

The Bathyal Holothurians of the
New Zealand Region

by

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The Bathyal Holothurians of the New Zealand Region

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Abstract

THE bathyal holothurian fauna is now known to comprise 21 genera and 24 species, of which 10 species are new records for the New Zealand region. Recent bathyal collections have revealed two new genera and five new species, which have been described elsewhere (Pawson, 1965a, 1965b).

The New Zealand shelf contributes little to the bathyal fauna, which is partly of cosmopolitan aspect, and also contains many elements of the Indo-west-Pacific deep water holothurian fauna. There is no evidence of bipolarity.

INTRODUCTION

IN 1874, the "Challenger" occupied four deepwater stations near New Zealand. From two of the stations (168 and 169) holothurians were collected. Station 168 (40° 28' S., 177° 43' E., 1,100 fathoms) revealed material of a new elasipod species, *Eynpniastes eximia* Theel. Station 169 (37° 34' S., 179° 22' E., 700 fathoms) was rather more fruitful, and the following holothurian species were taken:

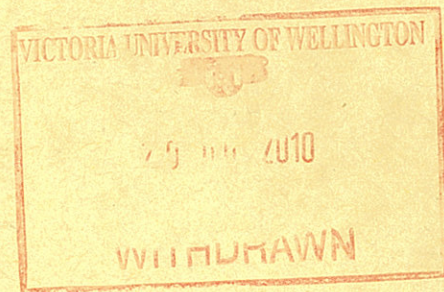
Mesothuria lactea (Theel)
Heteromolpadia marenzelleri (Theel)
Molpadia violacea (Studer)
Hedingia albicans (Theel)

Since the publication of these discoveries (Theel, 1882, 1886a) no further deep water holothurian species were recorded from the New Zealand region until 1963, when the molpadid *Paracaudina chilensis* (Müller) was described from the bathyal zone in Cook Strait (Pawson, 1963). More recently Pawson (1965a, 1965b) has described two new genera and five new species from deep water in the New Zealand region. Fell (1958) has already reported on the extremely rich deep sea fauna of echinoderms other than holothurians of the New Zealand region, and it was expected that the holothurians were correspondingly diverse and would reward further study. Recently several scientific institutions in New Zealand have conducted local investigations of the bathyal zone. The holothurians collected during these expeditions have been examined by the writer, and are described here.

Throughout this account the bathyal zone (= archibenthal) is taken to comprise the continental slope of New Zealand, from the edge of the shelf (at a depth of ca. 180 metres) to the abyssal zone (4,000 metres).

For access to material I would like to thank the following: Professor L. R. Richardson, formerly of the Department of Zoology, Victoria University of Wellington; Dr R. B. Pike, formerly of the Fisheries Laboratory, Marine Department; Dr R. K. Dell, Dominion Museum; Mr J. W. Brodie, New Zealand Oceanographic Institute; and Dr J. B. Gilpin-Brown, Auckland University. I am also grateful to

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Dr Bent Hansen of the Universitetets Zoologiske Museum, Copenhagen, Denmark, for comparative material of some elapid holothurians. Finally I would like to thank Professor H. B. Fell for his valued comments and advice, and colleagues at the U.S. National Museum for reading the manuscript of this paper.

CHECKLIST OF NEW ZEALAND BATHYAL HOLOTHURIANS

Species new to the fauna are marked with an asterisk (*).

Order DACTYLOCHIROTIDA

**Ypsilothuria bitentaculata* (Ludwig)

**Echinocucumis hispida* (Barrett)

Order DENDROCHIROTIDA

Heterothyone alba (Hutton)

Pentadactyla longidentis (Hutton)

Order MOLPADIDA

**Molpadia musculus* (Risso)

Molpadia violacea (Studer)

**Molpadia antarctica* (Theel)

**Molpadia* ? n.sp.

Heteromolpadia marenzelleri (Theel)

Heteromolpadia pikei Pawson

Paracaudina chilensis (Müller)

Hedingia albicans (Theel)

Order APODIDA

Protankyra rigida Pawson

Order ASPIDOCHIROTIDA

Stichopus mollis (Hutton)

**Bathyplotes natans* (Sars)

Mesothuria lactea (Theel)

Order ELASIPODIDA

**Ilyodaemon abstrusus* Sluiter

Pannychia moseleyi Theel

**Laetmogone violacea* Theel

Bathygone papillatum Pawson

**Benthogone rosea* Koehler

Eynpniastes eximia Theel

**Benthodytes hystrix* Sluiter

Amperima tui Pawson

Scotoplanes gilpinbrowni Pawson

The writer (Pawson, 1963) believes that three of the species on the above list, namely *Stichopus mollis* (Hutton), *Pentadactyla longidentis* (Hutton) and *Heterothyone alba* (Hutton) are shelf species which may have entered deep water accidentally, and these are not treated here.

COMPOSITION OF THE BATHYAL FAUNA

Bathyal holothurians now known from the New Zealand region comprise 21 genera and 24 species. Elapodida (nine genera, nine species) and Molpadida (four genera and seven, perhaps eight species) are particularly well represented, while the number of synallactid aspidochirotes (two genera and two species) is surprisingly small.

Dell (1956) has demonstrated that for the New Zealand Mollusca there is always some interrelationship between typically shelf and typically archibenthal (bathyal) species, and he notes further that the interrelationship becomes particularly marked where the change from shelf to bathyal conditions takes place suddenly, and the continental shelf is steep. Three shelf holothurian species have been taken from the bathyal zone in Cook Strait (Pawson, 1963). However apart from the presence in the fauna of such strays, the bathyal holothurian fauna as it is known at present bears no close relationship to that of the shelf, although two molpadid species *Paracaudina chilensis* (bathymetric range 0–990 metres) and *Heteromolpadia marenzelleri* (bathymetric range 25–1,260 metres) are common both on the shelf and in bathyal depths.

Further sampling of the deep bathyal and abyssal zones is needed before the vertical distribution of the New Zealand holothurians can be properly evaluated.

RELATIONSHIPS OF THE BATHYAL FAUNA

The bathyal holothurian fauna of the New Zealand region comprises an assemblage of genera and species which are in general widely distributed in the Pacific Ocean, or are cosmopolitan. Most of the genera are shared with the Indo-west-Pacific, and the similarity to the fauna of the Indo-west-Pacific region is also evident at the specific level. This is true also for the shelf echinoderm genera (Fell, 1953; Pawson, 1961 and in press).

The presence of northern Atlantic species in the New Zealand fauna is notable, but such forms as *Benthogone rosea* and *Echinocucumis hispida* are probably rather more widespread species than has formerly been supposed.

MATERIAL EXAMINED

The material forming the basis of this report has been collected by various institutions, as follows:

Department of Zoology, Victoria University of Wellington

Deep water investigations in Cook Strait have revealed four bathyal species of holothurians, namely *Paracaudina chilensis* (Müller), *Molpadia violacea* (Studer), *Heteromolpadia marenzelleri* (Theel), and *Benthodytes hystrix* Sluiter. The first three of these species are considered in detail elsewhere (Pawson, 1963). Stn. VUZ 109 off Palliser Bay, 41° 50' S., 175° 5' E., 29/12/57, ca. 600 fathoms. (1,080 metres), mud, 4 metre cone net fished on bottom.

Benthodytes hystrix Sluiter 2 specimens

New Zealand Oceanographic Institute, Wellington
(N.Z.O.I.)

Stn. C166, 39° 37' S., 171° 58' 12" E., 180–270 metres, soft grey sloppy mud.

Protankyra rigida Pawson 1 specimen

Stn. C603, Chatham Rise, 42° 33' S., 176° 41.9' E., 25/4/61, 1,530 metres.

Echinocucumis hispida (Barrett) 2 specimens

Eynpniastes eximia Theel 1 specimen

Stn. C604, Chatham Rise, 42° 49' S., 179° 30' E., 26/4/61, 990–865 metres.

Molpadia antarctica (Theel) 1 specimen

Stn. C609, Chatham Rise, 43° 03' S., 178° 58' E., 27/4/61, 580–570 metres.

Molpadia musculus (Risso) 1 specimen

Stn. C619, Chatham Rise, 43° 52' S., 174° 48' E., 2/5/61, 805–780 metres.

Laetmogone violacea Theel 3 specimens

Stn. B291, 42° 28.2' S., 173° 38.7' E., 12/6/60, 220 fathoms (396 metres), sloppy grey mud.

Molpadia sp. (? nov.) 2 specimens

Dominion Museum, Wellington

- Stn. B.S. 201 N.66 E. of Taiaroa Head, 44° 45.6' S., 171° 5' E., 23/1/57, ca. 300 fathoms (ca. 540 metres).
Ypsilothuria bitentaculata (Ludwig) 2 specimens + fragment
- Stn. B.S.202 N.66 E. of Taiaroa Head, 45° 44' S., 171° 2' E., 23/1/57, 75 fathoms (135 metres).
Ypsilothuria bitentaculata (Ludwig) 1 specimen + fragment
- Stn. B.S.209 off Mayor Island, Bay of Plenty, 37° 20.5' S., 27/2/57, 270 fathoms (486 metres).
Laetmogone violacea Theel 1 specimen

Department of Zoology, University of Auckland
 ("Tui" Expedition stations. See Pawson, 1965a)

- Stn. 003, 34° 20' S., 175° 12' E., 990 fathoms (1,782 metres), N.Z.O.I. beam trawl.
 Sample 02 *Scotoplanes gilpinbrowni* Pawson 1 specimen
- Stn. 098, 30° 18' S., 180° E., ca. 650 fathoms (1,170 metres), Isaacs-Kidd mid-water trawl (hit bottom).
 Sample 11 *Amperima tui* Pawson 14 specimens
 Sample 17 *Benthogone rosea* Koehler 2 specimens
 Sample 46 *Amperima tui* Pawson 2 specimens

Fisheries Laboratory, Marine Department, Wellington
 (all stations established in or near the Bay of Plenty)

- Stn. 2, between Alderman Islands and Red Mercury Islands, 25/9/1962, 204 fathoms (370 metres).
Heteromolpadia marenzelleri (Theel) 3 specimens
- Stn. 3, between Alderman Islands and Red Mercury Islands, 25/9/1962, 250 fathoms (450 metres).
Heteromolpadia marenzelleri (Theel) 6 specimens
- Stn. 5, between Alderman Islands and Red Mercury Islands, 26/9/1962, 340 fathoms (612 metres).
Heteromolpadia marenzelleri (Theel) 5 specimens
- Stn. 11, 14 miles N. 20° E. of Motiti Island, 29/9/1962, 290 fathoms (522 metres).
Laetmogone violacea Theel 6 specimens
- Stn. 16, 23 miles N.E. of Cuvier Island, 8/11/1962, 260–270 fathoms (468–486 metres).
Heteromolpadia marenzelleri (Theel) 2 specimens
- Stn. 20, 30 miles N.N.E. of Arid Island, 9/11/1962, 200 fathoms (360 metres).
Bathygone papillatum Pawson 7 specimens
- Stn. 21, 30 miles E.N.E. of Poor Knights Islands, 11/11/1962, 280 fathoms (504 metres).
Heteromolpadia pikei Pawson 1 specimen
- Stn. 23, 23 miles N.E. of Poor Knights Islands, 11/11/1962, 296–276 fathoms (543–490 metres).
Laetmogone violacea Theel 1 specimen
Ilyodaemon abstrusus Sluiter 1 specimen
- Stn. 24, 24 miles E.N.E. of Poor Knights Islands, 11/11/1962, 235–250 fathoms (423–450 metres).
Bathyplores natans (Sars) 2 specimens
- Stn. 25, 33 miles E.N.E. of Poor Knights Islands, 13/11/1962, 265 fathoms (477 metres).
Heteromolpadia pikei Pawson 1 specimen
Bathyplores natans (Sars) 2 specimens

- Stn. 27, 18 miles N., 30° E. of Poor Knights Islands, 20/11/1962, 256–267 fathoms (461–481 metres).
Bathyplores natans (Sars) 4 specimens
Laetmogone violacea Theel 3 specimens
- Stn. 31, 17 miles N.E. of Cavalli Islands, 22/11/1962, 260 fathoms (468 metres).
Ilyodaemon abstrusus Sluiter 4 specimens
Bathyplores natans (Sars) 4 specimens
- Stn. 32, 16 miles N. of Cavalli Islands, 23/11/1962, 350 fathoms (630 metres).
Laetmogone violacea Theel 1 specimen (juvenile)
- No Station data, Lower Chalky Sound, 160 fathoms (288 metres).
Bathyplores natans (Sars) Fragment

Order DACTYLOCHIROTIDA Pawson and Fell, 1965

DIAGNOSIS: Tentacles 8–30 in number, not branched but digitiform or digitate, the digits sometimes bifurcate. Retractor muscles, tubefeet and respiratory trees present. Calcareous ring simple, lacking complex posterior processes. Body U-shaped, enclosed in a test comprising imbricate plates.

REMARKS: Of the three families (Ypsilothuriidae, Rhopalodinidae and Vaneyellidae) included in this order (Pawson and Fell, 1965, p. 2) only the Ypsilothuriidae is well represented in bathyal depths.

Family YPSILOTHURIIDAE Heding, 1942

DIAGNOSIS: Spherical to U-shaped holothurians, with eight to ten tentacles, of which two are much larger than the others. Calcareous deposits large plates each with a spiny spire. Tube feet slightly developed, usually placed along the radii. (Partly after Heding, 1942).

REMARKS: Heding (1942) proposed this family to include the genera *Ypsilothuria* Parrier and *Echinocucumis* Sars, both of which are distinguished from the Cucumariidae in possessing the unique scales in the bodywall together with simple finger-shaped tentacles, of which two are usually larger than the rest.

