concavity the diameter of which is about equal to the disk radius, this concavity forming a sucking disk. The number of rhopalia is regularly 16, but often varies from 17 to 23. This variation is determined at the time of strobilization and is not related to the size of the medusa. The sense organs are short, blunt, clavate, and are set within niches protected above by a shelf-like membrane spanning the cleft between adjacent lappets. No exumbrella pit occurs above the club. Each sense organ contains an ectodermal ocellus with reddish brown pigment. There are five short, blunt, rounded lappets between each successive pair of sense organs; the two lappets adjacent to sense organs are only about half as wide as the others of the series. The mouth-arm disk which projects as a flattish plate from the center of the subumbrella is only about two-thirds as wide as the disk radius. Eight oral arms arise from this disk, each being rounded and slender with ten to fifteen alternate primary branches and numerous smaller ones. The arms project somewhat beyond the margin of the bell. There is a single flat ribbon-like filament in the axil of each primary branch of the oral arms. There are also five to thirteen ribbon-like filaments on the oral surface of

the mouth-arm disk. Besides these filaments there are many short, clavate, nematocyst-bearing vesicles scattered among the mouths. The mouths are located on the oral, principally on the primary and secondary branches of the arms and in less abundance on the oral sides of the eight basal trunks of the arms. In the adult medusa there are no mouths at the center of the mouth-arm disk. Very numerous fine waving tentacles fringe the mouths. There are four small, deep, oval, interradial, subgenital pits, and four separate invaginated genital sacs. The central stomach is cruciform; the four sac-like gonads somewhat encroaching upon it at the interradial sides. The axial ducts of the eight oral arms open into the central stomach at the four principal radii. Also arising from the central stomach are twice as many radial vessels as there are marginal sense organs; every other vessel extends to a sense organ, the remainder going to intermediate parts of the rim. All of these vessels communicate with one another by means of anastomosing branches, but this species lacks a well-defined circular vessel, such as is found in *Cassiopea ornata*.

REFERENCES: *Cassiopea xamachana* H. B. BIGELOW, Zoölog. Anz. Bd. 15, p. 212, 1892; Johns Hopkins Univ. Circ., vol. 11, p. 17, p. 84, 1892; Jrn. Inst. Jamaica, vol. I, p. 301, 1 pl., 1893; Mem. Boston Soc. Nat. Hist., vol. V, no. 6, p. 191, figs. A to L, pls. 31-38, 66 figs., 1900.—PERKINS, Yearbook, Carnegie Inst. Washington, No. 4, p. 118, 1904; Publ. 102, Carnegie Inst. Wash., p. 150, pl. 4, 1908.—MAYER, A. G., Yrbk., Carnegie Inst. Wash., no. 4, p. 117, 1906; Publ., Carnegie Inst. Wash., no. 47, pp. 1-62, 1906 (discusses rhythmical pulsation); Yrbk., Carnegie Inst. Wash., no. 6, p. 121, 1907; *ibid*, no. 7, p. 123, 1908.—MAAS, Scyphomedusen der Siboga Exped., Mon. 11, p. 40, 1903.—STOCKARD, Yrbk., Carnegie Inst. Wash., no. 6, p. 119, 1907 (discusses regeneration); *ibid*, no. 7, p. 130, 1908; Papers Tortugas Labr. Carnegie Inst. Wash., vol. 2, p. 61, figs. 1-29, 1909; Journ. Exper. Zoöl., vol. 6, p. 433, 8 figs., 1909.—ZELENY, C., Jrn. Exper. Zoöl., vol. 5, p. 265, 4 text figs., 1907 (discusses regeneration).—DAHLGREN and KEPNER, Text Book of Principles of Animal Histology, p. 88, fig. 85, 1908 (discusses histology of the muscles).—MAYER, A. G., Papers Tortugas Labr. Carnegie Inst. of Washington, Publ. 102, p. 113, 1908 (discusses cause of rhythmical pulsation); Popular Science Monthly, vol. 73, pp. 481-87, 4 figs., 1908; Rept. Seventh International Zoöl. Congress, 4 pp.—HARVEY, Yrbk., Carnegie Inst. Wash., no. 8, p. 120, 1909.



Cassiopea frondosa (Pallas), about one-half of natural size.

Cassiopea frondosa FEWKES, Bull. Mus. Comp. Zoöl., vol. XI, p. 254, pl. 1, figs. 7-19, pl. 2, figs. 1-2, pl. 3, figs. 1-3, 9, 10, 1882; *ibid.*, vol. 10, p. 80, pl. 1, fig. 16, 1883.

***Cassiopea frondosa* (Pallas).**

Plate 8.

TYPE: Pallas described the species in 1774 from the Caribbean Archipelago. The depository of his type is not given, but probably was the Leyden Museum.

DISTRIBUTION: Found throughout the West Indian region and Florida Reefs. It lives on sandy bottom in sheltered places, in preference to weedy bottom, and prefers purer water than does *C. xamachana*. In Jamaica *frondosa* has been found on the muddy bottom of protected lagoons, especially those surrounded by mangroves near the entrance to Kingston Harbor, Jamaica.

MATERIAL EXAMINED: One specimen taken on the south coast of Cuba, February 19, 1923; field no. 97, lot E.

COLOR: In life this jellyfish is amber-yellow with a greenish tinge, with a series of white spots near the margin. There is a large, bean-shaped white spot above each marginal lappet and above this an irregular line of three to five small white spots between each pair of marginal sense organs. A more or less definite axial white line extends through the length of each mouth-arm. The arrangement and number of the white spots is quite variable. The frilled mouths are cinnamon color.

HABITS: *C. frondosa* lives in fairly pure water in sheltered places where it lies for long periods on the bottom with the oral surface and mouth-arms uppermost, slowly contracting its disk in sluggish rhythm. This serves not only to maintain the disk on the bottom but also to create a water current over the mouth-arms. The habits and physiology of this species have been reported by Dr. Bigelow (1893).

TECHNICAL DESCRIPTION: *C. frondosa* is easily distinguished from *C. xamachana* by the fact that *frondosa* has regularly twelve marginal sense organs, while *xamachana* has normally sixteen, but these vary from seventeen to twenty-three. *C. frondosa* has no ocelli on the rhopalia and no median concavity on the exumbrella. It is amber color with white spots. Disk diameter 110 to 260 mm., flattish with rounded edges; no median sucker concavity on the exumbrella. The

number of rhopalia is regularly twelve; four perradial and eight adradial. There are no ocelli. There are five subrectangular, nearly straight marginal lappets between each pair of sense organs; the two lappets adjacent to the rhopalia are only half as wide as the other lappets. The mouth-arm disk arises from the center of the umbrella and is usually about three-fourths as long as the umbrella radius, but sometimes a specimen is taken in which the arms are much longer, approximating those of *C. xamachana*; in *frondosa* the arms bifurcate distally, giving rise to numerous short, pinnate branches from the oral side. The many frilled mouths are found only on the lower or oral side of the arms, the upper sides of the arms being smooth. There is no central mouth-opening in the adult, but Louis Agassiz discovered that the ephyra stage of *frondosa* does have a central mouth aperture. There are 30 to 40 small, flat, leaf-like, expanded vesicles expanded between the mouths. There are four small, round, subgenital pits placed interradially. There are four separate, invaginated genital sacs which project into the stomach cavity. The axial ducts of the eight oral arms open into the central stomach and 24 radial canals extend from the stomach into the subumbrella, 12 passing to the rhopalia, and 12 are intermediate in position; all 24 communicate with one another by means of numerous anastomosing branches.

REFERENCES: *Medusa frondosa* PALLAS, Spicilegia Zoölog. fasc. 10, pp. 29, 30, pl. 2, figs. 1 to 3, 1774.—GMELIN, in Linné, Syst. Nat. t. I, pt. 6, p. 3157, 1788.—BOSC, Hist. Nat. d. Vers, t. 2, p. 170, 1802.

Cassiopea frondosa LAMARCK, Hist. Nat. Anim. sans Vert. tome II, p. 512, 1816.—ESCHSCHOLTZ, Syst. der Acalephen, p. 43, 1829.—TILESIIUS, Acad. Caes. Leop. Nova Acta, tom. 15, pp. 263, 278, tab. 72, figs. 1-5, 1834.—LESSON, Zoöph. Acaleph., p. 405, 1843.—H. MILNE EDWARDS, in Cuvier's Regne Anim. Zoöph., pl. 51, fig. 3, 1849.—PERKINS, Yearbook, Carnegie Inst. Washington, no. 4, p. 115, 1906; Bull. 102, Carnegie Inst. Washington, p. 152, pl. 4, 1908.

Cassiopea pallasii PERON and LESUEUR, Ann. Mus. Hist. Nat., Paris, tome 14, p. 357, no. 85, 1808.

Polyclonia frondosa L. AGASSIZ, Contrib. Nat. Hist. U. S., vol. III, pls. 13, 13a, 1860; *ibid.*, vol. IV, p. 139, p. 152, pl. 4, 1862.—A. AGASSIZ, N. Amer. Acaleph., p. 41, 1865; Nature, vol. 24, p. 509,



Cotylorhiza tuberculata (Maeri), about one-half of natural size.

1881.—ARCHER, H., *ibid*, p. 307.—HAECKEL, Syst. der Medusen, p. 568, 1880; Report Voy. "*Challenger*," Zööl., vol. 4, p. 118, 1881.—VANHOFFEN, Bibliotheca Zoölogica, Bd. I, Heft, 3, p. 40, 1888.—BIGELOW, R. P., Johns Hopkins Univ. Circ., vol. 2, no. 106, p. 106, 1893.—PERKINS, Yearbook, Carnegie Inst. Washington, no. 4, p. 15, 1906; Publ. 102, Carnegie Inst. Washington, p. 152, 1908.—MAYER, A. G., Medusae of the World, vol. III, p. 647, pl. 69, figs. 1-3, pl. 72, upper three figs., color plate, 1910.

Rhizostommata *Dichtoma* Vanhoffen.

Genus: **COTYLORHIZA** L. Agassiz.

Cotylorhiza tuberculata (Macri).

Plate 9.

TYPE: Collected in the Mediterranean Sea; depository not traced.

DISTRIBUTION: This species is found chiefly in the Mediterranean Sea, but has also been found in the Atlantic Ocean near the Canary Islands. There is one valid record of its occurrence in the Red Sea, where it is believed to have been introduced via the Suez Canal. Pelagic. This species varies considerably in abundance, sometimes being very rare, especially so in midwinter. It is believed by Keller to be a deep water species which only comes to the surface occasionally when sexually mature and that the young remain at the bottom of the sea.

MATERIAL EXAMINED: One very large specimen, Monaco Harbor, 1927.

COLOR: The bell is rich olive tending to orange or brownish yellow, being darker brown on the dome-like apex of the exumbrella. Both the exumbrella and subumbrella show a rich yellow color due to the presence of multitudes of yellow and brown plant cells (*Zoöchlorellae*) which are present in the canal system and entoderm. The mouth-arms and disk are milky white tinged with creamy yellow; the free outer margins of the mouths are purple varying to violet or deep blue as are also the terminal parts of the milky white appendages. (See also Mayer's color plate.).

LIFE HISTORY: Much careful study has been made of the life history of this species by Busch, Frantzius, Gegenbaur, Kowalevsky, Claus, Goetle, du Plessis, Hein, Mayer and others.

TECHNICAL DESCRIPTION: Consult Mayer, 1910, vol. III, p. 659, for an excellent modern description of this species.

The "*Ara*" specimen is an unusually fine one, measuring 190 mm. diameter.

REFERENCES: *Medusa tuberculata* MACRI, G., Osservazioni Int. Polmone Marino, p. 20, 1778.

Cotylorhiza tuberculata AGASSIZ, L., Contrib. Nat. Hist. U. S., vol. IV, p. 158, 1864.—MAYER, A. G., Medusae of the World, Publ. 109, Carnegie Inst. of Washington, vol. III, p. 659, pl. 73, fig. 2, color plate, and text figs., 1910, (with critical diagnosis and full synonymy).

Rhizostommata Scapulata

Genus: **STOMOLOPHUS** L. Agassiz.

Stomolophus meleagris L. Agassiz.

Plate 10.

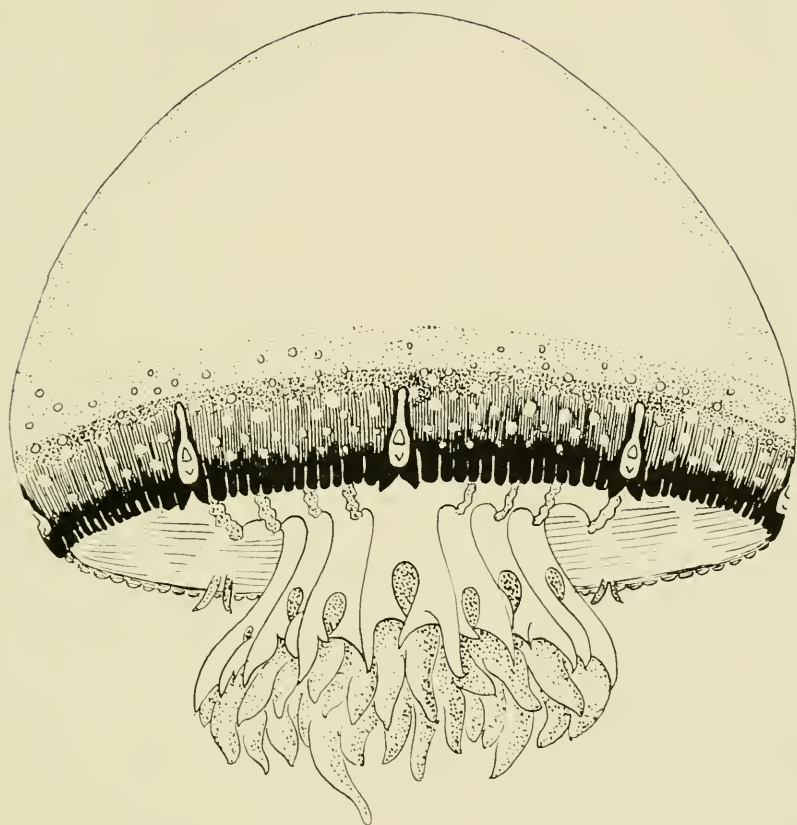
TYPE: Louis Agassiz states that he first observed myriads of this species in April, stranded upon the sand on the beach of Warsaw Island, below Savannah, Georgia; all of these were partially decomposed. Years later a specimen in similar condition was given him from the harbor, Charleston, S. C. Depository not stated.

DISTRIBUTION: Pelagic in pure ocean water off the coast of the southeastern United States, from the lower Chesapeake Bay southward to the Tortugas, Florida; it is abundant in the Gulf of Mexico, and also occurs along the northern coast of South America. Recorded as *S. chunii* Vanhoffen from the Bay of Panama.

MATERIAL EXAMINED: Eleven, collected off Miami Beach, Florida, by the "*Ara*."

COLOR: The bell is milky bluish or yellowish and the entodermal parts are yellow; the outer surface of the exumbrella is reticulated with brown which becomes a rather dense band near the margin, marked with many white or yellowish spots. The mouth frills are brownish pink.

TECHNICAL DESCRIPTION: Bell diameter 175 to 200 mm. axial diameter; hemiovoid, gelatinous substance thick and rigid, semi-opaque, marginal tentacles absent; eight rhopalia, four being radial and four interradial in position. Each rhopalium is deep-set in a niche between the ocular lappets and is also shielded above by a partial web between the lappets. The sense club is spindle-shaped, hollow, terminating in a knob-like end. Just above the base of each sense club there is a deep



Stomolophus meleagris L. Agassiz, about three-fourths of natural size.

three-sided, furrowed pit projecting inward from the surface of the exumbrella. There are about sixteen marginal lappets between each pair of rhopalia, the velar lappets having rounded margins, while the ocular lappets are longer and sharp pointed.

The manubrium is thick, rigid, extending 30 to 50 mm. below the bell, composed of the laterally coalesced eight radial arms, which are free only at the distal end, these free ends bifurcating and flaring outward at the lower end of the manubrium. Each of the eight arms has a deep groove on its lower side; this groove branches twice and extends over the free ends of the arms. The free edges of this branching groove are in turn much branched and folded and possess a row of many small, knobbed tentacles, constantly in motion to drive food particles into the mouth-groove. There are sixteen blade-shaped scapulets attached to the upper part of and occupying more than half the length of the manubrium. These bear many slit-like lateral mouths, the free edges of which are much crenulated and furnished with small tentacles of the same type found in the free margin of the central mouth. The eight principal mouth-grooves of the manubrium lead into a four-cornered central aesophagus, which opens into the wide, lenticular stomach, situated in the middle of the umbrella. There are sixteen branches, four from each side of the aesophagus, that extend outward to the slit-like mouths of the scapulets. From the stomach sixteen radial canals extend outward, the outer half of each canal branching many times and terminating in fine anastomosing branchlets which establish communication among all the radial canals. There is no ring canal present. The gonads are located in the four folded regions of the wall of the subumbrella at the base of the deep, cylindrical subgenital pits. Both the circular muscle areas and the radial muscle areas are well developed.

REFERENCES: *Cephea rhizostoma* GIBBES, Fauna of South Carolina, p. xxiii, 1847. Published as an appendix to Rept. Geology of South Carolina, by M. Toumey, state geologist, Columbia, S. C.

Stomolophus meleagris AGASSIZ, L., Contrib. Nat. Hist. U. S., vol. III, pl. 14, figs. 1-8, 1860; *ibid.*, vol. IV, pp. 138, 151, 1862.—AGASSIZ, A., N. American Acalephae, p. 40, 1865.—MAYER, A. G., Medusae of the World, vol. III, p. 710, pls. 75, 76, figs. 1-3, 1910; Publ. 109, Carnegie Inst. of Washington.

Order: **ALCYONACEA.**

Family: **ALCYONIDAE.**

Genus: **ALCYONIUM** Linné.

Alcyonium palmatum Pallas.

Plate 11.

TYPE: Pallas' type came from the Mediterranean Sea and was deposited either in the Leyden or the Belgian Museum; probably the former.

DISTRIBUTION: Littoral in the Mediterranean Sea.

MATERIAL EXAMINED: One colony, dredged in 35 fms. of water, five miles N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea, July, 1927.

Two specimens, dredged in 35 fms., five miles N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea, July 21, 1927. One of these colonies is attached at the base to a specimen of the gastropod shell, *Chenopus pespelicanus* Linné. One small specimen, Cape Spartivento, Sardinia, depth 325 fms., 1927.

COLOR: In life the color of this species is variable, being translucent light yellow or rose-red; the skeleton of the "fingers" being composed of loose calcareous spicules, the fingers being thus capable of swelling up by the absorption of large quantities of water.

TECHNICAL DESCRIPTION: A very thorough analysis of this species with diagnostic figures is to be found in G. von Koch's article, "Die Alcyonacea des Golfes von Neapel" (Mitth. Zoöl. Neapel, vol. IX, p. 663, figs. 14, 15, 16, 1891).

J. A. Thompson considers *A. acaule* Marion to be a variety of *palmatum* and gives an exquisite color figured of *acaule*. (Monaco, Fasc. LXXIII, p. 10, color plate II, fig. 16, 1927.)

There is a very fine photographic illustration of a living colony of *A. palmatum* given in Dr. A. J. Barreiro's article on *Coelenterates*, (Historia Natural Zoologica, t. II, p. 421, 1926, Barcelona).

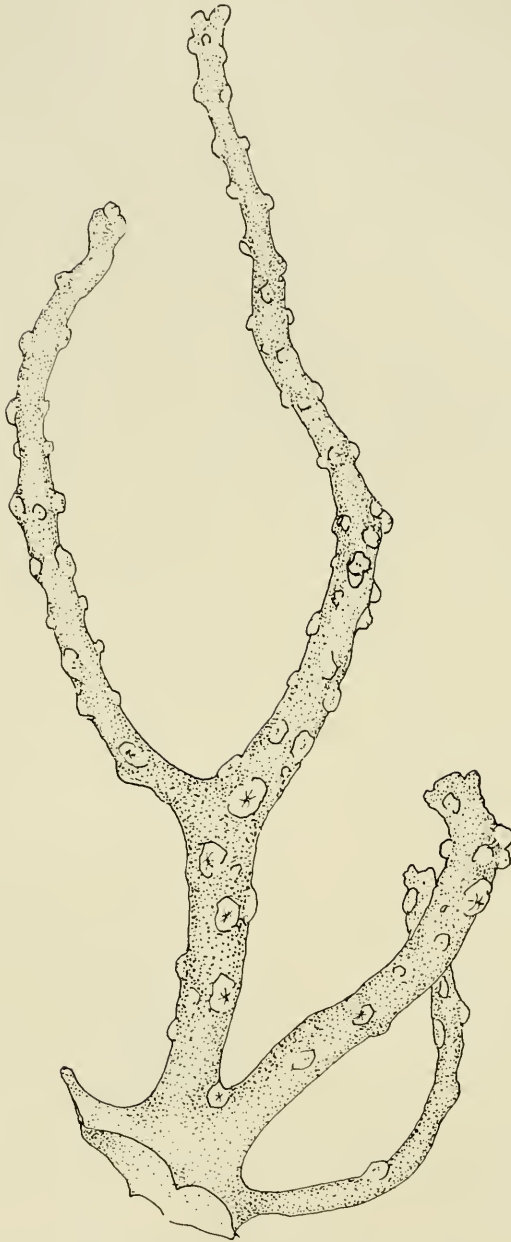
REFERENCES: *Alcyonium palmatum* PALLAS, Elenchus Zoöphytorum, etc., p. 349, 1766 (with list of pre-Linnaean references).—KOCH, G. VON, Mitth. Zoöl. Station Neapel, vol. IX, p. 663, text figs. 14, 15, 16, 1891.—KUKENTHAL, Jena Zeitschr. Naturw., vol. XLII, p. 61, 1 pl., 12 figs., 1906. (Compares *A. palmatum* and *A. brionense* n. sp.)—THOMSON, J. A., Res. Campag. Sci. Monaco Fasc. LXXIII, Alcyonaires, p. 10, pl. II, fig. 16, color plate, of variety *acaule* Marion, 1927.



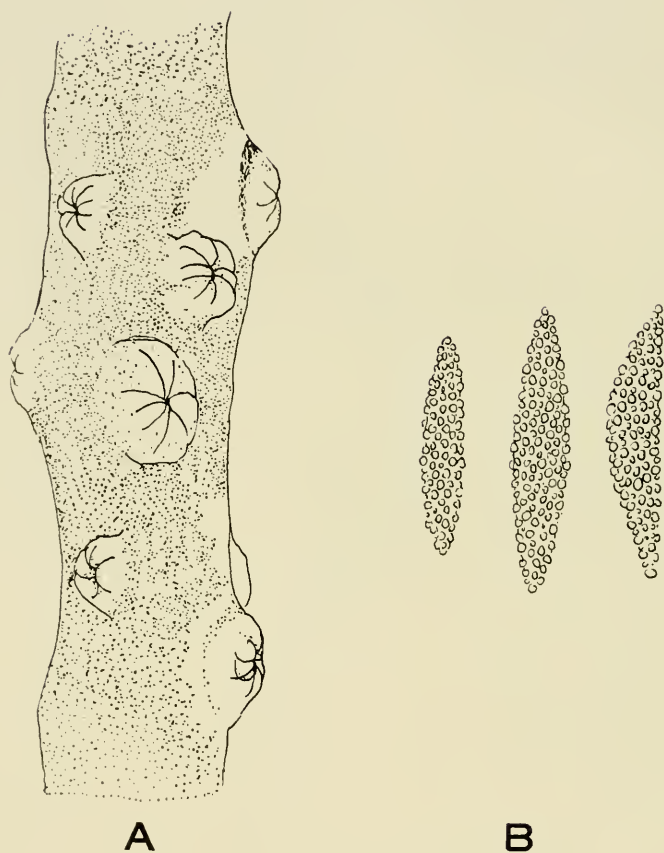
Aleyonium palmatum Pallas, natural size of retracted specimen.



Corallium vanderbilti Boone, holotype, $\times 1.67$.



Corallium vanderbilti Boone, holotype, $\times 2$.



A, *Corallium vanderbilti* Boone, section of holotype $\times 5$. B, several spicules greatly magnified.

Order: **PSEUDAXONIA.**

Family: **CORALLIIDAE.**

Genus: **CORALLIUM** Gray.

Corallium vanderbilti, new species.

Plates 12, 13 and 14.

TYPE: One four-branched colony, dredged near Casilda, south coast of Cuba, in over 100 fms. of water, by the "*Ara*," February 15, 1924.

DISTRIBUTION: Known only from the type locality.

COLOR: After eight years' preservation in spirit the specimen remains a vivid spectrum red with bright yellow suboval spots around and including the calicles.

TECHNICAL DESCRIPTION: Colony four-branched, of the shape figured, measures 87 mm. high. The base is in the form of a hollow disc, 17 mm. long diameter; the trunk of the larger branch is 5 mm. diameter just above the base. The branches are tortuous and show no indication of lateral compression and diminish gradually in thickness towards their tips. The shortest branch arising from the basal disc has a young branch budding out from its side near the tip. This younger portion is crystalline with a few red spicules formed inside the crystalline substance and shining through it like a fine network. The minute calicles are present represented as small projections on the surface with minute apertures and outlined by the above mentioned network of red spicules. The total length of this young crystalline branch is about 3.7 mm.

The axis of the red branch is hard, solid, almost cylindrical in cross-section of the wider branches, oval in cross-section near the tips; composed of closely fused, spindle-shaped spicules set at various longitudinal and oblique positions. The red surface is smooth, glistening, to the naked eye, but under high magnification it shows very fine indefinite markings. The coenchyma is thin, bright red, full of closely crowded small spicules, having the appearance of glistening sand grains.

The verrucae are bright chrome yellow, of the same glistening appearance as the adjacent crimson surface, and present a striking contrast to it. They are prominent, nearly cylindrical, about 1 to 1.5 mm. high (preserved specimen), with the summit rounded and divided by eight convergent segments. When the tentacles are

retracted the verrucae present the appearance of an eight-rayed circle, somewhat drawn inward or puckered at the center. The verrucae occur irregularly as shown in the photograph. On the basal portion of the colony the calicles are not elevated above the surface of the branches, but farther along the branches they form distinct verrucae. The zoöids are entirely retractile within the calicle, which is lined without and within with the chrome yellow spindle-shaped spicules and closed by eight rather inconspicuous convergent segments. The tentacles are short, fleshy, about 0.5 mm. to 1 mm. long, original color lost, and are closely covered by small spicules.

The spicules composing the axis and verrucae are of the kinds figured. The most abundant is the long, spindle-shaped type covered with rounded, granular protuberances. These spicules measure: 0.5 mm. to 0.6 mm. long; 0.1 mm. to 1.5 mm. greatest width. Much smaller granular spicules are found in the coenchyma.

NAME: I take pleasure in dedicating this species to the collector, Mr. William K. Vanderbilt.

Corallium vanderbilti is apparently the first precious coral to be described from West Indian waters, and is therefore of unusual interest.

Record of a single species of this genus from off the Irish coast constitutes the only other record of the genus in the Atlantic, it being known chiefly from the Mediterranean Sea, Indo-Pacific and Japanese waters.

Family: **PLEXAURIIDAE.**

Genus: **PLEXAURA** Lamouroux.

Plexaura fusca (Duchassaing and Michelotti).

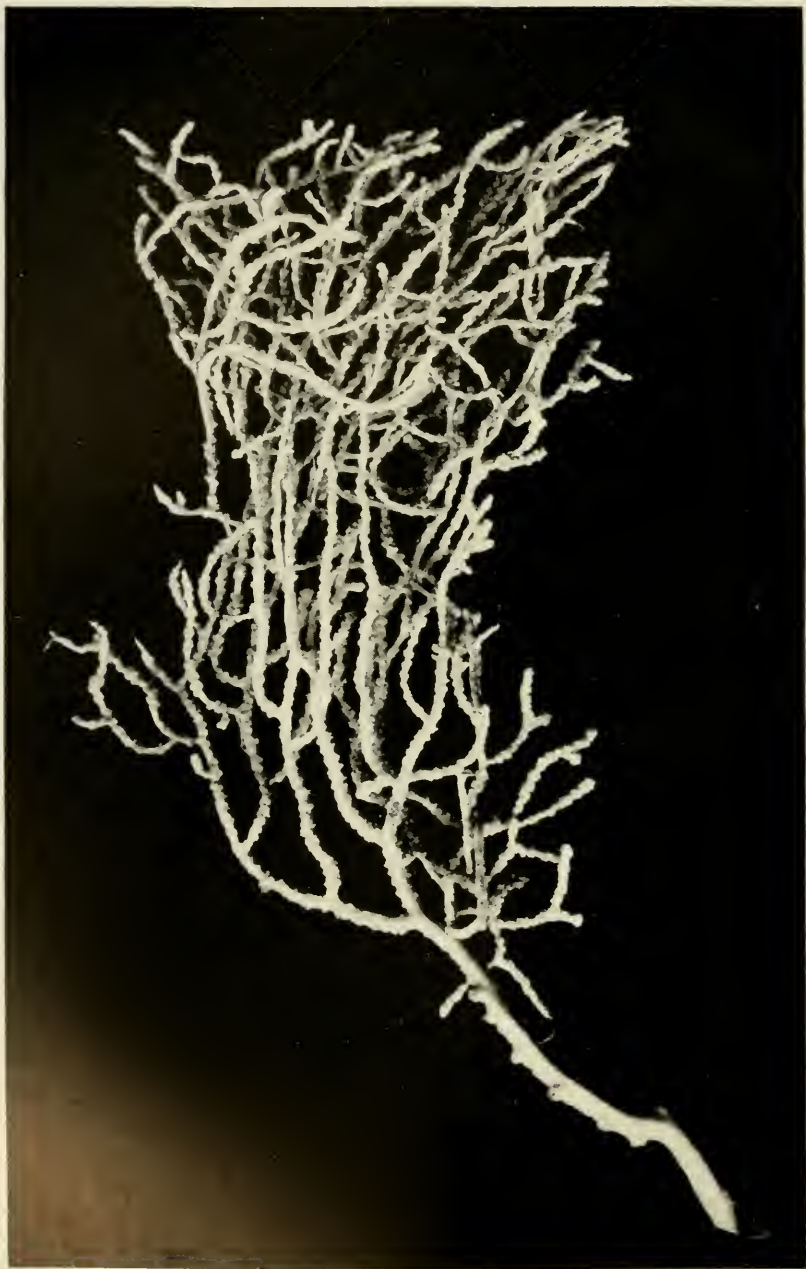
NAME: Sea-Whip.

TYPE: The localities cited for the species in the original description are Guadeloupe, St. Thomas, St. Croix, W. I. Depository: Museum d'histoire naturelle de Turin.

DISTRIBUTION: Littoral. The Florida Reefs, Bermudas and the West Indies.

MATERIAL EXAMINED: One very large specimen from the south coast of Cuba, February 15, 1924, by the "Ara."

COLOR: In life the rods are light yellow or brown. The polyps are very numerous, placed so closely together that their expanded tentacles overlap. The tentacles and disk are dull yellowish or brownish. When dried the coenchyma becomes very pale yellow or purplish



Stenogorgia casta Verrill, colony reduced about one-third.

gray or nearly white, due to the large, fusiform, white spicules, but near the axis the interior of the coenchyma is usually purple, due to the internal, fusiform purple spicules.

TECHNICAL DESCRIPTION: Colony three to five feet in height, basal trunk 1.5 to 2 inches diameter; it is repeatedly forked, the branchlets long, slender, slightly tapered, round. The calicles are of unequal sizes, rather large, round or oval, with the margins very little or not at all raised. The calicles are usually placed close together.

REFERENCES: *Eunicea fusca* DUCHASSAING and MICHELOTTI, Mem. Acad. Sci. Torina, serie 2, t. XIX, p. 301, pl. 3, figs. 5, 6, 1861.

Pseudoplexaura crassa VERRILL, A. E., Trans. Conn. Acad. Arts and Sci., vol. XII, p. 307, pls. 33, 34A, fig. 3, 1907.—CHESTER, Proc. Amer. Acad. Sci., vol. 48, p. 737, 1913.

Plexaura fusca KUNZE, G., Zoöl. Jahrb. suppl. 11, p. 509, 1916.—MOSER, Zoöl. Anz., vol. 53, p. 114, 1921.—KUKENTHAL, Das Tierreich, Lief. 47, p. 112, 1924.

Family: **GORGONIDAE.**

Genus: **STENOORGIA** Verrill

Stenogorgia casta Verrill.

Plates 15 and 16.

TYPE: Taken by the "*Blake*" at station 318, Lat. N. 31° 48' 50", Long. W. 77° 51' 50", in 337 fms.

DISTRIBUTION: Known only from the type locality and the "*Ara*" specimen, which is many times larger than the type.

MATERIAL EXAMINED: One colony, taken in 150 fms., in the dredge, seven miles off Alligator Reef, Florida, March 30, 1926, by the "*Ara*."

COLOR: Unknown. Preserved specimen a rich old ivory, nearly buff.

TECHNICAL DESCRIPTION: Colony 20 cm. high, 5 cm. of which is the basal trunk; the basal extremity is broken off; the trunk branches dichotomously less than an inch from the base; the branches fork irregularly, unequally and sometimes pinnately; the branches and branchlets curve outward and upward nearly in one plane. They are of much the same size, the terminal branches often being the largest and supporting more calicles. The axis is almost round, brownish in the larger branches; pale yellowish in the smaller ones. The calicles

are in approximately two rows on opposite sides of the branch, but the calicles in a given row alternately space one a little forward, the next a little backward, thus making a maximum use of the space in expansion. Likewise the calicles on the opposite side alternate. On the smaller branches the bases of the calicles of opposite rows are in contact but on the larger branches they are separated. The calicles are more dilated basally, a little narrowed at the summit, and closed by eight convergent segments. The summit of the calicle is surrounded by eight to twelve spicules, the tips of which form a thorn-like ring around the summit.

The spicules of the coenchyma and calicles are of three general types, as shown in Plate 15. There are numerous large, spindle-shaped spicules, especially on the coenchyma. These spicules are widest in the median region and are tapered toward both ends and are covered with small, nodular protruberances. They measure: 1.9 mm. long, 0.5 mm. median width; 1.7 mm. long, 0.4 mm. median width; 2 mm. long, 0.6 mm. median width. This type of spicule is most abundant on the surface of the branches which has fewest calicles. There are also many such spicules on the tips of some of the outermost branches; on one or two such branches these large spicules cover almost the entire surface, to the exclusion of the other types of spicules. A second type of spicule is long, slender, fusiform, tapered at each end and also covered with nodular protruberances, but this type of spicule is uniformly smaller than the preceding type and much less dilated in the middle. It measures 1.5 mm. long, 0.2 mm. median width; 1.1 mm. long, 0.15 mm. wide. The third and most abundant type of spicule is elongated but stout and blunt at both ends; these stout spicules are also covered with nodular protruberances. They measure: 1.2 mm. long, 0.5 mm. wide; 1 mm. long, 0.45 mm. wide; 0.5 mm. long, 0.2 mm. wide. The spicules of the tentacles are also of three types, slender, elongated, bent, tapered toward both ends, with thickly nodulated surfaces; or thicker spicules, blunted at both ends and nodulated; and flattish oblong spicules, with few granules on their surfaces.

REFERENCES: *Stenogorgia casta* VERRILL, Bull. Mus. Comp. Zoöl., vol. XI, p. 30, pl. 2, figs. 1, 1 a, b, 1883.—BIELSCHOWSKY, E., Zoöl. Jahrb. Heft 1, p. 188, 1929, Jena.



Rhipidogorgia flabellum (Linné), about one-fifth of natural size.

Genus: **RHIPIDOGORGIA** Valenciennes.

Rhipidogorgia flabellum (Linné).

Plate 17, text figure 1.

NAME: Royal Sea-Fan.

TYPE: Linnaeus simply states "Habitat in Oceano omni." The depository is not stated.

DISTRIBUTION: A reef-dwelling species found throughout the West Indian region from southern Florida to the shores of northern Brazil.

MATERIAL EXAMINED: Several specimens from Nassau, Bahamas. Several from Port Tanamo, Cuba.

DESCRIPTION: Because of its great beauty this species was one of the first to be carried to Europe by the returning explorers. It was



TEXT FIG. 1.—A. Spicules of *Rhipidogorgia flabellum* (Linné), greatly enlarged. B. An enlarged section of the fan. (B, after Agassiz.)

treasured in the cabinets of the kings and queens of Spain, France and England. Queen Elizabeth had a fan made of one.

Hans Sloane records that it was used in earlier colonial times by the wealthier planters to provide coolness and to keep away the flies and "Merrywings" (mosquitoes).

COLOR: In life the network forming the fan is a rich, dark wine-purple not infrequently marked with bright yellow. Sometimes this bright yellow is the predominating color, or even the entire fan is

bright yellow. When expanded the polyps are decidedly projected, small, and delicate, translucent, flower-like.

DISCUSSION: This is the large sea-fan found abundantly in the West Indian region and is readily distinguished in the field by its coloration and fan-like shape. On the outer reefs in three to eight fathoms of water, it frequently attains a height of six or seven feet and width of five to six feet. The shape of the fan is largely controlled by environment, sometimes being long and narrow, sometimes round or widely oval. Not infrequently smaller fans develop at different angles from the larger ones; sometimes two or three fans develop from the same base.

Specific identification of this fan is dependent upon the spicules found embedded in the coenchyma, which have the characteristic shapes shown in figure 1. The network of the fan is closely reticulated, the calicles arranged as shown.

REFERENCES: *Gorgonia flabellum* LINNÉ, Syst. Nat. ed. 12, p. 1293, 1767, (with early references); Esper. Pflanz, vol. II, pls. 2, 3A, 1794.—DANA, J. D., Zoöph., 1846; also the majority of other writers up to 1857.—KOLLIKER, Icones Histiol., vol. II, 1865.—VERRILL, Amer. Jrn. Sci., vol. XLVIII, p. 424, 1869, (designates *G. flabellum* the type of the most restricted genus of *Gorgonia*); Trans. Conn. Acad. Arts and Sci., vol. X, p. 568; *ibid*, vol. XII, p. 297, text fig. 142, pl. 33c, fig. 1, pl. 36, fig. 1, 1904-1907.—HARGITT and ROGERS, Bull. U. S. Fish. Comm., vol. XX, pt. 2, p. 287, pl. 3, 1901.

Rhipidogorgia flabellum BIELSCHOWSKY, Zoöl. Jahrb. suppl. 16, Heft. 1, p. 194, 1929, (with full synonymy).

Genus: **PTEROGORGIA** Ehrenberg.

Pterogorgia acerosa forma typica Bielschowsky.

Plate 18, text figure 2.

NAME: Royal Sea-Plume.

TYPE: Pallas gives as type locality: "Seas of America and the Mediterranean." The depository of his type is believed to be either Leyden or the Belgian Museum.

DISTRIBUTION: Littoral in 3 to 10 fms., on the reefs, throughout the West Indian region.



Pterogorgia acerosa (Linné), greatly reduced.



Ptilosarcus gurneyi (Gray), reduced two-fifths.

MATERIAL EXAMINED: Two large specimens from Nassau, Bahamas, collected by the "Ara."

COLOR: Variable. Light purple or purplish red, light yellow or straw color, more rarely a white specimen is found.

DISCUSSION: Well-grown specimens of this sea-plume attain a height of three and one-half to five and one-half feet, with a strong elastic central stem and a great many long, slender, flexible, pinnate branches, which are usually pendulous in the form of a loose plume. Not infrequently large specimens consist of several such plumes, arising from a common base. The axis in the central trunk and main



TEXT FIG. 2.—*Pterogorgia acerosa typica* Bielschowsky, spicules greatly enlarged.

branches is large, black, tough, horn-like, frequently much flattened while in the terminal branchlets it becomes capillary or setiform, translucent amber color. The spicules, which are the final diagnostic character of the species, are embedded in the coenchyma and have the shape shown in the figure.

REFERENCES: *Gorgonia acerosa* PALLAS, Elench. Zoöph, p. 172, 1766, (with early synonymy).

Pterogorgia acerosa forma typica BIELSCHOWSKY, Eva, Zoöl. Suppl. 16, Heft. I, p. 209, fig. 32, 1929, (with detailed diagnosis and full synonymy).

Order: Pennatulacea.

Family: PENNATULIDAE.

Genus: **PTILOSARCUS** Gray.

Ptilosarcus gurneyi (Gray).

Plate 19.

TYPE: Gray's type was from Monterey, California, and is deposited in the British Museum.

DISTRIBUTION: Previously known from Prince William Sound, Alaska, southward to Monterey, California. The "*Pawnee*," 1928, established the first record of the species in the Gulf of California: Angeles Bay. The "*Ara*" specimen from Punta Arenas, Costa Rica, is the southernmost record for the species on the west coast.

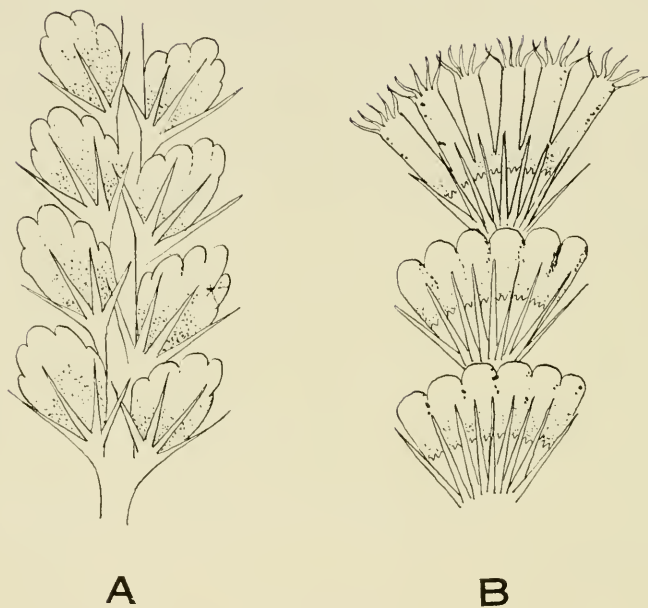
MATERIAL EXAMINED: One specimen, taken in seine, Punta Arenas, Costa Rica, February, 1928.

COLOR: The stalk is orange to red, the pinnules are semi-transparent hibiscus red. Preserved specimens are usually faded to a delicate ivory.

TECHNICAL DESCRIPTION: The stalk is swollen, bulbous, from one-third to one-half the length of the entire organism, its diameter varying from one-eighth to one-third the length of the stalk, the narrowest width being at the base and the greatest width a short distance below the beginning of the pinnae. The central rachis supporting the pinnae is subcylindrical on the back, the proximal three-fifths of its width being about the same width; the distal two-fifths tapering to a blunt point. The siphonozooids are small, papilliform, and form two broad rows, separated by a muscle-like line on the back of the rachis. Each of these broad rows is made up in width of three to five siphonozooids, close-set but irregularly placed. The pinnae are nearly semicircular, broadly rounded, with a wide base, the posterior edge extending beyond the basal attachment as a rounded lobe; the edge is thickened and bears four rows of polyps. Each calicle is set with two spiniform spicules. The sides of the pinnae are smooth; the basal five or six pairs of pinnae are small, gradually increasing in size, and the distal twelve or fifteen pairs of pinnae successively decrease in size, conforming to the tapered extremity of the pen. In life these pinnae are much more expanded and separated than they appear in the accompanying photograph. The tiny polyps appear to have eight primary tentacles each. The above notes are based on a preserved specimen.

REFERENCES: *Sarcoptilus (Ptilosarcus) gurneyi* GRAY, Ann. and Mag. Nat. Hist., vol. 5, p. 23, pl. 3, fig. 2, 1860.

Ptilosarcus gurneyi VERRILL, Proc. Essex Inst., Salem, Mass., vol. 4, p. 183, 1865; Proc. Conn. Acad. Arts and Sci., vol. I, pt. 2, p. 382, 1868.—KOLLIKER, Anat. Syst. d. Alcyon. Pennat., p. 146, pl. 9, fig. 79, 1869.—VERRILL, A. E., Alcyonaria, Canadian Arctic Exped., 1913-1918, vol. 8, part G, p. 11, pl. 12, figs. 1 and 2, 1922.



Paronaria californica Moroff, A, section of rachis showing retracted polyps;
B, section of rachis, shown from a different angle, showing retracted
and extended polyps, also the supporting cluster of spines.

MOROFF (1902)* and NUTTING (1909)** respectively describe this sea-pen as *Ptilosarcus quadrangularis*, new species, based on material from the southern California coast. Their descriptions, while excellent and in far greater detail than GRAY'S (1860), ignore the fact that his type came from Monterey, California, and give no characters differentiating *quadrangularis* from the older *gurneyi*. VERRILL (1865 and 1918) uses GRAY'S name for the New England and Arctic Canadian specimens that came under his observation. Should the Arctic and Tropic West American specimens prove distinct, as seems probable, GRAY'S name must be retained for the Monterey, California, species, with MOROFF'S *quadrangularis* as synonym, and VERRILL'S species would then be in need of a new name, in which event I designate the northern form *Ptilosarcus verrilli*.

Family: PAVONARIIDAE.

Genus: PAVONARIA Kolliker, emended.

Pavonaria californica Moroff.

Plate 20.

TYPE: Moroff's type is in the Munchen Museum; the locality of the specimen is not indicated, except by implication in the species name.

DISTRIBUTION: This is a deep-water species found off the Pacific coast of America from California, at Pt. Loma, La Jolla and Pt. Pinos to off Punta Arenas, Costa Rica, in depths ranging from 100 to 1083 fms., and on the Asiatic Pacific coast from Bering Island, Siberia, southward to Benkei Mizaki Light, Japan, in 72 to 224 fms.

MATERIAL EXAMINED: Eleven colonies, dredged in 100 fms., Punta Arenas, Costa Rica, February, 1928, by the "Ara."

This record substantially extends the southern distribution of this species on the American side of the Pacific, and is the least depth in which it has been taken.

COLOR: According to Dr. Nutting, the rachis is light yellow, the polyps reddish brown; the terminal bulb also reddish brown. He unfortunately neglects to state whether this information was obtained

* *Ptilosarcus quadrangularis* MOROFF, Zoöl. Jahrb. Abth. Syst. Geol. u. Biol. Thiere 17, p. 385, 1902.

** NUTTING, Proc. U. S. Nat. Mus., vol. 35, p. 689, pl. 84, figs. 4-10, pl. 85, figs. 1-11, pl. 91, figs. 1, 2, 1909.

as a field note from living specimens, or from preserved laboratory material.

TECHNICAL DESCRIPTION: Kukenthal (1913) gives the best description of this species.

The "Ara" specimens consist of eleven separate colonies, all of which are somewhat broken by the dredge.

The largest one is 165 mm. long with about 83 clusters of zoöids on each side of the rachis. Each cluster occupies about 2 mm. of height on the rachis. The terminal bulb is about 15 mm. long, very little dilated. There are about nine long, acuminate spines supporting each cluster of polyps, with two or three shorter spinules filling the space between each pair of spines. There are five to eight polyps to each cluster, each with numerous slender tentacles. Towards the base of the axis the zoöids are smaller while distally they are much larger.

REFERENCES: *Pavonaria californica* MOROFF, Zoöl. Jahrb. Abteil. Syst., vol. 17, p. 393, 1903.—KUKENTHAL, W., *ibid*, vol. 35, p. 249, taf. 8, figs. 6 u. 7, 1913.—HICKSON, Siboga Exped. Mon. 14, p. 136, 1916.

Balticina pacifica NUTTING, Proc. U. S. Nat. Mus., vol. 35, p. 704, pl. 87, figs. 1 and 2, 1909; *ibid*, vol. 43, p. 39, pl. 6, fig. 4, 1912.

Balticina californica NUTTING, *op. cit.*, p. 40, 1912.

Order: ZOANTHARIA.

Family: ZOANTHIDAE.

Subfamily: Brachycneminae.

Genus: ZOANTHUS Lamarek.

Zoanthus pulchellus (Duchassaing and Michelotti).

Plate 21.

TYPE: Collected in the West Indies and deposited in the Turin Museum.

DISTRIBUTION: Found throughout the West Indian region in shallow water.

MATERIAL EXAMINED: Four separate clusters dredged in Limon Bay, Panama, January 21, 1928, by the "Ara."

COLOR: Column olive-green, sometimes bluish to pure turquoise; disk pale ochre-yellow with white flecks, sometimes green with paler radial lines.



Zoanthus pulchellus (Duchassaing and Michelotti) about natural size.



Metridium dianthus (Ellis) about natural size.

TECHNICAL DESCRIPTION: Consult Duerdon, "Report on the Actinia of Porto Rico," p. 332, pl. 2, figs. 2, 3, pl. 4, fig. 14, 1900.

The "Ara" specimens establish a new locality record in the West Indies for this exceedingly beautiful anemone.

REFERENCES: *Mamillifera pulchella* DUCHASSAING and MICHELOTTI, Mem. Reale Acad. Sci. Turin, ser. II, tom. 23, p. 137, pl. IV, fig. 4, 1866.

Zoanthus pulchellus DUERDEN, Royal Dublin Soc. Trans., ser. 2, vol. VI, p. 341, pl. VII A, fig. 3, pl. XVIII A, figs. 3-4, 1898; Bull. U. S. Fish. Comm., vol. XX, part 2, p. 333, pl. 2, figs. 2-3, pl. 4, fig. 14, 1900, (with very fine description).

ACTINARIA.

Suborder: Actiniina.

Family: SAGARTIDAE.

Genus: METRIDIDIUM Oken.

Metridium dianthus (Ellis).

Plate 22.

TYPE: Ellis' type came from the rocks at Hastings, Sussex, England, and was deposited in the collections of the Royal Society.

DISTRIBUTION: This actinian is essentially littoral, seldom being found in more than 25 fms., although there are a few records of its occurrence down to 90 fms. It is shade loving, preferring rock crevices, etc., along the shore line. It is circumpolar, being found in European waters southward to England and the Danish coasts. In America it is found on the eastern coast as far south as Long Island Sound and northern New Jersey, but occurs in greatest abundance from Cape Cod, Mass., northward to the Gulf of St. Lawrence. It has been recorded from Port Clarence Bay, Alaska. On the American Pacific coast it has been recorded from Sitka; Bering Straits; Victoria, B. C.; Puget Sound and San Francisco.

MATERIAL EXAMINED: One large specimen, Bay of Islands, Newfoundland, September 3, 1926; another, York Harbor, Newfoundland, September 12, 1923.

COLOR: Quite variable. The east American species are usually dull yellowish brown, olivaceous, chestnut brown to umber, often splotched or streaked with lighter colors; occasionally it is pale buff, salmon, or flesh color, very rarely orange or brick red. The tentacles are

usually paler tones of the same color as the column. Occasionally cream color.

LIFE HISTORY: Much careful study both on the sexual and asexual stages of this species has been done by a number of workers. Consult G. H. Parker, Bull. Mus. Comp. Zoöl., vol. 25, p. 43, 1899; *ibid*, vol. 30, p. 259, 1897; H. B. Torrey, Proc. Calif. Acad. Sci., ser. 3, vol. I, p. 345, 1898; C. W. Hahn, Proc. Wash. Acad. Sci., vol. IV, p. 395, 1902; Jrn. Exper. Zoöl., vol. II, no. 2, p. 225, 1905, for studies on the sexual reproduction. Asexual reproduction may occur in several ways: by longitudinal fission; by budding near the base, less frequently elsewhere; by breaking off fragments from the expanded basal disk, each fragment rapidly developing into a young actinian. This last is the most usual mode of reproduction.

DIAGNOSIS: This well-known "sea-apple" has been frequently described. A very good anatomical description is given by McMurrich (1901), in English, another by Carlgren (1893), in Swedish. McMurrich (1910) gives a critical review of the synonymy of the species, and points out that *M. senile* (Linné) is the correct designation. Verrill (1922) contradicts this, resuming the generally accepted *M. dianthus* (Ellis), ignoring Pennant's proposed *pentapetala* (1766).

REFERENCES: *Actinia dianthus* ELLIS, Phil. Trans. Royal Soc., vol. 47, p. 428, pl. 19, fig. 67, 1767.—ELLIS and SOLANDER, Hist. Zoöphytes, p. 7, 1786.

Metridium dianthus OKEN, Lehrbuch der Naturg. Jena, vol. III, p. 450, 1816.—H. MILNE EDWARDS and HAIME, Corallines, vol. I, p. 253, 1857.—CARLGREN, O., Kongl. Svenska Vetenskaps Akad. Handling. Bd. 25, no. 10, p. 102, 1893, (excellent anatomic description and extensive synonymy, especially of the European writers).—McMURRICH, J. P., Ann. N. Y. Acad. Sci., vol. XIV, no. 1, p. 3, pl. 1, figs. 1-5, 1901, (anatomic dissection).—VERRILL, A. E., Canadian Arctic Exped., vol. VIII, part G, Actinia, p. 90, 1922, (Arctic American records).

Actinoloba dianthus GOSSE, Actinologia Brit., p. 12, pl. 1, fig. 1, 1860.—ANDRES, Attinie. Fauna u. Flora des Golfes von Neapel, vol. IX, p. 133, fig. 15, 1883, (with full synonymy).

Metridium marginatum LESUEUR, H. MILNE EDWARDS, *op. cit.*, p. 234, 1857.—VERRILL, A. E., Mem. Boston Soc. Nat. Hist., vol. I, pp. 22-24, 1864.—G. H. PARKER, Bull. Mus. Comp. Zoöl., vol. 25, pp. 43, 53, 1899; *ibid*, vol. XXX, pp. 259-274 and plate, 1897.



Actinauge rugosa Verrill, about natural size.

Metridium fimbriatum VERRILL, Proc. Essex Inst., vol. IV, p. 150, 1865.

Metridium senile McMURRICH, Proc. and Trans. Royal Soc. Canada, vol. IV, ser. 3, sect. 4, p. 60, 1910, (discusses the early synonymy of this species).

Genus: **ACTINAUGE** Verrill.

Actinauge rugosa Verrill.

Plate 23.

TYPE: When he described this species, Prof. Verrill had an extensive series of material from various localities, from Cape Cod to Hudson Bay, and ranging from shallow water to 430 fms., but he failed to designate a type or its depository.

DISTRIBUTION: Known from off Georges' Bank, 430 fms., where it was first collected by the "*Bache*," also from Casco Bay, 95 fms., and the Gulf of St. Lawrence; also taken at Grand Banks and other fishing banks by Gloucester fishermen; and by the U. S. Fish Commission off Cape Cod, 50 to 90 fms.; in the Gulf of Maine, Massachusetts Bay and Bay of Fundy in 50 to 110 fms. Specimens in the Victoria Memorial Museum, Ottawa, establish the most northern record for this species, Richmond Gulf, near the entrance, east side of Hudson Bay, in 12 to 25 fms. The "*Ara*" specimens from the Bay of Islands, Newfoundland, 180 fms., add another deep-water record for the species.

MATERIAL EXAMINED: Twelve specimens, dredged in 180 fms., Bay of Islands, Newfoundland, September 3, 1926, by the "*Ara*." Five larger specimens from the same locality, three attached to *Crassidromus lineatus*; one attached to *Cardium alatum* (Fabr.); one attached to *Chenopus occidentalis* (Beck).

COLOR: In life this anemone has the column with an outer dark brown coating, beneath which the column below the capitulum is flesh color or pale red, while the capitulum is brighter red and the tentacles vary from dull salmon color, or light to dark brown, occasionally to deep mahogany.

LIFE HISTORY: Unknown.

TECHNICAL DESCRIPTION: The "*Ara*" specimens are one to two inches high and about three-fourths to one inch in diameter. The column is firm, thick-walled, nearly cylindrical with the base expanded; with the thick stout cortex below the rather tough brown

epidermis. The capitulum is defined by a circumferal row of 12 to 15 larger, conspicuous, bluntly rounded or nearly conical tubercles; below this row, the columnar surface, except near the base, is covered with scattered tubercles, unevenly spaced, of different sizes; the columnar surface between these tubercles is strongly wrinkled in both directions, in contraction. The capitulum is capable of being completely retracted and infolded together with the contracted tentacles. The capitulum has a softer integument than the lower portion of the column and is entirely covered by conspicuous folds or crests, with the thicker, lower, aboral edge verrucose, or irregularly crenulated, each extends to a tentacle becoming smooth and thin near the margin. Tentacles are in five cycles; 84 to 96 in number, of moderate length, stout, bluntish; those forming the inner cycle are the larger, the remainder, of moderate size. The lip lobes and the two siphonoglyphs are thick and large. The stomodaeum is large with strong, longitudinal folds. The mesenteries are in four cycles of six each. Those of the primary cycle are nearly perfect; the secondaries almost reach the stomodeal wall; the tertiaries are small; the fourth cycle even smaller. Acontia are very scarce.

REFERENCES: *Urticina nodosa* (Fabricius), VERRILL, Amer. Jrn. Sci., vol. VI, p. 440; *ibid*, vol. VII, p. 413, pl. 7, fig. 7, 1874, (not Fabricius' species); Proc. Amer. Assoc. Adv. Sci. for 1873, p. 349, 1874.—SMITH and HARGER, Trans. Conn. Acad. Arts and Sci., vol. III, p. 11, p. 54, 1874.

Actinauge rugosa VERRILL, Rept. Canadian Arctic Exped., vol. VIII, part G, p. 95G, pl. 19, figs. 3 and 4, pl. 24, fig. 2, pl. 27, fig. 1, text fig. 14, 1922.

Family: **BOLOCERIDAE**.

Genus: **BOLOCERA** Gosse.

Bolocera longicornis Carlgren.

Plate 24.

TYPE: Collected on the west coast of Sweden; depository not stated, but it is very probably the Stockholm Zoölogical Museum.

DISTRIBUTION: This species is widely distributed in the deep water region of the North Atlantic, on both European and American coasts. Carlgren recorded it from off the Scandinavian coasts in 40 to 80 fms. It has also been taken in the deep water off Ireland. It has been frequently reported in abundance from the east American coast, from the fishing banks off Nova Scotia southward to Cape Fear, North



Bolocera longicornis Carlgren, about natural size.

Carolina. Bathymetric occurrence: 37 to 1106 fms., but not abundant in less than 100 fms. This anemone prefers muddy bottom.

MATERIAL EXAMINED: Five specimens, 200 fms., nine miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926.

COLOR: Variable. The column is usually deep salmon, orange or orange-red, somewhat lighter in tone than the disk. The mouth is thickened and even brighter rose-red or orange than the disk, the color being accentuated at the siphonoglyphs. The tentacles are ordinarily the same color as the disk, but this deeper tone is alternated with pale translucent longitudinal bands; the tips are usually pale. Verrill has described in detail several color variations of the species.

TECHNICAL DESCRIPTION: Consult Carlgren (1891). This species is closely related to *Bolocera tuediae* Johnston, but *B. longicornis* is said to have distinctly longer and more numerous tentacles than *tuediae*. *B. longicornis* is a large species. When expanded, it often has a diameter across the tentacles of six to eight inches, with tentacles two to three inches long and nearly a half inch thick. The column is often two to three inches in diameter and height and is smooth, lubricous, red or orange; the tentacles are very large, non-retractile and easily cast off, in which event they usually leave a round aperture in the disk. The tentacles each have a circular, basal muscle that contracts, closing the end of the tentacle when it breaks off from the disk. The tentacles are arranged in three to four submarginal rows, the inner ones much the larger. They are dilated basally and tapered to a blunt tip distally; longitudinal striations are conspicuous. The mouth is thickened, the sulcus of the siphonoglyph is large. The mesenteries are regularly hexamerous. There are no acontia or cinclidae.

REFERENCES: *Bolocera tuediae* VERRILL (not Gosse), Amer. Journ. Sci., vol. V, pp. 5, 14, 1873; *ibid*, vol. VI, p. 440; *ibid*, vol. VII, pp. 413, 500, 1874; *ibid*, vol. XXIII, p. 315, 1882, (discusses distribution); Bull. Mus. Comp. Zoöl., vol. XI, p. 59, 1883; *ibid*, vol. XXIII, pp. 514, 535, 1885.—WHITEAVES, Cat. Marine Invert, Fauna Eastern Canada, p. 41, 1901, (Publ. Geol. Surv. of Canada).

Bolocera longicornis CARLGREN, Ofversigt af Vetenskaps-Akad. Forhandlingar, No. 8, pp. 241-250, 1891.—McMURRICH, Proc. and Trans. Royal Soc. of Canada, vol. VI, sect. 4, p. 155, 1894.—VERRILL, Rept. Canadian Arctic Exped. 1913-1918, vol. VIII, part G, p. 115 G, 1922.

Family: **PARACTIDAE.**Genus: **STOMPHIA** Gosse.**Stomphia carneola** (Stimpson).

TYPE: Stimpson's type was a small specimen collected in 35 fms., on the Hake Ground, off the northeast shore of Grand Manan, New Brunswick, and deposited in the Smithsonian Institute.

DISTRIBUTION: This species dwells in the tide-pools and seaweed clad rock ledges along the coast of eastern Canada and Newfoundland, southward to Cape Cod, Mass. It is also found in northern European waters, Scandinavia and Scotland. It is essentially a shallow-water species, having been found from the tide-line down to 35 fms.

MATERIAL EXAMINED: One specimen, collected at Eastport, Maine, by the "*Eagle*."

COLOR: In life this species varies in color a great deal; it is often bluish green mottled with crimson, often bright cherry-red with flesh-colored tentacles. It lives in the tide-pools and shallow water and is very active for an anemone. It will traverse a distance of two or three yards during a half day.

LIFE HISTORY: Dr. Verrill states that this species discharges young of various sizes and probably eggs also.

TECHNICAL DESCRIPTION: In life this species may attain a diameter of two inches when expanded and a height of about the same, but usually it is scarcely half that size. It is frequently confused in the younger stages with *Urticina crassicornis*, but can best be distinguished therefrom by making a transverse section of the animal. *S. carneola* has the sphincter muscle mesogloal, while in *crassicornis* it is large, circumscribed, endodermal. *S. carneola* never has acontia or cinclidae, and has no small suckers, such as are usual in *crassicornis*.

For complete description consult Carlgren (1892, in Swedish) or Verrill (1899, in English).

REFERENCES: *Actinia carneola* STIMPSON, Smiths. Contrib. Knowl., vol. VI, art. 5, p. 7, 1853, (notes on young specimens one-half inch in diameter).

Actinia obtruncata STIMPSON, *op. cit.*, p. 7 (littoral form).

Rhodactinia davisii AGASSIZ, Compt. Rend., vol. XXV, p. 677, Nov., 1847; Rev. Zoöl. Soc. Cuvierienne, p. 394, 1847 (deep-sea form).

—VERRILL, A. E., Mem. Boston Soc. Nat. Hist., vol. I, part 1, p. 18, pl. 1, fig. 9, 1864.

Stomphia carneola VERRILL, A. E., Amer. Jrn. Sci., 4th Ser., vol. VII, p. 206, figs. 24, 24a-d, 1899. (Good description.)—WHITEAVES, Cat. Marine Invert. East. Canada, publ. Geol. Surv. Canada, p. 40, 1901.—VERRILL, A. E., Canadian Arctic Exped. 1913-18, vol. VIII, part G, p. 118, pl. 30, fig. 1, 1922.—CARLGREN (part), Kongl. Svenska Vet. Akad. Handl., vol. XXV, 2, p. 138, 1892. ?*Stomphia churchiae* GOSSE, Ann. Hist. Nat., ser. III, p. 48, 1859; Actinologi Brit., p. 22, pl. 8, fig. 5, 1860.—ANDRES, Attinie, Fauna u. Flora Golf von Neapel, IX, p. 369, 1883.—CARLGREN, *op. cit.*, p. 80, pl. I, VIII, IX, X, 1892, (anatomy and histology).

CTENOPHORAE.

Order: BEROIDA.

Family: BEROIDAE.

Genus: **BEROE** Browne.

Beroe forskalii H. Milne Edwards.

TYPE: H. Milne Edwards' type was collected at Nice and deposited in the Paris Museum.

DISTRIBUTION: This species is widely distributed in the tropic Atlantic and the tropic eastern Pacific, being known from Ellice Islands, Fiji, Hawaii, Malay Islands, the Maldives and several other stations where it was secured by the "*Albatross*." In the tropic western Pacific the only existing records are from the shores of southern California (Torrey) and from Peru, prior to the capture of the present material by the "*Ara*" in the Pacific Ocean 50 miles S. W. of Cape Mala, Panama, 300 fms. Maas has recorded this species from the Antarctic, a surprising record, in view of the fact that all other known stations for the species are in tropical and subtropical seas.

COLOR: Delicately diaphanous, the very young are transparent, colorless, the half grown are rose color with brilliantly iridescent bands of swimming plates.

LIFE HISTORY: Chun has made careful histological and anatomical studies of the embryo and larval forms of this species from the Gulf of Naples.

DISCUSSION: The four specimens taken by the "*Ara*" are of average size and conform in every essential with the type form of the species.

MATERIAL EXAMINED: Four specimens, taken in 300 fms., 50 miles S. W. of Cape Mala, Panama, March 16, 1926, by the "*Ara*." One, Jicarón Island, Panama, January 26, 1928. One, Pacific Ocean, Lat. 1° 14' N., Long. 90° W., June 30, 1928, 1090 fms.

- REFERENCES: *Beroe rufescens* FORSKAL, Descrip. Anim., etc., p. 111, 1775.—WILL, Horae Terg., p. 20, Triest.—SPAGNOLINI, Atti Soc. Ital. Sc. Nat., vol. XI, fasc. III, 1868, Naples.—PANCERI, Atti R. Acad. Naples, vol. V, p. 2, taf. 1, fig. 1, 1872.
- Cydalisia mitraeformis* LESSON, Voy. "Coquille," Zoöl., vol. II, p. 106, 1830; Atlas, Zoöphytes, pl. 15, fig. 3, 1826; taf. XV, fig. 3, Zoöph. Acaleph., p. 138, taf. 2, fig. 2 (Peru), 1843.
- Idya penicillata* MERTENS, Mem. Acad. St. Petersburg, p. 534, taf. 12, 1833.
- Beroe forskalii* MILNE EDWARDS, H., Ann. Soc. Nat. II e Ser., T. XVI, p. 207, taf. V, 1841.—CHUN, Fauna u. Flora, Golf von Neapel, vol. I, p. 309, taf. 14, figs. 3-5, 1880, (color plate).—TORREY, Univ. Publ. Zoöl., vol. II, p. 47, 1905-06.—MAAS, Medusen Exped. Antaretique Francais, 1903-05, p. 16, pl. 2, fig. 4, 1908.—MOSER, Ctenophoren der Siboga Exped. XII, p. 22, 1909.—BIGELOW, H. B., Bull. Mus. Comp. Zoöl., vol. 54, p. 387, 1912.—MAYER, A. G., Publ. 162, Carnegie Inst. Washington, p. 50, 1912.
- Beroe australis* MAYER, Bull. Mus. Comp. Zoöl., vol. 32, no. 9, p. 177, 1898-99.

ECHINODERMATA.

CRINOIDEA.

Order: **COMATULIDA.**

Suborder: **Oligophreata.**

Superfamily: **Comasteridae.**

Family: **COMASTERIDAE.**

Subfamily: **Capillasterinae.**

Genus: **NEOCOMATELLA** A. H. Clark.

Neocomatella pulchella (Pourtales).

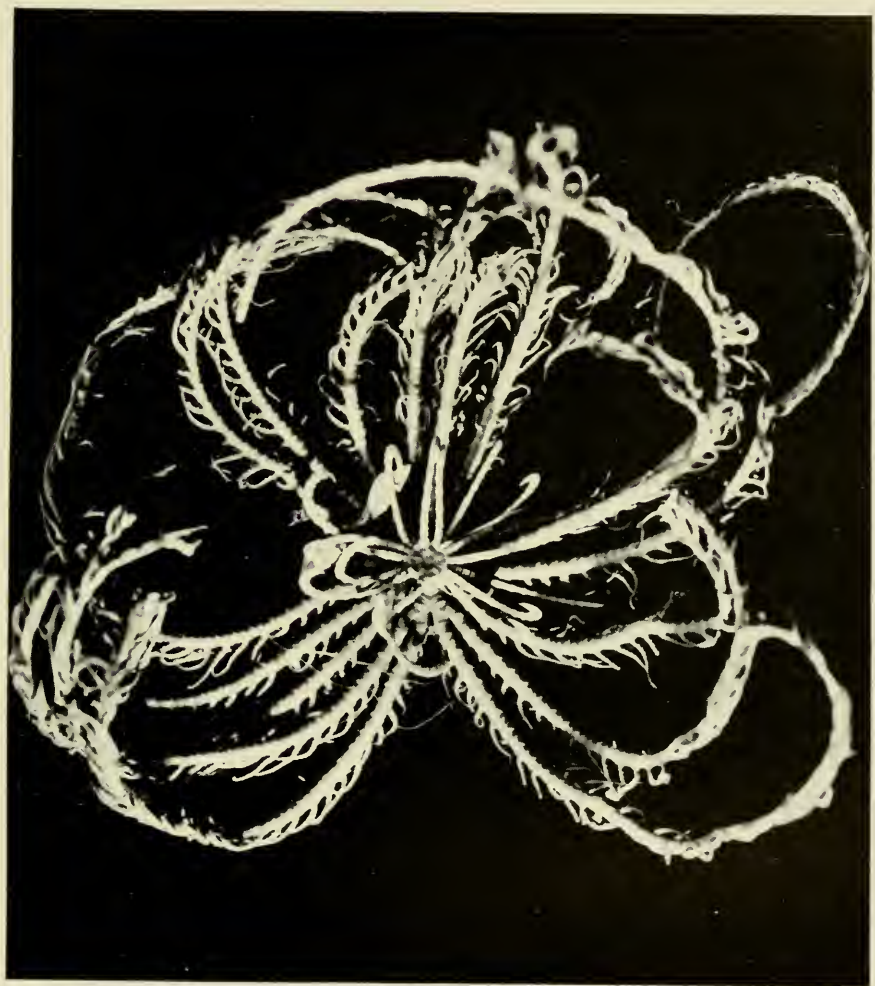
Plate 25.

TYPE: Count Pourtales' type material consisted of two specimens from the "Blake" collection in West Indian waters, but from these the original label had been lost, Cat. no. 494, Museum of Comparative Zoölogy, Cambridge, Mass.

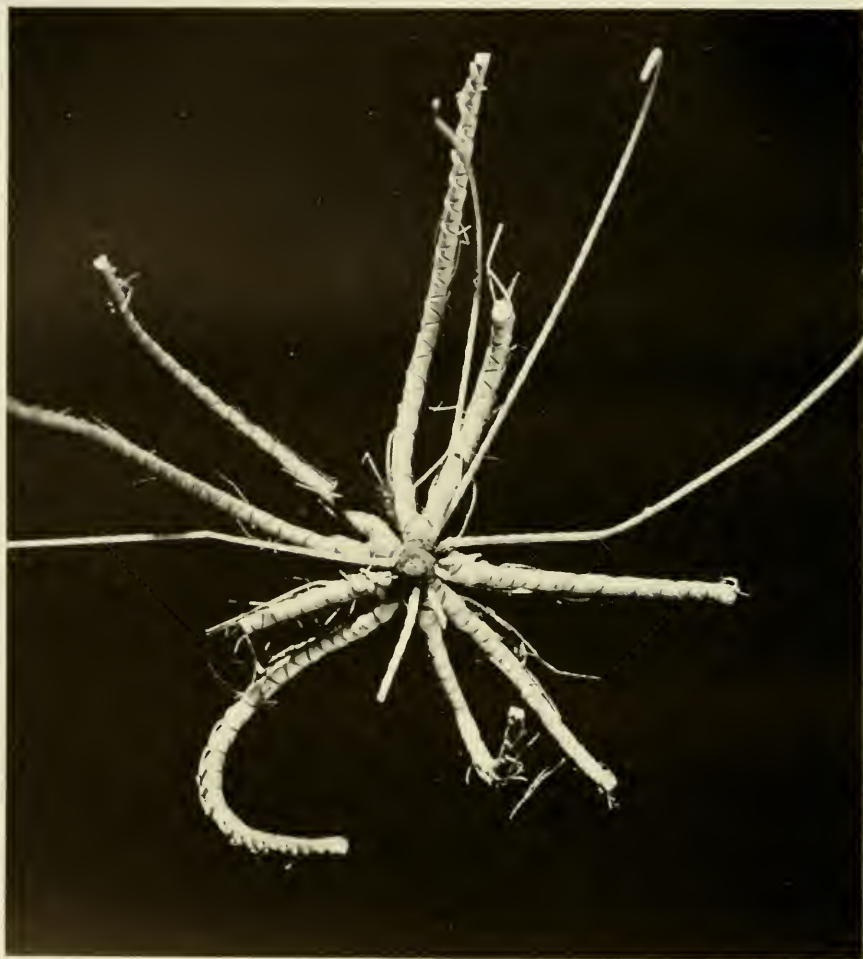
DISTRIBUTION: This species is abundantly distributed in the Caribbean Sea, northward to the Yucatan Bank and the Dry Tortugas, and southward to St. Paul's Rocks. Bathymetric occurrence: 18 to 567 meters. This species prefers to dwell on rough bottoms.

MATERIAL EXAMINED: One very fine specimen, dredged in 150 fms., seven miles S. W. of Alligator Reef, Florida, by the "Ara."

COLOR: The color of this living crinoid is lemon-yellow.



Neocomatella pulchella (Pourtales) $\times 2$.



Antedon adriatica A. H. Clark $\times 2$.

DISCUSSION: This specimen establishes the second time this species has been taken by an expedition other than the cruises of the "Blake." The other record was that of two specimens secured off Habana, Cuba, by the University of Iowa's Bahaman Expedition in 1893. The present specimen has two specimens of a *Lepadid* barnacle attached near the cirri. Clark states that these barnacles are of rare occurrence on cirri of Comatulids but that they are not infrequent on *Stylometra*.

Von Graff has recorded it as the host of *Myzostomum oblongum* von Graff, a free-living species and *M. inflata* von Graff in independent cysts.

Neocomatella pulchella Pourtales is the only Comatulid in the western Atlantic with more than ten arms, all the division series of two ossicles, the dental edges of the brachia are not produced and everted, and there is a conspicuous comb on the outer portion of the proximal pinnules.

Neocomatella pulchella is set apart from *N. europaea* by its more robust cirri, which consist of more numerous segments, the longest of which are only about twice or slightly more than twice as long as wide. *N. pulchella* is also much larger than *N. europaea*. In *N. pulchella* the cirri are 15 to 30, but seldom more than 20, frequently 18 to 19; the arms are 11 to 22, usually about 15 in number, from 100 to 120 mm. in length.

REFERENCES: *Antedon pulchella* POURTALES, Bull. Mus. Comp. Zoöl., vol. 5, no. 9, p. 216, 1878.

Neocomatella pulchella A. H. CLARK, Univ. of Iowa Studies in Nat. Hist., vol. 9, no. 5, pp. 9-11, 1921; Bull. 82, U. S. Nat. Mus., pt. 3, p. 124, pl. 5, figs. 10-12, pl. 6, figs. 13-16, pl. 7, fig. 21, pl. 23, fig. 64, 1931, (with full synonymy and description).

MACROPHREATA.

Family: **ANTEDONIDAE.**

Subfamily: **Antedoninae.**

Genus: **ANTEDON** de Freminville.

Antedon adriatica A. H. Clark.

Plate 26.

TYPE: Dr. Clark's type came from Trieste and is deposited in the United States National Museum, Cat. no. 24,313; cotypes are in the Copenhagen Museum, the Berlin Zoölogical Museum and the Museum of Comparative Zoölogy, Cambridge, Mass.

DISTRIBUTION: Littoral. Confined to the Mediterranean Sea.

Host of the following animals: Copepod, *Collocheres gracilicauda* (Brady); Annelida Polychaeta, *Myzostomum cirriferum* von Graff; *M. buccichii* Von Wagner; and *M. parasitium* Leuckart.

MATERIAL EXAMINED: One specimen, dredged in 65 fms., 11 miles N. W. of Lissa Island, Dalmatia, Adriatic Sea. Ten specimens, dredged in 100 fms., 9½ miles E. by S., ½ S. of Cape Bon Tunis, North Africa, by the "Ara."

COLOR: According to Dr. A. H. Clark, the majority of this species are red, while others are purple-red, or red of various hues spotted with lighter shades, yellow, sulphur-yellow or sulphur-yellow banded with white. The "Ara" specimens were all of the sulphur-yellow tones.

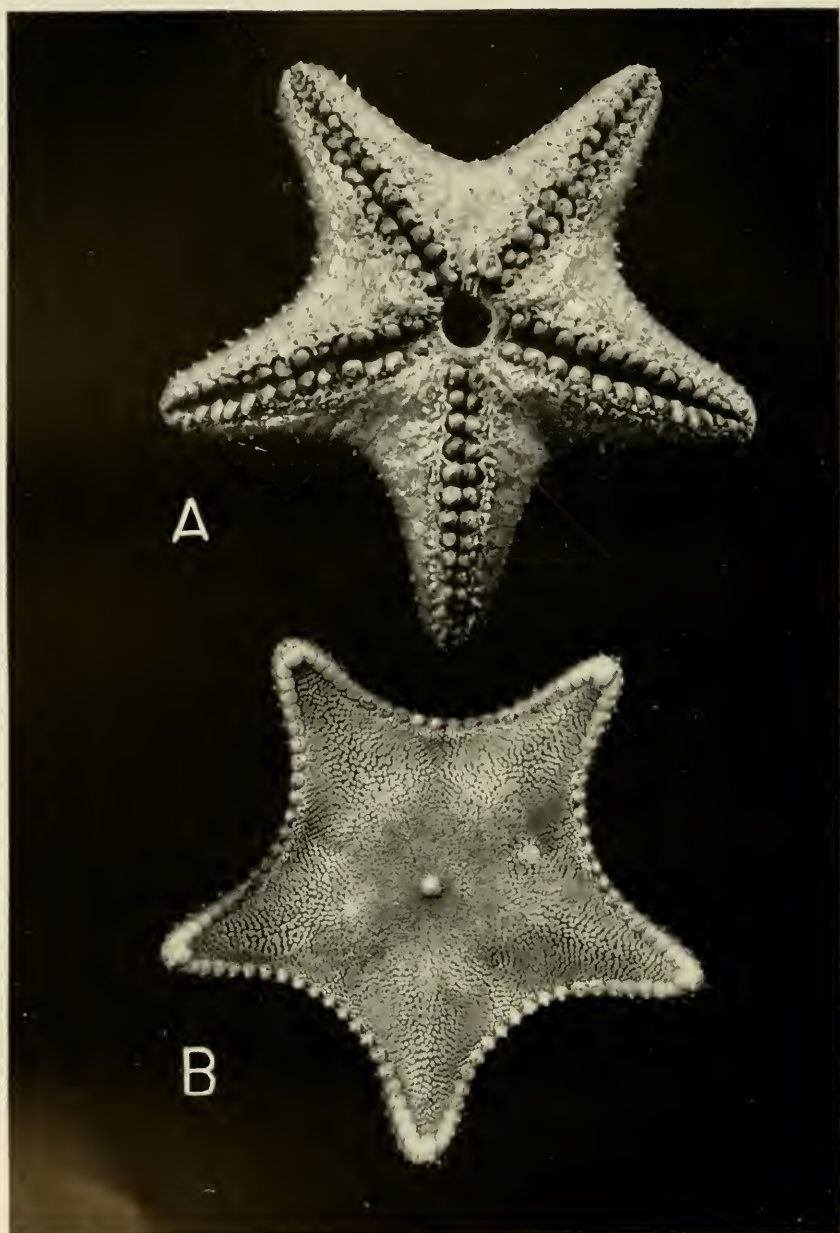
DEVELOPMENT: See Dr. Oswald Seeliger's memoir, 1892.

The eggs are encased in a tough membrane and are attached to the pinnules of the parent. The eggs have a comparatively large yolk. Infrabasals are developed at a little over four days' age; these are usually four to five, more rarely three in number. The known spawning time is the month of May. The eggs are opaque whitish yellowish or light red.

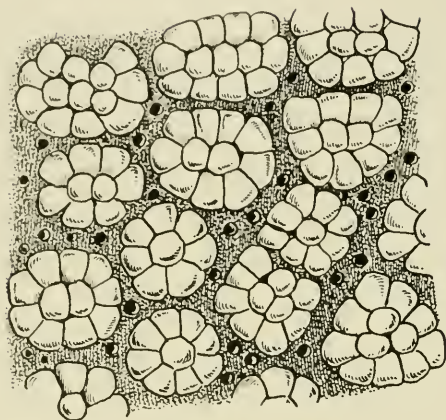
DISCUSSION: This very beautiful Crinoid, which was recorded by Olivi as long ago as 1792, was only established as a distinct species in 1910, when Dr. Austin H. Clark set it apart from *Antedon mediterranea*. Dr. Clark's thorough description of *A. adriatica* and his subsequent monographic analysis of it make further notes superfluous.

A. adriatica and *A. mediterranea* both have very long slender arms, cirri and cirrals, especially *adriatica*, and the two species closely resemble each other, but are distinguished by the differences in the length and in the proportions and the numbers of joints in the arms and cirri.

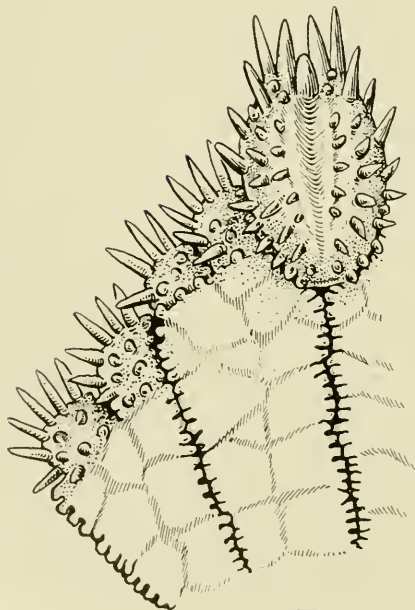
REFERENCES: *Antedon adriatica* A. H. CLARK, Proc. U. S. Nat. Mus., vol. 38, no. 1749, p. 331, June, 1910; Mon. Existing Crinoids, vol. I, pt. 1, Bull. 82, U. S. Nat. Mus., pp. 21, 43, 56, 60, 123, 132, 171, 300, 315, 316, fig. 1, fig. 106, 1915; *ibid*, pt. 2, pp. 52, 53, 73, 95, 119, 132, 150, 225, 265, 278, 291, 330, 349, 367, 373, 374, 410, 431, 433, 500, 502, 503, 509, 527, 578, 579, 580, 581, 583, 584, 585, 588, 589, 590, 595, 608, 610, 611, 635, 648, 654, 655, 657, 660, 663, 669, 684, 697, 723, 729, 730, 731, 732, 733, 735, 736, 747, 752, 755, fig. 80, fig. 757, 1921; *ibid*, pt. 3, pp. 43, 56, 1931.



