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REPORT ON SELECTED SPECIES OF BANZARE AND ANARE HOLOTHUROIDEA, WITH REVIEWS OF *MESERES* LUDWIG AND *HETEROCUCUMIS* PANNING (ECHINODERMATA)

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Abstract

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Selected Holothuroidea species collected by The British, Australian and New Zealand Antarctic Research Expedition (BANZARE) 1929–1931 from Kerguelen I. and eastern Antarctica, are listed. Relevant species of Holothuroidea also collected from the Kerguelen region (Heard I.) and eastern Antarctica by the Australian National Antarctic Research Expeditions (ANARE) 1985–1997 are reported and discussed. The genera *Meseres* Ludwig and *Heterocucumis* Panning are reviewed. The genus *Ekmocucumis* Heding and subgenus *Ekmocucumis* Panning are junior synonyms of *Staurocucumis* Ekman. A new Antarctic genus of the Cucumariidae, *Psolicrux*, and a new species of Synallactidae, *Meseres spiculiferus*, are described. Systematic and distribution notes are provided for *Chiridota pisanii* Ludwig, *Taeoniogyrus contortus* (Ludwig), *Bathyplores bongraini* Vaney, *B. gourdoni* (Vaney), *Meseres globigerinae* (Hérard), *M. hyalegerus* Sluiter, *M. involutus* Sluiter, *M. macdonaldi* Ludwig, *M. occultatus* (Marenzeller), *M. peripatus* Sluiter, *M. propinquus* (Fisher), *M. torvus* (Théel), *M. trachus* (Sluiter), *M. villosus* (Théel), *Mesothuria bifurcata* Hérard, *Pseudostichopus atlanticus* Perrier, *Heterocucumis godeffroyi* (Semper), *H. steineri* (Ludwig), *Psolicrux coatsi* (Vaney), *Staurocucumis liouvillei* (Vaney), *Trachythyrone lechleri* (Lampert), *Paracucumis turricata* (Vaney), *Amperima robusta* (Théel), *Rhipidothuria racovitzai* Hérard and *Laetmogone wyvillethomsoni* Théel. *Pseudostichopus globigerinae* Hérard is removed from the synonymy of *Pseudostichopus villosus* Théel, and assigned to *Meseres*. *Pseudostichopus propinquus* Fisher is removed from the synonymy of *Pseudostichopus pustulosus* Sluiter, and assigned to *Meseres*. A list of species with original and current name combinations, and a summary of new distributions, are tabulated.

Introduction

The British, Australian and New Zealand Antarctic Research Expedition (BANZARE), under the command of Sir Douglas Mawson, comprised two voyages by the *Discovery*. The first voyage left Cape Town in October 1929 and worked off southern Africa, Crozet, Kerguelen, Heard, eastern Antarctica (40° to 80°E), and south-western Australia. The second voyage left Hobart in November 1930 and worked off southern Tasmania, Macquarie, Scott, eastern Antarctica (60° to 180°E), and western Tasmania. Station data were detailed by Johnston (1937). In the *Reports* following the Expedition, John (1939) reported on the Crinoidea, Mortensen (1950) on the Echinoidea, A.M. Clark (1962) on the Asteroidea, and Madsen (1967) on the Ophiuroidea. The remaining Echinodermata from BANZARE,

the Holothuroidea, are reported in part here. Material examined comprised 20 lots of 12 species, including all of the Aspidochirotrida and Elaspodida with some Apodida and Dendrochirotrida. BANZARE Reports are no longer published by the University of Adelaide. This collection is lodged in the South Australian Museum.

Recent holothurian collections, taken by the Australian National Antarctic Research Expeditions (ANARE) 1985–1997 from Heard I. and eastern Antarctica, are held in part by Museum Victoria. Some ANARE species are referred to in this report to augment the data provided by the BANZARE material, for the purposes of refining the on-going systematic account of the Antarctic and Kerguelen region holothurians and clarifying which species have a distribution including the southern coasts of South America, Antarctic

coast, and Kerguelen region. Determination of some BANZARE lots necessitated a review of the genera *Meseres* Ludwig, 1894 and *Heterocucumis* Panning, 1949. A new Antarctic genus of the Cucumariidae, *Psolicrux*, and new species of Synallactidae, *Meseres spiculiferus*, are described. *Pseudostichopus globigerinae* Hérouard, 1923 is removed from the synonymy of *Pseudostichopus villosus* Théel, 1886, and referred to *Meseres*. *Pseudostichopus propinquus* Fisher, 1907 is removed from the synonymy of *Pseudostichopus pustulosus* Sluiter, 1901, and referred to *Meseres*. The genus *Ekmocucumis* Heding, 1942 and subgenus *Ekmocucumis* Panning, 1949 are synonymised with *Staurocucumis* Ekman, 1927, and *Heterocucumis* Panning, 1949 is raised to generic status. All species considered in this report, with new synonymies and new combinations, are listed in Table 1; BANZARE species are listed in Table 2; and new extensions of distribution are listed in Table 4.

Some of the material examined provided evidence of possible regional variations for some species, but in the absence of growth series and adequate numbers of specimens the evidence is considered to be insufficient for the establishment of additional species. Variations, principally in size, are noted.

Abbreviations for institutions are: AM, Australian Museum, Sydney; BMNH, The Natural History Museum, London; IRSNB, Institut Royal des Sciences naturelles de Belgique, Brussels; MNHN, Muséum National d'Histoire Naturelle, Paris; NMV, Museum Victoria, Melbourne, Australia; SAM, South Australian Museum, Adelaide; USNM, US Museum of Natural History, Smithsonian Institution, Washington; ZIM, Zoological Institute and Museum, Hamburg; ZMA, Zoologisch Museum, Amsterdam; ZMUC, Zoological Museum, University of Copenhagen.

The Magellanic region refers to southern Chile, southern Argentina, and the Falkland Is. The Kerguelen region refers to depths of less than 600 m around Kerguelen, Heard, and the McDonald Is. Bathyal refers to depths of 200–2600 m; abyssal to 2600–6000 m (following Hansen, 1975).

Order Apodida Brandt

Chiridotidae Östergren

Chiridota pisanii Ludwig

Chiridota pisanii Ludwig, 1886: 29–30, pl. 2 fig. 14.

Chiridota purpurea.—Théel, 1886a: 15, 35, pl. 2 fig. 1 [non *Trochodota purpurea* (Lesson, 1830)].

Chiridota pisanii.—Ludwig, 1892: 359.

Complete synonymy. See Pawson (1964: 464).

Material examined Heard I., 52°41'–53°13'S, 72°56'–73°41'E, 120–228 m [ANARE, NMV F84977–84979 (3 specimens)]. Argentina, Tierra del Fuego, 54°00'S, 67°24'W, 0 m, 1999 [NMV F86016 (2)].

Type locality. Calbuco, Chile.

Distribution. Magellanic region, from Seno Reloncavi in Chile to 43°S on the coast of Argentina, Falkland Is, 0–102 m (summary by Pawson, 1969). Kerguelen region, Heard I., 120–228 m (this paper).

Remarks. The specimens of *C. pisanii* from Heard I. and Tierra del Fuego were identical in tentacle number (12), tentacle digits (5–7 pairs, distalmost pair largest), and ossicle complement [wheels, up to 0.10 mm diameter, in papillae clusters; short unbranched rods (miliary granules), 0.04–0.05 mm long, in longitudinal muscles; curved tentacles rods, typically 0.08–0.10 mm long; lacking sigmoid hooks]. Théel (1886a) gave a similar description of specimens of *C. pisanii* from the Falkland Is (as *Chirodota purpurea*), but reported wheel diameters up to 0.16 mm. Pawson (1964) reported bracket-shaped tentacle rods with an average length of 0.05 mm in material from southern Chile. ANARE specimens of *C. pisanii* taken off Heard I. are the first record for the Kerguelen region, where the species is reported at a greater depth. *C. pisanii* has not been reported for Antarctica.

Taeniogyrus contortus (Ludwig)

Chirodota contorta Ludwig, 1875: 80–81, pl. 6 figs 6a–c.

Taeniogyrus contortus.—H.L. Clark, 1907: 121–123, pl. 7 figs 8–13.

Taeniogyrus cf. *contortus*.—O'Loughlin et al., 1994: 553, 554.

Complete synonymy. See Pawson (1964: 466–467).

Material examined. Syntypes (?). Argentina, Santa Cruz, east of Grande Bay, 51°34'S, 68°00'W, 91 m, 1888 [*Albatross* Stn 2771, USNM 19826 (3)].

Other material. Chile, Inutil Bay, 53°35'S, 69°45'W, 37–46 m, 1969 [USNM E33679 (13)]; 53°34'S, 69°59'W, 82–91 m, 1970 [USNM E33715 (9)]. Eastern Antarctica, off Wilkes Land, 66°18'S, 110°32'E, 101 m, 1961 [USNM E33725 (25)]; MacRobertson Shelf, 66°55'–67°16'S, 62°32'–68°59'E, 109–216 m [ANARE, NMV F68691 (20), F69099 (2), F69100 (2)]. Kerguelen I., Royal Sound, 49°28'S, 70°04'E, 4–5 m, 1929 [BANZARE Stn 12, SAM K1839 (1)]; 49°30'S, 69°48'E, 2–20 m, 1930 [BANZARE Stn 49, SAM K1840 (1)].

Table 1. Index of species in paper, including new synonymies and new combinations.

Original combination	Current combination or senior synonym	Family
<i>abyssorum</i> , <i>Cucumaria</i> , Théel, 1886	<i>Staurocucumis abyssorum</i> (Théel, 1886)	Cucumariidae
<i>acaudum</i> , <i>Molpadiodemas</i> , Heding, 1935	<i>Pseudostichopus atlanticus</i> Perrier, 1898	Synallactidae
<i>alatus</i> , <i>Pseudostichopus</i> (<i>Pseudostichopus</i>), Imaoka, 1990	<i>Pseudostichopus alatus</i> Imaoka, 1990	Synallactidae
<i>aleutianus</i> , <i>Pseudostichopus</i> , Ohshima, 1915	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>antarctica</i> , <i>Cucumaria</i> , Vaney, 1906	<i>Heterocucumis steineni</i> (Ludwig, 1898)	Cucumariidae
<i>antarctica</i> , <i>Paracucumis</i> , Mortensen, 1925	<i>Paracucumis turricata</i> (Vaney, 1906)	Paracucumidae
<i>arenosus</i> , <i>Pseudostichopus</i> , Ohshima, 1915	<i>Pseudostichopus arenosus</i> Ohshima, 1915	Synallactidae
<i>atlanticus</i> , <i>Pseudostichopus</i> , Perrier, 1898	<i>Pseudostichopus atlanticus</i> Perrier, 1898	Synallactidae
<i>belyaevi</i> , <i>Amperima</i> , Gebruk, 1988	<i>Amperima belyaevi</i> Gebruk, 1988	Elpidiidae
<i>bifurcata</i> , <i>Mesothuria</i> , Hérourard, 1901	<i>Mesothuria bifurcata</i> Hérourard, 1901	Synallactidae
<i>bistriatum</i> , <i>Psolidium</i> , Ludwig and Heding, 1935	<i>Psolirux coatsi</i> (Vaney, 1908)	Cucumariidae
<i>bongraini</i> , <i>Bathyplores</i> , Vaney, 1914	<i>Bathyplores bongraini</i> Vaney, 1914	Synallactidae
<i>coatsi</i> , <i>Psolidium</i> (<i>Cucumaria</i>), Vaney, 1908	<i>Psolirux coatsi</i> (Vaney, 1908)	Cucumariidae
<i>conspicua</i> , <i>Cucumaria</i> , Vaney, 1908	<i>Psolirux coatsi</i> (Vaney, 1908)	Cucumariidae
<i>contorta</i> , <i>Chirodota</i> , Ludwig, 1875	<i>Taeniogyrus contortus</i> (Ludwig, 1875)	Chiridotidae
<i>denticulata</i> , <i>Cucumaria</i> , Ekman, 1927	<i>Heterocucumis denticulata</i> (Ekman, 1927)	Cucumariidae
<i>dilatatorbis</i> , <i>Pseudostichopus</i> (<i>Pseudostichopus</i>), Imaoka, 1978	<i>Pseudostichopus dilatatorbis</i> Imaoka, 1978	Synallactidae
<i>fuscivinculum</i> , <i>Bathyplores</i> , Gutt, 1990	<i>Bathyplores bongraini</i> Vaney, 1914	Synallactidae
<i>globigerinae</i> , <i>Pseudostichopus</i> , Hérourard, 1923	<i>Meseres globigerinae</i> (Hérourard, 1923)	Synallactidae
<i>godeffroyi</i> , <i>Cucumaria</i> , Semper, 1868	<i>Heterocucumis godeffroyi</i> (Semper, 1868)	Cucumariidae
<i>godfroyi</i> , <i>Cucumaria</i> , Vaney, 1914	<i>Heterocucumis steineni</i> (Ludwig, 1898)	Cucumariidae
<i>gourdoni</i> , <i>Synallactes</i> (?), Vaney, 1914	<i>Bathyplores gourdoni</i> (Vaney, 1914)	Synallactidae
<i>grandis</i> , <i>Cucumaria</i> , Vaney, 1906	<i>Staurocucumis grandis</i> (Vaney, 1906)	Cucumariidae
<i>hassleri</i> , <i>Thyone</i> , Théel, 1886	<i>Trachythione lechleri</i> (Lampert, 1885)	Cucumariidae
<i>hyalegerus</i> , <i>Meseres</i> , Sluiter, 1901	<i>Meseres hyalegerus</i> Sluiter, 1901	Synallactidae
<i>ingolfi</i> , <i>Plicastichopus</i> , Heding, 1942	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>involutus</i> , <i>Meseres</i> , Sluiter, 1901	<i>Meseres involutus</i> Sluiter, 1901	Synallactidae
<i>japonensis</i> , <i>Pseudostichopus</i> (<i>Trachostichopus</i>), Imaoka, 1978	<i>Meseres hyalegerus</i> Sluiter, 1901	Synallactidae
<i>lechleri</i> , <i>Thyone</i> (<i>Thyonidium</i>), Lampert, 1885	<i>Trachythione lechleri</i> (Lampert, 1885)	Cucumariidae
<i>liouvillei</i> , <i>Cucumaria</i> , Vaney, 1914	<i>Staurocucumis liouvillei</i> (Vaney, 1914)	Cucumariidae
<i>macdonaldi</i> , <i>Meseres</i> , Ludwig, 1894	<i>Meseres macdonaldi</i> Ludwig, 1894	Synallactidae
<i>marenzelleri</i> , <i>Pseudostichopus</i> , Hérourard, 1923	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>mira</i> , <i>Cucumaria</i> , Ludwig and Heding, 1935	<i>Staurocucumis liouvillei</i> (Vaney, 1914)	Cucumariidae
<i>mollis</i> , <i>Pseudostichopus</i> , Théel, 1886	<i>Pseudostichopus mollis</i> Théel, 1886	Synallactidae
<i>molpadioides</i> , <i>Pseudostichopus</i> , Ohshima, 1915	<i>Pseudostichopus molpadioides</i> Ohshima, 1915	Synallactidae
<i>moseleyi</i> , <i>Stichopus</i> , Théel, 1886	<i>Bathyplores moseleyi</i> (Théel, 1886)	Synallactidae
<i>navicula</i> , <i>Psolidium</i> , Ekman, 1927	<i>Psolirux coatsi</i> (Vaney, 1908)	Cucumariidae
<i>nudus</i> , <i>Pseudostichopus</i> , Ohshima, 1915	<i>Pseudostichopus nudus</i> Ohshima, 1915	Synallactidae
<i>occultatus</i> , <i>Pseudostichopus</i> , Marenzeller, 1893	<i>Meseres occultatus</i> (Marenzeller, 1893)	Synallactidae
<i>peripatus</i> , <i>Meseres</i> , Sluiter, 1901	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae

Table 1. Continued.

