Supernumerary Malpighian Tubules in Chilopods

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ABSTRACT

In Chilopoda, up to now, one pair of Malpighian tubules was described. These tubules are inserted on each side of the gut at the junction of the mid and the hind-gut. In *Scutigera coleoptrata* an additional pair of Malpighian tubules is present, differing from the main one by its smaller diameter and in being dorsally and ventrally inserted on the gut, at the same level as the main pair, through small vesicles. In *Craterostigmus tasmanianus*, in addition to the main Malpighian tubules, there is a third one, inserted dorsally, in the median plane, and orientated backwards. Animals belonging to Lithobiidae, Henicopidae and Geophilomorpha show only the main pair. Additional Malpighian tubules of *Scutigera* and *Craterostigmus* may represent plesiomorphic characters.

RÉSUMÉ

Tubules de Malpighi surnuméraires chez les chilopodes.

Jusqu'à présent, on a décrit chez les chilopodes une seule paire de tubules de Malpighi. Les tubules sont insérés (un sur la partie gauche, l'autre sur la partie droite de l'intestin) au niveau de la jonction de l'intestin moyen (glandulaire) avec l'intestin postérieur. Chez *Scutigera coleoptrata* les deux tubules supplémentaires de Malpighi, avec un diamètre plus petit, sont insérés sur la partie dorsale et ventrale de l'intestin au même niveau que la paire principale. Chez *Craterostigmus tasmanianus*, un tubule de Malpighi supplémentaire, un troisième, est inséré dorsalement, dans le plan médian et orienté vers l'extrémité postérieure du corps. Les recherches réalisées chez les Lithobiidae, Henicopidae et Geophilomorpha ont démontré la présence d'une seule paire de tubules de Malpighi. La présence de tubules de Malpighi surnuméraires chez *Scutigera* et *Craterostigmus* peut être considérée comme un caractère plésiomorphe.

INTRODUCTION

All previous data concerning the anatomy of the Malpighian tubules indicates the existence of only one pair of Malpighian tubules in chilopods (LEWIS, 1981). A study of the microscopic anatomy permits the description of some supplementary Malpighian tubules in *Scutigera coleoptrata* and *Craterostigmus tasmanianus*.

MATERIAL AND METHOD

Specimens of *S. coleoptrata* (males, females and larvae) were collected in Sicily (Italy) in 1969 and in Dobrogea (Romania) between 1967 and 1992. Fixation was made in Bouin's solution or 70% ethylic alcohol. A material constituted by the caudal part of the body of two females of *C. tasmanianus*, embedded in paraffin, was offered to us by S. M. MANTON in 1964. This material was from Tasmania. Also from Tasmania were some females and males of *C. tasmanianus* gathered by R. MESIBOV in 1991. This material was fixed in formaldehyde-calcium (S. M. MANTON's lot) or in glutaraldehyde 2.5% in cacodylat buffer (R. MESIBOV's lot). The material was processed according normal histological technique.

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RESULTS

In *Scutigera coleoptrata*, transverse serial sections, taken through the junction of the mid-gut and hind-gut, confirmed the opening of the two main Malpighian tubules in the horizontal (bilateral) plane (Figs 1-2). Before the opening, each of the Malpighian tubules present an ampulla which narrows at the level of the opening in the intestine. Approximately at the same level, two other Malpighian tubules open into the intestine, but in a dorso-ventral plane. One of these Malpighian tubules opens in the median-dorsal plane and the other in the median-ventral plane (Figs 3-5). Before opening into the intestine, each of the dorso-ventral Malpighian tubule presents its own, small ampulla. The dorso-ventral Malpighian tubules are extended and coiled along the mid-gut, like the main pair of Malpighian tubules. We cannot make any statement about the length of the dorso-ventral Malpighian tubules.