Ctenodiscus crispatus (Retzius), natural size. A, Oral view; B, Aboral view.



A



B

Ctenodiscus crispatus (Retzius), A, section of the aboral surface $\times 20$; B, section of the oral surface, showing the jaw angle and adjacent region.

ASTEROIDEA.

Order: **PHANERAZONIA.**

Suborder: **Paxillosa.**

Family: **PORCELLANASTERIDAE.**

Genus: **CTENODISCUS** Muller and Troschel.

Ctenodiscus crispatus (Retzius).

Plates 27 and 28.

TYPE: Original description not available for examination.

DISTRIBUTION: Apparently circumpolar in the Arctic, in Europe on the Scandinavian and northern British coasts; at Iceland; Greenland; on the east coast of North America down to Massachusetts, and on the west American coasts down to Chile; on the Asian coast down to Japan. Bathymetric occurrence: from 2 to about 10 fms., but apparently the species is found in greatest abundance from about 25 to 300 fms.

MATERIAL EXAMINED: Seven specimens, dredged in the middle of St. George's Bay, Newfoundland, September 2, 1926.

COLOR: In life this species is yellowish.

HABITS AND DEVELOPMENT: *C. crispatus* apparently requires about three years to attain its full size. Its development is unknown, but from the fact that the eggs are large with big yolks, it is believed by Dr. Mortensen to probably have a direct development, without a free pelagic larval stage. It lives on muddy bottoms and feeds chiefly on the small creatures that live in the mud.

TECHNICAL DESCRIPTION: Rays five, rarely four or six; varying a great deal in length. $R = 28$; $r = 14$; $R = 2r$. The abactinal surface is covered with closely set paxillae, consisting of a short, tabular, subcircular base, crowned with 8 to 15 short, clavate spines, arranged rosette fashion; these rosettes are closely packed over the entire abactinal surface. The madreporite is oval, 5 mm. long diameter, crossed by numerous fine, wavy ridges alternated with grooves. The marginal plates and oral interradial surfaces and adambulacral plates are covered by a fine, soft skin. On the median dorsal margin of each marginal plate there is a prominent stout, conical spine. Cribriform organs are present between all of the marginal plates, but are concealed by a web of papillae along the margin of the plates and continued as simple channels similarly covered by webs, over the oral interradial region and between the adambulacral plates. There is also a stout, conical spine at about the median point of the outer or

dorsal end of each inferomarginal plate. The plates of the oral inter-radial area are much smaller than the marginal plates and are flat, of irregular size, closely placed. The adambulacral plates bear three to five short, stout, conical, skin-encased spines set fan-wise along the margin adjacent to the furrow; the two median spines are the largest of each series. The adambulacral furrows are quite wide; the tube-feet stout, arranged in two longitudinal series. The two jaw-plates of each ray are somewhat pear-seed shaped, encased in skin, which bears numerous small, conical spines. The oral teeth are long, conical, usually six, arranged in a stouter, median pair, and two, slenderer, longer spines below these on each side of the median pair.

REFERENCES: *Astropecten corniculatus* LINCK, De Stellis Marinis, p. 27, tab. 36, no. 763, 1733.

Asterias crispata RETZIUS, Dissert. sist. species cognitas Asteriarum, p. 17, 1805.

Asterias polaris SABINE, in Parry's Journal of a Voyage for the Discovery of a Northwest Passage, in 1819-20, Appendix, p. cexxiii, pl. 1, figs. 2, 3, 1821.—VERRILL, Proc. Boston Soc. Nat. Hist., vol. X, p. 356, 1866.—American Journ. Sci., 3rd ser., vol. 9, p. 420, 1876; vol. 49, p. 208, 1895.—LUTKEN, Vidensk. Meddel. Nat. Forening., p. 28, 1871.—BUSH, Proc. U. S. Nat. Mus., vol. VI, p. 246, 1883.—PERRIER, Arch. Zoöl. Exper., vol. IV, p. 322, 1875.

Asterias arancia DEWHURST, Nat. Hist. of Order Cetacea, etc., p. 283, 1834.

Astropecten polaris GRAY, Ann. and Mag. Nat. Hist., vol. VI, p. 180, 1840.

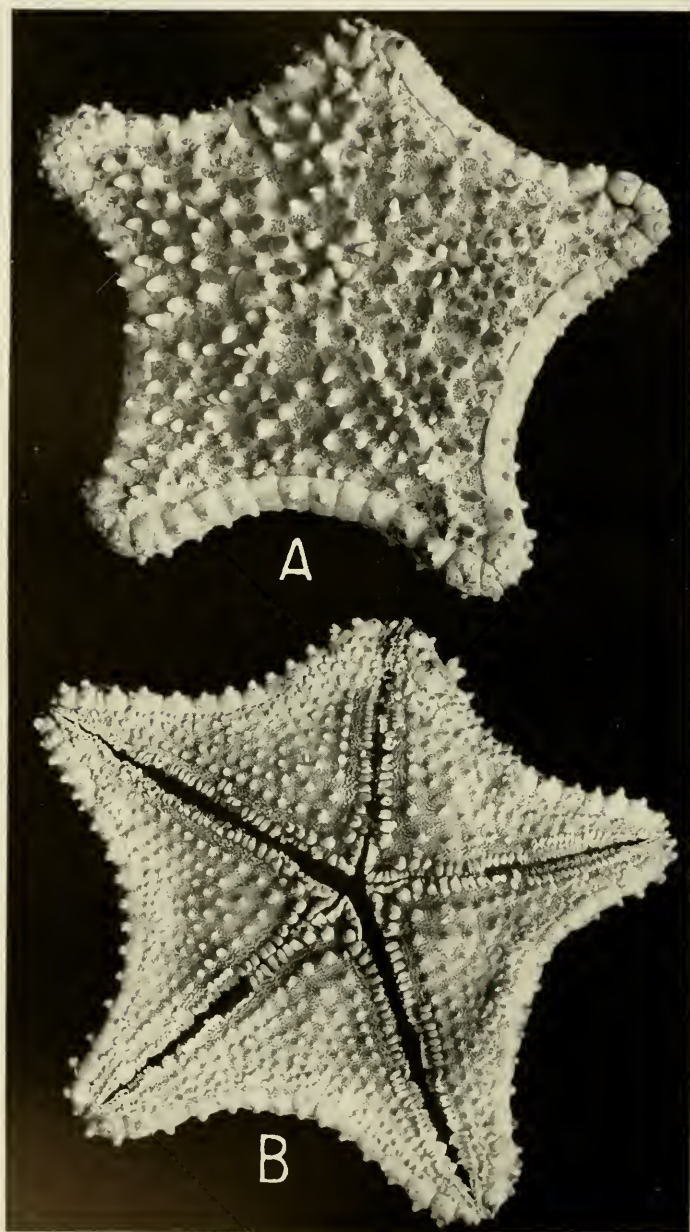
Ctenodiscus polaris MULLER and TROSCHER, Syst. Aster., p. 76, p. 129, 1842.

Ctenodiscus pygmaeus MULLER and TROSCHER, *ibid*, p. 76, p. 129.

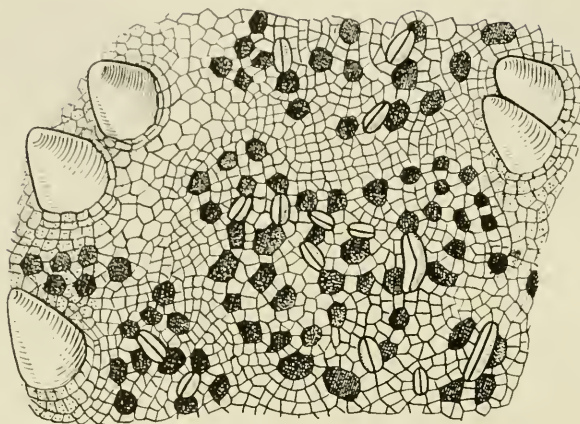
Ctenodiscus crispatus DUBEN and KOREN, K. Vet. Akad. Handl., p. 253, 1844.—GANONG, Bull. Nat. Hist. Soc. New Brunswick, no. 7, p. 49, pl. 3, fig. U, 1888.—MORTENSEN, TH., Echinod. British Isles, p. 53, fig. 30, 1927.

Anodiscus crispatus (?Val., Mss.) PERRIER, Ann. Sci. Nat., 5e ser., t. XII, p. 298, 1869.

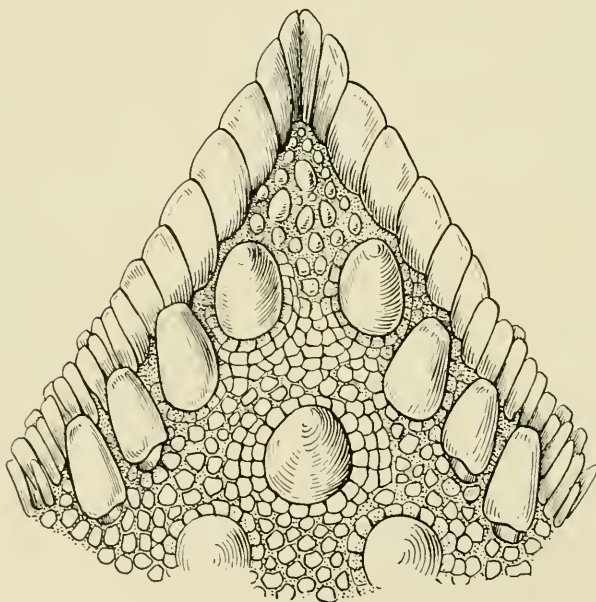
Ctenodiscus corniculatus PERRIER, Revis. Stell. Mus., p. 380, 1876; Arch. de Zoöl. Exper., t. V, p. 300, 1875.—SLADEN, Rept. Voy. "Challenger," Zoöl., Asteroidea, vol. XXX, p. 171, 1889.—A. H.



Nidorellia armata J. E. Gray, about two-thirds of natural size. A, abactinal view;
B, oral view; both of a specimen in which one arm has been injured.



A



B

Nidorellia armata Gray, A, section of aboral surface $\times 5$; B, section of oral surface at jaw angle, $\times 5$.

CLARK, Rept. Canadian Arctic Exped. 1913-18, vol. VIII, part C, Echinod., p. 7c, 1920.

Asteracanthion polaris MULLER and TROSCHER, *op. cit.*, p. 16.—LUTKEN, Syst. Overs. Gronslands Echinod., p. 28, 1857.—DUNCAN and SLADEN, Mem. Echinod. Arctic Sea to the west of Greenland, p. 23, pl. 2, figs. 4-8, 1881.

Family: **ASTROPECTENIDAE.**

Genus: **NIDORELLIA** Gray.

Nidorellia armata Gray.

Plates 29 and 30.

TYPE: The type was collected by H. Cuming in Punta Santa Elena, Ecuador, on rocky bottom, 12 to 15 fms. depth, and is deposited in the British Museum.

DISTRIBUTION: Found on the American Pacific coast from Lower California southward to Zorritos, Peru; also known from the Galapagos Islands; littoral.

MATERIAL EXAMINED: One specimen, Webb Cove, Albemarle Island, Galapagos Islands, March, 1928.

COLOR: In life this starfish is bright scarlet.

TECHNICAL DESCRIPTION: Dr. Verrill gives an excellent description of this species, based on an extensive series of specimens and discussing the types of variation found in different rays of the same specimen, as well as the types of variation occurring between different specimens.

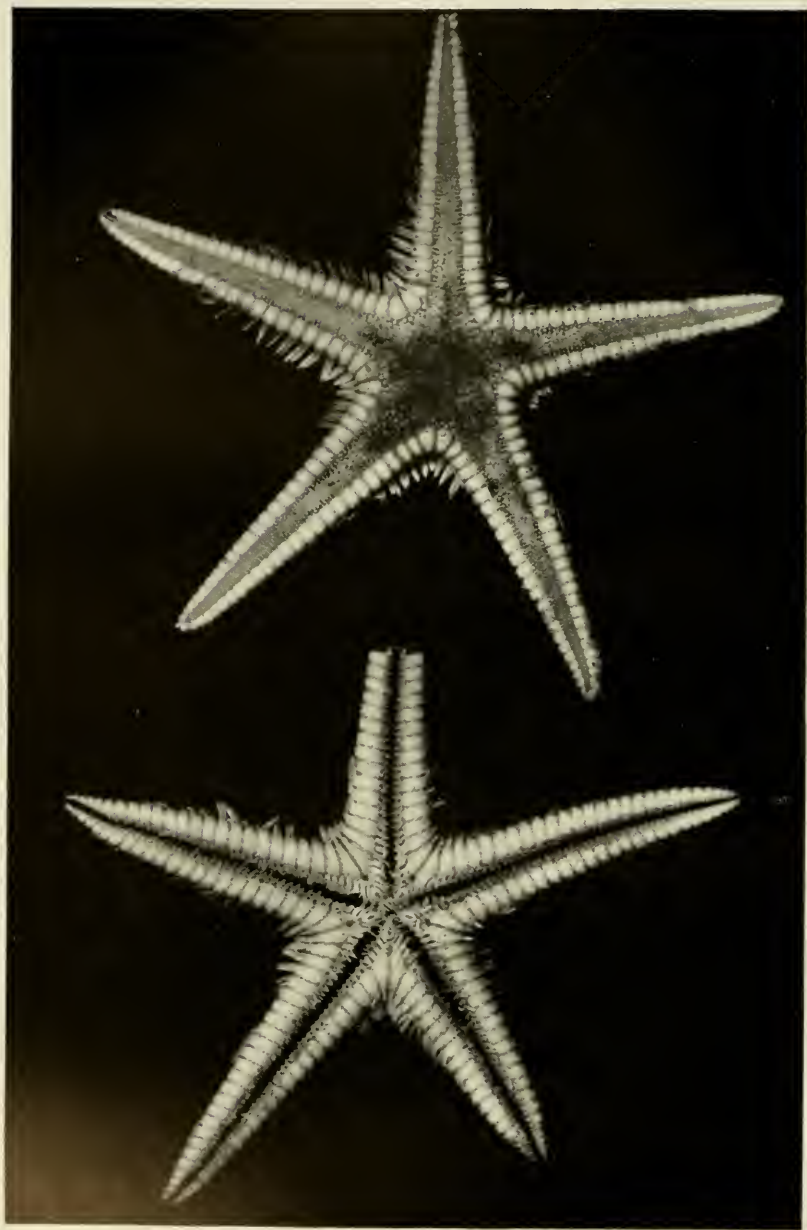
The "Ara" specimen has a radius of 73.5 mm. and is regularly pentagonal, with the interbrachial arc concave and the rays short, broad, rounded at the tips. The abactinal surface is a little convex, with a stout conical spine upon a tubercular prominence in the center and surrounded by similar spines, some of which correspond to the interradian zone, and some of the rays, down the center of each of which extends a row of similar spines. The interradian region is set with similar spines placed irregularly. The spines of the abactinal surface and margin are conical, thick, smooth and naked, except at the base, where they are surrounded by irregular patches composed of short, polygonal paxillae. Similar paxillae also form the network surrounding the large groups of pores which occupy all the intervals between the plates and frequently form large, sieve-like patches. Scattered among the pores are numerous small, short and broad, oblong

pedicellariae; as many as nine are found in a single cluster of pores. The madreporic plate is large, situated on one side of the ray, about half an inch from the center of the disk, and is irregularly sub-circular, with its upper surface broken into many irregular radiating ridges, separated by equivalent grooves. The superomarginal plates which form the greater part of the border are about a half inch deep in the median two-thirds of each arc, slightly less so towards the tips of the rays. There are 15 to 16 plates on each of the five arcs, the median seven or eight being oblong, much broader than long, while the outer four of each series are nearly square, the outermost one being swollen. There is a stout, conical spine on each plate near or slightly above the middle of the plate. The inferomarginal plates number twenty to the arc, and are near the ventral surface in the median region of the series, but tend to form more of the margin toward each end. Each plate bears a stout, conical spine similar to but larger than those of the actinal surface. The median plates of each series are the smaller, squarish; the outer one four or five times longer than broad, except the outermost one which is smaller, triangular and well up on the tip of the ray. The actinal surface is covered by numerous low, rounded, tabular paxillae that become finer and closer toward the marginal plates, both series of which they completely cover. On the actinal surface rather regularly spaced among the paxillae are larger, short, blunt, conical spines, the smaller spines of the series occupying the outer portion of each interradial space, while near the center the spines become distinctly larger. Scattered among the actinal paxillae are many small, stout, oblong pedicellariae, similar to those on the actinal surface. The interambulacral plates near the mouth bear seven or eight blunt, flattish, slender spines in a single row, the two apical spines the longest. Outside of these there is a row of very stout, rounded spines with blunt tips, spaced one opposite each cluster of the interambulacral spines, those near the jaw angle being the largest, the series diminishing in size toward the end of the rays, where they become small and more acuminate. The ambulacral furrows are narrow and turn upward at the end of the rays and terminate between the swollen upper plates.

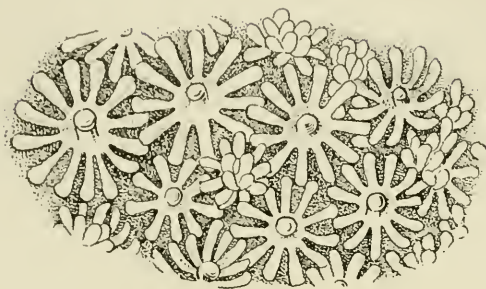
REFERENCES: *Pentaceros (Nidorellia) armatus* GRAY, Ann. Mag. Nat. Hist., vol. VI, p. 276, 1840.

Orcaster armatus MULLER and TROSCHEL, System der Asteriden, p. 52, 1842.

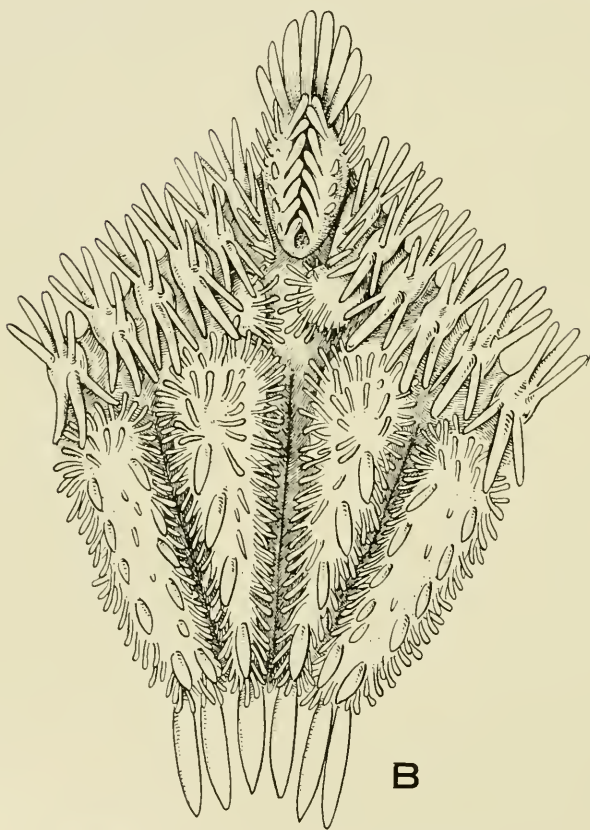
Goniodiscus armatus LUTKEN, Vidensk. Meddel., p. 59, 1859.



Astropecten antillensis Lutken, natural size of young specimen.



A



B

Astropecten antillensis Lutken, A, section of aboral surface $\times 9$; B, section showing jaw-angle $\times 9$.

Oreaster armatus LUTKEN, *op. cit.*, p. 148, 1864.—E. VON MARTENS, Monatsb. Akad. Berlin, 1865; an English translation of this is in Ann. Mag. Nat. Hist., XV, p. 433, 1865.

Nidorellia armata A. E. VERRILL, Trans. Conn. Acad. Arts and Sci., vol. I, p. 280, 1867.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 52, p. 332, pl. 4, fig. 2, 1910.—BOONE, L., Bull. Bingham Oceanog. Coll., vol. II, art. 6, p. 3, pl. 1, 1928.

Genus: **ASTROPECTEN** Linck.

Astropecten antillensis Lutken.

Plates 31 and 32.

TYPE: Lutken's type came from St. Thomas, W. I., and is deposited in the Copenhagen Museum.

DISTRIBUTION: This is one of the less abundant of the West Indian species of *Astropecten*, having been recorded from St. Thomas; Guadeloupe and Porto Padre, Cuba.

MATERIAL EXAMINED: Two specimens, collected at Porto Padre, Cuba, March, 1928.

HABITS: This species is reef-dwelling and spends a great deal of its time buried in the sand, but is also very agile and can move about rapidly.

TECHNICAL DESCRIPTION: Verrill considers this species very closely allied to *Astropecten duplicatus* and that it may possibly prove to be only a local variety of this species. *A. antillensis* is also closely allied to *A. brasiliensis* Muller and Troschel, but Perrier, who has examined the types of both species, considers the species distinct.

The "Ara" specimens are of about the same size. The slightly larger one is regularly stellate with five, slender, tapered rays. $R = 43$ mm., $r = 10$ mm. The superomarginal plates are 28 to each side of each ray, rectangular, except the innermost one and the one at the tip of each ray. Each superomarginal plate has its dorsal surface nearly square, and its lateral surface similar, the width of the plate being slightly less than one-half of its entire length; there is a stout, conical spine on each plate, arising from the center and forming a marginal series. There is also an incomplete row of similar spines on the plates of the superomarginal series from the interbrachial angle extending half way to the tip of each ray. The inferomarginal plates are opposite the superomarginals, and bear each two long, flattened, bluntly rounded slender marginal spines; the ventral surface of these

plates is sparsely covered with slender, flattish spinules and also has a transverse row of larger flattish spines. The adambulacral plates each bear two rows of spines, about five spines in each row, the middle spine being the largest of each series. The paxillar region of the abactinal surface is closely crowded with paxillae composed of a small base crowned with one central blunt spinule surrounded by six to eight, more rarely nine, marginal spinules, forming a flower-like design. Numerous pores are present among the dorsal paxillae.

REFERENCES: *Astropecten antillensis* LUTKEN, Vidensk. Meddelels., ser. 2, vol. I, p. 47, 1859.—VERRILL, Trans. Conn. Acad. Arts and Sci., vol. I, p. 343, 1867.—PERRIER, Revision Echini, Arch. Zool. Exper. et Gen., vol. V, p. 282, 1876.—VERRILL, Bull. Labr. Nat. Hist. State Univ. Iowa, vol. VII, no. 1, p. 172, 1915.

Family: **LUIDIIDAE**.

Genus: **LUIDIA** Forbes.

Luidia marcgravii (Lutken).

Plates 33, 34, 35 and 36.

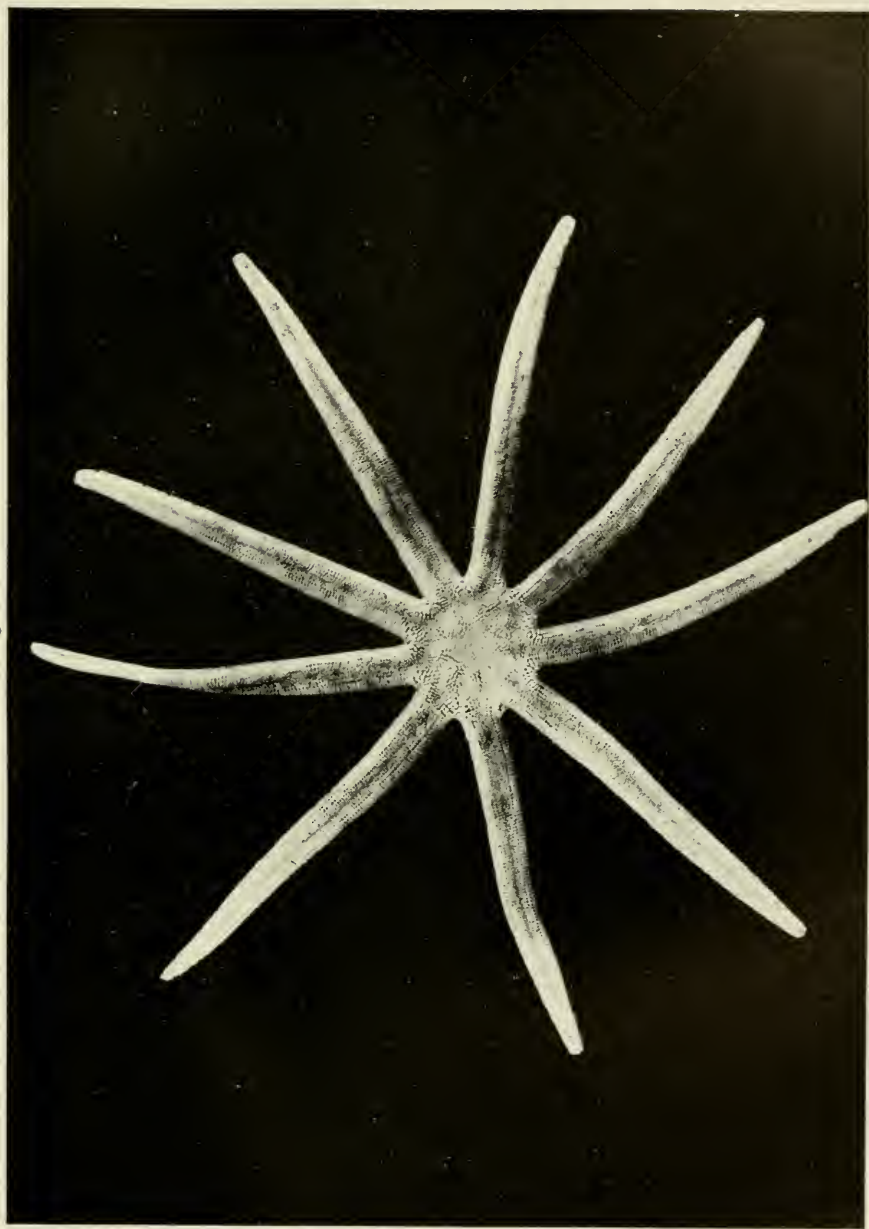
TYPE: Lutken's type material came from Cotinguiba, Brazil, and San Domingo and is deposited in the Copenhagen Museum. One of Lutken's cotypes from Brazil is in the Peabody Museum, New Haven, Conn. Marcgraf de Liebstad first recorded the species from Brazil in 1648, while Patrick Browne published it from Jamaica in 1746.

DISTRIBUTION: This species is quite abundant on the shores of Brazil and has also been reported from Jamaica at Kingston and Port Royal and from San Domingo and Guadeloupe. It is a reef-dwelling species which apparently is less abundant in its northern range of the West Indian region. Perrier considers the present species identical with the *L. senegalensis* known from the coast of West Africa. Lutken considers these two species closely related but distinct.

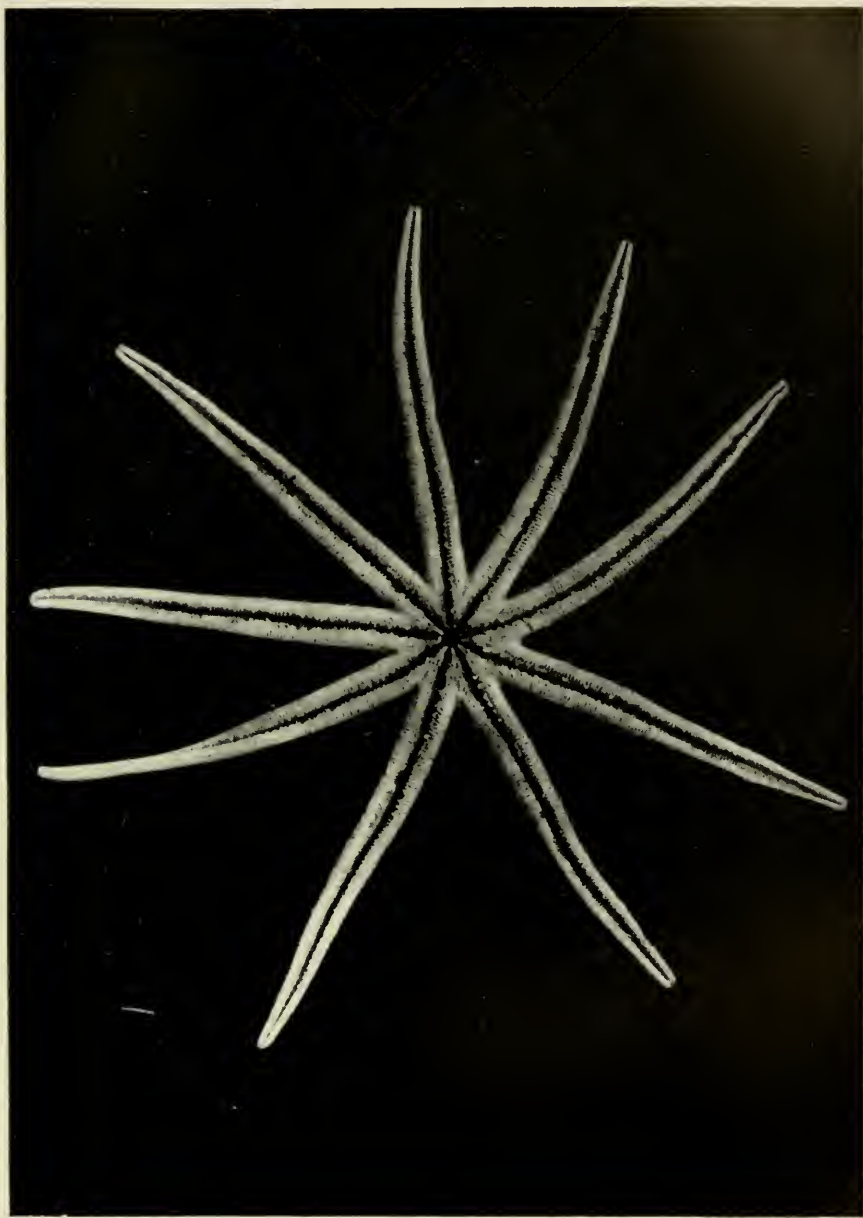
MATERIAL EXAMINED: Two specimens collected south of Catalina Creek, Cuba, February 11, 1924; one specimen from Guantanamo Bay, Cuba, February 8, 1924; one specimen collected at Port Segua la Grande, Cuba, February 23, 1925, by the "*Ara*."

COLOR: According to Dr. H. L. Clark, the color of this starfish when alive is greenish or grayish on the abactinal surface; yellow on the actinal surface.

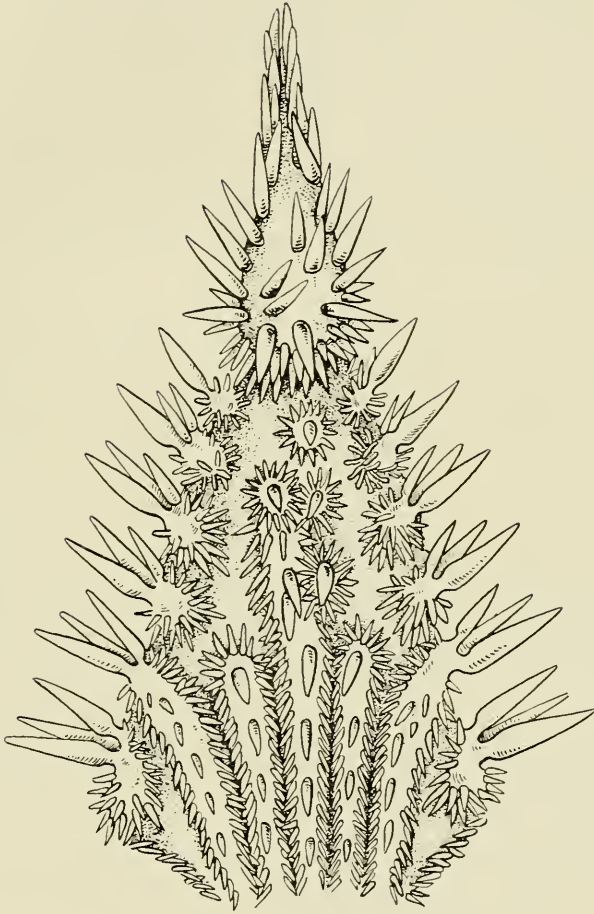
TECHNICAL DESCRIPTION: The largest "*Ara*" specimen has a diameter of 320 mm. Verrill records one with a diameter of 360 mm. All



Luidia maregravii (Lutken), about two-fifths of natural size.

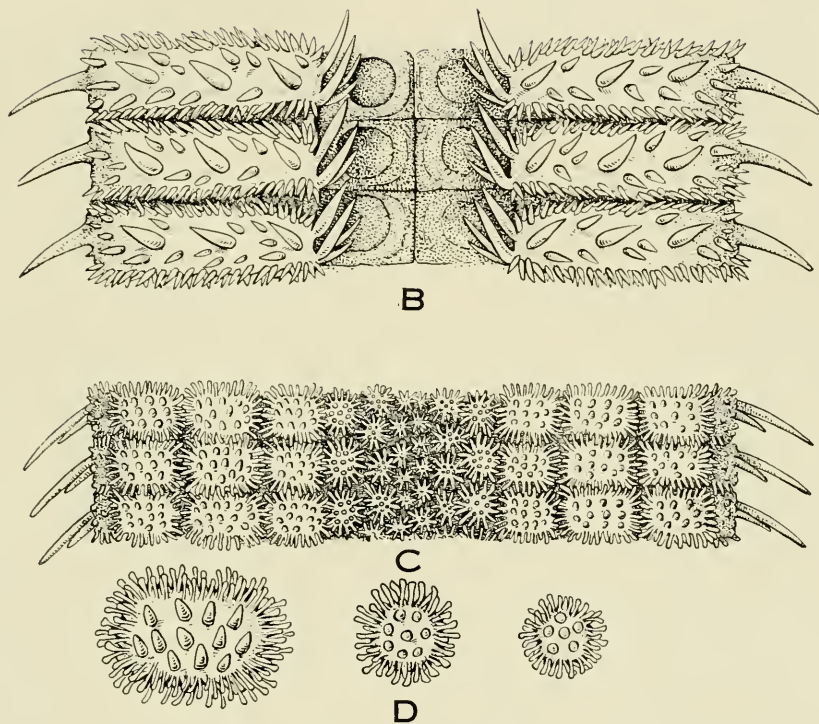


Luidia marcegravi (Lutken), about two-fifths of natural size.



A

Luidia maregravi (Lutken), section of oral surface, showing jaw-angle and adjacent region, $\times 8$.



Luidia maregravii (Lutken), B, cross-section of oral surface of an arm, near its base, $\times 7$; C, cross-section of aboral surface of an arm, $\times 7$; D, detail of patterns on aboral section, much enlarged.



Luidia columbia (J. E. Gray), about one-half of natural size.



Luidia columbia (J. E. Gray), about one-half of natural size.

the "Ara" specimens have nine rays each. Specimens with only eight rays have been recorded.

Rays nine, very long and slender, gradually tapered. $R = 160$ mm., $r = 18$ mm. Disk small, circular, interbrachial angle acute. Abactinal surface covered with close-set paxillae; those of the center of the disk and median area of the rays being much the smaller; in shape the smaller paxillae are nearly circular or oval; the spines are short with blunted convex tips, covered with small, rounded granules. The larger dorsolateral paxillae of the rays are in three series on each side and the paxillae are oval with 35 to 50 short rounded granulose spinules. In the interradian area the larger paxillae form a triangular area. The inferomarginals are densely covered with short, flat spines, larger toward the middle, and each plate bears two larger, acuminate, biserial marginal spines. The adambulacral plates bear three or four stout, tapered, laterally compressed spines, the inner two of each plate being curved and more acuminate than the others. The jaw angle bears 18 to 24 slender, long spines, 10 to 12 of which are paired in series, one above the other at the apex.

REFERENCES: *Stella marina* MARCGRAF, GEORGE, Hist. Rerum Nat. Brasiliae, vol. VIII, p. 189, 1648.

Asterias 4. "The large starfish with eight or more slender arms," PATRICK BROWNE, Civil and Natural History of Jamaica, p. 393, 1756.

Luidia marcgravii LUTKEN, Vidensk. Meddel., series 2, vol. I, p. 43, 1859 (issued 1860).—VERRILL, Trans. Conn. Acad. Arts and Sci., vol. I, p. 343, 1867; Bull. Labr. Nat. Hist. S. Univ. Iowa, vol. VII, no. 1, p. 208, pl. 5, fig. 1, 1915.

Luidia senegalensis STEENSTRUP, Mss. in the Copenhagen Museum.—MULLER and TROSCHEL, Syst. der Asterid., p. 78 (in part), 1842. (Not LAMARCK.).—PERRIER, Arch. Zoöl. Exper. de Génér., vol. V, p. 262, 1876.—RICHARD RATHBUN, Trans. Conn. Acad. Arts and Sci., vol. V, p. 149, 1879.

Luidia columbia (J. E. Gray).

Plates 37 and 38.

TYPE: Gray's type came from St. Blas, collected by H. Cuming, and is deposited in the British Museum.

DISTRIBUTION: A littoral species known from Magdalena Bay, Lower California and the Gulf of California, southward as far as northern Peru; also found in the Galapagos Archipelago.

MATERIAL EXAMINED: One specimen from Webb Cove, Albemarle Island, Galapagos Islands, February 3, 1926; Cat. no. 275.

COLOR: Dr. Robert Coker's field notes, made on Peruvian specimens, state that in life this starfish is "dorsally of a mouse color with many dark specks. Below yellowish white."

HABITS AND LIFE HISTORY: Unrecorded.

TECHNICAL DESCRIPTION: Rays five, regularly tapered; $R = 97$ mm., $r = 19$ mm. The abactinal surface of the disk is flat, of moderate size. The paxillae of the disk and median region of the rays are small, the tabulae irregularly circular, becoming angular at the margins. The margin of each tabulum bears 10 to 14 short spinelets inside of which are 4 to 10 short, stout, blunt spinelets. Along each side of the ray are three longitudinal rows of larger paxillae, each of which tend to squarish or rectangular outline. There are numerous large, circular pores, rather regularly spaced on the abactinal surface. The inferomarginal plates bear each three spines, the uppermost of which is distinctly shorter than the lower two, each of which is long, slender, acuminate, forming a distinct marginal fringe. On the actinal surface the inferomarginals are well separated from each other; they bear a median series of 10 to 12 longer spinelets on either side of which there is a double row of shorter spines along the transverse margin of each plate. The adambulacral plates bear usually four, occasionally three to five, large spines; the innermost one being long, slender, curved, well down towards the furrow, followed by a second, similar, but stouter spine, these two in single file, while the third and fourth spines are paired beside each other, not in line with the others, straight and a little smaller than the second spine. There are sometimes one or two spinelets also on the lateral margin of these plates. There are ten to twelve long slender teeth clustered at each jaw angle. The madreporic plate is small, subcircular, sculptured by fine radiating lines and situated well down in the interradiial angle.

REFERENCES: *Petalaster columbia* J. E. GRAY, Ann. Mag. Nat. Hist., vol. 6, p. 183, 1840.

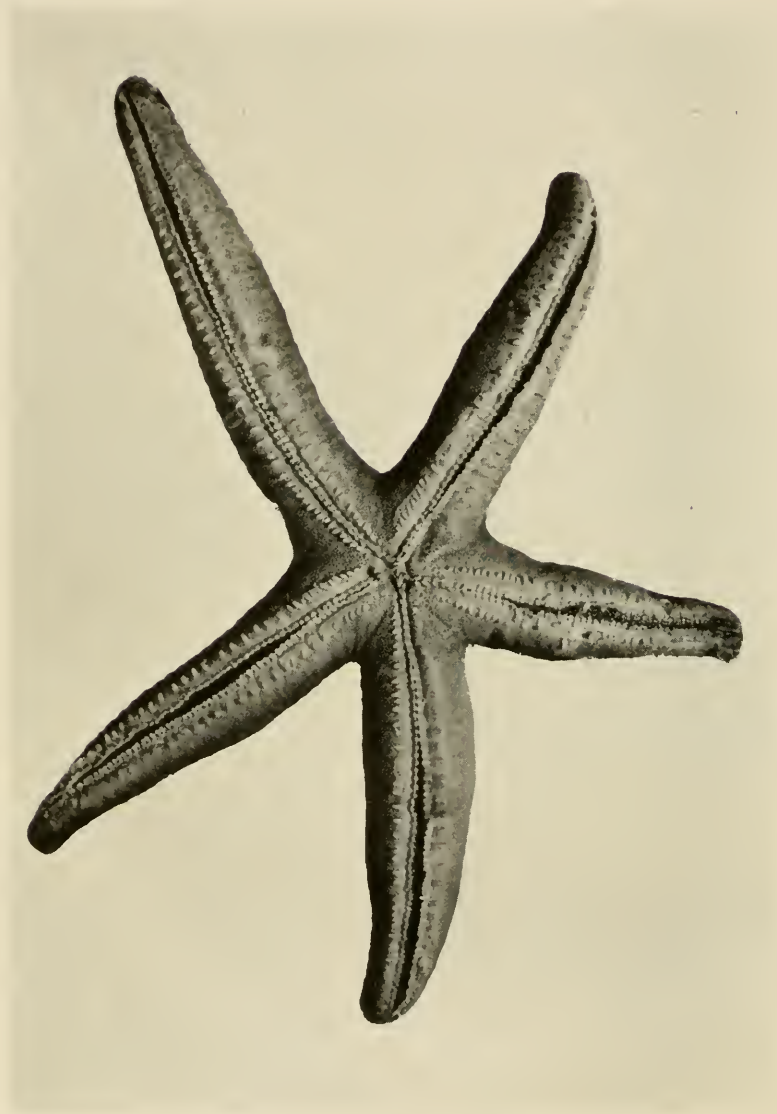
Luidia tessellata C. F. LUTKEN, Vidensk. Meddelel., p. 40, 1859.—

VERRILL, Trans. Conn. Acad. Arts and Sci., vol. 1, p. 271, 1867.

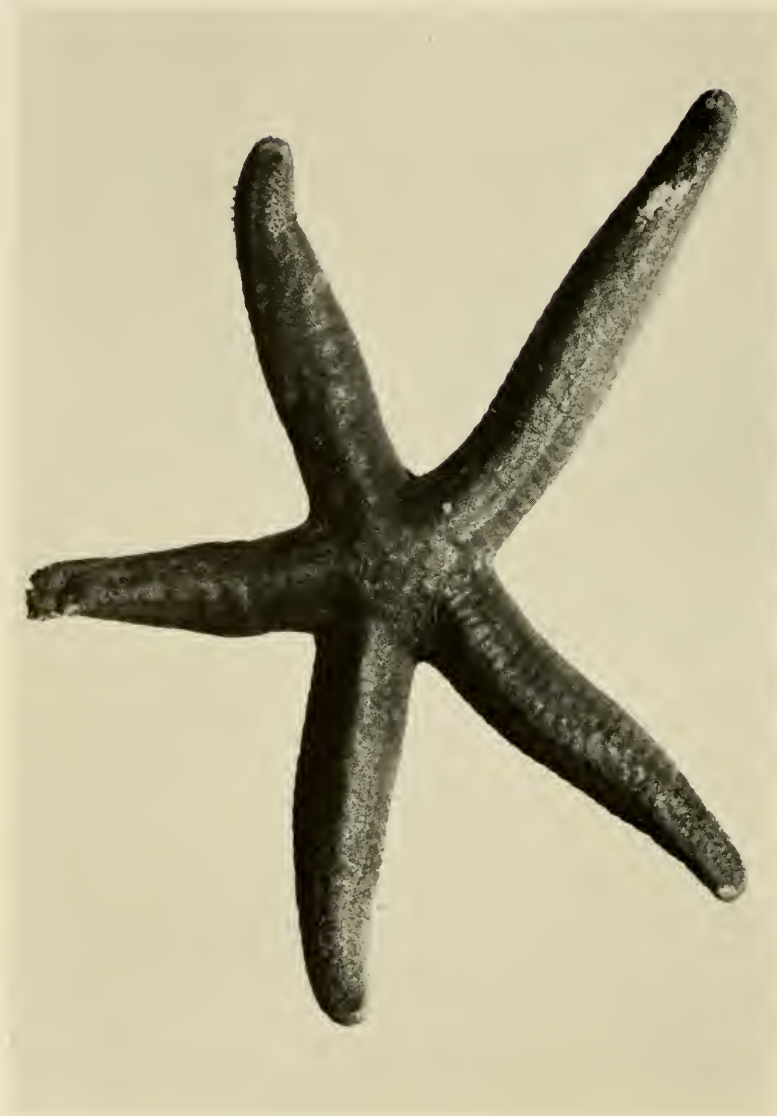
Petalaster columbiae VERRILL, *op. cit.*, p. 272.

Luidia columbiae E. PERRIER, Arch. Zoöl. Exper., vol. 5, p. 253, 1876.

—SLADEN, Sci. Rept. Voy. "Challenger," Asteroidea, vol. XXX, p. 247, 1889.



Linckia columbiae Gray, reduced about one-third.



Linckia columbiae Gray, reduced about one-third.

Luidia columbia H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 52, p. 331, pl. 1, fig. 2, October, 1910.

Suborder: **Valvata.**

Family: **OPHIDIASTERIDAE.**

Genus: **LINCKIA** Nardo.

Linckia columbiae Gray.

Plates 39 and 40.

TYPE: Gray's type was collected in the Bay of Caracas, West Colombia, on the rocks at low water, by H. Cuming, and is deposited in the British Museum.

DISTRIBUTION: A littoral species known from Lower California to northern Peru, including the Galapagos Islands.

MATERIAL EXAMINED: One specimen, collected in Webb Cove, Albe-marle Island, Galapagos Islands, February 3, 1928.

COLOR: In life the abactinal surface is cocoa-brown with numerous smaller brown flecks. This coloration persists on the outer portion of the actinal surface also, the median portion of the disk and rays being dirty light cocoa or cream color.

TECHNICAL DESCRIPTION: The single specimen taken by the "Ara" presents a curious malformation due to the regeneration of three of the five arms. The fully developed arm has an R of 104 mm., $r = 19$ mm. The normal rays are long, slender, tapered, well rounded. Only five-rayed specimens have been recorded, among the few specimens taken, but *L. columbiae* evidently possesses the capacity to regenerate lost arms in about the same degree as *L. guildingi*. It is probable that specimens of *L. columbiae* with four to seven arms may be found. The abactinal plates in this species are numerous, thick, irregularly polygonal, a little convex with the margins occasionally overlapping. The dorsal surface of the plates is regularly paved with large, rounded granules which are also found between the apertures of the papular areas, which latter are conspicuous and large with numerous papulae. The supero- and inferomarginal plates are nearly equal in size, each being irregularly polygonal or suboval and somewhat larger than those of the abactinal surface. The interactinal plates are small, crowded, and are covered by the crowded granulation. The adambulacral plates bear a single row of stout, thick, sub-cylindrical, blunt-tipped spines, set close together well down in the furrow margin. On the outer margin of the adambulacral plates there

is also a row of similarly thick, but much shorter blunt spines, which point outward toward the margin of the ray and are separated from each other at the base by a distance equal to the length of one spine.

REFERENCES: *Linckia columbiae* GRAY, Ann. Mag. Nat. Hist., vol. 6, (n. s.), p. 285, 1840.—H. L. CLARK, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 194, 1913.—BOONE, Bull. Bingham Oceanog. Coll., vol. II, p. 5, pl. 3, 1928.

Family: **OREASTERIDAE** Fisher.

Genus: **OREASTER** Muller and Troschel.

Oreaster reticulatus (Linné) Muller and Troschel.

Plates 41 and 42.

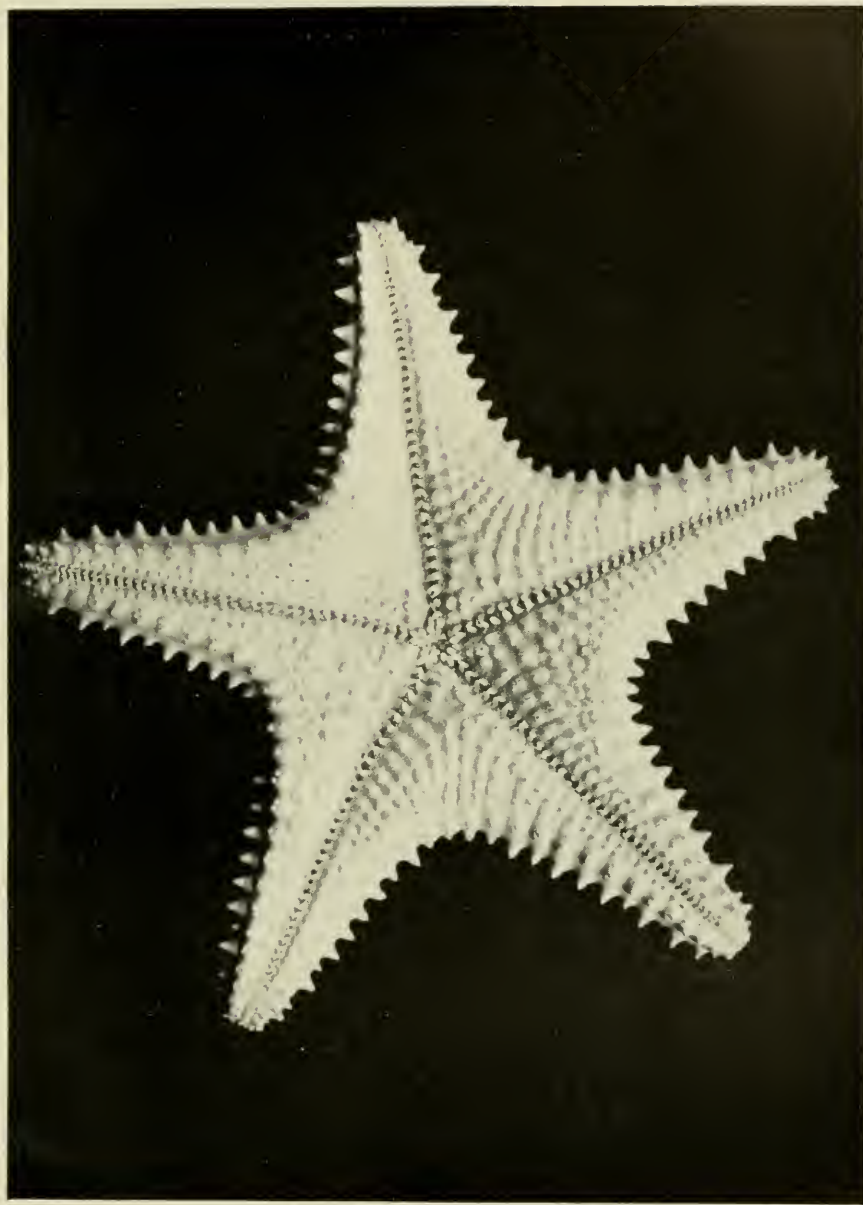
TYPE: Linné cites: "Habitat in M. Indico." Muller and Troschel described specimens from the east coast of America, which were deposited in the Berlin Museum.

DISTRIBUTION: This is the largest and most massive echinoderm found in the West Indian region where it is an abundant and widely distributed shallow-water species. It has been recorded from South Carolina southward throughout the West Indies, Gulf of Mexico, and Caribbean Sea, as far down as Abrolhos Reefs, Brazil, and is also found in the Cape Verde Islands.

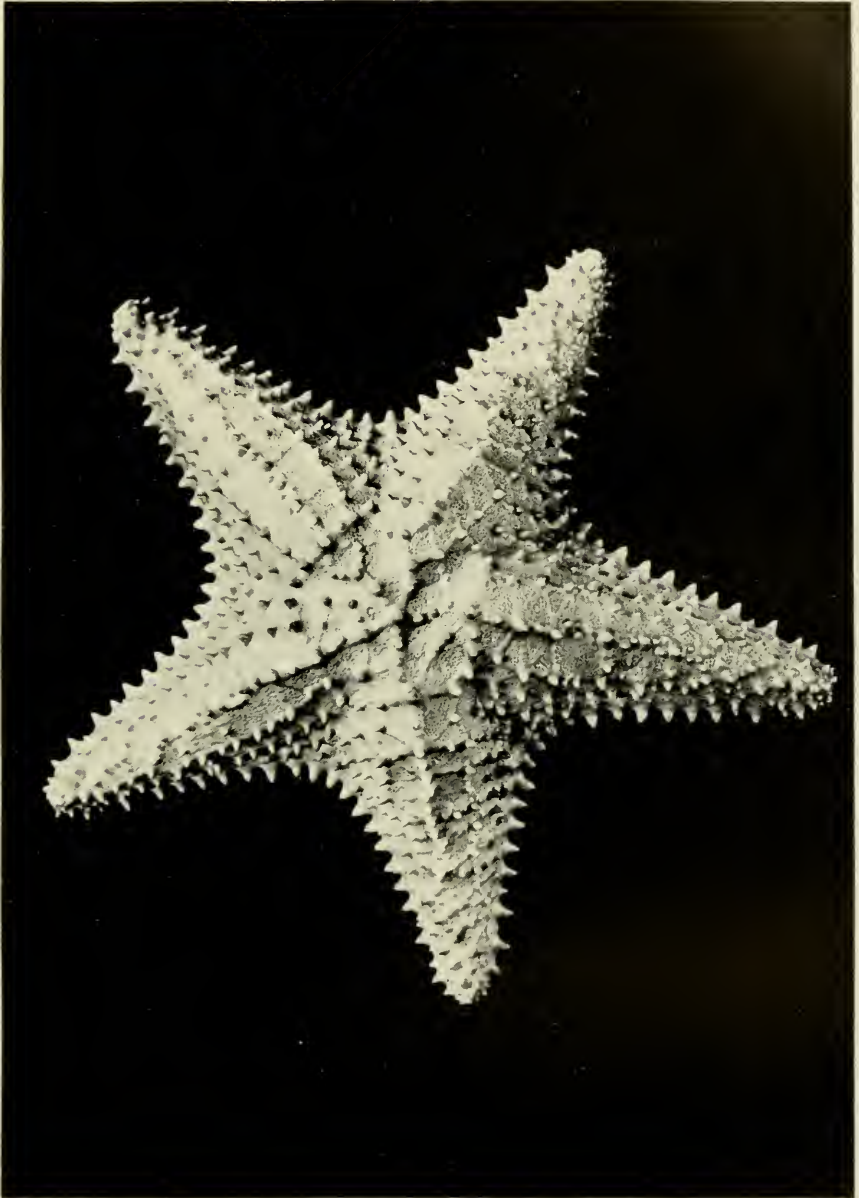
MATERIAL EXAMINED: Three large, dry specimens, from Bury Island Flats, West Indies, January 19, 1925. Cat. nos. 246, 247, 248. Five younger specimens of various ages, in spirit, from the same locality. Cat. no. 245.

COLOR: According to several authors, the color of this species is decidedly variable, some specimens being deep red, others of varying shades of red, while some are green or greenish, and others are yellow, orange or yellowish brown.

TECHNICAL DESCRIPTION: This is a very massive, rather rigid looking species, with the disk high and swollen. Specimens with a diameter of 500 mm. have been recorded. The largest of the "*Ara*" specimens has a diameter of 300 mm. The plates of the abactinal surface have a decided stellate-reticulate arrangement, leaving large papular areas between them, with many small papulae. The median radial row of plates is distinct, and is a little larger than the others. Their proportions, imperfectly visible at the dorsal surface are long and narrow and at their node there is nearly always a short, stout, conical spine, both on the disk and rays. The entire surface between



Oreaster reticulatus (Linné), young specimen, reduced one-third.



Oreaster reticulatus (Linné), abactinal surface, young specimen, reduced one-third.

the spines is paved with small, unequal, polygonal granules, interspersed with small, bivalve pedicellariae. These granules also surround the bases of the spines. The papular areas are very large and conspicuous, with numerous single papulae. The superomarginal plates are not very large; about 18 to 24 occur on each side of each ray in big sea-stars. They form the margin, but have their outlines concealed by the thick covering of granulose skin, and usually two to four short, stout, conical spines. Their granules are coarser than those further up on the disk and have quite numerous small, bivalve pedicellariae among them. The inferomarginal plates are quite similar in size and shape to the superomarginals and are placed well on the actinal side, except well toward the tips of the rays. They are granulated similar to the upper plates and each plate normally bears a cluster of three to five or more short, conical spines, the larger of which are much smaller than those of the superomarginals and quite like those of the interactinal plates. These latter are arranged in simple, divergent rows and the plates and their sutures are covered with large granules and pedicellariae, coarser than are found on the abactinal side, but each plate usually bears a more prominent central group of two, three, four, or more, short, stout, unequal, blunt spines. Their pedicellariae are larger than those of the abactinal side, with relatively wide valves.

The adambulacral plates each bear a marginal series of three to four small, flat, angulated, or blunted spines, and on the actinal face of the plate there is one, occasionally two, larger, short, conical spines, surrounded by coarse granules and numerous bivalve pedicellariae.

REFERENCES: Rumph. Muf. t. 15, fig. D, 1739.

Pentaceros lentiginosus LINCK, Stell., t. 41, fig. 72, t. 23, fig. 36.

Stella marina maxima reticulata SLOANE, Nat. and Civil Hist. Jamaica, pt. II, p. 272, 1725.

Asterias reticulata (part), LINNÉ, Syst. Nat., ed. 10, t. 1, p. 661, 1758.—RETZIUS, Dissert., p. 14, 1805.—LAMARCK, Anim. sans vert., vol. II, p. 556, 1816.

Oreaster reticulatus MULLER and TROSCHEL, Syst. Aster., p. 45, pl. III, fig. 2, 1842.

Pentaceros reticulatus GRAY, Ann. Mag. Nat. Hist., vol. 6, p. 276, 1840; *ibid.*, Synopsis, p. 6, 1866.—A. AGASSIZ, North American

Starfishes, p. 108, pl. 16, figs. 1-7, 1877 (gives details of structure).—VIGUIER, *Nouv. Arch. Zoöl. Exper. et Gen.*, vol. VII, p. 193, pl. XI, figs. 4-6, pl. XII, figs. 3, 4, 1878.—NUTTING, *Narrative Bahama Exped.*, *Bull. Labr. Nat. Hist.*, S. U. I., vol. III, pp. 52, 182, 202, 212, 1895.

Asterias gigas LINNÉ, *Mus. Tessinianum*, p. 114, pl. 9, 1753.

Oreaster gigas LUTKEN, *Vidensk. Meddelel.*, p. 64, 1859.—VERRILL, A. E., *Trans. Conn. Acad. Arts and Sci.*, vol. I, p. 367, 1867.—RICHARD RATHBUN, *ibid*, vol. V, p. 149, 1879.

Asterias sebae BLAINVILLE, *Actinologie*, p. 238, 1834.

Oreaster aculeatus GRAY, *op. cit.*, vol. VI, p. 238 (Young).

Family: GONIASTERIDAE.

Genus: **PELTASTER** Verrill.

Peltaster planus Verrill.

Plates 43, 44 and 45.

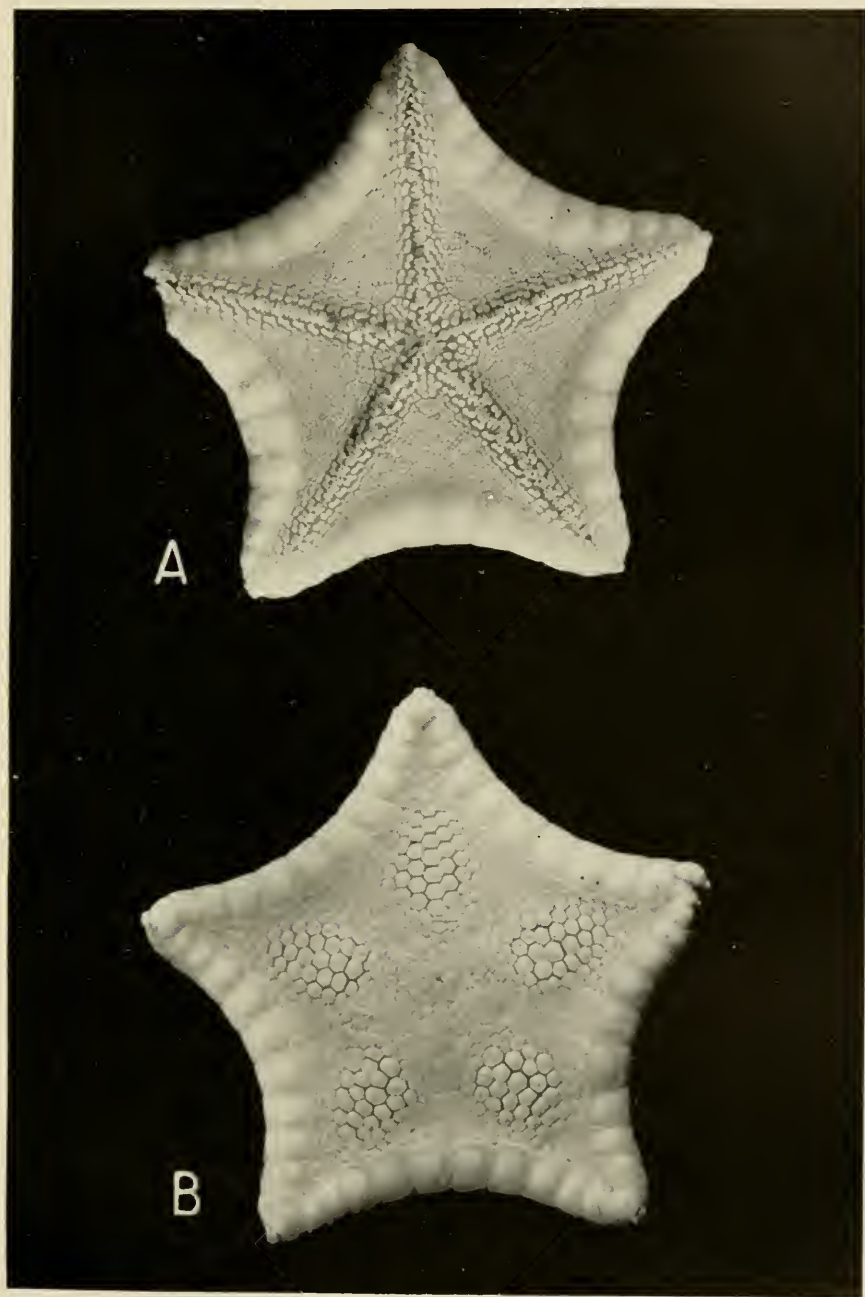
TYPE: Verrill's type was taken in N. lat. 39° 53' off Martha's Vineyard, in 156 fms. (Cat. nos. 13, 362), depository not stated.

DISTRIBUTION: Restricted to the type locality from off Martha's Vineyard, 156 fms., and the "*Ara*" specimen taken seven miles off Alligator Reef, Florida, in 150 fms. This specimen is about the same size as the type. One young specimen dredged in 200 fms., nine miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926.

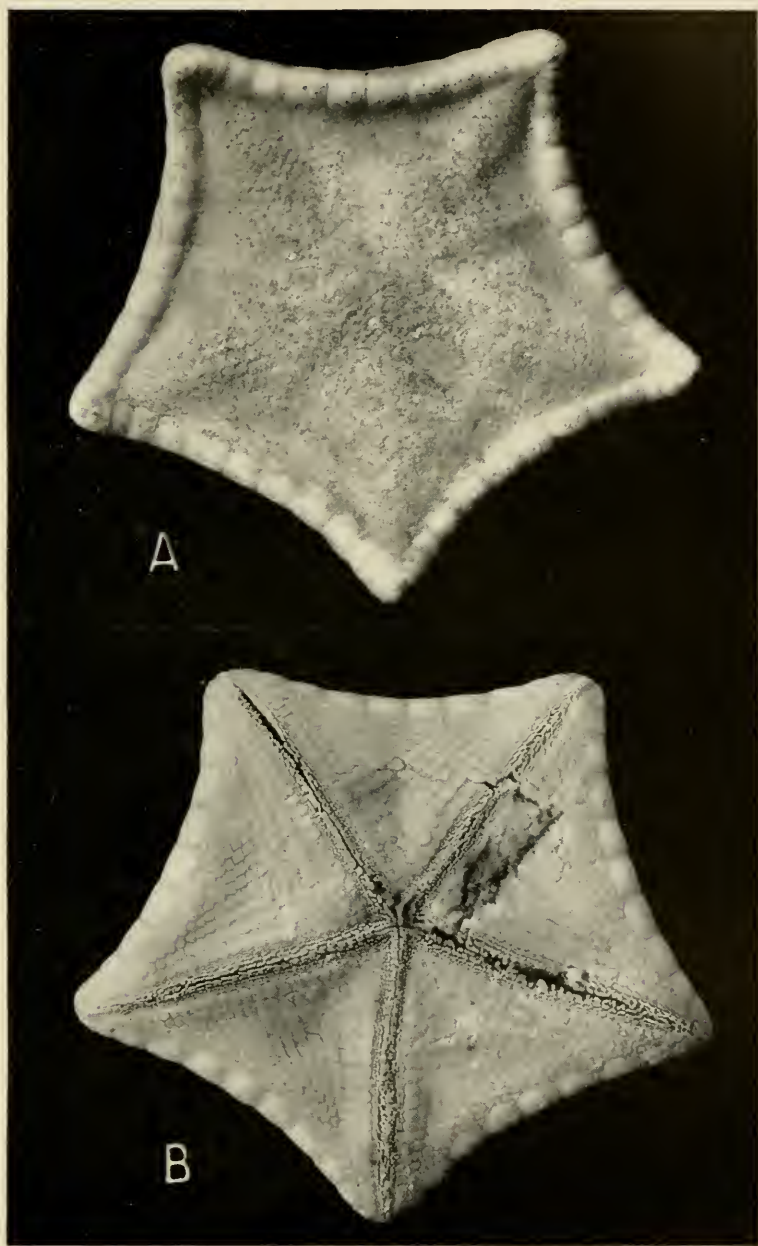
MATERIAL EXAMINED: One, 150 fms., seven miles off Alligator Reef, Florida, March 30, 1926; one, 200 fms., off Port Basque, Newfoundland.

COLOR: The color of the living animal is unknown, that of the alcohol preserved specimen is deep old ivory.

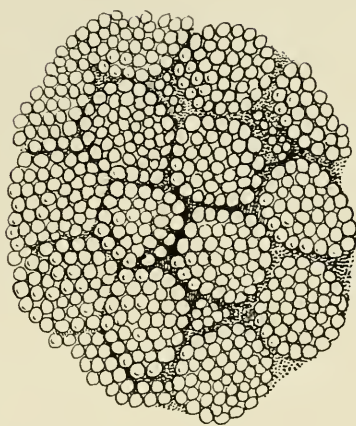
TECHNICAL DESCRIPTION: Starfish regularly nearly pentagonal with the interbrachial margin very little concave. Rays very short, blunt. R = 50 mm.; r = 37 mm. Abaetinal surface covered with plates which are of two types; the primary or larger plates are variously irregularly hexagonal with rounded angles, rhomboidal, or occasionally oval and the secondary plates closely interspersed among the primaries are smaller, unequal, subcircular. All the abaetinal plates are entirely covered with rather coarse, spaced, rounded granules. The primary plates frequently bear 60 to 100 granules; the secondary plates have as few as 8 to 25 granules. The abaetinal plates are so



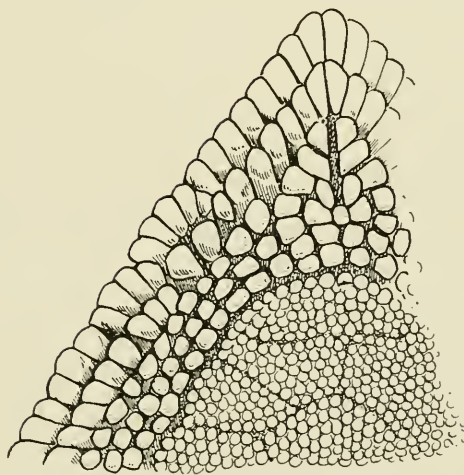
Peltaster planus Verrill, $\times 2$, A, oral view, B, aboral surface, of a very young specimen, from off Port Basque, Newfoundland, 200 fms.



Peltaster planus Verrill, $\times 0.8$; A, abactinal view, B, actinal view; both of specimen from off Alligator Reef, Fla., 150 fms.



A



B

Peltaster planus Verrill, A, section of the abactinal surface $\times 10$; B, section showing jaw-angle, $\times 10$.

closely crowded together that in undisturbed parts of the surface, the covering of granules appears continuous, concealing the individual contours of the plates, except for the faint impression of delineation. The marginal plates are similarly covered with these granules so that the entire dorsal surface has a remarkably uniform covering. The madreporite is small, unequally hexagonal, the dorsal surface flattish, traversed by fine, irregular radiating lines. The superomarginal plates are very prominent, similar to the inferomarginal plates from which they are separated by a linear marking. There are fourteen superomarginal plates on each ray, in addition to the small, rounded, subconical terminal plate at the tip of each ray. The distal three of the fourteen plates are smaller, wider than long, while the intermediate eight plates are larger, squarish. There are fifteen inferomarginal plates, the median seven being about opposite those of the upper series, while the distal four of inferomarginals are more crowded than the related distal three superomarginals. The inferomarginal plates have their actinal margin convex. The actinal inter-radial surface is covered with plates, those nearest the inferomarginal plates being the smallest, frequently hexagonal; while from the approximate third row from the inferomarginal to the center, the plates are much larger, rhombic, closely packed together, and are covered with rounded, coarse, spaced granules, which are distinctly larger than those covering the marginal plates. The adambulacral plates are similar to the actinal plates, but larger, numerous and very crowded together. Each plate bears a furrow of three, four to five coarse, blunt, four-sided club-like spines, closely packed together and laterally compressed. Outside of these is a second row, usually of three similar but slightly shorter spines, followed by a third row of three similar but shorter, squarish spines, beyond which there are eight to nine coarse, blunt granules, larger than those of the actinal plates, and forming two approximate rows. The furrow row spines along the jaw angle are similar but a little longer and stronger than the rest of the series. The papular pores occur singly and are quite numerous, occupying large radial areas and extending nearly to the center of the disk. A thorough microscopic examination of the specimen revealed no pedicellariae.

REFERENCES: *Peltaster planus* VERRILL, Amer. Journ. Sci., vol. XLIX, p. 135, 1885; Trans. Conn. Acad. Arts and Sci., vol. X, p. 170, pl. 28, figs. 3, 3a, August, 1899.

Order: **SPINULOSA.**

Family: **SOLASTERIDAE.**

Genus: **SOLASTER** Forbes.

Solaster (Crossaster) papposus (Linné).

Plate 46.

TYPE: Linnaeus' type material came from the seas of Europe and Asia.

DISTRIBUTION: Known from all over the Arctic region; found on the American Atlantic coast down as far as Massachusetts Bay; on the American Pacific coasts down as far as Vancouver; on the Asiatic Pacific down as far as the Ochotsk Sea, and in European seas the Channel is its most southern limit. Bathymetric occurrence: Shore down to about 1200 meters.

MATERIAL EXAMINED: Three young specimens dredged in 40 fms., from the middle of St. George's Bay, Newfoundland, September 2, 1926.

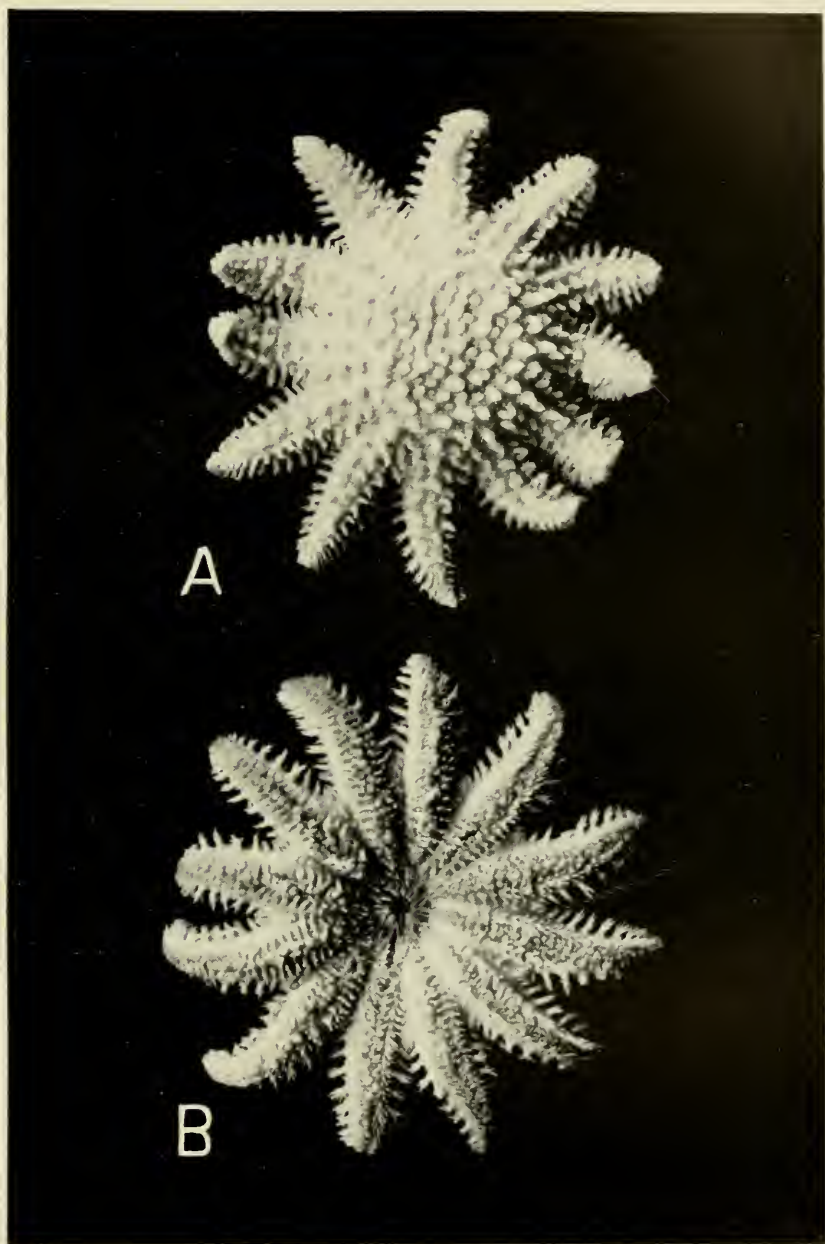
COLOR: Variable, but the more abundant form has the disk purplish red, the arms whitish with a broad, transverse band of red; the oral side is whitish. The less abundant form has the aboral side uniformly deep purple, the oral side creamy.

FOSSIL: This species has been found in fossil state in the Leda clay at Montreal, and in the Pleistocene at Green's Creek, near Ottawa, Canada.

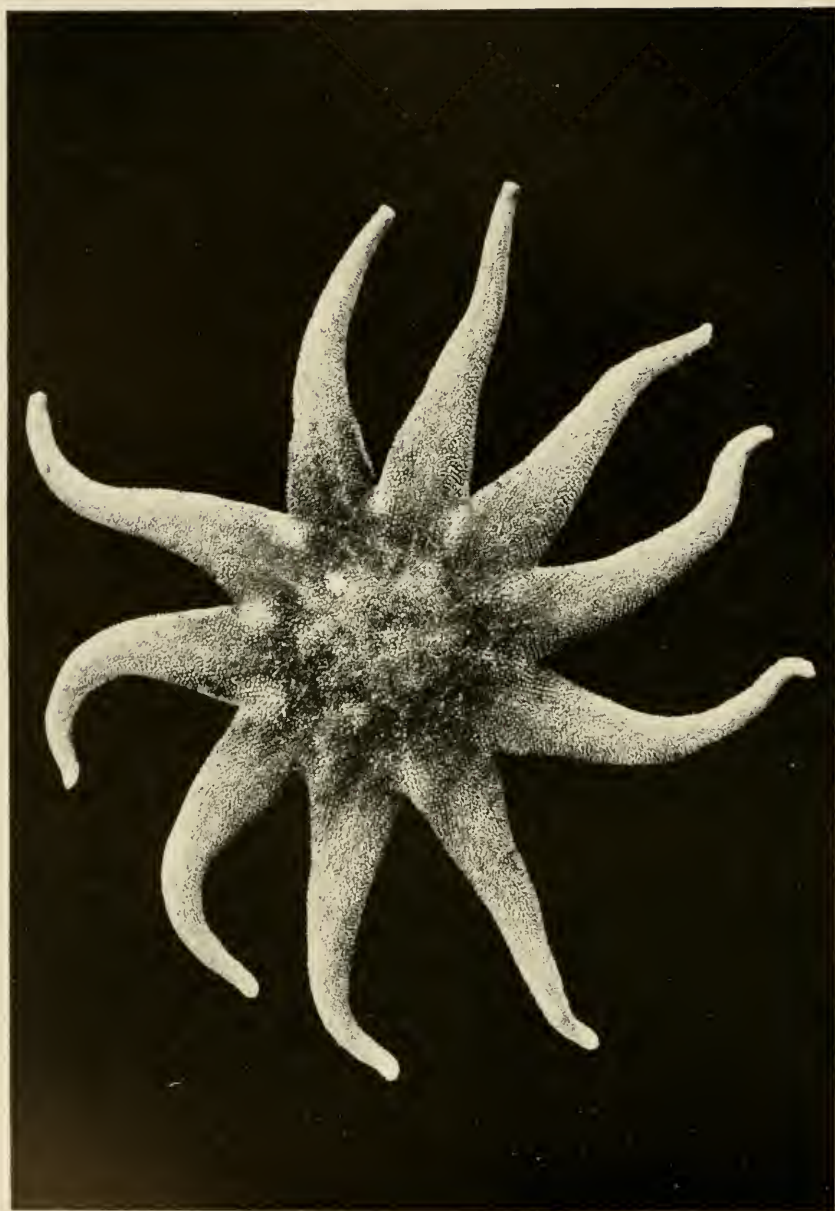
HABITS: The development is direct without a Bipinnaria stage. The young are found in spring and summer, not very abundantly on the East American coast, usually on hard bottom in depths ranging from tide-line to 40 to 50 fms.

This starfish is carnivorous and very voracious, frequently devouring starfish as large as itself. It feeds principally upon other Echinoderms, chiefly starfishes and sea-cucumbers, but also eats mollusks and anemones. It is definitely known to be an enemy of the oyster.

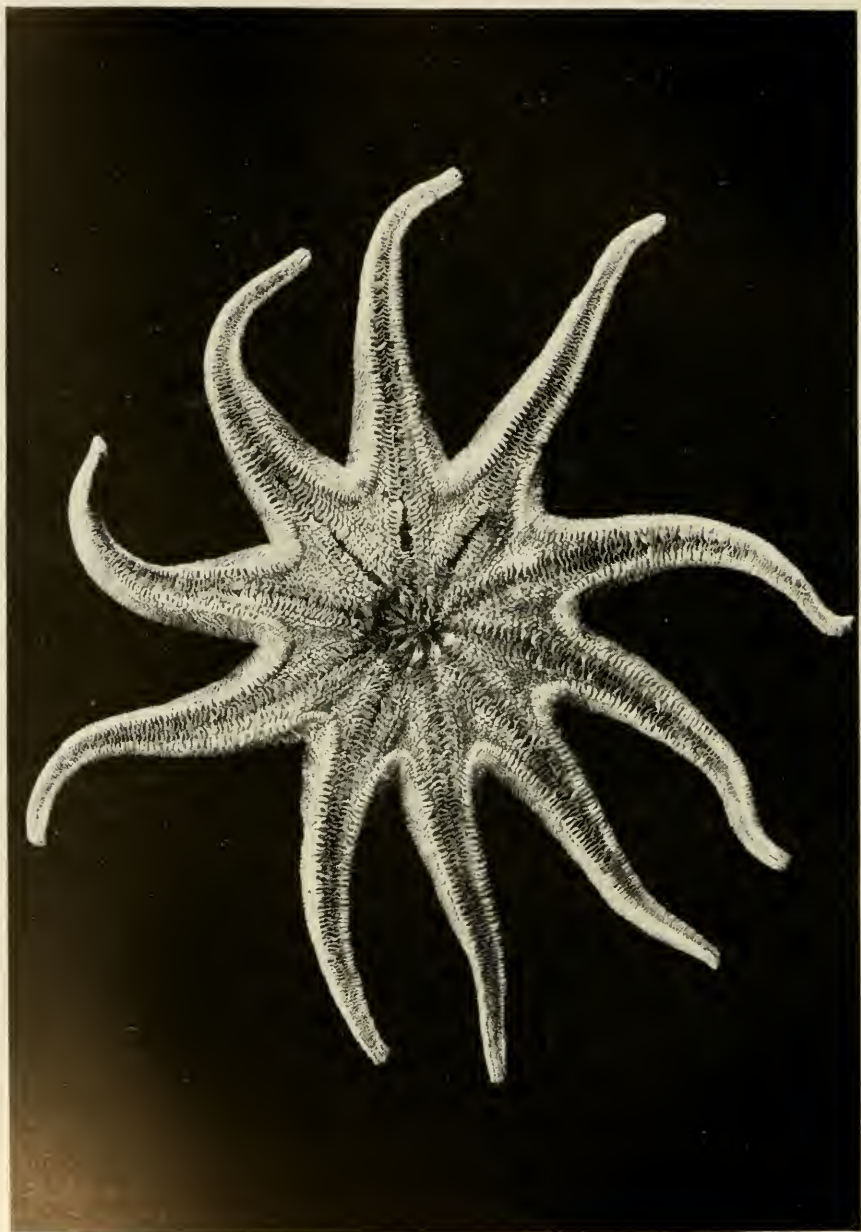
TECHNICAL DESCRIPTION: Rays usually 10 to 12; 12 in the present specimens; regularly stellate; disk of moderate size; the dorsal skeleton composed of narrow bars forming an irregular reticulation surrounding moderate sized membraneous spaces in which several rather coarse papulae are situated. No pedicellariae. Dorsal paxillae large, well separated, sparsely covering the surface, with rather long, slender spines, clustered, brush-like. Marginal plates obscure. Marginal



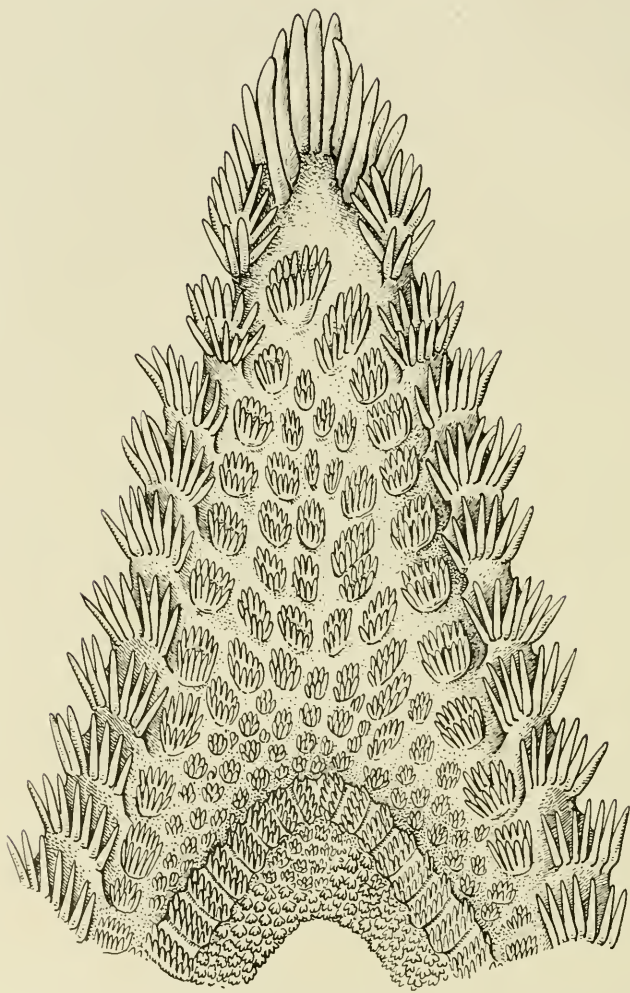
Solaster papposus (Linne), A, abactinal view of young specimen, natural size;
B, oral view of same specimen.



