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NEW EAST INDIAN STARFISHES.

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The new species of starfishes* herein described were collected by the U. S. Fisheries steamer *Albatross* during her cruise of 1907–1910. The type of *Asterina cristata* is from the Museum of Comparative Zoölogy, of Cambridge, Mass. The other types are in the U. S. National Museum. These species will be fully described and figured in the final report.

Asterina cristata new species.

Diagnosis.—Related to *A. cepheus*, but with a variable number of abactinal plates (upward of 50 to a ray) elevated and tubercular in form and surmounted by 1 to 5 unequal, robust, pointed spines, the largest 4 or 5 times as long as the spinelets of the other plates, and many times greater in diameter; other abactinal plates with 5 to 10 short, sharp spinelets in spaced groups, mostly on the adcentral border; in center of disk a poorly defined pentagon of elevated plates; at base of ray, 6 regular longitudinal series of papulæ on either side of a radial area of irregularly arranged pores. Inferomarginal plates with a conspicuous tapered spine surrounded by smaller spinelets. Actinal intermediate plates with a group of 2 to 4, mostly 3, basally webbed spinelets; furrow spinelets usually 6, webbed for about half their length, the 3 or 4 median conspicuously larger than the laterals; subambulacral spinelets usually 4, the 2 median much longer than the laterals (in another specimen there are 5 or 6, of which 2 are enlarged). Rays 5, rather narrow, with a rounded extremity. R=37 mm., r=14.5 mm., R=2.5 r; breadth of ray at base, 15 mm.

Type.—No. 689, Museum of Comparative Zoölogy.

Type-locality.—Ponapé, Caroline Islands.

*New genera and species from the *Albatross* Philippine collection have already been published in the Proceedings of the United States National Museum as follows: vol. 40, May 17, 1911, pp. 415–427; vol. 43, Feb. 5, 1913, pp. 599–648; vol. 46, Sept. 30, 1913, pp. 201–224.

The characteristic feature of this species is the presence of elevated abactinal plates with robust conical spines, forming conspicuous protuberances, very variable in number.

Pteraster corynetes new species.

Diagnosis.—Abactinal surface resembling superficially that of *P. pulvillus;* probably more nearly related to *P. semireticulatus.* Paxillæ with low pedicel surmounted by 7 or 8 longer, radiating, peripheral spinelets surrounding a central shorter one; tips of peripheral spinelets united by fibrous tissue; spiracula in lines between spinelets; no deposits in supradorsal membrane; furrow fans with 7 spines (distally, 6); actinolateral spines stout, the tips defining ambitus; 5 oral spines, the 10 united by a continuous membrane; suboral spine may be entirely lacking; when present, slender, tapering. Rays 5; R=24 mm., r=13 mm., R=1.8 r; breadth of ray at base, 14 or 15 mm.; thickness of disk, 9 mm.

Type.—Cat. No. 37,014 U. S. N. M.

Type-locality.—Station 5623, Molucca Passage, 7.5 miles northeast Makyan Island (0° 16′ 30″ N., 127° 30′ E.), 272 fathoms, fine sand, mud; 1 specimen.

In my key to the species of *Pteraster* (Asteroidea of the North Pacific, p. 368), *P. corynetes* belongs to the second section, although the rays are slightly longer than in the other species. Among those species having all the oral spines united by a continuous membrane, only 5 are comparable with *corynetes*, namely *pulvillus*, *temnochiton*, *rugatus*, *semireticulatus*, and *ingolfi*, to none of which it is closely related.

Pteraster obesus myonotus new subspecies.

Diagnosis.—Closely related to *P. obesus* H. L. Clark, of Japan, and resembling superficially *P. pulvillus* Sars. Differing from *obesus* in being nearly pentagonal in form, in having a fairly tough supradorsal membrane in which there are well developed bands of muscle forming a reticulum of hexagons and triangles; and in having fewer paxillar spines (7); adambulacral spines 5 (6 on the first few plates), the innermost very short; 7 or 8 free oral spines, the innermost flattened and truncate; suboral spine sharp, a little longer than longest oral spine, and with the distal half hyaline, tapering, three-edged. R=28 mm.; r=24 mm.; R =1.2 r.

