A NEW COMMENSAL HYDROID FROM ANTARCTICA

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ABSTRACT. A new marine gymnoblastic hydroid, *Monobrachium antarctica*, is described from Signy Island, South Orkney Islands. The hydroid lives in commensal association with several species of lamellibranch molluscs which burrow in fine sand. Various aspects of the ecology of the hydroid and the hosts *Mysella charcoti* and *M. miniascula* were studied by free-diving techniques and by laboratory investigation. The taxonomic position of this hydroid within the genus *Monobrachium* is considered together with a brief review of the characteristics of other species of the genus.

DURING the course of field investigations at Signy Island (lat. 60°43′S., long. 45°38′W.), South Orkney Islands, a gymnoblastic hydroid was found in commensal association with burrowing benthic lamellibranchs. The hydroid was distinctive in the possession of one tentacle, a feature which is only found in the family Monobrachiidae. The family contains a single genus *Monobrachium*, which to the present time has been represented by only two species. The newly found Antarctic form possesses the basic characteristics of the genus *Monobrachium*, to which it must be ascribed, while it shows distinctive features which necessitate the erection of a new species. As the locality from which it was collected is south of the Antarctic Convergence and as the area circumscribed by this convergence constitutes a discrete marine zoogeographical zone, it was designated by the specific name *antarctica*.

During the austral summer of 1969–70, an ecological study involving free-diving techniques was carried out by the author and other members of the Signy Island station, while taxonomic studies initiated at the station laboratory were continued in the United Kingdom.

MATERIAL AND METHODS

Living material was collected quantitatively from the fine sand substrate of Factory Cove using corers of 10 cm. diameter; non-quantitative samples were also taken from the same locality using a small, diver-operated trawl (Everson and White, 1969). The samples were sieved through a standard mesh with an aperture diameter of 0·5 mm., and the residue was sorted manually using a stereo-microscope. All bivalve molluscs, both with and without hydroid colonies, were transferred to containers of fresh sea-water at sea temperature; they were then either used for studies on the living animals or preserved by the addition of buffered formaldehyde to make a 10 per cent solution. A few specimens were preserved in 70 per cent alcohol to facilitate studies on the nematocysts. The behaviour of the hydroid colony was examined directly using a stereo-microscope. The gross activity of the host mollusc was studied by placing a few specimens in glass vessels containing sieved sand and sea-water, and examining burrowing movements over periods ranging from a few minutes to several hours.

Some core samples were quantitatively hand-sieved to determine the proportions of particles of various sizes present in the substrate. In these circumstances a pair of core samples was always taken from the same station so that one could be subjected to particle-size analysis while the other provided material for biological analysis. Wet samples were sieved through meshes with aperture diameter of 3·35, 0·50, 0·21 and 0·125 mm.; a very small quantity of material $< 0 \cdot 125$ mm. in diameter was discarded. Each residue was dried at 105° C for 24 hr. and then weighed.

Bivalve molluscs from occasional deep-water trawls off Signy Island were examined for the hydroid in order that knowledge of its range of hosts might be extended. Preserved core samples taken at various times throughout the year, from various localities in Borge Bay, Signy Island, were sorted and the lamellibranchs removed in order to study the infection rates of the hydroid and the population densities of the host molluscs.

Temporary microscopic preparations were made using lignin pink in ACS water-soluble mountant (Gurr). Nematocysts were studied using crush preparations of fresh or alcohol-fixed material. Sections were prepared using wax impregnation, lightly pre-staining specimens before processing to facilitate orientation in the wax. Sections were cut at 7 μm. and stained with haematoxylin and eosin. All microscopic measurements were taken using a calibrated eye-

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piece graticule. A comparison of *M. antarctica* with *M. parasitum* was carried out using a specimen of the latter species from Arctic waters off Novaya Zemlya.

A very brief study was made on the nematode fauna of the fine sand substrate of Factory Cove using a modified Baerman funnel technique; this was carried out because nematodes were noted as a prey of the hydroid.

FIELD STUDIES

Monobrachium antarctica was found at many localities in Borge Bay on the north-east of Signy Island (Table I). It had a depth range of 4–100 m. and was found on four burrowing lamellibranchs, *Mysella charcoti*, *Mysella miniascula*, *Nucula ? falklandica* and *Thyassira* sp. The first two molluscs were abundant in shallow waters, while the latter species were found rarely in material collected from deep-water trawls. On two occasions the hydroid was found on the dead valves of *M. charcoti*, but otherwise it was not found on inanimate objects or animals other than those mentioned above.