Original combination	Current combination or senior synonym	Family
<i>pisanii</i> , <i>Chirodota</i> , Ludwig, 1886	<i>Chiridota pisanii</i> Ludwig, 1886	Chiridotidae
<i>plicatus</i> var., <i>occultatus</i> , <i>Pseudostichopus</i> , Koehler and Vaney, 1905	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>propinquus</i> , <i>Pseudostichopus</i> , Fisher, 1907	<i>Meseres propinquus</i> (Fisher, 1907)	Synallactidae
<i>racovitzai</i> , <i>Rhipidothuria</i> , Hérourard, 1901	<i>Rhipidothuria racovitzai</i> Hérourard, 1901	Elpidiidae
<i>robusta</i> , <i>Scotoplanes</i> , Théel, 1882	<i>Amperima robusta</i> (Théel, 1882)	Elpidiidae
<i>rubipunctatus</i> , <i>Bathyplores</i> , Gutt, 1990	<i>Bathyplores gourdoni</i> (Vaney, 1914)	Synallactidae
<i>spatha</i> , <i>Cucumaria</i> , Cherbonnier, 1941	<i>Staurocucumis grandis</i> (Vaney, 1906)	Cucumariidae
<i>spiculiferus</i> , <i>Meseres</i> sp. nov.	<i>Meseres spiculiferus</i> sp. nov.	Synallactidae
<i>steineni</i> , <i>Cucumaria</i> , Ludwig, 1898	<i>Heterocucumis steineni</i> (Ludwig, 1898)	Cucumariidae
<i>tachimaruae</i> , <i>Pseudostichopus</i> (<i>Trachostichopus</i>), Imaoka, 1978	<i>Meseres hyalegerus</i> Sluiter, 1901	Synallactidae
<i>torvus</i> , <i>Stichopus</i> (?), Théel, 1886	<i>Meseres torvus</i> (Théel, 1886)	Synallactidae
<i>trachus</i> , <i>Pseudostichopus</i> , Sluiter, 1901	<i>Meseres trachus</i> (Sluiter, 1901)	Synallactidae
<i>tuberculatus</i> , <i>Pseudostichopus</i> (<i>Trachostichopus</i>), Imaoka, 1990	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>turqueti</i> , <i>Cucumaria</i> , Vaney, 1906	<i>Staurocucumis turqueti</i> (Vaney, 1906)	Cucumariidae
<i>turricata</i> , <i>Thyone</i> , Vaney, 1906	<i>Paracucumis turricata</i> (Vaney, 1906)	Paracucumidae
<i>unguiculatus</i> , <i>Pseudostichopus</i> , Ohshima, 1915	<i>Meseres peripatus</i> Sluiter, 1901	Synallactidae
<i>villosus</i> , <i>Pseudostichopus</i> , Théel, 1886	<i>Meseres villosus</i> (Théel, 1886)	Synallactidae
<i>violaeuspudata</i> , <i>Achlyonice</i> , Gutt, 1990	<i>Rhipidothuria racovitzai</i> Hérourard, 1901	Elpidiidae
<i>vitjazi</i> , <i>Amperima</i> , Gebruk, 1988	<i>Amperima vitjazi</i> Gebruk, 1988	Elpidiidae
<i>wyvillethomsoni</i> , <i>Laetmogone</i> , Théel, 1879	<i>Laetmogone wyvillethomsoni</i> Théel, 1879	Laetmogonidae

Type locality. Straits of Magellan.

Distribution. Magellanic region (from 42°S on the west and 43°S on the east of South America), Straits of Magellan, Falkland Is, South Georgia, Antarctic Peninsula, Antarctica at 88–89°E, Kerguelen and Marion and Prince Edward Is, 0–560 m (summaries by Pawson, 1964, 1969; Branch et al., 1993). Western Antarctica, Weddell Sea, 225–555 m (Gutt, 1991b). Eastern Antarctica, off Terre Adélie, 180–220 m (Cherbonnier, 1974); off Wilhelm II Land, 350–400 m (Ekman, 1927); off Wilkes and MacRobertson Lands, 101–216 m (this paper).

Remarks. In terms of tentacle number (12) and form (6–7 pairs of digits with the distal pair largest), ossicle distribution (wheels clustered, hooks spread), and ossicle form and size (wheels up to 0.17 mm diameter, sigmoid hooks up to 0.28 mm long, tentacle rods up to 0.27 mm long; lacking short rods in the longitudinal muscles), all of the material examined was consistent diagnostically and also with the descriptions by Théel (1886a) and H.L. Clark (1907). There were regional variations in ossicle size. Wheel diameter and hook length measure-

ments of the BANZARE Kerguelen specimens were the same as the measurements given by Théel (1886a) for the *Challenger* Marion and Falkland material, and were respectively up to 0.12 and 0.28 mm. In the type locality material they were up to 0.17 and 0.21 mm; in the Wilkes material up to 0.14 and 0.26 mm. Ekman (1927) reported hooks to be 0.25 mm long in western Antarctic material; Deichmann (1947) reported wheels up to 0.12 mm and hooks up to 0.2 mm in Patagonia specimens; Pawson (1964) reported wheels up to 0.13 mm diameter and hooks up to 0.2 mm long in southern Chile material; and O'Loughlin et al. (1994) reported both hooks and wheels up to 0.2 mm in length and diameter for eastern Antarctic material (as *Taeniogyrus* cf. *contortus*). The variations are not considered here to be based on sufficient evidence for the establishment of separate species, but they do provide some evidence of morphological change occurring with the reproductive isolation of these viviparous populations. Further to the extensive synonymy and distribution summary by Pawson (1964, 1969), there have been reports of *T. contortus* for Terre Adélie by Cherbonnier

Table 2. Selected BANZARE Holothuroidea species list.

Taxon, Registration, Specimens	Location	Station
APODIDA		
<i>Taeniogyrus contortus</i> (Ludwig, 1875)		
SAM K1839 (1)	Kerguelen, 4-5 m	12
SAM K1840 (1)	Kerguelen, 2-20 m	49
ASPIDOCHIROTIDA		
<i>Bathyplores bongraini</i> Vaney, 1914		
SAM K1836 (2)	Antarctica, off Kemp Land, 603 m	34
<i>Meseres spiculiferus</i> sp. nov.		
SAM K1850 (1)	Antarctica, off Enderby Land, 193 m	41
SAM K1851 (2)	Antarctica, Prydz Bay, 456 m	30
SAM K1852 (7)	Antarctica, off MacRobertson Land, 177 m	107
SAM K1853 (1)	Antarctica, off Wilkes Land, 695 m	98
<i>Mesothuria bifurcata</i> Hérourard, 1901		
SAM K1838 (1)	Antarctica, Prydz Bay, 1266 m	29
DENDROCHIROTIDA		
<i>Heterocucumis godeffroyi</i> (Semper, 1868)		
SAM K1844 (2)	Kerguelen, 47 m	59
SAM K1845 (2)	Kerguelen, 4-5 m	12
<i>Heterocucumis steineni</i> (Ludwig, 1898)		
SAM K1832 (1)	Antarctica, off Enderby Land, 193-209 m	41
<i>Staurocucumis liouvillei</i> (Vaney, 1914)		
SAM K1848 (4)	Antarctica, off Kemp Land, 177 m	107
<i>Trachythone lechleri</i> (Lampert, 1885)		
SAM K1849 (1)	Kerguelen, 47 m	59
<i>Paracucumis turricata</i> (Vaney, 1906)		
SAM K1846 (1)	Antarctica, off Wilkes Land, 474 m	97
ELASIPODIDA		
<i>Amperima robusta</i> (Théel, 1882)		
SAM K1842 (2)	North-east of Kerguelen, 3112 m	66
<i>Rhipidothuria racovitzai</i> Hérourard, 1901		
SAM K1829 (1)	Antarctica, off Enderby Land, 300 m	39
SAM K1830 (24)	Antarctica, off Enderby Land, 300 m	40
SAM K1831 (3)	Antarctica, off Wilkes Land, 474 m	97
<i>Laetmogone wyvillethomsoni</i> Théel, 1879		
SAM K1827 (1)	Antarctica, Prydz Bay, 540 m	30
SAM K1828 (1)	Antarctica, off Kemp Land, 603 m	34

(1974), for the Weddell Sea by Gutt (1991b), and for Marion and Prince Edward Is by Branch et al. (1993).

Order Aspidochirotida Grube

Synallactidae Ludwig

Bathyplores bongraini Vaney

Bathyplores bongraini Vaney, 1914: 5-8, pl. 1 fig. 4, pl. 2 figs 4, 7-9 and 11-12.

Bathyplores moseleyi.—Ekman, 1925: 25-28, fig. 3.—Ekman, 1927: 371 [non *Bathyplores moseleyi* (Théel, 1886a); not confirmed whether *B. bongraini* or *B. gourdoni*].

Bathyplores fuscivinculum Gutt, 1990: 121-123, figs 4-6, tbl. II.—Gutt, 1991b: 324.—Gutt and Klages, 1991: 305 [new synonymy].

Bathyplores sp. MoV 2018.—O'Loughlin et al., 1994: 553-554.

Material examined. *Bathyplores bongraini* Vaney, 1914. Holotype. Western side of Antarctic Peninsula, 68°00'S, 70°20'W, 250 m, 1909, MNHN [extensively dissected, disintegrating; ossicles few, eroded, measurable].

Bathyplores fuscivinculum Gutt, 1990. Paratype. Weddell Sea, 70°27'S, 8°40'W, 329-350 m, 1983 [ZIM E-7140 (1 specimen)] [no ossicles were detected].

Other material. Eastern Antarctica, off Kemp Land, 66°21'S, 58°50'E, 603 m, 1930 [BANZARE Stn 34,

Table 3. Selected diagnostic characters for *Meseres* species (x indicates present; – indicates absent; ? indicates unknown).

Species	distinct marginal projections	rounded longitudinal muscles	branched gonad tubules	gonad ossicles	respiratory tree ossicles	tentacle mesh ossicles
<i>globigerinae</i>	x	?	?	?	?	?
<i>hyalegerus</i>	–	x	–	–	–	–
<i>involutus</i>	x	–	x	–	–	x
<i>macdonaldi</i>	x	x	–	?	?	?
<i>occultatus</i>	x	x	–	–	x	–
<i>peripatus</i>	x	x	–	x	–	–
<i>propinquus</i>	x	x	–	x	x	?
<i>spiculiferus</i>	–	x	–	x	–	–
<i>torvus</i>	x	?	x	?	?	?
<i>trachus</i>	x	x	–	–	–	–
<i>villosus</i>	–	–	x	–	–	–

Table 4. Summary of significant new distribution data.

Taxon	Previous records (authors in text)	New records (this paper)
<i>Chiridota pisanii</i> Ludwig	Magellanic region	Heard Island
<i>Bathyplores bongraini</i> Vaney	western Antarctica	eastern Antarctica
<i>Bathyplores gourdoni</i> (Vaney)	western Antarctica	eastern Antarctica
<i>Meseres hyalegerus</i> Sluiter	Indonesia	Japan, south-eastern Australia
<i>Meseres involutus</i> Sluiter	Indonesia	eastern Australia, Tasman Sea
<i>Meseres peripatus</i> Sluiter	Indonesia	North Atlantic, Indo-Pacific
<i>Meseres villosus</i> (Théel)	Cosmopolitan, western Antarctica	eastern Antarctica
<i>Mesothuria bifurcata</i> Hérouard	western Antarctica, North Atlantic	eastern Antarctica
<i>Heterocucumis godeffroyi</i> (Semper)	Magellanic region, eastern Antarctica	Heard and Kerguelen Islands
<i>Psolirux coatsi</i> (Vaney)	western Antarctica	off Bouvet Island
<i>Staurocucumis liouvillei</i> (Vaney)	Antarctica	Heard I.
<i>Trachythione lechleri</i> (Lampert)	Magellanic, Heard Island	Kerguelen I.
<i>Amperima robusta</i> (Théel)	Antarctica, Kermadec Trench	southern Indian Ocean
<i>Rhipidothuria racovitzi</i> Hérouard	western Antarctica	eastern Antarctica
<i>Laetmogone wyvillethomsoni</i> Théel	Southern Ocean, western Antarctica	eastern Antarctica

SAM K1836 (2)]; Prydz Bay, 66°46'–68°55'S, 67°33'–78°14'E, 120–768 m [ANARE, NMV F68057 (1), F68070 (1), F68159–68160 (7), F68165 (1), F68167 (1), F68675 (1), F76574–76575 (2), F76577–76579 (3), F76587–76588 (2), F76599–76600(2), F80183 (2), F81796–81804 (37), F81818–81823 (42), F91299 (1)].

Distribution. Western Antarctica, Weddell Sea, 245–465 m (Gutt, 1991b, as *B. fuscivinculum*); western side of Antarctic Peninsula, 250 m

(Vaney, 1914). Eastern Antarctica, Prydz Bay, 120–768 m; off Kemp Land, 603 m (this paper).

Remarks. Ekman (1925, 1927) considered *B. bongraini* to be a junior synonym of the non-Antarctic *B. moseleyi* (Théel). A distinctive diagnostic feature of *B. moseleyi* is the presence of raised round “warts” or “fungiform papillae” on the dorsolateral and ventrolateral interradii, and these are

not present in any of the Antarctic specimens described or examined in this study. On this basis the synonymy of *B. bongraini* with *B. moseleyi* by Ekman (1925, 1927) is rejected. The type locality of *B. moseleyi* (Théel, 1886a) is off southern Chile. Rowe (in Rowe and Gates, 1995) regarded *B. moseleyi* as a junior synonym of *B. natans* (Sars).

Gutt (1990) acknowledged difficulty in diagnosing difference between *B. rubipunctatus* and *B. fuscivinculum*, and depended on recognition by live colour which is itself variable. Gutt and Klages (1991) acknowledged difficulty in distinguishing *B. rubipunctatus* and *B. fuscivinculum* from *B. moseleyi*. Based on the original descriptions and figures by Vaney (1914) and Gutt (1990), and the material examined, the distinctive features of *B. bongraini* are: large body size (up to 260 mm long); distinct ventrolateral brim with papillae; presence of two mid-ventral radial series of tube feet which are smaller and more numerous than in each of the lateroventral series; some bare ventral inter-radial areas; absence of warts; absence of C-shaped ossicles; table ossicle bases with predominantly four arms, very rarely up to six, arms up to 0.10 mm long [up to 0.07 in holotype; Vaney (1914) illustrated 0.07 mm; Gutt (1990) illustrated 0.12 mm and reported 0.13 mm]. The numbers of dorsal papillae and ventral tube feet vary with size, and the numbers given by Gutt (1990) for various sizes of *B. fuscivinculum* are comparable with numbers for ANARE material and the illustration of the holotype by Vaney (1914). The residual dark colour spots noted by Vaney (1914) are present on some of the ANARE material. *B. fuscivinculum* is judged here to be a junior synonym of *B. bongraini*, which is in turn distinct from *B. moseleyi* and other species of *Bathyplores*. Ekman (1925, 1927) reported *B. moseleyi* from western and eastern Antarctica, but descriptive detail is inadequate to distinguish whether the species was *B. bongraini* or *B. gourdoni*. *B. bongraini* occurs in eastern and western Antarctica.

***Bathyplores gourdoni* (Vaney) comb. nov.**

Synallactes (?) *gourdoni* Vaney, 1914: 4–5, pl. 2 figs 1–3, 5, 6.

Bathyplores moseleyi.—Ekman, 1925: 25–28, fig. 3.—Ekman, 1927: 371 [non *Bathyplores moseleyi* (Théel, 1886a); not confirmed whether *B. bongraini* or *B. gourdoni*].

Bathyplores rubipunctatus Gutt, 1990: 120–121, figs 1–3, tbl. I.—Gutt, 1991b: 324.—Gutt and Klages, 1991: 301–305, figs 1–3 [new synonymy].

Material examined. *Bathyplores rubipunctatus* Gutt, 1990. Paratypes. Weddell Sea, 74°57'S, 60°31'W, 646–661 m [ZIM E7138 (3)] [no ossicles were detected].

