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The Beginning of Double Spermatogenesis in *Scutigera coleoptrata*

(Chilopoda)

by

Carol Constantin PRUNESCU

Institute of Biological Sciences, 296 Spl. Independentei, RO-77748 Bucuresti, Romania

Abstract: The paper discusses the great discrepancy existing between the beginning of macrospermatogenesis and of microspermatogenesis during the larval development in *S. coleoptrata* (L.). The main cause of this discrepancy can be correlated to the delay in the progress of microtestis development to macrotestis development. This delay is connected with the subterminal growth of the body in the anamorphous development period.

1. Introduction:

BOUIN (1903, 1935) discovered a double spermatogenesis in several groups of Chilopoda and described this phenomenon in detail for *Scutigera coleoptrata* (L.); both macro- and microspermatozoa are characteristic and seem to be functional. TUZET & MANIER (1951, 1953) confirmed the existence of the two types of spermatozoa in some Chilopoda. CAMATINI et al. (1977) studied the spermiogenesis of the macrotestis in *Scutigera coleoptrata*. ZERBIB (1966) described the first stages of gonad formation and of the structure and differentiation of the gonocytes in the anamorphous period of *Lithobius forficatus* (L.). Following histologic-anatomical studies (PRUNESCU 1969) on the male genital system in *Scutigera coleoptrata*, a concise presentation of our data on the early stages of the development of testicles in this Chilopod may now be useful.

2. Material and Methods:

Scutigera coleoptrata from the anamorphous stage V (11 pediferous segments) onwards were collected in Sicily in April 1969 and in Dobrogea province (Romania) in 1970. The material was fixed in Bouin's mixture and sectioned at 5 - 7 μm after embedding in paraffin. The serial sections were stained with chrome alum-hematoxylin phloxine after permanganate oxidation.

3. Results:

Anamorphous period, Larva V (11 pairs of legs):

The spermatogonia are arranged in follicles in the macrotestis. They are elongated cells (Fig. 1), their large nucleus is surrounded by a small quantity of cytoplasm. The large diameter of the spermatogonia varies from 8 to 13 μm. In the microtestis spermatogonia are scarce, but equal in size to those in the macrotestis.

The macrotestis of another specimen of stage V presents a great number of spermatogonia in division (Fig. 2). Some of the gonia situated in the macrotestis lumen are about 15 μm in diameter, have a thicker cytoplasm and are apparently spermatocytes at the beginning of the growth stage. In the microtestis of the same specimen (Fig. 3), the spermatogonia have a diameter of 9 - 12 μm. Some