The hydroid occurred on all stages of the host molluscs greater than 0·5 mm., and apparently had no adverse effect on the maximum size achieved by the mollusc (Fig. 1). Core samples taken from various localities in Borge Bay revealed that the population density of host molluscs varied considerably, ranging from 0/m.^{2} on pebble bottoms to over 75,000/m.^{2} on bottoms of fine sand. *M. charcoti* was more common than *M. miniascula* in virtually all samples. Information relating to the population densities of the host *Mysella* spp. and the infection rates of *M. antarctica* is given in Table I.

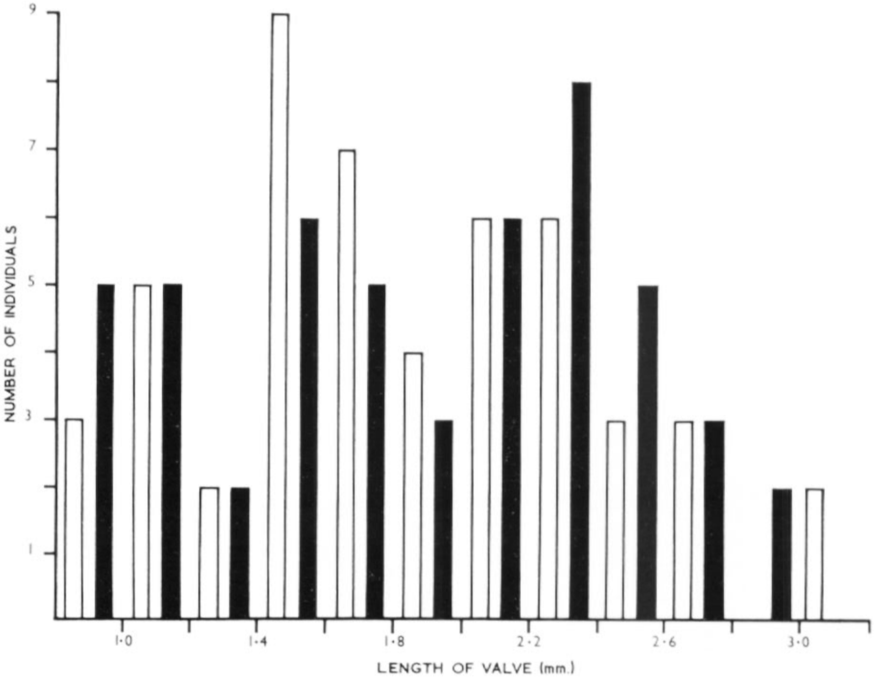

Fig. 1. Valve lengths of samples of 50 *Mysella charcoti;* solid columns—infected with *Monobrachium parasitum*; open columns—uninfected.

Particle-size analysis was limited to two contrasting paired core samples collected within Factory Cove. The results, summarized in Table II, indicate that the higher population densities of *Mysella* occurred in the samples composed mainly of fine sand. The *Mysella* from the pebbly sample lacked *Monobrachium*, while those from the sandy core had a reasonably high incidence of the hydroid.

TABLE I. POPULATION DENSITIES OF *Mysella* sp. AT LOCALITIES OFF SIGNY ISLAND, WITH DATA OF INFECTION RATES OF THE COMMENSAL HYDROID *Monobrachium antarctica*. DATA DERIVED FROM ONE OR TWO CORE SAMPLES OF 0·007 m.^{2}

