

NEW GENERA OF STARFISHES FROM THE PHILIPPINE ISLANDS.

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The new genera and species of starfishes described in this paper were obtained in the region of the Philippine Islands by the U. S. Fisheries steamer *Albatross* during her cruise of 1907-1910. These species will be fully illustrated and described in greater detail in the final report on the collection, now in course of preparation.

Family PORCELLANASTERIDÆ.

BENTHOGENIA, new genus.

Related to *Thoracaster* Sladen, but differing in having cribriform organs between all the marginals, in having the dorsal surface of distal half of ray one continuous cribriform organ, in having the cribriform organs of interbrachium merged into one, in the spiniferous distal superomarginals, and in the presence of a large spiniferous terminal plate, dorsal in position. No odd interradiial marginal. Superomarginals increasing in size very gradually to the sixth, which is considerably larger than the rest and meets its fellow in median line of ray; beyond this point all superomarginals in contact. Cribriform organs 29 or 30, the distal ones rudimentary and the 11 of the interbrachium merged into one (as far as middle of sixth superomarginal); structure papilliform. Adambulacral plates with a numerous furrow series and numerous smaller spinelets on surface. Actinal interradiial areas extensive, covered with small spaced spinelets. Intermediate plates extend nearly to end of ray. Abactinal paxillæ large, crowded.

Type.—*Benthoenia cribellosa*, new species.

BENTHOGENIA CRIBELLOSA, new species.

Rays 5. $R = 78$ mm., $r =$ about 30 mm., $R =$ about 2.6 r ; breadth of ray at base, about 34 mm., at sixth superomarginal, 12 mm. Over

half of ray formed by superomarginals which meet in median line. Superomarginals massive, increasing in size from the first to sixth, which is decidedly larger than the rest and meets its fellow on dorsal median line; next 6 plates decreasing slightly, higher than wide, and bearing on the rounded dorsolateral angle a stubby conical spine; final 3 or 4 plates decreasing rapidly in size and covered by the big elliptical, very convex spiniferous terminal plate, margined by a fimbriate channel. Inferomarginals lower than superomarginals and beyond the sixth plate not corresponding to them, but near tip of ray alternating, there being one more in the series. Cribriform organs spiniform and in the interbrachial arc, continuous without a break as far as the middle of the sixth or enlarged superomarginals, except for a slight wedge-shaped area in the middle of the lower edge of each inferomarginal. In each interbrachium 11 fused cribriform organs, the odd one over the median interradiial suture. The sixth supero- and inferomarginals have a median vertical bare space about as wide as the adjacent cribriform organs, which from here on rapidly narrow, and from the twelfth plate on may be said to be rudimentary. These separated cribriform organs extend upon the dorsal surface of ray and fuse with those of opposite side so that the whole area from the limit of paxillæ to terminal plate and between the two dorsal rows of spines is a thick continuous mat of spinelets, absolutely identical with the lateral cribriform organs, and a fimbriate channel leads on either side from this area along the lower edge of the terminal plate. The total number of lateral organs is: Rays $9+9$ +interbrachium $11=29$. This varies to 30, as some rays have an additional small one at tip. The distal organs are of course rudimentary.

Paxillæ large, fairly high, crowded, those on rays largest, decreasing in size toward center of disk. The larger paxillæ have 15 to 20 peripheral and 5 to 15 central spinelets, cylindrical and slightly knobbed at tip. Papulæ in radial areas at base of ray and adjacent portion of disk.

Actinal interradiial areas large, covered with spaced short slender bluntly pointed spinelets, which increase in length toward margin. The plates extend in a narrow area nearly to end of ray. Adambulacral plates longer than wide with 7 or 8 compressed, basally webbed furrow spines on a curved margin, and on surface of plate 10 to 12 much shorter spinelets, similar to the actinal intermediates, in about two series. Furrow very narrow. Mouth plates prominent and with wide suture. Marginal spines 12, the innermost abruptly enlarged into a flattened conspicuous lanceolate tooth, the others subsimilar to adambulacrals. Suborals about 15 to a plate, in two series, small except inner two, which form a series just back of the teeth. Madreporic body a little more than its own diameter from

margin, flat, with transverse striæ, which have near the periphery numerous blunt spiniform protuberances resembling paxillar spines.