Type.—Cat. No. 37,015 U. S. N. M.

Type-locality.—Station 5518, Mindanao Sea, off Point Tagalo, 200 fathoms, gray mud, globigerina; bottom temperature 54° Fahr.

Diplopteraster multipes patagiatus new subspecies.

Diagnosis.—Closely resembling *D. multipes*, but differing in having narrower paxillar areas (exclusive of actinostomial membrane) and in having the same number of spines in both sorts of furrow combs (or if an

unequal number, then one more in the non-prominent combs, instead of one less, as in *multipes*); adambulacral spines longer. R=95 mm.; r=60 mm. (measured to edge of actinostomial membrane); R=1.5 r; r=50 mm., measured to edge of paxillar area; breadth of paxillar area at interradias, 50 to 57 mm. (=60% or less of R, while in *multipes* it equals 80%, or more, of R.

Type.—Cat. No. 37,016 U. S. N. M.

Type-locality.—Station 5656, Gulf of Boni, Celebes (3° 17′ 40″ S., 120° 36′ 45″ E.), 484 fathoms, gray mud; bottom temperature, 41.2° Fahr.

Hymenaster rhodopeplus new species.

Diagnosis.—Closely resembling *H. nobilis* Sladen, but differing in having 7 instead of 6 rows of paxillae to each ray, in having a stouter and longer adambulacral spine (much longer than aperture papilla), and in having 2 acicular suboral spines to each plate (instead of 1, resembling an aperture papilla). Marginal contour pentagonal; R=82 mm.; r=55 mm.; breadth of paxillar area at base, 35 mm.; distance from center of disk to margin of paxillar area on interradial line, 30 to 32 mm.

Type.—Cat. No. 37,017 U. S. N. M.

Type-locality.—Station 5606, Gulf of Tomini, Celebes (0° 16′ 28″ N., 121° 33′ 30″ E.), 834 fathoms, green mud.

Hymenaster bartschi new species.

Diagnosis.—Very similar to *H. pullatus*, but differing in having the paxillar areas of the 5 rays separated interradially nearly to the oscular valves, and in having numerous spiracula in the supradorsal membrane, there being a series of band-like spiracular areas along either side of the paxillar areas extending toward the interradial line. General contour originally probably nearly pentagonal, produced at the corners into attenuate tips. R=about 70 mm. Supradorsal membrane very thin and transparent between the numerous, conspicuous, criss-crossing muscle bands. Pseudopaxillae in 7 rows, the median and adradial rudimentary, with 1 to 3 tiny spinelets; the 2 lateral series with 3 or 4 spinelets to each paxilla. Furrow spinelets 3, flattened at the base and tapering to a point, the adoral slightly the longest (1.5 to 1.75 mm.). Actinolateral membrane broad, rather thin, deep brown in color; twelfth to seventeenth actinolateral spines the longest.

Type.—Cat. No. 37,018 U. S. N. M.

Type-locality.—Station 5428, Sulu Sea, off eastern Palawan (9° 13′ N., 118° 51′ 15″ E.), 1105 fathoms, green mud; bottom temperature, 49.7′ Fahr.

Named for Dr. Paul Bartsch of the U. S. National Museum.

Zoroaster ophiactis new species.