Date	*Locality*	*Depth* (m.)	*Substrate*	*M. charcoti*					*M. miniascula*				
				Without	*With*	*Total*	*Percentage with*	*Population density/m.^{2}*	*Without*	*With*	*Total*	*Percentage with*	*Population density/m.^{2}*
1969													
9 May	Small Rock	9–15	Pebble beach	0	0	0	0	0	0	0	0	0	0
9 May	to	9–15	Sand between rocks	102	7	109	6·4	13,843	5	0	5	0	635
9 May	Billie Rock	9–15	Pebble beach	90	6	96	6·3	6,144	10	0	10	0	635
10 May	Small Rock	8–15	Sandy crevice	1	1	2	50·0	127	1	0	1	0	64
10 May		8–15	Pebble beach	2	0	2	0	128	0	0	0	0	0
10 May	to	8–15	Sand with pebbles	148	17	165	10·36	10,560	9	0	9	0	2,286
10 May		8–15	Sand with pebbles	223	18	241	7·5	15,424	0	0	0	0	0
10 May	Billie Rock	8–15	Sandy crevice	44	5	49	10·26	3,136	0	0	0	0	0
26 May	Off Drying Point	8–10	Sand below algae	254	86	343	25·0	21,952	70	16	86	18·6	445
27 May	Off Drying Point	8–10	Sand below rocks	11	0	11	0	704	2	0	2	0	127
27 May	Off Drying Point	8–10	Sand below algae	206	2	208	0·9	1,312	0	0	0	0	0
28 May	Small Rock to	13	Pebbly sand	7	0	7	0	448	22	0	22	0	1,397
28 May	Billie Rock	13	Pebbly sand	25	4	29	13·86	1,856	0	0	0	0	0
29 May	Between Mooring	6	Fine silt in crevices	9	0	9	0	576	2	0	2	0	127
	and Knife Points	6	Fine silt in crevices	4	0	4	0	256	2	0	2	0	127
30 May	Small Rock	15	Pebbles and sand	122	44	166	26·5	10,624	6	0	6	0	382
	Small Rock	15	Pebbles and sand	136	28	164	17·1	10,496	6	1	7	14·3	445
17 June	Off Mirounga Cove	4	Pebbly sand	212	4	216	1·9	13,824	9	0	9	0	573
18 June	Factory Cove	6	Sandy crevice	69	10	79	12·7	10,003	3	0	3	0	531
14 July	Small Rock to	15	Pebbly sand	41	7	48	14·6	3,072	1	0	1	0	63
14 July	Billie Rock	15	Pebbly sand	268	13	281	4·6	17,984	8	0	8	0	508
15 July	Small Rock	15	Pebbly sand	64	11	75	14·7	4,800	2	0	2	0	127
15 July	Small Rock	15	Pebbly sand	44	16	60	26·7	3,840	3	0	3	0	190
21 July	Small Rock	15	Pebbly sand	76	12	88	13·6	5,632	2	0	2	0	127
21 July	Small Rock	15	Pebbly sand	227	18	245	7·3	15,680	4	0	4	0	254
27 August	Small Rock	13·5	Gravel with sand	74	8	82	9·8	5,248	2	0	2	0	127
20 October	Small Rock	13	Gravel with sand	196	15	211	7·1	8,862	6	0	6	0	382
28 November	Small Rock	13	Pebbly sand	133	13	146	8·9	9,344	3	0	3	0	191
28 November	Small Rock	13	Pebbly sand	134	23	157	14·6	10,048	8	0	8	0	508
31 December	Berntsen Point	10	Boulder beach	149	18	167	10·8	10,688	13	0	13	0	826
1970													
2 February	Small Rock	13	Below algae	161	5	166	3·0	10,624	0	0	0	0	0
4 March	Factory Cove	5	Fine sand	311	209	520	40·26	33,280	52	0	52	0	3,302
6 March	Factory Cove	4·5	Fine sand	156	5	161	35·0	20,547	4	0	4	0	508
6 March	Factory Cove	4·5	Fine sand	1,051	116	1,167	10·0	74,688	11	29	40	72·5	2,540
7 March	Factory Cove	5	Fine sand	556	41	597	6·8	75,819	21	6	27	22·2	3,429
20 March	Factory Cove	4	Pebbly sand	156	5	161	3·1	13,589	4	0	4	0	508
20 March	Factory Cove	4	Pebbly sand	153	4	157	2·6	19,939	19	0	19	0	2,418

TABLE II. PARTICLE-SIZE ANALYSIS AND NUMBERS OF *Mysella* spp. FROM PAIRED CORE SAMPLES TAKEN FROM FACTORY COVE, SIGNY ISLAND

Particle diameter (mm.)	*Sample 1*		*Sample 2*	
	Sediment percentage of total weight	*Mysella* spp.	*Sediment percentage of total weight*	*Mysella* spp.
>3·35 (pebbles)	0·3		58·2	
>0·50 (coarse sand)	0·2	*M. charcoti* 597	20·2	*M. charcoti* 10
>0·21 (medium sand)	4·5	*M. miniascula* 27	11·5	*M. miniascula* 2
>0·125 (fine sand)	95·0		10·1	

Stereo-microscopic observations of living colonies of the hydroid revealed virtually no spontaneous movements; gentle stimulation with a probe caused only contraction of the hydranths. This general inactivity was in direct contrast with that of the host molluscs, which, when presented with suitable conditions, would rapidly bury themselves. When live *M. charcoti* were placed in a glass vessel containing fine sand and sea-water, they buried themselves to a depth of 3–5 mm. The burrows were not permanent as the molluscs move horizontally just below the surface; the maximum measured rate of movement was 105 mm./day. The gallery created in this way collapses behind the bivalve as it moves, leaving a shallow trench-like depression in the surface of the sand. Direct observations of the fine sand areas of Factory Cove revealed similar tracks. Live *Mysella* were never found on the surface of the substrate, but many were revealed when the uppermost few millimetres were removed by a gentle current generated by waving the hand.