Type-locality.—Station 5513, off northern Mindanao, lat. $8^{\circ} 16' 45''$ N.; long. $124^{\circ} 02' 48''$ E.; 505 fathoms; gray mud and fine sand.

Type.—Cat. No. 28655, U.S.N.M.

Family ASTROPECTINIDÆ.

ANTHOSTICTE, new genus.

Near *Tethyaster* but distinguished by the presence of very deep marginal fascioles, the absence of a regular midradial series of enlarged paxillæ, the extension of the gonads to end of ray, and the character of the paxillæ, which are tall and slender. Superomarginal plates without specialized spines; inferomarginals with a single transverse row of small flattened, sharp, appressed spines; fascioles between marginals very deep, lined with small spinelets and in continuation of the actinal fasciolar channels. Abactinal plates stellate, the shaft of paxilla tall, slender, and crowned by a floriform group of slender spinelets; papulæ all over abactinal surface. Actinal intermediate plates extending nearly to end of ray, and traversed, between marginals and adambulaerals, by deep channels; no enlarged actinal intermediate spines. Adambulacral plates with a very prominent furrow angle and an astropectinoid armature; no enlarged subambulacral on distal portion ray; fascioles between the plates shallow and not lined with spinelets, as in *Sideriaster*. Tufts of gonads extending to end of ray. Madreporic body not concealed. Superambulacral plates large. Tube feet pointed, with simple rod-like deposits at tip. Small spiniform abactinal pedicellariæ.

Type.—*Anthosticte aulophora*, new species.

ANTHOSTICTE AULOPHORA, new species.

Rays 5. $R=162$ mm., $r=34$ mm., $R=4.76+r$; breadth of ray at base, 40 mm., at tenth superomarginal, 29 mm. Disk moderate, rays long, rather narrow beyond interbrachium, tapering gradually to a bluntly pointed extremity. Abactinal surface covered with tall, slender-pediceled paxillæ springing from a 6-lobed (stellate) plate, these without definite order on center of disk and midradial region, but elsewhere in oblique transverse rows parallel to interradius. On the ray these series are slightly spaced, and consecutive plates of a row barely touch. In the midradial area the plates sometimes touch or are separated. Summit of pedicel crowned by a floriform group of 15 to 20 peripheral, and 5 to 15 or even more central, terete blunt spinelets, the latter often in a compact group resembling a pedicellarian apparatus, the former radiating like the rays of a composite flower. On most of the paxillæ 2 to 4 central spinelets are slightly modified with broader tips, and form actual pedicellariæ. Papulæ

distributed all over abactinal surface, as in *Dipsacaster* (not absent from midradial line or center of disk), single, 5 or 6 about each plate.

Marginal plates of the two series corresponding, with unusually deep fasciolar channels separated by thin high ridges, each of which is composed of the elevation of a combined superomarginal and inferomarginal plate and is thinner than the intervening channels. The height of this ridge above the bottom of the channel equals about one-half the dorsoventral dimension of the combined marginal plates. Superomarginals forming a rounded bevel as in *Tethyaster subinermis*, covered with short, clavate, papilliform spinelets, becoming slenderer on edge of grooves. Spinelets in grooves very numerous and delicate. Superomarginals, about 80.

Inferomarginals projecting slightly beyond superomarginals on outer part of ray, and forming a rounded bevel to actinal surface, being about one and one-half times wider than upper series. They are covered with a transverse series of 2 to 5 flat, lanceolate, sharp, appressed spinules and numerous shorter, slenderer, slightly flattened, blunt spinelets, which are very much longer than those of superomarginals. The spinelets lining the deep fascioles are similar to those of upper series.

