

# Ctenophores from the Waters of Cook Strait and Wellington Harbour

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## INTRODUCTION.

THE present paper describes three ctenophore genera from the waters of Cook Strait and Wellington Harbour area. Three of the six specimens of Beroids are juvenile with a size range of 0.4 mm. to 10 mm., so that no specific determination is possible. The other three specimens represent two species. Two of these are of exceptional size and are referable to *B. forskalii*. The other is a much smaller specimen of *B. cucumis*. The juvenile forms were obtained in plankton tows, while the two specimens of *B. forskalii* and the one specimen of *B. cucumis* were taken by a dip bucket. The other representatives of the group are the Cydippid genera *Pleurobrachia* and *Lampetia*. The specimens of *Lampetia* are juvenile, so that as with the juvenile *Beroë* no specific determination is possible. The specimens of *Pleurobrachia pileus* were taken in a plankton tow and the specimens of *Lampetia* by a dip bucket. All the specimens are in the possession of the Zoology Department, Victoria University College.

## BEROIDA

### **Beroidae** Eschscholtz

#### *Beroë forskalii* Milne-Edwards (Text-figure 1)

The specimens of *B. forskalii* were found off-shore at a depth of approximately one meter in Princess Bay, Cook Strait, north-west of the entrance to Wellington Harbour, on February 15, 1945. One of the specimens is 40 cm. in height and the other 18 cm. Hyman (1940), in speaking of the O. Beroidae, states: "The principal genus is *Beroë*, found in all seas, to 20 cm. in height and often of a pink colour, especially in colder waters." Delage and Herouard (1901) also give the height range of *B. forskalii* as 15 to 20 cm. The largest of the present specimens, then, according to the available literature, is twice the greatest recorded height for a Beroid, while the second is only 2 cm. less than the previous record height. A third *Beroë* seen at the same time was estimated at 18 cm. in height, but was too badly damaged to be worth retaining. All three specimens were originally an iridescent pink, agreeing with the above statement of Hyman (1940), and were actively swimming at the time of capture. The comb rows were colourless, but had a brilliant sheen. The larger *B. forskalii* is still a rose-pink colour after two years in formalin. The 18 cm. specimen has lost all trace of pink colouration and is an opaque cream-white.

