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Echinoderms from the Cocos-Keeling Islands

By AUSTIN H. CLARK¹

Plate No. 15.

So far as I know, the only echinoderms recorded from the Cocos-Keeling Islands are *Stephanometra spicata*, of which there is a specimen in the British Museum collected by Dr. Frederic Wood-Jones (A. H. Clark, 1912, 1913, 1941), and the common and widely distributed *Echinometra mathaei*, represented in the British Museum by a specimen labeled simply "Cocos Keeling Islands" (H. L. Clark, 1925).

The very extensive collection made by Dr. C. A. Gibson-Hill in 1941 includes, exclusive of the Holothuroidea and the Asteroidea of the family Linckiidae, 30 species—15 sea-urchins, 3 crinoids, 4 starfishes, and 8 brittle-stars. Dr. Gibson-Hill's collection is unique in being accompanied by extensive and detailed notes of great interest and value.

Most of the species represented in the collection are wide-ranging Indo-Pacific types found from east Africa to Polynesia. Those with a more restricted range indicate an affinity with the Sunda Islands and the regions farther east. Among the echinoids, *Metalia dicrana* was not previously known from west of the Philippines. In the crinoids, *Stephanometra indica protectus* occurs as far west as Ceylon and the Maldiv Islands, being replaced by *S. i. indica* farther westward and also in northeastern Australia. *Stephanometra spinipinna* was previously known from Borneo south to the Moluccas and the Kei Islands. Among the starfishes, *Othilia luzonica* is an eastern form extending to the Marshall Islands, closely related to *O. purpurea* of the western Indian Ocean.

It is interesting to compare the echinoderm fauna of the Cocos-Keeling Islands with what we know of that of Christmas Island farther east. Common to both localities are *Echinothrix diadema*, *Echinometra mathaei* (including *picta*), *Heterocentrotus mammillatus*, *Ophiocoma scolopendrina*, *O. erinaceus*, and *Ophiomastix annulosa*.

Reported from Christmas Island but not represented in the collection from the Cocos-Keeling Islands are *Echinometra mathaei* var. *oblonga*, *Colobocentrotus atratus*, *Ophioplocus imbricatus*, *Comissia pectinifer*, and *Lamprometra palmata*.

Of special interest is the occurrence of *Colobocentrotus atratus* on Christmas Island. This could scarcely be overlooked

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if it occurred in the Cocos-Keeling group. The distribution of this conspicuous species is extraordinarily erratic. *Comissia pectinifer*, originally described from Christmas Island, is otherwise known only from the Kei Islands. *Lamprometra palmata* is one of the commonest littoral crinoids, ranging from Baluchistan to the Hawaiian Islands; it should occur in the Cocos-Keeling group. *Echinometra mathaei* var. *oblonga* probably will be found in the Cocos-Keeling islands; it is more of a rock-borer than the typical form and thus is likely to be overlooked. *Ophioplocus imbricatus* probably occurs, but it is very secretive and seldom common.

The native names of the species listed, and the notes on the colours in life, habitats and other features given in this paper were provided by Dr. Gibson-Hill. It is seldom that a collector will take the trouble to provide extensive information of this sort, and all students of the Indo-Pacific echinoderms will be deeply appreciative of his contributions.

ECHINOIDEA

Family CIDARIDAE

Eucidaris metularia (Lamarck).

This urchin, which is not very common, has no local name. It is found under masses of dead coral in the shallow pools lying, at low tide, over both the inner and middle portions of the barrier.

The colour in life, irregularly blotched with dark brown, dull maroon brown, and off-white.

The specimens sent were taken in the neighbourhood of Pulo Pasir.

Family DIADEMATIDAE

Diadema savignyi Michelin.

The Cocos-Keeling Islanders call this urchin Jarum-jaruman Alus and Jarum-jaruman Panjang. The Jarum-jaruman Alus, the immature individuals, may occur in exposed situations, but the smaller individuals, at least, are always sheltering under jumbled fallen fragments of dead coral. These younger individuals are fairly common on the inner side of the barrier, in the shallow pools which are left at low tide.

The colour is jet black with a thin blue-green neon-like line on the aboral surface of the test. The primary spines are off-black with white or off-white rings.

The Jarum-jaruman Panjang, or fully developed individuals, occur in places similar to those favoured by the Jarum-jaruman Alus—in sheltered positions among the coral rock bordering some of the pools over the inner portion of the barrier—but they are much less plentiful.

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The colour is entirely jet black except for the thin bright blue-green line.

