

## The Crinoids of Madagascar

by Janet I. MARSHALL and F. W. E. ROWE \*

**Abstract.** — A collection of crinoids from the vicinity of the Malagasy Republic, held in the Muséum national d'Histoire naturelle, in Paris, is identified. Three new species are described in the genera *Chondrometra*, *Iridometra* and *Pentametrocrinus*. The nominal species *Comissia hartmeyeri* A. H. Clark is considered to be conspecific with *C. ignota* A. H. Clark, and *Dichrometra afra* A. H. Clark with *D. flagellata* (J. Müller). Comments are included on several systematic problems which have arisen during the study of this collection.

**Résumé.** — Détermination d'une collection de Crinoïdes de Madagascar, déposée au Muséum national d'Histoire naturelle de Paris. Trois nouvelles espèces sont décrites pour les genres *Chondrometra*, *Iridometra* et *Pentametrocrinus*. L'espèce *Comissia hartmeyeri* A. H. Clark est considérée comme synonyme de *C. ignota* A. H. Clark, et *Dichrometra afra* A. H. Clark comme synonyme de *D. flagellata* (J. Müller). Quelques problèmes systématiques sont discutés.

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### INTRODUCTION

The echinoderm fauna of South Africa and some parts of the Indian Ocean have been well documented, but that of Madagascar and of the African coast north of Mozambique is less well known. The island of Madagascar (the Malagasy Republic) stretches from approximately 12° S to 26° S through tropical to warm-temperate waters. The echinoderms found along the Malagasy coast are for the most part distinctly different from that of southern Africa as delimited by the Tropic of Capricorn (23°30' S) (see A. M. CLARK and J. COURTMAN-STOCK, 1976). Faunal affinities are closer to tropical East Africa, the Red Sea and the Indo-West Pacific region.

In previous publications fourteen species have been recorded from the Malagasy region, including five endemic species or subspecies.

The collection on which this paper is based, is housed in the Muséum national d'Histoire naturelle (MNHN). It comprises mainly specimens collected within the last decade from the vicinity of the marine stations at Nosy Bé (northern coast) and Tuléar (south-western coast) (see fig. 1). Other material from the same region in the MNHN collections has also been included. Three new species are described, in the genera *Chondrometra* (Charitometridae), *Iridometra* (Antedonidae) and *Pentametrocrinus* (Pentametrocrinidae). The known distribution of eight species is extended within the Western Indian Ocean either from the Red Sea (shallow-water species) or from more southern

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waters, (deep-water). Four species, three of which are presently considered endemic, are not represented. Twenty-six species representing nine families of crinoids are now known from the Malagasy region, of which twenty-two species are recorded in this paper. Where species identity has not been established, due principally to lack of sufficient comparative material, detailed descriptions of the specimens are provided. The validity of the known species of *Heterometra* from the Malagasy-East African region and the problem of distinguishing between the genera of the Mariametridae (see A. M. CLARK, 1972) are further discussed, as is the problem of variation within species of the genus *Comanthus*.

The genera and species are treated in alphabetical order within each family, the families being arranged systematically according to A. H. CLARK (1931, 1941, 1947, 1950) and A. H. and A. M. CLARK (1967). The list of references under each species has been kept as short as possible by including only the original description, the most recent references to the species and that of the relevant volume of A. H. CLARK'S monograph for reference to records of distribution and synonymy.

LIST OF CRINOID SPECIES RECORDED FROM MADAGASCAR

Family COMASTERIDAE

- Capillaster multiradiatus* (Linnaeus, 1758)
- Comanthus parvicirrus* (J. Müller, 1841)
- Comanthus wahlbergi tenuibrachia* A. M. Clark, 1972 \*
- Comanthus* sp. aff. *C. samoanus* A. H. Clark, 1909
- Comaster distinctus* (P. H. Carpenter, 1888)
- Comissia ignota* A. H. Clark, 1911*b*

Family HIMEROMETRIDAE

- Heterometra madagascarensis* (A. H. Clark, 1911*b*)

Family MARIAMETRIDAE

- Dichrometra austini* A. M. Clark, 1972 \*
- Dichrometra flagellata* (J. Müller, 1841)
- Lamprometra klunzingeri* (Hartlaub, 1890)
- Stephanometra indica* (Smith, 1876)

Family COLOBOMETRIDAE

- Cenometra emendatrix madagascarensis* A. M. Clark, 1972
- Oligometra serripinna* (P. H. Carpenter, 1881)
- Decametra* sp. aff. *D. alaudae* A. H. Clark, 1916

Family TROPIOMETRIDAE

- Tropiometra carinata carinata* (Lamarck, 1816)
- Tropiometra magna* A. H. Clark, 1937

Family THALASSOMETRIDAE

- Crotalometra magnicirra* (Bell, 1905)
- Thalassometra electrae* John, 1937

Family CHARITOMETRIDAE

*Chondrometra crosnieri* sp. nov.

Family ANTEDONIDAE

*Dorometra mauritiana* (A. H. Clark, 1916) \*

*Iridometra malagasiensis* sp. nov.

*Andrometra indica* (A. H. Clark, 1912a)

*Antedon arabica* (A. H. Clark, 1937)

*Perometra afra* A. H. Clark, 1911b \*

*Sarametra* sp.

Family PENTAMETROCRINIDAE

*Pentametrocrinus spinosus* sp. nov.

\* indicates species not recorded in this collection.

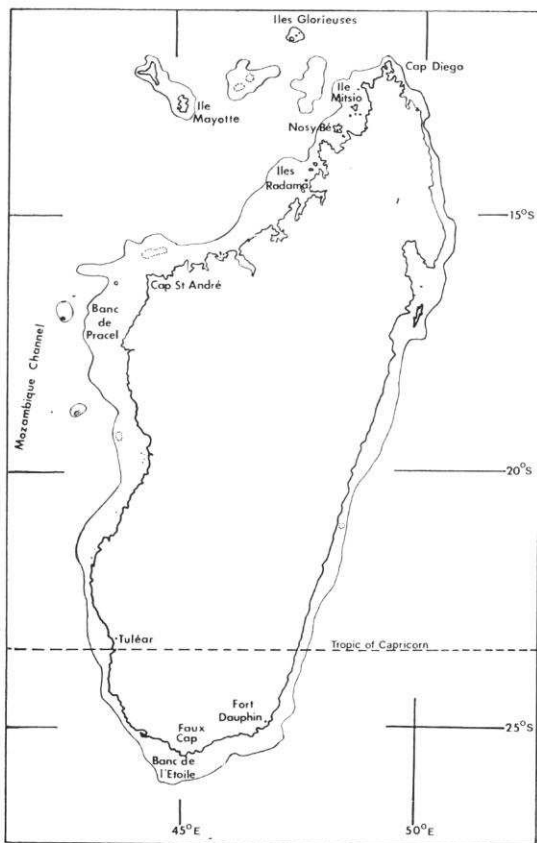


FIG. 1. — Outline of the island of Madagascar, with adjacent island groups.

Family COMASTERIDAE

**Capillaster multiradiatus** (Linnaeus)

*Asterias multiradiata* Linnaeus, 1758 : 663.

*Capillaster multiradiata*, A. H. CLARK, 1911*b* : 16 ; 1931 : 173.

*Capillaster multiradiatus*, A. M. CLARK, 1967*b* : 26 ; CLARK and ROWE, 1971 : 15 ; A. M. CLARK, 1972 : 76.

*Capillaster multiradiata* var. *coccodistoma* A. H. Clark, 1911*c* : 247.

*Capillaster coccodistoma* A. H. Clark, 1931 : 212.

MATERIAL : Banc de Pracel, north-west coast, 55 m ; 2 specimens, CROSNIER, (1959). Cap Saint-André, west coast, 30 m ; 1 specimen, JOLY (1901), coll. MNHN n° ECCH 33. Madagascar (no data) ; 1 specimen, ROUSSEAU (1841), coll. MNHN, n° ECCH 8.

DESCRIPTION

The specimens collected by JOLY and ROUSSEAU are small, with arms 65-70 mm long. They, and a third specimen not found during a recent revision of the MNHN collection, were briefly described by A. H. CLARK (1931).

The two specimens collected by CROSNIER are larger and more solid in appearance, with maximum arm length 95 mm, and breadth at the first syzygy 1.2 mm. Despite their size, they have only 14 and 20 arms respectively. The proximal arm segments are discoidal, those following the first syzygy wedge-shaped. This syzygy is at 3 + 4 after the IBr series, and at 2 + 3 after the IIBr series. The distal arm segments are also discoidal, three to four times broader than long, and about half the diameter of proximal segments. The specimen with 14 arms is in good condition and has XVII cirri ; the other specimen, with 20 arms (most of which are broken) has XXIV cirri.

On both, the cirri have no more than 24 segments, with low V-shaped dorsal crests distally from the ninth segment. The centrodorsal is thick discoidal, with a slightly concave dorsal pole.

REMARKS

The specimen collected by ROUSSEAU was given a specific formula and named *Actinometra coccodistoma* by P. H. CARPENTER (1882), though he included two other species in the same group. He later (1888) distinguished it from *fimbriata* by the position of the mouth, but did not describe the specimen. A. H. CLARK (1911*c*) gave a brief description of the ROUSSEAU and JOLY specimens and a third specimen from Madagascar (now lost) as a new variety *Capillaster multiradiata* var. *coccodistoma*. He included *coccodistoma*, a manuscript name which was with the ROUSSEAU specimen in the MNHN, in the synonymy. In 1931, he regarded *C. coccodistoma* a distinct species from *C. multiradiatus*, attributing the authorship of *coccodistoma* to P. H. CARPENTER, and nominated the ROUSSEAU specimen which CARPENTER (1882) had examined as the "type". However, because CARPENTER's formula included three species and was insufficient to recognise *coccodistoma* from the others, and since A. H. CLARK (1911*c*) was the first to actually describe the species, the

authorship has now been attributed to A. H. CLARK (1911c). The ROUSSEAU specimen is considered to be the lectotype and the JOLY specimen a paralectotype (after A. H. CLARK, 1931). CLARK and ROWE (1971) synonymised *C. coccodistoma* with *C. multiradiatus* considering *coccodistoma* to represent immature *multiradiatus*. A. M. CLARK (1972) reiterates this opinion. The differences between the two species according to A. H. CLARK were the occurrence of fewer and more slender arms and cirri in *C. coccodistoma*.

**Comanthus parvicirrus** (J. Müller)

(Fig. 2)

*Alecto parvicirra* J. Müller, 1841 : 185.

*Comanthus parvicirra*, A. H. CLARK, 1911b : 18 ; 1931 : 631.

*Comanthus parvicirrus*, A. M. CLARK, 1972 : 77 ; 1975 : 395.

MATERIAL : Banc de Pracel, north-west coast, 55 m ; 2 specimens, CROSNIER (1950).

REMARKS

These two specimens confirm the presence of *C. parvicirrus* in Madagascar. It had previously been recorded from Madagascar by A. H. CLARK (1931) and from Mozambique by A. M. CLARK (1972). One specimen has 15 arms 35-55 mm long, the other has 20 arms, 37-62 mm long.

*C. parvicirrus* has been recorded from Madagascar, the Seychelles and Mauritius (A. H. CLARK, 1911b, c) and from Mozambique (A. M. CLARK, 1972). Over its Indo-Pacific range, *C. parvicirrus* shows great variation in numbers of arms and cirri and the number of ossicles in IIBr and IIIBr series. *C. parvicirrus* is characterised by the more variable occurrence of 2 and 4 ossicles in these series than in those of sympatric species such as *C. samoanus*, but the distinction is not always clear (see A. M. CLARK, 1975). The few, discontinuously arranged cirri are also characteristic of this species.

