HOLOTHUROIDEA FROM CHILE

REPORT NO. 46 OF THE LUND UNIVERSITY CHILE
EXPEDITION 1948—1949

by

DAVID L. PAWSON
Smithsonian Institution, Washington, D. C., U.S.A.

Juan José Alvarado B.
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ABSTRACT

A total of 509 specimens, representing 11 genera and 12 species, were collected by the Lund University Chile Expedition 1958—59, and are described here. There are no new taxa or new records but the collection affords valuable new data on the distribution of several species, their bathymetric range and habitat preference. A key to the Chilean holothurians is given, together with a checklist of the 27 species now known from the area. A second small collection of 13 specimens from another source includes two specimens of *Psolothuria bitentaculata* (Ludwig), a new record for the Chilean region.

The holothurian fauna of Chile is notable in that it appears to include no members of the Order Aspidochirotida in shallow water, although one species is common at Juan Fernandez. Less than 15 per cent of the species are endemic, about 50 per cent are shared with Argentina, and about 33 per cent are more or less widely distributed in the subantarctic islands. It is likely that a significant part of the fauna was derived from a pool of circumpolar species; at the generic level, some relationships with the Indo-west-Paciﬁc generally are evident.
INTRODUCTION

This paper comprises an account of the holothurians collected in Chile by the Lund University Chile Expedition 1948—1949. In addition, a small collection of some six species, sent to me by Mr. Jorge Castillo A. of the University of Concepción, Chile, is also described. The collections proved to contain no new taxa, but they included 16 of the 27 species now known from Chile, and supplied interesting new data on distribution and ecology of several species.

The holothurian fauna of Chile is now quite well known. The most recent papers on the fauna are those of Deichmann (1947) and Pawson (1964). Deichmann (1947) published an important paper on the shallow water holothurians of the vicinity of Cape Horn, with keys and diagnoses for all species, but his report did not include any of the species known from the northern part of Chile. Pawson (1964) described the ten species of holothurians collected by the Royal Society of London Expedition to southern Chile, 1958—1959.

The Lund University Chile Expedition 1948—49 made extensive collections of marine organisms between September 1948 and July 1949. A detailed general account of the Expedition was published by Brattström & Dahl (1952). The collection of holothurians was entrusted to me for study by Professor Hans Brattström and Professor Erik Dahl, through the kind intercession of Dr. F. Jørgen Madsen of the Zoological Museum, Copenhagen, Denmark. Dr. Madsen had already made some preliminary identifications of several of the specimens in the collection, and very generously made available to me some of his rough notes, and translations from the Swedish of field notes which were made by biologists during the course of the expedition. I am very grateful to Drs. Brattström, Dahl, and Madsen for giving me access to this interesting collection, and to Mr. Castillo for his generous cooperation.

SCOPE OF THIS REPORT

It has not been considered necessary to include diagnoses and descriptions of all species; these can be found in Deichmann (1947) and Pawson (1964). However, a general key to the Chilean species is given here, and should prove to be an aid in routine identifications. Several name changes have occurred since the publication of Deichmann's paper. These stem largely from the work of Panning (1949 et al.) and Pawson & Fell (1965). To avoid possible future confusion, a checklist of the Chilean holothurians, giving names used by Deichmann (1947) and those in current use is included here.

Under descriptions of species, the color notes from life and some ecological data were extracted from diaries maintained by the biologists on the expedition; these notes afforded hitherto unknown information on the color and habits of several species. The distribution, habitat, and bathymetric range of each species is discussed.
Checklist of Chilean holothurians

As cited in Deichmann (1947)  Currently accepted name

*Cucumaria crocea* Lesson  *Cladodactyla crocea* (Lesson)
*Thynepectabilis* Ludwig  *Hemiodema spectabilis* (Ludwig)
*Cucumaria leoni*a Semper  *Pseudocochleaea leoni*us (Semper)
*Cucumaria lawicosta* (Verrill)  *Pseudocochleaea perrieri* Eman
*Cucumaria godesfroyi* Semper  *Cucumaria godesfroyi* Semper
*Cucumaria chilensis* Ludwig  *Athyroidium chilensis* (Semper)
Not listed  *Pattaius mollis* Senken
Not listed  *Trachythone para* Ludwig
*Thyne lechleri* Lampert  *Trachythone lechleri* (Lampert)
*Psolus dorsipectes* Ludwig  *Psolus dorsipectes* Ludwig
*Psolus disceformis* (Theel)  *Psolus disceformis* (Theel)
*Psolus convergens* Herouard  *Neopsolus convergens* (Herouard)
*Psolus antarcticus* (Philippi)  *Psolus antarcticus* (Philippi)
*Psolus squamatus* (Müller)  *Psolus squamatus* (Müller)
*Psolus patagonicus* Eman  *Psolus patagonicus* Eman
Not listed  *Ypsolothuria bitentaculata* (Ludwig)


No species in the Order Aspidochirotida have been reported with certainty from Chilean waters. Three species, *Stichopus fuscus* Ludwig, *Holothuria patagonicus Perrier*, and *Holothuria parda* Selenka have been recorded from southern Chile or Argentina, but it has been shown that in the case of all of these species the records are unreliable, and probably the specimens involved were incorrectly labelled (Deichmann 1947). Semper’s (1868) species *Holothuria chilensis* was based on a large single specimen 30 cm long, supposedly collected from “Chile”. The species has not been collected since, and I suspect that the labelling of the specimen was also incorrect.