Diagnosis.—Closely related to *Zoroaster alfredi* Alcock, from which it differs in having longer rays, stouter, conical, carinal spines, relatively smaller papular pedicellariæ, ungrooved spinelets, less numerous adambulacral pedicellariæ, and in lacking, deep in the furrow, the 2 large bunches

of pedicellariæ characteristic of *alfredi*. R=282 mm., r=15.5 mm., R =18 r; breadth of ray at base, 17 mm. Disk very small, fairly level on top in large specimens, tumid in small; rays slender and strongly carinate, the carinal plates forming a definite spiniferous ridge. Between adradial plates (which have no central spine) and adambulacrals, 7 longitudinal series of plates at base of ray, each plate with a central conspicuous, slender, tapering, sharp spine, which on the 3 lowermost rows becomes flattened and appressed. Adambulacral armature: 1 spine deep in furrow with a terminal three-cornered sacculus with upward of 10 unequal, medium sized and small pedicellariæ, and above this a row of 3 or 4 spines bent outward, the third usually the longest; that above furrow spine with a large pedicellaria.

Type.—Cat. No. 37,008 U. S. N. M.

Type-locality.—Station 5606, Gulf of Tomini, Celebes, 834 fathoms, green mud, 1 specimen.

Zoroaster microporus new species.

Diagnosis.—Related to *Zoroaster barathri* Alcock, from which it differs in having squarish, instead of hexagonal carinal plates, smaller miliary spinelets, longer central spines on 5 lateral rows of plates (instead of on the 2 or 3 lowermost series only), more numerous pedicellariæ, in having 2 inner spines of the prominent adambulacrals with pedicillariæ (3 in *barathri?*), and in having 2 transverse series of spines on the actinal face of both sorts of adambulacrals. R=205 mm., r=12 mm., R=17 r; breadth of ray at base, 13 mm. Disk small, scarcely more than the united bases of the rays; rays long, slender, with a conspicuous, rounded unarmed carinal ridge, and a well-defined sulcus along either side; 5 series of lateral plates with a central spine; tube-feet biserial.

Type.—Cat. No. 37,009 U. S. N. M.

Type-locality.—Station 5637, 21 miles southwest Amblan Island (off Bouro Island), Moluccas (3° 53′ 20″ S., 126° 48′ E), 700 fathoms, gray mud.

Zoroaster carinatus philippinensis new subspecies.

Diagnosis.—Differing from *Zoroaster carinatus* in having more numerous adambulacral spines, with many more pedicellariae; less tumid apical plates, less prominent central spinelets to carinal plates; more numerous pedicellariæ generally. Disk small, rays long, slender, pointed, with a midradial ridge or carina; central spinelets of carinal plates slightly enlarged; 4 rows of slender appressed spinelets along side of ray (3 in small specimens); superomarginal and proximal inferomarginal plates without central spine (the latter sporadically with spine in *carinatus*); prominent adambulacral plates with transverse series of 6 or 7 spines (5 in small specimens), the inner 2 with several large and small pedicellariæ. R=194 mm., r=13.5 mm., R=14 r; breadth of ray at base, 14 or 15 mm.

Type.—Cat. No. 37,010 U. S. N. M.

Type-locality.—Station 5587, Sibuko Bay, Borneo, 415 fathoms, green mud, sand, coral; bottom temperature 42.3° Fahr.

Bythiolophus new genus.

Diagnosis.—In general structure resembling *Zoroaster*, except in the presence of superambulacral plates and in the arrangement of the abactinal skeleton. In this the adradial series is more prominent than the carinal, consisting of alternately larger and smaller, transversely elongated plates, the larger of which overlie the lateral third of the carinals; both sorts strongly overlap the upper end of the superomarginals. Two series of marginals and 4 series of intermediate plates. Adambulacral plates as in *Zoroaster*.

Type.—*B. acanthinus*, new species.

Bythiolophus acanthinus new species.

Diagnosis.—Rays 5. R=105 mm., r=13 mm. R=8 r; breadth of ray at base, 14 mm. Rays 4 sided, very gradually tapering; abactinal surface of ray sunken along median line except near tip, where the surface is nearly plane; sides forming a steep bevel; interbrachial arcs angular; radial plates sunken, but tumid, with a short, sharp, appressed spine; adradial plates prominent, forming margin of abactinal surface, larger and smaller alternating, the larger and some of the smaller with a central spine similar to the carinal spines; 6 lateral series of plates, each with a prominent central spine, the third and fourth from top the longest; prominent adambulacral plates with transverse series of 4 spines, and about 3 spinelets (on actinal surface), the inner with 1 to several pedicellariæ.

