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ANARE RESEARCH NOTES 36

A guide to the Ctenophores of the Southern Ocean
and adjacent waters

David O'Sullivan

ANTARCTIC DIVISION
DEPARTMENT OF SCIENCE

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A N A R E

R E S E A R C H

N O T E S

36

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A GUIDE TO THE CTENOPHORES
OF THE SOUTHERN OCEAN AND ADJACENT WATERS

by

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ABSTRACT

A total of nine species, Pleurobrachia pileus Muller, Bathycytenidae chuni (Moser), Callianira antarctica Chun, C. cristata Moser, Lyrocteis flavopallidus Robilliard and Dayton, Beroe cucumis Fabricius, B. compacta Moser, B. forskalii Milne Edwards and Cryptocoda gerlachei Leloup have been reported from the Southern Ocean. Their diagnostic characters are given together with a diagram of their external features and a map of their distribution.

1. INTRODUCTION

The Ctenophora is a small phylum of marine animals commonly known as comb jellies. They are biradially symmetrical with a transparent gelatinous ectomesoderm containing mesenchymal muscle fibres (Hyman 1940). Eight rows of ciliary plates (or ctenes) are present throughout life, or in four genera, in the larvae only.

Ctenophores are among the most characteristic plankton organisms of the ocean although most species probably have a limited range of latitude. Predominately pelagic organisms, they also occur to depths of 4000 m (G.R. Harbison, pers. comm. 1985). One order, *Platyctena*, contains species that are benthic and some are reported to be sessile. Some ctenophores can endure great changes of salinity and may flourish in bays with a salinity not more than one-third that of the ocean (Hyman 1940).

Ctenophores are carnivores and play an important role as predators in the upper waters of the open sea and in neretic waters (Harbison et al. 1978). Ctenophores may also control phytoplankton blooms indirectly through their predation on herbivorous zooplankton and directly by the nutrient excretion accompanying such grazing (Deason and Smayda 1982a, 1982b).

While some species are well known, the paucity of information on many others is alarming. The systematic position of many species is uncertain, and to complicate matters there exists a large undescribed deep-sea fauna (Harbison 1984). Workers on this phyla are also hampered by the lack of suitable methods for the fixation and preservation of specimens.

This guide is a summary of the available data on the systematics of ctenophores from the Southern Ocean. It is not complete due to the lack of information on Southern Ocean ctenophores, but should at least identify the areas where research is needed.

The Southern Ocean is defined as the area of water between the Antarctic continent and the Subtropical Convergence. The area is divided into two zones, by the Antarctic Convergence, the subantarctic and the Antarctic.

Where possible the synonymy and diagnostic characters are given for each of the Southern Ocean species together with a distribution map and an illustration of its external structure. Incorrect names are mentioned in the synonymy for species reported from the Southern Ocean and adjacent waters (north of the Subtropical Convergence to 30° south). On the distribution maps the positions of the Antarctic and Subtropical Convergence are from Lomakina (1960). A symbol may represent more than one sampling site.

Hyman (1940) provided a thorough summary of the general morphology and physiology of the group, while an excellent synthesis of ctenophore classification is given in Harbison and Madin (1982). Except where specified, the order, family and generic descriptions used in this guide have been taken from Harbison and Madin (1982).

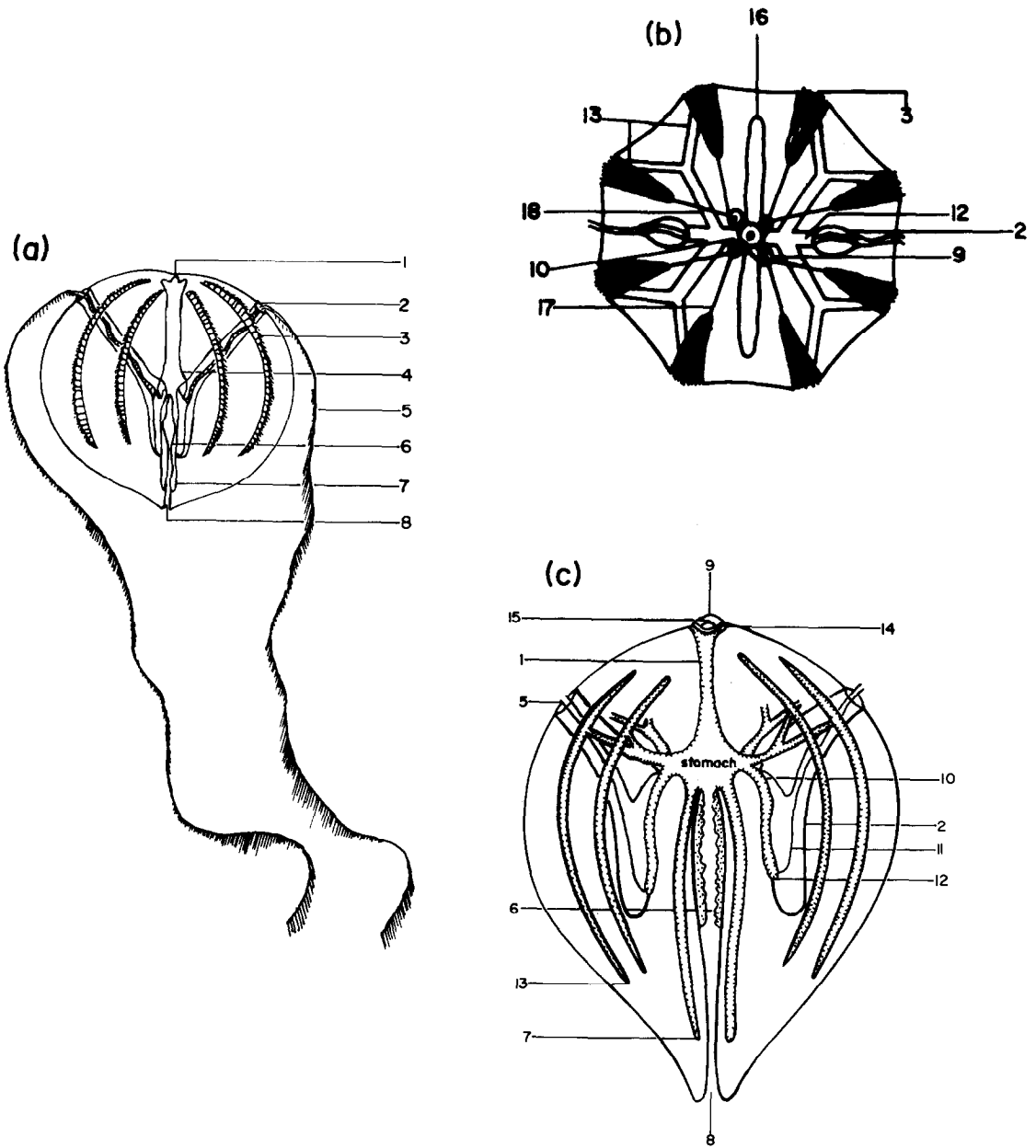


Figure 1. (a) Pleurobrachia, lateral view. (b) Pleurobrachia, aboral view. (c) digestive system of a cydippid ctenophore. (1) aboral canal; (2) tentacular sheath; (3) comb row; (4) infundibulum; (5) tentacle; (6) pharynx; (7) pharyngeal canal; (8) mouth; (9) anal pore; (10) transverse canal; (11) tentacular bulb; (12) tentacular canal; (13) meridional canal; (14) anal canal; (15) statocyst; (16) polar fields; (17) ciliated furrows; (18) interradial canal.

2. GENERAL STRUCTURE

(Barnes 1974, Harbison and Madin 1982)

The basic body plan is similar to that of Cnidarians, but is more advanced, with mesenchymal muscles and anal openings. Ctenophores are monomorphic, without any trace of polymorphism or of attached stages. The body shape ranges from spherical (Cydippida) to ribbon or plate-like (Cestida, Platyctenidae). With the exception of the Beroida and two families of Lobata, there are two tentacles.

Although the Ctenophore orders differ greatly in body shape and in the presence of tentacles, the main characteristics of the phylum can be seen in the primitive or generalised ctenophores such as Pleurobrachia (Figure 1). The spherical body can be divided into two hemispheres. The mouth on the lower side forms the oral pole, the diametrically opposite point on the body bears an apical organ and marks the aboral pole.

The body is further divided into equal sections by eight ciliated bands. These bands, called comb rows or ctenes, are characteristic of ctenophores and are the structures from which the name of the phylum is derived. Each band extends about four-fifths of the distance from the aboral pole to the oral end of the body and is made up of short transverse plates of long, fused cilia called combs. The combs are arranged in succession to form a comb row.

The combs provide the locomotor power in ctenophore, although some lobate forms can also swim by contractions of the lobes. The comb plates beat in regular sequence starting from the aboral end of a row (Tamm 1982). The effective sweep of each comb is toward the aboral pole so that the animal is driven with the mouth or oral end forward.

From each side of the aboral hemisphere is suspended a long branched tentacle. Unlike the tentacles of cnidarians, those of ctenophores are not attached to the surface of the sphere, but emerge from the bottom of a deep ciliated epidermal canal called the tentacular sheath or pouch. There are two pouch openings located between comb rows on opposite sides of the body, each approximately at a forty-five degree angle from the aboral pole.

Each tentacle consists of a mesenchymal core covered by epidermis. The muscle cells of the mesenchyme are frequently arranged in bundles so that the tentacles are very contractile. The tentacular epidermis, although lacking nematocysts, possesses peculiar adhesive cells called colloblasts. A colloblast cell is composed of a hemispherical head connected to the mesenchymal core of the tentacle by means of a straight filament, around which is coiled a contractile spiral filament. The surface head of the colloblast secretes a sticky material used in capturing prey.

Ctenophores are among the lowest animals possessing a nervous system, and, unlike Cnidarians, they have a separate muscular system (Tamm 1982). The nervous system of ctenophores is a subepidermal nerve network particularly well-developed beneath the comb rows. The only sense organ is the apical organ containing a statolith which lies in a deep pit resting on four tufts of balancer cilia. From each tuft extends a forked ciliated groove. Each fork runs to and extends through a comb row. When an animal is tilted,

the pressure exerted by the statolith on the respective balancer cilia is received by the sensory structures, and signals are transmitted by way of the ciliated grooves to the corresponding comb rows. The rate of beating of the comb rows is altered and the ctenophore rights itself.

Excretory organs have not been identified with certainty. The gastrovascular system consists of an axially arranged gut. Proceeding aborally, the gut is composed of mouth, stomodaeum (pharynx), infundibulum (funnel), infundibular canal, anal canals, and anal pores, with peripherally arranged gastrovascular canals (meridional canals) connecting to the axial system at various locations, mainly at the infundibulum.

The stomodaeum is flattened, defining the stomodaeal (also pharyngeal, sagittal, mouth, gastral or median) plane. At right angles to this plane, the tentacular (also transverse, lateral, frontal, funnel or cross) plane passes through the tentacle bulbs.

The infundibulum is flattened in the tentacular plane and gives off the paragastric canals orally and the transverse canals laterally. Transverse canals branch variously to connect with the meridional canals which lie under the eight comb rows. The meridional canals lie at right angles to the major planes of symmetry; pairs are called subtentacular or substomodaeal depending on which plane they lie closest to. The interconnections of the meridional and paragastric canals are important in distinguishing the higher taxa.

3. BIOLOGY

(Barnes 1974)

Ctenophores are carnivorous, feeding on small planktonic animals (Harbison et al. 1978). The food is caught on the colloblasts of the extended tentacles. Hyman (1940) suggested that poison probably also plays a role - a toxin extracted from Beroe causes death when injected into a number of invertebrates (Harbison et al. 1978).

The food is wiped into the mouth and passes into the pharynx where digestion begins extracellularly. This process is very rapid and the pharynx may empty itself in twenty to thirty minutes (Hyman 1940). The resulting broth passes into the infundibulum and canal system where digestion is completed intracellularly. Indigestible wastes are passed through the anal pores and mouth.

Species of Pleurobrachia usually maintain a vertical position with the mouth directed upward, but can swim downward and can right itself when tilted by currents. The beat can be temporarily reversed when an object is encountered. The nervous system and apical organ control the synchrony and co-ordination of the ciliary waves.

Under optimal conditions, many ctenophores are found resting or feeding at the water surface, their mouths facing upwards and the comb rows only beating occasionally (Tamm 1982). When disturbed, ctenophores will swim downwards. Ctenophores are reported to go below the surface waters in rough weather or bright sunlight although the reaction to light is not definite (Hyman 1940).

Ctenophores are noted for their luminescence. Light production takes place in the walls of the meridional canals so that externally the light appears to emanate from the comb rows.

Almost all ctenophores are free-living although the juveniles of one cydippid, Lampea pancerina (Chun 1880), is apparently parasitic in the tunicates Salpa and Cyclosalpa (Krumbach 1925).

