SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

Bulletin 100

VOLUME 14, PART 3

CONTRIBUTIONS TO THE BIOLOGY OF THE PHILIPPINE ARCHIPELAGO AND ADJACENT REGIONS

REPORT ON THE ECHINOIDEA COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION, 1907–1910. PART 3: THE ECHINONEIDAE, ECHINOLAMPADIDAE, CLYPEASTRIDAE, ARACHNOIDIDAE, LAGANIDAE, FIBULARIIDAE, URECHINIDAE, ECHINOCORYTHIDAE, PALAEOSTOMATIDAE, MICRASTERIDAE, PALAEOPNEUSTIDAE, HEMIASTERIDAE, AND SPATANGIDAE

By

THEODOR MORTENSEN

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1948

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 30 cents

CONTENTS

REPORT ON THE ECHINOIDEA COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION, 1907–1910. PART 3: THE ECHINONEIDAE, ECHINOLAMPADIDAE, CLYPEASTRIDAE, ARACHNOIDIDAE, LAGANIDAE, FIBULARIIDAE, URECHINIDAE, ECHINOCORYTHIDAE, PALAEOSTOMATIDAE, MICRASTERIDAE, PALAEOPNEUSTIDAE, HEMIASTERIDAE, AND SPATANGIDAE

By Theodor Mortensen

In presenting the third and final part of the report on the echinoids collected by the *Albatross* Philippine Expedition I want to thank again the authorities of the United States Fish and Wildlife Service and of the United States National Museum for the privilege of working up this important and interesting collection. Special thanks are due to Austin H. Clark, curator of echinoderms of the National Museum, for his encouragement and help, and above all to Dr. Alexander Wetmore, Secretary of the Smithsonian Institution, for permitting me to include the illustrations and the more detailed descriptions of the various new forms collected by the *Albatross* (apart from the cidarids) in my Monograph of the Echinoidea; from a scientific point of view it is a great advantage thus to have all the illustrations in one place. Further, I extend my deep gratitude for permission to study the *Albatross* collection in combination with the prosecution of the work on my monograph, for this has been a great advantage—much better than identifying the various forms simply on the basis of the already existing literature. On the other hand, it has caused considerable delay in the publication of the *Albatross* report. I am indeed grateful that I have had no word of complaint of the long time it has taken me to finish this report.

Foremost in interest among all the echinoids collected by the *Albatross* Philippine Expedition stands the discovery of a Recent representative of the family Micrasteridae, hitherto known only as fossils, namely *Isopatagus obovatus*. This find vies in importance with the discovery by the *Siboga* Expedition of a Recent echinocorythid, *Stereopneustes relictus*. Very noteworthy also is the discovery of a

species of *Conolampas* in the Philippine seas, the genus *Conolampas*, hitherto known to occur only in the West Indies. (The fact that I took another species of *Conolampas* at the Kei Islands in 1922 and that the Murray Expedition took a third species in the Indian Ocean gives quite a new conception of this fine echinolampadid and its geographical distribution.) Of considerable interest is likewise the discovery of a fine new *Pericosmus*, *P. melanostomus*. This genus was hitherto thought to be extinct, until the *Investigator* discovered a species, *P. macronesius* Koehler, in the Indian Ocean; but the discovery of this new species, together with Crossland's find of a fine large species, *Pericosmus akabanus* Mortensen, in the Red Sea and my own discovery of several more species (to be described in volume 5 of my Monograph of the Echinoidea), proves this genus to be still living in full vigor.

A notable fact is the strong development of the genus *Brissopsis* in the Philippine seas, no less than five species being taken by the *Albatross*, which means that six species occur there, one of them, the very common *Brissopsis luzonica*, having curiously enough not been taken at the Philippines by the *Albatross*. The absence of such interesting forms as *Aëropsis*, *Aceste*, and *Pourtalesia* is regrettable, but this is balanced by the presence of several specimens of a new *Plesiozonus* (though in a very poor condition).

On the whole this collection of echinoids from the Philippine seas is very rich and compares favorably with the collection of the *Siboga* Expedition. These two expeditions, combined with my own researches at the Kei Islands (1922) and in the Bali Sea (1928), have given the proof that the Malay Region, of which the Philippines form an integral part, is, together with the Japanese seas, particularly the Sagami Sea, the richest in the world in echinoids (and apparently also in the other classes of echinoderms), as were the then European seas in Jurassic and Cretaceous times.

Order HOLECTYPOIDA

Family ECHINONEIDAE

Genus ECHINONEUS Leske

ECHINONEUS CYCLOSTOMUS Leske

Echinoneus cyclostomus A. Agassiz, Revision of the Echini [Mem. Mus. Comp. Zool., vol. 3], pp. 117, 550, pl. 14, figs. 6–8; pl. 14a, figs. 5–10, 1873.—Westergren, Mem. Mus. Comp. Zool, vol. 39, No. 2, p. 44, 1911.—H. L. Clark, Hawaiian and other Pacific Echini: Echinoneidae . . . Spatangidae, p. 147, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 177, 1925.

Locality.—Station 5143; off Joló Light (lat. 6°05′50″ N., long. 121°02′15″ E.); 35 meters; February 15, 1908. One small dead test.

Order CASSIDULOIDA

Family ECHINOLAMPADIDAE

Genus ECHINOLAMPAS Gray

ECHINOLAMPAS ALEXANDRI de Loriol

Echinolampas alexandri DE LORIOL, Mém. Soc. Hist. Nat. Genève, vol. 24, p. 4, pl. 1, figs. 1–3, 1876.—H. L. CLARK, Hawaiian and other Pacific Echini: Echinoneidae . . . Spatangidae, p. 114, pl. 144, figs. 14–16; pl. 153, figs. 3, 4, 1917.—KOEHLER, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 144, pl. 4, fig. 10, 1922.—H. L. CLARK, Catalogue of the Recent sea-urchins in the British Museum, p. 182, 1925.

Remarks.—A single old, broken test, unfortunately without label, must, I think, be referred to *E. alexandri*, the characters of the petals, the coarse tuberculation, the broad transverse peristome, and the quite rudimentary floscelle conforming with this species. It would seem, then, that this species occurs also in the Malay region, though it has not till now been recorded from there. (The *Echinolampas depressa* recorded by de Meijere in his *Siboga* Echinoidea, p. 144, from off Saleyer is not that species but a close relative of *Echinolampas alexandri*, a fact that has been mentioned in volume 4, part 1, of my Monograph of the Echinoidea.)

Genus CONOLAMPAS A. Agassiz

CONOLAMPAS DIOMEDEAE, new species

Locality.—Station 5261, off Mindoro (lat. 12°30′55″ N., long. 121°34′24″ E.); 265 meters; June 4, 1908. One specimen.

Type.—U.S.N.M. No. E.7147, from station 5261.

Description.—The test is perfectly hemispherical, the apex being in the center; the oral side is perfectly flat, scarcely at all sunken in the middle and without any tumidity before the periproct. The outline is almost circular, only slightly ovoid, 70 mm. long, 66 mm. broad, the elongation hardly perceptible. The height is 33 mm., exactly half the breadth.

The mouth is slightly posterior, 36 mm. from the anterior, 34 mm. from the posterior edge of the test, measured from the center of the mouth; it is rather small, 8 mm. wide. Periproct a little smaller, 7 mm. wide, situated distinctly on the oral side. Apical system of the shape usual in *Echinolampas;* it is slightly knob-shaped, placed almost exactly in the center.

Ambulacra: The aboral poriferous areas, which are not at all petaloid, reach very nearly to the edge of the test. The anterior ambulacrum has 62 or 63 pore-pairs in both series; ambulacrum (II and) IV has 68 pore-pairs in the anterior, 72 in the posterior series,

and ambulacrum (I and) V has 71 pore-pairs in the anterior, 60 in the posterior series. There are 3–5 small tubercles on the ridge between the consecutive pore-pairs, forming a more or less regular transverse series. The outer pore is twice as broad as the inner and is connected with the latter by a short, not very deep furrow. The interporiferous zone has in the upper part only two, lower down three or four, larger tubercles in a transverse series. The ambulacra are about 7 mm. broad at the widest, distal part; they continue of the same width to the ambitus and on the oral side, narrowing slightly adorally. The phyllode is well developed, but not widened, with the three series of pores (tube feet) more or less regularly developed. The bourrelets are not very prominent. The tubercles of the interambulacra are of the same size as those of the ambulacra. The tuberculation of the oral side is rather dense. Glassy tubercles are less developed than in *C. sigsbei* and confined to the aboral side. The pedicellariae are not specifically characteristic. The spines, of the character usual in *Echinolampas*, afford no specific features. The color of the spines is yellowish, the denuded test whitish.

On account of the shape of the test this species must be referred to the genus *Conolampas*. From the only species of this genus hitherto made known, the West Indian *Conolampas sigsbei* A. Agassiz, it is very well distinguished by the much lower and correspondingly more numerous ambulacral plates and by the pores being unequal, the outer pore much larger than the inner one (in *C. sigsbei* they are of equal size); also the phyllodes and bourrelets are less developed than in *C. sigsbei;* on the other hand, the tuberculation of the oral side is much denser than in *C. sigsbei.* It is much more closely related to another species of *Conolampas* than it is to the West Indian species. The former was collected by the John Murray Expedition in the Indian Ocean, off the Maldive Islands, and is described in my Report on the Echinoids of that Expedition, part 2, under the name *Conolampas murrayana* Mortensen. *C. diomedeae* is distinguished from that species mainly by the petals being somewhat longer and narrower and by the denser tuberculation of the oral side.

Order CLYPEASTROIDA

Family CLYPEASTRIDAE

Genus CLYPEASTER Lamarck

CLYPEASTER (STOLONOCLYPUS)[1] HUMILIS (Leske)

Clypeaster humilis A. Agassiz, Revision of the Echini, pp. 100, 510, 1873.—H. L. Clark, Hawaiian and other Pacific Echini: Clypeastridae . . . Scutellidae,

[1] Concerning the subgenera of *Clypeaster* reference must be made to the forthcoming volume 4, part 2, of my Monograph of the Echinoidea.

p. 36, pl. 123, fig. 23; pl. 137; pl. 138, fig. 4, 1914.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 51, pl. 3, figs. 1–5, 12; pl. 14, fig. 5, 1922.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 149, 1925.

Clypeaster rosaceus de Meijere, *Siboga* Echinoidea, p. 133, pl. 18, figs. 352, 353, 1904.

Locality.—Station 5160, Tinakta Island (lat. 5°12′40″ N., long. 119°55′ E.); 22 meters; February 22, 1908. One specimen.

Remarks.—This is a fine specimen, 68 mm. long, of nearly oval outline. The petaloid area is only half the test length, the anterior petal slightly open. It is, on the whole, a fairly typical example of this rather variable species.

It is generally agreed that it was a very regrettable mistake by Lovén (whom de Meijere follows) to use the name *rosaceus* of Linnaeus for this specits. The name *rosaceus* is to be used for the common West Indian species, the genotype of the genus *Clypeaster*.

CLYPEASTER (STOLONOCLYPUS) VIRESCENS Döderlein

Clypeaster virescens Döderlein, Arch. für Naturg., vol. 51, p. 30, 1885.—H. L. Clark, Hawaiian and other Pacific Echini: Clypeastridae . . . Scutellidae, p. 39, pl. 122, fig. 15; pl. 123, figs. 28–31; pl. 128, fig. 8; pl. 139, fig. 4; pl. 140, figs. 1, 2, 1914; Catalogue of the Recent sea-urchins in the British Museum, p 153, 1925.

Locality.—Station 5415, between Cebu and Bohol (lat. 10°08′ N., long. 123°57′ E.); 160 meters; March 24, 1909. One specimen.

Remarks.—The specimen is a large one, 135 mm. long, and very badly broken. I have succeeded in gluing the larger fragments together, so that one gets an idea of what it looked like when alive. The distal part of the test rises fairly gradually toward the petaloid region, from where it rises more steeply. I have specimens of similar shape from the Kei Islands, together with such as have the edge flatter, as is the rule in the Japanese specimens. I have no doubt that this specimen actually belongs to *C. virescens*, so widely distributed in the Pacific, from Japan to New Zealand.

The tridentate pedicellariae have slender valves, as I find them in a specimen from off New South Wales. (These will be figured in volume 4, pt. 2, of the Monograph of the Echinoidea.)

CLYPEASTER (RHAPHIDOCLYPUS) RETICULATUS (Linnaeus)

Clypeaster scutiformis A. Agassiz, Revision of the Echini, pp. 101, 512, pl. 13, figs. 1–4, 1873.—de Meijere, *Siboga* Echinoidea, p. 131, pl. 18, figs. 344–351, 1904.

Clypeaster reticulatus H. L. Clark, Hawaiian and other Pacific Echini: Clypeastridae . . . Scutellidae, p. 34, pl. 124, figs. 3–6, 1914.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 68, pl. 6, figs. 3, 4; pl. 15, fig. 10, 1922.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 151, 1925.

Localities.—Station 5159, Tinakta Island, Tawi Tawi Group (lat. 5°12′ N., long. 119°54′ E.); 18 meters; February 21, 1908. Two specimens.

Station 5160, Tinakta Island (lat. 5°12′40″ N., long. 119°55′ E.); 22 meters; February 22, 1908. One specimen.

Station 5218, between Burias and Luzón (lat. 13°11′15″ N., long. 123°02′45″ E.); 37 meters; April 22, 1908. One young specimen.

Remarks.—These specimens are all of the relatively flat type, with the edge only moderately thick (5.5 mm. in the largest specimen); it will be dealt with more in detail in the forthcoming volume 4, pt. 2, of my Monograph of the Echinoidea. The specimen from station 5218 is a small one, 15.5 mm. long, but has the genital pores fully developed; it has the aboral side of the test distinctly sculptured, as is characteristic of young specimens of this species. It is of a uniform yellowish color, as is also the specimen from station 5160, while the two somewhat larger specimens from station 5159 (30 and 38 mm. long, respectively) show traces of the reddish marginal spots commonly found in this species.

CLYPEASTER (RHAPHIDOCLYPUS) FERVENS Koehler

Clypeaster fervens Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 45, pl. 6, figs. 1, 2, 6; pl. 13, fig. 6; pl. 15, fig. 1, 1922.

Locality.—Station 5640, Buton Strait (lat. 4°27′ S., 122°55′40″ E.); 45 meters; December 13, 1909. One specimen.

Remarks.—The single specimen is a dead test, 67 mm. long, 57 mm. broad, 14 mm. high. The petaloid area is 38 mm., thus somewhat more than half the test length. The edge of the test is about 6 mm. thick, or about one-tenth of the test length.