Other material. Prydz Bay, 67°01'–68°01'S, 70°46'–77°19'E, 304–341 m [ANARE, NMV F68157 (1), F91296 (2)].

Distribution. Western Antarctica, Weddell Sea, 225–840 m (Gutt, 1991b, as *B. rubipunctatus*); western side of Antarctic Peninsula, 250 m (Vaney, 1914). Eastern Antarctica, Prydz Bay, 304–341 m (this paper).

Remarks. Ekman (1925, 1927) considered the single very damaged type specimen of *S.* (?) *gourdoni*, collected close to the same location and depth as *B. bongraini*, to be conspecific with *B. bongraini* and then considered *B. bongraini* to be a junior synonym of the non-Antarctic *B. moseleyi* (Théel). The synonymy of *B. bongraini* with *B. moseleyi* is rejected above, and the synonymy of *S.* (?) *gourdoni* with *B. bongraini* is rejected here. Based on the original descriptions and figures by Vaney (1914) and Gutt (1990), and the material examined, the features which distinguish *S.* (?) *gourdoni* from *B. bongraini* are: smaller size (up to 120 mm long); residual pale pink preserved colour sometimes evident; gelatinous body wall, and consequent frequent loss of appendages; inconspicuous brim and ventrolateral edge; mid-ventral radial tube feet sometimes extending onto ventral interradian areas, frequently creating a complete ventral cover; table ossicle bases with frequently four arms, up to eight and some branching, arms up to 0.20 mm long (Vaney, 1914, illustrated 0.12 mm; Gutt, 1990, illustrated 0.13 mm and reported 0.11 mm). *S.* (?) *gourdoni* is referred here to *Bathyplores*, and *B. rubipunctatus* is considered here to be a junior synonym of *B. gourdoni*. *B. gourdoni* occurs in eastern and western Antarctica.

***Meseres* Ludwig**

Meseres Ludwig, 1894: 34, 36, 38.—Perrier, 1902: 359.—Rowe (in Rowe and Gates, 1995): 284–285.—O'Loughlin, 1998: 497.

Molpadiodemas Heding, 1935: 77–78.—Heding, 1940: 357.—Deichmann, 1940: 209–211.

Trachostichopus Heding, 1940: 357, 361.—Imaoka, 1978: 380.—Imaoka, 1990: 152.

Plicastichopus Heding, 1940: 357.—Heding, 1942: 5–6.

Comparative material examined. *Pseudostichopus mollis* Théel, 1886 [type species of *Pseudostichopus* Théel, 1886]. Syntype. Southern Ocean, off Marion I., 46°48'S, 37°49'E, 92–137 m, *Challenger* Stn 144a [BMNH 86.10.2.144 (1)].

Type species. *Meseres macdonaldi* Ludwig, 1894 [monotypy]; type locality: North Pacific Ocean, off Costa Rica (2149 m) and Colombia (1644 m).

Emended diagnosis. Up to 300 mm long; body wall soft, fragile; body rounded anteriorly and posteriorly, flat ventrally, convex dorsally, distinct lateroventral margin defined by acute angle or concentration of largest tube feet or series of pyramidal projections ("warts"); posterior vertical (pygal) furrow; mouth and anus ventral; calcareous ring solid, lacking posterior prolongations; up to 20 peltate tentacles; lacking tentacle ampullae; lacking retractor muscles; gonad tubules in 2 series on opposite sides of dorsal mesentery; respiratory trees well developed; radial tube feet very small, most conspicuous on ventrolateral margin; thin tubular appendages frequently present dorsally, laterally, ventrally, around mouth and anus, some branched, sometimes matted and entangled; ossicles present in tentacles and some tube feet, sometimes present in gonads and respiratory trees, absent from body wall except for large perforated plates or three-dimensional mesh ossicles sometimes present in posterior lobes; body frequently obscured by cover of sponge spicules or globigerines or detritus.

Species. *M. globigerinae* (Hérouard, 1923), *M. hyalegerus* Sluiter, 1901; *M. involutus* Sluiter, 1901; *M. macdonaldi* Ludwig, 1894; *M. occulta* (Marenzeller, 1893); *M. peripatus* Sluiter, 1901; *M. propinquus* (Fisher, 1907); *M. spiculiferus* sp. nov.; *M. torvus* (Théel, 1886); *M. trachus* (Sluiter, 1901); *M. villosus* (Théel, 1886).

Distribution. Cosmopolitan, including Antarctic coast; bathyal and abyssal.

Remarks. The diagnostic characters of the type material are incompletely known, and are discussed below under *M. macdonaldi*. Unbranched or branched gonad tubules, rounded or broad flat longitudinal muscles, and the presence or absence of ossicles in gonads and respiratory trees, are considered here to be diagnostically significant within the genus (Table 3).

Determination of *Meseres* material is made difficult by: specimens completely obscured by an actively created cover (distinguished from passive adherence of substrate matter) of fur-like sponge spicules or globigerines or other detrital material; outer attached cover frequently lost during collecting, resulting in loss of outer body wall with tube feet and ventrolateral margin features; variable degree of development of "teeth" on

the posterior edge of calcareous ring radial plates [observations in this work confirmed by illustrations for *Pseudostichopus* (*Trachostichopus*) *trachus* by Heding (1940)]; gonad tubules lost, or absent, and gonad ossicles sparse or absent in species in which gonad ossicles occur; ossicles in posterior lobes obscured amongst embedded detrital material; longitudinal muscles may or may not show evidence of longitudinal division within a species (type specimens of *M. involutus* have both grooved and ungrooved muscles).

A soft fragile body wall; lateroventral margin marked by pyramidal projections or a band of small tube feet or an acute angle; and thin tubular appendages around the mouth, in the pygal furrow, and over the body, distinguish *Meseres* from the closely-related genus *Pseudostichopus* Théel, 1886. The syntype of *P. mollis* (type species of *Pseudostichopus*) had a firm leathery body wall, was rounded in transverse section, lacked a distinct lateroventral margin, had very small tube feet present in sparse double series along the dorsolateral radii only, and lacked thin tubular appendages. Théel (1886a) was uncertain about the lateroventral distribution of tube feet in the syntypes of *P. mollis*, and referred to them as "more crowded in two to five (?) rows". This description is not valid for the syntype from off Marion I. There may be more than one species among the syntypes. A complete review of *Pseudostichopus* and *Meseres* and establishment of lectotypes for their species where necessary are beyond the scope of this work.

In a review of *Pseudostichopus* and related genera Heding (1940) did not include *Meseres*, and described a new genus *Plicastichopus* and the subgenera *Pseudostichopus* and *Trachostichopus* (for *Pseudostichopus*). Rowe (in Rowe and Gates, 1995) synonymised *Trachostichopus* Heding, 1940 and *Plicastichopus* Heding, 1940 with *Meseres*, assigning *Pseudostichopus* (*Trachostichopus*) *trachus* Sluiter, 1901 and *Plicastichopus ingolfi* Heding, 1942 to *Meseres*. Heding (1940) assigned *Pseudostichopus trachus* Sluiter, 1901, *P. propinquus* Fisher, 1907, *P. aleutianus* Ohshima, 1915, *P. arenosus* Ohshima, 1915, *P. molpadioides* Ohshima, 1915, and *P. nudus* Ohshima, 1915 to *Pseudostichopus* (*Trachostichopus*). *P. propinquus* is assigned below to *Meseres*. *P. aleutianus* is synonymised below with *M. peripatus* Sluiter, 1901. *P. molpadioides* Ohshima, 1915 [off eastern Japan, 714 m], with probably junior synonym *P. arenosus* Ohshima, 1915 [off southern Japan, 781m], were described

as being cylindrical with a brown globigerine cover, distinct dorsolateral and ventrolateral tube feet, and spinous perianal ossicles. In the absence of a distinctive ventrolateral margin they are assigned to *Pseudostichopus*. A specimen taken off eastern Australia at 3500 m, held in the Australian Museum (AM J23009), has similar diagnostic characters. *P. nudus* Ohshima, 1915 was described as subcylindrical, lacking a distinct ventrolateral margin, and is assigned to *Pseudostichopus*. Heding (1940) referred *P. ingolfi* Heding, 1940 (ms.) and *P. plicatus* (Koehler and Vaney, 1905) to *Plicastichopus* Heding, 1940. Both species are synonymised below with *M. peripatus*.

Heding (1940) assigned *Pseudostichopus atlanticus* Perrier, 1898, *P. occultatus* Marenzeller, 1893 and *P. villosus* Théel, 1886 to *Molpadiodemas* Heding, 1935 (type species *M. acaudum* Heding, 1935). O'Loughlin (1998) synonymised *Molpadiodemas* with *Meseres*, and assigned *M. acaudum*, *P. atlanticus*, *P. occultatus* and *P. villosus* to *Meseres*. The assignment of *P. atlanticus* Perrier and *M. acaudum* Heding to *Meseres* is not in accord with the emended diagnosis of *Meseres* above, and these two species are synonymised and assigned below to *Pseudostichopus*.

Imaoka (1978, 1990) referred five new species to *Pseudostichopus*: *P. (Pseudostichopus) dilatatorbis* Imaoka, 1978; *P. (Trachostichopus) tachimaruae* Imaoka, 1978; *P. (Trachostichopus) japonensis* Imaoka, 1978; *P. (Pseudostichopus) alatus* Imaoka, 1990; *P. (Trachostichopus) tuberculatus* Imaoka, 1990. *P. (Pseudostichopus) dilatatorbis* [off south-western Japan, 400–450 m] lacked a distinctive ventrolateral margin and is appropriately referred to *Pseudostichopus*. *P. (Trachostichopus) tachimaruae* and *P. (Trachostichopus) japonensis* are synonymised below with *M. hyalegerus*. *P. (Pseudostichopus) alatus* [off southern Japan, 350 m] lacked a distinctive lateroventral margin and is confirmed as *Pseudostichopus*. This species is similar to *P. arenosus* and *P. molpadioides*, also reported off Japan by Ohshima (1915), but Imaoka (1990) did not find spiny perianal ossicles in *P. alatus*. *P. (Trachostichopus) tuberculatus* is synonymised below with *M. peripatus*.

The new combinations *Meseres globigerinae* and *M. torvus* are discussed below. *M. spiculiferus* sp. nov. and *M. villosus* occur on the eastern Antarctic coast. *M. trachus* and *M. villosus* have been reported by a number of authors (see below), but frequently with insufficient detail

to confirm which species of *Meseres* was being reported. Ludwig (1894) determined North Atlantic material (2–6°N, 81–86°W, 245–3336 m) as *P. mollis*, but illustrated *peripatus*-like gonad ossicles which *P. mollis* lacks.

Meseres globigerinae

(Hérouard) comb. nov.

Pseudostichopus globigerinae Hérouard, 1923: 23–25, pl. 4 fig. 6.—Mortensen, 1927: 386–388.—Deichmann, 1930: 87, 90.

Pseudostichopus (Pseudostichopus) globigerinae.—Heding, 1940: 353–360.—Imaoka, 1978: tbl. 1–1.—Thandar, 1992: 167.

Pseudostichopus villosus.—Hansen, 1956: 47–48 (part) [non *Meseres villosus* (Théel, 1886)].

Type locality. North Atlantic, Bay of Biscay, 4380 m.

Remarks. Features of *P. globigerinae* described by Hérouard (1923) were: up to 30 mm long; thin soft translucent body wall, covered with globigerines; pygal furrow; mouth and anus ventral; villous-like cover of unequal tube feet, except mid-ventrally; posterior margin with tufts of tube feet on papillae; absence of ossicles. The description of the posterior margin indicates that diagnostically *P. globigerinae* is a *Meseres* species, and it is so assigned here. Hansen (1956) synonymised *P. globigerinae* with *P. villosus*, but the tufts of tube feet grouped on papillae along the posterior margin, cover of unequal tube feet, globigerine cover, and translucent body wall indicate that *P. globigerinae* is not *M. villosus* and it is removed from the synonymy here. The absence of descriptions of the form of the gonad tubules and longitudinal muscles, and presence or absence of ossicles in gonads and respiratory trees, leave any synonymy unresolved.

Meseres hyalegerus Sluiter

Meseres hyalegerus Sluiter, 1901a: 12.—Sluiter, 1901b: 50–51, pl. 5 figs 2–4.—Perrier, 1902: 359.

Pseudostichopus trachus.—Mitsukuri, 1912: 3–9, pl. 1 figs 1–5.—Ohshima, 1915: 227–228.—Mortensen, 1918: 80–81, fig. 16 [non *Meseres trachus* (Sluiter, 1901)].

Pseudostichopus (Trachostichopus) tachimaruae Imaoka, 1978: 380–382, fig. 2A–E, tbl. 1–2 [new synonymy].

Pseudostichopus (Trachostichopus) japonensis Imaoka, 1978: 382–384, fig. 3A–D, tbl. 1–2.—Imaoka, 1990: 148 [new synonymy].

Material examined. Syntypes. Indonesia, Banda Sea, 5°28'S, 132°00'E, 204 m, *Siboga* Stn 251 [ZMA 2177 (2 specimens)].

Other material. Sagami Sea, south of Honshu, 128–553 m [*Albatross* Stn 5092, USNM E17147 (47); Stns 4968, 5069, 5093, 5055, 5094, USNM 1001645–1001649 (15)]. Eastern Australia, Tasman Sea and Bass Strait, 293–530 m [NMV F80171 (2), F80172 (12), F80173 (1), F80174 (5), F80177 (1), F80178 (3), F80179 (3), F80180 (2), F80181 (19)].

Distribution. Indo-Pacific, Indonesia, Banda Sea, 204 m (Sluiter, 1901a); Japan, Sagami Sea, 141–564 m (Mitsukuri, 1912, as *P. trachus*); south of Honshu, 128–553 m (Ohshima, 1915, as *P. trachus*); eastern Australia, Tasman Sea and Bass Strait, 293–530 m (this paper).

Remarks. The syntypes of *M. hyalegerus* were collected at 204 m. Based on Sluiter (1901a, 1901b) and the syntypes studied, the features of *M. hyalegerus* are: largest was 100 mm long; all were covered with sponge spicules and other detrital matter, not predominantly globigerines; gonad tubules were unbranched, rarely bifid distally; lateroventral margin was subacute, and lacked small projections; ossicles comprising large open and close mesh bodies were present in the posterior lobes; tentacle ossicles were spinous rods up to 0.34 mm long, lacking a large central swelling and rarely branched. In contrast the syntypes of *P. trachus* (see below) were collected at 798–883 m; largest was 180 mm long; all were covered with globigerines; gonad tubules were long and thin; lateroventral margin was acute, with small projections (“warts”); ossicles were not detected in the posterior lobes; tentacle ossicles were thorny rods up to 0.20 mm long (0.13 mm in Sluiter, 1901b), frequently branched and with a central swelling. Material from the Sagami Sea, determined as *Pseudostichopus trachus* and described by Mitsukuri (1912), was collected at 141–564 m; largest was 120 mm long; all were covered with sponge spicules and other detrital material; gonad tubules were short, if branched only at the ends; no reference was made to lateroventral projections; close and open-mesh latticework ossicles were present posteriorly; tentacle ossicles (illustrated) were spinous rods, up to 0.30 mm long, lacking central swellings. The Sagami Bay specimens of Mitsukuri (1912) and Mortensen (1918), and the specimens from south of Honshu of Ohshima (1915), are considered here to be *M. hyalegerus*. Two species described by Imaoka (1978), *P. (Trachostichopus) tachimaruae* [off south-western Japan, 400–450 m] and *P. (Trachostichopus) japonensis* [off western Japan, 200–300 m], were both characterised by small size, dense cover of sponge spicules, dorso-lateral and ventrolateral series of small tube feet,

unbranched gonad tubules lacking ossicles, and mostly unbranched tentacle rods more than 0.2 mm long and lacking a distinct central swelling. Both species are synonymised here with *M. hyalegerus*. Sometimes tube foot rods were detected during this study in *M. hyalegerus* [reported for *japonensis* by Imaoka (1978)] and posterior ossicles [fragments reported for *tachimaruae* by Imaoka (1978)].

