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The Echinoids of Easter Island (Rapa Nui)[1]

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ABSTRACT: The known echinoid fauna of Easter Island now comprises seven species. Four of them, *Tripneustes gratilla*, *Echinostrephus* sp., *Clypeaster reticulatus*, and *Brissus agassizii* are reported here from Easter Island for the first time, *Tripneustes gratilla* apparently being represented by a previously unknown variant. The value of the pedicellariae and the heavily plated peristome as specific differences in the genus *Tripneustes* is questioned. Comparison of Easter Island material with specimens from other parts of the Pacific supports the synonymy of *Brissus meridionalis* with *Brissus agassizii*. One of the previously reported species, *Echinometra insularis*, is herein restricted to Easter Island, reports of its occurrence elsewhere being based upon erroneous identifications. The reported occurrence of *Diadema mexicanum* at Easter Island is discounted.

The remoteness of Easter Island has caused much curiosity about its faunistic affinities and yet has made collections there very infrequent until relatively recently. This paper was written in 1968 as a Medical Expedition to Easter Island (M.E.T.E.I.) report but delays have enabled the inclusion of material from various other sources.

The first echinoids recorded from Easter Island were collected by the U.S.S. *Albatross* Expedition in December 1904 (Agassiz and Clark 1908; H. L. Clark 1912, 1917). Only three species were found, one being the widely distributed *Echinoneus cyclostomus*, another being the Indo-West-Pacific *Diadema savignyi*, and one a new species, *Echinometra insularis*, which Clark (1912) also reported from Socorro Island. However, as shown below, the record from Socorro proves to be incorrect. No further references to Easter Island Echinoidea have been noted in the *Zoological Record*.

Since the *Albatross* collections the following sources have yielded echinoids from Easter Island. In February 1958, the *Downwind* Expedition from Scripps Institution of Oceanography collected a specimen of *Clypeaster reticulatus*. In January and February 1965, Dr. Ian E. Efford and John A. Mathias of M.E.T.E.I. collected specimens of *Tripneustes gratilla*, *Echinometra insularis*, and *Brissus agassizii*. In January and February 1969, Dr. John E. Randall and Gerald R. Allen, on an ichthyological expedition sponsored by the National Geographical Society, collected some specimens of *Echinometra insularis*. In January 1971, Dr. Richard U. Gooding collected some echinoids (which I have not examined) and made some observations which he has contributed for this paper.

These collections, although small, confirm that this eastern Pacific island has an Indo-West-Pacific affinity.

I wish to thank the following for their assistance to this study. Professor I. E. Efford, University of British Columbia, permitted me to report on the M.E.T.E.I. collection. Dr. R. H. Chesher loaned me material of *Brissus* from Panama and gave valuable advice on problems presented by the genus. Miss M. E. Downey and Dr. D. L. Pawson of the Smithsonian Institution, Drs. G. Nogrady of Montreal, E. C. Allison of San Diego State College, C. W. Allison of the University of Alaska, J. H. Peck of the University of California at Berkeley, and D. P. Kelso of George Mason University, Virginia, assisted me with a number of loans. Dr. Kelso also supplied data on Hawaiian *Echinometra*. Dr. Richard U. Gooding has sent me some of his observations, which have been included. Dr. Alan N. Baker of the National Museum, Wellington, New Zealand, assisted with the genus *Diadema*. Professor H. B. Fell at the Museum of Comparative Zoology, Harvard

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SYSTEMATICS

FAMILY DIADEMATIDAE

Regular echinoids with aulodont lantern. Ambulacral plates trigeminate, compounded in diadematoid fashion. Primary tubercles perforate and crenulate. Primary spines hollow and verticillate.

Diadema Gray, 1825

Primary ambulacral tubercles in two vertical series, regular throughout. Globiferous pedicellariae absent. No spines on buccal plates.

Diadema savignyi (Audouin)

Synonymy

Cidarites savignyi–Audouin 1826: 13; *Diadema savignyi*–Agassiz and Clark 1908: 114, Mortensen 1940: 265 (complete synonymy).

Type Locality

Egypt (Red Sea).

Type Specimen

Unknown. Audouin (in J. C. Savigny 1826) gave the name *Cidarites savignyi* to a *Diadema* illustrated by M. J. C. Savigny. Mortensen (1940: 268) gave reasons why this drawing is taken to be what is now known as *Diadema savignyi*.

Remarks

Dr. R. U. Gooding has reported of *D. savignyi* (personal communication) that "specimens were found in a rockpool at the entrance of Hanga-Piko Bay in 1 m and on top of or on the protected sides of rock ridges close and parallel to the mouth (S. side) of the bay off Vaihu in 2–3 m. It is not eaten locally, being said to cause a swelling and blistering of the mouth. The gonads were rather bitter in one that was tasted. The general polynesian term 'vana' (which is used in other islands only for diadematids) applies on Easter Island to *Tripneustes*, while 'hetuke patia' is used for this species."