In the outline of the test this specimen agrees with *Clypeaster fervens*, particularly with the specimens collected by the Murray Expedition. The markedly concave oral side is as typical of *fervens*. The specimen, however, differs from *fervens* in one character—the somewhat narrower petals. Whether this means that it is specifically different from the typical *fervens* is impossible to tell with only a single naked test at hand. For the present, at least, I cannot hesitate in referring this specimen to *C. fervens*, otherwise known only from the Indian Ocean.

CLYPEASTER (LEPTOCLYPUS) ANNANDALEI Koehler

Clypeaster annandalei Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 16, pl. 1, figs. 1–7; pl. 2, figs. 1–11; pl. 3, figs. 6–9; pl. 5, fig. 3; pl. 10, fig. 7; pl. 14, fig. 1, 1922.

Locality.—Station 5381, Ragay Gulf, Luzón (lat. 13°14′15″ N., long. 122°44′45″ E.); 160 meters; March 6, 1909. Three specimens.

Remarks.—The specimens are 51–65 mm. long; they are quite typical *annandalei.*

As this species was hitherto known only from the Indian Ocean, mainly the western part, it is of considerable zoogeographical interest that it is here shown to occur also in the Philippines, which implies that it must be more widely distributed in the Malay region.

CLYPEASTER (CORONANTHUS) PATERIFORMIS, new species

Station 5276, Malavatuan Island, Luzón (lat. 13°49′ N., long. 120°15′ E.); 33 meters; July 17, 1908. One specimen.

Type.—U.S.N.M. No. E.7148, from station 5276.

Description.—Test almost circular, 70 mm. long, 69 mm. wide; only between the paired petals the edge is nearly straight. It is very low, height only about 9 mm. The oral side is markedly concave, the shape of the test recalling, indeed, a sacrificial dish (*patera*) as expressed in the species name.

The petals are very short, the whole petaloid area only 28 mm., or much less than half the test length. The frontal petal is slightly the longest. The petals are leaf-shaped, broad adapically, pointed and closed distally. The ridges between the pore-pairs carry 4–7 primary spines (tubercles).

The primary spines of the oral side are about 3 mm. long, not or only slightly widened distally; the marginal spines form a distinct fringe. The spines around the peristome are not curved or widened. The aboral primaries are 1 mm. long, not club-shaped. Miliary spines not peculiar. The apical system is central; the genital pores are covered by fairly large genital papillae. The periproct is small, 2 mm. in diameter, covered with small spines as usual in *Clypeaster;* it is 7 mm. distant from the edge of the test. The peristome is small, transverse-oval; it is hardly at all sunken.

The tridentate pedicellariae have very slender valves, which meet only distally where they are widened and deeply serrate. The ophicephalous pedicellariae have a rather long narrow basal part, without a circle of thorns. Triphyllous pedicellariae not peculiar. The sucking disk of the tube feet is well developed.

The color is a uniform brownish.

Remarks.—This species appears to be the nearest related to *Clypeaster telurus*, with which it agrees in the important character of the great distance between the periproct and the edge of the test. It differs, however, from *telurus* by its round outline, the not club-shaped aboral primary spines, the smaller petaloid area, and the different shape of the tridentate and ophicephalous pedicellariae. There can be no doubt of its specific distinctness.

Family ARACHNOIDIDAE

Genus ARACHNOIDES Leske

ARACHNOIDES PLACENTA (Linnaeus)

Arachnoides placenta A. Agassiz, Revision of the Echini, p. 530, 1873 (*pro parte; non* pl. 13b, figs. 1–4=*A. zelandiae* Gray).—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 43, 1914 (*pro parte; non* pl. 125, figs. 1–3=*A. zelandiae*) ; Catalogue of the Recent sea-urchins in the British Museum, p. 154, 1925.

Only a single broken test of this species was collected by the *Albatross*, at Verde del Sur Island, Palawan, probably on the beach.

Family LAGANIDAE

Genus PERONELLA Gray

PERONELLA LESUEURI (Valenciennes)

Laganum lesueuri L. Agassiz, Monographie des scutelles, p. 116, pl. 24, figs. 3–6, 1841.—de Meijere, *Siboga* Echinoidea, p. 122, pl. 6, figs. 63, 67, 70; pl. 18, figs. 329–333, 1904.

Laganum rostratum L. Agassiz, Monographie des scutelles, p. 118, pl. 25, 1841.

Peronella decagonalis A. Agassiz, Revision of the Echini, pp. 148, 520, pl. 13e, figs. 8–11, 1873.

Peronella rostrata A. Agassiz, Revision of the Echini, pp. 149, 523, 1873.

Peronella lesueuri H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 53, pl. 124, figs. 23, 24, 1914; Catalogue of the Recent sea-urchins in the British Museum, p. 159, 1925; Mem. Mus. Comp. Zool., vol. 55, p. 417, pl. 15, fig. 3, 1938.

Localities.—Station 5161, Tinakta Island (lat. 5°10′ N., long. 119°53′ E.) ; 29 meters; February 22, 1908. Six dead tests.

Station 5181, off eastern Panay (lat. 11°37′ N., long. 123°27′ E.) ; 48 meters; March 27, 1908. Ten specimens, seven of which are dead tests.

Station 5276, China Sea, off Luzón (lat. 13°49′ N., long 120°15′ E.) ; 33 meters; July 17, 1908. Four specimens.

Remarks.—The specimens from stations 5161 and 5181 are of the variety *rostrata* (A. Agassiz).

I agree with de Meijere and Clark that the *Laganum rostratum* of L. Agassiz cannot be maintained as distinct from his *L. lesueuri;* still, the slightly prominent posterior end of the test gives so characteristic a general appearance that there is good reason for recognizing this form as a separate variety.

The largest of the specimens of the variety, a dead test, is 45 mm. long, much smaller than the type, which is 85 mm. long.

The localities New Zealand and Zanzibar, given by L. Agassiz for his *Laganum rostratum*, are evidently due to erroneous labels. The variety is till now known only from the Malay region.

From the shore at Capunuypugan Point (east coast of Mindanao), May 9, 1908, there is a single specimen, 56 mm. long, which has much the appearance of *Peronella lesueuri*, but the periproct is situated more inward than usual in that species, and, what is more important, the madreporic pores are placed in irregular furrows as in *Laganum;* there are only three genital pores. Also the outline is irregular. It is quite evident that this is an abnormal specimen, and I think it must be a hybrid of *Peronella lesueuri* and a *Laganum*, perhaps *L. depressum.* It is regrettable that only this specimen was taken; had a fair number of laganids been collected at this locality, it would probably have been possible to arrive at a more definite conclusion as to the affinities of this specimen.

PERONELLA (?) PELLUCIDA Döderlein

Peronella (*Laganum*) *pellucida* Döderlein, Arch. für. Naturg., vol. 51, p. 32, 1885.
Peronella pellucida H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 53, pl. 142, figs. 1, 8–10, 1914.

Locality.—Station 5156, Tinakta Island (lat. 5°13′ N., long. 119°56′ E.); 33 meters; February 21, 1908. One naked but otherwise well-preserved test.

Remarks.—This specimen I refer with some little doubt to the Japanese *Peronella pellucida.* It agrees with that species in its general shape, in the characters of the petals, and in the almost central position of the periproct, which is also naked as in *pellucida.* But it is somewhat lower than usual for *pellucida* and the periproct is triangular, with the point inward, not round as otherwise in *pellucida;* further it has the genital pores developed at a length of 24 mm., while in specimens from Japan the genital pores are only about to appear at a length of 27 mm.

It is, of course, quite possible that these characters come within the range of variation of *Peronella pellucida;* but with the material available at present this cannot be ascertained definitely. From a zoogeographical point of view there can be no objection to referring this specimen to *Peronella pellucida;* it is true, the species has till now been recorded only from Japanese seas, but I have some tests (unfortunately dead) from the Kei Islands, which almost certainly belong to *P. pellucida*, so that this species may be expected to occur all over the Malay region. On the other hand, the small depth, 33 meters, at which this specimen was taken is unusual for *P. pellucida*, which is otherwise more of a deep-sea form, hitherto not known from less than 77 meters. After all, then, I think it the best course to refer this specimen provisionally and with reservation to *Peronella pellucida.*

PERONELLA ORBICULARIS (Leske)

Laganum orbiculare L. Agassiz, Monographie des scutelles, p. 120, pl. 22, figs. 16–20, 1841.—de Meijere, *Siboga* Echinoidea, p. 126, pl. 6, figs. 69, 73–75; pl. 18, figs. 335–339, 1904.

Peronella orbicularis, A. Agassiz, Revision of the Echini, pp. 149, 521, 1873.—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 52, 1914; Catalogue of the Recent sea-urchins in the British Museum, p. 160, 1925.

Localities.—Station 5164 (lat. 5°02′ N., long. 119°52′ E.); 33 meters; February 24, 1908. One dead broken test.

Station 5181, off eastern Panay (lat. 11°37′ N., long. 123°27′ E.); 48 meters; March 27, 1908. Five dead partly broken tests.

Station 5432 (lat. 10°38′ N., long. 120°12′ E.); 93 meters; April 8, 1909. One dead broken test.

Remarks.—Although all these specimens are dead tests, partly rather badly broken, they appear to be referable to the species *orbicularis*, so that I have no doubt about the identification. The specimens from station 5181 are clearly of the variety *concava*, which I have established for some specimens from the Kei Islands (*cf.* my Monograph of the Echinoidea, vol. 4, part 2). The other specimens are in too poor condition for deciding whether they belong to the variety or the typical form.

PERONELLA MACROPROCTES Koehler

Peronella macroproctes Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 113, pl. 9, figs. 5, 11, 14; pl. 10, figs. 10–12; pl. 15, fig. 11, 1922.

Localities.—Station 5218, between Burias and Luzón (lat. 13°11′ N., long. 123°03′ E.); 37 meters; April 22, 1908. One specimen.

Station 5356, North Balabac Strait (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; January 5, 1909. One specimen.

Remarks.—I have no doubt about identifying these specimens with the *P. macroproctes* Koehler, hitherto known only from the south coast of Ceylon (*Investigator*); I have, however, collected a good number of specimens at the Kei Islands, and new information about this species will be given in volume 4, part 2, of my Monograph of the Echinoidea. The specimen from station 5218 is 29 mm. long and one of the largest specimens known. The peculiar broad-valved tridentate pedicellariae are well developed in this specimen.

PERONELLA MINUTA (de Meijere)

Laganum minutum de Meijere, *Siboga* Echinoidea, p. 125, pl. 6, figs. 76, 77; pl. 18, fig. 334, 1904.

Peronella minuta H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 51, 1914.

Localities.—Station 5149, Sulu Archipelago (lat. 5°33′ N., long. 120°42′10″ E.); 18 meters; February 18, 1908. One dead test.

Station 5165, Sulu Archipelago (lat. 4°58′20″ N., long. 119°50′30″ E.); 16 meters; February 24, 1908. One specimen in good condition.

Remarks.—These specimens are quite typical representatives of this well-marked species, which is known only from the Sulu Archipelago.

Genus LAGANUM Gray

LAGANUM LAGANUM (Leske)

Laganum bonani L. Agassiz, Monographie des scutelles, p. 108, pl. 22, figs. 25–29; pl. 23, figs. 8–12, 1841.—A. Agassiz, Revision of the Echini, p. 517, pl. 13e, figs. 6, 7, 1873.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 83, pl. 9, fig. 4; pl. 14, fig. 6, 1922.

Laganum laganum H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 45, pl. 124, fig. 17, 1914.

Localities.—Port Argo; January 31, 1908. Three dead tests.

Bubuán Island, Joló; February 14, 1908. One dead test.

Tataán, Simaluc Islands, shore; February 19, 1908. Several fine specimens.

Station 5166, Observation Island, Tawi Tawi Group; 97 fathoms; February 24, 1908. One dead test.

Sitanki Island; February 26, 1908. One dead test.

Romblón, shore; March 26, 1908. Several specimens.

Reef opposite Cebu; April 4, 1908. One specimen.

Catbalogan, Sámar; April 15, 1908. One specimen.

Busin Harbor, Burias Island; April 23, 1908. One specimen.

Capunuypugan, Mindanao; May 9, 1908. One specimen.

Malcochin Harbor, Linapacan Island; December 19, 1908. One specimen.

Ulugan Bay, Palawan Island; December 28, 1908. One specimen.

Remarks.—There can be no doubt that the dead specimen from station 5166 at 97 fathoms has not been living there, as this species is preeminently a littoral form. Although de Meijere, in his *Siboga* Echinoidea, records a specimen from a depth of 34 meters (station 299), he does not say whether it was a living specimen or a dead test; there is then no proof of the occurrence of this species outside the strictly littoral zone.

The specimens from Catbalogan and Malcochin Harbor are unusually broad, as broad as long (36 and 23 mm. long, respectively), but otherwise seem to be the typical form. I must regard them as only individual variations.

LAGANUM DECAGONALE (de Blainville)

Laganum decagonum L. Agassiz, Monographie des scutelles, p. 112, pl. 23, figs. 16–20, 1841.

Laganum (Peronella) decagonale de Meijere, *Siboga* Echinoidea, p. 117, pl. 6, figs. 58–62, 65; pl. 18, figs. 318–324, 1904.

Laganum decagonale H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 46, 1914.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 85, pl. 8, fig. 5; pl. 11, fig. 3; pl. 15, fig. 13, 1922.—H. L. Clark, Catalogue of Recent sea-urchins in the British Museum, p. 156, 1925.

Localities.—Station 5103, off southern Luzón (lat. 14°50′ N., long. 120°14′ E.); 37 meters; January 7, 1908. Ten specimens.

Station 5104, off southern Luzón (lat. 14°46′ N., long. 120°12′ E.); 60 meters; January 8, 1908. Four specimens, one of them a dead test.

Station 5181, off eastern Panay (lat. 11°37′ N., long. 123°27′ E.); 48 meters; March 27, 1908. Ten dead tests, one live specimen.

Station 5206, off western Sámar (lat. 11°32′ N., long. 124°43′ E.); 59 meters; April 14, 1908. Several dead tests and six live, mostly small specimens.

Station 5207, off western Sámar (lat. 11°38′ N., long. 124°41′ E.); 64 meters; April 14, 1908. Several mostly small specimens, many of them dead tests.

Station 5208, off western Sámar (lat. 11°46′ N., long. 124°43′ E.); 48 meters; April 14, 1908. Nine specimens.

Station 5210, off western Sámar (lat. 11°50′ N., long. 124°28′ E.); 92 meters; April 17, 1908. Six dead tests.

Station 5220, San Andreas Island (lat. 13°38′ N., long. 121°58′ E.); 92 meters; April 24, 1908. Several dead tests.