Panning (1949) reduced the family to the status of a subfamily (Ypsilothuriinae), and included five other genera, namely *Ekmocucumis* Heding, *Abyssocucumis* Heding, *Psolicucumis* Heding, *Staurocucumis* Ekman and *Ypsilocucumis* Panning. *Ypsilocucumis* was proposed (Panning, 1949) to accommodate the species *Echinocucumis asperrima* Theel. Deichman (1930) was of the opinion that this species is *Sphaerothuria*, while Heding (1942) regards the species as "a good *Echinocucumis*". In his diagnosis of the genus, Panning (1949) notes that the species *E. asperrima* has ten tentacles, and that in the bodywall there are large plates composed of many layers. *Ypsilothuria* (= *Sphaerothuria*) has eight tentacles according to Heding (1942) and eight to ten in the opinion of Deichman (1930). Deichmann notes that the two ventral tentacles may tend to become aborted. However, in view of Heding's emphatic statement that *Ypsilothuria* has "always . . . eight tentacles", it is probably desirable to maintain the genus *Ypsilocucumis* Panning.

The remainder of the genera included in this group by Panning (1949) do not have the remarkable combination of characters found in *Ypsilothuria*, *Echinocucumis* and *Ypsilocucumis*, and I feel that they should be separated from the Ypsilothuriidae and replaced in the Dendrochirotida; they may constitute a family in themselves. As the status of some of these genera is in doubt (*vide* Clark and Deichmann, 1936; Heding, 1942), I am unwilling at present to propose a new taxon to accommodate these genera, and prefer to consider them as *incertae sedis*. A comparative study of these rather unusual holothurians is urgently required.

KEY TO THE GENERA OF THE YPSILOTHURIDAE

- 1 (4) Tentacles eight or ten, bodywall with large spired plates composed of many layers of calcareous material. [Ypsilocucumis]
 2 (3) Tentacles ten Ypsilothuria (p. 6)
 3 (2) Tentacles eight
 4 (1) Tentacles ten, spired plates of bodywall composed of a single layer of calcareous material Echinocucumis (p. 7)

Ypsilothuria Perrier, 1886*Sphaerothuria* Ludwig, 1894

DIAGNOSIS: Tentacles eight, lateral tentacles enlarged. Body U-shaped, mouth and anus dorsal. Body invested in large (ca. 1mm diameter) thick scales composed of many layers of calcareous material. Each scale carries a long spire at or near its centre.

TYPE SPECIES: *Y. talismani* Perrier.*Ypsilothuria bitentaculata* (Ludwig) Text-fig. 1, figs. 2-5

Sphaerothuria bitentaculata Ludwig, 1893, p. 112; Ludwig, 1894, p. 141, Pl. 12, figs. 16-17, Pl. 14, figs. 5-14; Mitsukuri, 1897, p. 149; Koehler, 1898, p. 384; Sluiter, 1901b, p. 115; Ohshima, 1915, p. 266; Deichmann, 1930, p. 152, Pl. 19, figs. 4-5; Ludwig and Heding, 1935, p. 196; Baranova, 1957, p. 242.

Ypsilothuria bitentaculata Koehler and Vaney, 1905, p. 87; Heding, 1942, p. 28; Panning, 1949, p. 455.

MATERIAL EXAMINED: Dominion Museum Stn. B.S.201, 2 specimens + fragment of juvenile; B.S.202, 1 specimen + fragment of adult.

DESCRIPTION: Body subglobular, anterior and posterior ends drawn out to form short "siphons" (Text-fig. 1, fig. 3); anterior (oral) siphon wider than posterior siphon. Length measured about greater curvature 32, 25 and 24mm, horizontal diameter 10, 8 and 9mm respectively. Bodywall with numerous projecting spines; prickly to touch; tubefeet rare, restricted to radii, more common on siphons than elsewhere. Colour in alcohol, greyish-white to light brown.

Fragment of juvenile with anal and oral siphons intact; distance between them 2mm.

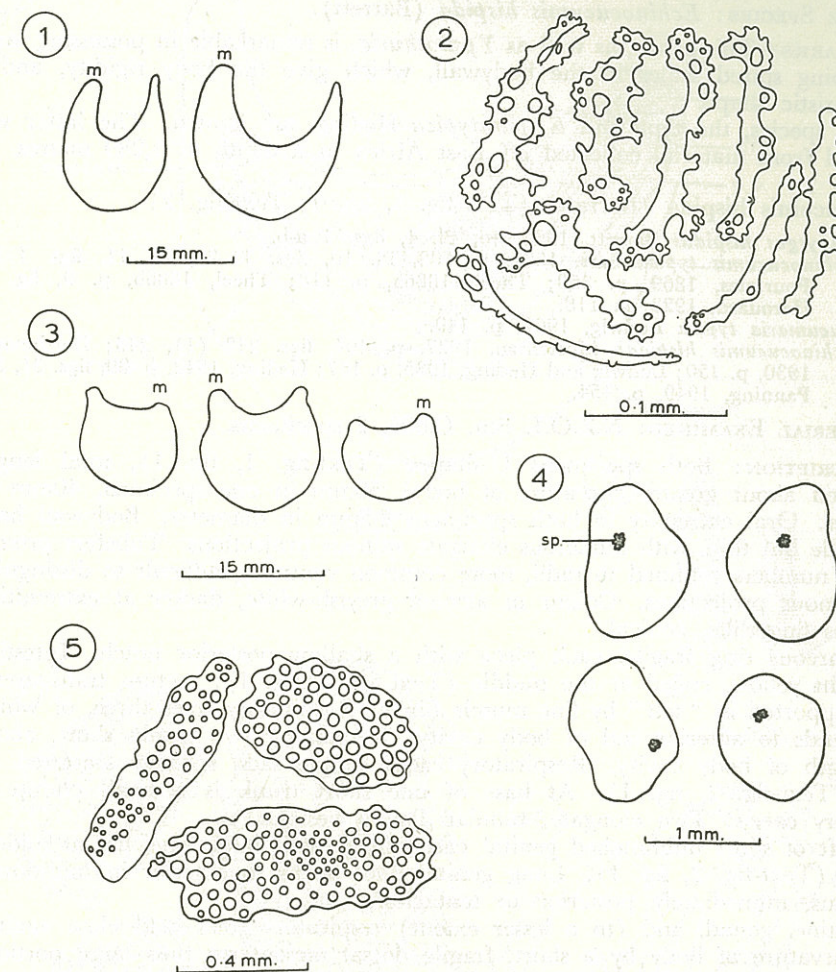
Tentacles typical, with two lateral tentacles much larger than rest. Internal anatomy is similar to that in *Echinocucumis hispida* (Barrett) (Text-fig. 2, fig. 1).

Body invested in overlapping spired scales, each scale composed of many layers of calcareous material, which forms a reticulated network. Scales of varying shape (Text-fig. 1, fig. 4), usually oval, of average diameter 1.2mm. An almost solid spiny spire arises from centre, or near centre of each scale; spires have an average height of 0.5mm. In anterior and posterior siphons, scales reduced to form simple perforated plates (Text-fig. 1, fig. 5) of average length 0.7mm which lack spires.

Largest tentacles contain straight or curved narrow plates of average length 0.13mm, with many short and blunt projections along their length, and a few perforations (Text-fig. 1, fig. 2).

REMARKS: Ludwig (1894) and Heding (1942) have given descriptions of northern representatives of this species. The New Zealand specimens are typical of the species in most respects.

Ypsilothuria bitentaculata has been recorded from numerous localities in the Pacific Ocean (see Ohshima, 1915), and appears to be circum-Pacific, ranging in depth from about 250-4,000 metres. Ohshima (1915) also notes that while in tropical regions *Y. bitentaculata* has a considerable bathymetric range, in temperate regions the animal lives in depths not exceeding about 700 metres. Heding (1942) has established that *Ypsilothuria* (= *Sphaerothuria*) *attenuata*



TEXT-FIG. 1.—*Echinocucumis hispida* (Barrett). Fig. 1: Two complete specimens (outline only). *Ypsilothuria bitentaculata* (Ludwig): Fig. 2, tentacle deposits; Fig. 3, three complete specimens (outline only); Fig. 4, spired scales from bodywall (outline only); Fig. 5, perforated plates from anterior and posterior siphons. Abbreviations: m., mouth; sp., spire.

Perrier is a variety of *Y. bitentaculata*, and notes that this form is "distributed in the abyssal parts of the Atlantic, from Davis Strait to the type locality off Senegal". In the same paper Heding erects another variety, *Y. bitentaculata* var. *virginiensis*, for a specimen collected in the West Indies at a depth of 375 metres.

Clearly, *Y. bitentaculata* is a cosmopolitan species, capable of some variation in the form of its deposits, but, nevertheless, well defined and readily recognisable.

Echinocucumis Sars, 1859

DIAGNOSIS: Tentacles 10, unequal in size. Body spherical; mouth and anus placed at ends of non-retractile tubes. Pedicels scarce, slender, threadlike, restricted to ambulacra. Body covered by very large scales (diameter greater than 1mm), perforated by numerous regular holes. Scales single-layered, never built up into several layers of reticulated network. Most scales with a single long spire placed near margin. (Partly after Deichmann, 1930.)

TYPE SPECIES: *Echinocucumis hispida* (Barrett).

REMARKS: This genus, as well as *Ypsilothuria*, is remarkable in possessing large overlapping spired scales in the bodywall, which give the body rigidity, and a characteristic shape.

Two species, the type and *E. paratypica* Heding, are known. The latter was described from material collected off East Africa in a depth of 1,289 metres.

Echinocucumis hispida (Barrett) (Text-fig. 1, fig. 1; Text-fig. 2)

Eupyrgus hispidus Barrett, 1856, 46, Pl. 4, figs. 1 a-b.

Echinocucumis typica Sars, 1861, p. 102, Pl. 10, figs. 11-20, Pl. 11, figs. 1-17; Pourtales, 1869, p. 359; Theel, 1886a, p. 118; Theel, 1886b, p. 9, fig. 3; Herouard, 1923, p. 118.

Cucumaria typica Ludwig, 1901, p. 149.

Echinocucumis hispida: Mortensen, 1927, p. 404, figs. 242 (1), 243; Deichmann, 1930, p. 150; Ludwig and Heding, 1935, p. 167; Heding, 1942, p. 29, figs. 31, 32; Panning, 1949, p. 454.

MATERIAL EXAMINED: N.Z.O.I. Stn. C.603, 2 specimens.

DESCRIPTION: Both specimens U-shaped (Text-fig. 1, fig. 1), total length (measured about greater curvature of body) 50mm in one specimen, 40mm in the other. Oral extremity in both specimens 2.5mm in diameter. Bodywall hard and brittle but thin, with numerous elongate spinous projections. Tubefeet present in small numbers confined to radii, more common ventrally, difficult to distinguish from spinous projections. Colour in alcohol greyish-white, darker at extremities. Tentacles fingerlike, conical.

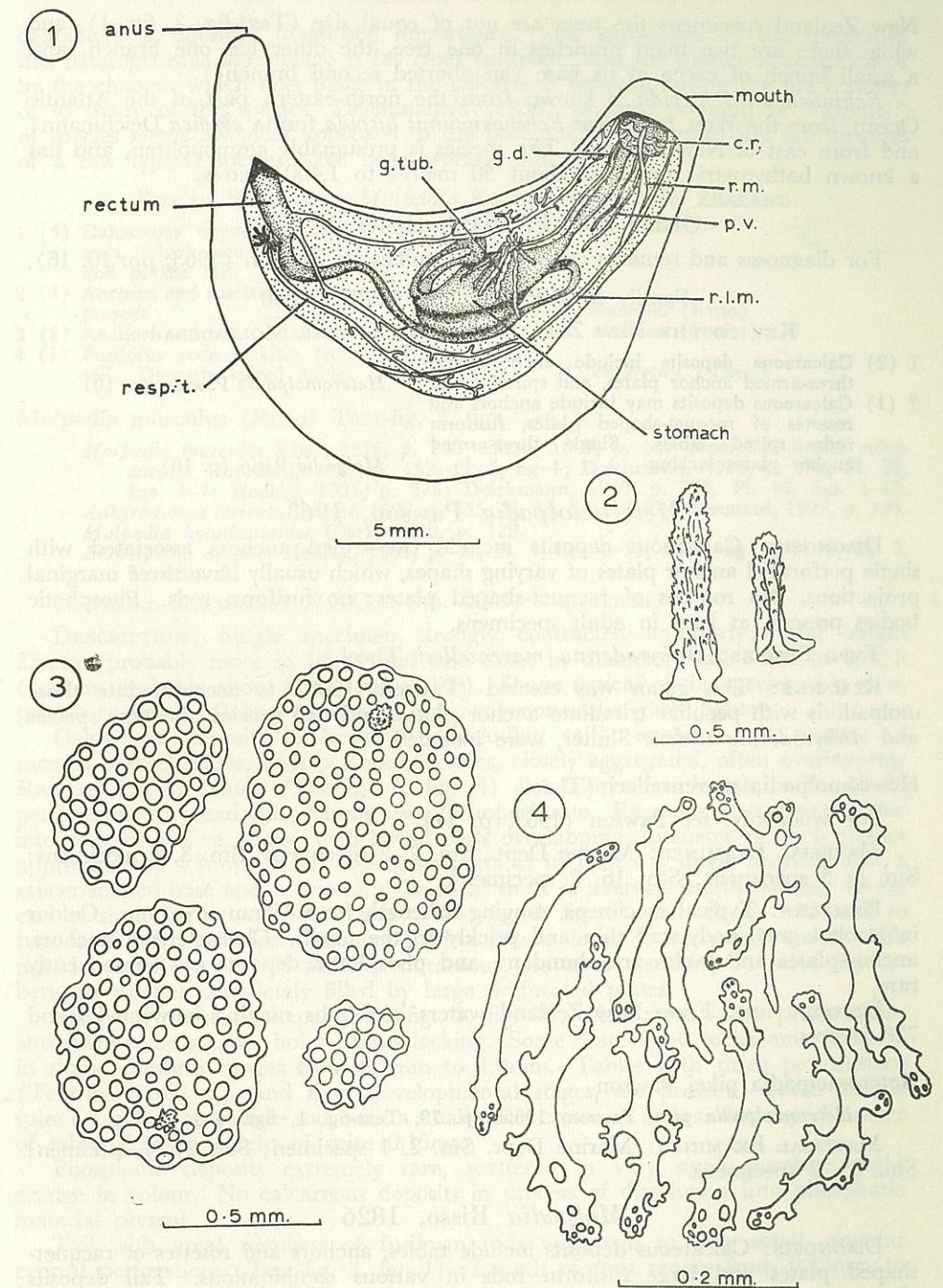
Calcareous ring fragile, each piece with a shallow posterior notch. Intestine long, light yellow, coiled at the middle (Text-fig. 2, fig. 1); rectum transparent, large, supported in "tail" by fine muscle fibres. Respiratory trees three, of which one extends to anterior end of body cavity. Remaining two trunks short, about half length of body cavity. Respiratory caeca simple sacs, sparsely scattered on trunks (Text-fig. 2, fig. 1). At base of one short trunk is a small clump of respiratory caeca. Two elongate, tubular Polian vesicles.

