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# RECORDS OF *THOMPSONIA* (CRUSTACEA: CIRRIPEDIA: RHIZOCEPHALA) FROM SINGAPORE, INCLUDING DESCRIPTION OF TWO NEW SPECIES, *T. LITTORALIS* AND *T. PILODIAE*

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*ABSTRACT.* - In Singapore, the parasitic barnacle *Thompsonia dofleini* Häfele occurs on the swimming crab *Portunus pelagicus*, while *T. littoralis*, new species, and *T. pilodiae*, new species, is present on two littoral xanthid crabs, *Leptodius exaratus* and *Pilodius nigrocrinitus* respectively. Very high infection percentages are recorded for *T. dofleini* and *T. littoralis*.

## INTRODUCTION

Species of the genus *Thompsonia* are small, gregarious rhizocephalans which infect a wide variety of hosts, ranging from stomatopods, carideans and anomurans to brachyurans. Compared with other rhizocephalans, their anatomy and biology are inadequately known. This is mainly because most of the previous finds have been chance records or originate from localities which are difficult to revisit. It was therefore fortunate that Phang (1975) reported a species of *Thompsonia* to be extremely common on the blue swimming crab *Portunus pelagicus* (L.) around Singapore. While visiting Singapore in order to sample this species, it came to our notice that two more Singaporean crabs were also infected with *Thompsonia*. The present paper describes the new finds and identifies the species from *Portunus*. Specimens are deposited in the Zoological Reference Collection, Department of Zoology, National University of Singapore (ZRC) and the Zoological Museum, University of Copenhagen (ZMUC), Denmark.

## RESULTS

### *Thompsonia ?dofleini* Häfele, 1911

*Material.* - In the ZRC are several infected male and female *Portunus pelagicus* collected around Singapore Island (Johore Straits, Ponggol, Bedok, Siglap, mouth of Geylang River and Tuas) and from off Kusu Island to the south. In addition, we have examined five infected live crabs obtained on 5 February 1990 near Tuas.

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*Description.* - The close similarity between Häfele's description and illustration (1911a: fig. 3) and those by Phang (1975) makes it very probable that the Singaporean species is identical with *T. dofleini.* In both cases the full-grown externa (only stage described by Häfele) exhibits an elongate or club-shaped form, which is unusual in species of *Thompsonia*, and the stalk is encircled by two, not a single, close-set annuli. The only difference is that Häfele described a button-shaped structure on the middle part of the externa, which he believed to cover a genital pore (meaning obviously a mantle aperture). Such a structure was not reported by Phang, and it is likewise absent in the material we have seen, as is also a mantle aperture. Whether the structure signalizes a real difference or is due to a misinterpretation could not be decided because Häfele's original material, deposited in the Zoologische Staatssammlung, Munich, Germany, was lost at the end of the Second World War.

*Number and position on host.* - Häfele (1911a) had a single infected crab at his disposal, also a *P. pelagicus* from an unknown locality. It was infested with an estimated 1500 externae, occurring on most parts of the body. According to Phang (1979), heavily parasitised crabs may often carry a few thousand externae, which are predominantly located on the ventral surfaces of the legs and thoracic sternum, but may occur also on many other parts of the body.

*Biological notes.* - From November 1974 through April 1975, Phang (1975) reported an infection percentage ranging between 23.8 and 67.7. Their high occurrence in Singapore might be rather local since there exist no other records of *Thompsonia* in the extensive literature dealing with this common, widely distributed and much studied edible crab (see Guinot, 1967). However it is known to occur also in other parts of Southeast Asia (P. K. L. Ng, pers. comm.) and it is possible that *Thompsonia* specimens from another swimming crab, *Thalamita prymna* (Herbst) from Murray Island, northern Australia (Potts, 1915: fig. 1, pl. 1 fig. 3) is identical or at least very closely related. The simple illustration given by Potts show no details, but the externae have an elongate shape reminiscent of *T. dofleini.*

### ***Thompsonia littoralis*, new species**

(Figs. 1-3)

*Material.* - Holotype - ZRC 1990.587, many externae on a male *Leptodius exaratus* (H. Milne-Edwards), Sentosa Reefs, Singapore, coll. P. K. L. Ng, 12 Dec. 1989.