Pianka (1974) noted that several authors have reported species of trematodes and nematodes as parasitic in the parenchyma and pharynx of both larval and adult ctenophores with no apparent effect on the animals. Sears (1976) sometimes found a vermiform larval sea anemone that was abundant in the ctenophore Mnemiopsis leidyi. Several species of hyperiid amphipods are closely associated with ctenophores, both as parasites and predators; medusae and heteropods have also been seen to feed on ctenophores (Harbison et al. 1978).

Swarms of a common species of pelagic ctenophores have been frequently observed. Occasionally a rare species may suddenly appear in a swarm (Pianka 1974, Yips 1984). Swarming behaviour in ctenophores has been correlated with simultaneous swarms of prey organisms such as the copepod Calanus (Chun 1898).

4. REPRODUCTION

(Pianka 1974)

All adult ctenophores studied are able to regenerate lost parts and many can regenerate completely from small fragments. Some platyctenid genera can reproduce asexually; small pieces break off from the edge of the adult body and each piece regenerates completely to form a new individual. Nutrients probably affect the natural occurrence of asexual reproduction.

Most members of the phylum are simultaneously hermaphroditic but protandry occurs among platyctenids. Harbison and Miller (1986) reported two species of *Ocyropsis* which are dioecious, rather than sequential hermaphrodites. Gametogenic tissues occur in eight meridional canals underlying the comb rows or their homologues or derivatives. Typically each canal contains tissues of both sexes, with perradial ovaries bordering the major (tentacular and sagittal) planes of the animal. Testes are interradiial and face the minor planes. This arrangement holds throughout the phylum, except that in cestids, some platyctenids and temporarily in certain larvae and juveniles, entire meridional canals (either the four subtentacular or the four subsagittal) are sterile.

Many ctenophores appear to be annual organisms, spawning in the late spring or early summer in coastal waters. Most ctenophores' gametes are released through the epidermis above the gonads, probably through ducts and pores. Platyctenids have internal brood chambers and are an exception.

As fertilisation occurs in the water, self-fertilisation may be a widespread occurrence. Cleavage is holoblastic, unequal, and determinate; gastrulation occurs through epiboly, followed by emboly.

Almost all ctenophores have cydippid larvae although the use of the term 'larva' to describe this stage is correct only for the Platyctenida since true metamorphosis occurs only in this group. The cydippid larvae of the platyctenids is their only freeswimming dispersal stage and is short lived. Varying degrees of transformation of the cydippid larvae into the adult form occurs among ctenophores. The smallest change is in the Cydippida and Beroida with considerably more taking place in the Lobata and Cestida (Hyman 1940). However, only in the Platyctenida is the change from larvae to juvenile rapid and spectacular and deserving of the term metamorphosis.

5. SYSTEMATIC NOTES

Ctenophores are found throughout oceans, in coastal waters and in the open sea where they exhibit the greatest diversity. Many species are quite well known and some were described more than two hundred years ago.

Their gelatinous bodies make them difficult to catch without damage. This, combined with often inadequate preserving methods, has meant that most groups are poorly known and their classification is subject to review.

Speculatively, Cydippida or Beroida are more primitive, however because ctenophores lack hard skeletons no confirming fossil record exists. Stanley and Sturmer (1983) described the pyritised fossil remains of a small, globular, softbodied ctenophore that was similar to Pleurobrachia and concluded that the basic ctenophore body plan has changed very little over the past four hundred million years.

Harbison (1984) considered the simplest evolutionary sequence regarding the first ctenophore as originally resembling present-day beroids - simply a ciliated sack with modified cilia for grasping and macerating prey. He also indicated that as the Ctenophora, Cnidaria and Platyhelminthes have extremely simple body plans with only the most rudimentary of organ systems, the three groups must have arisen in the earliest stages of metazoan evolution.

Harbison (1984) stated that all of the recognised orders of the Ctenophora appear to be monophyletic, except for the Cydippida. He presented two conflicting phylogenetic views, giving preference to the assumption that the common ancestor was atentaculate.

The most recent review of the Ctenophora is that of Harbison and Madin (1982) who divided the phylum into seven orders containing nineteen families. Although the presently accepted classifications of the Ctenophora are clearly not phylogenetic, Harbison (1984) observed that it seemed premature to drastically alter the conventionally recognised taxa until new evidence was forthcoming. He also pointed out that too many groups are too poorly known for any classification scheme to be very robust.

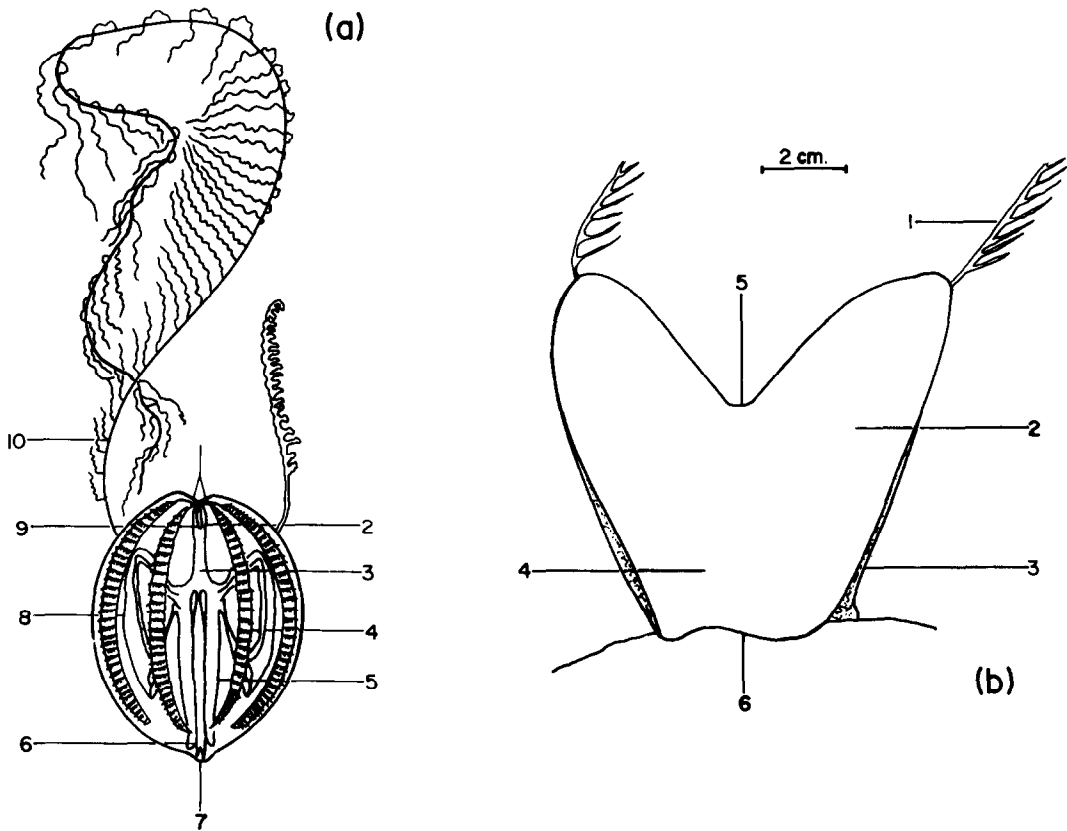


Figure 2. Examples of the five orders of ctenophores represented in the Southern Ocean or adjacent waters.

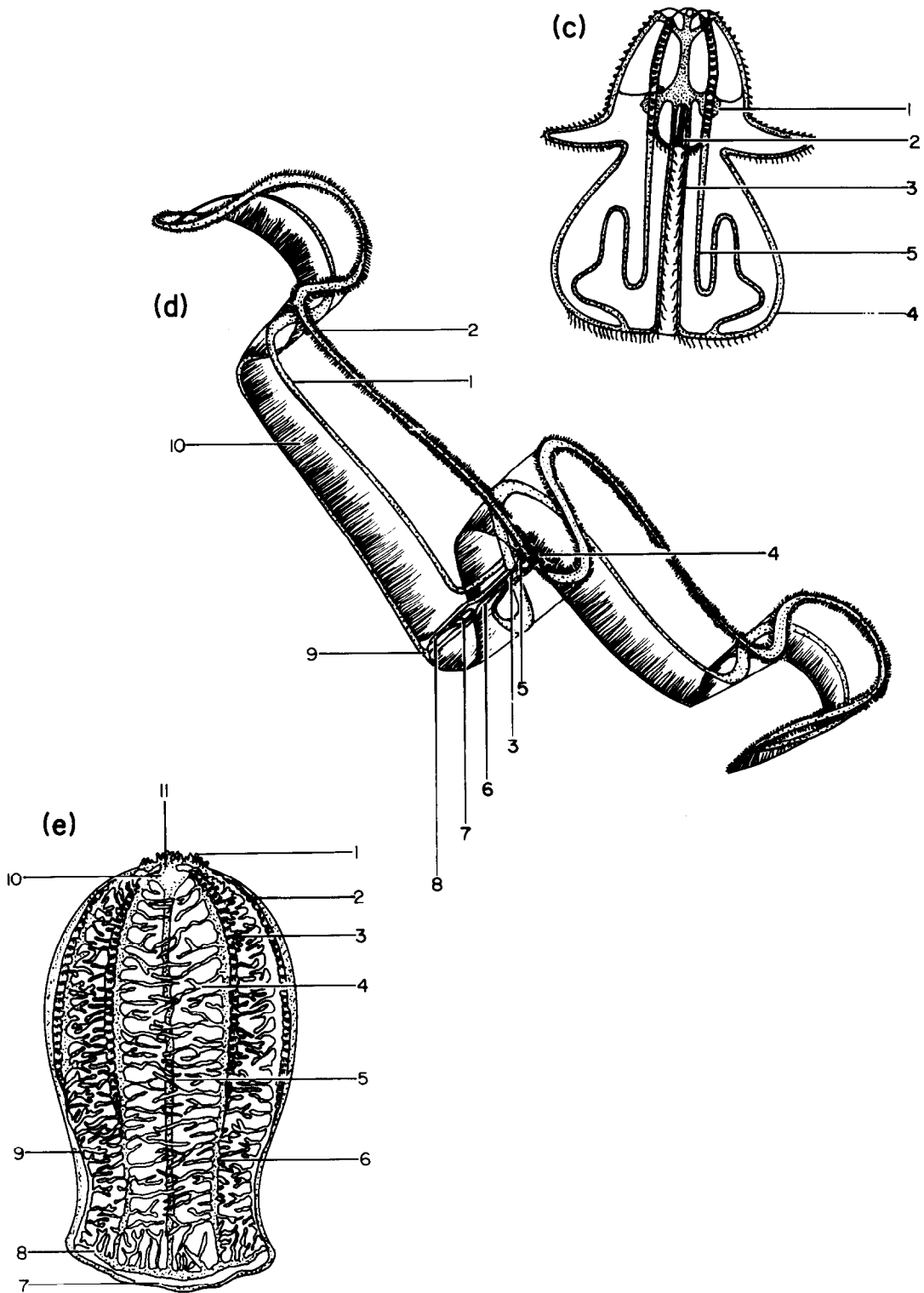
(a) *Cydippida*, *Pleurobrachia pileus*, lateral view; (1) anal pores; (2) aboral canal; (3) infundibulum; (4) tentacular canal; (5) paragastric canal; (6) pharynx; (7) mouth; (8) tentacular sheath; (9) pole plate; (10) tentacle.

(b) *Platyctenida*, *Lyrocteis flavopallidus*, lateral view; (1) tentacle; (2) arm; (3) marginal furrow; (4) trunk; (5) aboral surface; (6) oral surface.

(c) *Lobata*, *Bolinopsis paragaster*, lateral view. (1) tentacle bulb; (2) stomodeum; (3) pharynx; (4) meridional subtentacular canal; (5) meridional subventral canal.

(d) *Cestida*, *Cestum veneris*, lateral view. (1) subtentacular meridional canal; (2) substomodaeal comb row; (3) infundibulum; (4) subtentacular comb row; (5) statocyst; (6) stomodeum; (7) tentacular bulb; (8) tentacle; (9) mouth; (10) tentacle side branches.

(e) *Beroida*, *Beroe cucumis*, lateral view. (1) papilla; (2) substomodaeal comb row; (3) subtentacular comb row; (4) anastomosis of meridional canals; (5) brood chamber; (6) subtentacular meridional canal; (7) mouth; (8) circumoral ring; (9) substomodaeal meridional canal; (10) infundibulum; (11) statocyst.