A tuft of short unbranched genital caeca filled with large eggs lies at middle of body (Text-fig. 2, fig. 1). Long genital duct opens to exterior in mid-dorsal interradius, immediately posterior to tentacles.

Intestine, gonad, and (to a lesser extent) respiratory trees held close against lesser curvature of body by a short, fragile dorsal mesentery; thus large portions of body cavity virtually empty. Radial muscles thin strands, retractors well developed.

Calcareous deposits in bodywall exclusively single-layered, oval to rectangular plates (Text-fig. 2, fig. 3), with many perforations and an average length of 1.0mm. Most plates bear a single tall excentric spire, which lies near edge; spire spinous (Text-fig. 2, fig. 2), up to 0.7mm in length, derived from three vertical pillars joined by several crossbars. Smaller perforated plates, lacking spires, also common, especially near anterior and posterior ends of body. Tubefeet pass between plates, not through them. Tentacles contain large numbers of curved rods, of average length 0.3mm, perforated mainly at extremities, and with short blunt projections (Text-fig. 2, fig. 4).

REMARKS: These specimens represent *Echinocucumis hispida*, or a near relative of that species. Some slight differences in the calcareous deposits and internal anatomy between the present specimens and the typical *E. hispida* are evident. The large spired plates in the New Zealand specimens seem to have more numerous perforations than those in *E. hispida* from northern waters. In addition Deichmann (1930) notes that the respiratory trees are "quite abortive, with 1-2 small lobes" in *E. hispida*, while Heding (1942) states that the trees are well developed, and each has "two main branches of nearly equal size". In the



TEXT-FIG. 2.—*Echinocucumis hispida* (Barrett): Fig. 1, internal anatomy, right lateral view (partly diagrammatic); Fig. 2, spires from plates; Fig. 3, spired plates; Fig. 4, tentacle deposits. Abbreviations: c.r., calcareous ring; g.d., genital duct; g.tub., genital tubules (caeca); p.v., polian vesicle; r.m., retractor muscle; resp.t., respiratory tree; r.l.m., radial longitudinal muscle.

New Zealand specimens the trees are not of equal size (Text-fig. 2, fig. 1), and while there are two main branches in one tree, the other has one branch, and a small bunch of caeca at its base (an aborted second branch?).

Echinocucumis hispida is known from the north-eastern part of the Atlantic Ocean, from the West Indies (as *Echinocucumis hispida* forma *atypica* Deichmann) and from east of New Zealand. The species is presumably cosmopolitan, and has a known bathymetric range of about 50 metres to 1,400 metres.

Order MOLPADIDA Haeckel, 1896

For diagnoses and remarks on included families see Pawson (1963, pp. 10, 16).

Family MOLPADIIDAE Müller, 1850

KEY TO THE NEW ZEALAND GENERA OF THE MOLPADIIDAE

- | | |
|---|--------------------------------------|
| 1 (2) Calcareous deposits include anchors and three-armed anchor plates, and spired tables | <i>Heteromolpadia</i> Pawson (p. 10) |
| 2 (1) Calcareous deposits may include anchors and rosettes of racquet-shaped plates, fusiform rods, spired tables. Single three-armed anchor plates lacking | <i>Molpadia</i> Risso (p. 10) |

Heteromolpadia Pawson, 1963

DIAGNOSIS: Calcareous deposits include two-armed anchors associated with single perforated anchor plates of varying shapes, which usually have three marginal projections. No rosettes of racquet-shaped plates; no fusiform rods. Phosphatic bodies present, at least in adult specimens.

TYPE SPECIES: *Ankyroderma marenzelleri* Theel.

REMARKS: This genus was erected (Pawson, 1963) to accommodate those molpadiids with peculiar triradiate anchor plates, and two species, the type species and *Ankyroderma tridens* Sluiter, were included.

Heteromolpadia marenzelleri (Theel)

For synonymy, see Pawson (1963, p. 11).

MATERIAL EXAMINED: Marine Dept., Stn. 2, 2 specimens; Stn. 3, 6 specimens; Stn. 5, 5 specimens; Stn. 16, 2 specimens.

REMARKS: Typical specimens, ranging in length from 19mm to 45mm. Colour in alcohol grey, body-wall thin and prickly to the touch. Characteristic anchors, anchor-plates and tables are abundant, and phosphatic deposits are consequently rare.

DISTRIBUTION: From New Zealand waters in depths ranging between 25 and 720 metres.

Heteromolpadia pikei Pawson

Heteromolpadia pikei Pawson, 1965b, p. 79, Text-fig. 1, figs. 4-6.

MATERIAL EXAMINED: Marine Dept. Stn. 2, 1 specimen; Stn. 21, 1 specimen; Stn. 25, 2 specimens.

Molpadia Risso, 1826

DIAGNOSIS: Calcareous deposits include tables, anchors and rosettes of racquet-shaped plates and large fusiform rods in various combinations. Tail deposits elongate to fusiform.

TYPE SPECIES: *Molpadia musculus* Risso.

REMARKS: Attempts to subdivide the genus *Molpadia* by Heding (1931, 1935) have proved unsuccessful, as some genera were based on extremely variable

characters of doubtful diagnostic importance. Our knowledge of the species in this heterogeneous assemblage is far from complete, and the matter is complicated by the changes which take place in the calcareous deposits during the life histories of so many of the species. Deichmann's (1936) stopgap proposal of "groups" of species seems a logical approach to the problem, at least until the life histories of a few typical species have been worked out.

KEY TO SPECIES OF *Molpadia* KNOWN FROM NEW ZEALAND

- | | |
|---|------------------------------|
| 1 (4) Calcareous deposits include large fusiform rods, which are present in the bodywall and in the tail. | |
| 2 (3) Anchors and rosettes of racquet-shaped plates present | <i>M. musculus</i> (Risso) |
| 3 (2) Anchors and rosettes lacking | <i>M. violacea</i> (Studer) |
| 4 (1) Fusiform rods lacking from bodywall and tail. Deposits spired tables | <i>M. antarctica</i> (Theel) |

Molpadia musculus (Risso) Text-fig. 3, figs. 1-4, 6

Molpadia musculus Risso, 1826, p. 293; Clark, 1907, p. 165 (complete list of references); Herouard, 1923, p. 132, Pl. 5, fig. 1; Deichmann, 1930, p. 198, Pl. 23, figs. 4-7; Heding, 1931, p. 279; Deichmann, 1940, p. 225, Pl. 40, figs. 1-15. *Ankyroderma loricata* Perrier, 1902, p. 535, Pl. 33, figs. 23-28; Herouard, 1923, p. 135. *Molpadia holothurioides* Clark, 1920, p. 129. *Eumolpadia asaphes* Heding, 1935, p. 42, Pl. 5, figs. 9-10, Pl. 7, fig. 2, Pl. 8, fig. 3, Text-fig. 9.

MATERIAL EXAMINED: N.Z.O.I. Stn. 0609, 1 specimen.

DESCRIPTION: Single specimen strongly contracted anteriorly; total length 23mm (probably more in life); oral disc 3mm in diameter; tail 3mm in length (broken, probably about 6mm long in life). Shape typical of the species, skin thin, prickly to touch. Colour in alcohol grey, anterior end slightly lighter.

Calcareous deposits in bodywall (excluding tail), anchors and rosettes of racquet-shaped plates, with perforated plates, closely aggregated, often overlapping. Racquet-shaped plates (Text-fig. 3, fig. 4) 0.4-0.7mm in length, with 10-25 perforations at broad end; handle usually imperforate. Racquets always aggregated into rosettes of five or six, with broad ends overlapping, diameter of each rosette approximately 1.3mm. Each rosette supports at its centre a single anchor, with a saucer-shaped base and a smooth cylindrical shaft of average length 0.6mm. Distal end of shaft with two anchor arms (Text-fig. 3, fig. 6), smooth, or with one to two serrations near tips. Anchors project above level of bodywall, visible with naked eye. Rosettes and anchors numerous, scattered regularly in skin. Spaces between rosettes completely filled by large perforated plates.

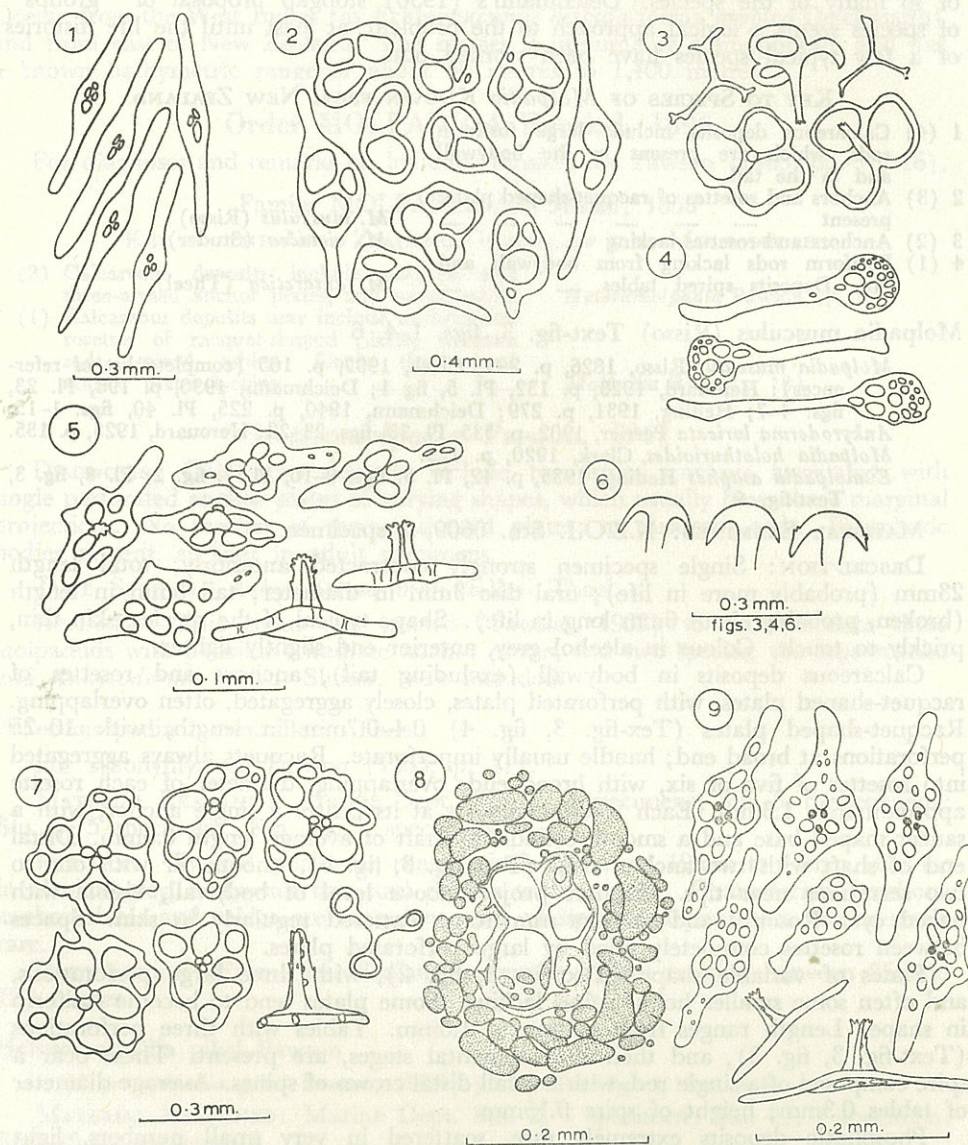
Plates of variable shape (Text-fig. 3, fig. 2), with three large perforations, and often some smaller holes; spires lacking. Some plates tend to become fusiform in shape. Length ranges from 0.3mm to 1.0mm. Tables with three perforations (Text-fig. 3, fig. 3), and their developmental stages, are present. These bear a spire composed of a single rod, with a small distal crown of spines. Average diameter of tables 0.3mm; height of spire 0.15mm.

Phosphatic deposits extremely rare, scattered in very small numbers, light orange in colour. No calcareous deposits in process of dissolution into phosphatic material present.

Tail with great numbers of fusiform rods with two to four small, angular central perforations (Text-fig. 3, fig. 1). Length of rods ranges from 0.55mm to 0.81mm, average length 0.73mm.

REMARKS: There is little doubt that this species falls into the *M. musculus* group as defined by Deichmann (1936). As the rosettes of racquets and the fusiform deposits of the bodywall and tail are characteristic of the species *M. musculus*, I have assigned the present material to that species. This constitutes

the first definite record of *M. musculus* from the New Zealand region. *M. musculus* is cosmopolitan, and has been taken from depths between about 100 and 900 metres.



