

**SYNDESMIS LONGICANALIS SP. NOV.,
AN UMAGILLID TURBELLARIAN (PLATHELMINTHES)
FROM ECHINOIDS FROM THE KENYAN COAST**

by

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SUMMARY

A new species of umagillid rhabdocoel is described from echinoids from the Kenyan coast. *Syndesmis longicanalis* sp. nov. is found in the intestine of both *Tripneustes gratilla* and *Toxopneustes pileolus* collected near Mombasa. The most striking characteristic, which distinguishes this new species from all known species of the *Syndesmis-Syndisyrinx* group is the very long sclerotic bursal canal and the three ventral glandular papillae. A more detailed comparison between the specimens from the two different hosts demonstrates that they belong to the same species although some differences are statistically significant.

Keywords : *Syndesmis longicanalis* n. sp., Umagillidae, commensal, turbellarians, Plathelminthes, Echinoidea.

INTRODUCTION

The majority of species of symbiotic turbellarians in echinoderms, described until now, belongs to the family Umagillidae (Rhabdocoela); only a few species are acoels (JANGOUX, 1990). They occur in the coelom and/or in the intestine of various echinoderms and some in sipunculids as well.

All umagillids found in echinoids belong to the *Syndesmis-Syndisyrinx* group. Although it is a cosmopolitan group, most species are known from relatively few well studied parts of the world : N.E. Atlantic and Brasil, N.E. Pacific and Australia. Only a few species are reported from the W. Indian Ocean (Madagascar) by HYMAN (1960). We presently carry out an inventorisation of commensal turbellarians of the E. African coasts. This is a first report on a representative of the Umagillidae from this region with the detailed description of a new species found in the intestine of two echinoids, *Tripneustes gratilla* L., 1758 and *Toxopneustes pileolus* LAMARCK, 1816. Specimens of both hosts are compared to demonstrate that only one species is concerned.

MATERIALS AND METHODS

The echinoids *Tripneustes gratilla* and *Toxopneustes pileolus* were collected in the lagoons at Nyali and Bamburi, N. of Mombasa (Kenya). The animals were kept for several days in running and continuously aerated sea water. The test was opened by carefully cutting out a disc at the aboral surface. Coelomic fluid and the washings with sea water of the test were examined under a stereoscopic microscope. Then the intestine was opened and the content washed out with sea water and examined as well. Many specimens were studied alive and then mounted in lachtophenol. For permanent whole mount preparations specimens were fixed in FAA (Formol-Alcohol-Acetic) (JOHANSEN, 1940) or Bouin's, flattened under a coverglass. For paraffine sectioning the worms were fixed in warm Bouin's or Stieve's fixative. Specimens for whole mounts were stained with borax carmine; 5 μ m serial paraffine sections were stained with iron hematoxylin and eosin or with Mallory's, modified after Casson (fixatives and stains : see ROMEIS, 1968). Measurements were obtained from photographs of living specimens or from camera lucida drawings from whole mounts or sections. They are given as mean \pm standard deviation, range and number of observations. The statistical analysis of the data was carried out according to SEBER (1984) using the statistical procedure Proc GLM (Manova statement) from SAS (1988).

RESULTS

Occurrence in hosts

The worms were only observed in the intestine of the hosts. In 34 specimens of *Tripneustes gratilla*, 0 to 247 worms per host were found with a frequency of 65 %. The distribution of *S. longicanalis* is very patchy : some sea urchins have a high infection rate while specimens from places at a relative short distance (\pm 100 m) are totally negative. In the four specimens of *Toxopneustes pileolus* a maximum of 2 to 35 worms was found. Here the frequency was 100 %.

Description of *Syndesmis longicanalis* sp. nov. (Figs 1-7)

