

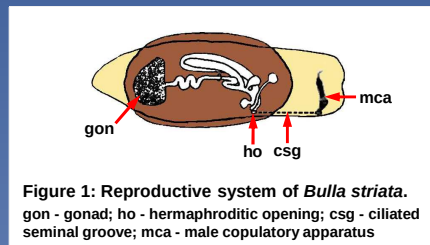
New insights into the functional morphology of the male copulatory apparatus of bullid gastropods

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In *Bulla striata*, a simultaneous hermaphrodite, the male copulatory organ is situated on the right side of the head. It is connected to the hermaphroditic opening by a ciliated seminal groove running along the right side of the body. Spermatozoa come out from the hermaphroditic opening, travel through the seminal groove and enter into the male copulatory apparatus where they are stored until mating.

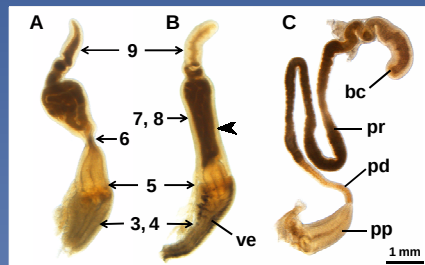


Figure 2: A-B - Variability in the male copulatory apparatus of *B. striata*. Numbers correspond to section plane in the following figures; ve - vestibule. C - Copulatory apparatus without the muscular sheath (arrowhead), showing the penial papilla (pp), prostatic duct (pd), glandular region of the coiled tubular prostate (pr) and the blind caecum (bc).

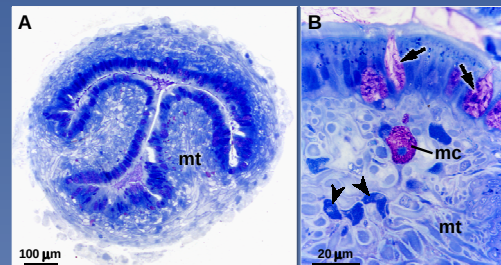


Figure 3: A - Semithin section of the vestibule stained with methylene blue and azure II. B - Detail showing the mucous epithelial cells with a metachromatic coloration (arrows) and two types of subepithelial secretory cells embedded in the muscular tissue (mt), one with a metachromatic coloration (mc) the other containing blue granules (arrowheads). Both subepithelial cells have cytoplasmic extensions reaching the lumen.

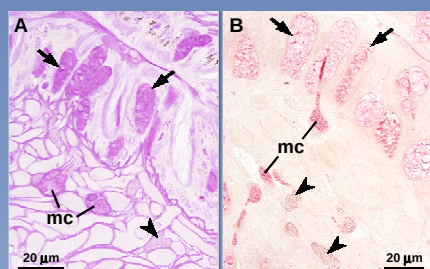


Figure 4: Semithin sections of the vestibule. A - PAS reaction detects polysaccharides in epithelial mucous cells (arrows) and metachromatic subepithelial secretory cells (mc), but not in non-metachromatic subepithelial secretory cells (arrowhead). B - Proteins are detected in all secretory cell types by the tetrazonum reaction.

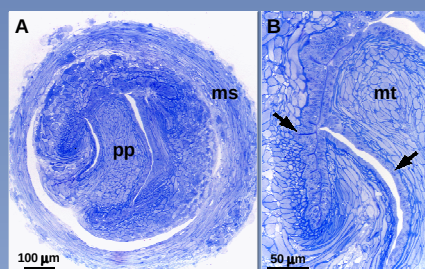


Figure 5: A - Semi-thin section of the muscular penial papilla (pp) surrounded by the muscular sheath (ms). B - Detail of the penial papilla showing the muscular tissue (mt) and the non-secretory cubic epithelium (arrows) lining a narrow lumen. According to our hypothesis, this papilla forms the tip of the everted penis.

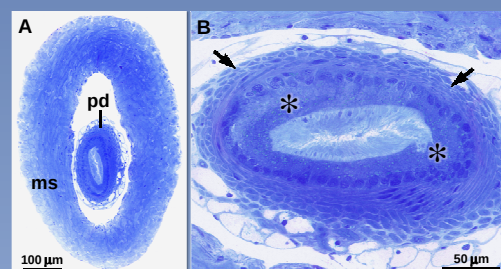


Figure 6: A - Semithin section of the prostatic duct (pd) enclosed by the muscular sheath (ms). B - Magnification of the duct, showing the non-glandular ciliated epithelium (asterisks) surrounded by a muscular layer (arrows). Spermatozoa were not found in this region of the copulatory apparatus.