Actinal interradiial areas fairly large, but rather abruptly narrowing at base of ray, along which two series of intermediate plates extend two-thirds of its length, while one series continues nearly to the extremity. Rather deep channels lead from the marginal fascioles to the fascioles between adambulacral plates, these being separated by single rows of intermediate plates. The marginal and adambulacral plates do not correspond, however. At the base of furrow the latter are slightly more numerous, while in the middle third, the former; distally they correspond. The high keel of the intermediate plates which forms the ridges between the channels is covered with spinelets, directed toward ambitus, and similar to those of inferomarginals.

Adambulacral plates astropectinoid, with an acute furrow angle, bearing a compressed blunt saber-shaped spine, and on either side of this, two strongly compressed rather slender blunt spines. Sometimes a third is added, making the total 5 to 7. Surface of plate with 5 to 7 more cylindrical, slender, blunt spines, one forming a series with the second lateral furrow spines, the rest disposed in about two longitudinal series behind this, the laterals of the first series often standing on margin and making on either side the supernumerary furrow spines. The plates are wider than long, well spaced, with a shallow channel between, over which extend several small terete spinelets belonging to the transverse margins of plates. First two plates much compressed.

Mouth plates prominent, densely covered with spines, increasing in length toward inner end of plate, where, directed over actinostome,

is a cluster of teeth. Marginals 7 or 8, distally with flat side to furrow, but at inner end of plate more knife-shaped and with edge thereto.

Madreporic body exposed, medium-sized, with fine radiating striæ. The ridges near center bear low tubercular prominences. It is situated about one-third R from margin.

Gonads disposed in independent tufts attached to the abactinal integument on either side of the median radial area and extending to end of ray. Ampullæ strongly two-lobed. Tube feet pointed, with deposits at the tip in the form of small, simple, straight, curved, or irregular rods. Superambulacral plates well developed.

Type-locality.—Station 5420, between Cebu and Bohol, 127 fathoms.

Type.—Cat. No. 28656, U.S.N.M.

Remarks.—The genera *Moiraster*, *Tethyaster*, *Sideriaster*, and *Anthosticte* agree in having unarmed supermarginals, inferomarginals with a few small enlarged spines, naked madreporite, large actinal interradial areas, and intermediate plates far along ray, marginal and actinal fascioles, true paxillæ, stellate abactinal plates, an astropectinoid adambulacral armature, and probably also in having the single papulæ uninterrupted all over the dorsal surface. The first two seem to be a little more closely related than either is to the last two, while *Sideriaster* and *Anthosticte* are possibly also nearly related. Unfortunately there is but one species in each genus and it is difficult to ascertain what characters are of generic importance. Applying the standards used in other and larger genera, *Anthosticte* differs from *Tethyaster* chiefly in having very deep marginal fascioles, gonads to the end of the ray, no midradial series of enlarged paxillæ, and taller, more delicate paxillæ. The last is probably of no generic importance, but may be. Its special points of agreement in addition to the characters listed above are the deposits in the tube feet (not recorded for *Moiraster* and *Sideriaster*) and shallow interadambulacral fascioles.

Anthosticte differs from *Sideriaster* Verrill in having very deep marginal fascioles, shallow interadambulacral fascioles, no distally enlarged subambulacral spine. Neither the deposits in the tube feet nor the gonads of *Sideriaster* are described—one of the unfortunate results of drying types. The fascioles between the adambulacral plates, which I examined in the type-specimen, form one of the most striking features of the genus. They are densely lined with small delicate spinelets, and are therefore similar to marginal fascioles. Such is not the case in *Anthosticte*, *Tethyaster*, or *Moiraster*.