The specimens seen were taken in the neighbourhood of Pulo Bêras.

Echinothrix calamaris (Pallas).

This urchin is known on the atoll as Jarum-jaruman Bêlang, a name also applied to certain varieties of *E. diadema*. The individuals called by the natives Jarum-jaruman Bêlang are very dark green, almost black, or even pure black, with broad paler, almost white, bands around the primary spines. In the water they have a distinct greenish sheen. In some of the larger individuals the rings on the primary spines are very faint, and the urchin then becomes almost identical in appearance with *E. diadema*.

On the Cocos-Keeling Islands this species, which is common, occurs in holes and crevices and under masses of coral in the pools over the outer portions of the barrier but, unlike *E. diadema*, it does not appear to be found on its seaward edge.

The specimens seen are from the neighbourhood of Pulo Bêras and Pulo Pasir.

In a specimen found in a cavity in coral rock at the edge of a broad shallow pool near the middle portion of the barrier in the neighbourhood of Pulo Bêras the fine ambulacral spines are a light olive brown, and the blunt primary spines are dull maroon ringed equally with white. When the animal was alive the test was a dull sea-weed brown.

A specimen taken under a coral overhang in a shallow pool in the middle of the barrier near Pulo Gangsa had the test and fine ambulacral spines appearing black. The larger and stouter spines of one or two rows on either side of the ambulacra were white, while the similar spines in the centre of the triangle appeared black faintly banded with dark olive green. The anal opening was large and distorted.

This species is commonly confused with the following. In *Echinothrix calamaris* the long primary spines are verticillate, bearing a series of whorls of spinelets, and the colour is usually more or less green. In *E. diadema* the long primary spines carry numerous fine longitudinal ridges instead of whorls, and there is no green in the colour, except sometimes a greenish tinge on the spines.

Echinothrix diadema (Linné).

When fully grown this urchin, like *Diadema savignyi*, is known as Jarum-jaruman Panjang. It occurs in sheltered cracks and crannies among the coral rock on the borders of the pools along the outer edge of the barrier and over certain of the seaward sections of the barrier flats.

In colour it is entirely jet black.

Young individuals, confused with *E. calamaris*, are called Jarum-jaruman Bêlang.

The specimens were taken in the neighbourhood of Pulo Tikus.

On the Cocos-Keeling Islands a dull crimson-purple crab is frequently found in the anal opening of this species which, when the crab is large, may be distorted to accommodate it. Several of the specimens I examined had evidently harboured this crab. At Mauritius Dr. Th. Mortensen found some individuals of this species infested by a small parasitic crab which lived in the rectum. He identified the crab as *Eumedonus convictor*. It is rather curious that no parasitic crabs have been found in *E. calamaris*.

Family TEMNOPLEURIDAE

Mespilia globulus (Linné).

This species, known as Terong-terong Hitam, lives in shallow sandy areas among weeds and coral fragments toward the south end of the lagoon. It is frequently left dry or partially dry at low tide.

The colour is entirely black, both of the test and of the spines. This species is highly variable in colour. Most commonly the test has the tuberculated portion more or less reddish contrasting sharply with the dark olive or nearly black non-tuberculated parts, and the spines reddish or greenish banded with white.

The specimens were taken in the neighbourhood of Pulo Atas and Pulo Pandan, where the species is very common.

Family TOXOPNEUSTIDAE

Toxopneustes pileolus (Lamarck).

On the Cocos-Keeling Islands this species is abundant in shallow water in the northeast corner of the lagoon between Pulo Tikus and Pulo Selma. It occurs over broad flat areas of almost unbroken sand which are usually partially uncovered at low tide. Frequently the individuals collect small coral fragments around and cover themselves so that when left dry they are like miniature cairns. Presumably this is for protection against the glare of the sun.

The general colour of this urchin when alive is vague and indecisive, being a blurred mixture of that of the tube feet, which are purple with a white edge, the pedicellariae, which are a mid-grey, and the blunt spines which are light red at the base with the outer half green and the tip white. No bare area on the test is visible.

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Dr. Th. Mortensen wrote that the small globiferous pedicellariae are exceedingly characteristic of this genus and give the individuals a most beautiful appearance. "The fact that the basal part of the valves is often bright purple increases their resemblance to small flowers, and it looks, indeed, as if the whole animal is covered by a dense bed of small flowers, the short spines being almost completely covered by them. These "flowers" are, however, not meant to attract any animal, but to warn them not to touch, as they are exceedingly poisonous."

