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The male genital system of *Anopsobiella dawydoffi*, ATTEMS, 1938 (Lithobiomorpha, Chilopoda)

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Abstract

The male genital system of an immaturus of *Anopsobiella dawydoffi* ATTEMS, 1938 is described. These new data demonstrated that another species belonging to the family Anopsobiidae presented elements of great similarity to the male genital system of the subclass Notostigmophora. This evidence is discussed in light of current knowledge about the Chilopoda evolution. New drawings of the 14th and 15th pairs of legs of *Anopsobiella dawydoffi* were made.

Key words: *Anopsobiella dawydoffi,* macrotestis, microtestis, Notostigmophora, Pleurostigmophora.

Zusammenfassung

Das männliche Genitalsystem eines Immaturus von *Anopsobiella dawydoffi* ATTEMS, 1938 wird beschrieben. Dies zeigt, dass noch eine weitere Art der Familie Anopsobiidae ähnliche Elemente des männlichen Genitalsystems wie bei der Unterklasse Notostigmophora aufweist. Dieser Nachweis wird analysiert im Licht der heutigen Kenntnisse über die Evolution der Chilopoden. Gleichzeitig werden die 14. und 15. Beinpaare von *Anopsobiella dawydoffi* dargestellt.

Introduction

Study of the evolution in the class Chilopoda encounters some problems related to the great differences between the subclasses Notostigmophora and Pleurostigmophora, especially regarding the respiratory and the male genital systems' structure and physiology.

During the last 30 years, some papers on the microscopic anatomy of the male genital system in representatives of the family Anopsobiidae (subclass Pleurostigmophora) were published (PRUNESCU & JOHNS 1969, PRUNESCU 1992, PRUNESCU & PRUNESCU 2000). Unexpected similarities with the male genital system of the subclass Notostigmophora were demonstrated.

In *Anopsobius neozelandicus* two genital tracts were described: one functional, formed by two successive segments, anatomically and cytological identified as a macrotestis and a microtestis, and the second one, which had a rudimentary, nonfunctional structure (PRUNESCU & PRUNESCU 2000).

The existence of two active genital tracts each composed of macrotestis and microtestis was known and long considered as a unique organization plan of male genital system exclusive to the subclass Notostigmophora (BOUIN 1934, FAHLANDER 1938, PRUNESCU 1969).

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The aim of this paper, is to add new data about the structure of the functional male gonad in the frame of the Family Anopsobiidae, with the description of this gonad in *Anopsobiella dawydoffi* ATTEMS.

Material and methods

Anopsobiella dawydoffi was collected in Vietnam, Cauda, by C. Dawydoff (ATTEMS 1938). The material was fixed in ethanol of low concentration. A male adolescent individual (NHMW 3815) was offered to us for study by the Natural History Museum of Vienna. Before the histological processing, the individual was observed by the stereomicroscope. The 14th and 15th legs were drawn. Then, routine histological techniques for paraffin embedding were used. Histological thin sections of 4 µm, were stained with Hemalum-Eosin (H-E), dehydrated and mounted in Eukitt.

Results

On the serial histological sections, the functional gonad was observed. The active genital tract was a tubular structure with a closed anterior extremity, the macrotestis, which was continued by a long coiled narrow tube, the microtestis. The latter was continued by a deferent canal.

In the macrotestis some large spermatocytes and groups of macrospermatids were observed (Fig. 1). The macrospermatids were placed both in the central zone of the lumen and in the peripheral zones of the macrotestis. The gradual transition between the macrotestis and microtestis was observed.