The distribution of gonads and deposits of tube feet are unknown in *Moiraster*. Kœhler describes the marginal fascioles as "peu profonds" while Sladen says they are deep, but the discrepancy is only apparent, for Sladen knew no genera with very deep fascioles, such as *Dipsacaster*. *Anthosticte* differs from *Moiraster* in respect to the marginal fascioles, and the thin elevated intervening ridges of the marginal plates. The inferomarginal and actinal spinelets of *Antho-*

stictæ are slender, and not flat, spatulate, and chisel-shaped. No pedicellariæ are described for *Moiraster*. If the gonads are found to extend to the end of the ray, it may become necessary to unite the two genera, although the difference in the marginal fascioles will remain. The paxillæ of *Moiraster* are probably lower than those of *Anthostictæ*, and less delicate. The character of the gonads is important, and is apparently very reliable for generic groups, but not for higher ones.

It seems better to keep *Anthostictæ* separate rather than to unite it with another genus, especially as it is not at all evident into which of the three groups it would go with the least disturbance.

The following table recapitulates the characters mentioned above. Will some one enlighten us concerning the gonads and tube feet of *Moiraster* and *Sideriaster*?

Comparison of the characters of Anthostictæ, Tethyaster, Sideriaster, and Moiraster.

Genus.	Gonads extend to end of ray.	Gonads confined to proximal half of ray.	Marginal fascioles deep.	Adambulacral fascioles shallow.	Deposits in tube feet.	Distal subambulacral spines enlarged.	Paxillæ tall; pedicel slender.	Paxillæ rather low; pedicel stout.	Midradial row of enlarged paxillæ.	Abactinal plates stellate.
<i>Anthostictæ</i>	×	×	×	×	×	×
<i>Tethyaster</i>	×	×	×	×	×
<i>Sideriaster</i>	(?)	(?)	(?)	×	×	×	×
<i>Moiraster</i>	(?)	(?)	×	(?)	×	×

Family GONIASTERIDÆ.

PONTIOCERAMUS, new genus.

Stellate, with a large disk and relatively short rays. Related to *Plinthaster* Verrill, but differing in having the surface of the abactinal plates perfectly smooth, not covered with minute bosses, in having the plates of the papular areas low-tabulate, and the adambulacral plates with an angular furrow margin armed with numerous short stubby spinelets; no enlarged subambulacral spine on distal part of ray. Abactinal and marginal plates bordered by a single series of small granules, the latter also with some on lateral face of ray, all flush with level of plate. Last few superomarginals in contact medially. Actinal intermediate plates reaching far along ray, closely granulate, and with small bivalved excavate pedicellariæ about as high as wide. Adambulacral plates proximally very narrow, distally becoming wider; with a large subambulacral toothed bivalved pedicellaria, and 10 or 11 furrow spinelets in angular series. No smaller secondary abactinal plates.

Type.—*Pontioceramus grandis*, new species.

PONTIOCERAMUS GRANDIS, new species.

Rays 5. $R=160$ mm., $r=70$ mm., $R=2.3$ r; breadth of ray at mid-interbrachium, 80 mm. Disk very large, arcuately pentagonal and produced into short pointed rays. Abactinal plates numerous, with a very smooth and slightly convex surface, on the radial region regularly hexagonal, and on center of disk and in about 9 longitudinal (radial) series distinctly tabulate, each tabulum surrounded by 6 papulae, the area of tabulate plates reaching about two-fifths R . The papular areas are proximally considerably wider than the area of obviously tabulate plates. Interradial plates flat, irregularly four to six-sided. All abactinal plates surrounded by a single series of flat squarish granules, set in membrane and flush with surface of plate, those on the radial plates hard to see, and larger on the lateral than on the transverse margins of tabulum.

Marginal plates conspicuous. Supermarginals (30 to a ray) form an even bevel in interbrachium, but on ray a rounded angle, being there somewhat wider than high. Inferomarginals on the contrary encroach more conspicuously upon actinal surface in interbrachium than on ray, but like the supermarginals the angle between lateral and ventral surface is more pronounced on ray. Supermarginals with one, and inferomarginals with two or three series of small flush granules forming an inconspicuous border, and in addition a variable number of scattered granules on the lateral face of plates, all flat and sunken flush with the level of plates.