During the course of sorting samples, six specimens of the hydroid were found in association with prey. In five instances a relatively large nematode was found projecting from the mouth of a hydranth, and once a small amphipod was observed stuck firmly to the tentacle. A single determination of nematode population density was made on a core sample of fine sand from Factory Cove; in this case 104 individuals were found in 1,120 cm.^{3}. No determination of amphipod population density was made but it is known that they form a major component of the meiobenthos in this environment.

DESCRIPTION OF *Monobrachium antarctica*

The colony occupies a position dorsal and posterior on the bivalve shell and spreads over the hinge (Fig. 2). The hydrorhiza takes the form of a continuous mat-like stolon, the edges of which are light brown in colour. The stolon is very occasionally drawn out into lobe-like extensions which spread more anteriorly and ventrally over the host's shell valves; these extensions are invariably devoid of hydranths. The colour of the colony is pale pink, which fades to white on preservation in 70 per cent alcohol or neutral sea-water formalin.

The hydranths arise singly from the stolonic mat and take the form of tall cylinders which terminate distally in a large cylindrical hypostome. The base of the hydranth is invested in a very delicate perisarc which is probably continuous with that of the stolon. A single filiform tentacle originates from the point of junction between the column and hypostome. The height of the column and hypostome is usually less than 1·0 mm. though it can reach up to 1·15 mm.; the tentacle is relatively long and may measure up to 1·70 mm. in length. Nematocysts are found over the entire surface of the hydranth, with concentrations on the tentacle and the hypostome. Only one type of nematocyst is present; this is a microbasic eurytele.

Up to six gonophores are present in any one colony; they arise singly from short peduncles on the stolonic mat and are elliptical in form, measuring up to 0·65 mm. in height and 0·45 mm. in diameter in the summer condition. The outermost layer is an acellular transparent cuticle upon which commensal vorticellid protozoans and bacterial colonies may be found growing. The cuticle is formed by a layer of flattened cells which is separated from the inner mass by a

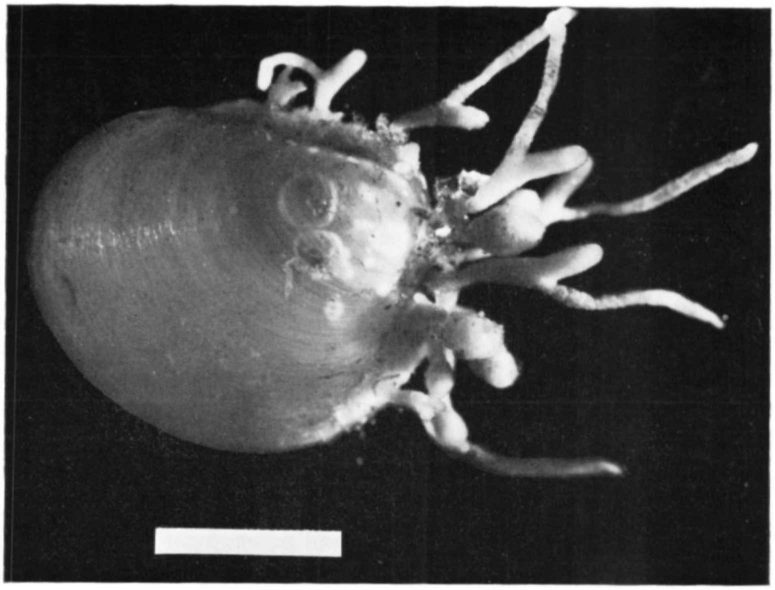

Fig. 2. *Monobrachium antarctica* on *Mysella charcoti*. The hydroid colony is immature and the gonophores are relatively small. The scale is equivalent to 1 mm.

narrow cleft. The inner cell mass, when viewed through the cuticle, has no outstanding features but in occasional specimens four optically dense streaks can be observed extending along the longitudinal axis.