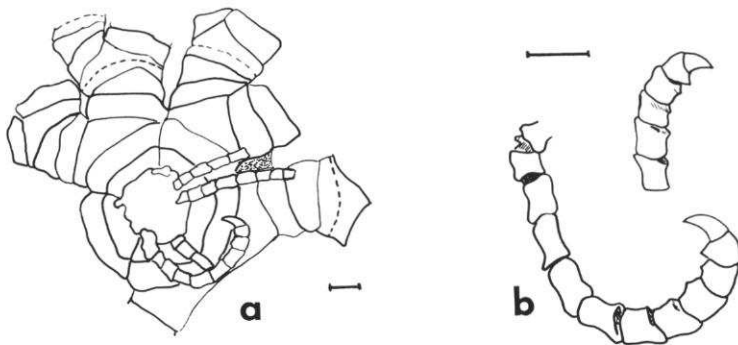


FIG. 2. — *Comanthus parvicirrus* (J. Müller) : a, dorsal view of centro-dorsal and division series ; b, lateral view of mature cirrus ; c, lateral view of cirrus tip, showing transverse ridges. (Scale = 1 mm.)

**Comanthus** sp. aff. **C. samoanus** A. H. Clark

(Fig. 3; pl. I, a)

*Comanthus samoana* A. H. Clark, 1909 : 30 ; 1931 : 593.

*Comanthus samoanus*, A. M. CLARK, 1975 : 395.

MATERIAL : Nosy-Tangam, Nosy-Bé ; 1 specimen, HUMES (1960). Nosy Taolankema ; 1 specimen, PICHON (1964).

DESCRIPTION

The specimen from Nosy-Tangam is in very good condition with 41 unbroken arms c. 85 mm in length. The IBr series are in lateral contact, and the first segments of the following division series are also in contact internally, but elsewhere there is a wide gap, with a considerable amount of perisome visible. The axillaries are about four times as broad as long, with an obtuse distal angle (pl. I, a). All the segments after the first syzygy (at 3 + 4) are distinctly wedge-shaped.  $P_d$  is present on the IIBr and IIIBr series.

The centrodorsal is flat, discoidal, 2.7 mm diameter, with one complete marginal row of XVI cirri. Mature cirri have up to 14 segments ; the first three are short and broad, the next eight up to twice as long as broad and the last three about as broad as long. The last six segments bear a low, narrow, transverse distal crest. The terminal claw is about twice as long as the penultimate segment, and curved. Some immature cirri are present, with 15 segments, of which the first three and last five are broader than long, the intervening ones longer than broad, and the terminal claw long and straight.

The specimen from Nosy Taolankema is preserved with arms curled, and with several of the 40 arms broken at the first syzygy after the IIBr. The arms, division series and centrodorsal are similar to the first specimen. There are (or were) XIX mature, and one immature, cirri, in one complete marginal row. The mature cirri have 15 segments, which bear a distal dorsal transverse ridge from the eighth segment. The cirri are very smooth and appear shiny. Segments 4-7 are much longer than broad, the rest shorter, but the penultimate segment is still slightly longer than broad. The terminal claw is half again to twice as long as the penultimate segment, and curved (fig. 3).

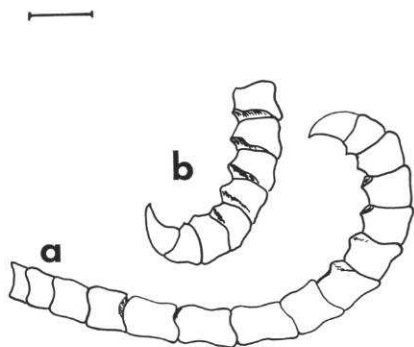


FIG. 3. — *Comanthus* sp. aff. *C. samoanus* A. H. Clark : a, lateral view of mature cirrus ; b, latero-dorsal view of cirrus tip with transverse ridges on middle segments. (Scale = 1 mm.)

#### REMARKS

These two specimens differ from the two identified as *C. parvicirrus* by their size, rugosity and the presence of complete rings of cirri. They are probably most closely related to *Comanthus samoanus* A. H. Clark, an Indo-Pacific species with the same fairly regular 4-ossicle division series, up to 40 arms and a complete ring of cirri.

*C. samoanus* has not previously been recorded from the western Indian Ocean, where the widespread *C. parvicirrus* has been found in tropical waters; *C. wahlbergi* is the common temperate-water species, restricted to waters south of 29° S (A. M. CLARK, 1972). Four subspecies have been described for *C. wahlbergi*. Only *C. wahlbergi tenuibrachia* A. M. Clark is recorded from anywhere near Madagascar, but it is much smaller than the specimens under consideration. Of the four subspecies, *C. wahlbergi multibrachia* Gislén (1938) is closest by description, since it has 38 arms and XXV cirri with 15-18 segments. However, the arms of the few recorded specimens are much smaller (38 mm), and type locality of False Bay, on the south-western coast of South Africa, make any close relationship extremely improbable.

Identification of species included in the Indo-Pacific genus *Comanthus* has for long caused difficulties. In the Australasian region, the temperate-water species *C. trichoptera* overlaps with *C. samoanus* on the east coast, and with the widespread *C. parvicirrus* on the west coast (A. M. CLARK, 1975). The same overlap does not seem to occur on the western side of the Indian Ocean, but this may be due to lack of collecting.

To further complicate the problem, many specimens of *Comanthus* species have distal transverse ridges rather than spines on the distal cirrus segments, which is a characteristic feature of the Australasian genus *Comanthoides* (A. M. CLARK, 1972, 1975; and personal observation). A thorough revision of the genus is necessary.

#### **Comaster distinctus** (P. H. Carpenter)

*Actinometra distincta* P. H. Carpenter, 1888 : 295.

*Antedon brevicirra* Bell, 1894 : 400.

*Comaster distincta*, A. H. CLARK, 1911a : 533; 1912a : 87; 1931 : 448.

*Comaster brevicirra*, A. H. CLARK, 1931 : 444.

*Comaster distinctus*, CLARK and ROWE, 1971 : 16; A. M. CLARK, 1972 : 81.

MATERIAL : Nosy Kitimany, Nosy-Bé, 25 m; 3 specimens, CROSNIER (1958). West of Ile Mitsio, 60 m, sand; 15 specimens, CROSNIER (1960). North of Ile Mitsio, 64 m, sand; 4 specimens, CROSNIER (1958). North-West of Ile Mitsio, 65 m, sand; 3 specimens, CROSNIER (1959). Banc de Pracel, 55 m, sand; 7 specimens, CROSNIER (1959). 12°49.5' S, 48°30' E, N.W. coast, 56 m; 1 specimen, CROSNIER (1973). Grand Recif, Tuléar, 34 m, in sponge; 1 specimen, PICHON (1969).

#### DESCRIPTION

All the specimens are rather delicate (dried), most of them with arms up to 70 mm long and only 1 mm diameter at the first syzgy. The largest specimen has 58 arms up to 90 mm long and VBr division series; but the majority of specimens have 36-45 arms, some as few as 20.

Most specimens have all the IIBr series present, usually with 4 ossicles; the IIIBr and following division series are mostly of 2. The classic *Comaster* feature of alternating arms and division series is not of frequent occurrence, and where it does occur the division series are internal. The brachials from about the 11th have slightly everted, spinose distal edges.

Cirri are always present, usually in one row around a flat discoidal centrodorsal. On the largest specimens the controdorsal is thicker, slightly hemispherical, with 2-3 rows of cirri. There are 10-12 cirrus segments, of which the first is very short, the second slightly longer than broad, the next 6-8 about twice as long as broad, and the last two only slightly longer than broad. The opposing spine is short but sharp, and the terminal claw is longer than the penultimate segment, and curved.

#### REMARKS

A. H. CLARK (1912a) considered *C. distinctus* and *C. brevicirrus* to be conspecific but in 1931 treated them as distinct species, using arm number and length and cirrus length as the main distinguishing features. A. M. CLARK (1972) discounting the characters used by A. H. CLARK, concluded that *C. brevicirrus* is conspecific with *C. distinctus*. The specimens of *C. distinctus* in the present collection, although smaller than those examined by A. M. CLARK, are otherwise similar, and verify the extension of the geographical range of the species. The Malagasy specimens recorded by A. M. CLARK (1972) also came from the Nosy-Bé area.

#### **Comissia ignota** A. H. Clark

(Fig. 4)

*Comissia ignota* A. H. Clark, 1911b : 17; 1931 : 269.

*Comissia hartmeyeri* A. H. Clark, 1912b : 386; 1931 : 267; A. M. CLARK, 1972 : 85.

MATERIAL : Nosy-Bé, under *Madreporaria*; 1 specimen, PICHON (1964). Iles Glorieuses, North-West of Madagascar; 22 specimens, MILLOT (1950). Iles Glorieuses, North-West of Madagascar; 1 specimen.

#### DESCRIPTION

There are 10-12 arms, 23-50 mm long; there are VIII-XXII cirri, 3.5-5.8 mm long, with 11-14 segments. The longest cirrus segment is 2.5 times longer than broad, centrally constricted. Cirrus segments from the fifth to the penultimate bear a curved crest distally which becomes a low spine on the last few segments. The terminal claw is 1.5 times longer than the previous segment, curved.

#### REMARKS

This collection provides more material of the little-known genus *Comissia*. The genus is distributed throughout the Indo-Pacific region, but most species are only known from one or a few specimens.



One of the specimens was very broken and has not been used for data, but some dimensions of the other specimens have been summarised in table 1, together with dimensions of type specimens of closely-related species in the genus *Comissia*, as given by A. H. CLARK (1937).

Included in the collection are specimens with 11 and 12 arms, although a diagnostic feature of the genus *Comissia* is the presence of only 10 arms. A similar occurrence was noted by A. M. CLARK (1972) who recorded specimens of *C. hartmeyeri* from the Gulf of Aqaba with 11 arms.

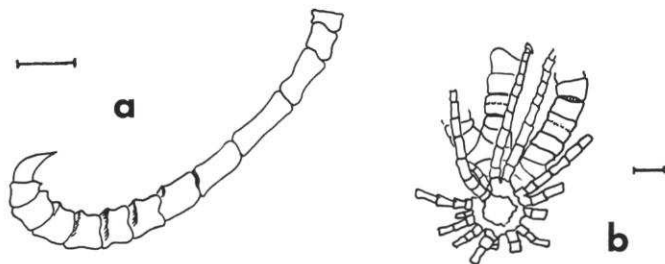


FIG. 4. — *Comissia ignota* A. H. Clark : a, mature cirrus ; b, dorsal view of centrodorsal, cirri and proximal part of one post-radial series. (Scale = 1 mm.)

The similarities between the descriptions of those specimens and the current collection, both of which contain specimens larger than previously recorded, confirm that *C. hartmeyeri* from the Red Sea is conspecific with *C. ignota*, previously known from the Amirante and the Seychelles Islands. Specimens from Watamu, Kenya, in the British Museum (Natural History) collection, were provisionally identified by A. M. CLARK (1972) as *C. hartmeyeri*, pending comparison with *C. ignota*. They fit into the upper size range of *C. ignota* from Madagascar as do other specimens for which data is provided in the literature (A. H. CLARK, 1931 ; A. M. CLARK, 1972) — there is overlap in arm length, number of cirri and segments, and number of teeth in the  $P_2$  comb. The other Indian Ocean species, *C. chadwicki* from Ceylon, has a much larger  $P_1$  comb, while *C. parvula* and *C. minuta*, from Japanese waters, have slightly larger combs.