Solaster endeca (Retzius), reduced one-third.



Solaster endeca (Retzius), reduced one-third.



Solaster endeca (Retzius), sections showing jaw-angle and adjacent region, greatly enlarged.

paxillae in a single series, large, prominent. Furrow spines long, slender, prominent, varying in number, usually three to five. Spines encircling the mouth long, slender, blunt. Very large specimens have been recorded with a diameter of ten inches. The "Ara" specimens are young, measuring two to three inches in diameter.

REFERENCES: *Triskaidecactis papposus* LINCK, De Stellis Marinis, p. 43, tab. XXII, no. 54, 1733.

Asterias papposus LINNÉ, 12th Ed., p. 1099, vol. 1, part 2, 1767.

Asterias helianthemoides PENNANT, British Zoölogy, vol. IV, p. 66, no. 72, 1777.

Asterias papposa FABRICIUS, Fauna Gronlandica, p. 369, no. 72, 1780.

Asterias papposus MULLER, Zoöl. Dan. Prod., 2832.—LAMARCK, Anim. sans Vert. II, p. 559, 1816; *ibid*, 2 ed., vol. III, p. 246, 1840.

Asterias (Solasterias) papposus BLAINVILLE, Manuel d'Actinologie, p. 241, 1834.

Stellonia papposa AGASSIZ, Prodr. Monog. Rad., Mem. Soc. Sci. Nat. Neuchatel, t. I, p. 192, 1835.

Solaster papposa FORBES, Ast. Irish Sea, Mem. Wern. Soc., vol. VIII, p. 121, 1839; British Starfishes, p. 112, figured, 1841.

Crossaster papposus MULLER and TROSCHEL, Monatsbr. d. k. Preuss. Akad. d. Wiss. Berlin, p. 103, 1840.—SLADEN, W. P., Rept. Voyage "Challenger," Zoöl., vol. XXX, p. 444, 1873-76.—J. F. WHITEAVES, Catal. Invert. Eastern Canada, in Geol. Surv. Canada, p. 52, 1901.—A. H. CLARK, Rep. Canadian Arctic Exped., vol. VIII, part C, p. 12c, 1920.

Solaster (Polyaster) papposa GRAY, Ann. and Mag. Nat. Hist., vol. 6, p. 183, 1840.

***Solaster endeca* (Retzius).**

Plates 47, 48 and 49.

TYPE: Retzius' type came from Torekov, Sweden; the despository is not stated, but it is quite probably the museum at Stockholm.

DISTRIBUTION: Circumpolar and subpolar. Found on the coasts of Greenland. On the east American coasts it is abundant from Newfoundland to Cape Cod, Mass., on the American Pacific coast down to Puget Sound and on the Asiatic coast down to the Ochotsk Sea. In Europe it is found in Scandinavian waters from Spitzbergen down to the Sound abundantly; also in the waters of the British Isles except on the south coast of England and the Channel. Bathymetric occurrence: tide-line to 450 meters.

MATERIAL EXAMINED: Three specimens collected on the coast of Maine, by the "*Eagle*," Cat. no. 298.

COLOR: The upper surface of this very beautiful starfish is frequently rose-purple or deep red, more rarely, a yellow or orange specimen is found. The under surface is always some shade of yellowish or orange.

LIFE HISTORY: The development of the species is direct, without a pelagic larval stage. The breeding season is March and April.

TECHNICAL DESCRIPTION: This species is very large, attaining a diameter of 300 to 400 mm. The rays vary from 7 to 13 but are usually 9 to 10. $R = 3 r$; $R = 75$ to 200 mm.; $r = 25$ to 65 mm. The disk is large, highly arched, the interbranchial arcs somewhat rounded. The rays are arched abactinally, flattened actinally, regularly tapered with blunt, rounded tips. The abactinal surface is covered by very firm skeleton, formed of a very close network of plates. These plates bear low columnar elevations, each of which is crowned with a group of 8 to 12 delicate spines. These spines are so short and of such nearly uniform length that in the living starfish they give a general impression of an almost smooth surface. Along the side of the rays, these columnar elevations tend to form longitudinal series; four to six such series usually being well defined. On the actinal surface of the ray there is a well-defined series of plates forming a lateral margin. Toward the tip these plates are in contact with the adambulacral plates, but as they approach the disk, they diverge, forming a margin for the actinal surface of the disk. The plates have transverse, ridge-like elevations, which each bear a cluster of ten to twenty-five small spines, of approximately equal length and arranged in regular double series. The actinal, interradian spaces are closely covered with plates bearing low, columnar elevations ornamented with spines somewhat bigger than those of the abactinal surface. These clusters are rather definitely arranged, tending to form four rows parallel to the adambulacral plates. The row adjacent to the adambulacral extends about halfway the length of the ray, while the others are successively shorter, the interradian series being the shortest. The adambulacral plates have two series of spines, one in the furrow and one on the face of the plate. The furrow series is made up of three spines in a row parallel to the furrow; one, or sometimes two, of these spines is often absent, but when present the middle one of the series is the longest and the distal one is usually the shortest. Near the mouth these spines are frequently partly fused at

the base. The spines on the face of the plate are somewhat pointed, six to eight, arranged in a single curved, transverse series, the concavity of the curve away from the mouth; the largest spine nearest the furrow. The oral plates are very conspicuous, bearing on the margin a series of 14 to 20 spines of which those at the oral end of the plate are much the largest, the others diminishing in size. On the face of each plate there is a ridge bearing three to twelve spines of variable length, the longest being nearest the oral end of the plate. The papulae are small, usually single. The madreporic is small with numerous fine furrows. The feet are stout, biserial.

The starfish is very voracious, frequently swallowing animals of its own approximate size. It feeds principally on other starfishes.

REFERENCES: Rumphius, Amboinsche Rariteten-kammer, Tab. XV, fig. F, 1705.

Octactis dactyloides LINCK, De Stellis Marinis, p. 39, pl. 14, no. 24, 1733.

Enneactis coriacea dentata LINCK, *ibid*, p. 40, pls. 15, 16, no. 26.

Asterias endeca RETZIUS, K. Vet. Akad. Hand. Stockholm, t. IV, p. 237, 1783.—GMELIN, Syst. Nat. Linn. ed. 13, t. I, pt. VI, p. 3162, 1789.—LAMARCK, Anim. sans Vert., vol. II, p. 560, no. 23, 1816.—FLEMMING, Hist. Brit. Animals, p. 487, 1828.—JOHNSTON, Mag. Nat. Hist., vol. IX, p. 300, fig. 44, 1835.

Stellonia endeca L. AGASSIZ, Mem. Soc. Sc. Nat. Neuchâtel, vol. I, p. 192, 1835.

Solaster endeca FORBES, Mem. Werner Soc., vol. 8, p. 121, 1839.—GRAY, Ann. Mag. Nat. Hist., vol. VI, p. 183, 1840.—FORBES, Hist. Brit. Starfishes, p. 109, 1841.—MULLER and TROSCHEL, System der Asteriden, p. 26, 1843.—STIMPSON, Synop. Marine Invert. Grand Manan, p. 14, 1853.—LUTKEN, Vidensk. Meddel., ser. 1, vol. 9, p. 35, 1857.—M. SARS, Oversigt af Norges Echinodermter, 1861.—VERRILL, Proc. Boston Soc. Nat. Hist., vol. X, p. 345, p. 356, 1866.—HODGE, Nat. Hist. Trans. Northumberland and Durham, vol. IV, p. 135, 1871.—PERRIER, E., Arch. de Zoologie Exp. and Gen., vol. IV, p. 95; *ibid*, 359, 1875.—MOEBIUS and BUETSCHLI, Die Exped. z. phys.-chem. und biol. Unters. der Nordsee, Bericht, 1875, p. 148.—VIGUIER, Arch. d. Zoöl. exp. et gen. tom. VII, p. 134, 1878.—DUNCAN and SLADEN, A. Memoir on the Echinodermata of the Arctic Sea to the west of Greenland, p. 40, 1881.—t. 3, figs. 3-8, 1881.—DANIELSEN and KOREN, N. Nordhavs-Exp., p. 50, t. 9, figs. 13, 18, 1884.—LEVINSEN, Dijnpha-Udbytte,

p. 398, 1887.—SLADEN, Rept. Vol. "Challenger," Zoöl., vol. 30, p. 452, 1889.—PFEFFER, Zoöl. Jahrb. Syst. Bd. 8, p. 104, 1894.—DODERLEIN, Wissenschaft, Meeres, N. F. Abth. Helgoland, p. 209, taf. VII, figs. 1, 4, 1900.—H. L. CLARK, Bull. U. S. Fish Comm., vol. XXII, p. 556, pl. 3, figs. 12, 13, 1902.—MORTENSEN, Danmarks Fauna Echinod., p. 67, fig. 26, 1924; Echinod. Brit. Isles, p. 115, fig. 68, 1927.

Family: **ECHINASTERIDAE.**

Subfamily: **Echinasterinae** Viguiér.

Genus: **HENRICIA** Gray.

Henricia sanguinolenta (O. F. Muller).

Plates 50 and 51.

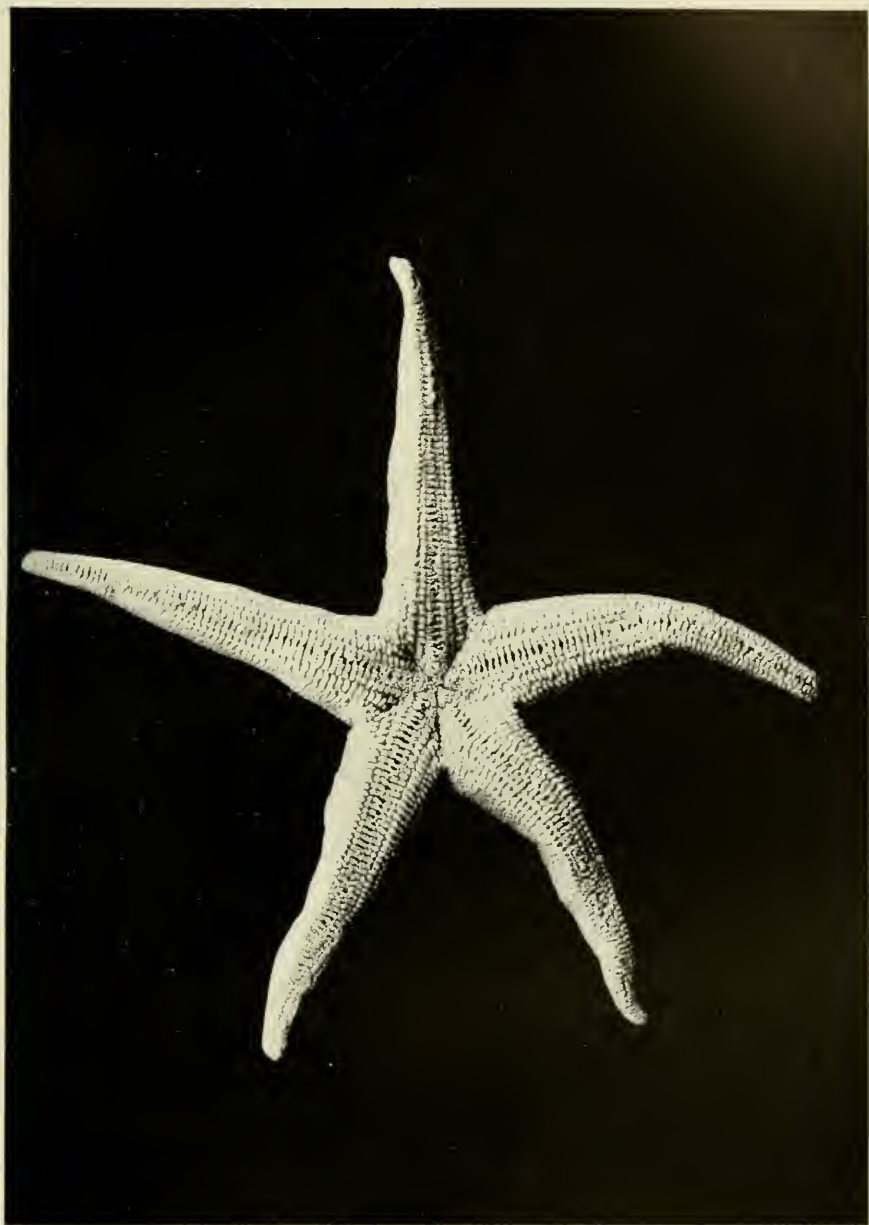
TYPE: This species was described from Torekov, Sweden, by Retzius.

DISTRIBUTION: *Henricia sanguinolenta* is circumpolar and circum-boreal and has been taken from the tide-line down to depths of 1000 meters; one record gives a depth of about 2450 meters. It is found on the east North American coast from the Arctic down to Cape Hatteras, N. C.; also on the coasts of Greenland and Iceland; across the American Arctic and on the American Pacific coast down as far as Washington State; and on the Asiatic coast down to the Kurile Islands. In European waters it is found in Scandinavian Seas from the Baltic to the Arctic region; rather common on all coasts of the British Isles excepting the Channel coasts. It is also found southward to the Bay of Biscay and the Azores.

MATERIAL EXAMINED: One specimen, dredged in 10 fms., off Cuttyhunk, Vineyard Sound, June 16, 1922, Cat. no. 205. Two small specimens, without label, but probably from Vineyard Sound, Mass., June, 1922. Cat. no. 239. One young specimen, dredged in 200 fms., nine miles S. W. of Port Basque, Newfoundland, September 2, 1926. Cat. no. 236. Two specimens, slightly larger, from the same locality, Cat. no. 237. One larger specimen, dredged in Long Island Sound, off Northport, N. Y. Cat. no. 238.

COLOR: The color of this starfish varies from entirely blood-red specimens to entirely yellow ones.

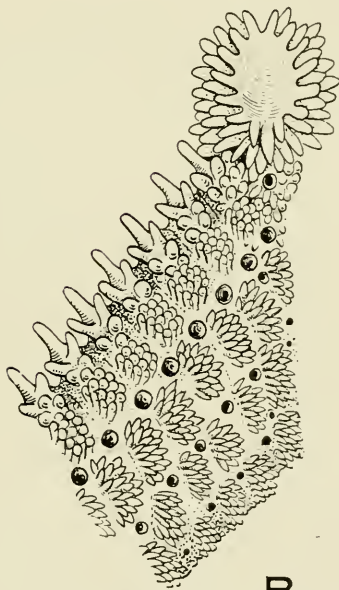
DEVELOPMENT: This species has no bipinnaria stage. It is one of the brood-protecting species. The parent attaches itself by means of the tube-feet in the distal part of the rays to the underside of a stone,



Henricia sanguinolenta (O. F. Muller), natural size.



A



B

Henricia sanguinolenta (O. F. Muller), A, section of abactinal surface, $\times 4$;
section of oral surface of disk, showing jaw-angle $\times 4$.

or to a vertical rock, or similar place, then elevates the disk and proximal part of the arms, in such a way as to form a closed cavity beneath. The eggs are then discharged into this cavity where they lie free, not attached to the parent. Development of the embryo takes approximately three weeks, during which period the parent apparently does not feed. The embryos subsist entirely on the contents of the egg yolk and do not receive any nourishment direct from the parent. If the parent be removed during this period, the larvae continue their normal development; they are occasionally found free, pelagic. The normal breeding period is February to April.

Food: Little is known of the food habits of this species. Remnants of mollusks have been found in its digestive tract. Dr. Mortensen reports it as being once found in the mounting position above a *Mytilus*.

TECHNICAL DESCRIPTION: Regularly stellate; rays five, slender, tapered. $R = 49$ mm. long, $r = 11$ mm. long; $R = r$ 4.5. Interbrachial arcs acute. Rays slender, dorsally convex, gradually tapered to a blunt recurved point. Plates of the abactinal surface are rather small, crowded, forming a close, irregular network, enclosing in each papular space two or three large, round papulae. Madreporite small, situated midway between the center of disk and an interbrachial angle. On the ventral surface of the rays the paxillae are large and form two longitudinal rows. The adambulacral plates are armed on the outer side with five or six similar but larger blunt spines of unequal size, and those of each series increasing in size towards the margin; there is one large, marginal spine directed inward and fitting alternately with a similar spine from the opposing margin, forming a deep intermeshing border over the ambulacral furrow. The jaw teeth are as figured. The dorsal paxillae are irregularly circular; each paxilla of the disk and of the median portion of the arm has from 10 to 15 short, blunt spines; on the sides and distal ends of the rays these paxillae average 8 to 10 spines apiece.

REFERENCES: *Pentadactylosaster oculatus* LINCK, De Stellis Marinis, p. 35, tab. XXXVI, no. 62, 1733.

Asterias sanguinolenta O. F. MULLER, Zoöl. Dan. Prodr., p. 234, no. 2836, 1776.—TH. MORTENSEN, Ann. and Mag. Nat. Hist., ser. 9, vol. 16, p. 546, 1925.

Asterias pertusa O. F. MULLER, *ibid*, p. 235, no. 2839, 1776.

Asterias oculata PENNANT, British Zoöl., vol. IV, p. 61, pl. XXX, fig. 56, 1777.

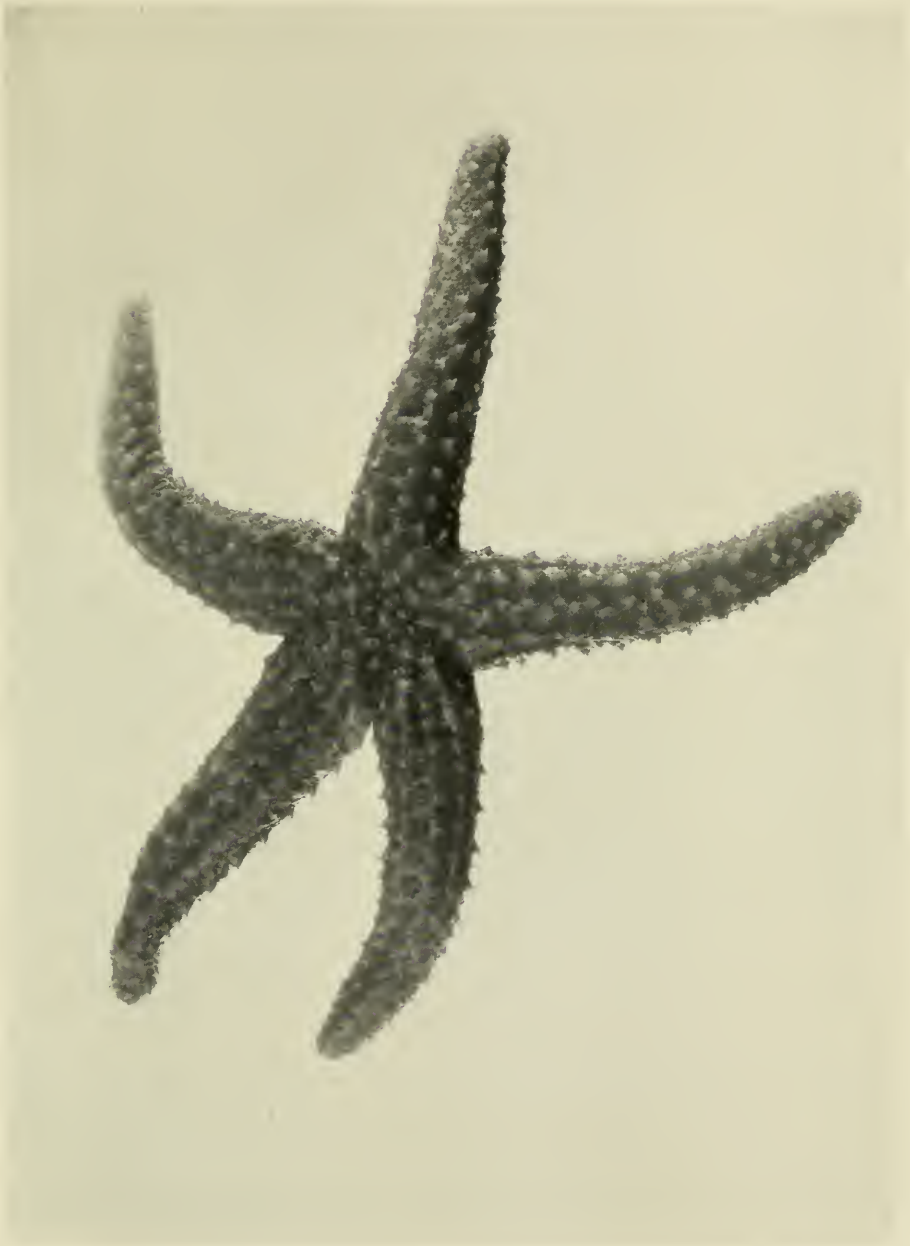
- Asterias spongiosa* FABRICIUS, Fauna Groenlandica, p. 368, no. 363, 1780.—GOULD, Invert. of Massachusetts, p. 345, 1841.
- Asterias seposita* RETZIUS, K. Svensk. Vet.-Akad. Nya Handl. Ar. 1783, t. IV, p. 237; Dissert. sist. spec. cog. Asteriarum, 1805, p. 21.
- Linckia oculata* FORBES, Mem. Wern. Soc., vol. VIII, p. 120, 1839.
- Henricia oculata* GRAY, Ann. and Mag. Nat. Hist., vol. VI, p. 184, 1840.
- Cribrella oculata* FORBES, Hist. British Starfishes, p. 100, 1841.—A. and E. C. AGASSIZ, Marine Animals of Massachusetts Bay. Radiates, p. 112, 1865, Boston.—PERRIER, Archives de Zoöl. Exper., t. IV, p. 373, 1875.—SLADEN, Rept. Voy. "*Challenger*," Zoöl., vol. XXX, p. 542, 1889.
- Echinaster oculatus* MULLER and TROSCHER, Syst. der Aster., p. 24, p. 127, 1842.
- Echinaster eschrichtii* MULLER and TROSCHER, *ibid*, p. 25.
- Echinaster sarsii* MULLER and TROSCHER, Archiv. f. Naturgesch. Jahrg., X, Bd. I, p. 169, 1844.
- Linckia pertusa* STIMPSON, Invert. Grand Manan, p. 14, 1853.
- Cribrella sanguinolenta* LUTKEN, Videnskab. Medd. naturh. Foren. i Kjobenhavn, p. 31, 1857.—VERRILL, Proc. Boston Soc. Nat. Hist., X, p. 345, 1866.—NORMAN, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 24, 1865.—H. L. CLARK, Bull. U. S. Fish. Comm., vol. XXII, p. 555, pl. 3, figs. 10-11, pl. 4, fig. 22, 1902.
- Cribrella eschrichtii* DUJARDIN and HUPE, Hist. Nat. Zoöph. Echin. (Suites a Buffon), p. 349, 1862.
- Cribrella sarsii* PERRIER, Nouv. Archives Mus. Hist. Nat. 2e Serie, t. I, p. 77, 1878.
- Echinaster scrobiculatus* DAN. and KOREN, K. Vet. Akad. Handl., 1844; Norwegian North Atlantic Exped., Asteroidea, XI, vol. 4, p. 40, pl. VI, figs. 10-11, pl. 7, pp. 12-14, 1887.
- Magdalenaster arcticus* KOEHLER, Echin. des Mers. D'Europe, vol. 2, p. 293, 1924.

Genus: **ECHINASTER** Muller and Troschel.

Echinaster echinophorus (Lamarek) Perrier.

Plates 52 and 53.

TYPE: Lamarek's type came from the coast of Virginia and is deposited in the Paris Museum.



Echinaster echinophorus (Lamarek) Perrier, natural size.



Echinaster echinophorus (Lamarek) Perrier, A, section of aboral surface;
B, section showing mouth angle, both much enlarged.

DISTRIBUTION: Southern Florida and throughout the West Indian region to Yucatan and the Abrolhos Reefs, Brazil. A shallow water and reef-dwelling species. Virginia. (Lamarck.).

MATERIAL EXAMINED: Two specimens, collected on the Florida Reefs, January, 1923, by the "Ara," Cat. no. 225. These appear to be the first Florida record for this species, thus extending its northern distribution. One specimen collected south of Catalina Creek, Cuba, in 5 fms., February 11, 1924, Cat. no. 234.

COLOR: Bright red or crimson on the abactinal surface.

TECHNICAL DESCRIPTION: Regularly stellate, rays normally five, somewhat angulated and moderately stout, tapered distally with a blunt tip. $R = 63$ mm., $r = 18$ mm. Abactinal surface with the plates covered by a tough skin and reticulated with the mamillary bosses, each bearing a stout, conical, skin-encased spine. The large, subcircular, papular areas, surrounded by the meshes of skin, bear each several, 8 to 12, large, papular pores. On the disk the spines are similar to those on the rays, where they are arranged in approximately five longitudinal rows on the dorsal and lateral surfaces. The outermost of these five rows, which are like the others, may be considered as superomarginals, and are separated from the inferomarginals by a wide and abundantly perforated papular area. The inferomarginal spines are a trifle larger than the dorsolateral spines and are well separated from the adambulacral spines. The adambulacral spines are two to each plate, partly webbed at the base and forming a double longitudinal series, the furrow spine being a trifle stronger and bearing on its inner side, lower down, almost in the furrow, a node, scarcely to be defined as a tooth. The jaw-teeth are as figured; six teeth to the jaw-plate, two webbed, on either side of the distal pair which are short and blunt.

REFERENCES: *Asterias spinosa* (part), RETZIUS, Dissert. sist. spec. cog.

Asteriarum, p. 18, 1805. (Not *Asterias spinosa* PENNANT, 1777.)

Asterias echinophora LAMARCK, Anim. sans Vert., ed. I, vol. II, p. 560, 1816.

Othilia spinosa GRAY, Ann. and Mag. Nat. Hist., vol. VI, p. 281, Dec., 1840; Synopsis Starfishes, p. 12, 1866.

Echinaster spinosus MULLER and TROSCHEL (part), Syst. Ast., p. 22, 1842; LUTKEN, Vidensk. Meddel., p. 90, 1859.—PERRIER, Pedicell. in Ann. Sci. Nat. Zoöl., ser. 5, vol. XII, p. 57, 1869.

Echinaster (Othilia) crassispina VERRILL, Trans. Conn. Acad. Arts and Sci., vol. I, p. 368, pl. IV, fig. 7, 1868.

Echinaster crassispina LUTKEN, *op. cit.*, p. 283, 1871.—IVES, Proc. Acad. Nat. Sci. for 1890, p. 326.—H. L. CLARK, Bull. U. S. Fish Comm., vol. XX, part 2, p. 238, 1899.

Echinaster echinophorus PERRIER, Arch. Zööl. Exper., vol. IV, p. 364, 1875.—RICHARD RATHBUN, Trans. Conn. Acad. Arts and Sci., vol. V, p. 147, 1879.—IVES, Proc. Acad. Phila. Acad. Nat. Sci. for 1889, p. 171.—VERRILL, Bull. Lab. Nat. Hist. State Univ. Iowa, vol. VII, no. 1, p. 42, 1915.

***Echinaster sagenus* (Retzius).**

See Ludwig's color plate, Taf. 4, figs. 4, 5.

TYPE: In 1805 Retzius designated this Mediterranean species *Asterias sagena*.

DISTRIBUTION: This brilliantly colored starfish is very abundant in the Mediterranean Sea, extending southward as far as Cape Verde, and northward on the Atlantic European coast as far as Brittany. Bathymetric occurrence: Littoral down to 1060 meters.

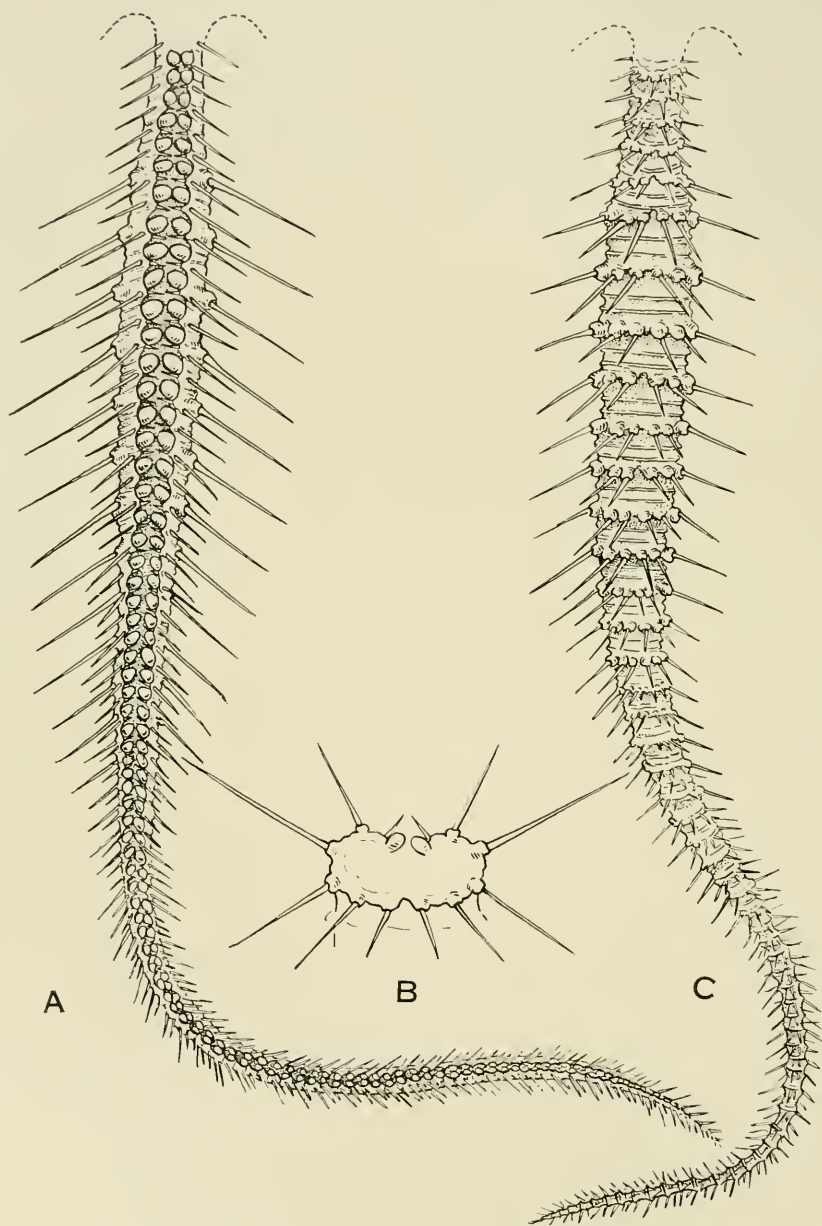
MATERIAL EXAMINED: One very young specimen dredged in 19 fms., grassy bottom, 10 miles south of Cagliari, Sardinia, July 23, 1927, Cat. no. 262.

COLOR: The abactinal surface is intensely red or orange-red; the actinal surface cream color.

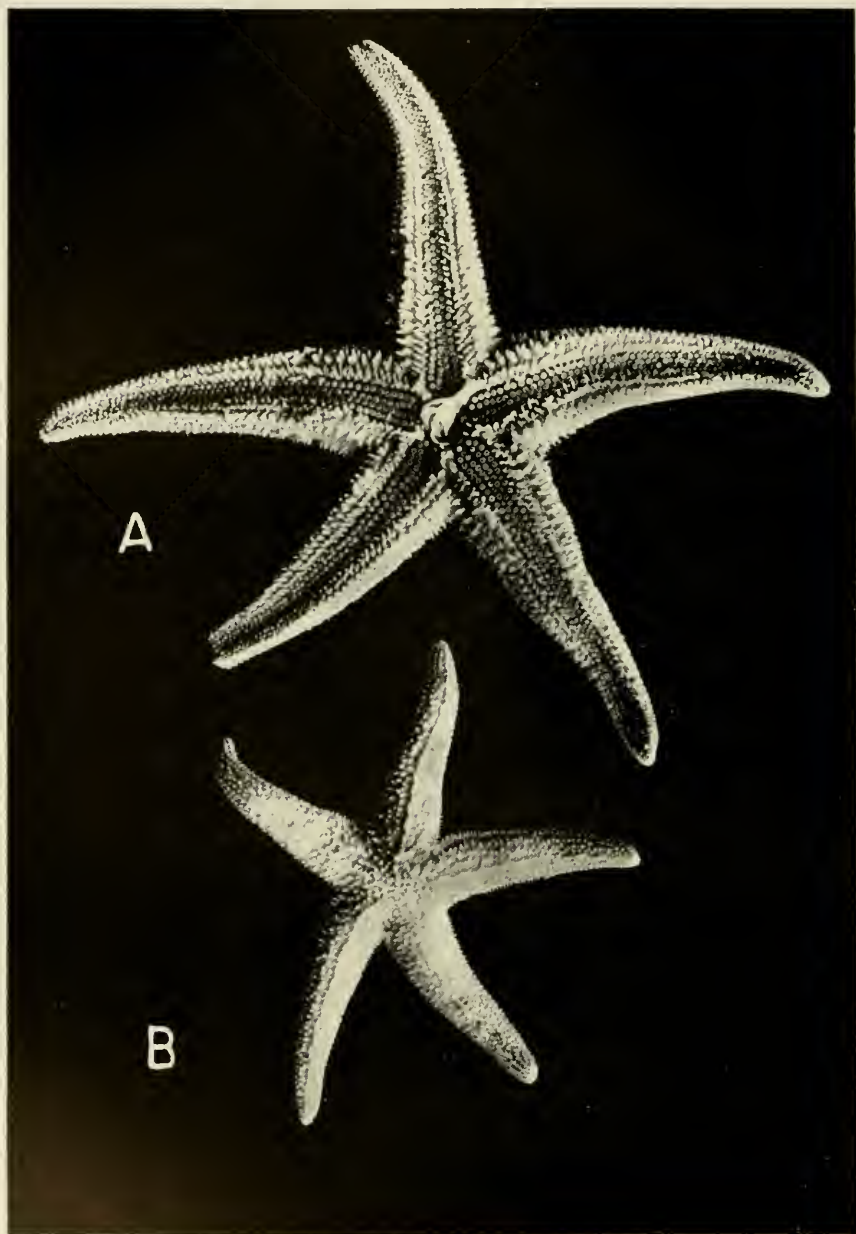
DIAGNOSTIC CHARACTERS: The single specimen taken by the "Ara" is a very young, five-rayed starfish, agreeing in all particulars with Ludwig's excellent description and figures of the species.

This starfish is usually five-rayed, occasionally six or more, rarely seven-rayed. It frequently attains a diameter of 15 to 20 cm., and specimens as large as 30 cm. diameter have been reported. The spines of the abactinal surface are large and there are no papulae on the actinal surface, two items which readily distinguish *E. sagenus* from the superficially similar *Henricia sanguinolentus*, in addition to their respectively different faunal distribution. For detailed diagnosis of the species consult Ludwig, 1897.

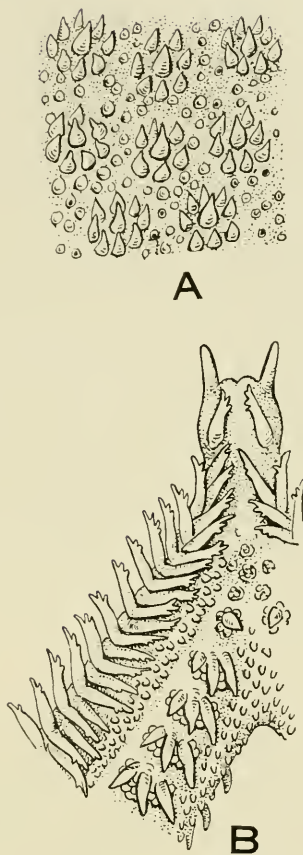
REFERENCES: *Asterias sagena* RETZIUS, Dissert. sist. spec. cog. Aster., p. 21, 1805.—LUDWIG, Fauna und Flora, Neapel, Mon. 24, p. 313, pl. IV, figs. 4, 5, 1897 (with full synonymy).—KOEHLER, Faune de France, p. 29, fig. 22, 1921; Les Echinodermes des Mers d'Europe, t. I, p. 125, 1924.—MORTENSEN, Ann. Mag. Nat. Hist., 9 ser., vol. 16, p. 546, 1925.—FISHER, W. K., *ibid.*, vol. 18, p. 196, 1926.—MORTENSEN, Echinod. Brit. Isles, p. 117, p. 439, 1927.



Brisinga mediterranea Perrier, A, ventral sketch of an arm; B, transverse section of an arm showing arrangement of spines; C, dorsal view of an arm, all $\times 1.2$.



Asterias vulgaris Verrill, A, actinal view of young specimen; B, abactinal view of another younger specimen; both natural size.



Asterias vulgaris Verrill, A, section of abactinal surface of disk; B, section of actinal surface of disk, showing jaw-angle; both much enlarged.

Order: **FORCIPULATA.**

Family: **BRISINGIDAE.**

Genus: **BRISINGA** Asbjornsen.

Brisinga mediterranea Perrier.

Plate 54.

TYPE: Perrier's type was taken by the "*Travailleur*" between Corsica and Marseillaise, in the Mediterranean Sea, depth 555-2660 meters. It is deposited in the Paris Museum.

MATERIAL EXAMINED: Six rays without the central disk, taken in dredge, in 102 fms., mud bottom, St. Andrea Island, off the Dalmatian Coast, Adriatic Sea.

COLOR: Unrecorded.

TECHNICAL DESCRIPTION: The longest ray taken measures 235 mm. As shown in the accompanying figure, the greatest diameter of the ray is about three-fourths of an inch from the disk. The raised ribs number about 70 and extend to the distal end of the ray, each carrying a series of twelve spines, six of which are abactinal, and the remaining six actinal. On the distal half the ray is much tapered and these spines are correspondingly reduced in size. The skin between the ribs is naked; on the proximal twenty-odd arches, the skin is elevated in two or more transverse bands like wrinkles, between each two arches. The spines appear to be silicious; the largest two of each series show distinctly that they are longitudinally ribbed or fluted with about eight grooves and nine convex elevations between these, converging at the apex. The spine is encased in tough skin, which forms a clavate-shaped tip. Although this club tip is figured in many of the best illustrations of *Brisinga* without comment, it appears in the present specimen to be the result of the skin having partially sluffed off the spine and formed a knob at or near the tip.

REFERENCES: *Brisinga mediterranea* PERRIER, Exped. "*Travailleur*" et "*Talisman*" Echin., Paris, p. 70, pl. 3, fig. 1, 1894.

Family: **ASTERIDAE.**

Genus: **ASTERIAS** Linné.

Asterias vulgaris Verrill.

Plates 55 and 56.

NAME: Northern starfish.

TYPE: Verrill's description of the species does not cite a type but rather appears to have been founded on an extensive series of specimens from various localities. Depository not stated.

DISTRIBUTION: Fairly abundant from Labrador to Woods Hole, Mass., less so southward to Cape Hatteras, N. C. Known from the tide-line down to 358 fms., seldom taken in shallow water south of Wood's Hole. Sometimes taken in association with *Asterias forbesi* (Desor).

MATERIAL EXAMINED: Three young specimens from the coast of Maine, collected by the "*Eagle*," William K. Vanderbilt, commanding. One large dry specimen from the same locality, Cat. no. 231. One young specimen dredged off Eastport, Maine, August 22, 1923, by the "*Ara*."

COLOR: In life the coloration of this species is remarkably variable; the more abundant kinds are yellow or purple, but variations of these dominant forms, including cream-colored, yellow-brown, orange, brown, pink, and even bright red specimens have been recorded.

HABITS AND LIFE HISTORY: This species is said to differ but little from its near relative, *A. forbesi*, and these slight differences occur in the early stages of the life of the species. These were described by Alexander Agassiz in the "Memoirs of the Museum of Comparative Zoölogy," volume V, part 1, 1877. The larval stages were thoroughly discussed by Field in the "Quarterly Journal of Microscopical Science," November, 1892, and additional investigations of the larvae were made and reported by Goto in the "Journal of the College of Sciences of the Imperial University of Tokio," 1898. A delightfully interesting and thorough account of the habits and life history of the closely related species, *A. forbesi*, was given by Mead in the "Bulletin of the United States Fish Commission" for 1899.

TECHNICAL DESCRIPTION: Rays normally five, rarely four, six, or eight. Dr. Verrill records specimens of fifteen inches diameter as not uncommon in Labrador waters. Dr. H. L. Clark reports specimens 425 mm. in diameter from Nova Scotia. The largest of the three young specimens collected by the "*Eagle*" measure $R = 55$ mm.; $r = 13$ mm.; $R 4.45 \times r$. Width of ray at base, 12 mm., moderately slender, somewhat flattened dorsally with nearly vertical sides, tapered to a not quite acuminate tip. The disk is rather large and frequently appears somewhat swollen. The interbranchial arcs are acute. The plates of the abactinal surface are narrow, forming a network with large meshes; the skeleton is not very firm. On each arm there is a median longitudinal series with large papular areas on each side,

with three or more papulae in each group. The plates of the dorsal surface each bear short, blunt spines, 1 to 2 mm. high, usually singly, but sometimes two or three together. Each spine is finely spinose at the apex, and is encircled at the base with a ring of pedicellariae, each of which is very blunt. The other pedicellariae scattered over the dorsal surface are large and quite acute. There is a very well defined lateral series of spines along the side of each ray below which there is a longitudinally extended area devoid of spines but with numerous pedicellariae. This lateral series varies in position, sometimes being quite near the abactinal surface, on the other specimens scarcely visible from above. It consists of plates bearing two spines side by side, so that there is apparently a single line of spines. In older specimens there is frequently a third spine below the distal one of each pair, and a fourth spine above, or beside the proximal one. Farther down on the actinal surface of the ray occurs another series of spines which are largest and most conspicuous. These are 2 to 4 mm. long, distinctly blunt-tipped; they occur in series of three spines forming an oblique row on each plate, with the most distal spine nearest the ambulacral furrow. Pedicellariae are numerous with these spines but seldom encircle them. The adambulacral plates are closely packed together, being much more numerous in this species than in any of its near relatives of the East American coast. Each adambulacral plate has usually two spines, which are somewhat compressed, with the apex, pointed, clavate or squarely cut; each spine with one to five long, very slender, acute pedicellariae on the adambulacral plates within the furrow. The oral spines are long, slender, quite similar to that of the adambulacral spines and affording no specific characters. The tube-feet are in four longitudinal rows, closely crowded together.

REFERENCES: *Asterias rubens* GOULD, Rept. Invert. Mass., p. 345, 1841. *Asteracanthion rubens* DESOR, Proc. Boston Soc. Nat. Hist., vol. III, p. 67, 1848.—STIMPSON, Smithsonian. Contrib. Knowl., vol. 6, p. 14, 1853.

Asteracanthion violaceus STIMPSON, *op. cit.*, p. 14, 1853.

Asteracanthion pallidus A. AGASSIZ, Proc. Amer. Acad. Sci., p. 106, 1863, no description.

Asterias vulgaris PACKARD, no description, Canadian Naturalist, vol. VIII, p. 405, 1863.—VERRILL, Proc. Boston Soc. Nat. Hist., vol. 10,

p. 347, 1866.—H. L. CLARK, Bull. U. S. Fish. Comm., vol. XXII, p. 553, pl. 1, figs. 3-4; pl. 4, figs. 16-17, 1902.

Asterias stimpsoni VERRILL, *op. cit.* (part), p. 349.

Asterias pallida GOTO, Journ. Coll. Sci. Imp. Univ. Tokio, vol. X, pt. 3, p. 239, 1896-98, (treats of metamorphosis).

Subfamily: **HELIASTERINAE.**

Genus: **HELIASTER** Gray.

Heliaster multiradiatus (Gray).

Plate 57, text figure 3.

TYPE: Gray's type came from Hood Island, Galapagos, and is deposited in the British Museum.

DISTRIBUTION: Restricted to the Galapagos Islands; reported from Hood Island, Chatham Island, Albemarle Island and Charles Island.

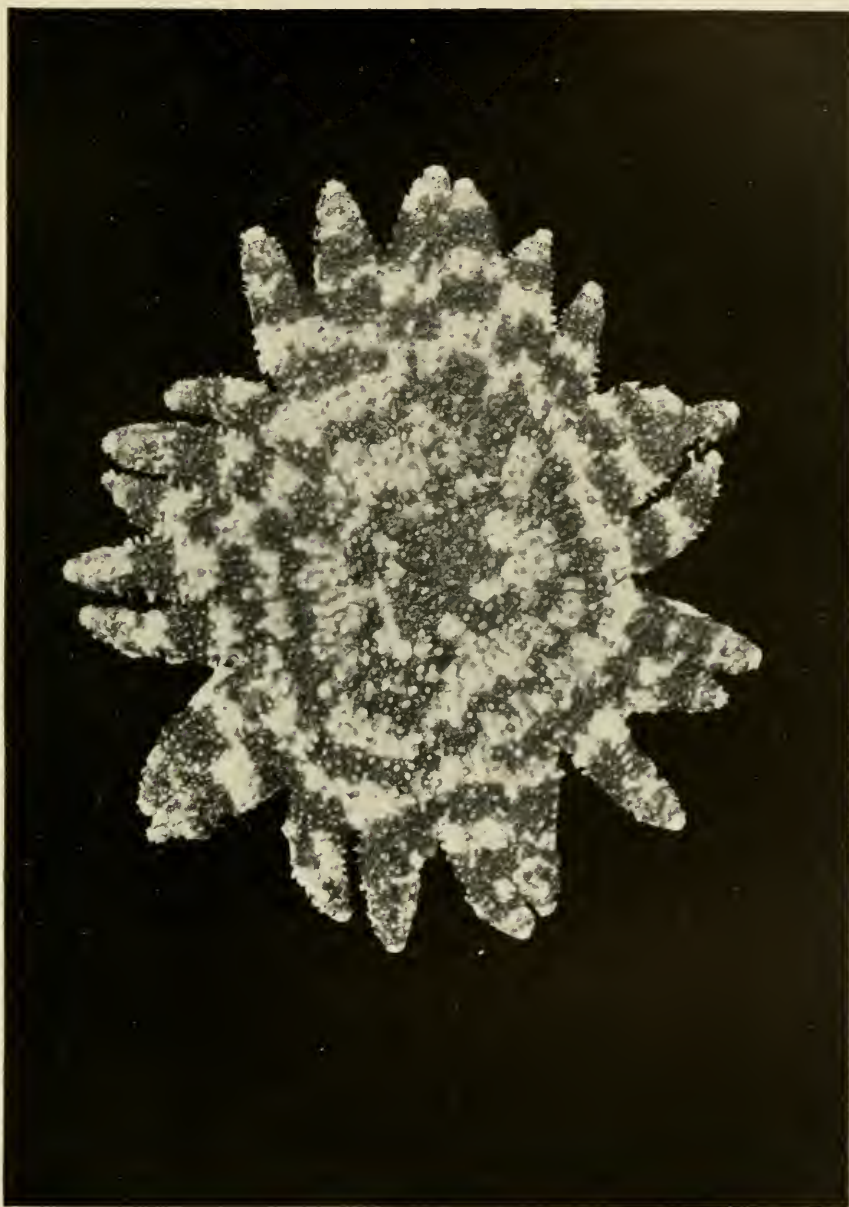
MATERIAL EXAMINED: One young specimen from Webb Cove, Albemarle Island, Galapagos, February 3, 1928, collected by the "*Ara*," William K. Vanderbilt, commanding.

COLOR: Leipoldt in 1895 gave the first color record of this species. The abactinal surface is creamy, yellowish or light gray, irregularly blotched with dark gray or blackish on the rays; the dark blotches appear as cross-bands. The abactinal spines are yellowish, whitish or brownish. The actinal surface is dominated by yellow, but the interbranchial areas and on the proximal half of the rays the outer side of the adambulacral are blackish markings. There is a striking contrast between the inner and outer sides of the adambulacral series and also between the basal and distal halves of each individual spine on its outer side. The oral spines are usually dark on the external side. The madreporite is yellow or creamy white.

The "*Ara*" specimen, preserved in alcohol, shows the abactinal surface alternately banded with purplish black and creamy color, in the proportions indicated in the plate.

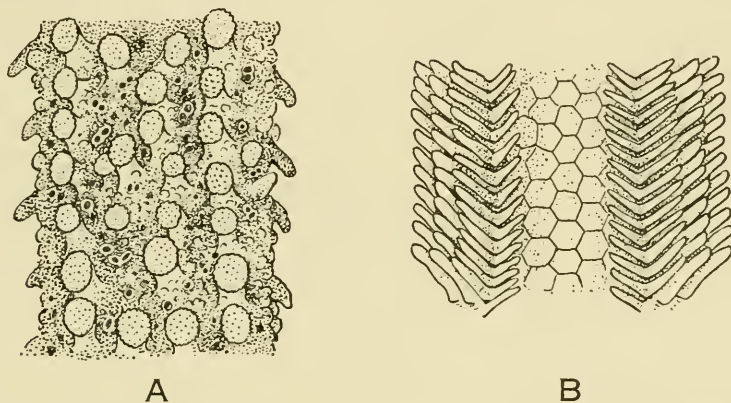
REMARKS: Dr. Hubert L. Clark's very thorough discussion of this species in his report on "The Starfishes of the Genus *Heliaster*," Bulletin Museum of Comparative Zoölogy, LI, p. 47, pl. 4, fig. 1, is based on a series of specimens.

TECHNICAL DESCRIPTION: Young starfish: Rays 24. Rays about 60 per centum free. $R = 35 - 26$; $r = 15 - 12$. Dr. Clark recorded specimens approximately three times as large as the "*Ara*" specimen.



Heliaster multiradiatus (J. E. Gray), abactinal view of young specimen from Galapagos, $\times 1.5$.

The abactinal surface of this species reminds one of an ox-eyed daisy. The rays are not quite cylindrical, a little depressed dorsally, tapered to a blunt point distally. The disk is not very large, but is usually abruptly elevated at the center. The abactinal skeleton is rather substantial, reticulated with fine meshes. The abactinal spines of the disk are short, thick, with blunt clavate or capitate summit, which under high magnification appears to be composed of rounded granules. These spines are numerous but distinctly separated. On the rays the spines form five definite longitudinal series, a median, a paired lateral and a paired marginal series. In addition there are two series of spines on the sides of the ray, which are slightly smaller than those



TEXT FIG. 3.—*Heliaster multiradiatus* (J. E. Gray). A. Section of abactinal surface of arm. B. Section across actinal surface of arm, both much enlarged.

of the actinal series. On the abactinal surface the largest spines are usually on the disk and the median series of the rays. The present specimen also has several "twin" or double spines, with one base splitting into two normal size spines distally. The actinal surface of the disk has the interbrachial areas reduced to a minimum, the surface being almost completely occupied by the ambulacra, adambulacral spines, pedicellariae and papulae. The actinal spines are in two series, an upper row in which the spines are shorter than the adambulacral spines, and the lower series which is longer than these latter. The adambulacral spines are close-set; usually each plate has a long, clavate outer spine, and closely appressed to this on the inner side is a second spine, which in some instances is a duplicate of the outer adambulacral spine, making a double series, but in other

instances, on the same ray is a much smaller, subacute spine. The ampullae are in two irregular series, so crowded mid-way the ray as to appear quadriseriate. The pedicellariae are quite small and rather numerous on the abactinal side of the rays near the tip; on the actinal surface there are also pedicellariae; occasionally quite large, forficulate pedicellariae are found here. The mouth depression is characteristic. The madreporite is small, convex, subcircular, button-like, about four times the long diameter of nearby spines, and shows numerous, fine, irregularly radiating lines.

REFERENCES: *Asterias multiradiata* GRAY, Ann. Mag. Nat. Hist., 6, p. 180, 1841.

Heliaster multiradiatus DUJARDIN and HUPE, Hist. Nat. Zoöp. Echinodermes, p. 344, 1862.—H. L. CLARK, Bull. Mus. Comp. Zoöl., LI, p. 46, pl. 4, fig. 1, 1907-08.

Heliaster multiradiata VERRILL, Trans. Conn. Acad. Arts & Sci., I, p. 292, 1867.

OPHIUROIDEA.

PHRYNOPHIURIDA.

Family: OPHIOMYXIDAE.

Genus: **OPHIOMYXA** Muller and Troschel.

Ophiomyxa pentagona (Lamarck).

Plate 58.

TYPE: Lamarck's type came from Sicily and is deposited in the Paris Museum.

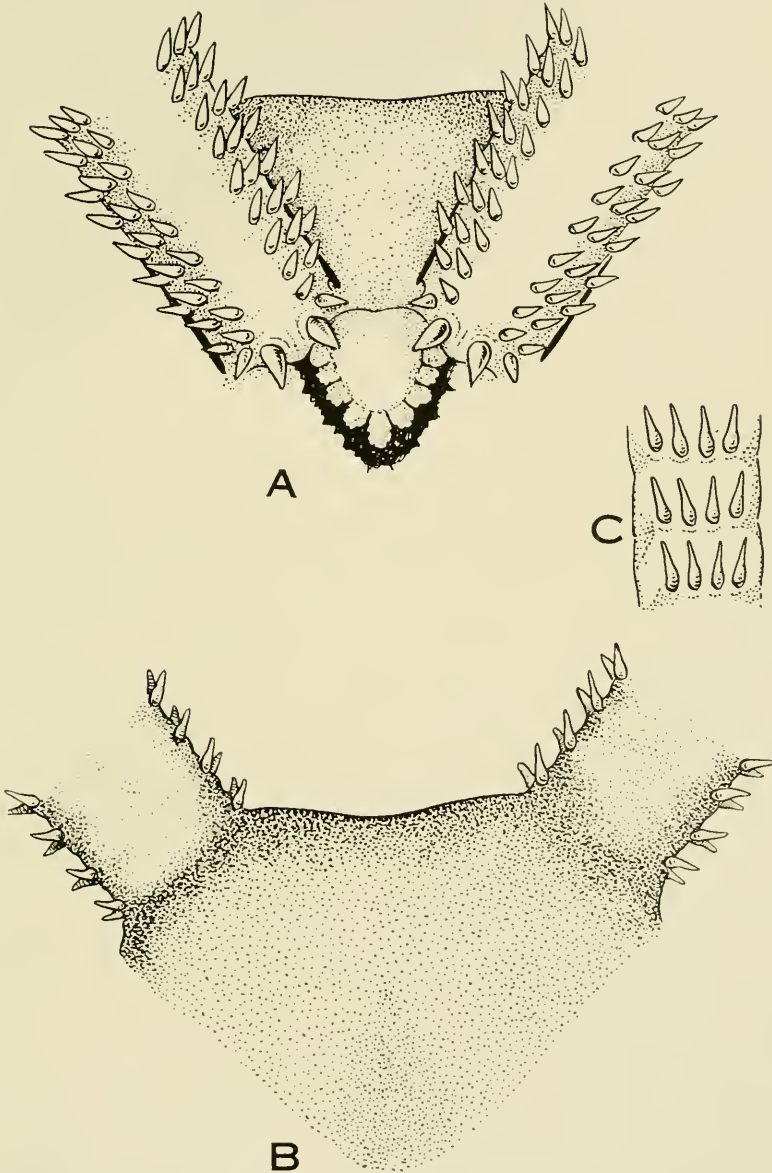
DISTRIBUTION: An abundant littoral species in the Mediterranean, also found on the African coast down as far as Cape Verde, and on the northern coast of Spain. Bathymetric occurrence: Chiefly littoral, but recorded from depths down to 235 meters.

MATERIAL EXAMINED: One specimen, dredged in 35 fms., 5 miles N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea, July 21, 1927, by the "Ara." One specimen, dredged in 100 fms., 9½ miles E. by S., ½ S. from Cape Bon Tunis, North Africa, July 19, 1927, Cat. no. 233.

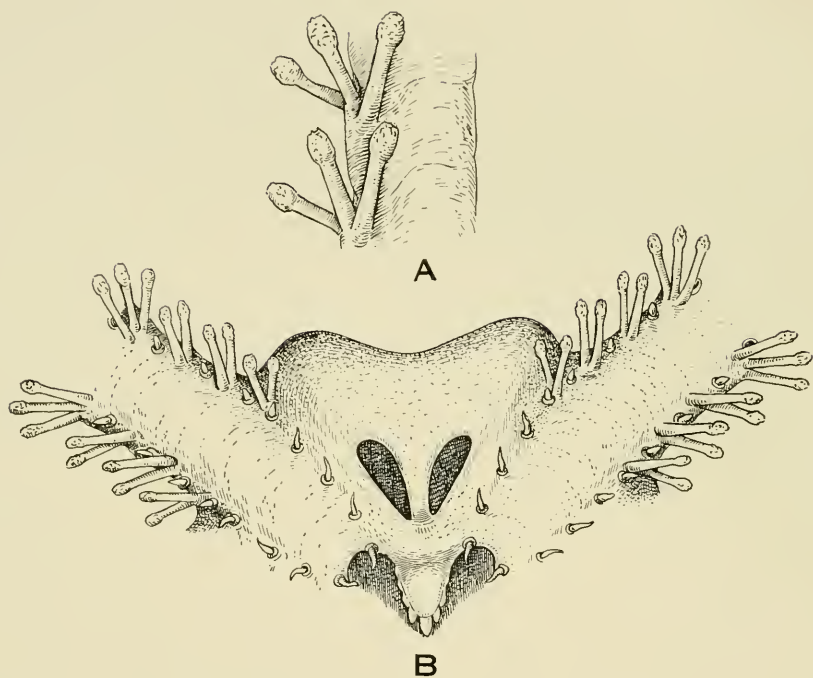
COLOR: Brown with dark flecks.

DEVELOPMENT: Unrecorded.

TECHNICAL DESCRIPTION: Disk diameter, 21 mm.; length of arm, 75 mm. Disk pentagonal with the interbrachial lateral margin slightly concave. The abactinal, actinal, interbrachial surfaces of the disk



Ophiomyxa pentagona (Lamarek) $\times 4$; A, section of oral surface; B, section of aboral surface; C, cross-section of arm.



Asteronyx loveni Muller and Troschel, A, cross-section of arm $\times 6.5$; B, section of oral surface, $\times 5$.

and the arms are encased in a tough thick skin, which also extends out upon the mouth-plate and side mouth-plates concealing them, reaching to the bases of the mouth papillae. There are eight mouth papillae set in regular series; each papilla is large, squarish, with the outer margin convex and finely crenulate. There are five or six teeth, each a broad, bluntly rounded lobe with its margin finely serrate. The genital slits which begin outside the mouth-shield extend about 55 per centum of the width of the interbrachial region. The arms are rounded, rather thick proximally, the arm-plates imperfectly developed and concealed beneath the tough skin which encases the entire arm. The arm-spines are in series of four, short, stocky, nearly equal, encased in skin at the base and with the tip thorny. There are no tentacle scales.

REFERENCES: *Ophiura pentagona* LAMARCK, Hist. Anim. sans Vert., vol. II, p. 546, 1816.

Stella pentagona scolopendroides regularis LINCK, De Stell. Marin., p. 51, pl. 27, fig. 46, 1733.

Ophiomyxa pentagona MULLER and TROSCHER, Syst. Ast., p. 108, 1842.

—LYMAN, Illus. Cat. Mus. Comp. Zoöl., Memoirs, vol. I, p. 180, 1865; Bull. Mus. Comp. Zoöl., vol. III, part 10, p. 272, pl. 7, fig. 18, 1871-76.—Rept. Voyage "Challenger," Zoöl., vol. V, p. 246, 1873-76.—LUDWIG, H., Zeits. für Wissen Zoölogie, vol. XXXI, p. 383, 1878; Echin. des Mittelmeeres, Mitt. Zoöl. Sta. Neapel, Bd. I, p. 552, 1879.—H. L. CLARK, Mem. Mus. Comp. Zoöl., XXV, p. 169, 1915.

Family: **ASTERONYCHIDAE.**

Genus: **ASTERONYX** Muller and Troschel.

Asteronyx loveni Muller and Troschel.

Plate 59.

TYPE: The type of this species came from Bohuslan and Hammerfest, Norway, and is deposited at the Museum at Stockholm.

DISTRIBUTION: This species is nearly cosmopolitan in its distribution, being known in Europe from the Scandinavian Seas to Finmark, also off Scotland and southwest Ireland; on the American east coast from Labrador down to the lower West Indies; on the African coast down to the Cape of Good Hope; also in the Indian Ocean, and in the Pacific Ocean from Australia to the Bering Sea. Bathymetric occurrence: 100 to 1800 meters.

MATERIAL EXAMINED: One specimen, dredged in 150 fms., 7 miles off Alligator Reef, Florida, March 30, 1926.

COLOR: Reddish.

LIFE HISTORY: Unknown. Eggs large.

TECHNICAL DESCRIPTION: Disk diameter, 18.5 mm. Disk encased in a tough, thick skin in which there are a few small, scattered plates. The dorsal plates are lacking; the ventral plates are irregular, rather well developed, covered by the thick skin. The radial shields are long, narrow ribs, extending almost to the disk. The mouth-shields are very small, or even lacking in older specimens. The mouth papillae are well developed. One madreporite, fairly large.

The arms are also skin-encased, three of them being decidedly longer and thicker than the other two. On these longer arms, the most central arm-spine of each series is, in the middle region of the arm, long and club-shaped, thorny and encased in a tough skin. On the smaller arms these spines are all short, hook-shaped. There are no spines present at the first pair of tentacle pores; no tentacle scales.

REFERENCES: *Asteronyx loveni* MULLER and TROSCHER, Syst. der Asterid., p. 119, 1842.—LYMAN, Mem. Mus. Comp. Zoöl., vol. I, p. 13, 1865.—H. L. CLARK, Mem. Mus. Comp. Zoöl., vol. XXV, p. 180, 1915.—MORTENSEN, TH., Denmark's Fauna, no. 27, Echinod., p. 151, fig. 65, 1924.—Handbook, Echinod., British Isles, p. 158, fig. 90, 1927.

Family: **GORGONOCEPHALIDAE.**

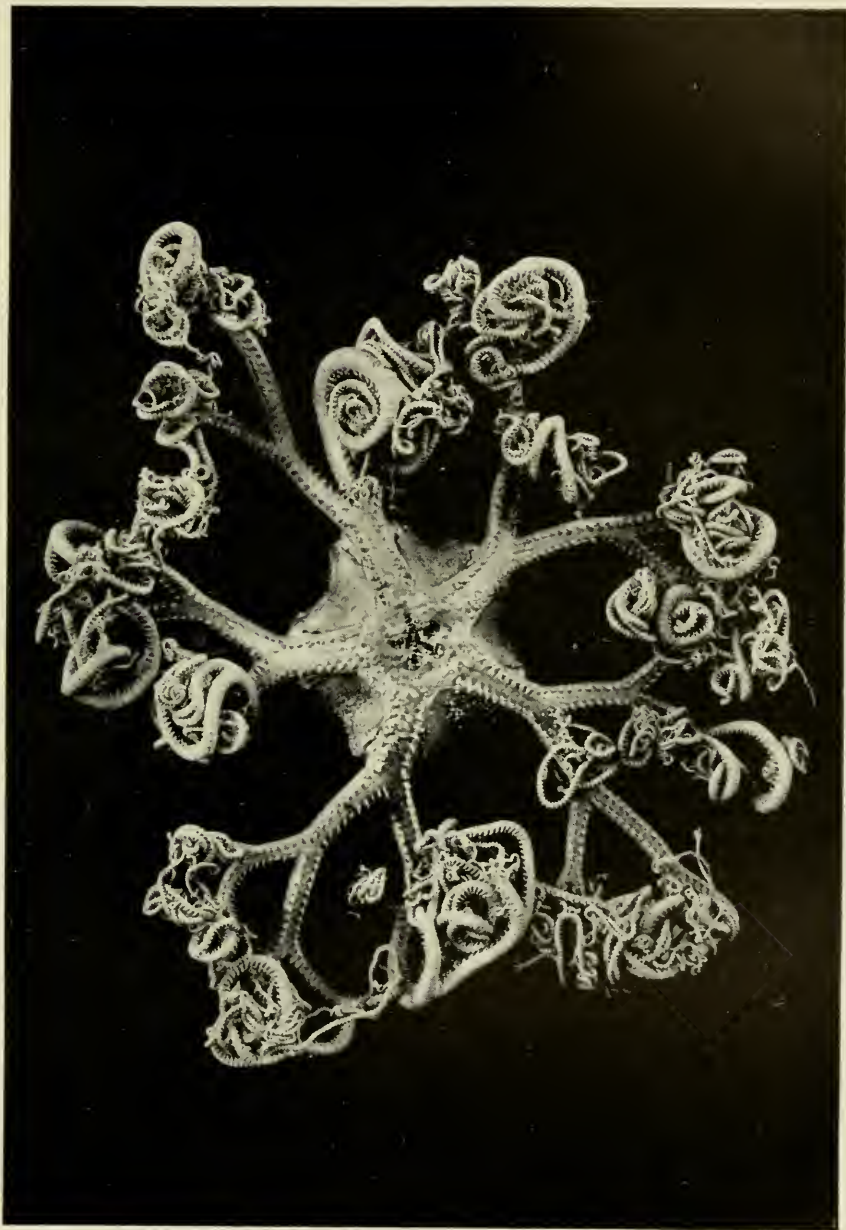
Genus: **GORGONOCEPHALUS** Leach.

Gorgonocephalus arcticus (Leach).

Plate 60.

TYPE: Leach's type was collected in Baffin's Bay, during the voyage of discovery in H. M. SS. "*Isabelle*" and "*Alexander*" in 1819, and deposited in the British Museum. In 1670 John Winthrop, governor of the colony of Connecticut, sent a specimen of this animal to the repository of the Royal Philosophical Society of London.

DISTRIBUTION: This is a polar and subpolar species known in Europe as far south in Scandinavian waters as 62° 43' N., 1° 26' S.; found also at Jan Mayen Land and on the coasts of Greenland, and on the East American coasts as far southward as Cape Cod. Bathymetric occurrence: Shore to 800 fms., the shallower records usually being correlated with the more southern localities.



Gorgonocephalus arcticus (Leach), oral view of a small specimen,
somewhat reduced.

MATERIAL EXAMINED: One large specimen in spirit, dredged in 200 fms., 9 miles S. by S. W. of Port Basque, Newfoundland, September 1, 1926, by the "Ara." One dry specimen, from the coast of Maine, collected by the "Eagle."

COLOR: There is an exquisite color plate of this curious basket-fish in the Monaco series, Fasc., XXXIV, pl. IX, showing the animal to be a rich burnt sienna on both faces, with deeper tones of this color on the disk.

TECHNICAL DESCRIPTION: This basket-fish is one of the earliest American echinoderms to be critically described and figured. The following notes were made by the colonial governor of Connecticut, John Winthrop, in 1670 and 1671, and published in the Philosophical Transactions of the Royal Society of London:

"There is besides a strange kind of fish, which was taken by a fisherman, when he was fishing for cods in the sea which is without Massachusetts Bay in New England. It was taken alive by a hook. The name of it I know not; nor can I write more particularly of it, because I could not yet speak with the fisherman who brought it from the sea. I have not seen the like. The mouth is in the middle; and they say that all the arms you see round about were in motion when it was first taken.

"We omit the other particulars here, that we may reflect a little on this elaborate piece of nature. The fish, as it is yet nameless, we may call *Piscis Echinostellaris Visciformis*; its body resembling an echinus or egg-fish, the main branches, a star, and the dividing of the branches, the plant mistletoe. See fig. 1, pl. XI. This fish spreads itself from a pentagonal root, which encompasses the mouth, being in the middle at (a), into five main limbs or branches, each of which, just at the issuing out from the body, subdivides itself into two (as at 1) and each of these 10 branches do again (at 2) divide into two parts, making 20 lesser branches: each of which again (at 3) divide into two smaller branches, making in all 40. Those again (at 4) into 80; and those (at 5) into 160; and those (at 6) into 320; those (at 7) into 640; at 8, into 1280; at 9, into 2560; at 10, into 5120; at 11, into 10,240; at 12, into 20,840; at 13, into 40,960; at 14, into 81,920; beyond which, the farther expanding of the fish could not be certainly traced, though possible each of those 81,920 small sprouts or threads, in which the branches of this fish seemed to terminate, might, if it could have been examined when living, have been found to subdivide yet farther. The branches between the joints

were not equally of a length, those for the most part pretty near; but those branches which were on that side of the joint on which the receding joint was placed were always about a fourth or fifth part longer than those on the other side. Every one of these branchings seemed to have, from the very mouth to the smallest twigs or threads in which it ended, a double chain or rank of pores, as appears by the figure. The body of the fish was on the other side; and seemed to have been protruberant, much like an echinus (egg-fish or button-fish) and, like that, divided into five ribs or ridges, and each of these seemed to be kept out by two small bony ribs.

"In the figure is represented fully, and at length, only one of the main branches, whence it is easy to imagine the rest, cut off at the fourth subdividing branch, which was done to avoid confusion, as well as too much labor and expense of time in the engraving."

A characteristically careful, modern description of this species is to be found in Theodore Lyman's "Ophiuridae and Astrophytidae," Ill. Cat. Mus. Comp. Zool., no. 1, p. 187, 1865. Excellent detailed illustrations are given by Sladen in the "*Challenger*" Report on the Ophiuroidea, pl. XXXV, fig. 26, pl. 36.

The outstanding diagnostic characters of this species are a large disk, with the arms branched from the base; the arm-spines beginning at the second pair of tube-feet. Only one madreporite is present. There are a series of plates among the edge of the disk in the inter-radial spaces. The disk is naked with only the radial ribs possessing a series of spines which are distinctly larger than the similarly placed rounded granules found on *G. eucnemis* (Muller and Troschel), another Arctic species having a similar range.

REFERENCES: The Basket-Fish, *Piscis Echinostellaris Visciformis* JOHN WINTHROP, Phil. Trans. Royal Soc. London, vol. V, p. 1152, 1670; *ibid.*, pl. XI, fig. 1, (p. 423 reprint), vol. V, p. 178, 1819. *Gorgonocephalus arcticus* LEACH, in Ross's Voyage of Discovery in H. M. SS. "*Isabella*" and "*Alexander*," vol. II, appendix IV, p. 178, in second edition, 1819.—H. L. CLARK, Mem. Mus. Comp. Zool., vol. XXV, p. 185, 1915.

Euryale scutatum GOULD, Rept. Invert. Mass., p. 345, 1841.

Astrophyton agassizii STIMPSON, Smiths. Contrib. Knowl., vol. VI, p. 12, 1853.—LYMAN, Ill. Cat. Mus. Comp. Zool., vol. 1, no. 1, p. 186, 1865.—Proc. Boston Soc. Nat. Hist., vol. 19, p. 102, 1877.—LUTKEN, Addit ad Hist. Ophiurid., part III, in Dansk Vidensk.

Selsk. Skrifter, 5th Raekke, p. 66, 1869.—DUNCAN and SLADEN, Mem. Echinod. Arctic Sea, etc., p. 69, pl. V, figs. 1-6, 1881.

Astrophyton arcticum DUNCAN and SLADEN, Ann. Mag. Nat. Hist., ser. 4, vol. 20, p. 468, 1877.

Gorgonocephalus agassizii SLADEN, Rept. Ophiuroidea, Voy. "Challenger" Zoöl., vol. V, pt. 14, p. 264, pl. 33, fig. 26, pl. 36, 1882.—FISCHER, Die Oesterreich Polarstation, Jan Mayen, Bd. III, p. 37, 1886.—GREIG, Ophiuroidea, Norwegian North Atlantic Exped., 1876-78; Zoöl., XXII, vol. 5, p. 35, pl. III, figs. 20, 21, 1893.—KOEHLER, Res. Campag. Sci. du yacht "l'Hirondelle," Fasc. XII, p. 59, 1898; Bull. Soc. Zoöl. France, vol. 26, p. 102, 1901, Paris.—GREIG, Fauna Arctica, Bd. I, Lief 2, p. 271, 1900.—MORTENSEN, Th., Medd. Gronland, Bd. 29, p. 88, 1909, Copenhagen.—H. L. CLARK, Bull. U. S. Bur. Fish. vol. XXII, p. 561, pl. 6, figs. 35, 36, pl. 7, figs. 46, 47, 1902; Occas. Papers Boston Soc. Nat. Hist., vol. VII, pt. 2, p. 7, 1905.—SCHMITT, Mon. de l'île Anticosti, Paris, p. 247, 1904.—GREIG, Rept. Second Norweg. Arctic Exped. in Fram, 1898-1902, p. 23, 1907.

Gorgonocephalus agassizi DODERLEIN, Wiss. Meeres Untersuch., Bd. IV, Heft 2, p. 227, 1900.—MICHAILOVSKY, Ann. Mus. Zoöl. Petersbourg, vol. 7, p. 498, 1902.—KALISCHEVSKY, Mem. Acad. Imp. Soc. St. Petersburg, ser. 8, vol. 18, no. 4, p. 21, 1907.—KOEHLER, Bull. Sci. France et Belg., vol. 61, p. 349, 1907; Res. Campag. Sci. du yacht "Princess Alice," fasc. XXXIV, p. 206, pl. IX, fig. 1, color plate, 1909.

Genus: **ASTROPHYTON** Muller and Troschel.

Astrophyton muricatum (Lamarek).

TYPE: Lamarek's type came from the West Indies and was deposited in the Paris Museum.

DISTRIBUTION: Found from Charleston, S. C., southward to the Tortugas and through the West Indian region. Littoral to 278 fms.

MATERIAL EXAMINED: One large specimen, taken on the Florida Reefs, 1923. One larger dry specimen, dredged off the south coast of Cuba, in deep water, by the "Ara." Another large dry specimen, dredged in 30 fms., 14 miles S. W. of Marquesas Keys, Florida, March, 1924.

COLOR: In life this basket-fish is usually bright orange-yellow, or yellowish brown.

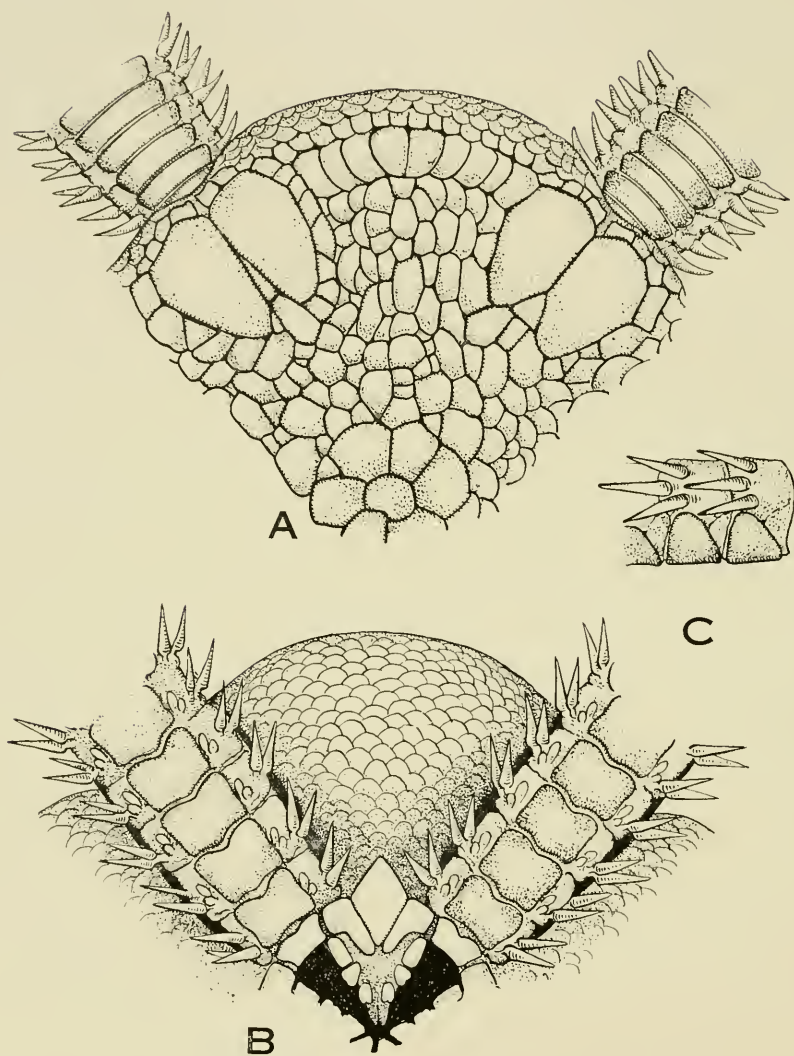
HABITS: This curious animal has a body composed of over 81,000 joints. It walks on the tips of its branches and arches the central portion upward. The multibranched arms serve as shelter for a number of species of small crustaceans, mollusks and ophiurans, some of which are external parasites, feeding on the food particles collected by the basket-fish. The network of arms of the basket-fish make a complete trellis and serve to enmesh small animals, *i. e.*, copepods, snails, worms, small fish, etc., on which the basket-fish feeds. The arms carrying food curl up, passing it into the star-shaped mouth.

TECHNICAL DESCRIPTION: This species, which is easily distinguished by the fact that the radial ribs of the disk are decidedly, sharply elevated, bearing a few large, fleshy spines, the sides of which are usually conspicuously fluted, is monotypic of the genus as at present restricted.

Diameter of disk 70 mm., from the outer corner of madreporic shield to the outer corner of the opposite mouth-slit 29 mm.; width of arm at base 24 mm. It is impractical to give the length of distances of the forks of the arms because of their dried and interlaced condition.

The teeth, tooth papillae and mouth papillae are sharp, conical, of unequal sizes. Eight to ten of these which occupy the place of teeth are largest, attaining a length of 3 to 3.2 mm. Those representing the mouth papillae are of intermediate sizes. The outer mouth papillae extend down to the outer corner of the mouth-slit. The madreporic plate is of irregular shape, somewhat between a rectangle and an oval in contour and is situated near the inner angle of the interbranchial space. The arms are covered above, below and on the sides by a close, fine, smooth pavement of microscopic granules. Transverse lines distinctly indicate the joints of the arms on the aboral surface and sides; on the oral surface there is a definite longitudinal sunken line, here are also scattered round spots composed of concentric rings of microscopic oblong round grains. On the outermost branches most of these grains form a double vertical row of grains which support the arm-spines, each of the latter being a single microscopic hook.

The disk, which is covered on both surfaces with the same granular covering as the arms, has also above the round spots in the interbranchial spaces. The paired radial ribs are very prominent, terminating outwardly in a smooth, concave cicatrix. On the median upper surface of each is an irregular, longitudinal series of coarse spines, 1.5 to 2 mm. high, with their sides deeply fluted. The under interbranchial spaces are very small because of the great breadth of the



Amphiura diomedea Lutken and Mortensen, $\times 8$; A, section of aboral surface;
B, section of oral surface; C, cross-section of arm.

arms. The genital slits are small and do not have a margin of grains; their long diameter is 5.5 mm. The tentacle scales are very fine, slender, spine-like. They are not to be found within the ninth fork, occasionally the tenth fork, of the arm on its main trunk; beyond this point there are one, two, three, sometimes four to each pore, the number being greatest on the smaller side branches; however, on the finer twigs the number decreases and on the finest twigs the tentacle scales are replaced by a single hook.

REFERENCES: *Euryale muricatum* LAMARCK, Anim. d. sans Vert., II, p. 538, 1816; second edition, vol. III, p. 217, 1840.

Astrophyton muricatum AGASSIZ, Mem. de la Soc. des Sciences Nat. Neuchatel, p. 12, 1839.—MULLER and TROSCHEL, Syst. der Asteriden, p. 122, 1842.—LUTKEN, Kongl. Danske Vidensk. Selsk. Skrift., 5th Raekke, Bd. 5, p. 258, 1861.—DODERLEIN, Japan. Euryalae, pl. 5, fig. 1, 1911.—H. L. CLARK, Mem. Mus. Comp. Zoöl., XXV, p. 188, 1915.

Astrophyton costosum LYMAN, Mem. Mus. Comp. Zoöl., vol. I, p. 192, 1865.

GNATHOPIURIDA.

Family: AMPHIURIDAE.

Genus: AMPHIURA Forbes.

Amphiura diomedae Lutken and Mortensen.

Plate 61.

TYPE: The type series of this species was taken by the "*Albatross*" at stations 3393, 1020 fms., 3394 in 511 fms., at 3398 in 1573 fms., and at 3429 in 919 fms. Deposited in the United States National Museum and the Museum of Comparative Zoölogy.

DISTRIBUTION: As cited above, in deep water off the Pacific coast of Panama; also taken by the "*Albatross*" at numerous stations in large numbers along the Japanese coast in 56 to 726 fms. Bathymetric occurrence: 56 to 1723 fms.

MATERIAL EXAMINED: Two disks with broken arms attached and 50 to 100 arms minus disks, collected in 100 fms., Punta Arenas, Costa Rica, by the "*Ara*," Cat. no. 292.

COLOR: The color of the living animal is not recorded.

LIFE HISTORY: Unknown.