Mortensen (1940: 277) reported *Diadema mexicanum* from Easter Island. This author considers the occurrence of a tropical west American echinoid at Easter Island to be most unlikely, although confusion between *D. savignyi*, *D. antillarum*, and *D. mexicanum* is very possible as these species may be reliably distinguished only by their tridentate pedicellariae. Mortensen (1940: 254) referred to them as "geographical species." Dr. Gooding collected a *Diadema* at Easter Island and sent it to Alan Baker, who (personal communication) found no *mexicanum*-type pedicellariae.

FAMILY TOXOPNEUSTIDAE

Regular camarodont echinoids with deep gill slits. Valves of globiferous pedicellariae without any side teeth below terminal tooth.

Tripneustes L. Agassiz, 1814

Ambulacral plates trigeminate, the compounded plates very low and wide so that there is only one primary tubercle to every three or four compound plates. Pore zones wide with three vertical series of pore pairs. Genus occurs in all tropical oceans.

Tripneustes gratilla (Linnaeus)

Fig. 1*a*, 1*g*

Synonymy

Echinus gratilla—Linnaeus 1758: 664; *Tripneustes gratilla*—Mortensen 1943*a*: 500 (complete synonymy).

Type Locality

"Habitat in O. Indico."

Type Specimen

The type specimen was in the collection of Queen Louisa Ulrika. Linnaeus examined this collection in 1751, 1752, and 1754. He hoped to publish a report on the queen's collection before 1758 in order to quote the more detailed descriptions in the *Systema Naturae*, 10th

