Ovarian Structure and Oogenesis in Pycnogonids: Some Similarities to Those in Chelicerates

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The Pycnogonida is a small group of marine arthropods, whose phylogenetic affinity is still in debate (Arnaud and Bamber, 1987). Recently, two different types of the ovarian structure and the oogenetic modes were proposed as correspomding to two main arthropod groups, the Chelicerata and the Mandibulata (Makioka, 1988). In spite of recent advances in ultrastructural studies (King and Jarvis, 1970; Jarvis and King, 1972, 1975, 1978), the knowledge about pycnogonid ovarian structure and the mode of oogenesis is still insufficient to be generalized for comparative studies with other arthropod groups. In the present study, we have found that the ovarian structure and the oogenetic modes of some pycnogonids from Japanese waters are very similar to those of the Chelicerata.

Adult female specimens of the following species were collected from waters near Shimoda, Izu, Central Japan, and processed for serial paraffin sections 5–7 μm thick, stained with Delafield's hematoxylin and eosin (H–E), Heidenhain's azan, Masson's trichrome, or alcian blue-PAS-hematoxylin staining method.

Family Ammotheidae: *Achelia echinata sinensis, Ammothea hilgendorfi, Ascorhynchus auchenicum, As. okai, Cilunculus armatus, C. sekiguchii.*

Family Endeidae: *Endeis nodosa.*

Family Callipallenidae: *Propallene longiceps.*

Family Phoxichilidiidae: *Anoplodactylus perforatus, An. shimodaensis, An. tubiferus.*

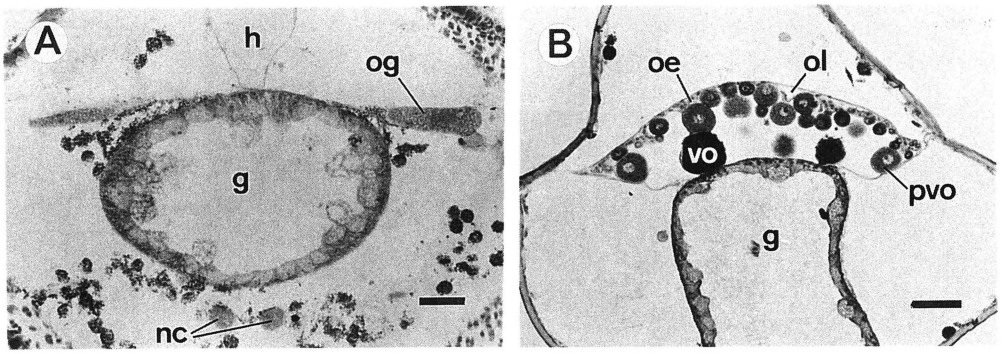

Fig. 1 Adult ovary in *Cilunculus armatus.*
A. Cross section of trunk ovary. H–E. Scale = 50 μm. B. Cross section of pedal ovary. Azan. Scale = 50 μm.
g: gut, h: heart, nc: nerve cord, oe: ovarian epithelium, og: oogonium, ol: ovarian lumen, pvo: previtellogenic oocyte, vo: vitellogenic oocyte.

In all the examined species, the ovary was located in the cephalothorax. In most of the species, the ovary consisted of the following two parts: a U-shaped trunk filled with oogonia (Fig. 1A) and tubular pedal branches which had growing oocytes and often mature eggs (Fig. 1B) and extended into walking legs up to the fourth (the femoral) segment. Each pedal branch had two or more longitudinal cord-shaped zones with very young oocytes, running in its wall (Figs. 1B, 2) throughout the total length of the branch. These zones were connected with the trunk part of the ovary at the basal region of each leg. Exceptions were two *Ascorhynchus* species, where the trunk part of the adult ovary had the same structure as the pedal branch with the growing oocytes, and in the adult ovary of *P. longiceps*, there was no trunk part, and each pedal branch was limited to the femoral segment, lacking the cord-shaped zones of very young oocytes.

In most of the species here studied, the ventral wall of the pedal ovary consisting of a layer of tall epithelial

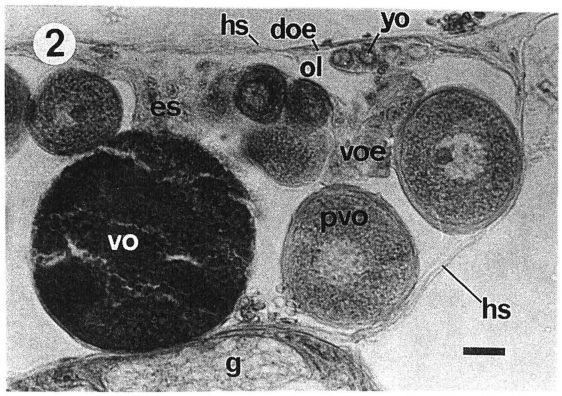

Fig. 2 Cross section of pedal ovary at the femoral segment in *Cilunculus armatus* showing the protruding oocytes and mature eggs with cellular stalks and the germ zone. H-E. Scale=10μm. doe: dorsal ovarian epithelium, es: egg stalk, hs: horizontal septum, ove: ventral ovarian epithelium, yo: young oocyte. Other abbreviatio nssame as Fig. 1.

cells was much thicker than the dorsal one (Fig. 2). The growing oocytes protruded from the ventral ovarian wall into the hemocoel with cellular stalks (Fig. 2). On their stalks, the oocytes grew with vitellogenesis and became mature (Fig. 2).

We confirmed the oviduct connecting between the ovarian lumen and the genital pore at the second pedal segment (the second coxa) of each walking leg (Fig. 3) in all the examined species. This is undoubtedly the passage of mature eggs to the exterior. Therefore, we can not agree with Sanchez (1959) on the release of mature eggs into the hemocoel.

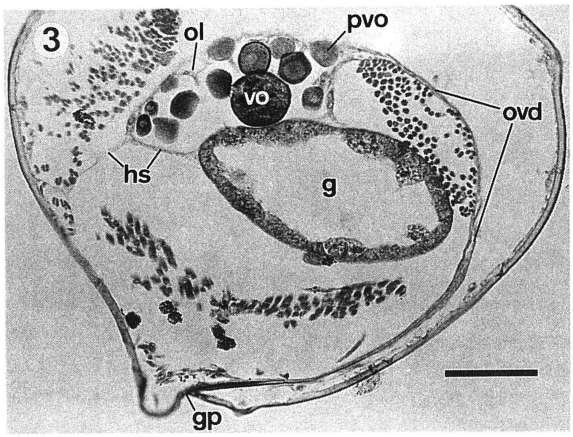

Fig. 3 Cross section of second coxa in *Cilunculus armatus* showing the direct connection among ovary, oviduct and genital pore. H-E. Scale=100 μm. gp: genital pore, ovd: oviduct. Other abbreviations same as in Figs. 1 and 2.

Through the present study, the ovarian structure and the oogenetic modes of some pycnogonids showed a remarkadle similarity with those of chelicerates. The cord-shaped young oocyte-zones (the germ zones) in the ovarian wall, the stalked oocytes protruding outward from the ovary and growing with the vitellogenesis, and the passage of mature eggs to be ovulated are common features with the chelicerate ovaries. The features such as the ovary located only in the cephalothorax and on the dorsal side of the gut, and the growing oocytes without follicle cells are common

with merostomes.

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