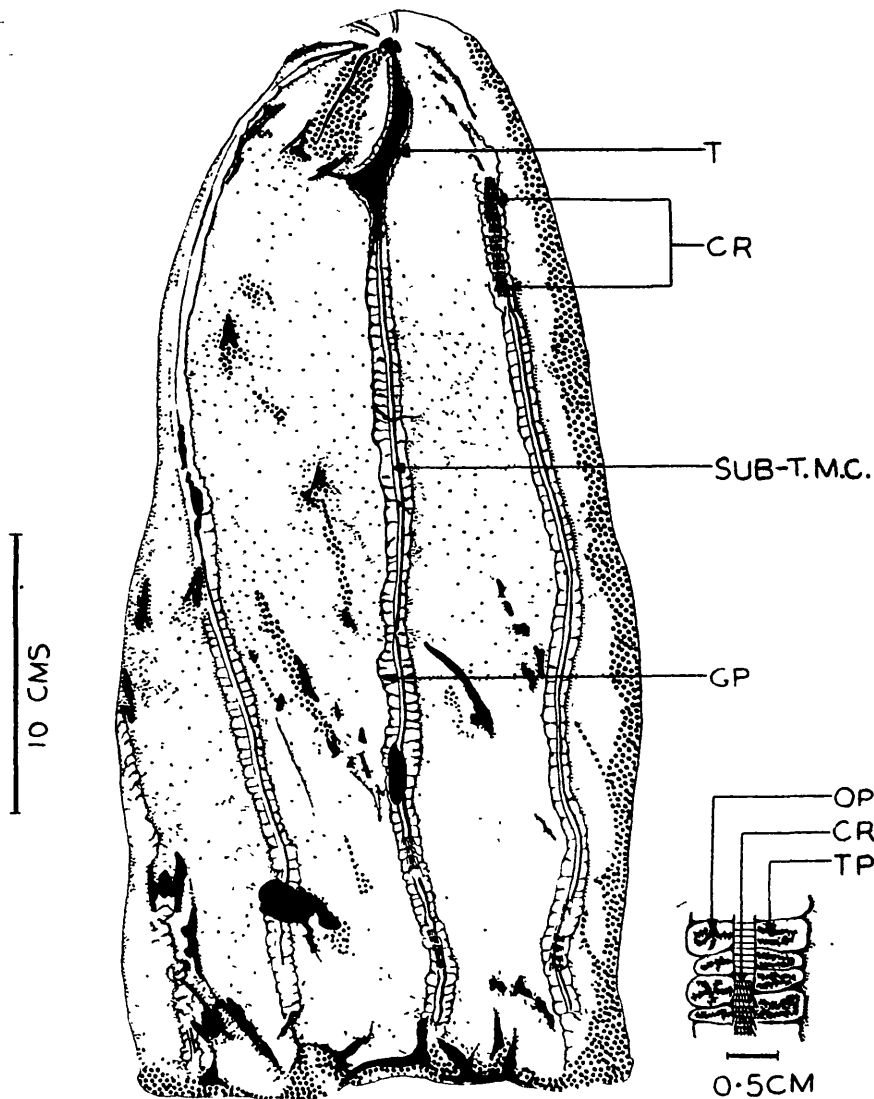


FIG. 1

FIG. 2

FIG. 1—*Beroë forskalii* of exceptional size. C.R., comb row; G.P., gonad pouch; SUB-T.M.C., sub-tentacular meridional canal; T., tear in the body wall.

FIG. 2—Gonad pouches of large *B. forskalii*. C.R., comb row; O.P., ovary pouch; T.P., testis pouch.

Text-figure 1 shows the typical mitre shape of the larger *B. forskalii* after preservation in formalin for two years and shows that the specimen is fairly extensively damaged. The polar field is 1.5 cm. in length. The body-wall is 5 to 6 mm. in thickness throughout the greater part of the body and is badly torn in several places. The tissue of the body-wall is dense, and consequently the lateral branches

of the meridional canals cannot be readily traced, but they are indicated by yellow fat globules which are present in the walls of the lateral branch canals and show clearly. The damage to the body-wall is greatest above the rim of the mouth and in the region of one pair of sub-sagittal canals. All the remaining canals are more or less damaged. Although the mouth region is damaged and in part contracted, it has the wide gape typical of *B. forskalii*. The mouth is 16 cm. in diameter. The diameter of the body at the equator is 15 cm. The specimen is now so delicate that any but the gentlest handling is sure to produce further tears in the body-wall. This makes direct observation of the canals difficult, but as far as could be ascertained the characteristic canal branching of *B. forskalii* exists, viz.: the frequent anastomosing of the branches of the meridional canals with each other and with the branches of the pharyngeal canals. The size of these branches in the present specimens and the distribution of the fat globules in their walls is shown in Fig. 5. Both the meridional and pharyngeal canals on each side are linked in the oral region by the typical peripheral canals above the rim of the mouth. The peripheral canals of each side do not join to form a ring canal above the mouth.

As is usual with *B. forskalii*, the sub-sagittal ribs run more closely together towards the aboral pole than do the sub-tentacular ribs and at the aboral pole almost touch each other. Two cm. from the apex the combs of a pair of sub-sagittal meridional canals are 1 cm. apart, while the combs of a pair of sub-tentacular canals are 2.5 cm. apart. In the present specimens all the comb rows are equidistant from each other about halfway down the body and terminate just short of the rim of the mouth. Thus the ribs extend at least the fourth-fifths the length of the body typical of *B. forskalii*. Isolated patches of combs rarely more than 1 cm. in length are all that remain of the original comb rows (Fig. 1). Ten combs per cm. were counted. The extent of the area of sabre-shaped cilia typical of *B. forskalii* could not be determined as the specimens are too badly damaged.

The gonads are well developed (Figs. 1 and 2) and typical of the species. They extend in special diverticula of the meridional canals from the apical region nearly to the rim of the mouth. The testes (and ovaries) of adjacent canals face one another as described by Hymen (1940). The majority of the ova in the diverticula measure approximately 0.5 mm. in diameter. The present specimens accordingly possess all the characters typical of the species *forskalii*, viz.: mitre shape, with marked lateral compression; a wide mouth; the ribs running  $\frac{3}{4}$  the length of the body; the sub-sagittal ribs close together towards the apex; frequent anastomoses of the meridional canal branches with each other and with the branches of the pharyngeal canals; and the gonads arranged in diverticula of the meridional canals and extending nearly to the rim of the mouth.

#### *Beroë cucumis* Fabricius (Text-figure 3)

The following description is taken from a single formalin preserved specimen 8 cm. in height and 4 cm. in diameter at the mouth and at the equator. This *Beroë* was captured off the coast of Island Bay, Cook Strait, in 1935 by Mr. Kaberry, of the Marine Department, Wellington.

It is mitre-shaped with marked lateral compression and the comb rows extend  $\frac{3}{4}$  of the length of the body. The canal system is injected with indian ink so that the meridional canals and their branches are fairly distinct. The meridional canals possess right and left lateral branches and to some extent the lateral branches of one canal interdigitate with those of a neighbouring canal (Fig. 3). Some anastomoses occur between the lateral branches of the pharyngeal canals and the meridional canals. These anastomoses are not frequent. Small branches are also given off from the peripheral vessel above the rim of the mouth. Gonads are present in the walls of the meridional canals of the present specimen. The spermatozoa are fully developed, but unfortunately the ova are immature and measure approximately 0.2 mm. in diameter. The specimen has most of the characters of a typical *B. cucumis*, viz.: mitre shape; marked lateral compression; the comb rows extending  $\frac{3}{4}$  the length of the body; and the gonads developing in the walls of the meridional canals. Typically *B. cucumis* has the pharyngeal canals unbranched and showing no communication with the lateral meridional canal branches. This feature is however an unreliable character for specific differentiation. The use of the canal branching as a character for specific differentiation is more fully explained in the discussion below.