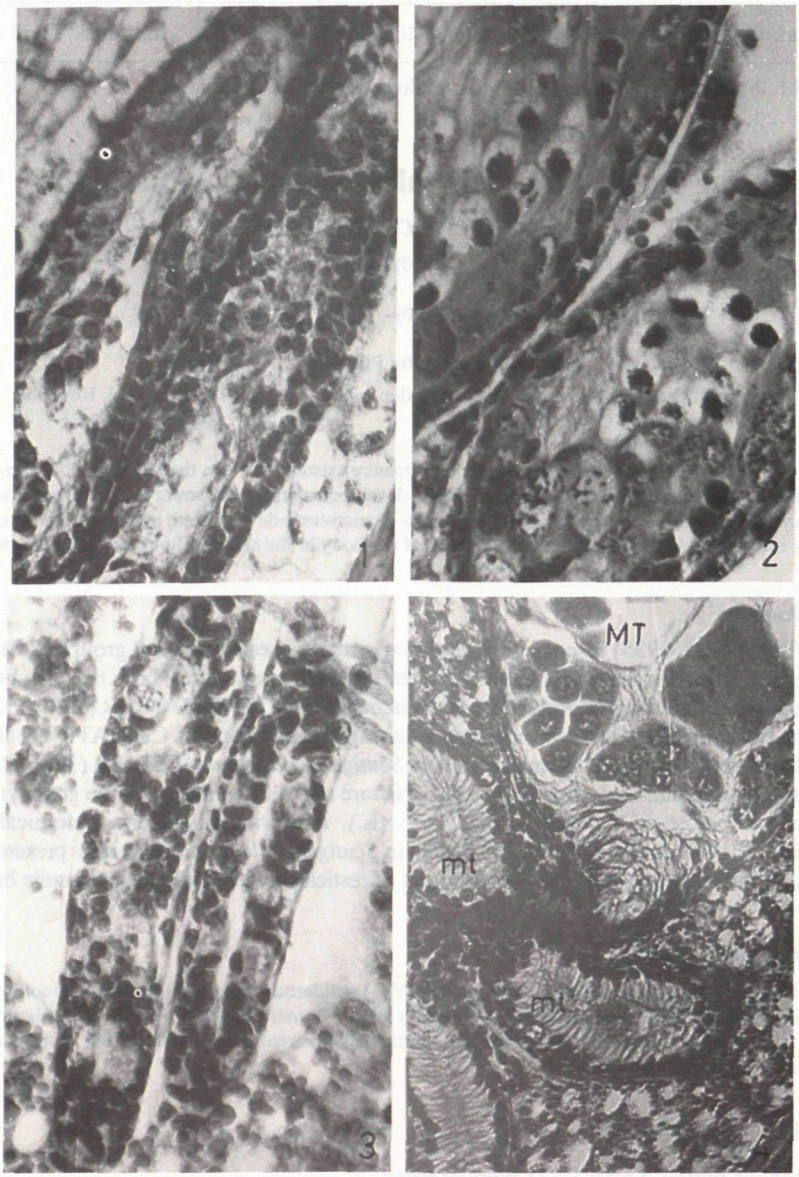

Fig. 1: *Scutigera coleoptrata,* Larva, anamorphous stage V: Macrotestis before the beginning of macrospermatogenesis; spermatogonia inactive. 485 x.

Fig. 2: *Scutigera coleoptrata,* Larva, anamorphous stage V: Macrotestis with commencing macrospermatogenesis. Begin of growth, with divisions of spermatogonia and spermatocytes. 620 x.

Fig. 3: *Scutigera coleoptrata,* Larva, anamorphous stage V: Microtestis. Spermatogonia among the follicular cells. 550 x.

Fig. 4: *Scutigera coleoptrata,* Agenitalis I: Macrotestis (MT) and microtestis (mt). Growing macrospermatocytes and divisons of spermatogonia in macrotestis, scarce spermatogonia among follicular cells in the microtestis. 350 x.