TEXT-FIG. 3.—*Molpadia musculus* (Risso): Fig. 1, tail deposits; Fig. 2, perforated plated from the bodywall; Fig. 3, tables; Fig. 4, racquets; Fig. 6, anchor arms. *Molpadia antarctica* (Theel): Fig. 5, tail deposits; Fig. 7, tables from the bodywall. *Molpadia* ?n.sp.: Fig. 8, table in process of transformation into phosphatic material; Fig. 9, tail deposits.

Molpadia violacea (Studer)

For synonymy and diagnosis, see Pawson (1963), p. 15.

MATERIAL EXAMINED: None.

REMARKS: *Molpadia violacea* is known from Kerguelen Island (Theel, 1886a) and the New Zealand region (Theel, 1886a; Pawson, 1963), from depths of 36–126 metres (Kerguelen Island) and 720–1,260 metres (New Zealand).

This species is considered a synonym of *M. musculus* by Deichmann (1940), but while the typical *M. musculus* has well developed anchors and rosettes of racquet-shaped plates, no trace of these deposits has been found in material of *M. violacea* from the New Zealand region (Pawson, 1963). Unfortunately no further material of *M. violacea* has come to hand, and unless it can be shown that *M. violacea* did at some stage of its life history have anchors and rosettes, I must regard the species as distinct from *M. musculus*.

Molpadia antarctica (Theel) Text-fig. 3, figs. 5, 7

Trochostoma antarcticum Theel, 1886a, p. 44, Pl. II, fig. 7; Theel, 1886b, p. 16; Herouard, 1901, p. 42; Augustin, 1908, p. 35, Text-fig. 22 a-o.

Molpadia antarctica: Clark, 1907, p. 32, 168; Ohshima, 1915, p. 252.

MATERIAL EXAMINED: N.Z.O.I. Stn. 604, 1 specimen.

DESCRIPTION: Total length 20mm, diameter of oral disc 3mm. Tail broken off near base; its length cannot be determined. Bodywall thin, prickly to touch. Colour in alcohol uniformly grey.

Calcareous deposits exclusively tables of average diameter 0.28mm, usually with six or more large perforations (Text-fig. 3, fig. 7); three central perforations usually largest. From centre of each table arises a tall three-pillared spire, pillars united by three or four crossbars. Spires project above level of bodywall, barely visible to naked eye. Tables very closely crowded together, often overlapping. Anchors and anchor plates or rosettes lacking.

Tail with great numbers of elongate three-pillared tables (Text-fig. 3, fig. 5) bearing 4–10 perforations and complex spinous spire. Average length of tables 0.16mm.

Phosphatic deposits present, exceedingly scarce. A small number of tables are in first stages of dissolution into phosphatic material which is very light yellow, therefore easily overlooked.

REMARKS: This specimen represents the species as originally described by Theel (1886). Ohshima (1915) recorded the same species from off Japan, noting that the average diameter of the tables in the bodywall is 0.185mm (as against 0.3mm in the present specimen). Also the tail deposits in Ohshima's material are smaller (0.04–0.11mm diameter) compared with 0.16mm length. However, Ohshima gave no indication of the shape of the tail deposits in his material, and mentioned the "disc diameter", which may perhaps be interpreted as the dimensions of the perforated area of the tail deposit.

Ohshima's specimen was 33mm in length, and phosphatic deposits were entirely absent, but he noted some tables undergoing a change in colour.

Molpadia antarctica is known from off Chile (Theel, 1886a), between Florida and Cuba (Theel, 1886b), off Alexander Land, Antarctica (Herouard, 1901), and from various localities off Japan (Augustin, 1907; Ohshima, 1915). Thus it is a widespread species in depths ranging from about 80 metres to 1,218 metres.

Molpadia ?n.sp. Text-fig. 3, figs. 8, 9

MATERIAL EXAMINED: N.Z.O.I. Stn. B.291, 2 specimens.

DESCRIPTION: Total length of specimens, 38mm and 61mm; body of typical molpadid shape. Colour in alcohol grey, with large numbers of small light red spots, more closely aggregated in smaller specimen. Tail grey.

Calcareous deposits almost completely transformed into phosphatic material (Text-fig. 3, fig. 8), and comprise only tables. No anchors, rosettes or anchor plates. Original shape of tables cannot be accurately determined, but fragments indicate

that they may have been similar to those in *Molpadia antarctica* (Theel). Phosphatic bodies vary greatly in size and shape, aggregated into small, scattered clusters (replacing calcareous deposits), forming red spots visible to naked eye.

Tail with elongate tables bearing three-pillared spires (Text-fig. 3, fig. 9), and numerous (10-16) small perforations. Average length of tail deposits 0.22mm.

REMARKS: These specimens clearly represent a species in which the calcareous deposits (apart from those in the tail) are entirely transformed into phosphatic material, probably early in life. It is possible that these are representatives of an undescribed species, closely allied to *M. antarctica*, although the latter has smaller (0.16mm) tail deposits with fewer perforations (6-10). Clark (1907, p. 32) notes that calcareous deposits tend to disappear from the bodywall of *M. antarctica* with growth but makes no mention of phosphatic deposits. Further the bodywall in present material is quite thin, but not delicate, as in *M. antarctica*.

Without a better knowledge of the calcareous deposits of the bodywall, it is felt that these specimens should not be assigned to a new species, and for the present they must remain unnamed.

Family CAUDINIDAE Heding, 1931

DIAGNOSIS: Tentacles with two pairs of digits. Caudal appendage usually long and slender. Deposits not tables but cups (buttons), perforated plates or irregular rods. (Heding, 1931, in part.)

TYPE SPECIES: *Paracaudina chilensis* (Müller).

Paracaudina chilensis (Müller)

For synonymy, see Pawson, 1963, p. 18.

MATERIAL EXAMINED: None.

REMARKS: A circum-Pacific species, bathymetric range from 0 to more than 900 metres.

Hedingia Deichmann, 1938

DIAGNOSIS: Tentacles with two pairs of digits. Deposits large tables (0.15-0.27mm diameter), with high spires composed of three converging rods.

TYPE SPECIES: *Trochostoma albicans* Theel.

Hedingia albicans (Theel)

Trochostoma albicans Theel, 1886a, p. 44, Pl. XI, fig. 3.

Trochostoma albicans var. *glabra* Theel, 1886a, p. 46; Koehler and Vaney, 1905, p. 89; Perrier, 1902, p. 526, Pl. 22, figs. 7-8.

Caudina arenata var. *armata* Theel, 1886b, p. 17; Gerould, 1897, p. 19, Pl. III, figs. 34-37.

Caudina albicans: Clark, 1907, p. 174, Pl. X, fig. 12; Deichmann, 1930, p. 201, Pl. 24, fig. 1; Heding, 1931, p. 283.

Haplodactyla albicans: Heding, 1935, p. 65, Pl. IV, fig. 9, Pl. V, fig. 17, Pl. VIII, fig. 10.

Hedingia albicans: Deichmann, 1938, p. 112; Madsen, 1953, p. 167; Deichmann, 1940, p. 216.

MATERIAL EXAMINED: None.

REMARKS: Occurs off New Zealand, south of Iceland, off the north-east coast of U.S.A., the Cape Verdes, Mediterranean Sea, Bay of Bengal in depths ranging from 500 metres to 3,200 metres (Madsen, 1953).

Order APODIDA Brandt, 1835

DIAGNOSIS: Tentacles simple, digitate or pinnate, retractor muscles, tubefeet and respiratory trees absent. Body vermiform. Calcareous deposits include anchors, anchor plates, wheels and sigmoid rods; sometimes absent.

REMARKS: Although the Order Apodida is of cosmopolitan distribution, very few species are found in bathyal depths, and the great majority are littoral forms.

Family SYNAPTIDAE Burmeister, 1837

DIAGNOSIS: Calcareous deposits in the form of anchors or anchor plates. Tentacle stalk cylindrical or terete, not becoming widened distally, either with digits along each side for most of its length (pinnate), or with only one or two digits along each side near the tip (digitate).

REMARKS: This widespread family is mostly of shallow-water distribution, but some species of the genus *Protankyra* are known from great depths. In the New Zealand region two species of *Protankyra* are known, of which one, *P. rigida* Pawson, has been collected from the bathyal zone.

Protankyra Ostergren, 1898

Protankyra rigida Pawson

Protankyra rigida Pawson, 1965b, p. 75, Text-fig. 1, figs. 1-3.

MATERIAL EXAMINED: N.Z.O.I. Stn. C166, 1 specimen.

REMARKS: This species had been described and discussed elsewhere (Pawson, 1965b).

DISTRIBUTION: The single known specimen was collected from off Cape Egmont, New Zealand, at a depth of 180-270 metres.

Order ASPIDOCHIROTIDA Grube, 1840

DIAGNOSIS: Tentacles shield-shaped, retractor muscles absent, respiratory trees and tubefeet present. Calcareous deposits usually in the form of tables or derivatives of tables.

REMARKS: Of the three families (Stichopodidae, Holothuriidae and Synallactidae) in this order, one, the Synallactidae, comprises mainly deep-water forms, while the other two are more or less restricted to shallow waters.

Family SYNALLACTIDAE Ludwig, 1894

DIAGNOSIS: Tentacle ampullae lacking. Respiratory trees usually not connected with a rete mirabile. Stone canal usually in connection with the bodywall, sometimes opening outwards through the bodywall. No Cuvierian organs. Deposits tables; C-shaped bodies may be present and, very rarely, buttons. (After Mortensen, 1927.)

REMARKS: This family is cosmopolitan, comprising mainly deepsea forms. Approximately fifteen genera are recognised at the present time, of which two, *Bathyploetes* Ostergren and *Mesothuria* Ludwig, are known from the New Zealand region. The genera may be readily distinguished as follows:

- | | | | | | |
|---|-------|-------|-------|-------|-----------------------------|
| 1 (2) Gonad composed of a single tuft; deposits tables with approximately circular discs bearing large perforations | ..... | ..... | ..... | ..... | <i>Mesothuria</i> (p. 18) |
| 2 (1) Gonad composed of two tufts; deposits tables with cross-shaped discs | ..... | ..... | ..... | ..... | <i>Bathyploetes</i> (p. 15) |

Bathyploetes Ostergren, 1896

DIAGNOSIS: Tentacles 15-20, mouth ventrally turned, anus subdorsal. Ventro-lateral radii with feet in one or more rows. Midventral radius naked, or with a small number of feet. Dorsal surface with small papillae more or less distinctly in rows. Genital organs in two tufts. Radial muscles undivided. Deposits tables with cross-shaped disc and spire built up of four rods, usually with several cross beams.

TYPE SPECIES: *Holothuria natans* M. Sars.

REMARKS: According to Deichmann (1930) this genus is very closely related to *Synallactes* Ludwig. *Bathyploetes* is a cosmopolitan genus, containing in excess of twenty species. Known bathymetric range is from 60 metres (*B. rubicundus* Sluiter) to about 3,000 metres (*B. profundens* Koehler and Vaney).

Bathyploetes natans (Sars) Text-fig. 4

Holothuria natans M. Sars, 1868, p. 20.

Stichopus tizardi Theel, 1886a, p. 193.

Bathyploetes tizardi: Östergren, 1896, p. 354, Pl. 13, figs. 36-43; Ludwig, 1901, p. 138, Pl. 12, figs. 3-4, Pl. 18, figs. 1-9; Mitsukuri, 1912, p. 35, Text-fig. 8; Ohshima, 1915, p. 224.

Bathyploetes fallax Östergren, 1896, p. 355.

Bathyploetes natans: Ludwig, 1901, p. 137 (complete list of references); Greig, 1921, p. 7; Mortensen, 1924, p. 220, figs. 105, 106; Mortensen, 1927, p. 384, figs. 228, 229; Deichmann, 1930, p. 100, Pl. 9, figs. 1, 2, 8; Heding, 1942, p. 11, Text-figs. 11, 12 (1-2).

Bathyploetes reptans Perrier, 1902, p. 352, Pl. 12, figs. 3-4, Pl. 18, figs. 1-9.

MATERIAL EXAMINED: Marine Dept. Stn. 24, 2 specimens; Stn. 25, 1 specimen; Stn. 27, 4 specimens; Stn. 27, 4 specimens; Stn. 31, 4 specimens; Lower Chalky Sound, 160 fathoms, fragment.

DESCRIPTION: Total length varies between 100mm and 230mm, most specimens over 150mm in length. Body approximately five times as long as broad, flattened ventrally. All specimens with outer layer of bodywall lacking, or partly torn away. Single specimen in fair condition with naked midventral radius; lateral ventral radii each with two rows of irregularly scattered short papillae approximately 2mm in diameter. Papillae soft, lacking calcareous deposits, or at most with a small number of spinous rods. Dorsal surface of body bears small papillae in radii, but arrangement cannot be determined. Tentacles 16-19, surrounding a ventrally turned mouth.

