

Summary

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élément servant à la capture de la proie. Au cours de l'évolution seulement, cet organe, chez certaines espèces, est devenu avant tout un élément de défense.

8° La position systématique actuelle d'*I. maculatus* fait sujet de discussion. La classification aujourd'hui valable qui place l'espèce dans la sous-famille des Buthinae est insatisfaisante. Un certain nombre de caractères morphologiques et biologiques importants éloignent *Isometrus* (ainsi que quelques autres genres, tels que *Lychas*, *Babycurus*, *Odonturus*, *Uroplectes*) des Buthinae typiques, mais le rapprochent des Centururinae/Tityinae. En vue d'études systématiques entreprises actuellement par d'autres chercheurs, on renonce ici à résoudre le problème de manière plus profonde.

Summary

On the reproduction of the scorpion *Isometrus maculatus* (De Geer, 1778) and on the development of its venom glands. (Scorpiones: Buthidae).

1. *I. maculatus*, a scorpion species collected in Tanzania (East Africa) was bred and reared under laboratory conditions. The methods used are described.

2. Concerning the general biology of this scorpion under natural and laboratory conditions, some data are given on its geographical distribution, biotopes, and behaviour. Cannibalistic behaviour and body cleaning are fully described. In the adult stage a "sex ratio" of 3 females to 1 male was determined; this result is discussed.

3. The courtship and mating behaviour was entirely observed several times. It is described in detail and compared to the findings of previous authors. Mating occurs only with non-pregnant females, i.e. mainly with virgin ones. In spite of the females' capacity of giving birth to five litters of young scorpions following a single insemination, additional mating is observed with females within a few days after the birth of their young. The significance and effect of such additional inseminations are not known, but are discussed and compared with some results from experiments on the reproduction in other arthropods.

Males often behave rather passively when pairing. Willing females in such cases take the initiative, and by "female courting" they procure successful mating. (Male) courting is of short duration and mainly directed at the female's "tail". Mating ("scorpion dance", "promenade à deux"), too, is unlike that found in other species, being of short duration and occurring over a small area. The male exclusively steps backwards, pulling the female with him. Deposition of the spermatophore and the consumption of sperm by the female proceed very quickly. The spermatophore is simple in structure and, compared with the length of the body is very small.

4. Similar to the findings in Scorpionidae, 3 different forms of follicles are found in the "ovario-uterus": (a) "rudimentary", before an embryo develops, (b) "embryonic", with an embryo in the course of development, and (c) "post-partum", after a fully developed embryo has been born (= "corpus luteum"). One female can produce (by 5 litters) a total of about 100 young. Consecutive gestations follow each other without interruption, due to a single insemination. The gestation period is rather constant, with an average of 76 days. Development of the embryos can be pursued through the intact ventral shields of a pregnant female. A "time-table" of development is given which enables age identification of the embryos by external features.

5. The process of parturition is described in detail, too, *I. maculatus* is born in an advanced condition, with a pigmentary integument, and fully mobile. Some young break their chorion already within the female's body and thus appear from

the genital aperture without a birth-membrane. This “pseudo-viviparity” must not be confused with true viviparity as known in the Scorpionidae. Care of the young, as a rule, only consists in defence and in carrying them on the back, thus providing the best protection and optimal micro-climatic conditions for them. Some individuals, however, further seem to provide their young with appropriate food.

6. Post-embryonic development is characterized by 6 moults and thus 7 instars (1 larval, 5 nymphal, 1 adult). About 5 to 10 per cent of the females, however, have a potency to neoteny; they reach maturity already by their 5th moulting. The significance of this observation is discussed.

The duration of instars in laboratory rearing is given. It is assumed that, under natural conditions, maturity is attained after about 250 days; in laboratory rearing it lasted 280–300 days at least. The entire life cycle of *I. maculatus* is probably not much more than 2 years.

For some representative parts of the body (pedipalpal claw, cephalothorax = carapace, and 5th postabdominal segment) the growth is illustrated by tables and diagrams. It is shown that the distinct sexual dimorphism does not become evident before the last two moults. Growth of the carapace is virtually equal in both sexes. The measurements of the carapace can be used for an approximate determination of post-embryonic instars of both sexes. Growth indices are particular for each moult and for each part of the body. The mean growth index counted over all moults rates at 1.3 per moult (i.e. increase of 30 per cent).

7. The venom glands of *I. maculatus* belong to the “complex type”; their epithelium, however, shows but a small number of folds. The epithelium contains a single type of secretory cells which can be in different phases of secretion; thereby their morphology varies considerably. The mode of secretion can be termed as merocrine.

Embryonic and post-embryonic development of the venom glands is outlined. In the initial stages of the second half of embryonic development (i.e. in embryos of 40 to 45 days), primordial glands are found as two longish accumulations of compact cells of ectodermal origin, lying along a longitudinal fold at either side of the lateral integument of the telson. These primordia increase in size, staying adjacent to the integument. The two excretory ducts are formed independently of the glands, from invaginations of the integument at the tip of the telson. From the very beginning, on the whole of their length, the two ducts are completely separate. The inner muscular wrapper of the gland is formed from presumptive dorso-ventral muscular tissue. Only a short time before hatching a minute cavity appears within the glands. Nevertheless the glands are not functional at the time of birth and stay inactive throughout the larval stage. Only after the first moult, cells begin to secrete venom. The folds, which increase the surface area of the epithelial layer, are formed from the second nymphal stage onwards.

On account of various facts and considerations it is assumed that the venom apparatus of the scorpions had primarily been used in catching prey. Only in the course of evolution has it come – in certain species – to being mainly used in defensive behaviour.

8. Systematic classification of *I. maculatus* is discussed. The position of this species within the subfamily of Buthinae is unsatisfactory. In a number of important morphological and biological characters *Isometrus* (and with him several other genera: *Lychas*, *Babycurus*, *Odonturus*, *Uroplectes*) differs from typical Buthinae, but is similar to Centruurinae/Tityinae. No final conclusion is presented, however; more systematic study has to be done.