COMPOSITION AND RELATIONSHIPS OF THE CHILEAN FAUNA

Composition. A notable feature of the Chilean fauna is the apparent absence of shallow water members of the Order Aspidochirotida; in this respect Chile parallels New Zealand, where only two shallow water aspidochirotids occur. It is also notable that about 60 percent of the Chilean holothurians are dendrochirotids.

A study of the distribution of the holothurians along the coast of Chile gives no definite evidence of provincial patterns of distribution, although there is a
dramatic increase in number of species south of 52—53°S. This has already been noted by Pawson (1964). The presence of the Straits of Magellan in these latitudes undoubtedly has a strong influence on the composition of the fauna in that area. Around 40—42°S, one finds the northern limit of the distribution of *Chiridota pisanii* and *Anapta fallax* and the southern limits of *Athyoniidium chilensis* and *Cucumaria godseffroyi*. Future investigations in these two areas should be rewarding.

**Relationships.** The relationships of the Chilean fauna have been discussed by Deichmann (1947) and Pawson (1964), and a lengthy discussion here is not necessary. The distribution of the 27 known species is as follows:

1. **Endemic**—4 (*Psolidium disciformis*, *Cucumaria godseffroyi*, *Molpadia annupha*, *Hedingia planapertura*). It is probable that all except *Cucumaria godseffroyi* will prove to be widely distributed, as they are relatively deep water forms. At least they should be discovered off Peru and Argentina.

2. Also in Peru—4 (*Pattalus mollis*, *Athyoniidium chilensis*, *Cucumaria godseffroyi*, *Pentamera chiloensis*).

3. Also in Argentina—13 (*Psolus patagonicus*, *Psolidium dorisipes*, *Hemieodema spectabilis*, *Cladodactyla crocea*, *Pseudocnus dubiosus leonis*, *Pseudocnus perrieri*, *Neopsolidium convergens*, *Trachythyone lechleri*, *Trachythyone parva*, *Chiridota marenzelleri*, *Chiridota pisanii*, *Trochodota purpurea*, *Anapta fallax*).

4. Also in Antarctica—4 (*Psolus antarcticus*, *Hemieodema spectabilis*, *Trachythyone parva*, *Taeniogyrus contortus*).

5. Also at one or more subantarctic islands—9 (*Psolus antarcticus*, *Hemieodema spectabilis*, *Cladodactyla crocea*, *Pseudocnus perrieri*, *Neopsolidium convergens*, *Trachythyone lechleri*, *Trachythyone parva*, *Taeniogyrus contortus*, *Trochodota purpurea*).

6. Elsewhere in the Pacific Ocean or cosmopolitan—6 (*Psolus squamatus*, *Pentamera chiloensis*, *Ypsilonia kentucky*, *Molpadia musculus*, *Molpadia antarctica*, *Paracaudina chilensis*).

7. Also in New Zealand—none. *Oenus calcareus* (Dendy) occurs in New Zealand and at Juan Fernandez Is., but is as yet unknown from the Chilean mainland.

It can be seen from the above table that the holothurian fauna of southern Argentina is very closely related to that of southern Chile; this is to be expected in view of the close proximity of these two countries. It is notable that nine species occur in the subantarctic islands. There is no tangible evidence that the Chilean fauna was derived from further north, and it seems most likely that a significant part of the fauna was derived from a pool of southern circumpolar species. At the generic level, some relationships with New Zealand and the Indo-west-Pacific generally are evident.
Key to the Chilean holothurians

1 (34) Tube feet present on body wall (sometimes inconspicuous). Body approximately cylindrical, sometimes U-shaped, never long and wormlike.  
2 (13) Body partly or completely invested by overlapping scales, forming a test.  
3 (4) Body completely invested by scales. Tentacles digitiform.  
4 (3) Body partly invested by scales. Tentacles dendritic.  
5 (8) Dorsal surface with tube feet. Midventral radius with numerous tube feet.  
6 (7) Deposits of sole four-holed buttons with marginal knobs.  
7 (6) Deposits of sole four-holed buttons with marginal knobs and also thin, smooth oval plates with few perforations or none.  
8 (5) Dorsal surface without tube feet. Midventral radius with few tube feet or none.  
9 (12) Five subequal oral valves, with or without radial valves internal to them.  
10 (11) No radial valves. Large species (up to 55 mm).  
11 (10) Five small radial valves. Small species (up to 20 mm).  
12 (9) Oral valves irregularly developed; more than five in adult specimens. Large species (up to 80 mm).  
13 (2) Body without overlapping scales. Calcareous deposits generally reduced to microscopic spicules.  
14 (15) Calcareous ring with posterior projections on radial pieces; body wall deposits as tables.  
15 (14) No posterior projections on calcareous ring. Deposits do not include tables.  
16 (29) Calcareous deposits merely plates or rods and/or buttons; no cups.  
17 (26) Tentacles ten.  
18 (21) Plates or rods smooth, without knobs or superficial secondary network.  
19 (20) Tube feet scattered all over body surface; deposits rods.  
20 (19) Tube feet mostly restricted to radii; deposits plates.  
21 (18) Plates with small or large knobs or with a secondary superficial network.  
22 (25) Plates usually pine-cone shaped, with conspicuous knobs; usually one end of plate denticate.  
23 (24) Four-holed knobby buttons present.  
24 (23) No four-holed knobby buttons.  
25 (22) Plates not pine-cone shaped; knobs usually inconspicuous. Plates with spinous edge and surface.  
26 (17) Tentacles 20.  
27 (28) Five large outer pairs and five smaller inner pairs of tentacles.  
28 (27) Tentacles approximately of equal size, arranged in a single ring.  
29 (16) Calcareous deposits include plates and cups.  
30 (31) Cups restricted to dorsal surface of body.  
31 (30) Cups not restricted to dorsal surface of body.  
32 (33) Deposits include rudimentary cups and small round plates with few perforations or none.  
33 (32) Deposits include well developed cups and perforated plates.  
34 (1) No tube feet on body wall. Body either cylindrical, wormlike, or stout with a distinct tail, but never U-shaped.  
35 (44) Body stout anteriorly, tapering to a distinct tail region. Tentacles 15, short, with simple finger-like processes.
36 (41) Tentacles with 1—3 pairs of digits and a terminal digit. Deposits include tablets, fusiform perforated rods, anchors, and associated plates. Body wall often red, due to presence of numerous phosphatic deposits.