Dr. Gibson-Hill says that the large globiferous pedicellariae, which are fairly numerous, are armed with three points set in a triangle about 4 mm. apart. Once they have gained a grip on the skin it is difficult to dislodge them. While inserted they are most painful. Even after they have been removed the area remains tender for several weeks, and may continue to produce, and to shed, callosities like small corns for two or three months. The Malays are much afraid of them and will not handle this species under any circumstances.

According to Professor Torsten Gislén the Japanese greatly fear this species. It is said that even death may result from being stung by these urchins.

Dr. Tsutomu Fujiwara wrote that when he handled with his bare hands a specimen of this urchin seven or eight pedicellariae stubbornly attached themselves to the side of one of his fingers. "Instantly I felt a severe pain resembling that caused by the cnidoblasts of Coelenterata, and I felt as if the toxin were beginning to move rapidly in the blood vessel from the stung area toward my heart. After a while I experienced a faint giddiness, difficulty of respiration, paralysis of lips, tongue and eyelids, relaxation of muscles in the limbs, was hardly able to speak or control my facial expression, and felt almost as if I were going to die. About fifteen minutes afterwards I felt that pains gradually diminished and after an hour they disappeared completely. But the facial paralysis like that caused by cocaine intoxication continued for about six hours."

This species is called Terong-terong Lebar. The specimens examined, which are up to 115 mm. in diameter with a height of 52 mm., were taken in the neighbourhood of Pulo Gangsa.

Tripneustes gratilla (Linné).

In the Cocos-Keeling islands this species, known as Terong-terong Bulat, has the same habits and distribution as *Toxopneustes pileolus*. In life the bare areas of the test are dark purple or black; the band about the base of the spines is white or off-white, and the spines themselves are white, white and rust brown, or entirely rust brown. One bare test is pure white with the bare ambulacral and interambulacral areas pale lavender.

The specimens examined were taken in the neighbourhood of Pulo Gangsa.

Family PARASALENIIDAE

Parasalenia gratiosa A. Agassiz.

This species, which has no local name, was found to be abundant among the stems of the thick masses of coral, mostly Karang Jahe Hitam, which form the shallow coral patches toward the south end of the lagoon. It does not appear to occur anywhere else in the islands. There are two colour patterns. In one the test is very dark grey, almost black, and the spines are full black. In the other the test is very dark maroon grey with the spines mauve or mauve-grey. In both the milled ring is white and very prominent.

The four specimens examined have the following dimensions

	—	1	2	3	4
		mm.	mm.	mm.	mm.
Length	27	25	25	23
Width	22	20	21	18
Spines	23	29	26	28

Family ECHINOMETRIDAE

Echinometra mathaei (de Blainville).

Dr. Gibson-Hill says that this species is very variable in colour. In all the colour forms the test appears a dark brown, almost black, but the Malays recognize four different colourations of the spines. These are Dëlimah, in which the spines are almost white at the base and rise to a delicate lilac or mauve-pink at the tip; Kuning, in which they are light olive or olive-yellow at the tip, dropping nearly to white at the base; Biru (here used for brown), in which they are slightly, or richly, reddish brown at the tip and paler, or off-white, at the base; and Këlabu, in which they are a dull purplish grey, only very slightly paler at the base. Although these are the commonest, there are other indefinite intermediate colourations. The name for the species as a whole is Jarum-jaruman Pëndek.

This species, which is very common, is found in small holes among the coral boulders, just below the low tide level, over the greater part of the barrier. There are frequently small clusters of about half a dozen in one place.

The specimens examined were taken in the neighbourhood of Pulo Bëras and on the barrier between Pulo Atas and Pulo Bëlanchi.

Heterocentrotus mammillatus (Linné).

This species, which is quite common and is known as Isapisapan, occurs in cracks and crevices among the coral bordering the pools on the inner portions of the barrier. It is never left dry at low tide.

The primary spines are brick red with the basal ring paler or even white, and from one to four slightly paler rings near the distal end. The secondary spines are either dark red-brown, almost black, or of the same colour as the primaries, or a pale pinkish red, almost white.

The specimens seen were taken in the neighbourhood of Pulo Bêras.

Family CLYPEASTRIDAE

Clypeaster reticulatus (Linné).

This species is called Terong-terong Pasir. No living individuals were seen, but the long dead bleached tests could be found, with but little search, on a number of beaches inside the lagoon from Pulo Bêras to Pulo Atas, usually in company with those of the species of *Metalia*.