TECHNICAL DESCRIPTION: Disk diameter 10 mm., arm length 46 mm. Abactinal surface paved with irregular scales, the primaries of which are well defined. Interbrachial regions of actinal surface of disk

similarly paved with similar smaller scales, which are rather conspicuous along the abactinal margin of disk. Radial shields broad pear-seed shaped, contiguous at base; in this, which differs even in pairs on the same disk, the present specimens differ from the figures given by Lutken and Mortensen. A few scales separate the distal portion of the paired radial shields in the three young specimens before me.

The mouth-shield is rhombic, varying quite a little in width. The side mouth-shields are slender, tapered inwardly, not quite meeting. Mouth papillae, three blunt ones on each side of a jaw, and two pointed teeth at the apex. The under arm-plates are somewhat rectangular, wider than long, with the outer margin concave in the middle and rounded on either side, and the inner margin correspondingly convex, the side margins relatively straight. The side arm-plates bear three strong, tapered spines. The upper arm-plates are short and quite wide with the outer margin rounded at the angles.

REFERENCES: *Amphiura diomedae* LUTKEN and MORTENSEN, Mem. Mus. Comp. Zool., vol. 23, pt. 2, p. 151, pl. XII, figs. 1-7, 1899.—H. L. CLARK, Bull. 75, U. S. Nat. Mus., p. 140, 1911; Mem. Mus. Comp. Zool., vol. XXV, p. 225, 1915.

Genus: **HEMIPHOLIS** Agassiz, *Mss.*, Lyman.

Hemipholis elongata (Say).

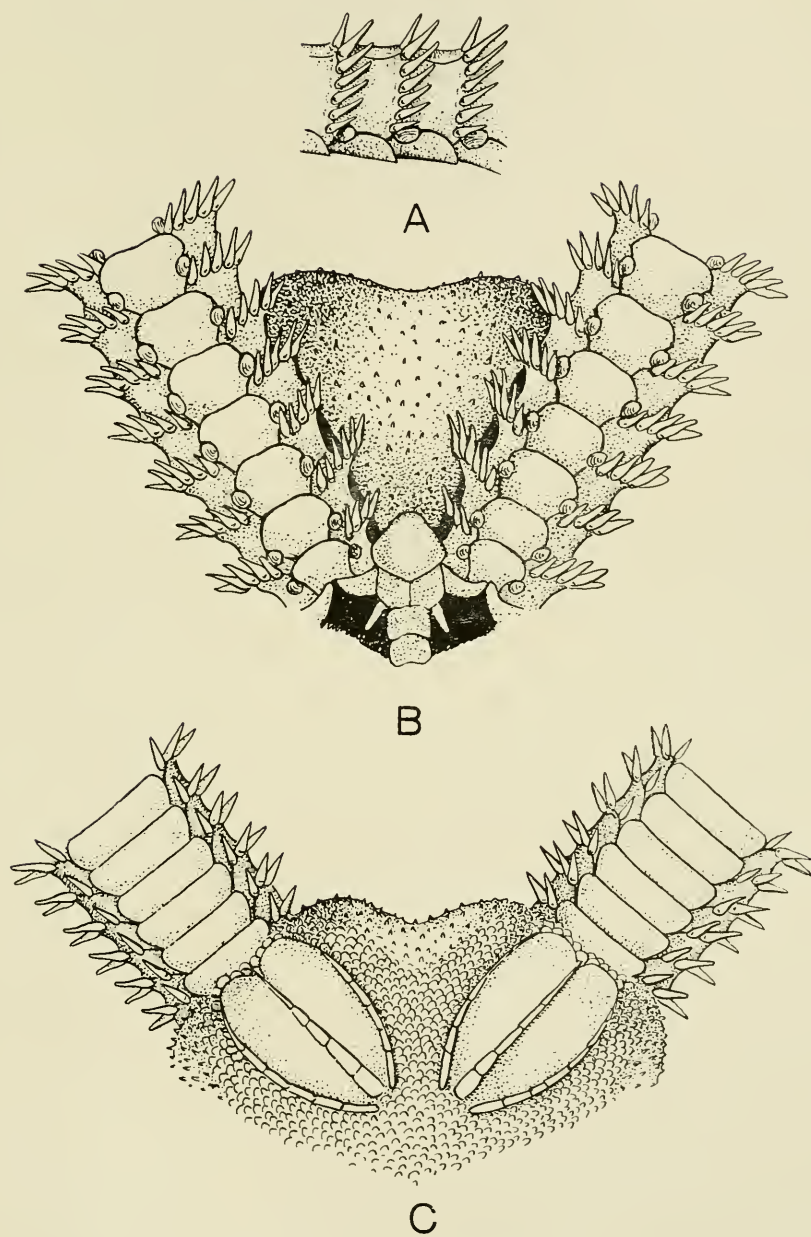
Plate 62.

TYPE: Say's type comes from Charleston Harbor, S. C., and is deposited in the Philadelphia Academy of Natural Sciences.

DISTRIBUTION: Charleston, S. C.; Turtle Harbor, Florida; Desterro, Brazil. Littoral.

MATERIAL EXAMINED: One specimen, dredged by the "*Ara*" in Turtle Harbor, Florida, April 14, 1923. This apparently establishes the first Floridian record of the species. Cat. no. 218.

HABITS: Stimpson reports that this species "is gregarious, living in companies of twenty to thirty. The existence of these groups is indicated at low water by spaces of about a foot in diameter, covered with small holes, looking very much as if a charge of shot had been fired into them. If these spots are watched as the tide rises, from each hole an arm of one of the starfishes will be seen to protrude, and wave about in the water. Generally each individual sends up one of its rays in this manner."



Hemipholis elongata (Say) $\times 12$. A, cross-section of arm; B, section of oral surface; C, section of aboral surface.

The young when quite small differ a great deal from the adult. They are frequently found clinging to the arms or disk of the parent.

COLOR: Agassiz's colored drawings made from living animals and first published by Dr. Lyman show this species to possess much variation. The ground color of the disk is almost always variegated, being variously dull indigo-blue, different shades of greenish, yellowish brown, yellow, gray or brownish flesh color, with the radial shields usually different from the disk, either bright or dull green, dark brown, lake-red, bluish, dull brown or gray; the arms also usually differ from the disk and are usually banded; one specimen had them sap-green, another lake-red and yet another brownish flesh color banded with black. The tentacles are red.

TECHNICAL DESCRIPTION: Disk orbicular, diameter 7 mm., length of arm 64 mm. or slightly more than nine times as long as the disk diameter. Abactinal surface of disk and lateral margins covered with small, flat, overlapping scales of uneven sizes. (Covering of central portion of disk torn off in the present specimen.) Five to six larger scales form a line between the radial shields. These shields are rather slender, pear-seed shape with the apex directed inward, the outer margin rounded; the length 2.1 mm., the greatest width 0.8 mm. The outer margin of the radial shield is separated from the first arm-plate by several small scales. The interbrachial region of the actinal surface is covered by tough skin and along the margin of the genital slit there are small, tapered papillae, also a few on the interbrachial region. The mouth-shields are small, suboval, wider than long, the outer margin more dilated than the inner. The side mouth-shields are long, narrow, meeting on the inner side. There are nine blunt, squarish teeth which are thickened on the median cutting edge. The mouth papillae are small, rounded, flattened, placed two in each angle at the base of the jaw-frames. The under arm-plates are slightly wider than long, with the outer margin slightly convex, the outer corners rounded, the inner margin is less convex than the outer but also with its corners rounded; the lateral margins are concave; the plate has the appearance almost of a shield with the angles rounded. There is one rather large, oval tentacle scale. The side arm-plates are wider than long, encroaching but little upon the surface of the upper arm, and supporting seven arm-spines. The upper arm-plates are nearly twice as wide as long, with both the inner and outer margins relatively straight with the lateral angles rounded. The

seven arm-spines are stout with tapered apices; the spines are of slightly unequal length, those of each series gradually increasing in length from the ventral to the dorsal side of the arm.

REFERENCES: *Ophiura elongata* SAY, Journ. Phila. Acad. Nat. Sci., V, p. 146, 1825.

Ophiolepis elongata STIMPSON, Proc. Boston Soc. Nat. Hist., IV, p. 225, 1854.

Amphiura elongata LUTKEN, Addit. ad Hist. Oph., pt. 2, p. 222, pl. 3, fig. 2, 1861.

Hemipholis elongata AGASSIZ, Mss.—H. L. CLARK, Mem. Mus. Comp. Zoöl., XXV, p. 237, 1915.

Amphiura cordifera LYMAN, Proc. Boston Soc. Nat. Hist., VII, p. 258, 1860.

Hemipholis cordifera LYMAN, Mem. Mus. Comp. Zoöl., I, p. 137, pl. 1, figs. 1, 3, 1865, (color plate).

Genus: **OPHIOPHOLIS** Muller and Troschel.

Ophiopholis aculeatus (Linné).

(Daisy Brittle-star).

Plate 63.

TYPE: Linnaeus stated merely that his type inhabits the ocean.

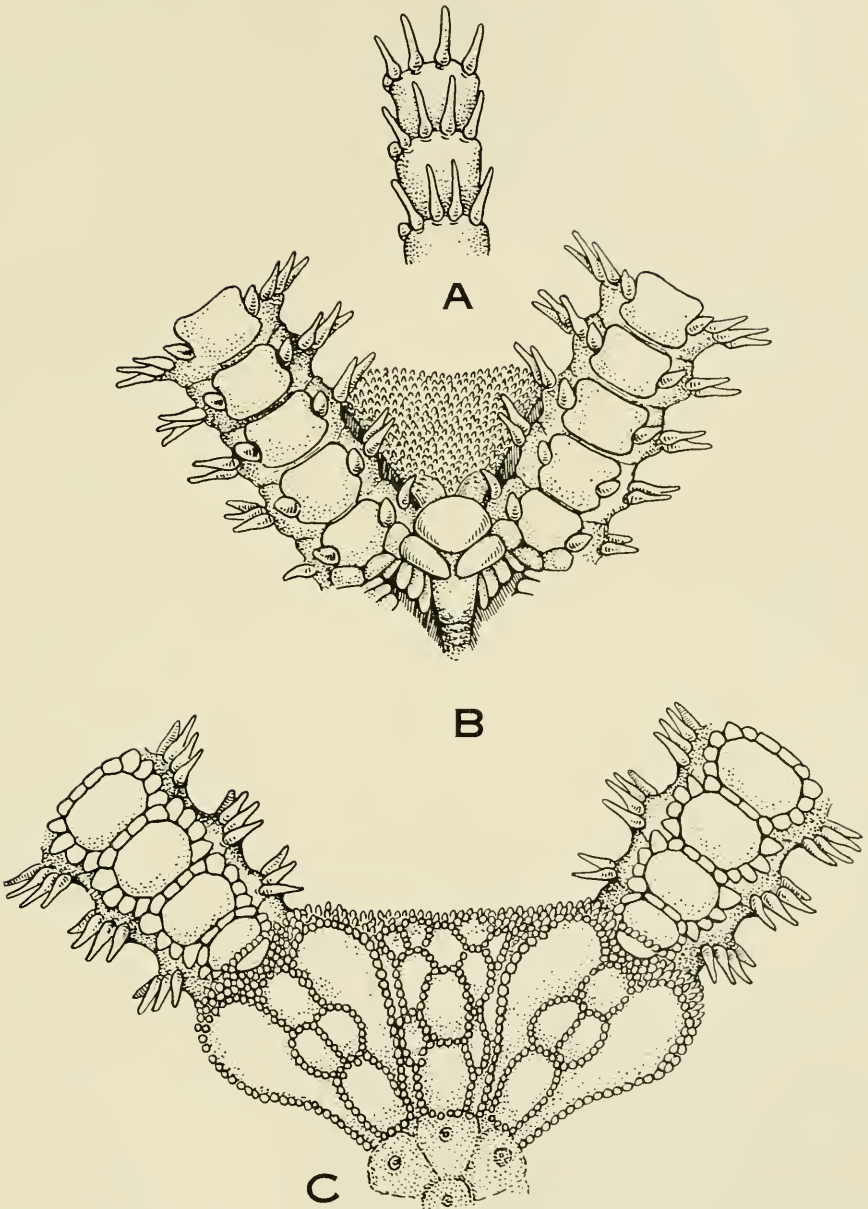
DISTRIBUTION: Circumpolar in Arctic waters; in Europe extending down to the Scandinavian coasts to the Danish shores; also to the southern shores of the British Isles. It is also found in Iceland and Greenland and on the East American coast down to Cape Cod; on the West American coast as far south as California, and on the Asiatic coast down to Japan. Bathymetrical occurrence: low tide-line down to 1880 meters.

MATERIAL EXAMINED: One specimen, dredged in 200 fms., 9 miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926.

HABITS: This is a sluggish brittle star which spends much of its time in rock crevices, feeding on the particles in the detritus. It has been found in the stomachs of codfishes.

COLOR: Frequently variegated, mostly red, more rarely with the disk bluish. American specimens frequently have the arms cross-banded.

TECHNICAL DESCRIPTION: Young specimen: Disk diameter 9 mm., arm length 25.5 mm. Disk covered with numerous granules among which small spines are abundantly scattered, excepting the primary



Ophiolis aculeatus (Linné), A, cross-section of arm $\times 10$; B, section of oral surface $\times 8$; C, section of aboral surface $\times 8$.

plates which are bare and which form a rosette in the center with ten radiating arms, five of which are interbrachial and five interrachial. The primary plates are rounded. The radial plates are pear-seed shaped with the apices directed inward, quite well separated, resembling the larger primary plates. Mouth papillae are six to each angle of the mouth and thin, flat, scale-like, squarish with rounded corners. There are twelve teeth, squarish, short, the middle of the cutting edge thickened; the upper ones somewhat narrower than the lower. The mouth-shields are almost oval, slightly pointed within. The side mouth-shields are large, thick, meeting within. The under arm-plates are wider than long, somewhat irregular, not quite touching, the inner and outer margins nearly straight, the inner a little shorter than the outer, the corners very rounded; the lateral margins concave. The side arm-plates encroach a little below between the under arm-plates and are distinctly separated from each other by smooth skin. There are six stout, flattened arm-spines, rather blunt-tipped, the outer four about equal, the lower two shorter, more conical. On the tip joints of the arm the lowest spines are armed with hooks. The tentacle scale is flat, elongate, stout, rounded. The dorsal arm-plates are widely oval, separated from each other, margined by the ten to twelve unequal, closely crowded supplementary pieces. Toward the tips of the arms the dorsal plates become nearly round.

REFERENCES: *Stella scolopendroides bellis scolopendrica* LINCK, De Stell. Mar., p. 52, pl. 40, fig. 71, 1733.

Asterias aculeata LINNÉ, Syst. Nat., ed. 12, p. 1101, 1767.

Asterias aculeatus RETZIUS, Ast. Gen., p. 240, 1783.

Asterias aculeata O. F. MÜLLER, Zool. Dan., p. 29, pl. XCIX, 1789.

Ophiura bellis JOHNSTON, Ann. Mag. Nat. Hist., p. 595, 1835.

Ophiocoma bellis FORBES, British Starfishes, p. 53, 1841.

Ophiopholis aculeata GRAY, Rad. Anim. Brit. Mus., p. 25, 1848.—

LUTKEN, Kong. Danske Vidensk. Selsk. Skr. 5th Raekke, Bd. 5, p. 60, 1861.—VERRILL, Proc. Boston Soc. Nat. Hist., vol. X, p. 344, 1866; Rept. U. S. Fish. Comm. for 1873, p. 718, pl. 35, fig. 270, issued 1873.—GREIG, Ophid. Norweg. North Atlantic Exped. Zool., 1876-78, p. 20, 1893.—H. L. CLARK, Bull. U. S. Bur. Fish. for 1902, p. 559, pl. 5, figs. 24-27, pl. 7, figs. 41-42, 1904; Mem. Mus. Comp. Zool., vol. XXV, p. 267, 1915.—MORTENSEN, Handb. British Echinoderms, p. 204, fig. 116, 1927.

Ophiolepis scolopendrica MULLER and TROSCHER, Syst. der Aster., p. 96, 1842.—STIMPSON, Smiths. Contrib. to Knowl., vol. VI, p. 13, 1853.

Ophiopholis bellis LYMAN, Mem. Mus. Comp. Zoöl., vol. I, p. 96, pl. 1, figs. 4-6, color plate, 1865.

Family: **OPHIOTRICHIDAE.**

Genus: **OPHIOTHRIX** Muller and Troschel.

Ophiothrix angulata (Say).

TYPE: Say's type was collected in Charleston Harbor, S. C., and is deposited in the Philadelphia Academy of Natural Sciences.

DISTRIBUTION: This species and its numerous varieties are found from North Carolina southward throughout the West Indian region and on the northern coast of Brazil. Bathymetric occurrence: Littoral to 200 fms.

MATERIAL EXAMINED: One specimen, Thompson Key, Florida, January 27, 1923, collected by the "Ara." Two, dredged in 150 fms., 7 miles off Alligator Reef, Florida, March 30, 1926.

COLOR: There is very great variation in the color of this species, but there is usually a characteristic white longitudinal stripe on the dorsal side of the arms. The ground color of the dorsal surface is more frequently some shade of bluish purple or brown, but may also be carmine, green or yellow.

DISCUSSION: Dr. H. L. Clark's discussion of the great variation existing in this species and his designation of six distinct varieties is a most welcome and helpful contribution to the knowledge of this very beautiful West Indian species (Bull. Mus. Comp. Zoöl., LII, p. 313, 1918-19).

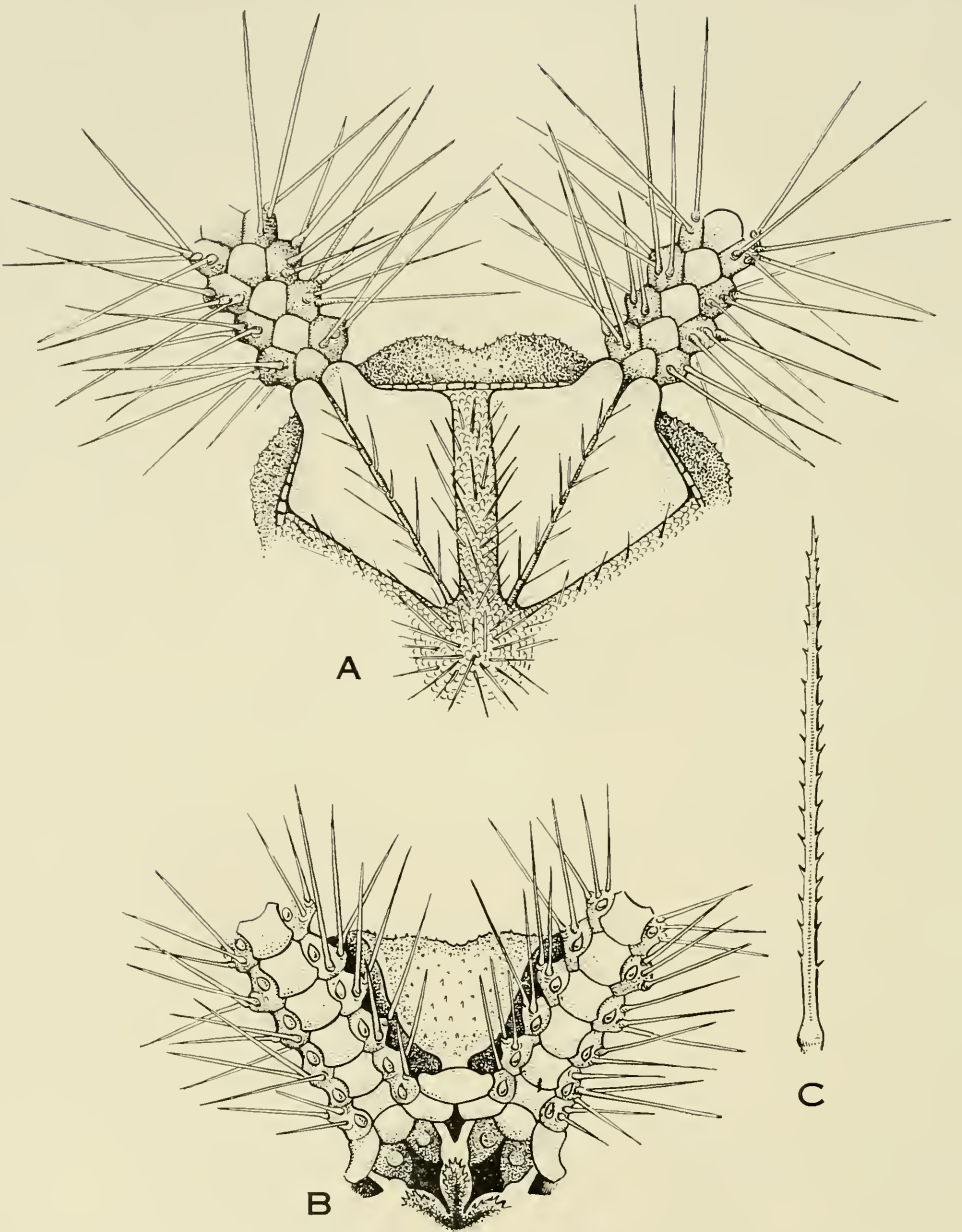
The three "Ara" specimens before me are young individuals, which are unfortunately broken and in poor condition, owing to their having been preserved in formalin.

REFERENCES: *Ophiura angulata* SAY, Journ. Acad. Nat. Sci. Phila., V, p. 145, 1825.

Ophiothrix angulata AYRES, Proc. Boston Soc. Nat. Hist., V, p. 249, 1852.—TH. LYMAN, Mem. Mus. Comp. Zoöl., I, pl. 2, figs. 1-3, 1865 (color plate).—H. L. CLARK, Bull. U. S. Fish. Comm., XX, p. 244, 1900; Mem. Mus. Comp. Zoöl., XXV, p. 269, 1901-15.

Ophiothrix hispida AYRES, *op. cit.*, p. 249.

Ophiothrix violacea LUTKEN, Vid. Selsk. Skrifter, Bd. V, p. 252, Tab. V, fig. 1, 1861.—RAEKKE, 1861, pt. II, p. 252, pl. 4, figs. 1 a-g.



Ophiothrix sucnsonii Lutken $\times 3$; A, section of aboral surface; B, section of oral surface;
C, a single arm spine greatly enlarged.

Ophiothrix suensonii Lutken.

Plate 64.

TYPE: Collected in the West Indies, on Gorgonian; deposited in the Copenhagen Museum.

DISTRIBUTION: Florida, Bahamas, Cuba, Jamaica, Haiti, St. Thomas, Dominica, St. Vincent, Grenada, Barbados, Venezuela.

MATERIAL EXAMINED: Two dry specimens, Pigeon Key, Florida, April 17, 1923, Cat. no. 212. Two young specimens, Turtle Harbor, Florida, 2½ fms., April 19, 1922. One, from the south of Catalina Creek, Cuba, February 14, 1923. Two, from Barnet Harbor, Bahamas, January, 19 , field tag 12. All collected by the "Ara."

COLOR: This brittle star is usually a delicate lavender with a line of deep purple bordered with creamy lines running down each arm and with radiating lines of purple on the disk. The spines are glassy, ornamented with tiny barbules along the edges, and banded transversely with deep lavender and creamy rings.

LIFE HISTORY: Apparently not yet studied.

TECHNICAL DESCRIPTION: Disk pentagonal, diameter 10.5 mm., arm length 54 mm. Almost the entire abactinal surface is covered by the radial shields except a narrow band on the interradiial region separating the pairs of radial shields and supporting a series of long, slender spines which are set in approximately three rows; these spines also occur on the center of the disk, also in a single line between the two radial shields of each pair. The radial shields are large, naked, occupying almost the entire dorsal surface of the disk; each shield is triangular with the apex directed inward, reaching almost to the center of the disk; the entire margin presents an acute angle terminating in a rounded peak. The interbrachial region of the actinal surface is covered with tough skin and bears several spines similar to those of the dorsal surface but much smaller. The genital slit is long, extending from the mouth-plate angle to the lateral margin. The mouth-shields are broadly nearly oval, or heart-shaped, with the outer margin rounded, the inner produced to a small peak; the width of the shield is twice its length. The side mouth-shields are short, triangular with the corners rounded, meeting within. Tooth papillae 18, arranged in an oval figure, the outer ones the longest, the inner ones shorter. There are four teeth, the uppermost one the longest,

with rounded cutting edges. The under arm-plates are as long as broad, with the outer margin wider than the inner, the corners rounded; the lateral margins are reënteringly curved where the tentacle scale fits. The side arm-plates are strongly developed and bear stout projections carrying the arm-spines. The arm-spines are in series of five; the uppermost one is the longest; all are long, slender, sharp, somewhat flattened, with about nine or ten spines on each margin. The dorsal arm-plates are small, about as long as broad, with the inner margin relatively straight and shorter than the outer margin which is decidedly convex, the lateral margins are straight and sloping.

REFERENCES: *Ophiothrix suensonii* LUTKEN, Vid. Med., p. 16, 1856; Add. ad Hist. Oph., pt. II, pl. 4, fig. 12 a-c, p. 250, 1861.—LYMAN, Mem. Mus. Comp. Zoöl., I, p. 157, 1864.—H. L. CLARK, *ibid*, XXV, p. 279, 1915; Bull. Mus. Comp. Zoöl., LXII, p. 313, 1918-19.

Family: OPHIOCOMIDAE.

Genus: OPHIOCOMA L. Agassiz.

Ophiocoma aethiops Lutken.

Plate 65.

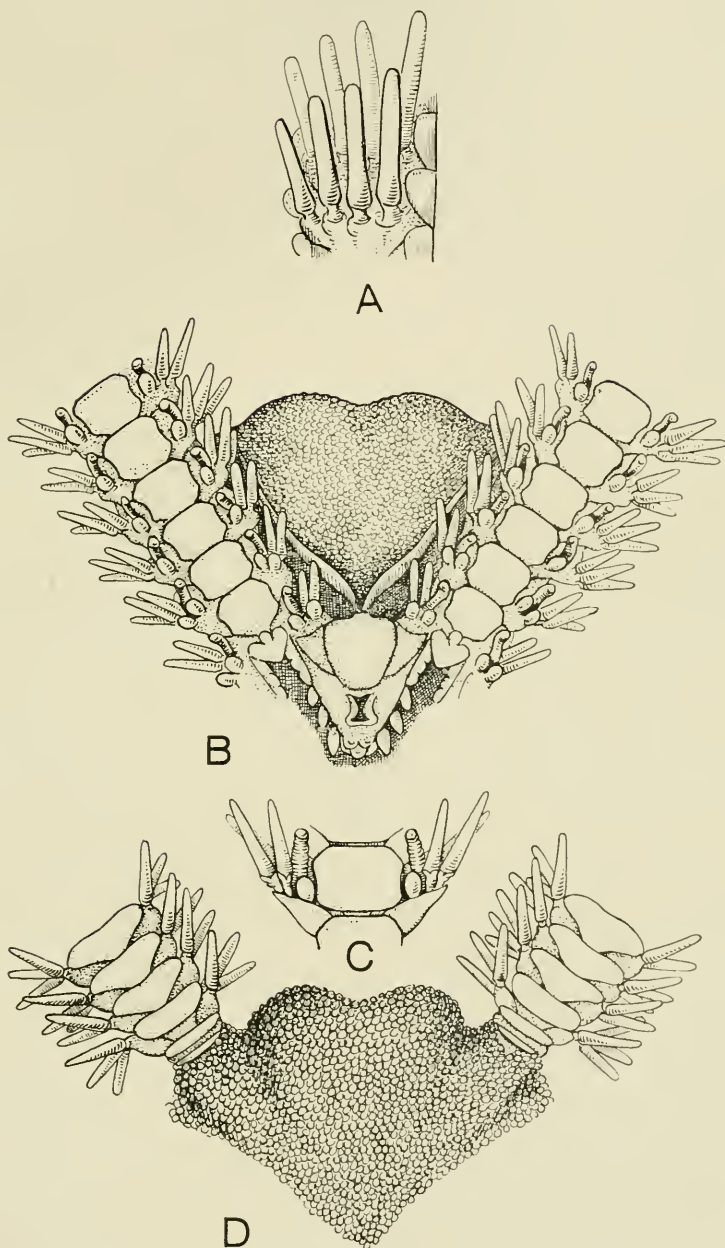
TYPE: Lutken's type was obtained at Panama and is deposited in the Copenhagen Museum.

DISTRIBUTION: The tropical west coast of America from Lower California to Panama and also at the Galapagos Islands. Littoral.

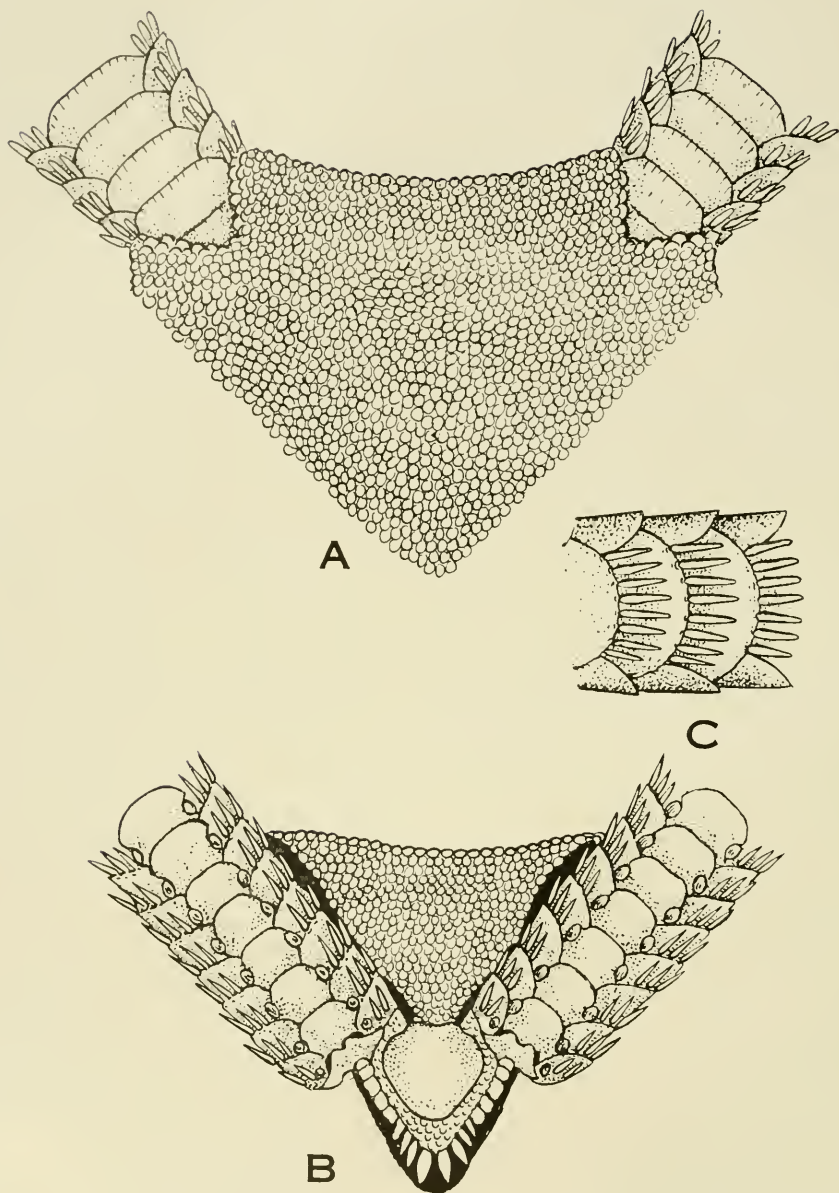
MATERIAL EXAMINED: Five very large specimens, collected in Webb Cove, Albemarle Island, Galapagos Islands, in a tide-pool, February, 1928, by the "*Ara*."

COLOR: Black, occasionally mottled with grayish.

TECHNICAL DESCRIPTION: Brittle star, large, arms stout. Disk diameter 34 mm.; arm length 125 mm. Abactinal surface and surface of interbrachial regions covered with fine round granules, which are much finer than those of its West Indian congener, *Ophiocoma echinata*. Mouth-shield small, squarish with angles rounded, forming a broad oval nearly circular. Side mouth-shields fitting close around the mouth-shields, meeting in the middle. Mouth papillae eight or nine; one very wide blunt tooth nearest the jaw angle, followed by two longer, narrow, blunt papillae and then a cluster of three shorter papillae at the apex. Teeth strong with truncated tips.



Ophiocoma aethiops Lutken, A, section of side-arm, showing spines, $\times 4$; B, section of oral surface of disk $\times 3$; C, detail of ventral arm-plate $\times 4$; D, section of aboral surface of disk $\times 3$.



Ophioderma appressum (Say), A, section of aboral surface of disk $\times 5$; section of oral surface of disk $\times 5$; cross-section of side arm $\times 7$.

The arms are wider and stouter than in *O. echinata*. The under arm-plates are small, slightly wider on the outer margin than long, the outer margin rounded; the side margins concave, the inner margin narrow, straight. The side arm-plates bear four spines each; these substantially increasing in size from ventral to dorsal of the series, the dorsal spine being very stout, blunt-tipped. The upper arm-plate is short and quite wide with the outer margin nearly parallel to the inner one.

REFERENCES: *Ophiocoma aethiops* LUTKEN, Kongl. Danske Vidensk. Selsk. Skrift. 5th Raekke, Bd. 5, p. 243, 1859.—H. L. CLARK, Bull. Amer. Mus. Nat. Hist., XXXII, p. 217, 1913; Mem. Mus. Comp. Zoöl., XXV, p. 291, pl. 13, figs. 6, 7, 1915.

Family: **OPHIODERMATIDAE.**

Genus: **OPHIODERMA** Muller and Troschel.

Ophioderma appressum (Say).

Plates 66, 75B and 76B.

TYPE: Say's type material came from the coasts of Florida and is deposited in the Philadelphia Academy of Natural Sciences.

DISTRIBUTION: South Carolina at Charleston, Florida, Bahamas, Bermuda, Jamaica, St. Thomas, Haiti, Venezuela, Brazil at Victoria. Littoral to 50 fms.

MATERIAL EXAMINED: Two specimens, taken at Porto Padre, Cuba, 2 fms., March, 1928, collected by the "Ara," Cat. no. 214.

COLOR: Variable, one form is dark ash-gray; another is dark green marbled with yellow.

TECHNICAL DESCRIPTION: Disk diameter 19 mm.; arm length 115 mm. The entire abactinal surface is covered by regularly distributed, coarse rounded granules which are also continuous on the outer lateral and interbrachial spaces of the actinal surface. The genital slit is long, granulated. Mouth papillae 16, or 18 to 20, unequal, but set in an even row, the first slender, the second more than twice as broad as the first, the third and fourth squarish; the fifth, sixth, seventh and eighth slender, acuminate, slightly increasing in size in the order named, the two teeth occurring at the apex of the jaw being substantially larger than the rest. Teeth five, strong, blunt, triangular, in series one above the other, the basal and uppermost ones of the series being somewhat smaller and shorter than those between. Mouth-shields heart-shaped, in some specimens with the height equal to or

slightly greater than the width, in others the mouth-plate is very much wider with the width 1.4 times the height. The side mouth-shields are very narrow, with the outer end forming a wedge that fits between the mouth-shield and arm-plate and extends to the margin of the genital slit. The side mouth-plates are covered by the same type of coarse, rounded granules that appear on the disk. The first under arm-plate is smaller than the others and its inner margin fills the angle of the mouth aperture. The second to eighth under arm-plates are subquadrate with the outer margin convex, the inner one slightly concave; the lateral margins concave. Near the tip of the arm these plates appear fan-shaped. Tentacular scales two, the inner one oblong-ovate, the outer one only two-thirds as long and broader, truncated at the distal end; both conspicuous, oval, the inner fitting into the concave margin on each side of the under arm-plate. The side arm-plates are arched, nearly twice as wide as long, with the outer margin a little convex, the inner nearly straight; the arm-spines in series of six to nine, about four-fifths as long as the supporting arm-plate and extending for almost that distance upon the adjacent plates from the second to eighth are each about twice as wide as long, with the inner and outer margins relatively straight, the outer angles rounded. Farther down toward the tip of the arm the inner margin of these plates is distinctly shorter than the outer margin and the plates are narrower. The dorsal arm-plates are wide.

REFERENCES: *Ophiura appressa* SAY, Journ. Acad. Nat. Sci., Phila., V, p. 151, 1825.—LYMAN, Mem. Mus. Comp. Zoöl., I, p. 94, 1864. *Ophioderma virescens* LUTKEN, Add. ad Hist. Oph., pt. 2, p. 194, pl. 1, figs. 4 a-4 d, 1859. *Ophioderma appressum* H. L. CLARK, Mem. Mus. Comp. Zoöl., XXV, p. 300, 1915.

Ophioderma variegatum Lutken.

Plate 67.

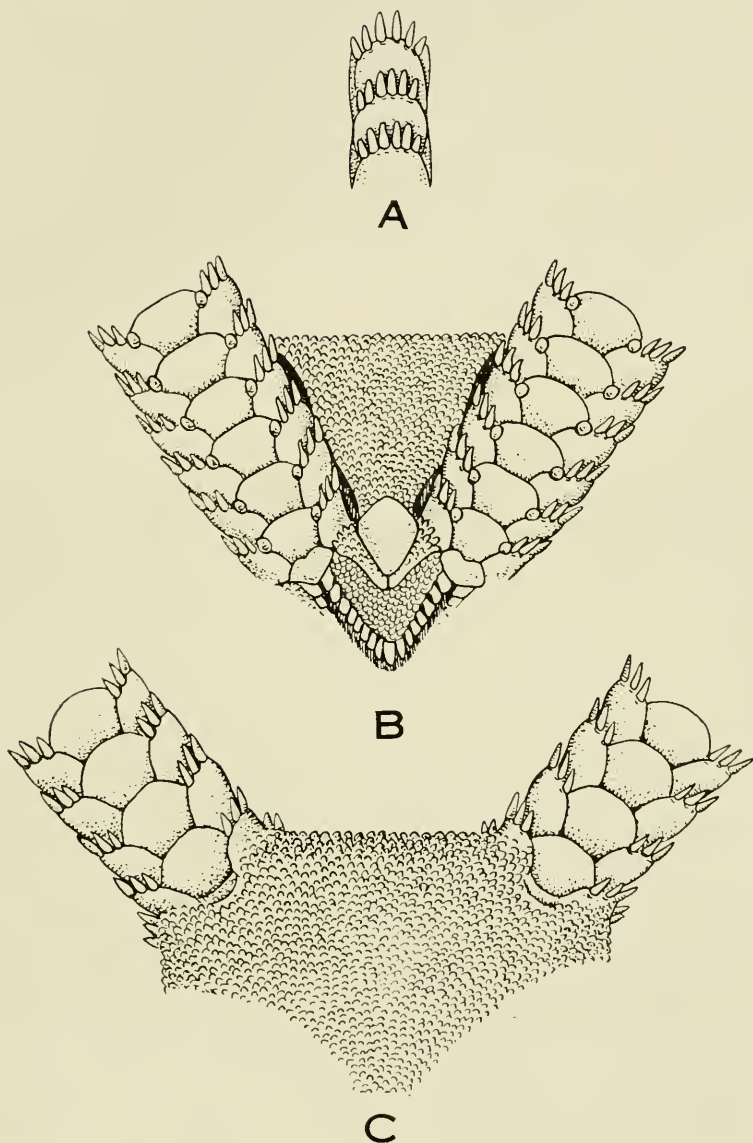
TYPE: Lutken's type came from Realego, Nicaragua, 5 fms., and is deposited in the Copenhagen Museum.

DISTRIBUTION: San Diego, Calif.; Lower California, Gulf of Lower California, Costa Rica, Pearl Islands, Galapagos Islands.

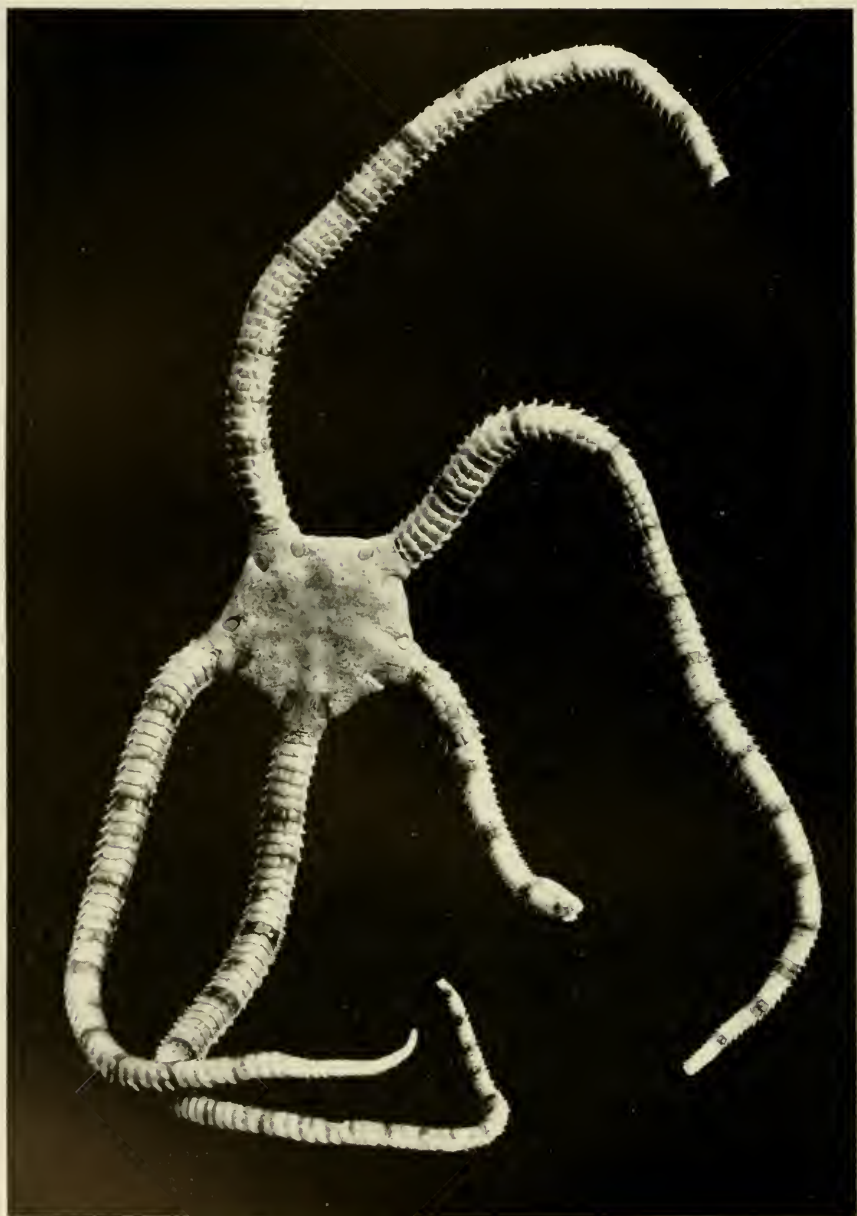
MATERIAL EXAMINED: Eight specimens, collected at Punta Arenas, Costa Rica, February, 1928, Cat. no. 260.

These establish the first record of the species from Costa Rica.

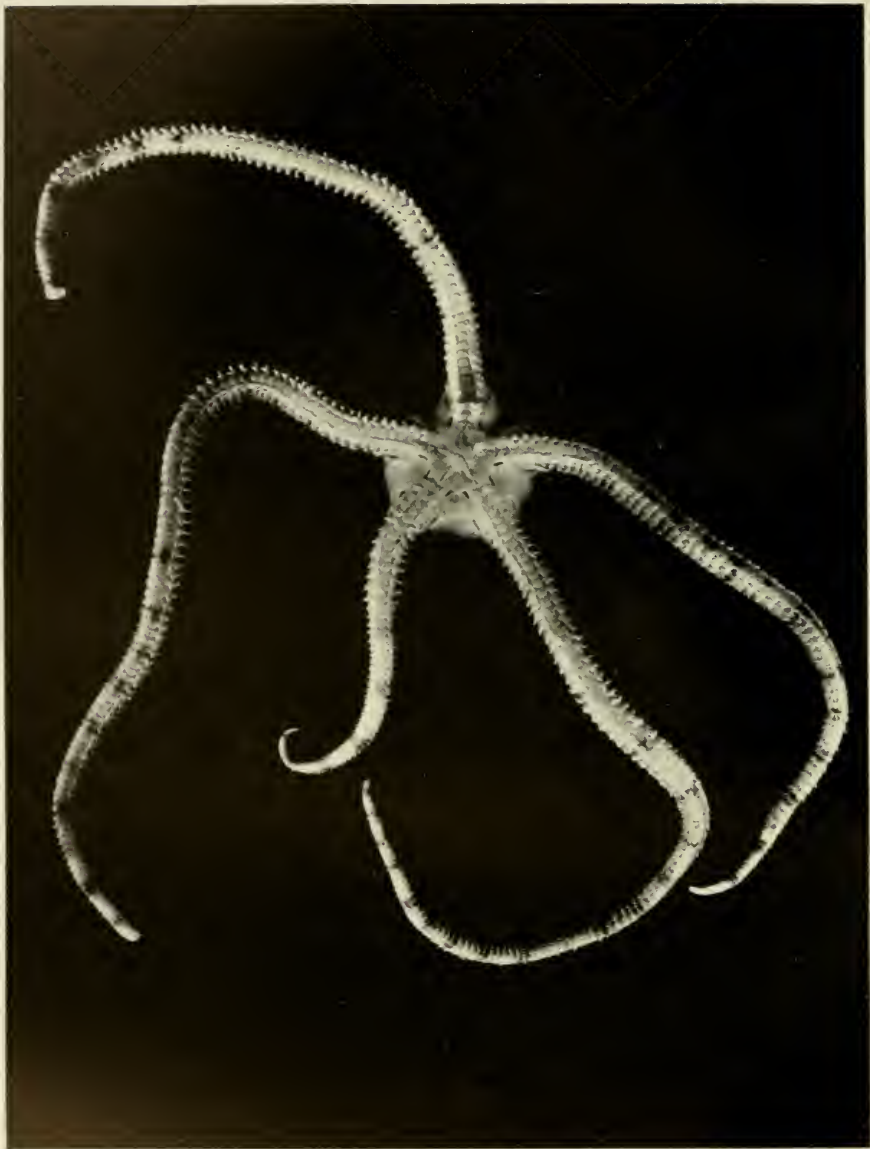
COLOR: Variable. The disk is usually vivid green, occasionally



Ophioderma variegatum Lutken $\times 3$; A, section showing spines of side-arm;
B, section of oral surface of disk; C, section of aboral surface of disk.



Ophioderma cinereum Muller and Troschel $\times 1$, aboral surface.



Ophioderma cinereum Muller and Troschel, oral surface of same specimen shown in plate 69, nearly natural size.

bright rose-red or dull yellowish brown; the arms are banded transversely with grayish green or dull yellowish brown on the dorsal surface.

LIFE HISTORY: Unrecorded.

TECHNICAL DESCRIPTION: All eight of the "Ara" specimens are young adults. The disk diameter of an average specimen is 8 mm., arm length 25 mm. The abactinal surface and interbrachial regions of the actinal surface are covered with small rounded granules, beneath which the surface is paved with large, flat scales. The mouth-shields are small, with the outer margin rounded; the inner margins wedge-shaped, forming an acute angle. The side mouth-shields are large, oblongish, meeting in the center. The mouth papillae are 16 to 17, blunt-tipped, squarish, except the two or three acuminate teeth of the apex. Tooth papillae strong, triangulate, acuminate. Genital slits not very long.

The under arm-plate is somewhat shield-shape, with the outer margin rounded, the sides excavate, the inner margin shorter than the outer, nearly straight. The side arm-plates are arched, projecting well down on the ventral and dorsal surfaces and furnished on the rounded outer margin with six short, pointed spines. The dorsal arm-plate is longer than wide, with the inner margin straight, the outer broader and convex, the lateral margins concave, divergent outwardly.

REFERENCES: *Ophioderma variegata* LUTKEN, Vidensk. Meddel. Naturh. Foren. Kjobenh., p. 21, 1856; Kong. Danske Vidensk. Selsk. Skrifter. 5th Raekke, Bd. 5, p. 199, 1861.—H. L. CLARK, Bull. Amer. Mus. Nat. Hist., XXXII, p. 205, 1913; Mem. Mus. Comp. Zoöl., vol. XXV, p. 302, pl. 18, figs. 7 and 8, 1915.—BOONE, Bull. Bingham Oceanog. Coll., vol. II, art. 6, p. 7, 1928.

Ophioderma cinereum Muller and Troschel.

Plates 68 and 69.

TYPE: Locality unknown. Deposited in the Wien Museum.

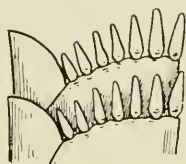
DISTRIBUTION: Southern Florida, Bahamas, Cuba, Jamaica, Haiti, St. Thomas, Barbados, Mexican coast south of Vera Cruz, Panama, Brazil, Port Seguro. Depth: littoral to 70 fms.

MATERIAL EXAMINED: Two very large specimens, dredged in 70 fms., south of Marquesas Keys, Florida, March 2, 1924, by the "Ara," William K. Vanderbilt, commanding.

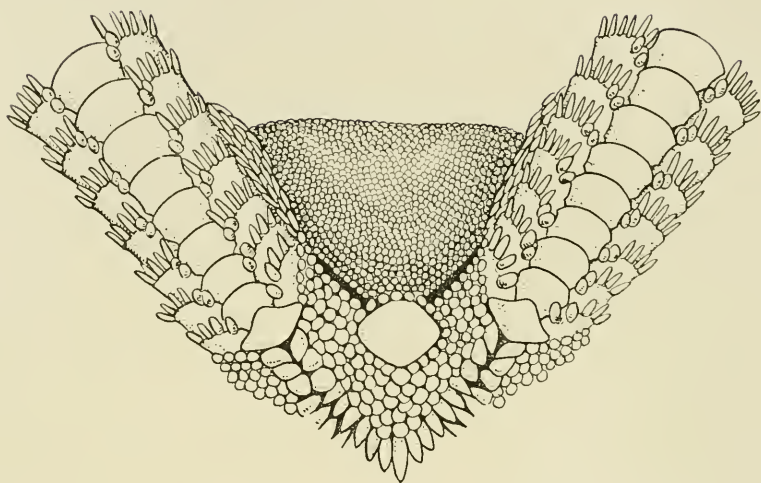
COLOR: In life this serpent-star is usually brown or deep gray, flecked with darker tones of these colors; the arms are cross-banded with brown and creamy tan alternately, the lighter bands usually considerably wider than the brown markings.

HABITS: This species apparently prefers to dwell in the sheltered rock crevices of the outer reefs.

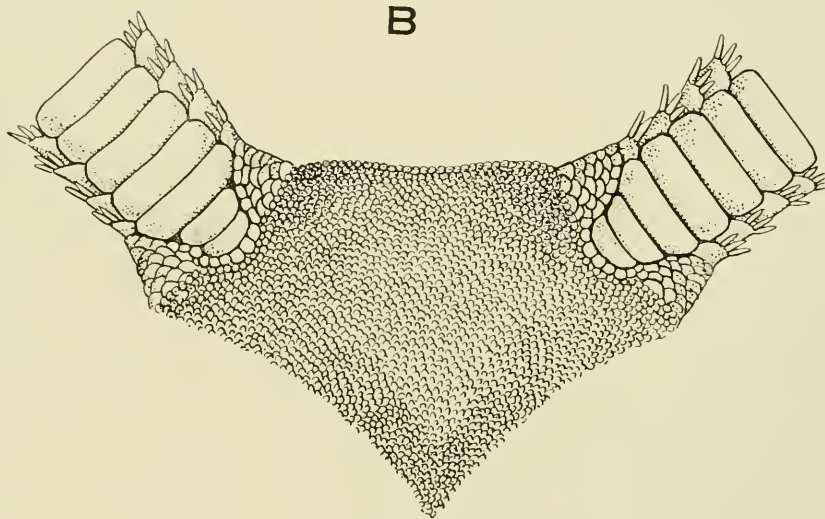
TECHNICAL DESCRIPTION: Disk pentagonal, diameter 19 mm.; arm length 94 mm. Abactinal surface except the radial plates entirely covered by small regular, rounded granules, which also cover the lateral walls and interbrachial region of the actinal surface and the side mouth-plates. The mouth-shields are wide heart-shaped with the apex directed inward, or nearly oval. The side mouth-shields are long and narrow, meeting inwardly and outwardly extending to the genital slit. There are 18 mouth papillae; the outermost one is larger than any of the others, with a squarish base and produced at the inner distal angle into a slender, acuminate process which extends inward across the margin of the second tooth to that of the third tooth. The second to eighth teeth inclusive are irregular, rectangular or wedge-shape; the ninth tooth is larger than the others and has a broad, triangular point. The inner genital slit is short, separated from the outer slit by a distance equal to one and one-half times the length of the inner slit, or about equal to the outer slit which is also short and does not extend to the lateral margin. The genital plates are smooth. The first under arm-plate is small, triangular, wider than long, with the apex directed outward and separated from the second plate by a pair of submedian pores. From the second plate outward, the plates are shield-shaped, about 1.4 times longer than wide, with the outer margin convex, the lateral margins slightly concave; the elongate oval tentacle scale fitting close against these lateral margins. The second or outer tentacle scale is not quite so long as the first and is more bluntly truncated distally. The side arm-plates are nearly three times as wide as the under arm-plates and have the outer margin convex and especially rounded toward each end. On the eighth plate, which is the first side plate entirely free, there are nine arm-spines which are repeated to the sixteenth plate, beyond which there are usually only eight spines, and near the arm tip these decrease to five on each plate. The spines are short, conical, laterally compressed, blunt-tipped, slightly decreasing in size from the ventral to dorsal size of the series. There are a series of coarse, flat scales at the base of the arm on the upper surface. The dorsal arm-plates are about four times



A



B



C

Ophioderma longicauda (Linck), A, section of side-arm, showing spines, much enlarged; B, section of oral surface of disk; C, section of aboral surface of disk.

as wide as long, with the outer and inner margins nearly straight, the outer lateral corner rounded; the lateral margins are somewhat rounded.

REFERENCES: *Ophioderma cinereum* MULLER and TROSCHER, Syst. Ast., p. 87, 1842.—H. L. CLARK, Mem. Mus. Comp. Zoöl., XXV, p. 301, 1915.

Ophioderma antillarum LUTKEN, Vid. Meddel., p. 9, 1856; Add. ad Hist. Ophiur., pt. 2, p. 88, pl. 1, figs. 1 a-1 e, 1859.

Ophiura cinerea LYMAN, Illus. Cat., Mem. Mus. Comp. Zoöl., I, p. 27, 1865.—VERRILL, Trans. Conn. Acad. Arts and Sci., X, p. 485, 1900; *ibid*, XII, p. 325, 1904-07.

Ophioderma longicauda (Linck).

Plate 70.

TYPE: The depository of Linck's type is not known to me.

DISTRIBUTION: Littoral. Abundant in the Mediterranean Sea, the Adriatic Sea, on both coasts of France, in the Atlantic it is found on the coast of the Hispanic Peninsula and the coast of France as far as La Rochelle, on the west African coast it is found down to the equator. It is also found in the Azores and at Madeira.

MATERIAL EXAMINED: Eight specimens, dredged in 19 fms., 10 miles south of Cagliari, Sardinia, July 23, 1927, by the "Ara," Cat no. 217.

COLOR: Alcohol preserved specimen: abactinal surface brown with grayish flecks; actinal surface creamy with grayish tinge.

TECHNICAL DESCRIPTION: Disk pentagonal, diameter 14 mm., arm length 65 mm. The entire abactinal surface is covered by regularly distributed, coarse, rounded granules which are also continuous on the outer lateral and the interbrachial spaces of the actinal surface. The genital slits are of moderate length with the margins granulated. Mouth papillae 10 to 12, unequal, with the outer surfaces flattish, the first tooth produced at its inner angle into a slender process; the second tooth the largest of the series, squarish; the third to ninth (or eleventh in the larger series) teeth are of irregular shape, usually tapered distally; the tooth at the apex of the jaw is about as large as the first tooth and is rounded distally. Teeth five, strong, blunt, triangular, in series, one above the other, the basal one being narrower distally than the others. Mouth-shields heart-shaped, wider than long, with the rounded apex directed inward. In some

specimens the mouth-shields are nearly oval. The side mouth-shields are long and narrow and are covered on their outer surface by a series of coarse, rounded granules, like those on the disk. The first under-arm plate is much smaller than the others and is nearly oval, or heart-shaped, and its inner margin fills the angle of the mouth aperture. The succeeding arm-plates are subquadrate, with the outer margins a very little convex, the lateral margins a little concave. On the outer third of the arm, these plates become fan-shaped. Tentacular scales, two, the inner, the longer, both bluntly rounded distally. The side arm-plates are arched, a little more than twice as wide as long, with the outer margin a little convex, tapered on the dorsal side especially. The dorsal arm-plates are very wide, three to three and one-half times as wide as long, with the inner and outer margins nearly parallel, the lateral margins somewhat rounded. The arm-spines are in series of eight, thick, bluntish tipped, slightly increasing in length from the dorsal to ventral of each series.

REFERENCES: *Stella lumbricalis longicauda* LINCK, De Stell. Marinis, p. 47, tab. XI, fig. 17, 1733.—SEBA, Thes. Tab. V, figs. 1, 2.

Asterias longicauda RETZIUS, Dissert. sist. spec. cog. Aster., p. 28, 1805.

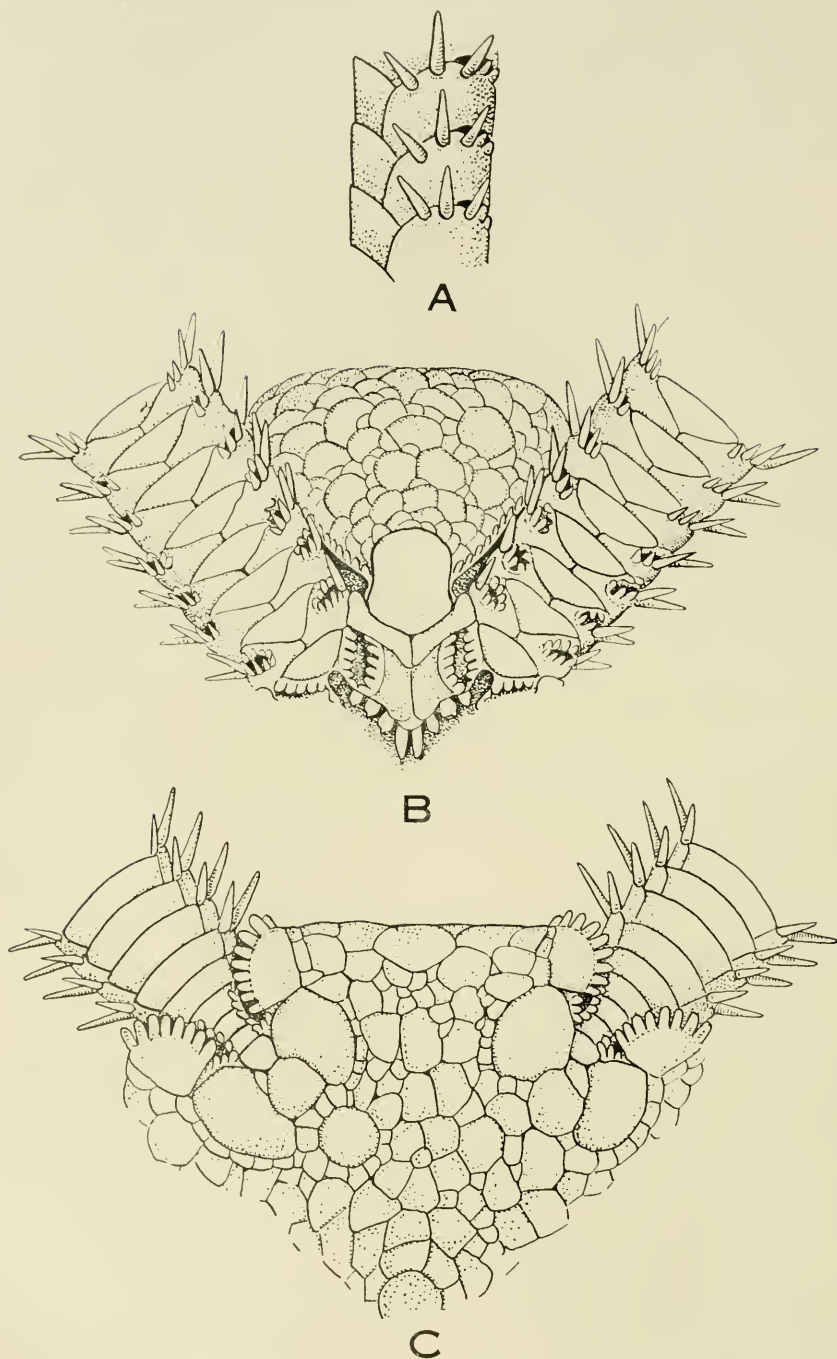
Ophiura lacertosa LAMARCK, Anim. sans Vert., ed. II, p. 542, 1835.
—BRONN, H. G., Syst. durweltl. Pflanzenth. taf. II, fig. 5, 1825.—GRUBE, Echinod. und Wurmer, des Adriatischen und Mittelmeeres, Königsberg, 1840, p. 16.

Asterias ophiura DELLE CHIAJE, Mem. Anim. sen. vert. Napoli, tom. III, tab. 20, fig. 1, 1823-29.

Ophioderma longicauda MULLER and TROSCHER, Syst. Asterid., p. 86, 1842.—LUDWIG, Mitt. Zoöl. Station Neapel. Bd. I, p. 545, 1879.—KOEHLER, Bull. Sei. France et Belgique, vol. XLI, p. 281, 1907; Exped. du "Travailleur" et "Talisman," Ophiurans, p. 249, 1907; Ann. Inst. Oceanog., vol. II, p. 13, Echinod. des Mers d'Europe, I, p. 333, 1924; Faune de France, I, Echinod., p. 87, fig. 58, 1921, Paris.—MARCHISIO, Bull. Mus. Torino, vol. XI, no. 227, p. 3, Feb., 1896.

Ophiura laevis LYMAN, Mem. Mus. Comp. Zoöl., vol. 1, p. 10, 1865.

Ophioderma longicauda var. *guineense* KOEHLER, Beit. zur Kenntniss der Meeresfauna Westafrika Bd. I, p. 173, pl. 9, figs. 1-3, 1914.



Ophiura sarsi Lutken, $\times 4$; A, section of side-arm with spines; B, section of oral surface of disk; C, section of aboral surface of disk.

Family: **OPHIOLEPIDIDAE.**

Genus: **OPHIURA** Lamarck.

Ophiura sarsii Lutken.

Plate 71.

TYPE: Lutken's type material came from Scandinavian waters and is deposited in the Copenhagen Museum.

DISTRIBUTION: This species has a remarkable bathymetric occurrence, ranging from 20 to 3123 meters. It is widely distributed in the Arctic and subarctic regions of Europe, Asia and America, having been recorded from the Russian and Scandinavian coasts, southward to the Faroes and Heligoland in the North Sea; in Greenland; on the east American coast down to Cape Hatteras, N. C., across the American Arctic and down to California on the American Pacific coast, and on the Asiatic coast down to Japan.

MATERIAL EXAMINED: One specimen, collected at Eastport, Maine, by the "Eagle," Cat. no. 297.

COLOR: See Koehler's color plate in the Report on the Echinoderms secured by the "Princess Alice." The brittle star is dark red or nearly red-brown and is often maculated.

LIFE HISTORY: Unknown. Dr. Mortensen suggests that *Ophiopluteus compressus* may be the larva of *O. sarsi*. In growth this latter species appears to be similar to the European *O. texturata*.

PARASITES: A curious undescribed organism of sac-like form, which attacks and destroys the genital organs of the brittle star, has been recorded as especially abundant in Trondhjem Fjord by Dr. Mortensen. Isn't this parasite a Rhizocephalid crustacean?

TECHNICAL DESCRIPTION: The specimen figured has a disk diameter of 26 mm.; arm length, tip incomplete, 64 mm. and is about five to six years old. The abactinal surface is covered with rather coarse irregular scales; the primaries of which are usually distinct. The radial shields are half, or scarcely half of the disk radius, widest just above the dorsal arm-plate where they are contiguous or slightly separated, approximately broad pear-seed shaped with the apices directed inward, or sometimes nearly circular. The outer arm-comb bears 9 to 14 short, stout, conic papillae. The interbrachial spaces of the actinal surface are paved with irregular large, coarse scales, those near the circumference being the larger. The mouth-shields are large, somewhat shield-shaped, with the outer margin rounded, the side margins a little concave, the inner margins meeting in an angle.

The side mouth-shields are long, slender, rectangular, not quite meeting in the middle and reaching to the border of the genital slit outwardly. The genital slits are long, reaching to the outer margin and paved on the interbrachial sidewall with large flat scales and margined with tooth-like papillae, similar to but smaller than those of the arm-comb. The mouth papillae are 9 to 10, flattish, blunt, well separated, the apical tooth pointed. The teeth are in series of 9 or 10, one above the other, the innermost one smaller than the others.

The under arm-plates are broad triangles, well separated from each other in the median line by the meeting side arm-plates. On the distal part of the arm these latter become larger and the under arm-plate smaller, so that the length in the median line is greater than that of the under arm-plate. The side arm-plates are arched, not extending high upon the dorsal surface. There are three stout, conical arm-spines in each series, these increasing slightly in length from ventral to dorsal. The dorsal arm-plates are very wide and short and strongly arched. The proximal pore pair has three or four tentacle scales at the inner edge; farther out there are only two tentacle scales and still farther toward the extremity, only one.

REFERENCES: *Ophiura sarsii* LUTKEN, Vidensk. Meddel. for 1854, p. 101; Kong. Dansk. Vidensk. Selsk. Skrifter, pt. 1, p. 42, pl. 1, figs. 3a-4d, 1858.—H. L. CLARK, Mem. Mus. Comp. Zool., vol. XXV, p. 323, 1915.—MORTENSEN, Echinod. of British Isles, p. 238, figs. 128-1-2, 1927.

Ophioglypha sarsii KOEHLER, Echinod. of the "Princess Alice," Monaco, fasc. XXXIV, p. 155, pl. 7, fig. 3, 1909 (color plate).

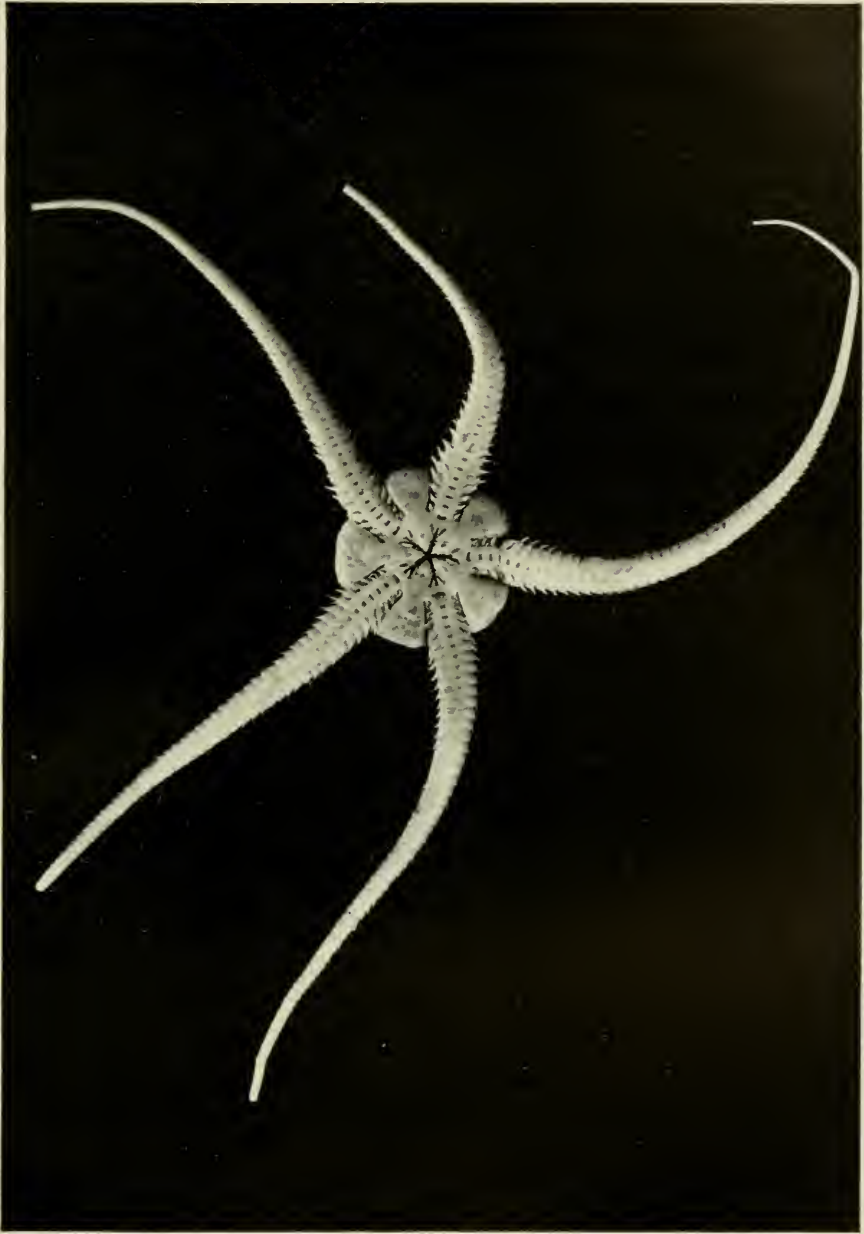
***Ophiura texturata* Lamarck.**

Plates 72 and 73.

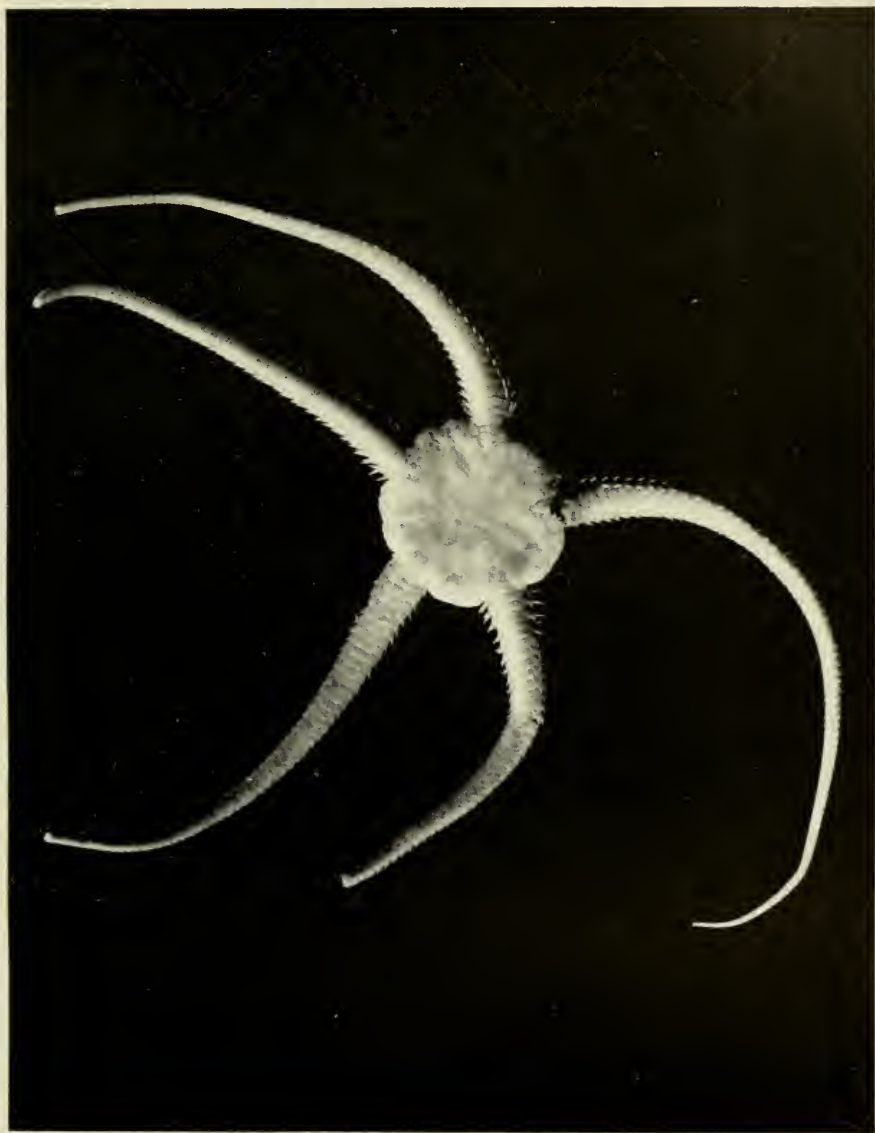
TYPE: Lamarck designated the habitat of this species as "the seas of Europe and the Atlantic Ocean," and deposited his type in his cabinet; since placed in the Paris Museum.

DISTRIBUTION: Known from the coasts of Norway, Denmark, the British Isles, northern France, the Hispanic Peninsula and the Mediterranean Sea. It has been recorded repeatedly from the tidal zone to 200 meters deep in northern waters and in the Mediterranean from depths reaching to 300 meters.

MATERIAL EXAMINED: One large specimen, dredged in 35 fms., N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea,



Ophiura texturata Lamarek, oral view of specimen from the Gulf of Tunis,
natural size.



Ophiura texturata Lamarek, aboral view of the same specimen shown in Plate 72, natural size.

July 21, 1927, collected by the "*Ara*," William K. Vanderbilt, commanding. Cat. no. 210.

COLOR: In life the abactinal surface is reddish or reddish brown, frequently maculated; the actinal surface is yellowish or whitish.

LIFE HISTORY: The early stages of this serpent star have been carefully studied. The larva is said to be clearly differentiated from those of other closely related species by having fenestrated rods in the posterolateral arms. The young attain sexual maturity in the third year, at a diameter of 7 to 11 mm.

TECHNICAL DESCRIPTION: The "*Ara*" specimen figured is between five and six years old. Disk diameter 25 mm., length of arm 71 mm. The abactinal surface is covered with flat, irregular, overlapping scales, the central one of which is circular and is surrounded by a sort of rosette formed of primary and secondary scales, radiating from this center, down the middle of each interbrachial space is a series of larger, roundish scales overlapping smaller ones adjacent to the radial plates. The radial plates are only about one-half as long as the disk radius, widest just above the innermost dorsal arm-plate, where they are contiguous or slightly separated, approximately pear-seed shape with the apices directed inward. The outer arm-comb bears about 30 to 34 long, slender papillae. The interbrachial spaces of the actinal surface are paved with irregular-sized, large, flat scales, those near the lateral border being the largest. The genital slits are very long and are outlined on the outer lateral wall by a long, flat scale, which bears on its upper margin a fringe of fine short spinules.

The mouth-shields are very large with the inner lateral margins convergent, forming a triangle; the outer lateral margins are nearly parallel the greater part of their length, converging outwardly with the rounded outer margin. The side mouth-plates are long and narrow with the slenderer, outer distal angle reaching down to the genital slit, inwardly the side mouth-plates narrow, but the tips, which are triangular, do not meet. The mouth papillae are 18 to 21, acuminate, of moderate size; 10 to 12 of these are clustered in two rows across the apex of the jaw. The teeth are acuminate, the innermost one slightly narrower and sharper than the others.

The first under arm-plate is rectangular, about twice as wide as long, well separated in the median line by a pair of large, pore-shaped grooves. The second tentacle pore is outside the mouth-slit, but opens into the mouth-angle. The second to eighth under arm-plates are wide, triangular, each with the apex directed inward and

well separated from each other; beyond the eighth plate the under arm-plates noticeably narrow and the outer margin of each becomes slightly convex. The side arm-plates are wide and extend upon both the ventral and dorsal surfaces. On the proximal part of the arm there are three to four tentacle scales on each side, and farther out on the arm, two and distally, only one tentacle scale. There are three stout, conical arm-spines present. The lower one is the shortest, scarcely exceeding the length of the adjacent tentacle scale; the median spine is the largest, about as long as the supporting arm-plate; the third spine is nearly as long as the second; all three are equally well separated. The first dorsal arm-plate is triangular, small; the second, third and fourth plates are also small, squarish or rectangular; the remaining proximal dorsal arm-plates are much wider than long, four to five times as wide as long, with the inner and outer margins nearly straight, the lateral margins dovetailing with those of the side arm-plates; farther out on the arm, the outer margin of each dorsal plate is rounded.

REFERENCES: *Ophiura texturata* LAMARCK, Anim. sans Vert., 2nd ed., vol. III, p. 221, 1840, (with early synonymy).—LUTKEN, Kongl. Danske Videnskab. Skrifter, 5th Raekke, Bd. 5, part 1, p. 36, pl. 1, figs. 1a-e, 1861.—MORTENSEN, TH., Handb. Brit. Echinod., p. 236, fig. 128, parts 3, 4, 1927.

Asterias ciliaris LINNÉ, ed. 12, p. 1101, 1767.

Asterias ciliata RETZIUS (Retzius not available in American libraries).

Asterias ophiura LINNÉ, ed. 10, p. 662, 1758.

Asterias lacertosa PENNANT, Brit. Zoöl., vol. IV, p. 130, tab. 34, fig. 1, 1812.

Ophiura ophiura H. L. CLARK, Mem. Mus. Comp. Zoöl., vol. XXV, p. 323, 1915.

Genus: **OPHIOLEPIS** Muller and Troschel.

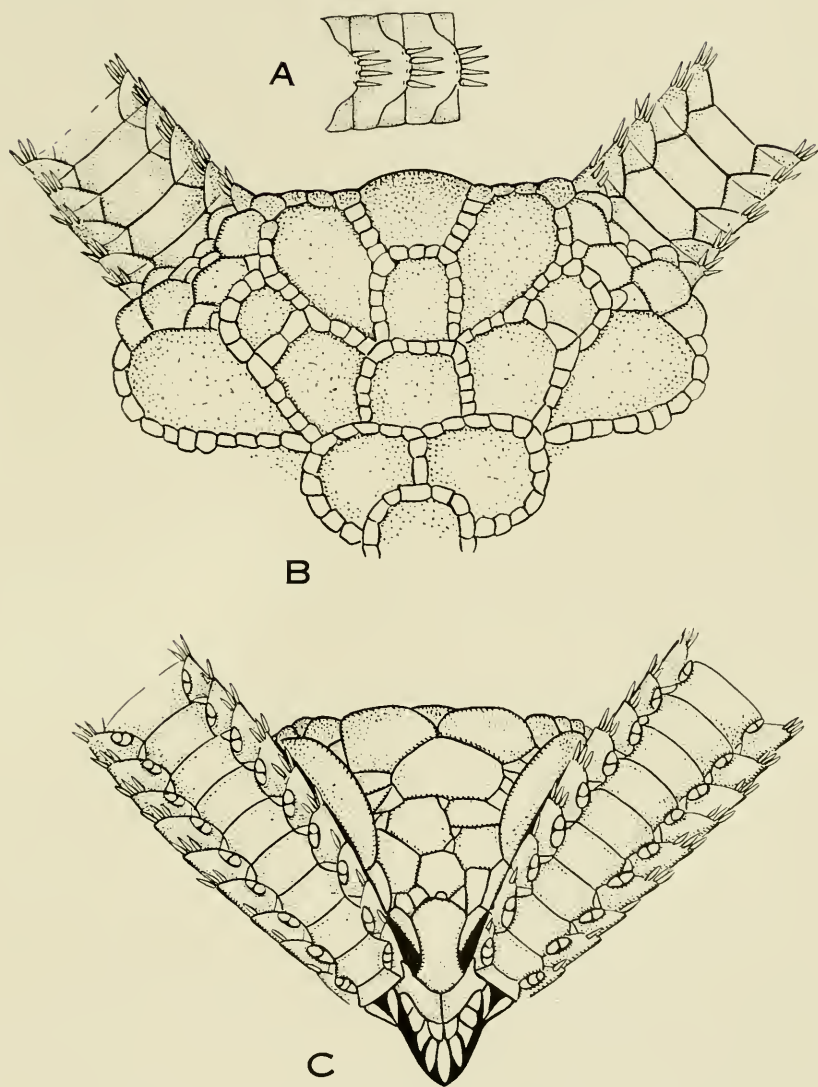
Ophiolepis elegans Lutken.

Plates 74, 75A and 76A.

TYPE: Taken at St. Thomas, Danish West Indies, and deposited in the Copenhagen Museum.

DISTRIBUTION: Charleston, S. C.; Florida, Cuba, Mexico, Jamaica. Depth: 2 to 30 fms.

MATERIAL EXAMINED: One specimen, taken in Porto Padre, Cuba, March, 1928, by the "Ara" (Plates 74, 75A and 76A). Cat. no. 215.



Ophiolepis elegans Lutken, $\times 3$; A, section of side-arm; B, section of aboral surface of disk; C, section of oral surface of disk.