Actinal intermediate plates very numerous, those nearest furrow largest, and the only ones at all regularly arranged. They are closely granulate, the granules flat and immersed in thin membrane. The plates next to adambulacrals bear one or two small rather delicate bivalved pedicellariae, whose denticulate jaws are slightly wider than high (the larger ones) or as wide as high (smaller) and fit into slight depressions when open.

Adambulacral plates proximally long and narrow, very gradually widening on outer half of R , until near tip; beyond the last actinal intermediate plates they are as wide as long. Each plate is angular toward furrow, the angle being sharper deep in furrow than on margin, and is usually adoral to the middle of plate, varying in position between the middle and adoral margin of plate. Furrow spinelets 11 or 12, stout, short, round-tipped or blunt, much flattened, those near the angle of margin with edge to furrow, the others with flat side thereto. The aboral spinelet of the series is the broadest and stoutest, and often the adoral spinelet is similarly enlarged. The spinelets are subequal in length, or the median slightly the shorter. The actinal surface proximally is wide enough for only one longitudinal series of unequal granules, but as the plate widens more

are added, until distally the plates have an even granular surface, like that of actinal plates. Proximally most of the plates have a large bivalved denticulate pedicellaria, the jaws much wider than high. This occupies a third or a fourth the length of a plate.

Mouth plates small, triangular with a fairly straight furrow margin, with nine or ten spinelets, the innermost heaviest. Surface covered with spaced stout granuliform spinelets.

Madreporic body small, near center of disk and about as large as surrounding plates. Ridges radiating and coarse.

Type-locality.—Station 5273, off western Luzon, 27 miles southwest Corregidor Light; 114 fathoms; mud, shells, and coral sand.

Type.—Cat. No. 28657, U.S.N.M.

Remarks.—This genus differs from *Circeaster* in lacking the abruptly larger abactinal plates of rays, in having smooth marginals, and regular tabulate radial plates; and from *Lydiaster* in the character of abactinal, marginal, and adambulacral plates. *Lydiaster* is more nearly related to *Circeaster* than to *Pontioceramus*. *Ceramaster* is distinguished by the wholly granulate tabulate abactinal plates and *Eugoniaster*, which is perhaps the most nearly related form, has the abactinal plates arranged without regularity although "tabulate," and the adambulacral plates are of uniform width throughout.

LITHOSOMA, new genus.

Related to *Iconaster* Sladen, but differs in having the regular longitudinal radial series of abactinal plates completely surrounded by granules, not on the lateral edges only, and in having the subambulacral granulation short and spaced from the furrow comb, not crowded and graduated into the furrow armature. All plates smooth and bordered by a single series of granules, the plates of papular areas sensibly elevated. Small spatulate excavate pedicellariæ on both surfaces. Disk large, rays long, slender, and beyond base of ray composed only of marginal plates abactinally.

Type.—*Lithosoma actinometra*, new species.

LITHOSOMA ACTINOMETRA, new species.

Rays 5 $R=155$ mm., $r=42$ mm., $R=3.7$ r; breadth of ray at base, 49 mm., at eighth superomarginal 19 mm. Disk large, rays narrow; interbrachial arcs very open, the disk being arcuate pentagonal and produced at the corners into the long slender rays, composed abactinally of the marginal plates only. All plates smooth, porcelain-like, bordered by a single complete series of granules flush with the general surface; only the adambulacral and mouth plates with granules on surface. Marginal plates block-like massive, the superomarginals, 40 in number, in contact along median line beyond the seventh to ninth, and encroaching conspicuously upon dorsal surface, being wider than high. Marginal granules small,

being immersed in a membrane which nearly or quite obscures the outlines. Inferomarginals correspond with superomarginals proximally; distally they alternate. Proximally they bear on the actinal surface one to several very small spatulate excavate pedicellariæ with narrow smooth jaws.