Family ECHINONEIDAE

Echinoneus cyclostomus Leske.

This little species has no local name. It has a light, slightly pinkish, ground colour, with the ambulacral grooves outlined in dark grey. The two living specimens were found in a cavity in corai rock on the outer edge of the barrier near Pulo Gangsa. No others were seen. A single bleached test was also picked up on the shore of Pulo Bêras.

Family SPATANGIDAE

Metalia sternalis (Lamarck).

The single specimen is 115 mm. long and 100 mm. broad.

The species is easily distinguished from the two following by having the two posterior petals confluent in the proximal third with the distal two thirds strongly curved outward. The few spines that remain attached to the test are pure white.

Metalia spatagus (Linné).

The local name Terong-terong Chuchut given by Dr. Gibson-Hill probably covers all three species of *Metalia*, which look very much alike, especially when alive.

He says that this urchin (possibly referring chiefly to *M. dicrana*) is very plentiful in shallow water all down the east side of the lagoon, from Pulo Bêras to Pulo Atas, wherever there are broad flat areas of almost unbroken sand. It occurs about, or a little below, the low tide mark, and when alive is always found burrowing beneath the surface of the mud.

Since all the specimens of *M. dicrana* were bleached tests, and the single specimen of *M. sternalis* had white spines, his colour notes presumably refer to this species, a large, unfortunately broken, specimen of which was evidently captured alive. He noted that the spines, which entirely cover the test, are a good mid mouse-brown.

Metalia dicrana H. L. Clark.

Plate 15

Of the six specimens of this species examined all are bare tests, and five are more or less deformed. The measurements of the six specimens are as follows:—

Specimen No.	1	2	3	4	5	6
Length of test	63	82	77	71	61	65
Maximum width	57	73	68	60	54	61
Height at middle where highest ¹	42	51	a	50	a	a
Height at apical system ..	39	44	47	44	40	40
Distance between apical system and anterior end	9	23	20	12	9	14
Length of anterior petals	25	26	27	22	22	18 22
Length of posterior petals	30	29	32	30	25	25 9
Length of plastron	32	38	36	28	27	32
Width of plastron	25	33	33	24	23	26
Height of periproct	13	14	15	11	11	15
Width of periproct	10	12	10	8	7	10
Length of peristome	5	8	6	6	6	6
Width of peristome	12	15	15	12	11	11

1. a. Highest at apical system.

ECHINODERMS FROM THE COCOS-KEELING ISLANDS

No. 1. A specimen with the apical system displaced anteriorly.

No. 2. A normal specimen.

No. 3. A specimen with the apical system anterior and elevated.

No. 4. A specimen with the apical system close to the anterior border of the test; the anterior end slants downward and inward, parallel with the anterior petals.

No. 5. A specimen similar to No. 4.

No. 6. In this specimen the right anterior petal is longer and broader than the left, and the right posterior petal is absent except for a short terminal portion; the apical system is displaced toward the right.

Metalia dicrana was described by Dr. Hubert Lyman Clark in 1917 from a specimen 58 mm. long that had been collected at the island of Panglao, Bohol Province, Philippines, by Dr. Carl Semper and received at the Museum of Comparative Zoology in 1873. At the same time he figured the test of a second specimen 61 mm. long collected at Thuvu (or Thuva) Harbour, Viti Levu, Fiji, by Mr. Alexander Agassiz or one of his party in 1897. He also recorded a third specimen 40 mm. long collected by Semper in the Pelew (Palao) Islands. In 1925 he recorded another from Samoa.

In the collection of the United States National Museum there are two bare tests without data 55 and 51 mm. long.

Apparently this is a small species, as specimen No. 2 in the above list is the largest yet recorded, while all except No. 5 are larger than any previously known.

The most obvious differences between *M. spatagus* and *M. dicrana*, apart from the much smaller size of the latter, are the following. In *M. spatagus* the tuberculated portion of the ventral plastron is more than twice as long as broad, whereas in *M. dicrana* the width is more than 87 per cent of the length. In *M. spatagus* a single low ridge with a hump in the middle runs from the lip forming the posterior border of the peristome to the subanal plastron; in *M. dicrana* the ridge forks at the central hump, two diverging ridges running to the subanal plastron which they meet at two points about 6 mm. apart. In *M. spatagus* the two anterior petals make an obtuse angle with each other, and the two posterior petals curve outward in the distal third; in *M. dicrana* the two anterior petals lie in the same straight line and the posterior petals are straight.