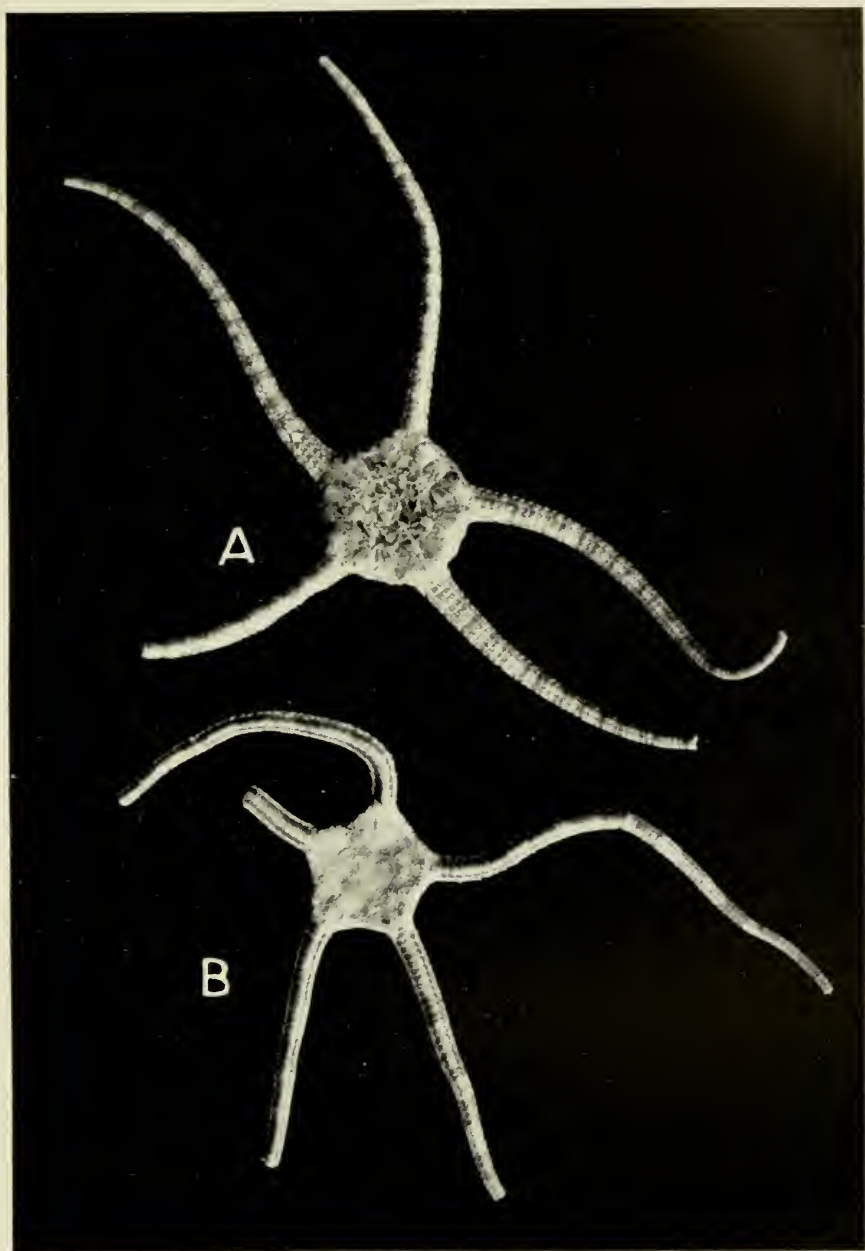


Fig. A, *Ophiolepis elegans* Lutken, view of aboral surface.

Fig. B, *Ophioderma appressum* (Say), aboral view; natural size of both specimens.

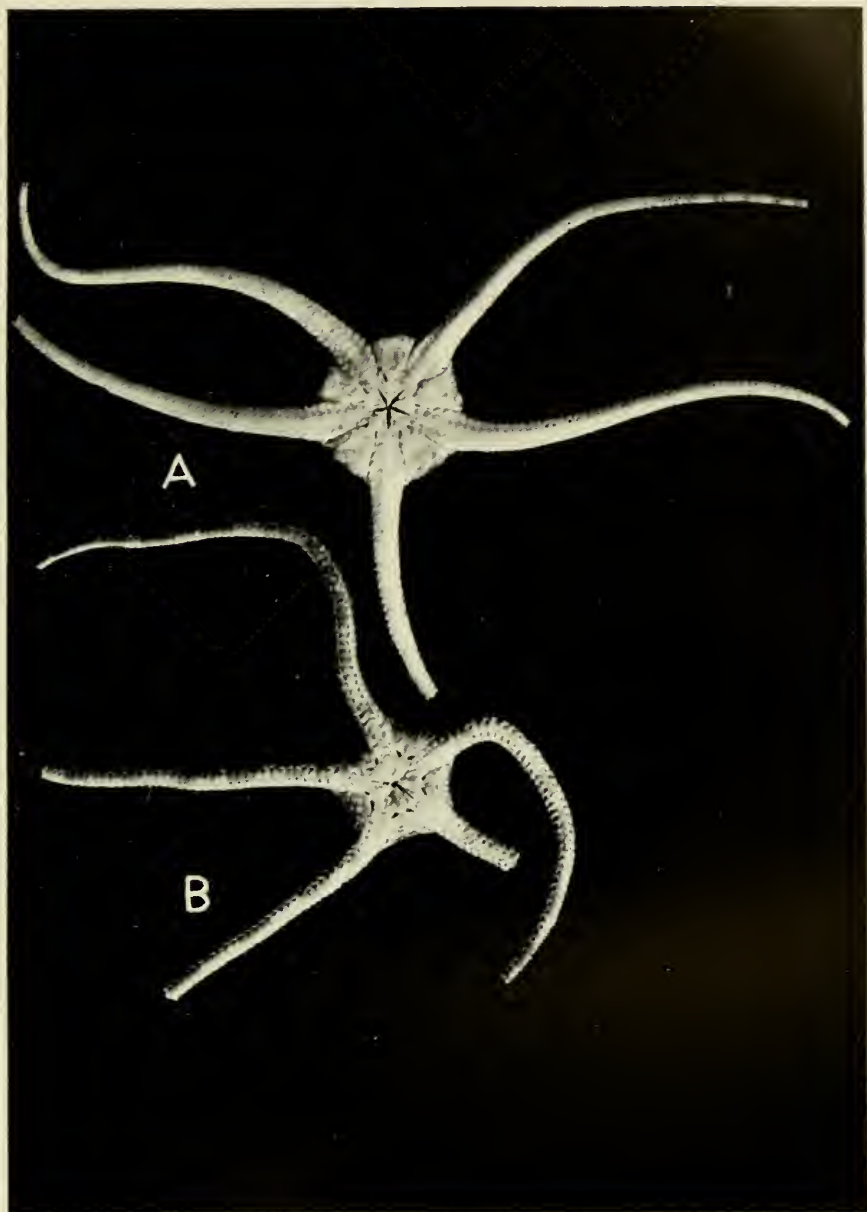


Fig. A, *Ophiolepis elegans* Lutken, oral surface, natural size.
Fig. B, *Ophioderma appressum* (Say), oral surface, natural size.

COLOR: Variable. One kind, recorded from living specimens by Agassiz, had the abactinal surface of the central primary plate yellow, the remainder of the surface vandyke brown with flecks of brown and white, this color being continuous on the dorsal plates of the arms, the later arm-plates yellow. On another specimen there was a large, oblong patch of yellow in the center of the disk and a smaller, round, yellow spot in each interbrachial space, all these spots being limited by black flecks; the remainder of the disk is mottled with brownish and greenish gray with black flecks; the dorsal arm-plates are lighter or darker greenish gray and the lateral arm-plates bright yellow, giving the effect of bands of color on the arms.

TECHNICAL DESCRIPTION: Disk diameter 18 mm., arm length 48 mm., with the tip broken off. The abactinal surface is covered with flat, regular, primary plates, each surrounded by a single line of 14 to 20 small, angular scales. The primary plates are very regularly arranged in the following order: a rosette in the center, composed of six plates, of which the central one is rounded and slightly smaller than the surrounding five which are more angular; from this group there are arranged five radiating interbrachial rows, each consisting of three primary plates. In the interbrachial space there is one large primary plate between the central rosette and the inner ends of the radial shields. The radial shields are of moderate size, pear-seed shape, with the points inwards, large, dilated; greatest width of the shield is equal to two-thirds of their length; they are widely separated from each other within by the projecting brachial primary plate, followed by a large, belted scale and without margined by a broad wedge formed of three scales, the outer two of which are quite large and swollen. The outer, under interbrachial space is covered by three large, swollen, triangular plates, and the actinal interbrachial space by three transverse rows of smaller, irregular, flattish plates. The outer genital plate is enlarged and forms a prominent ridge. Mouth papillae eleven, closely set in an even row, the outermost one elongated and very acuminate, somewhat overlapping the adjacent one which is nearly twice as wide as long and is the widest of the series; the balance are squarish with beveled cutting edges, the innermost one directed toward the mouth center. There are four teeth, regularly, slightly decreasing in breadth from below upwards, the lower three are broad, flat, with a curved cutting edge; the uppermost one is narrower and more acuminate. The mouth-shields are longer than broad, 2:1, with the outer side convex, the lateral side nearly straight,

the inner lateral short, somewhat recurved, meeting in an angle in their middle line. The side mouth-shields are as wide as the mouth-shield, the margins are very little curved and produced without to a point. The under arm-plates are wider than long, 1.6:1, a trifle narrower within than without, squarish with rounded corners; the outer and inner sides almost straight; the lateral margins slightly concave. The first under arm-plate is much wider than long, nearly oval, with an inward projection filling the end of the mouth-slit. Toward the outer end of the arm these plates are distinctly wider and more convex on the outer than on the inner margin, bounded within by a nearly straight median lateral and two oblique inner laterals; the lateral concave and the outer margin shallowly convex. Tentacle scales two, together forming almost an oval. The side arm-plates are decidedly arched extending on the surface for a distance fully equal to the width of the ventral plate. These side plates also arch over on the dorsal surface of the arm for a considerable space. The dorsal plates are for the first seven or eight wider than long, margined within and without by straight lines, and laterally by short, convex lines; beyond the eighth, these plates become hexagonal, still farther towards the tip they become fan-shaped. The supplementary pieces are slender, triangular, with the apex directed downward. Arm-spines, near the base of the arm, six, farther out five short, rounded, blunt, scarcely tapering.

REFERENCES: *Ophiolepis elegans* LUTKEN, C. F., Vid. Selsk. Skrifter V. Raekke, Naturg. og Math. Afh. V, Bind, V, p. 207, 1861.—LYMAN, TH., Mem. Mus. Comp. Zoöl., vol. I, art. 1, p. 58, pl. 2, fig. 5, (colored), 1865.—H. L. CLARK, *ibid*, XXXV, p. 342, 1915.

ECHINOIDEA.

Order: **CIDAROIDA.**

Family: **CIDARIDAE.**

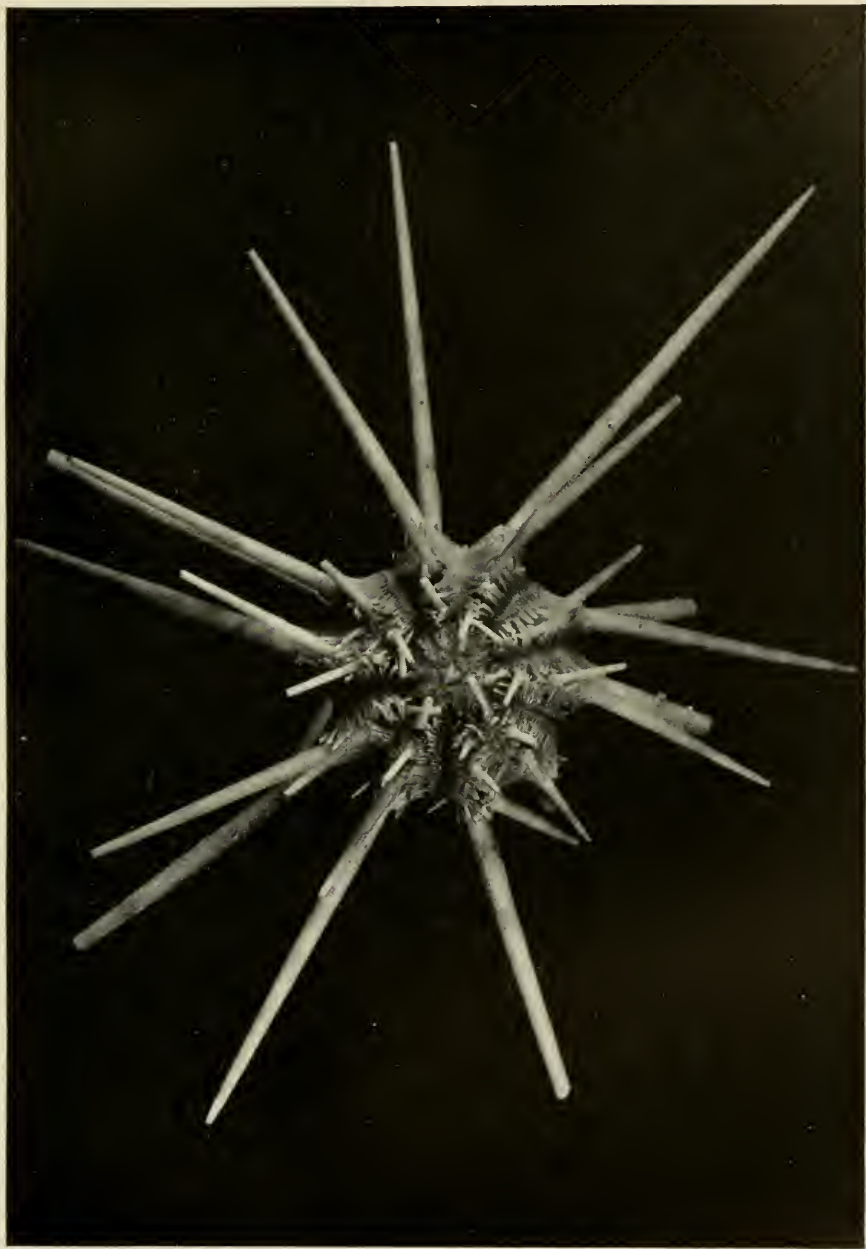
Genus: **CIDARIS** Klein, s.s.

Cidaris affinis (Philippi).

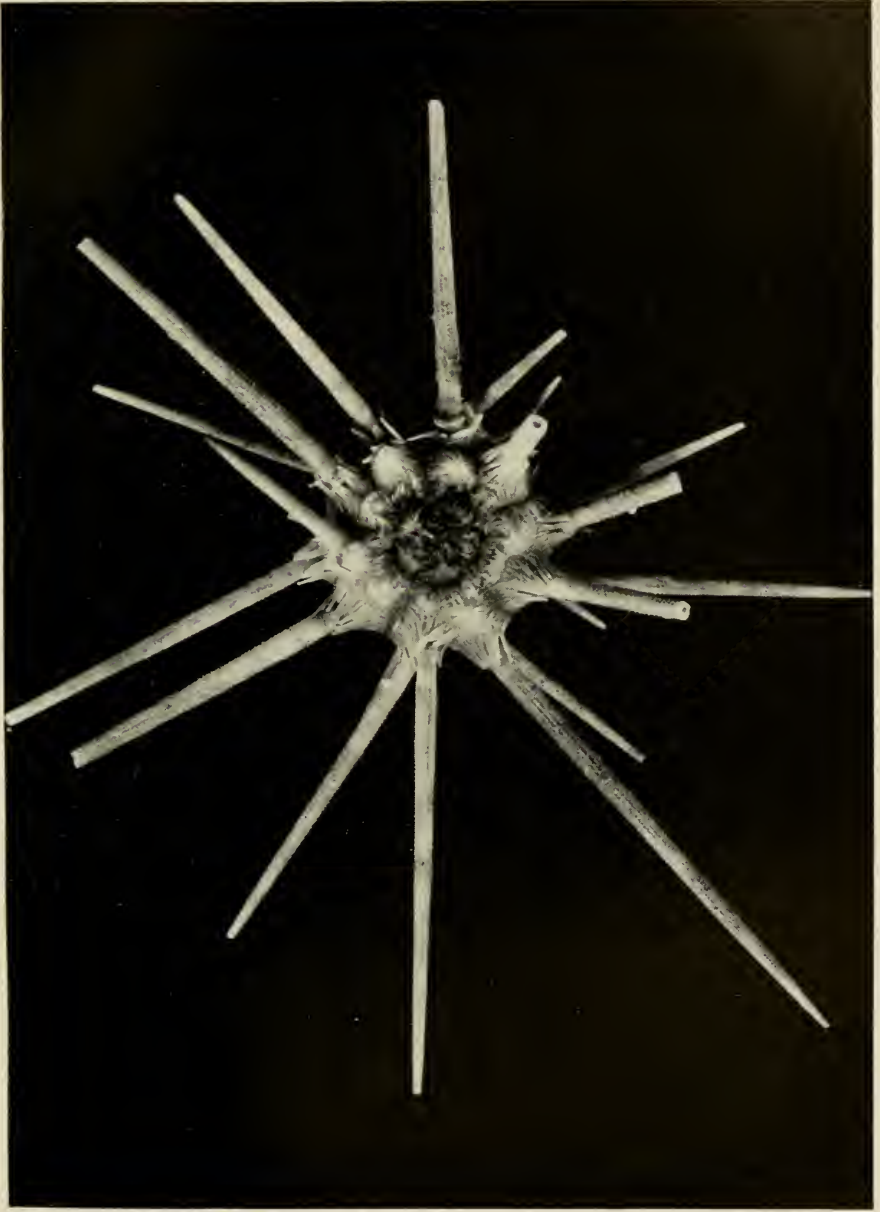
Plates 77, 78 and 79.

TYPE: Philippi's type was taken in the Bay of Naples, in 50-100 fms.

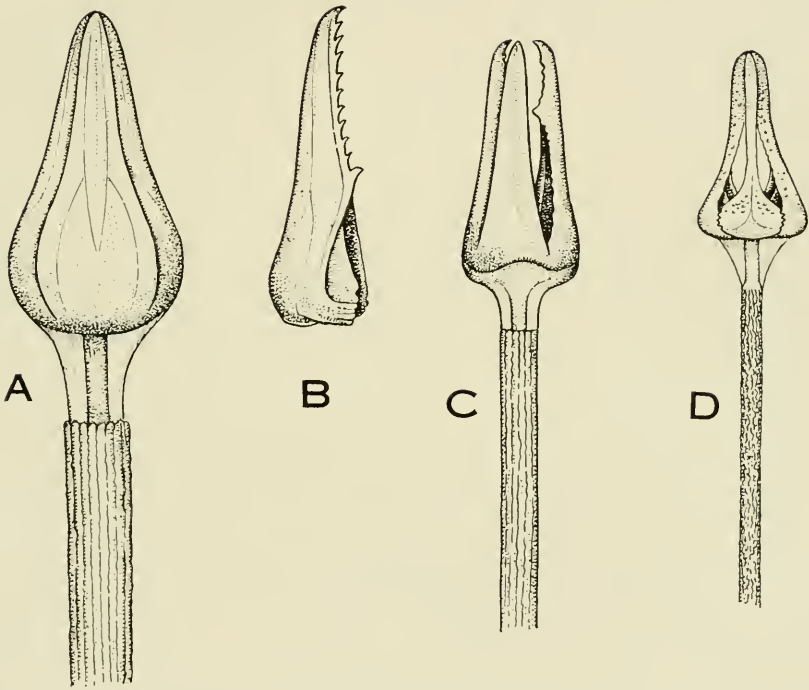
DISTRIBUTION: This species is found in both the Mediterranean region and the West Indian region. Bathymetric occurrence: 3 to 426 fms.



Cidaris affinis (Philippi) oral view, one-half of natural size.



Cidaris affinis (Philippi), aboral view, one-half of natural size.



Cidaris affinis (Philippi), A, large, globiferous pedicellaria; B, detail of same, showing dentition; C, large, tridentate pedicellaria; D, small, tridentate pedicellaria; all greatly enlarged.

MATERIAL EXAMINED: Four specimens, collected in seine in Porto Padre, Cuba, in 3 fms., 1928, by the "Ara."

COLOR: There is an excellent color plate of this species in Dr. Mortensen's report on the Echinoidea of the Danish Ingolf Expedition, pl. 1, fig. 1. The test is a clear red, the spines are alternately lighter and darker bands of brownish.

TECHNICAL DESCRIPTION: This species has been very thoroughly described in comparison with *Dorocidaris papillata* (Leske) by Dr. Mortensen in the above report.

The test of *C. affinis* is turban-shaped, wider than high, very similar to that of *papillata*, as it also is in the breadth of the ambulacral and the interambulacral areas and the number of ambulacral plates for each ambulacral area 10 to 12. The interambulacral plates of *affinis* are more closely covered with tubercles; there are 13 to 16 on the edge of each areole and outside of these there is a circle of tubercles opposite to those of the first series. Beyond this second series are several more tubercles more or less circularly arranged and except a narrow strip at the median line the entire plate is covered; also on the lower part of the test it is covered by these tubercles. There are no furrows in the edge of the plates. The ambulacral region in *affinis* is more diagnostic, having the secondary tubercles in the lower part of the plate so that they are placed opposite to the intervals between the primary tubercles. On only the uppermost and lowermost plates of the ambulacral area the secondary tubercles are wanting; in the median area inside the secondary series there are some still smaller tubercles. The pore area in *affinis* is comparatively broader than in *papillata*.

The spines of *affinis* are one to one and a half times the diameter of the test, regularly tapering, blunt-tipped. Each spine has about eighteen longitudinal series of coarse serrations; the fine thorns between these do not coalesce, whereas in *papillata* they do, forming a reticulation. The radioles around the mouth are short, blunt, flat-tish, without dents in the margin. There is an ampulla at the base of the small spines, particularly well developed at the base of the small spines of the apical area.

The pedicellariae of *affinis* are characteristic of the genus *Cidaris*. On the three specimens taken at Porto Padre, Cuba, the tridentate pedicellariae are very numerous all over the test. The large, globiferous pedicellariae are much less abundant.

- REFERENCES: *Cidaris affinis* A. PHILIPPI, Arch. f. Naturgh., I, p. 351, 1845.—M. SARS, Middelhavets Littoral Fauna, p. 110, in Zool. Tracts, XV; original publication in Nyt Mag. f. Naturvidensk, Bd. IX and X, 1857-59.—WYVILLE-THOMPSON, Proc. Royal Soc. London, vol. XX, p. 492, 1872; Ann. Mag. Nat. Hist., 1872, vol. 10, ser. IV, p. 302.—MORTENSEN, Danish Ingolf Exped. Echinodea, vol. IV, pt. 1, p. 35, pl. 1, fig. 1, pl. 6, figs. 9-10, pl. 8, fig. 2, pl. 9, figs. 1, 8-9, 11-12, 17-19, 21-24, pl. 11, figs. 1, 22, 1903.
- Cidaris stokesi* L. AGASSIZ and DESOR, Ann. Sci. Nat. III, ser. I, vol. VI, p. 326, 1846-47.
- Dorocidaris papillata* (Leske), A. AGASSIZ, Rev. Ech., p. 254, (in part), pl. 1, fig. 5, 1872.—H. L. CLARK, Bull. U. S. Fish. Comm., vol. XX, part 2, p. 252, 1901.
- Stylocidaris affinis* MORTENSEN, Echinod. Deutsch. Sudpolar Exp., p. 52, 1909.—H. L. CLARK, Iowa Studies Nat. Hist., vol. IX, p. 105, 1920-21.

Genus: **EUCIDARIS** Gray.

Eucidaris thouarsii (Valentin).

Plates 80 and 81.

TYPE: The type series of this species was collected in California and the Galapagos Islands, and is deposited in the Paris Museum.

DISTRIBUTION: From Lower California to Panama and the Galapagos Islands. Littoral.

MATERIAL EXAMINED: Three large specimens, Hood Island, Galapagos Islands, March, 1928, Cat. no. 228. Three young specimens from Webb Cove, Albemarle Island, Galapagos Islands, February 3, 1928, Cat. no. 229, collected by the "Ara."

COLOR: Unrecorded.

LIFE HISTORY: The larval stages of this urchin have been studied and figured in part by Dr. Mortensen.

TECHNICAL DESCRIPTION: The "pencil urchin" of the tropical American Pacific coast is superficially very similar to its West Indian congener, *E. tribuloides*, but is readily distinguished therefrom by the fact that *thouarsii* has the median area of the interambulacra wider but more closely granulated and in having the primary spines much stouter, relatively shorter and with distinctly coarser sculpturing.



Eucidaris thouarsii (Valentin), oral surface, natural size.



Eucidaris thouarsii (Valentin), aboral surface, natural size.



Eucidaris tribuloides (Lamarck), young specimen, natural size.

These primaries are larger just beyond the base and thence diminish slightly distally; the apex being dilated and obtusely blunt. They are covered with coarse, rounded tubercles set in clearly defined longitudinal series which converge on the tip of the spine. The secondary spines are laterally compressed, flat, covered by microscopic longitudinal lines and with the apex truncated, slightly rounded. In *thouarsii* the genital plates form a regular five-rayed star which is much more distinct than in *E. tribuloides*.

In the Galapagos specimens before me, the large, globiferous pedicellariae are almost entirely lacking; only five being discovered after most careful observation. These were similar to, but relatively larger, than those of *E. tribuloides*. The small globiferous pedicellariae were abundant on the actinostome, ambulacra, interambulacra and abactinal system. They were similar to, but somewhat larger, than those of *tribuloides*. The tridentate pedicellariae of *thouarsii* were found sparsely on the actinal surface. They also are similar to, but distinctly larger, than those of *tribuloides*.

The largest "*Ara*" specimen measures 63.5 mm. test diameter. One in the collection of the American Museum of Natural History from Galapagos has a test diameter of 68 mm.

REFERENCES: *Cidaris thouarsii* Valentin, in AGASSIZ and DESOR, Ann. Sci. Nat., vol. 6, p. 326, 1846.

Eucidaris thouarsii DODERLEIN, Jap. Seeigel, p. 42, 1887.; Bull. Amer. Mus. Nat. Hist., vol. 32, p. 220, 1913.—MORTENSEN, Studies Development and Larval Forms of Echinoderms, p. 23, pl. V, figs. 1-2 (larval stages), 1921 (Copenhagen).—BOONE, Bull. Bingham Oceanog. Coll., vol. II, art. 6, p. 8, pl. 5, lower figure, 1928.

Cidaris thouarsii A. AGASSIZ and H. L. CLARK, Mem. Mus. Comp. Zoöl., XXXIV, no. 1, p. 5, pl. 1, figs. 1, 2, 1907.

Eucidaris tribuloides (Lamarck).

Plate 82.

TYPE: Lamarck's type came from the "Indian Ocean" and was originally deposited in the Jardin des Plantes, later placed in the Paris Museum.

DISTRIBUTION: Littoral to 120 fms., especially abundant as a reef-dwelling species. Found from South Carolina southward throughout

the West Indies, the Gulf of Mexico, and the northern coast of South America, as far down as Abrolhos Islands, Brazil.

MATERIAL EXAMINED: Six specimens dredged in shallow water, Egg Island, Bahamas, British West Indies, January 19, 1925, by the "*Ara*," Cat. no. 230. One specimen, from the same locality, Cat. no. 271; photographed. Two specimens from south of Catalina Creek, Cuba, 5 fms., February 11, 1924, Cat. no. 261.

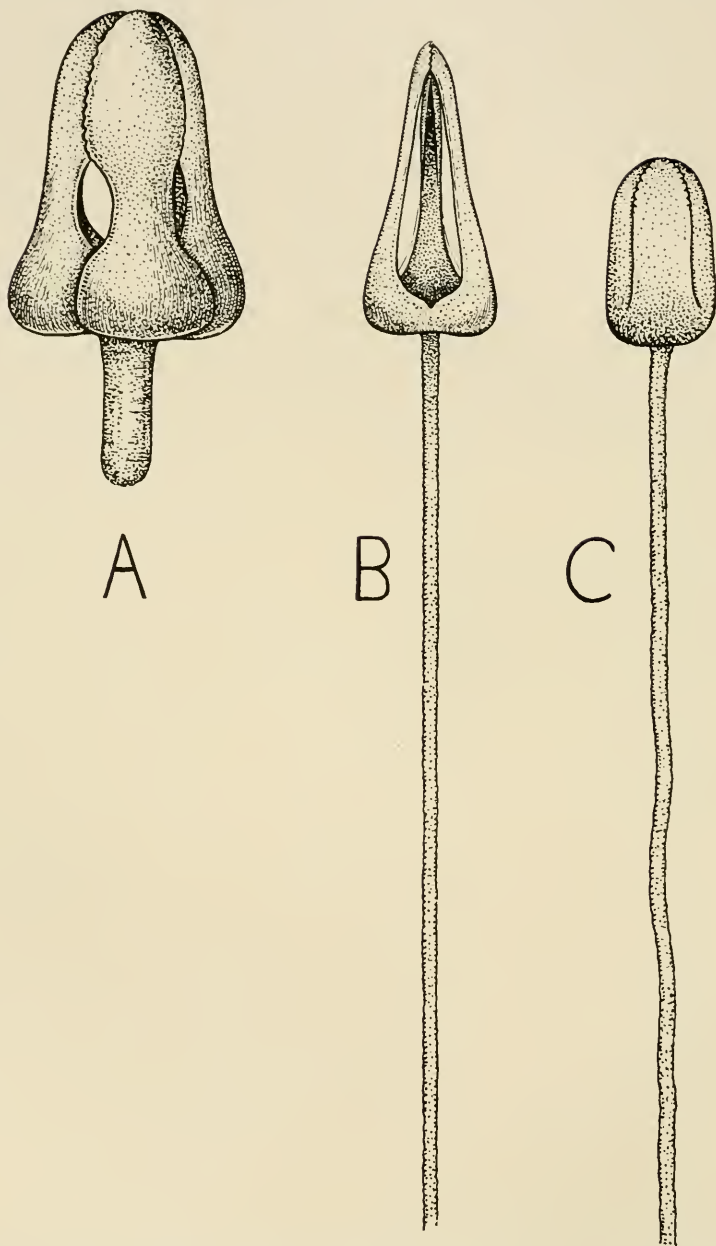
COLOR: This, the "pencil urchin" of the West Indies, is chocolate-brown, marbled with white or cream color; there are frequently touches of red, especially on the spines. Full-grown specimens with a test diameter of 60 mm. have been recorded by Dr. H. L. Clark. The present writer has records of some taken at Miami, Florida, 1923, with a test diameter of 71, 73 and 75 mm., respectively, with primary spines 46, 44 and 48 mm. long.

HABITS: Unrecorded.

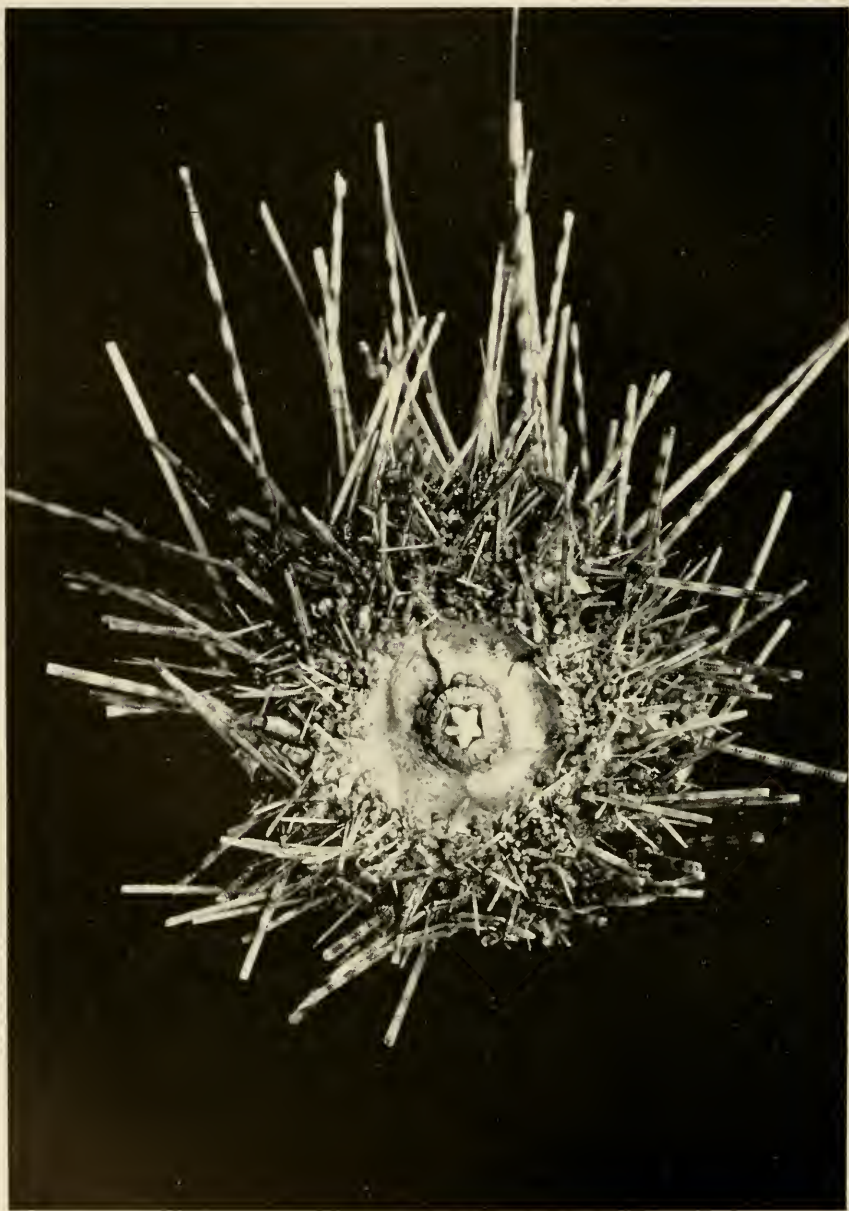
DEVELOPMENT: Not exhaustively studied.

TECHNICAL DESCRIPTION: Test thick, circular, turban-shaped with the actinal and abactinal regions similarly flattened. The genital plates are nearly rectangular; the ocular plates are somewhat triangular with somewhat rounded sides. The anal system is pentagonal; the larger plates adjoining the genital plates extend a short distance towards the ocular plates, separating the genital plates but very little. The genital openings are placed near the outer margins of the plates. The entire abactinal system is covered with miliary tubercles of approximately equal size which bear small, blunt, laterally flattened secondary spines. The ambulacral region has one outer row of miliary tubercles separating it from the poriferous zone and four rows of smaller miliary tubercles, two rows of which are well defined and extend between them almost the full length of the ambulacra, while the other two rows are very irregular and are composed of still smaller tubercles. The two principal rows of interambulacral tubercles are separated by a wide median row of miliaries of almost equal size, the miliaries on the median line being a little smaller, while those around the scrobicular circle are very little larger. The mamelon is small.

The primary spines are cylindrical, slightly tapering distally, of moderate diameter. The convex lateral surface of each primary has a roughened, fluted appearance, caused by rather regular, coarse, rounded tubercles or granules, arranged in longitudinal series; these



Diadema setosum (Leske): A, stout tridentate pedicellaria; B, slender tridentate pedicellaria; C, ophicephalous pedicellaria; all enlarged about $\times 45$.



Diadema setosum (Leske), natural size; majority of spines broken off on this urchin.

lines converge on the tip of a young spine, giving it also a rough aspect, but in the great majority of primaries this tip is worn smooth. The secondary spines are short, laterally flattened, with fine longitudinal ridges separated by fine lines; the tips of the spines are rather bluntly truncated, or, in some instances, very slightly rounded. The miliary spines of the ambulacral region are elongated while on the interambulacral region they are reduced to papillae.

The pedicellariae are of three types: (a) The large, globiferous kind which are found principally on the abactinal surface of the interambulacral region. These have a large, terminal aperture with the lip well developed and margins dentate; the blade is curved; the stalk has no limb. (b) The small globiferous kind which are found all over the urchin on the actinostome, ambulacra, interambulacra and the abactinal regions, have a decidedly different appearance from the larger ones. The small ones have a prominent end-tooth on each valve; the aperture is not terminal and the blade is not curved. (c) The third kind, the tridentate pedicellariae are found most abundantly on the actinal surface of the interambulacra. They have the stalks shorter than the valves which are narrow and somewhat compressed.

REFERENCES: *Cidaris tribuloides* LAMARCK, Anim. sans Vert., p. 56, 1816.

REFERENCES: *Cidarites tribuloides* LAMARCK, Anim. sans Vert., p. 56, 1816.

Cidaris tribuloides BLAINVILLE, Dict. Sci. Nat., p. 200, 1830.—A. AGASSIZ, Mem. Mus. Comp. Zoöl., III, part I, Rev. Echini, p. 99, 1872 (with full synonymy).—A. AGASSIZ and H. L. CLARK, Mem. Mus. Comp. Zoöl., XXXIV, p. 3, pl. 2, figs. 1-4, 1907.

Order: **DIADEMATOIDA.**

Suborder: **Aulodonta.**

Family: **DIADEMATIDAE.**

Genus: **DIADEMA** Gray.

Diadema setosum (Leske) 1778.

Plates 83 and 84.

TYPE: Leske's type came from Amboina.

DISTRIBUTION: This is one of the best known urchins of the tropics, having a world-wide tropical distribution from Cuba eastward to the Tonga Islands.

MATERIAL EXAMINED: One large specimen collected at Port Tanamo, north coast of Cuba, 2 fms., January 23, 1924, Cat. no. 263. Two very young specimens from the same locality, Cat. no. 264. One large specimen from Dry Tortugas, Florida, Cat. no. 272.

COLOR: The West Indian form of this species has both the test and spines deep violaceous black in the larger adults, but in the younger adults the slender spines are alternately cross-banded with creamy or yellowish and purple.

Dr. H. L. Clark presents most interesting data on the color variation found in this species in the Indo-Pacific, in his "Echinoderm Fauna of Torres Strait," p. 146, also in his "Catalog of the Recent Sea Urchins."

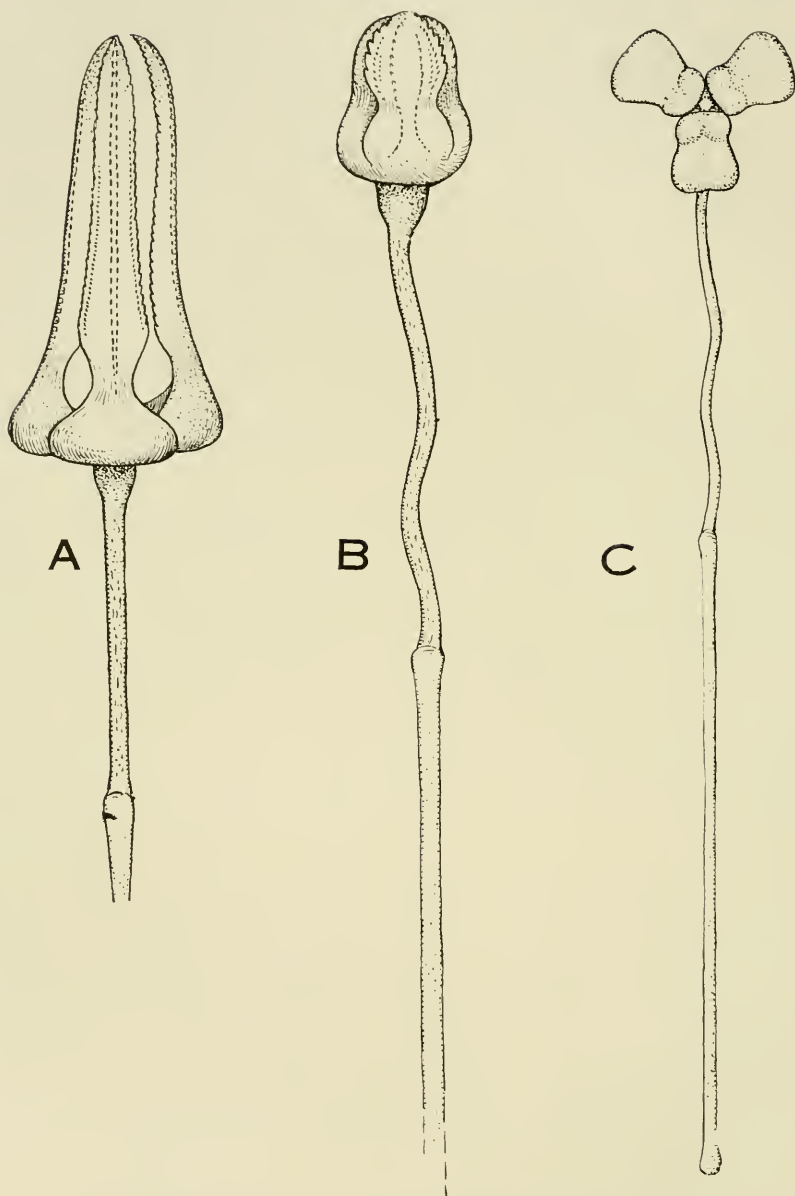
LIFE HISTORY: This species has been studied and reported by Dr. Mortensen.

TECHNICAL DESCRIPTION: Adult specimens may attain a test diameter of three to three and one-half inches, with spines six inches long. The test is moderately thin, flattened at both poles. The ambulacral region has the tubercles arranged in two vertical rows; these tubercles are somewhat smaller than those of the interambulacral region. The ambulacra are narrower abactinally than at the ambitus, with few or no tubercles above the midzone. The tubercles of both areas are crenulate and perforate. The poriferous zones are narrow with the pores arranged in simple pairs forming arcs around the adjacent tubercles. The primary spines are long, three to six inches, slender, hollow, black, finely verticillate. The three types of pedicellariae found are illustrated.

NOMENCLATURE: I have followed the precedent of Dr. H. L. Clark (1925), in using *Diadema* Gray, 1825, and *Diadematidae* Peters, for this urchin, instead of *Centrechinus* Jackson, 1912, and *Centrichinidae* Jackson, the correct names, for the reasons stated by Dr. Clark, who deferred to such authorities as Mortensen and Bather, who had proposed to continue the use of *Diadema* and *Diadematidae* and to secure these a place on the list of *Nomina Conservanda* authorized by the International Congress of Zoölogists. Search of the opinions rendered by the Congress, 1924 to June, 1931, fails to show any action taken on this question.

REFERENCES: *Echinometra setosa* LESKE, Add. ad Klein, p. 100, 1778, tab. 37, figs. 1 and 2.

Diadema setosa GRAY, Ann. Phil., vol. X, p. 4, 1825.



Lytechinus variegatus (Leske): A, tridentate pedicellaria; B, globiferous pedicellaria; C, triphyllous pedicellaria expanded; all $\times 45$.

Diadema setosum TH. MORTENSEN, Echinoidea, D. Kgl. Dan. Vid. Selsk. Skr., 7, Naturhg. og Math. Afd., I, p. 124, 1904; Echinoidea, Danish Ingolf Exped., vol. 4, pt. 2, p. 184, footnote, 1907.—VERRILL, A. E., Trans. Conn. Acad. Arts and Sci., vol. XII, p. 323, pl. 34, fig. 1, text fig. 174, 1904-07.

Centrechinus setosus JACKSON, Mem. Boston Soc. Nat. Hist., vol. 7, p. 28, 1912.—H. L. CLARK, Papers Marine Biol. Carnegie Inst. Washington, vol. X, p. 146, color plate 17, figs. 3 and 4, 1921.

Diadema setosum H. L. CLARK, Cat. Recent Sea Urchins, Brit. Mus., p. 43, 1925.—TH. MORTENSEN, D. Kgl. Danske Vidensk. Selsk. Skrifter Naturvidensk og Mathem. Afd. 9 Raekke, IV, 1, p. 17, figs. 1-3, 1931.

Suborder: **Camarodonta.**

Family: **ECHINIDAE.**

Genus: **LYTECHINUS** A. Agassiz.

***Lytechinus variegatus* (Leske).**

Plate 85.

TYPE: Leske described the species in 1734, from material in the Klein collection, now preserved at Erlangen; locality of type not stated.

DISTRIBUTION: This is one of the common sea urchins of the tropical west Atlantic, ranging from North Carolina and Bermuda, southward through the Gulf of Mexico and West Indies, down to Rio de Janeiro, Brazil. Littoral to 50 fms.

MATERIAL EXAMINED: Eight beached tests from the West Indies, Cat. no. 274. One specimen collected at Dry Tortugas, Florida, by the "*Ara*," Cat. no. 273.

COLOR: Very variable, ranging from rich violet to bright green or creamy white.

HABITS: This species frequents sandy bottom and often disguises itself by covering its test with seaweed and similar detritus.

LIFE HISTORY: The life history of this species has been carefully studied by Tennant, Journ. Exper. Zoöl., vol. 9, 1910; also by Mortensen, "Studies of the Development and Larval Forms of the Echinoderms," p. 35, 1921, Copenhagen.

TECHNICAL DESCRIPTION: Agassiz's description of this species, based on a very extensive collection of specimens of varying ages and from different localities, remains the standard diagnosis of *L. variegatus*.

The test is somewhat conical, the width diameter one and two-thirds times the height diameter. The ambulacral and interambulacral areas both have the tubercles arranged in regular vertical rows, closely crowded on the lower surface in the interambulacral area, with but one vertical row of large tubercles extending from the ambitus to the apex; the one next to the poriferous zone gradually becoming much smaller, while the others, according to the size of the specimen, extend in varying degree toward the abactinal region, leaving a bare median space on which the granulation of the plate is very fine and compact. The secondaries are far apart and irregularly scattered around the primaries. In the ambulacral space only the vertical rows of tubercles extend to the abactinal region, the others but a short way above the ambitus, leaving a bare median space as in the interambulacral space. The spines which are short, needle-like, vary much in thickness and coloration. The buccal membrane is entirely covered by closely crowded, prominent, large plates. There is a depression of the median interambulacral space near the apex, leaving the ambulacra elevated.

The pedicellariae are of the three types figured. (Plate 85.)

REFERENCES: *Cidaris variegatus* LESKE, Add. ad Klein, p. 149, tab. X, figs. B, C, 1778.

Echinus variegatus LAMARCK, Anim. sans Vert., 2nd ed., vol. III, p. 365, 1816.

Lytechinus variegatus A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. 1, p. 24, 1863.—H. L. CLARK, Univ. Iowa Studies Nat. Hist., vol. 9, p. 113, 1922; Cat. Recent Sea Urchins, Brit. Mus., p. 120, 1925.

Toxopneustes variegatus A. AGASSIZ, Rev. Echini, part I, p. 298, pl. II, figs. 5, 6, pl. IVa, figs. 4, 5, pl. VII, figs. 7-20, 1872.—H. L. CLARK, Rept. U. S. Fish. Comm., vol. XX, part 2, p. 253, 1900.

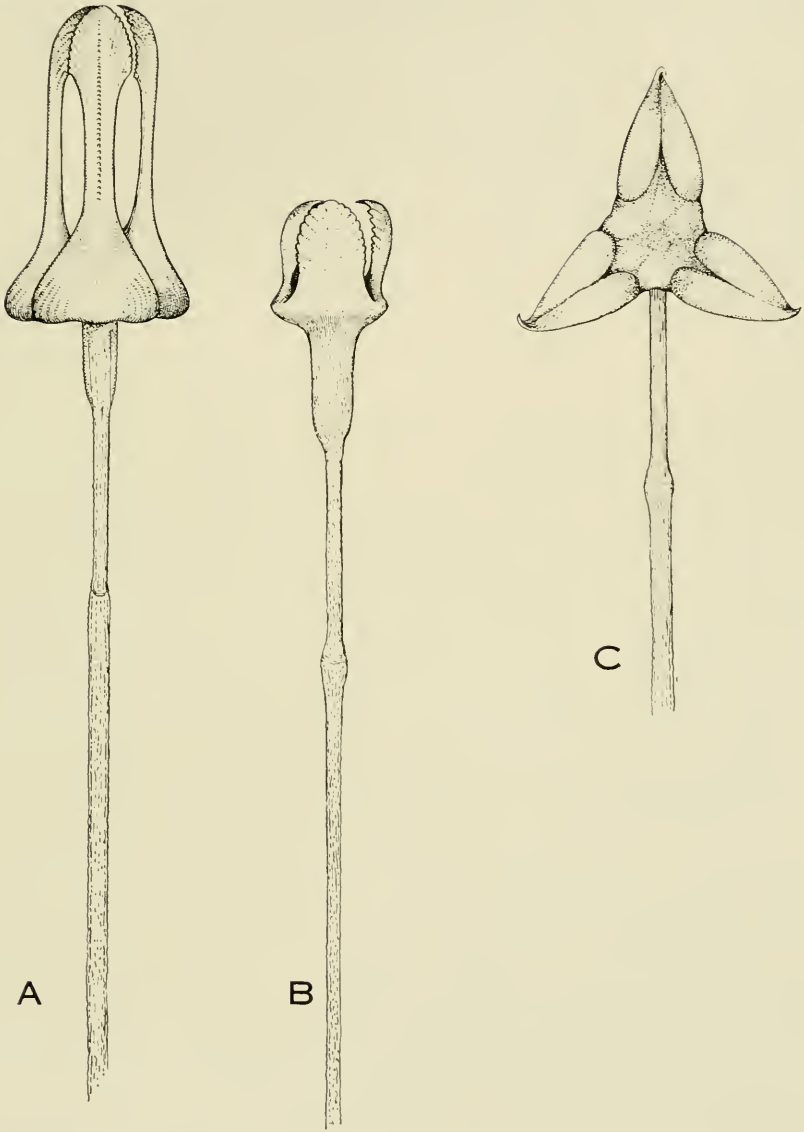
Genus: **TRIPNEUSTES** A. Agassiz.

Tripneustes esculentus (Leske).

Plate 86.

TYPE: Leske's type material came from the West Indies. The species was founded on specimens in the museums of Trier, Linck and Richter. Most of Leske's types are now in the Leipsig Museum.

DISTRIBUTION: Littoral to 690 fms., West Indian region. Dr. Mortensen has also recorded this urchin from West Africa.



Tripneustes esculentus (Leske): A, large tridentate pedicellaria; B, ophicephalous pedicellaria; C, triphyllous pedicellaria; all $\times 30$.

MATERIAL EXAMINED: Ten very young specimens collected at Bury Island, British West Indies, January 19, 1925, by the "*Ara*," Cat. no. 268. Two small urchins, Porto Padre, Cuba, March, 1928, Cat. no. 269.

COLOR: This urchin, which may attain a diameter of five to six inches, in life has the spines straw color or creamy, brownish yellow at the base. The median interambulacral region is spotted with black, the color of the heads of the numerous pedicellariae found all over that region. When the suckers are fully expanded they form lighter bands intermediate between the black bands of the median interambulacral region.

LIFE HISTORY: The larval forms of this species were studied and reported by Dr. Th. Mortensen.

HABITS: The young urchins spend the greater part of their time concealed among and under rocks. The older urchins appear to prefer an open grassy bottom.

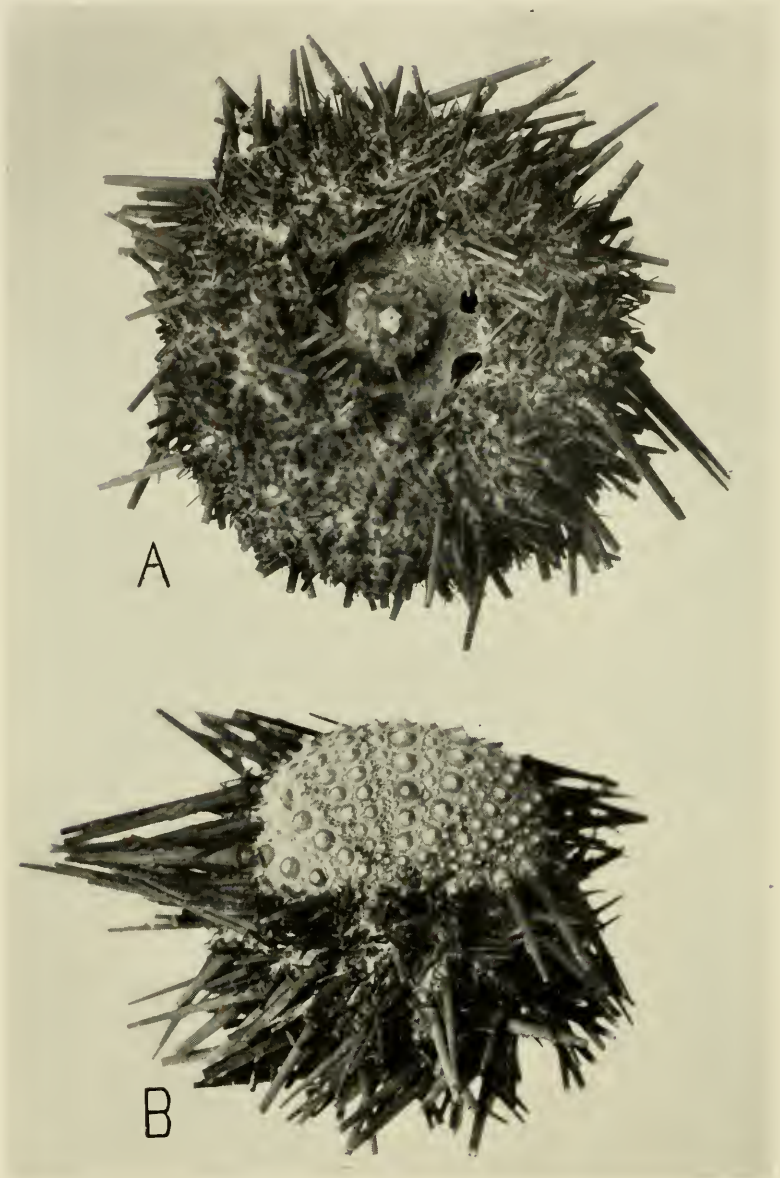
TECHNICAL DESCRIPTION: Test large, sometimes attaining a width diameter of six inches; thin, in a specimen from Nassau measuring 80 mm. diameter the interambulacral space has twelve vertical rows of primary tubercles, these are arranged on each plate more in horizontal series; towards the median line which is more or less bare from the ambitus to the abactinal pole, the coronal plates are covered by miliaries. The third and fourth vertical rows from the poriferous zone are the most prominent and the only two extending to the abactinal system. The tubercles are usually uniform. On the lower surfaces of ambulacral and interambulacral regions the tubercles are uniform and closely crowded in concentric rows around the actinostome as a center. In the median ambulacral region there are five vertical rows of tubercles, more or less distinct, decidedly so at the ambitus, the middle row indefinite, the exterior rows more prominent; these tubercles also tend to arrange in horizontal series. The vertical lines of pores are separated by two to three irregularly arranged vertical rows of small, secondary tubercles. The abactinal system is distinctly marked; the madreporic body is larger than the others. The large anal system is covered by a relatively small number of plates of a nearly uniform size with a very few smaller plates immediately surrounding the anus, each plate carrying only one or two small, secondary tubercles and a very few miliaries. The genital ring has but few secondary tubercles, they are few on the ocular and

genital plates. The actinal aperture is small, the cuts deep; the actinal membrane is covered by minute, irregularly well scattered plates. Three ocular plates are excluded from the anal system.

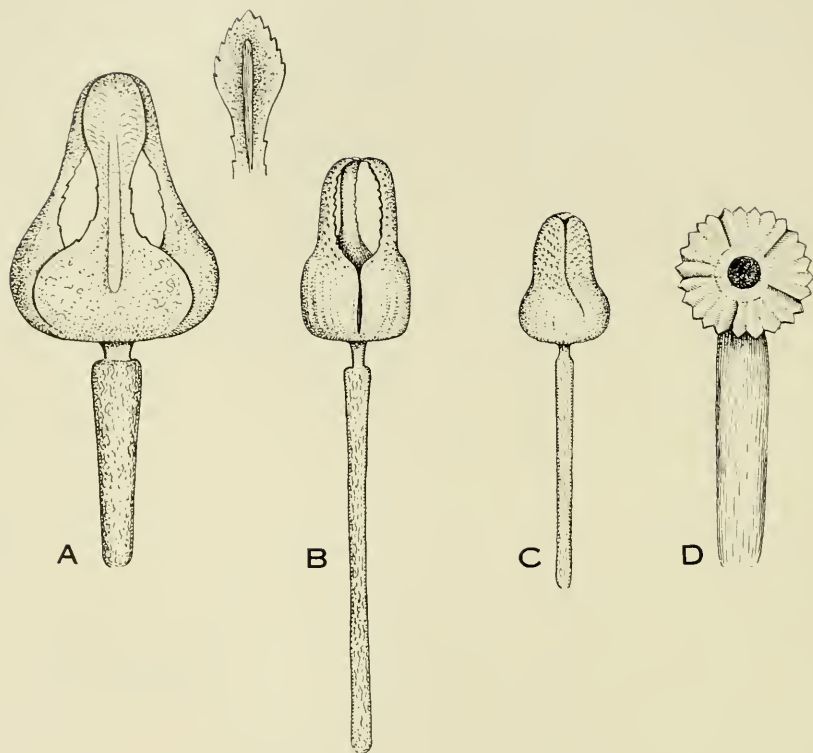
The primary spines are short, about half an inch long or less, comparatively stout, tapered, with about 18 to 20 fine longitudinal striations.

The ophicephalous pedicellariae are most numerous on the actinal regions and very abundant all over the test, having a very long, slender stem, and a rather small, globose head, each valve of which has the distal margin broadly rounded, lightly crenulate. (See figure B.) The gemmiform pedicellariae are very numerous all over the test, but especially so on the side walls and have the form figured. Scattered among these pedicellariae it is sometimes possible to find a solitary quadrivalved pedicellaria, of the same general structure, but possessing four instead of three blades; each composed of valves that taper toward the distal end and bear a small hook. The tridentate pedicellariae are the largest type found on this urchin but are rather sparsely scattered among the gemmiform and ophicephalous pedicellariae. The tridentates have the basal bowl of the head shallow, the distal portion of each valve thin, much elongated, with the distal margin lightly toothed.

In his report on "Hawaiian and Other Pacific Echini, The Cidaridae," Dr. H. L. Clark points out that the three nominal species in the genus, *gratilla* Linné from the Indo-Pacific region, *esculentus* Leske from the West Indies, and *depressus* A. Agassiz from the west coast of Mexico, are distinguished on characters of only slight importance, "and there is probably but a single species which is very variable in form, proportions, tuberculation, character of spines and color." The only character that proved constant in the study of the extensive series of specimens at Dr. Clark's disposal was the amount of plating on the buccal membrane; that of the West Indian *esculentus* with few small, scattered plates, while both the Indo-Pacific and west Mexican species have the buccal membrane with thick, moderately large plates. In the event that other students of the group accept Dr. Clark's statement that there is probably but one valid species, this would of course be known as *gratilla* Linné, 1758, which antedates Leske's *esculentus*, 1778, by twenty years. For the present, I have followed Dr. Clark's example in retaining *esculentus* for the West Indian form.



Strongylocentrotus gibbosus (L. Agassiz and DeSor) : A, oral view; B, aboral view, with spines removed from one-half of test, $\times 1.5$.



Strongylocentrotus gibbosus (L. Agassiz and DeSor): A, large, tridentate pedicellaria and detail of tip of valve; B, small, tridentate pedicellaria; C, globiferous pedicellaria; D, tip of actinal pedicel; all $\times 30$.

- REFERENCES: *Cidaris esculentus* LESKE, Add. ad Klein, p. 74, 1778.
Echinus ventricosus LAMARCK, Anim. sans Vert., vol. III, p. 44, 1816.
Hipponoe esculenta A. AGASSIZ, Mem. Mus. Comp. Zoöl., III, pt. 1, p. 135, 1872 (with extensive synonymy); *ibid*, part II, p. 301; *ibid*, part III, p. 501, pl. VI, figs. 28, 29, pl. VIa, figs. 1-3, pl. VIII, fig. 29, 1872.—H. L. CLARK, Bull. U. S. Fish Comm., vol. XX, part 2, p. 254, 1901.—VERRILL, Trans. Conn. Acad. Arts and Sci., vol. XII, p. 324, pl. 34 B, fig. 2, 1907.—D. H. TENNANT, Publ. 132, Carnegie Inst. Washington, p. 135, 1910; (reports use of this urchin in hybridization experiments).
Tripneustes esculentus BELL, Proc. Zoöl. Soc. London, p. 657, 1879.—R. RATHBUN, Trans. Conn. Arts and Sci., vol. V, p. 144, 1879.—MORTENSEN, Danish Ingolf Exped. Echinoidea, vol. IV, part 1, pp. 110, 112-113, 137; part II, pp. 184, 185, 186, 188, 189, 193, 1907.
Tripneustes angulosus BELL, Ann. Mag. Nat. Hist., ser. 5, vol. VIII, p. 437, 1881.

Family: **STRONGYLOCENTROTIDAE.**

Genus: **STRONGYLOCENTROTUS** Brandt.

Strongylocentrotus gibbosus (Agassiz and DeSor).

Plates 87 and 88.

TYPE: The type was collected in the Galapagos Islands and is deposited in the Paris Museum.

DISTRIBUTION: Panama to northern Chile, including the Galapagos Islands. Littoral.

MATERIAL EXAMINED: Six specimens, collected in shallow water, Webb Cove, Albemarle Island, Galapagos Islands, March, 1928, by the "Ara."

COLOR: These dried specimens show the test to be reddish brown, the spines olivaceous green.

TECHNICAL DESCRIPTION: The largest specimen of the series measures 43 mm. diameter, 26 mm. height. The test is thin, somewhat depressed, the abactinal area rather sunken, the sidewalls regularly arched, the actinal surface flattish. The actinal area is small, with slight cuts. The ambulacral zones are a little elevated above and slightly wider than the interambulacral zones. The poriferous zones

are wide, this width increasing underneath; above, the pores are arranged in oblique, slightly curved rows of four or five pairs, but on the lower surface they are more transverse in nearly straight rows of four pairs, with rows of tiny tubercles intervening. There are two rows of primary tubercles on the ambulacra with an irregular, median row of smaller tubercles between them. The interambulacra have two primary rows of somewhat larger tubercles midway between the lateral margin and median line and a row of smaller ones on each side bordering the poriferous zones, also a median double row of alternating tubercles of still smaller size. The genital plates unite so as to separate the small ocular plates from the anal area. The madreporic is small, transversely oval. The majority of the spines are less than half an inch long, moderately slender, tapering, with many fine, longitudinal striations, the ribs crossed by numerous fine lines.

The figures of the pedicellariae given were of necessity made from dried specimens. The stout, tridentate pedicellariae are rare, six to eight per urchin, and have the stalk slender, about two-thirds as long as the head which is 1.6 mm. long and quite wide at the base, the median part of each valve narrowed, the apical part widened somewhat, the margins regularly toothed, meeting closely on those of the adjacent valves.

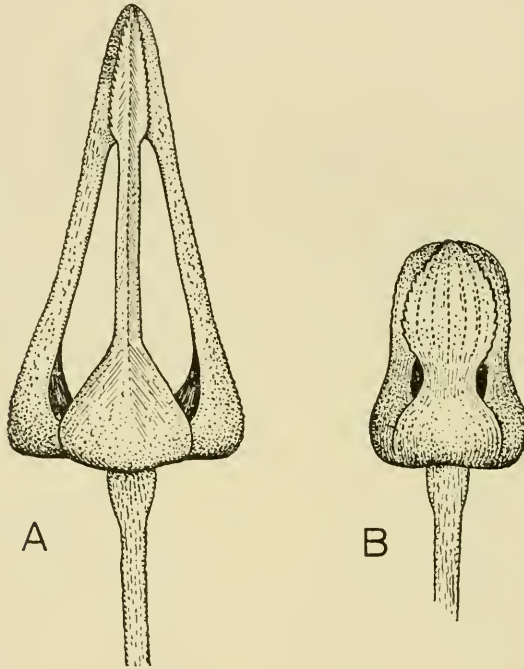
The slender tridentate pedicellariae are fairly abundant on the dorsal surface and have the stalk very slender, four to five times as long as the head which is very small, has the base of each valve broad, the distal three-fifths slender, with the apex slightly wider and toothed. (See figure B.)

The small globiferous pedicellariae are very abundant on the actinal region, each with a slender stalk approximately the length of the head, the valves as figured, taper to a point and are closely toothed on the margins.

REFERENCES: *Echinus (Toxopneustes) gibbosus* L. AGASSIZ et E. DESOR, Ann. Sci. Nat., vol. VI, p. 367, 1846.

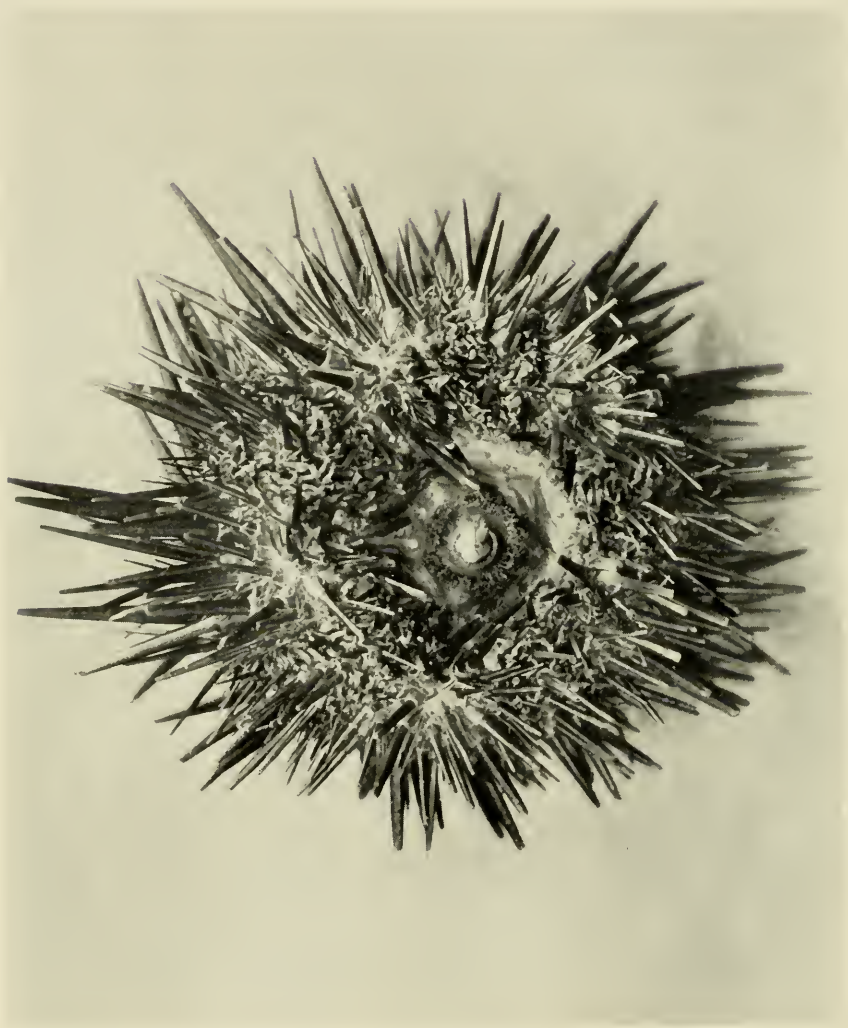
Strongylocentrotus gibbosus A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. III, part I, p. 164, 1872 (and synonymy).—H. L. CLARK, Proc. Wash. Acad. Sci., vol. IV, p. 526, 1902; Bull. Mus. Comp. Zoöl., vol. 52, p. 346, pl. 12, fig. 2, 1909.

and extend to the anal system. The genital ring is narrow, the madreporic genital larger than the others. There are a few large secondaries on the genital and ocular plates near the anal system and also additional tubercles on the madreporic genital. The poriferous zone is a little sunken, the pores usually arranged in very regular arcs—varying with age from four to six pairs. The actinostome is small, the

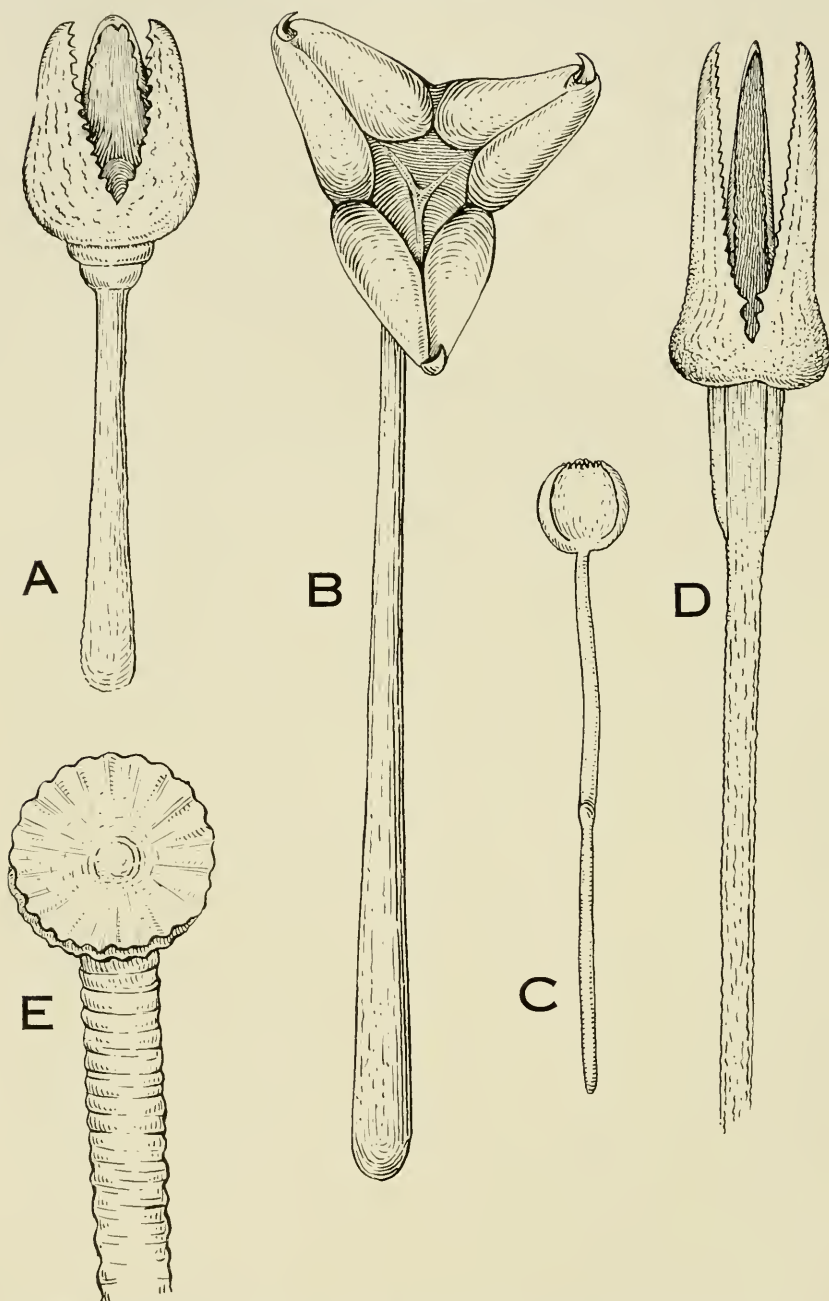


TEXT FIG. 4.—*Sphaerechinus granularis* (Lamarck). A. Tridentate pedicellaria. B. Globiferous pedicellaria, $\times 50$.

actinal cuts deep. The tubercles are a little smaller in the ambulacral zone than in the interambulacral zone and are arranged in two to four regular vertical rows, with an irregular median vertical line, also with very small secondary tubercles placed between adjacent arcs of pores along the entire poriferous line. In the interambulacral zone the vertical rows of closely packed primary tubercles are also simultaneously arranged in regular horizontal rows, separated by vertical and horizontal lines of secondaries and miliaries forming irregular rectangles. The globiferous pedicellariae have rather short valves, while the tridentate pedicellariae have somewhat broad, leaf-shaped valves.



Echinometra lucunter (Linné), oral surface of urchin, natural size.



Echinometra lucunter (Linné): A, gemmiform pedicellaria from actinosome;
 B, large, open, gemmiform pedicellaria; C, trifoliate pedicellaria;
 D, large tridentate pedicellaria; E, tip of actinal
 pedicel; all enlarged about $\times 30$.

REFERENCES: *Echinus granularis* LAMARCK, Anim. sans Vert., ed. 12, vol. 5, p. 359, 1840.

Echinus aequituberculatus DESMOULINS, Echin. in Actes de la Soc. Linn. Bordeaux, t. VII, livr. IV, p. 280, 1835.—BLAINVILLE, Dict. Sci. Nat., t. 37, p. 86, 1830.

Echinus (Toxopneustes) brevispinosus RISSO, Hist. Nat. de Europe Merid., V, p. 277, 1826.

Spaerechinus granularis A. AGASSIZ, Mem. Mus. Comp. Zoöl., III, part 2, p. 452, pl. V, fig. 7, pl. VI, figs. 16-17, 1873.—MORTENSEN, Echinoderms of the British Isles, p. 309, figs. 178, 179, 180, 1927.

Family: **ECHINOMETRIDAE.**

Genus: **ECHINOMETRA** Rondelet, Gray.

Echinometra lucunter (Linné).

Plates 90 and 91.

TYPE: Linné's type is in the Coll. Lud. Ulric Reginae in the Museum of Upsala, but unfortunately the labels have been lost. The Twelfth Edition Systema Natura states "Habitat in O. Indico." Leske's type of *Cidaris subangularis* came from the West Indies and is preserved at Erlangen.

DISTRIBUTION: Littoral to 8 fms. Widely distributed from southern Florida, the Bermudas, Bahamas, West Indies, Gulf of Mexico, Caribbean Sea and northern coast of South America, down to the northern mouth of the Amazon. Also with a continuous distribution across the tropical Atlantic from St. Croix and Puerto Cabello to the Gold Coast of Africa and St. Helena.

MATERIAL EXAMINED: Two small specimens, collected at Dry Tortugas, Florida, by the "Ara," Cat. no. 299.

COLOR: In life the spines of this urchin are dull purplish or green, the test a shade darker. Dr. H. L. Clark records specimens from Antigua of a dark purple drab or violet-black; others fawn color becoming purplish red at the spine tips. Still others were dark olive, the primaries with purple tips.

HABITS: This urchin is said to have the curious habit of excavating holes for itself in the limestone rocks, these holes being just large enough to fit the urchin. It is not certainly known how it bores the rock. Of more than a hundred museum specimens examined by the present writer it is of interest in this connection, that none possessed spines in the worn condition that might be expected, were they used in excavating the rock. Is it not possible that the urchin locates a

suitable hole, just as the hermit crab finds a shell? This problem is one well worth investigation by field workers.

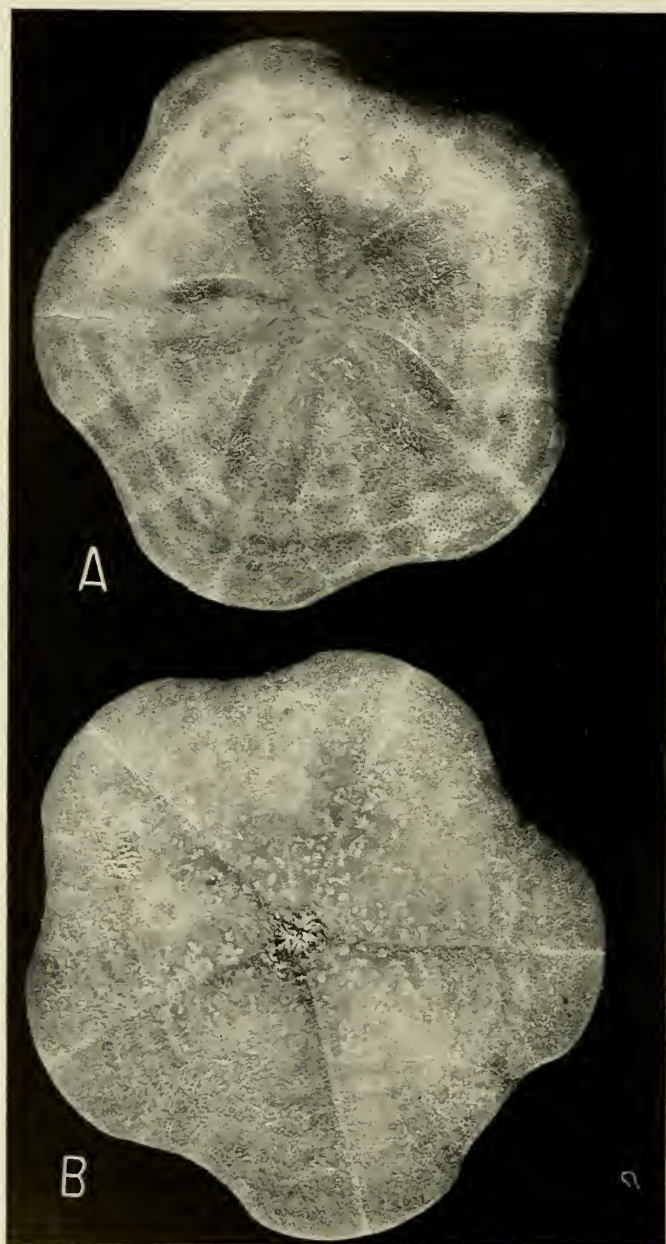
LIFE HISTORY: Critical investigation of the life history of *E. lucunter* (Linné) has been reported by Dr. Th. Mortensen, who reared the species at Tobago, B. W. I. (Studies of the Development and Larval Forms of Echinoderms, p. 71, pl. I, figs. 1-2, pl. XII, fig. 1, 1921, Copenhagen.)

TECHNICAL DESCRIPTION: Agassiz states that there is such variation within this species, in the proportion of the test, the structure of the ambulacra near the actinostome, more or less petaloid, and in the proportions of the spines and test, that only by examination of a large series of specimens, that the few good specific characters of *E. lucunter* may be determined. The test is thin, elongated, the poriferous zone broad, the pore pairs arranged in arcs of seven or eight, sometimes only six, the pores of pair large, distant; the auricles of very great size, extending in a T-shaped, broad column half way the length of the polar axis, connected by a stout ridge at base, equalling in height one-third of the auricles. The auricular arch is small. The actinostome is large, pentagonal; in young specimens the number of coronal plates of ambulacra is materially greater than in the interambulacra but older specimens show little difference in the size of the primary tubercles of the two areas. In very large old specimens as the test becomes more gibbous, the size of the coronal plates greatly increases and the primary vertical rows of tubercles frequently attain an astonishing size, and are sometimes flattened which has caused such specimens to be confused with true *Stomopneustes*.

The primary spines are stout, conical, finely striated longitudinally. The secondary spines are very fine, fragile, of similar design as the primaries but less than one-fourth as long.

There are numerous clusters of small, gemmiform pedicellariae encircling the actinostome. These each have a long, slender stem and a head composed of three rounded triangulate valves, the distal margins of which are distinctly dentate. These are also moderately abundant, more scattered among the secondary spines and such isolated gemmiform pedicellariae are frequently substantially larger than those on the actinostome, and each valve has a distinct hook at the tip. (Figs. A and B.)

The large, tridactyl pedicellariae are less abundant on the actinostome than the gemmiform, but are present in goodly numbers. Each has a long, slender stem, the neck of which is flexible, the head much



Clypeaster ravenelii (A. Agassiz): A, aboral surface; B, oral surface of urchin; both reduced about one-fourth.

elongated, consisting of three slender valves, each with a small base and an attenuated tongue-like distal portion, the margin of which is crenulate.

A third type of pedicellariae, the trifoliate, is also found abundantly on the actinostome, outside the principal ring of gemmiform pedicellariae and also is found abundantly scattered among the spines on the test. Each has an exceedingly long, slender stem, approximately the distal half of which is flexible, the head composed of three valves, each of which is convex outwardly, nearly subcircular, with the distal margin a bit flattish, crenulate. (Fig. C.)

REFERENCES: *Echinus lucunter* LINNÉ, Syst. Nat. ed. 10, p. 665, 1758.

Echinometra lucunter DESMOULINS, C. k., Etudes sur les Echinides, p. 260, 1835-37 (with synonymy, partim).—LOVEN, Bih. Svensk. Vet.-Akad. Handl., vol. 13 (4), no. 5, p. 157, 1887.—MORTENSEN, TH., Studies Devel. and Larval Forms Echinod., p. 71, pl. 1, figs. 1-2, pl. 12, fig. 1, 1921.—H. L. CLARK, Univ. Iowa Studies Nat. Hist., vol. 9, p. 118, 1921; Cat. Recent Sea Urchins, Brit. Mus., p. 143, 1925.—BOONE, L., Bull. Bingham Oceanog. Coll., vol. I, art. 4, p. 221, 1928.

Cidaris lucunter LESKE, Klein Addit. Echinod., p. 109, tab. IV, C, D, 1778 (part).

Cidaris subangularis LESKE, *ibid*, p. 106, tab. III, C, D, 1778.

Echinometra subangularis DESMOULIN, *op. cit.*, p. 266, 1835, part.—A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. III, part I, p. 283, pl. X, a, figs. 2, 3, 4, 1872.—H. L. CLARK, Rept. U. S. Fish Comm., vol. XX, part 2, p. 253, 1901.—A. E. VERRILL, Trans. Conn. Acad. Arts and Sci., vol. XIII, p. 324, pl. 34A, fig. 2, 1904-07.—TENNANT, D. H., GARDNER, M. S., and SMITH, D. E., Papers from Tortugas Laboratory of Carnegie Institution of Washington, vol. XXVII, pp. 1 to 46, 7 plates; pp. 47-52, 6 plates, 1931.

Suborder: **Clypeastrina.**

Family: **CLYPEASTRIDAE.**

Genus: **CLYPEASTER** Lamarek.

Clypeaster ravenelii (A. Agassiz).

Plate 92.

TYPE: Agassiz founded the species on a small specimen dredged off Florida in 34 fms., by Count Pourtales and deposited in the Museum of Comparative Zoölogy, and a much larger specimen

dredged off Charleston Harbor, S. C., and deposited in the Charleston Museum.

DISTRIBUTION: A deep-water species. In addition to the type specimens, a single specimen was dredged by the "*Blake*" in 84 fms., on Yucatan Bank, also one on the west Florida Bank, in 14 fms. It was not taken by the "*Fish Hawk*" in the extensive dredgings of the Porto Rican Survey.

MATERIAL EXAMINED: Two specimens, dredged in 70 fms., south of Marquesas Keys, Florida, March 2, 1924, by the "*Ara*," Cat. no. 296.

COLOR: Agassiz states that the broad, bare bands of the ambulacral area are colored light yellow, giving this species a striking appearance. The spines are greenish yellow on the smaller specimens and in the larger specimen the color was duller.

TECHNICAL DESCRIPTION: The specimen is 97 mm. long and in contour is equilaterally pentagonal with the angles evenly rounded, with the central portion of the test abruptly elevated from the extremity of the ambulacral rosette; the entire actinal surface is flat, and the ambulacral areas are marked by furrows which are most sharply defined on their inner four-fifths of their length, but which are quite distinct to the margin and continued on the abactinal surface as a well-defined narrow line running inward to the central plate. The margin of the test is quite thick and rounded. The ambulacral rosette is not elevated but is flush with the rest of the test. The petals are symmetrically placed and are well defined by the position of the respiratory tube-feet. The petals widen distally and have the ends well separated. The ambulacral rosette extends to within one-third the distance of the apex from the edge. The peristome is small, sunken; the five teeth are stout and very broadly rounded. The spines around the peristome are 3 to 3.5 mm. long, slender, tapered distally and regularly striated. The actinal and abactinal surfaces are regularly covered with short spines; the primaries like those around the peristome with large, node-like tubercles on the test. The secondaries are similar to the primaries but are much more abundant and much slenderer.

The large tridentate pedicellariae are scarce on the two dried specimens before me, but this may be due to handling. The head is shaped elongate, with the tips of the valves dentate.

The gemmiform pedicellariae are smaller and more abundant, each having the shape of an elongate bud.

The anus is small and is situated nearly half way the distance between the tip of the petal and the outer margin.

REFERENCES: *Stolonoclypus ravenelii* A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. I, p. 265, 1863-67.