Meseres involutus Sluiter

Figure 2e

Meseres involutus Sluiter, 1901a: 11–12.—Sluiter, 1901b: 49–50, pl. 8 fig. 6.—Perrier, 1902: 359 (incorrectly as *convolutus*).

Material examined. Syntypes. Indonesia, Seram Sea, 3°27'S, 131°01'E, 567 m, *Siboga* Stn 173; Sawu Sea, 10°49'S, 123°23'E, 918 m, *Siboga* Stn 300 [ZMA (2)].

Other material. Eastern Australia, Tasman Sea, Lord Howe Rise, 1423 m [AM J23326 (1)]; off Newcastle, 2984–3058 m [AM J16833 (1)]; off Nowra, 1650–1750 m [NMV F80451 (1)].

Distribution. Indonesia, Seram and Sawu Seas, 567–918 m (Sluiter, 1901a); eastern Australia, Tasman Sea, 1423–3058 m (this paper).

Remarks. All five specimens were covered with globigerines, not sponge spicules. Most were covered with thin tubular appendages, most conspicuous laterally, smallest ventrally. The grey body wall with surface ridges and pockets and lumps, and finely serrated lateroventral margin created by transverse ridges, was similar to *M. peripatus*, but the marginal projections were not as pronounced as in some *M. peripatus* specimens. *M. involutus* is distinguished from *M. peripatus* by the form of the tentacle ossicles (include elongate, curved, distally tapered rods with mesh-like perforations); by branched gonad tubules; by broad flat longitudinal muscles; and by the absence of ossicles in the gonads. Posterior lobe ossicles were not detected. The longitudinal muscles were flat, some with two to three longitudinal grooves.

Meseres macdonaldi Ludwig

Meseres macdonaldi Ludwig, 1894: 34–36.—Perrier, 1902: 359.—Rowe (in Rowe and Gates, 1995): 284.—O'Loughlin, 1998: 497.

Material examined. *Meseres macdonaldi* Ludwig, 1894. Syntype. Northern Pacific Ocean, off Costa Rica, 5°56'N, 85°10'W, 2149 m, *Albatross* Stn 3362, 1891 [USNM 30501 (1)].

Type locality. North Pacific Ocean, off Costa Rica (2149 m) and Colombia (1644 m).

Remarks. The six syntypes of the type species *M. macdonaldi* are in an advanced stage of decomposition (C. Ahearn, USNM, pers. com.). Ludwig (1894) described maximum length as 30 mm; some covered with globigerines; body flattened dorsoventrally, with distinct edge; mouth and anus ventral; body wall thin, transparent; very small tube feet distributed thickly over whole body; 15 tentacles; tentacle ampullae absent; tufts of unbranched gonad tubules on both sides of dorsal mesentery; respiratory trees well-developed; longitudinal muscles undivided; ossicles not found in body wall or tube feet or tentacles. Ludwig (1894) did not report on ossicles in gonads or respiratory trees or posteriorly, and did not report a pygal furrow. In the syntype examined in this study no ossicles were found, and a pygal furrow was not evident in the disintegrating material. Two series of lateroventral pyramidal projections were present, each with about three very small digitate projections closely resembling the illustration of *S. torvus* by Théel (1886a) which was referred to by Ludwig (1894) in describing *M. macdonaldi*. There were very small tube feet and thin tubular appendages over the body. The longitudinal muscles were cylindrical. Gonad tubules were not detected.

M. occultatus, *M. peripatus* and *M. propinquus* share with *M. macdonaldi* having unbranched gonad tubules, rounded longitudinal muscles, and prominent lateroventral projections, but it is not possible to confirm any synonymy in the absence of observations on gonad and respiratory tree ossicles in *M. macdonaldi*.

Meseres occultatus (Marenzeller)

Pseudostichopus occultatus Marenzeller, 1893a: 15–17, pl. 4 fig. 9.—Marenzeller, 1893b: 10, pl. 2 fig. 3.—Perrier, 1902: 337–338.—Hérouard, 1902: 14–15, pl. 2 figs 4–14.—Mortensen, 1918: 81.—Mortensen, 1927: 387–388.—Deichmann, 1930: 89–90.

Molpadiodemas occultatus.—Heding, 1940: 353–359.

Meseres occultatus.—O'Loughlin, 1998: 497.

Material examined Syntypes, Mediterranean Sea, 24°16'N, 35°03'E, 1445 m [MNHN EcHh 3658 (2)].

Distribution. Mediterranean Sea, 415–1445 m (Marenzeller, 1893a); North Atlantic, Spain, off Cape Finisterre, 363–510 m (Marenzeller, 1893b); bathyal.

Remarks. Based on the description and illustrations by Marenzeller (1893a, 1893b), and examination of two syntypes, two unique diagnostic characters for *M. occultatus* are the presence of branched ossicles in the respiratory trees, and not

the gonads, and the presence of large posterior ossicles which are large partly double-layered perforated plates and not multilayered mesh. Otherwise the active attachment of detrital material; grey parchment-like body wall; reticulate outer body wall with lateroventral marginal projections; complete cover of thin tubular appendages; double series of small tube feet lateroventrally; rounded longitudinal muscles; unbranched gonad tubules; and form of ossicles in tube feet, are similar to *M. peripatus*. Hérouard (1902) determined material as *P. occultatus*, but subsequently (1923) referred the material to two new species (*P. marenzelleri* and *P. lapidus*). *P. marenzelleri* is synonymised below with *M. peripatus*. Deichmann (1930) determined an Atlantic specimen from Cuba (232 m) as *P. occultatus*, but described complex branched gonad ossicles. This character indicates that it was not *M. occultatus*, but data are insufficient to confirm any synonymy.

Meseres peripatus Sluiter

Figure 2f

Meseres peripatus Sluiter, 1901a: 10–11.—Sluiter, 1901b: 48–49, pl. 5 fig. 5, pl. 8 fig. 7.—Perrier, 1902: 359.—Rowe (in Rowe and Gates, 1995): 285.

Pseudostichopus occultatus.—Hérouard, 1902: 14–15, pl. 2 figs 4–14 (part, illustrated) [non *Meseres occultatus* (Marenzeller, 1893)].

Pseudostichopus occultatus var. *plicatus* Koehler and Vaney, 1905: 9–10, pl. 3 fig. 8, pl. 9 figs 1–3.—Heding, 1940: 353 [non *Meseres occultatus* (Marenzeller, 1893)].

Pseudostichopus aleutianus Ohshima, 1915: 228, pl. 8 figs 5a–c.—Imaoka, 1978: 380.

Pseudostichopus unguiculatus Ohshima, 1915: 230–231, pl. 8 fig 7a–c.—Imaoka, 1978: 384.—Rowe (in Rowe and Gates, 1995): 285 [synonymy by Rowe (in Rowe and Gates, 1995)].

Pseudostichopus marenzelleri Hérouard, 1923: 25.—Mortensen, 1927: 287–288.—Deichmann, 1930: 90.

Pseudostichopus (Pseudostichopus) marenzelleri.—Heding, 1940: 353–359.—Imaoka, 1978: tbl. 1–1.—Thandar, 1992: 167 [new synonymy].

Pseudostichopus (Pseudostichopus) unguiculatus.—Heding, 1940: 353–360.—Imaoka, 1978: tbl. 1–1.—Imaoka, 1990: 152.—Thandar, 1992: 167.

Pseudostichopus (Trachostichopus) aleutianus.—Heding, 1940: 353–359.—Imaoka, 1978: tbl. 1–2 [new synonymy].

Plicastichopus plicatus.—Heding, 1940: 354–359.—Heding, 1942: 6 [new synonymy].

Plicastichopus ingolfi Heding, 1942: 5–6, figs 4–5, pl. 1 figs 4–5.

Pseudostichopus (Trachostichopus) tuberculatus Imaoka, 1990: 149–152, pl. p. 149, fig. p. 151 [new synonymy].

Meseres ingolfi.—Rowe (in Rowe and Gates, 1995): 285 [new synonymy].

Material examined. *Meseres peripatus* Sluiter, 1901. Syntypes. Indonesia, Flores Sea, 7°24'S, 118°15'E, 794 m, *Siboga* Stn 45; Maluka Sea, 1°59'N, 125°01'E, 1200 m, *Siboga* Stn 122 [ZMA (2)].

Other material. Eastern Australia, Tasman Sea, off New South Wales, 823–1750 m [AM J20026 (2), J20027 (1), J22980 (9), J23219 (1), J23267 (2); NMV F80449 (1), F80450 (3), F90070 (2)].

Pseudostichopus unguiculatus Ohshima, 1915. Syntypes. Off southern Japan, 1058–1680 m, [*Albatross* Stns 4960, 5083, 5084, USNM E34151 (2), E24543 (1), E24544 (1)].

Pseudostichopus marenzelleri Hérouard, 1923. North Atlantic, 36°58' N, 26°20' W, 2871–2917 m [MNHN EcHh 6073 (1)].

Distribution. Indo-Pacific, Indonesia, Flores and Maluka Seas, 794–1200 m (Sluiter, 1901, as *M. peripatus*); Bay of Bengal, 3009 m (Koehler and Vaney, 1905, as *P. plicatus*); off southern Japan, 1058–1680 m (Ohshima, 1915, as *P. unguiculatus*), 660–700 m (Imaoka, 1990, as *P. tuberculatus*); Aleutian Is, 1019–1398 m (Ohshima, 1915, as *P. aleutianus*); eastern Australia, Tasman Sea, 823–1750 m (this paper). North Atlantic, off Greenland, 2137–3192 m (Heding, 1942, as *P. ingolfi*); between Portugal and the Azores, 4400 m (Hérouard, 1923, as *P. marenzelleri*).

Remarks. The features of *M. peripatus* shared by the material examined, and descriptions and illustrations of *Plicastichopus plicatus* (Koehler and Vaney, 1905), *Pseudostichopus aleutianus* Ohshima, 1915, *Pseudostichopus unguiculatus* Ohshima, 1915, *Pseudostichopus marenzelleri* Hérouard, 1923, *Plicastichopus ingolfi* Heding, 1942 and *P. (Trachostichopus) tuberculatus* Imaoka, 1990 are: up to 135 mm long; body normally covered with globigerines; body flat ventrally, domed dorsally, acute lateroventral margin with prominent serrations; body wall soft, thin, grey, semi-translucent; reticulate body ridges and large to small pockets, ridges with lumps and flaps with very small digitate projections, ridges projecting at margin to create prominent irregular pyramidal projections (conical warts); very small thread-like appendages variably present over whole body, prominent around mouth and anus, frequently massed, some branched; small radial tube feet, in irregular paired series dorsolaterally and lateroventrally (ventral to marginal projections), not detected midventrally; calcareous ring radial plates with minute teeth on posterior indentation; longitudinal muscles narrow, rounded, lacking divisions; up to 20 tentacles; gonad

tubules unbranched; tentacle ossicles rods, frequently bluntly spinous, frequently with central swelling, rarely branched, up to 0.28 mm long; lateroventral tube feet with endplates up to 0.12 mm wide, comprising central irregular perforated plate intergrading with surrounding mesh of short nodular rods, sometimes with support rods up to 0.14 mm long; dorsolateral tube feet lacking endplates, with support rods up to 0.10 mm long; gonads with ossicles, commonly rods or X- or Y-shaped, smooth to spinous, up to 0.18 mm long, rarely irregularly branched with branches sometimes joined; ossicles absent from body wall, posterior lateral lobes, respiratory trees and thread-like appendages.

The diagnostic characteristic of *M. peripatus* is a combination of distinctive lateroventral body margin, and presence of ossicles in unbranched gonad tubules. The distinctive margin was illustrated by Sluiter (1901b, for *M. peripatus*), by Koehler and Vaney (1905, for *P. plicatus*), by Heding (1942, for *P. ingolfi*) and by Imaoka (1990, for *P. tuberculatus*). Ludwig (1894) referred to the illustration of *S. torvus* by Théel (1886a) in the description of *M. macdonaldi*. The type of *M. macdonaldi* has this distinctive margin, but data are insufficient to confirm a synonymy with *M. peripatus*. *M. involutus* has this form of margin to a lesser degree, but has branched gonad tubules lacking ossicles, and flat longitudinal muscles. *M. torvus* has this form of margin, but has branched gonad tubules and other data are insufficient to confirm a synonymy. The gonad ossicles are illustrated by Hérouard (1902, for *P. marenzelleri* as *P. occultatus*), by Koehler and Vaney (1905, for *P. plicatus*), by Ohshima (1915, for *P. aleutianus* and *P. unguiculatus*), and by Heding (1942, for *P. ingolfi*).

Hérouard (1902) incorrectly determined material from the North Atlantic as *P. occultatus* Marenzeller, but subsequently by his own admission (1923) described the material as the two species *P. marenzelleri* and *P. lapidus*. Hérouard (1902, as *P. occultatus*) illustrated *P. marenzelleri*, and showed branched ossicles in the gonads. The description of *M. villosus* (Théel) by Hérouard (1902) from the North Atlantic (3745–4360 m) refers to gonad ossicles in unbranched tubules, indicating that the material was not *M. villosus* [see below] and was possibly *M. peripatus*. But the size (up to 170 mm) and absence of the distinctive lateroventral margin make a synonymy uncertain. The North Atlantic specimen determined as *P. marenzelleri* (EcHh 6073) and examined here is identical in body

form with Indo-Pacific specimens of *M. peripatus*, but there were no gonad ossicles and the tentacle ossicles were significantly more irregularly branched than in *M. peripatus*. The determination is uncertain. Imaoka (1990) reported and illustrated tube foot plates and anal body wall ossicles for *P. tuberculatus* which are considered here to be not holothurian ossicles, and did not find ossicles in the gonad of the single specimen described (absence in a single specimen is not diagnostically reliable). The globigerine-covered grey translucent body with distinctive serrated margin, distribution of tube feet, form of gonad tubules and colour photo of the holotype are diagnostically identical with *M. peripatus*.

Mitsukuri (1912) conducted a detailed study of the holothurians of the Sagami Sea, and reported *Meseres hyalegerus* (as *P. trachus*) up to depths of 564 m and probably did not sample depths at which *M. peripatus* occurs. *M. peripatus* is reported off southern Japan at 1058–1680 m by Ohshima (1915, as *P. unguiculatus*) and at 660–700 by Imaoka (1990, as *P. tuberculatus*). *M. peripatus* is a deep bathyal to upper abyssal cosmopolitan species.

***Meseres propinquus* (Fisher)**
comb. nov.

Pseudostichopus propinquus Fisher, 1907: 691–693, pl. 71 fig. 3, pl. 72 fig. 2, pl. 73 fig. 3, pl. 74 fig. 1, pl. 76 fig. 3.—Imaoka, 1978: 382.—Rowe (in Rowe and Gates, 1995): 285.

Pseudostichopus (Trachostichopus) propinquus.—Heding, 1940: 357.—Imaoka, 1978: tbl. 1–1.—Imaoka, 1990: 148, 152.

Material examined. Holotype. Hawaiian Is, 21°11'N, 156°35'W, 518–519 m [USNM 21217].

Remarks. The holotype is in a very poor state of preservation. Based on the description and illustrations by Fisher (1907), this species has the characteristics of *Meseres* including a thin translucent body wall, acute lateroventral margin with mammiform tubercles, small radial tube feet, scattered very small thread-like appendages, and body cover of sponge spicules and foraminiferans. A unique diagnostic character is the presence of ossicles in both gonads and respiratory trees. Rowe (in Rowe and Gates, 1995) synonymised *P. propinquus* with *Pseudostichopus pustulosus* Sluiter, 1901. *P. pustulosus* lacks respiratory tree and gonad ossicles, and has multiple-branching gonad tubules (Sluiter, 1901a), and the synonymy is rejected here.

***Meseres spiculiferus* sp. nov.**

Figures 1a–f, 2a–d

Pseudostichopus sp. MoV 2068.—O'Loughlin et al., 1994: 253–255.

