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FOREWORD

Since the first major Symposium on Echinoderm Biology was held in London in 1966, sponsored by the Royal Zoological Society, at least six subsequent meetings have been organised by echinodermologists. These have been held in Washington D.C., U.S.A. (2), Rovinj, Yugoslavia (1), Sydney, Australia (1), London (1); the last two meetings (Sydney and London), within the same year (1978), and Brussels, Belgium. Also, at least four meetings are known to have been held in U.S.S.R. Such has been the surge of interest in the study of echinoderms over the past decade, that there is now a demand for the organisation of regular, and more frequent, meetings. The international representation at these meetings indicates the enormous involvement and co-operation which now exists between colleagues working in this exciting field, the world over.

It is more than evident that the satisfaction and pleasure expressed by Professor Norman Millott, in his foreword to the first Symposium volume (1967), at the resurgence of interest in Echinoderm Biology has been clearly justified and can continue so to be.

This volume presents twelve of the forty-one contributions offered at the Echinoderm Conference, Sydney, 1978. The papers are representative of the wide coverage of topics dealt with during the Conference, including echinoderm palaeontology, physiology, reproduction, ecology, behaviour and taxonomy.

To the speakers and chairmen, and to all those who attended the Sydney Conference, I convey my thanks. I must also thank my Technical Officer, Ms Jan Marshall, and Dr Susan Oldfield (Queen's Fellow at The Australian Museum, February, 1977-1979) for their unstinting assistance in the organisation of the Conference. Thanks are also due to the Department of State Fisheries (N.S.W.), Taronga Park Zoo, McWilliams Wines Pty, Leo Buring Wines Pty, Qantas Airways Ltd, and Trans-Australia Airlines (T.A.A.). To The Australian Museum Society (TAMS) I extend a special thanks for assistance.

This Conference could not have been held without the tremendous support and encouragement afforded to the organiser by Dr D. J. G. Griffin, Director, The Australian Museum, and the very generous financial support of the Trustees of the Museum, to both of whom I offer my very sincere thanks.

DECEMBER 1979

FRANCIS W. E. ROWE

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5. A NEW GENUS AND SPECIES OF OPHIACANTHID BRITTLESTAR (ECHINODERMATA: OPHIUROIDEA) FROM THE KERGUELEN ISLANDS, WITH NEW TAXONOMIC, BIOGEOGRAPHIC AND QUANTITATIVE DATA ON THE ECHINODERM FAUNA

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SUMMARY

Forty-two species have been sampled on the continental shelf of Kerguelen islands during MD04/Benthos cruise of M.S. "Marion-Dufresne" (March 1975). Among the species, the taxonomic position of a few animals is still uncertain. Four ophiuroids however, allow interesting taxonomic and biogeographical comments: a new genus and new species in the family Ophiacanthidae, *Ophioparva blochi*, is described; *Ophiomisidium speciosum* Koehler was known previously only from the tropical deep Atlantic; *Ophiocten hastatum* Lyman and *Ophiocten amitinum* Lyman are placed in the genus *Ophiura*. The fauna has a generally wide antarctic and sub-antarctic distribution, but a few species are endemic to the Kerguelen province. *Ophiura hastata* and the newly recorded *Ophiomisidium speciosum* are also known from the deeper parts of the sub-tropical Atlantic.

On the continental shelf, the average density of echinoderm individuals is 52.8 m⁻² at depths between 10 and 180 metres. In fjords, the density of individuals is high but the number of species is low. On the contrary, outside of the fjords in open sea, the density of individuals is low but the specific diversity is high. Around the Kerguelen islands, the specific and quantitative composition of the echinoderm fauna is correlated with hydrological conditions, in particular with the west wind drift.

INTRODUCTION

The Kerguelen islands are located approximately 50°S latitude, 70°E longitude, at the limit of the antarctic convergence, in the southern part of the Indian Ocean, half-way between South Africa and Australia. The bionomic and physiographic characteristics of the continental shelf of the archipelago, as well as the fjords and interior gulfs and bays, have been the subject of several publications (Desbruyères and Guille, 1973 and 1977; Guille and Soyer, 1976; Guille, 1977a and b; Murail, David and Panouse, 1977).

Since 1972, an intensive programme of bionomic and biological research has been in operation on the benthic fauna of the continental shelf of the Kerguelen islands, in particular on the echinoderms. After the study of the qualitative and quantitative composition of the echinoderm fauna of the Morbihan gulf, virtually an enclosed sea with distinct hydrological and substrate conditions (Guille, 1977a), a similar study has been carried out on the open sea, on the continental shelf surrounding the archipelago, during the MD04/Benthos cruise of "Marion-Dufresne" (Guille, 1977b). Before the present programme, the echinoderm fauna of Kerguelen was essentially known through the major expeditions at the turn of the century and shore collections by Rallier du Baty published by Koehler (1917). More recent studies have encompassed a wider geographic area and added to our taxonomical understanding of related faunas, Hertz (1927), Mortensen (1936), Madsen (1955), and A. M. Clark (1962). The only ecological data, pertaining to the Kerguelen echinoderms, has been given by Arnaud (1974) and Cherbonnier and Guille (1974).

The collection studied here concerns only the samples of the MD04/Benthos cruise taken by an Okean grab with a 0.5 m² opening. In fact, of the many kinds of benthic samplers used in Australian Museum Memoir No. 16, 1982, 67-87.

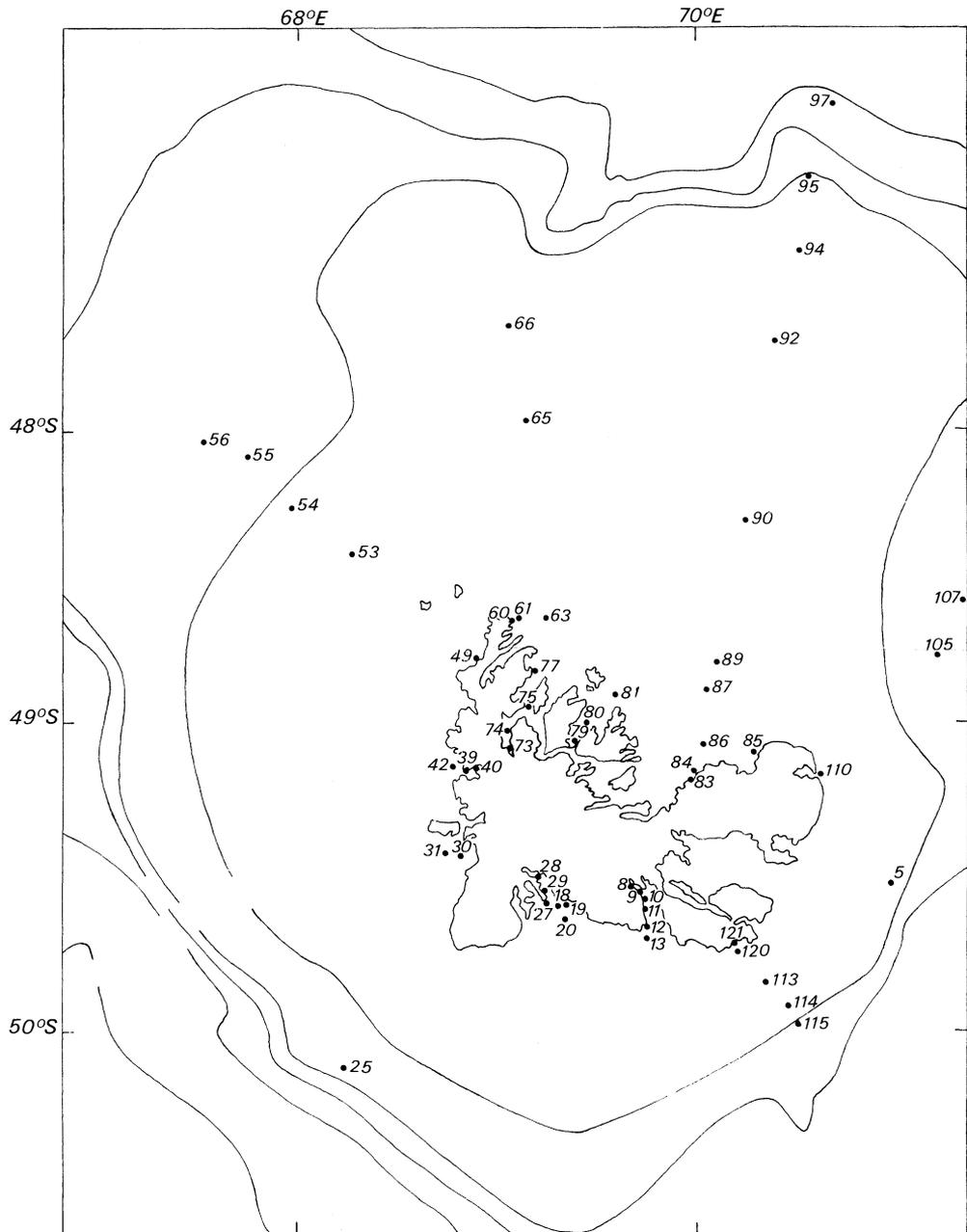


Fig. 1. Map of grab samples of MD04/Benthos cruise.