Clypeaster ravenelii A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. X, p. 43, pl. XV b, figs. 1, 2, pl. XV c, figs. 1, 2, 1883.—MORTENSEN, TH., Echinoidea, Danish Ingolf Exped., vol. II, pp. 185, 186, 193, 1907.

Clypeaster ravenelii H. L. CLARK, Cat. Recent Urchins, Brit. Mus., p. 151, 1925.

Clypeaster rosaceus (Linné).

Text figure 5.

TYPE: Linné's type locality is cited as the "oceans of Asia," in the Tenth Edition.

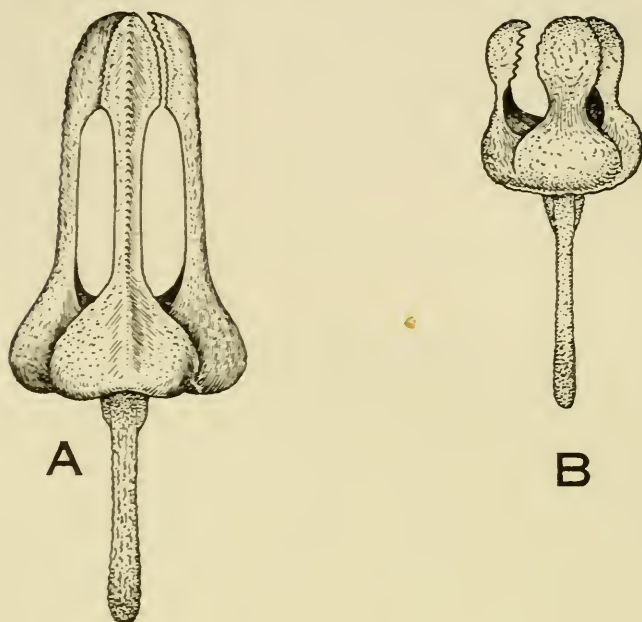
DISTRIBUTION: West Indian region. Littoral to 15 fms.

MATERIAL EXAMINED: Two beach worn tests from Dry Tortugas, Florida, Cat. no. 295. Notes made from a complete specimen, collected at Nassau, Bahamas, in the collections of the American Museum of Natural History.

COLOR: Dark reddish brown.

TECHNICAL DESCRIPTION: Test high, with outline not quite oval, more blunt at one end and narrowed at the opposite end; abactinal surface so arched that there is scarcely a margin; the oral surface deeply concave, mouth sunken, jaw-teeth strong, blunt. The ambulacral rosette is large, with three of the petals a little longer than the other two; all five very broad, sharply defined by the poriferous area, the interporiferous region more or less elevated. On the actinal surface the ambulacral areas are marked by straight furrows, which are widest for the inner two-thirds of their length and become vague, sometimes scarcely distinguishable, on the outer third. The anus is almost on the margin of the lower surface of the broad blunt end of the test. The spines are very short, tapered at the tip, longitudinally striated. Near the ambulacral furrows and round the peristome the spines are a little longer and stronger than elsewhere. The secondary spines are less than half so long as the primaries, similarly striated, very slender and swollen distally.

The large, tridentate pedicellariae are quite abundant on both the actinal and abactinal surfaces, and have the shape shown in figure A.



TEXT FIG. 5.—*Clypeaster rosaceus* (Linné). A. A large, tridentate pedicellaria, $\times 50$. B. Gemmiform pedicellaria, $\times 50$.

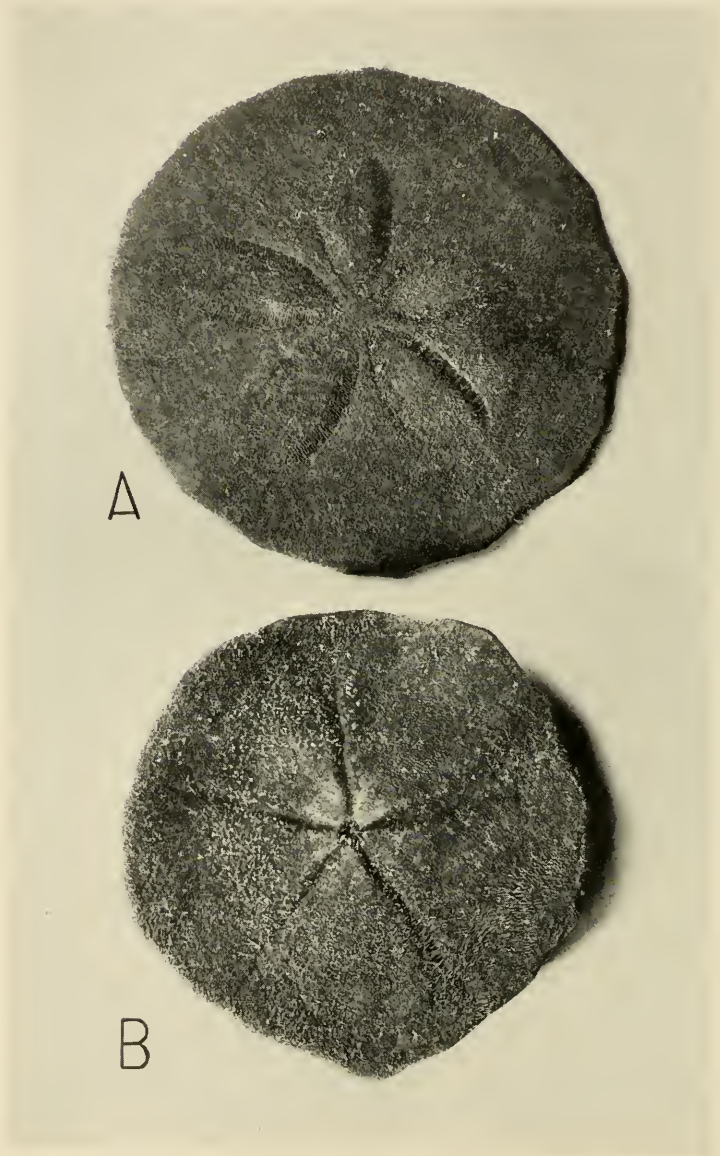
The gemmiform pedicellariae are much more numerous than the tridentate form but not so large, with the head short, each valve distally has the form of a subcircular spoon with its margin crenulate (figure B).

REFERENCES: *Echinus rosaceus* LINNÉ, Syst. Nat., ed. 10, p. 665, 1758.

Clypeaster rosaceus LAMARCK, Anim. sans vert., p. 349, 1801; ed. II, vol. III, p. 289, 1840.—A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. I, p. 264, 1863-67.—H. L. CLARK, Univ. Iowa Studies Nat. Hist., vol. 9, p. 101, 1921; Cat. Recent Sea Urchins, Brit. Mus., p. 152, 1925.

Echinanthus rosaceus GRAY, Ann. Phil., 1825 (not examined).—

A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. III, part 1, p. 311, pls. XI c, XI d, figs. 1, 2, pl. XI f, figs. 1-18, pl. XIII, fig. 9, 1872 (with synonymy).—H. L. CLARK, Rept. U. S. Fish. Comm., vol. XX, part 2, p. 254, 1901.



Echinarachinus parma (Lamarek): A, abactinal surface; B, actinal surface, both natural size, of two different specimens.

SCUTELLIDAE.

Genus: **ECHINARACHINUS** Leske.

Echinarachinus parma (Lamarek).

Plate 93 and text figure 6.

NAME: Sand Dollar.

TYPE: Lamarek states of his type, "Habitat l'Océan des Indes. Mon Cabinet." This cabinet was later placed in the Paris Museum.

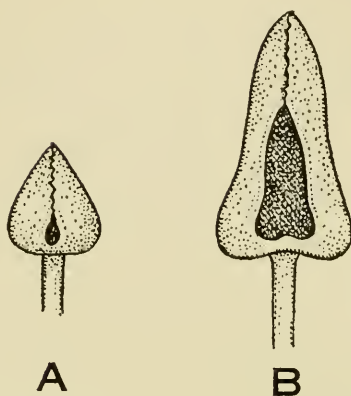
DISTRIBUTION: This species has a very wide distribution, being found on the American Atlantic coast from Labrador to southern New Jersey and on both American and Asiatic shores of the Pacific; on the American Pacific coast it ranges from the Aleutian Islands down to British Columbia, and on the Asiatic shore southward to Japan. In the more northern localities it is found inshore, near the low-water mark, while farther south it inhabits deeper water. It has a recorded bathymetric occurrence from the tide-line down to 800 fms.

MATERIAL EXAMINED: Three specimens, Eastport, Maine, August 24, 1924, Cat. no. 293. Four specimens, from the estate, Northport Harbor, Long Island Sound, Cat. no. 294.

HABITS: This odd urchin is one of the group which has its body exceedingly flattened and modified in order to enable the animal to meet the requirements of its environment. It lives on sandy bottom off shore, partly buried beneath the surface of the loose sand. It feeds on the minute organisms, especially diatoms and other algae, found among the sand which it ingests. The disk-like body enables it to withstand its being upset or displaced by the shifting of the sand under the influence of the waves.

COLOR: In life the larger adults are reddish brown or purplish brown, while the smaller adults are paler red.

TECHNICAL DESCRIPTION: Test exceedingly flattened, disk-like, nearly circular in outline but slightly indented at one point, indicating the anus. Test closely covered with minute spines, which are nearly uniform on the abactinal surface, longer on the margin, but longest in the interradiar areas at the peristome. On the abactinal surface the slenderer, ambulacral areas or "petals" are placed symmetrically around the central plate and are well defined by the position of the respiratory tube-feet. The petals are widely open, somewhat obtuse, extending three-fifths of the distance to the margin. On the flattish actinal surface the ambulacral areas are marked by furrows, which



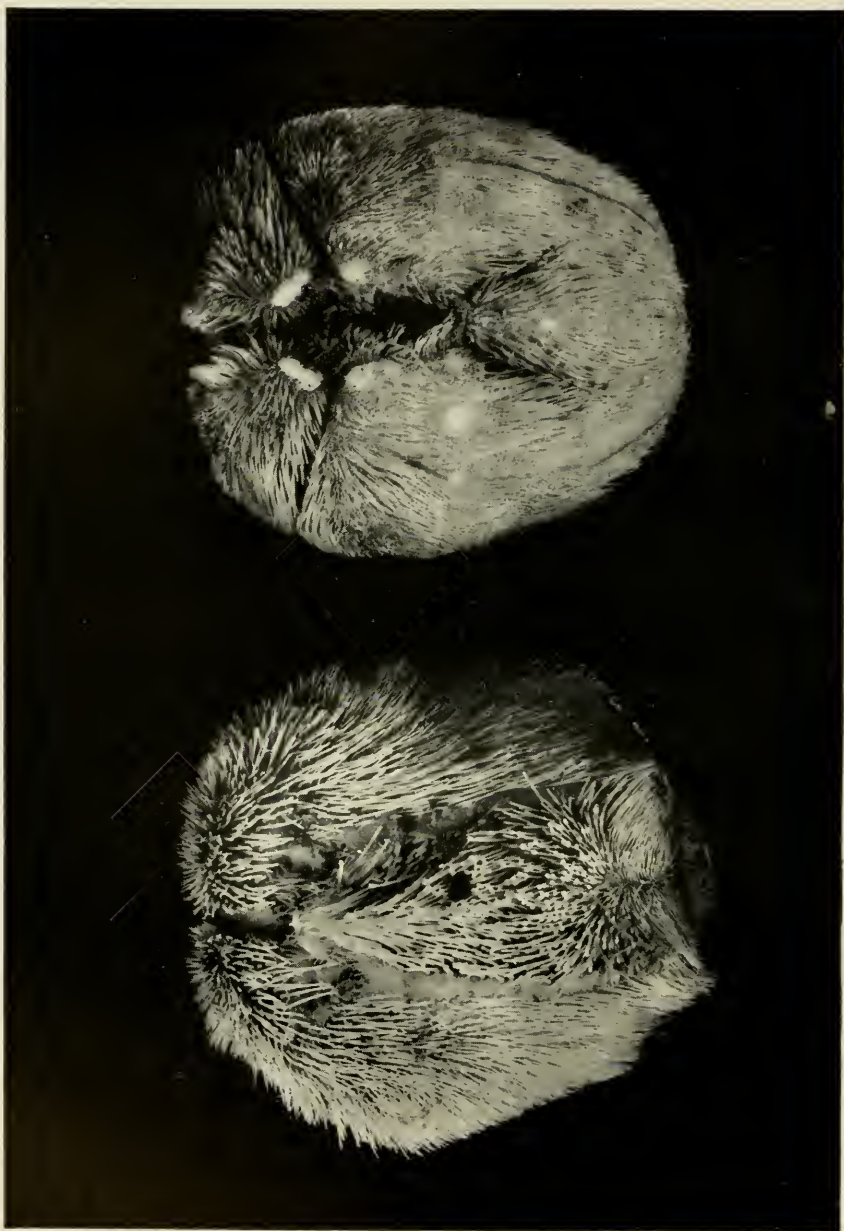
TEXT FIG. 6.—*Echinarachinus parma* (Lamarck). A. Small bidentate gemmiform pedicellaria, $\times 50$. B. Bidentate tridactyl pedicellaria, $\times 50$.

are widest at the peristome and which about three-fifths the way to the margin give off a prominent branch on each side, at about an angle of 45° ; all three branches of each furrow extending to the margin; the median furrow sometimes is continued abactinally. The peristome is quite small, the five calcareous teeth strong and very sharp. The abactinal system is approximately central; there are four genital pores. The anal aperture is situated abactinally in very young specimens, marginal in many adults and actinal in very large, old specimens. The primary spines are close-set, each with a disk-like base forming a rim, the spine slenderer proximally than distally, where it is swollen; the lateral surface is longitudinally verticillate. The smaller spines are similar to the primaries but slenderer.

The largest specimen of the series before me measures 76 mm. long diameter, 74 mm. short diameter, 8.5 mm. vertical diameter, diameter of abactinal system 7.5 mm., length of anterior petal 26 mm., length of posterior petal 19 mm., length of spine at margin 1 mm., length of spine at peristome 2.5 to 3 mm.

The gemmiform pedicellariae are abundant on the specimens before me, especially on the actinal surface each has a slender short stem, slightly longer than the bud-like head, which is composed of two elongated, tapered valves, each of which has a pointed hook distally; the two valves forming a laterally compressed head.

The ophecephalous pedicellariae are very abundant on both surfaces, especially on the actinal. They are small, bivalve, laterally compressed, short-stalked.



Moira atropus (Lamarek), natural size of two specimens, dredged at Cape Cruz, Cuba, depth 3 fms.

The tridactyl pedicellariae are very rare, scattered on the actinal surface. They are long, slender, bivalve, with a gap between the valves, long-stemmed.

REFERENCES: *Scutella parma* LAMARCK, Anim. sans Vert., vol. III, p. 284, 1816.

Echinarachnius parma GRAY, Ann. Phil., vol. 26, p. 428, 1825.—A. AGASSIZ, Mon. des Scutellidae: Fam. des Clypeastroides, p. 89, pl. 20, figs. 9 to 18, 1841; Rev. Echini, part I, Mem. Mus. Comp. Zoöl., III, p. 107, p. 179, 1872 (with extensive synonymy).—E. W. MCBRIDE, Echinodermata, in Cambridge Natural History, vol. I, p. 542, figs. 241, 242, 243, 244, with detailed discussion of the anatomy, 1909.—H. L. CLARK, Bull. U. S. Com. Fish., vol. XXII, p. 564, pl. 10, figs. 58-62, 1902.—W. R. COE, Conn. Geol. and Nat. Hist. Surv., vol. IV, Bull. 19, p. 110, pls. 23, 24, fig. 2, pl. 27, 1912.—H. L. CLARK, Cat. Recent Sea Urchins, Brit. Mus., p. 168, 1925.—A. H. CLARK, Rept. Canadian Arctic Exped., 1913-18, vol. VIII, part C, p. 4 c, 1920.

Suborder: **Spatangina.**

Family: **HEMIASTERIDAE.**

Genus: **MOIRA** A. Agassiz.

Moira atropus (Lamarck).

Plate 94.

TYPE: Lamarck states in his type description "Habite l'Océan Européen, la Man Manche." His specimen was deposited in his cabinet; later placed in the Paris Museum.

DISTRIBUTION: Recorded from South Carolina southward into the Gulf of Mexico and West Indian region. Littoral to 80 fms.

MATERIAL EXAMINED: Three large specimens, dredged in 3 fms., Cape Cruz, Cuba, tag 410A, February 11, 1924, by the "*Ara*," Cat. nos. 218, 219, 220. Five young specimens, Porto Padre, Cuba, March, 1928, Cat. no. 232.

COLOR: Yellowish with brownish spines.

HABITS: Unrecorded.

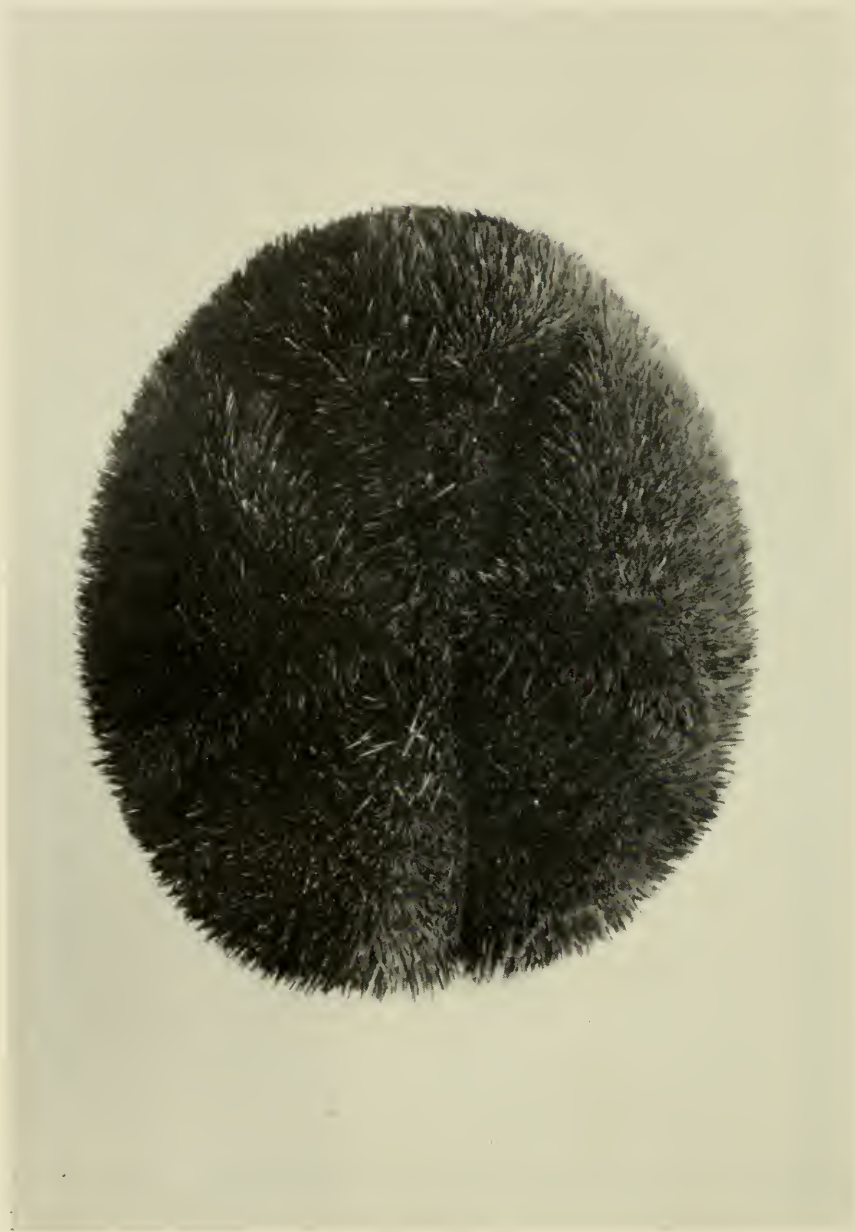
TECHNICAL DESCRIPTION: Agassiz's masterly description and illustrations of this common West Indian species are the principal reference for students. *M. atropus* is distinguished from the other West Indian echinoids by its very deeply sunken ambulacra which gives it

an almost deformed appearance. Specimens attaining a length of 50 mm. have been authentically recorded. The "*Ara*" specimens are about 57 mm. long diameter.

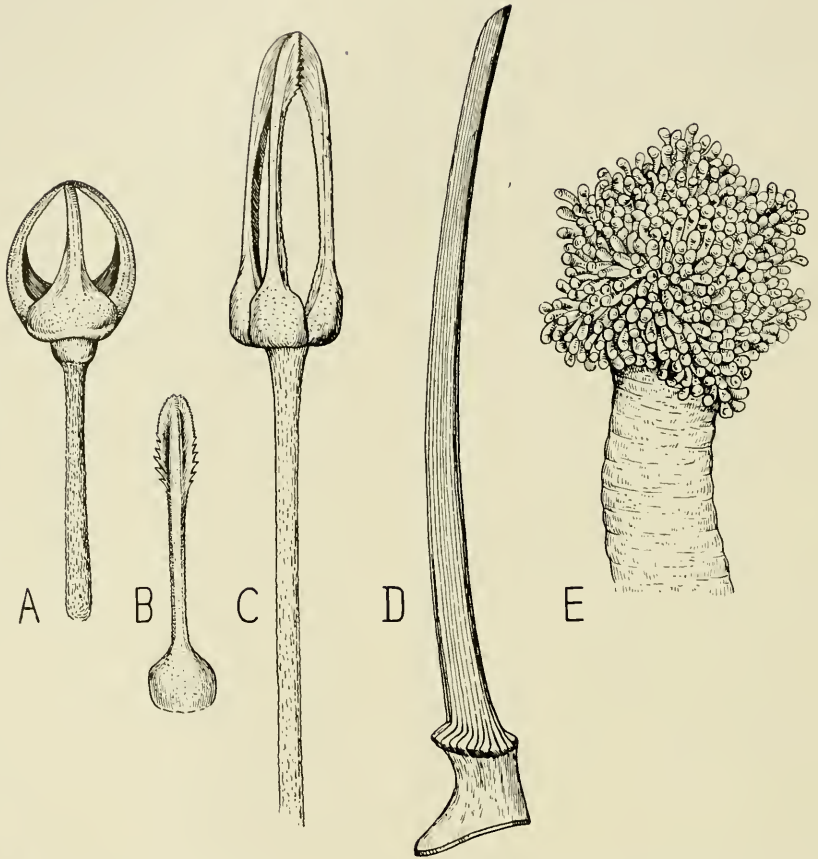
The test is moderately thin, ovoid, its contour from above almost elliptical, almost angular near the junction of the interambulacral plates. This angular outline is most evident in old specimens, the younger forms tending to be more ovoid. The plates composing the test are each somewhat conical, rising slightly towards one side and tapering gently towards the margin; from their highest point the tubercles radiate irregularly towards the margin. The anterior ambulacrum has part of the posterior edge of its apical part projected over the anterior edge, completely closing the upper portion of the anterior lateral ambulacra. It then recedes again and thus causes the ambulacral groove to appear to commence at a distance from the apex and form a distinct angle with the longitudinal axis. The unusual anterior adambulacrum is divided into two connected cavities, by the closing up of the slightly sunken edge of the anterior groove. When examined from above the projecting lips form two triangular spaces, closely covered with the small tubercles, to the anterior edge of which the peripetalous fasciole extends and thence passes on to the edge of the lateral ambulacra. The anterior lateral ambulacra are decidedly longer than the posterior. The vertex is situated slightly behind the apical system; the posterior extremity is truncated vertically, forming a sharp angle with the actinal plastron which has a small, well-developed keel immediately below the subanal fasciole. The anal system is flush with the test, small, elliptical, margined by eight plates surrounding the small, interior plates. The lateral fasciole is narrow, widening slightly under the anal system; that portion of the fasciole adjacent to the deep groove is narrow and the connecting parts between the petals are narrow.

The spines are numerous, fine and short excepting those that meet above and almost entirely conceal the sunken ambulacra. The interambulacral plastron on the lower surface also is covered by longer spines, which when worn become spatulate at the tip. The spines also are somewhat longer on the upper lateral part of the posterior ambulacra particularly towards the mouth, and also on the side of the ambitus.

REFERENCES: *Spatangus atropus* LAMARCK, Anim. sans Vert., III, p. 32, 1816, *ibid*, 12th ed., III, p. 327.



Meoma ventricosa (Lamarck) reduced about one-third.



Meoma ventricosa (Lamarck): A, smaller tridentate pedicellaria; B, detail of valve of tridentate pedicellaria, showing dentition; C, larger tridentate pedicellaria; D, primary spine from the region of the actinosome; E, distal end of an actinal pedicel, showing mat-like mass of tentacles; A, B and C $\times 18$, D and E $\times 15$.

Moira atropus A. AGASSIZ, Mem. Mus. Comp. Zoöl., Rev. Echini, vol. III, part I, p. 146, 1872; *ibid*, part II, p. 146; *ibid*, part III, p. 365, pl. 23.

Family: **SPATANGIDAE**.

Subfamily: **Brissina**.

Genus: **MEOMA** Gray.

Meoma ventricosa (Lamarek).

Plates 95 and 96.

TYPE: Lamarek's type came from "l'ocean des Antilles." It is deposited in the Paris Museum.

DISTRIBUTION: Recent: Littoral to 240 fms. West Indian region. Fossil: Recorded from the Tertiary of Cuba and the West Indies by Agassiz.

MATERIAL EXAMINED: One large specimen, dredged at Egg Island, British West Indies, January 19, 1925, by the "Ara."

COLOR: Yellowish brown or reddish brown.

TECHNICAL DESCRIPTION: Urchin large, specimens attaining a long diameter of 188 mm. having been recorded. The test is thick, broadly elliptical, somewhat heart-shaped from above. The actinal surface is flat, except the projecting posterior lip of the actinostome. The anal extremity is truncated obliquely towards the sloping actinal surface; regularly arched from the edge of the test to the apex, which latter is anterior, almost corresponding with the abactinal center; regularly arched from anal and anterior extremity to apex, lateral ambulacra deeply sunken, with the posterior pair distinctly longer than the anterior pair which diverges at a much greater angle from the very shallowly defined odd, or fifth, ambulacrum, which is situated in a very lightly marked anterior groove. The peripetalous fasciole is of uniform breadth, clearly defined, the four genital openings diverging posteriorly. On the interambulacral plates, enclosed by the fasciole, the tubercles are arranged in single rows parallel to the suture; the remainder of the test is covered by closely crowded tubercles of uniform size, supporting short, sharp spines. On the actinal region of the test the tubercles are larger immediately adjacent to the ambulacra, diminishing in size towards the edge and towards the central part of the actinal plastron. This actinal plastron is bottle-shaped, short-necked near the actinostome, with a very faint keel near the central part, and bounded posteriorly by the narrow, usually open, subanal fasciole, the anal extremity of which is bent near the base of

the anal system. The actinostome is deeply sunken with the posterior lip very prominent and projecting almost as far as the anterior margin of the actinostome. The anal system is small, elliptical, covered by irregular, polygonal plates supporting spines, diminishing rapidly in size toward the anal opening. The margin of the interambulacra adjacent to the ambulacral plates of the lower side, the space around the anal system and around the actinostome is closely packed with two kinds of pedicellariae.

The large, tridentate pedicellariae are rare (fig. C), and have the head about one-fourth longer than that of the large, globiferous pedicellariae, slender, tapered, the tips of the valves dentate, meeting.

The actinal pedicels are stout, very muscular, with the distal end divided into a mat-like mass of numerous, (20 to 30), tiny tentacles.

The primary spines around the actinostome are somewhat longer than the others, curved basally, verticillate, distally flattened, with a deep groove on the under side.

The large globiferous pedicellariae are rare and have a very long stem, about four times the length of the head. The head has three valves, forming a slightly convex, three-sided, cup-like base, with the distal three-fifths of each valve slender throughout its length, but narrower proximally than distally, where it has a rounded, dentate margin.

REFERENCES: *Spatangus ventricosus* LAMARCK, Anim. sans Vert., vol. 3, p. 29, 1816.

Meoma ventricosa LUTKEN, Vid. Meddel. Naturk. For. Kjobenhavn, p. 120, 1863.—A. AGASSIZ, Mem. Mus. Comp. Zoöl., vol. III, part 1, p. 358, pl. XX, fig. 8, pl. XXII, figs. 3, 4, 1872; Rept. "Challenger" Echinoidea, vol. III, p. 221, 1881.—H. L. CLARK, Rept. U. S. Fish. Comm., vol. XX, part 2, p. 255, 1901; Cat. Recent Sea Urchins, Brit. Mus., p. 220, 1925.—MORTENSEN, TH., Danish In-golf Exped. Echinoidea, vol. IV, part 2, pp. 184, 185, 186, 189, 194, 1907.

HOLOTHURIOIDEA.

Order: ELASIPODA.

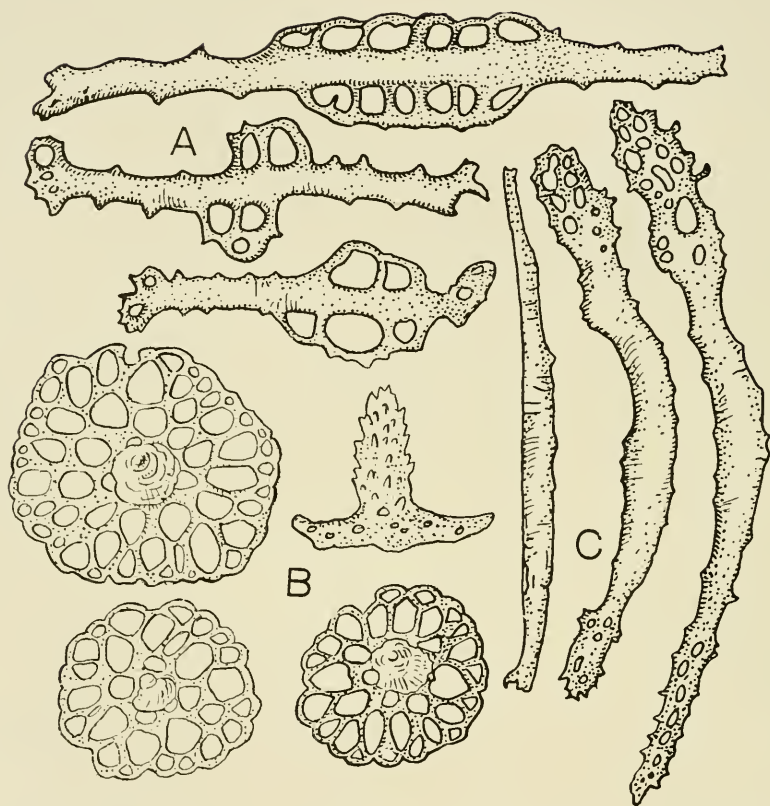
Family: PELAGOTHURIIDAE.

Genus: PELAGOTHURIA Ludwig.

Pelagothuria natatrix Ludwig.

Illustration: See Ludwig.

TYPE: Ludwig had 18 specimens, taken by the "Albatross" at eleven stations in the vicinity of the Galapagos Islands, Cocos Island



Sticopus regalis (Cuvier): A, elongate bars with perforations, much enlarged; turriiform tables, greatly magnified; C, curved, elongate bars with porons, rough ends, enlarged.

and Malpelo Island, and the Bay of Panama, in depths ranging from 331 to 1832 fms. Some of these are deposited in the Museum of Comparative Zoölogy.

DISTRIBUTION: This unusual pelagic holothurian is evidently abundant in the eastern tropical Pacific, for in addition to the distribution noted above, thirty-three specimens, taken at ten stations, in depths ranging from surface tow to 300 to 2440 fms., were obtained by the "Albatross" in 1904-05. The "Ara" record adds another station for this species. It is of interest to note that the extensive dredgings of the "Siboga" did not obtain a single record of the species in the Indo-Pacific.

MATERIAL EXAMINED: Three adult specimens in very good condition, collected when the dredge was down 300 fms., bottom depth 1400 fms., 50 miles S. W. of Cape Malo, Panama, March, 1928, by the "Ara," Cat. no. 227.

COLOR: In life this holothurian is a delicate fuchsia red with shadings of purplish.

DISCUSSION: All the "Ara" specimens are adult and conform with Ludwig's very thorough description of the animal. Exquisite color and detail illustrations of the species are given by Ludwig, in volume 17, part 3, plate 19, of the Memoirs of the Museum of Comparative Zoölogy, 1894.

REFERENCES: *Pelagothuria natatrix* LUDWIG, Bull. Mus. Comp. Zoöl., vol. 24, p. 111, 1893; Mem. Mus. Comp. Zoöl., vol. 17, p. 114, pl. 19, 1894 (color plate).—H. L. CLARK, *ibid*, vol. 39, p. 132, 1920.

Order: **ASPIDOCHIROTA.**

Family: **STICHOPODIDAE.**

Genus: **STICHOPUS** Brandt.

Stichopus regalis (Cuvier).

Plate 97.

TYPE: Cuvier's type came from the Mediterranean; its depository is not stated.

DISTRIBUTION: This is essentially a Mediterranean species which is also found on the coasts of the Hispanic Peninsula, in the Bay of Biscay, and in British waters off the west coast of Ireland. It also is found at the Canaries. Bathymetric occurrence: 10 to 1029 fms.

MATERIAL EXAMINED: Three specimens, dredged in 100 fms., $9\frac{1}{2}$ miles E. by S., $\frac{1}{2}$ S. from Cape Bon Tunis, North Africa, July 19, 1927, by the "Ara." Two of these are quite large, the third being small.

COLOR: The living sea-cucumber is brownish with large, white rounded spots on the dorsal side; the ventral surface is usually lighter.

LIFE HISTORY: Unknown.

TECHNICAL DESCRIPTION: This species is large, attaining a body length of 25 to 30 cm., the body flattened on the ventral side, forming a distinct sole; the margin of its union with the body set with large papillae forming a decided rim, which is continued anteriorly above the ventrally situated mouth. The dorsal surface is ornamented with large, nearly serially arranged tubercles, each of which terminates in a conical papilla. The ventral surface has three definite series of tube-feet. The calcareous deposits of the skin are of three types: tables with a large, circular perforated disk, with the rods of the spire connected by 3 to 5 sets of cross bars; elongate flattened rods, and star-shaped bodies, these latter being located chiefly in the radii, near the longitudinal muscles.

REFERENCES: *Pudendum regale* FABRICIUS, Columna Aquat. XXVI, I. *Holothuria regalis* CUVIER, Le Regne Animal distribue suivant son organization, t. IV, p. 22, 1817.—SARS, Medd. litt. Fauna, p. 96, t. 2, figs. 78-81, 1857. Dujardin and Hupe, Hist. Nat. des Zoöph. et Echinod, p. 617, 1862.

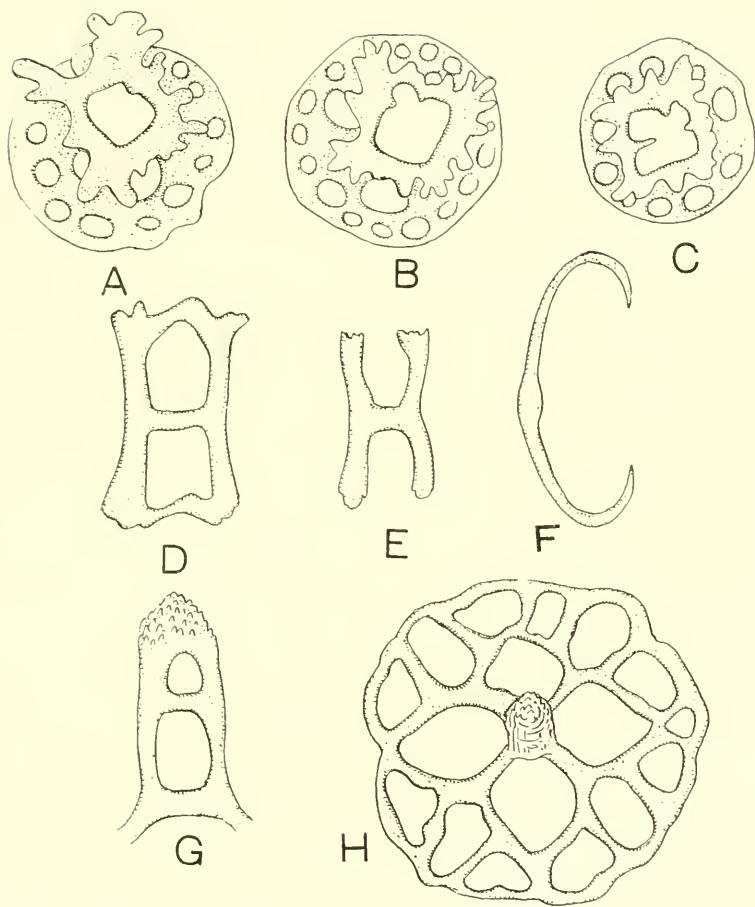
Holothuria triquetra DELLE CHIAJE, Descrip. anim. Invert. Sicilia, vol. IV, p. 4; vol. V, p. 63, tab. 112, figs. 16, 17, tab. 113, figs. 1-7, tab. 136, fig. 4, 1841.

Stichopus regalis, LUDWIG, H., Mitt. Zoöl. Sta. Neapel, Bd. 1, p. 569, 1879 (with extensive synonymy).—PERRIER, Holothuriidae, Exp. Sci. du "Travailleur" et du "Talisman," p. 482, 1902.—HEROUARD, E., Res. Sci. Compag. "Princess Alice," Monaco, Fasc. XXI, p. 11, 1902; *ibid*, Fasc. LXVI, p. 10, 1923.—KOEHLER, R., Faune de France, Echinod, p. 182, fig. 138, 1921; Echinod. des Mers D'l'Europe, part 2, p. 237, pl. XVI, fig. 24, 1924.—MORTENSEN, Handbook, British Echinod., p. 391, fig. 232, 233, 1927.

Stichopus badionotus Selenka.

Plate 98.

TYPE: Selenka's type was collected in Florida and Acapulco (?) and is deposited in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.



Stichopus badionotus Selenka: A, B and C, typical tables seen from above; D, partially resorbed table, seen from side; E, more fully resorbed table, seen from side; F, C-shaped particle; G, tip of turritiform table; H, disk of same table, all much enlarged.
(After H. L. Clark).

DISTRIBUTION: According to Dr. H. L. Clark this common West Indian *Stichopus* is identical with specimens found in the West Panamic and west African regions. Littoral.

MATERIAL EXAMINED: Three specimens collected in Egg Island Harbor, Bahamas, B. W. I., January 19, 1925, by the "Ara," Cat. no. 283. One specimen, badly corroded, from Port Tanamo, north coast of Cuba, 2 fms., February 23, 1924, Cat. no. 284. One young specimen, from Port Tanamo, Cuba, 2 fms., Feb. 23, 1924, Cat. no. 285.

COLOR: The typical design of coloration is a buff ground color with blackish or dark brown spots. From the study of extensive series of living holothurians Dr. Clark found three definite lines of color variations: (a) one toward a uniform black coloration; (b) one toward brown, olive or purple with few markings of buff, yellowish or white through increased pigmentation accompanied by alteration in the density of the pigment, and (c) a third, toward uniformly brownish yellow specimens, through decreased pigmentation. The tentacles range from deep blackish to nearly white but are more frequently yellow.

HABITS: The younger adult stages of this species are colorless, transparent, gelatinous-like animals that settle down in rock crevices and lead a very sheltered existence until they are 80 to 100 mm. long, by which time the pigmentation has begun to develop, giving the cucumber distinct coloration but still translucent, the translucency disappearing as the animals become older. By the time they are 125 to 150 mm. long, they live more in the open, the larger adults seeking the weedy or sandy flats inshore, usually in 1 to 3 fms., but occasionally found down to 10 fms.

DISCUSSION: The number of tentacles is 18 to 20 in adults, while immature specimens frequently have fewer. The warty or tuberculated appearance of the skin of the tuberculated animal is too variable to have value as a specific character. Similar diversity exists in the number of pedicels.

Dr. Clark has found that the calcareous deposits in the skin of this species are subject to certain phases of growth changes.

The typical deposits are of two kinds: (a) well developed, nearly circular tables of about 40 to 50 μ diameter and ornamented with a peripheral circle of holes. The top of the spire usually has 12 to 16 teeth. (b) The C-shaped bodies vary a good deal in size, but a typical one is about 60 μ long. Both types of deposits are more fully developed than those of *S. chloronotus*, which they otherwise resemble.

- REFERENCES: *Stichopus badionotus* SELENKA, Zeitsch. Wiss. Zoöl., vol. 17, p. 316, 1867.—H. L. CLARK, Bull. Mus. Comp. Zoöl., vol. 65, p. 55, pl. 5, figs. 11-18, 1922.
- Stichopus haytiensis* SEMPER, Reisen im archipel der Philippinen, Holothurien, Wissenschaft. Result. th. II, Bd. I, p. 75, pl. 30, color plate, fig. 5, 1868.
- Stichopus moebii* SEMPER, *ibid*, p. 246, pl. 40, fig. 11.
- Stichopus errans* LUDWIG, Arb. Zoöl. zoot inst. Wurzburg, vol. 2, p. 97, 1875.
- ?*Stichopus maculatus* GREEF, Zoöl. Anz., vol. 5, p. 158 (13 reprint), 1882.
- ?*Stichopus assimilis* BELL, F. J., Proc. Zoöl. Soc. London, p. 62, 1883.
- Stichopus diaboli* HEILPRIN, Proc. Acad. Nat. Sci. Phila., vol. 40, p. 312, 1888.
- Stichopus xanthomala* HEILPRIN, *ibid*, p. 313, 1888.
- Stichopus acanthomela*, Zoöl. Record, Echinoderms, p. 78, 1900.
Typographical error.

Family: **HOLOTHURIDAE.**

Genus: **HOLOTHURIA** Linné.

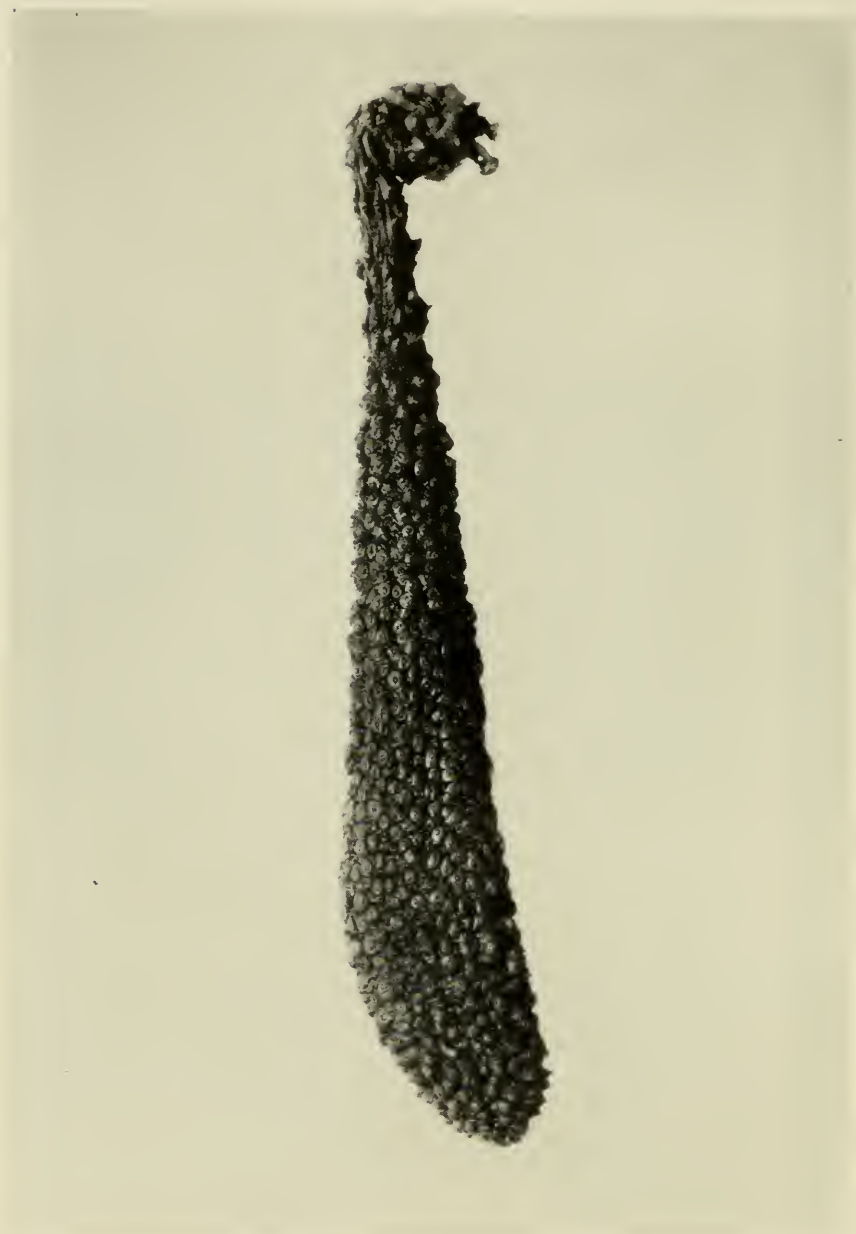
Holothuria arenicola Brandt.

TYPE: I have not had access to the original description of this species, consequently am unable to cite the type locality or depository.

DISTRIBUTION: This widely distributed species ranges from the Red Sea and Indian Ocean to the west coast of tropical America and in the Atlantic on the north and east coasts of South America. The "*Ara*" record appears to be the first from Florida. It has previously been reported from the following principal stations: Surinam, and in Bahia, Brazil; the Hawaiian Islands; the Galapagos Islands; Cocos Island; Zanzibar, the Philippines; Bonin and Marshall Islands; Amboina; Rotti; Sula Besi; Fiji and Samoan Islands; Kosseir, Red Sea and Mauritius.

MATERIAL EXAMINED: One specimen, Dry Tortugas, Fla., March, 1925.

DISCUSSION: The Florida specimen agrees well with the description of this species, which possesses considerable variation. It has unfortunately been formalined and consequently the specimen is in poor condition. I am indebted to Dr. H. L. Clark and Dr. Elizabeth Deichmann for examination of this specimen.



Holothuria impatiens (Forsk.), photograph of a preserved and much shrunken specimen, taken in Gardner Bay, Galapagos Islands, by the "Ara."

REFERENCES: *Sporadipus (Acolpos) maculatus* BRANDT, Prodröm. descrip. Anim., etc., Fasc. I, p. 35, 1835.—LAMPERT, Die See-
walzen, p. 73, 1885.

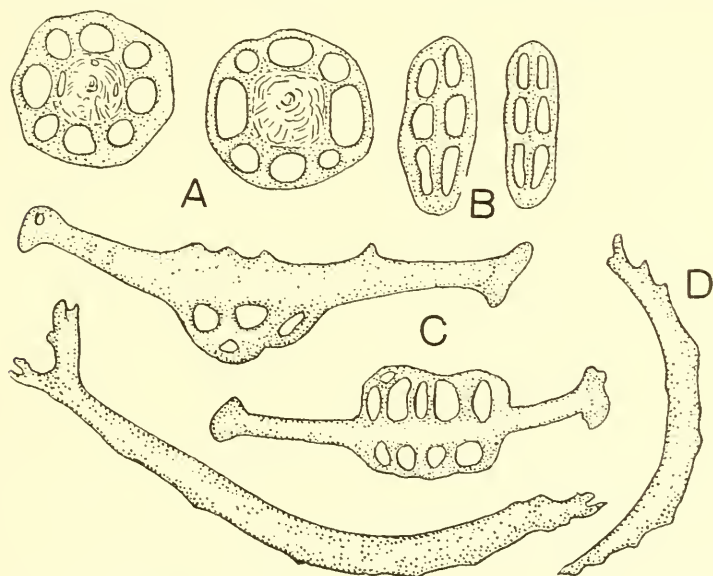
Holothuria arenicola SEMPER, C., Reisen in Archipel. der Philippen, Bd. 1, Holothurien, p. 81, pl. XX, pl. XXX, fig. 13, pl. XXXV, fig. 4m, 1867.—THEEL, Rept. Voy. "Challenger" Zoöl. Holothuri-
odea, XIV, p. 222, 1886.—FISHER, W. K., Proc. U. S. Nat. Mus., vol. XXXII, p. 662, 1907.

***Holothuria impatiens* (Forskäl).**

Plate 99 and text figure 7.

TYPE: Forskal stated that his type came from the shores of the Suez Canal, where it was found under stones and certain sponges. The depository of his type is not given.

DISTRIBUTION: This species is widely spread in the Indo-Pacific. It has been recorded by Fisher from the Hawaiian Islands; by Clark



TEXT FIG. 7.—*Holothuria impatiens* (Forskäl). A. Turriform tables. B. Elongate, perforate tables. C. Perforate, elongate bars. D. Curved bars with roughened tips, $\times 260$ (after Koehler).

from the Paumotu Islands and by the "Siboga" Expedition from 24 different stations in the Far East. It was also reported by H. L. Clark from a single specimen without specific locality taken by the

"Albatross" Lower California Expedition. Of this latter record Dr. H. L. Clark states: that he believes that more specimens with definite locality would probably serve as the basis for a new species.

The "*Ara*" specimens appear to be the first record of the species from Galapagos Islands.

MATERIAL EXAMINED: Two, Gardner Bay, Hood Island, Galapagos, February, 1928.

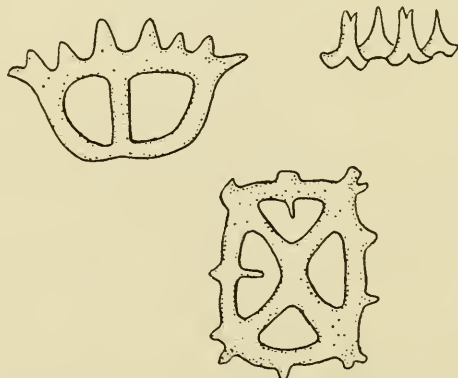
DISCUSSION: Both of the "*Ara*" specimens from Galapagos are unfortunately in poor condition owing to corrosion. They appear to be *H. impatiens*, but are not typical specimens of this species. I am indebted to Dr. H. L. Clark and Dr. Elizabeth Deichmann for examination of these specimens.

REFERENCES: *Fistularia impatiens* FORSKAL, Descript. animalium, p. 121, pl. 39, fig. B, 1775.

Holothuria impatiens GMELIN, Linné Syst. Nat., 13th Ed., p. 3142, 1788.—LAMPERT, Die Seewalzen, p. 65, 1885.—FISHER, W. K., Proc. U. S. Nat. Mus., vol. XXXII, p. 666, pl. LXIX, figs. 4, 4a-d, 1907.—H. L. CLARK, Bull. Amer. Mus. Nat. Hist., vol. XXXII, p. 235, 1913; Mem. Mus. Comp. Zoöl., vol. XXXIX, p. 149, 1920; Papers Dept. Marine Biology, Carnegie Inst., Washington, X, p. 178, color plate 19, figs. 3 and 5, 1921.

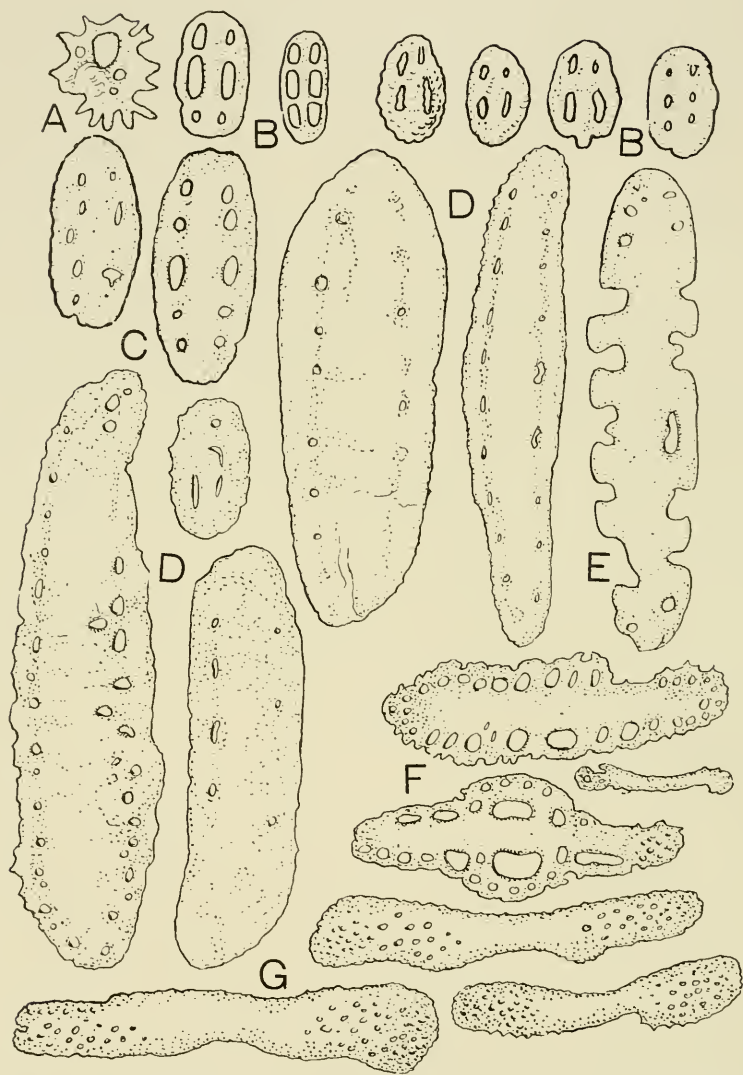
Holothuria kefersteinii (Selenka).

Text figure 8.



TEXT FIG. 8.—*Holothuria kefersteinii* (Selenka), calcareous deposits found in the skin, as figured by Selenka; much enlarged.

TYPE: Collected at Acapulco, Mexico; deposited in the Gottingen Museum, also in the Museum of Comparative Zoölogy.



Holothuria tubulosa Gmelin: A, small turriform tables; B, the predominant type of table; C, elongate ovate tables; D, elongated tables from the ventral surface; E, tables found in the skin of the ventral surface; F, tables in the skin of the dorsal papillae; G, bars found in the tentacles. (After Koehler, R.). A to E $\times$ about 280; F and G $\times$ about 185.

DISTRIBUTION: This species is known from the west coast of Mexico and the Galapagos Islands.

MATERIAL EXAMINED: Ten specimens, collected in tide-pool, Hood Island, Galapagos Islands, February, 1928, by the "Ara" expedition, Cat. no. 286.

DISCUSSION: The spicules in the "Ara" specimen are poor, owing to partial corrosion. I am indebted to Dr. H. L. Clark and Dr. Elizabeth Deichmann of the Museum of Comparative Zoölogy for the examination of one of these specimens. In the retracted condition, this holothurian has a body length of 15 cm. Mr. Belanske, staff artist of the expedition, noted that the animal is a dusky reddish-brownish color when alive.

REFERENCES: *Stichopus kefersteinii* SELENKA, Zeit. f. w. Zoöl. Bd., XVII, p. 318, pl. XVIII, figs. 37-40, 1867.

Holothuria tubulosa Gmelin.

Plate 100.

TYPE: Gmelin's type material came from the Mediterranean and Adriatic Seas.

DISTRIBUTION: This is a typical Mediterranean species, which is also found on the Atlantic coasts of the Hispanic Peninsula and of France, also in the Bay of Biscay. Bathymetric occurrence: shallow water to 19 fms.

MATERIAL EXAMINED: Three specimens, dredged in 19 fms., on grassy bottom, ten miles south of Cagliari, Sardinia, July 23, 1927, by the "Ara," Cat. no. 281, Cat. no. 282.

COLOR: The living animal is on the dorsal side more or less dark maroon, reddish brown, or violaceous brown; with the ventral side correspondingly lighter. The tips of the tentacles are never white.

TECHNICAL DESCRIPTION: The body of this species is quite large, attaining a length of 20 to 30 cm. with a corresponding width of 5 to 6 cm. The skin is very thick, rather tough, with numerous well-developed deposits of several forms. The dorsal region has several conical tubercles of different sizes; these are scattered and each terminates in a small elongated papilla. The ventral surface has several closely crowded, irregularly placed pedicels. The first kind of calcareous deposits are small, perforate, turritiform tables whose basal part has a rough, spiny surface, and whose spire ends in several points (fig. A). The most numerous type of deposit is that shown in figure

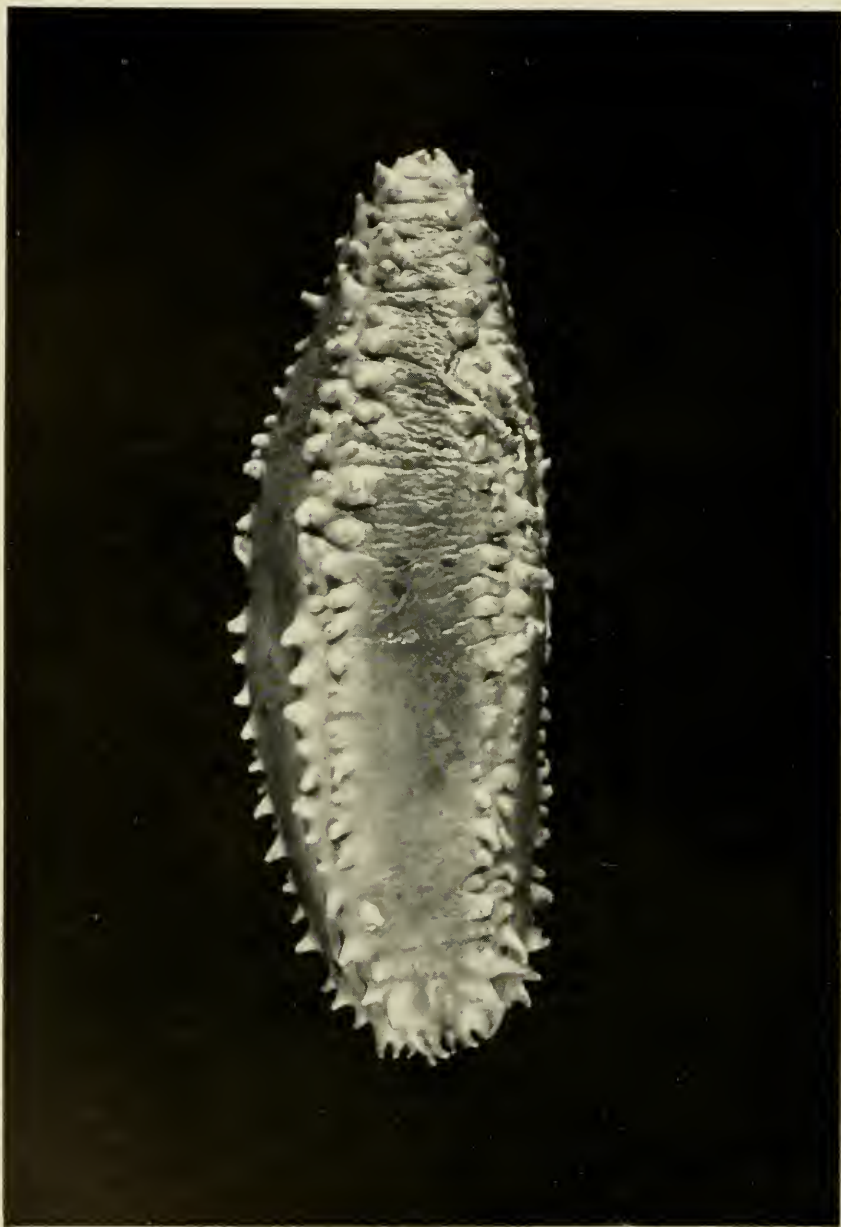
B, which has the outer surface always roughened with little, conical, close-set points. The most abundant of these deposits have an oval form, with three pairs of holes in symmetrical series. Some of these deposits are more elongate-oval, as in figure C, and have four to six pairs of holes in successive series. These may have considerable variation or irregularity in their shape and the holes may be quite small, or even lacking, especially in the deposits of the ventral surface. The deposits of the ventral side are the most elongated and the number of holes in each may be as many as twelve to sixteen, as in figure D. The deposits of the dorsal papillae are turritiform tables and elongated bars, the latter often dilated in the median region as in figure F. There are also more elongated ones, with seven or eight pairs of holes, on the dorsal papillae, but these deposits are never as large as those on the ventral surface (fig. E). Besides these typical forms there are many intermediate forms between the tables and bars. The ventral pedicels have tables with spires, and elongated perforated buttons, also bars. The tentacles have straight or slightly arched bars of a hyalin tissue with the margins furnished with short, little spikes. There are also much larger bars whose surface is so covered with short, closed spines or spikes, that the bars are not transparent. These are elongated, as in figure G, with no perforations in the middle region, but with the ends perforated by several little pore-like holes. There are no Cuvierian organs present in this species.

REFERENCES: *Holothuria tubulosa* GMELIN, Syst. Nat. Ed. 13, p. 3138, 1788 (with early synonymy).—SELENKA, EMIL, Zeitschr. f. wiss. Zoöl., Bd. XVII, p. 323, pl. 18, figs. 42, 43, 1867.—SEMPER, Reisen in den Philippinen, Bd. I, Holothurien, p. 279, 1867-68 (with extensive synonymy).—HELLER, C., K. k. Zoölog. botan. Ges. Wien, Bd. XVIII, p. 72, 1868.—VON MARENZELLER, Verhandl. K. k. Zoölog. botan. Ges. Wien, Bd. XXIV, p. 314, 1874.—THEEL, Rept. Voy. "*Challenger*," Zoöl., vol. XIV, p. 229, 1886.—KOEHLER, R., Faune de France, p. 174, fig. 130, 1921; Echin. des Mers d'Europe, vol. II, p. 215, 1924.—MORTENSEN, TH., Handbk. Echinod. British Isles, p. 393, 1927.

Mentula marina JANUS PLANCUS, De Conchis minus notis Romae, p. 108, app. tab. VIII, figs. A, B, 1760.

Die Zitterblase, Bohadsch, Beschrb. cinig. minderbek. Seeth. Dresden, p. 67, taf. VI, VII, figs. 1-5, 1776.

Fistularia tubulosa LAMOUROUX, Encyclop. method. Paris, p. 400, pl. 86, fig. 12, 1824. (Copy from Bohadsch.).



Cucumaria planci von Marenzeller, photo from preserved specimen, $\times 2$.

Order: **DENDROCHIROTA.**

Family: **CUCUMARIIDAE.**

Subfamily: **Cucumiinae.**

Genus: **CUCUMARIA** Blainville.

Cucumaria planci von Marenzeller.

Plate 101 and text figure 9.

TYPE: Von Marenzeller's type came from the Mediterranean. The type depository is not stated.

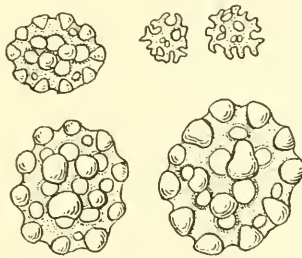
DISTRIBUTION: Bathymetrical occurrence 15 to 175 meters; usually found on muddy bottom. This species is found abundantly in the Mediterranean Sea and on the Atlantic coast of Portugal; in the British Isles as far north as the Clyde; on the west African coast at Senegal.

MATERIAL EXAMINED: One specimen, dredged in 35 fms., five miles N. E. by N. of Cape Carthage, Gulf of Tunis, Mediterranean Sea, July 21, 1927. One specimen, dredged in 19 fms., grassy bottom, ten miles S. of Cagliari, Sardinia, July 23, 1927, Cat. no. 235.

COLOR: Brownish, irregularly spotted with darker brown.

LIFE HISTORY: Dr. Mortensen states that the development is direct, without a pelagic larval stage.

DISCUSSION: The single specimen taken by the "Ara" agrees in all essentials with Dr. Koehler's excellent description and figure of the species. In its retracted state the holothurian before me measures 6.5 cm. long; Dr. Koehler records specimens 15 cm. long with a thick-



TEXT FIG. 9.—*Cucumaria planci* von Marenzeller, button-like deposits from the skin, greatly enlarged. (After Mortensen.)

ness of 3 to 3.5 cm. The body is somewhat cylindrical, prismatic with five sides; the retractile tube-feet are in distinct double series in the five ambulacra. The encasing skin is smooth, thick and leathery. The

deposits are very numerous, button-like, covered with roundish, large nodules. As a rule they are similar to those of *C. lactea*, but are distinctly larger and with more holes. The small, irregular cups in the outermost layer of the skin are identical in *C. planci* and *C. lactea*. Excellent figures of the various types of microscopic deposits of *C. planci* are to be found in Koehler's "Faune de France, Echinodermes," p. 153, fig. 104, 1924.

REFERENCES: *Cucumis marinus* RONDELET, Univ. Aquat. Hist. pars altera Lugduni, cap. 27, 1555.

Echinus coriaceus ad os fimbriatus JANUS PLANCUS, De conchis minus notis, Roma, 1760, p. 99, tab. VI, figs. D, E.; De Incessu marinorum Echinor. etc., De Bononiensi scient. et art. instit atque acad. commentarii, Bononiae, 1766, tom. V, part I, opuscula pg. 242, tab. II, figs. 1, 2.

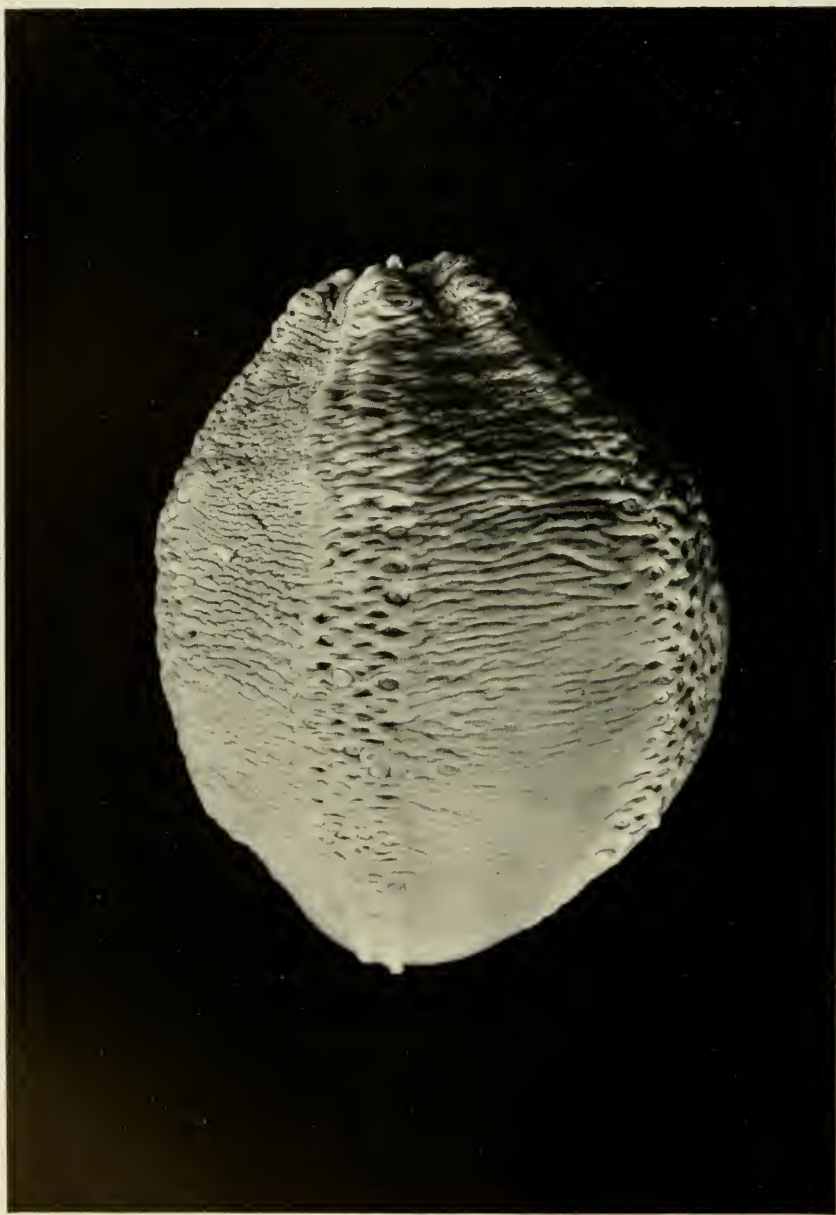
Holothuria pentacta L. GMELIN, Syst. Nat. ed. XIII, p. 74, part, 1788.

Holothuria doliolum LAMARCK, Hist. nat. d'anim. sans Vert., tome III, p. 74, 1816.—BLAINVILLE, Diet. Sci. Nat., Paris, t. 21, p. 317, 1821; Man. d'Actin. Paris, p. 193, 1834.—LAMOUROUX, Encyclop. tom. II, pl. 86, figs. 6, 7, 1824.—DELLE CHIAJE, Mem. sulla storia e notom. degli anim. s. vert. Napoli, vol. III, pp. 67, 71, 80, tab. 35, figs. 8, 9, 1828.—LAMARCK, *op. cit.*, II E. (DESHAYES and MILNE EDWARDS), Paris, p. 443, 1840.

Cladodactyla planci BRANDT, Prodrum descript. Petropoli, p. 45, 1835.

Cladodactyla doliolum GRUBE, M. Sars, Bidrag til Kundsk. om Middelhav. Littoral-Fauna Christiania Nyt. Magaz. f. Naturv. Bd. IX, Christiania, 1857, p. 120, pl. 1, figs. 18–23.—HELLER, K. k. zoöl. bot. Ges. Wien, p. 74, 1868.—SELENKA, Beit. z. Anat. u. Syst. de. Holoth. Zeitsch. f. wissensch. Zoöl., Bd. 17, Leipzig, p. 348, taf. XX, p. 108, 1867.

Cucumaria planci VON MARENZELLER, Verh. zoöl.-bot. Ges. Wien, Bd. XXIV, p. 30, 1874.—LUDWIG, Mitth. zoöl. stat. Neap. Bd. I, p. 565, 1879.—CARUS, Faun. Mediterranean, p. 107, 1885.—LAMPERT, Die Seewalzen, p. 140, 1885.—THEEL, Rept. Voy. "Challenger," Zoöl., Holothuria, vol. XIV, p. 101, 1886.—CHADWICK, Proc. Liverpool Biol. Soc., vol. III, p. 180, 1889; *idem*, *op. cit.*, vol. V, p. 81, 1891 (discusses spontaneous fission).—BELL, F. J., Cat. Brit.



Cucumaria frondosa (Gunnerus), one-half of natural size. Photo from a preserved specimen, which unfortunately gives no idea of the beauty of the living animal.

Echinod., p. 37, pl. II, fig. 2, pl. VIII, fig. 1, 1892.—KOEHLER, Faune de France, Echnid., p. 153, fig. 103, and fig. 104, 1924.—MORTENSEN, Echnid. British Isles, p. 403, fig. 241, -1, 1927.

***Cucumaria frondosa* (Gunnerus).**

Plate 102 and text figure 10.

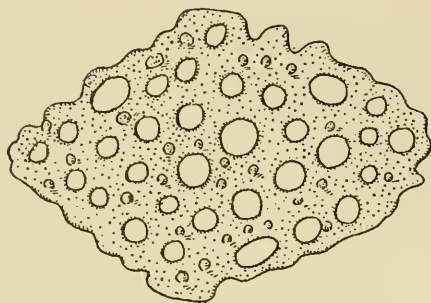
TYPE: The type was taken on the sea-bottom near Roodeons, Praftgard in Nordland, also near Trondjem, Norway, where it was found quite still on the sea-bottom. Depository not stated.

DISTRIBUTION: Subarctic, found in Greenland, Iceland, Spitzbergen to Norway and southward to the coasts of the British Isles; found on the east American coast from Labrador to Nantucket. Bathymetric occurrence: shallow water to 200 meters.

MATERIAL EXAMINED: Two specimens, dredged in the Bay of Islands, Newfoundland, September 10, 1923, by the "*Ara*."

HABITS: This large cucumber is found in great numbers along the lower tidal limits of the Laminarians, where a true idea of its beauty is best observed. The breeding season is summer in the Arctic, February to March in more southern waters. The larvae are red, barrel-shaped, and frequently occur in masses so abundantly as to make the water appear red. They are eaten by certain fishes. The adult cucumbers are reddish or purplish brown, much darker tinted on the dorsal side and lighter on the ventral, sometimes nearly white; the pedicels are frequently rose-tinted.

TECHNICAL DESCRIPTION: This is the largest sea-cucumber of the northeast American coast, in life ranging, when fully extended, from 250 mm. to 600 mm. or more, with a body diameter of 80 to 100 mm., which is, of course, much less when the animal is fully extended. In life the ventral surface is decidedly flattened, the sides curving upward, the dorsal surface moderately flattened, the anterior end truncated, the posterior bluntly rounded. The accompanying photograph was made from a much contracted, dead, museum specimen, and, unfortunately, gives no adequate conception of the living sea-cucumber. There are ten tentacles, more rarely nine or eleven, of approximately equal size, short, stout and much branched. The pedicels are quite large, forming a broad series on each ambulacrum, with smaller, less perfect ones scattered over the dorsal interam-



TEXT FIG. 10.—Table from the skin of *Cucumaria frondosa* (Gunnerus) $\times 200$.
(After Mortensen.)

bulacra. None of the pedicels has the usual terminal, perforated, calcareous plate. The calcareous deposits of the skin are in the form of irregular, usually smooth, perforated plates which vary greatly in size, number and distribution, being less abundant in the larger, older specimens. The largest plates occur near the cloacal opening, but in this species they do not form the "anal teeth." The plates found at the base of the pedicels and tentacles are more irregular and often bear slight projections, or more or less well-defined ridges. The calcareous ring is quite slender and imperfectly developed, with the radial pieces a bit wider than the interradiial pieces, with a very wide, deep notch in the posterior margin; the interradiial pieces are without this notch. The stone canal is simple, of moderate size, and has from one to six madreporic plates. The polian vessel is normally single, very long.

REFERENCES: *Holothuria frondosa* GUNNERUS, Vet. Akad. Handlg., vol. XXVIII, p. 115, pl. 4, figs. 1, 2, 1767.

Cladodactyla pentactes GOULD, Invert. of Mass., p. 345, 1841.

Cucumaria frondosa FORBES, Hist. of British Starfishes and other Echinod., p. 209, fig. on p. 209, and full synonymy, 1841.—BELL, F. J., Cat. Brit. Echinod. in Brit. Mus., p. 39, 1892 (with early synonymy).—DODERLEIN, L., Wissenschaftliche Meeresuntersuchungen, Biol. auf. Helgoland, N. F., Abth., p. 229, 1900.—H. L. CLARK, Rept. U. S. Fish Comm., vol. XXII, p. 566, pl. 11, figs. 65, 66, pl. 12, figs. 76-80, 1904; Bull. U. S. Bur. Fish., vol. XXXI, pt. 2, p. 613, 1911.—MORTENSEN, Danmarks Fauna, Echinod.,

p. 321, figs. 111-2, 1924; Echinod. of British Isles, p. 398, fig. 236, 1927.

Botryodactyla grandis AYRES, Proc. Boston Soc. Nat. Hist., vol. IV, p. 52, 1851.

Pentactes frondosa STIMPSON, Invert. Grand Manan, p. 16, 1853.

Family: **PSOLIDAE**.

Genus: **PSOLUS** Oken.

Psolus phantapus (Strussenfelt).

Text figure 11.

TYPE: The type was taken in the Sound between Landskrona and Hwen, Sweden, in 18 to 20 fms.; the depository is not given but it is probably the Stockholm Museum.

DISTRIBUTION: In European waters this holothurian is known from the White Sea and Spitzbergen southward to, and including the British Isles; it also occurs on the coasts of Greenland and the North American Arctic coast at Walker Bay, Prince of Wales Strait, Victoria Island, down to Nova Scotia and the coast of Maine. Bathymetrical occurrence: littoral to 380 meters.

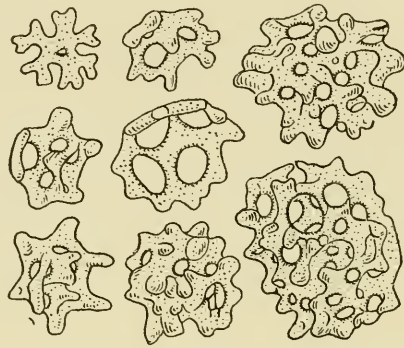
MATERIAL EXAMINED: One specimen, dredged in 40 fms., middle of St. Georges' Bay, Newfoundland, September 2, 1926, by the "*Ara*."

COLOR: In life this species is usually yellowish brown with the orange tentacles; the very large specimens are frequently nearly black. The larva is red, barrel-shaped.

HABITS: Young specimens of this species live attached by their ventral sole, which forms a strong sucker or disk, to stones, shells, or other hard objects. The older specimens live free in the sea-bottom, usually with only the anterior and posterior ends protruded above the surface. The breeding season is March in its more southern distribution, to midsummer in the more northern waters of its range.

TECHNICAL DESCRIPTION: This species is said to attain a length of six to eight inches, but those recorded from American waters rarely measure more than two to three inches. The body is high, vaulted, with the anterior and posterior ends prominent, the posterior end more so, being prolonged into a conical tail-like process. The mouth and anus are terminal and subterminal. The ventral sole is sharply defined, rather small, rectangular, narrower than the body. The body

wall is thick, the scales rather small, immersed in the skin, granulated. The grains on the scales are globular, about 0.3 mm. diameter. The deposits of the ventral sole are of two kinds: small cups and larger spherical, oval bodies of a perforated, somewhat complicated structure. The tube-feet are arranged in three irregular rows, those in the mid-radius in a complete series in the whole length of the sole. The two dorsal retractor muscles are attached to the body-wall in the inter-radii, a character which establishes a very constant distinction between



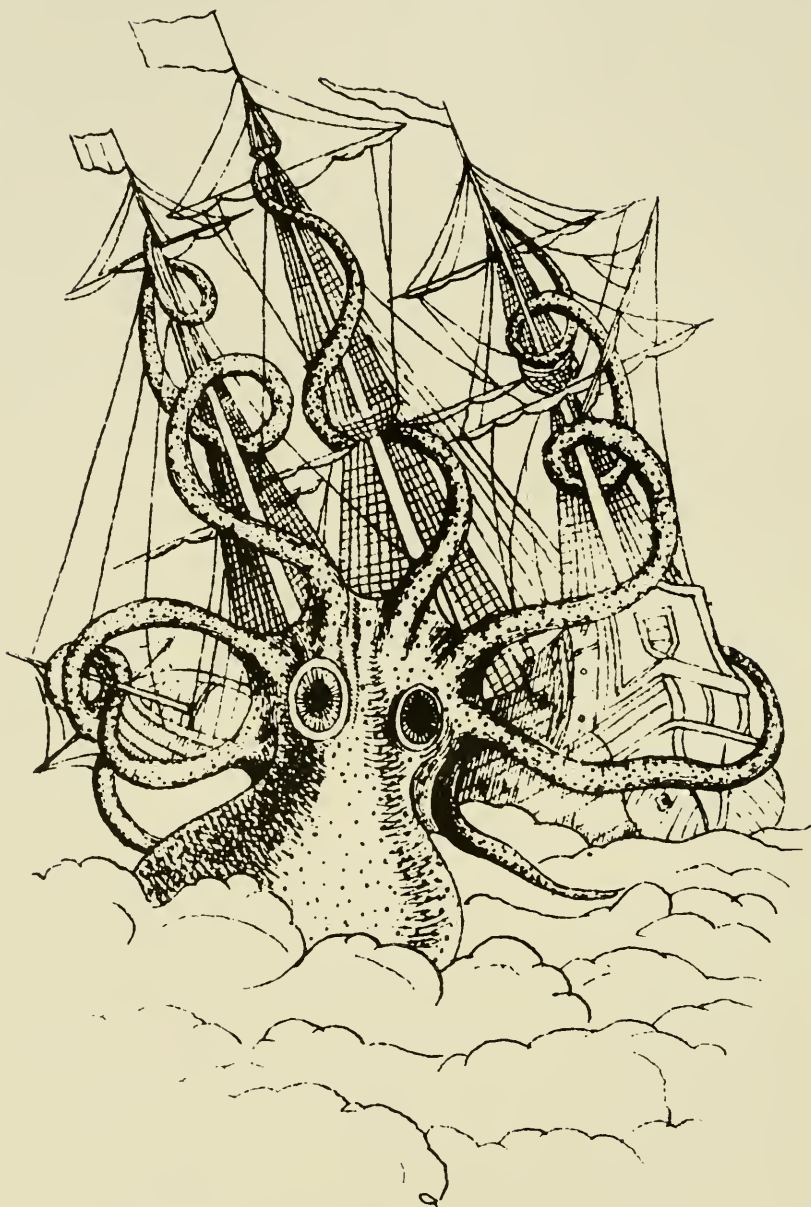
TEXT FIG. 11.—*Psolus phantapus* (Strussenfelt), typical calcareous bodies from the skin, greatly magnified. (After Mortensen.)

this species and *P. squamatus* in the younger stages where they closely resemble one another.

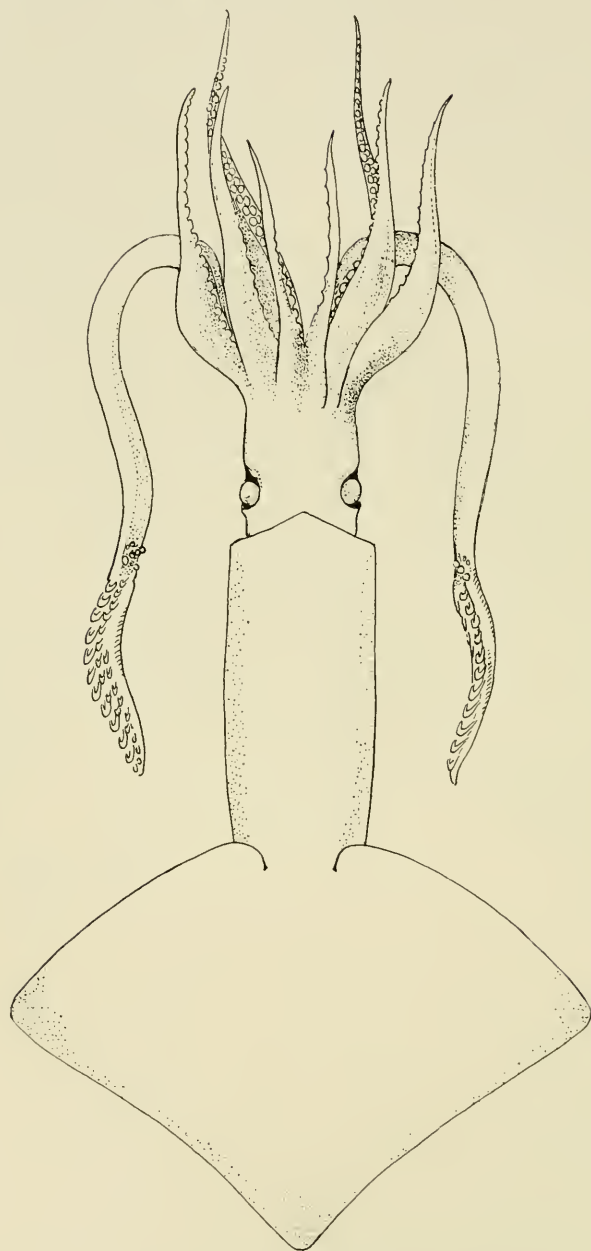
REFERENCES: *Holothuria phantapus* STRUSSENFELDT, Vet. Akad. Handlg., vol. XXVI, pl. 10, p. 263, 1765.