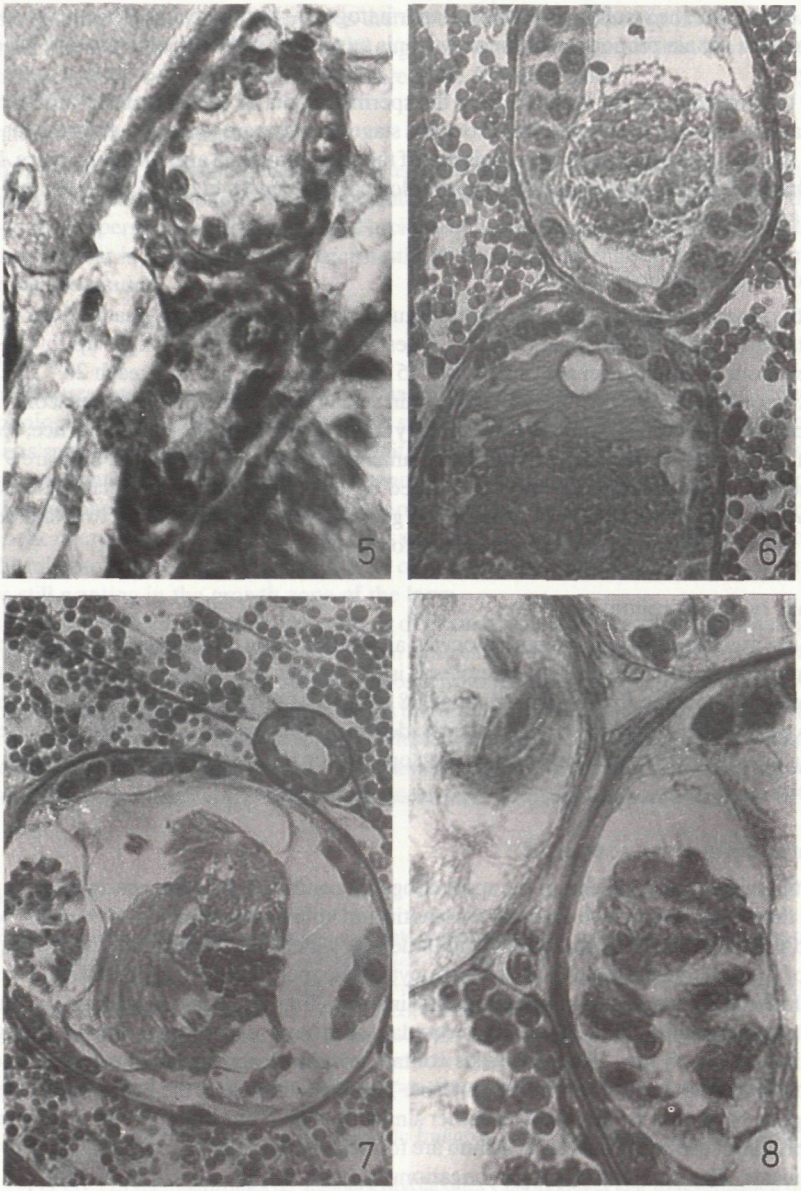

Fig. 5: *Scutigera coleoptrata,* Immaturus: Transverse section of microtestis. Spermatogonia among the parietal cells of microtestis. 610 x.

Fig. 6: *Scutigera coleoptrata,* Prematurus: Transverse section of microtestis with growing spermatocytes. In the lumen, fascicles of macrospermatozoids. 540 x.

Fig. 7: Pseudomaturus: Microtestis, median region. Spermatocytes in growth and spermiogenesis. 540 x.

Fig. 8: Pseudomaturus: Large spermatocytes and spermatids in microspermiogenesis. 1020 x.

of them divide, but the resulting cells are still spermatogonia. Multiplicative divisions of spermatogonia ensure a certain proportion of spermatogonia to somatic cells in the microtestis, which is still growing.

At the beginning of the larval stage V the spermatogonia of the macrotestis are inactive and comparable to those in the microtestis. From this stage on spermatogenesis starts in the macrotestis while in the microtestis multiplicative divisions of the spermatogonia are still taking place. It should be emphasized that there are no initial morphological differences between the spermatogonia of macro- and microtestis.

Agenitalis I (epimorphous stage I):

In the macrotestis the spermatogonia continue to divide, resulting in a great number of primary spermatocytes in full development (Fig. 4). These are elongated cells, length up to 40 - 60 µm, diameter about 20 µm. Nuclei are usually 10 - 15 µm in diameter but may reach 20 - 25 µm in the most advanced spermatocytes. The nuclei contain small nucleoli and one large nucleolus of 4 µm. The microtesticular canals elongate continuously and begin to fold. As a consequence, spermatogonia in the microtestis are scarcer than in the anamorphous stage examined; they are 9 - 13 µm long, the nuclei are voluminous and surrounded by thin cytoplasm. The microtesticles reach a length of 1200 µm. At this stage the whole male genital system is formed. The two vasa deferentia may be traced to their opening into the newly formed genital atrium.