this expedition (grabs, trawls, dredges, large diameter corer), only the grabs provided a precise quantitative estimate of the fauna present. Because of the great extent of hard substrates (rock platforms and basalt pebbles), especially in the south-east region of the archipelago, the grabs were used at only 63 of the 120 stations. Of these 63 stations (fig. 1) only 45 yielded echinoderms; 34 were at depths of 10-180 metres, 8 at 180-390 metres, and 3 on the continental slope, between 843 and 1390 metres deep (cf Guille, 1977b, for geographic co-ordinates, depth, nature of substrate of each station).

SYSTEMATIC ACCOUNT

Among the 42 species collected (Tables 1 and 2; fig. 1), four species require taxonomic discussion: the discovery of the new species and genus of ophiacanthid, *Ophioparva blochi*; the species *Ophiomisidium speciosum* Koehler, previously known only from the deep tropical Atlantic; and the change of generic position of the species *Ophiura hastata* and *Ophiura amitina*, previously placed in the genus *Ophiocten*.

Family OPHIACANTHIDAE

Ophioparva n. gen.

DESCRIPTION: Disc covered entirely by small well-calcified plates, imbricated, finely granular but naked, among which are visible, only dorsally, small, widely separated radial shields, at the edge of the disc. Oral papillae contiguous, the distal one enlarged, completely closing the buccal orifice; one unpaired infradental papilla; a row of dental papillae. Genital slits elongated and narrow. Arm length up to six times the disc diameter. Arm spines erect, cylindrical. A small tentacle scale.

TYPE SPECIES: *O. blochi* n. sp.

Ophioparva blochi n. sp.

Figs 2 and 3a, b

MATERIAL EXAMINED: 13 specimens (d.d. 2.5-5.5 mm), st.5, February 22nd, 1975, 49°30.0'S-70° 56.0'E, 147 m basalt pebbles and shelly sand (holotype d.d. 5.5 mm) coll. MNHN n° ECOS 20371 and 12 paratypes (d.d. 2.5-5.0 mm) coll. MNHN n° ECOS 20371, 4 specimens (d.d. 3-4 mm), Kerguelen, st. 54, March 3rd, 1975, 48°19.0'S-67°56.5'E, 192 m, basalt gravel and muddy sand. All type and non-type material deposited in the Muséum National d'Histoire Naturelle, Paris.

DESCRIPTION: The disc diameter of the holotype measures 5.5 mm; the arms, broken, measure at least six times the disc diameter. The disc is completely calcified, pentagonal, the interradial edges straight or more or less excavated. The disc plates and the arms all have a finely granular appearance.

The dorsal side of the disc is swollen, covered with small imbricated plates, rounded or oval, among which neither the centrodorsal nor primary plates are apparent. The radial shields are at the edge of the disc, encasing the arm base, and are widely separated by several rows of plates which extend onto the first arm segments. The radial shields are small, three times longer than wide, more or less triangular, approximately equal to the one third of the disc radius (figs. 2a and 3a).

The ventral interradial areas are covered with plates similar to, but larger than, those of the dorsal face of the disc. The genital slits, mostly very narrow, are usually bordered by two or three elongated plates with either fine granules or traces of them. The oral shields are cordate, as long as broad, the distal edge broadly convex, the proximal angle subacute. The adoral shields are large, trapezoidal, more than twice as long as broad, the proximal edge shorter than the distal

Table 1. List of species with station number and specimen number ().

Species	Station number and number (in parenthesis) of specimens
Crinoidea:	
<i>Promachochrinus kerguelensis</i> P. H. Carpenter	5(4); 8(1); 9(1); 18(1); 19(1); 53(2); 54(1).
Echinoidea:	
<i>Ctenocidaris nutrix</i> (W. Thomson)	5(5); 113(1); 114(1).
<i>Sterechinus diadema</i> (Studer)	5(1); 8(3); 62(1); 75(1); 77(1); 84(1); 90(1); 113(1); 114(1).
<i>Abatus cordatus</i> (Verrill)	8(8); 10(1); 12(2); 18(4); 19(1); 30(3); 31(2); 49(2); 60(11); 73(15); 74(5); 79(2); 86(5); 90(1); 110(16); 113(1); 121(8).
<i>Brisaster kerguelensis</i> H. L. Clark	77(1); 89(1); 92(2); 94(1); 97(1); 105(1); 107(1).
Asteroidea:	
<i>Bathybiaster loripes obesus</i> Sladen	66(1); 89(1).
<i>Leptychaster kerguelensis kerguelensis</i> Smith	60(2); 61(1); 84(2); 90(3).
<i>Odontaster meridionalis</i> (Smith)	5(2).
<i>Pteraster affinis lebruni</i> Perrier	5(2).
<i>Porania antarctica antarctica</i> Smith	29(1).
<i>P. antarctica glaber</i> Fisher	5(1); 8(3).
<i>Anasterias perrieri</i> (Smith)	29(1).
<i>Diplasterias meridionalis</i> (Perrier)	8(3); 113(2).
<i>Labidiaster annulatus</i> Sladen	29(1).
<i>Smilasterias scalprifera</i> (Sladen)	5(3).
Holothuroidea:	
<i>Eumolpadia violacea</i> (Studer)	8(4); 10(1); 20(3); 28(2); 42(1); 74(1); 79(3); 81(2); 86(2); 87(3); 89(3).
<i>Pseudocnus laevigatus</i> (Verrill)	5(6); 8(124); 9(1); 10(1); 29(4); 53(141); 55(1).
<i>Staurucucumis liouvillei</i> (Vaney)	5(4); 113(1).
<i>Trachythyone parva</i> (Ludwig)	42(2); 55(1); 74(1); 79(1).
<i>T. denticulata</i> (Ekman)	53(1).
<i>Psolidium incertum</i> (Théel)	5(1).
<i>Heterocucumis georgiana</i> (Lampert)	90(1).
<i>Chiridota</i> sp.	84(1).
<i>Psolus</i> sp.	90(1).
<i>Cucumaria</i> sp.	53(1).
Ophiuroidea:	
<i>Ophiacantha vivipara</i> Ljungman	5(1); 10(1); 53(7).
<i>O. imago</i> Lyman	5(11); 53(22); 90(2); 113(1).
<i>Ophioparva blochi</i> n.g., n.sp.	5(13); 54(4).
<i>Amphiura angularis angularis</i> Lyman	5(1).
<i>A. angularis protecta</i> Hertz	5(4); 8(21); 29(1); 79(1); 89(1); 90(7).
<i>A. antarctica</i> Studer	5(10); 8(157); 9(2); 10(16); 19(1); 60(3); 79(1); 90(12); 113(12).

