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Scientific Results of the First Oceanographic Expedition
of the "Pawnee"
1926.

ECHINODERMS FROM THE GULF OF CALIFORNIA
AND THE PERLAS ISLANDS.

By Lee Boone

Issued December, 1928.

ECHINODERMS FROM THE GULF OF CALIFORNIA AND THE PERLAS ISLANDS.

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The second Bingham Oceanographic Expedition brought home a small collection of echinoderms, consisting of seven species of starfish, nine species of echinoids, three of ophiurans, and one holothurian, which form the basis of this report. No crinoids were taken.

This expedition, undertaken and personally directed by Mr. Harry Payne Bingham, of New York City, in his yacht "Pawnee II," primarily for the purpose of ichthyological research, conducted some dredging operations in the waters of the Perlas Islands, Panama, and then cruised northward, exploring the Gulf of California at the points indicated on the accompanying map (page 2).

Preeminent in interest among the starfishes is the series of the strikingly beautiful *Amphiaster insignis* Verrill (plate 2) hitherto known only from the type material and one other specimen, subsequently taken by the 'Albatross.'

Among the Echinoids, an extensive series of the two species of *Encope*, *grandis* and *californica*, were taken. *Encope californica* is here fully figured for the first time.

The finding of *Brissopsus columbaris* A. Agassiz, burrowing along the tide line, is of especial interest because this species, which Agassiz founded on deep sea material but listed as littoral "by analogy," has hitherto only been known from depths ranging from 491 to 1793 fms.

The finding of the holothurian, *Euapta lappa* (Muller) in the Gulf of California, though necessarily a provisional determination, due to the condition of the specimens, is of interest. It is hoped that future collections will verify or correct this record.

Acknowledgments.

I am indebted to Mr. Harry Payne Bingham, owner of the collection, for the privilege of preparing this report.
Cruise of the PAWNEE, 1926, in the Gulf of California.
During the preparation of this report I have enjoyed full privileges of study in the library and research laboratory of the Department of Lower Invertebrates of the American Museum of Natural History, New York City.

The photographs for plates 2, 3, 4, and 5b, were made by Mrs. Elizabeth Fulda; those for plates 1, 5a, 6, 7, 8, and 9 were made by Mr. Julius Kirschner. The necessary retouching on some of these photographs has been done by Mr. W. H. Southwick.

The chart of the cruise was made by Mr. W. S. Bronson, staff artist of the expedition; data for some of the color notes was also supplied by Mr. Bronson.

Class ASTEROIDEA.

Family ASTROPECTINIDAE.

Genus Astropecten Schultze.

**Astropecten erinaceus** Gray.

Plate 2.


*Diagnostic characters:* *Astropecten erinaceus* may be readily distinguished in the field by the fact that the superomarginal plates are conspicuous in contrast to the papilla; the superomarginal plates at the base of the ray, but not in the interbrachial area, have two spinelets each, one placed on the inner edge and one on the outer edge near the margin. The inferomarginal plates have long spines which form a conspicuous fringe along the lateral margin of the ray.

*Type:* Taken at St. Elena, sandy mud, 6 fms. by H. Cuming, and deposited in the British Museum.

*Distribution:* Known from Lower California and the Gulf of California to Peru; chiefly a Panamic species.

*Material examined:* Seven young specimens of this beautiful Panamic *Astropecten* were taken in shallow water at Rey Isle, Perlas Islands by the "Pawnee II."

Genus *Nidorellia* Gray.

**Nidorellia armata** Gray.

Plate 1.


Diagnostic characters: The distinctive form and vivid coloration of this well known starfish prevent its being mistaken in the field for any other member of the West Coast fauna.

Type: From Punta Santa Elena, Ecuador, rock ground, 12 to 15 fms., collected by H. Cuming, and deposited in the British Museum.

Distribution: This species is known from Lower California, southward to Zorritos, Peru; also at Galapagos Islands.

Material examined: One large specimen of this well known West Coast starfish was taken at Pedro Gonzales Island, Perlas Islands. It is dry and still retains the bright red coloration characteristic of this beautiful species.

**Oreaster occidentalis** Verrill.

Plate 1.