Station 5235, east of Mindanao (lat. 9°43′ N., long. 125°48′ E.); 82 meters; May 9, 1908. Several specimens, eight of them dead tests.

Station 5257, south of Mindanao (lat. 7°22′ N., long. 124°12′ E.); 51 meters; May 22, 1908. Eighteen dead tests and one live specimen.

Station 5302, China Sea (lat. 21°42′ N., long. 114°50′ E.); 70 meters; August 9, 1908. Nine specimens.

Station 5303, China Sea (lat. 21°44′ N., long. 114°48′ E.); 62 meters; August 9, 1908. Nineteen specimens.

Station 5304, China Sea (lat. 21°46′ N., long. 114°47′ E.); 62 meters; August 9, 1908. Several specimens.

Station 5335, Linapacan Strait (lat. 11°37′ N., long. 119°49′ E.); 84 meters; December 18, 1908. Eleven dead tests.

Station 5342, Palawan Island (lat. 10°57′ N., long. 119°17′ E.); 26–46 meters; December 23, 1908. Four live specimens and seven dead tests.

Station 5358 (lat. 6°07′ N., long. 118°18′ E.); 71 meters; January 7, 1909. Three dead tests.

Station 5369 (lat. 13°48′ N., long. 121°43′ E.); 194 meters; February 24, 1909. One dead fragmentary test.

Station 5426, Palawan Island (lat. 9°12′ N., long. 118°28′ E.); 49 meters; April 3, 1909. One live specimen and two dead tests.

Station 5427, Palawan Island (lat. 9°11′ N., long. 118°37′ E.); 68 meters; April 3, 1909. Three live specimens and one dead test.

Station 5442, west of Luzón (lat. 16°31′ N., long. 120°11′ E.); 82 meters; May 10, 1909. Several small live specimens and several dead tests.

Station 5477, between Sámar and Leyte (lat. 10°45′ N., long. 125°12′ E.); 88 meters; July 29, 1909. Three live specimens and one dead test.

Station 5480, between Sámar and Leyte (lat. 10°45′ N., long. 125°19′ E.); 113 meters; July 29, 1909. Two dead tests.

Remarks.—Because of its poor condition the identification of the specimen from station 5369 is not beyond doubt.

From station 5206 there are a number of small dead tests of laganids, most of them broken. They are quite unidentifiable; since the genital pores have not appeared it is not even possible to tell with certainty whether they belong to *Laganum* or to *Peronella*, or to both of these genera.

LAGANUM DEPRESSUM Lesson

Laganum depressum L. Agassiz, Monographie des scutelles, p. 110, pl. 23, figs. 1–7, 1841.—A. Agassiz, Revision of the Echini, pp. 138, 518, pl. 13f, figs. 5–8, 1873.—de Meijere, *Siboga* Echinoidea, p. 114, pl. 6, fig. 57; pl. 18, figs. 317, 318, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 45, pl. 124, figs. 7–12, 1914.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 88, pl. 9, figs. 1, 2, 7, 8; pl. 13, fig. 3; pl. 14, fig. 2, 1922.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 157, 1925.

Localities.—Subig Bay, shore; January 7, 1908. Three small specimens in fair condition.

Panabutan Bay; February 5, 1908. One test.

Station 5104, off southern Luzón (lat. 14°46′ N., long. 120°12′ E.); 60 meters; January 8, 1908. One specimen.

Station 5156, Tinakta Island (lat. 5°13′ N., long. 119°56′ E.); 33 meters; February 21, 1908. One specimen.

Station 5157, Tinakta Island (lat. 5°12′30″ N., long. 119°55′50″ E.); 33 meters; February 21, 1908. One dead broken test.

Station 5159, Tinakta Island (lat. 5°11′50″ N., long. 119°54′ E.); 18 meters; February 21, 1908. Three specimens.

Station 5160, Tinakta Island (lat. 5°12′ N., long. 119°55′ E.); 22 meters; February 22, 1908. One dead broken test.

Station 5161, Tinakta Island (lat. 5°10′15″ N., long. 119°53′ E.); 29 meters; February 22, 1908. Three broken tests and one good live specimen.

Station 5164, Observation Island (lat. 5°01′40″ N., long. 119°52′20″ E.); 33 meters; February 24, 1908. Two broken tests and one live specimen of irregular outline.

Station 5212, east of Masbate (lat. 12°04′ N., long. 124°05′ E.); 198 meters; April 17, 1908. Three dead tests.

Station 5218, between Burias and Luzón (lat. 13°11′35″ N., long. 123°03′ E.); 37 meters; April 22, 1908. One young specimen.

Station 5242, Melampaya Sound, Palawan Island; 26–46 meters; December 23, 1908. One broken test.

Station 5408, between Cebu and Leyte; 290 meters; March 18, 1909. One broken test.

Remarks.—These specimens call for no comment, except one from station 5159 that is unusually elongate, 32 mm. long, but only 25 mm. broad. The one live specimen from station 5164 is abnormal, of quite irregular outline.

The depth of 159 fathoms (station 5408) is quite unusual for this species, otherwise it is not known from greater depths than about 45 fathoms. But since the specimen taken from this station is an old, broken test, it does not count; there is no certainty that it has actually been living in the place where collected.

LAGANUM FUDSIYAMA Döderlein

Laganum fudsiyama Döderlein, Arch. für Naturg., vol. 51, p. 32, 1885.—A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 50, p. 249, 1907.—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 46, pl. 124, figs. 13–16; pl. 127, figs. 7, 8; pl. 140, figs. 3, 4; pl. 141, figs. 4–9, 1914; Catalogue of the Recent sea-urchins in the British Museum, p. 158, 1925.

Laganum solidum de Meijere, *Siboga* Echinoidea, p. 121, pl. 6, figs. 64, 66, 1904.

Laganum conicum de Meijere, *Siboga* Echinoidea, p. 120, pl. 6, fig. 68; pl. 18, figs. 325–328, 1904.

Laganum diploporum A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 51, p. 129, 1907.—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 46, pl. 127, figs. 9–12; pl. 142, figs. 2–4, 1914.

Locality.—Station 5592, northeastern Borneo (lat. 4°13′ N., long. 118°28′ E.); 558 meters; September 29, 1909. One large, somewhat fragmentary, dead test, 56 mm. long.

Remarks.—Though in poor condition this specimen may with a fair degree of certainty be referred to the species *L. fudsiyama*, with which I think, in agreement with H. L. Clark, de Meijere's two species *L. solidum* and *L. conicum* are identical. Moreover, I must likewise regard *L. diploporum* A. Agassiz and H. L. Clark as identical with *L. fudsiyama*, the only essential character distinguishing it from the latter species, the doubling of the posterior genital pore, being not at all constant (as already realized by Clark), and there are no other reliable characters by which to distinguish them.

Family FIBULARIIDAE

Genus ECHINOCYAMUS van Phelsum

ECHINOCYAMUS CRISPUS Mazzetti

Echinocyamus crispus Mazzetti, Atti Soc. Nat. Modena, ser. 2, vol. 12, p. 239, 1893.—de Meijere, *Siboga* Echinoidea, p. 105, pl. 6, figs. 48–50; pl. 17, fig. 300, 1904.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 137, pl. 12, figs. 16, 17, 21, 1922.

Localities.—Station 5098, off southern Luzón (lat. 14°18′40″ N., long. 120°32′40″ E.); 70 meters; January 2, 1908. Several young specimens, all dead tests.

Station 5133 off Panabutan Point; 70 meters; February 6, 1908. Several specimens, all dead tests.

Station 5137, off Joló (lat. 6°04′25″ N., long. 120°58′30″ E.); 36.5 meters; February 7, 1908. Two dead tests.

Station 5143, off Joló (lat. 6°05′50″ N., long. 121°02′15″ E.); 35 meters; February 15, 1908. Ten dead tests.

Station 5144, off Joló (lat. 6°05′50″ N., long. 121°02′15″ E.); 35 meters; February 15, 1908. Several dead tests.

Station 5159, Tinakta Island (lat. 5°11′50″ N., long. 119°54′ E.); 18 meters; February 21, 1908. One dead test.

Station 5178, off Romblón (lat. 12°43′ N., long. 122°06′15″ E.); 133 meters; March 25, 1908. Two dead tests.

Station 5217, Anima Sola Island (lat. 13°20′ N., long. 123°14′15″ E.); 192 meters; April 22, 1908. Three dead tests.

Station 5220, San Andreas Island (lat. 13°28′ N., long. 121°58′ E.); 92 meters; April 24, 1908. Numerous young specimens, all dead tests.

Remarks.—The curious fact that among all these specimens not a single one was alive when taken indicates that this species lives buried rather deep in the ground. There is no certainty that it lives at so great a depth as 133–192 meters.

ECHINOCYAMUS PROVECTUS de Meijere

Echinocyamus provectus de Meijere, *Siboga* Echinoidea, p. 109, pl. 6, figs. 51, 62; pl. 17, fig. 306; pl. 18, figs. 307–310, 1904.

Localities.—Station 5178, vicinity of Romblón; 133 meters; March 25, 1908. Three small dead tests.

Station 5313, China Sea, vicinity of Hongkong; about 275 meters; November 1908. One dead test.

Remarks.—Although the three specimens from station 5178 are beyond doubt *Echinocyamus provectus*, I do not feel sure about the one from station 5313; it may rather be referable to *E. scaber* de Meijere, but I do not think it possible to reach full certainty in the determination of this small dead test.

Genus FIBULARIA Lamarck

FIBULARIA OVULUM Lamarck

Fibularia ovulum A. Agassiz, Revision of the Echini, pp. 129, 507, pl. 13, figs. 1-3, 1873.

Fibularia craniolaris H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae. . . Scutellidae, p. 57, 1914.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 2, p. 138, pl. 15, fig. 4, 1922.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 163, 1925.

Localities.—Station 5133, off Panabutan Point; two meters; February 6, 1908. Several small dead tests.

Station 5159, Tinakta Island; 18 meters; February 19, 1908. Numerous small dead tests.

Station 5164, Observation Island; 33 meters; February 28, 1908. Several small dead tests.

Station 5217, Ánima Sola Island; 192 meters; April 21, 1908. One small, old, worn test.

Remarks.—That not a single one of these numerous specimens was alive when taken is, no doubt, due to the fact that this species lives buried rather deeply in the ground. Several of the specimens are old and worn, some of them more recently dead; in one of the specimens from station 5159 the characteristic radiating periproctal plates are preserved. In the old, worn specimens the pores of the petals are often somewhat enlarged.

In 1914 H. L. Clark took the ill-considered and very regrettable step of changing the hitherto unanimously used name *ovulum* of Lamarck to the name *craniolaris* of Leske, and later authors, myself included, have adopted the name *craniolaris* without going critically into the matter. It is only now that I have studied this nomenclatural question more carefully.

Leske, in his "Additamenta ad I.Th.Kleinii Naturalis Dispositio Echinodermatum," p. 214. 1778, designated by the name of *Echinocyamus craniolaris* the species represented in plate 1, figures 16–20, of van Phelsum's "Brief aan Corn. Nozeman over de Gewelv-Slekken of Zee-Egelen." It is true that the figures 18–20 resemble the high globose *Fibularia ovulum*, but figures 16 and 17 resemble more a flat form like *Echinocyamus pusillus*. It is evident that all van Phelsum's figures are grossly misdrawn and not recognizable with certainty. The only thing that is certain is that van Phelsum says that his specimens came from the Adriatic, where only *Echinocyamus pusillus* occurs. All agree that van Phelsum's 14 species are in reality only one and the same species, which leads to the conclusion that *craniolaris*, and all the other species of Leske based on the figures of van Phelsum, are in reality synonyms of *Echinocyamus pusillus*. Clark's action in taking Leske's species *craniolaris* to be identical with *Fibularia ovulum* in reality leads him to endorse Lambert's interchanging the two names

Echinocyamus and *Fibularia*—a result that Clark, no doubt, would have emphatically rejected.

FIBULARIA OVULUM var. TRIGONA Lamarck

Fibularia trigona Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 3, p. 17, 1816.

Locality.—Station 5134, near Basilan Island (lat. 6°44′45″ N., long. 121°48′00″ E.); 45 meters; February 7, 1908. Two small dead tests.

Remarks.—These small specimens, only 2 mm. long, are, I think, though with some little doubt, referable to *Fibularia trigona* Lamarck. This species was hitherto not recognizable, but I have recently received photographs of the type specimen in the Paris Museum, which show that some specimens in my own collections which I had distinguished as a variety of *F. ovulum* are identical with *F. trigona*. The two above-mentioned specimens from the *Albatross* fit fairly well with *trigona*, but as they are evidently quite young, though the genital pores have already been formed, it is hardly possible to reach full certainty in their identification. So far as can be judged from the naked tests alone I do not think *F. trigona* can rank higher than as a variety of *F. ovulum*.

FIBULARIA CRIBELLUM de Meijere

Fibularia cribellum de Meijere, *Siboga* Echinoidea, p. 112, pl. 6, figs. 53, 54; pl. 18, figs. 313, 314, 1904.

Localities.—Station 5143, Sulu Sea (lat. 6°05′50″ N., long. 121°02′ 15″ E); 35 meters; February 15, 1908. Ten specimens.

Station 5144, Sulu Sea (lat. 6°05′50″ N., long. 121°02′15″ E.); 18 meters; February 15, 1908. Four specimens.

Station 5148, Sulu Sea (lat. 5°35′40″ N., long. 120°47′30″ E); 31 meters; February 16, 1908. Three specimens.

Station 5159, Sulu Sea (lat. 5°11′50″ N., long. 119°54′ E.); 38 meters; February 18, 1908. Two specimens.

Remarks.—All these specimens are dead tests, more or less worn. None of them exceeds a size of 5 mm. in length; upon the whole this small species, well characterized by its few but large round pores of the petals, does not appear to grow longer than 7 mm.

FIBULARIA ACUTA Yoshiwara

Fibularia acuta Yoshiwara, Annot. Zool. Japon., vol. 2, p. 60, 1898; Japanese Echini, pl. 14, figs. 3, 4, 1906.—H. L. Clark, Hawaiian and other Pacific Echini, Clypeastridae . . . Scutellidae, p. 58, 1914.

Locality.—Station 5144, off Joló Strait (lat. 6°05′50″ N., long. 121°02′15″ E.); 35 meters; February 15, 1908. Four small dead tests.

Remarks.—So far as it is possible to decide from dead tests alone, these specimens must be referable to *F. acuta;* but it would have been important to ascertain whether they agree with the typical *acuta* in the buccal membrane containing calcareous plates and in the presence of globiferous pedicellariae.

FIBULARIA sp. (?)