37 (38) Deposits include fusiform rods with 3—6 central perforations, and tables with single pillar. *Molpadia musculus* (Kissel)

38 (37) No fusiform rods; tablets (when present) with three pillars.

39 (40) Tables deformed; phosphatic deposits always present. *Molpadia amorpha* Clark

40 (39) Tables normal, tending to disappear in large specimens; phosphatic deposits extremely rare or absent. *Molpadia antarctica* (Trel)

41 (36) Tentacles with two pairs of digits and no terminal digit. Deposits large tables or plates or small crossed cups. Phosphatic deposits, anchors, and anchor plates absent.

42 (43) Deposits crossed cups. *Paracaudina chilensis* (Mueller)

43 (42) Deposits large tables with high spires. *Hedinga planaperforata* (Clark)

44 (35) Body cylindrical, wormlike. Tentacles 10—12, either pinnate or bearing finger-like processes.

45 (52) Deposits include wheels.

46 (49) No sigmoid bodies present. Wheels aggregated into papillae.

47 (48) Skin with stellate perforated plates. *Chiridotella marenzelleri* Perrier

48 (47) No stellate plates in skin. *Chiridotella pisani* Ludwig

49 (46) Sigmoid bodies present. Wheels aggregated into papillae or scattered in body wall.

50 (51) Wheels aggregated into papillae. *Tenuisquilla contorta* (Ludwig)

51 (50) Wheels scattered. *Trochota purpurea* (Lessons)

52 (45) Wheels absent. *Anopela fusalia* Lampert

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**STATION DATA**


*St. M14*. Seno Reloncavi, the bay off Puerto Montt, between Isla Tenglo and Punta Piluco, 41°30'05"S, 72°56'22"W, 225 m, small stones and boulders in fine sand, Agassiz trawl, 1 Dec. 1948. *Polis squamatus* (36).


1) The number in brackets refers to the number of specimens.


St. M30. Golfo de Ancud, SW of Isla Quellín, 41°35'S, 72°38"W, 300 m, fine clay with fragments of polychaete tubes, Agassiz trawl, triangular dredge, Petersen grab, 22 Jan. 1949. *Anaphta fallax* (75 specimens and fragments).


St. M44. Golfo de Ancud, SW of Isla Tabon, 41°58'S, 73°18"W, ca. 200 m, fine sand mixed with clay, triangular dredge, 24 Jan. 1949. *Poulus squamatus* (3).

St. M47. Seno Reloncaví, Paso Maillén, between Punta Panita and Punta Puchegui, 41°33'45"S, 73°02'05"W, ca. 22 m, coarse sand with *Charafler* *gites*, small stones with calcareous algae, triangular dredge, 25 Jan. 1949. *Pseudocinclus dubius* *leninensis* (18).


St. M74. Archipiélago de los Chonos, Canal Moraleda, Puerto Lagunas, 45°17'S, 73°45"W, 5—7 m, stones with algae and Mytilidae, diving, 22 Feb. 1949. *Pseudocinclus dubius* *leninensis* (5).


St. M91. Seno Reloncaví, Ensenada de Guatrál, SW of Punta Guatrál, 41°43'S, 73°03'15"W, tidal belt, rather sheltered, boulders and stones on sand, sampling by hand, 15 April 1949. *Cucumaria godfreyi* (22), *Pseudocinclus dubius* *leninensis* (5), *Chiridota pisanii* (1).

St. M95. Canal Chacao, Golfo de Quetalmahue, SW of Punta Aucan, 41°51'S, 73°57'10"W, 6—7 m, muddy sand covered with dead algae and shells, triangular and rectangular dredges, 4 May 1949. *Pseudocinclus dubius* *leninensis* (1).

St. M96. Canal Chacao, Bahía de Ancud, SE of Punta Ahui, 41°50'10"S, 73°51'20"W, 8 m, small stones with algae, triangular and rectangular dredges, 5 May 1949. *Pseudocinclus dubius* *leninensis* (2).


St. M104. Golfo de Ancud, SE of Punta Tres Cruces, NE of Punta Piedras, 41°50'30"S, 73°28'30"W, 50—60 m, stones, clinkers, triangular dredge, 5 May 1949. Cucumaria godeffroyi (42), Pseudocirrus perrieri (2).

St. M106. Golfo de Ancud, between Punta Abtao and Isla Abtao, 41°48'40"S, 73°21'W, 36 m, coarse sand and shells, triangular dredge, 5 May 1949. Psolus squamatus (5).

St. M107. Golfo de Ancud, N of Punta Barranco at Isla Abtao, 41°47'18"S, 73°20'55"W, 60 m, coarse sand with mud and dead algae, Agassiz trawl, circular and triangular dredges, Petersen grab, 5 and 6 May 1949. Paracucumaria chilensis (1+22 fragments).