Diagnostic characters: This is the West Coast analog of the West Indian *O. gigas*, from which it differs in being less spinose on the abactinal surface, and not at all spinose on the actinal surface; the marginal plates are devoid of spines or with only a few near the ends of the rays.

Type: Prof. Verrill’s type material consisted of two specimens, collected at Panama, in 6-8 fms., by F. H. Bradley.

Distribution: Definitely known from the Gulf of California, southward to Panama. It is believed by Dr. H. L. Clark, that Gray’s *Pentaceros cumingii* from Ecuador, is the young of this species.

Material examined: One young specimen, photographed natural size, from Pedro Gonzales Island, Perlas Islands, by the “Pawnee II.”

Colour: Prof. Verrill states that in life the dorsal plates are bright crimson, the spaces between greenish brown.

Family GONIASTERIDAE (emended)

Subfamily GONIASTERINAE Verrill.

Genus *Amphiaster* Verrill, 1878.

*Amphiaster insignis* Verrill.

Plate 2.


Material examined: Seven specimens of this strikingly beautiful starfish were taken by the “Pawnee II,” at La Paz, Lower California, the same locality from which the type was taken. The largest specimen measures 85 mm. R. This
Plate 1. *Nidorella armata* Gray, one-half natural size above; below, *Oreaster occidentalis* Verrill, young.
Plate 2. Upper figure *Amphiaster insignis* Verrill, reduced to two-thirds of natural size. Lower figure, a very young *Astropecten crinaceus* Gray.
species, which is the only member of the genus so far described from the west coast of America, is at once distinguished from other West Coast starfishes by its remarkable sculpture.

**Distribution:** This species is known only from a few records in the Gulf of California. The type which came from La Paz, is deposited in the Yale Museum; a single specimen was taken by the "Albatross" in Magdalena Bay, Lower California.

**Original description:** "Disk moderately developed, flat above and below, with five broad, triangular rays, and two well developed series of marginal plates. Skeleton of the upper side formed by regular, polygonal, spine bearing, tessellated plates, with pores between them; on the lower side composed of smaller granulated plates, each bearing a tubercle. Marginal plates granulated around the margin, smooth at center, or bearing a large, smooth spine. Inter-ambulacral plates bearing a row of smaller, inner spines, several on each plate, and an outer series of larger ones, one to each plate.

"This genus is nearly allied to Oreaster, and still more so to Nidorellia. From the former it differs in its depressed form, tessellated, polygonal plates, the character of the spines, etc.; from the latter, in the larger and less numerous plates of the upper surface, consisting mainly of the three median rows of the rays, with very few in the interradial regions, while in Nidorellia they are much more numerous and the interradial regions of the upper surface are well developed. The marginal plates, also, in the single known species, are granulated only around the margin." (Verrill.)

**Family OPHIDIASTERIDAE.**

**Genus Linckia** Nardo.

*Linckia columbiae* Gray.

**Plate 3.**


**Diagnostic characters:** A large starfish, attaining a ray of 50. to 60. mm.; with the dorsal surface covered with papillae which practically conceal the supramarginal plates; inferomarginals each furnished with 2 to 3 long spines, usually no papillae with large central tubercle (except occasionally some along the sides of the ray).

**Type:** Collected from the Bay of Caracas, West Columbia, on the rocks at low water by H. Cuming, and deposited in the British Museum.

**Distribution:** Known from Lower California to Northern Peru, including the Galapagos Islands.

**Material examined:** This species is represented in the Bingham collection by four specimens from Espiritu Santo, Lower California, April 23, 1926.

**Colour:** Dorsal surface cocoa brown with darker brown flecks.
Genus **Phataria** Gray.

**Phataria unifascialis** Gray.

Plate 3.


**Diagnostic characters:** A slender, starfish, with the disk small, rays 4–10r; disk and rays covered with a smooth granulated coat, with no projecting spines except those beside the ambulacral furrows. The papular areas are usually in a simple broad series along each side of the ray.

*Type:* Collected in the Bay of Caracas, West Columbia, on the rocks at low water by H. Cuming, and deposited in the British Museum.