#### Comasterid sp. juv.

MATERIAL : Fort Dauphin ; 1 specimen, CROSNIER.

DESCRIPTION : A very small specimen, with 10 arms, c. 6 mm long, with markedly everted brachials. The XI cirri, 2.5 mm long, are arranged in the interradials. These features are related to the small size of the animal.

TABLE 1. — Some numerical data of the Malagasy specimens of *Comissia ignota* A. H. Clark.

SPECIMENS	Arms			Cirri			II Br Series	No. of segments on P <sub>1</sub> comb.	
	No.	Length (mm)	Diam.	No.	Segs.	Length (mm)			
13	10	23	0.8	IX (XI)	12	4.4	—	5	
4	10	25	1	XIX	11	4	—	5	
11	10	25-31	0.6	XVIII	12	4.4	—	6	
7	10	27	0.7	XIII	11	3.5	—	5	
17	10	27	0.7	XVI	11	4.1	—	6	
20	10	27	0.7	XIV (XV)	12	4.3	—	6	
19	10	30	0.8	XI (XIV)	11	5	—	6	
10	10	30-38	0.9	XVI	12	4.5	—	6	
8	11	32-43	1.0	XII (XV)	12	5	1 (4)	7	
18	10	33	0.8	XI (XIV)	11	5	—	5	
1	10	33.5	1	XVI	11	5	—	—	
5	10	34	0.8	XVII	11	4.4	—	—	
6	10	34	1	XI (XVI)	12	5	—	6	
2	10	35	1.2	XI (XII)	12	5	—	6	
12	10	35	0.8	XVII	11	4.2	—	7	
9	10	37	1	XIX	12	4.5	—	5	
22	11	37	1.2	XX	13	6	6 × IBr	5	
PICHON	10	38	1	VIII (XIX)	13	5	—	7	
	14	11	40	1.3	XII (XXI)	12	4.4	1 (4)	—
	15	10	42	1.1	XVI	12	4.4	—	7
	3	10	43	1.0	XI (XII)	13	5	—	7
	16	12	45	1.1	XV (XIX)	13	5	2 (4)	6
	21	12	50	1.3	XIX (XXII)	12	5.8	2 (4)	7
	<i>C. chadwicki</i>	10	60	no record	XXIV	11-14	10	—	26-28
<i>C. hartmeyeri</i>	10	30	0.6-0.8	IX	11-14	5-6	—	5-8	
<i>C. ignota</i>	10	25-35	—	XII-XV	9-14	4-5	—	7	
<i>C. minuta</i>	10	30	0.7	XV-XVI	9-10	4	—	8-10	
<i>C. parvula</i>	10	45	—	XXIII	11-13	9	—	9-10	

Family HIMEROMETRIDAE

***Heterometra madagascarensis*** (A. H. Clark)

(Fig. 5)

*Craspedometra madagascarensis* A. H. Clark, 1911b : 23.

*Heterometra madagascarensis* A. H. Clark, 1918 : 78 ; 1941 : 295 ; A. M. CLARK, 1972 : 113.

MATERIAL : North-West of Ile Mitsio, 40 m, sand ; 2 specimens, CROSNIER (1960). North-West of Ile Mitsio, 60 m, sand ; 4 specimens, CROSNIER (1960). Cap Tanjona, north-west coast, 8 m ; 1 specimen, CROSNIER (1958). Banc de Pracel, north-west coast, 55 m, sand ; 1 specimen, CROSNIER (1959). Baie Mozamba, 30 m, sand ; 2 specimens, CROSNIER (1958). Madagascar ; 2 specimens, G. PETIT (1926).

DESCRIPTION

One of the two specimens from north-west of Ile Mitsio (40 m) has ridged brachials and short cirri resembling *H. africana* (A. H. Clark).

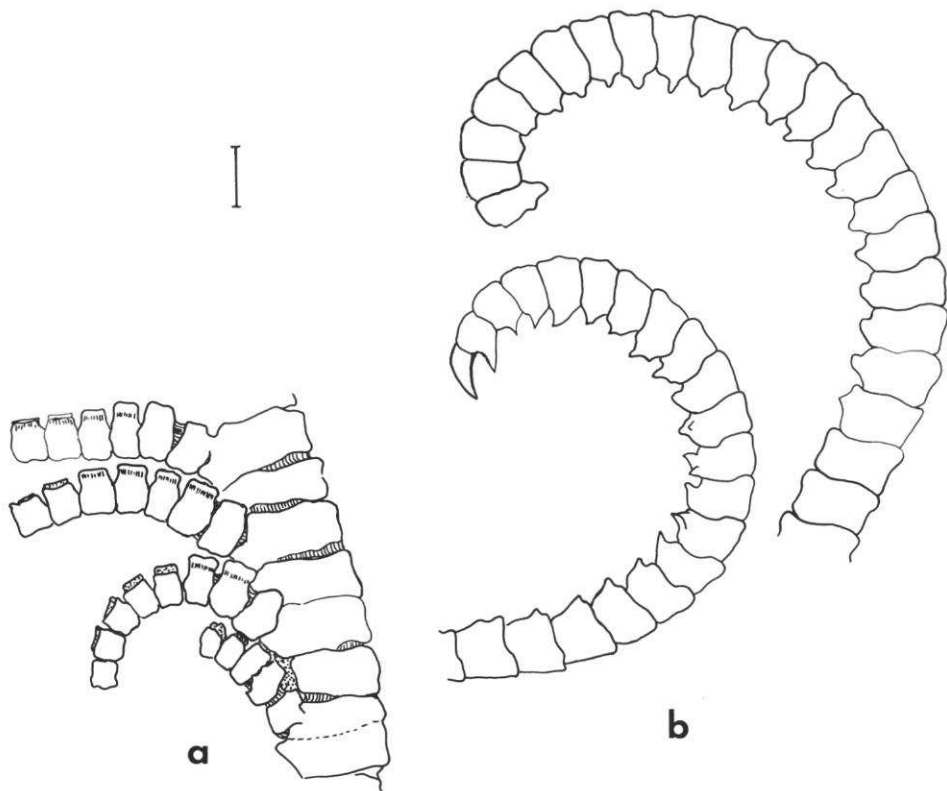


FIG. 5. — *Heterometra madagascarensis* (A. H. Clark) : a, lateral view of proximal arm section, with keeled pinnules ; b, sections of two mature cirri, showing variations in dorsal spines. (Scale = 1 mm.)

One of the specimens from north-west of Ile Mitsio (60 m) has 12 arms up to 80 mm long, with distinct keels on the proximal pinnules. The cirri are long, with spines that develop over a few segments, and vary from broad and blunt to fairly sharply-pointed. The terminal claw may be blunt or sharp, often about as long as the penultimate segment.

One of the specimens from Baie Mozamba has a IIBr series of 14 ossicles.

Some specimens have distinct synarthrial tubercles, some have ventrolateral flanges, and there is wide variation in the size and development of cirrus spines. The opposing spine is present on all cirri of all specimens, and is variable in shape; on some cirri, there is a gap of several segments without dorsal spines (fig. 5).

Various dimensions of the specimens have been tabulated (see table 2). Comparison of these data with those given by A. M. CLARK (1972 : table 6) shows that they are within the extended range of arm number and length, and have similar numbers of cirri and cirrus segments. Unfortunately, as the specimens are all dry, most of the proximal pinnules are broken, and could not be measured.

TABLE 2. — Numerical data from the specimens of *Heterometra madagascarensis* (A. H. Clark).

LOCALITY	Arms		Cirri	
	No.	Length (mm)	No.	Segs.
Banc de Pracel	14	123	XXI	35
? (PETIT)	18	70 <sup>1</sup>	XXIII	35
»	16	40 <sup>1</sup>	XXI	34
Baie Mozamba	17	50 <sup>1</sup>	XXII	31
»	22	55 <sup>1</sup>	XXI	32
Cap Tanjona	20	110	XIV	all broken
Ile Mitsio 40 m	11	75	XXI	34
Ile Mitsio 60 m	18	90	XXIV	32
»	15	60	XIX	32
»	17	80	XIX	25
»	14	50	XV	23

1. Arms broken, but still quite solid and compared with whole arms on other specimens could be expected to be much longer.

#### REMARKS

There are several nominal species of *Heterometra* described from along the African coast. Preliminary identification of the Malagasy specimens using the keys of A. H. CLARK (1941) placed them in at least three different species (*H. africana*, *H. delagoae* and *H. madagascarensis*) and no specimen had all the characteristics of any one species. The specimens are provisionally allocated to the species *madagascarensis* because of locality. The three species found in the East African region need revisionary treatment when sufficient material is available. To date published records include only 24 specimens of *H. africana*, 18 specimens of *H. delagoae* and 23 specimens of *H. madagascarensis*.

Family MARIAMETRIDAE

A. M. CLARK (1972) comments that the genera and species of the family Mariametridae are very poorly defined, so that some of the present generic and specific distinctions may be unjustified. The separation of the genera *Lamprometra*, *Liparometra* and *Dichrometra* relies on the relative length of the proximal pinnules — in *Dichrometra*  $P_3$  is the longest pinnule, in *Lamprometra*  $P_2$  is the longest, and in *Liparometra*  $P_2$  and  $P_3$  are approximately equal in length. However, the variation within a genus appears to be very great. The problem is complicated by the fact that the elongate proximal pinnules are often broken, especially in dried specimens.

Only four species of mariametrids have been recorded from south-eastern Africa and the western Indian Ocean region (CLARK and ROWE, 1971; A. M. CLARK, 1972); *Dichrometra afra* A. H. Clark, *D. austini* A. M. Clark, *Lamprometra klunzingeri* (Hartlaub) and *Stephanometra indica* (Smith). *D. afra* is considered here to be conspecific with *D. flagellata* (Müller), a widespread Indo-West Pacific species. *S. indica* is also an Indo-West Pacific species and *D. austini* is known only from Madagascar. *L. klunzingeri*, known from the Red Sea and Madagascar, is poorly distinguished from *L. palmata*, another widespread Indo-Pacific species and the two may be considered conspecific (A. M. CLARK, 1972).

***Dichrometra flagellata* (J. Müller)**

(Fig. 6)

*Alecto flagellata* J. Müller, 1841 : 186.

*Dichrometra flagellata*, A. H. CLARK, 1909 : 13; 1941 : 544.

*Dichrometra flagellata* var. *afra*. A. H. Clark, 1912a : 23.

*Dichrometra afra* A. H. Clark, 1913 : 31; 1941 : 558; A. M. CLARK, 1972 : 97.

MATERIAL : FAUX Cap, South coast, 55 m sand; 2 specimens, CROSNIER (1952). West of the Mitsio, 40 m, sand; 1 specimen, CROSNIER (1960). Baie d'Ambaro, north-west coast, 15 m, sand; 1 specimen, CROSNIER (1959). Baie Tsimipaika, north-west coast, 35 m, sand; 2 specimens, CROSNIER (1959). Nosy-Bé, 48 m; 1 specimen, PICHON (1964). Cap Saint André, 30 m, 2 specimens (small), Dr JOLY (1901).

DESCRIPTION

In all of the large specimens,  $P_2$  is only slightly longer than  $P_1$  (fig. 6 a). The division series are often quite well-separated laterally, with slight lateral flanges. The centro-dorsal is large and thick, discoidal or irregularly round, with one or more irregular rows of XXV-XXX cirri bearing dorsal spines distally (fig. 6 c). The arm number varies from 21 to 36, and alternation of arms and division series is common at the HBr level or later.