Paratypes - ZRC 1990.588, three infested *L. exaratus*, locality and date as above. – – Many infested *L. exaratus*, Labrador Park beach, Singapore Island, 7-11 Feb. 1990; part of this material was preserved in Bouin's fluid, transferred to ethanol and deposited in the ZMUC. Several specimens representing various developmental stages were embedded in araldite and cut into 1-2 µm thick serial sections stained with toluidine blue.

*Description.* - Ovigerous externae are perfectly drop-shaped, consisting of an evenly rounded, ovoid body, 0.9-1.3 mm long and 0.7-0.8 mm in diameter, that tapers gently into a ca. 1.0 mm long and 0.15 mm thick stalk (Fig. 2B). Immediately above the level where the stalk penetrates the host's skin, the cuticle surrounding the stalk is thickened to an annulus, which is often difficult to distinguish. Although the cuticle is tough, it is so transparent that the embryos or cyprid larvae are easily visible through it. Not even in externae with fully developed cyprids was a mantle aperture ever found to be present. Live externae are pale yellowish but tend to turn greyish-yellow when they contain cyprids.

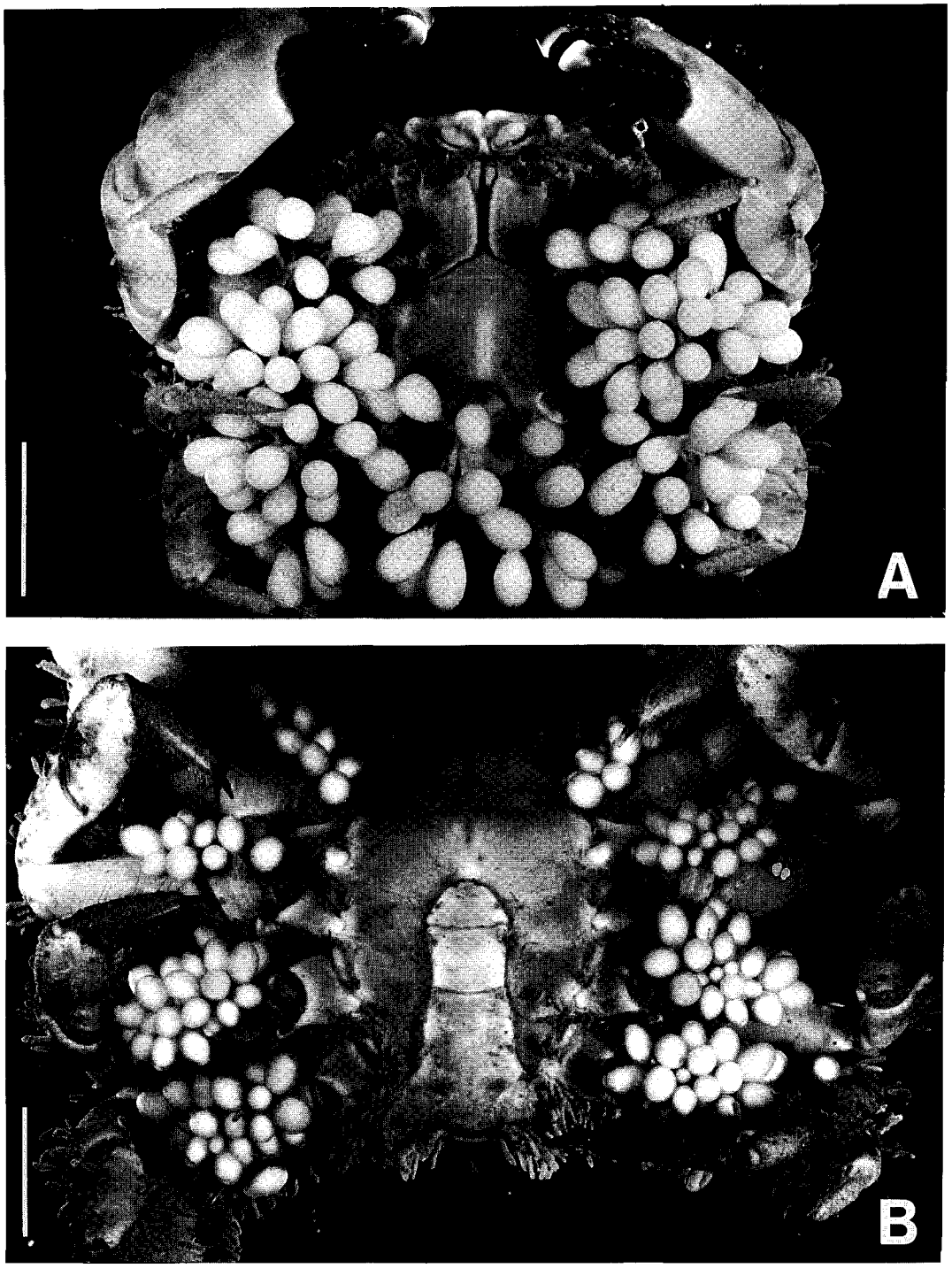


Fig. 1. *Thompsonia littoralis,* new species. Holotype with pregnant externae (A) and one of the paratypes, with immature externae (B). Scales represent 3 mm.