*Material examined:* Six specimens from Espiritu Santo, Lower California, were collected by the "Pawnee II."

*Colour:* "Dorsal surface reddish brown, with median longitudinal stripe of purple on the rays." (L. L. Mowbray.)

**Family ASTERIDAE.**

**Subfamily HELIASTERINAE.**

Genus **Heliaster** Gray.

**Heliaster kubiniji** Xantus.

Plate 4.


**Diagnostic characters:** This species, which is known from the Gulf of California, the West Coast of Mexico and Central America, is distinguished by its distinctive coloration which is deep purple on the abactinal surface with the spines, pedicellariae and madrepor plate usually deep yellow; the rays are rather indistinctly banded in the specimens before me, but this banding is absent on some of the American Museum specimens. The average number of rays is 24; they are free for half or less than half their length. The fact that these rays are less free and are stouter with larger spines than *H. multiradiatus*, the nearest related species, which differs also in distribution, being confined to the Galapagos, also serves to distinguish the two.

*Type:* Mr. Xantus' type, which had a diameter of seven inches, was collected at Cerro Blanco, off Cape St. Lucas, Lower California, and deposited in the Smithsonian Institution. It was named for M. Kubiniji, Director of the Hungarian National Museum at Pesth.

**Distribution:** This species was originally taken at Cerro Blanco, off Cape St. Lucas, Lower California; it has subsequently been taken at many localities.
Plate 4. Abaxial surface of *Heliaster kubiniji* Xantus, reduced to about three-fourths of natural size.
Boone: Echinoderms from the Gulf of California

between 30° N. lat. and 10° N. lat.; Nicaragua is the southernmost record for this species to date.

*Material examined:* Five specimens from Espiritu Santo, Lower California, April 23, 1926. A specimen of average size measures $R. = 3$ inches and has twenty-four rays.

*Colour:* Abactinal surface deep purple, with pedicellariae, spines and madre-pore deep yellow; rays sometimes indistinctly banded.

**Class OPHIUROIDEA.**

**Family OPHIOCOMIDAE.**

*Genus Ophiocoma* L. Agassiz.

*Ophiocoma alexandri* Lyman.


*Diagnostic characters:* Disk grayish to yellowish brown; arms barred; arm spines five to seven, the third to fourth of which are longest. Upper arm plates regular, oval hearts with the apex directed inward. Mouth shields nearly round with the inner end slightly truncated.

*Type:* The species was founded on two specimens, taken at Acapulco, Mexico, by Alexander Agassiz and deposited in the Museum of Comparative Zoology.

*Distribution:* Known from the Pearl Islands northward to Lower California, in the Gulf of California.

*Material examined:* One specimen from San José Id., Lower California, 3 fms., April 23, 1926.

**Family OPHIODERMATIDAE.**

*Genus Ophioderma* Muller and Troschel.

*Ophioderma variegata* Lutken


*Material examined:* Five specimens from Espiritu Santo Isle, L. C., 6 fms., April 21, 1926. These are all young adults and show the multicolored red, green and yellow design characteristic of this species. One very large specimen from Gonzales Bay, has a disk diameter of three-fourths of an inch, or about twice the size of the preceding specimens, and is a dull grey brown (preserved specimen, but in the same fluid as the foregoing specimens).

**Family AMPHIURIDAE.**

*Genus Ophiactis* Lutken.

*Ophiactis savignyi* Muller and Troschel

*Ophiactis savignyi* Muller and Troschel, Syst. Ast., p. 95, 1842.


Diagnostic characters: Except in very young specimens, the arm is abruptly dilated near the disk. Arm spines are stout, near the base usually five, two of which, the two upper ones, are the longest. Dorsal arm plates twice as wide as long, with the distal transverse margin lobed.

Type: The type material was taken at Realejo, in 3 fms., and at Puntarenas, by Dr. Oersted; deposited in the Copenhagen Museum.

Distribution: Practically cosmopolitan in the tropic and subtropic regions of both the Atlantic and Pacific Oceans.

Material examined: Six specimens of this very beautiful cosmopolitan species were taken by the “Pawnee II” at San José Island, Lower California, in 3 fms., April 23, 1925.