The juvenile specimens collected by Dr JOLY were described by A. H. CLARK (1941 : 559). The specimens from Tsimipaika had the commensal ophiuroid *Ophiomaza cacao-tica*.

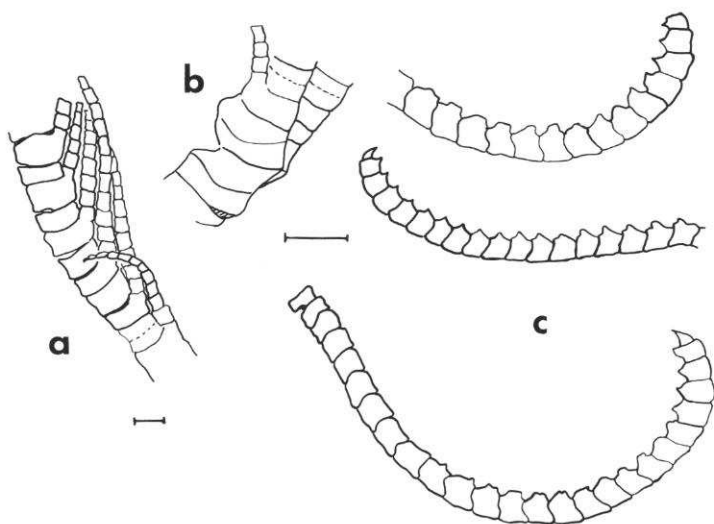


FIG. 6. — *Dichrometra flagellata* (J. Müller) : a, lateral view of proximal arm section, with pinnules ; b, latero-dorsal view of division series ; c, three cirri, with variable dorsal spines. (Scale = 1 mm.)

#### REMARKS

A. M. CLARK (1972) found that in the material she examined from Madagascar,  $P_3$  was only slightly longer than  $P_2$ . She discussed the difficulty of distinguishing this genus from *Liparometra* due to variations shown in this character. Re-examination of A. M. CLARK'S (1972) collection data indicates that some of those specimens could in fact be attributed to *Lamprometra klunzingeri* on the basis of the pinnule ratios.

Difficulties also arise in distinguishing *D. afra* from *D. flagellata*. Previously, *D. afra* had been considered restricted to the African region and *D. flagellata* to the Australian side of the Indo-West Pacific. Differences in the relative lengths of the first 3 pinnules were used to separate the two species : in *D. afra*  $P_1$ - $P_3$  show only a slight increase, whereas it is quite marked in *D. flagellata*. Development of synarthrial tubercles is supposedly also more marked in *D. flagellata*. However, these differences do not always hold good. In the present collection,  $P_1$  is often considerably shorter than  $P_2$ , and  $P_3$  is only slightly longer than  $P_2$ . The development of synarthrial tubercles is also variable (see fig. 6 b).

Examination of the holotype of *D. flagellata* at Leyden by one of us (J.I.M.) has shown that the size of the synarthrial tubercles of that specimen is not consistent with their description, and is similar to those on some of the specimens from Madagascar. Most of the proximal pinnules of the holotype are broken, but there is a distinct size difference between intact ones —  $P_1$  is half the length of  $P_2$ , which is three-quarters the length of  $P_3$ . However, specimens identified as *D. flagellata* in the Australian Museum collection have a distinct, but not extremely-developed, synarthrial tubercle, and the pinnule ratio is not as different as expected.

The major difference between *Dichrometra afra* and *D. flagellata* appears to be one

of size, since most records of *D. afra* have a maximum arm length of 100 mm, compared to 150 mm for *D. flagellata*. Such a situation appears to occur fairly frequently in other crinoid species common in Indonesian-Australasian region but also extending to the western Indian Ocean (cf. *Comaster distinctus*, *Capillaster multiradiatus*, *Lamprometra palmata*/*L. klunzingeri*). The characters used to define the species *D. afra* as a separate species from *D. flagellata* are no longer considered valid, and the two nominal species are now considered to be conspecific.

**Lamprometra klunzingeri** (Hartlaub)

(Fig. 7)

*Antedon klunzingeri* Hartlaub, 1890 : 175.

*Lamprometra klunzingeri*, A. H. CLARK, 1909 : 144 ; 1941 : 527 ; A. M. CLARK, 1972 : 102.

MATERIAL : Fort Dauphin, South coast, 90 m ; 1 specimen, CROSNIER, (1958). North-West of Ile Mitsio, 60 m, sand ; 1 specimen, CROSNIER, (1960).

DESCRIPTION

The specimen from Fort Dauphin is fine and delicate, pale (dried) with dark bands at the syzygies. It has 29 arms, up to 47 mm long. The division series are rounded, with slight ventrolateral extensions (fig. 7 a).  $P_2$  is distinctly larger than  $P_1$  and  $P_3$  (fig. 7 b) as is characteristic for the genus. The XXVI cirri have up to 29 segments, with low but sharp distal dorsal spines (fig. 7 c).

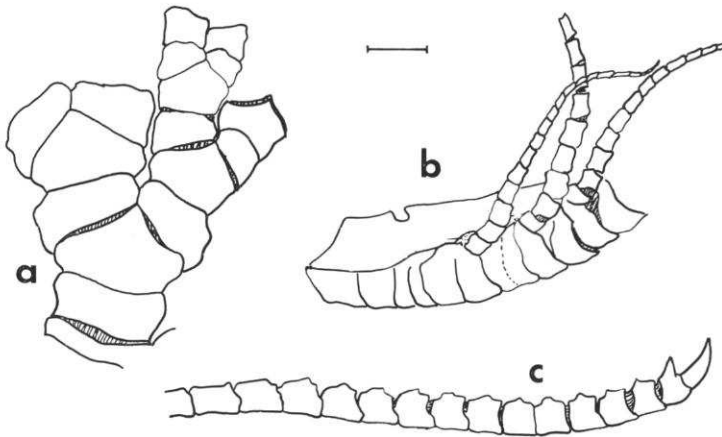


FIG. 7. — *Lamprometra klunzingeri* (Hartlaub) : a, one post-radial division series, dorsal view ; b, proximal pinnules ; c, lateral view of cirrus. (Scale = 1 mm.)

The small specimen from Ile Mitsio has arms 35 mm long, and well separated division series with very slight ventrolateral extensions. The pinnules are quite fine, with  $P_2$  markedly longer than  $P_1$  and  $P_3$ .

**Stephanometra indica** (Smith)

*Comatula indica* Smith, 1876 : 406.

*Stephanometra indica*, A. H. CLARK, 1911b : 26 ; A. M. CLARK, 1976 : 107.

*Stephanometra indica indica*, A. H. CLARK, 1941 : 436.

*Stephanometra indica protectus* A. H. Clark, 1941 : 443.

MATERIAL : Nosy-Komba, West coast under *Acropora* ; 1 specimen, HUMES (1960). Nosy-Bé Navetsy, under blocks ; 1 specimen, HUMES (1964). Iles Radama Berafia, 12 m ; 1 specimen, PICHON (1964). West of Pte Ambarioraomby, Nosy-Komba ; 1 specimen, HUMES (1960). Iles Glorieuses, north-west of Madagascar ; 1 specimen, MILLOT (1958). Ambatolaoka, Nosy-Bé, Vigio-Hellville ; 2 specimens, MILLOT (1958). Madagascar (no data) ; 1 specimen, GRANDIDIER (1905).

REMARKS

All of these specimens have only  $P_2$  and  $P_b$  erect and stiffened, as is characteristic of the species.  $P_2$  is usually greatly enlarged, due to elongation of the middle segments, which may be twice as long as broad, or even longer, so that a pinnule 8-10 mm long has only 11-15 segments.

One very large specimen, from Radama Berafia, has 33 arms up to 90 mm long ;  $P_2$  is 16 mm, with 17 segments. Despite its large size, there is no stiffening of following pinnules. Thus, characteristics of both the subspecies, *indica* and *protecta*, occur in one isolated region, supporting the doubts expressed by A. M. CLARK (1972) regarding the validity of the subspecies of *S. indica*.

Family COLOBOMETRIDAE

**Cenometra emendatrix madagascarensis** A. M. Clark

*Cenometra emendatrix*, A. M. CLARK in HUMES and Ho, 1970 : 5.

*Cenometra emendatrix madagascarensis* A. M. Clark, 1972 : 121.

MATERIAL : Nosy-Bé, Tany Kely on *Eucirripates* ; 2 specimens, PICHON (1963).

DESCRIPTION

The two specimens in the present collection conform with the characters described for *C. emendatrix madagascarensis* A. M. Clark (1972).

Both specimens have some arms broken off at the first syzygy after the last division series present (IIBr or IIIBr). The maximum arm length is 80 mm, and the maximum number of arms is 30, with a pattern of alternating arms and division series at the IIBr level. The division series are well-separated, with ventrolateral extensions on all ossicles, and a constriction at the joints. There is distinct carination of the basal segments of the proximal pinnules.  $P_1$ , 9 mm long, has 27-29 segments.  $P_2$ , the largest pinnule, is up to 20 mm long with a variable number of segments (23-40).  $P_3$ , much shorter, is 6 mm, with 17-20 segments.

The centrodorsal is irregular in outline, with two irregular rows of cirrus sockets



encroaching on it. The total diameter of the dorsal pole is 5.4 mm, but the naked part is only 2 mm.

There are c. XXX cirri, with 39-41 segments. A ridge on the eleventh segment develops into twin tubercles from the thirteenth, and these persist until the antepenultimate segment, which in some cases bears only a single spine. The terminal claw is sharply curved, up to twice as long as the penultimate segment.

***Oligometra serripinna occidentalis* A. H. Clark**

*Antedon serripinna* P. H. Carpenter, 1881 : 175.

*Oligometra serripinna* var *occidentalis* A. H. Clark, 1911b : 3; 1947 : 239.

*Oligometra serripinna occidentalis* A. H. Clark, 1912b : 401.

*Oligometra serripinna*, A. M. CLARK, 1972 : 129; 1976 : 16.

MATERIAL : Tuléar, outer slope of Grand Recif, 22 m, in sponge; 1 specimen, PICHON (1969). West of Ile Mitsio, 60 m sand; 5 specimens, CROSNIER (1960). 25°4.8' S, 46°55.7' E, 28 m; 1 specimen, CROSNIER (1973). 25°6.1' S, 46°56.2' E, 42 m; 1 specimen, CROSNIER (1973). West of Ile Mitsio, 40 m, sand; 2 specimens, CROSNIER (1960). Ile Mitsio, 15-20 m, in sponge; 4 specimens, CHERBONNIER (1959).

DESCRIPTION

The Tuléar specimen has  $P_1$  4.3 mm, 17 segments, the distal edges of all but the proximal three segments bearing spines.  $P_2$ , 6 mm long, has 19 segments, of which all but the first five have distal lateral spines about half the length of the segment in height, and the segments all at least as broad as long. The following pinnules, all smaller than  $P_2$ , also have spinose produced distal edges.

On the other specimens, the spines on the first two pinnules are much smaller, although following pinnules have spinose projections.

All specimens have variably-developed lateral flanges on the ossicles of the division series, and  $P_a$  is always present.

REMARKS

All but one of these specimens run down to the subspecies *O. serripinna occidentalis* in the A. H. CLARK key to the subspecies (1947 : 216-7); the specimen from Tuléar is closer to *O. serripinna serripinna*. In contrast, A. M. CLARK (1972) identified specimens from Madagascar as *O. serripinna serripinna*, while a specimen from Aldabra was closer to *occidentalis*.

***Decametra* sp. aff. *D. alaudae* A. H. Clark**

(Fig. 8)

*Decametra alaudae* A. H. Clark, 1911b : 8, 1947 : 183.