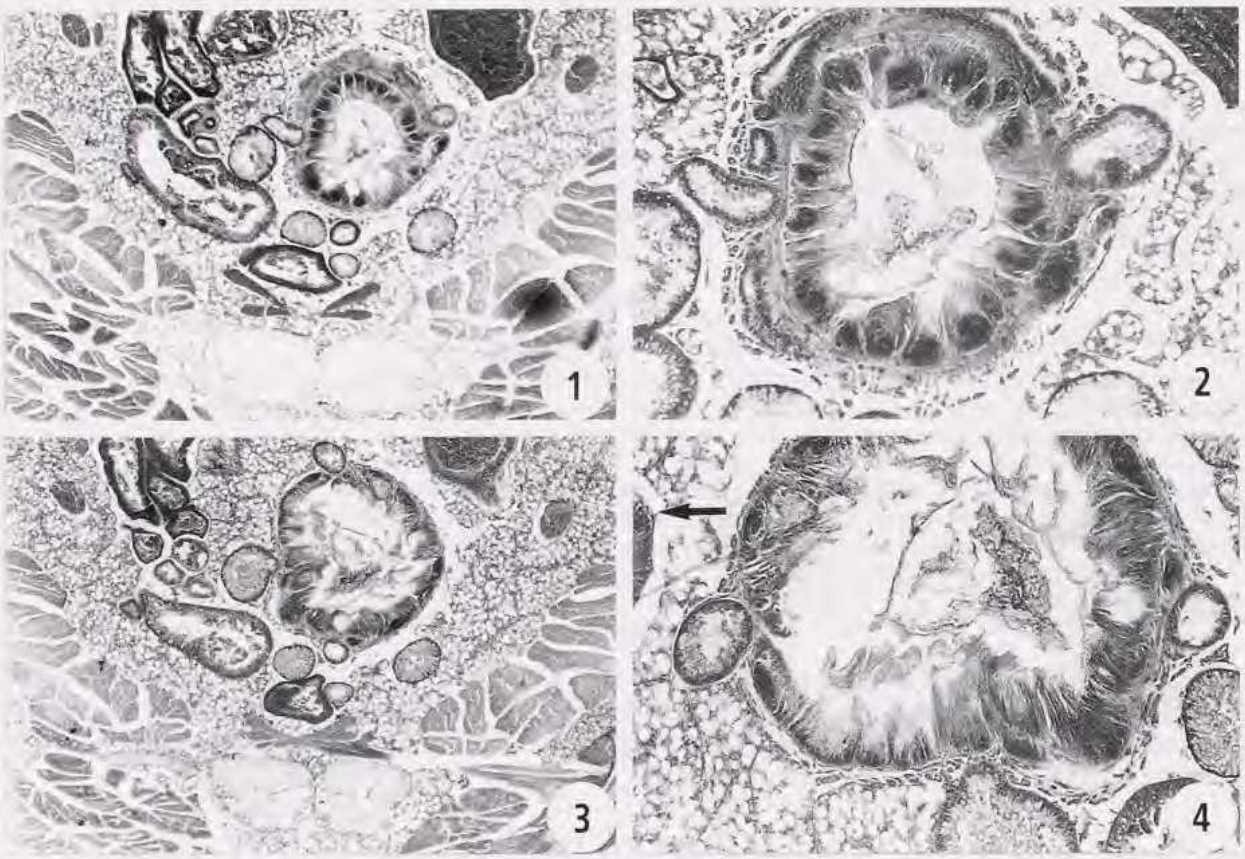


FIG. 1. — Lateral Malpighian tubules opening into the intestine (*S. coleoptrata*), H-e. x80.
FIG. 2. — Detail of the opening of the lateral Malpighian tubules at the level of the junction of the mid and hind-gut (*S. coleoptrata*) x160.
FIG. 3. — Opening of the dorso-ventral Malpighian tubules into the gut (*S. coleoptrata*) x80.
FIG. 4. — Detail of FIG. 3. x200. The arrow shows the top of the slide.

FIG. 6. — Dorsal Malpighian tubule (arrow) (*C. tasmanianus*) x400. (see next page FIG. 6-9).
FIG. 7. — Dorsal Malpighian tubule drawn near the dorsal wall of the gut (arrow). — The lateral Malpighian tubules ampullas open into the intestine (*C. tasmanianus*). x120.
FIG. 8. — Dorsal Malpighian tubule opening into the dorso-median zone of the intestine (arrow) (*C. tasmanianus*) x120.
FIG. 9. — Detail of the opening of the dorsal Malpighian tubule (arrow). (*C. tasmanianus*) x400. →