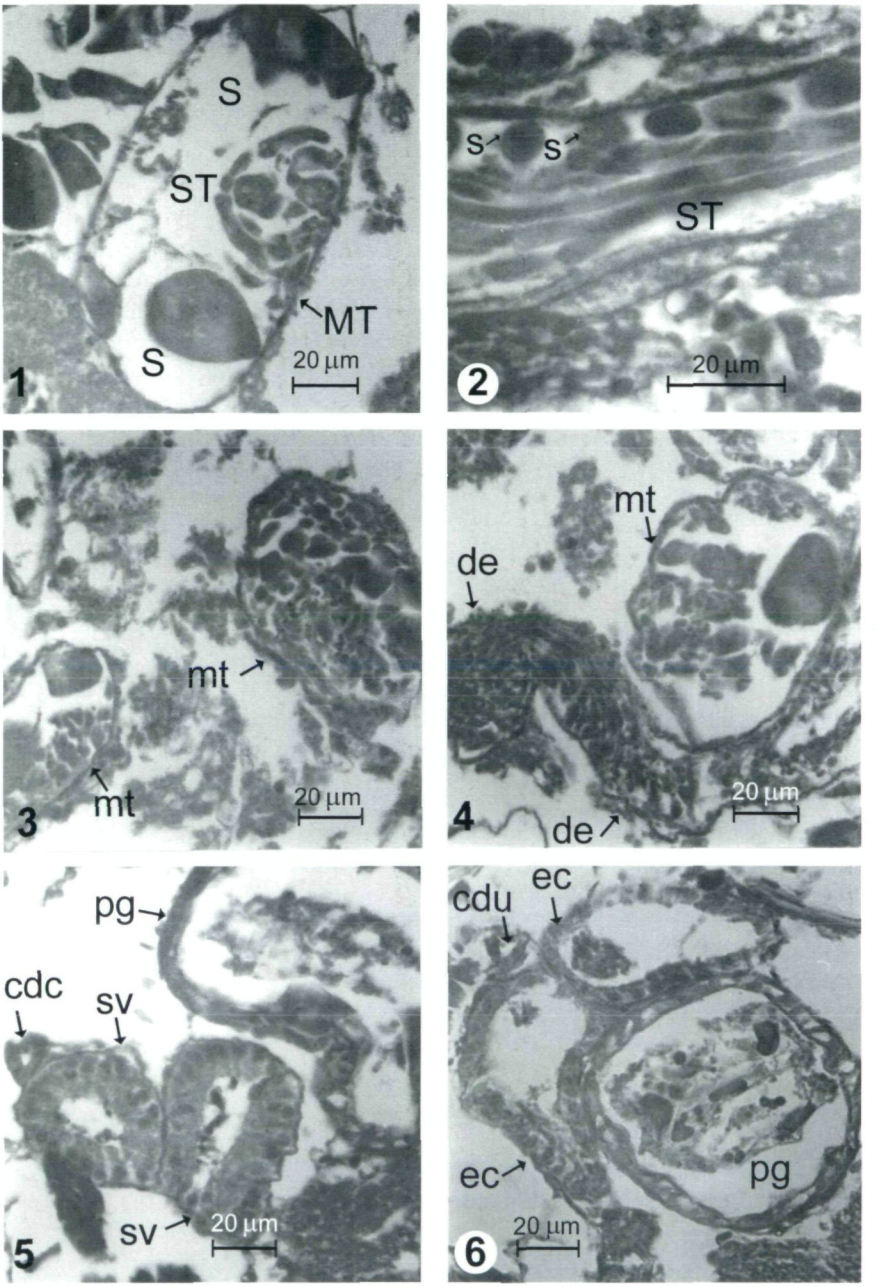
In the anterior part of the microtestis, growing microspermatocytes were observed. Also, in the lumen there were numerous macrospermatids (Fig. 2). In its median and posterior zone, the microtestis contained microspermatocytes and microspermatids (Fig. 3). In some profiles of the microtestis, macrospermatocytes occurred, probably coming from the macrotestis (Fig. 3, 4).

The microtestis was continued by a deferent canal which presented in its lumen significant quantities of spermatids and other aborted seminal cells (Fig. 4). The deferent canal becomes narrower towards its caudal extremity (Fig. 5).