6. KEY TO THE ORDERS OF CTENOPHORA

Figure 2

- 1a) Tentacles or tentacular bulbs present..... 2
- b) No tentacles or tentacular bulbs present; body
 conical, strongly flattened in tentacular plane,
 round at aboral end or with extended prominent keels... Beroida

- 2a) Body rounded or oval, either circular in section
 or slightly compressed in stomodaeal plane..... 3
- b) Body not oval, compressed in certain planes..... 4

- 3a) Long branched tentacles retractile into sheaths..... Cydippida
- b) Tentacles lack sheaths..... Thalassocalycida

- 4a) Body flattened in oral-aboral axis; oral portion of
 the stomodaeum is permanently or temporarily everted
 to form a creeping sole; tentacles retractile into
 sheaths; tentacular canals bifid..... Platyctenida
- b) Body compressed in tentacular plane..... 5

- 5a) Two large oral lobes or lappets on either side of
 mouth; sub-tentacular comb rows give rise to four
 flap-like auricles; tentacles present but no sheath.... Lobata
- b) No oral lobes or auricles present..... 6

- 6a) Body greatly compressed in tentacular plane and
 elongated in stomodaeal plane, ribbon-like
 appearance..... Cestida
- b) Mouth large and expanded in tentacular plane..... Ganeshida

As neither the Ganeshida nor the Thalassocalycida have been reported from the Southern Ocean or adjacent waters, they will not be considered further.

7. ORDER CYDIPPIDA

In the Cydippida order the paired primary tentacles are retractile into tentacle sheaths; the comb rows are well-developed. The general body shape is globular or ovoid; some forms are generally flattened in the stomodaeal plane. The meridional canals end blindly; the paragastric canals (when present) end blindly at the mouth.

Cydippida are generally regarded as primitive, since Platyctenida, Ganeshida, Lobata, and Cestida (and probably Thalassocalycida) have developmental stages resembling adult cydippids. Thus many described cydippid species probably are larval stages of other.

The five families of Cydippida may be divided into two major groups; those with tentacle sheaths opening aborally above the level of the infundibulum (Pleurobrachiidae, Mertensiidae), and those with tentacle sheaths opening orally below the level of the infundibulum (Haeckeliidae, Lampeidae, Bathyctenidae). Species of Pleurobrachiidae, Bathyctenidae and Mertensiidae have been reported from the Southern Ocean, while some Lampeidae have been found in adjacent waters.

7.1 FAMILY PLEUROBRANCHIIDAE

The body is slightly compressed in the stomodaeal plane and is spherical, oval or cylindrical in appearance. The tentacle sheaths open aborally to the infundibulum, near the apical sense organ. Gonads are present on all meridional canals. Newly hatched juveniles closely resemble adults. Adults are less than 20 mm high and usually transparent although some are pigmented.

Prey including small crustaceans and larval fish are captured with the tentacles and conveyed to the mouth by means of a reversal of ciliary beating by adjacent subtentacular comb rows.

There are three genera, Hormiphora, Euplokamis and Pleurobrachia, of which only the latter genus is represented in the Southern Ocean.

Genus Pleurobrachia Fleming 1822

Cydippidae with an egg-shaped body with a little lateral compression, the tentacular diameter being only slightly wider than the sagittal. The tentacle bulbs are placed within deep clefts, midway between the sides of the infundibulum and the general surface of the body. Two long, lateral tentacles give rise to numerous, simple filamentous side branches. Eight meridional canals extend under and along eight rows of cilia and end blindly, not forming a closed system of tubes (Mayer 1912). The tentacle sacs lie some distance from the stomodaeum; gonads are present on all meridional canals (Harbison and Madin 1982). Only Pleurobrachia pileus has been reported from the Southern Ocean.

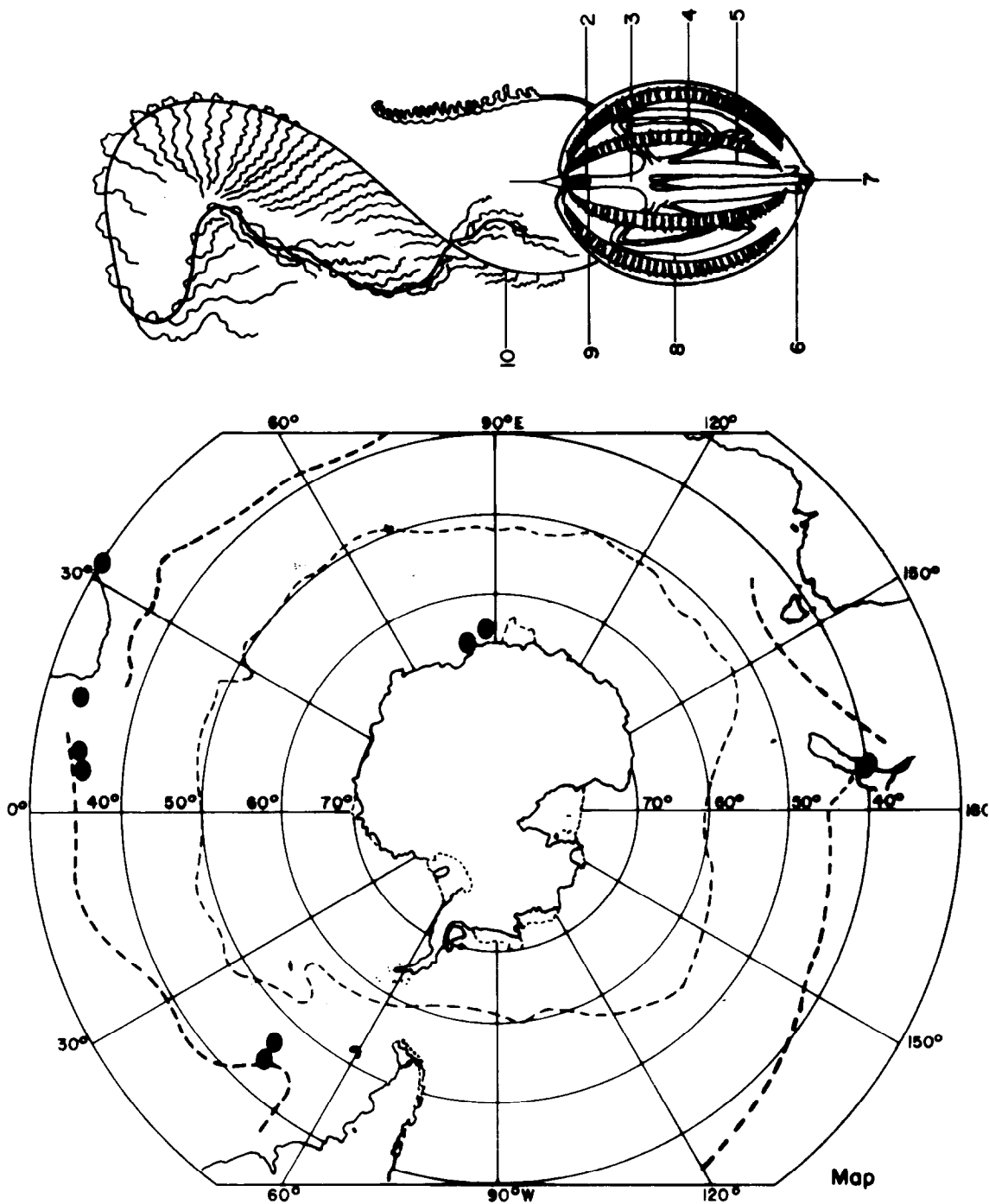


Figure 3. *Pleurobrachia pileus*, lateral view. (1) anal pores; (2) aboral canal; (3) infundibulum; (4) tentacular canal; (5) paragastric canal; (6) pharynx; (7) mouth; (8) tentacular sheath; (9) pole plate; (10) tentacle. Map of distribution.

Pleurobrachia pileus (O.F. Muller 1776)

Figure 3

Diagnostic Characters (Greve 1975):

Body egg- to spherical-shaped, tentacular diameter slightly wider than the saggital.

Comb rows equal in length, starting near the aboral pole and extending more than three-quarters of the distance towards the mouth.

Tentacles contractile, may be fifteen to twenty times the length of the body; row of similar lateral filaments along one side of the tentacles; tentacles base widely separated from the pharyngeal vessel.

Gastrovascular system blind ending, unbranched.

Colour of comb rows milky opaque, ectomesoderm glassy transparent, tentacles and sheath and pharynx are milky or in some specimens dull orange in colour.

Development; in newly hatched specimens four pairs of parallel comb rows form clusters of interradially placed long combs, the body is pear-shaped and the tentacles develop at the surface; during development the comb rows lengthen and separate, the tentacle base invaginates and the lateral filaments develop, the body becomes more spherical.

Size along the oral-aboral axis in the adult is 10 to 25 mm.

This cosmopolitan species has been recorded from the Southern Ocean by Moser (1909). In New Zealand waters Pleurobrachia pileus are efficient fish catchers (Ralph and Kaberry 1950). The economic importance of this habit is discussed by Bigelow (1924).

Three other species of Pleurobrachia have been reported from waters adjacent to the Southern Ocean; P. helicoides Ralph and Kaberry (1950) from New Zealand by Ralph and Kaberry (1950); P. pigmentata Moser 1903 from South Africa by Moser (1909); and P. australis (Benham 1907) from New Zealand by Benham (1907) as Euplokamis australis, see Ralph 1949.

7.2 FAMILY BATHYCTENIDAE

The body is moderately compressed in the stomodaeal plane. The openings of the tentacular sheath are close to the mouth, oral to the infundibulum. The paragastric and meridional canals have numerous blind side branches. The meridional canals are much longer than the comb rows. The mesoglea is very dense and firm.

Nothing is known about the development, behaviour, and feeding biology of bathyctenids. The family contains two monotypic genera, Bathyctena and Aulococtena, both of which appear to be deep-sea forms but have been collected rarely. Only Bathyctena is represented in the Southern Ocean.

Genus Bathyctena Mortensen 1913

Body rounded; no lateral furrow; apical organ not sunken; pharynx in the lower part strongly widened in the transversal plane; no lateral processes from the tentacular basis (Mortensen 1913).

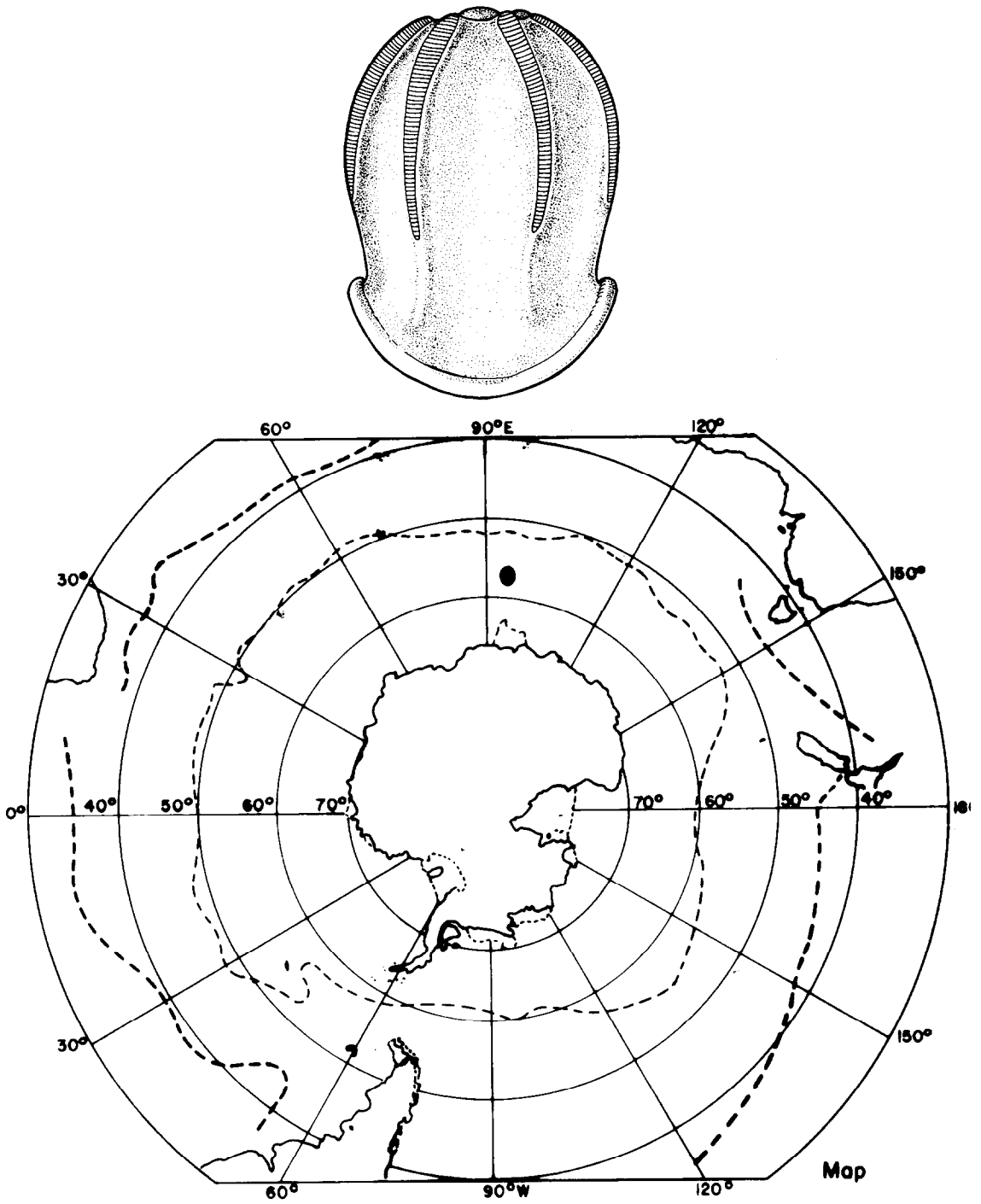


Figure 4. *Bathyctena chuni*, lateral view, and map of distribution.