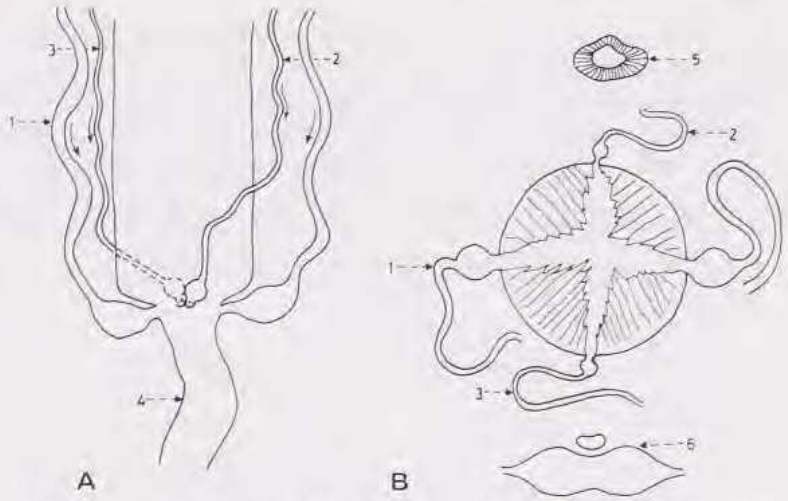
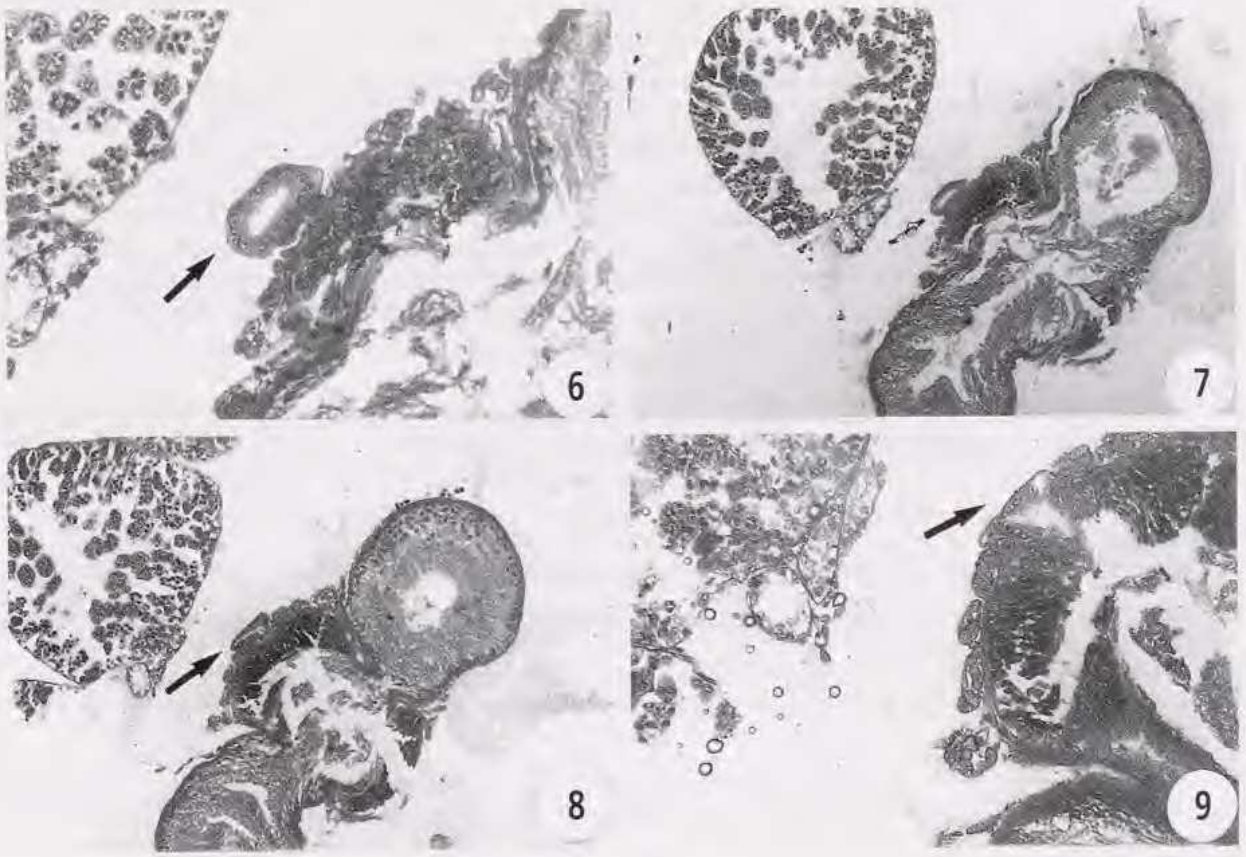


FIG. 5. — Schematic representation of the insertion of the Malpighian tubules of *Scutigera coleoptrata*.
A: dorsal view;
B: Transversal section;
1: lateral Malpighian tubule;
2: dorsal Malpighian tubule;
3: ventral Malpighian tubule;
4: hind-gut;
5: vas dorsalis;
6: ventral nerve ganglia.