The short and coiled pair of seminal vesicles was clearly immature (Fig. 5). The parietal epithelial cells of these vesicles were not yet at their characteristic morpho-functional maturity. The cytoplasm of these cells was hyaline. Only a few epithelial cells presented a characteristic eosinophilic secretion. The spermatozoa fascicles were not yet present in the lumen of the seminal vesicles.

The two seminal vesicles united in a large, short canal. The unique deferent canal also opened in this short canal. At an immediate posterior level, this short canal bifurcated in two symmetrical ejaculatory canals which descended under the hinter gut (Fig. 6).

The paired genital tract, which in *Anopsobius neozelandicus* (PRUNESCU AND JOHNS 1969) and in *Dichelobius bicuspis* (PRUNESCU 1992) is an embryonic small gonad, was not identified in this material, as a consequence of the medium gut autolysis, because of the fixation with a low concentration of ethanol.



Figs. 1 - 6. *Anopsobiella dawydoffi* ATTEMS, 1938, histological sections. 1: Macrotestis (MT). Note two macrospermatocytes (S) and a group of macrospermatids (ST). 2: Anterior zone of the microtestis: microspermatocytes (s) and macrospermatids (ST). 3: Median zone of the microtestis (mt); microspermatocytes and numerous spermatids. 4: Deferent canal (de) filled with aborted seminal cells. Note one microtestis profile. 5: Immature seminal vesicles (sv), deferent canal at its caudal extremity (cdc) and posterior gut (pg). 6: Ejaculatory canals (ec), unique deferent canal (cdu) and hindgut (posterior gut) (pg).

Description of legs 14 and 15 (Fig. 7)

The fourteenth pair of legs. The prefemur, femur and tibia are cylindrical in shape and almost equal in length, with the exception of the prefemur which is a little longer. Dorsally, tarsus 1 has a prolongation of about 1/3 of its length. Tarsus 2 is short, thin and delicate, articulating at the ventral extremity of tarsus 1. Tarsus 2 ends in a very small claw.

The fifteenth pair of legs is longer and stouter than the pair of legs 14. The prefemur and femur are of relatively equal length. The tibia is super dimensioned, especially in the dorsal zone, with a prolongation of about 1/5 of its length. Tarsi 1 and 2 are very thin in comparison with the thickness of the other articles. Tarsus 1 articulates to the ventral extremity of the tibia. Tarsus 2 is continued with a small claw.

Discussion

The representatives of the Chilopoda present numerous common characters which demonstrate the homogeneity of this class and its monophyletic origin (FAHLANDER 1938, PRUNESCU 1965, DOHLE 1985, PRUNESCU 1996). Two main exceptions to the uniformity of the Chilopoda internal organization are the respiratory system and the male genital system.

In the subclass Pleurostigmophora, the pleural repartition of the pair of spiracles is correlated with air transport through the tracheae to the tissue and cellular level, and the condition of gas exchange without the participation of respiratory pigments. In the Diplopoda, respectively Insecta, this type of tracheal respiration is observed without exception (CHAPMAN 1969, WIGGLESWORTH 1983).

In the subclass Notostigmophora, another type of respiration is characteristic. The spiracles open in the medio-dorsal zone. Air penetrates via bundles of tracheoles, in the tracheal lungs (PRUNESCU & PRUNESCU 1996, HILKEN, 1998). Here, the oxygen combines with the respiratory pigment – hemocyanin, which is dissolved in the haemolymph (MANGUM & GODETTE 1986). Gas exchange is realized in two phases: first in the tracheal lungs at the level of the circulatory system, and then between the hemocyanin and the tissues.

The occurrence of this respiration type in one group of Chilopoda (subclass Notostigmophora) may be explained by the necessity to decrease the water vapor loss in the scutigeras which live and hunt in an open aerial environment (PRUNESCU 1996).

The Pleurostigmophora chilopods which live and hunt beneath a leafy roof - a wet keeping environment – do not need a respiratory system which must assure the protection of the internal organs' humidity.