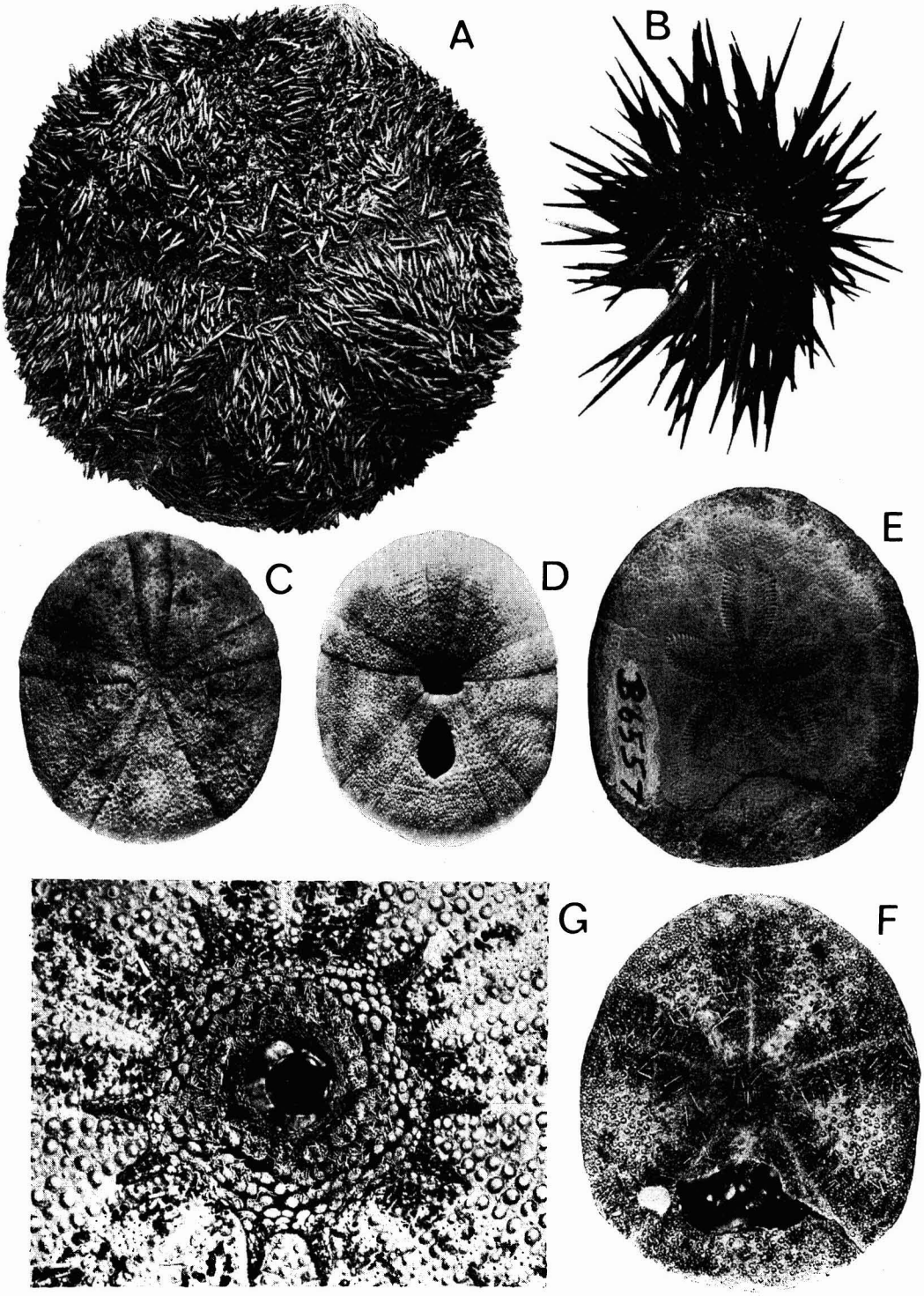

FIG. 1. *A*, *G*, *Tripneustes gratilla*: *A*, aboral aspect, MCZ 8331, 122 mm diameter; *G*, heavily plated peristome of Easter Island specimen, MCZ 8333, peristome diameter 45 mm. *B*, *Echinometra insularis*: aboral aspect, MCZ 4045, paralectotype, test diameter 38 mm. *C*, *D*, *Echinoneus cyclostomus*: *C*, aboral aspect and *D*, oral aspect, MCZ 8233, test length 34 mm. *E*, *F*, *Clypeaster reticulatus*: *E*, aboral aspect and *F*, oral aspect, test length 55 mm.

edition. However, his report was delayed until 1764 and then it was published without the plates he originally had hoped to include. In 1803 the queen's collection was transferred from the palace at Dröttningholm to the University Museum at Uppsala. Lovén (1887: 75) reported that the type was missing.

Material Examined

EASTER ISLAND—five specimens collected by M.E.T.E.I.: MCZ 8329–8330, Anakena, 2–25 ft (1–8 m), "not from closed off tide pools," 15–16 Jan. 1965; MCZ 8331–8333, off Hanga-Roa, 5–10 ft (1–3 m), 2 Feb. 1965.

Also specimens in the MCZ collection from other central and eastern Pacific localities, these including:

SOCIETY ISLANDS—MCZ 1384, Society Islands, two specimens.

TUAMOTU ARCHIPELAGO—MCZ 3949, Fakarava, *Albatross* collection, two specimens.

HAWAIIAN ISLANDS—MCZ 990, Hawaiian Islands, one specimen; MCZ 1389, Hawaiian Islands, one specimen; MCZ 4030, reef in front of Honolulu, Oahu, *Albatross* collection, 1901, three specimens; MCZ 4031, Puako Bay, west coast of island of Hawaii, *Albatross* collection, 1902, three specimens; MCZ 1383, Hawaiian Islands, six specimens; MCZ 7024, Honolulu, Oahu, three specimens.

JOHNSTON ISLAND—MCZ 4658, one specimen.

SAMOA—MCZ 3355, Samoa, purchased from vendor by R. T. Jackson, 1908, nine specimens.

Remarks

Two forms were taken at Easter Island by M.E.T.E.I. A single specimen (MCZ 8329) represents the typical central Pacific *gratilla*. The test is 83 mm in diameter and 58 mm high. It has the usual deep purple to black color of the spines and test. The median areas of the interambulacra aborally carry only a few small spines. The entire test is densely covered with ophicephalous pedicellariae. The buccal membrane is rather badly preserved but appears to have the few small scattered plates regarded as typical of the species.

The other four specimens are quite unlike the first. One of these (MCZ 8330), an almost completely denuded test with the peristome intact and with a few tube feet, spines, and pedicellariae attached, has a diameter of 155 mm and a height of 92 mm. The largest specimen of *T. gratilla* recorded (Baker 1968) measures 149 mm diameter of test. Two others (MCZ 8331, MCZ 8332) of these four retain the spines and pedicellariae. The tests of these four specimens all are closely covered with numerous, rather small, primary tubercles in regular vertical and horizontal series in the interambulacra on and below the ambitus. This regularity (especially in the horizontal rows) disappears aborally except on the smallest specimen (MCZ 8333, 97 mm diam.), where it ceases at the ambitus. The test is densely covered by spines, which do not exceed 12 mm on the adoral side and 8 mm on the ambitus and the aboral side. The spines taper distad, but terminate abruptly with a blunt end. On the adoral side of the test the spines are light gray; on the aboral side they are brownish, becoming darker at the tips. The aboral median areas of the interambulacra are not bare, as is commonly the case in *T. gratilla*, but are covered with short, dark brown spines. The peristomes of all four specimens are covered by numerous, thick, irregularly scattered plates that carry numerous pedicellariae and a few small spines (Fig. 1*g*). Such a condition was previously considered (H. L. Clark 1912, Mortensen 1943*a*) to be characteristic of the species *T. depressus*.

Discussion

The foregoing data disclose variations in characters hitherto used to distinguish *T. gratilla* from *T. depressus*. Specimens of *T. depressus* (MCZ 1361, La Paz, SE Lower California, one specimen; MCZ 3948, Clarion Island, off W. Mexico, *Albatross* collection, 4 March 1889, one specimen; MCZ 7352, Clarion Island, Templeton Crocker Expedition collection, 12 May 1936, one specimen; MCZ 7465, from shore of Darwin Bay, Tower Island, Galápagos, Hancock Pacific Expedition collection, 17 Jan. 1938, two specimens; MCZ 7464, from shore of Cartago Bay, Albemarle Island, Galápagos, Hancock Pacific Expedition, 22 Jan. 1938, two specimens; MCZ

7691, Point Lobos, Espíritu Santo Island, Gulf of California, E. K. Ricketts collector, 20 Mar. 1940, one specimen) have proved to have fewer spines than does *T. gratilla* at Easter Island, and the primary spines are longer, paler, and taper more distinctly toward the tip.