Type.—Cat. No. 37,011, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes, 559 fathoms, green mud, bottom temperature, 39.2° Fahr.

Odinia penichra new species.

Diagnosis.—Rays 16, rather slender, the costal region extending about half the length of ray and containing 10 to 12 complete, rather weak, conspicuously spiniferous costæ, widely and nearly equidistantly spaced; disk with steeply beveled margin and conspicuous, terminally denticulate spinelets in ones and twos on its slightly convex plates; adambulacral armature with 1 slender aboral furrow spinelet and 1 actinal spine, proximally bifid; oral plates with 4 or 5 actinostomial spinelets, and 1 aboral furrow spinelet; no suboral spine. R=100 mm., r=7.5 mm. (to edge of disk), R=13.3 r; breadth of ray at base, 3.5 mm.; breadth of actinostome, 9 mm.

Type.—Cat. No. 37,019 U. S. N. M.

Type-locality.—Station 5217, between Burias and Luzon, 105 fathoms, coarse gray sand.

Brisinga trachydisca new species.

Diagnosis.—Rays 13 or 12; a multicostate form with the spinelets of disk in groups of 2 to 6, spaced like pseudopaxillæ; costæ 40–45, very prominent, irregular and sinuous, without intercostal bands of pedi-

cellariæ, and with relatively coarse spinelets, the costal region occupying more than a third of the total length of ray but less than one-half; adambulacral plates not crowded; armature with 1 aboral furrow spinelet, 1 adoral actinal spine, 1½ to 1¾ the length of the plate, and 1 prominent actinal spine 3 times the length of plate. Rays slender, very long; breadth of disk equals 4 to 4½ times width of ray at base.

Type.—Cat. No. 37,020, U. S. N. M.

Type-locality.—Station 5491, between Leyte and Mindanao, 736 fathoms, green mud, coral, bottom temperature 52.3° Fahr.

This species differs from *B. andamanica* in having more closely crowded costæ, with strongly, not feebly developed plates, in having a longer costal region, in lacking well-developed bands of pedicellariæ between the costæ and in having fewer (12 or 13, not 15), less deciduous rays. *B. gunnii* differs in having more numerous rays, much thinner disk, which has a downy appearance, only 20 to 30 ridges, especially prominent laterally but obsolete abactinally, intercostal bands of pedicellariæ, a much shorter major subambulacral spine, and mouth plates composed of 2 incompletely fused adambulacrals, leaving a "ligamentous symphysis between."

Brisinga mimica new species.

Diagnosis.—Rays 16. Costæ numerous (25 to 30), closely placed, prominent, irregular, with relatively coarse spinelets, without intervening bands of pedicellariæ; costæ confined to basal fifth of ray, beyond which for an equal distance are about 15 very inconspicuous ridges composed of small plates, but carrying a fairly heavy felting of pedicellariæ; disk large, with isolated delicate spinelets not in groups; adambulacral plates proximally wider than long and crowded in appearance; armature typically 1 aboral furrow spinelet, 1 aboral actinal spinule and 1 longer adoral actinal spine (equaling 2 plates in length), and 1 major spine about 3 plates in length. Rays slender, very long; R=385 mm., r=19 mm.

Type.—Cat. No. 37,021, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes (5° 35′ S., 122° 20′ E.), 559 fathoms, green mud; bottom temperature 39.2° Fahr.

B. insularum has 13 rays and disk spinelets in groups, intercostal ridges of pedicellariæ, only 13 to 17 costæ, and longer lateral spines. *B. bengalensis* has 14 rays, a small disk, with the abactinal spinelets in tufts, 20 costæ, occupying basal ninth of the ray, intercostal bands of pedicellariæ equally salient with the ribs.