Material examined. Holotype. Prydz Bay, 67°10'S, 74°28'E, 428 m, T. Bardsley, R. Ickeringill and C. Hayward, 6 Mar 1997, NMV F81857.

Paratypes (8). Prydz Bay, 66°46'–67°34'S, 70°42'–77°32'E, 298–540 m, 1991, 1997, NMV F68054 (1), F68156 (1), F72542 (1), F81805 (4), F81806 (1).

Other material. Eastern Antarctica, off Wilkes Land, 65°07'S, 107°29'E, 695 m, 1931 [BANZARE Stn 98, SAM K1853 (1)]; Prydz Bay, 66°48'S, 71°24'E, 456 m, 1929 [BANZARE Stn 30, SAM K1851 (2)]; off Mac-Robertson Land, 66°45'S, 62°03'E, 177 m, 1931 [BANZARE Stn 107, SAM K1852 (7)]; off Enderby Land, 65°48'S, 53°16'E, 193 m, 1930 [BANZARE Stn 41, SAM K1850 (1)]; Prydz Bay, Vincennes Bay, 65°33'–68°32'S, 70°20'–108°48'E, 290–600 m [ANARE, NMV F68153 (2), F68163 (1), F76598 (1), F81807 (4), F81813–81815 (3), F81824 (1), F81838–81840 (6), F81860 (1), F81862 (1), F82701 (1), F90071 (1)].

Description. Up to 105 mm long, 27 mm broad, 21 mm high; body wall soft, off-white; body normally covered with sponge spicules, sometimes globigerines; body flat ventrally, domed dorsally, rounded anteriorly and posteriorly, posterior pygal vertical furrow; mouth, anus ventral; lateroventral margin semi-acute, rounded, some reticulate ridges with very small digitate projections, lacking prominent ventrolateral projections; up to 20 reddish-brown tentacles; very small thread-like appendages variably present over whole body, typically 0.2 mm diameter, prominent around mouth and furrow, frequently entangled; small radial tube feet, up to 1.0 mm diameter, largest along lateroventral margin in band up to 5 very irregular rows wide continuous around anterior body, irregular double rows dorsolaterally, sparse to absent midventrally; longitudinal muscles rounded, undivided; single ventral polian vesicle; calcareous ring plates solid, more wide than high, lacking posterior prolongations, radials frequently with 4 posterior teeth on edge of indentation; ossicles in tentacles, tube feet, gonads, absent from body wall (including posterior lobes), respiratory trees; tentacle ossicles curved to straight rods up to 0.28 mm long, frequently with central rarely distal swellings, very rarely branched, rarely bluntly spinous; tube feet distal support rods up to 0.20 mm long, same form as tentacles; "endplates" up to 0.13 mm wide, open mesh of irregular thin knobbed branched rods;

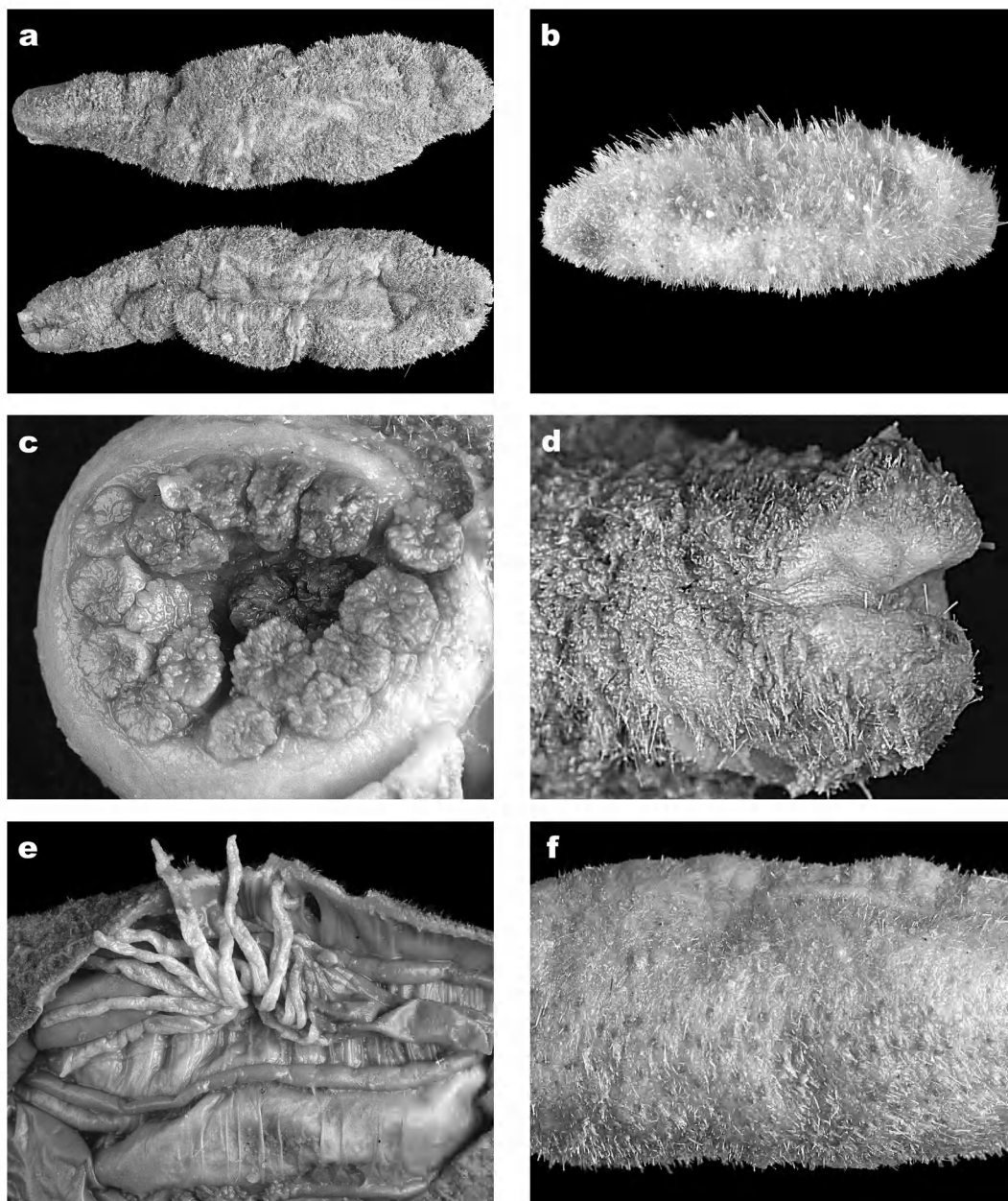


Figure 1. a–f. *Meseres spiculiferus* sp. nov. a. dorsal (above) and ventral (below) views of holotype (102 mm long); b. sponge cover, dorsal (paratype F68054, 30 mm long); c. tentacles (paratype F72542, specimen 83 mm long); d. pygal posterior furrow (paratype F81805, specimen 95 mm long); e. unbranched gonad tubules and rounded longitudinal muscles (paratype F81806, specimen 100 mm long); f. lateroventral tube feet (paratype F68156, specimen 54 mm long).

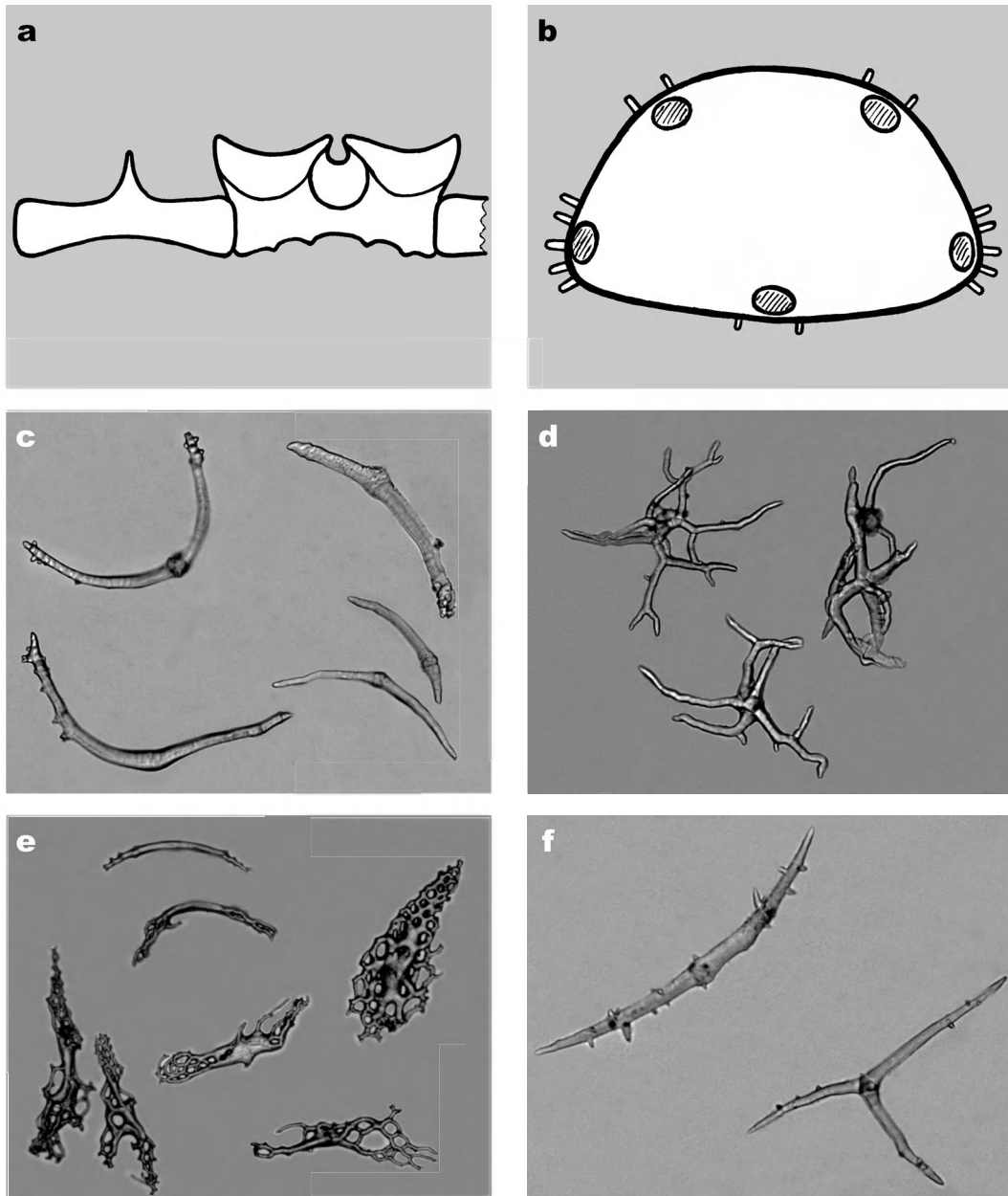


Figure 2. a–d, *Meseres spiculiferus* sp. nov. a, radial (right) and interradial (left) plates of calcareous ring; b, midbody section with tube feet distribution; c, tentacle ossicles (largest 0.22 mm across; BANZARE specimens); d, gonad ossicles (0.16 mm across; paratype F81806). e, *Meseres involutus* Sluiter. Tentacle ossicles (longest 0.30 mm long; F80451) f, *Meseres peripatus* Sluiter. Gonad ossicles (longest 0.20 mm long; F80450).

gonad tubules with abundant very irregular ossicles, frequently with large central swellings, rod to X- to Y-shaped to complex branching, branches sometimes joined to create large perforations, up to 0.30 mm long.

Etymology. From *spiculum* (Latin, sharp point) referring to sponge spicules, and *ferre* (Latin, to bear), describing the attached body cover of sponge spicules.

Distribution. Eastern Antarctica, off Wilkes, MacRobertson, Enderby Lands, 177–695 m.

Remarks. The distinguishing diagnostic characters of *M. spiculiferus* are very irregular ossicles in unbranched gonad tubules, absence of conspicuous lateroventral body wall projections, and narrow rounded and undivided longitudinal muscles. *Pseudostichopus atlanticus* Perrier, 1898 has similar gonad ossicles, but gonad tubules are branched and longitudinal muscles broad and flat. *M. peripatus* has gonad ossicles which overlap in form but are smaller (up to 0.18 mm long), and less branched; has smaller tube foot support rods (up to 0.14 mm long); and has prominent lateroventral marginal projections.

In the light of a general circumpolar occurrence of Antarctic holothurian species, and inadequate diagnostic detail recorded, material reported from western Antarctica as *Pseudostichopus mollis* Théel and *P. villosus* Théel was possibly *M. spiculiferus*. Gutt (1991a) reported that "sponge spicules adhere to the body wall of *Pseudostichopus villosus* giving it a furry appearance". This is not true of *M. villosus* in eastern Antarctica, and the description accurately fits *M. spiculiferus*.

***Meseres torvus* (Théel) comb. nov.**

Stichopus (?) *torvus* Théel, 1886a: 164–165, pl. 10 figs 2–4.—Ludwig, 1894: 34.

Type locality. Southern Pacific Ocean, off Chile, 33°42'S, 78°18'W, 2516 m.

Remarks. This species is known from a single damaged specimen. Théel (1886a) described a wrinkled body covered with foreign matter, lateroventral conical projections, 20 tentacles, small crowded tube feet, solid calcareous ring lacking posterior prolongations, and absence of body wall ossicles. All are features of *Meseres*, to which *S. torvus* is assigned here. Gonad tubules were branched, and longitudinal muscles not divided. Reference was not made to ossicles in gonad tubules or respiratory trees or perianally, or to a pygal furrow which is presumed here to have

been obscured by damage or the cover of foreign matter. Data are insufficient to confirm any synonymy.

***Meseres trachus* (Sluiter)**

Pseudostichopus trachus Sluiter, 1901a: 15–16.—Sluiter, 1901b: 52–53, pl. 5 fig. 1, pl. 8 fig. 8.—Perrier, 1902: 337–338.—Fisher, 1907: 693.—Savel'eva, 1941: 74.—Djakonov, 1952: 127, 129.—Baranova, 1957: 239.—Djakonov et al., 1958: 366.—Imaoka, 1978: 384.—Cherbonnier and Féral, 1981: 383, 385, fig. 16.

Pseudostichopus (Trachostichopus) trachus.—Heding, 1940: 353–362, fig. 17.—Imaoka, 1978: tbl. 1–2.—Thandar, 1992: 166.

Meseres trachus.—Rowe (in Rowe and Gates, 1995): 285.—O'Loughlin, 1998: 497.

Material examined. Syntype. Indonesia, Arafura Sea, 8°50'S, 127°02'E, 883 m, *Siboga* Stn 286 [ZMA 2496.1 (1)].

Other material. Eastern Australia, Tasman Sea, 882–1198 m [AM J16836 (1), J23220 (1), J22957 (1), J22972 (1), J23218 (1); NMV F80175 (1), F80176 (1), F80448 (1)].

Distribution. Indo-Pacific, Indonesia, Arafura Sea, 798–883 m (Sluiter, 1901a); Philippines, 14°N, 120°E, 448–1125 m (Cherbonnier and Féral, 1981); Sea of Japan, 1600 m (Savel'eva, 1941); off Kuril Is, 113–560 m (Djakonov et al., 1958); Bering Sea, 110 m (Baranova, 1957); eastern Africa, off Kenya, 638–977 m (Heding, 1940); eastern Australia, Tasman Sea, 882–1198 m (this paper).

Remarks. Rowe (in Rowe and Gates, 1995) reassigned *P. trachus* to *Meseres*. Based particularly on the presence of a series of small but distinct lateroventral projections on a subacute ventrolateral margin, which were noted by Sluiter (1901b) and observed here on the type, the reassignment is supported here. Diagnostic characters for *M. trachus* are discussed under *M. hyalegerus* above. There is an absence of reference to other *Meseres* species, such as *M. hyalegerus*, and insufficient diagnostic data in the reports of *P. trachus* by Heding (1940), Savel'eva (1941), Baranova (1957), Djakonov et al. (1958) and Cherbonnier and Féral (1981), to confirm their determinations. Depths as shallow as 110 m (Baranova, 1957) and 113 m (Djakonov et al., 1958), complete sponge spicule cover (Savel'eva, 1941), and specimens up to 300 mm long (Djakonov et al., 1958), raise doubts about the determinations. Mitsukuri (1912) and Ohshima (1915) reported *P. trachus* for Japan, but their material is considered above to be *M. hyalegerus*.