MATERIAL : West of the Mitsio, 60 m, sand; 8 specimens, CROSNIER (1960).

## DESCRIPTION

Very slight synarthrial tubercles are present on the division series of the Malagasy specimens.  $P_1$  is 5 mm, 13 segments;  $P_2$  is 9 mm, 18 segments;  $P_3$  is 5.5 mm, 15-18 segments.  $P_a$  is absent. All the pinnule segments are smooth (fig. 8 a). The centrodorsal is rounded, pitted with one marginal row of closely crowded cirri. The proximal cirrus segments are smooth, but on middle segments a dorsal raised area is present, with a small spine on each end, which distally become twin spines without the intervening crest, and finally resolve into a single spine (fig. 8 b).

The XVII-XX cirri have 24-27 segments, and may be as long as 13 mm, while the arms of five of the specimens are more than 70 mm, and one has arms 110 mm long.

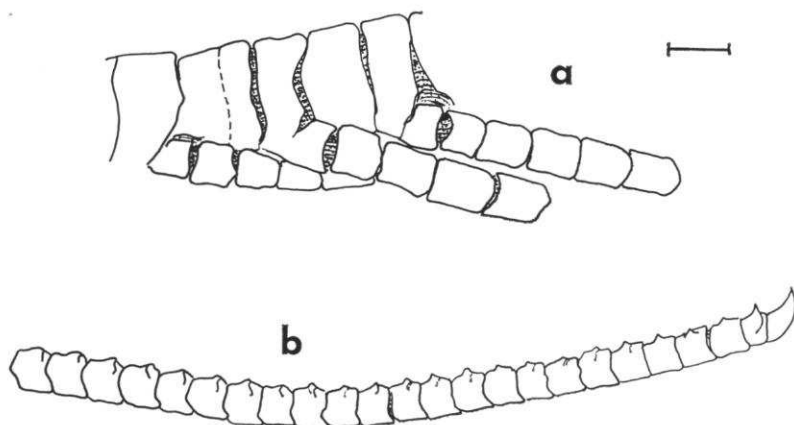


FIG. 8. — *Decametra* sp. aff. *D. alaudae* A. H. Clark : a, lateral view of proximal section of one arm, with pinnule bases ; b, latero-dorsal view of mature cirrus. (Scale = 1 mm.)

## REMARKS

The features of these specimens are close to the description (A. H. CLARK, 1947) of *Decametra alaudae* A. H. Clark, from Cargados Carajos.

The type specimen of *D. alaudae* has XV cirri, 12-14 mm, with 26-28 segments and 10 arms 90 mm long. This specimen could not be found during a recent search at the BM(NH). Other specimens of *D. alaudae* in that collection have longer, stouter and more angular pinnules, but a similar distal projection on the pinnule segments.

The other geographically close species, *Decametra mollis* (A. H. Clark), known from the Maldives was also compared with the Malagasy specimens, but the recorded dimensions of this species are smaller : arms c. 65 mm long, XX cirri with 20-22 segments.

Family TROPIOMETRIDAE

**Tropiometra carinata carinata** (Lamarck)

*Comatula carinata* Lamarck, 1816 : 534.

*Tropiometra carinata*, A. H. CLARK, 1911b : 34 ; A. M. CLARK in HUMES and Ho, 1970 : 4.

*Tropiometra carinata carinata*, A. H. CLARK, 1947 : 291 ; A. M. CLARK, 1972 : 131.

MATERIAL : Madagascar (no data) ; 1 specimen, CLOUE, 1847. Lagon du Mayotte, 10 m coral ; 1 specimen, CROSNIER (1973). Sainte-Luce, 4 m ; 2 specimens, CROSNIER (1973). 25°04' S, 46°55.7' E, 28 m ; 1 specimen, CROSNIER (1973). Ambatoloaka, Nosy-Bé, under *Madreporaria* ; 4 specimens, CHERBONNIER (1959). Ambatoloaka, Nosy-Bé ; 3 specimens, CHERBONNIER (1959). Ambatoloaka, Nosy-Bé, coral zone ; 5 specimens, CHERBONNIER (1959). Cap Diego, under stones in a high pool ; 3 specimens, DECARY (1916). Fort Dauphin (south coast) ; 1 specimen, DECARY (1916). Antsakoabe, Nosy-Bé, under *Madreporaria* ; 1 specimen, HUMES (1964). Nosy-Komba, Nosy-Bé, west of Ambatoriomby ; 9 specimens, HUMES (1960). Ambatoloaka, Nosy-Bé, coral zone ; 1 specimen, LEGENDRE (1959). Madriokely, Nosy-Bé ; 1 specimen, MILLOT (1958). Antsakoabe, Nosy-Bé ; 1 specimen, PICHON (1964). Nosy-Tangam, Nosy-Bé in *Madreporaria* ; 1 specimen, PICHON (1963). Iles Radama Berafia, 14 m on gorgonian ; 1 specimen, PICHON (1964). Diego Suarez (north coast) ; 7 specimens, POISSON (1919).

REMARKS

All specimens conform to the description of the subspecies *carinata* (Lamarck) (A. H. CLARK, 1947 : 291). The colour pattern of the dried specimens varies from brown to brownish-purple with bands of yellow on the arms ; the cirri and centrodorsal are either purple or yellow. The largest specimen has arms 58 mm long. The dorsal pole is quite flat, and the cirri are usually in one marginal row, sometimes two.

**Tropiometra magnifica** A. H. Clark

*Tropiometra magnifica* A. H. Clark, 1937 : 90 ; 1947 : 266 ; A. M. CLARK and COURTMAN-STOCK, 1976 : 17.

MATERIAL : Sainte-Luce (south-east coast), 60 m ; 2 specimens, CROSNIER (1958). Fort Dauphin (south coast), 80 m ; 1 specimen, CROSNIER (1958). 25°31'S, 46°36' E, 110 m ; 1 specimen (in pieces), PLANTE (1969).

DESCRIPTION

Three of the four specimens are very large, but the arms are broken. An estimate of the length of complete arms on the largest specimen would be over 220 mm, since the width at the first syzygy is 7 mm.

The small specimen, from Sainte-Luce, has arms c. 78 mm long, 2.1 mm at 3 + 4, comparable in size to *T. carinata*, but with a complete absence of dorsal carination on the arms. The proximal arm segments are slightly expanded laterally. The arms have purple stripes or spots, and the cirri and centrodorsal also have purple spots. There are XVII mature and IV immature cirri ; the mature cirri are 22 mm long, curled, with

up to 25 segments, of which the first five are broader than long and the rest are longer than broad. All the cirri are quite smooth dorsally. The opposing spine is low, and the terminal claw varies from quite short and straight to long, fine and curved. The short ones may have been broken off and regenerated. The centrodorsal is low hemispherical with two rows of cirri or sockets. P<sub>1</sub>, 8 mm long, has 16 segments : P<sub>2</sub>, 6 mm, has 15 segments : P<sub>3</sub>, 5 mm also has 15 segments.

Two of the large specimens and the small one each bear the commensal ophiuroid *Ophiomaza cacaoica* ; the fourth, from 110 m consists of recognisable pieces but no centrodorsal or cirri.

#### REMARKS

These records, from southern Madagascar extend the geographical range of the species east, from the Mozambique coast (see A. M. CLARK and COURTMAN-STOCK, 1976 : 18). It had previously been recorded from the Gulf of Aden (the type locality) and the waters off the Kenya-Somalia border (2°43' S, 40°53' E).

#### Family THALASSOMETRIDAE

#### *Crotalometra magnicirra* (Bell)

*Antedon magnicirra* Bell, 1905 : 141.

*Crotalometra magnicirra*, A. H. CLARK, 1909 : 80 ; 1950 : 97 ; A. M. CLARK and COURTMAN-STOCK, 1976 : 18.

MATERIAL : 12°49.5' S, 48°5.9' E, 760-810 m ; 1 specimen, CROSNIER (1972). 12°48.7' S, 48°3.4' E, 910-915 m ; 1 specimen, CROSNIER (1972). 22°20.3' S, 42°59' E, 995-1 020 m ; 2 specimens (in pieces), CROSNIER (1973). 12°42.9' S, 48°12.1' E, 445-455 m ; 1 specimen, CROSNIER (1972). 25°9.2' S, 47°22.6' E, 460-465 m ; 1 specimen, CROSNIER (1973). 23°35.5' S, 43°28.6' E, 740-760 m ; 8 specimens, CROSNIER (1973). 15°24.5' S, 46°2' E, 250-265 m ; 1 specimen, CROSNIER (1972). 12°27' S, 48°10' E, 700-780 m ; 12 specimens, CROSNIER (1972). 22°16.6' S, 43°1.9' E, 695-710 m ; 3 specimens, CROSNIER (1973). 13°50' S, 47°31' E, 850-1 125 m ; 1 specimen, CROSNIER (1975).

#### REMARKS

The specimens come from a range of depths between 250 m and 1 125 m. There is a good deal of variation in the shape of the centrodorsal, from rounded hemispherical to conical. The division series are also variably rugose, some with synarthrial tubercles. Some specimens have everted ends on the basal segments, others are smooth.

Most of the specimens are in poor condition, either with arms broken at the first syzygy, or with few, if any, complete cirri. One specimen from 740-760 m had commensal ophiuroids of two different genera.

**Thalassometra electrae** John

(Pl. I, b)

*Thalassometra electrae* John, 1937 : 161 ; A. H. CLARK, 1950 : 156.

MATERIAL : 13°46' S, 47°33' E, 1 490-1 600 m ; 6 broken specimens, CROSNIER (1975). 13°50' E, 85°0-1 125 m ; 1 specimen, CROSNIER (1975).

DESCRIPTION

This material was identified by Miss A. M. CLARK, who was able to compare it with the holotype from Sokotra. There is elaborate ornamentation on the basal brachials, and the cirri are arranged in vertical columns of 2-3 in each radius ; the largest with a 4th peripheral column forming a triangle with the other two near the mid-radial sockets. All the IIBrs are 4 and the first subsequent syzygy is at 3 + 4. There may be c. 44 cirrus segments, with a transition segment at 8 or 9. The centrodorsal is relatively high and domed, with a spinose apical pole. The largest specimen has at least 20 arms, all broken at the first syzygy after the IIBr series.

The shallower-water specimen has a low, flattened centrodorsal with cirri crowded around the edge, not in distinct columns, and with relatively huge spinose processes all over the dorsal pole and on the proximal and distal edges of the arm segments. The distal edges of the segments are also very flared.

Family CHARITOMETRIDAE

**Chondrometra crosnieri** sp. nov.

(Pl. I, c, d)

MATERIAL : 21°26.5' S, 43°11' E, 810-1 020 m ; 1 specimen, CROSNIER (holotype : MNHN n° EcCs 1395).

DIAGNOSIS : All but the basal cirrus segments are longer than broad. The XXIX cirri are arranged in 3 rows each of 10 columns on the rounded conical centrodorsal. The peripheral cirri are 31 mm long, 18-19 segments, and the apical cirri are 15 mm, 15 segments. The 15 (16) arms are 180 mm long. The ossicles of the division series have low synarthrial tubercles, and the brachials in the middle section of the arms have the distal edge everted, crenulated or scalloped.

DESCRIPTION

The centrodorsal is truncated conical, 5.8 mm at the base, 3.25 mm high. The small dorsal pole has conical tubercles. The cirrus sockets are arranged in 10 columns of 3 vertical rows each, separated by smooth interradiar areas.