Both *M. spatagus* and *M. dicrana* are readily distinguished from *M. sternalis* by having the posterior petals separate for their whole length, these in *M. sternalis* being confluent in the inner third.

AUSTIN H. CLARK

CRINOIDEA

Crinoids are rare on the accessible portions of the Cocos-Keeling Islands and occur only on the outer section of the barrier between Pulo Bēras and Pulo Selma. They are not known to the Malays, who have no name for them. They were all found under coral boulders in a habitat similar to, though nearer the sea than, that of the ophiurans.

Family MARIAMETRIDAE

Stephanometra spinipinna (Hartlaub).

The single specimen was in life a light greyish mauve with greyer reticulations at the arm bases, rising rapidly about half way along the arms to full black.

Stephanometra spicata (P. H. Carpenter).

Three of the six specimens resembled the preceding in colour. Two were off-black with a light grey band about two brachials long half way out on each arm. One was greyish fawn at the base of the arms rising to a full ochreous yellow at the tips, with a black band about half way out on each arm.

This species was recorded from the Cocos-Keeling islands in 1913 on the basis of a specimen in the British Museum collected by Dr. Frederic Wood-Jones.

Stephanometra indica protectus (Lütken).

This small specimen was a light yellow brown on the disc, with the arms marked with bands of dirty white and dark brown three-eighths of an inch wide.

ASTEROIDEA

Most of the starfishes in the present collection, 141 specimens, belong to the family Linckiidae. As Dr. H. Engel of Amsterdam is engaged in monographing this family for publication in the reports of the "Siboga" expedition the specimens were sent to him to study in connection with his rich material from the Indo-Malayan region. He will prepare a special report on those from the Cocos-Keeling Islands.

Family OREASTERIDAE

Culcita novae-guineae var. *grex* Müller and Troschel.

The two specimens examined are nearest the variety *grex*, differing only in having the tubercles of the aboral surface coarser and those on the oral surface less crowded and on the inner and adradial portions of the interambulacral areas more or less widely separated by granules.

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ECHINODERMS FROM THE COCOS-KEELING ISLANDS

Dr. Gibson-Hill notes that this species is called Buntal Karang. It is a deep grey-purple on the aboral surface and a light fawn-yellow on the oral, with a deep rose-red blush along the ambulacral grooves. It is found among coral rocks near the low tide level over the outer portions of the barrier. It is nowhere common, but it is most plentiful at the south end of the atoll. The specimens were taken between Pulo Atas and Pulo Bèlanchi.

Family ECHINASTERIDAE

Othilia luzonica Gray.

This starfish is found under coral boulders and fragments of dead coral over the inner portions of the barrier. It is not very common, but it is most plentiful at the north-east corner of the atoll. It has no specific local name. It usually has six or seven rays and is known to the Malays as Kaki Unum or Kaki Tujoh, according to the number.

The two specimens examined, one with six and one with seven rays, were taken in the neighbourhood of Pulo Gangsa.

Family ACANTHASTERIDAE

Acanthaster planci (Linné).

This starfish, the Makanan Kong of the natives, which may reach a diameter of over a foot, is very conspicuous on the atoll, but not very common. It occurs among coral rocks near the low tide level over the centre and outer portions of the barrier. It is most plentiful on the north and east coasts of the atoll. According to the Malays it feeds on a gastropod, *Cassis cornuta*, known locally as Siput Kong. Most Makanan Kong have 17 arms, but the number is variable.

The colour is variable. Basically the dorsal surface is a dull mid-grey, but the greater part of it, except the tips of the arms, is covered by expansile patches. When these are contracted they are grey, but when fully extended they range from madder purple to a rich crimson. The tube feet are a very light, slightly greyish, yellow.

The specimens studied were taken in the neighbourhood of Pulo Bèras.

Family MITHRODIIDAE

Mithrodia clavigera (Lamarck).

This species has no specific local name. One of the two specimens was found under a boulder of coral rock near the extreme outer edge of the barrier, between Pulo Gangsa and Pulo Selma. It was a dull brick red mottled with black, like patches of mildew.

The larger of the two specimens had the rays 200 mm. long.

OPHIUROIDEA

Family OPHIOTRICHIDAE

Ophiothrix longipeda (Lamarck).

