

**Dimorphic Malpighian tubules
observed in *Mastigus pilifer* (Kraatz)
(Coleoptera Scydmaenidae)**

Note 08 (Staphylinidea), released by Luigi De Marzo on October 2012 –
In memory of the clever entomologist, Baccio Baccetti.
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SUBJECTS

- Anatomical diversity of the Insect Malpighian tubules is minutely documented in textbooks of Entomology (e.g., Berlese, 1909);
- it involves shape, length, number of units and connection of the apexes;
- in Coleoptera, it expresses with both the cryptonephridial type of members of the series Cucujiformia, where apices of all tubes connect to the midgut,
- and the “type ansé” reported by Paulian (1988) for some Adephaga and Staphylinidae, where tubules are handle-like do.
- Modified Malpighian tubules of Coleoptera include enlarged sectors, which workers relate to colonies of symbiotic microorganisms (Buchner, 1965; Nardon & Grenier, 1989).
- A new instance of modification is described in the present note.
- This is dedicated to the memory of the clever entomologist, Prof. Baccio Baccetti, who provided several anatomical, histological and histochemical details of the Malpighian tubules for a curculionid beetle (Mazzi & Baccetti, 1956).

MATERIAL AND METHODS

- Both adults and full-grown larvae of *Mastigus pilifer* Kraatz were obtained by sifting the litter in a forest of Southern Italy.
- Adults were collected in October, i.e., in the oviposition period; larvae were found in November, when they disperse in the litter, as known from the literature (De Marzo, 1983).
- Internal organs were studied in fresh preparations; they were separated from specimens anaesthetized with ethyl acetate vapours and dissected in salt solution (NaCl 0,9%).
- Content of the Malpighian tubules was inspected with a 40x phase-contrast lens.

RESULTS

- According to the rule in the Insects, the Malpighian tubules of *Mastigus pilifer* do connect in a crown at the boundary between the mid- and the hindgut (Fig. 1);
- they include four units in both adults and larvae.
- Each unit is merely tubular in the full-grown larvae, except for a moderately enlarged segment at base,
- whereas it exhibits in the adults a basal sack-like diverticulum.
- Although tubules of both sexes are similar in their schematic view (Figs. 2.A-B), their basal sectors are clearly greater in the females.
- Tubules of both males and females were inspected by crushing them on slides in the salt solution.
- Their content consisted in a myriad of spherical/ellipsoid corpuscles about 1-2 μm large in diameter (Fig. 3)
- and did show any morphological difference neither between the sack-like and the tubular sectors nor between males and females.

DISCUSSION

- Besides their typical excretory function, the Insect Malpighian tubules can be engaged otherwise (Maggenti & Gardner, 2005);
- e.g., in Rhynchota they are engaged in producing the characteristic froth of the young Cercopidae and are the source of the so-called “brochosomes” of the Cicadellidae;
- furthermore, they provide a silk-like material, which is employed in building cocoons by larvae of several Neuroptera, Coleoptera and Hymenoptera.
- A list of the Coleopteran larvae provided of silk-producing Malpighian tubules is reported by Mazzi & Baccetti (l.c.)
- and includes *Lebia scapularis* (Fourcroy) (Carabidae), *Niptus hololeucus* (Faldermann) (Ptinidae), *Hypera* spp. and *Donus crinitus* (Boheman) (Curculionidae).
- Moreover, Mazzi & Baccetti (l.c.) made a detailed histological-histochemical study of the larval Malpighian tubules of the latter species;
- although they detected the sectors where the silk-precursory substances are produced, they didn't find any anatomical modification of the Malpighian tubules of the above larvae, except for the lower length of two out of six units.
- Elsewhere, Coleopteran Malpighian tubules show deeper morphological modifications;
- e.g., in females of certain Melyridae they are associated with mulberry-shaped cellular masses, which have been classified as *oenocytes* in the

classical instance of *Dasytes niger* (Linnaeus) (Holmgren, 1902) as well as in a recent report on *Psilothrix viridicoerulea* (Geoffroy) (Fig. 4.A).

- Furthermore, in both larvae and adults of *Holotrichapion pisi* (Fabricius) (Apionidae) two units of the Malpighian tubules (out of six) are club-like (Fig. 4.B) and have been assigned to the category of the “transmission organs” for symbiotic fungi (Buchner, l.c.; Nardon & Grenier, l.c.).
- Literature provides another instance of “transmission organs” in Coleoptera by including the modified larval Malpighian tubules of *Donacia semicuprea* Panzer (Chrysomelidae) (Fig. 4.C).
- In the latter instance, the involved microorganisms are referred as “batterioids”.