Brisinga moluccana new species.

Diagnosis.—Rays 16. Costæ 25, complete, prominent, well-spaced, with 1 to 3 intercostal bands of pedicellariæ; costal spinelets relatively coarse; disk medium, with isolated papilliform, small, spinelets, and minute pedicellariæ; adambulacral plates about as wide as long proximally; armature typically: 1 true furrow spinelet at either end of plate and equal to about ⅔ the length of plate; aborad and actinad to the

adoral spinelet is a shorter one generally pointed away from the furrow; the large actinal spine, equal to 2 or 3 plates in length, is situated on the aboral half of plate. Costal area swollen, occupying somewhat more than basal third of ray; integument thin, devoid of prickles. Breadth of disk equal 5 times width of ray at base (6 mm.). R=410 mm., r=15 mm.

Type.—Cat. No. 37,022, U. S. N. M.

Type-locality.—Station 5626, between Gillolo and Kayoa Islands, Molucca Islands, 265 fathoms, gray mud, fine sand.

Brisinga acanthogenys new species.

Diagnosis.—Rays 11. Costæ 20, complete, prominent, well spaced, with 1 complete and 1 or 2 incomplete bands of intercostal pedicellariæ; costal spinelets fairly prominent, few in number; disk *small*, with beveled margin; plates granuliform, spaced, with usually 2 or 3 very small spinelets but no pedicellariæ; lateral spines long, equaling length of 7 or 8 adambulacral plates; no integumentary prickles on rays; adambulacral plates about as wide as long proximally; armature, proximally: 1 true furrow spinelet at each end, 1 minor adoral subambulacral spinule a little longer than the plate, and a major subambulacral spine 3½ to 4 plates in length, situated on a prominence of the aboral half of the plate; mouth plates each with 2 suboral spines. Breadth of disk equal to 3½ times width of ray at base (6 mm.). R=350 mm., r=11 mm.

Type.—Cat. No. 37,023, U. S. N. M.

Type-locality.—Station 5440, mouth of Lingayan Gulf, Luzon, 172 fathoms, fine gray sand, globigerina; bottom temperature, 53.2° Fahr.

Craterobrisinga new subgenus.

Diagnosis.—Proximal adambulacral plates short, wider than long; the major subambulacral spines of proximal plates clavate, with enlarged capitate, often truncate tip. Type, *Brisinga panopla* Fisher.

This subgenus includes *B. panopla* Fisher, *B. alberti* Fisher, *B. cricophora* Sladen, *B. parallela* Koehler, besides the species described below.

Brisinga (Craterobrisinga) eucoryne new species.

Diagnosis.—Rays 11. Related to *B. alberti* Fisher. Five or 6 inconspicuous rudimentary costæ at base of ray, followed by 17 to 20 well-spaced prominent ridges occupying proximal third of ray; numerous small integumentary spinelets, and about 3 inconspicuous bands of pedicellariæ between the costæ, which are composed of elongate elliptical plates, usually not compressed, bearing 1 or 2 spinelets in center; disk small, with crowded, rather long, solitary spinelets giving a hirsute appearance; adambulacral plates proximally wider than long, with crowded armature; first dozen plates with the slenderer of the 2 subambulacrals often truncate and slightly flaring; typical armature; a true furrow spinelet at either end of the plate and 2 large actinal grooved

spines sometimes in a transverse series at middle of plate or in an oblique series; outer spine of first 10 plates with a flaring truncate tip, ending in numerous points; each mouth plate with 2 large pointed suboral spines. Breadth of disk equaling 3⅓ times width of ray at base (6 mm.). R= 205 + mm., r=10.5 mm. (small section from tip of ray missing).

Type.—Cat. No. 37,024, U. S. N. M.