The local name of this species is given as Ular Babi Kêlabu. Dr. Gibson-Hill says that it is found under coral rock and dead coral in the shallow sandy pools near the middle of the barrier and appears to be restricted to the north-east corner of the atoll. Though usually solitary, it may occasionally be found in company with *Ophiocoma insularia* var. *variegata* or *O. scolopendrina*. It is not common.

Some of the individuals are slightly paler than mid-grey with the arms ringed, fairly regularly, two or three arm plates to each colour, with pale grey and mid-grey. Other individuals are a fairly uniform mid-grey with slightly paler rings of two or three plates and the attached spines on the arms.

All the specimens seen were taken in the neighbourhood of Pulo Bêras. The largest has the disk 25 mm. in diameter and the arms 472 mm. long.

Family OPHIOCOMIDAE

Ophiocoma scolopendrina (Lamarck).

The native name for this species is Ular Babi Hitam. Dr. Gibson-Hill notes that it is jet black and says that it is abundant all over the outer portions of the barrier. It can be found in cracks and crannies of the coral rock almost as far up as the high tide level where many individuals are left uncovered at low water, and under stones and fragments in the shallow pools. In the latter situation it is definitely gregarious, and he has found as many as twenty under a single boulder.

The specimens are from the neighbourhood of Pulo Tikus and Pulo Bêras.

Ophiocoma erinaceus Müller and Troschel.

This species has no specific local name. It is jet black, but with bright red tentacles which give the ventral surface a slightly reddish appearance. It is fairly common under stones and coral boulders over the same areas of the barrier as *O. scolopendrina*.

Ophiocoma pica Müller and Troschel.

This species, which has no local name, is not common, and Dr. Gibson-Hill found it only under boulders and coral fragments toward the outer area of the barrier, on the limited stretch between Pulo Tikus and Pulo Bêras. He says that the spines are grey-purple; the arms and disc are black with neat light yellow

rings around the bases of the spines on alternate segments which occasionally unite to form a thin bar completely across the dorsal surface of the segment, and thin radial lines of the same colour across the disk.

Ophiocoma insularia var. *variegata* E. A. Smith.

This ophiuran, called by the natives Ular Babi Kuning, appears to be restricted to the north and east coasts of the atoll. It is fairly common in the same habitat as *Ophiomastix annulosa*, being found under stones and fallen coral in the shallow pools over the middle portions of the barrier. The individuals are usually solitary, though they may be found with *O. erinaceus*.

Typically the dorsal surface of the disc is buff with a series of fine black lines marking it out as though it were a drawing of pebbles on a beach, or forming a regular reticulation, each light area being from 0.75 to 1 mm. in diameter. The arms are buff with about every sixth, or sixth and seventh, upper arm plate black. In some individuals the lines on the disc are coarser and more of the arm plates and their attendant spines are black. In a small individual there is an irregular black ring around the disc about 1 mm. from the edge. This is the colour variety *dentata* Lütken.

In some specimens the disc is fawn-brown speckled with fine pin-point black dots. The arms rather resemble those of the darker individuals of the preceding colour type, having three or four fawn-brown plates and then two or three black ones. This colour form, *döderleini* de Loriol, is a little less plentiful than the other.

The specimens examined are from the neighbourhood of Pulo Bêras and Pulo Pandan.

Ophiomastix annulosa (Lamarck).

This species, which is called Ular Babi Merah by the Malays, is fairly common. It is found mostly under stones and fallen coral in the shallow pools over the middle portions of the barrier. It appears to be gregarious, and as many as six or eight may be seen under one stone, while no other can be found within a radius of twenty feet.

The spines are white with grey rings and the remainder of the dorsal surface is a light reddish brown with darker, richer, reticulations. Dr. Gibson-Hill says that in the water it is most attractive, appearing a soft brown-pink surrounded by a delicate grey fringe.

A very small and young individual probably of this species from the neighbourhood of Pulo Gangsa, found in company with large individuals and also *Ophiothrix longipeda*, had the centre of the dorsal surface of the disc dull crimson and the arms white.

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The large specimens are all from the neighbourhood of Pulo Bēras.

Dr. Gibson-Hill says that this species also occurs on Christmas Island, where it is not very plentiful.

Ophiarthrum elegans Peters.

A single individual of this species was found under a large piece of dead Karang Jahe China toward the outer portion of the barrier in the neighbourhood of Pulo Bēras. It was dark grey-brown on the disc with the arms white and the spines lightly ringed with grey-brown.

Family OPHIODERMATIDAE

Ophiopezella spinosa (Ljungman).