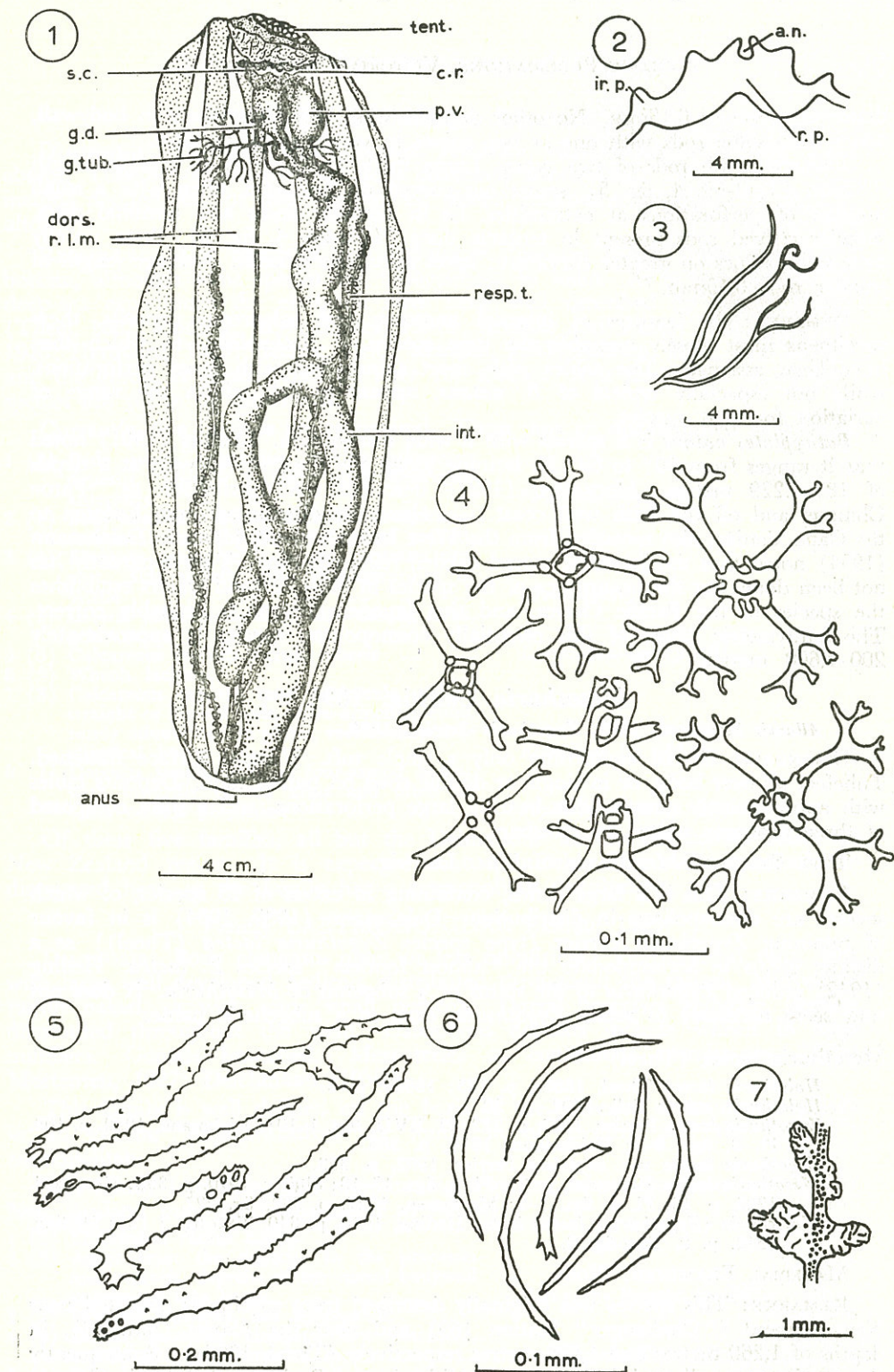
In alcohol, dorsal surface of body with light brown spots of varying size, up to 1.5mm diameter. Ventral surface similar laterally, but at centre bodywall light violet, with brown spots in general approximately half size of those on dorsal side. Tentacles uniformly light to dark brown.

Calcareous ring firm, pieces fused together. Radials notched anteriorly, interradials bluntly pointed (Text-fig. 4, fig. 2). Radial pieces rather larger than interradials, with small anterior projections, one to each side of anterior notch. Both radials and interradials notched posteriorly.

A single bulbous Polian vesicle (Text-fig. 4, fig. 1) arises from ventral side of water-vascular ring. Madreporite small, attached to bodywall, but not deeply embedded. Stone canal a simple, short tube, not coiled. Gonad two bunches of weakly branching caeca (Text-fig. 4, figs. 1, 3), one bunch to each side of dorsal mesentery. Common genital duct 20mm in length, opening to exterior near madreporite. Respiratory trees long (approximately $\frac{2}{3}$ length of body), unbranched, slightly flattened tubes, carrying numerous simple respiratory sacs (Text-fig. 4, figs. 1, 7). Trunks arise from a single root; they contain small brown pigment (?) spots along their entire length (Text-fig. 4, fig. 7).

Intestine thin-walled, light to dark brown, describing an S-shaped loop in posterior half of body. Radial longitudinal muscles broad, flat, undivided, dark brown straps. Dorsal radial muscles lie very close together for most of their length (Text-fig. 4, fig. 1); area of mid-dorsal interradius greatly reduced.

Calcareous deposits of bodywall four-armed tables, extremities of arms branching dichotomously, forming terminal perforations. Arm length varies from 0.04mm to 0.08mm. A spire comprising four pillars united by several crossbars arises from centre of each table, at point of union of arms. Spire long, with several crossbars, but sometimes (Text-fig. 4, fig. 4) short, with but one or two crossbars. Average



TEXT-FIG. 4.—*Bathyploetes natans* (Sars): Fig. 1, internal anatomy, right ventral view; Fig. 2, portion of calcareous ring; Fig. 3, portion of gonad; Fig. 4, four-armed tables; Fig. 5, prickly rods from tentacles; Fig. 6, curved rods from tentacles; Fig. 7, portion of respiratory tree. Abbreviations: a.n., anterior notch; c.r., calcareous ring; dors.r.l.m., dorsal radial longitudinal muscle; g.d., genital duct; g.tub., genital tubules (caeca); int., intestine; ir.p., interradial piece; p.v., polian vesicle; r.p., radial piece; resp.t., respiratory tree; s.c., stone canal; tent., tentacles.

diameter of tables 0.13mm. No other deposits were found elsewhere in bodywall, apart from some rods with one or two spines in ventrolateral papillae.

Tentacles with rods of two types. Large thick prickly rods of average length 0.35mm (Text-fig. 4, fig. 5), sometimes curved or Y-shaped, often with a small number of perforations at extremities, lie in tentacle stems and terminal discs. Smaller curved rods present in tentacle discs (Text-fig. 4, fig. 6); these usually bear small spines on greater curvature; lesser curvature smooth. Average length of smaller rods 0.15mm.

REMARKS: In features of internal anatomy and calcareous deposits, these specimens most closely resemble the type species of *Bathyploetes*, to which they have been assigned. The tables with short spines and with large perforations, while not especially typical of *B. natans*, appear to fall within the range of variation for that species.

Bathyploetes natans is a species with a wide distribution. Ludwig (1901) noted that it ranges from 60° to 69° N. latitude along the coast of Norway, at a depth of 183–1,229 metres. Mortensen (1927) describes the distribution as "Faroe Channel and off the Irish west coast . . . elsewhere distributed from Lofoten to the Cape Verdes; also recorded from the West Indies and off Japan". Deichmann (1954) noted that the Japanese record needed reinvestigation. This apparently has not been done, but the occurrence of the species in New Zealand waters establishes the species in the Pacific Ocean, and the Japanese record is probably correct. The bathymetric range of this essentially cosmopolitan species is approximately 200–1,600 metres.

Mesothuria Ludwig, 1894

Allantis Herouard, 1902, *Zygothuria* Perrier, 1898.

DIAGNOSIS: Gonad comprising only a single tuft. Ventral surface flattened. Tubefeet all over body, or in single or double rows on paired radii. Deposits tables with approximately circular disc bearing large perforations, and a spire composed of three processes united by crossbars.

TYPE SPECIES: *Mesothuria multipes* Ludwig.

REMARKS: This is a large genus, containing in excess of 25 species, of which several are cosmopolitan in distribution. Deichmann (1930, 1954) is in favour of retaining *Zygothuria* Perrier (type species *Zygothuria lactea* (Theel)) as a distinct genus to accommodate the "almost footless" species *Z. lactea*. Heding (1942) reduced *Zygothuria* to the status of a subgenus of *Mesothuria*. It does not now seem necessary to retain *Zygothuria*, even as a subgeneric name.

Mesothuria lactea (Theel)

Holothuria lactea Theel, 1886a, p. 183; 1886b, p. 6.

Holothuria aspera Bell, 1892, p. 50.

Zygothuria lactea Perrier, 1902, p. 322, Pl. XVII, figs. 1–10; Deichmann, 1930, p. 108, Pl. 8, figs. 8–9; Deichmann, 1954, p. 386.

Zygothuria lactea var. *oxysclera* Perrier, 1902, p. 323.

Mesothuria lactea Herouard, p. 21, Pl. 1, figs. 17–19; Sluiter, 1910, p. 332; Herouard, 1923, p. 13, Pl. 4, figs. 1–3; Mortensen, 1927, p. 382, fig. 227.

Mesothuria (Zygothuria) lactea lactea Heding, 1940, p. 340, Text-fig. 7 (3); Heding, 1942, p. 9, Text-fig. 9.

MATERIAL EXAMINED: None.

REMARKS: This species was originally described from specimens collected near New Zealand ("Challenger" Station 169) and near the Azores (Stn. 78), in depths of 1,260 metres and 1,800 metres respectively (Theel, 1886a). Subsequently the species was collected from many localities in the Pacific and Atlantic Oceans, and in the Arctic region. *Mesothuria lactea* is cosmopolitan, in depths ranging from approximately 700 metres to 5,100 metres.

Order ELASIPODIDA Theel, 1882

DIAGNOSIS: Tentacles shield-shaped, retractor muscles and respiratory trees absent. Tubefeet usually present. Body bilaterally symmetrical. Calcareous deposits include pointed rods or their derivatives, wheels, cruciform bodies, or are lacking altogether.

REMARKS: Most elasipods are exclusively deep-sea forms, living on a soft bottom, although some species are bathypelagic in habit. As a result of several deep-sea expeditions the elasipods have been well described by many workers (Theel, 1882; Ludwig, 1894; Sluiter, 1901b; Koehler and Vaney, 1905; Ohshima, 1915; Herouard, 1923; Heding, 1940; Madsen, 1953; Hansen, 1956, and others), and the group at present contains over 100 species. It is likely that many more species are yet to be discovered.

Currently, five families are recognised. These may be distinguished as follows:

- | | | |
|--|-------|--------------------------------|
| 1 (2) Body ovoid, gelatinous, lacking calcareous deposits. Usually a large brim developed anteriorly | ..... | <i>Pelagothuriidae</i> (p. 27) |
| 2 (1) Body bilaterally symmetrical. No conspicuous anterior brim. Calcareous deposits present. | ..... |  |
| 3 (4) Elongate nonretractile lateral processes present. Skin usually thin, parchment-like or brittle | ..... | [<i>Deimatidae</i>] |
| 4 (3) Lateral processes lacking; skin usually thick, gelatinous. | ..... |  |
| 5 (6) Calcareous deposits include wheels | ..... | <i>Laetmogonidae</i> (p. 19) |
| 6 (5) Wheels lacking. | ..... |  |
| 7 (8) Calcareous deposits most commonly include straight or curved rods, three-armed spicules, rarely minute netlike plates, rosette-shaped or elliptical bodies | ..... | <i>Elpidiidae</i> (p. 30) |
| 8 (7) Deposits simple rods or four-armed bodies, with inwardly curved arms and often an outer central projection | ..... | <i>Psychropotidae</i> (p. 27) |

Of these five families, all but the Deimatidae are so far known from the New Zealand region. It is expected that the Deimatidae will eventually be discovered here, as the family has a cosmopolitan distribution.

Family LAETMOGONIDAE Ekman, 1925

DIAGNOSIS: Body elongate, more or less cylindrical. Ventrolateral radii each with large well developed pedicels, distributed throughout the radius. Midventral radius naked, or with some small pedicels. Dorsal processes elongate, flexible, distributed throughout the radii. Calcareous deposits include wheels in large numbers. Gonads branched. Mesenteries as continuous membranes. (After Mortensen, 1927; Deichmann, 1930.)

This family is well defined on the basis of the presence of numerous wheels in all genera. Representatives are found in all depths, and the family is cosmopolitan.

The family Laetmogonidae contains eight genera, of which those known from New Zealand may be distinguished as follows:

- | | | |
|--|-------|-----------------------------------|
| 1 (8) Midventral radius naked. | ..... |  |
| 2 (3) Apart from the deposits in the processes and pedicels, deposits of the dorsal bodywall aggregated into heaps | ..... | <i>Bathygone</i> Pawson (p. 26) |
| 3 (2) Deposits scattered, not aggregated. | ..... |  |
| 4 (5) Dorsal processes elongate, not retractile, usually not in a crowded series | ..... | <i>Laetmogone</i> Theel (p. 22) |
| 5 (4) Dorsal processes short, small, retractile, in a crowded series in each radius. | ..... |  |
| 6 (7) Deposits wheels of one type strongly vaulted | ..... | <i>Benthogone</i> Koehler (p. 26) |
| 7 (6) Deposits wheels of two distinct types | ..... | <i>Ilyodaemon</i> Theel (p. 20) |

- 8 (1) Midventral radius with a double series of pedicels *Pannychia* Theel (p. 22)

Ilyodaemon Theel, 1879

DIAGNOSIS: Tentacles 15, large, non-retractile. Ventrolateral pedicels large, in a single row throughout each radius. Midventral radius naked. Dorsal radii each with a crowded series of very numerous retractile slender processes, usually in a double row.

TYPE SPECIMEN: *Ilyodaemon maculatus* Theel.

REMARKS: The genus is widespread in the Indo-west-Pacific (*I. fimbriatus*, *I. maculatus* and *I. abstrusus*) and off Japan (*I. ijimai* and *I. muriense*) in depths ranging between about 159 metres and 1,000 metres. The fact that *Ilyodaemon* is now known to occur in New Zealand waters considerably extends the known range of distribution, and it seems likely that the genus will be found to have a far wider distribution than formerly has been supposed.