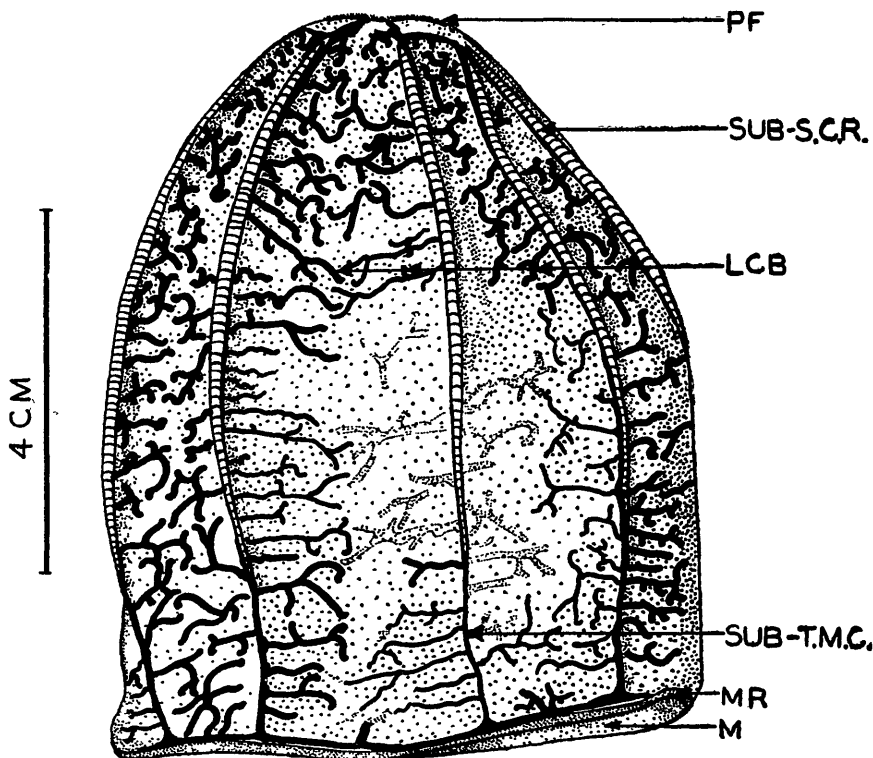


FIG. 3—*B. cucumis* to show the interdigitating canal branches. L.C.B., lateral canal branch; M., mouth; M.R., rim of mouth; P.F., polar field; SUB-S.C.R., sub-sagittal comb row; SUB-T.M.C., sub-tentacular meridional canal.

Juvenile *Beroë* (Text-figure 4)

Three juvenile *Beroë* are described from preserved material. Two of these were taken in a plankton tow off Barrett's Reef at the entrance to the Wellington Harbour, on July 21, 1947. Both specimens are 10 mm. in height with the apex dome-shaped. The comb rows are broad in comparison with large specimens. They are all of equal length and extend over the aboral third of the body. The apical sense organ is damaged. The pharyngeal canals are distinct and join with the meridional canals of their respective sides to form the peripheral canals above the rim of the mouth. The pharyngeal canals open into the infundibulum, which gives rise to the usual four interradial and eight adradial meridional canals. In one of these juvenile *Beroë* both pairs of sub-sagittal canals possess small blind branches. The sub-tentacular meridional canals and pharyngeal canals are however unbranched. The third juvenile *Beroë* was obtained in a plankton tow off Point Halswell, in the Wellington Harbour on November 1, 1947. It is only 4 mm. in height and almost as broad as it is high. The apex is dome-shaped. There are ten sets of combs in each comb row above the meridional canals and the rows extend over the aboral third of the body. All the meridional canals and the pharyngeal canals are unbranched. There are no visible pigment spots on any part of the body of these juvenile specimens, but this may be due to their preservation in formalin and a consequent fading of the pigment.