Abactinal plates hexagonal, in regular radial and parallel series, smooth except for scattered minute elevations (not granules) and bordered by a single complete series of flat immersed granules, squarish or oblong in shape. Papulæ in a petaloid radial area, 6 about each plate. Here the plates are sensibly elevated, although not at all markedly tabulate. If somewhat higher they would be called tabulate. No secondary, smaller, intermediate plates. Small scattered abactinal pedicellariæ.

Actinal intermediate plates not very regular either in shape or arrangement but four- or five-sided, very smooth and with numerous small pedicellariæ, especially near furrow. They extend slightly beyond middle of R.

Adambulacral plates with slightly curved furrow margin, bearing proximally 6 to 8, farther along ray 9 or 10, short, blunt, granuliform, subequal spinelets, the mesial more or less compressed with edge to furrow, the lateralmost somewhat thicker and prismatic or flattened with side to furrow. Border of plate with a row of unequal subconical immersed granules, and several on the surface, usually forming a longitudinal series spaced from furrow comb. One or two small pedicellariæ usually present, often taking the place of several granules or surrounded by a smooth area. Mouth plate small, with 8 furrow spinelets and a granular actinal surface.

Madreporic body hexagonal, one-fourth minor radius from center of disk. Furrow narrow; tube feet with strong disks.

Type-locality.—Station 5272, western Luzon, 25.5 miles southwest Corregidor Light, lat. 14° N.; long. $12^{\circ} 22' 30''$ E.; 118 fathoms; mud, shells, and coral sand.

Type.—Cat. No. 28658, U.S.N.M.

Remarks.—Abactinally this species resembles somewhat a *Plinthaster* with long slender rays, but has perfectly smooth marginals. Barring this it would bear to *Plinthaster* much the same relation that *Nymphaster* does to *Ceramaster*. The actinal intermediate plates, in contradistinction to those of *Plinthaster*, are smooth, not granulate, and the smaller secondary abactinal plates which are variously developed in *Plinthaster* are absent. The genus seems to be most nearly related to *Iconaster*. It differs from *Astroceramus*, another relative, in lacking the coarse marginal and actinal granules and tubercles, and the specialized, robust subambulacral spines. In some species of *Astroceramus* the adambulacral armature approaches that of the Hippasteriinae.

As in *Iconaster* the only spines are those of the furrow margin. The animal is hard, smooth, of a stony or porcelain texture, and of conspicuous size.

ATELORIAS, new genus.

Goniasteridæ with unequal marginals, the supermarginals the larger and defining entire angular ambitus; with all the plates granulate, and covered with thin soft membrane leaving each plate distinct; abactinal plates flat, numerous, extending to tip of ray; papulæ in radial petaloid areas; adambulacrals with an angular furrow series and subambulaeral granules; actinal interradiar areas large; disk large, rays slender. Entrenched small upright two-jawed pedicellariæ on abactinal, marginal, actinal intermediate, and adambulacrals plates. No specialized spines; the furrow spinelets the only ones present.

Type.—*Atelorias anacanthus*, new species.

ATELORIAS ANACANTHUS, new species.

Rays 5. $R=205$ mm., $r=43$ mm., $R=4.76$ r.; breadth of ray at mid interbrachium, 53 mm., at middle of R, 14 mm. Disk large, thin, with wide interbrachial arcs. Rays very long, slender, thin, with an angular margin formed entirely of supermarginal plates. No specialized spines; all plates covered with hemispherical granules immersed in a thin membrane which partly obscures them, and fills up the interstices but which leaves the outlines of plates distinct. Small excavate pedicellariæ with two jaws slightly higher than wide, and usually with depressions in the membrane into which they fit when open, are present on plates of both surfaces.