CONCLUDING REMARKS

- When compared with other Scydmaenidae, the traditional genus *Mastigus* (now reported as *Palaeostigus* by Smetana, 2008) exhibits a number of peculiarities.
- Referring to the adult stage, *Mastigus* spp. are large-sized, exhibit a wide subelytral chamber (false physogastry), possess knee-bend antennae, and are provided with a long endophallic filament at the male copulatory device (Lhoste, 1936; Bordoni & Castellini, 1973).
- Further particularities of *Mastigus* adults are specifically reported for *Mastigus pilifer* and refer to the glandular equipment of the females and full-grown larvae.
- Females provide an instance of “brood cares”, as they are used to mature a dozen of large eggs at the same time and do cover the egg mass with to a froth-like secretion, which arises from an intersegmental gland of their abdomen (De Marzo, 1983).
- Full-grown larvae exhibit a unpaired glandular field on head discum and supposedly they obtain from this gland a secretion to clean their very long antennae (De Marzo, 1985).
- The particular oviposition behaviour of *Mastigus pilifer* leads to suspect that the females are used to transfer symbiotic microorganisms to their brood.
- Anyhow, the new observations didn’t provide compelling evidence about the presence of symbionts into the Malpighian tubules of this species.

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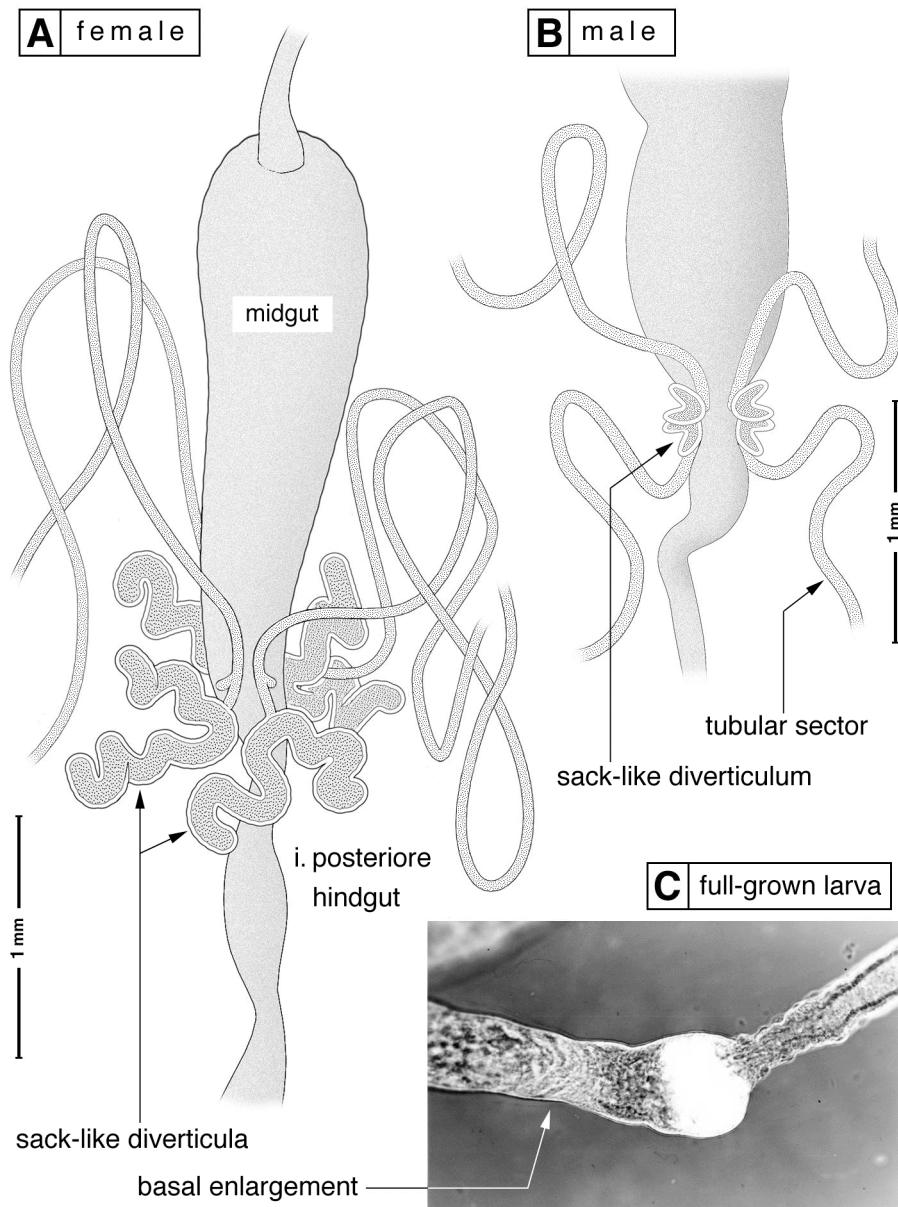


Fig. 1 - *Mastigus pilifer* Kraatz: anatomical details of the Malpighian tubules of adults and full-grown larvae.