From Port Binang, Subic Bay, Luzón, there is a small dead test that I cannot with certainty identify with any known fibulariid. There are traces of internal radiating partition walls; I cannot therefore even say definitely whether it is an *Echinocyamus* or a *Fibularia.* It is too incomplete (apical system lost) for being described or named; but it may be worth while mentioning the existence of such a small fibulariid at the Philippines.

The specimen measures 4 by 3.2 by 2 mm. It is of ovoid outline. Petals short, with 3 or 4 pore-pairs. Peristome central, round; periproct much smaller, elliptical, midway between peristome and posterior end of test.

Order SPATANGOIDA

Family URECHINIDAE

Genus PLEXECHINUS A. Agassiz

PLEXECHINUS SPECTABILIS, new species

Locality.—Station 5359, Sulu Sea (lat. 8°13′ N., long. 120°37′ E.); 4,163 meters, January 9, 1909. Nine specimens, in the main in fair condition.

Type.—U.S.N.M. No. E. 7161 from station 5359.

Description.—The shape of the test is that typical of *Plexechinus*, only the anal snout is somewhat more projecting than in the other species of the genus. The sternum rises into a conspicuous keel. The largest specimen is 33 mm. long, 27 mm. broad, about 21 mm. high (the sternum broken); the smallest specimen is 28 mm. long, 23 mm. broad, 18 mm. high. There is no frontal depression, but adorally the frontal ambulacrum is somewhat depressed. The phyllode is fairly well developed, with 2 or 3 penicillate tube feet in each series, quite conspicuous on account of their dark, brownish color.

There are four genital pores, each superseded by a long genital papilla. The two anterior pores are placed in one unpaired plate, the two posterior pores each in its own large plate; the anterior and posterior genital pores are rather widely separated from each other by a couple of plates as large as the posterior genital plates; most probably these separating plates are the anterolateral ocular plates. The peristome is more or less conspicuously oblong. The upper part of the periproct may rise as a hood over the lower part; but there is a

considerable variation in the outline of the periproct, from about as broad as long to longer than broad. Three or four interambulacral plates surround the periproct. The plate No. 4 of ambulacra Ia and Vb is traversed by the subanal fasciole, which includes three interambulacral plates. The test is densely covered by miliary tubercles among which rise the primary tubercles, scattered without order, few on the aboral side, but larger and more numerous toward the posterior end and along the sides of the test, as well as on the oral side, excepting the posterior ambulacra, where they are again smaller.

Of pedicellariae only the tridentate, ophicephalous, and triphyllous types are found, none of the globiferous and rostrate types. The tridentate pedicellariae have broad, simply leaf-shaped valves, with the edges of the basal part irregularly serrate; the largest examples measure 0.7–0.8 mm. in length of head, with a very short neck. Ophicephalous and triphyllous pedicellariae are not peculiar.

Color a light brownish or whitish.

Remarks.—From the only other species of *Plexechinus* with four genital pores, the sub-Antarctic *P. nordenskjöldi*, the present species differs markedly by the two anterior pores being situated in a single plate, the fused genitals 2 and 3; in *P. nordenskjöldi* these plates are separate, not fused.

This is much the largest of the species of *Plexechinus*, none of the other species exceeding 20 mm. in length.

The genus *Plexechinus* has thus been found to be represented also in the Malay region and may be expected to have a world-wide distribution; the three other species known are from the Gulf of California (*P. cinctus*), the North Atlantic (*P. hirsutus*), and the sub-Antarctic (*P. nordenskjöldi*).

Family ECHINOCORYTHIDÆ

Genus STEREOPNEUSTES de Meijere

STEREOPNEUSTES RELICTUS de Meijere

Stereopneustes relictus DE MEIJERE, *Siboga* Echinoidea, p. 148, pl. 5, figs. 41–43; pl. 19, figs. 390–393; pl. 20, figs. 394–407, 1904.—MORTENSEN, Annot. Zool. Japon., vol. 12, p. 393, 1930.

Localities.—Station 5116 (lat. 13°41′ N., long. 120°47′ E.); 622 meters; January 20, 1908. One specimen.

Station 5425 (lat. 9°38′ N., long. 121°11′ E.); 907 meters; March 31, 1909. One specimen.

Station 5527 (lat. 9°12′ N., long. 123°44′ E.); 741 meters; August 11, 1909. Two specimens.

Remarks.—The specimen from station 5425 is 90 mm. long, 85 mm. broad, and 67 mm. high, the largest specimen known of this species.

The specimen from station 5116 is smaller, 70 mm. long, 63 mm. broad, and 45 mm. high; it is very badly broken and incomplete, but it was found possible to glue the fragments together so as to form a tolerably good specimen. Of the two specimens from station 5527 one is a very fine one, 75 mm. long, 70 mm. broad, and 61 mm. high; the other is slightly larger but badly broken and incomplete.

The two specimens from station 5527 are lighter in color than the others; they are brownish whereas the others are dark purplish. One might be tempted to regard them as forming another species than *relictus*, or a variety of the latter; but I do not think it justifiable on the basis of the material now available to separate them from the typical *relictus*. It is important that they do not differ from the typical *relictus* in the shape and characters of the test. In regard to the pedicellariae it is noteworthy that the ophicephalous type varies considerably, the valves being either broad as in the type or slenderer, with the blade distinctly narrower than the basal part; but the same is found in the specimen from station 5116, which is dark purplish like the type. We must therefore acknowledge as a fact that the ophicephalous pedicellariae of *S. relictus* may vary considerably in the shape of the valves, the various forms occurring in one and the same specimen; but in some specimens only the broad-valved form occurs, as appears to have been the case in the type specimens.

Globiferous pedicellariae (described by de Meijere as a particular kind of ophicephalous pedicellariae) I have found in the specimen from station 5425 but, unfortunately, not in the other specimen; if they had been found and proved to differ in shape from those of the type and of the specimen from station 5425, that would have been an important argument for regarding these light-colored specimens as different from the typical *relictus*.

Family PALAEOSTOMATIDAE

Genus PALAEOSTOMA A. Agassiz

PALAEOSTOMA MIRABILE (Gray)

Leskia mirabilis Gray, Ann. Mag. Nat. Hist., ser. 2, vol. 7, p. 134, 1851.

Palaeostoma mirabilis A. Agassiz, Revision of the Echini, p. 583, pl. 32, figs. 13–15, 1873.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 193, 1925.

Palaeostoma mirabile Lovén, On Pourtalesia, p. 27, pl. 16, figs. 184–196, 1883.—de Meijere, *Siboga* Echinoidea, p. 172, 1904.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 36, pl. 3, figs. 1, 2, 6, 8, 9; pl. 17, figs. 19–29, 1914.

Locality.—Station 5206, Badian Island (lat. 11°32′ N., long. 124°41′ E.); 59 meters; April 14, 1908. One dead test, 12 mm. long.

Family MICRASTERIDAE

ISOPATAGUS, new genus

Large forms of high, rounded-conical shape; oral side slightly convex. Test fairly strong. Ambulacra all equally developed, petaloid, slightly sunken. The pores remain distinct from the distal end of the petals to the edge of the test. Anterior end of the test rounded, not at all sunken. Apical system slightly anterior, ethmophract, with three genital pores. Mouth very near the anterior end, with fairly prominent labrum. Periproct inframarginal, very small, of ovoid outline. Test densely tuberculated with very small, uniform tubercles. Spines uniform, smooth, only about 5 mm. long. No fascioles. Pedicellariae of only the tridentate and triphyllous types. Color dark purplish, the denuded test whitish.

Genotype: *Isopatagus obovatus*, new species.

This interesting genus is nearly related to the Cretaceous genus *Isaster* Desor, of the *Micraster* group, no recent forms of which were known till now.

ISOPATAGUS OBOVATUS, new species

Locality.—Station 5425, Sulu Sea (lat. 9°38′ N., 121°11′ E.); 907 meters; March 31, 1909. Four specimens, one of them very badly broken, but the fragments could be fitted together so as to form a tolerably complete specimen.

Type.—U.S.N.M. No. E.7149, from station 5425.

Description.—The diagnosis of the genus applies equally well to the species, this being the only one so far known. It need only be added that the tridentate pedicellariae have slender valves, somewhat involuted in the lower part of the blade; the epiphysis usually has a small prominence at its upper end. They are on the whole small and very inconspicuous, hardly exceeding 0.5 mm. in length of head.

Family PALAEOPNEUSTIDAE

Genus ARGOPATAGUS A. Agassiz

ARGOPATAGUS VITREUS A. Agassiz

Argopatagus vitreus A. Agassiz, *Challenger* Echinoidea, p. 160, pl. 32, figs. 1–6, 1881.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 146, 1917.

Phrissocystis humilis de Meijere, *Siboga* Echinoidea, p. 198, pl. 10, figs. 99, 100; pl. 23, figs. 494–500, 1904.

Meijerea humilis Döderlein, Echinoidea d. deutschen Tiefsee-Exped., p. 243, pl. 31, figs. 1–4; pl. 49, fig. 7, 1906.

Meijerea excentrica A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 50, p. 252, 1907; vol. 51, p. 132, 1907.

781385—48——4

Localities.—Station 5630, Patiente Strait (Halmahera) (lat. 0°56′ S., long. 127°05′ E.); 1,480 meters; December 2, 1909. One rather large specimen, about 100 mm. long, fairly complete though badly broken.

Station 5660, Flores Sea (lat. 5°36′ S., long. 120°49′ E.); 1,266 meters; December 20, 1909. Fragments of two or three specimens.

Genus LINOPNEUSTES A. Agassiz

LINOPNEUSTES MURRAYI (A. Agassiz)

Paleopneustes murrayi A. Agassiz, Proc. Amer. Acad. Arts and Sci., vol. 14, p. 210, 1879.

Linopneustes murrayi A. Agassiz, *Challenger* Echinoidea, p. 168, pl. 25, 1881.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 223, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 223, 1925.

Localities.—Station 5582 (lat. 4°20′ N., long. 118°58′ E.); 1,480 meters; September 26, 1909. One specimen.

Station 5618 (lat. 0°37′ N., long. 127°15′ E.); 763 meters; November 27, 1909. One specimen.

Station 5648 (lat. 5°35′ S., long. 122°20′ E.); 1,023 meters; December 16, 1909. One specimen.

Remarks.—All these specimens are badly broken, but it has been possible to glue the fragments together so as to give a fair idea of their shape and size. The largest, the one from station 5582, is 92 mm. long, about 50 mm. high, and 80 mm. broad; the two others are a little smaller, about 80 mm. long.

They agree very closely with the illustrations given in the *Challenger* Echini, plate 25; particularly the spine-covering is quite as shown there, the spines being short and fairly robust. In a specimen at hand from Japan, a cotype, the spines are somewhat slenderer; but I think it beyond doubt that these specimens are identical with the typical form from the Japanese seas. It is not quite clear whether the specimen(s) taken in the Philippine seas by the *Challenger* (station 210) are actually *L. murrayi* (the fragments of a large specimen mentioned by A. Agassiz, p. 168, are rather certainly *L. spectabilis*); but the specimens collected by the *Albatross* prove that *L. murrayi* occurs in the Philippine seas.

LINOPNEUSTES FRAGILIS (de Meijere)

Palaeopneustes fragilis de Meijere, *Siboga* Echinoidea, p. 175, pl. 9, figs. 90–93; pl. 21, figs. 427–432; pl. 22, figs. 433–437, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 145, 1917.

Localities.—Station 5447 (lat. 13°28′ N., long. 123°46′ E.): 567 meters; June 4, 1909. Two specimens.

Station 5460 (lat. 13°32′ N., long. 123°58′ E.); 1,034 meters; June 9, 1909. One specimen.

Station 5508 (lat. 8°17′ N., long. 124°12′ E.); 494 meters; August 5, 1909. One specimen.

Station 5657 (lat. 3°20′ S., long. 120°36′ E.); 900 meters; December 19, 1909. One specimen.

Station 5658, Gulf of Boni (lat. 3°33′ S., long. 120°31′ E.); 933 meters; December 19, 1909. Five specimens.

Remarks.—All these specimens, except the one from station 5508, were badly broken (particularly those from station 5658, very badly crushed), but it was possible to glue the fragments together so as to form fairly complete specimens, especially the largest one. The specimen from station 5508 has the oral side complete, only the labrum being broken, and thus gives important information about the characters of the oral side, hitherto incompletely known. It is of great interest that the plates 6–8 of the ambulacral series adjoining the sternum are adproctally prolonged, the plates 7 and 8 having their pores at their adproctal end. This indicates that a subanal fasciole is typically present in this species, even though it is obliterated in the adult; it will be sure to be present in the young specimens. But it is herewith made evident that this species has nothing to do with *Palaeopneustes*, the genotype of which, *P. cristatus* (A. Agassiz), has no trace of a subanal fasciole even in the youngest specimens, and no adproctal prolongation of the adjoining ambulacral plates (as also the pedicellariae are very different from those of the present species). There can be no doubt that this species belongs to the genus *Linopneustes*, being very closely related to the genotype of that genus, *L. murrayi* (A. Agassiz).

The specimen from station 5657 is a very large one, 160 mm. long, 135 mm. broad, and 115 mm. high. This is thus by far the largest on record; the largest specimen from the *Siboga* was 113 mm. long. The smallest of the *Albatross* specimens is 115 mm. long.

LINOPNEUSTES SPECTABILIS (de Meijere)

Palaeopneustes spectabilis DE MEIJERE, *Siboga* Echinoidea, p. 172, pl. 8, figs. 86–90; pl. 21, figs. 422–426, 1904.—H. L. CLARK, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 145, 1917.

Linopneustes spectabilis KOEHLER, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 62, pl. 5, figs. 3, 6; pl. 11, figs. 7, 8; pl. 17, figs. 36–51, 1914.

Localities.—Station 5491 (lat. 9°24′ N., long. 125°12′ E.); 1,347 meters; August 1, 1909. One young specimen, fairly complete.

Station 5492 (lat. 9°13′ N., long. 125°20′ E.); 1,345 meters; August 1, 1909. Four more or less fragmentary specimens, the largest 90 mm. long.

Station 5494 (lat. 9°06′ N., 125°19′ E.); 1,241 meters; August 2, 1909. One fairly complete specimen, 82 mm. long.

Station 5511 (lat. 8°15′ N., long. 123°57′ E.); 750 meters; August 7, 1909. Fragments of two young specimens.

Station 5512 (lat. 8°16′ N., long. 123°58′ E.); 814 meters; August 7, 1909. One specimen 95 mm. long, oral side lacking, and fragments of two smaller specimens.

Station 5528 (lat. 9°25′ N., long. 123°39′ E.); 803 meters; August 11, 1909. Two large specimens, plastron lacking, and one smaller, almost complete specimen.