Bathyctena chuni (Moser 1909)

Figure 4

(Mertensia chuni Moser 1909)

Diagnostic Characters (Moser 1909):

Body is the shape of an irregular square with a blunt rounded end, quite strongly flattened in the funnel region; the body wall is very thick and tough.

Comb rows small and densely overlapping.

Mouth formed from two half-circles, very fat lips.

Pharynx large and long, about four-fifths of body axis, aboral end almost ball shaped, a little flattened towards the oral end and constricted where it proceeds to become two wing-shaped lips.

Infundibulum thick and tough, many hairs or "villi" on the inside.

Paragastric canals strongly branched.

Tentacle bases lie obliquely at the height of the infundibulum, close to the stomach.

Tentacle sheaths narrow, totally filled by the tentacles.

Meridional canals long and branched.

Colour is green-grey though a little transparent, the stomach and lips are purple-brown.

Size up to 27 mm.

This deep sea species was described from specimens taken southwest of Kerguelen Island. Moser (1909) also reported a damaged juvenile of this species from the northern hemisphere.

7.3 FAMILY MERTENSIIDAE

The body is strongly compressed in the stomodaeal plane. The tentacles have side branches; the tentacle sheaths open aborally. Large projections (keels) occur aborally, and are most pronounced in adult species of Callianira. Early developmental stages lack keels, which gradually become apparent as the animal increases in size. All species are extremely active swimmers and are probably like Pleurobrachiidae in the mode of feeding. Two genera of which Callianira has been recorded from the Southern Ocean or adjacent waters.

Genus Callianira Peron and Lesueur 1808

Mertensiidae with pronounced aboral keels into which the meridional canals extend; all comb rows stop at the levels of the keels; some species are transparent, others are covered with red pigment spots (Harbison and Madin 1982). Many of the nominal species in this genus may prove to be synonymous (Harbison et al. 1978). Two species have been reported from the Southern Ocean.

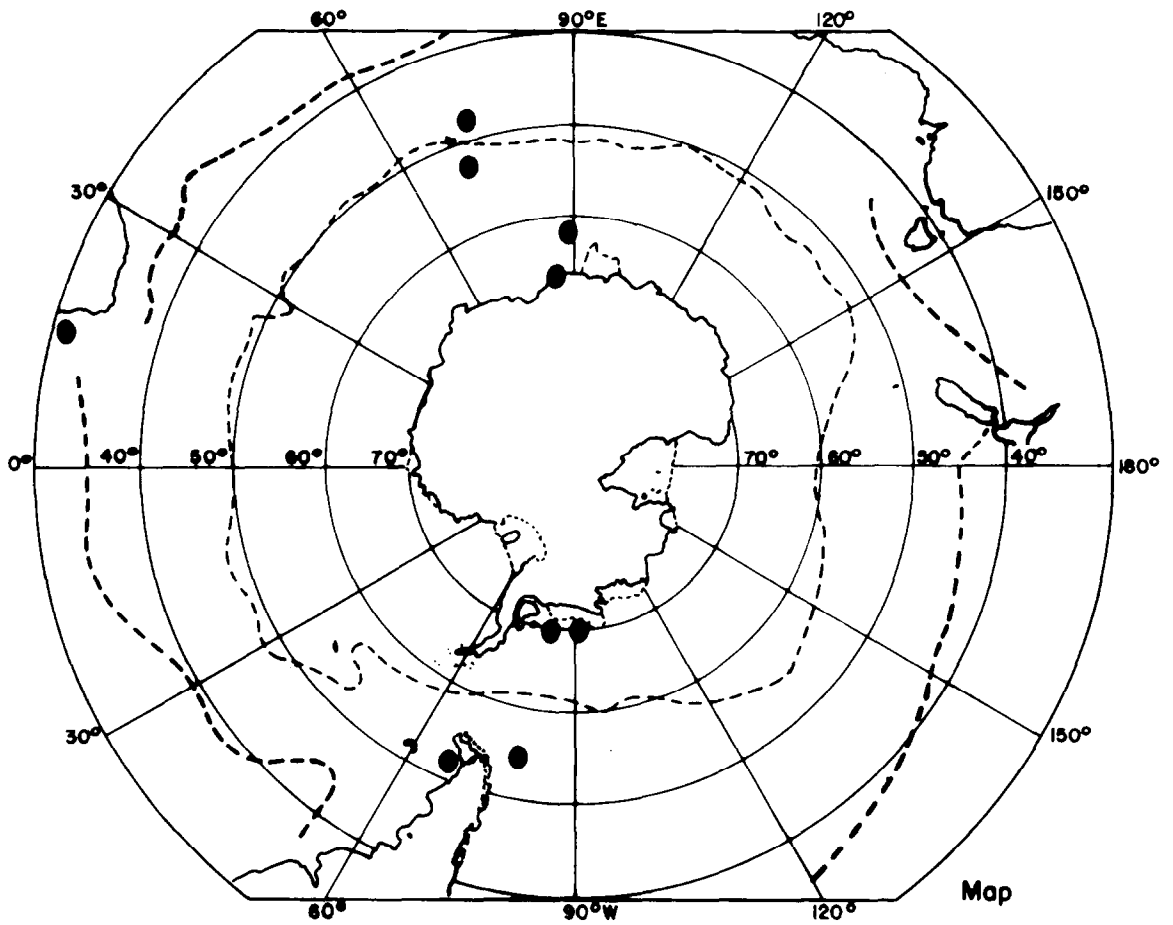


Figure 5. Map of distribution of *Callianira antarctica*. No illustration available.

Callianira antarctica Chun 1897

Figure 5

Diagnostic Characters (Moser 1909):

Body long and narrow, quite strongly compressed in the stomodaeal plane.
Aboral keels wing shaped, though quite short and blunt.
Comb rows uneven, the substomodaeal ones are a little longer than the subtentacular ones, reaching from the sensory pole to near the mouth; the subtentacular ones start some distance from the mouth and cease at the base of the keels.
Meridional canals start at the mouth and finish on top of keels.
Tentacle bases are quite long and narrow, situated at the height of the infundibulum.
Tentacle sheaths open at beginning of keels, at same height as sensory pole.
Tentacles start about half way along sheaths, with side branches.
Pharynx voluminous, quite long - three-quarters of vertical axis, with conspicuous swelling.
Infundibulum short.
Transverse canals enter meridional canals at same height of infundibulum.
Colour; body clear, tentacles and pharynx reddish.
Size to 60 mm.

This species has been reported from the Southern Ocean by Chun (1897) and Moser (1909). It differs from Callianira cristata in the shortness of its keels, the narrow body shape, the lack of edges on the sensory pole and the narrow tentacle bases (Moser 1909).

Callianira cristata Moser 1909

Figure 6

Diagnostic Characters (Moser 1909):

Body narrow, flattened in the stomodaeal region.
Keels wide and short.
Comb rows with very long, narrow combs which do not overlap the keels; substomodaeal ones start at the same height as the sensory body and finish in the oral one-fifth while the shorter subtentacular ones start a little deeper in the base of the wings and finish at the oral one-quarter.
Mouth wide and bound by two lips on the stomodaeal plane.
Pharynx narrow and long - four-fifths of body length, small swelling in middle.
Transverse canals enter meridional canals at same height as infundibulum.
Tentacle bases short and wide, very high, situated at infundibulum.
Tentacle sheath short, very wide, opens close to keels.
Tentacles possibly without side branches.
Colour not stated, therefore most likely colourless.
Size to 11 mm.

This species has been reported in the Southern Ocean by Moser (1909). It is differentiated from other species in the genus due to the narrow, extremely long combs, the short keels and long tentacles.

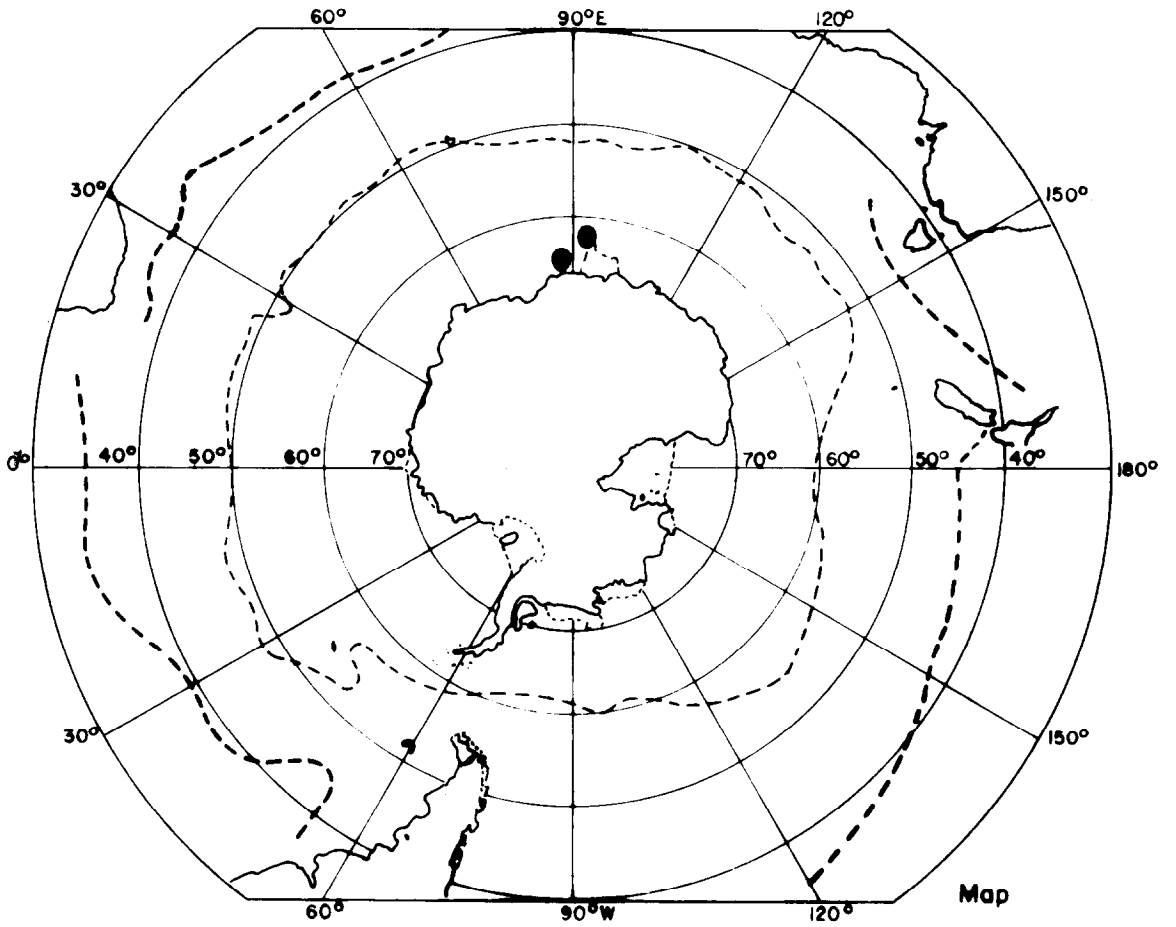
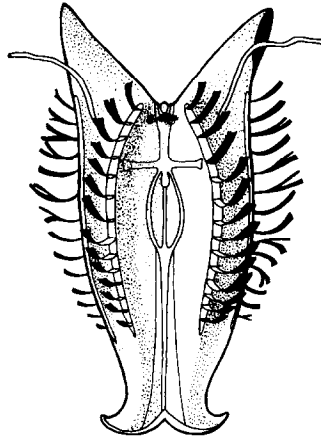


Figure 6. *Callianira cristata*, lateral view, and map of distribution.

7.4 FAMILY LAMPEIDAE

A monogeneric family represented by Lampea. The morphology closely resembles that of the Haeckeliidae: the tentacles have side branches; the opening of the tentacle sheath occurs at the oral margin of the comb rows. The comb rows are equal in length; the meridional canals are much longer. There are no tubercles around the statocyst. The pharynx is widely eversible.