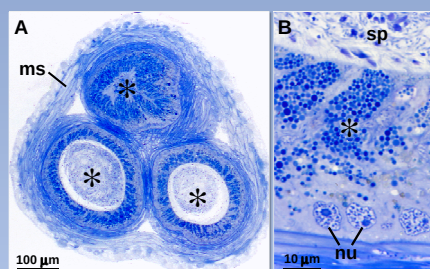


Figure 7: A - Semithin section of the coiled tubular prostate (asterisks) within the muscular sheath (ms). B - Epithelium of the prostate with numerous secretory cells (asterisk) with a basal nucleus (nu). Spermatozoa (sp) in the lumen.

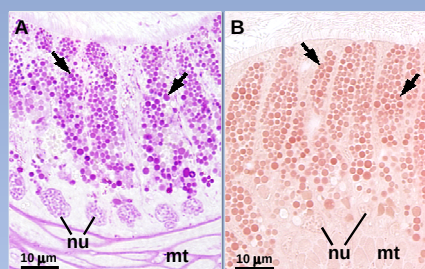


Figure 8: Semithin sections of the prostate. A - Vesicles (arrows) of epithelial secretory cells are stained by the PAS reaction for polysaccharides. B - The tetrazonum coupling reaction detect proteins in these vesicles (arrows).

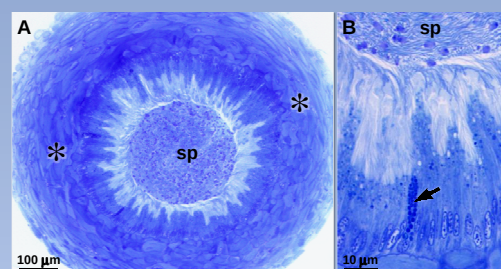


Figure 9: A - In the blind caecum, at the posterior end of the coiled tube, the muscular layer of the tube merges with the muscular sheath (asterisks). B - In this region only a few secretory cells are visible (arrow), but many spermatozoa (sp) are found in the lumen.

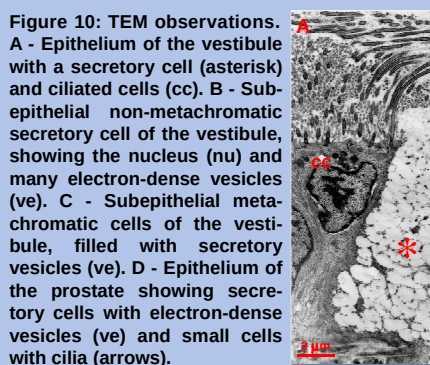
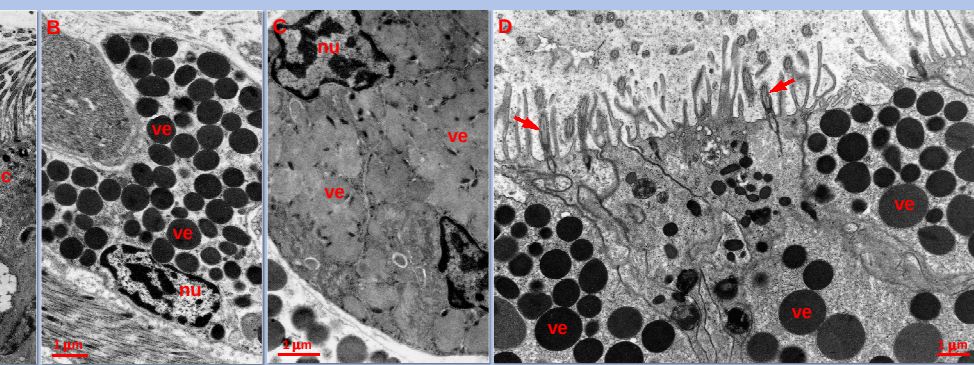


Figure 10: TEM observations. A - Epithelium of the vestibule with a secretory cell (asterisk) and ciliated cells (cc). B - Subepithelial non-metachromatic secretory cell of the vestibule, showing the nucleus (nu) and many electron-dense vesicles (ve). C - Subepithelial metachromatic cells of the vestibule, filled with secretory vesicles (ve). D - Epithelium of the prostate showing secretory cells with electron-dense vesicles (ve) and small cells with cilia (arrows).



Mucous cells of the vestibule seem to be important for lubrication of that zone and the secretory products of the prostate are probably necessary to maintain the spermatozoa in good conditions during storage inside the coiled tube.