St. M113. Estrecho de Magallanes, Punta Santa María, near Agua Fresca, 53°22'8"S, 70°37'7"W, tidal belt, exposed, sand gravel and muddy clay covered with boulders, sampling by hand, 2 May 1949. Chiridota pisani (1), Trochodota purpurea (1).


St. M120. Bahía San Vicente, the Ramuntcho Bay, SE of Punta Gualpén, 36°44'54"S, 73°11'02"W, tidal belt, hard rock and boulders on coarse sand, sampling by hand, 8 June 1949. Athyoniidium chilenis (10).

St. M121. Bahía San Vicente, Punta Liles just W of San Vicente, 36°43'36"S, 73°08'14"W, tidal belt, rocks with small shells, rocks, pools, sampling by hand, 9 June 1949. Athyoniidium chilenis (1).

St. M122. Golfo de Arauco, Bahía de Lota, small promontories SE of Punta Fuerte Viejo, 37°06'17"S, 73°09'15"W, tidal belt, extremely exposed, hard rocks and boulders in coarse sand, sampling by hand, 10 June 1949. Athyoniidium chilenis (1).


St. M144. Seno Reloncavi, E of Isla Guar, 41°41'S, 72°47'W, ca. 250 m, coarse black sand with clay and fragments of polychaete tubes, triangular dredge, 15 July 1949. Anapta fallax (13 specimens and fragments).


Order Dendrochirotida Grube, 1840
Family Psolidae Perrier, 1902
Psolus Oken, 1815
Psolus squamatus (Koren, 1844)

Psolus squamatus: EKMAN 1923, pp. 1—59, 37 figs. (analysis and discussion).
Psolus squamatus var. segregatus PERRIER 1905, p. 59; EKMAN 1925, p. 136, text-fig. 33; DEICHHANN 1941, p. 147, pl. 30 fig. 7; 1947, p. 340.
Psolus segregatus: VANNEY 1906, p. 27.
(This is a partial synonymy, dealing chiefly with southern representatives of this species).

Material examined. 105 specimens. M14 (60), M16 (6), M25 (1), M27 (1), M40 (1), M41 (20), M44 (3), M106 (5 juveniles), M115 (2), M149 (30).

Description. Total length of sole 10—46 mm. Colour in life light brown to light red; tentacles light red with darker red spots, more densely aggregated near tentacle bases. Specimens greatly variable in shape. Some almost flat, with almost circular soles; others up to 25 mm high at anterior end, with sole elongate, rectangular.

Most specimens with no tube feet in midventral radius; some with few (3—4) at each end; rarely a continuous row of about eight feet occurs. Dorsal scales generally thin, and either smooth or more or less completely covered in small numerous granules. Various intermediate stages between completely smooth and completely granuliferous occur. Variation appears not be correlated with depth, habitat or latitude.

Numerous oral and anal valves. Calcareous deposits variable within narrow limits. Specimens typical of southern representatives of species.

Distribution. The southern “form” of this species occurs around the southern part of South America from 41°30'05"S in the west to about 42°S in the east. Also Burwood Bank and the Falkland Islands. The species is known from the Eastern Pacific Ocean (Bering Sea to Cape Horn), and the North Atlantic Ocean.

Habitat. At all stations but two (M25 and M44) the substrate included either stones (gravel) or shells. At M14, specimens were noted to be very common on stones. Psolids are well adapted to living attached to a hard substrate, and it would appear that P. squamatus almost invariably lives attached in this way.

Depth 7—1,087 m. EKMAN (1925) gives the bathymetric range of the southern form as 7—207 m. In northern waters, the range is approximately 279—1,087 m (DEICHHANN 1947).

Psolus patagonicus EKMAN, 1925

Psolus patagonicus EKMAN 1925, p. 140, text-figs. 35, 36; DEICHHANN 1941, p. 148, pl. 30, fig. 8; 1947, p. 339, figs. 1, 2; PAWSON 1964, p. 463, text-fig. 3, 1—7.

Material examined. Tierra del Fuego, 5 May, 1962, coll. A. GALLARDO, 3 specimens.

1) The numbers in brackets refer to the number of specimens.
Remarks. Three typical members of this small species; total length 2.5 and 6 mm.

Distribution. Known from the Patagonia Bank at 45° S (Ekman 1925) and the vicinity of the Straits of Magellan (Deichmann 1941, 1947; Pawson 1964, and present record).

Habitat. Rocks, Macrocystis fronds and holdfasts.

Depth. Intertidal to about 110 m.

Psolus antarcticus (Philippi, 1857)

Holothuria antarctica Philippi 1857, p. 133.

Psolus antarcticus: Ludwig 1898, p. 53, pl. 3, figs. 34—36 (complete synonymy); Ekman 1923, p. 42, figs. 31—33; 1925, p. 139, text-fig. 34; Deichmann 1947, p. 339; Pawson 1968a, p. 19, fig. 2 (1—4).


Remarks. Total length 52 mm. Specimen typical of the species, differing conspicuously from P. squamatus (the only other species in the area with which it can be confused) in having only five large and distinct interradial oral valves.

Distribution. Magellanic region (Philippi 1857; Deichmann 1947), Antarctic Peninsula (Vanev 1906; Ekman 1925) and near Macquarie Island (Pawson 1968a). A circumpolar species in cold temperate and presumably also in Antarctic waters.

Habitat. Rock.

Depth. 35—1,080 m.