There are also a couple of fragments of a large specimen, without label.

Remarks.—The two larger specimens from station 5528 are 135 mm. long, 114 mm. broad, and 60 mm. high; the smaller specimen is 80 mm. long, 67 mm. broad, and 27 mm. high. The young specimen from station 5491 is 40 mm. long, 32 mm. broad, and 13 mm. high; this is the smallest specimen known of this species. Genital pores do not appear until a length of about 80 mm. is reached; this is in good accordance with the large size to which this species grows. The test of the young specimens is, on the whole, low, not at all conical or subconical, as is the case in the adult specimens, and recalls to no small degree *Argopatagus vitreus*, from which it is, however, at once distinguished by its well-developed petals and by the conspicuous notch in the front end of the test, as well as by the presence of a peripetalous (or marginal) and a subanal fasciole. It is particularly important that there is a well-developed subanal fasciole in these young specimens; also one of the large specimens has a well-developed subanal fasciole, whereas the other one has only an incomplete subanal fasicole, only the anterior part of it being present. The presence of the subanal fasciole in this specimens proves that Koehler (*op. cit.*) was right in referring this species to the genus *Linopneustes*.

The pedicellariae were very carefully described and figured by Koehler (*op. cit.*). The two large specimens from station 5528 are in a very poor state of preservation and show only a very few of the slender form of tridentate pedicellariae; in the small specimens pedicellariae are fairly numerous; some of the tridentate pedicellariae have four valves. Only a single example of the characteristic coarse form of tridentate pedicellariae (cf. Koehler, *op. cit.*, pl. 17, figs. 42, 45, 46, 49) was observed. Of considerable interest is the fact that ophicephalous pedicellariae are found on the oral side of the young specimens, in the posterior part of the posterior ambulacra. The valves are constricted in the middle, thus very different from the peculiar ophicephalous pedicellariae of *Argopatagus*. Even a sort of globiferous pedicellariae, with remarkably irregular valves, occurs—but very rarely—in the young specimens.

Genus HOMOLAMPAS A. Agassiz

HOMOLAMPAS LOVENIOIDES, new species

Locality.—Station 5650, Gulf of Boni (lat. 4°54′ S., long. 121°29′ E.); 988 meters; December 17, 1909; two specimens.

Type.—U.S.N.M. No. E.7150, from station 5650.

Description.—The two specimens are of the same size, 31 mm. long, 25 mm. broad, and 16 mm. high; but they differ somewhat in shape, one of them, the holotype, having the greatest width more anteriorly than the other, the paratype; also the test rises in the type more sharply from the anterior edge toward the apical system than in the paratype. In general the shape of the test resembles that of *Homolampas fragilis*, only the sides rise less steeply toward the apical system than in *H. fragilis*. Although the test is very fragile, the two specimens are in fair condition, particularly the type specimen.

In the characters of the ambulacra and interambulacra this new species very closely resembles *H. fragilis;* it is of particular importance that there are no primary spines in the odd posterior interambulacrum. The labrum appears to offer a good distinguishing character, its posterior prolongation reaching in the new species to the middle of plate 3 of the adjoining ambulacra, not beyond plate 2 in *H. fragilis*. The number of genital pores is four in the type, three in the paratype; it is thus impossible to tell what is the normal number of the genital pores. There is no trace of a peripetalous fasciole (likewise lacking in *H. fragilis*); the subanal fasciole appears to be somewhat broader (three times as broad as long) in the present species than in *H. fragilis* (twice as broad as long). The primary aboral spines are (so far as preserved) unilaterally serrate (as in *fragilis*); the spines of the plastron are conspicuously serrate along the convex side. There are three tube feet to each side within the subanal fasciole. The pedicellariae are, as in *H. fragilis*, of the five usual types, globiferous, tridentate, rostrate, ophicephalous, and triphyllous. The globiferous pedicellariae, which are found only on the aboral side, between the secondary spines, have the valves terminating in one or two long teeth. On the whole the pedicellariae are very much like those of *H. fragilis*, only the valves of the rostrate pedicellariae are somewhat slenderer. The color is white.

Remarks.—This species so closely resembles the West Indian *Homolampas fragilis* that were they found together they would probably be regarded as the same species; but since one is known only from the West Indies and the mid-Atlantic and the other only from the Malay region, they must be regarded as distinct species, at least so long as they are not known from intermediate localities (South Atlantic; Indian Ocean)

The species name *lovenioides* might apply equally well to the other species of the genus *Homolampas*, which not only in its general appearance strongly recalls, but, in my opinion, also actually is closely related to *Lovenia*.

Genus PALAEOTREMA Koehler

PALAEOTREMA LOVENI (A. Agassiz)

Palaeotropus loveni A. Agassiz, *Challenger* Echinoidea, p. 158, pl. 21, figs. 3–16; pl. 39, fig. 33; pl. 41, figs. 28, 29, 1881; Panamic Deep-sea Echini, p. 168, pl. 87, 1904.—de Meijere, *Siboga* Echinoidea, p. 200, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 153, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 197, 1925.

Palaeotrema loveni Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 45, 1914.

Localities.—Station 5183, between Panay and Negros (lat. 10°32′48″ N., long. 122°26′ E.); 176 meters; March 30, 1908. Fourteen specimens, most of them in fair condition.

Station 5421, between Panay and Guimarás (lat. 10°33′30″ N., long. 122°26′ E.); 251 meters; March 30, 1909. Three specimens in poor condition.

Remarks.—These specimens range from 17 to 26 mm. in length of the test, the 26 mm. being the largest size hitherto recorded. It is then very probable that the species does not reach any larger size, and this conclusion is based on a fairly good number of specimens.

It is noteworthy that only two or three of the *Albatross* specimens are narrower anteriorly than behind, as shown in the *Challenger* Echinoidea, pl. 31, figs. 3, 4, this shape being emphasized by both A. Agassiz and H. L. Clark as particularly characteristic of this species; the others are regularly oval in outline, or slightly broader in the middle. Accordingly, the shape of the test is not a reliable specific character.

Genus PLESIOZONUS de Meijere

PLESIOZONUS DIOMEDEAE, new species

Localities.—Station 5242 (lat. 6°52′ N., long. 126°14′ E.); 360 meters; May 14, 1908. Fragments of 10 specimens.

Station 5520 (lat. 8°41′ N., long. 123°18′ E.); 187 meters; August 10, 1909. Two specimens.

Type.—U.S.N.M. No. E. 7151, from station 5520.

Description.—In general appearance this species resembles *Plesiozonus hirsutus* de Meijere, but it differs markedly from it in several important characters. The frontal ambulacrum is somewhat sunken, producing a distinct notch at the front edge of the test, which is not at all the case in *hirsutus*, which has the front edge simply rounded. The last 1–3 plates of the petals are occluded from the edge of the ambulacra; in *hirsutus* it is some alternating plates in the distal part

of the petals which are thus occluded. The labrum is straight cut at the anterior end, whereas in *hirsutus* it is quite prominent. The periproct is marginal, in *hirsutus* inframarginal.

The specimens are all large and high, but somewhat different in outline, as appears from the following measurements of two specimens: (1) 130 mm. long, 123 mm. broad, 75 mm. high; (2) 115 mm. long, 115 mm. broad, 81 mm. high.

One of the specimens (all of them dry) has the spines fairly well preserved. They are quite short, as in *P. hirsutus*. The pedicellariae are as in *hirsutus*, but in the present species also rostrate pedicellariae are found, even in great numbers, this type of pedicellariae being unknown in *hirsutus*.

The characters pointed out above leave no doubt that the specimens collected by the *Albatross* are specifically different from those collected by the *Siboga*. One would have expected them to be identical with the single specimen of *Plesiozonus* hitherto known (from the Flores Sea); but this is evidently not the case, to judge from the description and figures given by de Meijere, the correctness of which it is hardly permissible to doubt. It is particularly to be emphasized that all the specimens agree in the important character of the petals that the last 1–3 plates are occluded.

The specimens from station 5242 were all very badly crushed, but it has been possible to fit the fragments together so as to form tolerably complete specimens.

Family HEMIASTERIDAE

Genus PERICOSMUS L. Agassiz

PERICOSMUS MELANOSTOMUS, new species

Locality.—Station 5302, China Sea, near Hongkong (lat. 21°42′ N., long. 114°50′ E.); 70 meters; August 9, 1908. One specimen.

Type.—U.S.N.M. No. E.7153, from station 5302.

Description.—The specimen, which is in good condition except somewhat bleached, is a young one, only 12 mm. long, the genital pores still wanting. That it represents a new distinct species is, however, beyond doubt. The fact that I dredged in 1922 in the Sunda Strait a goodly number of specimens in every respect agreeing with the specimen collected by the *Albatross* serves to confirm the validity of this species, the second recent species of the genus *Pericosmus* made known.

The test is egg-shaped, the oral side convex, not flattened; the frontal depression is very shallow (more pronounced in larger specimens). The posterior edge is vertical, the periproct close to the upper edge. The petals are only slightly sunken, short, but rather broad; the posterior only about half as long as the anterior petals. Frontal ambulacrum somewhat broader than the petals, tube feet large, with a

conspicuous sucking disk. The fascioles very conspicuous; the peripetalous fasciole not bending inward between the petals. Labrum not forming a prominent lip; its posterior prolongation ends off the middle of the second adjoining ambulacral plates, as usual in the genus. Globiferous pedicellariae lacking (in all the specimens available). Very characteristic is the presence of two sorts of ophicephalous pedicellariae, the larger with broad valves, the blade much shorter and usually broader than the basal part. The general color is whitish with a tinge of purplish, but the peristome, periproct, and the frontal tube feet are a very conspicuous dark purplish.

This species apparently bears no relation to any of the fossil species of *Pericosmus* known from the Malay region.

Genus FAORINA Gray

FAORINA CHINENSIS Gray

Faorina chinensis Gray, Ann. Mag. Nat. Hist., ser, 2, vol. 7, p. 132, 1851.—A. Agassiz, Revision of the Echini, p. 607, pl. 19a, figs. 4–6, 1873.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, p. 129, pl. 13, figs. 14, 15; pl. 19, figs. 14–24, 1914.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 203, 1925.

Locality.—Station 5335 (lat. 11°37′ N., long. 119°49′ E.); 84 meters; December 18, 1908. One specimen, 59 mm. long, in rather fine state of preservation.

Genus HEMIASTER Desor

HEMIASTER EXPERGITUS var. GIBBOSUS A. Agassiz

Hemiaster gibbosus A. Agassiz, *Challenger* Echinoidea, p. 184, pl. 20, figs. 5, 16, 22, 1881.

Hemiaster expergitus, var. *gibbosus* Mortensen, *Ingolf* Echinoidea, vol. 2, pp. 103–104, 1907.

Hemiaster expergitus H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae. . . . Spatangidae, p. 165, 1917.

Localities.—Station 5127, Nogas Island, Sulu Sea (lat. 10°03′ N., long. 121°48′ E.); 1,753 meters; February 4, 1908. One large badly broken specimen.

Station 5410, between Cebu and Leyte (lat. 10°29′ N., long. 124°05′ E.); 705 meters; March 18, 1909. Two young specimens, badly broken.

Station 5650, Gulf of Boni (lat. 4°54′ S., 121°29′ E.); 988 meters; December 17, 1909. One young specimen.

Remarks.—The specimen from station 5127 measures 56 mm. in length and is the largest recorded, but whether it is also the largest found till now is unknown, because Clark does not say anything about the size of the numerous specimens taken by the *Albatross* in the Japanese waters. The specimen was badly broken into fragments,

but I have succeeded in restoring the specimen to some degree, so that we can at least measure its length.

In my *Ingolf* Echinoidea, *loc. cit.*, I concluded that the *Hemiaster gibbosus* of A. Agassiz cannot be maintained as a distinct species beside the Atlantic *H. expergitus*, but in view of their wide geographical separation I thought it advisable to keep the form from the Malay region as a separate variety, var. *gibbosus*. Clark did not agree therewith, but regarded the latter as simply identical with *expergitus*. I cannot agree with him in this. So long as we know one form only from the Atlantic, the other only from the Malay region and Japan I do not think it justifiable to regard them as identical. If they were actually identical, we would be sure to find some specimens also in other regions, e. g., the Indian Ocean or in the southern Pacific, indicating its distribution to be continuous. But so far no specimens have been found in any connecting locality. I rather expect that, when once an extensive series of both forms becomes available, characters will be found by which we shall be able actually to distinguish them.

Genus HYPSELASTER H. L. Clark

HYPSELASTER AFFINIS, new species

Localities.—Station 5469, Atalayan Island (lat. 13°37′ N., long. 123°28′ E.); 915 meters; June 18, 1909. One very fragmentary specimen.

Station 5582, Darvel Bay, Borneo (lat. 4°20′ N., long. 118°59′ E.); 1,629 meters; September 26, 1909. Two broken specimens.

Station 5637, vicinity of Bouro (lat. 3°53′ S., long. 126°48′ E.); 1,281 meters; December 10, 1909. Fragments of two dead tests.

Type.—U.S.N.M. No. E.7152, from station 5582.

Description.—The type, the better of the two specimens from station 5582, is 48 mm. long, about 40 mm. broad, and 32 mm. high; the second specimen from the same station is 48 mm. long, 38 mm. broad, and 31 mm. high. The other specimens are too fragmentary to permit measuring them. The greatest height of the test is just behind the peripetalous fasciole, from where it slopes gradually backward; the posterior end of the test is subvertical, slightly inward-sloping, and distinctly concave. The anterior end of the test is 16–17 mm. high. rounded; it is thus only about half as high as the posterior end.

The petals are rather much sunken. The posterior petals are somewhat less than half the length of the anterior ones, which latter are straight, only their anterior border lightly convex. The plates of the anterolateral ambulacra outside the petals with only one or two tubercles, or naked. The frontal ambulacrum less sunken and also narrower than the petals; at the peripetalous fasciole it rises almost to the level of the test, and there is only a faint depression in the frontal

edge of the test. The plates of the frontal ambulacrum below the fasciole are narrow and naked. There are three well-developed (? penicillate) tube feet to each side of the episternum. Phyllodes little developed; the three first plates of the anterolateral ambulacra with penicillate tube feet.

The anterolateral and the posterior interambulacra form rather sharp keels, less so the posterolateral interambulacra. The sternum is moderately broad, narrowing anteriorly; the tubercles continue to the anterior end, where the sternum meets the posterior prolongation of the labrum, which does not pass beyond the end of the first adjoining ambulacral plates. The labrum forms a prominent lip with reversed edge. Peristome small, 6 mm. broad, 3 mm. long; the mouth opening large; the peristomial membrane contains only small, rounded plates, which are not contiguous. The first interambulacral plates are broadly in contact with the peristome. The apical system is distinctly posterior, 28 mm. from the anterior, 20 mm. from the posterior end. The madreporite does not extend beyond the posterior ocular plate, and the madreporic pores are confined to the part between and a little anterior to the two large genital pores. The periproct, which is situated at the upper edge of the concave posterior end, is round or irregularly oval; the anal opening is nearer the lower edge, the periproctal plates at the upper edge being the largest.