Type-locality.—Station 5348, Palawan Passage, 375 fathoms, coral sand, bottom temperature, 56.4° Fahr.

Stegnobrisinga new subgenus.

Diagnosis.—Integument between the costal arches of ray strengthened by many close-set, mostly contiguous or sometimes overlapping papery plates of irregular form and conspicuous size, completely filling the interspaces; proximal subambulacral spines acicular, as in typical *Brisinga*. Type, *Brisinga placoderma*.

The numerous costæ will at once separate this subgenus from *Freyella*, which has a characteristic appearance, quite unlike that of *Stegnobrisinga*.

Brisinga (Stegnobrisinga) placoderma new species.

Diagnosis.—Rays 13 or 14. Costæ 35 to 40, close together and not very prominent; intercostal areas paved with close-set, irregular, often overlapping papery plates devoid of spinelets; costal arches fairly regular and parallel, opposite every adambulacral, or occasionally more frequent, but only every third to fifth with a lateral spine; disk with beveled border and with close-set isolated spinelets and conspicuous slender-jawed pedicellariæ; adambulacral armature variable, usually 2 furrow spinelets at each end of the furrow margin, or 1 aboral and 2 adoral about as long as the plate, and a subambulacral spine 2½ to 3 plates in length. Breadth of disk equal to 3½ to 4 times width of ray at base (8 mm.). Rays long.

Type.—Cat. No. 37,025, U. S. N. M.

Type-locality.—Station 5648, Buton Strait, Celebes, 559 fathoms, green mud, bottom temperature, 39.2° Fahr.

Freyella spatulifera new species.

Diagnosis.—Rays 14, not very long. Disk with a beveled margin, covered with a close, uniform nap of mostly solitary, delicate spinelets; disk plates not distinguishable. Genital region of ray short, slightly swollen, the spinelets in clusters of 2 to about 6 per plate. On all but basal fourth of ray there are low, transverse, parallel ridges, caused by the plates being slightly elevated, upon which the spinelets are more numerous than in the narrow intervening areas. These ridges resemble somewhat the costæ of *Brisinga*, but are much less prominent. A slender, needle-like spine on the side of every adambulacral, beginning with the eighth, increases in length until equal to about 6 or 7 adambulacral plates. Adambulacral armature at base of ray consists of 1 furrow spine-

let at each end of the plate and a third, longer one, above the aboral spinelet; on the actinal surface is a prominent subambulacral spine which on the first 15 plates is conspicuously spatulate, the broad lip being sometimes flat, sometimes scoop-shaped, sometimes grooved. The truncated end has, often, 2 or 3 knobs, and the part of the spine which is flattened decreases from about half to about a fifth, or even less, on the distal spines affected. Mouth plates each with 3 short spinelets on the actinostomial margin, and 2 on the distal furrow corner; suboral spine about as long as the first subambulacral, with a slightly flattened, sublanceolate tip, sometimes ending in 2 distinct, sharp points. R=135 mm. + r=9 mm.; breadth of ray at base, 4.5 mm.; length of genital region, 30–35 mm.

Type.—Cat. No. 36,747, U. S. N. M.

Type-locality.—Station 5668, 2° 28′ 30″ S., 118° 43′ E. (off Mamuju Island), 901 fathoms., gray mud.

This species which is characterized by the broadly spatulate, proximal subambulacral spines and the rudimentary, transverse, abactinal spiniferous ridges differs from *F. echinata* Sladen in lacking the conspicuous abactinal spines of the genital region, and from *F. insignis* Ludwig (from off Panama) in having differently formed proximal subambulacral spines. In *insignis* the spines usually end in 2 to 4 diverging prongs and are only exceptionally flattened to any extent, while the lateral spine is opposite every alternate adambulacral plate and there is only 1 small aboral furrow spinelet. *Freyella pacifica* Ludwig, which has the tip of the proximal subambulacral spines slightly enlarged, has the lateral spine and furrow spinelet as in *insignis*.