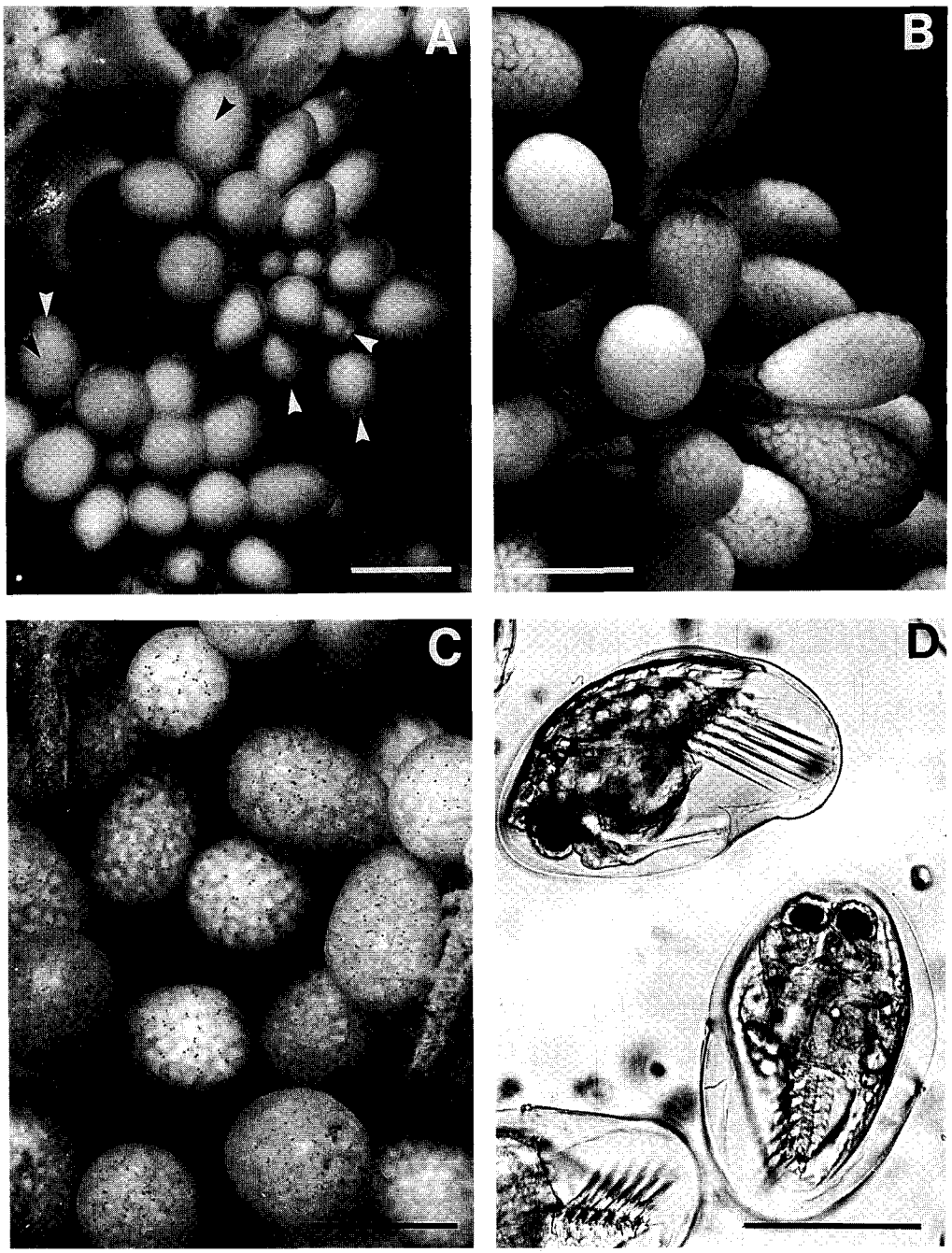


Fig. 2. *Thompsonia littoralis*, new species. A-C successive stages in the development of the externae: A, immature externae with unsegmented eggs in the ovary (black arrowheads) and a whitish body at the apical end (white arrowheads); B, externae with embryos (type-specimen); C, externae with the mantle cavity crowded with cyprids. D, two cyprid larvae, each with a pair of black compound eyes. Scales represent 1 mm (A-C) and 100 µm (D).

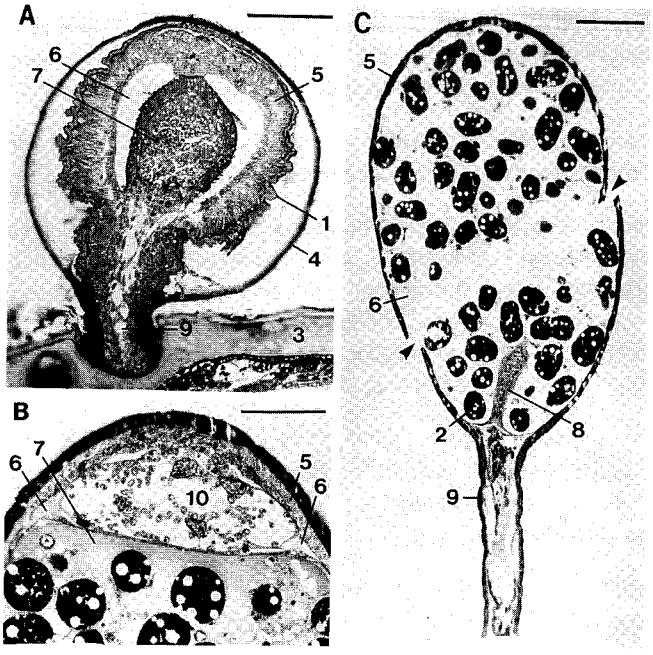


Fig. 3. *Thompsonia littoralis*, new species. Longitudinal sections through a small (A), medium-sized (B) and ovigerous specimen (C), embedded in Araldite and stained with toluidine-blue. 1: definitive cuticle; 2: embryos; 3: host cuticle; 4: juvenile cuticle; 5: mantle; 6: mantle cavity; 7: ovary; 8: spent ovary in visceral sac; 9: stalk; 10: vesicle containing spermatocytes. Arrowheads indicate cut made to facilitate penetration of fixative and embedding medium. Scales represent 100 μm (A), 100 μm (B), and 200 μm (C).

The smallest external stages seen are spherical, 0.13-0.15 mm in diameter, and with a stalk so short that it is hardly visible. A number of specimens which are intermediate in size and development between this stage and the pregnant one measure 0.4-0.7 mm in length and 0.3-0.5 mm in width. They are perfectly ovoid, although with a tendency in some to become slightly pointed towards the apex (Fig. 2A). The stalk in these specimens is relatively short and sharply set off from the body. In such stages, a compact yellowish ovary containing oocytes or unsegmented eggs can be seen to occupy most of the external body except for the apical region, where it is replaced by a milky-white tissue.

*Etymology*. - The specific name is derived from the littoral habitat of the host species, *Leptodius exaratus*.

*Number and position on host*. - More than one hundred externae were frequently found on a single host (Fig. 1B), but some crabs carried much less, e.g., only 15 to 20. In almost all infected crabs the majority of the externae emerge, singly or in bunches of a few together, from the anterior or ventral margins of the chelipeds and all four pereiopods; they are exclusively present on the basal parts of the legs, invariably occurring on the ischium and merus, more rarely on the basis, and never on the carpus, propodus and dactylus. Often, but less regularly, a number of externae attach to the dorsal surface and lateral margins of the abdomen. A few externae are sometimes found attached to the third

pair of maxillipeds, to other parts of the mouth region, or to the ventral or dorsal aspects of the frontal margin of the carapace. Generally, there is a striking symmetry in the arrangement and number of the externae on right and left sides of the host.