The very conspicuous peripetalous fasciole bends only slightly inward between the petals, the latero-anal fasciole distinct only as a straight line below the periproct.

The globiferous pedicellariae I have found only on the aboral side, in the petals and in the frontal ambulacrum; the valves terminate in a single tooth. The other pedicellariae are not peculiar. Ophicephalous pedicellariae are not found on any of the specimens at hand.

The color, which is well preserved on the type specimen, is dark brownish on the aboral side in the anterior part but gradually fades behind the peripetalous fasciole, the posterior part being whitish. On the oral side the same dark color is found also at least in the posterior part of the sternum. The peripetalous fasciole is also dark brown and very conspicuous. In the specimen from station 5469 the aboral side is more light brownish, and no dark color is found on the sternum.

Remarks.—It seems evident that this species is nearly related to *Hypselaster fragilis* H. L. Clark; it bears particularly a considerable likeness to the specimen figured in his Catalogue of the Recent Sea-urchins of the British Museum, plate 11, figures 1–3, and one might be tempted to regard it as identical with that species. However, it differs from *fragilis* in the important character of the apical system being distinctly posterior, whereas it is central or anterior in *fragilis*. Further, in the analysis of the test given in Clark's Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae plate 148, figure 8, the

plates No. 1 of the posterolateral interambulacra are seen to be excluded from the peristome, while in *affinis* they are broadly in contact therewith. If this be correct, and a constant character, the identity of *affinis* with *fragilis* is unthinkable. But the type of *H. fragilis* (from Japan) is a young specimen, only 16 mm. long, as yet without genital pores; and the second specimen (from the Arafura Sea, 28 fathoms) has not been more closely studied, so that we do not know its characters more exactly—and Clark himself was in doubt as to its identity with the type of *H. fragilis*. Thus it is impossible for the present to form a definite opinion of the relation between *fragilis* and *affinis* and their possible identity. Another near relation of *affinis* appears to be the West Indian *H. brachypetalus* H. L. Clark.

Family SPATANGIDAE

Genus BRISSOPSIS L. Agassiz

BRISSOPSIS SIMILIS, new species

Localities.—Station 5188, east of Negros (lat. 9°44′ N., long. 123°14′ E.); 364 meters; April 1, 1908. Eight young specimens in poor condition, mainly naked tests.

Station 5201, south of Leyte (lat. 10°10′ N., long. 125°04′ E.); 1,014 meters; April 10, 1908. One specimen (the type) in good condition.

Station 5203, south of Leyte (lat. 9°58′ N., long. 125°08′ E.); 1,418 meters; April 10, 1908. One fragmentary specimen.

Station 5350, Palawan Passage (lat. 10°47′ N., long. 118°29′ E.); 942 meters; December 27, 1908. One small naked test.

Station 5487, Panaón Island (lat. 10°03′ N., long. 125°03′ E.); 1,340 meters; July 31, 1909. Five specimens, partly fragmentary.

Station 5488, Panaón Island (lat. 10° N., long. 125°07′ E.); 1,413 meters; July 31, 1909. Four specimens, partly fragmentary.

Station 5513, north of Mindanao (lat. 8°17′ N., long. 124°03′ E.); 924 meters; August 7, 1909. One large specimen in good condition.

Station 5527, near Bohol (lat. 9°22′ N., long. 123°43′ E.); 717 meters; August 11, 1909. Two specimens in fair condition.

Station 5529, near Bohol (lat. 9°24′ N., long. 123°40′ E.); 807 meters; August 11, 1909. Two specimens, one nearly complete, the other badly broken.

Type.—U.S.N.M. No. E.7154, from station 5201.

Description.—In the character of the petals this species closely resembles *Brissopsis luzonica;* but the profile of the test is characteristically different, much higher posteriorly than *luzonica*, and while in the latter species the posterior end of the test is vertical, in *similis* it slopes outward. Otherwise the outline of the test is similar in both species, and the size is about the same; the largest specimen is 66

mm. long. Another marked difference between the two species is found in the anterolateral ambulacra outside the petals; in both species they are very narrow, but while in *luzonica* each plate carries one or a few tubercles, in *similis* they are quite naked (apart from the minute miliary tubercles observable only on a higher magnification). This character is particularly useful for distinguishing the young specimens of the two species, the tubercles being present already in quite young specimens of *luzonica*. As in *luzonica*, there are four penicillate tube feet to each side within the subanal fasciole.

A further conspicuous character of *B. similis* is that the adapical tube feet of the frontal ambulacrum are very long, almost black, with a small, lobed sucking disk; no spicules are found in these tube feet. The anal branches from the subanal fasciole are distinct. Finally the pedicellariae, particularly the globiferous ones, offer a very marked distinction from *luzonica;* while in the latter species the valves of the globiferous pedicellariae, both sorts of them, terminate in two long divergent teeth; in *similis* they terminate in six small teeth surrounding a terminal opening. The tridentate pedicellariae are usually 4-valved; the valves have some long thorns along the edges of the lower part of the blade. The rostrate and ophicephalous pedicellariae are like those of *luzonica*, but only one form of the ophicephalous pedicellariae has been observed.

It is interesting to find that this is the species common in the deeper parts of the Philippine seas, while *B. luzonica* was not taken there at all by the *Albatross*.

BRISSOPSIS MICROPETALA, new species

Localities.—Station 5201, Leyte Island (lat. 10°10′ N., long. 125°04′ E.); 1,014 meters; April 10, 1908. One specimen.

Station 5424, Joló Sea (lat. 9°37′ N., long. 121°13′ E.); 622 meters; March 31, 1909. One young specimen.

Station 5468, Atalayan Island (13°36′ N., long. 123°40′ E.); 1,041 meters; April 18, 1909. Two fragmentary specimens, which must be regarded as belonging to a variety of the species; see below.

Station 5513, north of Mindanao (lat. 8°17′ N., long. 124°03′ E.); 924 meters; August 7, 1909. Three large specimens.

Station 5520, Mindanao (lat. 8°41′ N., long. 123°18′ E.); 187 meters; August 10, 1909. One specimen.

Station 5527, near Bohol (lat. 9°22′ N., long. 123°43′ E.); 717 meters; August 11, 1909. Five specimens.

Type.—U.S.N.M. No. E.7155, from station 5513.

Description.—This species is characteristic by the shape of its test, which is almost as broad as long; it is rather low, rising gradually toward the posterior end, the point of greatest height. The posterior

end is vertical or at most sloping very slightly posteriorly. It reaches a conspicuous size, the largest specimen being 76 mm. long.

The shape of the petals is like that of *luzonica*, or even rather that of *B. parallela*, the posterior petals being to a high degree confluent, diverging only at the very end. Together with the narrow separating bridge of the posterior interambulacrum they are, in the adult specimens, quite markedly sunken. The whole of the petaloid area is remarkably small, less than half the length of the test. The plates of the anterolateral ambulacra outside the petals are rather broad, each with a number of tubercles, leaving the midline naked. It is a rather peculiar feature that fairly large conical tube feet issue from the innermost 4 or 5 rudimentary pores of the anterior series of the anterolateral petals. There are only 3 tube feet to each side within the subanal fasciole. The edge of the sucking disk of the frontal ambulacrum is not lobed.

The anal branches from the subanal fasciole are lacking; in one specimen, however, the merest traces of these branches are observable.

The globiferous pedicellariae occur in one form only; the valves are coarse, terminating in two strong teeth. These pedicellariae occur mainly in the anterior ambulacra on the oral side but may sometimes be found also in the posterior ambulacra and even in great numbers; they are very dark colored. The tridentate pedicellariae occur in two forms, one with slender valves, with the edges rather coarsely dentate in the lower part of the blade, the other with broad, spoon-shaped valves; this latter form is found only in the petals. Ophicephalous pedicellariae appear to be totally lacking.

Remarks.—The two specimens from station 5468 differ from the others in having the posterior petals distinctly longer than the anterior ones. Only the aboral side of the test is preserved, though not completely; it has the appearance that the petals are less broad than is typical of the species. Not one of the characteristic broad-valved tridentate pedicellariae is found; but the conical tube feet of the adapical rudimentary pores of the anterior series of the anterolateral petals are well developed, and the plates outside the petals of the anterolateral ambulacra are broad and tuberculated as typical of *B. micropetala*. I think it the best course for the present to designate these specimens as a variety of *B. micropetala* without giving a definite varietal name, because there is no certainty that they actually belong to this species.

BRISSOPSIS OBLIQUA, new species

Locality.—Station 5421, between Panay and Guimarás; 251 meters; March 20, 1909. Three specimens.

Type.—U.S.N.M. No. E.7156, from station 5421.

Description.—The largest of the three specimens is 40 mm. long, 28 mm. broad, and 17 mm. high, the others a little smaller. The test is very elongate and narrow; the greatest breadth is at the middle of the test, from where it narrows gently toward both ends. The greatest height is behind the posterior petals; from there the test slopes very gradually toward the posterior end, the periproct being completely visible when the test is viewed from above. The frontal depression is moderate; oral side flat, but the narrow sternum rising into a conspicuous knob at its posterior end. The peristome is placed rather far from the anterior edge. The labrum reaches posteriorly to the middle of the second adjoining ambulacral plates. Five ambulacral plates reach within the subanal fasciole, the first of them being the sixth. The petals are rather short but relatively broad and only slightly sunken; the posterior petals are confluent proximally, but the pores of the inner (posterior) series are rudimentary only in about the proximal half of the petal. The tube feet of the frontal ambulacrum are long and reddish, with an unlobed sucking disk. The apical system is central. The periproct is produced at its upper end.

It is a noteworthy feature that the spines within the subanal fasciole form a pair of conspicuous tufts. The peripetalous fasciole bends only slightly inward between the petals. The subanal fasciole is almost circular, nearly as high as it is broad; the anal branches are well developed.

The globiferous pedicellariae have rather slender valves, terminating in two long divergent teeth. The tridentate pedicellariae have very simple, narrow valves. Rostrate pedicellariae not peculiar; ophicephalous pedicellariae appear to be lacking.

Color of test and spines whitish, but the subanal fasciole somewhat darker and thus quite conspicuous.

Remarks.—The strongly sloping posterior end of the test, the posterior prolongation of the labrum, reaching to the middle of the second adjoining ambulacral plates, and the conspicuous tufts formed by the spines within the subanal fasciole distinguish this species very markedly from all the other species of *Brissopsis* known from the Indo-West Pacific.

BRISSOPSIS OLDHAMI Alcock

Brissopsis oldhami Alcock, Journ. Asiatic Soc. Bengal, vol. 62, p. 174, pl. 8, figs 7. 8, 1893.—A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 50, p. 256, 1907; vol. 51, p. 136, 1907.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 218, pl. 14, figs. 1–3, 8, 9, 15; pl. 15, fig. 12; pl. 20, figs. 28–43, 1914.

Localities.—Station 5468, Atalayan Island (lat. 13°40′ N., long. 123°40′ E.); 1,041 meters; June 18, 1909. Two specimens, the larger

one, 83 mm. long, in fairly good condition; the smaller, 69 mm. long, badly broken on the oral side.

Station 5582, Darval Bay, northwestern Borneo (lat. 4°20′ N., 118°59′ E.); 1,629 meters; September 26, 1909. One young specimen, 32 mm. long, and fragments of two larger ones.

Station 5602, Gulf of Tomini, Celebes (lat. 0°22′ N., long. 132°03′ E.); 1,760 meters; November 14, 1909. One young specimen, very fragmentary.

Station 5668, Macassar Strait (lat. 2°28′ S., long. 118°49′ E.); 1,649 meters; December 29, 1909. Two badly broken specimens.

Remarks.—The identification of these specimens is not quite beyond doubt. In the character of the petals they correspond very well with the illustrations given by Koehler, and the specimens in which the posterior end is sufficiently well preserved for ascertaining the character of the subanal fasciole, viz, the two specimens from station 5468 and the young specimen from station 5582, agree with Koehler's description of the species in having this fasciole very broad and in having only three tube feet to each side within the fasciole.

The two specimens from station 5468 are peculiar in that the labrum has only a very short but broad posterior prolongation, not nearly reaching to the middle of the adjoining first ambulacral plates, and carrying a few large tubercles in continuation of the tubercles of the sternum. In the specimens from station 5668 the posterior prolongation of the labrum is narrower and longer, with no larger tubercles; the same is the case in the two smaller of the specimens from station 5582, while the third resembles the specimens from station 5468 in the character of the labrum. It thus seems that the shape of the labrum varies to an unusual degree within this species.

The pedicellariae, particularly the rostrate, likewise vary to a considerable degree. In the specimens from station 5668 a very coarse form, with short broad valves, occurs in the petals; it is covered with very dark skin and has no neck, so that one might be inclined to regard it as a globiferous pedicellaria, but, rostrate forms transitional to the more usual slender type exist in other specimens. Another form of rostrate pedicellaria with unusually narrow valves is found in these same specimens. Nothing quite like these forms of rostrate pedicellariae has been observed in any of the other specimens, but forms more like the common rostrate type are found. The tridentate pedicellariae are very faintly developed in these specimens from station 5668, but in the other specimens they are well developed and of various forms, corresponding to those figured by Koehler, *op. cit.*, pl. 20. Globiferous pedicellariae, with long and slender valves terminating in two divergent teeth, as figured by Koehler, *op cit.*, pl. 20, fig. 32, are found in the specimens from stations 5668 and 5582. Ophicephalous pedicellariae not observed.

BRISSOPSIS BENGALENSIS Koehler

Brissopsis bengalensis KOEHLER, Echinoderma of the Indian Museum, Echinoidea, pt. 1, p. 230, pl. 15, figs. 1–11; pl. 20, figs. 63, 64, 1914.

Localities.—Station 5587, Sipadan Island, northwestern Borneo (lat. 4°10′ N., long. 118°37′ E.); 759 meters; September 28, 1909. One large specimen, 85 mm. long, in a very fine state of preservation except that part of the oral side is lacking.

Station 5603, Gulf of Tomini (lat. 0°24′ N., long. 123°04′ E); 1,469 meters; November 15, 1909. One large complete specimen, 70 mm. long, one nearly complete, and two very fragmentary specimens.