<i>A. joubini</i> Koehler	55(3); 56(4); 105(3); 107(2).
<i>A. tomentosa</i> Lyman	5(2); 54(3).
<i>Toporkovia antarctica</i> (Lyman)	5(1).
<i>Ophiomysidium speciosum</i> Koehler	5(9); 54(1); 56(2); 66(1); 114(1).
<i>Ophionotus hexactis</i> (Smith)	8(1); 10(3); 19(2); 39(10); 42(6); 60(19).
<i>Ophiogona laevigata</i> Studer	85(5); 107(5).
<i>Ophiurolepis carinata</i> (Studer)	5(3); 90(1).
<i>Ophiura brevispina</i> (Smith)	5(1); 8(41); 9(1); 20(1); 60(1); 79(3); 84(6); 89(10); 90(1).
<i>O. ambigua</i> (Lyman)	5(3); 90(4); 113(1); 114(2).
<i>O. amitina</i> (Lyman)	54(4); 55(1); 85(1); 92(1); 97(5); 115(16).
<i>O. hastata</i> (Lyman)	105(1).

Table 2. Station Co-ordinates and depths

St.No.	Co-ordinates	Depth	St.No.	Co-ordinates	Depth	St.No.	Co-ordinates	Depth
5	49°30.0'S : 70°56.0'E;	147 m	53	48°30.0'S : 68°16.0'E;	155 m	85	49°06.2'S : 70°13.2'E;	50 m
8	49°31.2'S : 69°38.3'E;	22 m	54	48°19.0'S : 67°56.5'E;	192 m	86	49°02.9'S : 69°58.0'E;	95 m
9	49°32.2'S : 69°39.4'E;	111 m	55	48°11.2'S : 67°41.9'E;	275 m	87	48°55.2'S : 70°00.0'E;	106 m
10	49°33.2'S : 69°40.8'E;	58 m	56	48°05.4'S : 67°28.1'E;	39 m	89	48°38.0'S : 70°06.0'E;	105 m
12	49°39.8'S : 69°43.1'E;	36 m	60	48°41.0'S : 69°02.2'E;	17 m	90	48°20.9'S : 70°09.0'E;	128 m
18	49°35.2'S : 69°20.0'E;	18 m	61	48°40.5'S : 69°03.6'E;	50 m	92	47°44.8'S : 70°15.7'E;	167 m
19	49°36.1'S : 69°20.7'E;	70 m	62	48°40.6'S : 69°11.3'E;	61 m	94	47°26.5'S : 70°23.8'E;	170 m
20	49°37.9'S : 69°20.2'E;	117 m	66	47°41.5'S : 69°00.0'E;	202 m	97	46°52.7'S : 70°33.1'E;	920 m
28	49°30.0'S : 69°12.5'E;	89 m	73	49°06.3'S : 69°04.0'E;	30 m	105	48°43.9'S : 71°06.5'E;	843 m
29	49°31.0'S : 69°11.7'E;	23 m	74	49°02.3'S : 69°01.1'E;	31 m	107	48°32.3'S : 71°18.5'E;	1390 m
30	49°27.7'S : 68°50.1'E;	35 m	75	48°58.1'S : 69°08.0'E;	211 m	110	49°10.0'S : 70°34.0'E;	18 m
31	49°27.3'S : 68°46.5'E;	68 m	77	48°51.3'S : 69°10.3'E;	185 m	113	49°51.0'S : 70°19.8'E;	145 m
39	49°08.8'S : 68°54.0'E;	80 m	79	49°04.0'S : 69°21.3'E;	43 m	114	49°54.5'S : 70°24.4'E;	168 m
42	49°09.3'S : 68°46.8'E;	142 m	81	48°57.6'S : 69°28.0'E;	230 m	115	49°59.0'S : 70°29.6'E;	252 m
49	48°48.2'S : 68°50.2'E;	65 m	84	49°08.3'S : 69°56.5'E;	50 m	121	49°41.8'S : 70°08.1'E;	16 m

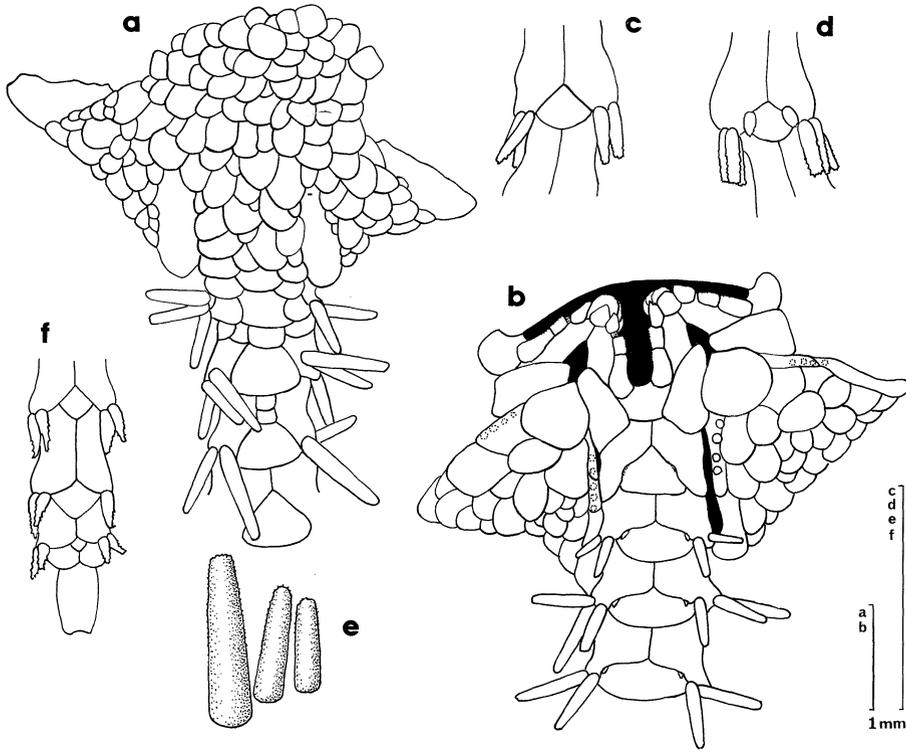


Fig. 2. *Ophioparva blochi* n. gen., n.sp.: a. dorsal view; b. ventral view; c. dorsal view of an arm (13th segment); d. ventral view of an arm (13th segment); e. arm spines (7th segment); f. dorsal view of the end of an arm.

which is broadly contiguous with the first lateral arm plate without arm spines. Proximally the adoral shields and oral plates leave an obvious diastema, the latter only joined in their proximal third. These oral plates are subtriangular, more than twice as long as wide; they bear three lateral oral papillae, the distal papilla the largest rectangular, the middle one also rectangular but shorter, the proximal papilla conical. This proximal papilla is separated from the middle one by a short diastema when the buccal orifice is broadly open in larger sized specimens. There is an unpaired infradental papilla, more developed than the proximal lateral papillae, conical or more or less rounded at the tip; this is immediately beneath a row of 4-5 oval, well-developed dental papillae. The oral and dental papillae are bordered by very fine denticles. The contiguous oral papillae are capable of completely closing the buccal orifice (figs. 2b and 3b).

The first two or three dorsal arm-plates are separated by one or two small rectangular plates, the following dorsal arm plates by lateral plates which become more and more broadly joined on the median line (fig. 2c). The dorsal arm-plates are triangular, the distal edge broadly convex, the proximal angle acute, as wide as long. Towards the distal end of the arm, they become smaller and smaller, although the segments become longer. (fig. 2f). The first ventral arm-plate is pentagonal; the next, larger, is triangular, as wide as long, the distal edge almost straight, the lateral edges convex to the level of the scarcely visible tentacle pore which is without tentacle

scales, the proximal angle sub-acute. The other ventral arm-plates are oval, more than twice as broad as long, the distal edge broadly convex, the proximal edge composed of two sides united by a short acute angle, slightly excavated at the level of the tentacle pore, marked by a tiny pointed tentacle scale (fig. 2d). Towards the end of the arm, the ventral plates become similar in appearance to the dorsal plates, triangular, as long as broad, the distal edge convex, the straight proximal sides joined by a sub-acute angle; the tentacle scale, always single, becomes comparatively more developed, lanceolate and finely denticulate at its extremity. At the end of the arm (fig. 2f) the last two segments become abruptly shorter; the penultimate dorsal and ventral arm-plates become broader while the last ones are much reduced. A long cylindrical, non-segmented section ends the arm.