Colour: An exquisite marbling of moss-green interspersed with cream color; the green being dominant and varying somewhat in intensity and design.

Class ECHINOIDEA.

Family CIDARIDAE.

Subfamily GONIOCIDARIDAE.

Genus Euclidaris Gray.

Euclidaris thouarsii (Valentin).

Plate 5.


Diagnostic characters: “This species is at once recognized by its stout “pencil” spines. It is readily distinguished from its West Indian congener, E. tribuloides, by the fact that the West Coast species has the median area of the interambulacra wider but more closely granulated; and in having much stouter and relatively shorter spines which are more coarsely sculptured. The primary spines are stout; largest just beyond the base and then slightly diminished to the ends which are dilated and obtuse-blunt. The little spines at the base of the big ones are thin, flat, spatulate, obtuse at the ends. The ovarian plates form a regular 5-rayed star which is more distinct than is that in the West Indian species.

Type: The type material came from California and the Galapagos Islands and is deposited in the Museum National d’Histoire Naturelle, Paris.
Plate 5. Upper figure *Centrostephanus coronatus* Verrill, young; lower figure, *Eucidaris thouarsii* (Valentin), slightly reduced.
Distribution: From Lower California to Panama and the Galapagos Islands.

Material examined: There is only a single specimen, a fairly large one measuring, disk width, diameter two and one-eighth inches, primary spines one and one quarter inches long, from Espiritu Santo, Lower California, April 23, 1926.

Family **DIADEMATIDAE**.

Genus **Centrostephanus** Peters.

**Centrostephanus coronatus** Verrill.

Plate 5.


Type: The type was collected at Cape St. Lucas, Lower California, by Mr. J. Xantus and is deposited in the U. S. National Museum.

Distribution: This rather rare species appears to be confined to the Gulf of California and Lower California.

Material examined: Three very young specimens were taken in 3 fms., San José Island, Lower California, April 23, 1926.

Genus **Astropyga** Gray.

**Astropyga pulvinata** (Lamarck).

Plate 6.


Diagnostic characters: This species is readily distinguished from _A. radiata_ by the fact that _pulvinata_ has the test less depressed, more globular, with broader bare median interambulacral spaces. The column of primary tubercles on the actinal surface are parallel with the midline of the interambulacrum; on _radiata_ these corresponding tubercles are parallel with the margin of the ambulacrum.

Type: Lamarck's type, the locality of which is unknown, is in the Paris Museum, Ecole des Mines.

Distribution: This rather rare species appears to be confined to the region from Lower California to Panama. It was taken by the "Albatross" at only one station in the Gulf of California, i.e. 15 specimens at San Franciscquito Bay, East coast of Lower California. The "Pawnee" material appears to be the first record of the species from Concepcion Bay.
Material examined: Two specimens from Concepcion Bay, Lower California, May 3, 1926.

Colour: Dr. H. C. Clark states that "The most interesting feature of these Astropyga is the coloration." All specimens of pulvinala which I have seen hitherto have had a dull greenish ground color, in marked contrast to the deep red of A. radiata. The present specimens however show that the ground color in pulvina is deep purplish red at and above the ambitus and that the greenish color of dry museum material is due to the peeling off and loss of the red epidermis, which appears to flake off and disappear very easily. A very constant feature of the coloration of pulvinala, conspicuous in all but one of the present series, is a yellowish triangular spot in each interradius just above the ambitus. This is usually visible even in the greenish specimens and is very noticeable in the red ones. Apparently this spot is pale yellow, or possibly even white, in life." (Clark.) Agassiz states that this yellow spot is bright blue in life.

Family ARBACIADAE.

Genus Arbacia Gray.

Arbacia incisa (A. Agassiz).
Plate 6.


Diagnostic characters: The test of this species is very distinctive; the plates of the abactinal system and bare interambulacral areas exceedingly finely granular; the primary tubercles are few, short, stout; oculars small, usually exsert.

Type: The type came from Guaymas, Panama, and is deposited in the Museum of Comparative Zoology, Cambridge, Mass.

Distribution: Lower California, Western Mexico and Central America.