Meseres villosus (Théel)

Figures 3a–b

Pseudostichopus villosus Théel, 1886a: 170–171.—Ludwig, 1898a: 8.—Perrier, 1902: 337–338.—Hérouard, 1902: 11–14, pl. 2 figs 1–3, pl. 7 fig. 3.—Vaney, 1908: 407–408.—Grieg, 1921: 4.—Hérouard, 1923: 23.—Mortensen, 1927: 387–388.—Deichmann, 1930: 89.—Hansen, 1956: 47–48, 51–53.—Gutt, 1991b: 324.

Pseudostichopus villosus var. *violaceus* Théel, 1886a: 172, pl. 10 fig. 6b.

Molpadiodemas villosus.—Heding, 1940: 353–360.

Pseudostichopus sp. MoV 2033.—O'Loughlin et al., 1994: 253–254.

Meseres villosus.—O'Loughlin, 1998: 497.

Material examined. Syntype. Southern Ocean, 46°16'S, 48°27'E, 2928 m, *Challenger* Stn 147 [BMNH 86.10.2.154 (1)].

Other material. Eastern Antarctica, Prydz Bay, 66°46'–68°50'S, 72°14'–77°19'E, 333–765 m [ANARE, NMV F68152 (9), F68158 (1), F68162 (5), F72534 (2), F76583 (2), F76597 (1), F76606 (1), F81816–81817 (3)].

Type locality. Syntypes (11) from Atlantic, Indian, Pacific and Southern Oceans; abyssal.

Distribution. Atlantic, Indian, Pacific and Southern Oceans, 2516–5307 m (Théel, 1886a). Western Antarctica, Weddell Sea, 4575–4795 m (Vaney, 1908); 405–465 m (Gutt, 1991b). Kermadec Trench, 6660–7000 m (Hansen, 1956); North Atlantic, 34°59'N, 33°01'W, 2615–2965 m (Grieg, 1921). Eastern Antarctica, Prydz Bay, 333–765 m (this paper).

Remarks. The distinctive characteristics of *M. villosus* are: up to 150 mm long; subcylindrical form; absence of a cover of sponge spicules or globigerines or detrital matter; broad band of numerous larger tube feet lateroventrally (up to 2 mm long); lacking thin tubular appendages; broad flat undivided longitudinal muscles; multiple branching gonad tubules; absence of ossicles in tube feet, gonad tubules, respiratory trees, posteriorly; dark reddish-brown body colour. Deichmann (1930) thought that material off Morocco determined by Hérouard (1902) as *P. villosus* was probably *P. atlanticus*, but Hérouard (1902) described rod ossicles in unbranched gonad tubules which suggests *M. peripatus* [see above]. Deichmann (1930) determined material from the French West Indies (896 m) as *P. villosus*, but described tube feet in bundles on distinct lateral conical warts. This feature and the shallow bathyal depth indicate that the material was not *M. villosus*. Hansen (1956) synonymised

P. globigerinae with *P. villosus*, but it is removed here from the synonymy [see above]. This cosmopolitan abyssal species occurs at shallow bathyal depths around the Antarctic coast.

Mesothuria bifurcata Hérouard

Mesothuria bifurcata Hérouard, 1901: 40.—Hérouard, 1906: 4–6, pl. 2 fig. 3.—Heding, 1942: 8, fig. 7.—O'Loughlin et al., 1994: 553–4.

Material examined. Holotype. Western Antarctica, Bellingshausen Sea, 71°14'S, 89°14'W, approximately 800 m (estimated from given latitude and longitude), 1898 [IRSNB IG 10131].

Other material. Eastern Antarctica, off Princess Elizabeth Land, 66°28'S, 72°41'E, 1266 m, 1929 [BANZARE Stn 29, SAM K1838 (1 specimen)]; Prydz Bay, 66°46'–68°32'S, 70°41'–77°19'E, 320–743 m [ANARE, NMV F68050 (1), F68154 (1), F72540 (3), F76594–76596 (3), F81808–81812 (38), F81858–81859 (5), F81861 (1), F81863 (2)].

Distribution. Western Antarctica, Bellingshausen Sea, 800 m (Hérouard, 1901). Eastern Antarctica, off Princess Elizabeth Land, Prydz Bay, 320–1266 m (this paper). North Atlantic, 61°44'N, 30°29'W, 2337 m (Heding, 1942).

Remarks. The holotype has shrunk to 4.6 mm long, and is in poor condition. No ossicles were found. The ANARE material is consistent with the holotype and the descriptions and figure by Hérouard (1901, 1906). The ANARE specimens have the following characteristics: up to 70 mm long, subcylindrical, rounded anteriorly, slightly tapered posteriorly, mouth ventral, anus posterior; lacking pygal furrow, anal teeth; body wall thick, firm, flexible; preserved colour grey to reddish-brown dorsally, darker ventrally; up to 20 reddish-brown peltate tentacles; gonad tubules with multiple branching; longitudinal muscles divided; largest tube feet in single ventrolateral row, smaller tube feet in row lateral to ventrolateral row; very small tube feet scattered dorsally, laterally, few ventrally, absent midventrally; calcareous ring solid, lacking posterior prolongations, radial plates as high as wide with anterior V-shaped notch, interradial plates at least twice as wide as high; all of body surface with close bristle of table spires; form of table ossicles variable, normally height of spire similar to width of disc; largest discs with three large, three smaller perforations, angular margin, up to 0.23 mm wide; smaller discs less regular, typically nine perforations, more rounded margin, typically 0.08 mm wide; spires with three pillars, joined proximally and distally, extending into radiating tapered spines, height of spires variable up to 0.18

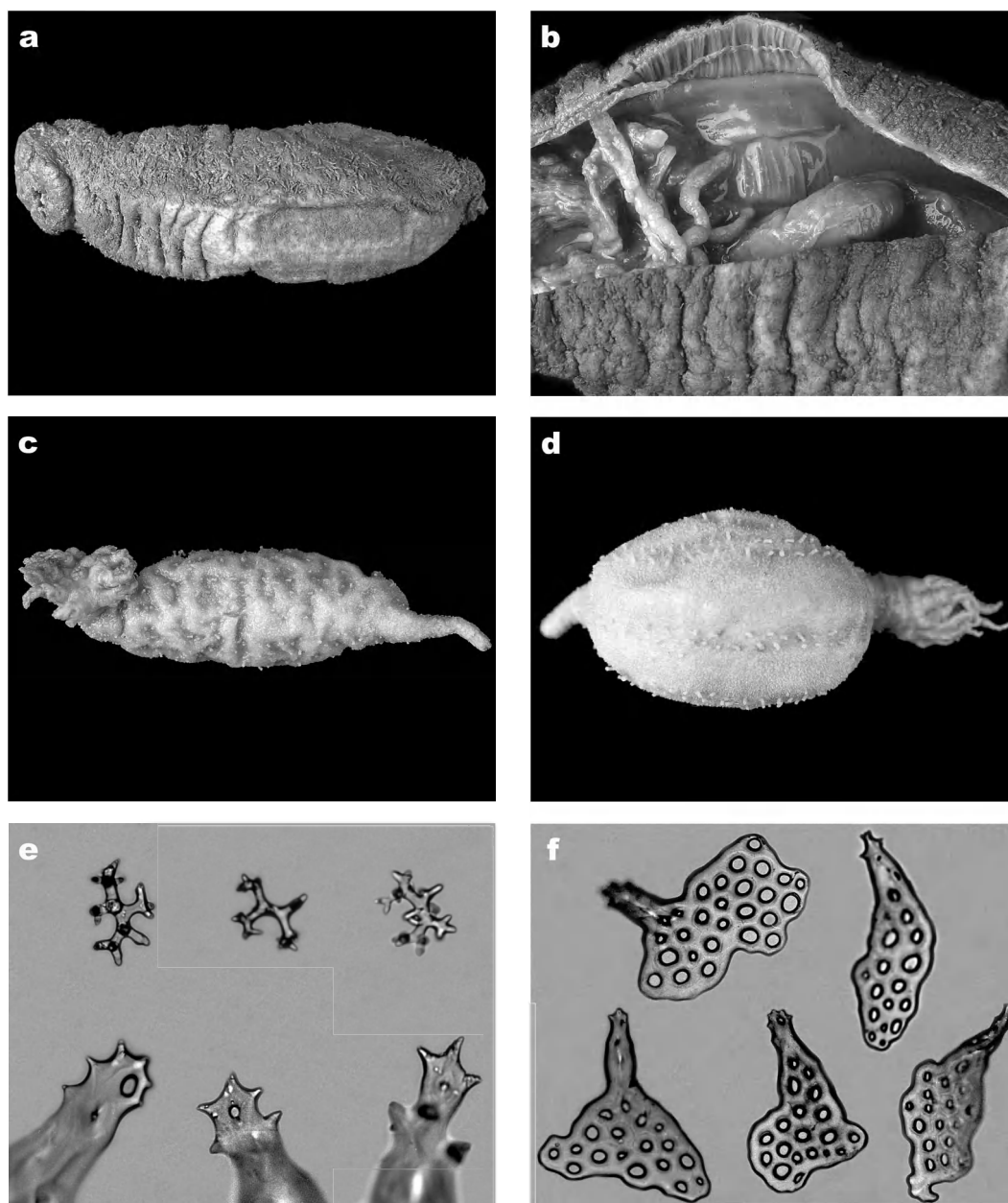


Figure 3. a–b, *Meseres villosus* (Théel), specimen F81816, 88 mm long. a, lateroventral tube feet; b, branched gonad tubules and broad flat longitudinal muscle. c–f, *Psoligrux coatsi* (Vaney). c, tentacles and elongate thin tail (F68044, 39 mm long); d, sole-like ventrum (F68047, specimen 33 mm long); e above, knobbed crosses (0.07 mm long; F72614); e below, plate spires (F68084); f, spired plates (largest 0.51 mm long; F68084).

mm; radiating spines variable with single point, or up to four terminal spinelets, or strongly bifurcate with or without terminal spinelets, or doubly bifurcate.

The description and illustrations of the single North Atlantic *Ingolf* specimen by Heding (1942) are also consistent diagnostically with the ANARE material, including table size (illustrated disc 0.12 mm wide, spire 0.13 mm high) and the occurrence of doubly bifurcate spines minutely spinous distally. Gutt (1991b) reported *Mesothuria lactea* (Théel, 1886) from the Weddell Sea, but did not report *M. bifurcata*. Ossicles are similar, except for the frequently bifurcate spines at the ends of the table spires. Weddell Sea material was probably *M. bifurcata*. This near abyssal Atlantic occurrence and shallow bathyal occurrence near the Antarctic continent are comparable with the distribution of *Meseres villosus* Théel. The BANZARE and ANARE specimens extend the distribution to eastern Antarctica.

Pseudostichopus atlanticus Perrier

Pseudostichopus atlanticus Perrier, 1898: 1665.—Perrier, 1902: 333–338, pl. 17 figs 15–20.—Mortensen, 1927: 386–387.—Deichmann, 1930: 87–88.—Deichmann, 1940: 209, 211.—Heding, 1942: 5.

Molpadiodemas acaudum Heding, 1935: 78–80, pl. 6 figs 1–2.—Heding, 1940: 354–357.—Deichmann, 1940: 209, 211.—Heding, 1942: 4–5.

Molpadiodemas atlanticus.—Heding, 1940: 353–359.

Meseres atlanticus.—O'Loughlin, 1998: 497.—Thandar, 1999: 376–379, fig. 4.

Meseres acaudum.—O'Loughlin, 1998: 497, fig. 1 g–h [new synonymy].

Material examined. *Pseudostichopus atlanticus* Perrier, 1898. Holotype, paratype. North Atlantic, off the Azores, 42°19' N, 23°36' W, 4060 m, *Talisman* Stn 134, 1883 [MNHN EcHh 2772, EcHh 658].

Molpadiodemas acaudum Heding, 1935. Paratype. North Atlantic, 60°17' N, 54°05' W, 3230 m, *Ingolf* Stn 37, 1895 [ZMUC].

Distribution. North Atlantic, 3230–4060 m (Perrier, 1902, as *P. atlanticus*; Heding, 1935, as *M. acaudum*); South Atlantic, off South Africa, 34°42' S, 16°54' E, 3155–3255 m (Thandar, 1999); abyssal.

Remarks. Heding (1940) referred *Pseudostichopus atlanticus*, *P. villosus* and *P. occultatus* to *Molpadiodemas* Heding, 1935 (type species *M. acaudum*). O'Loughlin (1998) synonymised *Molpadiodemas* with *Meseres*. Both *P. atlanticus* and *M. acaudum* lack a distinctive ventrolateral margin, and do not belong in the emended diagnosis of *Meseres* above. The two species are reassigned

to *Pseudostichopus*. Deichmann (1940) and Heding (1942) considered that *P. atlanticus* and *M. acaudum* might be synonymous. The types of both species were taken at abyssal depths in the North Atlantic; are pale brown in colour, with very small brown spots (collapsed papillae); have a large sac-like form, very rugose ventrally, with some globigerines attached; have a thick body wall lacking a ventrolateral margin; have a cover of very small tube feet, frequently withdrawn; have very broad flat longitudinal muscles; have branched gonad tubules with complex ossicles; and lack ossicles in tube feet and respiratory trees. *Molpadiodemas acaudum* Heding, 1935 is considered here to be a junior synonym of *Pseudostichopus atlanticus* Perrier, 1898. *Meseres peripatus*, *M. propinquus* and *M. spiculiferus* also have ossicles in the gonads. *P. atlanticus* is distinguished from *M. peripatus* which has unbranched gonad tubules, projections on the lateroventral margin, and rounded longitudinal muscles. *M. propinquus* has ossicles in the respiratory trees, marginal projections, rounded longitudinal muscles, and unbranched gonad tubules. *P. atlanticus* and *M. spiculiferus* have similar complex gonad ossicles, but *M. spiculiferus* has unbranched gonad tubules and rounded longitudinal muscles. Deichmann (1930) described a specimen of *P. atlanticus* from the British West Indies (2920 m) as having narrow, undivided, circular muscle bands, which indicates probable misidentification. The rounded body form and branched gonad tubules and broad longitudinal muscles of *P. atlanticus* are similar to *M. villosus* which is distinguished by a prominent band of ventrolateral tube feet, and by lacking gonad ossicles. The “mulberry” bodies from the body wall of *P. atlanticus*, illustrated by Perrier (1902) and Thandar (1999), and referred to by Théel (1886a) as present in some specimens of *P. villosus*, are considered here to be detrital accretions and not holothurian ossicles and species specific.

Order **Dendrochirotida** Grube

Cucumariidae Ludwig

Heterocucumis Panning

Ekmoecucumis (*Heterocucumis*) Panning, 1949: 452.

Type species. *Cucumaria steineni* Ludwig, 1898 [original designation].

Emended diagnosis. Ten equal tentacles; tube feet on larger specimens in more than single radial rows; calcareous ring lacks posterior prolongations, frequently soft or absent with age;

significant change in ossicle form with age; plates with narrow extension at some developmental stage; plates in larger specimens single-layered, perforated; some plates with one spinous edge or spinous tapered end or marginal pointed projections; plates with surface spines; lacking tables, cups and crosses; lacking towered crosses at any developmental stage.

Species. *H. denticulata* (Ekman, 1927); *H. godeffroyi* (Semper 1868); *H. steineni* (Ludwig, 1898).

Distribution. Antarctica, Magellanic region, Kerguelen region.