Psolus phantapus JAGER, de Hol., p. 21, 1833.—FORBES, British Starfishes, p. 203, 1841.—STIMPSON, Proc. Boston Soc. Nat. Hist., IV, p. 67, 1851.—VERRILL, A. E., Proc. Boston Soc. Nat. Hist., vol. X, p. 353, 1866, Bull. Essex Inst., vol. III, p. 5, 1871.—GANONG, W. F., Bull. Nat. Hist. Soc. New Brunswick, no. VI, p. 56, 1887.—BELL, F. J., Cat. Brit. Echinod. Brit. Mus., p. 44, 1892 (with extensive synonymy).—A. H. CLARK, Rept. Canadian Arctic Exped., 1913-18, vol. VIII, part C, Echinoderms, p. 11c, 1920.—MORTENSEN, Danmarks Fauna, Echinod., p. a40, figs. 119, 120, 1924; Handbook Echinod. British Isles, p. 415, fig. 251, 1927.

Psolus laevigatus AYRES, W. O., Proc. Boston Soc. Nat. Hist., vol. IV, p. 6, 1851.



Reproduction of a fifteenth century painting in the chapel of St. Thomas, at Malos, France, said to have been placed there by the captain of a sailing vessel, in commemoration of his ship's escape from an attack by a gigantic octopus. (From Denys Montfort, *Histoire Naturelle des Mollusques*, tome II, Paris.)



Onychoteuthis banksii (Leach), about one-half of natural size.

MOLLUSCA: SYSTEMATIC DISCUSSION
CEPHALOPODA.

ORDER: DIBRANCHIATA.

Suborder: Decapoda.

Family: **ONYCHOTEUTHIDAE**.

Subfamily: **Onychoteuthinae**.

Genus: **ONYCHOTEUTHIS** Lichenstein.

Onychoteuthis banksii (Leach).

Plate 104.

TYPE: Leach's type was deposited in the British Museum. The type locality was not cited in the original description, which is in a synopsis of Cephalopoda. In 1818 this species is described a little more fully and referred to as a new species from the Gulf of Guinea.

DISTRIBUTION: Practically cosmopolitan. This sea-arrow has been taken in all the oceans at numerous stations. It seems equally at home in Arctic or tropic seas. It is known from the Arctic to the Cape of Good Hope and Indian Ocean and also throughout the Atlantic and Pacific Oceans.

MATERIAL EXAMINED: Two very young specimens from Bimini, British West Indies, January 19, 1923. One young specimen, taken seventeen miles S. W. of Pinta Island, Galapagos, January 31, 1928. One specimen about six inches long, washed up on the upper deck of the "Ara" between Madeira and Casa Blanca, Morocco, August 4, 1924. One, slightly larger, that "flew" twenty feet above sea level, coming over the bow of the "Ara" and landing on the bridge, during a cruise between Madeira and Casa Blanca, Morocco, August 19, 1924.

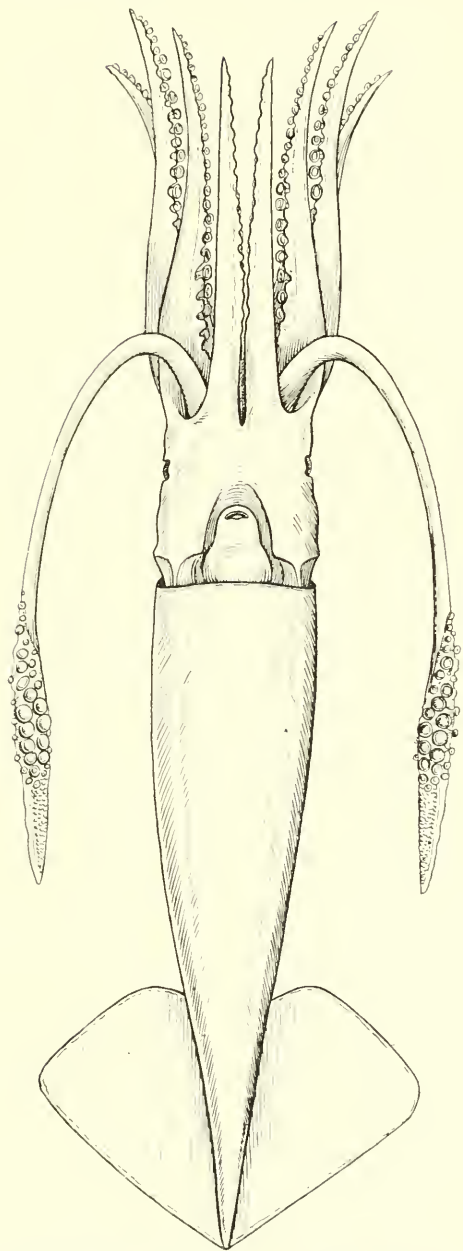
COLOR: See Tryon's color plate, which shows this squid to be wine red with darker chromatophores and bluish circles about the eyes. Leach described the living specimens as "pale flesh color, the body yellowish posteriorly sprinkled irregularly with blackish spots tinted with purple."

TECHNICAL DESCRIPTION: Consult Pfeffer, 1912, for a very thorough anatomic description. The average body length is six inches. The present specimen is 105 mm. long, subcylindrical anteriorly, decidedly tapered posteriorly, cone-like; anterior mantle margin produced to a median dorsal angle; ventral margin shallowly excavate beneath the siphon. Fins rhomboidal, not quite half the body length; width across from tip to tip equal to three-fourths of body length, or about one and one-half times the length of the fins; there is a slight angle at the anterior insertion of the fins; their lateral and posterior angles

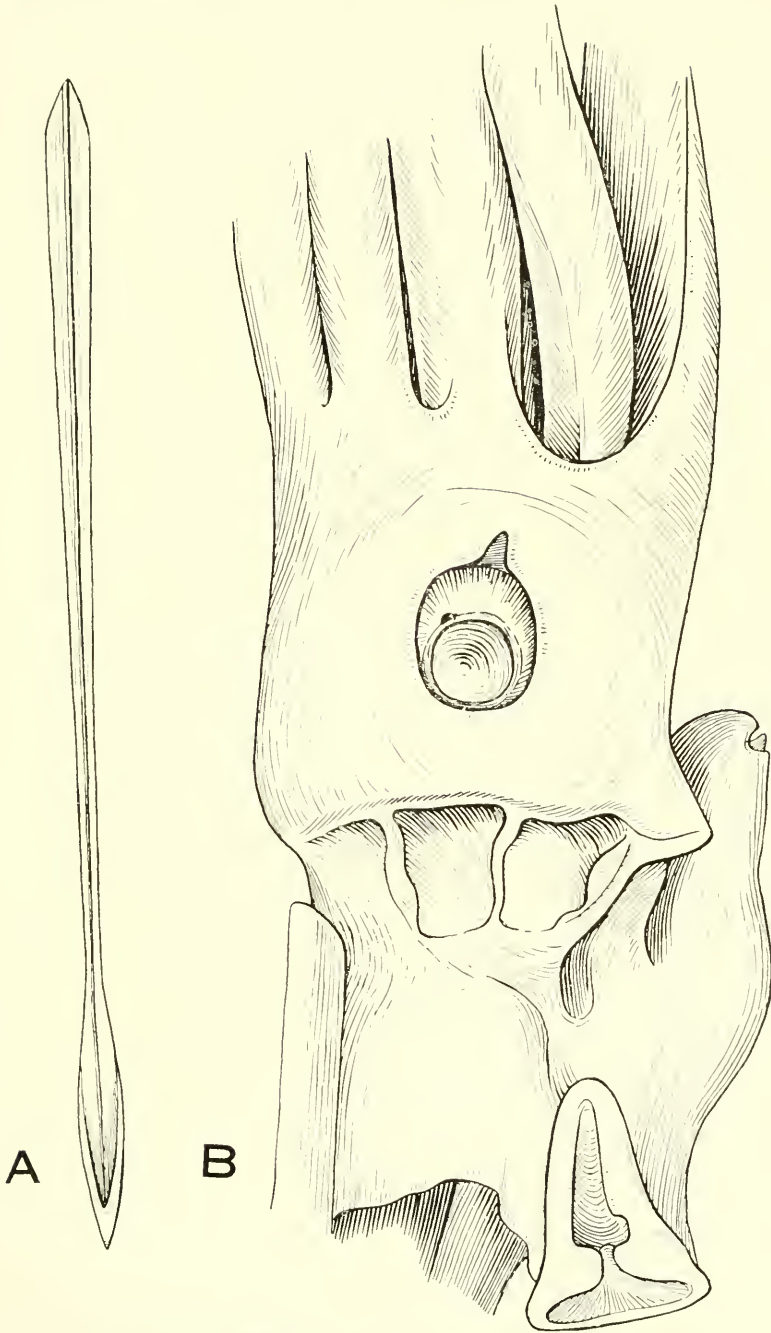
are almost right angled. The siphon is large. The head is slightly longer than wide, decidedly narrowed into a neck posteriorly, bearing dorsolaterally eight slender, longitudinal cartilages of unequal sizes; the more dorsal ones are very small, increasing in size from one to seven, the eighth being equally as large, but only half as long as the seventh. The mantle margin around the eye is produced at the lower anterior angle into a forward projecting curved point. The eye is large; the ventral surface of the head flattish anteriorly and is much excavated posteriorly beneath the siphon. There are two ventral longitudinal neck cartilages on each side, one on the margin and a much thicker one adjacent one on the outer side. The sessile arms decrease in length in the order 4, 3, 2, 1; there being but little differences in the lengths of 4, 3, and 2, while 1 are only a little more than half as long as 2. The second pair has a slight web on its outer margin; the third pair has this web accentuated; on the fourth pair the web is on the upper lateral margin. The suckers are in two longitudinal rows, and are of moderate size, rounded, set obliquely, with an odd rounded, ear-like process set on the anterior margin of each sucker. The horny ring is smooth. Transverse muscle prominences occur on the ventral face of the arm between each sucker and the next one. The tentacular arms are very extensile, as long as, or a little longer than the body, with a distinct keel along the outer lateral margin, which along the club becomes wider, forming a web. The club is about one-fourth of the total arm length, armed basally with a pad of ten or twelve small suckers and a double row of curved hooks, the outer or ventral row of which are the larger hooks, of which there are eleven; the smaller row has twelve hooks. About midway the club, four or five of the hooks are greatly enlarged, these each have basally a rounded or sucker-like opening. The hooks diminish in size toward the tip of the club. The very tip of the arm has eleven or twelve small, round, short-set suckers, the horny rings of each being smooth. These suckers form a pad-like cluster. The hooks are gloved in a thick skin. The pen is dark brownish, lanceolate-pinnate with a short shaft, anteriorly pointed; the wings are thin with rounded outer margin.

REFERENCES: *Loligo banksii* LEACH, Zööl. Misc. The Class Cephalopoda, vol. III, p. 141, 1817, London; Tuckey's River Zaire, Appendix IV, p. 411, 1818, London.

Onychoteuthis banksii FERRUSAC and D'ORBIGNY, Cephal. Acetab., p. 330, 1839.—PFEFFER, Die Cephal. der Plankton Exped., p. 70,



Illex illecebrosus illecebrosus (Lesueur), about two-fifths of natural size.



Iller illecebrosus illecebrosus (Lesueur): A, pen from the ventral side, $\times 1$;
B, profile of head and neck, showing nuchal cartilages, $\times 1$.

taf. 3, figs. 13-25, taf. 4, figs. 5, 6, 1912 (with anatomic description and full synonymy).—Joubin, *Res. Campag. Sci. Monaco*, fasc. LXVII, p. 107, 1924.

Family: **OMMATOSTREPHIDAE**.

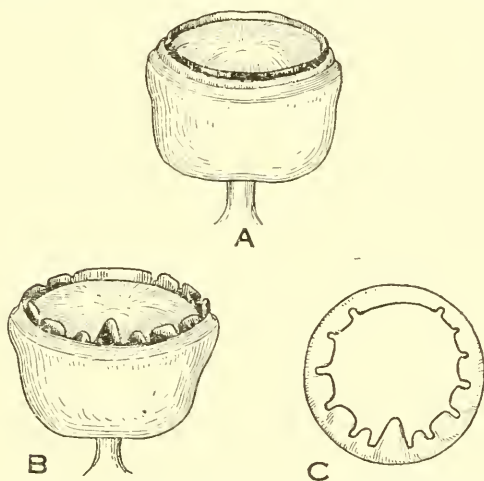
Subfamily: **Illicinae**.

Genus: **ILLEX** Steenstrup.

Illex illecebrosus illecebrosus (Lesueur).

Plates 105, 106 and text figure 12.

TYPES: Lesueur's original description was based on a drawing of a specimen, which he examined at Sandy Bay, Newfoundland, in 1816 and which drawing is deposited in the collections of the Philadelphia



TEXT FIG. 12.—*Illex illecebrosus illecebrosus* (Lesueur). A. Sucker from tentacular arm. B. Sucker from sessile arm. C. Dentition of sucker from sessile arm. All $\times 16$.

Academy of Natural Sciences. Verrill (in 1872) stated that Lesueur's description equals *O. sagittatus* Binney but not the figure (pl. 25, fig. 340), which is a *Loligo* (? *L. pealeii*, female). Verrill described the species without designating the depository of his material, which was collected on the New England coast.

DISTRIBUTION: Found on the East American coast from the Arctic Ocean southward to Cape Cod, Mass., but most abundantly from Newfoundland to Cape Cod. This is a rapid-swimming, near-the-surface species, ranging from near the coast to deep water. It is one of the swiftest swimmers of the sea, consequently it is rarely caught in dredging.

This species is most intimately related with *I. illecebrosus coindetii* (Verany) 1837, which is known from European waters, according to Pfeffer.

MATERIAL EXAMINED: One specimen dredged in 200 fms., 9 miles S. W. by W. of Port Basque, Newfoundland, September 1, 1926. One specimen, tag 263, taken at Halifax, Nova Scotia, August 3, 1923, by the "*Ara*."

DIAGNOSTIC CHARACTERS: For full diagnosis of the anatomy with numerous illustrations and notes on the habits and color of this species consult A. E. Verrill: North American Cephalopods, p. 268, pls. 28, 29, figs. 5, 5a, p. 37, fig. 8, and pl. 39; Trans. Conn. Acad. Arts and Sci. V., 1880. This masterly diagnosis resulted from the study of an unusually large series of living as well as laboratory specimens of various stages of growth development.

The larger "*Ara*" specimen is well grown, with the body dorsal line measuring 245 mm.; the dorsal arms 130 mm. long from tip to the umbrella margin; the head from umbrella margin to posterior margin measures 45 mm. in the dorsal line, giving the shrunken specimen a total length of 410 mm. in the dorsal line; the tentacular arm is 235 mm. long. The caudal fin is transversely rhomboidal; 110 mm. long from the insertion of fin to tip of tail; the greatest width 150 mm.

The body is long and slender in young specimens, stouter in older adults and especially so in gravid females. The caudal fin is transversely rhomboidal or very broadly spearhead-shaped, about one-third wider than long, its breadth not quite half the length of the mantle. The exposed portion of the head is large, well rounded, wider than long, its width about equal to that of the adjacent body; its sides in the region of the eyes somewhat swollen; the ventral surface is flattened, with a deep semi-elliptical depression into which the dorsal half of the siphon-tube fits closely.

Behind the eyes the sides of the head have a conspicuous transverse ridge, which curve back a little, becoming less conspicuous and meeting on the dorsal side of the head. Behind these ridges the head abruptly narrows to the neck. There are three thin, erect, lamelliform folds of the skin, extending backward from the transverse ridge, on each side of the head; the median fold is about in line with the lower eyelid; the upper fold at its upper end is about midway between the upper fold and the median dorsal line but inwardly curving downward to the base of the median fold. The lower fold is a little shorter than the others and curves upward posteriorly to the median one. A small pore is situated within the lower facet.

The eye is large, highly developed, the pupils large, although the opening between the lids is usually rather small. The aperture is usually slit-like, the anterior sinus is narrowed and extended downward and forward. Both eyelids are well developed. The living eye is a deep blue-black like a jewel.

The mantle is thick, very muscular, with its anterior margin concave beneath, forming almost an angle on each side, above which it advances to the median dorsal lobe, which is very slight. The caudal fin is transversely rhomboidal, wider than long, tapered to an angle posteriorly; usually its breadth is less than half the length of the body.

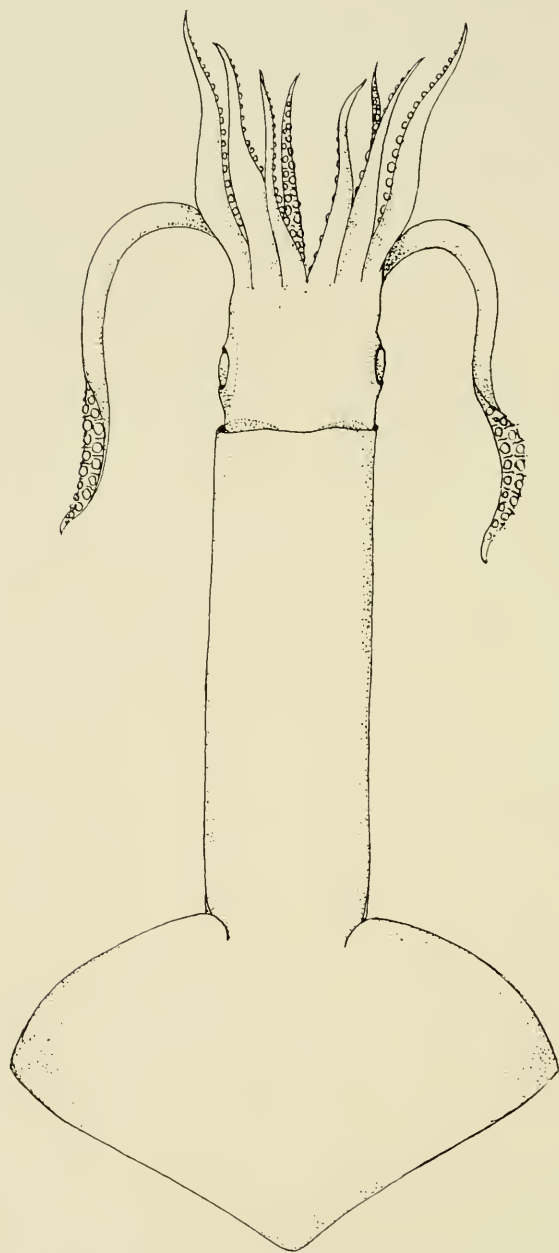
The sessile arms are all four pairs short, their length decreasing in the order 2, 3, 4, 1, counting from the dorsal pair, which are the shortest; the second to third pairs are nearly equal; the fourth pair is normally intermediate between the first and second pairs. All have the suckers similar, and all are provided along their inner angles outside the suckers, with similar marginal membranes, which are of about the same height as the suckers. Just proximal to each sucker on the inner face of the arm arises a thickened, transverse, muscular fold that reaches to the edge of the lateral membrane; the margin of the latter between these folds is frequently concave, having a scalloped appearance. The suckers are in two alternating rows, becoming smaller and more crowded on the distal two-fifths; the teeth of a large sucker are figured.

In living specimens the tentacular arms are quite long; when extended they reach back to the caudal fin. Proximally the arm is rounded trapezoidal, tapered distally. Along the upper outer edge a thin fold runs from the base to tip, forming a wider carina on the back of the club; two less-distinct folds run along the inner angles, defining a narrow inner face throughout its entire length. This face bears no suckers except near where it begins to expand into the club; along the margins of the club the membrane widens, reaching a level with the suckers. In the middle region of the club there are two rows of large suckers and alternating with these on each margin is a row of very small ones. The upper of the two rows of large suckers usually has one to two more suckers, and the suckers are larger than those of the lower row. In the present specimen there are seven in the upper, six in the lower line. The suckers in midway each series are the largest and have the edge of the marginal ring more nearly smooth; at each end of each row the suckers decrease in size, and in these the marginal ring becomes denticulate, with rather broad, blunt denticles on the

first few suckers, but toward the outer end the suckers become very small and the denticles quite sharp. The big suckers are a little oblique, wide and deep, swollen underneath. The marginal suckers are very much smaller, shallower, more oblique, with the entire rim finely denticulate, the denticles on the outer margin of each ring being longer and strongly incurved. Toward the tip immediately beyond the rows of larger suckers there are a little group of sharply denticulated suckers arranged in four rows and resembling the small marginal suckers. These four rows decrease in size rapidly and are supplanted by eight rows of very small suckers with tiny apertures, all crowded closely together and covering the entire surface of the terminal section to the tip.

The suckers of the sessile arms are large and approximately equal on the second and third pairs of arms, on which they are nearly equal to those of the tentacular arms; the suckers of the dorsal arms are intermediate in size between those of the lateral and ventral arms; the suckers of the ventral arms being the smallest. Proximally on each arm there are four or five smaller suckers, beyond which the suckers increase rapidly in size, these suckers having the rim margin nearly entire, with only a few blunt teeth on the outer side. Beyond these are about a dozen of the largest size suckers, which are deep, oblique, cup-shaped, somewhat swollen in the middle, with oblique horny rings, entire on the inner margin but on the outer half with a strongly incurved, acute median tooth; on either side of which there are four or five short blunt teeth; on the suckers near the base of the arm these teeth are fewer and shorter, but distally they are more numerous, sharper and the entire ring is frequently denticulate. Beyond the large suckers on the outer fourth of the arm there is a regularly decreasing series of 30 to 40 smaller ones, extending quite to the tip. These smaller suckers graduate in size and shape to the large ones, but have the inner margin usually entire and the outer set with four to five sharp incurved teeth. The small suckers are very oblique and one-sided. The membrane around the margin of the suckers is thickened, but especially so on the basal ones. Both "*Ara*" specimens are females; for description of the hectocotylized arm of the male consult Verrill (1872).

The external buccal membrane is small, much wrinkled on its inner surface, with its border prolonged into seven acute angles, from which membranes extend to the opposite arms. The jaws are very sharp, reddish brown or reddish black, with the posterior borders of the



Dosidicus gigas (D'Orbigny), three-fifths of natural size.

laminae whitish and translucent. The tips of both upper and lower mandibles are decidedly incurved.

The pen is long, slender, with a slender midrib and strong marginal ribs (see plate 106, fig. A).

REFERENCES: *Loligo illecebrosa* LESUEUR, Journ. Acad. Nat. Sci. Phila., vol. II, pt. 1, p. 95, pl. 10, 1821.—BLAINVILLE, Dict. des Sci. Nat., vol. 27, p. 142, 1823.—GOULD, Rept. Invert. Mass., 1st ed., p. 318, 1841.

Loligo piscatorum LA PYLAIE, Ann. des. Sci. Nat., ser. I, vol. IV, p. 319, pl. 16, 1825.

Ommastrephes sagittatus (part) D'ORBIGNY, Cephalopod. Acetab., p. 345, pl. 7, figs. 1-3, 1835-38.—GRAY (part), Cat. Mollusks Brit. Mus., pt. I, Cephalopod. An., p. 58, 1847.—BINNEY, in Gould, Rept. Invert. Mass., 2nd ed., p. 510, 1870; pl. 26, figs. 341-344, not pl. 25d, fig. 339.—TRYON, Man. Conch., I, p. 177, pl. 78, figs. 341, 342 (after Lesueur); pl. 79, fig. 343, 1879 (not pl. 78, figs. 341, 345).

Ommastrephes illecebrosa VERRILL, Amer. Journ. Sci., vol. III, p. 281, 1872; Rept. Invert. Vineyard Sound, p. 441, p. 634, 1873; Amer. Journ. Sci., vol. 19, p. 289, 1880; Trans. Conn. Acad. Arts and Sci., vol. V, p. 268, pls. 28, 29, figs. 5, 5a, pl. 37, fig. 8, pl. 39, 1879.—TRYON, *op. cit.*, p. 176, 1879.—SUMNER, OSBORN AND COLE, Bull. U. S. Bur. Fish., vol. XXXI, part 2, p. 727, 1911.

Illex illecebrosus WHITEAVES, Marine Invert. Eastern Canada, Geol. Survey of Canada, p. 210, 1901.

Illex illecebrosus illecebrosus PFEFFER, Cephalopoden der Plankton-Exped, p. 405, 1912.

Subfamily: **Stenoteuthinae**.

Genus: **DOSIDICUS** Steenstrup.

Dosidicus gigas (D'Orbigny).

Plate 107.

TYPE: D'Orbigny described this species from an extensive series of specimens captured during his "Voyage dans L'Amerique Meridionale 1826-1833," and deposited in the Paris Museum. These were taken between the latitudes 40 and 60 degrees south. He lists and discusses material from various points between Peru and Valparaiso, Chile.

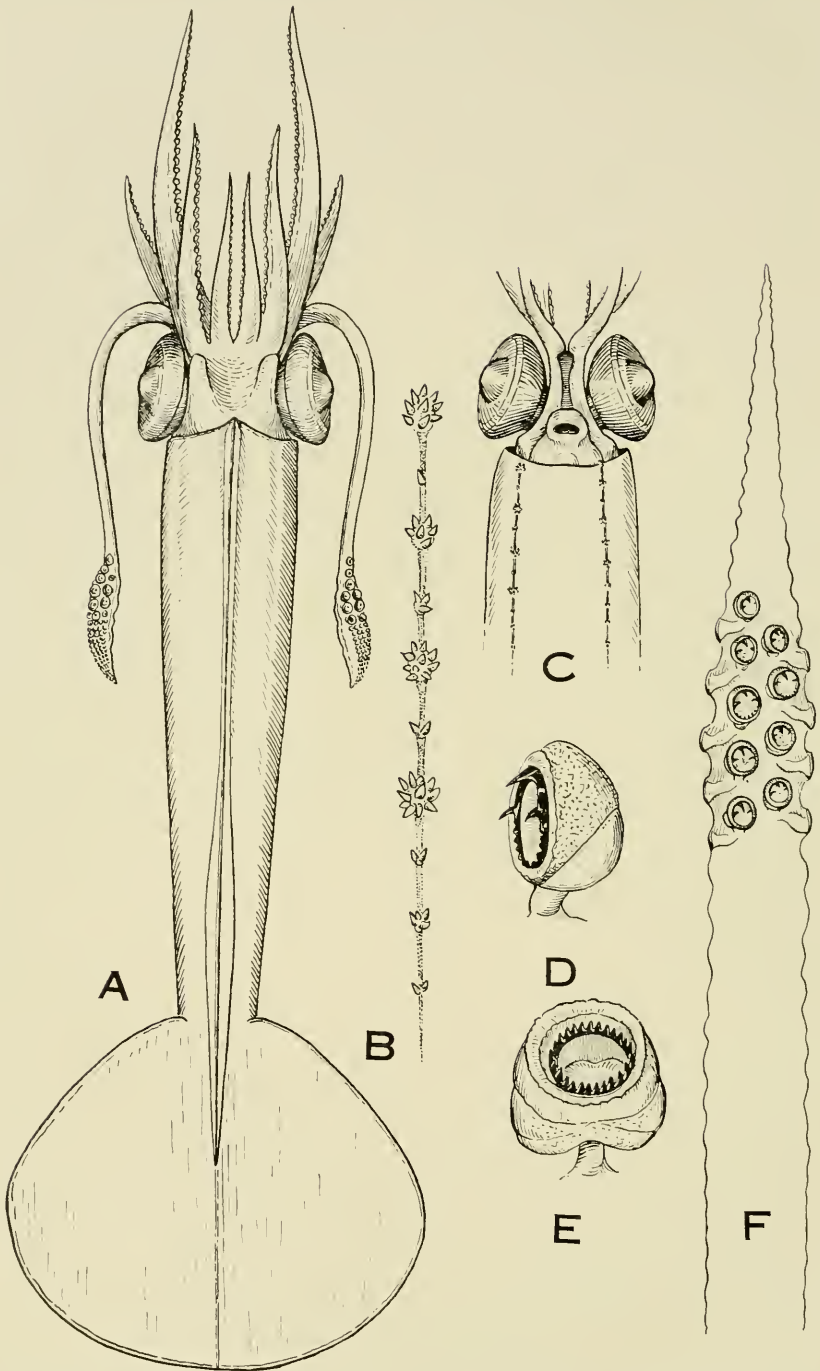
DISTRIBUTION: Pacific Ocean, off South America: taken at Arica, Coquimbo, Valparaiso and Taltal, Chile; off the coasts of Peru and north to San Clemente Island, California. The "Ara" specimen appears to be the first record of the species from Galapagos.

MATERIAL EXAMINED: One specimen, dredged seventeen miles S. W. of Pinta Island, Galapagos Islands, January 31, 1928, by the "*Ara*."

COLOR: Although like all of its kind, this species is richly set with chromatophores, which enable it to instantly change color, its most accustomed color is a rich grape-purple, with a vivid violet-blue ring above the jewel-like eyes.

TECHNICAL DESCRIPTION: This is a very large species, attaining a total length of 3.5 feet, with the body about one and one-half feet long.

The present specimen is 265 mm. long, from the tip of the longest sessile arm to the posterior of the body. The body is 170 mm. long, regularly cylindrical to the fin insertion, from this point abruptly tapered to an acuminate tip; the fin is rhomboidal, wedge-shaped, equal to two-fifths of the total body length; the insertion slightly notched, the anterior margin slightly shorter than the postlateral margin; the lateral and posterior angles are nearly right angles. The head is cylindrical, posteriorly necked, with two well-separated, prominent lateral nuchal cartilages on each side. The orbit is large, of characteristic shape. The ventral median excavation beneath the funnel is deep. The funnel is large with an elliptical aperture. The sessile arms decrease in length in the order 3, 2, 4, 1; the second pair are furnished with a fleshy excrescence on the outer lateral margin; on the third pair of arms this becomes a wider keel, while the fourth pair have the upper lateral margin laminate. The suckers are in two well-developed longitudinal rows with well-developed transverse muscle ridges between each sucker and its neighbor. The horny ring of an average large cup bears six to ten very acute, well-separated teeth on the outer half, the shallower side of the ring may be smooth or bear eight to ten small acute teeth. The tentacular arms are very extensile, nearly as long as the body, the club not quite one-third of the arm length, with a ventral keel on its distal half. The suckers are in four approximate rows, small ones proximally, followed by eight to ten much enlarged suckers in each of the two inner rows; these larger suckers are two and one-half to three times the diameter of those in the adjacent outer lateral rows. The suckers are set obliquely in hollows created by the transverse muscle prominences between the suckers. The horny ring of an average large sucker is cut into 21 to 24 well-separated acute teeth, the teeth on the deeper side of the cup being much longer and sometimes curved over apically. The buccal membrane is produced into seven acute points. The beak is very strong.



Pyrgopsis schneehageni (Pfeffer): A, dorsal sketch showing also the outline of the pen which is visible beneath the transparent skin; B, detail of ornamentation on ventral cartilaginous ridge; C, ventral sketch of head; D, profile of sucker from tentacular arm; E, typical sucker from a sessile arm; F, tentacular arm. Figures A and C enlarged $\times 1$ and $\frac{1}{3}$; figures B, D, E, and F all greatly enlarged.

- REFERENCES: *Ommastrephes gigas* D'ORBIGNY, Voy. Amer. Merid., vol. V, p. 50, Atlas of Mollusks, pl. IV, as *Loligo gigas*, 1846.—TRYON, Man. Conch., vol. I, p. 179, pl. 80, figs. 357-360, 1879.—VON MARTENS, Sitz. naturf. Freunde Berlin, p. 234, 1894.
- Ommastrephes giganteus* FERUSSAC and D'ORBIGNY, Cephal. Acetab., p. 350, 1839. *Loligo* tab. 20; *Ommastrephes* tab. 1, figs. 1-13, 1839.—GRAY, Catal. Mollusks Brit. Mus. Cephal., p. 60, 1849.
- Dosidicus steenstrupi* PFEFFER, Abh. Ver. Hamburg, vol. VIII, p. 20, fig. 27, 1884.
- Dosidicus gigas* PFEFFER, Jahrb. Hamburg, Wissensch. Anstalten XVII, p. 180, 1900; Cephalopoden der Plankton-Exped., p. 509, taf. 42, figs. 9-14, taf. 43, 1912.

Family: **CRANCHIIDAE.**

Subfamily: **Cranchinae.**

Genus: **PYRGOPSIS** Rochebrune.

Pyrgopsis schneehageni (Pfeffer).

Plate 108.

TYPE: The type which is apparently the only other specimen recorded, was collected in Chile, by Schneehagen, and is deposited in the Hamburg Museum.

DISTRIBUTION: Known only from the type locality and the present specimens, dredged in 300 fms., Pacific Ocean, fifty miles S. W. of Cape Mala, Panama. The "Ara" record substantially extends the northern record of this species.

MATERIAL EXAMINED: Two specimens, dredged in 300 fms., fifty miles S. W. of Cape Mala, Panama, March 16, 1926, by the "Ara."

COLOR: The color plate in Mr. Vanderbilt's "To the Galapagos on the 'Ara,'" painted from the living animal, by Mr. W. E. Belanske, shows this deep-sea squid to be opalescent ivory.

TECHNICAL DESCRIPTION: The larger of the "Ara" specimens measures 106 mm. long from the median dorsal point of the anterior mantle margin to the posterior margin of the fin. The fin comprises 36 mm. of this length, or about one-third of the total length. The head is 8 mm. long and not very wide. The mantle is very slender, tapered posteriorly to a pointed apex that terminates midway the ventral surface of the fin. The anterior margin forms a slight median dorsal point. The pen shows through the mantle as shown in figure A and is of the shape figured; pointed anteriorly, the shaft long and tapered posteriorly, with the narrow lanceolate wing expansion on the pos-

terior two-fifths. The ventral cartilaginous ridges are short, extending less than one-fourth of the distance from the mantle margin to the fin insertion, and are ornamented with ten clusters of tubercles of different sizes, as illustrated in figs. B and C. The tubercles of the two ridges are not identically developed, but are very similar. The fin is subcircular, with the posterior half of the margin more broadly rounded than the anterior half, which is somewhat sloping, as shown in figure A. The funnel is short. The head is small. In the dead specimens, the strong muscle bands show prominently, as indicated in figures A and C. The arms are weak, slender, decreasing in length in the order 3, 2, 4, 1; two and four being subequal, one slightly shorter, while three is one and two-fifths times as long as two. A typical sucker from one of the sessile arms is shown in figure E. The tentacular arms are well developed, very extensile, with a well-developed club, which has the lateral margin developed into a protective membrane, with wavy margin, and transverse muscle ridges on the ventral surface between the suckers as indicated in figure F. One of the large suckers from the tentacular arm is shown in figure D. There is an adhesive organ at the proximal end of the club, formed of a cluster of small suckers.

REFERENCES: *Loligopsis schneehageni* PFEFFER, Abhand. Gebeite der Naturwissenschaften, Hamburg, vol. VIII, Heft. 2, p. 23, fig. 31, 1884.

Zygaenopsis zygaena PFEFFER (Partim), Mitteil Naturhist. Mus., vol. XXV, (Jahrb. Hamburg Wissensch. Anstalten), vol. XVII, p. 193, 1900.

Taonius schneehageni HOYLE, Rept. Voyage "Challenger," Zoöl., vol. XXVI, p. 44, 1886.—VANDERBILT, WM. K., To the Galapagos on the "Ara," Appendix, p. 149, color plate 30, 1927.

Pyrgopsis schneehageni PFEFFER, Die Cephalopoden der Plankton Exped. der Humboldt Stiftung, p. 658, pl. 47, figs. 14-17, 1912.

Section: **MYOPSIDA** D'Orbigny.

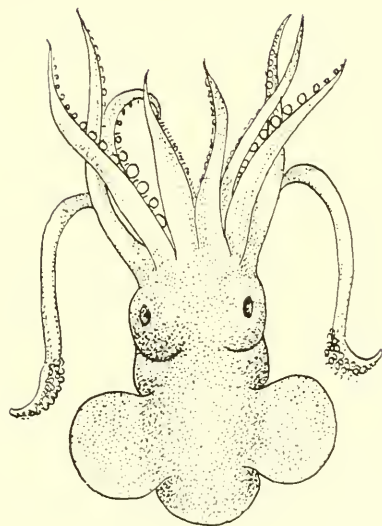
Family: **SEPIOLIDAE** Steenstrup.

Genus: **SEPIOLA** Rondelet, Leach.

Sepiola rondeletii (Gesner, 1555) Leach, 1817.

Plate 109.

TYPE: Not traced. This is one of the oldest described European species, having been discussed by Rondelet in 1554, and described by Gesner in 1555.



Sepioteuthis rondeletii (Gesner, 1555) Leach, 1817, natural size.

DISTRIBUTION: Mediterranean Sea, Azores, Senegal, British Isles, Greenland.

MATERIAL EXAMINED: One specimen dredged in 100 fms., nine and one-half miles E. by S. from Cape Bon Tunis, North Africa, July 19, 1927, by the "Ara."

HABITS: This is a sedentary species, frequently found burrowed in the mud, with only the big eyes protruding watchfully; when it moves it is a rapid swimmer. It spawns in May and June; a female will deposit from 40 to 130 eggs; these hatch in from 22 to 25 days, into opalescent, miniature squid.

ECONOMIC USE: This species is used abundantly as food in the Mediterranean countries.

TECHNICAL DESCRIPTION: Consult Guiseppe Jatta: *Cefalopodi viventi nel Golfo de Napoli*; Mon. 23, Fauna und Flora des Golfes von Neapel, p. 124, tav. 4, figs. 5 e 6; tav. 5, fig. 3; tav. 7, figs. 7 e 15; tav. 8, fig. 2; tav. 14, figs. 16-20; 1896.

The "Ara" specimen is a small one, but is of interest in that it establishes a new station for the species.

REFERENCES: *Sepiola RONDELET*, De Pisibus Marinis, Lugduni, 1553, libr. XVII, cap. X, p. 519, 1554.

Sepiola, Rondeletius GESNER, Hist. Animalium, libr. 4, p. 855, 1555, 1558. *Sepiola rondeletii* JATTA, G., Fauna und Flora des Golfes von Neapel, mon. 23, p. 124, tav. 4, figs. 5 e 6; tav. 5, fig. 3; tav. 7, figs. 7 e 15; tav. 8, fig. 2; tav. 14, figs. 16-20, 1896 (with full synonymy from 1554 to 1894).

Sepiola rondeleti JOUBIN, Res. Campag. Sci. Monaco, Fasc. IX, p. 23, 1895; *ibid*, Fasc. XVII, p. 40, 1900; Mem. Soc. Zoöl. France, XV, p. 85, text fig. 1, 1902.

Genus: **ROSSIA** Owen, 1835.

Subgenus: **Rossia**

Rossia (Rossia) macrosoma (delle Chiaje).

TYPE: D'Orbigny's type is deposited in the Paris Museum.

DISTRIBUTION: Mediterranean and west coast of Europe as far north as the British Isles, Ireland, Denmark and the Scandinavian coasts. Bathymetric occurrence: 20 to 150 fms.

MATERIAL EXAMINED: One specimen, dredged in 100 fms., Cape Bon Tunis, North Africa, July 19, 1927, by the "Ara."

COLOR: See Jatta, 1896, color plate 2, figure 5. The body, fins and head are a delicate jade-green with rosy tints in the median region of head and body; the arms are rosy, tinged externally with delicate blue along the border of the suckers.

TECHNICAL DESCRIPTION: Jatta gives an excellent description of this species, based on an extensive series of specimens, with many careful figures. (Printed in Italian.)

This species is said to attain a length of five inches. The body is short, three-fourths as wide as long, broadly rounded posteriorly; anteriorly the margin is produced to a somewhat prominent rounded median dorsal point; the fins are placed anteriorly and are thin, nearly semicircular, a little larger anteriorly. The head is short, nearly as wide as long, flattish dorsally, the optical region swollen. The eye is of moderate size, jewel-like in its beauty. The arms are awl-shaped, somewhat compressed, of unequal length, decreasing in the order 3, 2, 4, 1, the cups are nearly spherical, arranged in two rows proximally, in four towards the tips. The horny rings or the suckers are smooth. The tentacular arms are very slender, the clubs of moderate width; the cups are larger proximally, diminishing in size and increasing in number towards the tip. The shell is about two-thirds as long as the body, lanceolate.

REFERENCES: *Sepiola macrosoma* DELLE CHIAJE, vol. I, p. 11, tav. 71, figs. 1-11, 1829.

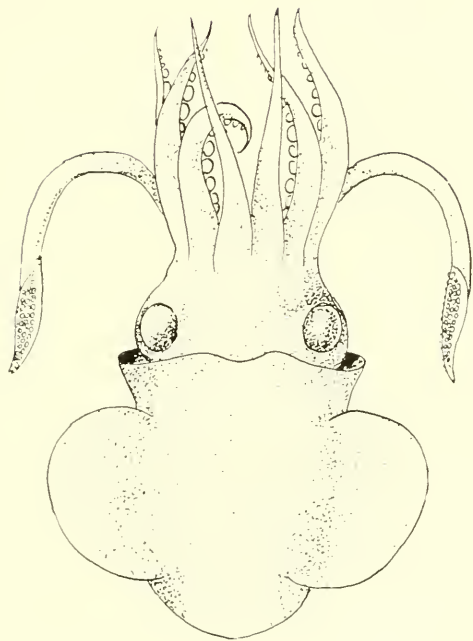
Rossia macrosoma D'ORBIGNY and FERUSSAC, Cephal. Acet., p. 245, pl. IV, figs. 13-24, 1839.—JATTA, Fauna und Flora, des Golfes von Neapel, Mon. 23, p. 124, tav. 4, figs. 5 e 6 (color plate); tav. 5, fig. 3; tav. 7, figs. 7 e 15; tav. 8, fig. 2; tav. 14, figs. 16-30; 1895 (full description and synonymy).—NÆF, *ibid*, Mon. 35, p. 590, text figs. 338-340, 1923 (Morphology).—JOUBIN, L., Mem. Soc. Zoöl. France, p. 118, fig. 21, 1902.

Subgenus: *Semirossia* Steenstrup.

Rossia tenera (Verrill).

Plate 110.

TYPE: Founded on about 200 specimens taken by the United States Bureau of Fisheries Steamer "*Fish Hawk*" at stations 865 to 880. The depository is not cited, but probably is the United States National Museum.



Rossia tenera (Verrill), natural size.

DISTRIBUTION: Found off the east coast of North America, from Cape Cod, Mass., southward to the Marquesas Keys, Florida, and in the West Indies at St. Kitts and off Glover Reef, British Honduras. Verrill records this species as abundant in the "*Fish Hawk*" dredgings off Massachusetts and the northeast Atlantic States in deep water. Bathymetric occurrence: 20 to 233 fms.

MATERIAL EXAMINED: One specimen, dredged in 100 fms., Marquesas Keys, Florida, 1924, by the "*Ara*."

COLOR: In life this species is pale translucent, with delicate opalescent tints and rosy chromatophores.

TECHNICAL DESCRIPTION: A small specimen. Body short, subcylindrical, dorsoventrally compressed, not quite twice as long as wide, posteriorly rounded; anterior mantle margin a little produced in the median dorsal region extending forward. The fin is large, rounded, about two-thirds the length of the body; the width of the fin is a little more than one-half the body width. The head is large, rounded, one-half the body length, wider than long. The eyes are large, prominent, with the lower eyelid slightly thickened. The arms are small, increasing in length in the order 1, 2, 4, 3, the first, or dorsal pair, being decidedly shorter than the others. The lateral and ventral arms are subequal. The suckers are in two regular rows on the lateral and ventral arms in both sexes; those suckers along the middle of the arms become conspicuously larger. The suckers are deep, subglobose, laterally attached, with a small aperture and smooth rim. The marginal web along beside the suckers forms a conspicuous saw-teeth effect. In the male the left dorsal arm is specialized. The tentacular arms are very long, slender, elastic, with the club dilated, with the suckers numerous, unequal, arranged in approximately eight rows; the suckers of the two or three rows next to the upper margin are three or four times as broad as the others and with a row of small denticles on the horny rim. The pen is small, very delicate, pen-shaped anteriorly, the shaft narrowing posteriorly; the lanceolate wing extending along the posterior half of the shaft. The upper jaw is a decidedly incurved beak without a notch at the base. The lower jaw is strongly incurved with a wide rounded lobe on the median region of the cutting edges.

REFERENCES: *Heteroteuthis tenera* VERRILL, Amer. Journ. Sci. and Arts, 3rd series, vol. XX, p. 392, 1880; Proc. U. S. Nat. Mus., vol. III, p. 360, 1880; Trans. Conn. Acad. Arts and Sci., vol. V, p. 357, pl. 46, figs. 2-2d, 3-3b, 1881; Bull. Mus. Comp. Zoöl.,

vol. VIII, p. 103, pl. 3, figs. 5, 5b, pl. 7, figs. 2-2d, 3-3b, pl. 7, figs. 2-2d, 3-3b, 1881; Rept. U. S. Fish Comm. for 1879, p. 175, pl. 33, pl. 34, fig. 1, 1882; Bull. Mus. Comp. Zoöl., vol. XI, p. 111, 1883-85.

Rossia tenera HOYLE, Rept. Sci. Res. "Challenger," Zoöl., vol. XVI, p. 118, 1886.—Joubin, Mem. Soc. Zoöl. France, vol. 15, p. 138, figs. 37 a-e, 1902.—Boone, Lee, Bull. Bingham Oceanog. Coll., vol. I, art. 3, p. 19, 1928.

Family: **LOLIGINIDAE.**

Genus: **LOLIGO** Lamarck.

Loligo brevis Blainville.

Plate 111.

TYPE: Blainville's type material came from Brazil and the coast of the Carolinas, and is deposited in the Paris Museum.

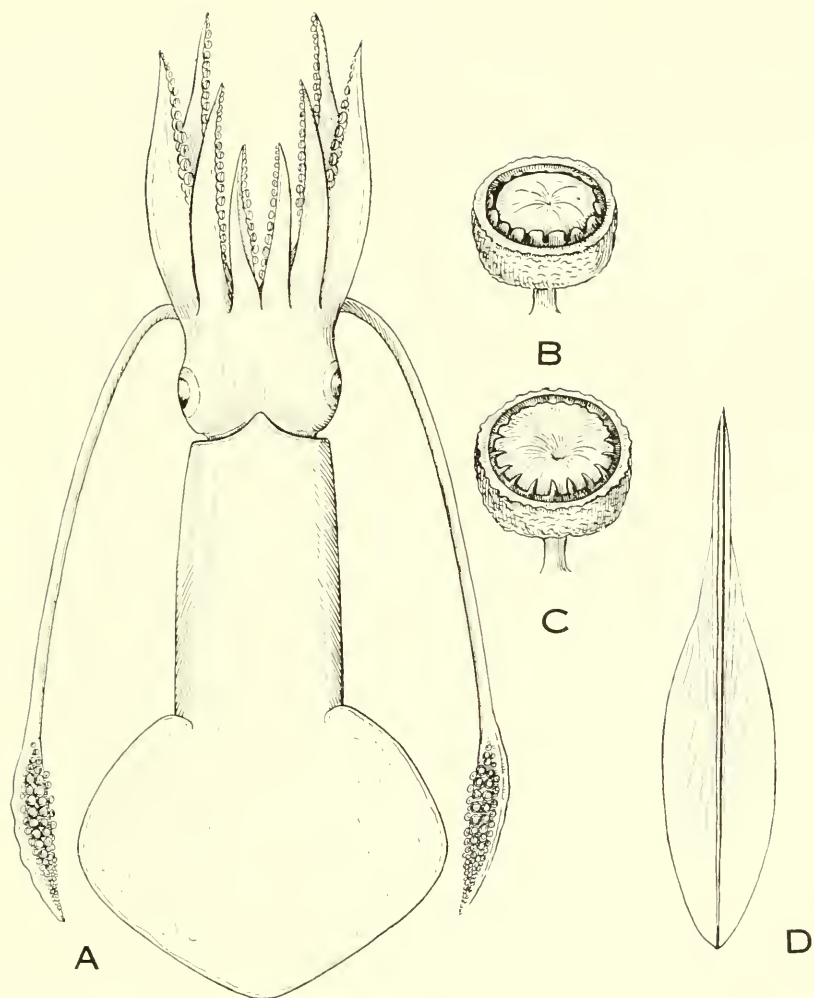
DISTRIBUTION: West Indian region, having been recorded from Florida to Brazil, including several records from along the Gulf Coast of the southern United States. There is one record of its occurrence at Delaware Bay and another at Hampton Roads, Va.

MATERIAL EXAMINED: One specimen taken at Hogsty Island, San Salvador, British West Indies, February 13, 1926. One young specimen taken at Limon Bay, Panama, in dragnet, 12/3 fms., January 21, 1928.

COLOR: The color of the living animal has not been recorded. In alcoholic specimens the ground color approximates that of *Loligo pealeii* and the chromatophores are rather large, abundant, reddish.

LIFE HISTORY: Unrecorded.

TECHNICAL DESCRIPTION: This species is small and stout as compared to *Loligo pealeii*, average size specimens of *L. brevis* having a mantle length of 60 to 70 mm., the largest specimen so far recorded measuring 130 mm. mantle length. Body stout, cylindrical, tapered to a blunt broad point, the greatest width of the mantle being equal to one-fourth of its length; length of caudal fin from insertion to tip almost equal to one-half of mantle length; caudal fins widely rounded forming a broad oval, as contrasted to the rhomboidal contour of those of *L. pealeii*. The anterior margin of the mantle is produced to a prominent rounded triangle in the median dorsal line, on either side of which it slopes backward; the ventral margin is produced



Loligo brevis Blainville, three-fifths of natural size; B, sucker from sessile arm, enlarged; C, sucker from tentacular arm, enlarged; D, pen, three-fifths of natural size.

to a triangle on either side of the siphon, being concave between these angles. The head is of moderate size, decidedly flattened dorsally in all nine dead specimens before me, the length in the median line one-third less than the greatest width, which occurs in the ocular region. The eye is large, pupil circular. The ventral surface of the head is excavate for the reception of the dorsal side of the siphon. The siphon is large, stout, with a bilabial aperture. The outer buccal membrane is large, produced into seven acute angles. The buccal process is capable of being produced almost entirely beyond the head. The beaks of the jaws are both strong. The female has no especial tubercle for the attachment of spermatophores. All the arms are short, successively increasing in length by 3 to 5 mm. each, in the order 1, 2, 3, 4 (fig. A). The dorsal arms have a strong median dorsal carina extending their entire length; the second pair are thick at the base and keeled on the lower outer margin; the third arms are heavily keeled throughout their entire length but especially so on the distal half; the fourth arms, which are only a little longer than the third pair and have a wide membrane on the upper angle which expands at the base and connects them with the third pair, a narrower membrane runs along the ventral margins. The suckers of the sessile arms are in two rows, extending quite to the tip of the arm. The suckers are small, cup-shaped, very deep and oblique, the sinus much higher on the outer side, where the chitinous rim is divided into several wide, bluntly rounded teeth, distinctly separated by narrow spaces. On the smaller, more crowded cups towards the distal tip of the six arms, these teeth are usually more acuminate.

In the dead specimens the tentacular arms are as long as the body; it is very probable that in the living ones they are even longer. At the base these arms are stout, farther out, compressed, the club very well developed, approximately twice as wide as the rest of the arm, with a thin, elevated, oblique dorsal keel arising midway the club and extending to the tip. The suckers are arranged regularly in four rows, 8 to 10, occasionally 12 large suckers in each row, followed distally by a series of smaller suckers, which in turn are succeeded by the even smaller, smooth-rimmed terminal suckers. The larger suckers of the median rows are slightly larger than those of the adjacent lateral rows, and are wide, cup-shaped, the rims cut into sharp, incurved teeth smaller on the inner side; the suckers of the lateral rows are comparatively large, deep, cup-shaped, very oblique with the outer half of the horny ring cut into acute incurved teeth. The

membraneous borders of the large suckers are covered with minute, sharp, incurved teeth, smaller on the inner side; the suckers of the lateral rows are comparatively large, deep, cup-shaped, very oblique with the outer half of the horny ring cut into acute incurved teeth. The membraneous borders of the large suckers are covered with minute sharp chitinous scales.

The pen is short, with the narrow part of the shaft short; halfway between the anterior end of the shaft and the blade proper, a thin margin begins, increasing in width towards the blade which latter is wide and thin with rounded lateral margins and the posterior end obtuse. The surface of the pen is marked with thin divergent lines.

REFERENCES: *Loligo brevis* BLAINVILLE, Journ. de Phys., March, 1823; Dict. des Sci. Nat., vol. 27, p. 145, 1823.

? D'ORBIGNY, Cephal. Acet., p. 314, *Loligo*, pl. 13, figs. 4-6 (after Lesueur); pl. 15, figs. 1-3, and pl. 24, figs. 14-19, original, 1835-38. —TRYON, Man. Conch., vol. I, p. 142, pl. 52, figs. 143, 144 (after D'Orbigny), 1879. —VERRILL, Trans. Conn. Acad. Arts and Sci., vol. V, p. 343, 1881; Rept. U. S. Comm. Fish. for 1879, p. 371, figs. 4-4c, issued 1882.

Loligo brevipinna LESUEUR, Journ. Acad. Nat. Sci., Phila., vol. III, p. 282, with plate, 1824. —TRYON, *op. cit.*, vol. I, p. 142, pl. 51, figs. 128-130 (after Lesueur), 1879.

Loligo diomedae Hoyle.

Plate 112.

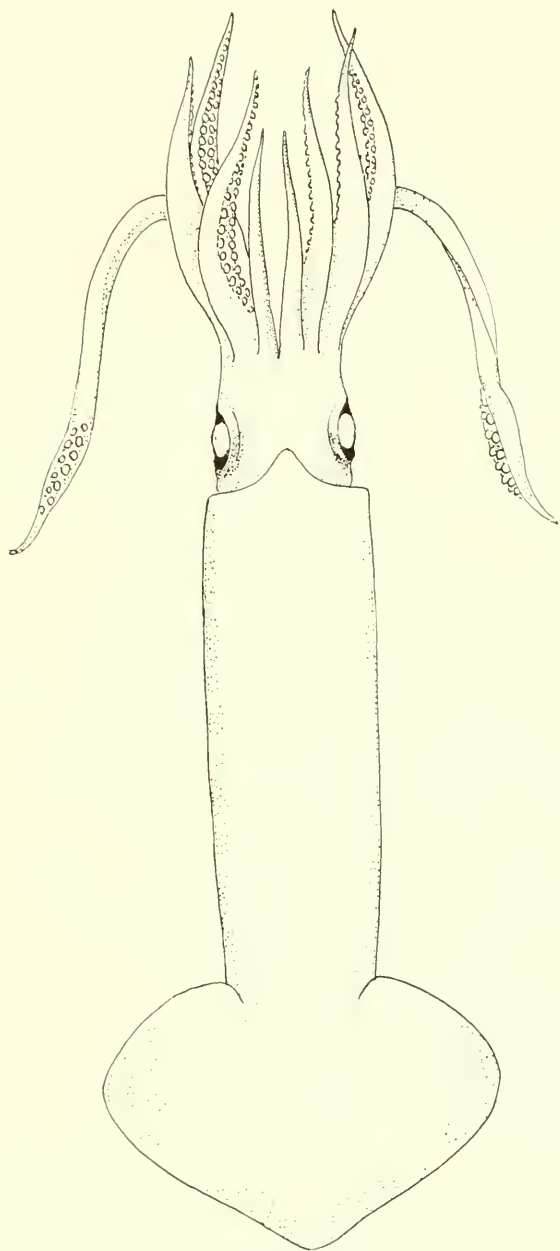
TYPE: One female specimen collected by the "*Albatross*" at station 3422, Lat. 16° 47' 30" N., Long. 99° 59' 30" W. in 141 fms., depository not stated.

Restricted to the type locality, thirty-six specimens taken by the Bingham Expedition to the Gulf of California and Pearl Islands, and the present "*Ara*" record, fifty miles S. W. of Cape Mala, Panama, in the Pacific. Bathymetric occurrence: surface, 19-23 to 141 to 300 fms.

MATERIAL EXAMINED: One adult specimen, dredged in 300 fms., fifty miles S. W. of Cape Mala, Panama, March 16, 1926. Seven young in the post-embryonic stage just from the capsule, Punta Arenas, Costa Rica, 100 fms., 1928.

COLOR: Unknown.

HABITS: Not recorded.



Loligo diomedae Hoyle, $\times 0.9$.

TECHNICAL DESCRIPTION: The "*Ara*" specimen is somewhat larger than the type, measuring 130 mm. total length. The body is 90 mm. long, moderately slender, cylindrical anteriorly for some two-thirds of its length; posteriorly tapered conically. The anterior mantle margin is produced to a rounded triangulate median dorsal angle, and has a moderate median ventral concavity accentuated by distinct triangular points, one on each side of the siphon. The fins are stout, a little more than one-third of the total body length, slightly incised at the anterior point of attachment and with the lateral margin moderately rounded, the pair forming a wide heart-shaped contour which is widest anteriorly. The posterior angle of the fins of the present specimen is bluntly rounded and projects beyond the tip of the body a trifle, in this respect differing from Hoyle's type, a younger specimen.

The head is that of a typical *Loligo*, wider than long, flattish dorso-ventrally, with the optical region large; a deep ventral groove beneath the siphon.

The arms are of unequal length, decreasing in length in the order 4, 3, 2, 1; the first pair are slender, with a definite dorsal keel; the second pair have a distinct ventrolateral keel; the third pair are wide and flattened with a distinct web externally; the fourth pair are about as stout as the third and laterally have a groove-like excavation, especially the side towards the tentacle. The suckers are of the usual type, the horny ring set with a series of blunt squarish teeth, separated by distinct notches; there are about twelve smallish teeth on the proximal side of the ring and eight or nine larger ones on the upper side. The tentacular arms are small, slender, distinctly three-sided up to the club; the club is about one-third of the total length, typically *Loligo*, with a web on each side and a separate small, ventral web on the distal half, widening distally; the club is set with about six or eight proximal suckers, followed by a double median row consisting of about eight to ten large suckers, each about twice the diameter of the adjacent lateral ones and succeeding these suckers are four rows of closely crowded distally diminishing small suckers. The horny ring of a typically large tentacular sucker has five broad blunt square-cut teeth on the upper side and eight or nine acute teeth separated by spaces slightly wider than themselves on the proximal side. The buccal membrane has seven points, each with one or two very minute suckers. The beak and pen have not been extracted, as this is the only specimen on hand.

The young specimens from Punta Arenas are each from 10 to 15 mm. total length and are perfect replicas of the older one, except that the orbits appear larger, and the chromatophores more conspicuous.

REFERENCES: *Loligo diomedea* HOYLE, Bull. Mus. Comp. Zööl., vol. 63, p. 29, pl. 5, fig. 13, pl. 6, figs. 1-7, 1904.—BOONE, Bull. Bingham. Oceanog. Coll., vol. II, art. 5, p. I, 1928.

Loligo pealeii (Lesueur).

Plate 113.

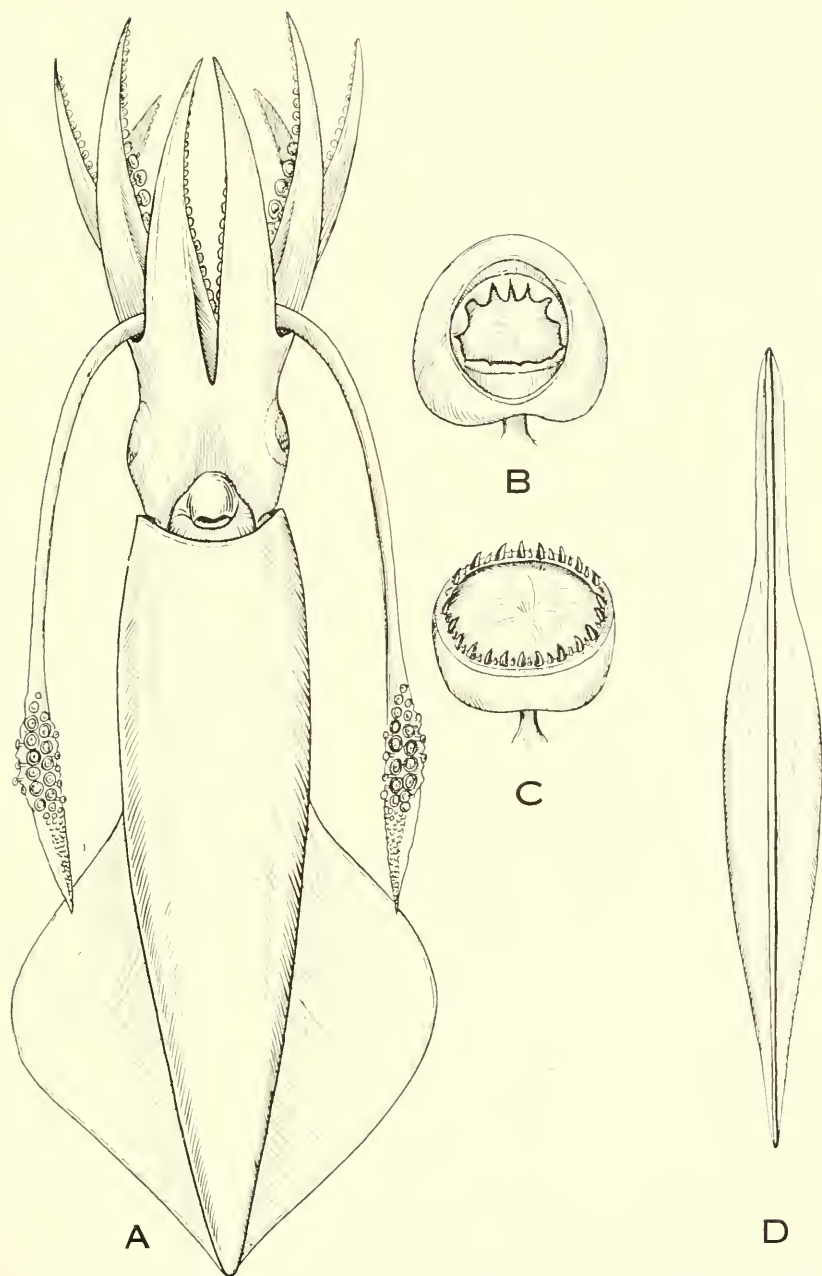
TYPE: Lesueur's type locality is given as "coasts of S. C.?" and deposited in the "Philadelphia Museum."

DISTRIBUTION: Found on the east coast of the United States from Maine to Florida, and southward through the West Indies and Caribbean Sea.

MATERIAL EXAMINED: One specimen, Miami, Florida, taken in net, tag 484, Marquesas Keys, Florida, November 28, 1923. Three specimens, Thompson Key, Florida, January 26, 1926. One specimen, Hawk's Nest, Cat Island, Bahamas, January 15, 1928, taken with electric light at night. Three specimens, south coast of Cuba, February 14, 1923.

COLOR: As nearly as the changing coloration of these living palettes may be described the ground color of the head, body and arms is a delicate translucent bluish white, the caudal fin similar, but becoming nearly transparent toward the margins. On the upper surfaces of the body, head and caudal fin there are abundantly scattered large, circular to elliptical chromatophores which, when expanded, are light red to dark lake red, varying to purplish red and pink; when contracted they become brownish purple. Behind the middle region of the eyes on the head and near the margin of the caudal fin these chromatophores are smaller and less numerous. They are also less abundant on the underside of the body and on the arms.

LIFE HISTORY: This is one of the few squid whose life history is known. The eggs are encased in paper-like capsules, from the outer end of which fully developed miniature squid escape at maturity and immediately begin an independent free-swimming existence. Although less than a quarter of an inch long, they are fully equipped with chromatophores and an ink-sac. They attain a body length of six to nine inches and are very rapid swimmers. Jellyfish prey on



Loligo pealeii (Lesueur): A, ventral sketch, two-thirds of natural size; B, sucker from sessile arm, $\times 6.5$; C, sucker from tentacular arm, $\times 6.5$; D, pen, two-thirds of natural size.

the young and whales feed on the larger ones. Man is also their enemy, using them both as food for himself and as bait for commercial fishing. W. K. Brooks has given a masterly account of the embryology of this species. A. E. Verrill has reported carefully on the growth rates of *L. pealeii*.

TECHNICAL DESCRIPTION: Squids of six to nine inches. The body is moderately stout, subcylindrical, tapered to a bluntish point posteriorly. The length of the caudal fin is equal to three-fifths of that of the body, if the fin is measured from point of insertion to tip. The fins are rounded, long, rhomboidal, their greatest width a little anterior to the middle of their length. The anterior margin of the body is produced to a prominent triangulate point with the tip rounded, on either side of which the margin slopes backward; there are two well-developed, angular points on the ventral margin, one on either side opposite the lateral cartilages. The dorsal connective cartilage is long, tapering posteriorly, with a conspicuous, broad, dorsal keel, the anterior end free, shaped like that of the pen.

The head is only four-fifths as long as wide, somewhat flattish dorsally, bulging in the dorsal region and excavate ventrally for the reception of the dorsal surface of the siphon, which latter is large, anteriorly rounded, with broad, bilabiate aperture. The lateral cartilages are long, narrow, subacute anteriorly and posteriorly, in the form of a thin, rounded outer lobe, the median groove narrow. The mantle connective cartilages are simple longitudinal ridges diminishing posteriorly. The eye is large. Behind the eye and above the ear, the nuchal crests are situated, consisting of a longer upper and a shorter inferior oblique, longitudinal membranes, these united by a doubly curved V-shaped membrane, with its angle directed forward, the whole approximating a W-shaped design.

The sessile arms are large, stout, decreasing in size in the order 3, 4, 2, 1. All have thin marginal membranes, reinforced by strong, transverse muscle ridges. The first and second arms are trapezoidal basally; the third pair of arms are shorter, compressed and with a median carina on the outer surface. The suckers on all the sessile arms are arranged in two rows, those of the third and second arms respectively being the largest of the series and are very deep, oblique. Toward the distal fourth to fifth of each arm the suckers diminish rapidly in size. The larger suckers have the chitinous ring with the higher outer side divided into six to seven broad flattened subtruncate, blunted, incurved teeth; the inner half of the ring is nearly even.

In the smaller suckers the teeth are longer, slenderer and much more acute.

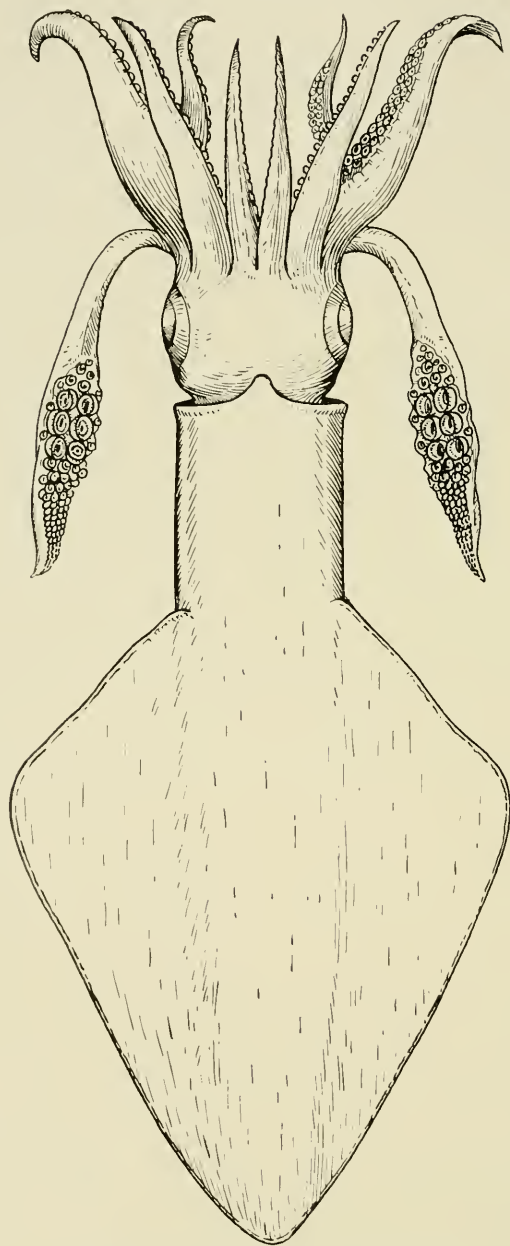
The tentacular arms are nearly as long as the body in living specimens, slender, compressed, with a membranous keel along the outer edge which widens on the club especially on its distal half. The tentacular suckers are arranged in four rows, two median alternating rows composed of seven or eight large, wide, depressed suckers on the center of the club with several smaller ones at each end. Along each margin alternating with the larger suckers there is a row of much smaller, very oblique ones. On the proximal part of the club there are few small, denticulated suckers; the distal part bears a great many, very small, sharply denticulated, pedicelled suckers, crowded in four rows; those at the very tip are usually devoid of dentition. The large suckers vary considerably in size according to age and sex. The larger suckers are higher on one side than the other with a wide aperture, encircled by a chitinous marginal ring which is divided all around in sharp, unequal teeth, usually those on the outer side the larger; usually one small, very sharp tooth occurs between two larger ones (fig. C); there is a wide soft basal membrane surrounding the horny ring. The smaller suckers have the aperture more oblique and the horny ring larger on one side with the outer marginal teeth longer and more incurved, usually a larger tooth alternating with a smaller one.

The outer buccal membrane is large, thin, produced into seven elongated acute angles, all of which have a cluster of ten to fifteen small, pedicelled suckers, arranged in two rows; the chitinous ring of these suckers is denticulated on one side. In adult females there is also a horseshoe-shaped thickened organ on the inner ventral surface of the buccal membrane, which serves for the attachment of the spermatophores by the male.

The pen is very thin, translucent, pale amber with the extreme anterior end thin, abruptly pointed like a pen, the anterior shaft long and narrow with a thin, lanceolate blade, with the edges curved downward, the tip pointed, slightly thickened and curved a little downward (fig. D.).

VISCERAL ANATOMY: Verrill has given a masterly report of this species (1882).

REFERENCES: *Loligo pealeii* LESUEUR, Journ. Acad. Nat. Sci., Phila., vol. II, p. 92, pl. 8, 1821.



Loligo vulgaris Lamarek, natural size.

- Loligo pealii* BLAINVILLE, Diet. Sci. Nat., vol. 27, p. 144, 1832.—FERUSSAC and D'ORBIGNY, Ceph. Acetab., p. 311, Calmars, pl. 11, figs. 1-5, pl. 20, figs. 17-21, 1835-38.—GRAY, Catal. Mollusks Brit. Mus., vol. I, p. 71, 1849.—BINNEY, in Gould Rept. Invert. Mass., ed. 2, p. 514, pl. 25, figs. 339, 340 (figure incorrectly referred to as *O. bartramii*), 1870.—VERRILL, Rept. Invert. Vineyard Sound, in Rept. U. S. Fish Comm., pp. 440, 635, pl. 20, figs. 102-105, 1877.—TRYON, Man. Conch., vol. I, p. 142, pl. 51, figs. 133-140, 1879.—VERRILL, Amer. Journ. Sci., vol. III, p. 281, 1872; Amer. Naturalist, vol. VIII, p. 170, 1874; Amer. Journ. Sci., vol. XIX, p. 292, 1880; *Loligo pealei* Trans. Conn. Acad. Arts and Sci., vol. V, pp. 308-340, pl. 29, figs. 1-4, pl. 37, figs. 1-3, pl. 39, fig. 4, pl. 40, pl. 45, figs. 3, 4, 1881.—BROOKS, W. K., Develop. of Squid, in Anniv. Mem. Boston Soc. Nat. Hist., pp. 1-22, pls. 1-3, 1880, issued March, 1881 (embryology).—VERRILL, Rept. U. S. Comm. Fish and Fisheries for 1879, issued 1882, p. 342, pl. 26, figs. 1-4, pl. 27, figs. 1-4, pl. 28, figs. 1-9, pl. 29, pl. 30, pl. 31, figs. 1-3, pl. 32, fig. 2, 1882.
- Loligo punctata* DEKAY, Nat. Hist. N. Y. Mollusca, p. 3, pl. 1, fig. 1, 1843.—BINNEY, in Gould, *op. cit.*, p. 513, 1870.—TRYON, *op. cit.*, p. 14, pl. 43, figs. 10-11.
- Loligo pealei* variety *borealis* VERRILL, in Amer. Journ. Sci., vol. XIX, p. 292, 1880.
- Loligo pealei* variety *pallida* VERRILL, Rept. U. S. Comm. Fish and Fisheries, vol. 1, p. 635, pl. 20, figs. 101, 101a, 1874; *ibid.* for 1879, p. 343, issued 1882 (with synonymy); Bull. U. S. Bur. Fish., vol. XXXI, pt. 2, p. 727, 1911.

***Loligo vulgaris* Lamarck.**

Plate 114.

TYPE: Lamarck's type consists of an imperfect specimen from the Mediterranean; first deposited in his cabinet and later in the Paris Museum.

DISTRIBUTION: Mediterranean Sea and Atlantic coasts of northwestern Africa and of southern Europe, as far north as the Bay of Biscay.

MATERIAL EXAMINED: One young specimen dredged in 11 fms., Casa Blanca, Morocco, August 20, 1924.

TECHNICAL DESCRIPTION: This squid attains a length of 50 cm. and is highly esteemed as a food in the Mediterranean countries. An excellent color plate of the species is given by Jatta, 1896.

The body is moderately slender, cylindrical anteriorly, tapered posteriorly with the apex bluntly rounded. The anterior mantle margin is produced to a prominent rounded, median dorsal process and into paired angles on the ventral surface, one each side of the siphon. The fins are rhomboidal and in the larger adults occupy two-thirds or slightly more than three-fourths of the body length, but in young specimens only about one-fourth to one-half the body length. The exposed portion of the siphon is short, rounded with a moderate sized aperture. The head is slightly longer than wide, rounded. The eyes are fairly large. The arms decrease in length in the order 3, 2, 4, 1, with the third pair dorsally webbed. The suckers are of moderate size, arranged in approximately two rows; the horny ring of the sucker is armed with a series of jagged sharp teeth. The tentacular arms are quite long and with well-developed clubs; the suckers are very large in the median region, set obliquely; the teeth of the horny ring are triangulate in the large suckers; similar but incomplete series occur in the smaller suckers. On the distal third of the arm the suckers are small, decreasing in size distally, set in four crowded rows. The pen is very well developed, pen-point shape anteriorly, sharp, with the shaft very tapered posteriorly; the wings occupy the posterior four-fifths of the pen length, widely expanded, its greatest width equal to one-fourth of its length; lanceolate, with the outer margins broadly rounded, gradually tapered in both directions.

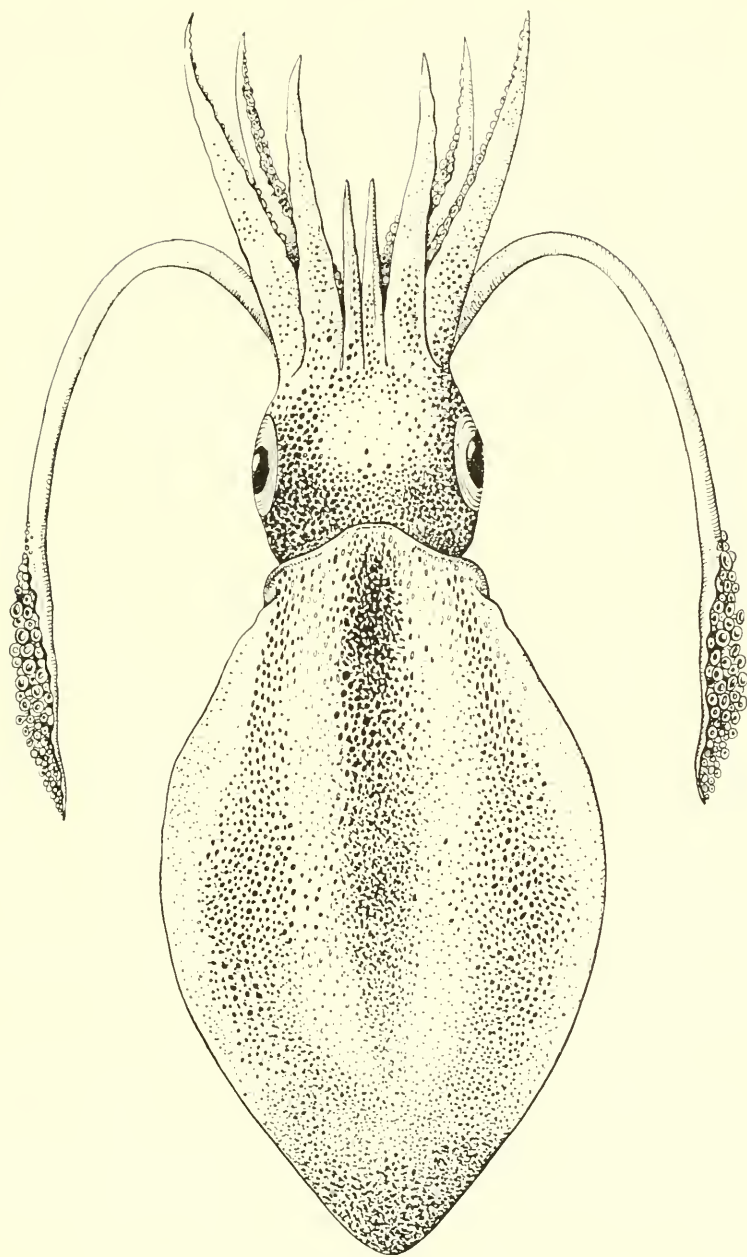
REFERENCES: *Loligo vulgaris* LAMARCK, Mem. Soc. Hist. Nat., vol. I, p. 132, 1799. Paris.—JATTA, Fauna und Flora, des Golfes von Neapel, Mon. 23, p. 169, tav. 3, fig. I, 1896 (with critical diagnosis and full synonymy). NAEF, *ibid*, Mon. 35, p. 197, text figs. 91-93, 1923 (growth stages critically discussed and figured with full synonymy). JOUBIN, Res. Campag. Sci. Monaco, fasc. XVII, p. 13, 1900.

Genus: **SEPIOTEUTHIS** Blainville.

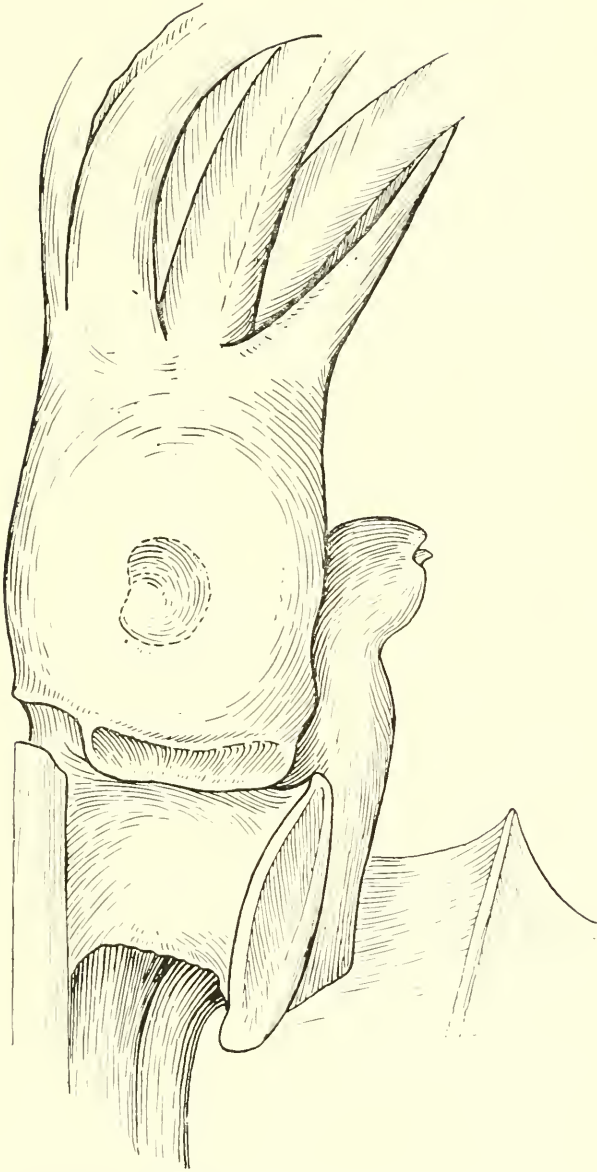
Sepioteuthis sloanii Leach.

Plates 115, 116 and 117.

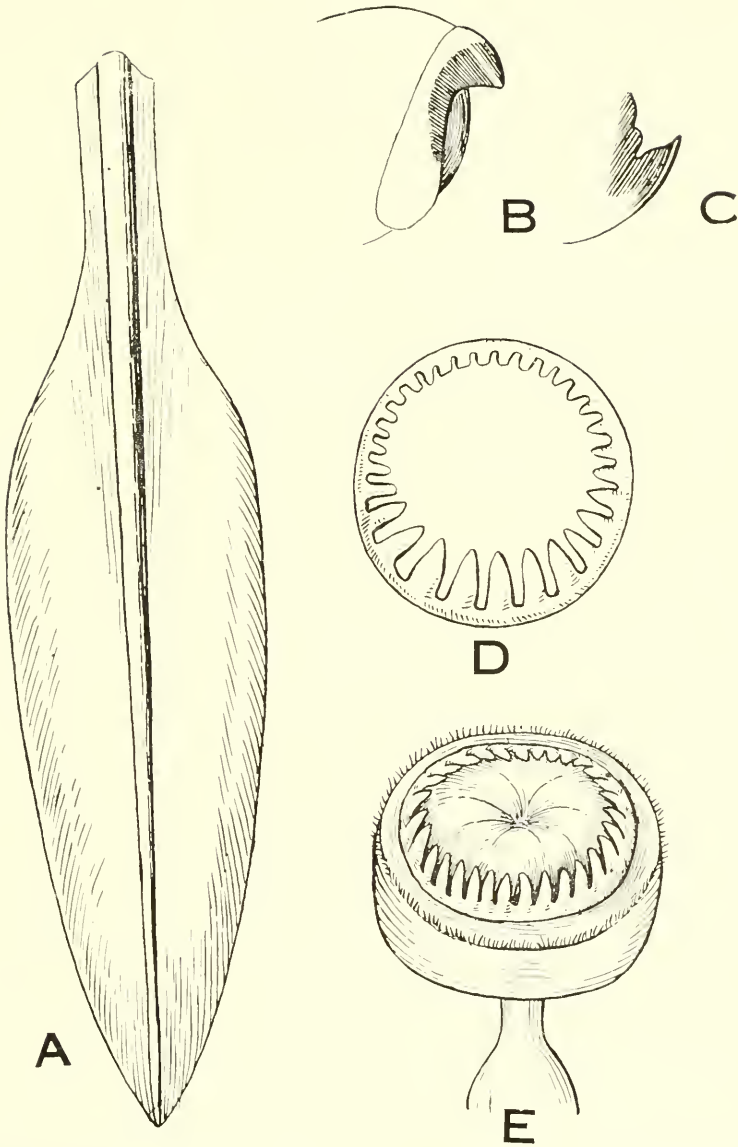
TYPE: Leach's manuscript (1817) type was from the West Indies: one specimen from Honduras, another, without locality, from the "Sloane Mus." Both are deposited in the British Museum.