In *Craterostigmus tasmanianus*, the laterally-inserted Malpighian tubules show an ampulla of great size at their proximal end (Figs 7-8), by which they open into the intestine. At the same level (the junction of the mid and the hind-gut) in the medio-dorsal plane, opens a short and relatively thin Malpighian tubule (Figs 6-10), which has its own, small ampulla. This tubule follows a sinuous line along the hind-gut. It is oriented towards the posterior extremity of the body. The dorsal Malpighian tubule has the distal extremity blindening. The histological structure of the dorsal Malpighian tubule is similar to that of the main lateral Malpighian tubules (Fig. 6). The epithelium of the tubule is of cuboid shaped cells with brush borders.



The dorso-ventral Malpighian tubules of *S. coleoptrata* show a similar histological structure. Examination of the serial sections of the contact zone between the mid and hind-gut in many species of Lithobiomorpha, Scolopendromorpha and Geophilomorpha confirmed the presence of the main pair of bilaterally-inserted Malpighian tubules. We never found Malpighian tubules with a dorsal or ventral insertion in any representatives of these orders.

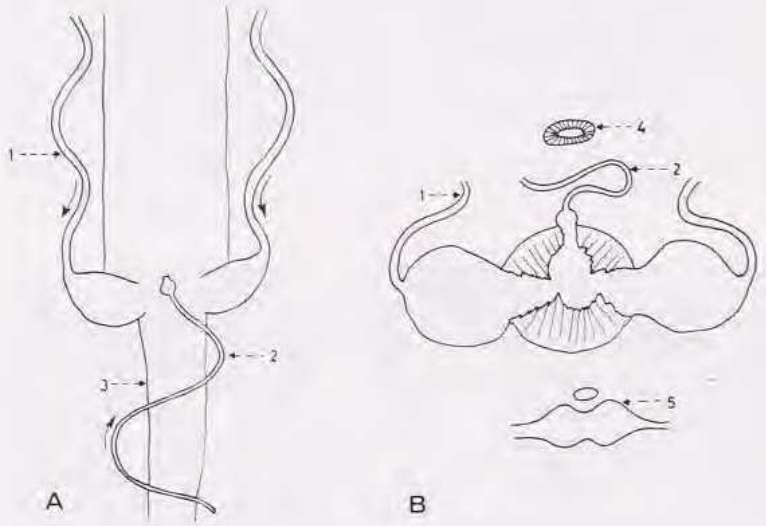


FIG. 10. — Schematic representation of the insertion of the Malpighian tubules of *C. tasmanianus*.
A: dorsal view;
B: transverse section;
1: lateral Malpighian tubule;
2: dorsal Malpighian tubule;
3: hind-gut;
4: vas dorsalis;
5: ventral nerve ganglion.

DISCUSSION

This work does not present data concerning the function of the Malpighian tubules with a dorso-ventral or ventral insertion. Sections through these Malpighian tubules show a similar histological structure to those with a lateral insertion (PALM, 1953; BERTHEAU, 1971).

The presence of a pair of Malpighian tubules with dorso-ventral insertions in *S. coleoptrata* suggests that this feature could represent a plesiomorphic character (PRUNESCU, this volume).

Since, during evolution, different systems and organs in Chilopoda have become simpler, the existence of four Malpighian tubules, in an order which present numerous plesiomorphic characters, may be considered as a plesiomorphic feature. The disappearance of the dorso-ventral Malpighian tubules in the more evolved groups may be considered as an apomorphic feature.

C. tasmanianus represents the archetype of the epimorphic Chilopoda, meaning that their ancestor presented many of the subsequent features of epimorphic Chilopoda. The presence, in this primitive type, of a Malpighian tubule homologous to the dorsal Malpighian tubule in Scutigeromorpha, confirms the plesiomorphic nature of this supernumerary tubule.

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