The cirri are XXIX, about one-sixth the length of the arms. Those in the two peripheral rows are 3 mm long, 18-19 segments, while those in the apical row are 15 mm long, with 15 segments. In all cirri, the first segment is up to six times broader than long, the next 3 are slightly broader than long, and the rest are 1 1/2-2 times longer than broad.

A low distal dorsal tubercle is present from about the 11th segment, developing into a low opposing spine on the penultimate segment. The terminal claw is usually almost as long as the penultimate segment, sharp and curved.

The radials are completely concealed. The  $I\text{Br}_1$  have slightly everted, crenulated sides, and convex distal edges which form a low synarthrial tubercle with the axillaries, which are rhombic. Low tubercles are also present on the  $I\text{Br}_1$  and  $I\text{Br}_2$ , and on the first two brachials of undivided arms. Six  $I\text{Br}$  series are present, all 4 (3 + 4), with narrow lateral flanges (pl. I, c).

There are 15 (? 16) arms, 180 mm long. The proximal brachials have smooth everted edges and low scattered tubercles. Brachials beyond the first syzygy (at 2 + 3 or 3 + 4) are more rugose, with strongly everted, crenulate and finely spinose edges, and a thickened convex median section which flattens out on distal segments. The arms also taper markedly, from 3.2 mm at the first syzygy to 2.8 mm at  $\text{Br}_{12}$ , 2.5 mm at  $\text{Br}_{30}$  and 1.0 mm at  $\text{Br}_{50}$ . The position of the second syzygy varies from 12 + 13 to 21 + 22, and following syzygies are also irregularly spaced. Proximal brachials are rectangular, broader than long, becoming wedge-shaped to triangular and again wedge-shaped distally.

$P_1$  occurs on  $\text{Br}_1$  after a  $I\text{Br}$  series, and on  $\text{Br}_2$  when there is no  $I\text{Br}$  series. It is smaller and more delicate than following pinnules. The basal eight segments are strongly keeled, 2-3 times broader than long, then the rest of the segments taper evenly. It is 8 mm, with 22 segments.

$P_2$  is the first genital pinnule. It and the other genital pinnules (to  $P_{10}$ - $P_{12}$ ) have markedly expanded and rounded segments except for the basal two. The basal segment is always about 3 times as broad as long, the next segment only twice as broad as long, and the following 3 or 4 expanded laterally to cover the gonad. Distal segments taper gradually to a fine flexible tip. All the genital pinnules are about 10.5 mm long, with 19 segments (pl. I, d).

A few pinnules distal to the genital pinnules have slightly expanded segments; the rest have only the basal segments expanded, with remaining segments fine, elongate, twice as long as broad.

#### REMARKS

This is the first record of a species of *Chondrometra* from the western Indian Ocean. Previously, the family Charitometridae was represented there by the genus *Glyptometra*, which differs from *Chondrometra* in having smoother, more rounded division series and arms.

The major difference between this species and the 13 specimens attributed to the other three species of *Chondrometra* (A. H. Clark, 1950) is that of arm number — this is the first recorded species of the genus with more than 10 arms, a character previously regarded as of generic significance. However, A. H. CLARK (1950) considers the number of arms of little significance, and other genera within the family include species with more than 10 arms.

This species is most closely related to *C. rugosa* A. H. Clark, from the East Timor Sea. It differs in having a smaller, rounded conical centrodorsal, slightly shorter arms, and in lacking the distinct small spines on the dorsal segment of the brachials (see A. H. CLARK, 1950).

This species is named after A. CROSNIER, who collected many of the specimens reported in this paper.

Family ANTEDONIDAE

*Iridometra malagasiensis* sp. nov.

(Pl. II, a, b)

MATERIAL : Fort Dauphin, south coast ; DECARY (holotype (alcohol) : MNHN n° ECCH 140). Banc de l'Étoile, south coast, 20-80 m ; CROSNIER (paratype : MNHN no. Ec Cs 1168).

DIAGNOSIS : The first three pinnules on the outer side of each arm are similar, elongate, tapering, longer than their successors, with 20-24 short, finely spinose segments. The ten arms are up to 25 mm long, the XX-XXXV cirri to 5.2 mm long.

DESCRIPTION

The holotype has 10 arms 25 mm long, 0.6 mm at the first syzygy (at 3 + 4). The centrodorsal is low hemispherical, with 3 closely-crowded irregular rows of XXXV cirri. The bare dorsal pole, 0.7 mm, is pitted with obsolete cirrus sockets.

The cirri are up to 5.2 mm long, fairly straight and only slightly recurved distally. Of the 12-13 segments, the first two are broader than long, the next eight at least twice as long as broad, and the last few about as long as broad. The opposing spine is low but sharp, and the terminal claw is curved, slightly longer than the preceding segment. Ventral and dorsal surfaces are parallel, the distal end of the ventral surface of middle segments slightly overlapping the following segment.

The radials are level with the centrodorsal. The  $IBr_2$  are 3-4 times broader than long, well-separated laterally, with rounded lateral extensions and a notch at the joint with the  $IBr_2$  (axillary), which are broad and triangular with a very acute distal angle. The first two brachials are slightly broader than long and wedge-shaped, also with a slight notch at the joint. Br 3 + 4 are rectangular, and following brachials are broadly wedge-shaped to rectangular, with spinose everted distal edges. Syzygies are at 3 + 4, 9 + 10 then at intervals of three muscular articulations.

$P_1$ , 3.5 mm long, has 24 segments, all about as broad as long, with spinose everted distal edges, as are those of all the pinnules and the brachials after 3 + 4.  $P_2$  is 3.7 mm, with about 20 segments.  $P_3$ , up to 4.1 mm, has 20 segments, and is the first genital pinnule. The middle segments of  $P_2$  and  $P_3$  are up to twice as long as broad.  $P_4$  is shorter than the preceding pinnules, about 1.9 mm, with 10 segments, and following pinnules gradually become longer again. Distal pinnules are slender, elongate, with numerous short segments. The inner pinnules are all short —  $P_a$ , with 10-11 segments, is 2 mm long.

The paratype has 10 arms 23 mm long, XX cirri, the centrodorsal 1.5 mm in diameter with a pitted dorsal pole 0,8 mm diameter.

REMARKS

The presence of three proximal pinnules of approximately the same length, and a low hemispherical centrodorsal indicates that these specimens belong to the genus *Irido-*

*metra*. This genus formerly only comprised of two species, *I. adrestine* (A. H. Clark) from Japan to Hong Kong and *I. maxima* A. H. Clark from the Timor region. The new species is smaller than the other two, with relatively much shorter cirri and pinnules. The most distinctive feature is the spinosity of the pinnule and brachial segments.

The specific name is derived from the name of the independent Malagasy Republic (formerly Madagascar).

***Antedon arabica* (A. H. Clark)**

(Fig. 9)

*Repometra arabica* A. H. Clark, 1937 : 87.

*Antedon arabica*, A. H. CLARK and A. M. CLARK, 1967 : 188.

MATERIAL : Cap Diego, north coast, in a tidal pool ; 1 specimen, DECARY (1916). Fort Dauphin, south coast ; 1 specimen, CROSNIER (1960).

DESCRIPTION

The arms of the Cap Diego specimen are 29 mm long, 0.9 mm diameter at the first syzygy (3 + 4) (fig. 9 a).  $P_1$ , 6 mm, is the longest pinnule, about half as long again as  $P_2$  and  $P_3$ . It has about 24 segments, of which the first eight are twice as long as broad, and the rest taper and decrease in length to the end (fig. 9 b).  $P_2$  has c. 16 segments, and  $P_3$  c. 14 (all the tips are broken).  $P_3$  is the first genital pinnule. Following pinnules have 18 segments, slightly longer than broad on the earlier pinnules, but distal pinnules have fewer, elongate segments.

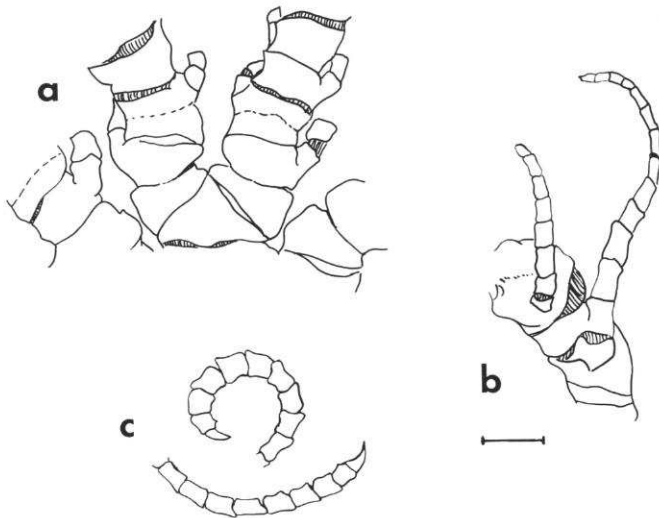


FIG. 9. — *Antedon arabica* (A. H. Clark) : a, dorsal view of division series and arm bases ; b, lateral view of proximal section of one arm with  $P_1$  and part of  $P_2$  ; c, two mature cirri, lateral view. (Scale = 1 mm.)



There are c. XLV tightly curled cirri, with 15 segments in two or three irregular rows around a flat, or slightly rounded, discoidal centrodorsal.

The specimen from Fort Dauphin is tiny, with arms only 12 mm long, 0.6 mm at 3 + 4, XX cirri with 13 segments in one complete marginal row around a flat, discoidal centrodorsal.

The terminal claws of both specimens are enlarged, as in typical *A. arabica* (fig. 9 c).

#### REMARKS

The only previous published record of *A. arabica* is of the holotype, from the south coast of Arabia, 19°22'36" N, 57°53' E (A. H. and A. M. CLARK, 1967 : 178). This record extends the range of the species to southern Madagascar which is still within the tropical zone.

The holotype has all its arms broken so that arm length is unknown, but all the other dimensions are in comparable ratio with these specimens — XXX cirri with 10-12 segments and width at 3 + 4, 0.7 mm.

### **Andrometra indica** (A. H. Clark)

(Pl. II, c, d)

*Eumetra indica* A. H. Clark, 1909 : 84.

*Andrometra indica* A. H. Clark, 1918 : 210 ; A. H. and A. M. CLARK, 1967 : 84.

MATERIAL : 12°52'4" S, 48°10'4" E, 415-403 m ; 2 specimens, CROSNIER (1971). 12°52'4" S, 48°10'4" E, 400-410 m ; 1 specimen, CROSNIER (1971). 23°36' S, 43°31'6" E, 395-410 m ; 1 specimen, CROSNIER (1971).

#### DESCRIPTION

The centrodorsal is conical, 2.6 mm at the base and 1.9 mm high, 0.3 mm at the bare dorsal pole. The XLV-L cirrus sockets are scattered over the centrodorsal, becoming smaller at the apex. Peripherally there are three sockets opposite each radial.

Only one of the four specimens has cirri and these are broken near the base. The peripheral cirri are extremely fine, about 20 mm long with 22-23 completely smooth, elongate segments up to 4 times as long as broad, slightly broader at the distal end and overlapping on the distal ventral edge. Distal segments taper gradually to about half the dimensions of the longest proximal. There is no opposing spine, and the terminal claw is straight and evenly tapering, slightly shorter than the preceding segment (see pl. II, c). The apical cirri have 14 segments mostly about twice as long as broad, and are quite short.