Material examined: Twelve specimens, most of which are quite young individuals, from Concepcion Bay, L. C., May 3, 1926.

Family SCUTELLIDAE.

Genus Encope Agassiz.

Encope californica Verrill.
Plate 7.


Diagnostic characters: This species is at once distinguished from its nearest ally, E. micropora, by the fact that californica has its greatest height behind
Plate 6. Upper figure Arbacia incisa (Agassiz), reduced one-half; lower figure Astropyga putrinata (Lamarck), reduced one-third.
Plate 7. *Encope californica* Vecchill, reduced to about three-fifths of natural size.
the center, due to the fact that difference in internal structure causes this posterior interambulacral region to be swollen. The ambulacra have completely closed, rounded lunules; none of the petals much exceed one-fourth the test length.

Type: Prof. Verrill founded this species on 74 specimens from La Paz, Lower California.

Distribution: Restricted to Lower California and the Gulf of California.

Material examined: Twelve specimens in good condition and nine very worn tests were taken in Concepcion Bay, Lower California, May 3, 1926, by the "Pawnee II."

Original description: "Test broad, thin at the edge, rounded anteriorly, broadest behind the middle, sub-truncate or rounded posteriorly; usually about as broad as long, sometimes broader than long. Apex behind the center. In profile the outline descends from the center to the anterior edge, but rises from the center to the posterior foramen, from which it descends rapidly to the edge. The posterior interambulacrum is, therefore, swollen and the test is most elevated near its foramen. Ambulacral rosette with the petals long-oval, somewhat obovate, broadly rounded outwardly; the anterior pair shortest and most rounded; the odd anterior one somewhat longer and narrower and a little shorter than those of the posterior pair, which are of about the same form and not curved. Posterior foramen variable in form and size, usually rather small, regularly oval or rounded, sometimes long, oval, or even narrow and elongated, occasionally quite large and broad oval, often obovate beneath, sometimes constricted in the middle. Ambulacral foramina also quite variable in form and size, but commonly small and rather regularly oval, often at a considerable distance from the margin."

(Prof. Verrill also gives tabular measurements showing the extreme variations exhibited by two of the 74 specimens which he had in the collection from La Paz.)

"It varies considerably in outline and in the form of the openings, especially the posterior one; the ambulacral rosette varies somewhat in the form of the petals, as shown by the above measurements; the ambulacral grooves beneath also vary in direction. But all the specimens agree in having their greatest elevation behind the center, or the posterior interambulacral region swollen." (Verrill.)

Prof. Verrill's figures show only a cross-section of the species; I have therefore included both dorsal and ventral views of the species in the present paper.

Encope grandis Agassiz.

Plate 8.


Diagnostic characters: This is the only "key-hole" urchin of the Gulf of
California and is readily recognized by its very heavy test which is approximately as wide as long, with the margins decidedly thickened, 5-8 mm. thick; the interambulacral lunule large, oval; marginal notches deep and wide.

Type: Prof. Agassiz's type was given him by M. Michelin, and was believed at the time to be probably from the Antilles. In 1870 Prof. Verrill examined several hundred specimens of this species obtained at La Paz by Capt. Pederson, and established the true locality of the species.

Distribution: This species is confined to the Gulf of California.

Material examined: Twenty-three specimens were taken by the "Pawnee II," in Concepcion Bay, May 3, 1926.

Genus Clypeaster A. Agassiz.

Clypeaster testudinarius (Gray).

Plate 8.


Clypeaster speciosus Verrill, American Jrn. Sci., vol. 49, p. 95, Pl. X, figs. 7, 7a, 1870.

Clypeaster testudinarius nob. (non Martens) Verrill, Trans. Conn. Acad. Arts and Sci., I, p. 588, Pl. 10, figs. 7, 7a, 1871.

Diagnostic characters: Test flattened, but stout, margins thick; lower surface only slightly concave; tuberculation coarse, the ridges between the fore pairs with 4-6 primary tubercles.