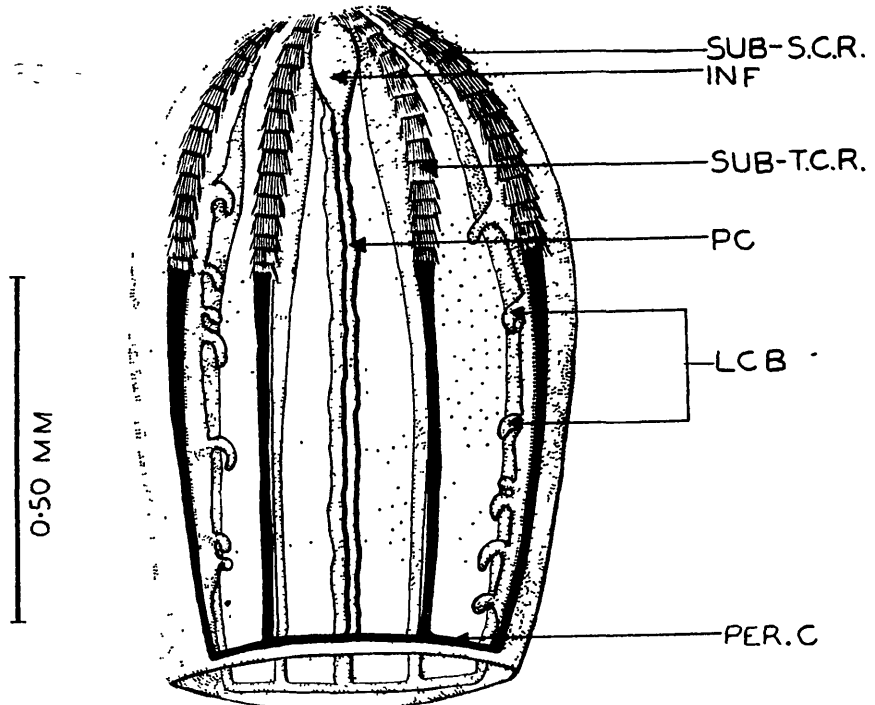


FIG. 4—Juvenile *Beroë*. I.N.F., infundibulum; L.C.B., lateral canal branch; P.C., pharyngeal canal; PER.C., peripheral canal; SUB-S.C.R., sub-sagittal comb row; SUB-T.C.R., sub-tentacular comb row.

Mayer (1912), speaking of the juvenile *B. ovata* and *B. cucumis*, states that "no specific differences can be detected in the immature individuals of both species," and also, "that the pink colour of the stellate pigment cells of the meridional canals does not appear till the young *B. cucumis* is about 25 mm. long and after the side branches grow out from the meridional vessels. The side branches do not begin to develop till the animal is 19 mm. long." As the present juvenile specimens already possess small side branches from the sub-sagittal canals they cannot be reasonably credited to either *B. ovata* or *B. cucumis*. In *B. forskalii*, however, in a specimen 8 mm. in height, Bigelow (1912) states, "the ribs now extend over the aboral third of the body and a few of the branches of the meridional canal anastomose. The gastric (pharyngeal) canals are still quite simple." It is therefore probable that the present 10 mm. juvenile specimens are *B. forskalii*, because in the one specimen the sub-sagittal canals possess small side branches. Other specific characters are however lacking.