Ilyodaemon embraces five species, which may be distinguished as follows:

- | | |
|---|------------------------------|
| 1 (4) Deposits include dichotomously branching "rosettes" | |
| 2 (3) Approximately 140-150 processes in each dorsal radius | <i>I. maculatus</i> Theel |
| 3 (2) Approximately 100 processes in each dorsal radius | <i>I. muriense</i> Ohshima |
| 4 (1) "Rosettes" lacking | |
| 5 (8) Less than 50 pedicels in each ventrolateral interradius | |
| 6 (7) Dorsal radii each with approximately 140-160 processes. Colour in alcohol violet to dark violet | <i>I. abstrusus</i> Sluiter |
| 7 (6) Dorsal radii each with approximately 100 processes. Colour in alcohol whitish-grey | <i>I. ijimai</i> Mitsukuri |
| 8 (5) At least 50 pedicels in each ventrolateral radius | <i>I. fimbriatus</i> Sluiter |

Ilyodaemon abstrusus Sluiter Text-fig. 5, figs. 1-4

Ilyodaemon abstrusus Sluiter, 1901a, p. 24; 1901b, p. 69, Pl. IV, figs. 1-3, Pl. IX, fig. 9.

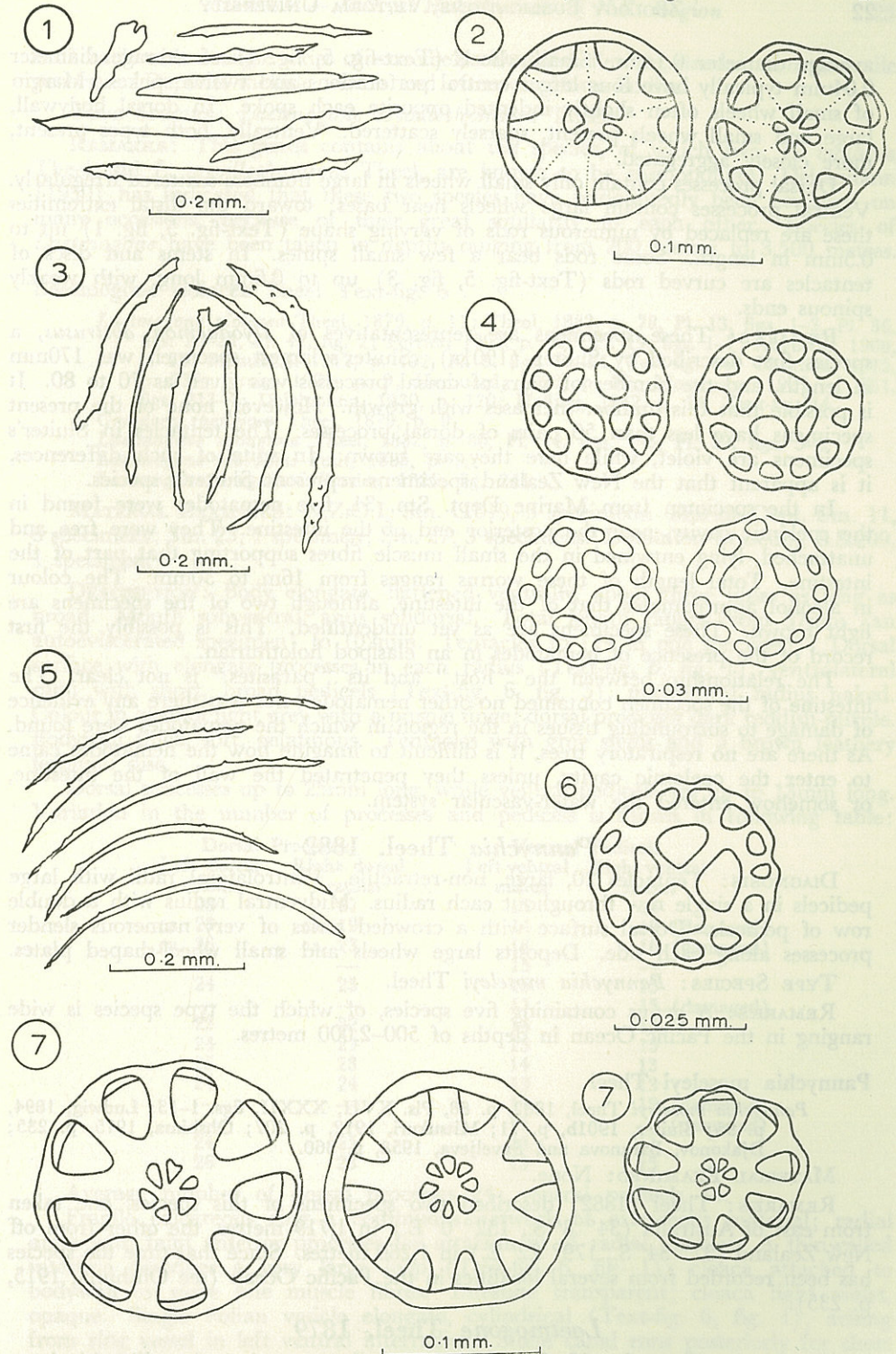
MATERIAL EXAMINED: Marine Dept. Stn. 23, 1 specimen; Stn. 31, 4 specimens.

DESCRIPTION: Total length ranges from 108mm to 142mm. Body elongate, approximately four times as long as broad. Bodywall extremely slimy, thick, gelatinous. Midventral radius naked, lateral ventral radii each with a single row of soft triangular processes, of average length 10mm. Processes regularly spaced along radii, numbers varying between 16 and 20 in each radius, although 18 processes is usual number. Lateral dorsal radii each carry approximately 55 pairs of short (5mm long) processes, regularly arranged; thus there are two rows of processes in each dorsal radius. Mouth ventrally turned, anus terminal.

In five specimens tentacle numbers are 11, 10, 15, 14, 14. Anterior end of each specimen damaged, normal tentacle number indeterminate, although there are probably more than 15.

Colour in alcohol dark purple overall, dorsal processes violet, ventrolateral processes lighter in colour. Tentacles dark brown, with leathery circular terminal discs. Intestine purplish-black, describing a large S-shaped loop. Polian vesicle large, bulbous. Gonad consists of small deep purple tufts of caeca.

Calcareous deposits include large wheels, smaller wheel-shaped perforated deposits, spinous rods. Large wheels (Text-fig. 5, fig. 2) regular, with 9-11 spokes and some central perforations. Wheels with 9 spokes (45%), or with 10 (40%), most commonly present. Diameter of wheels ranges from 0.085mm to 0.13mm;



TEXT-FIG. 5.—*Ilyodaemon abstrusus* Sluiter: Fig. 1, rods from dorsal processes; Fig. 2, large wheels; Fig. 3, rods from tentacles; Fig. 4, small wheels. *?Laetmogone violacea* juv.: Fig. 5, rods from ventral pedicels; Fig. 6, small wheel; Fig. 7, large wheels.

average diameter 0.1mm. Small wheels (Text-fig. 5, fig. 4) of average diameter 0.04mm typically have four larger central perforations and twelve spokes. Margin of small wheels often slightly indented opposite each spoke. In dorsal bodywall, large and small wheels present, sparsely scattered. Ventrally, both types present, more closely aggregated.

Dorsal processes contain only small wheels in large numbers scattered irregularly. Ventral processes contain large wheels near bases; toward the distal extremities these are replaced by numerous rods of varying shape (Text-fig. 5, fig. 1) up to 0.5mm in length. Some rods bear a few small spines. In stems and discs of tentacles are curved rods (Text-fig. 5, fig. 3) up to 0.6mm long, with weakly spinous ends.

REMARKS: These specimens are representatives of *Ilyodaemon abstrusus*, a species first described by Sluiter (1901a). Sluiter's largest specimen was 170mm in length, and the number of pairs of dorsal processes was given as 70 to 80. It is possible that this number increases with growth. However, none of the present specimens have less than 50 pairs of dorsal processes. The tentacles in Sluiter's specimens are violet, while here they are brown. In spite of such differences, it is apparent that the New Zealand specimens represent Sluiter's species.

In the specimen from Marine Dept. Stn. 31, five nematodes were found in the coelomic cavity, near the posterior end of the intestine. They were free and unattached, lying entwined in the small muscle fibres supporting that part of the intestine. Total length of these worms ranges from 16m to 30mm. The colour in alcohol approximates that of the intestine, although two of the specimens are light brown. These specimens are as yet unidentified. This is possibly the first record of the presence of nematodes in an elapod holothurian.

The relationship between the "host" and its "parasites" is not clear. The intestine of the specimen contained no other nematodes, nor was there any evidence of damage to surrounding tissues in the region in which the nematodes were found. As there are no respiratory trees, it is difficult to imagine how the nematodes came to enter the coelomic cavity, unless they penetrated the wall of the intestine, or somehow entered the water-vascular system.

Pannychia Theel, 1882

DIAGNOSIS: Tentacles 20, large, non-retractile. Ventrolateral radii with large pedicels in a single row throughout each radius. Midventral radius with a double row of pedicels. Dorsal surface with a crowded series of very numerous slender processes along each side. Deposits large wheels and small wheel-shaped plates.

TYPE SPECIES: *Pannychia moseleyi* Theel.

REMARKS: A genus containing five species, of which the type species is wide ranging in the Pacific Ocean in depths of 500–2,000 metres.

Pannychia moseleyi Theel

Pannychia moseleyi Theel, 1882, p. 88, Pls. XVII, XXXII, figs. 1–13; Ludwig, 1894, p. 95; Sluiter, 1901b, p. 71; Mitsukuri, 1912, p. 207; Ohshima, 1915, p. 235; Djakonov, Baranova and Saveljeva, 1958, p. 360.

MATERIAL EXAMINED: None.

REMARKS: Theel (1882) described two specimens of this species, one taken from east of Australia (34° 8' S., 152° 0' E.) in 1,719 metres, the other from off New Zealand (37° 34' S., 179° 22' E.) in 1,260 metres. Since that time the species has been recorded from several localities in the Pacific Ocean (see Ohshima, 1915, p. 235).

Laetmogone Theel, 1879

DIAGNOSIS: Tentacles 15, large, non-retractile, ventrolateral radii with large pedicels in a single row throughout each radius. Midventral radius naked. Dorsal

radii each with a single series of extremely elongated, flexible, slender, non-retractile processes. Deposits include wheels and often cruciform bodies.

TYPE SPECIES: *Laetmogone wyvillethomsoni* Theel.

REMARKS: This genus contains about ten species, of which two, *L. violacea* Theel and *L. wyvillethomsoni* Theel, are known to be cosmopolitan. Deichmann (1930) has indicated that these two species have undoubtedly been confused on many occasions, because of their great similarity to each other. Species of *Laetmogone* have been taken in depths ranging from 200 metres to 3,500 metres.

Laetmogone violacea Theel Text-fig. 6

Laetmogone violacea Theel, 1879, p. 11; Theel, 1882, p. 78, Pl. 13, figs. 1–3, Pl. 36, figs. 20–24, Pl. 42, fig. 2; Perrier, 1902, p. 390, Pl. 19, figs. 1–7; Augustin, 1908, p. 21; Mitsukuri, 1912, p. 192, Pl. 6, figs. 52–54, Text-fig. 36; Ohshima, 1915, p. 237; Greig, 1921, p. 9; Herouard, 1923, p. 37; Mortensen, 1927, p. 361, figs. 213–4; Deichmann, 1930, p. 120; Hedding, 1942, p. 14, Text-fig. 14.

Cryodora spongiosa Theel, 1879, p. 9.

Laetmogone spongiosa Theel, 1882, p. 80, Pl. 14, figs. 1–3, Pl. 39, figs. 5–6.

Laetmogone jourdaini Petit, 1885, p. 9.

Laetmogone brogniarti Perrier, 1886, fig. 241.

MATERIAL EXAMINED: N.Z.O.I. Stn. C.619, 3 specimens. Marine Dept. Stn. 11, 6 specimens; Stn. 23, 1 specimen; Stn. 27, 3 specimens. Dominion Museum, B.S.209, 1 specimen.

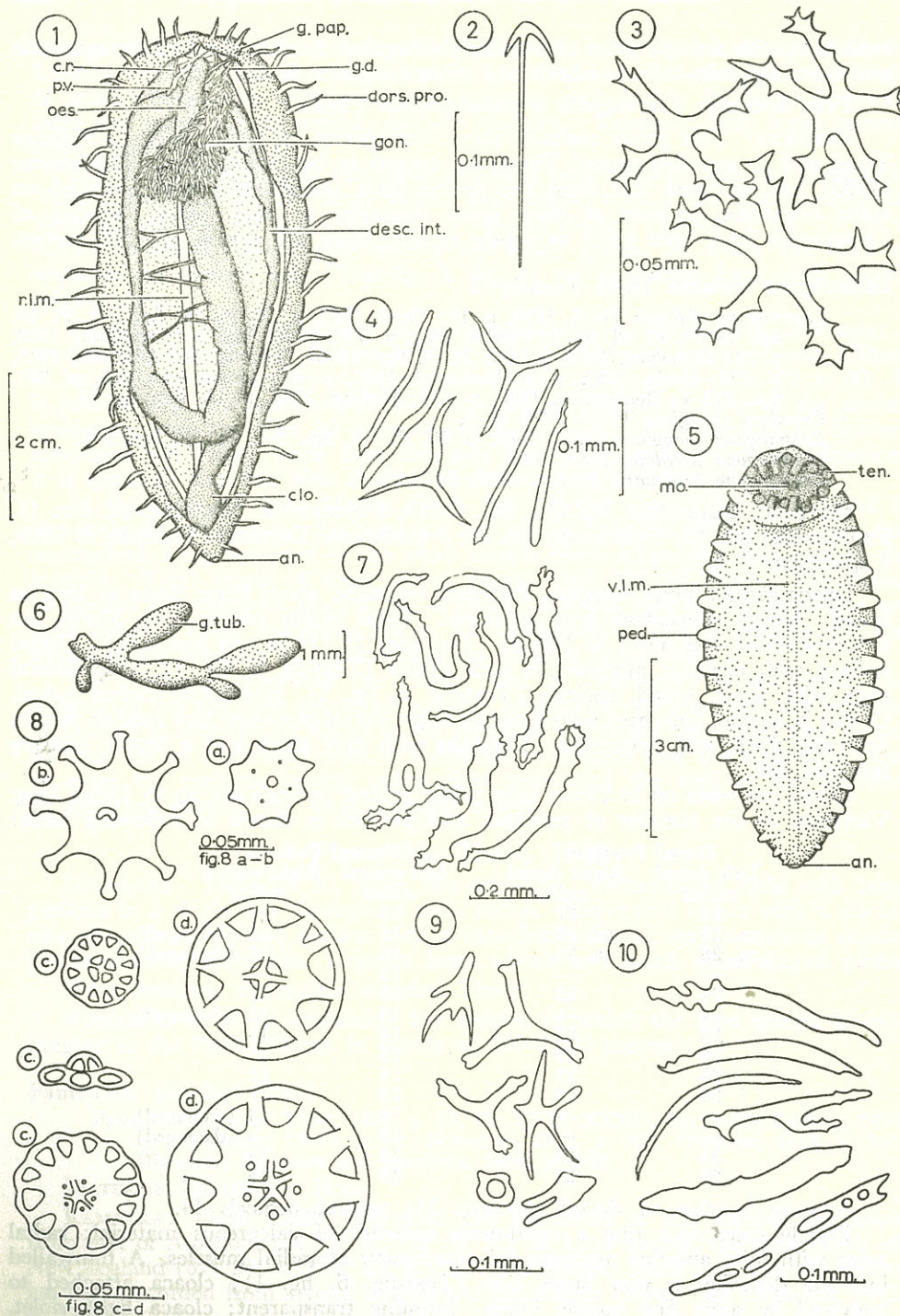
DESCRIPTION: Body elongate, flattened ventrally, about three times as long as broad. Mouth subventral, anus subdorsal. Total length ranges from 57mm (an autoeviscerated specimen) to 102mm. Tentacles 15 (14 in one specimen). Dorsal surface with elongate processes in each radius (Text-fig. 6, fig. 1), ventrolateral radii with short, broad pedicels (Text-fig. 6, fig. 5), midventral radius naked. Colour in alcohol light grey with a purple tinge; dorsal processes dark reddish-purple. Bodywall thick, soft, gelatinous. Tentacles with grey stems and a brown leathery terminal disc.