Type: Gray's original description cites "Hab.: Indian Ocean, Borneo"; his type is deposited in the British Museum. In 1871 Professor Verrill stated: "Dr. Gray erroneously gave Borneo as the locality of his specimens, which Mr. Agassiz has identified, by direct comparison in the British Museum, with specimens sent by me." The specimens Dr. Verrill refers to were from La Paz, Lower California. In 1925, Dr. H. L. Clark, discussing C. speciosus states "The single bare specimen from La Paz, carries a label showing that it is a cotype of C. speciosus." Prof. Verrill's other cotypes are deposited in the Peabody Museum, Yale University and the Museum of Comparative Zoology, Cambridge, Mass.

Distribution: Lower California and the Gulf of California.

Material examined: Two specimens from La Paz, Lower California collected by the "Pawnee II."

Color: The specimens are a deep purplish brown.

Family SPATANGIDAE.

Subfamily BRISINA.

Genus Meoma Gray.

Meoma grandis Gray.

Plate 9.

Plate 8. Upper figure Clypeaster testudinarius Gray, three-fifths of natural size; lower figure Encope grandis Agassiz, natural size.
Plate 9. *Munea grandis* Gray, reduced to about four-fifths of natural size.

**Diagnostic characters:** This big urchin is the only *Meoma* known in the Gulf of California and is readily recognized by its size and blackish brown coloring. The West Indian congener, *M. ventricosa*, is a lighter reddish or yellowish brown. *M. grandis* has a large heavy test, with petals conspicuous except in the third ambulacrum; a well marked peripetalous fasciole, no interior or anal fascioles; the subanal fasciole is imperfect and incomplete dorsally.

**Type:** Gray's type, which is deposited in the British Museum, is labeled Australia. Comparison of this material with Californian material by Prof. A. Agassiz convinced him that Prof. Verrill's *nigra* is identical with this species; it is generally accepted that Gray's locality was erroneous.

**Distribution:** Known only from the Gulf of California, and West Mexico.

**Material examined:** Two specimens of this distinctive species are in the collection from La Paz, Lower California.

**Genus Brissopsis** A. Agassiz.

**Brissopsis columbaris** A. Agassiz

*Brissopsis columbaris* A. Agassiz, Bull. Mus. Comp. Zool., vol. 32, p. 82, 1898; Mem. Mus. Comp. Zool., vol. 31, p. 190, Pls. 100, figs. 6, 7, 102, figs. 5-9, figs. 1, 2.

**Diagnostic characters:** This species is distinguished by the great length of the lateral ambulacra, the flatness of the test and the great width of the area enclosed by the subanal fasciole.

**Type:** Material from four 'Albatross' stations off Mariato Point, off Mala Point and Panama Bay.

**Distribution:** This species is known from Cape St. Lucas, Lower California, to Panama Bay, in depths ranging from 491 to 1793 fms. The present record of one large and 16 very young found burrowing in the sand of the beach, Angeles Bay, Lower California, is the first record of the species from shallow water. However, in 1898, Prof. Agassiz listed *B. columbaris* in the littoral fauna of the West Coast "by analogy." The fact that the "Pawnee" material consists of one large adult and sixteen very young specimens of about the same age, raises the interesting question as to whether this deep sea species migrates to shallow water during the breeding season.

**Material examined:** This species is represented in the Bingham collection by 17 perfect and two broken specimens, found burrowing in the sand of the beach, Angeles Bay, Lower California, May 12, 1926. All of these, except the specimen photographed, are quite small, the majority being less than one-half inch long in diameter.
Class **HOLOTHUROIDEA.**

Family **SYNAPTIDAE.**

Subfamily **SYNAPTINAe.**

Genus **Euapta** Ostergein.

**Euapta lappa** (J. Muller).


_Material examined:_ There are three large specimens in the ‘Pawnee’ collection from Hidden Harbour, Lower California, April 27, 1926, taken at night, which have most unfortunately been placed in strong formalin for the past two years. These specimens agree with the description of the West Indian _E. lappa_ (Muller) in all essentials. The anchor plates of the West Coast specimens are identical with those of specimens taken in Porto Rico. Each of the three specimens has 15 tentacles. Uninjured specimens might prove this to be a distinct species, but it would be very precarious to so designate these formalized animals, especially in view of the reliably established, wide distribution which several other species of this genus are known to possess.