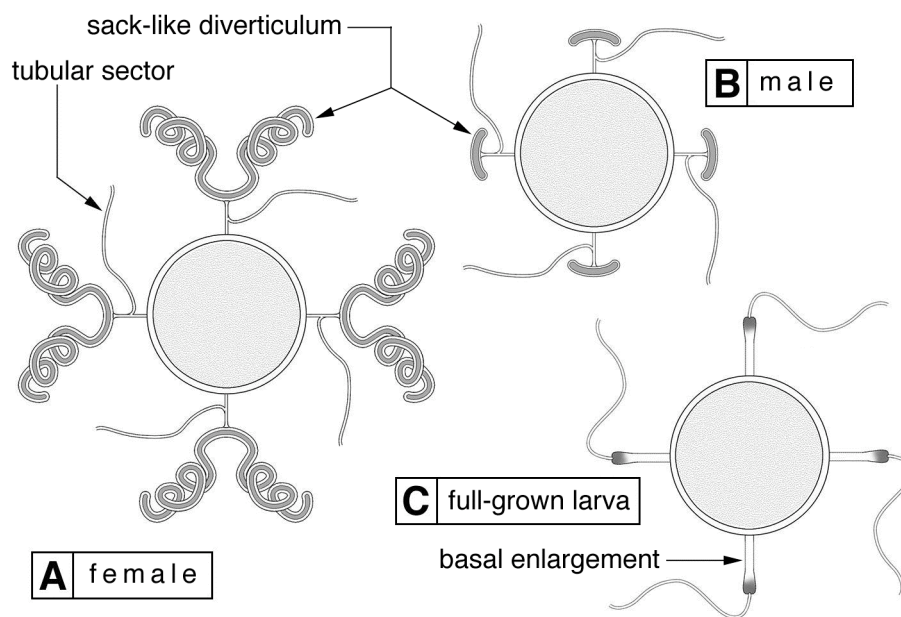


Fig. 2 - *Mastigus pilifer* Kraatz: schematic sections of the Malpighian tubules in adults and full-grown larvae.

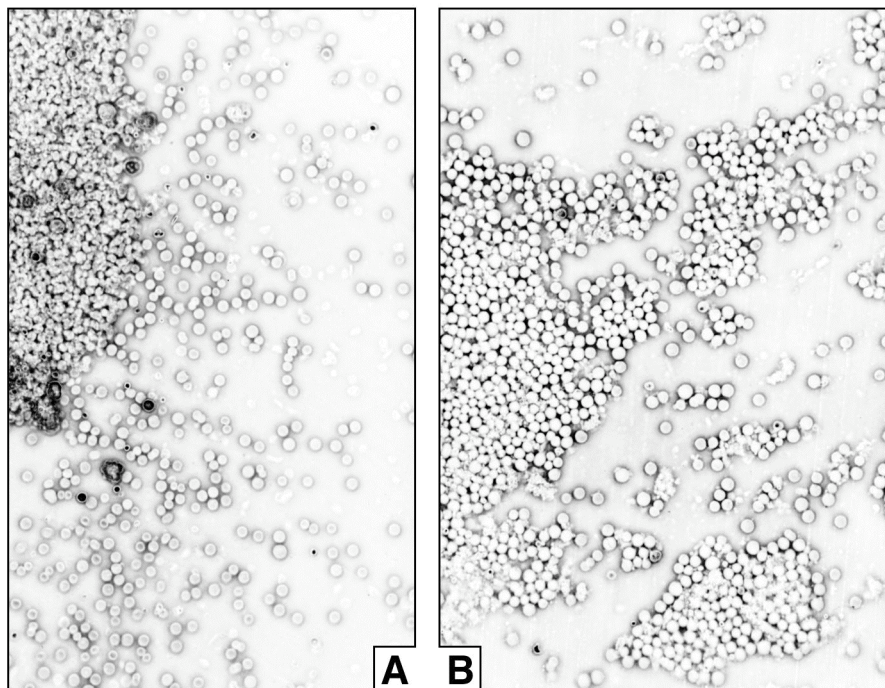


Fig. 3 - *Mastigus pilifer* Kraatz female: content of a sack-like diverticulum of the Malpighian tubules observed on slides in saline at 40x phase-contrast lens. Scale: most corpuscles 1-2 μm large in diameter.