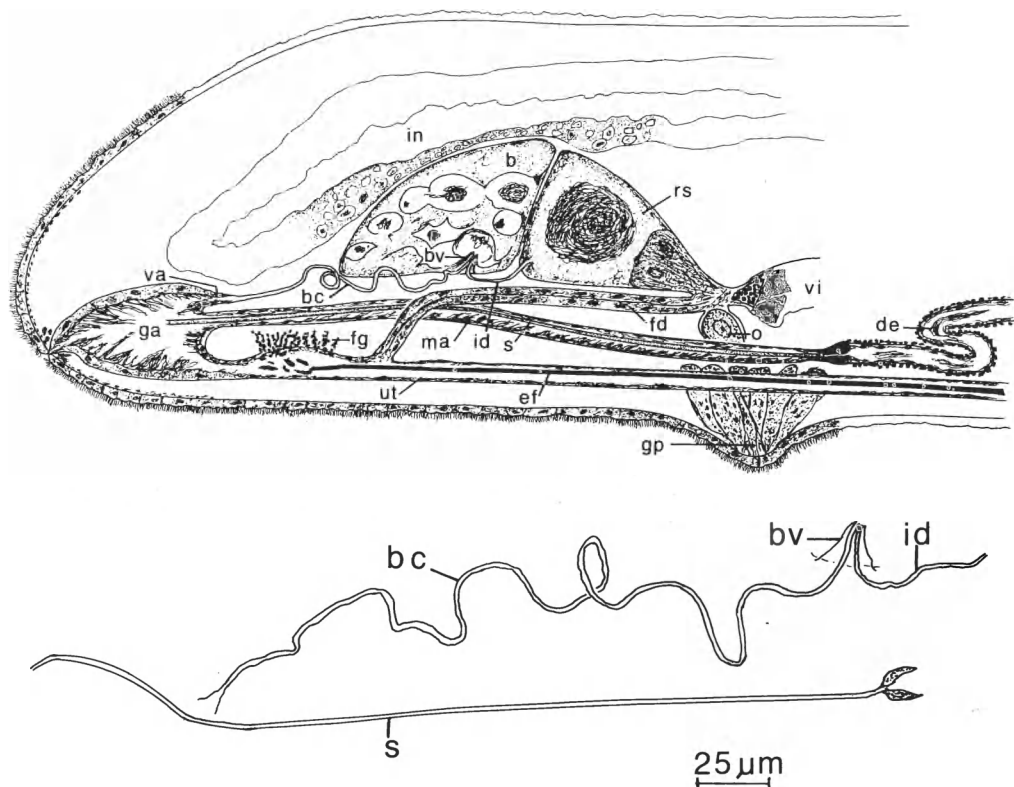
Material studied : many living animals and whole mounts ; several specimens sectioned.

Holotype : permanent mount stained with boraxcarmine.

Type locality : Nyali, N. of Mombasa (Kenya), in intestine of *Toxopneustes pileolus* (February 1992) from a depth of 2-5 m.

Other localities : Nyali and Bamburi, N. of Mombasa, in the intestine of *Tripneustes gratilla* and *Toxopneustes pileolus* at depths of 2-5 m. (February 1992 and October 1992).

Type material is deposited in the zoological collection of the Limburg University Center, Diepenbeek, Belgium.