H. L. Clark (1912: 285), after comparing numerous specimens of the three known species of *Tripneustes*, found the test characters to vary so much that he suggested that the genus may comprise only a single very variable species. The characters of the Easter Island material lend support to Clark's suggestion that *Tripneustes* is monotypic. The four specimens (MCZ 8330–8333) discussed above, seem to comprise a previously undescribed form of *T. gratilla* that is intermediate between the Indo-West-Pacific *gratilla* and the West American *depressus*, sharing characters of both. Mortensen (1943*a*) considered (on the basis of only two specimens of *depressus*) that the shape of the tridentate pedicellariae and the thickly plated peristome are good characters for differentiating *depressus* and *gratilla* and also the tropical Atlantic *ventricosus*. The occurrence of a thickly plated peristome in specimens from Easter Island and the fact that specimens of *depressus* in the MCZ collection from Clarion Island have lightly plated peristomes show that the peristome is variable. The supposed differences in the tridentate pedicellariae prove to be inconstant. The pedicellariae on specimens of *gratilla* in the MCZ collection show great variation. The tridentate pedicellariae on the four Easter Island specimens that still carried them show that, although there is little variation on any single individual (4–6 samples were taken from each specimen), there is, on the other hand, great variation between specimens. Of the two complete specimens (MCZ 8331–8332), identical in other respects, one (MCZ 8331) has pedicellariae of the form that Mortensen (1943*a*, pl. 56, fig. 12) considered to be typical of *depressus*; the other has the form that Mortensen (1943*a*, pl. 56, fig. 11) considered to be typical of *gratilla*. The other two specimens (MCZ 8329–8330), which, as shown above, differ considerably in their macroscopic characters, proved to have tridentate pedicellariae of a form that Mortensen (1943*a*, pl. 56, fig. 6) found on *ventricosus* of the Atlantic Ocean.

The conclusion drawn from this study is that the three nominal species of *Tripneustes* cannot always be distinguished on the basis of the characters customarily employed.

Dr. Gooding reported (personal communication) of *Tripneustes gratilla* that "some were found on weed and rock patches beyond the coastal rocks of a small cove just north of the landing-place at Hanga-Roa in ca. 6 m. Some were also seen in the bay of Vaihu and it is abundant on weed bed of Ovahi Bay. All were dark-phase with orange spines. The gonads are relished as food locally."

FAMILY ECHINOMETRIDAE

Camarodont echinoids with shallow gill slits and the test without pits, grooves, or surface crenulations (epistroma). Valves of globiferous pedicellariae with a solitary side tooth below the end tooth.

Echinometra Gray, 1825

Test elliptical, long axis passing through amb I and interamb 3. Amb plates polyporous (3–10 geminate). Spines usually stout and pointed, not exceeding diameter of test in length except in some juvenile stages. Genus is pantropical.

Echinometra insularis H. L. Clark

Fig. 1*b*, 2

Synonymy

Echinometra insularis—Clark 1912: 374, Clark 1925: 143, Clark 1939: 17, Mortensen 1943*b*: 397, Downey 1968: 26.

Type Material

Echinometra insularis was described from Easter Island and Socorro Island by H. L. Clark (1912). The range was later extended to the Galápagos Islands (H. L. Clark 1925, A. H. Clark 1939).

While examining the specimen collected by M.E.T.E.I. (MCZ 8328) and specimens of *E. insularis* in the Museum of Comparative Zoology taken by the *Albatross*, I saw that a syntype

(MCZ 3985) from Scorro Island clearly did not match the Easter Island specimens; this syntype proved, in fact, to be *E. vanbrunti* A. Agassiz, 1863. Through the courtesy of Dr. D. L. Pawson of the Smithsonian Institution I have examined the Socorro Island syntypes of *E. insularis* held by that institution (USNM 32804, two specimens) and they proved to be *E. oblonga* (Blainville 1825). A specimen identified as *E. insularis* (USNM E5621) from the Galápagos turns out to be *E. vanbrunti*.

H. L. Clark (1948: 293) reporting on the *Velero III* echinoidea from the Central American Pacific did not find any *E. insularis* in the collections from Socorro and the Galápagos, as he had hoped he would. He then suggested that his species was not really valid.

It is now evident that the species which Clark (1912) described as *insularis* is endemic to Easter Island. I have no doubt that the Easter Island specimens of *Echinometra* comprise a distinct species, presenting a combination of test characters not found on either *E. oblonga*, *E. mathaei*, or *E. vanbrunti*.