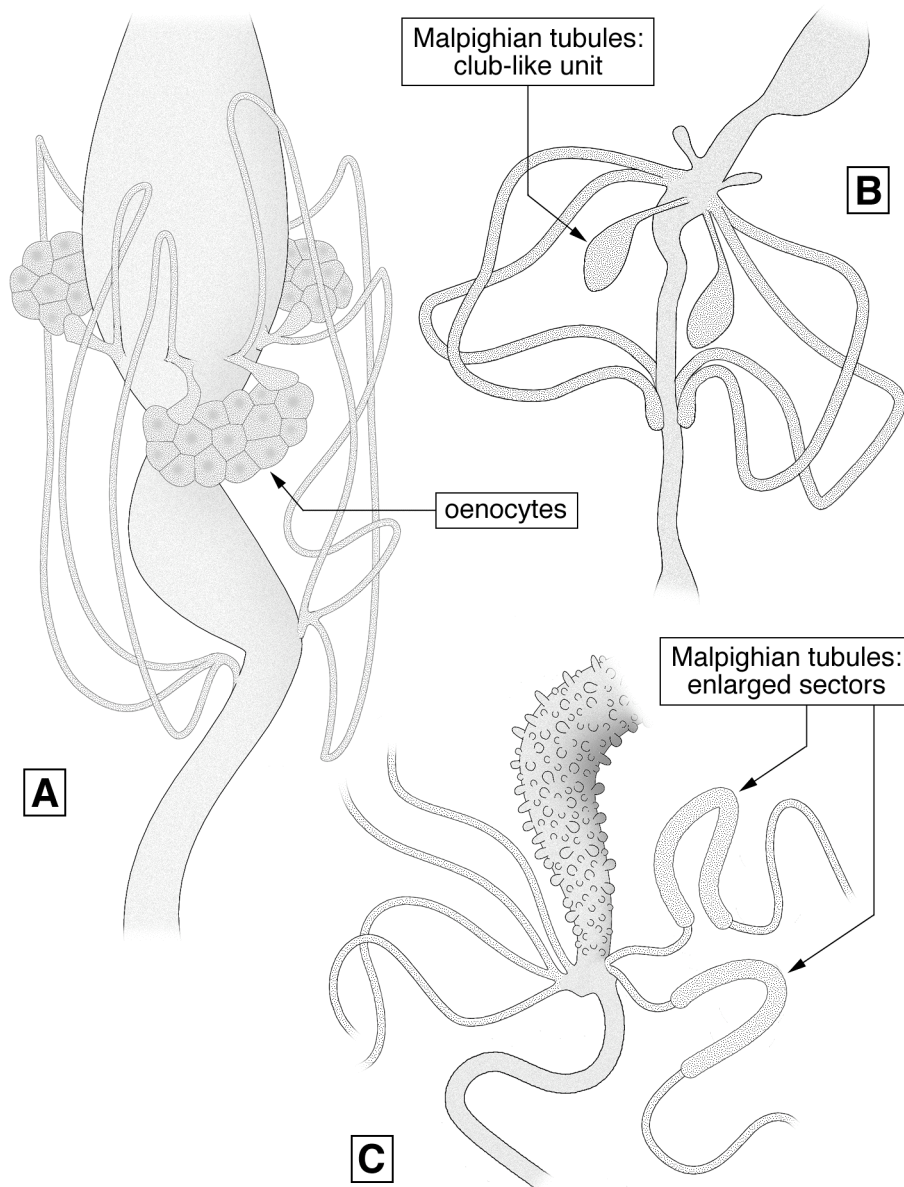


Fig. 4 - Instances of modified Malpighian tubules in Coleoptera redrawn from the literature: A, *Psilothrix viridicoerulea* (Geoffroy) female (Melyridae) (from De Marzo, 1995); B, *Holotrichapion pisi* (Fabricius) adult and larva (Apionidae) (from Nardon & Grenier, 1989); *Donacia semicuprea* Panzer larva (Chrysomelidae) (from Nardon & Grenier, 1989).