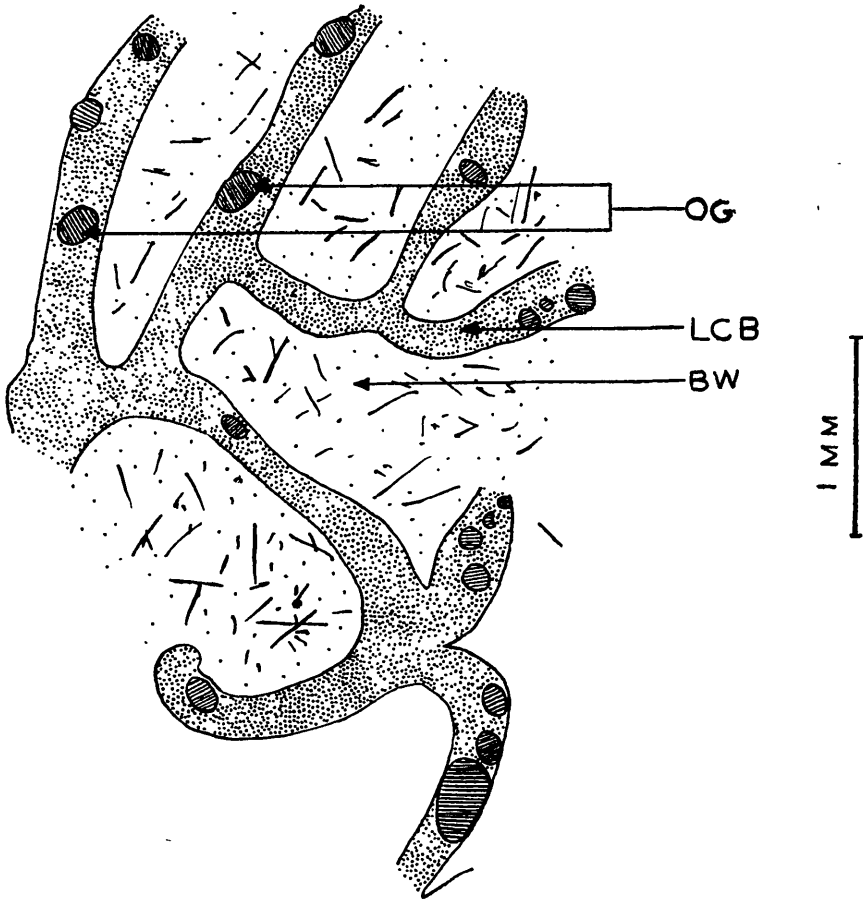


FIG. 5—Canal branches of *B. forskalii* to show fat globules. B.W., body-wall; L.C.B., lateral canal branch; O.G., fat globules.

The genus *Beroë* has been recorded for New Zealand waters prior to the present paper. Benham (1907) described *B. shakespearei* n.sp. from several specimens taken round the coast—(a) from the waters off Little Barrier Island, (b) off D'Urville Island, on the north coast of the South Island, and (c) off Tauranga, on the east coast of the North Island. The 8 cm. specimen described above differs from *B. shakespearei* Benham only in size and shape. The 8 cm. specimen is the typical mitre shape of *B. cucumis*, whereas *B. shakespearei* is globular. Mayer (1912) however states that form, size and colour are practically worthless as specific criteria in the genus *Beroë*. Therefore, although of different shape, *B. shakespearei* and the 8 cm. specimen described above as *B. cucumis* can be considered identical. Benham considered *B. shakespearei* most nearly related to *B. ovata*. Mayer (1912) however states that "*B. shakespearei* Benham, from New Zealand, is, I believe, identical with *B. ovata*, for it bears so close a resemblance to the form of *B. ovata* from Florida that were the two found together one could not separate them specifically." Mayer in his figure 73 shows a specimen of *B. ovata* from Florida comparable in size with Benham's specimen for his figure of *B. shakespearei*. Both specimens are globular in shape, but the canal system of the specimen from Florida is that of a typical *B. ovata*, viz.: the lateral meridional canal branches freely anastomosing with each other and with the pharyngeal canals. The illustration of Benham's New Zealand specimen shows the typical meridional canal system of *B. cucumis*, viz.: interdigitating lateral meridional canal branches, and although not illustrated, Benham's New Zealand specimens show a few anastomoses between the lateral branches of the pharyngeal and meridional canals. Komai (1918) considers as *B. cucumis* specimens with a few anastomoses between both the lateral meridional canal branches and the pharyngeal canal branches.

Benham (1907) states that the interdigitating meridional canal "caeca" of *B. shakespearei* are similar in nature to *B. ovata*. This seems to be a mistake, as non-anastomosing lateral meridional canal branches are typical of *B. cucumis* [Chun (1880) and Mayer (1912), Figs. 67 and 76]. Mayer's figure illustrates a *B. cucumis* of the same size as Benham's specimen for (Figure 1) *B. shakespearei*. Both figures show lateral interdigitating meridional canal branches. After comparing the canal system figured by Mayer (1912) for *B. cucumis*, it is difficult to accept Mayer's correctness in considering *B. shakespearei* synonymous with *B. ovata*. It seems far more likely that the 8 cm. specimen described above as *B. cucumis* and *B. shakespearei* are identical and should be specifically distinguished as *B. cucumis*. Bigelow (1912) considers *B. clarkii* (= *Idyiopsis clarkii* L. Agassiz) and *B. shakespearei* as undoubtedly identical and probably representing not a distinct species but a variety of *ovata*. *B. clarkii* as figured by Agassiz (1865) has interdigitating meridional canal branches. It would be preferable therefore to recognise *B. clarkii* as specifically identical with *B. cucumis*.

Doubt has arisen as to the advisability of accepting *B. cucumis* as specifically distinct from *B. ovata*. Most authors accept Chun's view (Mayer, 1912, and Bigelow, 1912) and consider *B. cucumis* as distinct from *B. ovata*: "bei *Beroë cucumis* enden die auf die Magen-