The arm-spines are raised, 3 in number, cylindrical, slightly narrower and finely denticulate at their extremity. In the proximal part of the arm the dorsal spine is twice as long as the ventral one, which is slightly shorter than the length of the segment. Towards the distal end of the arm the spines become sub-equal, more pointed and more denticulate (fig. 2e).

REMARKS: Specimens of this species were found only in grab samples of two stations and not in the dredge and trawl samples from the same stations or any other stations of the MD04/Benthos cruise.

Although the external skeletal plates are well calcified, their fine granules suggest that the 17 specimens collected were juvenile. But those, whose maximum disc diameter is only 5.5 mm, do not appear to correspond with any species from the sub-antarctic region, or even from the antarctic or Indian Ocean areas. These specimens have not been identified with any known genus, so it is with much hesitation that I place them in a specific family. The characters of *Ophioparva blochi* suggest affinities with several families: the genus *Ophiochytra* of the Amphilepidae by the buccal structure and several other characters, the juvenile Ophiocomidae (for example *Ophiocoma erinaceus*) by the dorsal side of the disc, the Ophiolepidinae by the ventral side of the disc. The link with the Ophiacanthidae is however, most suggested by the arm and buccal structures; sub-rectangular oral papillae occur in certain species of this family.

Family OPHIURIDAE

Ophiomisidium speciosum Koehler

Figs. 3c, d and 4

Ophiomisidium speciosum Koehler, 1914: 34-36, pl. 3, figs 3-4. — Schoener, 1969: 131-133, figs 3-4.

MATERIAL EXAMINED: 9 specimens, st. 5, February 22nd, 1975, 49°30.0'S-70°56.0'E, 147 m, basalt pebbles and shelly sand; 1 specimen, st. 54, March 3rd, 1975, 48°19.0'S-67°56.5'E, 192 m basalt gravel and muddy sand; 2 specimens, st. 56, March 3rd, 1975, 48°05.4'S-67°28.1'E, 390 m, gravel and organic mud; 1 specimen, st. 66, March 12th, 1975, 47°41.5'S-69°00.0'E, 202 m; 1 specimen st. 114, March 15th, 1975, 49°54.5'S-70°24.4'E, 168 m basalt pebbles and sand with bryozoans.

DESCRIPTION: The disc diameters of the 14 specimens measure from 1.5 to 4 mm; the arms, mostly broken, are 5 mm on the largest specimen (incomplete) which is described here.

In dorsal view, the disc appears circular, covered by a small number of large, regular, symmetrical plates (figs. 3c and 4a). The centrodorsal is pentagonal, surrounded by 5 primary plates, much wider than long, trapezoidal, the proximal and distal edges semi-circular. The radial shields are longer than wide, joined proximally, diverging and rounded distally, separated by two small plates: the first of which is triangular, the second semi-circular. A single row of two

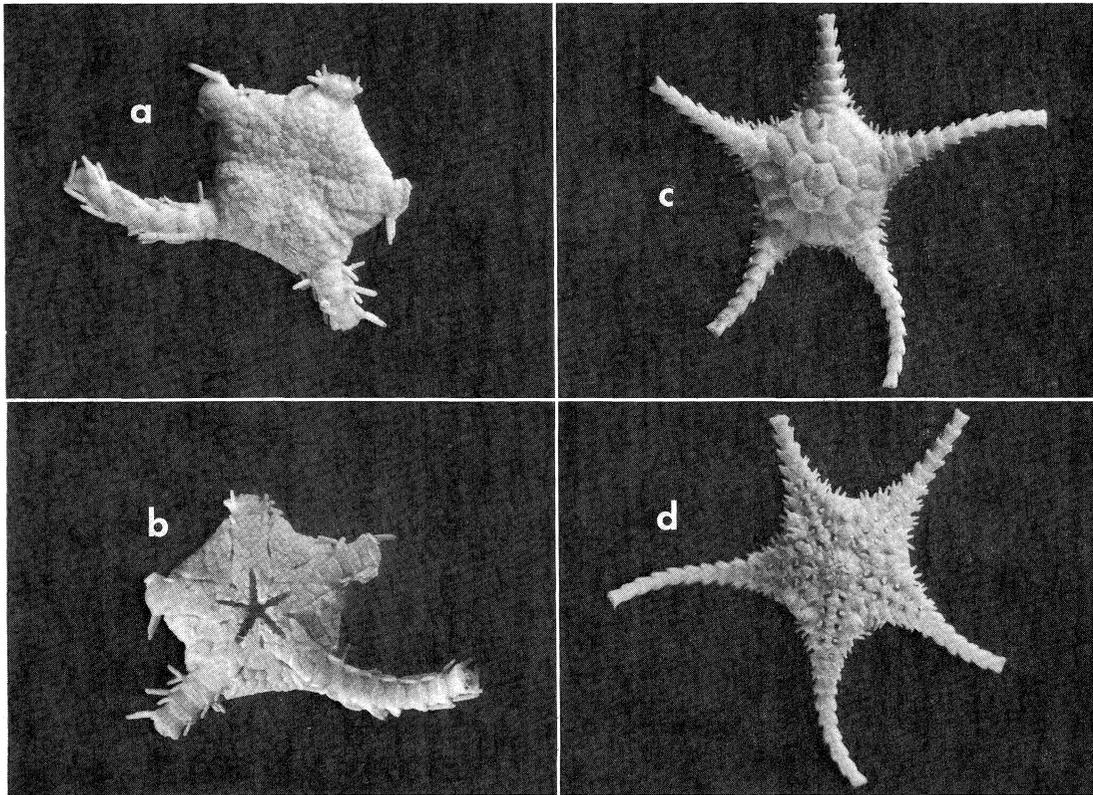


Fig. 3. *Ophioparva blochi* n. gen., n.sp. : a. dorsal view; b. ventral view. *Ophiomisdium speciosum* Koehler: c. dorsal view; d. ventral view.

plates covers the interradial spaces, the first rectangular, much longer than wide, the second trapezoidal and enlarged.

In ventral view, the disc appears pentagonal due to the great development of the first three lateral arm-plates. The interradial spaces are much reduced, covered by a large elongated, fan-shaped, plate, the convex distal edge revealing, subjacent, the edge of the marginal dorsal interradial plate; the ventral interradial plate is bordered by two very narrow plates, sometimes almost entirely hidden by the first lateral arm-plates. The oral shields are small, pentagonal, with an acute proximal angle, the subequal sides joined by an obtuse angle, the distal edge straight. Their sides are distally bordered by an elongated genital plate marking a very narrow genital slit. The adoral shields and oral plates are well-developed; the former are trapezoidal, contiguous, the lateral sides slightly indented by the first arm tentacle pore; the latter sub-triangular, bordered by a very long and narrow distal oral papilla, rectangular, preceded by a much shorter proximal papilla, usually small and difficult to see. The pointed single terminal papilla is likewise small (figs. 3d and 4b).

The first dorsal arm-plate is larger than the following ones, rectangular, sometimes pentagonal, wider than long. The following plates are triangular, with an acute proximal angle, the distal edge slightly convex; further along the arm they become smaller and smaller and have almost disappeared after the 10th segment.

The first five ventral arm-plates are large, becoming smaller towards the distal end of the arm, hour-glass shaped, hexagonal with an obtuse proximal angle, the distal edge broadly convex, the sides excavated at the level of the tentacle pores. The tentacle pores are wide, circular, bordered by a large, sometimes double, oval tentacle scale. Beyond the fifth segment the tentacle pores disappear and the ventral arm-plates become abruptly triangular, of a similar shape to the dorsal arm-plates. They become smaller along the arm, and disappear beyond the 10th segment.