H. L. Clark (1912) described the species from 28 specimens collected by shore parties from the *Albatross* at Socorro Island (1889) and Easter Island (1904). He did not state the number of specimens from either island, nor did he designate a holotype. Downey (1968) listed 17 syntypes deposited in the MCZ and USNM collections. Three of these (cited above) are from Socorro Island. The present repository of the remaining 11 syntypes is unknown.

Easter Island thus becomes the type locality for *Echinometra insularis*. Since there is no holotype, one of the two specimens in MCZ lot 3984 may be selected as a lectotype. One specimen in MCZ lot 3984 has been renumbered MCZ 8335, leaving the larger and sole remaining specimen as MCZ 3984, which is hereby designated the lectotype. All the other syntypes of *E. insularis*, therefore, become paralectotypes, though the specimens from Socorro Island are, of course, actually *E. oblonga* and *E. vanbrunti*.

Material Examined

Easter Island. MCZ 8328, Hanga-Roa, M.E.T.E.I. collection, 25 Feb. 1965, one specimen; MCZ 3984, shore party from *Albatross* collection, Dec. 1904, one specimen, lectotype: MCZ 4045, data as for MCZ 3984, two specimens, paralectotypes; MCZ 8335, data as for MCZ 3984, one specimen, paralectotype; DPK 11, from rocky crevices constantly wet by sea swells and spray, approximately 60 cm above sea level, G. R. Allen collector, 26 Jan. 1969, one specimen; DPK 12, data as for DPK 11, one specimen; DPK 13, shore near Hanga-Roa, J. E. Randall collector, 14 Feb. 1969.

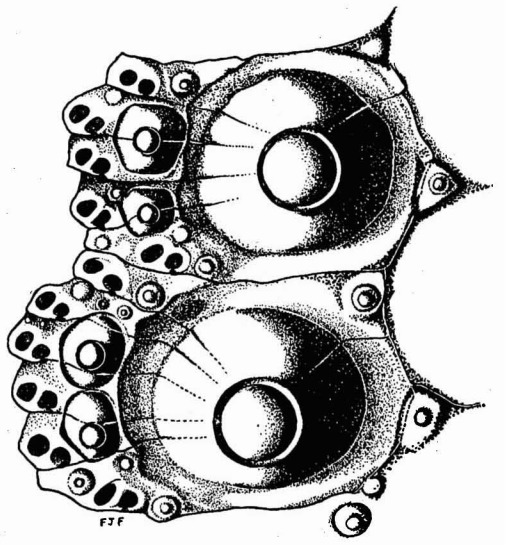

FIG. 2. *Echinometra insularis*: Aboral ambulacral plates from near ambitus, MCZ 3984, lectotype, height of illustrated portion 9 mm.

There is some confusion between *E. oblonga* and *E. mathaei*. These cannot be distinguished by characters of the test. Outwardly they present, in most instances, quite different appearances but there is much variation in these forms. Mortensen (1943*b*: 394) explained the situation succinctly and concluded that the overlap makes it impossible to consider the two forms to be separate species. D. P. Kelso (personal communication) has recently studied these *Echinometra*s in Hawaii (Oahu) and believes that they are separate species.

E. mathaei ranges from east Africa to Hawaii. *E. oblonga* has the same range, but also occurs at Socorro and Clarion islands off western Mexico and at Bindloe, South Seymour, and Albemarle islands in the Galápagos Archipelago. *E. vanbrunti* ranges from the Gulf of

California to Peru and at Socorro, Clarion, and the Galápagos islands.

Due to the confusion between the Pacific species of *Echinometra* a diagnosis of each is desirable.

Diagnosis of Echinometra insularis

Test well arched in adults, juveniles tending to be flatter. Usually five pore-pairs to each arc at the ambitus and 5–6 pore-pairs to each arc aborally (Fig. 2). Pore areas becoming irregular and difficult to trace below the ambitus. Adoral pore zone conspicuously widened. All oculars exsert.

Diagnosis of Echinometra mathaei

Test well arched. Four pore-pairs to each arc adorally (three extreme adorally), four or rarely five pore-pairs to each arc on ambitus and above. In *Echinometra mathaei* the pore arcs below the ambitus are regularly arranged and remain distinct, whereas in *E. insularis* this is not so. Pore zones scarcely widened adorally. All oculars exsert. Color white, reddish, or greenish. Spines tapered with white tips.

Diagnosis of Echinometra oblonga

Test as for *E. mathaei*. Color black. Spines stout, widened centrally.

Diagnosis of Echinometra vanbrunti

Test usually low, the oral and aboral sides somewhat flattened. Five to seven pore-pairs in the pore arcs adorally, six to eight pore-pairs to the arc aborally. In *Echinometra vanbrunti* the pore arcs are regularly arranged and distinct below the ambitus; in *E. insularis* they are not. Pore zones conspicuously widened on adoral side. Two oculars insert.