Remarks.—It is of considerable zoogeographical interest that the *Albatross* found this species, hitherto known only from south of Ceylon and the Bay of Bengal, in the waters of Borneo and Celebes. It may thus be expected to be more widely distributed in the Malay region.

The identification of these specimens of *B. bengalensis* meets some difficulty, because of the fact that they have five ambulacral plates (four tube feet) reaching within the subanal fasciole, while the type would seem to have only four ambulacral plates (three tube feet) included. But a specimen from near the type locality of *bengalensis*, which I have received from the Indian Museum, has five ambulacral plates (four tube feet) within the fasciole, like the *Albatross* specimens. It would seem thus that Koehler has made some confusion of *bengalensis* and *oldhami*. That *bengalensis* should vary so much in this important character as to have sometimes four and sometimes five plates is highly improbable.

BRISSOPSIS LUZONICA (Gray)

Kleinia luzonica GRAY, Catalogue of the Recent Echinida of the British Museum, p. 49, 1855.

Brissopsis luzonica A. AGASSIZ, Revision of the Echini, p. 593, 1873.—DE MEIJERE, *Siboga* Echinoidea, p. 188, pl. 5, figs. 44, 45; pl. 23, figs. 469–476, 1904.—KOEHLER, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 207, pl. 13, fig. 16; pl. 14, figs. 4, 5, 7, 12, 13; pl. 20, figs. 51–54, 1914.—H. L. CLARK, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 204, pl. 152, figs. 5–8; pl. 155, figs. 2, 3, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 213, 1925.

Brissopsis duplex KOEHLER, Echinoderma of the Indian Museum, etc., p. 212, 1914.

Locality.—Station 5161, Tinakta Island (lat. 5°10′ N., long. 119°53′ E.); 29 meters; February 2, 1908. Six specimens.

Remarks.—One of these specimens is most interesting in having two different kinds of globiferous pedicellariae, viz, the form with very slender valves figured by de Meijere in his *Siboga* Echinoidea, pl. 23, fig. 474, and another form with shorter and coarser valves, but likewise terminating in two long, diverging teeth.

That Koehler's *Brissopsis duplex*, characterized by having two different kinds of ophicephalous pedicellariae, is identical with *luzon-*

ica, as maintained by H. L. Clark, *op. cit.* 1917, cannot be doubted. The few specimens with both kinds of ophicephalous pedicellariae I have seen, among which is one of the *Albatross* specimens, differ in no other way from typical *luzonica*. On the other hand, I cannot at all agree with Clark in regarding *oldhami* and *bengalensis* as synonyms of *luzonica;* as will be set forth in volume 5 of my Monograph of the Echinoidea, I must regard these two as perfectly distinct species. On the whole, I think it beyond doubt that the *Brissopsis "luzonica"* of Clark's works of 1917 and 1925, as well as that of de Meijere in his *Siboga* Echinoidea, will be found, on a careful revision, to contain various species, among which no doubt will be the species here described as *Brissopsis similis*. To judge from the characters of the petals alone the several specimens of this latter species would evidently have been referred to *luzonica*, according to the literature the only species occurring in the Malay region; a careful examination of the material collected by the *Albatross* shows that no less than six different species of *Brissopsis* occur there, and of these *B. similis* appears to be the most common.

Genus EUPATAGUS L. Agassiz

EUPATAGUS RUBELLUS, new species

Locality.—Station 5158, Tinakta Island (lat. 5°12′ N., long 119°55′ E.); 22 meters; February 18, 1908. One specimen.

Type.—U.S.N.M. No. E.7157, from station 5158.

Description.—The specimen is 22 mm. long, 19 mm. broad, and 14 mm. high; probably it is not adult, though the genital pores are well developed.

The test is regularly egg-shaped, not flattened on the oral side. The vertex is a little behind the apical system. The petals are short but well formed, the posterior slightly the longer. There are 10 pore-pairs in the posterior series of the anterior petals, 12 in the posterior series of the posterior petals; in the anterior series of the anterior petals only the 7 distal pore-pairs are well developed, the proximal 3–4 quite rudimentary. The frontal ambulacrum almost flush with the test, with only the merest indication of a frontal depression. Phyllodes quite rudimentary. The posterior ambulacra broad, naked; plates 6–9 (10) prolonged within the subanal fasciole, so that there will probably be three tubefeet to each side within the fasciole. There are 2 or 3 large tubercles (spines) within the peripetalous fasciole to each of the paired interambulacra, none in the posterior interambulacrum. Some larger secondary tubercles to each side of the frontal ambulacrum, not arranged in regular transverse series. The plates of the aboral side otherwise rather densely covered with small secondary and miliary tubercles (spines). On the oral side the interambula-

cral spaces narrow, in correspondence with the broad ambulacra; their tubercles not conspicuous. The labrum is prolonged posteriorly only to the end of the second adjoining ambulacral plates. The sternum is densely covered with spines throughout.

The apical system, which is slightly anterior, has four genital pores, as typical of the genus; the madreporite is not much prolonged posteriorly. The peristome is large, rounded, not at all sunken; the labrum does not form a prominent lip, the mouth opening being rather far anterior to it. The rather large periproct is close to the upper edge of the vertical posterior end of the test; it appears to be slightly sunken at its lower edge.

The primary aboral spines are all broken but apparently are about half the length of the test; they are curved basally. To judge from the part preserved they are entirely smooth. Secondary and miliary spines curved as usual; those at the posterior end longer, forming together with those of the subanal plastron a fence around the periproct. The spines of the sternum and the oral interambulacra are not widened distally.

The peripetalous fasciole is slightly sinuate in the posterior interambulacrum, straight in the posterolateral interambulacra, but bends downward at a right angle a little before the anterior petals, then disappears before reaching the frontal ambulacrum. The subanal fasciole has an anterior angle; the posterior band straight.

Pedicellariae of the tridentate, rostrate, ophicephalous, and triphyllous types, not very characteristic. Globiferous pedicellariae not observed.

The color is a light reddish on the aboral side, whitish on the oral side. The large aboral spines banded with narrow red-brown bands; also the spines of the oral side are thus banded.

Remarks.—This species appears to be the nearest related to *Eupatagus lymani* (Lambert and Thiéry) (the *Gymnopatagus pulchellus* of H. L. Clark), with which it agrees in the color. It is, however, markedly distinct from it in the labrum being much shorter; also it appears that the shape of the test is different, not so high in *lymani* as in the present species.

Genus SPATANGUS Klein

SPATANGUS sp.

Locality.—Station 5565 (lat. 5°52′ N., long. 120°30′ E.); 445 meters; September 21, 1909. One specimen.

Remarks.—The specimen is an old naked test; it was broken to pieces, but it was possible to glue the fragments together so as to form a fairly complete test.

It is evident that this specimen is related to the Hawaiian *Spatangus paucituberculatus* A. Agassiz and H. L. Clark (cf. H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 237, pl. 157, figs. 7–9). As in that species (and in the Mediterranean species *S. inermis* Mortensen) the paired interambulacra have no large tubercles aborally, there being only a very few larger tubercles along the midline of the posterior interambulacrum. It differs from the Hawaiian species in having the frontal depression much deeper, and the outline of the test not nearly circular, but distinctly narrowing toward the anterior end. The characters of the oral side seem to be as in *paucituberculatus* (so far as may be concluded from the description and the rather unsatisfactory fig. 9, pl. 157). There are only 2 pore-pairs to each side within the subanal fasciole.

It is quite probable that we have here a new species of the genus *Spatangus*, but in view of the deficient condition of the single specimen at hand I prefer not to name it, particularly in view of the uncertainty of the specific value of the character of the total absence of larger tubercles in the paired interambulacra. I have a couple of specimens from off Nagasaki, Japan, which would seem to be identical with *Spatangus pallidus* H. L. Clark, but here again the lateral interambulacra have no large tubercles at all. The study of the fossil forms of *Spatangus* also indicates that the character of the absence or the presence of a very few larger tubercles in the lateral interambulacra is of no great value.

Unfortunately the two Japanese specimens are likewise very incomplete, the oral side badly broken in one, totally lacking in the other specimen. A couple of specimens from the Kei Islands, likewise with larger tubercles only along the midline of the posterior interambulacrum, and very probably identical with the specimen from the *Albatross*, are also very incomplete, naked tests.

Till new, better-preserved specimens become available it must remain undecided which species of the genus *Spatangus* it is that occurs in the Malay region.

Genus MARETIA Gray

MARETIA PLANULATA (Lamarck)

Maretia planulata A. Agassiz, Revision of the Echini, pp. 140, 570, pl. 19b, figs. 7–17, 1873.—de Meijere, *Siboga* Echinoidea, p. 190, pl. 23, figs. 478, 479, 1904.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 106, pl. 11, figs. 18, 19; pl. 20, figs. 8–13, 1914.

Maretia ovata H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 248, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 226, 1925.

Localities.—Tubig Bay, shore; January 7, 1908. Three specimens.

Olongapó, Luzón, beach; January 7, 1908. Many small dark specimens.

Station 5142 (lat. 6°06′ N., long. 121°03′ E.); 38 meters; February 15, 1908. One specimen.

Station 5158 (lat. 5°12′ N., long. 119°54′ E.); 22 meters; February 21, 1908. Two specimens.

Station 5159 (lat. 5°11′50″ N., long. 119°54′ E.); 18 meters; February 21, 1908. Two specimens.

Station 5160 (lat. 5°12′40″ N., long. 119°55′ E.); 22 meters; February 22, 1908. One specimen.

Station 5161 (lat. 5°10′40″ N., long. 119°55′ E.); 22 meters; February 22, 1908. Four specimens.

Station 5342 (lat. 10°57′ N., long. 119°17′ E.); 26–46 meters; December 23, 1908. Several large specimens.

Remarks.—Ophicephalous pedicellariae, hitherto unknown in this species, are found in goodly numbers in several of the smaller specimens; they do not call for any special comment.

I must emphatically protest against H. L. Clark's changing of the species name *planulata* (Lamarck) into *ovata* (Leske). The two very poor figures of "*Spatangus ouatus*" given by Leske, Additamenta, pl. 49, figs. 12, 13, do not resemble *Maretia planulata* in the outline of the test, and in the description (p. 252, in the edition with Klein's Naturalis dispositio Echinod.) it is stated to differ from the preceding species, "*Spatangus brissoides*," a fairly large, very poorly preserved, but judged from the figure (pl. 27, B) not at all flattened, fossil spatangoid, "Testa ouata conuexa, altiore." This means that this "*Spatangus ouatus*" was at least not at all flattened, as is *Maretia planulata.* Whatever this *Spatangus ouatus* of Leske really is (it has generally been taken to be *Echinocardium flavescens;* cf. Agassiz, Revision of the Echini, p. 570), it is evident that it cannot be *Maretia planulata*, which very characteristically flattened form it would be most inappropriate to describe as "higher" than another not at all flattened form, and Clark may well be blamed for, on such exceedingly poor evidence, changing the universally used species name *planulata* (Lamarck) into *ovata* (Leske).

MARETIA CORDATA, new species

Localities.—Station 5104 (lat. 14°45′48″ N., long. 120°12′ E.); 60 meters; January 8, 1908. One young specimen.

Station 5192 (lat. 11°09′ N., long. 123°50′ E.); 59 meters; April 3, 1908. One fine specimen.

Station 5257, Mindanao (lat. 7°22′ N., long. 124°12′ E.); 51 meters; May 22, 1908. One specimen.

Station 5431 (lat. 10°38′45″ N., long. 120°12′45″ E.); 93 meters; April 8, 1909. Two specimens.

Type.—U.S.N.M. No. E.7158, from station 5192.

Description.—The holotype is 22 mm. long, 20 mm. broad, and 8 mm. high; the specimen from station 5257 is of the same size; the other specimens are smaller; the one from station 5104, the smallest, is 13 mm. long, 11.5 mm. broad, and 6 mm. high.

From *Maretia planulata* of corresponding sizes the present species differs in being broader and also slightly higher; but particularly it differs from *planulata* in having the depression of the frontal edge of the test broader and deeper, the test being distinctly heart-shaped. On the oral side the anterior ambulacrum is conspicuously sunken, which it is not in *planulata*. The petals are a little shorter than those of *planulata* of corresponding sizes. The peristome is rounded pentagonal; the labrum, which does not form a prominent lip, reaches posteriorly to the end of the third adjoining ambulacral plates, as in *planulata*. The periproct is only about as long as broad and is nearly round in outline, whereas in *planulata* it is much longer than broad, pointed at both ends. The subanal fasciole is well developed; only two tube feet to each side within the fasciole. The long aboral spines are about equally long and numerous in both species, but somewhat slenderer in *cordata*. A very conspicuous difference between the two species is found in the basal widening of the spines of the lateral interambulacra; it is much shorter in *cordata* than in *planulata*. The pedicellariae are not markedly different from those of *planulata*, but I have found only a very small form of tridentate pedicellariae, whereas the rostrate grow to quite a fair size. The color is whitish, the type specimen with a faint tinge of reddish on the spines at the posterior end.

Probably none of the specimens at hand are adult; but genital pores are present already in the youngest of them.

EURYPATAGUS, new genus

Test low, arched: oral side flat, but sunken at the peristome. Outline elliptical, no groove or depression in the frontal edge; the posterior end slightly produced. Paired ambulacra distinctly petaloid, continuing to the edge of the test, open distally; frontal ambulacrum very narrow, the pores very small. The phyllodes of the anterior paired ambulacra very conspicuous, with 12–14 pores (tube feet) in each series, each accompanied by a sphaeridium. Peristome broad, pentagonal, rather far from the anterior edge. Labrum well developed, with a narrow posterior prolongation ending off the middle of plates No. 4 of the adjoining ambulacral series. Plastron very small, entirely naked, or at most with a very few tubercles (spines) at the posterior end. The 3 or 4 ambulacral plates adjoining the episternal plates adproctally prolonged, indicating the presence of a subanal fasciole in the young specimens; but there is no trace of such fasciole in the adults. No internal or peripetalous (or marginal) fasciole. Periproct placed vertically on the posterior end of the test, somewhat

produced upward and visible from above. Apical system anterior; 4 genital pores. Primary tubercles of the aboral side not very conspicuous, scattered all over the interambulacra, also the posterior unpaired interambulacrum: on the sides of the test they may be distinctly arranged in horizontal series. The primary spines curved at the base, directed backward, with a few distant serrations; secondary spines curved. Tridentate, rostrate, and triphyllous pedicellariae present; but none of the globiferous type. Ophicephalous pedicellariae found in the young of one species (*paucituberculatus*). Color of test red, spines red or banded or yellowish. The denuded test white.

Genotype: *Eurypatagus ovalis*, new species.