wand übertretenden Prolifikationen der Meridionalgefäßen blind, ohne ein anastomosirendes Netzwerk von Gefäßmaschen zu bilden, welches mit dem Magengefäß kommuniziert; bei, *B. ovata* anastomosiert ein Teil der Gefäßprolifikationen, indem sie nicht nur unter sich, sondern auch mit dem Magengefäße Verbindungen eingehen." Thus in *B. ovata* the lateral meridional canal branches anastomose with each other and with the lateral branches of the pharyngeal canals forming a net work. In *B. cucumis* no such anastomosing of the lateral branches occurs. The lateral branches of the meridional canals simply interdigitate. It seems a simple task to distinguish the species by Chun's definition, as the two species present very different canal patterns, but difficulties arise when a specimen such as the 8 cm. specimen described above must be identified. In this specimen the interdigitating lateral meridional canal branches are characteristic of *B. cucumis*, while the anastomosing of the lateral branches of the pharyngeal canals with the meridional canals is a feature of *B. ovata*. Komai (1918) has however described large specimens of *B. cucumis* from Japan that show a small number of lateral meridional canal branches that anastomose among themselves and also possess a few communications with the pharyngeal canals. In Komai's small specimens there is no anastomosing of the canal branches, i.e., they are typical *B. cucumis* as defined by Chun. Komai states that possibly the size of the egg may constitute "a point of difference between the two forms." In *B. ovata* the egg size is 1.0 to 1.2 mm. in diameter, while in *B. cucumis* the egg is approximately half that size, being between 0.4 and 0.5 mm.

Mortensen (1912) originally considered that it was impossible to maintain *B. ovata* as a separate species because the character thought to distinguish it from *B. cucumis*, viz.: the proliferations from the meridional vessels, is quite unreliable on account of its great variability. Mortensen found all transitional stages in the proliferations of the pharyngeal vessels in the same locality, in Greenland as well as the Mediterranean, and in his opinion these "species" only represent two phases of the one species. In a later paper, Mortensen (1927) agrees with Komai (1918), accepting the distinctness of *B. ovata* and *B. cucumis*, but considers that the species can be definitely separated only in terms of the size of the egg, which is taken to imply that there is a difference in development for the two species. Perrier (1936) and Korschelt (1936) distinguish *B. ovata* and *B. cucumis*, but at present I have not access to these papers, and consequently their basis for considering *ovata* as distinct from *cucumis* is unknown to me.

The size of the egg is not a really practical means of separating *B. ovata* from *B. cucumis*. In *B. shakespearei* as described by Benham (1907) and in the 8 cm. specimen described above, fully developed spermatozoa, but only immature ova, occur in the meridional canals. Such material could not be specifically identified with Mortensen's later criterion. This seems a highly unsatisfactory position and forces one back to a study of other characters, most of which have been discarded as inadequate. Some of the uncertainty that has arisen is due in part to the fact that Bigelow, Mayer and Mortensen published concurrently (1912). Mayer and Bigelow accept Chun's view and recognise *B. ovata* and *B. cucumis* as distinct species, while Mortensen



considers them one and the same species. Mortensen attempted to find characters other than the canal branching by which it might be possible readily to distinguish *B. ovata* from *B. cucumis*, but without success. Transitional stages from the freely anastomosing canal system of a typical *B. ovata* to the non-anastomosing canal system typical of *B. cucumis* undoubtedly exist. Unless Mortensen's earlier conclusion that *B. cucumis* and *B. ovata* are synonymous is generally accepted, it is apparent that there will be difficulty in the specific determination of much material, since, as in the present instance, the eagerly sought single diagnostic feature—whether the pattern of the canals, shape, colour, egg size—has proved unreliable or impractical. As there is variation in any one feature, diagnosis is difficult, but it must be kept in mind that such variation and the consequent uncertainty is not significant to the species but only to the systematist. With regard to the New Zealand specimens there seems little doubt that they should be recognised as *B. cucumis*. Whatever criterion is employed in diagnosis—whether Mortensen's earlier conclusion that the two species are synonymous or the canal system as defined by Chun, the characters of the specimens described above still serve to show that these are more properly assigned to *B. cucumis*.

The specimens described above and assigned to *B. cucumis* are however distinct from the two larger specimens described as *B. forskalii*, the chief distinguishing features being the length of the ribs, the distribution of the gonads and the frequency of the anastomosing of the canal system. In *B. forskalii*, very frequent anastomosing of the meridional canal branches with each other and with the branches of the pharyngeal canals is a constant feature. In *B. cucumis* the ribs extend only  $\frac{3}{4}$  of the distance between the apical region and the mouth, whereas in *B. forskalii* they extend  $\frac{5}{8}$  or more the length of the body. The gonads in *B. cucumis* develop entirely in the walls of the meridional canals, but in *B. forskalii* they are situated in diverticula of the meridional canals and the diverticula terminate just above the rim of the mouth. The position of the gonad, the length of the ribs and the difference in the canal systems constitute the major distinctions between the present specimens assigned to *B. forskalii* and *B. cucumis* and are the bases for their separation as distinct species in this paper.

Two species of *Beroë*, namely *B. forskalii* and *B. cucumis*, are represented in New Zealand waters. At present these are recorded from a small number of preserved specimens—*B. forskalii* from two specimens with a height of 18 cm. and 40 cm. and *B. cucumis* from one specimen 8 cm. high and from several smaller specimens with a height range of 27 to 62 mm. Bigelow (1912) considers it noteworthy that not a single specimen of his *B. forskalii* was taken in a surface haul. Bigelow's specimens of *B. forskalii* range in height from 5 to 29 mm. It has been reported to the author that *Beroë* of a similar size, shape and colour to the large *B. forskalii* described above have been sighted at the surface off Island Bay several times in the past two to three years. At the one time eight to ten specimens have been seen together. It is not possible to state at the present whether the large *B. forskalii* are surface-water forms or forms that have come inshore under exceptional conditions.