Remarks

Dr. John E. Randall and Gerald R. Allen collected 13 specimens of *Echinometra insularis*, which will be deposited in the Bernice P. Bishop Museum in Honolulu. One of these specimens (DPK 12) is a very light purple color instead of the usual dark purple. These light-colored specimens occurred with a frequency of about one in 200 (D. P. Kelso, personal communication).

Dr. Gooding reported (personal communication) that this species is very abundant in a number of localities all around the island. All were in holes in honeycomblike rock. They are said to be eaten. The local name is "eliso." The species occupies the intertidal zone and extends to a depth of ca. 2 meters.

Echinostrephus A. Agassiz, 1863

Test widest above circular ambitus. Aboral spines very long and slender. Amb plates 3–4 geminate. Blackish, tropical Indo-West-Pacific forms.

Echinostrephus sp. (probably *molaris*)

The presence of an *Echinostrephus* at Easter Island rests on the observations of Dr. Gooding (personal communication) who said, "It is common where *Echinometra insularis* is found but is usually subtidal, in places with slightly more protection. They lived in close-fitting, tubular holes 15–20 cm deep and have long sharp spines on the outer side. They are therefore relatively inaccessible and none were taken."

FAMILY ECHINONEIDAE

Test ovoid. Peristome sunken, oblique, and asymmetric. Living forms with pore zones straight and very narrow. Periproct on oral side posterior to peristome and longitudinally oval.

Echinoneus Leske, 1778

Pore zones slightly sunken.

Echinoneus cyclostomus Leske

Fig. 1*c*, *d*

Synonymy

Echinoneus cyclostomus—Leske 1778: 109, Gmelin 1778: 3183, Clark 1917: 102, Mortensen 1948*a*: 75 (complete synonymy).

Type Locality and Specimen

The species has been known since 1705. Leske (1778) is given credit as the first post-Linnaean author, but he cited earlier works. Neither

Leske or Gmelin (1778) gave any information on the sources of their material. The type locality is, therefore, unknown and Lovén (1887) apparently did not discover any type material.

Material Examined

MCZ 2669, Easter Island, *Albatross* shore party collection, Dec. 1904, one specimen: MCZ 4302, data as for MCZ 2669, one specimen.

Remarks

This species occurs in the Caribbean and in the tropical Indo-West-Pacific from east Africa to Hawaii and Easter Island. It is not known from west Africa, west Australia, or west America.

FAMILY CLYPEASTERIDAE

Sand dollars with five genital pores. Food grooves simple. Petals pseudocompound. Auricles separate. Contains one large and very diverse genus.

Clypeaster Lamarck, 1801

Clypeaster reticulatus (Linnaeus)

Fig. 1*e, f*

Synonymy

Echinus reticulatus—Linnaeus 1758: 666; *Clypeaster reticulatus*—Mortensen 1948*b*: 71 (complete synonymy).

Type Locality

Unknown (Lovén 1887: 174).

Type Specimen

Given by Linnaeus (1758) as "O. Americano," there being at the time confusion with the West Indian *C. rosaceus* (Mortensen 1948*b*: 78).

Material Examined

B6557, La Perouse Bay, Easter Island, 40–100 m., *Downwind* Station 76, dredge haul, 2 Feb. 1958, one specimen. Repository is the paleontological museum at the University of California at Berkeley.

FAMILY BRISSIDAE

Heart urchins with a peripetalous fasciole and a subanal fasciole.

Brissus Gray, 1825

Test ovoid. Frontal ambulacrum not petaloid, not conspicuously sunken, frontal edge of test not notched. Tubercles occurring at the frontal end of the test (interambs 2 and 3) larger than those over the rest of the test. Subanal fasciole complete, forming two lobes. Labrum wide and very short. Genus occurs in all tropical seas.

Brissus agassizii Döderlein

Fig. 3*a–d*

Synonymy

Brissus agassizii—Döderlein 1885: 108, Mortensen 1951: 520 (complete synonymy), Baker 1967: 239; *Brissus meridionalis*—Mortensen 1951: 522.

Type Locality

Enoshima, Sagami Bay, Japan.

Type Specimen

Döderlein (1885) obtained the two type specimens from a fisherman in 1881, but he did not indicate any repository. At that time he was curator of the Natural History Museum at Strassburg, Germany.

Material Examined

Two specimens collected by M.E.T.E.I.: MCZ 8334, rocky beach below campsite, Hanga-Roa, 24 Jan. 1965, one specimen; the other specimen, for which there are no data, is the property of Dr. G. Nogrady, University of Montreal. Also, MCZ 3901, 3264, Sagami Bay, Japan, Owston collector, Oct. 1901, four specimens; MCZ 7266, Lord Howe Island, H. L. Clark collector, April 1932, two specimens; MCZ 3106, Samoa, three specimens.