Histological sections of the gonophores reveal that the central mass has the characteristics of a degenerate medusa. The substance of the bell is very thin except where four longitudinal ridges, which contain one radial canal in each, bulge into the sub-umbrellar cavity (Fig. 3). In most sections examined, the radial canal was obliterated by the contents of the gonads which fill the entire sub-umbrellar cavity. The circular canal, statocysts, manubrium, stomach and

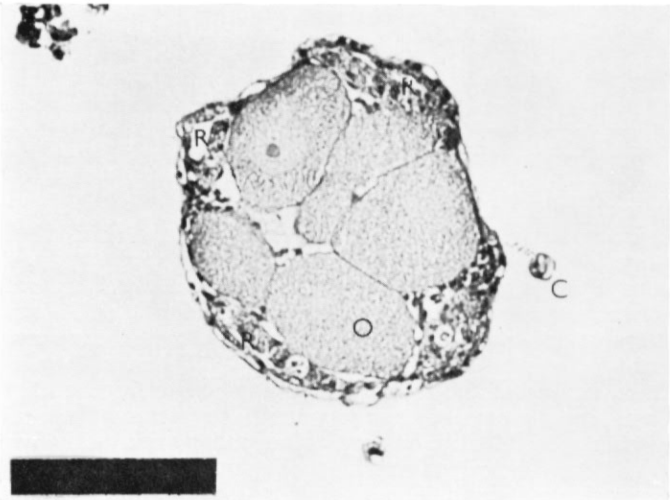

Fig. 3. Transverse section of a female gonophore of *Monobrachium antarctica*. Note the radial canals (R), ova (O), and the commensal vorticellid (C). The scale is equivalent to 20 μm.

velum are apparently absent. It is possible, however, that these structures have a transient existence during development, only to be obliterated by the growth of the gonads. In summer (January–February) specimens, the sub-umbrellar cavity is completely filled with gonads. In female medusae there are up to 14 ova in an indeterminate number of ovaries; similarly, in the male medusae the testes fill the sub-umbrellar cavity so completely that their number cannot be determined accurately. While it is possible to distinguish mature female gonophores using a high-powered stereo-microscope, it is not possible to differentiate between male and immature female gonophores. Therefore, it cannot be determined whether the colonies are monoecious or dioecious. In all cases examined, the cuticle surrounding the gonophore was entire and no free medusae were found.

The holotype and paratypes have been deposited in the British Museum (Nat. Hist.), catalogue numbers 1971.8.24.1 and 1971.8.24.2–13.

THE GENUS *Monobrachium*

Monobrachium is the only genus contained within the family Monobrachiidae (Mereschkowsky, 1877; Naumov, 1960); two species of this conservative genus have been described previously and it is necessary to consider these carefully in defining the present species. The main features of the three species of *Monobrachium* are given in a comparative form in Table III. From this it will be seen that there are two forms of *M. parasitum* which can be separated on the basis of their geographical distribution and several features of their anatomy and life history. Hand (1957) noted some of these differences, but did not consider them to be of specific significance. Nevertheless, until the time when the relationship between the two forms within this species complex has been resolved, it would be desirable to limit the specific name *parasitum* to the Arctic/North Atlantic form only.

Direct comparison carried out between the preserved mature specimen of *M. parasitum* and similar samples of *M. antarctica* confirmed the marked size difference between the two species. While some size discrepancy might be expected due to variation in method of fixation, the nature of the host, etc., the difference is of such magnitude that it must be considered as real. Comparison was also made of the dimensions of 100 nematocyst capsules from each of the two species. Mean values for *M. parasitum* were: length $14{\cdot}59\pm1{\cdot}72$ μm., breadth $10{\cdot}24\pm1{\cdot}91$ μm., while those for *M. antarctica* were $14{\cdot}42\pm0{\cdot}94$ μm. and $10{\cdot}26\pm1{\cdot}17$ μm., respectively. The differences in length and breadth were not significant, $p>0{\cdot}1$ in both cases.

DISCUSSION

Monobrachium antarctica is a hydroid found in apparently obligate commensal relationship with several species of burrowing Antarctic lamellibranchs. During the course of field studies many core samples were sieved and many hundreds of specimens were examined; only on two occasions was the hydroid found on an inanimate object, in both instances the still-joined valves of a recently dead host mollusc. Undoubtedly, the conditions provided by the host are of prime importance in the life of the hydroid. In the area studied *M. antarctica* is limited to only four species of small bivalves; as it is known that the benthos of Factory Cove includes many lamellibranchs such as *Laternula elliptica*, *Yoldia eightsi*, *Cyamiomactra laminifera* and *Yoldiella* sp., which are never infected, it is apparent that the relationship between the host and the hydroid is of a highly specific nature. This host specificity is especially noticeable in the genus *Mysella* where the hydroid infects *M. charcoti* and *M. miniascula* but is never found on *Mysella* "*B*" (personal communication from I. Rabarts). This implies a high degree of selection during the settlement phase of the planula larva of the hydroid and also the probability of micro-environmental specialization within the community of burrowing bivalves at the locality investigated, or extinction on unsuitable substrates.