The radials are clearly visible, five times as broad as long, the distal edge slightly concave and the lateral edges of adjacent plates united. The  $IBr_1$  are two and a half times as broad as long, the sides convergent distally and the edge convex. The  $IBr_2$  are more or less rhombic, with a low synarthrial tubercle at the articulation with the  $IBr_1$  and an extension of the lateral angles to form a rhombic pore in each interradius — the distal angles of the axillaries are concave and the angle acute. A low synarthrial tubercle is

also present at the articulation of the first two brachials, and the lower brachials of adjacent arms are well-separated (see pl. II, d).

The ten arms are mostly broken at about 20 mm, but are estimated to have been up to 80 mm in length. The diameter at the first syzygy (at 3 + 4) is 1.5 mm.

The first brachial is broader than long, the outer edge longer than the inner. The second brachial is also broader than long, and is constricted proximally so that a second pore is formed by the first two brachials of adjacent arms. Following brachials are rectangular until the second syzygy at 9 + 10, and the rest of the brachials are broadly wedge-shaped. Syzygies occur distally at intervals of three muscular articulations.

All of the pinnules are similar, elongate and evenly tapering, with segments from two to four times as long as broad, except the basal segments which are broader than long. The lengths of the first three pinnules are extremely variable : on one specimen  $P_1$  is 5.5-6.1 mm, 10-13 segments,  $P_2$  is 6.3-6.9 mm, 12-14 segments, and  $P_3$  is 6.1-6.9 mm, 13 segments, on another ;  $P_1$  is 5.7-8.8 mm, 8 + -17 segments (the very long one is one of two on the same brachial),  $P_2$  is 5.1-6.7 mm, 11-14 segments, and  $P_3$  is 5.6-7.5 mm, 10 + -13 segments. In most cases  $P_1$  is slightly shorter than  $P_2$  and  $P_3$ , with  $P_3$  slightly the longest, but this is not consistent.  $P_4$ - $P_{10}$  are shorter (about 4.5 mm) while distal pinnules are extremely fine and elongate.  $P_4$  appears to be the first genital pinnule.

#### REMARKS

These four specimens, one of which has remains of cirri, possess a combination of features of *Andrometra indica*, *Eumetra chamberlaini* A. H. Clark, of the subfamily Antedoninae, and some species of the genus *Fariometra*, subfamily Bathymetrinae.

The only recorded specimen of *Andrometra indica*, from Port Blair, Andaman Islands (Indian Ocean) lacks cirri, and was originally described in the genus *Eumetra*. The two genera are separated on the relative lengths of the elongate proximal pinnules : in *Andrometra*  $P_2$  is slightly longer than  $P_3$ , whereas in *Eumetra*  $P_3$  is much the longest pinnule (CLARK and CLARK, 1967). However, the two species in each genus may not form discrete generic groups (A. M. CLARK, in CLARK and CLARK, 1967). The Malagasy specimens have elongate proximal pinnules, but the length ratio is variable. The cirri are similar to those of *E. chamberlaini* in length and attenuation of segments, no opposing spine or dorsal processes and a straight terminal claw. However, the centrodorsal is conical and completely covered with cirrus sockets, as in *A. indica*. The prominence of the radial plate is also a feature of *A. indica*.

The genus *Fariometra* comprises thirteen nominal species which have been divided into two groups by the presence or absence of a rhombic "pore" between the elements of adjacent IBr series. All species have a pore at the IIBr level (CLARK and CLARK, 1967). The Malagasy specimens and the holotype of *A. indica* also have two pores, while *A. psyche*, *E. chamberlaini* and *E. aphrodite* only have one. All species of *Fariometra* have a conical centrodorsal covered with cirrus sockets, as in *A. indica*. However, the cirri, where known, have dorsal processes, a curved terminal claw and an opposing spine.

Table 3 lists dimensions of all the nominal species of *Fariometra*, *Eumetra* and *Andrometra* as given in descriptions, with the corresponding data from the Malagasy specimens. Examination of these data in relationship to the present collection has highlighted the

TABLE 3. — Data for the species of *Fariometra*, *Eumetra* and *Andrometra*, taken from CLARK and CLARK, 1967(1); A.M CLARK, 1967(2) 1972(3); MNHN Collection (4)

Name	Cd Shape	Cirri			P <sub>1</sub>		P <sub>2</sub>		P <sub>3</sub>		Arm Length (mm)	Pore
		No.	No. segs.	Length (mm)	No. segs.	Length (mm)	No. segs.	Length (mm)	No. segs.	Length (mm)		
<i>F. explicata</i> (1)	conical		25-28	?	20	10	20	7	20	7	50	No
<i>F. io</i> (1)	rounded	XL	20-22	?	15	5	10	3.5	10		30	No
	conical											
<i>F. obscura</i> (1)	conical	?	?	?			?	?			?	Yes
<i>F. sewelli</i> (1)	conical	LV	26	13	23	10	15	7	?	?	50	Yes
<i>F. dione</i> (1)	conical	XLV-C	21	15	15-16	6.5	15	6.5-7	13	6.5	?	Yes
<i>F. aleyon</i> (1)	conical	L-LX	28	18	19-23	7-9	16	10	15	10	60	Yes
<i>F. nicippe</i> (1)	rounded	L	19-21	13	20	7	20	7	11 +	5	50	Yes
	conical											
<i>F. parvula</i> (1)	conical	LX	28-29	25	20-22	9	22	11	16	8.5	85	?
<i>F. scutifera</i> (1)	conical	?	?	?	?	?	?	?	?	?	?	Yes
<i>F. sokotrae</i> (1)	conical	LX	21-36	20		Pa 4	9 +	4	?	?		No
<i>F. sp. A</i> (2)	conical	LX	26	13	17-20	8.4-9.5	11-12	4.5-5	12	6	70-75	No
<i>F. sp. B</i> (2)	conical	LXX	?	?	15	8	14	7	16	8	45	No
<i>F. liobrachia</i> (3)	rounded	LXXV-LXXV	21	17	18-23	11-12.5	11-17	6.8-9.2	10-15	5.4-7.7	60	No
	conical											
<i>E. chamberlaini</i> (1)	low hemi	XL-LX	25-33	30-40	12	6	16	9	20-22	13	80	No
<i>E. aphrodite</i> (1)	low hemi	XXV-L	16-18	16-18	11-12	5.5	15	7	19	10	75	No
<i>A. indica</i> (1)	conical	LXX	?	?	9	6	15	10	15	8	60	Yes
<i>A. psyche</i> (1)	low hemi	XXXVIII-XXXV	10-18	5-7	8-10	3-4	10-13	4-7	10-11	4-7	55-65	No
<i>A. psyche</i> (4)	conical	XLV-L	22-23	20	8-13	5.5-6.1	11-14	5.1-6.9	13	5.6-7.5	80	Yes

confused state of understanding of the limits not only of the genera but also some sub-families of the Antedonidae. However, because of the poor condition and low numbers of specimens used to establish species, no further clarification is possible at present.

Identification of these specimens as *Andrometra indica* extends the range of this genus from the Andaman Islands to Madagascar, and from 205 m to 415 m.

**Sarametra** sp.

(Pl. II, e)

MATERIAL : 13°45.8' S, 47°38.5' E, chalutage 430-700 m ; 1 specimen, CROSNIER (1975).

DESCRIPTION

The centrodorsal is conical, 5.0 mm high and 3.5 mm in diameter with a spinose apical area, and cirrus sockets sometimes in columns. There is a complete basal ring adjoining the centrodorsal, with interbasal sutures just visible midradially. Cirri remain on the peripheral two rows, but these are broken at the 9th segment or earlier. The first three segments are broader than long, but the following are elongate, at least twice as long as broad, with expanded distal ends.

The ten arms are c. 90 mm long, the width at 3 + 4 2.0 mm. The second syzygy is at 9 + 10 or 10 + 11, and all the pinnules are present, with P<sub>1</sub> on Br<sub>2</sub>. The pinnules are very slender and elongate, and very compressed laterally, the first two segments are short, the rest elongate. Pinnules and brachials have flared, dorsally spinose distal ends, and the brachials are not markedly attenuated. The division series is also finely spinose.

There are galls between the arm bases.

REMARKS

This specimen is closest in characteristics to *S. triserialis* (A. H. Clark) from the Hawaiian Islands, although it is closer geographically to *S. nicobarica* (A. H. Clark), from Nicobar.

*S. triserialis* has a tall conical centrodorsal 3.5 mm diameter and 6 mm high in the holotype, cirrus sockets in 3 columns separated by bare interradiial lines and the apical area very spinose. *S. nicobarica* has a smooth apical pole and radials, the centrodorsal 5 mm in diameter and 8.5 mm high, and short spines on the division series.

Family PENTAMETROCRINIDAE

**Pentametrocrinus spinosus** sp. nov.

(Fig. 10 ; pl. II, f-h)

MATERIAL : 13°48.8' S, 47°29.4' E, chalutage 1 800-2 000 m ; 2 specimens, CROSNIER (1975) (holotype : MNHN EcCs 1301 ; paratype : MNHN EcCs 1389).

DIAGNOSIS : The lowest pinnule is on the second brachial. The first brachial has rows of thorny spines on the proximal and distal borders, with a third sometimes present between. Later brachials may also be spinose. Arm length up to 200 mm.

#### DESCRIPTION

The centrodorsal is low hemispherical, 5.6 mm in diameter, with the bare, pitted dorsal pole 2.4 mm. Cirrus bases and sockets are arranged in two more or less alternating rows (pl. II, f, g).

Basal segments of 14 cirri plus 10 cirrus sockets are present on the holotype, and 9 basal segments with 16 empty sockets on the paratype. The attached basal segments are twice as broad as long.

Two broken sections of cirri, with five and seven segments respectively, show that the first two segments are broader than long, segments 3-7 elongate (up to 3 mm long) more than three times as long as broad, constricted medially (fig. 10 b).

The radials are smooth. The distal borders are straight, projecting slightly beyond the centrodorsal.

The five arms are broken on both holotype and paratype. On the holotype, the longest attached arm section is 13.3 mm long, consisting of seven, and a partial eighth, rectangular brachials, each approximately 3.5 mm wide and 1.9 mm long. The first syzygy is at 4 + 5. The other arms are broken at this syzygy, one is represented by the first brachial, and the fifth arm is absent from the radial (see pl. II, h).

On the paratype, the longest arm section is 10 mm, comprising six segments with the first syzygy at 3 + 4. It is broken at the second syzygy, at 6 + 7. Two arms are broken at the first syzygy which is at 4 + 5. One arm is broken at Br<sub>3</sub> and the fifth arm is represented by Br<sub>1</sub>. Broken lengths of arm indicated that the total arm length must be over 200 mm.

Br<sub>1</sub> and Br<sub>2</sub> bear two or more rows of thorny stumps which become more rounded on Br<sub>3</sub> and Br<sub>4</sub>. On Br<sub>1</sub> and Br<sub>2</sub> the rows are close to the proximal and distal borders, with a third incomplete row between. On 4 + 5 these stumps are reduced to one or two rows of knobs. There is a rounded median synarthrial tubercle between Br<sub>1</sub> and Br<sub>2</sub>. These tubercles continue along the arm but become lateral, and adjacent to the pinnules. The brachials become distinctly wedge-shaped distally along the broken arm sections, and taper to 1.2 mm.

Most of the proximal pinnules are absent, but sections of P<sub>1</sub>, P<sub>2</sub> and P<sub>4</sub> are present on some arms. P<sub>1</sub> is on Br<sub>2</sub>. The longest remaining pinnules on the holotype are P<sub>1</sub> and P<sub>2</sub>. These are 3.6 mm and 5 mm long respectively, and consist of 7 and 9 segments. The first 3 segments are broader than long, and the remainder taper gradually so that the sixth to ninth are longer than broad. The first 4-5 segments have a slight spinose keel on the side facing the arm (fig. 10 a).