Family Cucumariidae Ludwig, 1894

Pawson & Fell (1965) revised the classification of the dendrochirote holothurians, and referred three subfamilies to the Cucumariidae. These were the Cucumariinae Ludwig, 1894; Thyoniidae Heding & Panning, 1954, and Colochirinae Panning, 1949.

All three subfamilies are represented in Chilean waters. They may be distinguished as follows:

1 (4) Ten tentacles. Calcareous deposits of body wall plates and often cups.

2 (3) Calcareous deposits plates only, often knobbed

3 (2) Calcareous deposits plates and cups

   [Colochirinae Panning, 1949, not in present collections]

4 (1) More than ten tentacles (15—20). Calcareous deposits of body wall plates or tables

   Thyoniidae Heding & Panning, 1954
Subfamily Cucumariinae Ludwig, 1894

Cucumaria Blainville, 1834

Cucumaria godeffroyi Semper, 1868

Cucumaria godeffroyi Semper 1868, p. 53, pl. 15 fig. 12, 14; Lampert 1885, p. 144; Theel 1886, p. 95; Clark 1910, p. 352; Diechmann 1941, p. 83; Panning 1955, p. 43, figs. 8, 9.

Material examined. 81 specimens. M17 (9), M21 (1), M22 (2), M27 (4), M91 (22), M103 (1), M104 (42).

Description. Total length (excluding juveniles) 13–50 mm. Colour in life and in alcohol, yellow, tentacles yellowish white with dark brown patches on oral surfaces at tentacle bases and at major bifurcations.

Body more or less cylindrical; when contracted, many specimens almost spherical. Tube feet confined to radii, in two rows, giving impression that several rows are present when specimen is contracted. Tentacles subequal. Calcareous ring simple, no posterior projections. Single large polian vesicle.

Juvenile specimens (M17) 3.3–7.5 mm in total length, light grey-yellow. In largest specimen two ventral tentacles only very slightly smaller than others. Tube feet confined to radii; on smallest specimens tube feet virtually absent from dorsal radii.

Calcareous deposits common in body wall of smallest (3.5 mm long) specimen, consisting of smooth to tumid plates of varying size, up to about 0.40 mm in greatest length (Fig. 1A). The 7.5 mm long specimen has numerous body-wall deposits of two types. Larger plates average 0.30 mm in greatest length, are tumid to knobbled with one end denticulate and several perforations. Smaller plates have pointed marginal projections, small surface knobs, and one to six perforations; most have four perforations (Fig. 1B). In larger specimens the larger plates have disappeared, and only the smaller plates of average length 0.17 mm with pointed marginal projections remain (Fig. 1C). In present material deposits in larger specimens slightly eroded, so that marginal projections not as sharply pointed as usual.

Tentacles of smaller specimens (7.5 mm long) with perforated rods of two distinct sizes. Larger rods 0.28 mm in average length (Fig. 1D); smaller rods 0.10 mm in average length (Fig. 1F). Supporting rods from tube feet average 0.21 mm in length, have several terminal perforations and a central projection which often carries one or more larger perforations (Fig. 1G). Larger specimens with tentacle rods of one type, averaging 0.31 mm in length, with central and terminal perforations (Fig. 1E).

Remarks. This species was poorly known until Panning (1955) described a specimen (probably the unique type) from Iquique, Chile. The present specimens, especially the juveniles, provide additional data about the species. It is notable that the larger spicule type found in the 7.5 mm long specimen (Fig. 1B) appears
Fig. 1. Cucumaria godeffroyi Semper. A. Plates from body wall of specimen 3.5 mm in length. B. Plates from body wall of specimen 7.5 mm in length. C. Plates (partly eroded) from body wall of specimen 20 mm in length. D. Larger tentacle rods from 7.5 mm specimen. E. Tentacle rods from 20 mm specimen. F. Smaller tentacle rods from 7.5 mm specimen. G. Supporting rods from tube foot.
to drop out as the animal grows, or perhaps becomes transformed into the typical adult deposit. These larger deposits are strongly reminiscent of those in Pseudococcus perrieri (Ekman) and P. dubiosus (Semper), which also occur in Chile, but in the case of these two latter species, the deposits are retained as the animal grows.

**Distribution.** Originally described from Iquique, Chile (Semper 1868). Dieckmann (1947) gives the range as west coast of South America, between 20° and 40°S latitude; probably the two specimens he examined were from the vicinity of Isla Chiloé. Present specimens extend the southern limit of the species to 41°59'30"S, but it is likely that the species ranges the entire Chilean coast.

**Habitat.** Substrate ranges from coarse sand and shells through stones and polychaete tubes.

**Depth.** Intertidal to 60 m.

*Pseudococcus Panning, 1949*

**Pseudococcus dubiosus leoninus (Semper, 1868)**

*Cucumaria leonina* Semper 1868, p. 53, pl. 15 fig. 9.

*Pseudococcus dubiosus leoninus* : Panning 1963, p. 60, figs. 3—4 (synonymy).

**Material examined.** 131 specimens. M17 (4), M21 (15), M24 (9), M27 (5), M40 (2), M41 (4), M47 (13), M74 (5), M91 (5), M95 (1), M98 (2), M103 (22), M108 (1), M115 (37), Isla Talcahuano, near Chiloé, 25 Mar. 1962, from algae, coll. J. Vidal and H. Mendoza (1).

**Description.** Total length 3—40 mm. Colour in life yellow to white. In alcohol colour yellowish to light brown. Varying degrees of contraction and variation in disposition of tube feet render specimens of this species very dissimilar in external appearance. Calcareous deposits typical of the subspecies; these have been described and illustrated by Panning (1951, 1963) and Pawson (1964).