Agenitalis II (Epimorphous stage II):

In the macrotestis primary spermatocytes are still growing, and spermatogonia continue to divide into new spermatocytes. The microtestis is in a continuous state of elongation, with scarce and exceedingly small spermatogonia: diameter 8 - 10 µm. Male genital system still in development. The two pairs of accessory glands can be clearly identified. The fusion of the canals of the ventral accessory gland to form a single one with a median opening on the ventral wall of the atrium is also recognizable.

Immaturus (epimorphous stages III):

In the macrotestis, division of the spermatogonia continues. Primary spermatocytes reach 60 -75 µm, their nuclei large, with granular chromatin and voluminous nucleoli. Cytoplasm with eosinophilic inclusions and frequent zones of minor density which may lead to autolysis. In the posterior region of the macrotestis meiosis of spermatocytes and spermatids in advanced state can be observed. In the microtestis spermatogonia are still inactive (Fig. 5). Their diameter is 10 - 11 µm, their nucleus often strongly incised. The microtesticular tubes have reached a considerable length, their lumen diameter is 45 µm. The microtestis contains neither macrospermatozoa nor degenerated remnants of the seminal cells of the macrotestis. The terminal part of the genital system is still developing. In the genital atrium, which is rather similar to that of the adult, the lateral-dorsal tubular prolongations of the future glandular atrium are formed, with which the terminal ejaculatory canals communicate. The lumen of these prolongations is covered with a chitinous sheath.

Prematurus (epimorphous stage IV):

Numerous large spermatocytes are present in the macrotestis, some of them in meiosis. In marginal zones small groups of spermatogonia are still in mitosis. There are also small spermatocytes, groups of spermatids in spermiogenesis and fascicles of spermatozoa passing into the microtestis. In the microtestis, the strongly enlarged lumen contains great quantities of spermatids and spermatozoa from the macrotestis. At least some of these spermatids apparently degenerate. Spherical eosinophilic bodies occurring among the fascicles of spermatids result from degeneration of some mac-

rotesticular spermatocytes. In the microtestis there are numerous spermatogonia in mitosis as well as microspermatocytes in growth (Fig. 6). Although microspermatogenesis started at the posterior end of the microtestis inactive spermatogonia are more frequent there.

Pseudomaturus (epimorphous stage V)

In the macrotestis, spermatogenesis occurs as in the adult but more slowly. In the microtestis, there is less microspermatogenesis than in the adult: microspermatocytes are growing and microspermatids are in spermiogenesis (Fig. 7, 8). Fascicles of macrospermatozoa and macrospermatocyte remnants occur in the lumen of the microtestis, its parietal cells endocyte macrospermatozoa and abortive spermatids.

4. Discussion:

The data presented show that primary spermatogonia from macro- and microtestis have identical morphological dimensions and aspects. This suggests that before the beginning of macrospermatogenesis spermatogonia from the whole genital tract may have identical potentialities. In the macrotestis spermatogonia commence spermatogenesis in the anamorphous stage V, earlier than in Chilopoda with one single spermatogenesis. Spermatogenesis starts much later in spermatogonia situated in the microtestis, i.e. in the epimorphous stage IV (prematurus) stage. In the anamorphous stage V the microtestis has not even reached 1/10 of its prematurus length, and four pediferous segments are still wanting in the growth zone of the larva.

It may be supposed that stimuli determining division of somatic cells and of spermatogonia in the microtestis, which make possible the formation of an elongated gonad uniformly populated with spermatogonia, exert an inhibitory action on microspermatogenesis, thus preventing the gonia from entering the growing phase. When the microtestis has attained its adult size, the influence of inhibitory factors is diminished; spermatogonia which have multiplied only in the five larval stages now begin microspermatogenesis. Furthermore, the passage of spermatozoa and abortive cells from the macrotestis into the microtestis may also contribute to the start of microspermatogenesis in the prematurus stage.

5. Literature:

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