In ventral view, the first four lateral arm-plates are much larger than the rest, of decreasing size, trapezoidal. The distal end of the second pair, sometimes the spines of the first, are visible in dorsal view, beyond the edge of the disc. These first four pairs of lateral arm-plates are barely joined ventrally; dorsally only the fourth pair is much in contact, like the following plates which become much narrower and longer, giving the arm a fusiform appearance. After the fifth segment, like the dorsal and ventral arm-plates, the appearance of the lateral arm-plates is similar on both dorsal and ventral surfaces.

There are two spines on the first arm-segment, then three on all others. These spines are subcylindrical, squat, and are armed with spinelets distally (fig. 4c). They become shorter and shorter along the arm.

Seen under a binocular microscope, the disc and arm-plates appear granular.

REMARKS: Six species of the genus *Ophiomisidium* are presently known, but none has been commonly collected. The species appear to have restricted distributions (fig. 5): *O. pulchellum* (W. Thomson) from the south Atlantic, close to the South Africa coast (275 to more than 3000 m), *O. flabellum* (Lyman) from the Sydney coastal region (60 m), *O. leurum* Ziesenhenné from similar coastal regions of the Galapagos Islands and Chacahua Bay (Mexico) (80-140 m), *O. irene* Fell from the Chatham Islands and Pegasus canyon (New Zealand) (230-1006 m), *O. speciosum* Koehler from the tropical Atlantic (587-1562 m) and *O. mirabile* Smirnov from the Ob'Bank (Antarctic part of the Indian Ocean) (240 m).

Three of these species, *O. flabellum*, *O. irene*, and *O. mirabile* are characterised by a great development of the first pair of lateral arm-plates which, ventrally, are joined at the back of the

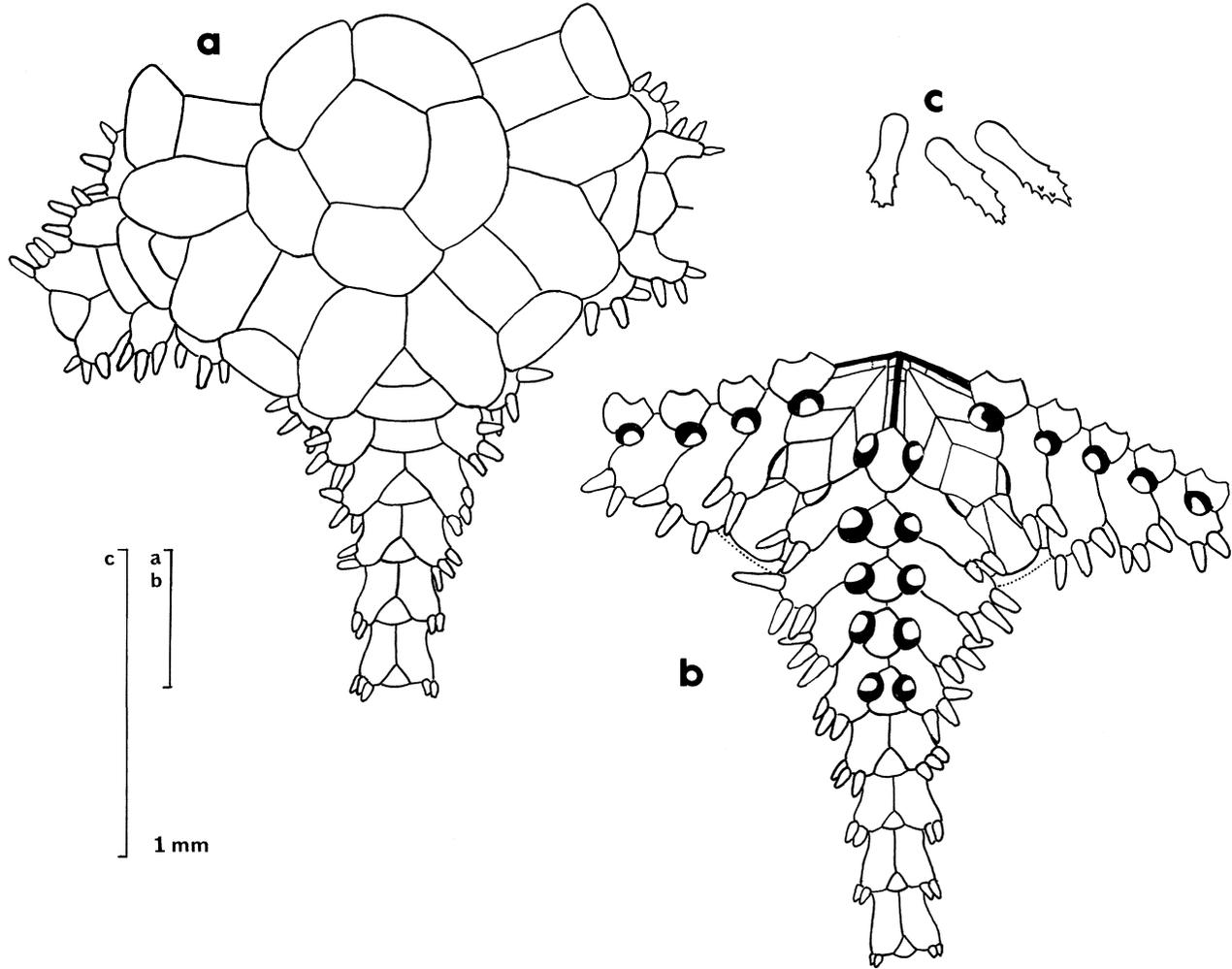


Fig. 4. *Ophiomisdium speciosum* Koehler: a. dorsal view; b. ventral view; c. arm spines (2nd segment).

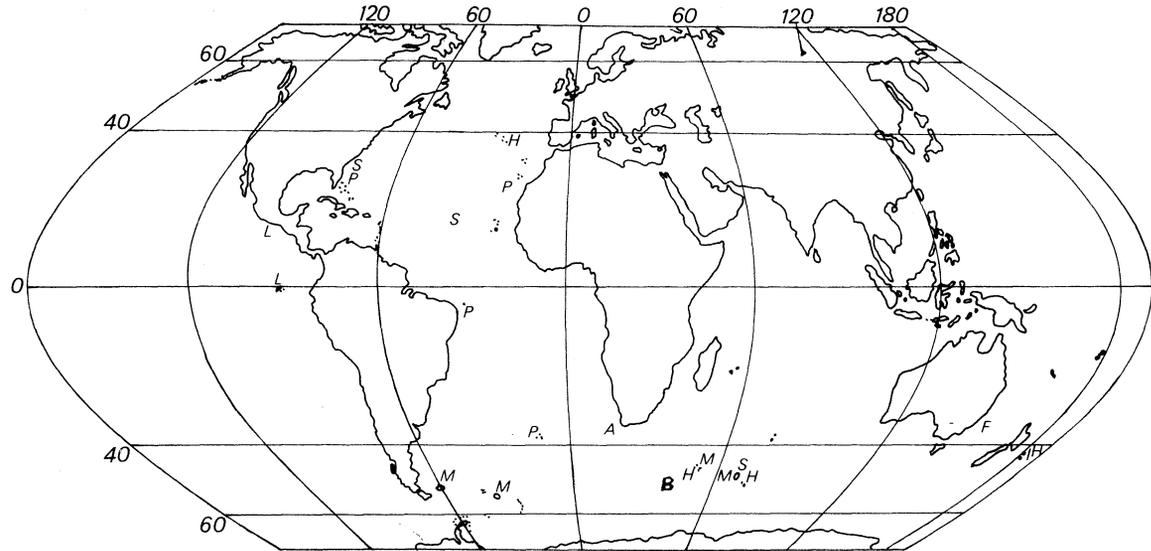


Fig. 5. Geographic distribution of species of genus *Ophiomisdium* and of three species of genus *Ophiura*: a. *Ophiura affinis simulans* (Mortensen); b. *Ophiomisdium mirabile* Smirnov; f. *Ophiomisdium flabellum* (Lyman); h. *Ophiura hastata* (Lyman); i. *Ophiomisdium irene* Fell; l. *Ophiomisdium leurum* Ziesenhenne; m. *Ophiura amitina* (Lyman); p. *Ophiomisdium pulchellum* (W. Thomson); s. *Ophiomisdium speciosum* Koehler.

much reduced oral shield. The three other species, as is characteristic of the genus *Ophiomisidium*, also have the first lateral arm-plates well-developed, but these are no longer joined and reveal, distal to the oral shield, one to three interradiial plates. The genital slits are present only in *O. pulchellum* and *O. speciosum* but Fell (1960) and Baker (1977) record, in new material of *O. irene*, the appearance of tiny genital slits on the largest specimen.