## CYDIPPIDA

## Pleurobrachiidae Chun

*Pleurobrachia* Fleming

One species of this genus, namely *pileus*, was recorded from New Zealand by Moser (1909). The present specimens are also *Pl. pileus* and were obtained in plankton tows from Barrett's Reef at the entrance to Wellington Harbour and off Point Halswell within the harbour area. They were netted over a period of nine months from June, 1947, to February, 1948. They range in size from 0.4 mm. to 23.5 mm. in height. The largest specimen was taken off Point Halswell on January 30, 1948.

Great variability in shape, size, and the position of the various body structures is found. This is in accord with the findings of other writers, notably Mortensen (1912) and Bigelow (1912). The present specimens show the different relationship of the gastrovascular system and tentacle bases due to contraction as figured by Mortensen (1912) [Fig. 13 a, b]. Transitional forms occur together in the same locality in the present material, but as Mortensen states, observations on a large number of living specimens are necessary in order to decide whether these differences occur in the living animal. The opportunity to do this, so far as the present writer is concerned, has not arisen. Apart from these variations, the specimens from the Wellington Harbour area are typical *Pleurobrachia pileus*.

Benham (1907) described the cydippid *Euplokamis australis* n.sp. from the north coast of the South Island, near Farewell Spit, and from Otago Harbour. Bigelow (1912) states that *Euplokamis australis* "is apparently a *Pleurobrachia* to judge from its tentacle sheaths. In form it resembles the more cylindrical specimens of the species of corresponding size in having much shorter tentacle sheaths and longer ribs. But the fact that *pileus* is now known from New Zealand suggests that *australis* is an extreme variant of that unstable form." Mortensen (1912) thinks that *Euplokamis australis* may have affinities with *Pl. pigmentata* Moser and *Pl. striata*, for these species also have the mouth edge bent outwards so as to form a funnel-shaped collar, but is not convinced that this is the correct grouping for the species.

None of the present specimens show the pronounced funnel-shaped collar of *Euplokamis australis*, nor have they its cylindrical shape. The position of the tentacle sheaths in *Euplokamis australis*, as pointed out by Bigelow, certainly leads to the conclusion that Benham's specimens are some species of pleurobrachid rather than a species of *Euplokamis*, which has the tentacles borne towards the lower third of the body. In 1935 Mr. Kaberry, of the Marine Department, Wellington, collected from Cook Strait in the living condition three specimens of a cydippid identical with that described by Benham (1907) as *Euplokamis australis*. The largest was 23 mm. in height and 12 mm. in diameter and the smallest 17 mm. high and 10 mm. in diameter. There seems little doubt that there exists in New Zealand waters a pleurobrachid distinguishable from *Pleurobrachia pileus*, particularly in the living condition, by the body shape, the structure of the comb rows and the shorter tentacle sheaths. On the evidence at present available it seems that *Euplokamis australis* is more

correctly a pleurobrachid and should be named *Pleurobrachia australis* (Benham).

*Lampetia* Chun (Text-figures 6 and 7)

Eight specimens of this genus were obtained by Mr. Kaberry, of the Marine Department, on October 1, 1942, off-shore at Island Bay, Cook Strait. All are juvenile with a size range of 7 mm. to 17 mm., so that no specific identification is possible. This is the first record of this genus for New Zealand waters. Komai (1918) described the species *pancerina* from Japan. The Japanese specimens showed no features differentiating them from the material described originally by Chun from the Mediterranean. The size and positional relationship between the different organs in the present material differ, as might be expected, from the adult specimen figured by Komai. The size range of Komai's specimens was 15 mm. to 40 mm.