Adults often have diffuse brown, yellow, or pink pigmentation; the younger stages are transparent. Adults attain heights of 50 to 70 mm. All species are predatory or parasitic on salps, depending on their size. Small individuals flatten themselves on the salp's body. Larger individuals completely ingest the salps. Since development includes a planula larva, this family must be distinguished from the Heackeliidae. The development of the larva to a free-swimming stage 2 to 3 mm takes place on the salp.

Genus Lampea Stechow 1921

Body cylindrical, only a little narrower towards the oval end. Mouth opening wide. Lips dilatatable to a wide sole on which the animal moves over solid objects (Chun 1880).

Ralph (1949) reported some juvenile specimens of this genus from New Zealand as Lampetia.

8. ORDER PLATYCTENIDA

An order of planktonic (Ctenoplanidae), creeping (Ctenoplanidae, Coeloplanidae, Savangiidae), or sessile (Coeloplanidae, Tjalifiellidae) ctenophores, often greatly compressed in the oral-aboral axis. The oral portion of the stomodaeum is permanently or temporarily everted to form a creeping sole. Comb rows are absent in the adult (except Ctenoplanidae). The tentacular apparatus is like that in Cydippida; there are tentacle sheaths (except in Savangiidae). The tentacle canals are bifid. The gastrovascular system has complex anastomoses, or is reduced (Tjalifiellidae). All except the Savangiidae have anal pores and aboral sensory organs, although the latter may be greatly reduced.

Most platyctenids are usually less than 30 mm in the longest dimension. Many are commensal in specific situations such as among colonies of bryozoans, anthozoans, hydroids, tunicates and the spines of echinoids (Rankin 1956, Matthews and Townsley 1964, Gordon 1969, Robilliard and Dayton 1971).

Platyctenids are often brightly coloured especially in the tropical forms. Fertilisation is often internal, in contrast to all other orders of Ctenophora. In many, development to a cydippid larva stage takes place within the brood chambers. The cydippid larva is the primary means of dispersal for forms without comb rows. Asexual reproduction, analogous to pedal laceration in anemones, is common. Platyctenids are found in coastal waters of the tropics and polar regions, although only the family Coeloplanidae is represented in the Southern Ocean.

8.1 FAMILY COELOPLANIDAE

Adults lack comb rows, which are present in larvae. An aboral sense organ is present. The tentacles have side branches, enclosed in sheaths. The pharynx is permanently everted and flattened. The meridional canals are branched and anastomosing. The tentacular canals are bifid. The gonads are on canals, with externally opening spermatoducts and with oviducts opening into the gastrovascular system. Coeloplanids use their tentacles for feeding. Members of the three genera of this family are found worldwide in tropical to polar coastal waters although only species of Coeloplana and Lyrocties have been found in the Southern Ocean and adjacent waters.

Genus Lyrocteis Komai 1942

Sedentary; 50 to 150 mm tall; body lyre-shaped, compressed in the planes of the arms and circumscribed by a deep marginal furrow; beautifully coloured; comb rows absent in the adult; tentacles branched on one side only, the branches are simple; tentacle sheath opens in marginal furrow at tip of arm; peripheral canals from a network; gonads develop in numerous diverticula of meridional canals; each testis with a duct to the exterior; viviparous, cydippid embryo develops in brood chamber formed at the end of the ovarian diverticulum (Robilliard and Dayton 1971).

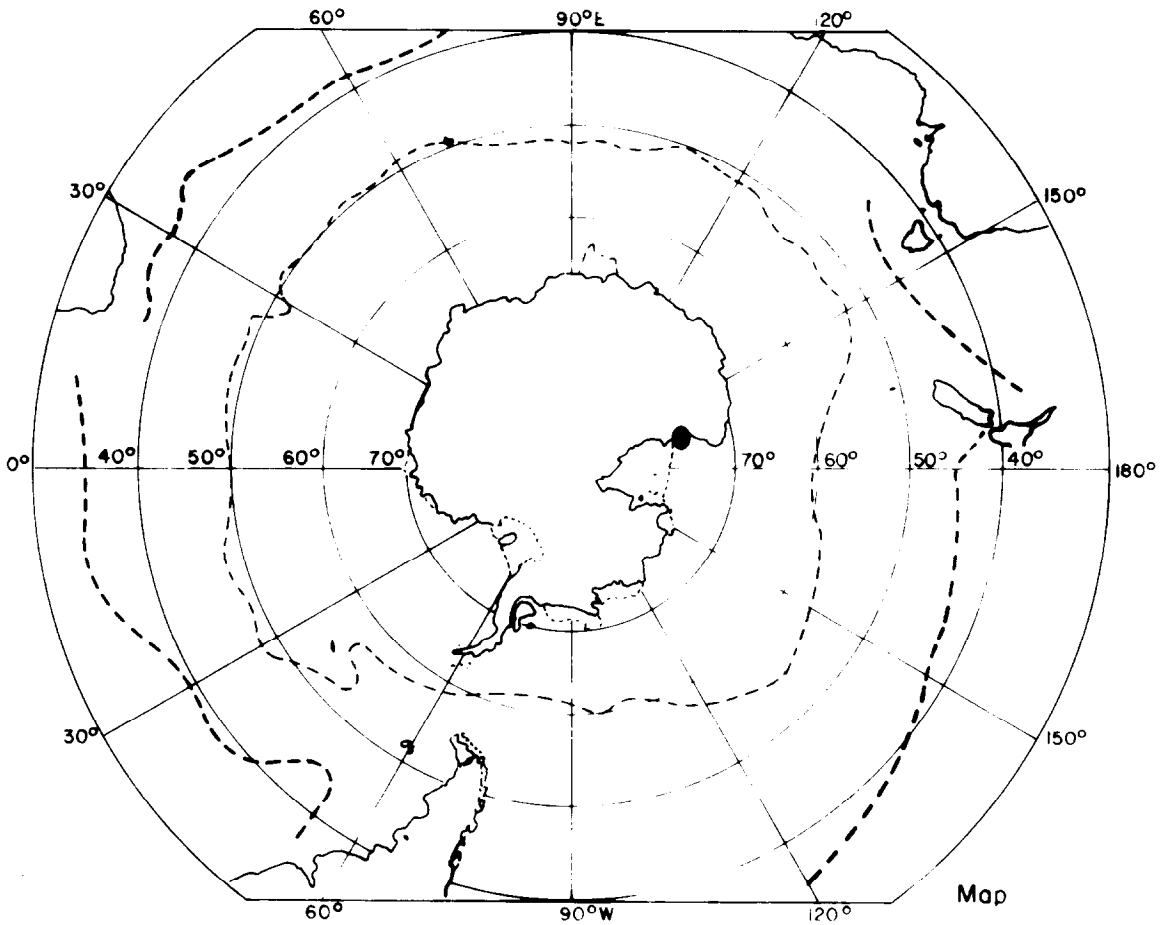
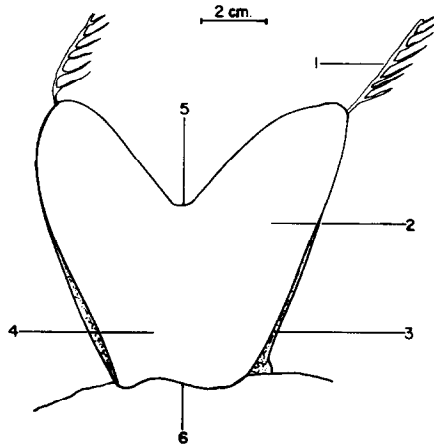


Figure 7. *Lyrocteis flavopallidus*, lateral view; (1) tentacle; (2) arm; (3) marginal furrow; (4) trunk; (5) aboral surface; (6) oral surface. Map of distribution.

Lyrocteis flavopallidus Robilliard and Dayton 1971

Figure 7

Diagnostic Characters:

Trunk saddle-shaped, slightly compressed in the plane of the "arms", somewhat wider than tall.
Arms (vertical prolongations of the body) aborally extended, nearly circular in cross-section, taper slightly to a bluntly rounded tip, may diverge up to forty-five degrees from the vertical axis of the body.
Marginal furrow runs from apex of each arm down the lateral border and then along the oral surface to join its opposite member at the mouth.
Epidermis relatively smooth or only slightly wrinkled.
Papillae numerous, conical to sub-conical, 1 to 3 mm tall, on sides of trunk between the arms and on the proximal half of the arms.
Comb rows not present in the adult.
Tentacles bear numerous, evenly spaced, long, filamentous branches restricted to one side of the tentacle.
Tentacle sheath extends from the apex to the base of the arm.
Colour; body pale straw-yellow, tentacles white.
Size up to 110 mm tall.

Robilliard and Dayton (1971) tentatively assigned some specimens from McMurdo Sound to the genus Lyrocteis but pointed out that they may well represent a new genus and possibly a new family. Details on reproduction, ecology and behaviour of this species are given in Robilliard and Dayton (1971).

Genus Coeloplana Kawalevsky 1880

No specialised brood chamber; aboral papillae are used to brood young. Species of Coeloplana are often specifically associated with benthic organisms (Harbison and Madin 1982). Although no species of Coeloplana have been found in the Southern Ocean, C. willeyi Abbott 1907 has been reported from New Zealand by Gordon (1969), and C. gonoctena Krempf var natalensis was described by Pople (1960) from specimens collected from South Africa.

9. ORDER LOBATA

Order of pelagic ctenophores in which the body is laterally compressed in the tentacular plane; it is expanded on each side of the mouth, forming a pair of oral lobes. The subtentacular comb rows give rise to four flap-like auricles and are usually shorter than the substomodaeal comb rows. The meridional canals are much longer than the comb rows, and extend into oral lobes. The paragastric canals join the subtentacular meridional canals orally. The statocyst is usually deeply sunk.

Development includes a cydippid form, flattened in the stomodaeal plane, with tentacles in the sheaths. The tentacles migrate orally as the lobes develop, the tentacle sheaths are lost and the tentacles become reduced surrounding the mouth and extending onto the oral lobes. This order contains six families of which the Bolinopsidae, Leucotheidae and possibly Eurhamphaeidae are found in waters adjacent to the Southern Ocean.

It is evident that the Lobatae are derived from the Cydippidae and that they came from Mertensia-like ancestors. It is interesting that the Cestidae are closely related to the Lobatae, and the canal-systems of the Cestidae and Beroidae are similar to each other in general features (Mayer 1912).

9.1 FAMILY BOLINOPSIDAE

Lobatae in which the paragastric canals join the subtentacular meridional canals at the bases of the auricles. The subtentacular meridional canals continue around the margin of the oral lobes joining their counterparts on the opposite side. Adjacent substomodaeal meridional canals wind complexly in the oral lobes and meet or closely approximate. The subtentacular meridional canals join the adradial canals aborally or extend beyond them, ending blindly. Gonads are present on the walls of all meridional canals when maturity is reached.

Most species are transparent. The feeding mechanism is the same in all species studied. The animal swims slowly forward with the oral lobes expanded, trapping small organism (predominantly crustaceans) on the mucus-covered inner surfaces of the lobes. Food is transported to the mouth by means of the oral tentacles and cilia. Of the three genera only Bolinopsis has been recorded in waters adjacent to the Southern Ocean while Mnemiopsis may occur around the Falkland Islands.

Genus Bolinopsis L. Agassiz 1860

Lobatae in which the two oral lobes are of medium size and not provided with powerful muscles. The oral lobes commence about half way between the mouth and the infundibulum. The subtentacular comb rows are about half the length of the substomodaeal comb rows. Adjacent substomodaeal meridional canals wind complexly in the oral lobes and meet. The subtentacular meridional canals join the adradial canals aborally (Harbison and Madin 1982). The four relatively short, simple auricles arise from the sides of the body immediately above the mouth and close to the sides of the oral lobes. They are not set within deep grooves. The peripheral chymiferous tubes form closed circuits in the oral lobes. While the auricles are relatively short, the oral lobes are long. The combs of cilia are small and numerous.

Species occur in polar to tropical neretic waters of all oceans (Harbison and Madin 1982) although none have been reported from the Southern Ocean. Bolinopsis chuni (von Lendenfeld 1884) was described as Bolina chuni using material collected in southeastern Australia. The Lesueuria pinnata described by Ralph and Kaberry (1950) may possibly be degenerate Bolinopsis, or may be Leucothea. The inadequate description does not permit further identification (G.R. Harbison, pers. comm. 1985).

Genus Mnemiopsis L. Agassiz 1860

Closely allied to Bolinopsis, is distinguished by having four deep, lateral furrows which extend upward from the level of the mouth along the edges of the oral lobes to about the level of the apical sense-organ. A lateral branch from the paragastric canal extends upward along each of these grooves, and numerous short, simple tentacles arise along the length of this canal. The outer edge of an auricle also extends upward along each groove and is bordered with numerous cilia (Mayer 1912).

Harbison (pers. comm. 1985) believes that a ctenophore from north of the Falkland Islands described by Mertens (1833) as Alcinoe rosea is actually a species of Mnemiopsis.