The genus is nearly related to *Maretia* but differs from it in the open petals, the stronger development of the phyllodes, the greater posterior prolongation of the labrum, and the almost totally naked sternum. It is more nearly related to *Platybrissus*, from which it differs mainly in the character of the peristome.

EURYPATAGUS OVALIS, new species

Locality.—Station 5217 (13°20′ N., 123°14′ E.); 192 meters; April 22, 1908. Five well-preserved specimens.

Type.—U.S.N.M. No. E.7159, from station 5217.

Description.—The largest specimen is 88 mm. long, 66 mm. broad, and 26 mm. high; the smallest is 71 mm. long, 55 mm. broad, and 20 mm. high.

The above description of the genus *Eurypatagus* applies equally to the species *ovalis*; a more detailed description therefore need not be given here. A full description, with illustrations, will be given in volume 5 of the Monograph of the Echinoidea. It may be stated here only that the tridentate pedicellariae occur in two forms, a large form, up to 1.5 mm. in length of head, with very slender, slightly curved valves, wide apart, meeting only at the point, and a smaller form with broader, spoon-shaped valves. The spines are to a varying degree red-brown with lighter bands.

Genus GYMNOPATAGUS Döderlein

GYMNOPATAGUS MAGNUS A. Agassiz and H. L. Clark

Gymnopatagus magnus A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 51, p. 133, 1907.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 231, pl. 146, fig. 13; pl. 159, fig. 1, 197.

Gymnopatagus sewelli Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 98, pl. 13, figs. 1–7; pl. 19, figs. 51–60, 1914.

Localities.—Station 5332 (lat. 12°47′ N., long. 120°41′ E.); 1,363 meters; December 18, 1908. One young fragmentary specimen.

Station 5349 (lat. 10°54′ N., 118°26′ E.); 1,336 meters; December 27, 1908. Fragments of two large specimens.

Station 5439 (lat. 15°58′ N., long. 119°40′ E.); 1,720 meters; May 9, 1909. One young badly broken specimen.

Station 5468 (lat. 13°36′ N., long. 123°40′ E.); 1,041 meters; June 18, 1909. Six large badly broken specimens, only one of them nearly complete.

Station 5612 (lat. 0°38′ S., long. 121°44′ E.); 1,373 meters; November 20, 1909. One young badly broken specimen.

Station 5619 (lat. 0°35′ N., long. 127°15′ E.); 796 meters; November 27, 1909. One young badly broken specimen.

Station 5654 (lat. 3°42′ S., long. 120°46′ E.); 1,473 meters; December 18, 1909. Fragments of two large specimens.

Station 5668 (lat. 2°28′ S., long. 118°49′ E.); 1,649 meters; December 29, 1909. One nearly complete medium-sized specimen.

Uncertain locality: Fragments of one large specimen.

Remarks.—It is very regrettable that all these specimens are very badly broken; only one specimen, a naked test from station 5468, is nearly complete. Evidently the oral side is much more fragile than the aboral side; the mud-filled, very heavy intestinal canal causes it to break by the capture in the trawl, and in most cases only small fragments or nothing at all of the oral side is preserved. In the specimen from station 5668 the anterior half of the oral side is preserved. To some degree it has been possible to glue the fragments together so as to get tolerably good aboral sides; the extremely thin fragments of oral sides it has in no case been possible to fit together.

The largest of the specimens is about 108 mm. long, but a good deal smaller than Koehler's largest specimen, which is stated to exceed 130 mm. in length. The smallest specimen (station 5332) is 50 mm. long. Genital pores are fully developed in this young specimen.

Genus PSEUDOMARETIA Koehler

PSEUDOMARETIA ALTA (A. Agassiz)

Maretia alta A. Agassiz, Revision of the Echini, p. 569, 1873.—de Loriol, Mém. Soc. Hist. Nat. Genève, vol. 28, p. 49, pl. 5, figs. 7–7e, 1883.—de Meijere, *Siboga* Echinoidea, p. 192, 1904.

Pseudomaretia alta Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 111, pl. 11, figs. 14–17, 20; pl. 20, figs. 1–7, 1914.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 249, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 228, 1925.

Locality.—Station 5141, off Joló (lat. 6°09′ N., long. 120°58′ E.); 53 meters; February 15, 1908. One fine specimen, 35 mm. long.

PSEUDOMARETIA TYLOTA (H. L. Clark)

Maretia alta A. Agassiz, *Challenger* Echinoidea, pl. 38, figs. 1–4, 1881 (*non Maretia* (*Pseudomaretia*) *alta* A. Agassiz).

Gonimaretia tylota H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 241, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 226, 1925.

Locality.—Station 5467, San Bernardino Strait (lat. 12°56′ N., long. 124°25′ E.); 494 meters; June 24, 1909. Three specimens, more or less broken.

Remarks.—The best-preserved specimen is 43 mm. long, therefore the largest on record; it is 35 mm. broad and 20 mm. high. Another specimen evidently was somewhat larger, but it is too fragmentary and incomplete to be measured.

The genus *Gonimaretia*, established by H. L. Clark (*op. cit.* 1917), with the species *tylota* as the genotype, is in my opinion not distinguishable from *Pseudomaretia.* It is not the place here for a discussion of this matter; it will be dealt with in my Monograph of the Echinoidea, volume 5, under the genus *Pseudomaretia.*

Genus LOVENIA Desor

LOVENIA ELONGATA (Gray)

Lovenia elongata A. Agassiz, Revision of the Echini, p. 575, pl. 19c, figs. 1–4, 1873.—Döderlein, Echinoiden d. deutschen Tiefsee Exped., p. 265, pl. 48, fig. 5, 1906.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 111, pl. 11, figs. 5, 6; pl. 12, fig. 10; pl. 13, fig. 8; pl. 19, figs. 25–32, 1914.—H. L. Clark, Catalogue of the Recent sea-urchins in the British Museum, p. 230, 1925.

Localities.—Station 5160 (lat. 5°13′ N., long. 119°55′ E.); 22 meters; February 22, 1908. Two specimens.

Station 5164 (lat. 5°02′ N., long 119°52′ E.); 33 meters; February 24, 1908. Two specimens.

Station 5218 (lat. 13°11′ N., long. 123°03′ E.); 37 meters; April 22, 1908. One specimen.

Remarks.—All these specimens are young, about 25 mm. long, and not in a very good state of preservation.

LOVENIA SUBCARINATA Gray

Lovenia subcarinata Gray, Catalogue of the Recent Echinida in the collection of the British Museum, p. 45, pl. 5, fig. 3, 1855.—A. Agassiz, *Challenger* Echinoidea, p. 175, pl. 35b, figs. 5–7, 1881.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 114, pl. 19, figs. 47–50, 1914.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 256, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 231, 1925.

Locality.—Station 5204, off east coast of Leyte Island (lat. 11°04′ N., long. 125°05′ E.); 27 meters; April 11, 1908. Two fine adult specimens.

LOVENIA GREGALIS Alcock

Lovenia gregalis Alcock, Journ. Asiatic Soc. Bengal, vol. 62, p. 175, 1893.—de Meijere, *Siboga* Echinoidea, p. 194, pl. 10, figs. 97, 98, 1904.—Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 115, pl. 12, figs. 6–9, 11; pl. 19, figs. 33–45, 1914.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 256, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 231, 1925.

Localities.—Station 5348, Palawan Passage (lat. 10°58′ N., long. 118°38′ E.); 686 meters; December 27, 1908. One large specimen.

Station 5646, Buton Strait (lat. 5°31′ N., long. 122°23′ E.); 834 meters; December 16, 1909. Three large specimens.

Station 5656, Gulf of Boni (lat. 3°18′ S., long. 120°37′ E.); 886 meters; December 19, 1909. Two medium-sized specimens.

Station 5657, Gulf of Boni (lat. 3°20′ S., long. 120°36′ E.); 900 meters; December 19, 1909. Three medium-sized specimens, all very badly broken.

Station 5658, Gulf of Boni (lat. 3°33′ S., long. 120°31′ E.); 933 meters; December 19, 1909. Fragments of an old test.

Remarks.—These specimens conform perfectly with the description given by Koehler, *op. cit.*, 1914; but whereas the largest of the *Investigator* specimens was 76 mm. long and the largest of the *Siboga* ones 86 mm. long, the largest of the specimens from station 5646 is 96 mm. long, the largest known till now. This specimen was denuded and has afforded a very fine preparation of the test; it will be figured in volume 5 of my Monograph of the Echinoidea.

LOVENIA TRIFORIS Koehler

Lovenia triforis Koehler, Echinoderma of the Indian Museum, Echinoidea, pt. 1, Spatangidés, p. 124, pl. 12, figs. 9–13, 1914.

Locality.—Station 5355, North Balabac Strait, north of Borneo (lat. 8°08′ N., long. 117°19′ E.); 81 meters; January 5, 1908. One specimen.

Remarks.—This species was hitherto known only from the single incomplete specimen taken by the *Investigator* in the Gulf of Martaban. Later (1914) I took one specimen near the Goto Islands, Japan, and (1929) a few specimens in the Bali Sea, all except one very badly broken. The specimen from the *Albatross* is in fairly good condition, the test not broken; it is 33 mm. long.

The rostrate pedicellariae, the only type of pedicellariae found on this specimen, differ from those of the specimens from the Bali Sea in being smooth, whereas they are more or less conspicuously knobbed in the Bali Sea specimens. Since, however, there are no other differences, and all other characters are identical, and, moreover, only quite small examples of these rostrate pedicellariae are found, I can have no doubt that this specimen from off North Borneo is conspecific with

those from the Bali Sea. The species *L. triforis* is thus now known to be distributed from the Bay of Bengal to Japan, and must be supposed to have its center of distribution in the Malay region.

LOVENIA DÖDERLEINI Mortensen ACUMINATA, new variety

Localities.—Station 5161, Tinakta Island, Tawi Tawi Group (lat. 5°10′ N., long. 119°53′ E.); 29 meters; February 21, 1908. One specimen.

Station 5164, Tawi Tawi Group (lat. 5°02′ N., long. 119°52′ E.); 33 meters; February 24, 1908. One specimen.

Type.—U.S.N.M. No. E.7160, from station 5161.

Description.—The type specimen is well preserved, 32 mm. long, 26 mm. broad, and 14 mm. high. The other specimen is smaller, 25 mm. long, also well preserved.

This form differs from typical *L. döderleini*, which will be described in volume 5 of my Monograph of the Echinoidea, in being markedly attenuated posteriorly (particularly the large specimen). Further, it differs in having the internal fasciole single anteriorly (double in the typical *döderleini*), and in having the stalk of the globiferous pedicellariae thin, not at all thickened as it is in the typical *döderleini;* these pedicellariae are found only in the type. That ophicephalous pedicellariae are wanting is probably not a constant character, since they are not always present in typical *döderleini.* In all the other characters these specimens agree with typical *döderleini* (apart from the fact that the aboral globiferous pedicellariae so characteristic of that species are not found).

It is quite probable that these specimens actually represent a distinct new species; but with the quite insufficient material at hand I do not think it advisable to establish it as more than a variety of *L. döderleini*, with which it is at any rate very closely allied.

Genus BREYNIA Desor

BREYNIA ELEGANS Mortensen

Locality.—Station 5152, near the Tawi-Tawi Islands (lat. 5° 23′ N., long. 120°16′ E.); 62 meters; February 18, 1908.

One specimen, a very badly broken, incomplete test. The fragments could be fitted together so as to form a tolerable specimen, 95 mm. long, 73 mm. broad, and 36 mm. high.

Remarks.—Though in poor condition, this specimen can be identified with certainty as belonging to the new species *B. elegans*, established for a large specimen from the Kei Islands, also rather badly broken, but still in much better condition than the specimen from the *Albatross*, particularly in that the spines are preserved. It was thus necessary to take the specimen from the Kei Islands as the

type, and I must refer to the description of the species which will be given in volume 5 of my Monograph of the Echinoidea. It must suffice here to state that the species is characterized by its unusually low test, the numerous primary aboral tubercles (spines), and the very uniform fine granulation of the aboral side. The oral side is flat, not at all sunken toward the peristome. The labrum has a narrow posterior prolongation, reaching almost to the end of the third plate of the adjoining ambulacra. The sternum is tuberculated only in its posterior part. The primary spines are banded with narrow purplish bands.

Genus BRISSUS Klein

BRISSUS LATECARINATUS (Leske)

Brissus carinatus A. Agassiz, Revision of the Echini, p. 596, pl. 21a, figs. 1–3, 1873.

Brissus latecarinatus H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 219, pl. 146, fig. 15, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 219, 1925.

Locality.—Catbalogan, Sámar, shore; April 16, 1908. One young specimen.

Genus METALIA Gray

METALIA STERNALIS (Lamarck)

Metalia sternalis A. Agassiz, Revision of the Echini, p. 600, pl. 21a, figs. 4, 5; pl. 21c, figs. 5–9, 1873.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 209, pl. 146, fig. 30, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 216, 1925.

Locality.—Station 5159, Tinakta Island, Tawi Tawi Group (lat. 5°12′ N., long. 119°54′ E.); 18 meters; February 21, 1908. One medium-sized specimen, 40 mm. long.

The specimen has only five tube feet to each side within the subanal plastron, as against nine or ten in adult specimens.

METALIA SPATAGUS (Linnaeus)

Metalia maculosa A. Agassiz, Revision of the Echini, p. 598, pl. 21b, figs. 8, 9, 1873.

Metalia spatagus Lovén, Bihang Svenska Vet.-Akad. Handl., ser. 13, vol. 4, No. 5, p. 162, pl. 6, fig. 1, 1887.—H. L. Clark, Hawaiian and other Pacific Echini, Echinoneidae . . . Spatangidae, p. 210, 1917; Catalogue of the Recent sea-urchins in the British Museum, p. 216, 1925.

Locality.—Station 5160, Tinakta Island, Tawi Tawi Group (lat. 5°12′40″ N., long. 119°55′ E.); 22 meters; February 22, 1908. One young specimen, 20 mm. long.

Remarks.—This specimen has already the genital pores fully developed. The subanal fasciole is very distinct; there are three tube

feet to each side within the subanal plastron, but the fact that the ambulacral plate No. 10 reaches within the fasciole proves that there would have been 4 tube feet enclosed in a later stage.

It is rather surprising to find the genital pores fully developed already at such young age, as it is otherwise a general rule that in species attaining a large size (as does *M. spatagus;* it exceeds a length of 100 mm.) genital pores are rather late in appearing. I am then not altogether sure that it may not ultimately be found that this young specimen (and I have similar specimens of the same size from Mauritius) represents another species, related to *M. spatagus;* also Clark (1925) finds such young specimens perplexing. I have, however, no specimens of intermediate sizes and must therefore for the present content myself with referring these young specimens to *Metalia spatagus.*

○