Dorsal processes up to 25mm long, while ventral pedicels are up to 13mm long. Variation in the number of processes and pedicels is shown in following table:

Dorsal Processes		Ventral Pedicels	
Left dorsal radius	Right dorsal radius	Left ventral radius	Right ventral radius
28	27	15	14
ca. 23	ca. 19	14	12 (damaged)
ca. 26	ca. 23	16	16 (damaged)
—	—	15	—
24	23	15	15
—	—	13	15 (damaged)
23	22	14	15
24	21	13	15
25	23	14	13
24	24	13	13
—	—	14	13 (damaged)
—	—	13	— (damaged)
24	25	13	11
26	23	15	15

Average number of dorsal processes 24; ventral pedicels 14.

Fragile calcareous ring a continuous network of calcareous material; radial areas with faint anterior processes for attachment of radial muscles. A thinwalled intestine describes a very large loop (Text-fig. 6, fig. 1); cloaca attached to bodywall by some fine muscle fibres. Intestine transparent; cloaca light violet, opaque. Single Polian vesicle elongate, cylindrical (Text-fig. 6, fig. 1), arising from ring vessel in left ventral interradius. Stone canal runs posteriorly for short distance in dorsal mesentery, terminating in a minute nodular madreporite, which opens to exterior near opening of genital duct.



TEXT-FIG. 6.—*Laetmogone violacea* Theel: Fig. 1, internal anatomy, margins intact, dorsal view; Fig. 2, anchor shaped spicule of doubtful origin; Fig. 3, spinous deposits from ventral bodywall; Fig. 4, deposits from dorsal processes; Fig. 5, entire animal, ventral view; Fig. 6, portion of gonad; Fig. 7, tentacle deposits; Fig. 8, wheels (a, b, developing; c, small; d, large); Fig. 9, "endplate" deposits from ventrolateral pedicel; Fig. 10, rods from ventrolateral pedicels. Abbreviations: an., anus; clo., cloaca; c.r., calcareous ring; desc. int., descending intestine; dors. proc., dorsal process; g.d., genital duct; gon., gonad; g.pap., genital papilla; g.tub., genital tubule (caecum); mo., mouth; oes., oesophagus; ped., pedicel; p.v., polian vesicle; r.l.m., radial longitudinal muscle; ten., tentacle; v.l.m., ventral longitudinal muscle.

Gonad a large bunch of dichotomously branching genital caeca (Text-fig. 6, fig. 6). Genital duct short, opening to exterior at tip of genital papilla, a short distance from anterior end of body in mid-dorsal interradius. Longitudinal muscles five broad undivided dark brown straps.

Calcareous deposits include wheels, spinous spicules. Wheels of two types, large and small. Large wheels (Text-fig. 6, fig. 8d) typically have 8-9 spokes and average 0.9mm in diameter. Smaller wheels (Text-fig. 6, fig. 8c) have 12-13 spokes, and are 0.05mm in diameter. All wheels approximately saucer-shaped, lying with concave surface facing outwards. Stages in development of large wheels commonly found (Text-fig. 6, fig. 8 a, b). Three- to six-armed spinous deposits of average length 0.1mm are numerous in ventral bodywall, but rare dorsally (Text-fig. 6, fig. 3).

Dorsal processes contain wheels, together with numerous rods and three-armed deposits, often with weakly spinous extremities (Text-fig. 6, fig. 4). Small wheels more common near distal extremities of processes, while large wheels mostly found near bases. In ventrolateral pedicels wheels numerous, and at distal extremity of each pedicel is an "endplate" composed of an aggregation of small, smooth deposits of variable shape (Text-fig. 6, fig. 9), surrounded by a ring of curved spinous rods (Text-fig. 6, fig. 10).

Tentacles contain wheels, as well as spinous rods of variable size (Text-fig. 6, fig. 7). Average length of rods 0.4mm. In walls of genital caeca are small spinous rods of average length 0.2mm.

In dorsal bodywall, a spicule of unusual character, resembling an anchor, was found (Text-fig. 6, fig. 2). This spicule is 0.2mm in length, and is possibly not of holothurian origin.

REMARKS: The variation shown by the dorsal processes and ventrolateral pedicels is quite considerable. The spiculation can also vary greatly. Heding (1942) described variation in specimens collected during the "Ingolf" Expedition, and considered that such differences are too slight to be used for distinguishing the numerous forms of this species.

This is the first record of *L. violacea* from New Zealand. Its occurrence here is not unexpected, as *L. violacea* is one of the most widespread of elasipod species, being known from the Arctic, Atlantic and Pacific Oceans. Heding (1942) notes that "*L. violacea* appears to be a cosmopolitan species, originating from the Indo-Pacific . . ." The species is usually confined to deeper waters beyond the continental shelf, and has been taken from depths exceeding 1,800 metres.

?*Laetmogone violacea* Theel juv. Text-fig. 5, figs. 5, 6, 7

MATERIAL EXAMINED: Marine Dept. Stn. 32, 1 specimen.

DESCRIPTION: The juvenile elasipod of total length 15mm has calcareous deposits greatly resembling those of *Laetmogone violacea*. Body contracted, skin thick, gelatinous, translucent, light purple. Lateral ventral pedicels and dorsal processes present, midventral radius naked.

Ventral processes elongate tubefeet, each about 4mm in length; a concave perforated endplate (0.5mm diameter) present, surrounded by curved spinous rods up to 0.5mm in length (Text-fig. 5, fig. 5) and small wheels (Text-fig. 5, fig. 6). Stems packed with spinous rods, which lie tranverse to longitudinal axes of tubefeet. There are 18 processes in left ventral radius, and 11 in right (damaged).

Dorsal processes deep red in colour, up to 6mm in length, with thick gelatinous bases. Processes less numerous than ventral tubefeet, there being only eight in left dorsal radius and nine in right. Calcareous deposits in processes include numerous large and small wheels (Text-fig. 5, figs. 6, 7).

Deposits apparently lacking from ventral side, but wheels common dorsally. Smaller wheels are of average diameter of 0.037mm, with 12 spokes and four

central holes. Large wheels are of average diameter 0.146mm, typically with nine spokes, although wheels with more or less than nine spokes not uncommon; raised central boss has about six perforations.

REMARKS: There is little doubt that this is a juvenile of an elasipod, of the genus *Laetmogone*, or a closely allied genus. However, there are some puzzling features about the specimen. The ventral processes are more numerous than the dorsal processes. This is not the case in *L. violacea*, although it is quite possible that *L. violacea* does not achieve its full complement of dorsal processes until later in its life history. Moreover, the ventral pedicels of the juvenile specimen exceed in number those of the adult. However, until new material becomes available it seems appropriate to consider this specimen a juvenile of *L. violacea*.

Bathygone Pawson, 1965

DIAGNOSIS: Tentacles 15. Body elongate, flattened ventrally, arched dorsally. Midventral radius naked. Lateroventral radii each with approximately 50 narrow, elongate pedicels arranged in a single, often apparently double series. Dorsal radii each with about ten small retractile processes, regularly spaced. Deposits include wheels, circular perforated plates and spinous rods. Wheels and plates tend to be aggregated into scattered heaps on the dorsal side of the body.

TYPE SPECIES: *Bathygone papillatum* Pawson.

REMARKS: This genus differs from the others in Family Laetmogonidae in possessing peculiar heaps of calcareous deposits in the dorsal side of the body. Also the extremely numerous circular plates, while not unique to this family, are usually found in the papillae or pedicels, and are rare elsewhere.

Bathygone seems most closely related to *Laetmogone* Theel, differing from that genus in the smaller size of the dorsal papillae, and in the absence of accessory rods and cross-shaped deposits. *Bathygone* differs from *Benthogone* Koehler in having smaller ventrolateral processes, and more than one type of deposit in the bodywall.

Bathygone papillatum Pawson

Bathygone papillatum Pawson, 1965b, p. 77, figs. 7-11.

MATERIAL EXAMINED: Marine Dept. Stn. 20, 7 specimens.

REMARKS: This species has already been discussed elsewhere (Pawson, 1965b).

Benthogone Koehler, 1896

DIAGNOSIS: Mouth ventral, surrounded by 15-20 tentacles. Body flattened or almost cylindrical. Ventrolateral radii each with a single row of ca. 15 retractile pedicels; midventral radius naked. Dorsal radii with numerous small processes in a single, sometimes double row. Deposits strongly vaulted wheels of one type, with an average diameter of 0.078mm.

TYPE SPECIES: *Benthogone rosea* Koehler.

REMARKS: This genus is monotypic, differing from other genera in the family Laetmogonidae in possessing wheels of only one type; these are not associated with any other deposits, except in the pedicels. Accessory deposits are spinous rods, which are found in the pedicels, processes and tentacles.

Benthogone rosea Koehler

Benthogone rosea Koehler, 1896, p. 114; Pawson, 1965a, p. 219, Pl. V, figs. 2-5 (synonymy).

MATERIAL EXAMINED: "Tui" Stn. 098-17, 2 specimens.

REMARKS: This species is described and discussed elsewhere (Pawson, 1965a).

DISTRIBUTION: Off south-west Ireland, 1,200-1,765 metres, Bay of Biscay, off Azores Is., African coast to Cape Verde Islands, 1,000-2,320 metres (Mortensen, 1927). The occurrence of species north of New Zealand is unexpected, but it now seems likely that *B. rosea* is widespread in the Atlantic and southern Pacific Oceans.

Family PELAGOTHURIIDAE Ludwig, 1894

DIAGNOSIS: Tentacles 12-20. Bodywall thick, gelatinous, completely lacking calcareous deposits. A large brim is usually present anteriorly, and the pelagothuriids have adopted a bathypelagic habit.

This most unusual group of holothurians of bathypelagic habit is represented in New Zealand by a single genus. As Hansen and Madsen (1956) have pointed out, the systematic position of this group is not established with certainty, and they have suggested that the bathypelagic elasipods are neotenic.

Enypniaestes Theel, 1882

DIAGNOSIS: Tentacles 20. Body depressed, with extension of bodywall around anterior extremity, constituting a very broad, large flat brim. Dorsal surface with some small projections around margin of brim, also some very small processes on ambulacra. Calcareous deposits lacking. (After Theel, 1882.)

TYPE SPECIES: *Enypniaestes eximia* Theel.

REMARKS: The three species in this genus are all so far known only from the Pacific Ocean, and *E. eximia* Theel, in particular, is known from off Japan (Mitsukuri, 1912; Ohshima, 1915), the Moluccas (Sluiter, 1901b), and New Zealand (Theel, 1882). In commenting on Heding's (1950) attempt to revise the classification of the bathypelagic holothurians, Hansen and Madsen (1956) note that perhaps at least three species are confused under the name *Enypniaestes eximia*.

Enypniaestes eximia Theel

Enypniaestes eximia Theel, 1882, p. 56, Pl. 8, figs. 6, 7; Sluiter, 1901b, p. 77, Pl. 2, figs. 8, 9, Pl. 10, fig. 5; Mitsukuri, 1912, p. 215, Pl. 7, figs. 59, 60; Ohshima, 1915, p. 243; Heding, 1950, p. 117.

MATERIAL EXAMINED: N.Z.O.I. Stn. 603, 1 specimen.

DESCRIPTION: Single specimen badly damaged, 80mm in length and 55mm broad. Mouth apparently ventral; a large web of tissue projects from anterior end of body. Other external features indistinguishable, but anus appears dorsally placed. Colour in alcohol grey, tentacles purple. Most internal structures missing or lacerated. Small remaining fragment of intestine dark brown, supported by strong mesenteries. Longitudinal muscles pinkish-brown. Calcareous deposits lacking.

REMARKS: The general form of this specimen somewhat resembles that of *E. eximia* Theel, which was described (Theel, 1882) from four specimens taken near New Zealand (40° 28' S., 177° 43' E.) at a depth of 1,980 metres. As the specimen was taken from the vicinity of the type locality of the species it probably represents the true *E. eximia*, and not one of the synonyms referred to by Hansen and Madsen (1956).