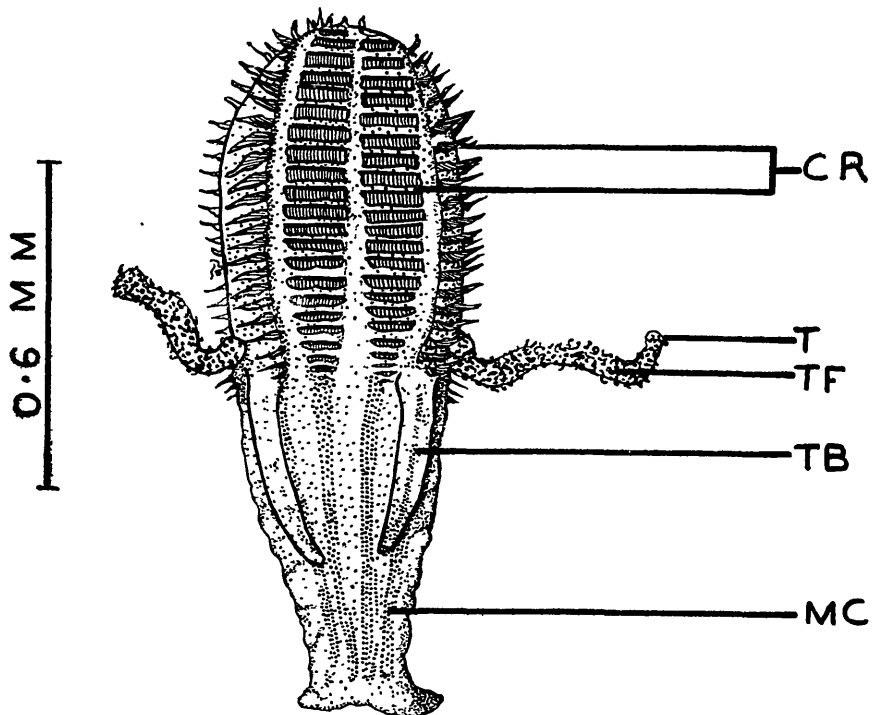


FIG. 6—Juvenile *Lampetia*. C.R., comb rows; M.C., meridional canal; T., tentacle; T.F., tentacle filament; T.B., tentacle base.

The present juvenile specimens possess large, broad comb rows and narrow intercostal spaces. In an individual 12 mm. in length there are approximately 20 combs in each rib. The rows extend to the opening of the tentacle sheaths or just beyond. The tentacle bases are large in relation to the size of the body, but the tentacle bases are recurved and the opening of the tentacle sheaths situated slightly above the middle of the body as in the Japanese species. The tentacles

when reasonably extended are long, and in a specimen 1.7 cm. in length the tentacle measures 5 cm. The pharynx occupies only the oral half of the body and is not divided into distinct regions as in the Japanese specimens. Small pharyngeal folds are however present at the entrance of the pharynx into the infundibular canal. The infundibulum is narrow and runs from the pharyngeal folds to the aboral pole. The two perradial canals are almost horizontal as are the adradial canals. Both run at a level somewhat above the opening of the tentacle sheath. The meridional canals are broad, but are not the complete width of the comb rows and are of equal length. Their

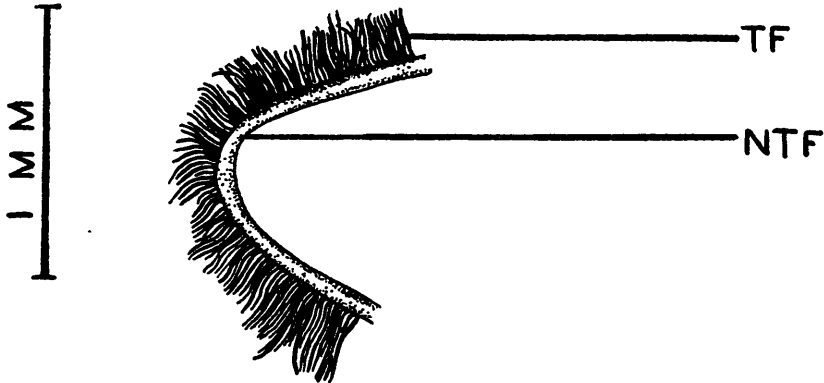


FIG. 7.—Portion of tentacle of *Lampetia* to show the partially contracted tentacle filaments and non filamentous portion of tentacle. N.T.F., non filamentous portion of tentacle; T.F., tentacle filaments.

oral ends terminate quite close to the margin of the mouth, where the pharyngeal canals also terminate. No gonads are visible. Large broad comb plates appear to be a feature of the juvenile forms of *Beroë* and *Lampetia*. None of the New Zealand specimens display the pharynx in the everted position. The size of the comb plates, the tentacle bases and the tentacles, and the size of the pharynx in relation to the infundibulum distinguish the present specimens from the Japanese material. The difference in size relationship of these structures in the New Zealand specimens is probably associated with their immaturity rather than marking a specific difference between the New Zealand and Japanese material.

The author's thanks are due to Professor Richardson for kindly encouragement and advice, to Professor Sir William Benham for useful information on the literature of the ctenophores, and to Mr. Taylor, Island Bay, Wellington, who collected and presented the two large *B. forskalii* to the Department.

#### SUMMARY

Two specimens of *Beroë forskalii* of exceptional size are recorded. The largest of these is 40 cm. in height, which is twice the greatest height previously determined for a Beroid. A single specimen of *B. cucumis* is described as well as three juvenile *Beroë* of undetermined species. *Pleurobrachia pileus* and *Lampetia* sp. are also recorded.

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