**Distribution.** *P. dubiosus leoninus* occurs in the southern part of South America, and the Falkland Islands. The northern limit of its range is not well defined (see Panning 1951, 1963).

**Habitat.** Pawson (1964) described material collected from boulder beaches and associated with fronds and holdfasts of the brown seaweed *Macrocystis*. Present material was collected from a variety of habitats, including sand and shell, sand and stones, small stones, muddy sand and shell, gravel and clay mixed with mud, and kelp. Probably the species is a plankton or selective detritus feeder (stomach contents included several species of diatoms), and prefers a hard substrate.

**Depth.** 0—300 m. Previously recorded as 0—100 m (Pawson 1964).

*Pseudococcus perrieri* (Ekman, 1927)

*Cucumaria laevigata*: Lüdewig 1898, p. 32, pl. 2 fig. 25; Pérrier 1905, p. 22; Hérouard 1906, p. 15, pl. 1 fig. 6, pl. 6 figs. 5, 6; Vaney 1909, p. 430; Ekman 1925, p. 56; Dieckmann 1947, p. 353.

*Cucumaria perrieri* Ekman 1927, p. 403.


*Pseudococcus perrieri*: Panning 1963, p. 71, figs. 15, 16.

**Material examined.** 3 specimens. M27 (1), M194 (2).
Description. Total length 6, 10, 19 mm. Colour in life white; in alcohol white to light yellow. Calcareous deposits typical.

Remarks. Ekman (1927) has shown that the South American cucumariids previously referred to as Cucumaria laevisata do not in fact belong in that species, but should be regarded as a distinct species, which he named C. perrieri. Neither Deichmann (1947) nor Pawson (1964) were aware of the step taken by Ekman, and they described the South American forms as laevisata. The species P. laevisata is now regarded as being restricted to several subantarctic islands, namely Prince Edward Is., Crozet Is., Kerguelen, and Heard Is. (Panning 1963). More recently (Pawson 1968b) the species has been recorded from Macquarie Island.

Distribution, Ekman (1927) stated that P. perrieri ranges from 44°S on the west coast of South America to 43°S on the east coast, and also occurs at the Falkland Islands. He also suspected that material from South Georgia identified by Lamprey (1886) as Cucumaria crocea also belongs to this species. Panning (1963) has confirmed the occurrence of P. perrieri at South Georgia. The present records extend the known range of the species further north along the west coast of South America to 41°49′40″S (M27).

Habitat. Sand, rock, shell.

Depth. 0—197 m.

Subfamily Thyoniidae Heding & Panning, 1954

Pattalus Seelenk, 1868

Pattalus mollis Seelenk, 1868

Pattalus mollis Seelenk 1868, p. 113, pl. 8 figs. 1—5; Heding & Panning 1954, p. 34, fig. 1 (full synonymy).

Material examined. 20 specimens. M131 (4), M135 (8 + 8 juveniles).

Description. Total length (excluding juveniles) 66—157 mm. Colour in alcohol light brown to almost black. Typical specimens of this species. Juveniles (M135) probably of this species, total length 4—14 mm. Colour in alcohol greyish-brown, tentacles with brownish yellow tinge. Largest specimen with 14 tentacles. Stone canal single, several polian vesicles. Apart from endplates in tube feet, no calcareous deposits found anywhere in body wall or tentacles.

Remarks. Deichmann (1941) has clarified the systematic position of this species, which is common in both Peru and Chile.

Distribution. Peru and Chile. The record from station M121 (36°43′35″S) appears to be the southernmost for the species. It is unlikely that P. mollis extends very much further to the south, for it is a conspicuous species and not easily overlooked by shore collectors.

Habitat. Generally found clinging to rocks in exposed localities. At M135, specimens were buried in cracks, and some had pieces of shell attached to the body wall, presumably held there by numerous tube feet.

Depth. Known from the intertidal zone to about 45 m (Deichmann 1941), but apparently common near shore.
HOLOTHUROIDEA FROM CHILE

Athyoniidium Deichmann, 1941

Athyoniidium chilensis (Semper, 1868)

Thyone (Stolus) chilensis Semper 1868, p. 241, pl. 40, figs. 3—6.

Material examined. 14 specimens. M6 (1), M120 (10), M121 (1), M122 (1), M131 (1).

Description. Total length 30—200 mm. Colour in alcohol usually dark brown to blackish dorsally, lighter ventrally. Body cavity of female specimen 195 mm long filled with transparent genital ducts containing bright yellow eggs 0.5 mm in diameter. Small specimen 30 mm in length (M120) resembles larger specimens in having no deposits in body wall. Only radial pieces developed in calcareous ring, but widely separated; probably they grow together as animal grows.

Remarks. This well-known species (Deichmann 1941; Pawson 1964) is quite distinct and cannot be confused with any other of the common Chilean holothurians.

Distribution. From Ancon, Peru to Chile (Deichmann 1941). In Chile, the southernmost record is from Punta Gaviota, 42°03'56"S (Pawson 1964).

Habitat. A. chilensis has been collected from the Macrocystis zone, immediately below low tide level (Pawson 1964). The present material was collected from the intertidal zone in very exposed localities from rocks, rock pools, and boulders. In only one case the rocks were lying in coarse sand.

Conversely, Deichmann (1941) noted that this species lives buried in the sand with its tentacles extending flaily on the surface. It is apparent that A. chilensis can tolerate a variety of habitats on the exposed coast. These specimens described by Pawson (1964) had large pieces of Macrocystis sp. in their intestines, indicating an active vegetarian browsing method of feeding. Specimens buried in the substrate would probably feed on planktonic organisms or selected detritus.