9.2 FAMILY LEUCOTHEIDAE

Monogeneric family represented by Leucothea in which the oral lobes are extremely large and delicate, and contain complex windings of the substomodaeal meridional canal. In general, the arrangement of the canals is like that in Bolinopsidae. The auricles are long and serpentine. Long primary tentacles extend aborally from the tentacle bulbs; secondary tentacles form a dense veil along the labial ridge extending onto the oral lobes. The body surface is covered with numerous papillae which extend rapidly when touched. Unique to the genus are two long pits which open to the outside aborally to the tentacle bulbs and which run aborally to the level of the infundibulum where they end blindly. The substomodaeal comb rows are much longer than the subtentaculars.

The feeding habits of Leucothea are like those of the Bolinopsidae. Development from a cydippid larva proceeds from a medusoid form and Bolinopsis-like stage to the adult. All larval stages may develop gonads under certain conditions. The genus is distributed in temperate to tropical waters. Young individuals are usually transparent; adults may have yellow or brown pigmentation on the oral lobes or papillae.

Genus Leucothea Mertens 1833

Lobatae in which the oral lobes are of large size and contain complexly-winding chymiferous tubes. The auricles are long, thick, and coiled in helices with the cilia extending in a loop up and down one side. The outer surface of the body and lobes are covered with long, conical papillae. The aboral blind ends of subtentacular meridional canals are long. The two median tentacles are very long; two long, blindly ending, pit-like depressions extend inward from above the tentacles nearly to the level of the funnel (Mayer 1912).

This genus is descended from a Bolinopsis-like ancestor. It passes through a stage in which it cannot be distinguished from Bolinopsis. The large papillae which cover the external surface of the oral lobes and of the body are late in developing and do not appear until the animal has passed through the Bolinopsis stage (Mayer 1912). Leucothea multicornis Eschscholtz 1825 has been reported from the waters off New Zealand by Ralph and Kaberry (1950). The Lesueuria pinnata described by Ralph and Kaberry from New Zealand, may possibly be a Leucothea (G.R. Harbison, pers. comm. 1985).

9.3 FAMILY EURHAMPHAEIDAE

Monotypic family represented by Eurhamphaea vexilligera. This species is a delicate and characteristically oceanic form that rarely occurs close to shore. It is characterised by two conical processes on the aboral end that terminate in long flexible filaments. The subtentacular comb rows extend onto these processes. The canal pattern is like that in Bolinopsidae, except that the subtentacular meridional canals extend into the aboral processes. The body is transparent; there are small red vesicles interspersed between the ctenes of the comb rows, extending onto the oral lobes along the substomodaeal meridional canals. These vesicles release a reddish-brown ink into the water when the ctenophore is touched. The ink is bioluminescent and produces blue-green sparks. The vesicles are also present in the cydippid larva. Adults reach a height of 100 mm.

Genus Eurhamphaea Gegenbaur 1856

Moser (1909) lists Eurhamphaea heteroptera (Callianira heteroptera Chamisso and Eysenhardt) as occurring in the Atlantic Ocean between thirty and forty degrees South, but Harbison (pers. comm. 1985) said that the description by Chamisso and Eysenhardt (1821) is altogether too weird and incomplete for him to be able to agree that it is Eurhamphaea.

9.4 FAMILY BATHOCYROIDAE

Monogeneric family represented by Bathocyroe. The auricles are wide and short; the oral lobes are muscular. The comb rows are short. A tentacle bulb and oral tentacles are present. The paragastric canals extend into the oral lobes, fusing with the subtentacular and substomodaeal meridional canals at the edge of the oral lobe. The substomodaeal meridional canals form simple loops in the oral lobes.

Genus Bathocyroe Madin and Harbison 1978

Bathocyroe paragaster (Ralph and Kaberry 1950) was originally described as Bolinopsis paragaster from specimens caught in surface waters near New Zealand.

10. ORDER CESTIDA

Order of pelagic ctenophores containing a single family Cestidae, with two genera, Cestum and Velamen. These animals are extremely compressed in the tentacular plane and greatly elongated in the stomodaeal plane and have a ribbon-like appearance. The substomodaeal comb rows are elongate, extending along the entire aboral edge. The subtentacular comb rows are greatly reduced. The substomodaeal meridional comb rows arise under the subtentacular comb rows (Cestum) or equatorially from the interradial canals (Velamen); they extend equatorially to the lateral edges, joining the substomodaeal meridional canals. The paragastric canals extend along the oral edge, fusing with the substomodaeal and subtentacular meridional canals. Gonads only occur along the substomodaeal meridional canals. A ciliated oral groove extends along the entire oral edge. Tentacles and tentacle bulbs are present, but the homologies are unclear; there are either two primary tentacles, with numerous side branches fixed in the oral groove, or reduced primary tentacles, with numerous secondary tentacles along the oral edge.

In the Cestidae an extraordinary development of the lateral compression is found, seen to a lesser degree in the Lobata. The funnel-axis is thus reduced and the stomodaeal axis greatly extended. This causes the subtentacular comb rows to be rudimentary while the sub-ventral rows are correspondingly lengthened (Mayer 1912).

The sheaths of the median tentacles recall the conditions seen in the Cydippida, and indeed the larvae of the Cestidae when hatched from the eggs are Mertensia-like in appearance with the tentacular axis longer than the saggital. This is the reverse of the condition which pertains in the adult (Mayer 1912).

All cestids feed similarly. The animal swims in an oral direction, propelled by the substomodaeal comb rows. The side branches (or secondary tentacles) stream aborally, covering both sides of the animal so that the entire organism is a capture surface. Prey, usually small crustaceans, are caught by the tentacles which contract, transferring them to the oral groove, where they are conveyed by cilia to the mouth. Development includes a cydippid stage, with gradual elongation occurring in the stomodaeal plane until the adult form is reached. All cestids are capable of a serpent-like, wriggling escape response. Species of Velamen show a much more vigorous and coordinated response than do species of Cestum.

Both species are found worldwide with greatest abundance in tropical waters. Species of Cestum are encountered more frequently in tropical and subtropical waters than any other ctenophores (Harbison and Madin 1982).

10.1 FAMILY CESTIDAE

With the characters of the order.

Genus Cestum Lesueur 1813

Cestidae in which the extension of the sides in the stomodaeal axis and the marked compressions of the body in the tentacular axis cause the animal to

assume the shape of a flat ribbon. Four interradial canals arise directly from the funnel. Four very long meridional subventral vessels extend around the aboral side of the narrow edge of the body. Four meridional subtentacular canals each give rise to a short tract of cilia and then bend downward and outward along the sides of the animal and join with the meridional subventral canals and the oral forks of the paragastric canals at the extremities of the long sides of the animal. Each of the two median tentacles arises from a deep sheath (Mayer 1912).

Specimens of Cestum veneris Lesueur 1813, commonly known as Venus's Girdle, have been reported from New Zealand (Ralph and Kaberry 1950).

11. ORDER BEROIDA

Order of pelagic ctenophores containing a single family, Beroidae, with two genera, Beroe and Neis. Tentacles and tentacle bulbs are absent. The body is strongly flattened in the tentacular plane but not to the extent seen in Cestida. The aboral end is rounded (Beroe) or extended into two prominent keels (Neis). The stomodaeum is voluminous, occupying most of the body. The aboral sensory organ is well developed and flanked by gelatinous papillae. The well developed comb rows extend from one-half to most of the body height. The meridional canals have numerous side branches, the paragastric canals are simple, or have side branches. In some forms the side branches anastomose, forming interconnections between canals in all parts of the body; in others the canals are interconnected only by a circumoral ring. The mouth is muscular and flexible.

Species of Beroe are primarily predators on other ctenophores but they also eat other gelatinous macroplankton. They can completely engulf prey as large as themselves. Larger prey are bitten into pieces with bundles of fused cilia which line the inner lips. Adults are usually brown, pink, yellow, or milky white. Some forms have prominent red, yellow or brown spots. Some species attain 400 mm in height.

Neis is monotypic (N. cordigera), but more than fifty species of Beroe have been described; undoubtedly many are synonymous. Species of Beroe occur worldwide in all latitudes. N. cordigera is only known from Australia (Harbison and Madin 1982).

11.1 FAMILY BEROIDAE

With the characters of the order.

Genus Beroe Browne 1756

Body mitre-shaped, egg-shaped or conical; extended laterally in the stomodaeal axis. Mouth opening wide and ectodermal portion of stomach (stomodaeum) voluminous. The polar-plate surrounding the sense-organ at the aboral pole is fringed with a row of papillae; there are neither tentacles nor tentacular vessels. There are ciliated areas upon the walls of the stomodaeum near the mouth. The axial funnel-tube which extends upward to the sense-organ is deeply cleft so that the two lateral vessels extend upward to the two apical excretion-pores on the sides of the pole-plate. Eight meridional vessels and paragastric canals present. The meridional vessels lie under the eight comb rows. The two paragastric vessels extend down the middle of the broad sides of the animal and branch out in an inverted T-like manner near the mouth and fuse with the meridional canals of that side only (Mayer 1912).

Three species (Beroe cucumis, B. forskalii, B. compacta) have been reported from the Southern Ocean and B. hyalina Moser 1908 was found off South Africa by Moser (1909). Ralph (1949) recorded a number of juvenile specimens of Beroe off New Zealand but was unable to determine their species. The specimens of Pandora mitrata found by Moser (1909) are most likely young Beroe (G.R. Harbison, pers. comm. 1985).

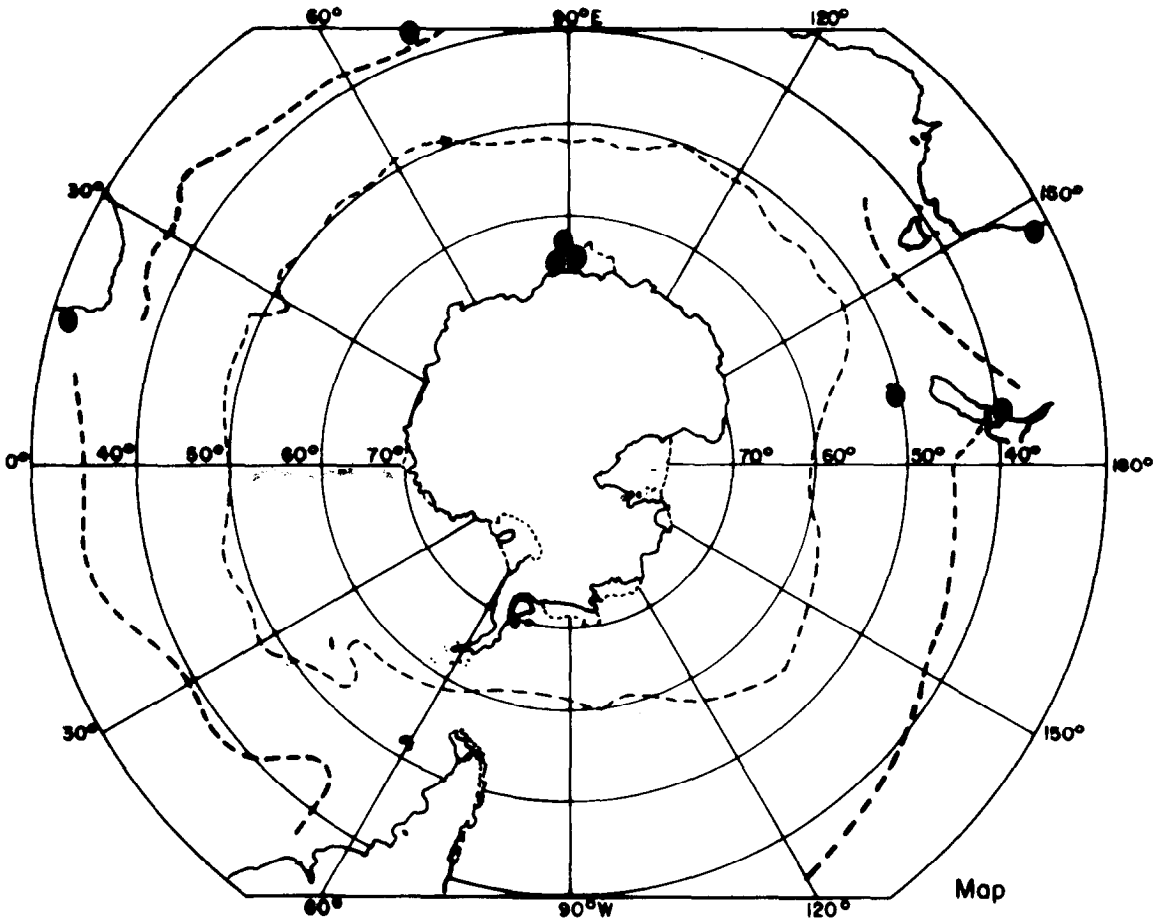
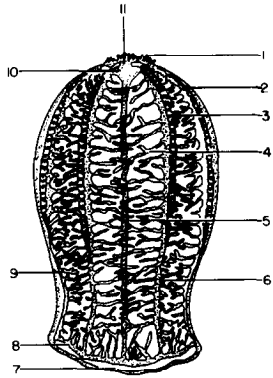


Figure 8. *Beroe cucumis*, lateral view; (1) papilla; (2) substomodaeal comb row; (3) subtentacular comb row; (4) anastomosis of meridional canal; (5) brood chamber; (6) subtentacular meridional canal; (7) mouth; (8) circumoral canal; (9) substomodaeal meridional canal; (10) infundibulum; (11) statocyst. Map of distribution.