Sepioteuthis sloanii Leach, one-half of natural size.



Sepioteuthis sloanii (Leach), natural size; mantle opened
showing nuchal cartilages.



Sepioteuthis sloanii Leach, A, pen, $\times 1.5$; B, upper beak of jaw; C, lower beak, both $\times 1.5$; D, sucker of sessile arm $\times 24$; E, typical tentacular sucker $\times 24$.

DISTRIBUTION: West Indian region: Honduras; Swan Island; Royal Isle Harbor.

MATERIAL EXAMINED: Two specimens, captured in Turtle Harbor, Florida, by the "*Ara*."

COLOR: Unrecorded.

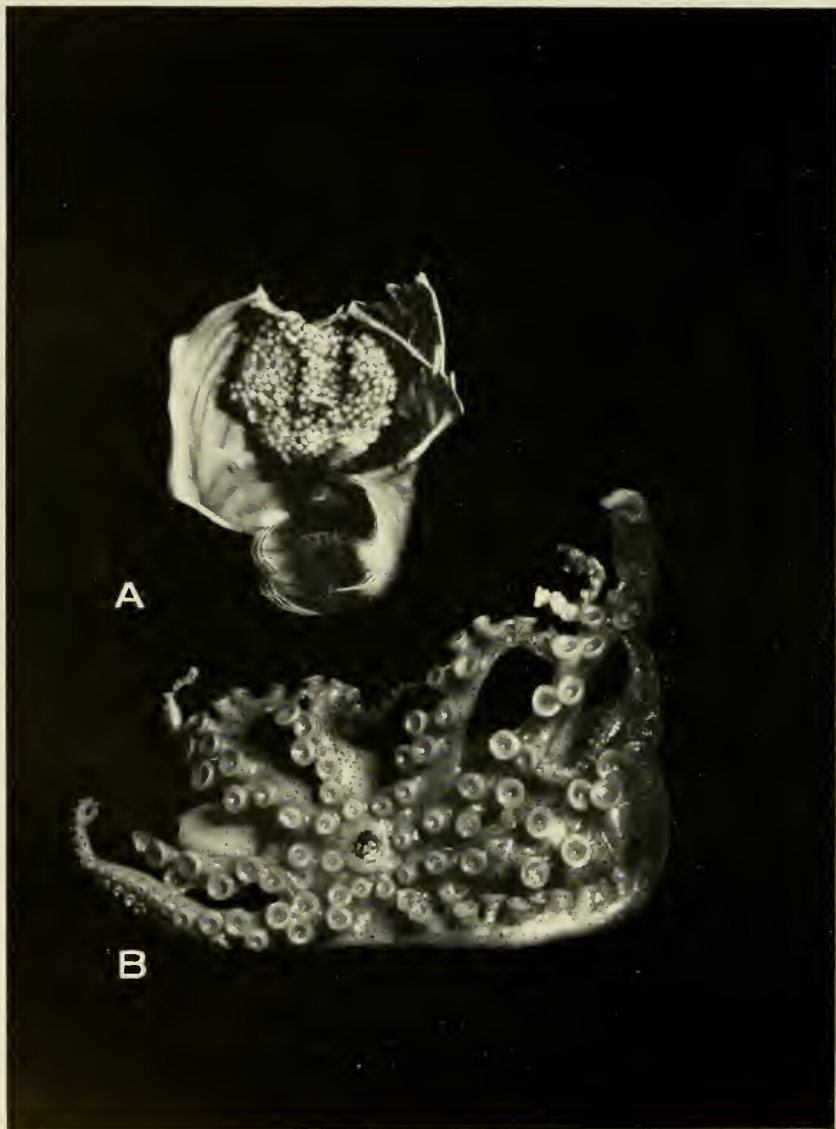
LIFE HISTORY: Unrecorded.

TECHNICAL DESCRIPTION: Body subcylindrical, tapering posteriorly bluntly rounded distally; anteriorly the free edge is produced to a slight blunt triangular point in the median dorsal line, on either side of which it tapers towards the lateral margin; on the ventral surface it is produced into a rounded point on either side of the siphon and is concave between these points. The caudal fins begin a short distance behind the mantle edge, about 5 mm., and they are widest in the middle, tapering toward each extremity, but a trifle more so near the posterior end; the free margins of the fins are very convex; considered together, the fins and body form a long oval, broadest in the middle. The head is large, much wider than long, flattish dorsally, somewhat rounded laterally and with a deep triangulate depression on the ventral surface, into which the dorsal surface of the siphon fits. Posteriorly the dorsal margin of each is produced into a decided ridge, diverging from a truncated point in the median region into an arc on each side, which terminates behind the upper margin of the eye. Behind this ridge the head narrows abruptly to the body. On either side of the head the marginal ridge is less sharply defined but distinct, and behind it there is a wide, thin, broadly rounded laminate membrane which bears on either side of its outer surface a cap-like concavity. The eye is large, with prominent pupil in the dead specimen.

The outer buccal membrane is well developed with its outer margin produced into six acute points, the lower three of which are the larger; one point extends between the two dorsal arms; one each between the dorsal and upper lateral arms; one between the margin of the lower lateral arm and tentacular arm and the sixth point occurs between the two ventral arms. The exposed surface of the buccal membrane is rough on the upper half, and on the lower is furnished with numerous closely set, fleshy, tapered hook-like, soft-bodied, tentacle-like processes. The inner margin of the buccal membrane closely surrounds the beak and is very muscular. The lower mandible has a strong upcurved beak, into which the upper mandible fits.

The sessile arms are in the order of 3, 4, 2, 1; the fourth pair are nearly equal to the third, whereas the second pair are more than half an inch shorter than the third, and the first pair are quite five-eighths of an inch shorter than the second. The dorsal and lower lateral pairs of arms each have a definite dorsal keel, which is thin, laminate, more conspicuous on the distal half of each arm. There is also along both lateral margins of all four pairs of sessile arms a marginal membrane that is about as high as the adjacent suckers and which has a series of transverse ridges formed by a strong muscle band, one on each side of each sucker. The suckers on the sessile arms are in two rows, but in some places they are so crowded as to appear in three rows, and extend quite to the tip of the arms. The suckers on the dorsal and ventral pairs of arms are very small, those of the upper lateral arms are intermediate in size between these and those of the upper lateral arms. The largest of these latter suckers are smaller than the largest suckers of the tentacular arms. A typical sucker of the sessile arm is figured. The suckers are distinctly cup-like, very oblique, the outer side more swollen, the rim muscle thickened, with a little pointed incision; the ring is set with subequal, distally tapered, bluntly rounded teeth.

It is quite impossible to estimate the true length of the tentacular arms from the dead specimens before me. The proximal part of the arm is laterally compressed, with a distinct dorsal carina, which on the distal half of the club broadens into a web-like lamina. There is also a carina proximally on the ventral margins of the arm, which for nearly an inch immediately below the club is divided by a narrow groove, the margins of which anteriorly pass into the marginal membrane, which is as high as the adjacent suckers and ribbed between each sucker by a strong, transverse muscle fiber that does not extend to the extreme edge of the membrane. The suckers are arranged in four closely crowded rows; the proximal two or three of each row being quite small, graduating in larger ones, of which there are about ten, followed by four or five successively smaller ones, beyond which there are five or six very minute suckers, extending quite to the tip of the arm. The dentition of these very small suckers is rudimentary. The larger suckers (one of which is figured) have the marginal ring thickened with a narrow incision or "lip" on the outer side. The chitinous ring has the teeth longer on the outer half, sharp, triangulate; on the inner half they are similar but not so long.



Argonauta argo Linné: A, shell containing egg-clutch; B, ventral view of the female whose eggs are shown above; both $\times 1.5$.

The pen has a strongly defined midrib that tapers posteriorly and widens decidedly anteriorly where it is bluntly truncated and slightly rounded. Anteriorly the wings are represented by a slight, almost linear margin, widening for about one-sixth of the pen's length, thence abruptly widening into a broad, convex-concave lamina with rounded, thickened lateral margin; posteriorly these wings narrow, converging into a blunted rounded tip (see plate 117, fig. A).

REFERENCES: *Sepioteuthis sloanii* LEACH, Mss. 1817; GRAY, Catal. Mollusks Brit. Mus., vol. I, p. 81, 1849.—TRYON, Man, Conch., vol. I, Cephalopoda, p. 153, 1879.—HOYLE, Rept. Voy. "*Challenger*" Zool., Cephalopoda, vol. 16, p. 27, 1886.—BOONE, Bull. Bingham Oceanog. Coll., vol. I, art. 3, p. 16, figs. 3, 4, 5, 1928.

Suborder: **Octopoda.**

Family: **ARGONAUTIDAE.**

Genus: **ARGONAUTA** Linné.

Argonauta argo Linné.

Plate 118.

TYPE: Linné stated of his type: "*Habitat in Pelago, M. Indico, Mediterraneo.*"

DISTRIBUTION: Mediterranean; tropic and subtropic Atlantic, Cape of Good Hope, Madeira; east coast of the United States and West Indies; tropical American Pacific off Lower California, the Gulf of California, the west coast of Mexico and Panama; Cocos Island. Pelagic.

MATERIAL EXAMINED: One egg-laden female with shell, from 50 miles off Cape Mala, Panama, March 16, 1926, caught by dredge on a trip down 300 fms.

TECHNICAL DESCRIPTION: A very thorough diagnosis of this species, based on material from the Mediterranean Sea, with most careful figures, and including studies of the young stages, also a comprehensive list of the literature from Aristotle to 1921 is given by Dr. Adolf Naef in his "*Die Cephalopoden, Fauna E Flora del Golfo di Napoli,*" vol. 35, Bd. I, pp. 763, 788, text figs. 455-470, 1923.

The "*Ara*" specimen is an egg-laden shell and female, the body of which is 20 mm. long, the longest arm 40 mm. There are approxi-

mately 500 eggs, each of which is ovoid, with a long diameter of about 1 mm.

REFERENCES: *Argonauta argo* LINNÉ, Syst. Nat. Ed. X, Holmiae, p. 708, 1758.—TRYON, Man. Conch. vol. I, p. 138, pl. 49, fig. 10, (color plate), 1879.—NAEF, ADOLF, Fauna E Flora del Golfo di Napoli, vol. 35, Bd. I, p. 763, 788, text figs. 455-470, 1923 (full description and synonymy).—BOONE, Bull. Bingham Oceanog. Coll., vol. II, art. 5, p. 3, pl. 2, 1928.

Family: **OCTOPODIDAE.**

Genus: **OCTOPUS** Lamarek.

Subgenus: **Octopus.**

Octopus bimaculatus Verrill.

Plate 119.

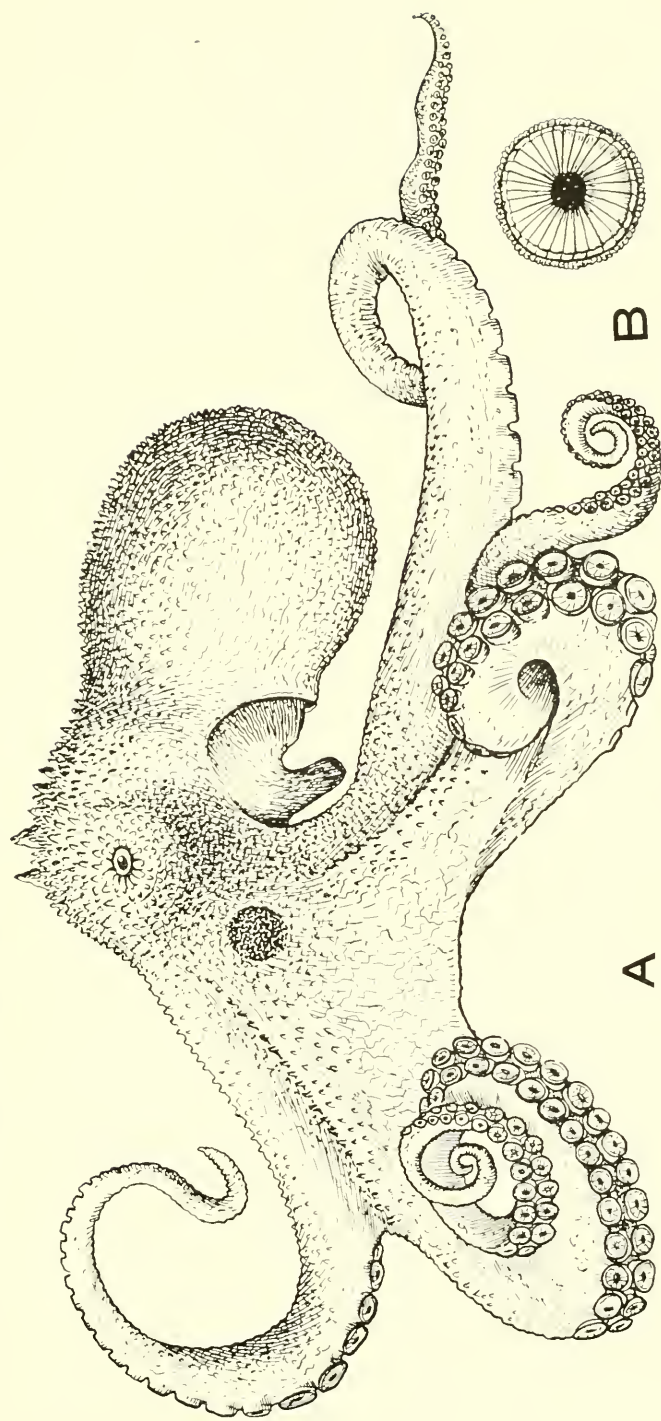
TYPE: Verrill founded the species on a series of animals collected at San Diego, California, Panama, and on the coast of San Salvador, which are deposited in the Peabody Museum, Yale University, and the United States National Museum. The type is not designated but appears to be a large male from San Diego, California, and deposited in the National Museum and a female from the same locality, deposited in the Peabody Museum.

DISTRIBUTION: This is a reef-dwelling species found from San Diego, California, to Panama. It lives under rocks and feeds chiefly at night on small crabs, shrimp and mollusks, the broken fragments of which make a heap outside its den.

MATERIAL EXAMINED: One specimen, caught near Eden Island, Indefatigable Island, Galapagos, by blasting, March 12, 1926. One small specimen, taken in dragnet, Coiba Island, Panama, Pacific Ocean, February, 1928.

LIFE HISTORY: The eggs are encased in capsules, attached on a mucus-like thread and fastened in some sheltered cranny but where they will not be smothered by sedimentation. No study has been made of the early stages of this species. The larger adults are uniformly smaller than adults of the more common species, *O. americanus*, also found on the West Coast.

COLOR: When living, this species is highly endowed with the ability to change its color. Adequate color notes of the living specimens are



Octopus bimaculatus Verrill, four-fifths of natural size; B, typical sucker, greatly enlarged.

lacking. The alcoholic specimens are purplish brown with a wart-like skin. There is a large circular peacock eyespot of purplish black below the eye on either side near the base of the web and approximately between the second and third arms. The inner surface of the suckers is creamy yellowish.

TECHNICAL DESCRIPTION: The body is elongate pyriform, enlarged and rounded posteriorly. The head is large, narrower than the body, from which it is defined by a slight constriction. The sides of the head about the eyes are prominent. The upper surface of the head, body and web is entirely covered with conspicuous, elevated warts of different sizes. These are especially numerous around the eye. Above and behind the eye there is one conspicuous warted surface. On the ventral surface of the body these warts are normally smaller. The web is well developed, uniting the proximal region of the arms for a considerable distance. It is broadest between the second and third pairs of arms, also more extensive between the dorsal pairs of arms than between the ventral pair. The ventral surface of the web and arms and lateral surface of the arms are covered with very numerous conical warts, closely crowded and frequently appearing in patches, separated by reticulated wrinkles. The arms are unequal, the dorsal pair being distinctly the shortest; the second, third and fourth pairs are very nearly equal. Near the base the arms are rounded trapezoidal, the ventral face broad, bearing two rows of alternating suckers, the dorsal surface is rounded; the membrane along the sides of the arm in continuation of the web is narrow, almost linear, and extends for only a short distance. The suckers, arranged alternately in two rows, are large, circular, with a deep central pit, saucer-shaped, with strong, fine, radiating grooves; the margin is distinctly expanded with two borders, the outer of which is soft and finely crenulated, the inner one divided into lobes by radiating grooves. There are 30 to 32 suckers on the proximal part of the arms; these are large, but little elevated, with broad bases. Beyond the web, the suckers diminish rapidly in size. On the distal half of the free arms they become very small but extend quite to the tip. For description and figures of the hectocotylized third right arm of the male, consult Verrill. The largest specimen recorded by Verrill has its greatest arm length 550 mm., or a total maximum reach of 1100 mm. The specimen before me is scarcely half that size.

REFERENCES: *Octopus bimaculatus* VERRILL, Bull. Mus. Comp. Zoöl., vol. XI, p. 121, pl. V, figs. 1, 1a, pl. VI, 1883.

Octopus brevipes D'Orbigny.

Plate 120.

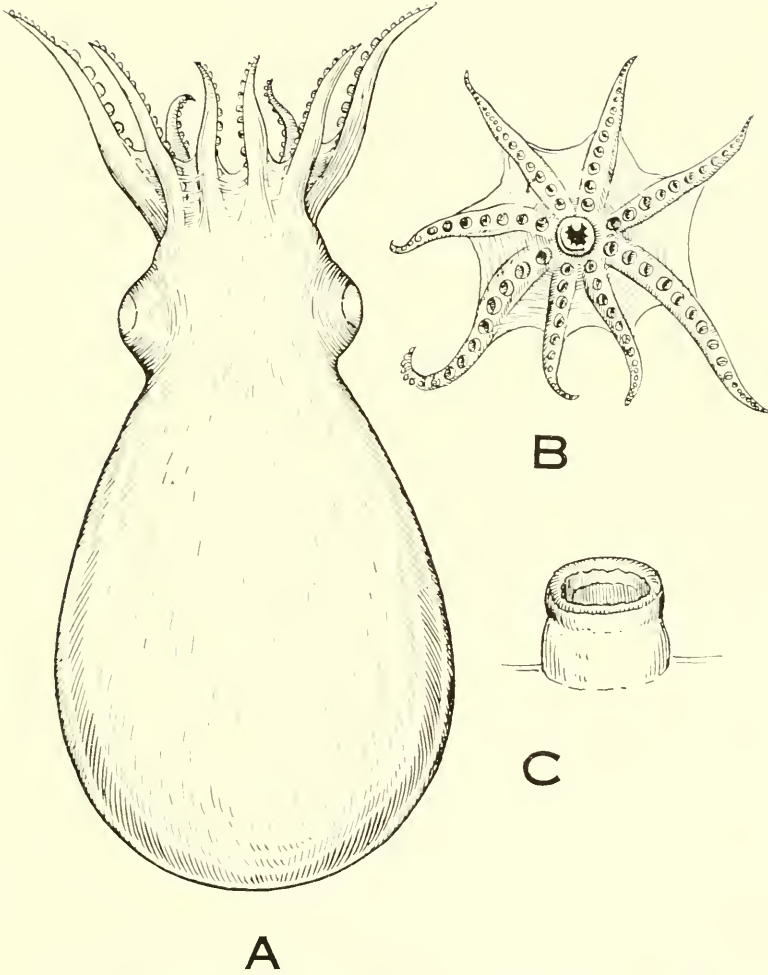
TYPE: Collected "23° N., 35° W. de Paris." Deposited in the Paris Museum. Measurement: 17 mm. long.

DISTRIBUTION: Known only from the type, to which the "*Ara*" specimens dredged in 300 fms., fifty miles S. W. of Cape Mala, Panama, Pacific Ocean, add a second record. The present specimens are referred to this species with some doubt, in view of the rejection of D'Orbigny's species by Mr. Robson, yet the identity of the Pacific specimens with D'Orbigny's imperfect description precludes their being designated as new.

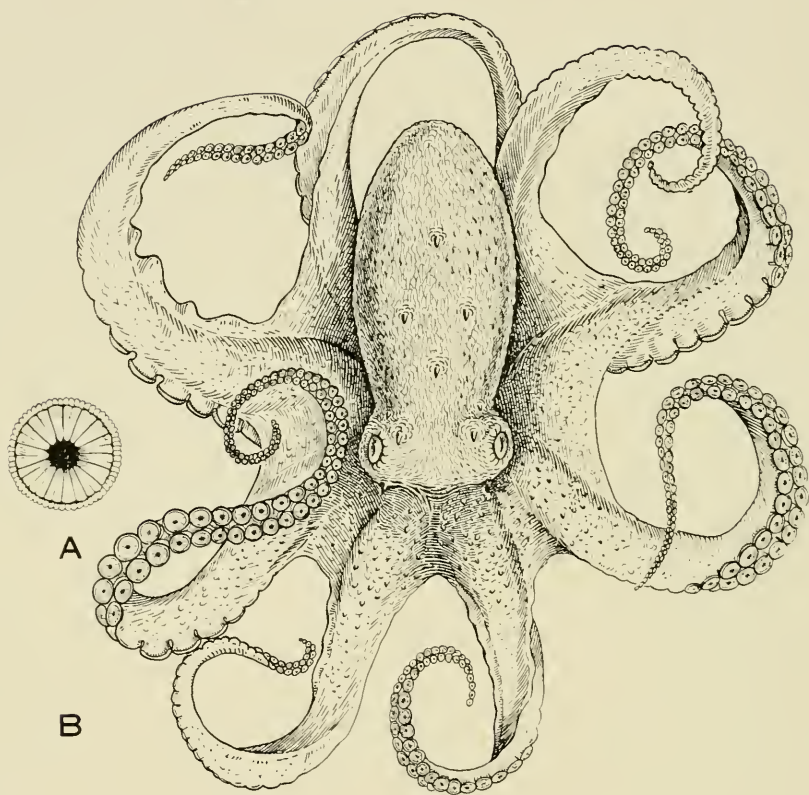
MATERIAL EXAMINED: Five specimens dredged in 300 fms., 50 miles S. W. of Cape Mala, Panama, Pacific Ocean, March 16, 1926, by the "*Ara*."

TECHNICAL DESCRIPTION: Body very soft, almost gelatinous, ovoid, its posterior margin broadly rounded; body somewhat narrowed anteriorly; mantle margin free from a point in line with and behind the upper orbital margin across the ventral surface to an identical point on the opposite side, thus creating a very wide aperture. Head small, scarcely as long as its dorsal width between the eyes; funnel short, set almost in line with the eyes; funnel aperture with the upper margin slightly longer than the lower and curved a little over the aperture, in all five dead specimens, forming a sort of protective flap. Eye large, with deep steely blue rim and medium-sized ball. Arms very short, decreasing in length in the order 3, 2, 4, 1, as figured. Web short, transparent, relatively of subequal areas. Suckers in a single row, set well apart. The third arm has 16 suckers; the second arm also has 15 suckers; the fourth arm has 22 to 24 very small suckers, and the first arm has 9 or 10 suckers. Chromatophores are very abundant in the dead specimen and are of very jagged, irregular, blotch-like contour. The beak is strong.

REFERENCES: *Octopus brevipes* D'ORBIGNY, Voy. dans L'Amerique Merid., tome V, p. 22. Atlas, pl. I, figs. 1-3, 1835-43. Hist. Nat. Cephal. Acet., t. I, p. 22, figs. 1-3, 1835.—ROBSON, Mon. Cephal. Brit. Mus., p. 215, 1929.



Octopus brevipēs D'Orbigny: A, dorsal view $\times 2$; B, umbrella $\times 2$;
C, typical sucker $\times 6$.



Octopus vulgaris Lamarck, about one-third of natural size; A, typical sucker, $\times 4$.

Octopus (Octopus) vulgaris Lamareck.

Plate 121.

TYPE: Lamareck's type was deposited in the Paris Museum.

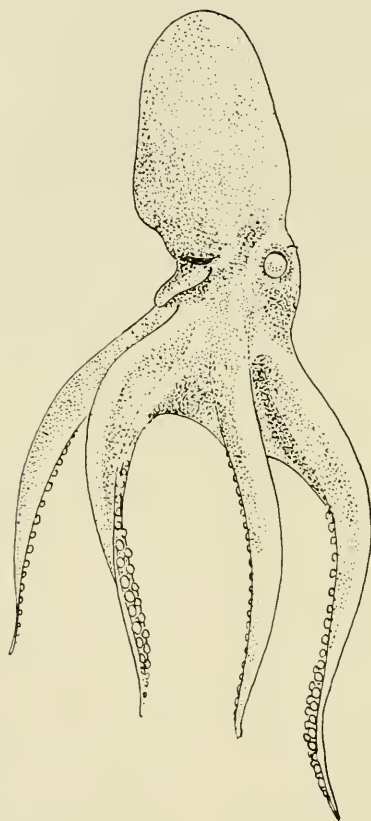
DISTRIBUTION: This species has practically a circumtropic distribution, having been reliably recorded in European and adjacent waters from Heligoland in the North Sea southward to through the Mediterranean and Aegean Seas; it is also found on the English coast, north-west Ireland, Mauritania and the Azores. It is also found on the West African coast down to South Africa. In American waters it is known on the East Coast from Cape Hatteras, N. C., southward through the West Indies to Bahia, Brazil. On the West Coast of America it is known from the Gulf of California at Angel de la Guardia and San Jose Island, also from the Bay of Panama. In Asian waters it has been reliably recorded from Japan. It was reported in 1840 by D'Orbigny from Mauritius, India and Timor in the Indo-Pacific. Robson (1929) calls attention to the fact that in recent years reports of the Indo-Malaysian, Indian Ocean and South African regions do not record *O. vulgaris*. The present writer has re-examined specimens recorded (Boone, 1928) from Double Headed Shot Cay and at Swan Island, Caribbean Sea, also those cited above from Lower California, in critical comparison with true *O. rugosus* from both regions and with careful regard for Robson's masterly diagnoses (1929) of the two species and finds that her original classification of these as *O. vulgaris* is valid.

MATERIAL EXAMINED: One specimen, Bimini, Bahamas Islands, March, 1924. One taken at Miami, Florida. The cut-off arm of a specimen which resisted capture and attacked one of the sailors on the schooner "*Sonia*" while the boat was crossing from Bimini to Miami Beach, Florida. This specimen was probably between seven and eight feet umbrella diameter. The naturalist of the "*Sonia*," Mr. L. L. Mowbray, reported that the octopus was basking in the sunlight close to the surface, as if asleep, when first sighted. A mother octopus, with umbrella diameter of about 10 inches, and her brood of 522 young, seven of which are not fully escaped from the egg-capsule; taken from loggerhead sponge, Knight's Key, Florida, dredging 2 fms., March 6, 1925. Two young, Le Mole, Carenge Bay, Haiti, February 5, 1924. One very minute young, taken in 34 fms., off Fowey Rock Light, Florida, April 26, 1922. One large specimen, Bimini, British West Indies. Another large specimen, Miami, Flor-

ida, 1923. One very young specimen, Cualeo Reales Channel, Cuba, February 18, 1923. One large octopus, caught by hand in rock crevice, Miami, Florida, no. 10, lot B. One very large specimen, Monaco Harbor, Mediterranean Sea.

HABITS: This octopus makes its home in rock crevices and is entirely carnivorous. It is of about one-quarter-inch body length when it escapes from the egg capsule. One mother will lay about 800 to 1000 eggs at a brood; each egg is encased in a thin capsule, and all of these are connected by a flexible gelatin-like rope, which is fastened in some protected rock crevice. The mother tends these, blowing water on them through her funnel, cleansing and aerating them. The above record of a mother and her brood appears to be the first capture of practically an entire brood, reliably establishing the large progeny of one mother. It is most interesting to note the practically identical development of these young octopi. Only thirteen of the five hundred and twenty-two were appreciably larger than the others, while the seven remaining partially within the capsules were but a trifle smaller than the rest.

COLOR: In life this species is ordinarily purplish but is capable of changing its color very rapidly, either to assume the color of its surroundings or, under excitement, to frighten its prey. I have watched specimens which we kept alive for several months in the Miami, Florida, Aquarium with much interest. When resting or sleeping in the rock crevices the octopus would assume a dull reddish gray or brown, similar to the sand or rock on which it was resting and would retain this color for an observed period of as much as four hours. But the slightest disturbance of the animal would prompt a quick change of color, dull purplish red being the usual color under excitement. In battle with another octopus or a large spiny lobster (*Panulirus argus* Latreille), this purplish red would become intensified, then receding, passing over the octopus' body in recurrent waves. If this, combined with the sinuous motions of the arms, failed to frighten the foe, discharge of ink from the ink-sac would next be practiced, the ink being discharged in as many as six separate ejections, the second discharge replacing the discoloration of the first discharge as the latter faded, and so forth. I have also seen these octopi, when robbed of their rocky crevices and placed in a clear sunlit tank with whitish coral sand bottom, fade themselves into this background by assuming a creamy color. I have also seen the octopi quite frequently in the Bay Biscayne resting on the bottom with the umbrella spread sucker side up, the contour of the arms half buried in the sand.



Octopus (Octopus) verrilli Hoyle, $\times 1.5$.

TECHNICAL DESCRIPTION: Robson in his "Monograph of Recent Cephalopoda," part I, p. 57, pl. 1, fig. 1, etc., has given a masterly diagnosis of this species based upon an extensive series of animals.

The "Ara" specimens present an unusually fine series of this species, ranging in size from young, half-escaped from the capsule, to part of an adult of 6 to 8 feet web diameter. The mother and nest of 522 young are especially interesting, and, so far as I am aware, they represent the only catch of this kind on record.

REFERENCES: *Octopus vulgaris* LAMARCK, Bull. Soc. Phil. Paris, II, p. 130, 1798.

Octopus (Octopus) vulgaris ROBSON, Mon. Cephal. Brit. Mus., p. 57, pl. 1, fig. 1, text figs. 6, 7, 1929.

Octopus (Octopus) verrilli Hoyle

Plate 122.

TYPE: This species was founded on two very young specimens, one taken by the "Blake" at Station 142, Flannegan Passage, 27 fms., the other taken at Station 278, off Barbados. Depository not stated.

DISTRIBUTION: Apparently restricted to the type localities and the three specimens taken by the "Ara," off Miami, Florida, in 200 fms., March 31, 1926.

COLOR: There is no record of the color of the living specimens. Verrill records from dead specimens that the entire surface of the body above and below had numerous large round, reddish brown or dark brown spots, usually with a darker center, between which spots there were numerous smaller chromatophores. The inner surfaces of the web and arms he described as being yellowish white. The "Ara" specimens, which are about of a diameter of four to four and a half inches, have been so long preserved that the color is too faded to merit description.

Hoyle (1886) pointed out that the name *pictus* originally given this species by Verrill was preoccupied by Brock's Australian *pictus*. Robson (1929) pointed out that there is a still earlier usage of the name for an octopus by de Blainville (1828).

TECHNICAL DESCRIPTION: The largest of the "Ara" specimens measures: total length, 78 mm.; arm, 44 mm. from base to tip. The body

in all three specimens is decidedly dorsoventrally compressed, ovoid, somewhat quadrate in contour, with the head but little narrower than the body, not separated by a neck. The optical lobes are prominent, the eyes of moderate size, with a single wart above each. The mantle aperture is somewhat narrowed, the siphon very short, tapered, with small aperture. The arms decrease in length in the order 1, 2, 3, 4, pairs 1, 2 and 3 being almost equal and 4 about 5 mm. shorter than 3. The suckers are in double series, large, round, diminishing in size distally. The arcs of the web are of approximately subequal depth equivalent to about one-third of the arm length, except in the ventral pair, where it is minutely shallower. The entire surface is very soft, with fine punctae, which, under the microscope, show as papillae, forming an approximate reticulation. There are many large chromatophores on the body and web, especially on the dorsal surface. The beak is very strong.

Verrill suggests that this may be the young of some other species. Robson (1929) suggests that it may be the young of *O. rugosus*. Possibly so, but it appears distinctly different from the many hundreds of young *Octopus rugosus* the present writer has observed in the Florida Keys and hatched in her aquaria.

REFERENCES: *Octopus pictus* VERRILL, Bull. Mus. Comp. Zoöl., vol. XI, p. 112, pl. 3, fig. 3, 1883 (preoccupied de Blainville, 1828, p. 8.). *Octopus verrilli* HOYLE, Rept. Voy. "Challenger" Zoöl., XVI, p. 93, 1886.—ROBSON, Mon. of Cephalopoda in British Museum, p. 162, 1929.

Genus: **SCAEURGUS** Troschel.

Scaeurgus unicirrhus (delle Chiaje, Mss., 1838) D'Orbigny, 1840.

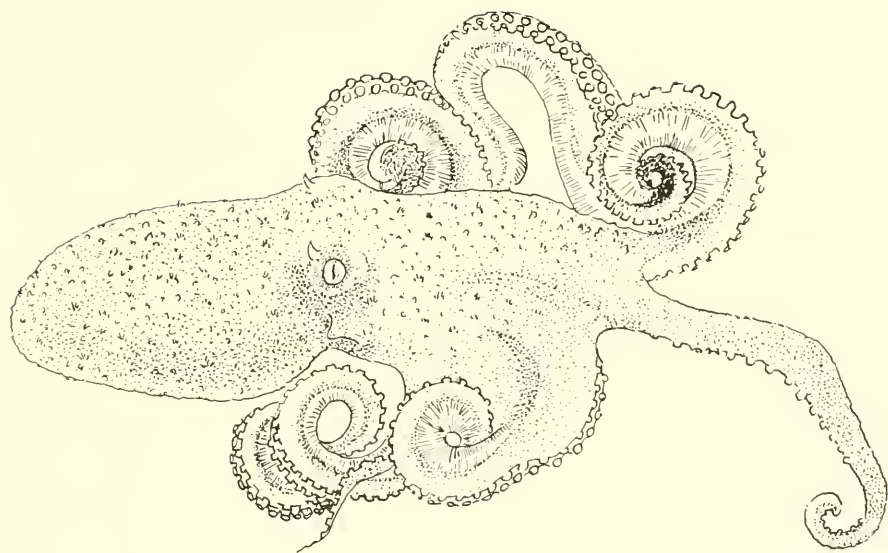
Plate 123.

TYPE: Not traced.

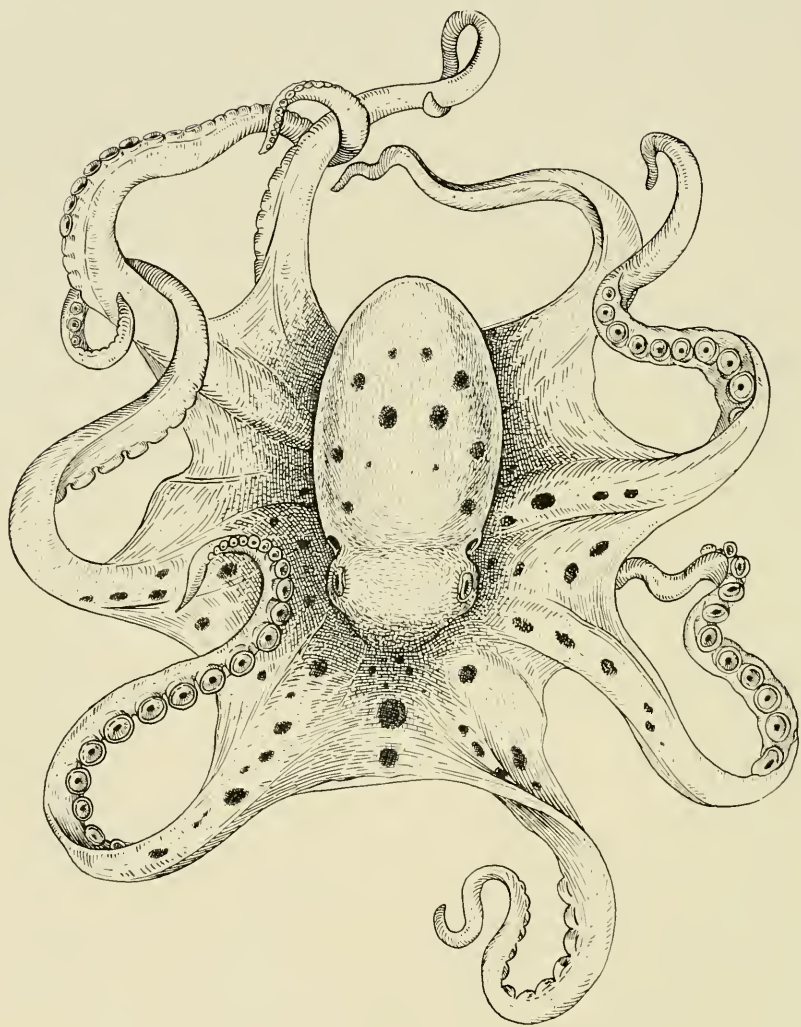
DISTRIBUTION: Mediterranean Sea, Indian Ocean, Hawaiian Islands, Japan. Shallow water to 178 fms.

MATERIAL EXAMINED: One specimen, dredged in 100 fms., off Cape Bon Tunis, $9\frac{1}{2}$ miles E. by S. $\frac{1}{2}$ S., Mediterranean Sea, July 19, 1927, by the "Ara."

COLOR: The living octopus is a clear light green on the upper surface with brownish maculations, fading into a paler hue, with bluish iridescence near the margins of the arms.



Scaevargus uniccirrus (delle Chiaje, Mss., 1838), D'Orbigny, 1840.
Natural size.



Eledone moschatus (Lamarek), about one-half of natural size.

TECHNICAL DESCRIPTION: The "Ara" specimen measures 32 mm. body length and is rather widely elongate oval, being about three-fifths as wide as long, convex posteriorly. There is a distinct low peripheral keel on the mantle. The head is a little narrower than the body, the eye rather small, with a single prominent cirrus above the eye; outside and below the eye there is a linear rugosity of skin. The mantle aperture is narrow. The surface of the body is regularly covered with five roundish warts, some of which are individually multifid. These warts are somewhat less abundant on the ventral side of the body and web. The arms are about 75 per cent. of the total length and are nearly subequal. The suckers are very small, arranged in double rows, with 5 or 6 pairs of larger ones proximally, graduating to very minute ones distally. The web between is nearly 25 per cent. of the depth of the arms and is approximately of subequal depth. The web along the outer keel of each arm is very well developed on the proximal portion and extends in a narrowed form to within a short distance of the tip of the arm. The funnel organ is W-shaped.

REFERENCES: *Octopus unicolor* DELLE CHIAJE, Mss., 1838.—D'ORBIGNY, and FERUSSAC, Cephal. Acetab., p. 70, pl. 1, 1835-38.

Scaevargus unicolor TIBERI, Boll. Soc. Mal. Ital., vol. 6, p. 12, 1880. —JATTA, Fauna und Flora Neapel, Mon. 23, p. 234, tav. 3, fig. 2, color plate, tav. 25, figs. 14-22, tav. 26, figs. 1-3, 1895 (with full synonymy and description).—ROBSON, Mon. Recent Cephalopoda, Brit. Mus., p. 192, 1929 (with synonymy and description).

Genus: **ELEDONE** Leach.

Eledone moschatus (Lamarek).

Plate 124.

TYPE: Collected in the Mediterranean; deposited in the Paris Museum.

DISTRIBUTION: Mediterranean Sea, littoral to 50 fms., on both rocky and sandy bottoms.

MATERIAL EXAMINED: One specimen, collected at Monaco, Mediterranean Sea, 1927, by the "Ara."

COLOR: There is a very fine color plate of this species in the "Flora and Fauna of the Gulf of Naples," table 3, figure 4, showing the octopus to be a light brownish mud color on the dorsal surface, with

conspicuous, big, circular spots of deep brownish black. The lower surface of the web and arms is brownish, with strong orange tones.

REMARKS: This octopus, which is considered a great table delicacy in the Mediterranean countries, is very powerful, having been known to jump out of the water for a distance of ten feet, also to pump a stream of water one foot high from its funnel. This species has a strong, musk-like odor, which persists even after death. Algerian women of the tribe M'talassa are said to anoint their hair with the inky liquid of this octopus, because of its musk-like odor.

This is one of the oldest known species of octopus, having been recorded by Aristotle, Pliny, Belon, Rondelet and other naturalists of early times.

TECHNICAL DESCRIPTION: Consult Jatta, 1896, p. 239; also Naef, 1923, p. 717.

The body is elongate-ovoid, smooth or finely granulate, as desired by the octopus, the anterior margin of the mantle is free from a point immediately in line with and behind the upper margin of the orbit, across the ventral surface to that of the opposite orbit, thus creating a large aperture. The funnel is well developed, about as long as the head. The head is narrower than the body, rounded; the eye large. The web between the arms is of moderate depth, increasing in depth but very slightly from ventral to dorsal; the length from the post-orbital angle to the margin of the web is almost equal to the length of the body or is equal to about two-fifths of the length of the free portion of the arms. The arms are very long, slender, graceful, tapered, three and one-half to four times as long as the body, slightly decreasing in length from dorsal to ventral, in the order 1, 2, 3, 4. The suckers are in a single row, the large ones proximally situated.

For discussion of the minute differences between this and the closely similar Mediterranean form, *E. aldrovandi* (Delle Chiaje), consult Jatta.

REFERENCES: *Octopus moschatus* LAMARCK, Mem. d'Hist. Nat. Paris, tome I, p. 22, 1799.

Eledone moschatus LEACH, Zoöl. Misc., vol. III, p. 138, 1817.—JATTA, Fauna u. Flora Neapel, Mon. 23, p. 239, tav. 3, fig. 14; tav. 7, figs. 3 e 5; tav. 26, figs. 4-13; tav. 27, figs. 1, 2, 3, 4, 10 e 11, 1896.—NAEF, *ibid*, Mon. 35, p. 716, Bd. I, text figs. 426-430, 1923.

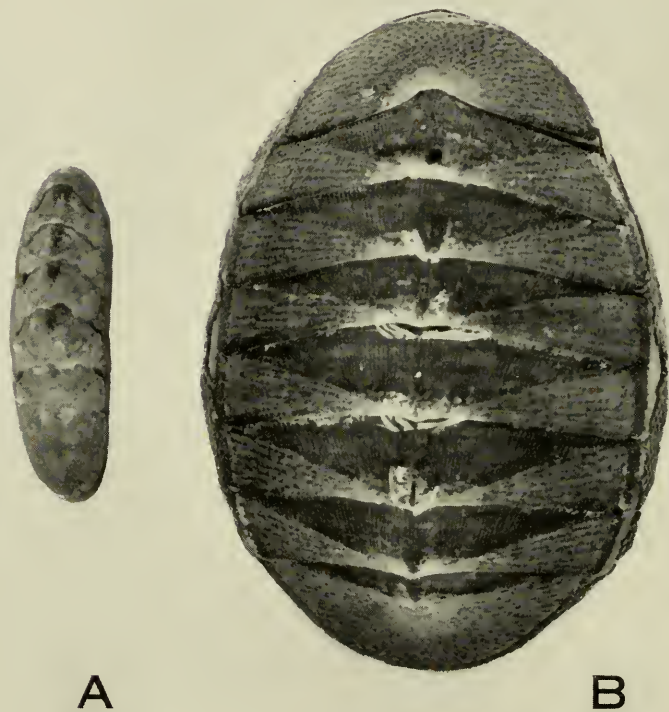


Figure A: *Ischnochiton (Stenoplax) limaciformis* Sowerby, natural size.
Figure B: *Chiton (Chiton) latus* Sowerby, natural size.

GASTEROPODA.

AMPHINEURA.

Subclass: **Isopleura.**

Order: **POLYPLACOPHORA.**

Superfamily: **Mesoplacophora.**

Family: **ISCHNOCHITONIDAE.**

Genus: **ISCHNOCHITON** Gray.

Subgenus: **Stenoplax** Carpenter, s.s.

Ischnochiton (Stenoplax) limaciformis Sowerby.

Plate 125, fig. A.

TYPE: The type material was collected at Lobos Island, Peru, and Guaycomayo, Central America, by Hugh Cuming. Depository not stated.

DISTRIBUTION: Mazatlan, Mexico, southward to the Lobos Islands, Peru, and also in the West Indies. According to Dr. Dall, it is, perhaps, also found in Japan.

MATERIAL EXAMINED: One specimen, dredged in 5 fms., American Shoal Light, Florida, by the "*Ara*." This is a very large specimen.

COLOR: Dorsally buff-gray or greenish, indistinctly mottled with darker tones and sometimes spotted with red; ventral surface stained with bright pink and blue-green.

TECHNICAL DESCRIPTION: Shell very elongated, narrow, elevated, well arched, costulate longitudinally.

ANTERIOR VALVE: Finely sculptured with close, regular, concentric ridge, composed of irregular, wavy lines, also marked by occasional lines, indicating arrested growth development. Eleven slits are present.

INTERMEDIATE VALVES: The central areas are separated from the lateral areas by a decided obtuse ridge, the lateral areas being well elevated. The sculpture on the central areas consists of fine longitudinal riblets, separated by interstices of equivalent width; these riblets are continued upon the lateral areas, becoming heavier and wider there and being distinctly wavier on the slope between the two areas. One slit is present in each valve.

POSTERIOR VALVE: With the umbo subcentral, not very high; the central region marked with fine longitudinal riblets as on the other valves, and with the posterolateral slope behind the umbo sculptured with concentric rings of wavy ridges. Nine slits are present.

The sutural plates are well developed, the sinus flat, wide. Teeth sharp, smooth, Eaves solid, grayish.

The girdle consists of very minute, flat, solid, non-striated scales.

This species is readily recognized in the field by the sculpture of the lateral areas and end valves, which are not granulated but have slightly serrated concentric flat riblets. The girdle scales are very minute, flat, solid, not striated.

REFERENCES: *Chiton limaciformis* BRODERIP AND SOWERBY, Proc. Zool. Soc., London, 1832, p. 26.—SOWERBY, Conch Illus., fig. 38.—

REEVE, Conch. Icon., tab. 8, fig. 42.

Ischnochiton limaciformis SHUTTLEWORTH, Bern. Mittheil, p. 190, 1853.

Ischnochiton (Stenoplax) limaciformis CARPENTER, Mss.—DALL, Bull. Mus. Comp. Zool., vol. 18, pt. 2, p. 415, 1889.—TRYON, Man.

Conch., vol. 14, p. 57, 1892.—DALL, Proc. U. S. Nat. Mus., vol. 37, p. 245, 1910.

Ischnochiton multicostatus DALL (not C. B. Adams), Proc. U. S. Nat. Mus., vol. 6, p. 337, 1883.

Chiton productus REEVE, Conch. Icon., t. 17, fig. 97, 1847.

Chiton sanguineus REEVE, l. c., fig. 98.

Superfamily: Teleoplacophora.

Family: CHITONIDAE.

Subfamily: Chitoninae.

Genus: CHITON Linné, s.s.

Subgenus: Chiton

Chiton (Chiton) latus Sowerby.

Plate 125, fig. B.

TYPE: The type locality was not known to Sowerby. It was first known in the private collection of the Earl of Tankerville, which was sold in 1825; present depository not traced.

DISTRIBUTION: Chile; Valparaiso and Coquimbo; Galapagos Islands. A reef-dwelling species.

MATERIAL EXAMINED: One large specimen, collected at Gardner Bay, Hood Island, Galapagos Islands, by the "Ara," February 4, 1928.

COLOR: Shell black with small blue flecks distributed abundantly over the valves. Interior light blue. Girdle black.

SHELL: Strong, large, oval, moderately elevated, jugum finely carinated, pleura slightly convex.



Chiton goodallii Broderip, natural size, of an average sized specimen, from Cocos Island.

MEASUREMENTS: Long diameter 75 mm., short diameter 46 mm.

ANTERIOR VALVE: Regularly convex, entire surface covered by fine, radiating, subobsolete riblets that appear as almost interrupted series of granules. Twelve slits are present.

INTERMEDIATE VALVES: The central areas of these valves are finely sculptured, with close longitudinal riblets separated by deeper interstices, about 80 riblets are on the fourth intermediate valve. The lateral areas are well defined, but little rounded, sculptured by about the lines of fine, radiating obsolete riblets, each consisting of a wavy line, formed by the irregularity of the rib; interstices well defined, quite porous. One slit is present in each valve. The sutural plates are wide, the sinus square, finely toothed.

POSTERIOR VALVE: With the umbo very near the posterior margin, the central region short, regularly striated with fine riblets separated by deeper interstices, as in the preceding valves; the region behind the umbo sloping, the postlateral region evenly rounded, sculptured by wavy, concentric lines of fine radiating subobsolete riblets separated by porous interstices. Fourteen slits are present.

GIRDLE: In the preserved specimen 9 mm. wide, shining black, paved with strong, imbricating scales; an average scale has a rhomboidal contour with the dorsal surface convex; some are less rhombic in outline.

REFERENCES: *Chiton latus* SOWERBY, Tankerville's Catal. of Shells, Appendix, p. 5, Jan., 1825 (not of Lowe, April, 1825, nor of Guilding, 1829).—DALL, Proc. U. S. Nat. Mus., vol. 37, p. 247, 1910.

Chiton magnificus DESHAYES, Dict. Class. des Sci. Nat., vol. XII, p. 455, 1827; Encycl. Meth., p. 680.—LAMARCK, Anim. sans Vert., Deshayes Ed., vol. 7, p. 498, 1836.—REEVE, L., Conch. Icon., pl. 1, fig. 3.

Section: **RADSIA** Gray.

Chiton goodallii Broderip.

Plate 126.

TYPE: Collected at James Island, Galapagos, by Hugh Cuming; the older specimens were found in exposed situations; the younger individuals under stones and ledges of rock at low tide. Depository not cited; type first in the Hugh Cuming collection.

DISTRIBUTION: Galapagos Islands; Cocos Island.

MATERIAL EXAMINED: Six specimens, Wafer Bay, Cocos Island, March 5, 1926. Seven very large specimens, Wafer Bay, Cocos Island, February 4, 1928; all collected by the "Ara."

COLOR: Olive-black, blackish, or brownish dorsally, dappled with olive, with a transverse olive-green stripe on each side of the keel. With transverse ziczac lines of light blue, six on each side of the seven posterior valves. Girdle mottled green. Interior white, each valve with a pair of median rays and a central spot of brown.

TECHNICAL DESCRIPTION: Shell large, heavy, widely oval, moderately elevated and moderately carinated, with the lateral slopes nearly straight or but little convex; entire surface nearly smooth.

MEASUREMENTS: 120 mm. long diameter; 72 mm. short diameter.

ANTERIOR VALVE: Regularly convex, devoid of sculpture, except exceedingly minute granulations and with several concentric lines of growth arrest. Twenty-six slits present.

INTERMEDIATE VALVES: The central areas of these valves are separated by an obtuse blunt carina from the lateral areas; there is no sculpture except very fine lines indicating growth arrest. Two or three slits are present in each valve.

POSTERIOR VALVE: With the umbo extremely close to the anterior margin; the postlateral region rounded, sloping. Twenty-six slits present.

The sutural plates are broad, the sinus somewhat shallow, with eight teeth.

GIRDLE: 12 mm. wide (preserved specimen), strong, composed of olivaceous blackish, imbricating scales, each of which has the dorsal surface a little convex.

REFERENCES: *Chiton goodallii* BRODERIP, Proc. Zoöl. Soc. London, 1832, p. 25.—TRYON, Man. Conch., vol. XIV, p. 191, pl. 29, figs. 9, 18.—STEARNS, Proc. U. S. Nat. Mus., vol. 16, p. 404, 1893 (issued 1894).—DALL, *ibid*, vol. 37, p. 247, 1909.

Chiton goodallii SOWERBY, Conch. Illus., figs. 34, 40.

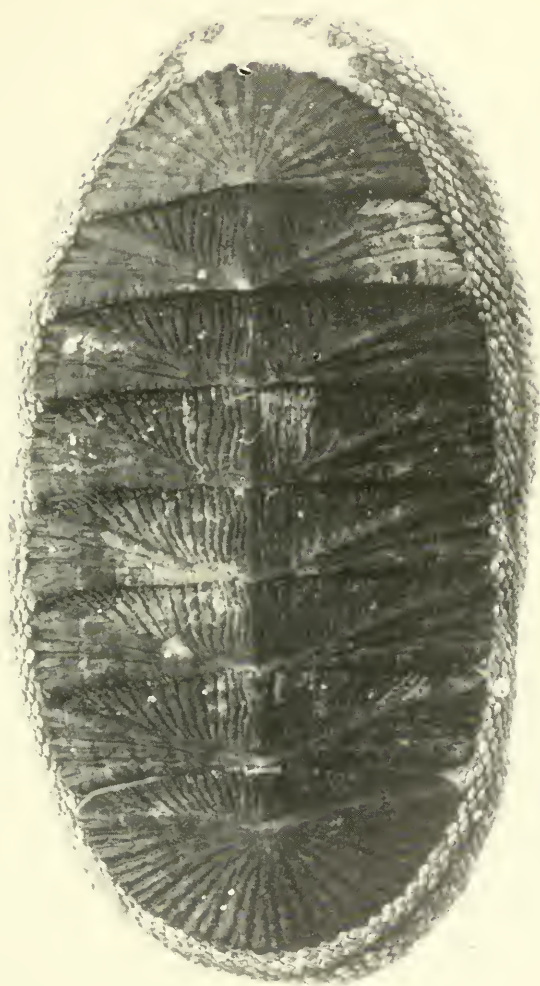
Chiton goodallii REEVE, Conch. Icon. fig. 8.

Radsia goodallii CARPENTER, MSS.

Chiton (Radsia) sulcatus Sowerby.

Plate 127.

TYPE: Wood states: "This rugged *Chiton* is said to inhabit the South Seas." Depository not stated.



Chiton (Radsia) sulcatus Sowerby, natural size of Galapagan specimen.

DISTRIBUTION: Galapagos Islands. Reef dwelling.

MATERIAL EXAMINED: One specimen, very large, Gardner Bay, Hood Island, Galapagos Islands, February 4, 1928.

COLOR: Dorsally uniformly olive-black or purplish black; interior surface blue-green.

TECHNICAL DESCRIPTION: Shell oval, or oblong-oval, moderately elevated and moderately carinated, with the lateral slopes nearly straight. Surface radiately ribbed.

MEASUREMENTS: 130 mm. long diameter; 70 mm. short diameter.

ANTERIOR VALVE: Sculptured with strong radiating ribs, deep sculptured and split toward the periphery. Twenty-four slits present.

INTERMEDIATE VALVES: The central areas of these valves are sculptured with numerous strong, small riblets, which converge forward near the dorsal edge, but on the pleura they diverge strongly. The lateral areas are very strong, radiately ribbed and grooved, the posterior rib of each valve is broad and crenulated; the other ribs are unequal, usually split toward the outer margin. Two or three slits are present.

POSTERIOR VALVE: With the umbo conspicuous, in front of the middle. Surface sculptured with fine radiating ribs, which split toward the periphery. Three slits present.

The suture plates are broad, the sinus fairly deep and square, finely toothed.

GIRDLE: Formed of coarse convex scales, which are larger toward the periphery.

REFERENCES: *Chiton sulcatus* WOOD, Gen. Conch., p. 16, fig. 1.—SOWERBY, Conch. Illus., fig. 12.—REEVE, L., Conch. Icon., fig. 15.

Radsia sulcata CARPENTER, Mss.

Chiton (Radsia) sulcatus TRYON, Man. Conch., vol. XIV, p. 191, pl. 28, figs. 1, 2, 3, 4, 1892.—STEARNS, Proc. U. S. Nat. Mus., vol. 16, p. 404, 1893 (issued 1894).—DALL, *ibid*, vol. 37, p. 247, 1910.

EUPTEROPODA BOAS.

Family: CYMBULIIDAE.

Genus: **CYMBULIA** Peron and Lesueur, 1810.

Cymbulia peronii Blainville.

TYPE: Not located.

DISTRIBUTION: Pelagic in the Mediterranean Sea and tropical zone of the Atlantic Ocean.

MATERIAL EXAMINED: Four specimens, pelagic in the Mediterranean Sea, 10 miles S. by E. of Monaco Harbor, April 19, 1927, collected by the "*Ara*." Two specimens, St. Raphael, bearing S. S. E., 9 miles, S. of France, 400 fms., March 23, 1927.

TECHNICAL DESCRIPTION: Consult M. Vayssiere's masterly report of this species (Res. Campag. Sci. Monaco, Fasc. XLVII, p. 174, pl. XIII, figs. 291-303; pl. XIV, figs. 304-322, 1915). The "*Ara*" specimens conform in all essentials with the above-mentioned diagnosis.

REFERENCES: *Cymbulia peronii* DE BLAINVILLE, Dict. Sci. Nat., t. XII, p. 333, pl. 69, fig. a, 1818.—PELSENER, Rept. Voy. "*Challenger*" Zool., vol. XXIII, Heteropoda, part 2, p. 98, 1888.—DELLE CHIAJE, Anim. sans Vert. Reg. di Napoli, atlas, pl. 32, fig. 1, 1823-29.—VAYSSIERE, Encycl. Sci., Mollusques de France, t. I, p. 179, 1913; Res. Campag. Sci. Monaco, Fasc. XLVII, Mollusques Eupteropodes, p. 174, pl. XIII, figs. 291-303, pl. XIV, figs. 304-322, 1915 (complete diagnosis with synonymy); *ibid*, Fasc. LXXI, Mollusques Heteropodes et Eupteropodes, p. 20, 1927.

TECTIBRANCHIATA.

Family: **TETHYMELIBIDAE** Bergh.

Genus: **TETHYS** Linné.

Tethys dactylomela (Rang.).

Plate 128.

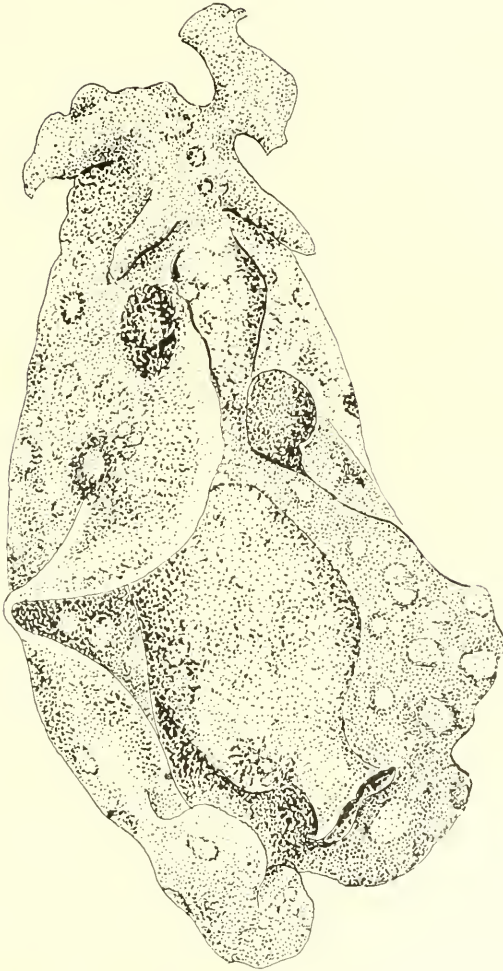
NAME: Sea-Hare or Sea-Cat.

TYPE: Rang's type came from Saint Yago de la Praya, Cape Verde Islands, and was first deposited in the "Cabinet d'Anatomique du Jardin des Plantes, No. 12"; later placed in the Paris Museum.

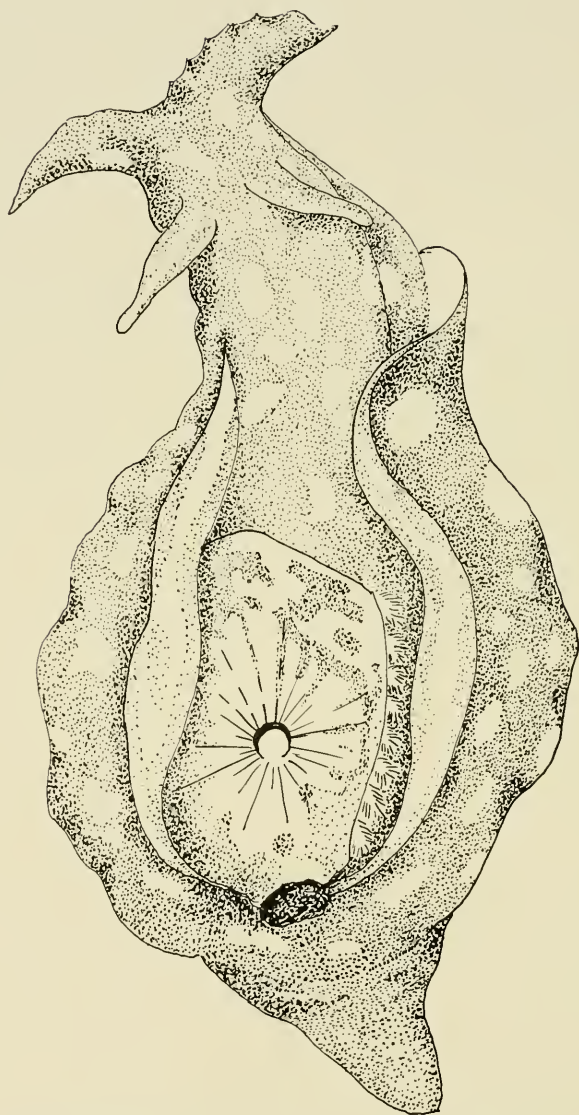
DISTRIBUTION: This species, originally described from the tropical eastern Atlantic has later been found abundantly in the West Indian region. Verrill and Heilprin each record it from Bermuda.

MATERIAL EXAMINED: One specimen, taken off American Shoal Light, Florida, 5 fms., March 23, 1924.

COLOR: In life this species is exquisite, having a rich velvety olivaceous drab ground color, marked all over with circles and streaks of velvety black and with the margins of the swimming lobes tinged with violet. Its gracefulness of motion, effected by a gentle undulation of the lateral swimming lobes, is indescribably lovely.



Tethys dactyloscula (Rang), about natural size; sketched from dorsal profile.



Tethys depilans (Linné), seen from the dorsal side, $\times 0.7$.

TECHNICAL DESCRIPTION: See Rang's original description, also Dobson's additional notes and figures on the lingual ribbon and teeth.

The "*Ara*" specimen is figured in plate 128.

REFERENCES: *Aplysia dactylomela* RANG, Hist. Nat. des Aplysiens, p. 56, pl. IX, 1828, Paris.—DOBSON, G. E., Jrn. Linn. Soc. Zool. London, vol. XV, p. 159, text figures, 1, 2, 1881.—HEILPRIN, The Bermuda Islands, p. 186, 1889. *Tethys dactylomela* VERRILL, Trans. Conn. Acad. Arts and Sci., vol. X, p. 545; *ibid*, vol. XI, p. 27, pl. III, fig. 3, 1901-03.

Tethys depilans (Linné).

Plate 129.

NAME: Sea-Pigeon.

TYPE: Not located. Linnaeus states: "Habitat in M. Mediterraneo."

DISTRIBUTION: This species is chiefly an inhabitant of the Adriatic and Mediterranean Seas but is also known from the Atlantic coast of Europe as far north as the south coast of Devon, England, and the Channel Islands and southward on the west coast of France and Madeira. Watson has recorded it from Simon's Bay, Cape of Good Hope, Africa, 1873.

MATERIAL EXAMINED: One large specimen, taken at Palermo, Italy, September 2, 1924, by the "*Ara*."

COLOR: The coloration of this sea-hare is quite variable, the ground color being light brown, grayish brown, or, more rarely, very dark, the markings always being irregularly shaped white or light gray spots.

TECHNICAL DESCRIPTION: The living animal frequently attains a length of 18 to 20 cm., but has the body distinctly more compressed and shorter than its ally, *T. leporina*. The swimming lobes of *T. depilans* are united posteriorly as far forward as the mantle siphon; the foot is posteriorly rounded. The mantle has a broad round orifice leading into the shell cavity and surrounded by dark brown rays. The many glands which in life secrete a milky fluid open on the under side of the mantle. The mantle siphon is shorter than that of *T. leporina*. The genital and anal apertures are like those of *leporina*. Behind the genital opening there are many one-celled glands, each with its individual opening, thus differing from the grape-bunch like gland of *leporina*. The anatomy of *depilans* has been worked out carefully by Vayssiére (1890), also by Blochmann (1884). The teeth and

jaws are figured by Zuccardi (1890). The embryology of *depilans* was reported by Lankaster (1875).

The shell of *depilans* is subquadrangular, convex, thin, nearly opaque, composed of two layers, the outer layer corneous, pale amber, membranous, and the inner calcareous layer, which is decidedly thicker than that of *leporina* and has a shining, light vitreous surface, marked by growth lines and obsolete radial folds and grooves. The spire is covered by an irregular callous, except in very young adults.

REFERENCES: *Lernaea* (part) BOHADSCH, de Quibusdam animalibus, etc., pls. 1-3, 1761, Dresden (not available for examination).

Laplysia depilans LINNÉ, Syst. Nat., ed. XII, p. 1082, 1767.

Aplysia depilans GMELIN, Syst. Nat., p. 3103.—VAYSSIÈRE, A., Rech. Moll. Opistobr. Atlas d'Anat. Comp. Invert., Paris, p. 65, figs. 51-58, 1890 (not available for examination. Discusses anatomy). —BLOCHMANN, Mittheil. Zoöl. Stat. Neapel, vol. V, p. 32, pl. 3, figs. 2, 5, 10, 1884 (Anatomy). —ZUCCARDI, Boll. Soc. Nat. in Napoli (1), vol. IV, p. 6, pl. 1, figs. 1, 4, 10, 13, 15; pl. 2, figs. 25-29 (teeth and jaws figured). —WATSON, Rept. Voy. "Challenger" Zoöl., vol. XV, p. 672, 1886 (synonymy). —MAZZARELLI, G., Mem. Soc. Ital. Sci., 3rd series, vol. IX, p. 29, pl. 1, fig. 9, 1893 (Anatomy).

?*Aplysia major* LANKASTER, Philos. Trans., vol. CLXV, p. 13, 1875 (Embryology).

Aplisia leporina DELLE CHIAJE, Mem. Anim. Senza Vert., vol. I, p. 28, atlas, pl. II (not pl. XXXI), 1823-29.

Tethys depilans TRYON, Man. Conch., vol. XVI, p. 69, pl. 23, figs. 26, 27; pl. 24; pl. 33; fig. 25, 1895-96 (with extensive synonymy).

Tethys fimbria (Bohadsch).

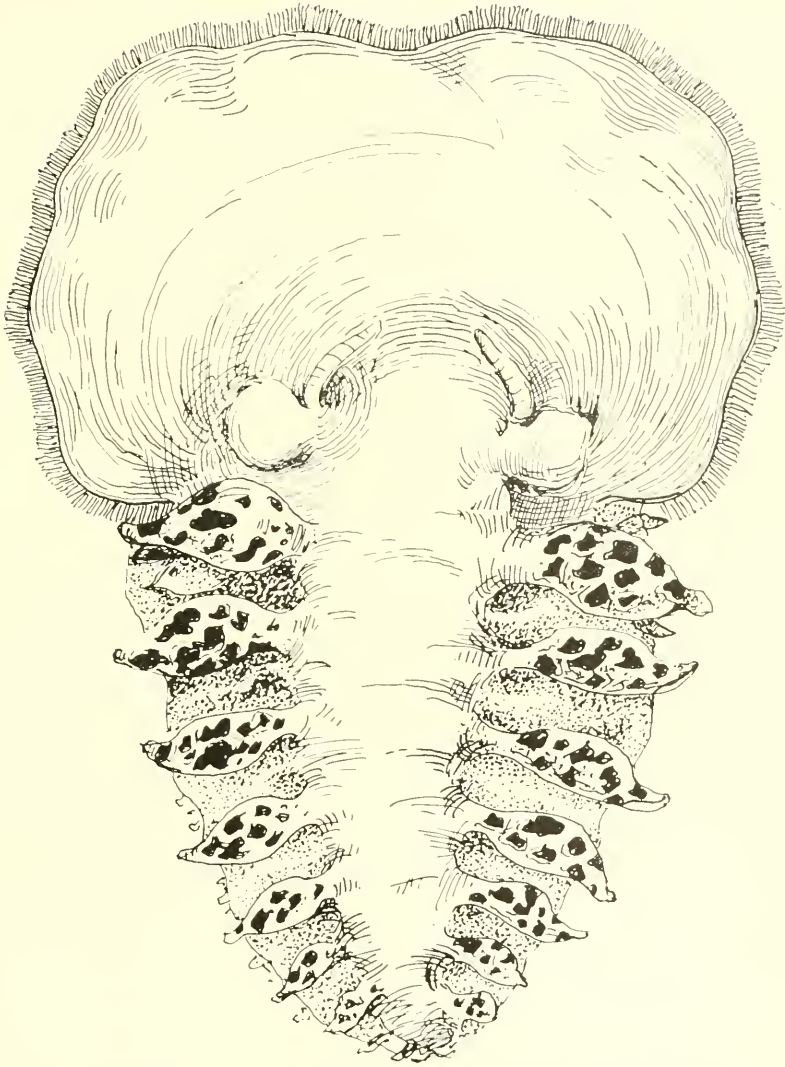
Plate 130.

TYPE: Not located; original description not available.

DISTRIBUTION: Mediterranean: southern coast of France; coasts of Italy and Sicily; Balears Isles; coast of Algeria.

COLOR: Semitranslucent milky white, with numerous irregular blotches of black.

MATERIAL EXAMINED: One very large specimen, Monaco, Mediterranean, May 14, 1927.



Tethys fimbria (Bohadsch), about three-fourths of natural size.



Dolabrifera virens Verrill, natural size; dorsal profile.

TECHNICAL DESCRIPTION: Diagnostic description, including the anatomy of this species, has been carefully reported by M. A. Vaysiere in his "Recherches Zoologiques et anatomiques sur les Mollusques Opisthobranches du Golfe de Marseilles. Part III, Nudi-branches," p. 82.

The development of this species has been studied by M. Viguier, "Archives de Zoologie Experimentale," 3me serie, tome VI, 1893, pl. VII, fig. 1, and text.

The "Ara" specimen is a large and strikingly beautiful one, about 14 cm. long. This species is readily recognized in the living state by its distinctive coloration and by the large spotted appendages. The fact that these latter break off easily if the animal is disturbed, have caused them to be considered parasites by many people.

REFERENCES: *Fimbria* BOHADSCH, J. B., de quibusdam Animalibus marinis eorumque proprietatibus . . . etc., Dresden, XVIII pp. and 169 pp., 12 plates, 1761 (not available for examination).

Aplysia leporina DELLE CHIAJE, Mem. Animali senza Vertebre del Regno di Napoli, 1823-29, vol. II, p. 138, p. 146, atlas, pl. 39, fig. 1, fig. 2.

Tethys fimbria VIGUIER, Archiv. Zoöl. Exper. 3me serie, tome VI, pl. VII, fig. 1, 1893 (development). A. VAYSSIERE, Ann. Mus. Marseille, tome VI, Zoöl., 1900-1901, p. 82, pl. 7, fig. 14; Faune de France, Mollusques, I, p. 259, pl. 28, fig. 7, 1913.

Subfamily: **Dolabriferinae** Pilsbry.

Genus: **DOLABRIFERA** Gray.

Dolabrifera virens Verrill.

Plate 131.

TYPE: Founded on six specimens taken at Hungry Bay, Bermuda, in 1901; depository not stated.

DISTRIBUTION: This is a rare species, known only from the type locality Bermuda, and the present record from the southern coast of Cuba.

MATERIAL EXAMINED: One large specimen taken at surface, 15 miles east of Casilda, Cuba, February 14, 1923, by Mr. W. K. Vanderbilt.

COLOR: In life this sea-hare is dull yellowish green, marbled with pale brownish and with white spots, the margin is pale bluish with white flecks, the undersurface is olive-green. It swims with an indescribable, shimmering, fluid gracefulness.

TECHNICAL DESCRIPTION: The "Ara" specimen is 110 mm. long, in its dead, constricted condition. The body is globose-ovate, broadly rounded posteriorly. The tentacles are very large, elongated, distally much expanded, the broad, thin edges undulated. The rhinophores are decidedly shorter and much smaller than the tentacles, very muscular, with the ends dilated. The mantle lobe is nearly semicircular, with a small open sinus at each end of the branchial cavity. The entire upper surface of the body and head is covered with rather closely spaced, fleshy, conical papillae, 2 to 3 mm. high in the dead specimen; some of these papillae are acute-tipped, but the majority are divided distally into two, four or, more rarely, six small branches. This ornamentation, combined with the color-pattern, gives this species an excellent mimicry of seaweed.

SHELL: Well developed, calcareous, with the beak produced, somewhat spoon-shaped with concavity; the sinus incurved with the inner margin thickened; the outer margin nearly straight, with a faint curvature; the anterior margin obliquely truncated. The outer surface bears obscure radial ribs.

There is definite need of more critical work on the anatomy of this species than has been presented, but this must await the capture of additional fresh specimens.

REFERENCE: *Dolabrifera virens* VERRILL, Trans. Conn. Acad. Arts and Sci., vol. XI, part I, p. 24, text fig. 1, 1901-03.

HETEROPODA.

Section: **PTEROTRACHEATA.**

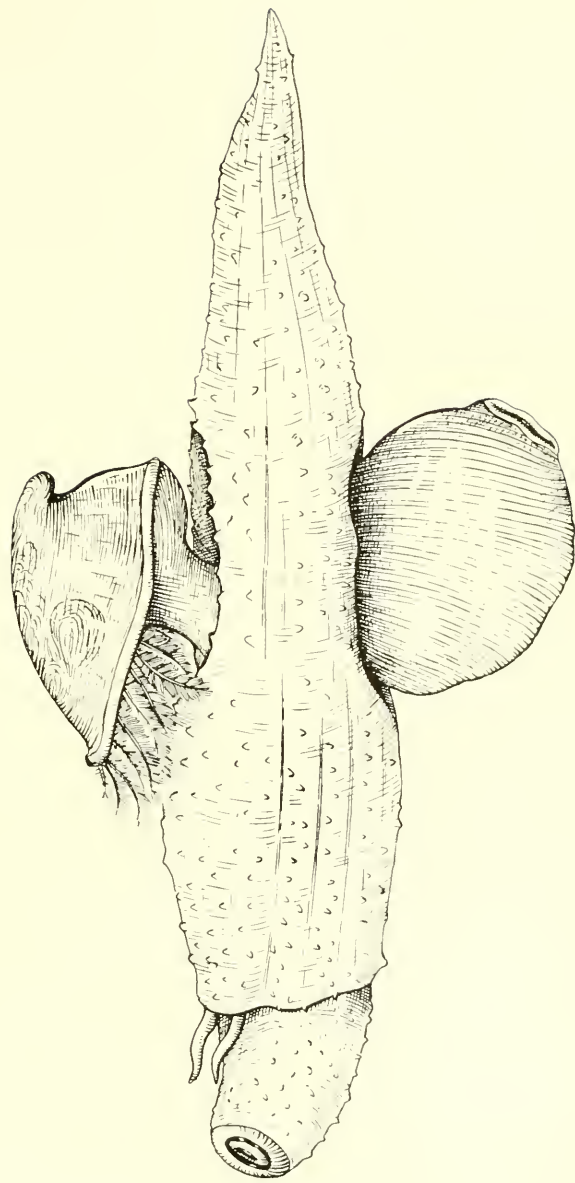
Family: **CARINARIIDAE.**

Genus: **CARINARIA** Lamarck.

Carinaria mediterranea Peron and Lesueur.

Plate 132.

TYPE: Not stated; the writers refer to and figure this species, under



Carinaria mediterranea Peron and Lesueur, natural size. (After Vayssiere).

Carinaria Lamarck, published in the Annales Museum d'Histoire Naturelle Paris, volume XV, 1810.

DISTRIBUTION: Pelagic in the Mediterranean Sea.

MATERIAL EXAMINED: One specimen caught in the dip-net, Monaco, Mediterranean Sea, May 2, 1927, by the "Ara." Another specimen from the same locality, May 14, 1927, broken.

COLOR: Both shell and tissues are semitranslucent in life, showing the internal organs.

REMARKS: *C. mediterranea* swims upside down, that is, with the ventral surface upward; the foot takes the form of a fan-like fin. The species is dioecious; the female deposits a long chain of granular eggs and has been known to deposit a string of a meter's length in a day.

TECHNICAL DESCRIPTION: Consult Vayssiere's excellent presentation of this species, in the Monaco Report, fascicule XXVI, p. 11, pl. 1, figs. 1-10, pl. 2, fig. 17, 1904. The internal anatomy of *mediterranea* has been very critically studied by several scientists, notably Cuvier, Lesueur, Souleyet and Eydoux, Leukart and Gegenbaur.

The single specimen taken by the "Ara" is quite large and conforms in every detail with M. Vayssiere's description of the species.

REFERENCES: *Carinaria mediterranea* PERON and LESUEUR, Ann. Mus. Hist. Nat. Paris, vol. 15, p. 67, pl. 2, fig. 15, 1810.—VAYSSIERE, Res. Campag. Sci. Monaco, Fasc. XXVI, p. 11, pl. 1, figs. 1-10, pl. 2, fig. 17, 1904.—GEGENBAUR, C., Untersuchungen uber Pteropoden und Heteropoden, Leipsig, p. 37, 1854.

Pterotrachea lophira DELLE CHIAJE, Mem. Anim. Senza Vert., vol. III, p. 161, in atlas as *P. lophyra*, pls. 14, 15, 41, 1823-29.

Carinaria vitrea O. G. COSTA, Ann. Sci. Nat. Paris, t. XVI, ser. I, p. 107, pl. 1, 1829.

Carinaria cymbium LAMARCK, Anim. sans Vert. Mollusques, ed. II, vol. XI, p. 381, 1840.—CUVIER, G., Regne Anim., Mollusques par Deshayes et H. Milne Edwards, Paris, t. I, p. 101, atlas II, pl. 38, 1840-1855.

Family: **FIROLIDAE** Gegenbaur.

Genus: **FIROLA** Bruguiere.

Firola coronata Forskal.

Plate 133.

TYPE: Not located. Described from specimens from the Mediterranean Sea and Archipelago.

DISTRIBUTION: Pelagic in the Mediterranean Sea.

MATERIAL EXAMINED: Dredged in 500 fms. bottom depth, dredge down 400 fms., St. Raphael bearing S. S. E., distance 9 miles, south of France, Mediterranean Sea, March 23, 1927, by the "*Ara*."

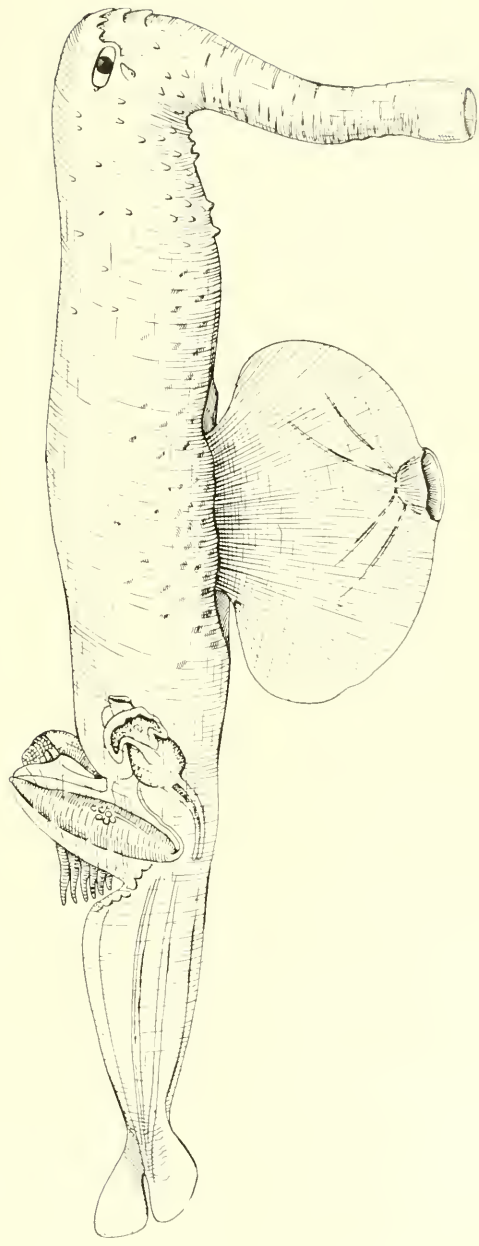
COLOR: In life *Firola coronata* is a semitranslucent pale amber. It is a living poem of gracefulness and evanescent beauty.

TECHNICAL DESCRIPTION: Consult Vayssiere, Monaco Fasc. XXVI, p. 33, pl. III, figs. 33-41, 1904.

Firola coronata is one of the largest and loveliest of the Heteropod mollusks; M. Vayssiere's excellent illustrations and diagnosis of the species render additional description superfluous.

REFERENCES: *Pterotrachea coronata* FORSKAL, Descript. Animalium, etc. . . . in itinere orientali observavit, p. 117, pl. 34, figs. 1-9, 1775.—DELLE CHIAJE, Mem. Anim. senza Vert., atlas, pl. 69, 1823-29.

Firola coronata VAYSSIERE, Res. Campag. Sci. Monaco, Fasc. XXVI, Mollusques Heteropodes, p. 33, pl. III, fig. 33-41, 1904 (diagnosis and synonymy); *ibid*, Fasc. LXXI, Mollusques Heteropodes et Eupteropodes, p. 9, 1927.



Firola coronata Forskal, about natural size. (After Vayssiere).

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