Abactinal plates numerous, very slightly convex or flat, hexagonal on papular areas but elsewhere irregularly hexagonal, pentagonal, squarish or roundish, and reaching terminal plate. Plates not at all tabulate but sensibly higher on the petaloid radial papular areas; papulæ 5 or 6 about each plate, and inconspicuous, not extending far along ray. All plates covered with hemispherical granules, sunken in soft membrane, and with a pedicellaria.

Supermarginals about 80 to a ray encroaching conspicuously upon abactinal area and with a nearly flat upper surface; throughout wider than long. They encroach upon actinal surface about one-half as far as upon abactinal and thus form the margin of ray. The convexity of the lateral angle of plate causes the margin of ray to appear scalloped except near extremity. Inferomarginals proximally considerably wider, and beyond interbrachium only slightly wider than the actinal surface of supermarginals, and entirely actinal in position; surface very slightly convex. Both series with the characteristic granules and pedicellariæ.

Actinal interradial areas large, irregularly disposed, nearly flat, granulated, and with pedicellariæ. They extend about to the middle of R.

Adambulacral plates with angular furrow margin but the angle nearer the adoral side, so that the facets are very unequal. Spinelets 10 to 12, rather short, round-tipped or truncate, in a crowded series, the longest on the angle and compressed in a plane transverse to furrow, the others gradually shortening and with flat side to furrow. Actinal surface of plates with crowded low conical granules and occasionally a pedicellaria.

Mouth plates nearly flat, coarsely granulate, with 16 to 18 marginal robust spinelets, increasing in size toward inner angle. The furrow surface of each plate has a shallow vertical depression for first tube foot.

Madreporic body one-third minor radius from center. Tube feet with strong disks; ampullæ double.

Type-locality.—Station 5655, Gulf of Boni, Celebes; 608 fathoms; gray mud, fine sand.

Type.—Cat. No. 28659, U.S.N.M.

Remarks.—The new genus is quite unlike any other and probably belongs in the Leptogonasterinæ, although further study may warrant placing it in the Goniasterinæ. It is somewhat intermediate. The large overhanging superomarginals and flat granulate membrane-invested plates, which are however distinct, are the most trenchant features of the genus.

Family PTERASTERIDÆ.

HYMENASTERIDES, new genus.

In general structure similar to *Hymenaster* but with two kinds of adambulacral plates alternating; (1) prominent plates bearing a transverse series of 3 rather long slender spines, and (2) nonprominent plates with only 1 spine. Tube feet in 4 series, the feet of the outermost series corresponding to the nonprominent plates. Combined mouth plates produced actinally into a cone, the apex of which is about the middle of median suture. Two suboral spines.

Type.—*Hymenasterides zenognathus*, new species.

HYMENASTERIDES ZENOGNATHUS, new species.

Diagnosis.—Paxillar area raised above the actinolateral membrane which forms an even narrow border; paxillæ in 9 longitudinal series, 5, or laterally, as many as 7 spines to a paxilla, one being longer than the rest; no visible muscle-fibres; scattered spiracula. Prominent adambulacrals with 3 slender membrane invested sacculate spines; nonprominent with one, each of which is opposite a tube foot of outer series. Mouth plates conical actinally with 2 suborals, and 3 or 4

marginals. Fourteenth actinolateral spine the longest. $R = 36$ mm., $r = 22$ mm., $R = 1.64$ r. Breadth of ray, over all, 21 to 25 mm.; of paxillar area alone, 17 to 21 mm.