From the study of core samples collected by free-diving in Factory Cove, it became apparent that the common host molluscs for the hydroid occur most frequently in fine sand deposits, though they may also occur less commonly in coarser sand and pebble bottoms (Tables I and II). Aquarium studies on the behaviour of the most abundant host lamellibranch, *Mysella charcoti*, in fine sand substrates revealed that it burrowed horizontally a few millimetres below the surface and that the gallery thus created collapsed behind the mollusc as it moved. While it

TABLE III. CHARACTERISTICS OF THE SPECIES OF THE GENUS *Monobrachium*

	M. parasitum (Arctic/ North Atlantic)	*Reference*	*M. parasitum* (Pacific)	*Reference*	*M. drachi*	*M. antarctica*
Localities	White Sea	(Mereschkowsky, 1877)	Canadian Pacific	(Fraser, 1937)	Tropical East Atlantic (Marche-Marchad, 1963)	Weddell Sea
	Barents Sea	(Naumov, 1960)	California	(Hand, 1957)		
	Kara Sea		Sea of Japan	(Naumov, 1960)		
	Chukchi Sea					
	Okhotsk Sea					
	Spitsbergen	(Bonnevie, 1899)				
	West Greenland	(Levinsen, 1893)				
	Canadian Atlantic	(Fraser, 1944)				
Depth range (m.)	5–155		18–307		18	4–100
Hosts	*Macoma baltica*		*Tellina* sp.		*Cuna gambieuse*	*Mysella charcoti*
	M. calcarea		*Axinopsis viridis*			*M. miniascula*
	M. moesta		*A. serricatus*			*Nucula ? falklandica*
	M. tenera		*Aligena redondoensis*			*Thyassira* sp.
	Astarte crenata		*Haplophragmoides planissimum*			
Height hydranth	Up to 2 mm.		Up to 1 mm.		Up to *c.* 2 mm.	Up to *c.* 1 mm.
Stolon	Reticulum or mat		Reticulum		Reticulum	Mat
Defensive zoids	Present or absent		Present		Absent	Absent
Number of gonophores	Up to 6		Usually 1–2		Up to 10	Up to 6
Free medusae	Probably no		Probably yes		Yes	Probably no
Nematocyst	Microbasic eurytele		Microbasic eurytele		—	Microbasic eurytele

cannot be assumed that the aquarium conditions were the same as those prevailing in the sea bed, direct inspection of the natural environment whilst diving confirms both the shallow buried position of *Mysella* spp. and the presence of fine V-shaped grooves indicative of collapsed horizontal burrows which can probably be ascribed to *Mysella* spp. The dorsal position of the hydroid on the host's shell is such that as the mollusc moves the hydroid colony is pulled through a mobile semi-fluid medium of fine particles. Small surface-dwelling meiobenthic organisms must be drawn into this region of collapse and here caught by the hydroid. This situation is similar to that described by Edwards (1965) for the hydroid *Neoturris pileata*, which similarly lives on the shell of burrowing bivalves in British waters. Nematodes and an amphipod were found in association with *M. antarctica* in such a manner that they must be regarded as its prey.

The presence of *M. antarctica* on the mollusc *Mysella charcoti* does not affect the length of the host's shell nor, it may be assumed, the general well-being of the host (Fig. 1). This might appear to be a rather unusual finding as the presence of the hydroid on the mollusc must increase the drag on the bivalve as it moves through the sand and hence to diminish burrowing efficiency. However, bivalves lacking the hydroid frequently carry epizoic growths of bryozoans and vorticellid protozoans; so it might be assumed that the presence of the hydroid has no effect on the mollusc different from the other common epizoic organisms.

Although the life cycle of *Monobrachium antarctica* is not yet fully understood, study of mature gonophores gives some information on this point. The contained medusae are degenerate in structure and contain large and fully developed gonads; therefore it is probable that the medusae are not released from the gonophores. Fertilization probably occurs *in situ* and the planula larva may be retained until suitable conditions for release and settlement occur.

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