Even though some variation occurs, the size and stage of development of all externae from one and the same infested crab are more or less identical.

*Biological notes.* - The host, *L. exaratus* (family Xanthidae), is a small crab with a carapace that reaches ca. 30 mm in width. It is common in the intertidal zone of rocky beaches from Japan and Hawaii throughout the warmer parts of the Indo-Pacific to the Red Sea and east coast of Africa (Sakai, 1976). At Labrador Park beach it is restricted to a narrow zone estimated to be submerged for two thirds of the tidal period. Infected and uninfected crabs were collected together at low tide, when they lie buried in coarse sand under stones.

Both sexes of crabs were infected. Although many uninfected females were berried, this was the case in only one infected one. There was no apparent indication of any modification of the secondary sex characters in either sex of the host.

The type material from Sentosa Reef consists of the rhizocephalans on four crabs and was collected along with 15 uninfected crabs. At Labrador Park the infection percentage was very high, every second of ca. 150 examined crabs being infected with *T. littoralis*. Some of the *L. exaratus* at this locality were parasitized by another rhizocephalan; this was not sampled for identification, but presumably was either *Sacculina leptodiae* Guérin-Ganivet or *Loxothylacus brachythrix* Boschma, both of which are known from this species of crab in the central Indo-Pacific region (Boschma, 1937). Double infections of crabs by this sacculinid and *T. littoralis* were not observed.

### *Thompsonia pilodiae*, new species
(Fig. 4)

*Material.* - Holotype - ZRC 1990.589, 33 externae on a male *Pilodius nigrocrinitus* Stimpson (family Xanthidae), Sentosa Coral Reef, Singapore, coll. P. K. L. Ng, 27 May 1982.

*Description.* - All the externae contain larvae. The body is ovoid, 0.9-1.4 mm in length and 0.6-0.8 mm in diameter, and set on a relatively short (0.3 mm) stalk, surrounded basally by an inconspicuous cuticular annulus. The mantle is very thin and transparent; the outer layer of the external cuticle here and there detach in flakes. There is a circular mantle aperture, 140 µm across, at the apical end of the body. It leads into a spacious mantle cavity crowded with cyprid larvae that can be plainly made out through the mantle. The exhausted, rod-shaped visceral sac is seen to arise from the floor of the mantle cavity and to pass through the cavity towards the mantle aperture where it ends.

*Etymology.* - The species name is derived from the host genus, *Pilodius*.

*Position on host.* - All externae are located on the ischium and the merus, a few on the basis, of pereiopods one to three, but scars from earlier infections occur also on the ischium of one of the chelipeds and on the sternum.