Remarks. Heding (1942) nominated *Cucumaria turqueti* Vaney, 1906b as type species for his new genus *Ekmocucumis*. Panning (1949) created two subgenera of *Ekmocucumis*: *Ekmocucumis* (type species *Cucumaria turqueti*), and *Heterocucumis* (type species *Cucumaria steineni*). Based on very close similarity of developmental changes in ossicle form, Hansen (1988) supported the original thinking of Ekman (1927) and assigned *Cucumaria liouvillei* Vaney, 1914, *C. abyssorum* Théel, 1886a and *C. turqueti* Vaney, 1906b to *Staurocucumis* Ekman, 1927 (type species *C. liouvillei*). Massin (1994) followed Hansen (1988). Thus the type species (*Cucumaria turqueti*) of the genus and subgenus *Ekmocucumis* Heding, 1942 has been assigned to *Staurocucumis*, the genus name *Ekmocucumis* becoming a junior synonym. The subgenus *Heterocucumis* Panning, 1949 is raised here to generic status.

Cucumaria grandis Vaney, 1906b was considered by Ekman (1925, 1927) to be a junior synonym of *Cucumaria turqueti* [*C. grandis* has page precedence over *C. turqueti* in Vaney 1906b, but the relegation of *C. grandis* to junior synonymy by Ekman (1925) stands under the "Principle of the First Reviser" (ICZN Article 24a)]. Cherbonnier (1974) retained *Ekmocucumis grandis* (junior synonym *Cucumaria spatha* Cherbonnier, 1941b). With a probable synonymy [adequate comparative material not yet examined] of *E. grandis* with *S. turqueti*, the former is provisionally referred here to *Staurocucumis*.

Of the three species (*coatsi*, *denticulata*, *steineni*) originally assigned by Panning (1949) to his new subgenus *Heterocucumis*, *denticulata* and *steineni* are retained here in *Heterocucumis*, and *coatsi* is referred below to a new genus *Psolierux*. *C. godeffroyi* is referred here to *Heterocucumis* on the basis of: ten subequal tentacles; radial double rows of tube feet; elongate perforated plates with spinous surface and pointed marginal projections, some plates with one end narrow and

spinous in smaller specimens; significant ossicle change during development (Ludwig, 1898b; Pawson, 1969); and tendency to lose the calcareous ring with age. Although body wall ossicles in large specimens of *H. godeffroyi* are significantly smaller than in large specimens of *H. steineni*, they are indistinguishable from the small ossicles present in *H. steineni*. Both species have a leathery non-calcareous body wall, tend to lose the calcareous ring with size, have a maximum size of about 70 mm, and have dark brown colouration anteriorly.

***Heterocucumis godeffroyi* (Semper) comb. nov.**

Cucumaria godeffroyi Semper, 1868: 53, pl. 15 figs 12, 14.—Lampert, 1885: 144.—Théel, 1886a: 99–100.—Ludwig, 1898b: 435–437, pl. 26 figs 15–21.—H.L. Clark, 1910: 352–353.—Ekman, 1925: 49.—Deichmann, 1941: 83–84.—Deichmann, 1947: 334.—Panning, 1955: 43–45, figs 7–9.—Pawson, 1969: 131–133, fig. 1.

Stereoderma godeffroyi.—Panning, 1949: 422.—Pawson, 1964: 457.

Material examined. Kerguelen region, Kerguelen I., Royal Sound, 49°28'S, 70°04'E, 4–5 m, 1929 [BANZARE Stn 12, SAM K1845 (2 specimens)]; 49°28'S, 70°12'E, 47 m, 1930 [BANZARE Stn 59, SAM K1844 (2)]; Heard I., 51°16'–53°12'S, 73°05'–76°02'E, 200–379 m [ANARE, NMV F84996 (1), F84999–85001(3)].

Type locality. Chile, Iquique.

Distribution. Magellanic region, Chile, 0–60 m (summary by Pawson, 1969). Kerguelen region, Kerguelen and Heard Is, 4–379 m (this paper).

Remarks. Panning (1949) assigned *C. godeffroyi* to *Stereoderma* Ayres, but subsequently (1955) provided a description of *Cucumaria godeffroyi*, implicitly returning the species to *Cucumaria*. Panning (1964) formally regarded *Stereoderma* as monotypic, excluding *C. godeffroyi*.

The sparse flat perforated plates with spinous surface and pointed marginal projections are commonly 0.06 and up to 0.10 mm long in larger Heard and Kerguelen specimens, and up to 0.14 mm long in smaller specimens. Pawson (1969) reported plates in larger specimens from off Chile as larger (average 0.17 mm long). The change in ossicle form with size reported and illustrated by Pawson (1969) is evident in the Heard and Kerguelen material, and the dark brown colour around the base of the tentacles is present in some Heard specimens.

This species is not *Cucumaria godeffroyi* Vaney, 1914, which Ekman (1925, 1927), Panning (1949) and Massin (1994) regarded as a junior

synonym of *Ekmocucumis steineni* (Ludwig), now *Heterocucumis steineni* (below). This paper reports an extension of the distribution of *H. godffroyi* from the Magellanic to Kerguelen region, at a generally greater depth. It has not been reported from the Antarctic coast.

***Heterocucumis steineni* (Ludwig)**

Cucumaria steineni Ludwig, 1898a: 30–32, pl. 2 figs 22–24.—Ekman, 1925: 38–45, fig. 6.—Ekman, 1927: 363, 390–393, figs 12, 13.—Panning, 1936: 15–16, figs 6, 7.—Cherbonnier, 1941a: 464–468.

Cucumaria antarctica Vaney, 1906b: 6–10, figs 3, 8, 26.—Vaney, 1908: 427.—Vaney, 1914: 8–9.

Cucumaria godffroyi Vaney, 1914: 11–12, pl. 4 figs 1–5.

Ekmocucumis (Heterocucumis) steineni.—Panning, 1949: 452–453, fig. 51.

Heterocucumis antarctica.—Cherbonnier, 1974: 609.

Heterocucumis godffroyi.—Cherbonnier, 1974: 609.

Ekmocucumis steineni.—Gutt, 1991b: 324.—O'Loughlin et al., 1994: 549, 554.

Heterocucumis steineni.—Massin, 1994: 130–145, figs 5–16.

Ekmocucumis sp. MoV 2005.—O'Loughlin et al., 1994: 551–552, 554.

Material examined. Antarctica, off Enderby Land, 65°48'S, 53°16'E, 193–209 m, 1930 [BANZARE Stn 41, SAM K1832 (1)]; Prydz Bay, off Enderby and MacRobertson Lands, 66°53'–68°31'S, 65°26'–78°13'E, 105–743 m [ANARE, NMV F68024 (1), F68030 (2), F68053 (1), F68100 (3), F68678 (1), F69109 (1), F69111 (1), F72615 (4), F91297 (27)].

Type locality. South Georgia.

Distribution. Western Antarctica, South Orkney Is, South Georgia, Falkland Is and Burdwood Bank, 2–400 m (summary by Ekman, 1927); off Graham Land, 0–110 m (Vaney, 1906b, as *C. antarctica*); off Alexander I., 6–297 m (Vaney, 1914, as *C. antarctica* and *C. godffroyi*); Weddell Sea, 160–1180 m (Gutt, 1991b). Eastern Antarctica, off Terre Adélie, 6–210 m (Cherbonnier, 1974, as *H. antarctica* and *H. godffroyi*); off Wilhelm II Land, 350–400 m (Ekman, 1927); off Enderby and MacRobertson Lands, 105–743 m (this paper).

Remarks. Ekman (1927) considered *C. antarctica* and *C. godffroyi* to be junior synonyms of *C. steineni*. Cherbonnier (1941a, 1974) rejected the synonymies by Ekman (1927), and reported *Heterocucumis antarctica* (Vaney) and *Heterocucumis godffroyi* (Vaney) for Terre Adélie. Massin (1994) supported the synonymies after a study of developmental changes in ossicle form. Determination of *H. steineni* in this study is based on the

illustrations of variation in ossicle form with size by Massin (1994). Material determined as *Ekmocucumis* sp. MoV 2005 by O'Loughlin et al. (1994) comprises mostly larger specimens of *H. steineni*.

***Psolicrux* gen. nov.**

Type species. *Psolidium coatsi* Vaney, 1908.

Diagnosis. Body wall thin, calcareous; mouth anterior on short taper; anus posterior on elongate tapered tail; 10 subequal dendritic tentacles; calcareous ring lacking posterior prolongations; mid-body ventral radial tube feet larger than those extending to introvert and anus, creating sole-like ventrum; scattering of dorsal and lateral tube feet beyond dorsolateral radial series; body wall ossicles plates and knobbed crosses; plates irregularly oval, typically 0.44 mm long in western Antarctica (0.60 mm in eastern Antarctica), perforated, smooth surface and margin, one end tapered into narrow, sometimes perforated, distally spinous spire angled above plate surface; crosses small, typically 0.08 mm long in western Antarctica (0.06 mm in eastern Antarctica), not cupped, with irregular short frequently distally knobbed branches; lacking tables and cups.

Etymology. From a family name Psolidae, referring to the sole-like ventrum, and crux (Latin for cross), referring to the knobbed crosses.

Remarks. *Psolicrux* is distinguished from other genera of Cucumariidae by a combination of elongate thin tail, sole-like ventrum, scattered dorsal and dorsolateral tube feet, smooth perforated plates with angled spinous spires, and irregular knobbed crosses.

***Psolicrux coatsi* (Vaney) comb. nov.**

Figures 3c–f

Psolidium (Cucumaria) coatsi Vaney, 1908: 424–425, pl. 4 figs 47–50.

Cucumaria conspicua Vaney, 1908: 433, pl. 2 figs 15–16, pl. 5 fig. 67.—Ekman, 1927: 414.—Panning, 1949: 416 [new synonymy].

Psolidium navicula Ekman, 1927: 408–414, fig. 18.—Panning, 1949: 455.—Gutt, 1991b: 324 [new synonymy].

Psolidium bistratum Ludwig and Heding, 1935: 165–167, figs 30–31.—Panning, 1949: 455 [new synonymy].

Ekmocucumis (Heterocucumis) coatsi.—Panning, 1949: 452.

Heterocucumis coatsi.—Cherbonnier, 1974: 609.

Ekmocucumis sp. MoV 2013.—O'Loughlin et al., 1994: 549.

Material examined. Western Antarctica, Weddell Sea, 115 m, 1958 [USNM E51318 (7 specimens)]; South Sandwich Is, 415–613 m, 1975 [USNM E51314 (1)]; South Shetland Is, 97–113 m, 1966 [USNM E51317 (2)]; Palmer Archipelago, 55 m, 1972 [USNM E51315 (1)]. Eastern Antarctica, off Wilkes Land, 183–237 m, 1961 [USNM E51316 (3)]; off Enderby and Mac-Robertson Lands, Prydz Bay, 65°56'–67°41'S, 50°52'–77°32'E, 98–400 m [ANARE, NMV F68044 (1), F68047 (2), F68084 (1), F68668 (1), F72614 (1), F84985 (1)].

Type locality. Western Antarctica, Scotia Sea.

Distribution. Western Antarctica, Weddell Sea, 125–990 m (Gutt, 1991b, as *P. navicula*); Scotia Sea, 165–183 m (Vaney, 1908); off Coats Land, South Shetland Is, South Sandwich Is, Palmer Archipelago, 55–613 m (this paper). Southern Ocean, east of Bouvet I., 567 m (Ludwig and Heding, 1935, as *P. bistratum*). Eastern Antarctica, off Terre Adélie, 10–170 m (Cherbonnier, 1974); off Wilhelm II Land, 350–385 m (Ekman, 1927, as *P. navicula*); Prydz Bay, 98–400 m (this paper).

Remarks. Based on the original descriptions, and examination of *P. coatsi* specimens, *Psolidium navicula* Ekman, 1927 and *Psolidium bistratum* Ludwig and Heding, 1935 are considered here to be junior synonyms of *Psolirux coatsi* (Vaney, 1908). A distinctive diagnostic character is the consistent occurrence of the small, irregular, bluntly spinous crosses illustrated by Vaney (1908) for *P. coatsi*, by Ekman (1927) for *P. navicula*, by Ludwig and Heding (1935) for *P. bistratum*, and referred to as "cups" by Panning (1949) [they are not cupped]. The three authors illustrated short spinous apophyses rising from the end of smooth perforated oval to elongate plates, and observed that the mid-body ventral radial tube feet were larger than those extending to the introvert and anus and referred their species to *Psolidium*. All recognised the posterior tapered conical body form. Ekman (1927) and Ludwig and Heding (1935) illustrated the distinctive constricted base of the anterior projections of the radial plates of the calcareous ring. Ludwig and Heding (1935) considered that the plates with a narrow perforated spinous end and the knobbed crosses were similar to the ossicles of *Cucumaria insolens* Théel, 1886 from South Africa, but in the illustrations by Théel (1886a) the plates in *C. insolens* are knobbed, not smooth, and the spinous end is not angled above the plate. The knobbed crosses in *C. insolens* are cupped.

Cucumaria conspicua Vaney, 1908 was described from a single small specimen (10 mm

long) taken at the same station as *P. coatsi*. It had a thin flat oval ventrum with large radial tube feet, small tube feet scattered beyond the dorsolateral radial series, terminal mouth and anus, short posterior taper, and single-layered perforated plate ossicles with spinous taper. This specimen is considered here to be a juvenile *P. coatsi*.

Ekman (1925) described material as *Cucumaria coatsi* which had anterior interrational brood pouches, ten tentacles with the two ventral ones smaller, and ossicles not consistent with those of *P. coatsi*, which does not have brood pouches, has ten subequal tentacles, and has small spinous crosses and elongate perforated plate ossicles with raised narrow short perforated spinous ends. The material described by Ekman (1925) was not *P. coatsi*. Ossicles of *P. coatsi* illustrated by Massin (1994) are similar to those of Ekman (1925), and do not resemble those illustrated by Vaney (1908) for the type of *P. coatsi*. The distribution of *P. coatsi* is extended here to eastern Antarctica.

Staurocucumis liouvillei (Vaney)

Cucumaria liouvillei Vaney, 1914: 12–14, pl. 3 figs 1–3.—Ekman, 1925: 85–89, fig. 18.

Staurocucumis liouvillei.—Ekman, 1927: 363, 374–381, figs 7, 8.—Heding, 1942: 33.—Panning, 1949: 455.—Cherbonnier, 1974: 609.—Hansen, 1988: 301–302, 304, 307, fig. 3.—Massin, 1994: 129–132, fig. 1.—O'Loughlin et al., 1994: 552, 554.

Cucumaria mira Ludwig and Heding, 1935: 172–179, figs 39–41.

Trachythione mira.—Panning, 1949: 426.—O'Loughlin et al., 1994: 552, 554 [new synonymy].

Abyssocucumis liouvillei.—Gutt, 1991b: 324.

Material examined. Eastern Antarctica, off Kemp Land, 66°45'S, 62°03'E, 177 m, 1931 [BANZARE Stn 107, SAM K1848 (4 specimens)]; Prydz Bay, 66°53'–68°58'S, 68°56'–77°33'E, 131–791 m [ANARE, NMV F68018 (1), F68022 (1), F68025–68027 (12), F68029 (5), F68031–68034 (27), F68036 (1), F68038 (1), F68040 (2), F68048 (1), F68055 (1), F68059 (1), F68061–68062 (2), F68064 (1), F68077–68078 (2), F68080–68081 (4), F68086 (1), F68089 (1), F68096 (2), F68099 (1), F68656 (1), F69101 (2), F69103 (4), F69129 (1), F69133 (2), F71991 (1)]. Heard I., 51°17'–53°13'S, 71°45'–76°32'E, 60–541 m [ANARE, NMV F85015–85034 (105)].

Type locality. Western Antarctica, Bellingshausen Sea side of Antarctic Peninsula.

Distribution. Western Antarctica, west of Antarctic Peninsula, 98–297 m (Vaney, 1914); South Georgia, 125–310 m (Ekman, 1925); Weddell Sea, 160–745 m (Gutt, 1991b). Southern Ocean, east of Bouvet I., 439–567 m (Ludwig

and Heding, 1935, as *C. mira*). Eastern Antarctica, off Terre Adélie, 385 m (Cherbonnier, 1974); off Wilhelm II Land, 350–485 m (Ekman, 1927); Prydz Bay, 131–791 m (this paper). Kerguelen region, Heard I., 60–541 m (this paper).