Distal pinnules, on broken arm sections, are slender and elongate, c. 13 mm, all but the first segment about three times as long as broad with expanded articulations. The most complete pinnules have 11 segments. Because the arms are broken it is not possible to determine the position of the genital pinnules, but they extend for at least 12 pinnules on each side of the arm. Gonads are evident between the third and fifth segments of the genital pinnules.

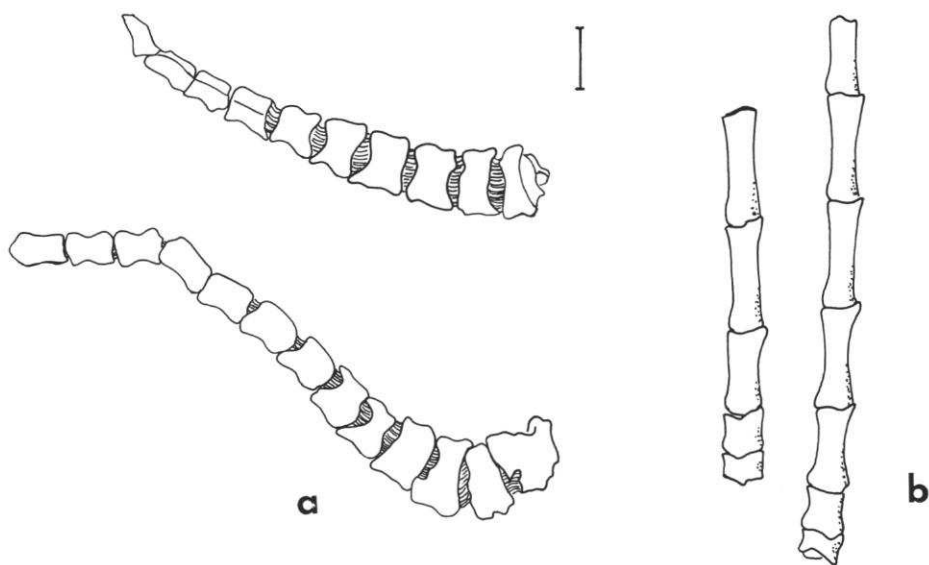


FIG. 10. — *Pentametrocrinus spinosus* sp. nov. : a, two proximal pinnules ; b, lateral views of basal segments of two cirri. (Scale = 1 mm.)

#### REMARKS

This species, together with *P. varians* (P. H. Carpenter) and *P. australis* McKnight has  $P_1$  on  $Br_2$ . However, *P. spinosus* is much larger than either of the other two species, and the first five brachials are spinose.

*P. varians* has been recorded from a similar depth off southern Mozambique (A. M. CLARK, 1972 : 146), and is known also from the Maldives, the Andamans, Lesser Sunda Island and southern Japan in depths from about 400-2 800 m (CLARK and CLARK, 1967). *P. australis* has only been recorded from off the southern coast of the South Island of New Zealand in 1 100-1 500 m.

The name is derived from the distinctively spinose brachials.

#### Acknowledgements

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The photographs were taken by Alain FOUBERT of the Muséum national d'Histoire naturelle, Paris, and John FIELDS, of the Australian Museum.

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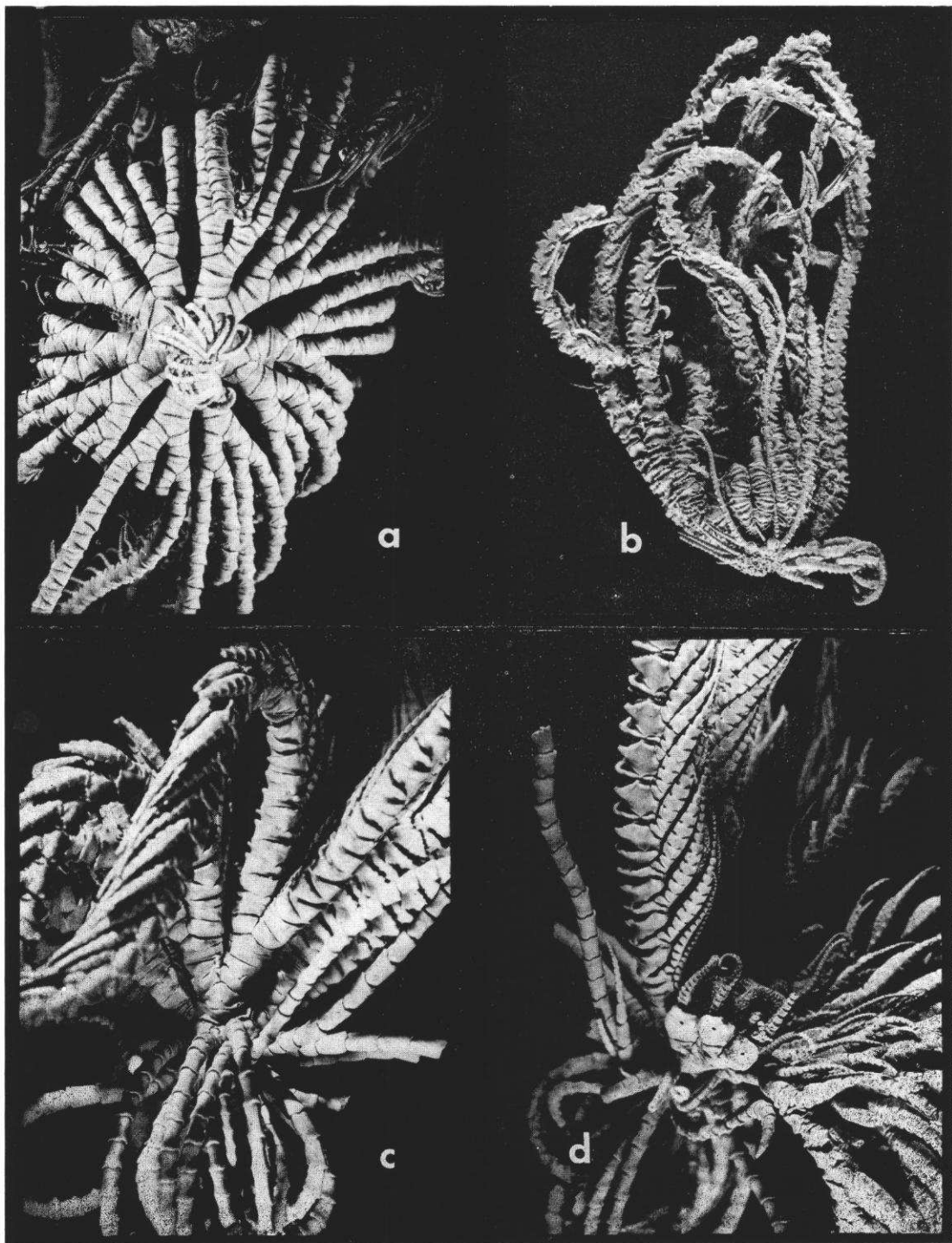
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PLATE I

- a — *Comanthus* sp. aff. *C. samoanus* A. H. Clark : dorsal view.  
b — *Thalassometra electrae* John : dorso-lateral view.  
c, d — *Chondrometra crosnieri* sp. nov., holotype : c, dorso-lateral view ; d, ventro-lateral view.





*PLATE I*

PLATE II

a, b — *Iridometra malagasiensis* sp. nov. : a, holotype, lateral view ; b, paratype, ventral view.

c, d — *Andrometra indica* (A. H. Clark) : c, lateral view ; d, peripheral and apical cirri.

e — *Sarametra* sp.

f-h — *Pentametrocrinus spinosus* sp. nov. : f, holotype, centrodorsal and arm bases ; g, paratype, centrodorsal ; h, proximal section of one arm, with pinnules.

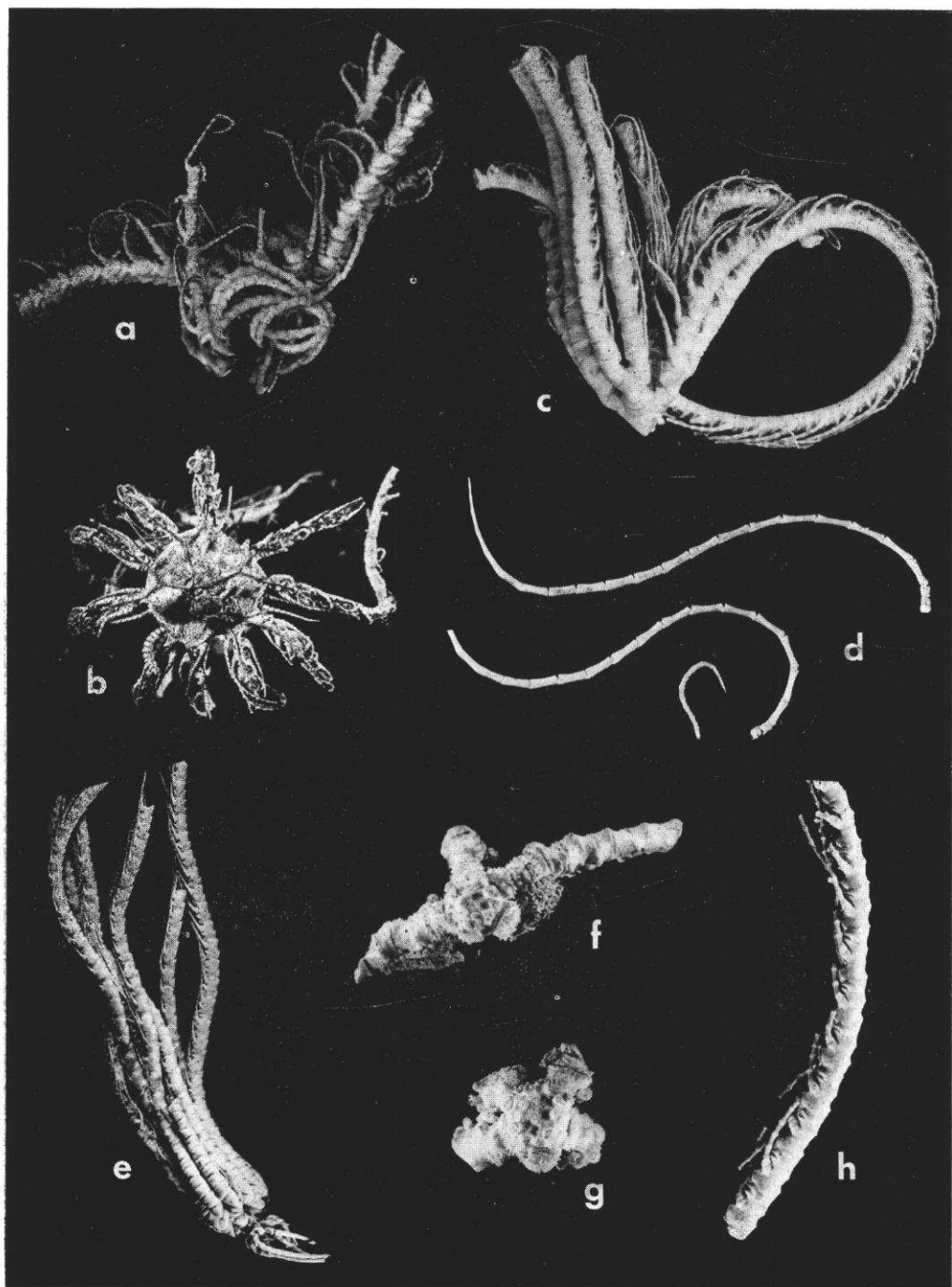


PLATE II