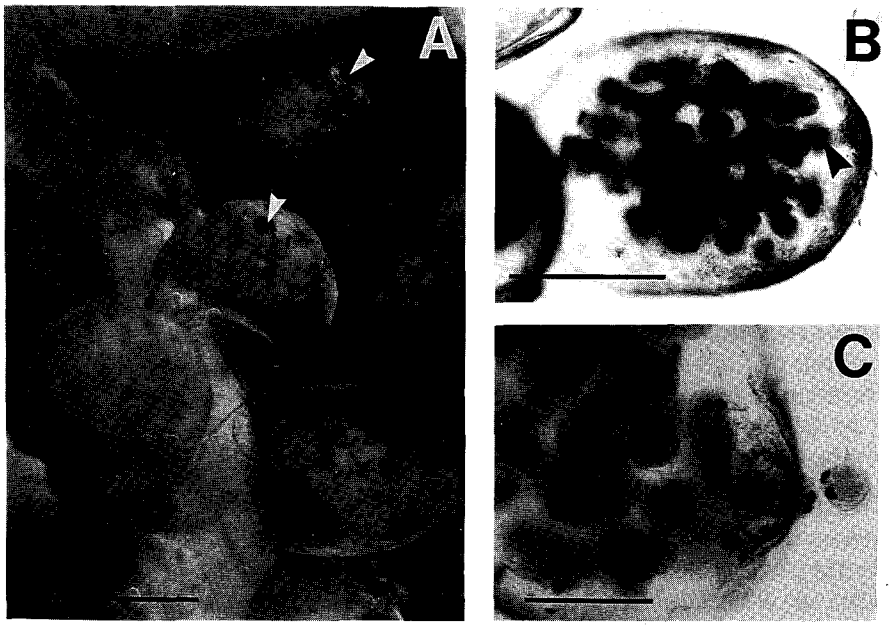


Fig. 4. *Thompsonia pilodiae*, new species. Holotype showing the mantle apertures (arrowheads) of two externae (A), the rod-shaped visceral sac (arrowhead) (B), and cyprids emerging from the mantle aperture (C). Scales represent 1 mm (A), 500 μm (B), and 200 μm (C).

## DISCUSSION

Species of *Thompsonia* are now known from two families of crabs, the Portunidae and Xanthidae sensu lato. The records from species of Portunidae are mentioned under *T. dofleini*.

Besides the two xanthid crabs recorded as new hosts, four other xanthids are known to be infected; these are *Lybia tessellata* (Latreille) from the Philippines, by *T. globosa* Kossmann, 1874; *Pilumnus dofleini* Balss and *Actumnus squamosus* (de Haan) from several Japanese localities (depth 20 to 150 m), by *T. japonica* Häfele, 1911; and *Paractaea rueppelli* (Krauss) from Natal, South Africa, by an unnamed species (Potts, 1915).

*Thompsonia globosa* is hardly recognizable, as the only two specimens were insufficiently described. The same applies to the species from *P. rueppelli*, of which there is no description at all and only a sketchy illustration (Potts, 1915: pl. 1 fig. 4). In size and morphology of the various developmental stages (Fig. 3) as well as in position on the host, *T. littoralis*, new species, exhibits so many similarities with *T. japonica* (as described by Häfele, 1911a,b; Yanagimachi & Fujimaki, 1967) that the two are very difficult to separate. However, the carapace length of the cyprid larvae of the new species (300 larvae were measured from a total of 12 externae), is 167 to 170 μm (Fig. 2D), which is considerably less than in *T. japonica* (ca. 200 μm according to Häfele, 1911b). *T. pilodiae* differs from both of these species by the presence of a mantle aperture.

Sections demonstrated that the milky-white tissue in the apical part of many medium-sized externae is a derivation from the mantle and contains smaller or larger vesicles with

numerous spermatocytes or mature sperm cells (Fig. 3B). It occupies exactly the same position as the "testes" in *T. japonica* described by Yanagimachi & Fujimaki (1967). Whereas fertilization of the eggs and the embryonic development in other rhizocephalans occur in the mantle cavity, in species of *Thompsonia* these events are claimed to take place within the ovary, and it has been questioned whether a mantle cavity is at all present in *Thompsonia*. Microanatomical studies of *T. littoralis* have proven that even if it is not evident from outside, such a cavity nevertheless exists from an early stage (Fig. 3A), and that larval development is completed, and presumably also starts, in it (Fig. 3C). This is in contrast to *T. japonica*, in which Häfele (1911b) and Yanagimachi & Fujimaki (1967) report the development to take place within the ovary, unless these authors have mistaken the mantle cavity filled with embryos for the ovary. Although many externae containing active cyprids of *T. littoralis* were examined, no mantle aperture was ever found and perhaps, therefore, as Häfele suggested for *T. japonica*, the cyprids become liberated by rupture of the delicate mantle of the ageing externae. A few of the externae in *T. pilodiae* had been evacuated by the cyprids, and since the mantle wall was unbroken the mantle aperture in this species must serve as an exit.

*Thompsonia dofleini* is easily distinguished from the species known from xanthid crabs by the elongate club-shaped form of the externa and by the presence of two annuli, rather than one around the stalk base. It is further characterised by its development of the externae being never synchronized, as it is in other crab parasites, but that a complete series of developmental stages occur together on each infected swimming crab (Phang, 1975; personal observations).

The discovery of heavy parazitization of *Leptodius exaratus* by *Thompsonia* in Singapore is of great interest. A large number of infected crabs can be collected easily and, as we have experienced, maintained for months in the laboratory without difficulties and apparent negative effects to the parasites. This offers a unique opportunity to study the anatomy, biology and host relations in a rhizocephalan genus that has otherwise been so difficult to obtain.

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