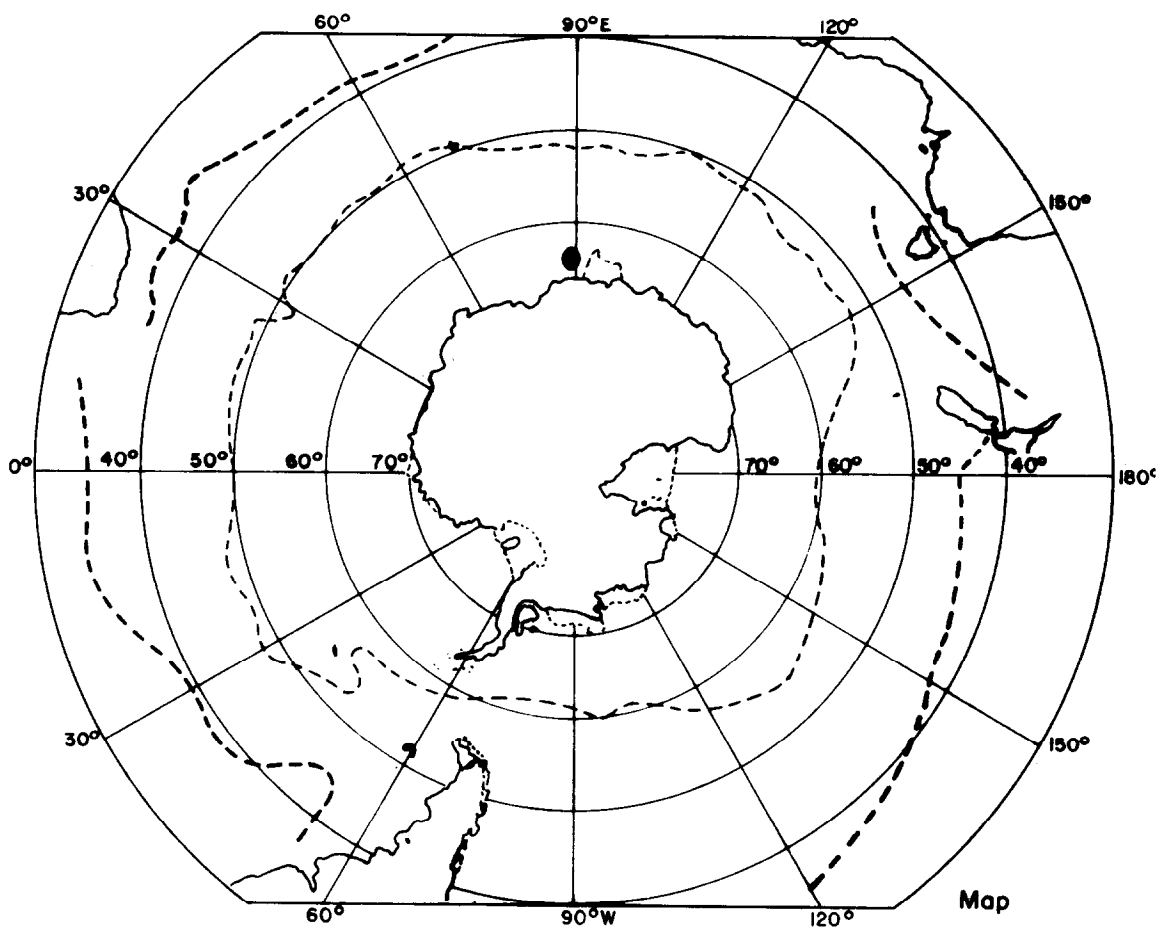


Figure 9. Map of distribution of *Beroe compacta*. No illustration available.

Beroe cucumis Fabricius 1780

Figure 8

(B. shakespearei Benham 1907)

Diagnostic Characters (Greve 1975):

Body sac- or vase-shaped, often compressed in what corresponds to the tentacular plane.

Comb rows equal in length, extending from the aboral pole and to about three-quarters of the distance towards the mouth.

Tentacles not present.

Gastrovascular system consists of four meridional canals on each broad side, these connect orally by means of oral forks of the pharyngeal canal; branched anastomoses protrude into the ectoderm from the meridional canals.

Branched papillae; in a row in the form of a figure of eight around the pole plate at the aboral plate.

Colour pink; in mature specimens, especially along the meridional canals and comb rows.

Size; adult up to 150 mm high.

This cosmopolitan species (Moser 1909) has been reported from the Southern Ocean by Moser (1909) and Kramp (1957). Ralph (1949) discussed the synonymy of B. shakespearei to B. cucumis and pointed out the differences between B. cucumis and B. forskalii.

Beroe compacta Moser 1909

Figure 9

Diagnostic Characters (Moser 1909):

Body small, cylindrical, similar in shape to Pleurobrachia, walls thin.

Comb rows narrow with small densely arranged combs.

Mouth edge frilled.

Pharynx wall extremely thick and folded, fills up much of body; saber-shaped cilia numerous on inside walls.

Meridional and paragastric canals of same height.

Colour opaque.

Size to 5 mm.

This species was described with specimens from the Southern Ocean by Moser (1909). It can be differentiated from all other known Beroe because of the similar shape to Pleurobrachia, the reduction in wall thickness and the unusual development of the pharynx (Moser 1909).

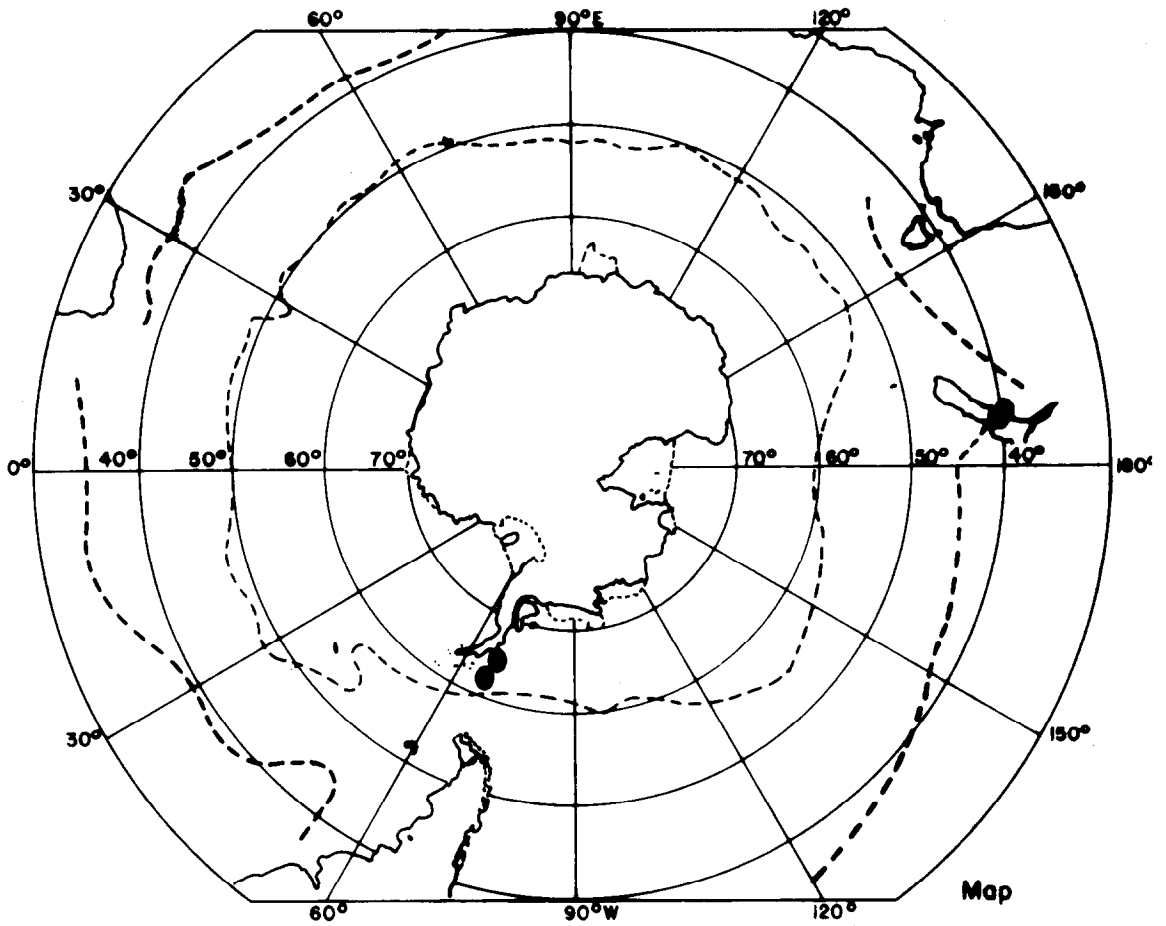
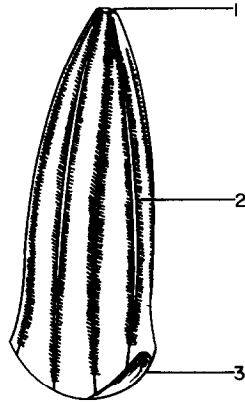


Figure 10. *Beroe forskalii*, lateral view; (1) infundibulum; (2) comb row; (3) mouth. Map of distribution.

Beroe forskalii Milne Edwards 1841

Figure 10

Diagnostic Characters (Chun 1880):

Body strongly compressed.

Mouth opening wide with large, half-circle shaped lips.

Cilia saber-shaped in pointed long rows.

Gonads in follicle type side protrusion.

Colour, when young, almost transparent, becoming slightly pinkish with age.

Size to 200 mm.

This species has been recorded from the Antarctic Peninsula by Chun (1880) and from New Zealand (Ralph 1949). It is also found in the Northern Hemisphere.

Genus Neis Lesson 1830

Aboral end is extended into two prominent keels giving a heart-shaped appearance.

Neis cordigera has been reported from southeastern Australia by Lesson (1830), von Lendenfeld (1885) and Stiasny (1931).

12. FAMILY CRYPTOCODIDAE

Monotypic family erected by Leloup (1938) for some specimens found during the Belgium Antarctic Expedition of 1897-99.

Genus Cryptocoda Leloup 1938

Cryptocoda gerlachi Leloup 1938

Figure 11

Diagnostic Characters (Leloup 1938):

Body cylindrical, thinned out at the two extremities (living form elongated and globular); in equatorial section it has the form of an octagon with rounded angles, slightly flattened in the tentacular plane; in the apical plane it becomes quadrangular.

Comb rows wide, extending almost to the oral pole, nineteen to twenty comb plates in each row.

Aboral winglets small, a pair is situated on each side of median plane.

Tentacles simple, retracting into a vertical tentacular sheath.

Apical cavity deep.

Size 6.5 mm in height, 2.5 mm maximum diameter.

Leloup (1938) said that this species is distinguished from all other known species by the structures of its aboral region. He classed it as a Cydippid, being intermediate to the Pleurobrachiidae and the Callianiridae (now contained in the Mertensiidae).

No further specimens of this species have been found and the family is yet to be recognised. Undoubtedly, when living specimens are examined, its phylogenetic position and anatomy will be clarified (G.R. Harbison pers. comm. 1985).