Remarks

The M.E.T.E.I. material is the first of the species from Easter Island. Both specimens

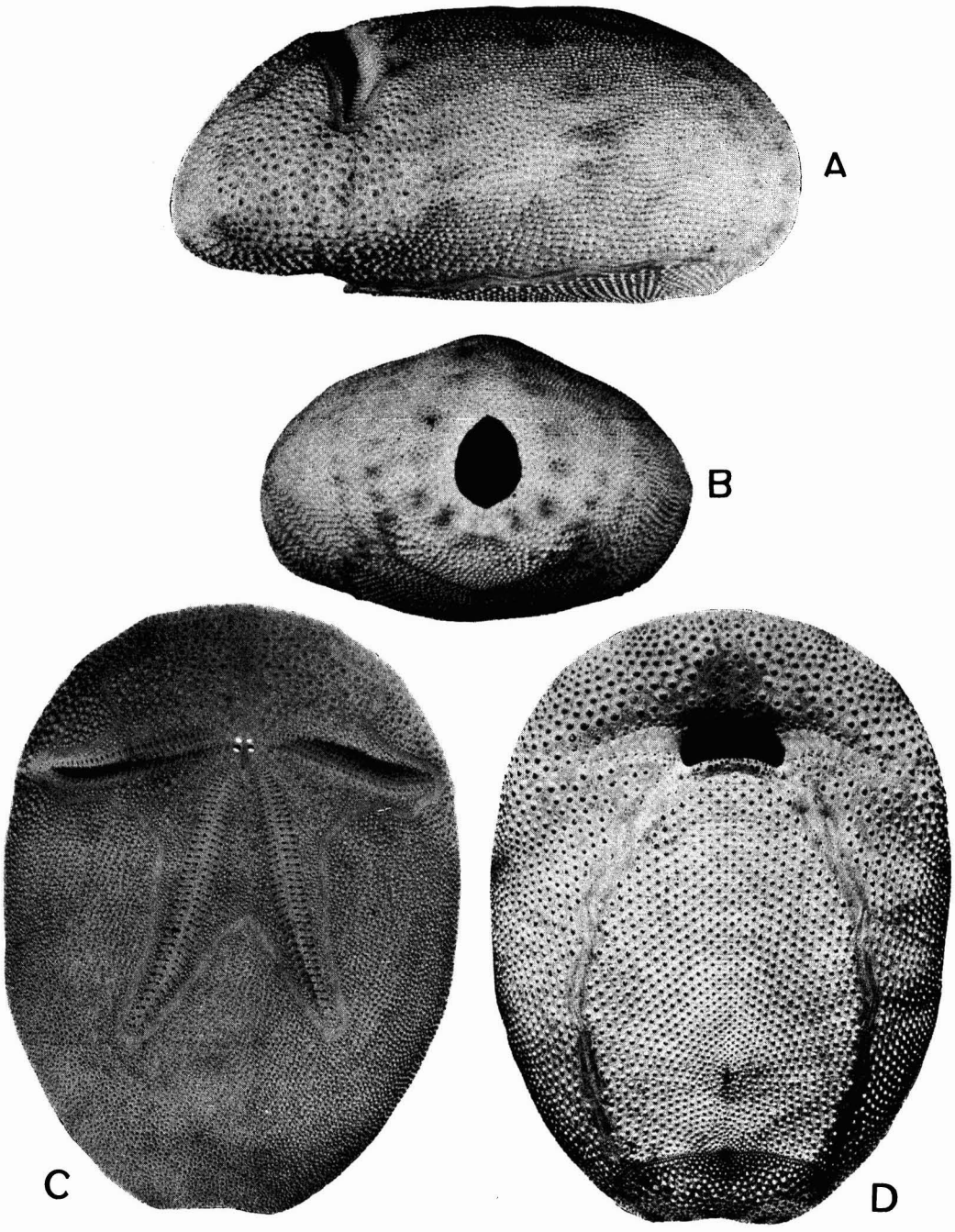

FIG. 3. *Brissus agassizii*: *A*, lateral aspect; *B*, posterior aspect; *C*, aboral aspect (photograph by R. H. Chesher); *D*, oral aspect; test length 83 mm.

are completely naked tests. Their dimensions are 83 mm (length) × 63 mm (width) × 40 mm (height, IA 5) and 56 × 43 × 29.

It is immediately evident that these specimens are not referable to the common Indo-West-Pacific species *B. latecarinatus*, because the posterior margin is vertically truncate, and the posterior interambulacra are only slightly carinate. *Brissus latecarinatus* is distinguished by a distinctly carinate posterior interambulacrum that conspicuously overhangs the periproct so that the posterior end of the test slopes towards the plastron, making the periproct fully and only visible from below.

Comparison of the Easter Island material with specimens of *Brissus* in the MCZ collection showed the larger specimen to resemble most closely *B. agassizii* from Japan. On the other hand, the smaller specimen appeared to be like *B. unicolor* of the Atlantic and now reported from the Pacific coast of Central America (Chesher 1972).