Depth. Apparently restricted to the shore; not found much below low tide level.

Family Phyllophoridae Östergren, 1907
Subfamily Thyoniace Panning, 1949

Pentamera Ayres, 1852

Pentamera chilensis (Ludwig, 1886)

Cucumaria chilensis Ludwig 1886, p. 12, pl. fig. 4; 1898, p. 38; Ekman 1925, p. 97, fig. 21; Deichmann 1947, p. 334.

Cucumaria tabulifera Perrier 1904, p. 14; 105, p. 17, pl. 1 figs. 4—5, pl. 3 figs. 1—15.

Pentamera chilensis: Deichmann 1941, p. 88, pl. 13 figs. 15—18, text-fig. 1; Panning 1949, p. 465.

Material examined. Golfo de Arauco, near Concepción, Sept. 1962, coll. A. Gallardo, 3 specimens.

Description. All specimens 20 mm in total length. Colour in alcohol light brown. Body fusiform, tube feet restricted to radii, arranged in crowded rows. Calcareous deposits of body wall exclusively tables (Fig. 2A) with oval to squarish disc, perforated by 4—16 holes; four holes are central. Disc surmounted by complex spire (Fig. 2D) made up of two rods joined by 1—4 crossbars. Average
diameter of disc 0.10 mm; average height of spire 0.073 mm. Tube feet with endplates (Fig. 2B) surrounded by curved supporting tables (Fig. 2C) which are elongate and fusiform, with four central perforations and a short two-pillared spire. Average length of tables 0.16 mm; average height of spire 0.02 mm. Tentacles contain perforated rods (Fig. 2E) from 0.16 to 0.29 mm in length and minute rosettes (Fig. 2G) of 0.075 mm average length.

Remarks. The present specimens agree well with those described by earlier authors, although the tables from the body wall appear to have more numerous perforations than those described by Deichmann (1941, 1947). However, it would appear that the specimens illustrated here would fall within the range of variation of this species.

Distribution. From Cape Horn to Lower California, and in Argentina to the mouth of the River Plate (see Deichmann 1941, 1947).

Habitat. Unknown.

Depth. 14—108 m.

Order dactylochirotida Pawson & Fell, 1965
Family Ypsilonthuriidae Heding, 1942

Ypsilonthuria Perrier, 1886

Ypsilonthuria bitentaculata (Ludwig, 1893)

Sphaeronothuria bitentaculata Ludwig 1893, p. 112; 1894, p. 141, p. 12 figs. 16—17, pl. 14 figs. 5—14; Mitihan 1897, p. 149; Koehler 1899, p. 384; Sutter 1901, p. 115; Oshima 1915, p. 256; Deichmann 1930, p. 132, pl. 19 figs. 4—5; Ludwig & Heding 1935, p. 196; Baranova 1957, p. 242.

Ypsilonthuria bitentaculata: Koehler & Vaney, 1905, p. 87; Heding, 1942, p. 28; Panning, 1949, p. 435; Pawson, 1965, p. 6, text-fig. 1, figs. 2—5.

Material examined. 20°15′5″S, 70°18′0″W, 582 m, triangular dredge, 1962, coll. A. Gallardo, 2 specimens.

Remarks. Specimens U-shaped, distance between mouth and anus 7, 12 mm. Calcareous deposits typical.

Distribution. Y. bitentaculata is presumed to be cosmopolitan (see Pawson 1965). This is the first record of the species from the southeastern Pacific Ocean.

Habitat. Generally mud.

Depth. 250—4,000 m.

Order molpadida Haeckel, 1896

Remarks. The Lund University Chile collections include representatives of four species of molpadids, two of which have been recorded previously from off Chile. The remaining two species are represented by single specimens of the genus Molpadia; both may be new, but they have not been described as such here. Deichmann (1931, 1940) has demonstrated that for proper identification of molpadids a good series of specimens is required. This is necessary because
molpadids are unique among holothurians in that the calcareous deposits of most of the body wall are transformed with growth of the animal into phosphatic deposits (see Pawson 1963). Young stages are required for reliable descriptions, and thus no attempt has been made to define the two unusual species in the present collection. It is regrettable that this step must be taken, especially in view of the fact that both Ekman (1927) and Pawson (1965) have taken the same step with two other possibly new southern species of Molpadia. However, attention has been called to these unusual forms, and future collections may help to resolve the problems in these four species. The collections at present being amassed by the U.S.N.S. Eltanin in Antarctic and subantarctic waters at the present time promise to provide a good basis for revision of the Southern Hemisphere molpadids.

**Family Molpadiidae Müller, 1850**

*Molpadia* Reso, 1826

*Molpadia antarctica* (Theel, 1886)

*Trochostoma antarcticum* Theel 1886, p. 44, pl. 2 fig. 7; Herouard 1901, p. 42; 1906, p. 15; Augustin 1908, p. 35, text-fig. 22 a–c. 

*Molpadia antarctica*: Clark 1907, p. 32, 168; Oshima 1915, p. 252; Deichmann 1947, p. 342; Pawson 1965, p. 13, text-fig. 3 figs. 5–7.

**Material examined.** 2 specimens. **M80** (1), **M83** (1).

**Description.** Larger specimen 80 mm in total length, tail 10 mm; colour white overall, body wall thin and translucent; no calcareous deposits found anywhere. Smaller specimen 45 mm in total length, tail 9 mm; body wall light brown (possibly due to stain from associated mud); no calcareous deposits found anywhere.