The specimens examined here, agree closely with the original diagnosis of *O. speciosum*. However, Koehler's holotype and five paratypes, housed at the USNM and kindly lent to me by Maureen Downey for examination, are missing a well-developed and rectangular first dorsal arm-plate; this is also missing from my larger specimens. Also, the surface of the disc plates, like the arms of the types, are much more granular than those of the Kerguelen specimens. These two differences however, seem merely to represent intraspecific variation. The evolution of the skeleton structure of *O. speciosum* as a function of size as shown by Schoener (1969), and the appearance of genital slits in the larger specimens of *O. irene* suggests that the criteria used to distinguish the species of the genus *Ophiomisidium* may need reconsidering. The discovery of *O. speciosum* on the continental shelf of the Kerguelen islands and the variability described above, suggests that some of the other "species" of *Ophiomisidium* may not, in fact, be separable from one another. Thus, the only other antarctic species of the genus, *O. mirabile* Smirnov (1977), is very close to *O. irene*, and according to Baker (1977) *O. flabellum* and *O. irene* can be distinguished only by the number and the size of the upper disc-plates and in the shape and relief of the plates on the underside.

The other two genera at present placed in the family Ophiuridae (Ophiurinae), *Astrophiura* Sladen and *Ophiophycis* Koehler are also characterised by the large first lateral arm-plates. With the genus *Ophiomisidium* they could be considered to form a distinct family, the Astrophiuridae Sladen (Cherbonnier and Guille, 1976).

Ophiura amitina (Lyman)

Figs 6a-c and 7c, d

Ophiocten amitinum Lyman, 1878: 100, pl. 5, figs 129-130; 1882, 79, pl. 9, figs 7-9. — Studer, 1885: 16, pl. 2, figs 8a-f. — Koehler, 1907: 288; 1923: 122. — H. L. Clark, 1915; 328. — Mortensen, 1936: 335, fig. 48a. — Madsen, 1967: 138. — Fell, Holtzinger and Sherraden, 1969: pl. 26, map 2. — A. M. Clark and Courtman-Stock, 1976: 192.

MATERIAL EXAMINED: 1 specimen, st. 85, March 9th, 1975, 49°06.2'S-70°13.2'E, 50 m, basalt gravel and pebbles, organic muddy sand; 1 specimen, st. 92, March 10th, 1975, 47°44.8'S-70°15.7'E, 164 m, basalt gravel and pebbles, green muddy sand; 4 specimens, st. 54, March 3rd, 1975, 48°19.0'S-67°56.5'E, 92 m, basalt gravel and muddy sand; 16 specimens, st. 115, March 15th, 1975, 49°59.0'S-70°29.6'E, 252 m, fine sand with bryozoans; 1 specimen, st. March 3rd, 1975, 48°11.2'S-67°41.9'E, 275 m, fine sand, 5 specimens, st. 97, March 11th, 1975, 46°52.7'S-70°33.1'E, 920 m, mud. (d.d. range 3-7 mm).

REMARKS: Two species of the genus *Ophiocten* are known from the southern part of the Indian Ocean: *O. amitinum* Lyman from the Kerguelen islands and *O. hastatum* Lyman. Examination of the "Challenger" types, deposited in the British Museum and loaned to me by A. M. Clark, reveal several errors in Lyman's diagnoses and figures, which have doubtless led to confusion of the species.

Lyman, in effect, distinguishes the two species mainly by the presence of sub-equal arm-spines, a smaller, more triangular first ventral arm-plate in *O. amitinum*, and oral papillae of different shapes. In fact, in all the specimens of *O. amitinum* from the "Challenger", the first arm-segments bear an upper spine thicker and twice as long as the next two; the oral papillae and

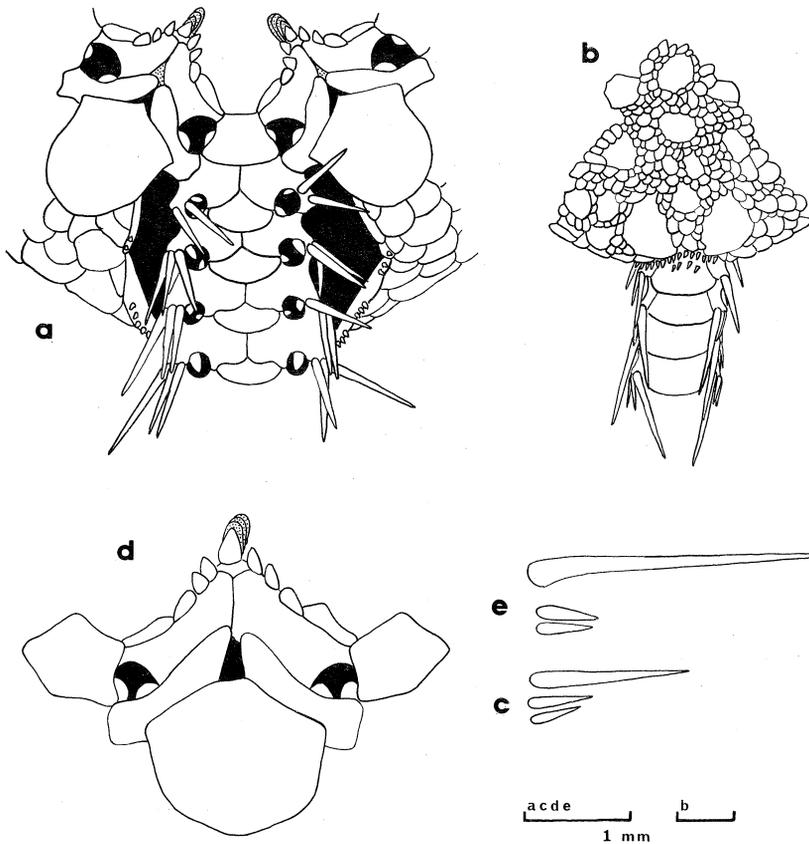


Fig. 6. *Ophiura amitina* (Lyman): a. ventral view; b. dorsal view; c. arm spines (5th segment). *Ophiura hastata* (Lyman): d. one jaw; e. arm spines (5th segment).

the first ventral arm-plate are similar to those of *O. hastatum*.

As a further point of confusion, two sub-species of *O. amitinum*, *O. amitinum microplax* and *O. amitinum simulans* were distinguished by Mortensen (1933, 1936) and their distribution seems limited to South Africa. However, A. M. Clark and J. Courtman-Stock (1976) showed that these two sub-species should really be reunited and linked with the north Atlantic *Ophiura affinis*. These two authors stress that the distinction between the genera *Ophiura* and *Ophiocten* is "clearly very slight with *Ophiura affinis* bridging the gap between them".

While the forms *hastatum*, *amitinum* and *affinis simulans* are very distinct (Table 3), they appear too close to be generically separated. Until there has been a worldwide revision of the generic limits of the family Ophiuridae, these three forms must be placed in the same genus *Ophiura*, as A. M. Clark and J. Courtman-Stock have already concluded for one of them.

Ophiura amitina is considered by Madsen (1967) as a common circumpolar species, principally sub-antarctic, but in the South African region it is replaced by *O. affinis simulans* (Fig. 5) which is very abundant in some biotopes (Day, Field and Penrith, 1970).

***Ophiura hastata* (Lyman)**

Figs 6d, e and 7a, b

Ophiocten hastatum Lyman, 1878: 103, pl. 5, figs 133-134; 1882: 82, pl. 9, figs 10-11. — Koehler, 1898: 42, pl. 7, figs 32-33. — Fell, 1958: 29.