Description.—The paxillar area is sharply defined from the lateral fringe, or actinolateral membrane, which is interradially deeply indented and follows the contour of the raised supradorsal membrane. Thus the actinolateral membrane forms a narrow border of nearly uniform width, and the spines do not project beyond the edge. They are clearly visible as the membrane is translucent. The supradorsal membrane is thin and translucent, without visible muscle-fibres, and with small rather widely spaced inconspicuous spiracula, which are not in definite areas, but sometimes form irregular lines. With the exception of an interradiial area they are pretty uniformly distributed all over the membrane. Membrane everywhere rough with the points of the paxillar spinelets, of which there are usually 5 (laterally sometimes 7) to a paxilla. The latter are in 9 quincuncial longitudinal series. Each paxilla springs from a cruciform or 4-lobed base, the lobes overlapping those of 4 other plates leaving quadrate or lozenge-shaped papular areas. The pedicels are longest on the lateral paxillæ; those of midradial series about half as long as the laterals, and the spines, which are webbed, are in all cases longer than the pedicels. One spine is usually longer and stouter than the others. The spines are three-edged or triradiate in cross section. The papulæ (1 to an area) are attached to the pedicels. The valves guarding the osculum have a truncate summit and are strengthened by about 12 spines, of which the 5 or 6 median are longest. About 8 other spines, much shorter, form a comb just back of the valves, and are attached to the same pedicel. The membrane at the base of the fans is pierced by scattered spiracula, and that between the fans has numerous spiracula in short irregular lines. The supradorsal membrane is dotted with numerous very small whitish spots of unequal size, due probably to groups of gland cells. There are rather large well-spaced brownish rings or spots on the outer half of R.

Ambulacral furrow wide; tube feet, with small disks, in 4 longitudinal series. Adambulacral plates of two sorts, prominent and nonprominent. The former project farther into furrow and bear an oblique transverse series of 3 slender spines invested in membrane which forms a small sacculus at tip. The outer spine is the longest (equals the length of 5 plates at base of furrow), the other two decreasing slightly in length. The innermost often projects between 2 feet of the outermost series. The nonprominent plate corresponds to a tube foot of the outermost series, is set back slightly, and bears only 1 spine, which stands in the same longitudinal series (with reference to long axis of ray) with the outermost spine of the prominent plates, and is of about the same length

as this spine. Aperture papillæ short, broadly ovate, with a membranous envelope produced into a short blunt sacculus. The calcareous part is only about one-fourth the length of the adjacent subambulacral spine, and there is no difference between the papillæ of the two sorts of plates. The apertures are narrow and not completely covered by the papillæ. The first adambulacral plate, sometimes prominent, sometimes nonprominent, has 2 equal or unequal spines and a large aperture papilla immersed in the actinolateral membrane.

Mouth plates small and very high, the combined pair produced actinally into a conical eminence, the apex of which is situated at the middle of the median suture. The height of this extraordinary beak or cone equals the interradial diameter of the pair of plates. From the blunt point at the top the plates slope straight and steeply to the actinostomial margin, which is produced into a slight beak, but in the opposite direction the plates diverge, leaving an open suture, and the margin of the plates is arcuate and nearly perpendicular. Marginal spines 3 or 4, the lateral-most the strongest and longest, situated on a slight angle of the margin and directed across mouth of furrow. The innermost spine which is well spaced from the median beak of actinostomial margin is nearly as long as the lateral-most and the 1 or 2 intermediate spines are somewhat shorter. Suborals 2, nearly like the subambulacrals and situated in a line parallel to and near median suture, on the actinostomial face of the cone.

Actinolateral membrane translucent forming a broad margin which decreases in width evenly from interradial angle. The fourteenth spine is the longest, and is the first to meet the free edge of membrane. The first is articulated to the second adambulacral. The spines do not meet interradially their fellows of adjacent ray, but leave a narrow wedge-shaped area. The length of this wedge (the apex touching mouth plates) is about half the extent of the free edge of one ray measured along edge of actinolateral membrane. This actinolateral membrane is nearly flat.

Madreporic body globular, and without a paxilla on its surface.

Type-locality.—Station 5623, Molucca Passage between Gillolo and Makyan Islands, 272 fathoms; fine sand, mud.

Type.—Cat. No. 28660, U.S.N.M.