Remarks. The Antarctic and Heard I. specimens were indistinguishable in terms of: size (up to 80 mm long); thin body wall with outer gelatinous brown layer, darkens with age; ten equal long very branched tentacles, always extended, frequently lost; tube feet on radii only, more developed ventrally; calcareous ring normally not evident; ossicles frequently not evident in larger specimens; oval bowl ossicles with denticulate perforations. Vaney (1914) illustrated a bowl 0.22 mm long for type material [size of specimen sampled not given]. For Bouvet material Ludwig and Heding (1935) illustrated a bowl 0.11 mm long for a 7.5 mm specimen. For western Antarctic material Massin (1994) illustrated bowls up to 0.13 mm long in a 10 mm long specimen, and 0.22 mm long in a 51 mm specimen. Eastern Antarctic material in this study had bowl sizes up to 0.29 mm long in a 65 mm long contracted specimen (NMV F68031). Bowl size increases significantly with increasing size of specimens. Eastern Antarctic and Heard bowl sizes differed significantly for specimens of similar size, the largest bowls up to 0.29 mm long in a 65 mm long contracted specimen (Antarctic, NMV F68031) and 0.17 mm long for a 70 mm long contracted specimen (Heard, NMV F85033). Based on the description and illustrations of *C. mira* Ludwig and Heding, 1935, it is considered here to be conspecific with *S. liouvillei*. The distribution of *S. liouvillei* is extended here to the Kerguelen region.

Trachythyone lechleri (Lampert)

Thyone (*Thyonidium*) *lechleri* Lampert, 1885: 253, pl. 1 fig. 64.—Théel, 1886a: 267.

Thyone lechleri.—Ludwig, 1898a: 44–49, pl. 2 figs 26–30, pl. 3 figs 31–33.—Perrier, 1905: 35–38.—Ekman, 1925: 101–103, fig. 22.—Deichmann, 1947: 335–336.

Thyone hassleri Théel, 1886b: 11–12.

Trachythyone lechleri.—Panning, 1949: 426, figs 12–14.—Panning, 1964: 166–167, figs 6, 7.—Pawson, 1964: 459–461, fig. 2(1–5).—Hernandez, 1982: 256–257; figs 1b, 3b, 4; pl. 2j–m.

Material examined. Kerguelen I., Royal Sound, 49°28'S, 70°12'E, 47 m, 1930 [BANZARE Stn 59, SAM K1849 (1 specimen)]; Heard I., 52°32'–53°30'S, 73°10'–73°41'E, 60–238 m [ANARE, NMV F84992–84995 (6)].

Type locality. Straits of Magellan.

Distribution. Magellanic region, Straits of Magellan, Tierra del Fuego, up to 30 m (summary by Pawson, 1964). Kerguelen region, Kerguelen and Heard Is, 47–238 m (Pawson, 1964; this paper).

Remarks. The Heard I. material does not differ in any recognisable way from the descriptions and illustrations of Magellanic region material by Ludwig (1898a), Ekman (1925) and Pawson (1964). The largest specimen is 145 mm long (Pawson gave 150 mm), and the multiple series of radial tube feet create a superficial appearance of covering the whole body. The distinctive irregularly oval plates, with sparse to absent small perforations, are typically 0.16 and up to 0.28 mm long (Ekman gave 0.12 mm, Pawson 0.2 mm). The large perforated plates, present in small specimens only, are up to 0.38 mm long (Ludwig gave 0.43 mm, Ekman 0.21 mm). The thick cupped spinous crosses are 0.05–0.06 mm long (Pawson gave 0.05 mm).

The type material for *T. hassleri* was taken in the Straits of Magellan, and Théel (1886b) acknowledged the strong resemblance to *T. lechleri*. Ludwig (1898a) synonymised the two species, and Pawson (1964) commented in detail on the synonymy and agreed. Pawson (1964) identified a single specimen from Heard I. in the Dominion Museum (Wellington, New Zealand) as *T. lechleri*, and additional material is present in the BANZARE collection from Kerguelen and ANARE collections from Heard I. This species has not been reported for Antarctica, but occurs in the Magellanic region and at greater depth in the Kerguelen region.

Paracucumidae Pawson and Fell

Paracucumis turricata (Vaney) comb. nov.

Thyone turricata Vaney, 1906a: 401–402, fig. 3.—Ekman, 1925: 108–111, fig. 25.

Paracucumis antarctica Mortensen, 1925: 9–12, figs 6–8.—Panning, 1936: 11–14, figs 1–5.—Heding and Panning, 1954: 46–47, fig. 7.—Pawson, 1982: 815.—O'Loughlin et al., 1994: 552, 554 [new synonymy].

Paracucumis turricata.—Panning, 1936: 14.

Ypsilocucumis turricata.—Panning, 1949: 455.—Cherbonnier, 1974: 610.—Gutt, 1991b: 324.

Material examined. *Thyone turricata*, Vaney, 1906. Holotype (MNHN). Western Antarctica, South Orkney Is, Scotia Bay, littoral, 1905.

Other material. Eastern Antarctica, off Wilkes Land, 65°10'S, 108°12'E, 474 m, 1931 [BANZARE Stn 97, SAM K1846 (1 specimen)]; Prydz Bay and MacRobertson Shelf, 66°54'–68°57'S, 63°06'–76°38'E,

367–1240 m [ANARE, NMV F68101 (1), F68151 (5), F68671–68674 (5), F69122–69123 (48), F69128 (2), F69132 (29), F71983–71984 (9), F71986 (1), F81430 (1), F91298 (3)].

Distribution. Western Antarctica, Weddell Sea, 620–705 m (Gutt, 1991b); off Graham Land, 125 m (Ekman, 1925); South Orkney Is (Vaney, 1906a). Eastern Antarctica, Ross Sea, Discovery Inlet, 550–560 m (Mortensen, 1925, as *P. antarctica*); off Terre Adélie, 10–15 m (Cherbonnier, 1974, as *T. turricata*); off Wilkes Land, Prydz Bay, MacRobertson Shelf, 367–1240 m (this paper).

Remarks. The illustrations of unique large plates with central digitate towers for *P. antarctica* by Mortensen (1925) and Heding and Panning (1954), and for *T. turricata* by Vaney (1906a) and Ekman (1925), show the same ossicle form, and illustrate the plates seen in this study of the type and BANZARE and ANARE material. *Paracucumis antarctica* Mortensen, 1925 is considered here to be a junior synonym of *Thyone turricata* Vaney, 1906a. This synonymy removes the anomaly of the previously reported mutually exclusive occurrences of *T. turricata* in Western Antarctica and off Terre Adélie, and of *P. antarctica* in the Ross Sea and Prydz Bay.

Ossicle form does not vary significantly with specimen size, but tentacle form and number (up to 15) are variable. The description by Vaney (1906a) of eight and two small tentacles on the small (12 mm long) type specimen of *T. turricata* does not apply to large specimens. ANARE specimens were up to 220 mm long (excluding tentacles). Two specimens (more than 200 mm long, NMV F91298) had 14 tentacles in combinations of ten large subequal with four adjacent small subequal, and 12 large with two adjacent small. Calcareous ring form is also variable, as noted and illustrated for *P. antarctica* by Mortensen (1925) and Heding and Panning (1954). One specimen (200 mm long, NMV F68101) had five radial plates deeply bifurcate anteriorly and five interradials with single narrow anterior projections, creating 15 anterior projections. Mortensen (1925) noted for *P. antarctica* that ossicles were spaced in a thin transparent body wall in relaxed specimens, but imbricating in contracted specimens.

Panning (1936) recognised the close similarity of *T. turricata* to *P. antarctica*, and reassigned *T. turricata* to *Paracucumis*. Panning (1949) subsequently reassigned *T. turricata* to his new genus *Ypsilocucumis*. *T. turricata* has dendritic tentacles and belongs in the Dendrochirotrida, not the

Dactylochirotrida with digitiform tentacles (Pawson and Fell, 1965), and cannot be retained in *Ypsilocucumis* Panning, 1949. It is reassigned here to *Paracucumis* Mortensen, 1925.

Order Elaspodida Théel

Elpidiidae Théel

Amperima robusta (Théel)

Scotoplanes robusta Théel, 1882: 35–36, pls 6, 34(6–7), 37(9).

Amperima robustum.—Agatep, 1967a: 56–57.

Amperima robusta.—Hansen, 1975: 161–162, figs 77–78.

Material examined. North-east of Kerguelen, 47°05'S, 79°16'E, 3112 m, 1930 [BANZARE Stn 66, SAM K1842 (2 specimens)].

Type locality. Southern Ocean, 53°55'S, 108°35'E, 3568 m.

Distribution. Antarctica, 2010–4240 m; Kermadec Trench, 2640 m (summary by Hansen, 1975); southern Indian Ocean, 3112 m (this paper).

Remarks. The two specimens were small (up to 14 mm long) and very damaged, but had the characteristics of the species as described by Hansen (1975). There were ten tentacles; the velum consisted of the two pairs of papillae with a pair of very small lateral ones; the small specimens had only nine pairs of tube feet, but they bordered the posterior two-thirds of the sole with the anterior pairs larger and more spaced and the posterior pairs decreasing in size; the ossicles were tripartite with distal spines and spinous apophyses on each arm. The ossicles were eroded, but two variations from the descriptions by Hansen (1975) were evident. Spinous apophyses were present on ventral tripartite ossicles which were up to 0.26 mm wide, and no C-shaped ossicles were found. These damaged specimens were similar to two species described by Gebruk (1988). On the limited evidence available, they differed from *Amperima belyaevi* Gebruk, 1988 [Aleutian Is, 5030 m] by having slightly larger ventral ossicles, larger ossicle spinelets, and less evenly spaced tube feet. They differed from *A. vitjazi* Gebruk, 1988 [off Chile, 4300 m; Japan Sea, 6096 m] by being significantly smaller, having unbranched ossicles, and unevenly spaced tube feet.

Rhipidothuria racovitzai Hérouard

Rhipidothuria racovitzai Hérouard, 1901: 41–42.—Hérouard, 1906: 7–8, pl. 1 figs 1–3.—Hansen, 1975: 131.—Gebruk, 1990: 81, fig. 28 (3–4).—Gebruk and Shirshov, 1994: 148–149, fig. 1.

Achlyonice violaeuspida Gutt, 1990: 123–125, figs 7–10.—Gutt, 1991b: 324.

Material examined. *Achlyonice violaeuspida*, Gutt, 1990. Paratypes. Western Antarctica, Weddell Sea, 77°08'S, 48°36'W, 235 m, 1984 [ZIM E-7144 (2 specimens)].

Other material. Eastern Antarctica, off Enderby Land, 66°10'S, 49°41'E, 300 m, 1930 [BANZARE Stn 39, SAM K1829 (1)]; 66°12'S, 49°37'E, 300 m, 1930 [BANZARE Stn 40, SAM K1830 (24)]; off Wilkes Land, 65°10'S, 108°12'E, 474 m, 1931 [BANZARE Stn 97, SAM K1831 (3)].

Type locality. Western Antarctica, Bellingshausen Sea.

Distribution. Western Antarctica, Weddell Sea, 225–785 m (Gutt, 1991b, as *Achlyonice violaeuspida*); Bellingshausen Sea, 800 m (Hérouard, 1901; depth estimated from latitude and longitude). Eastern Antarctica, off Enderby and Wilkes Lands, 300–474 m (this paper).

Remarks. The 28 BANZARE specimens fitted the diagnosis by Gebruk and Shirshov (1994), except that no crosses were found. Specimens were up to 60 mm long. There were ten tentacles, the anteriormost largest; seven pairs of dorsal papillae, distributed evenly along the dorsum; 12 pairs of tube feet, the posterior ones smallest and webbed; and a velum comprising two pairs of transverse papillae. Tentacles, mouth, papillae, tube feet and anus were a residual violet brown colour. Rod ossicles were found in the tentacles, tube feet and body wall. Rods were bent or straight or curved, unbranched, not perforated, sometimes thickened centrally, and sometimes with small knobs. Rod lengths were up to 0.46 mm (tentacles) and 0.37 mm (body wall). Hérouard (1901) noted that ossicles were probably in the form of a cross surmounted by a single point. Crosses were not found by Gutt (1990), Gebruk and Shirshov (1994), and this author. "Crosses" were observed in the BANZARE material, but were sponge spicules. This species is not represented in the extensive ANARE collections from eastern Antarctica, but the BANZARE specimens do extend the distribution of this species to eastern Antarctica.

Laetmogonidae Ekman

Laetmogone wyvillethomsoni Théel

Laetmogone wyvillethomsoni Théel, 1879: 10, pl. 1 figs 12–13.—Théel, 1882: 73–78, pls 11, 12, 31(14–16), 34(1), 36(3), 37(5, 7, 11), 38(9), 39(4), 42(1, 7), 43(4), 44(14), 46(2–3).—Agatep, 1967b: 63, pls 8(1–11), 9(1–10); tbl. 1.—Hansen, 1975: 54–57, fig.

20, tpls 5–8.—Gutt, 1991b: 324.—Gebruk, 1993: 240, fig. 6 (1).

Laetmogone cf. *wyvillethomsoni*.—O'Loughlin et al., 1994: 553–554.

Material examined. Syntype. Pacific Ocean, 33°42'S, 78°18'W, 2514 m, *Challenger* Stn 300 [BMNH 83.6.1.8.45 (1 specimen)].

Other material. Eastern Antarctica, off MacRobertson Land, 66°48'S, 71°24'E, 540 m, 1929 [BANZARE Stn 30, SAM K1827 (1)]; off Kemp Land, 66°21'S, 58°50'E, 603 m, 1930 [BANZARE Stn 34, SAM K1828 (1)]; Prydz Bay, 67°10'–68°32'S, 71°18'–73°14'E, 515–743 m [ANARE, NMV F68168 (1), F76585 (1), F76605 (1), F81826–81828 (22)].

Type locality. Southern Pacific Ocean, off Chile.

Distribution. Southern Ocean, Kermadec Trench, 2514–4410 m (Hansen, 1975); Scotia Sea, South Shetland Is, 2672–4136 m (Agatep, 1967b). Western Antarctica, Weddell Sea, 245–1130 m (Gutt, 1991b). Eastern Antarctica, off Kemp Land, Prydz Bay, 515–743 m (this paper).

Remarks. One well-preserved specimen (NMV F81825) was 55 mm long and had 14 tentacles, 20 pairs of tube feet, 14 pairs of thin papillae some as long as the body, large terminally spinous ventral rods up to 0.4 mm long, an overall body range of wheel sizes from 0.04 to 0.21 mm diameter with 8–16 outer spokes and 4–6 inner rays, and showed no significant variations from the type examined and the observations by Hansen (1975). Hansen (1975) gave wheel diameters up to 0.17 mm, Théel (1879) up to 0.16 mm. Two eastern Antarctic specimens (NMV F81826), 80 and 140 mm long, had wheel diameters up to 0.19 and 0.18 mm respectively. Wheel size does not vary with increase in specimen size. In the Southern Ocean and the Kermadec Trench this species is abyssal, but around the Antarctic continent it occurs at bathyal depths.

New distributions summary

Four holothurian species are confirmed here as occurring in both the Magellanic and Kerguelen regions: *Chiridota pisanii* Ludwig, 1886, *Taeniogyrus contortus* (Ludwig, 1875), *Heterocucumis godeffroyi* (Semper, 1868) and *Trachythione lechleri* (Lampert, 1885). Only *T. contortus* occurs also on the Antarctic coast. *Staurocucumis liouvillei* (Vaney, 1914) occurs in Antarctica and off Heard I., but not in the Magellanic region. All of the holothurians reported here with an Antarctic distribution occur in both western and eastern Antarctica, with *Meseres spiculiferus* sp. nov. an unconfirmed exception. Significant new distribution data are tabulated in Table 4.

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