Family PSYCHROPOTIDAE Theel, 1882

DIAGNOSIS: Tentacles 10 to 20. Body elongate, either subcylindrical or depressed; anterior end always depressed. Bodywall thick, forming a brim anteriorly. Lateral ventral radii with a single row of numerous small pedicels. Midventral radius naked, or with double row of minute pedicels. Dorsal surface naked, or with numerous or few large or small processes. Deposits usually four-armed bodies, with inwardly curved arms, often an outer central projection. Mesenteries con-

tinuous membranes; calcareous ring composed of five separate pieces, incompletely developed. (After Theel, 1882; Ekman, 1925.)

This family contains four genera, of which three have a cosmopolitan distribution. The fourth genus (*Psycheostrepes*) is so far known from a single central Pacific species.

The collection includes two specimens of the genus *Benthodytes* Theel.

Benthodytes Theel, 1882

DIAGNOSIS: Midventral radius with a double row of pedicels. Dorsal surface lacking any large appendages.

TYPE SPECIES: *Benthodytes typica* Theel.

REMARKS: *Benthodytes* embraces approximately 20 species, of which one, *B. typica*, has a cosmopolitan distribution, while *B. sanguinolenta* appears to be confined to the Pacific Ocean. The species are most commonly found at depths of approximately 3,000 metres, and have been taken from depths in excess of 5,000 metres.

Benthodytes hystrix Sluiter Text-fig. 7

Benthodytes hystrix Sluiter, 1901b, p. 59, Pl. IV, fig. 4, Pl. IX, fig. 10; Heding, 1940, p. 367.

MATERIAL EXAMINED: In the collection of the Department of Zoology, Victoria University of Wellington, VUZ 109, off Palliser Bay, 600 fathoms, mud, 2 specimens.

DESCRIPTION: Both specimens extensively damaged externally; some features of external anatomy impossible to determine. One specimen approximately 130mm long, while another approximately 155mm long. Body more or less cylindrical, four to five times as long as broad. Tentacles destroyed in both specimens. Mouth appears to lie on ventral surface of body, a short distance behind anterior end. Anus subdorsal, a large aperture. Bodywall thick, soft, but parts of dorsal side invested in a thin rough layer comprising calcareous deposits. (This layer of calcareous material may have been continuous in living specimens). Layer finely papillate; each papilla contains a calcareous deposit.

Colour in life, "uniformly dark purple". In alcohol, specimens grey ventrally, mottled dark purple dorsally.

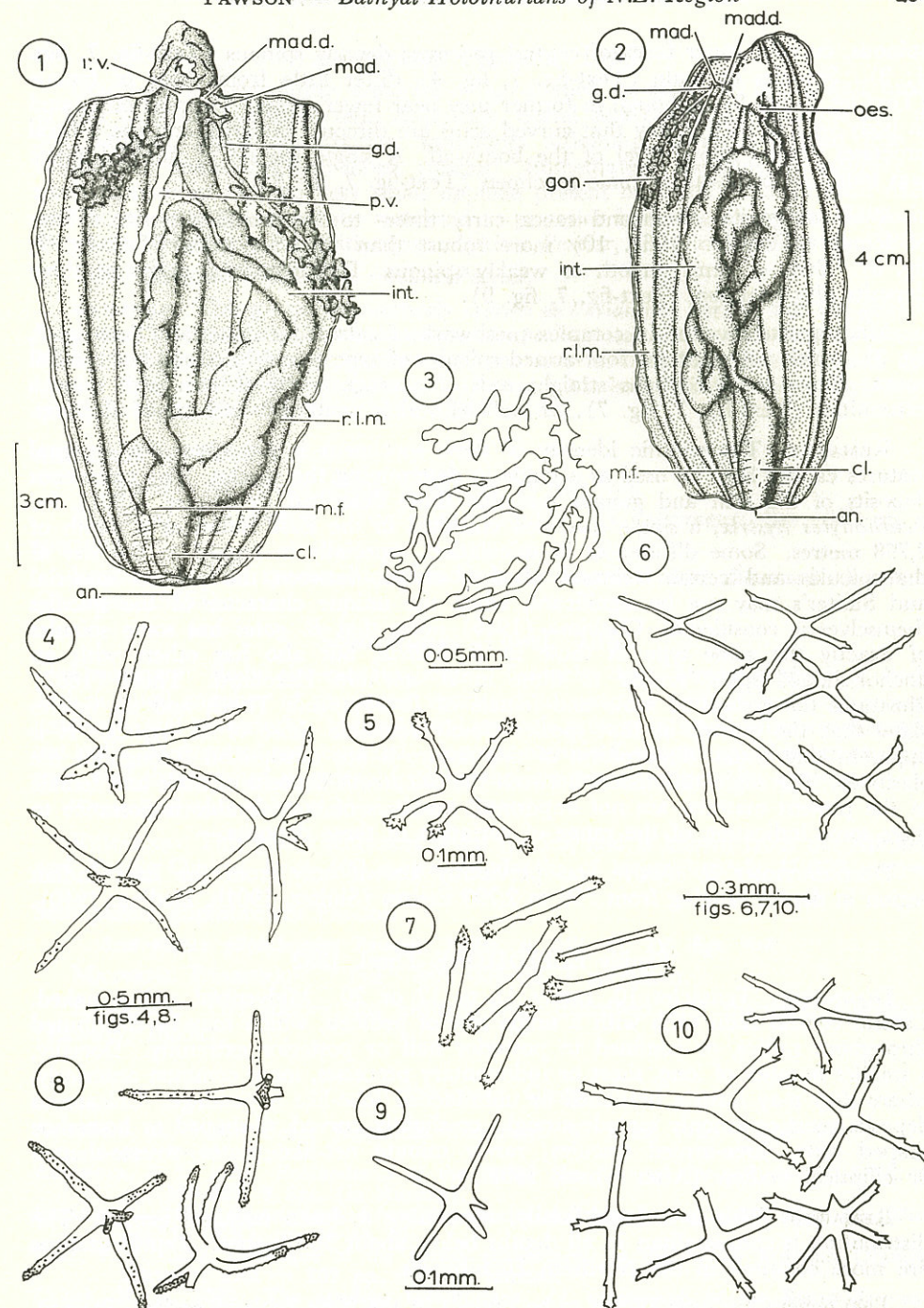
The two specimens are a male and a female of same species. In both, oesophagus thin-walled and intestine describes a large S-shaped loop (Text-fig. 7, figs. 1, 2). Cloaca enlarged, attached to bodywall by fine muscle fibres. Entire alimentary canal purplish-black. Longitudinal muscles broad straps, dark brown in male, violet in female. Transverse muscles inconspicuous.

Male damaged anteriorly, lacking water-vascular ring and some related structures, but in female, there is a single cylindrical Polian vesicle 45mm long, which arises from ventral side of water-vascular ring. Dorsally, stone canal emerges from ring vessel, terminating in a small bulbous madreporite, which opens to exterior in dorsal interradius, about 20mm from anterior end of body.

Gonad well developed in both specimens. In male, there are two genital ducts, each about 45mm in length, which subtend short branching tufts of genital caeca. Female has two genital ducts, one being about 30mm long, the other almost twice that length. Genital caeca composed of a small number of conspicuous bifurcate sacs, containing large eggs 0.9–1.1mm in diameter. In male and female, the two genital ducts unite to form a single canal which opens to exterior immediately adjacent to madreporite (Text-fig. 7, figs. 1, 2).

Calcareous deposits present in bodywall, gonad, stone canal and madreporite.

Bodywall with large numbers of four-armed spicules, arms radiating from a central point, which also carries two smaller processes; arms 0.4–0.6mm in length,



TEXT-FIG. 7.—*Benthodytes hystrix* Sluiter: Fig. 1, internal anatomy of female, left ventral view; Fig. 2, internal anatomy of male, right ventral view; Fig. 3, calcareous meshwork from madreporite; Fig. 4, four armed deposits of male; Fig. 5, unusual deposit from male specimen; Fig. 6, deposits from male genital duct; Fig. 7, rods from stone canal; Fig. 8, four armed deposits of female; Fig. 9, developing genital duct deposit; Fig. 10, deposits from female genital duct. Abbreviations: an., anus; cl., cloaca; g.d., genital duct; gon., gonad; int., intestine; mad., madreporite; mad.d., stone canal; m.f., muscle fibres; oes., oesophagus; p.v., polian vesicle; r.l.m., radial longitudinal muscle; r.v., ring vessel.

spinous, curved; inner faces of central processes densely spinous (Text-fig. 7, figs. 4; 8). Spicules of male (Text-fig. 7, fig. 4) differ little from those of female (Text-fig. 7, fig. 8), although in former they bear fewer spines. Deposits orientated in body wall in such a way that curved arms are directed inwards, and the central processes project above level of the bodywall. A single spicule of unusual shape was found in bodywall of male specimen (Text-fig. 7, fig. 5).

Walls of genital ducts and caeca carry three- to five-armed deposits. Those of female (Text-fig. 7, fig. 10) more robust than those of male (Text-fig. 7, fig. 6). Ends of arms smooth or weakly spinous. Developmental stages of these deposits also common (Text-fig. 7, fig. 9).

Madreporite invested in complex meshwork of calcareous material (Text-fig. 7, fig. 3), which also contains four-armed spicules of type found in gonad and genital caeca. Stone canal contains straight rods of average length 0.3mm with spinous extremities (Text-fig. 7, fig. 7), as well as widely scattered four-armed deposits.

REMARKS: The specific identity of these specimens is not clear, for external features cannot here be used as a guide in determining the species. The calcareous deposits of the skin and gonads resemble those described by Sluiter (1901) for *Benthodytes hystrix*, a single specimen collected in the East Indies at a depth of 2,798 metres. Some differences in spiculation, especially in regard to the size of the spicules and certain features of their shape, between the present material and Sluiter's may not be significant, when the unique character of the spicules themselves is considered. Ohshima (1915) notes that *B. gotoi* has some spicules of exactly the same type as those in *B. hystrix*, but also has others with an anchor-shaped spire, similar to those in *B. anchora* Herouard. Theel (1882) illustrates the gonads of male and female of *B. abyssicola* Theel, and his figures show that the gonads in that species closely resemble those of *B. hystrix*. It is apparent that sexual dimorphism of this nature is not uncommon throughout the elaspods. The slight differences between the calcareous deposits of male and female in the present material are not important, but it is of considerable importance to have some indication of the range of variation of these deposits.

DISTRIBUTION: *B. hystrix* was previously known only from the East Indian region in depths ranging from 768 to 2,798 metres (Sluiter, 1901b, Heding, 1940).

Family ELPIDIIDAE Theel, 1882

DIAGNOSIS: Tentacles 10, rarely 11 to 12 or 20. Midventral radius naked. Lateral ventral radii each with a single row of pedicels, which may be distributed throughout radius, or confined to posterior half or posterior extremity. Dorsally, a smaller number of long, short or rudimentary processes, more common anteriorly, where they may form a branched or unbranched lobe-like appendage. Calcareous deposits most commonly include straight or slightly curved, C-shaped or horseshoe shaped rods, three-armed spicules; rarely minute net-like plates, rosette-shaped or elliptical bodies. (After Theel, 1882.)

REMARKS: This is a large family, containing a dozen nominal genera. The distribution is cosmopolitan in all depths below about 500 metres. Representatives are more common in the Northern Hemisphere.

Two genera are now known to be present in the New Zealand region (Pawson, 1964a). They may be distinguished as follows:

- | | |
|---|--------------------------|
| 1 (2) Lateral ventral radii with pedicels distributed along their entire length | <i>Scotoplanes</i> Theel |
| 2 (1) Pedicels of the lateral ventral radii confined to the posterior half of each radius | <i>Amperima</i> Pawson |

Amperima Pawson, 1965

DIAGNOSIS: Body slightly elongate or egg-shaped, at most two and a half times as long as broad; tentacles ten. Anteriorly, dorsal side carries a transverse row of 3-4 papillae, sometimes discrete, sometimes adjoining, sometimes fused into a voluminous transverse four-lobed process. Immediately posterior to papillae a small number of isolated very small papillae present on radii. Ventral radii each with a row of pedicels, usually restricted to posterior half of each radius. Deposits triradiate bodies, together with sigmas. (After Perrier, 1901 in Deichmann, 1930.)

TYPE SPECIES: *Periamma roseum* Perrier.

REMARKS: This genus was formerly known as *Periamma* Perrier, but the generic name was preoccupied. The new name *Amperima* was given elsewhere (Pawson, 1965a). *Amperima* is cosmopolitan and contains seven species, five of which are known from the Pacific and Indian Oceans. Madsen (1958) notes that most species can be found below about 3,000 metres.

Amperima tui Pawson

Amperima tui Pawson, 1965a, p. 216, Pl. IV, figs. 1-3.

MATERIAL EXAMINED: "Tui" Stn. 098-111, 14 specimens; Stn. 098-46, 2 specimens.

REMARKS: The species has already been described and discussed elsewhere (Pawson, 1965a).

Scotoplanes Theel, 1882

DIAGNOSIS: Body elongate to ovate. Tentacles ten. Dorsal surface of body with a small number of processes, restricted to anterior end of body or present anteriorly and posteriorly. Ventrolateral pedicels present in small numbers throughout radii. Midventral radius naked. Deposits include C-shaped spicules, unbranched rods, and three-armed spicules, of which the last two types may be spinous.

TYPE SPECIES: *Scotoplanes globosa* Theel.

REMARKS: This genus embraces seven species, and is known from the Atlantic and Pacific Oceans, from 500 metres to depths of approximately 10,000 metres.

Scotoplanes gilpinbrowni Pawson

Scotoplanes gilpinbrowni Pawson, 1965a, p. 217, Pl. IV, figs. 4-6.

MATERIAL EXAMINED: "Tui" Stn. 003-02, 1 specimen.

REMARKS: The species has already been described and discussed elsewhere (Pawson, 1965a).

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