The absence of pedicellariae is unfortunate as *B. agassizii* differs from *unicolor* and *latecarinatus* in that the blade of the valves of the globiferous pedicellariae terminate in a slit bordered by long narrow teeth instead of terminating in a small opening surrounded by a number of small teeth, as is the case with *unicolor* and *latecarinatus*. This led Mortensen (1951) to establish the subgenus *Allobrissus* for *agassizii* and *meridionalis*.

A study was made on the tests of *B. agassizii* and *B. unicolor* to find a character of the test that would distinguish these two species. The tests of 16 of the more than 70 specimens of *unicolor* in the MCZ collection and another five recently collected from the Atlantic coast of Panama by Dr. R. H. Chesher and lent to me for this study, were measured and checked for 31 characteristic dimensions and features. By this the amount of variation of each character was determined. These data were then combined with unpublished data of the same characters previously determined by Dr. Chesher from another 40 specimens of *unicolor*. The same measurements were made on specimens of *agassizii* from Japan (MCZ 3901, 3264), two specimens labelled *B. meridionalis* (MCZ 7266) from Lord Howe Island, and three small, denuded specimens of *Brissus* (MCZ 3106) from Samoa labelled *B. latecarinatus*. These Samoan specimens were obviously not *latecarinatus*, being indistinguishable from *unicolor*.

A comparison of the data from the Pacific with the means and standard deviations of the data from the Atlantic confirmed what was already evident from examination of the specimens, namely that the juveniles of *agassizii* and *unicolor* are too similar to permit reliable identification from the tests alone if the test is less than 60 mm in length. Even in the adults there is little to rely on, as the amount of variation is considerable. The specimens available to me and the illustrations in Mortensen's monograph (1951) seem to show that features such as relative height, degree of carination, and relative position of the apical system in *agassizii* and *unicolor* disclose no consistent difference between the two species. A distinction is found in the petals. The petals are more slender in *agassizii* and comprise 10–15 percent more pore-pairs than do petals of *unicolor* of a corresponding size. In these respects the Easter Island species matches *agassizii*.

Mortensen (1951) defined *B. meridionalis* on the basis of a form of *Brissus* (*Allobrissus*) living off New South Wales, Australia, and at Norfolk Island. It differs from *agassizii* in the shape of the test and in the shape of the pedicellariae. Specimens of *Brissus* (*Allobrissus*) subsequently found off northern New Zealand (Baker 1967) have pedicellariae that combine features of both *meridionalis* and *agassizii*. This led Baker to consider *meridionalis* as being identical to *agassizii*. The evidence available to me supports Baker. It is clear from the specimens of *agassizii* and *meridionalis* in the MCZ collection and from the illustrations in Mortensen's monograph (1951) that the differences in the shape of the test pointed out by Mortensen (1951) are inconstant. Also, Mortensen found that *meridionalis* has large rostrate pedicellariae with long slender valves, but he did not find this form of rostrate pedicellariae on *agassizii*. This he considered to provide a major difference. However, this large slender form of rostrate pedicellariae was found on two specimens of *agassizii* in the MCZ collection from Sagami Bay, Japan.

The occurrence of *B. agassizii* in Japan and Australasia and at Easter Island makes it very probable that the three specimens of *Brissus*

from Samoa (mentioned above) are also *agassizii*, and doubtless some specimens of this species are in major world's collections incorrectly labelled *B. latecarinatus*. *B. agassizii* may also be known from a Miocene fossil from southern Persia (Kier 1972: 101).

ZOOGEOGRAPHY

1. The echinoid fauna of Easter Island is of Indo-West-Pacific origin. *Tripneustes gratilla* is represented at Easter Island both by the typical central Pacific form and also by a form, known only from Easter Island, characterized by the heavily plated peristome. *Echinoneus cyclostomus* has a pantropical distribution. *Brissus agassizii* is evidently more widespread than previously thought, as is indicated by its occurrence in Japan, Australasia, Samoa, and Easter Island. *Diadema savignyi*, *Clypeaster reticulatus* and *Echinostrephus* are typically Indo-West-Pacific.
2. A significant fact is the absence of obvious west American affinities. *Echinometra insularis*, hitherto thought to range the east Pacific—from Easter Island to Socorro and the Galápagos—is, in fact, restricted to Easter Island, as shown in this paper. This endemic echinoid, in all probability, evolved from *Echinometra oblonga*, a species with a very wide Indo-Pacific range from east Africa to Clarion and Socorro islands off western Mexico, and to the Galápagos Islands.
3. The evidence thus far is that the Easter Island echinoid fauna is derived only from species that have, or have had, an effective means of crossing ocean gaps. The species so far known are probably only a representative sample of the echinoid fauna of Easter Island. The island has not been thoroughly collected in the past, as is indicated by the fact that such a large species as *T. gratilla* was not found until 1965. Offshore samples have not been taken. Genera that may yet be found at Easter Island are *Phyllacanthus*, *Eucidaris*, *Echinothrix*, *Heterocentrotus*, *Spatangus*, *Brissopsis*, and *Metalia*. The species *Echinometra oblonga* and *Brissus latecarinatus* may well prove also to occur at Easter Island.

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