This little species is fairly plentiful under boulders and coral fragments over the outer half of the middle zone of the barrier, but only on the south and east coasts of the atoll. It may be found in company with *Ophiocoma scolopendrina* or *O. insularia* var. *variegata*.

In colour it is a very light biscuit-colour with the bands on the arms a light fawn-grey.

Bibliography

- CLARK, AUSTIN H. 1911. A new unstalked Crinoid from Christmas Island. *Ann. and Mag. Nat. Hist.* (8), vol. 7, pp. 644-645, 1911.
p. 644, *Comissia pectinifer*, sp. nov., Christmas Island [H.M.S. *Flying Fish*, 1886].
- . 1912. Crinoids of the Indian Ocean. *Echinoderma of the Indian Museum, Part VII, Crinoidea*, pp. i-iii, 1-325, figs. 1-61. Calcutta, 1912.
p. 78, *Comissia pectinifer* (record of 1911).
p. 133, *Stephanometra tuberculata* (= *spicata*), Cocos Island [Dr. Frederic Wood-Jones].
- . 1913. Notes on the Recent Crinoids in the British Museum. *Smithsonian Miscell. Coll.*, vol. 61, No. 15, pp. 1-89, 1913.
p. 6, *Comissia pectinifer* (records of 1911 and 1912).
p. 28, *Stephanometra tuberculata* (= *spicata*) (record of 1912).
- CLARK, HUBERT LYMAN. 1925. A Catalogue of the Recent Sea-Urchins (Echinoidea) of the British Museum (Natural History), pp. i-xxviii, 1-250, pls. I-XII, 1925.
p. 45, *Echinothrix diadema*, Christmas Island, [C. W. Andrews].
p. 144, *Echinometra mathaei*, Cocos Keeling Islands; Christmas Island [C. W. Andrews].
p. 145, *Podophora* (= *Colobocentrotus*) *atrata*, Christmas Island [C. W. Andrews].

ECHINODERMS FROM THE COCOS-KEELING ISLANDS

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CLARK, AUSTIN H. 1929. On some Recent Crinoids in the collection of the British Museum. Journ. Linn. Soc. (Zool.), vol. 36, No. 249, pp. 635-664, pls. 40-44, 1929.
 p. 636, *Comissia pectinifer*, Flying Fish Cove, Christmas Island, C. W. Andrews.
 p. 641, *Lamprometra palmata*, Flying Fish Cove, Christmas Island, C. W. Andrews.

———. 1931. A Monograph of the Existing Crinoids, Bull. 82, U.S. National Museum, vol. 1, Part 3, pp. i-vii, 1-816, pls. 1-82, 1931.
 p. 255, *Comissia pectinifer*, Christmas Island (records of 1911 and 1929).