In larger specimen genital caeca filled with eggs of varying size, up to 0.3 mm in diameter.

**Remarks.** This species is readily recognizable, for red phosphatic deposits are rare or totally lacking from the body wall; the colour is thus usually white or grey.

**Distribution.** Circum-Pacific, known from off Japan (Oshima 1915), New Zealand (Pawson 1965), the Caribbean (Theel 1886), Chile, and the Antarctic Peninsula. The northernmost record for the Chilean coast is 38°38′S (Clark 1908).

**Habitat.** Mud to sand.

**Depth.** 80–1,218 m.

*Molpadia* species A

**Material examined.** **M83** (1).

**Description.** Total length 72 mm, tail 5 mm. Colour mottled red-purple, darker anteriorly; oral disc and tail grey. General body shape typical of molpadids. Deposits of body wall almost exclusively phosphatic deposits in great numbers. Few calcareous deposits remaining almost completely absorbed (Fig. 2H); but
it is apparent that when the animal was smaller, the body wall contained tables approximately 0.11 mm across, with three or more large perforations. No evidence of structure of spire. Tail deposits tables, partly eroded away, exact details difficult to determine. Deposits elongate to circular with two to four (commonly three) large central perforations and up to 20 smaller perforations external to them (Fig. 2F). Average diameter of tail deposits 0.11 mm. Spire composed of three or four rods arises from centre of table; average height of spire 0.04 mm. Tables apparently derived from common molpadid table with three large perforations and three-pillared spire.

**Remarks.** This species differs from other southern molpadids in the structure of the tail deposits. It may have some relationship to the northeastern Pacific species *M. intermedia* (Ludwig), but more material of the species would be required for a definite identification.

**Distribution.** Estero Reloncavi, 41°38'05"S, 72°20'45"W.

**Habitat.** Very fine mud mixed with sand.

**Depth.** ca. 170 m.

**Molpadia** species B

**Material examined.** M141 (1).

**Description.** Total length 38 mm. Colour grey-white with numerous small light brown spots (phosphatic deposits); anterior and posterior extremities of body uniformly greyish white. Body molpadid in shape, although tail not pronounced.

Calcereous deposits once present in body wall but have completely transformed into phosphatic deposits; latter deposits not numerous. Tail with no calcereous deposits. Other structures apparently typical of family.

**Remarks.** The present specimen may represent an undescribed species, but no known members of the genus *Molpadia* completely lack deposits in the tail, and it is quite possible that this specimen is an aberrant form. Another molpadid from the same area, *M. antarctica* (Theel), tends to lose its deposits with growth, but the phosphatic deposits are rare, and the tail deposits are usually numerous.

**Distribution.** Seno Reloncavi, 41°36'15"S, 72°48'45"W.

**Habitat.** Clay with fragments of polychaete tubes.

**Depth.** Ca. 260 m.

**Family Caudinidae** Heding, 1931

**Paracaudina** Heding, 1931

**Paracaudina chilensis** (Müller, 1850)

*Molpadia chilensis* Müller 1850, p. 139.

*Paracaudina chilensis:* Pawson 1963, p. 18, pl. 4 (synonymy).

**Material examined.** 35 specimens and fragments. M16 (3 tail fragments), M29 (6 tail fragments), M107 (1+ ca. 22 tail fragments), M108 (3 tail fragments).
Remarks. Total length of single complete specimen, 54 mm. Color generally greyish white, but some fragments with light brownish tinge. Calcareous deposits typical of this species. Like other molpadids, *P. chilensis* lives buried, with the tail uppermost, near the surface of the substrate, and thus dredging usually produces only the posterior end of the body, leaving the anterior end buried deep in the sea floor.

Distribution. Circum-Pacific, occurring off northwest Australia, Japan, California, Florida, Chile, and New Zealand. For details, see Pawson 1963, p. 21.

Habitat. Ranges from coarse shell sand to fine sand mixed with mud. Similar habitats are recorded from New Zealand (Pawson, in press).

Depth. 9–990 m.

Order Apodida Brandt, 1835

Family Chiridotidae Östergren, 1895

*Chiridota* Eschscholtz, 1829

*Chiridota pisanii* Ludwig, 1886

*Chiridota pisanii* Ludwig 1886, p. 29, pl. 2 fig. 14; Pawson 1964, p. 164 (complete synonymy).


Description. Total length of complete specimens 35–95 mm; specimens in various stages of contraction. Colour in alcohol pale yellow, body wall translucent in expanded areas, so that dark colour of intestine can be seen. Wheel papillae arranged in single rows in each of the three dorsal interradii, more numerous and scattered anteriorly. No papillae found on ventral surface of body. Calcareous deposits typical.

Distribution. The record of the species from *M91, 41°43'S* (Seno Reloncavi) extends its known range some distance to the north, although it was expected to occur there. *C. pisanii* ranges from Seno Reloncavi on the Chilean coast to about 43°S off the coast of Argentina, and also occurs at the Falkland Islands.

Habitat. Has been collected in sandy to muddy areas in the intertidal zone.

Depth. 0–102 m.

*Chiridota* sp.


Remarks. The specimens from *M22* have wheels aggregated into papillae, but no deposits in the tentacles. Total length of complete specimen 50 mm, colour in alcohol light orange-pink, partly translucent in relaxed areas. The specimen from *M65* is an anterior end of the body only, with wheels aggregated into papillae. Total length 18 mm, colour in alcohol light pinkish red.

These specimens might not represent the same species, but their condition prohibits identification to the species level.