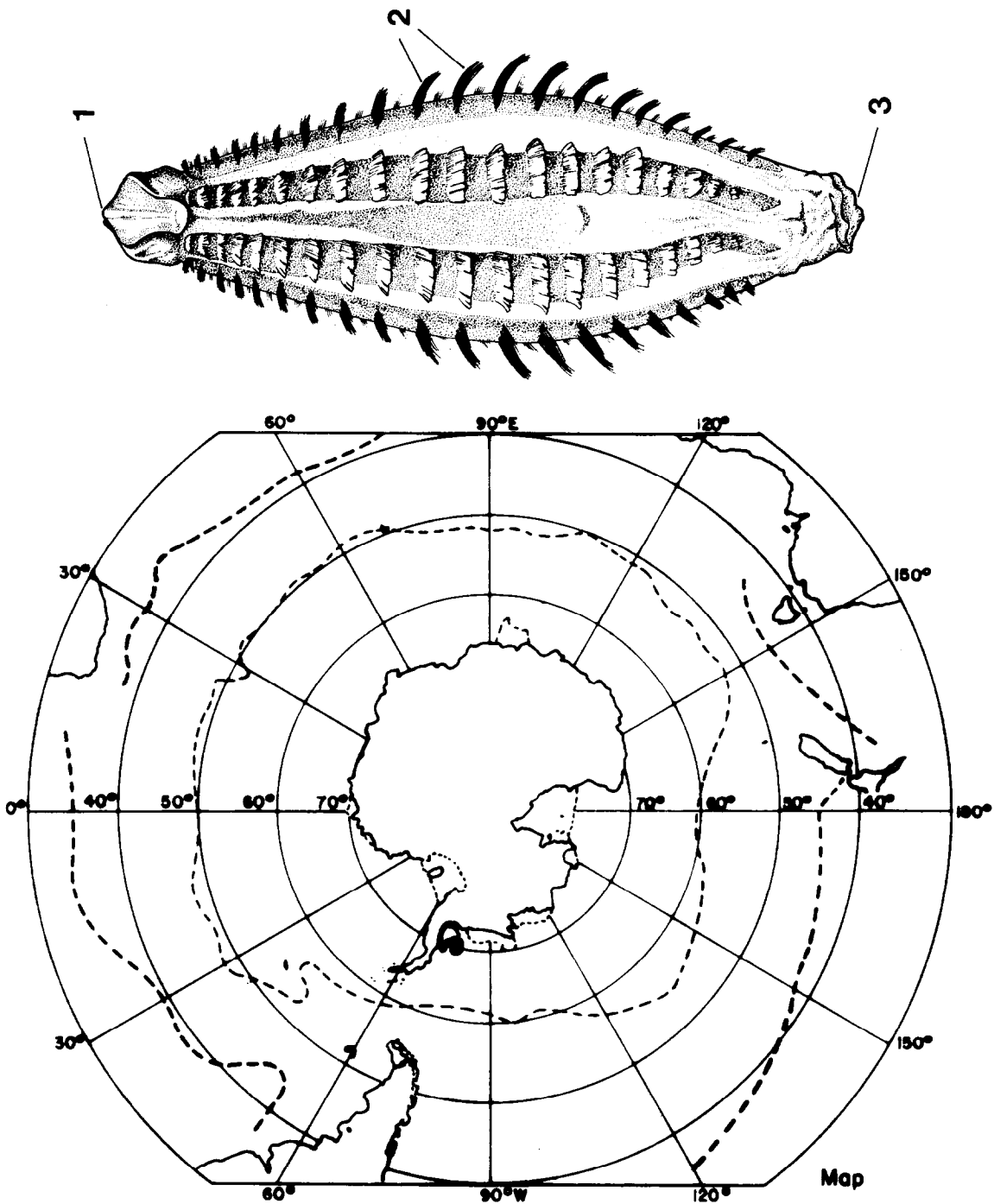


Figure 11. *Cryptocoda gerlachi*, lateral view; (1) anal pore; (2) comb row; (3) mouth. Map of distribution.

13. COLLECTION AND PRESERVATION

(Adams et al. 1976)

Planktonic ctenophores can be taken by a tow net or dip net. A dip net is the best method as it causes less damage to the ctenophore. Plankton nets towed at low speeds (1 knot) are also suitable. As with the Cnidaria, it is an advantage to collect at night when time the animals are more abundant near the surface. Benthic ctenophores can be collected by divers using jars to capture the specimens. This method can also be used for pelagic species (Harbison et al. 1978).

Specimens should be separated from other organisms and carefully transferred to a glass jar filled with fresh clean seawater using a spoon, bolting cloth or a glass pipette. It is recommended that for identification the ctenophores be examined alive. If the specimens have to be preserved for later examination, photographs should be taken first in case the ctenophores are damaged or not preserved properly.

Ctenophores are extremely fragile and difficult to fix and preserve. Incorrect fixation can result in specimens becoming a mass of amorphous jelly. Even with great care some distortion and shrinkage of specimens will occur. Formalin solutions should never be used to fix ctenophores. Early methods used solutions containing osmic or chromic acid causing discolouration and sometimes disintegration of the specimens.

For fixation, either of the following solutions can be used:

- | | |
|------------------------------|--------|
| (a) tri-chloroacetic acid | 1 gram |
| seawater | 99 mL |
| (b) p-toluene sulphuric acid | 1 gram |
| seawater | 99 mL |

Fix for thirty minutes. The specimens will change slightly from transparency to translucency. It is best to pour the specimens into a jar of fixative.

To preserve the ctenophores transfer from the acid/seawater solution to a solution of 1 mL stock preserving solution and 99 mL seawater. The stock preserving solution is made of:

propylene phenoxetal	0.5 mL
propylene glycol	4.5 mL
40% formaldehyde	5 mL
seawater	90 mL

This gives a formaldehyde concentration of about 0.2% for the ctenophore preserving solution. Keep the specimens in this fluid for five to seven days then transfer to 5 mL of stock solution and 95 mL of seawater for storage. Never store ctenophores with crustacea as the sharp spines will cut the ctenophores, leading to disintegration. Storage temperatures should be between 5°C and 20°C. Avoid knocking or shaking the jars.

14. SOURCES OF FIGURES AND MAPS

Sources	Figures
Barnes (1974)	1c
Chun (1897)	10
Harbison and Madin (1982)	2d, 2e, 8
Hyman (1940)	1a, 1b,
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Ralph (1949)	3, 8, 10
Ralph and Kaberry (1950)	3
Robilliard and Dayton (1971)	7
Stiasny (1931)	8

15. REFERENCES

- Adams, H.R., Flerchinger, A.P. and Steedman, H.F. (1976). Ctenophora fixation and preservation. In: H.F. Steedman (Ed.). Zooplankton Fixation and Preservation. UNESCO Press, Paris. Pp. 270-271.
- Barnes, R.D. (1974). Invertebrate Zoology. (3rd edition). W.B. Saunders Co., Philadelphia. Pp. 138-143.
- Benham, W.B. (1907). New Zealand Ctenophores. Transactions of New Zealand Institute 39:117-192.
- Bigelow, H.B. (1924). Bulletin of U.S. Bureau of Fisheries 90:365.
- Chamisso, A. and Eysenhardt (1821). De anim. ect. In: Nova Acta Academie Caes, Leopoldinae 10:543-574.
- Chun, C. (1880). Die Ctenophoren des Golfes von Neapel, Fauna und Flora des Golfes von Neapel 1:1-313. Zoologischshen Station zu Neapel, Leipzig.
- Chun, C. (1897). Die beziehungen zwischen dem arkischen und antarktischen plankton. Stuttgart.
- Chun, C. (1898). Die Ctenophoren der Plankton-Expedition. Ergebnisse Plankton-Expedition der Humboldt-Stiftung 2, K.a., 32 pp. Verlag Lipsius and Tischer, Kiel and Leipzig.
- Deason, E.E. and Smayda, T.J. (1982a). Ctenophore-zooplankton-phytoplankton interactions in Narragansett Bay, Rhode Island, USA, during 1972-1977. Journal of Plankton Research 4(2):203-217.
- Deason, E.E. and Smayda, T.J. (1982b). Experimental evaluation of herbivory in the ctenophore Mnemiopsis leidyi relevant to the ctenophore-zooplankton-phytoplankton interactions in Narragansett Bay, Rhode Island, USA. Journal of Plankton Research 4(2):219-236.
- Ealey, E.H.M. and Chittleborough, R.G. (1956). Plankton, hydrology and marine fouling at Heard Island. ANARE Interim Report Number 15. 81 pp.
- Gordon, D.P. (1969). A platyctenean Ctenophore from New Zealand. New Zealand Journal of Marine and Freshwater Research 3:466-471.
- Greve, W. (1975). Ctenophora. Fiches Identification Zooplankton 146:1-6. Conseil International Pour L'exploration de la Mer.
- Harbison, G.R. (1984). On the classification and evolution of the Ctenophora. In: S.C. Morris, J.D. George, R. Gibson and H.M. Platt (Eds). The Origins and Relationships of Lower Invertebrates. Clarendon Press, Oxford. Pp. 78-100.
- Harbison, G.R. (1986). Not all ctenophores are hermaphrodites: Studies on the systematics, distribution, sexuality and development of two species of Ocyropsis. Marine Biology 90:413-424.

- Harbison, G.R. and Madin, L.P. (1982). Ctenophora. In: S.P. Parker (Ed.). Synopsis and Classification of Living Organisms 1:707-715. McGraw-Hill, New York. Plates 68-69.
- Harbison, G.R., Madin, L.P. and Swanberg, N.R. (1978). On the natural history and distribution of oceanic ctenophores. Deep-sea Research 25:233-256.
- Hyman, L.H. (1940). The Invertebrates : Protozoa through Ctenophora. McGraw-Hill, New York. Pp. 662-696.
- Kramp, P.L. (1957). Some jellyfish from Macquarie and Heard Island. ANARE Scientific Reports, Series B, 1 Zoology. Antarctic Division, Melbourne. 6 pp.
- Krumbach, T. (1925). Ctenophora. Handbuch der Zoologie 1:905-995.
- Leloup, E. (1938). Siphonophores et Ctenophores. Resultats du Voyage De La Belgica en 1897-99, Zoologie 4-12, 2 plates.
- Lendenfeld, R. (1884). Zeitschrift fur wissenschaftliche, Zoologie 41:673-682.
- Lesson, R.P. (1830). Description de la Famille des Beroides. Voyage autour du Monde de la Coquille, Zoologie 2(17):95.
- Lomakina, N.B. (1960). The Euphausiid fauna of the Antarctic and notal regions. Biological Reports of the Soviet Antarctic Expedition (1955-1958) 2:260-342.
- Mathews, D.C. and Townsley, S.J. (1964). Additional records of Hawaiian Platyctenea (Ctenophora). Pacific Science 18(3):349-351.
- Mayer, A.G. (1912). Ctenophores of the Atlantic Coast of North America. Publication Carnegie Institution of Washington 162:1-58, 17 plates.
- Mertens, H. (1833). Beobachtungen uber die Beroartigen Acalephen. Memoires de l'Academie imperiale des Sciences, St Petersburg, Series 6 2:497-544.
- Mortensen, T. (1913). Ctenophora from the "Michael Sars" North Atlantic Deep-Sea Expedition, 1910. Reports of the "Michael Sars" North Atlantic Deep-Sea Expedition, 1910 3:1-9.
- Moser, F. (1909). Die Ctenophoren der Deutschen Sudpolar-Expedition 1901-1903. Deutsche Sudpolar-Expedition 11:1-192, plates 20-22.
- Pianka, H.D. (1974). Ctenophora. In: A.C. Giese and J.S. Pearse (Eds). Reproduction of Marine Invertebrates 1:201-265. Academic Press, New York.
- Pople, W. (1960). The occurrence of Coeloplana in Natal, South Africa. South African Journal of Science 56:39-42.
- Ralph, P.M. (1949). Ctenophores from the waters of Cook Strait and Wellington Harbour. Transactions of Royal Society of New Zealand 78(1):70-82.

- Ralph, P.M. and Kaberry, C. (1950). New Zealand Coelenterates, Ctenophores from Cook Strait 3:1-11. Victoria University College.
- Rankin, J.J. (1956). The structure and biology of Vallicula multiformis gen. et. sp. nov., a platyctenid ctenophore. Journal of the Linnean Society of London 43:55-71.
- Robilliard, G.A. and Dayton, P.K. (1971). A new species of platyctenian ctenophore, Lyrocteis flavopallidus sp. nov., from McMurdo Sound, Antarctica. Canadian Journal of Zoology 50:47-52, 1 plate.
- Sears, C. (1976). An Edwardsiid larva parasitic in Mnemiopsis. In: G.O. Mackie (Ed.). Coelenterate Ecology and Behaviour. Plenum Press, New York. Pp. 247-250.
- Stanley, G.D. and Sturmer, W. (1983). The first fossil ctenophore from the lower Devonian of West Germany. Nature 303:518-520.
- Stechow, E. (1921). Arch. Naturgesch. 87 Abt. A (3 H.), p 262.
- Stiasny, G. (1931). Ueber einige Coelenterata von Australien. Rijks Museum Van Natuurlijke Historie - Leiden 14:27-41.
- Tamm, S.L. (1982). Ctenophora. In: G.A.B. Shelton (Ed.). Electrical Conduction and Behaviour in "Simple" Invertebrates, Clarendon Press, Oxford. Pp. 260-358.
- Yips, S.Y. (1984). Parasites of Pleurobrachia pileus Muller, 1776 (Ctenophora), from Galway Bay, western Iceland. Journal of Plankton Research 6:107-121.

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(continued inside back cover)

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18. G.R. Copson (1984). An annotated atlas of the vascular flora of Macquarie Island.
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28. T.H. Jacka (1985). Australian glaciological research; 1982-83.
29. R.J. Tomkins (1985). Attendance of Wandering Albatrosses (Diomedea exulans) at a small colony on Macquarie Island.
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