Ophiocten longispinum Koehler, 1896a: 204; 1896b: 243.

MATERIAL EXAMINED: 1 specimen, st. 105, March 13th, 1975, 48°43.0'S-71°06.5'E, 843 m, mud (d.d. = 13 mm).

REMARKS: *Ophiura hastata* does not appear to have been found since the expeditions of the "Challenger" and "Hirondelle", and is known from widely separated localities, and from only a few specimens: the central Atlantic (Azores), the southern Indian Ocean and New Zealand, always at depths of more than 1800 m. The discovery of *O. hastata* at only 843 m is an important extension of bathymetric range.

As I have indicated in the discussion about the taxonomic problems relating to *O. amitina*, the similar characteristics of these two species and the errors in Lyman's descriptions have caused confusion between them, and this explains to some extent the absence of data on *O. hastata*. In presently available collections *O. hastata* can be easily distinguished from *O. amitina* by the ornamentation of the dorsal face of the disc, the wider than long oral shields, and the very long upper arm-spine. But one must also note that all the known specimens of *O. hastata* are of a larger size than those of *O. amitina*.

BIOGEOGRAPHY OF SPECIES COLLECTED

Except for the discovery of *Ophioparva blochi* and *Ophiomisidium speciosum*, the species collected have a wide antarctic and sub-antarctic distribution, or are endemic to the Kerguelen islands or the Kerguelen province, as defined by Koehler (1912), which includes Heard, Crozet, Marion and Prince Edward Islands. However these endemic species are very closely related to circum-antarctic species.

Thus, the single species of crinoid collected, *Promachochrinus kerguelensis*, is the most widespread and abundant crinoid in the antarctic and sub-antarctic region between 10 and 1080 metres deep. Three of the four echinoids are endemic to the Kerguelen islands; one, *Ctenocidaris nutrix*, has also been found around the Crozet islands. The number of asteroid species is low compared with previous studies, probably due to the sampling method used. Their collection was in fact, almost limited to two stations: one at the south-east of the archipelago, at the base of the fjord of Table Bay (st. 29, 23 m), the other at the entrance of Royal Pass leading to the Morbihan Gulf (st. 5, 147 m). Of the asteroids, only *Anasterias perrieri* is endemic. Two of the ophiuroids are similarly endemic, and are also the most common and most abundant ophiuroids in the littoral sedimentary substrates: *Amphiura antarctica* (synonymous with *A. eugeniae* Koehler 1917) and *Ophiura brevispina*. *Amphiura joubini* is only found at Kerguelen at depths of more than 275 metres, although this species, littoral in the Antarctic, is considered by Fell et al. (1969) as the only eurythermal form of a stenothermål genus (*Hemilepis*). Of the holothurians identified, only *Eumolpadia violacea* is endemic and similarly very common in the muddy substrates to a depth of 250 metres.

ASSESSMENT OF QUANTITATIVE DATA OF SPECIES COLLECTED

Thirty-four of the forty-two species collected were only present at one to five of the sixty-three stations sampled, and their densities were always low; eight other species were more

Table 3. Relationships between *Ophiura hastata*, *O. amitina* and *O. affinis simulans*

<i>Ophiura hastata</i> (figs. 6d-e; 7a-b)	<i>Ophiura amitina</i> (figs. 6a-e; 7c-d)	<i>Ophiura affinis simulans</i> (fig. 7e-f)
Radial shield separated slightly divergent; $l/w = 3/1$; $l = +1/3r$	Radial shields small, separated, proximally divergent; $l/w = 5/3$; $l = -1/3r$	Radial shields separated, slightly divergent; $l/w = 2/1$; $l = +1/3r$
Centrodorsal and primary plates little-developed, and barely visible	Centrodorsal and primary plates well-developed, obvious	Centrodorsal and primary plates well-developed, obvious
Spines of arm-combs not more than twice as long as wide	Spines of arm-combs not more than twice as long as wide	Spines of arm-combs spiniform more than three times as long as wide
Oral shields more wide than long or as long as wide	Oral shields longer than wide	Oral shields longer than wide
Upper arm-spine of first proximal segments thickened more than 4 times longer than the next two	Upper arm-spine of first proximal segments thickened more than twice as long as the next two	Arm-spines sub-equal
Upper surface of arm convex d.d. 8 to 14 mm	Upper surface of arm convex d.d. 3 to 8 mm	Upper surface of arm carinate d.d. to 7.5 mm

(l and w = length and width of radial shields; r = ray of disc; d.d. = diameter of disc).

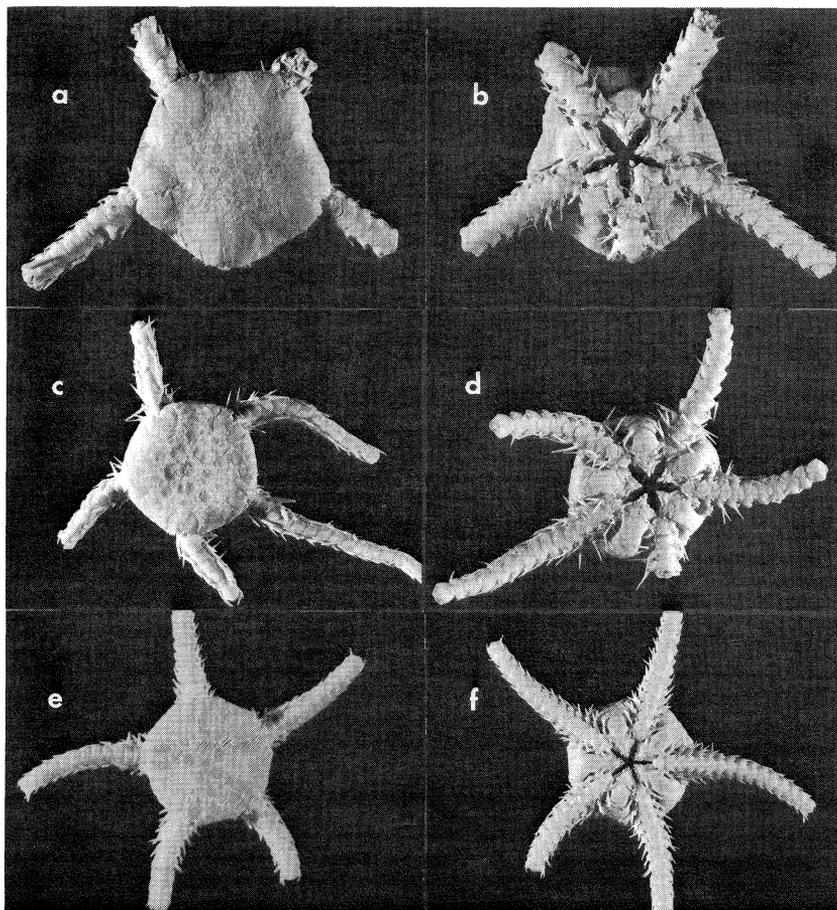


Fig. 7. *Ophiura hastata* (Lyman) (type Challenger 82, 12, 23, 352, British Museum): a. dorsal view; b. ventral view. *Ophiura amitina* (Lyman) (type Challenger Kerguelen 82, 12, 23, 346, British Museum): c. dorsal view; d. ventral view. *Ophiura affinis simulans* (Mortensen) (type Discovery South Africa 1936, 12, 30 144, British Museum): e. dorsal view; f. ventral view.

common.

The crinoid *Promachochrinus kerguelensis*, present at eight stations between 18 and 200 metres depth, had a maximum density of 8 specimens/m² (st. 5, 147 m). *Abatus cordatus* is the most common echinoderm at Kerguelen, present at 17 stations, at 8-147 metres depth and reaching a density of 32 specimens/m² at the mouth of Lac Marville, at the east of the archipelago, at 18 metres depth. The density of this euryhaline urchin is also relatively high in the sands of the lower intertidal zone where many juveniles occur (Guille and Lasserre, 1979). The ophiuroid *Ophionotus hexactis*, common throughout the antarctic and sub-antarctic, was present in only six stations.