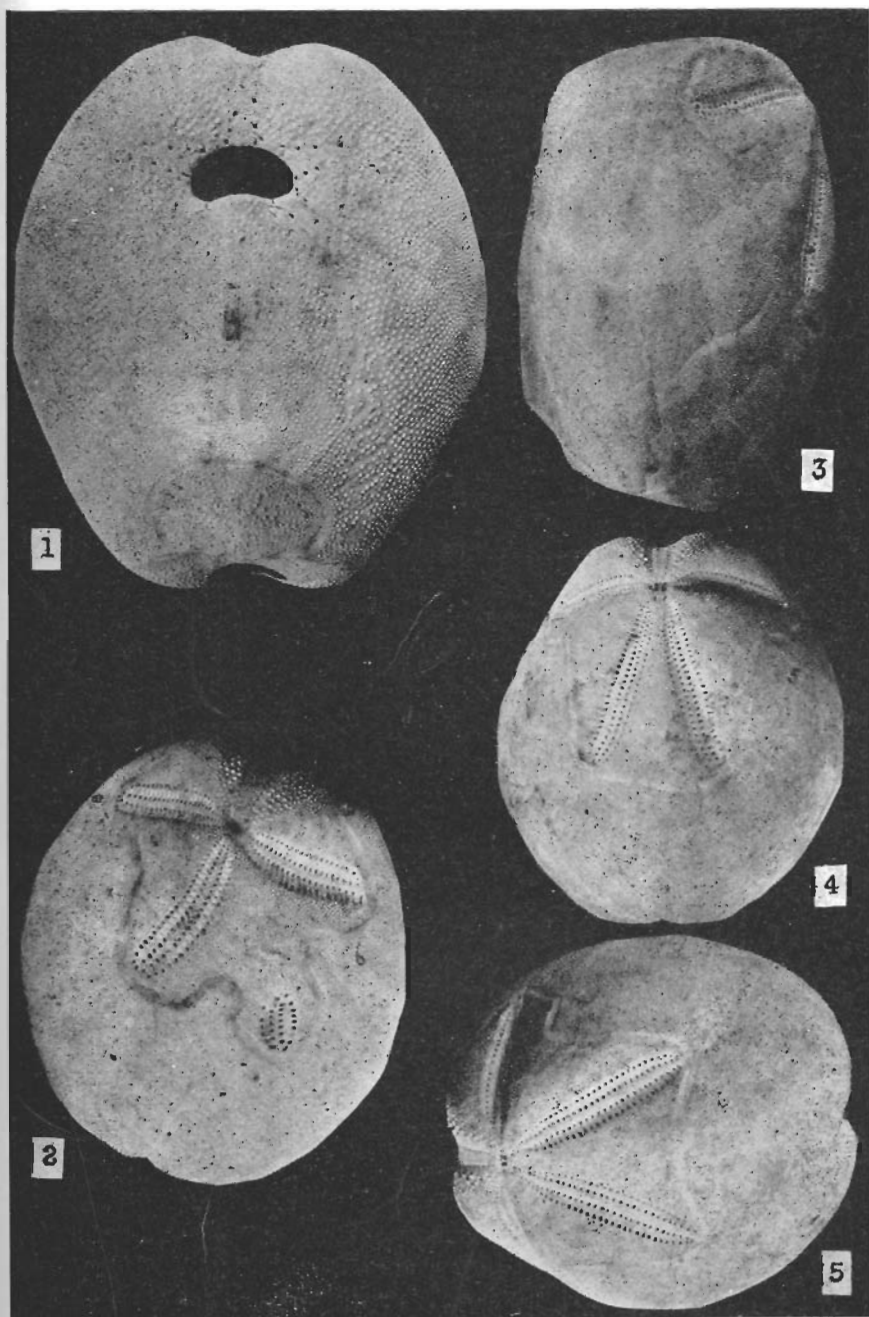
———. 1934. On a collection of Crinoids from the Raffles Museum, Singapore. Proc. Biol. Soc. Washington, vol. 47, pp. 9-14, 1934.
 p. 11, *Lamprometra palmata*, Christmas Island.

FISHER, W. K. 1934. Note on a Starfish from Christmas Island, Indian Ocean. Bull. Raffles Mus., No. 9, p. 74, 1934.
 p. 74, *Neoferdina cumingii*, Christmas Island, M. W. F. Tweedie.

WARD, MELBOURNE. 1934. Notes on a collection of Crabs from Christmas Island. Bull. Raffles Mus., No. 9, pp. 5-28, 1934.
 p. 9, *Colobocentrotus atratus*, Christmas Island, M. W. F. Tweedie.

CLARK, AUSTIN H. 1941. A Monograph of the Existing Crinoids. Bull. 82, U.S. National Museum, vol. 1, Part 4a, pp. i-vii, 1-603, pls. 1-61, 1941.
 p. 434, *Stephanometra spicata* (records of 1912 and 1913).
 p. 509, *Lamprometra protectus*, Christmas Island (records of 1929 and 1934).

GIBSON-HILL, C. A. 1947. The Echinodermata [of Christmas Island, Indian Ocean]. Bull. Raffles Mus., No. 18, pp. 22-26, 1947.
 p. 22, *Echinothrix diadema*, *Echinometra mathaei*, *E. picta*, *E. oblonga*.
 p. 23, *Colobocentrotus atratus*, *Heterocentrotus mamillatus*.
 p. 24, *Ophidiaster squameus*, *Linckia multifora*, *Neoferdina cumingii*, *Ophiocoma scolopendrina*.
 p. 25, *Ophiocoma erinacea*, *Ophiomastix annulosa*.
 p. 26, *Ophioplocus imbricatus*, *Lamprometra palmata*.
 The specimens recorded were collected by M. W. F. Tweedie (1933) and C. A. Gibson-Hill (1938-40), and notes are given on most of the species.



Metalia dicrana H. L. Clark. Fig. 1, No. 2 in the table on page . . .
 Fig. 2, No. 6 in the table. Fig. 3, No. 4 in the table. Fig. 4, No. 5
 in the table. Fig. 5, No. 1 in the table. Photographs by courtesy of the
 Smithsonian Institution. (Austin L. Clark, Echinoderms from the Cocos-
 Keeling Islands).