In Notostigmophora (*Thereonema, Scutigera),* the two plesiomorphic genital tracts remain separated from the apical extremity of the testes to the zone where the two tracts open in a unique deferent canal (FAHLANDER 1938, PRUNESCU 1969).

In Lithobiomorpha (subclass Pleurostigmophora) during the anamorphic development, the two larval gonads unite along the median line, forming a unique flagelliform testis (BIEGEL 1922, ZERBIB 1966).

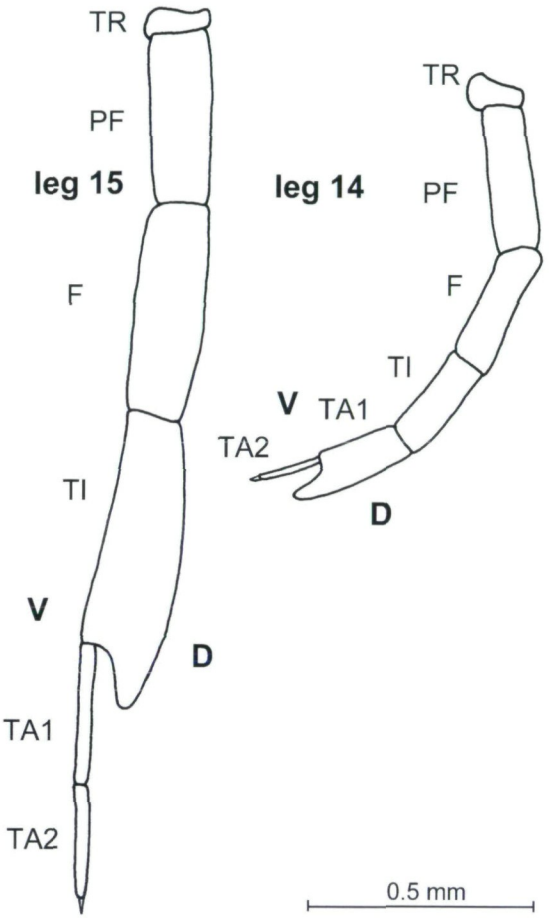


Fig. 7. *Anopsobiella dawydoffi* ATTEMS, 1938. Legs 14 and 15 (lateral view). TR-trochanter; PF-prefemur; F-femur; TI-tibia; TA1-tarsus 1; TA2-tarsus 2; D-dorsal; V-ventral.

In the context of the family Anopsobiidae, *Anopsobiella* is among the species with the most reduced size. This fact could be the cause of the developmental arrest of one of the two testes, as an original solution indispensable to normal spermatogenesis. This solution is different in comparison with the alternative encountered in the family Lithobiidae, where the two larval testes unite in a single male gonad.

The association of the organizational plans of the respiratory system with the male genital system pleads for the great distance of the Scutigeromorpha evolutionary line towards a great part of the order Lithobiomorpha and the other orders of Chilopoda. Nevertheless, a small group of the order Lithobiomorpha (Anopsobiinae) demonstrates the fact that ancestors of order Lithobiomorpha had the genital system organized similarly to the order Scutigeromorpha. In this way, the great distance between subclasses Notostigmophora and Pleurostigmophora is much reduced.

The genus *Anopsobiella* occupies a marginal edge outside the Gondwanan area of the family Anopsobiidae. The SE Asian extent of two genera – one in Vietnam and another in Japan, and the existence of a third genus in Tajikistan (Central Asia) suggests the extraordinary vitality of these primitive Lithobiomorpha.

The description and remaking of the illustration of *Anopsobiella* legs 14 and 15, was undertaken because it seems, that in the original drawings (ATTEMS 1938: figs 319-320) some characters were not exactly presented.

The structure of the tibia of the fifteenth pair of legs, and tarsus 1 of the fourteenth pair could represent secondary sexual characters – rare or possible unique in the family Anopsobiidae, if it should be demonstrate that the adult female individuals of this species do not present such features.

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