It had a maximum density of 38 specimens/m² in mud, at 18 metres depth, in the small bay

of Port Christmas at the far north of Kerguelen (st. 60).

One station (st. 8) in the south of Kerguelen at the base of the fjord of Swains Bay, at a depth of 22 metres and in mud, yielded the highest densities of the five other most common species: *Sterechinus diadema* (6 specimens/m², present at 8 other stations), *Amphiura antarctica* (314 specimens/m², present at 8 other stations), *Ophiura brevispina* (82 specimens/m², present at 7 other stations), *Eumolpadia violacea* (8 specimens/m², present at 10 other stations) and *Pseudocnus laevigatus* (248 specimens/m²). This last holothurian, present at 6 other stations, was more abundant at one of these others (st. 53), situated at the north west of Kerguelen, 162 metres depth, in pebbles and basalt blocks (282 specimens/m²).

Station 8 also had the highest total density of echinoderms with 958 specimens/m² for 14 species present. The station yielding the highest number of species, with 25 species/0.5 m² for 218 specimens/m², was in the open sea, to the east of the archipelago, opposite the entrance of Royal Pass which gives access to Morbihan Gulf, a pass usually swept by strong oceanic currents (st. 5, 147 m). Because of the sudden shoaling here, upwellings are frequently produced.

The average densities of species and specimens for all the 49 stations where echinoderms were present, are respectively 3.7 species/0.5 m² and 52.8 specimens/m². These results, or more precisely those limited to the same bathymetrical range as the data obtained in Morbihan Gulf, indicate, by comparison with the latter (Table 4), a greater density of species and a lower numerical density in the stations outside the gulf, really a separate sea, with a surface of 700 km². The significance of these differences is even more evident if the data obtained in the MD04/Benthos stations situated in fjords is separated from those from stations on the continental shelf (Table 4; fig. 8).

The diversity of the echinoderms is thus greater, and their numerical density lower on the exterior continental shelf than in the protected fjords and bays. This qualitative and quantitative distribution is related to the topography and its effect on hydrological circulation. In fact, the fauna of fjords and interior gulfs is relatively isolated from the strong oceanic currents where as the exterior continental shelf benefits from the supply of nutritive salts and planktonic larvae from the oceanic environment. The south coast of Kerguelen, comprised partly of fjords (e.g. the very rich station 8) is enriched by the general south-west to north-east direction of hydrological circulation (Murail et al., 1977; fig. 8).

The kind of distribution shown by the echinoderms at Kerguelen has been noted for other groups of benthic invertebrates, for example the ascidians (Monniot, 1979). However, it is still only a preliminary observation, obtained from few samples. Some stations, moreover, are exceptions such as station 53 (162 m) at the north east of Kerguelen where the numerical density is markedly raised due to the abundance only of the holothurian *Pseudocnus laevigatus*, whose mode of reproduction produces a patchy distribution.

Thus, the collection from the MDO4/Benthos cruise confirms again the qualitative and quantitative richness of the echinoderm fauna of the Kerguelen islands (Guille, 1977a).

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Table 4. Summary of species and specimen densities from Guille (1977a) and this work

	Bathymetric range	Number of samples	Number of species	Average density of species	Average density of individuals
Morbihan Gulf (Kerguelen I.) Smith McIntyre grab 0.1m ² (Guille, 1977a)	5-180 m	130	36	2.9 sp/0.1 m ²	137.7 ind./m ²
Kerguelen I. Okean grab, 0.5 m ² (this work)	10-1390 m	49	42	3.7 sp/0.5m ²	52.8 ind./m ²
Stations at depths comparable to Morbihan Gulf stations	10-180 m	38	40	4.3 sp/0.5m ²	62 ind./m ²
Stations in fjords	10-230 m	17	18	3.6 sp/0.5 m ²	75.5 ind./m ²
Stations in open sea	18-1390 m	32	33	4.2 sp/0.5 m ²	36.7 ind./m ²

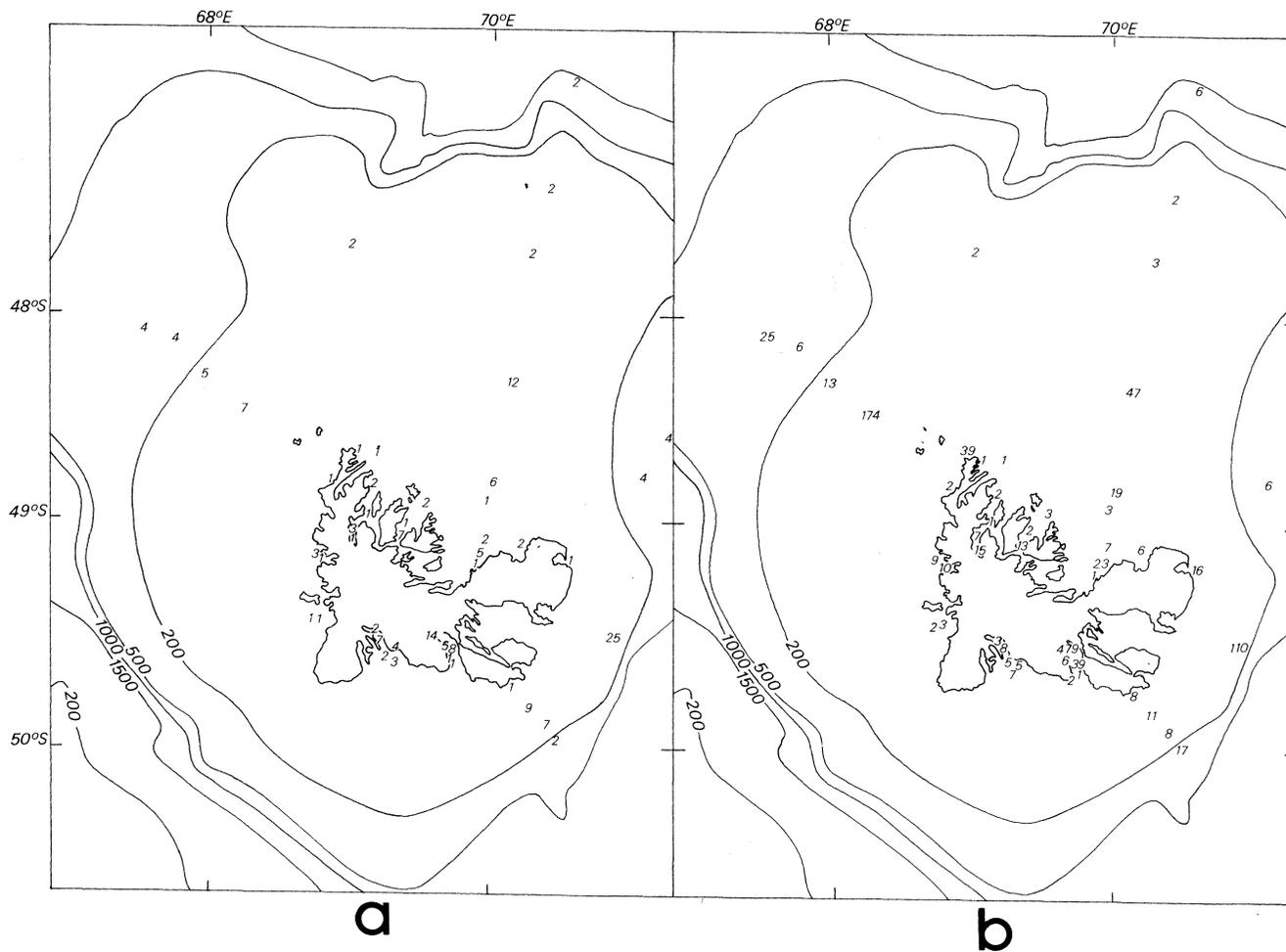


Fig. 8. Maps of grab samples of MD04/Benthos cruise: **a**. number of echinoderm species in each station for 0.5 m²; **b**. number of Echinoderm individuals in each station for 0.5 m².

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