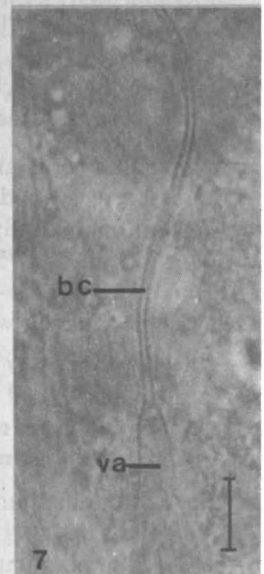
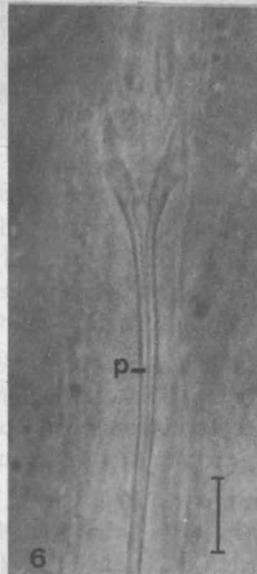
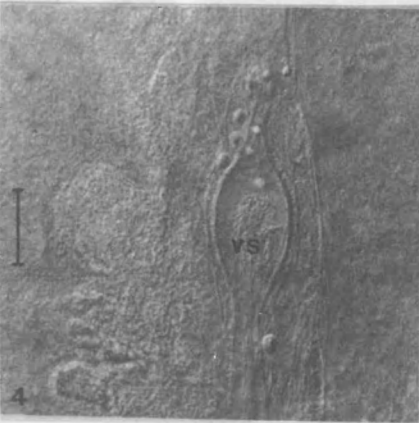
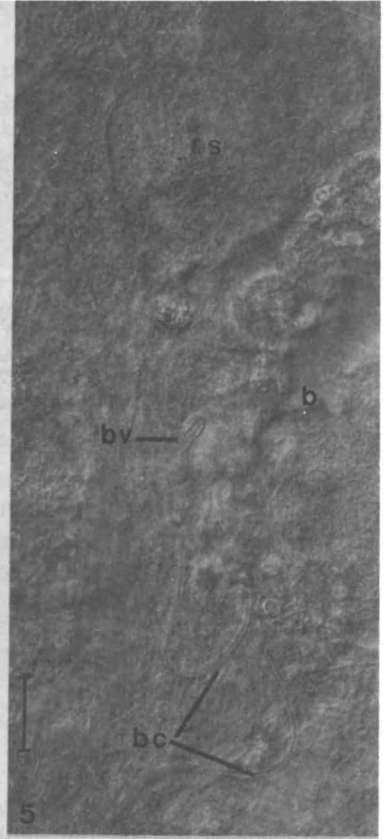
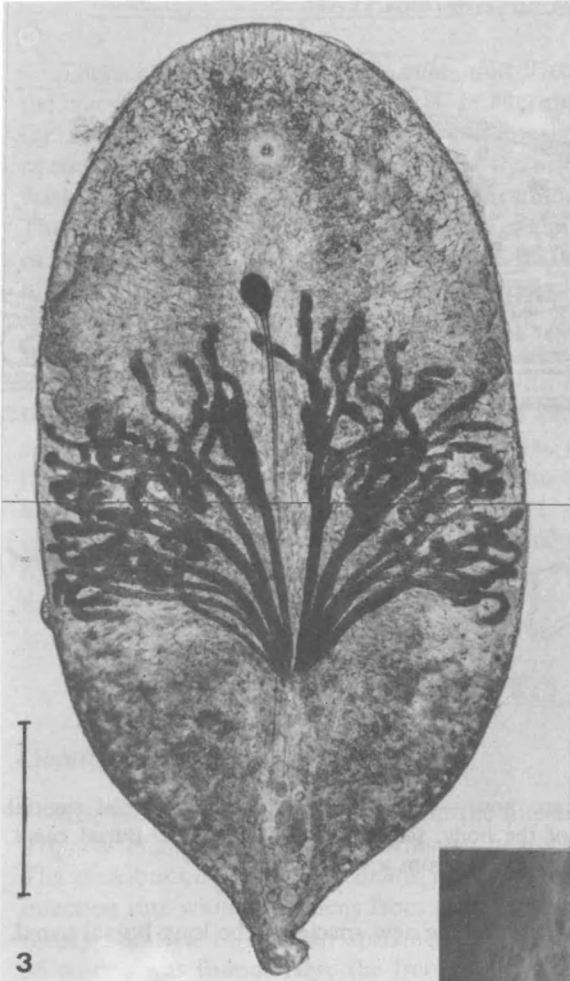
Figs 1-2. — *Syndesmis longicanalis* sp. nov. — 1. Semi diagrammatic medial sagittal reconstruction of the posterior third of the body, seen from the right — 2. Bursal canal, bursal valve, insemination duct and penis stylet (from a whole mount).

Etymology : the distinctive characteristic of the new species is the long bursal canal, hence the species name *longicanalis*.

Living specimens are markedly red to red-orange. The anterior end is rounded while the posterior end tapers to a nipple-like tip. The width is greatest in the middle portion of the body. Body length and width in the living animal are : gliding : $2246 \mu\text{m} \pm 174$ (1875-2416) and $579 \mu\text{m} \pm 91$ (458-708) ($n = 10$); rest : $2193 \mu\text{m} \pm 259$ (1875-2916) and $1262 \mu\text{m} \pm 96$ (1041-1500) ($n = 20$). Various measurements in the whole mounts can be found in Table I.

The whole body is ciliated. Three poorly developed glandular papillae are present in the midventral region. The anteriormost one is at the level of the anterior edge of the bursa or receptacle, the second one just posteriorly to the confluence of the vitellaries and ovaries and the third one just anteriorly to the pharynx.

The subterminal mouth is at $229 \mu\text{m} \pm 32.7$ (102-279, $n = 43$) from the anterior edge of the body in the living animal; ratio to bodylength is 1:6.8 (1:8.8-1:5, $n = 43$). Pharynx diameter is $96 \mu\text{m} \pm 10$ (115-75, $n = 45$). The blind saccate



intestine extends posteriorly (dorsal to the vitellaries and ovaries) to the anterior edge of the genital atrium which is nearly at the posterior end of the worm. Laterally, the intestine extends to one third of the lateral aspect of the vitellaries.

The paired lobular testes are in the anterior third of the body from the posterior edge of the pharynx and extend backwards to overlap the anteriormost branches of the vitellaries. The medial portions are close to the intestine, the lateral portions of the posterior half come close to the lateral margins of the body. The sperm ducts arise from the posterolateral part of the testis and run towards the middle of the body. They then turn anteriorly and run close and parallel to each other and to the uterus. Just behind the pharynx they become very narrow, turn posteriorly and unite to form a bulb-shaped seminal vesicle from which the ejaculatory duct originates. Both ejaculatory duct and seminal vesicle have two muscle layers: well developed outer circular muscles and inner longitudinal muscles. The narrowed anterior end of the seminal vesicle is surrounded by glands. Seminal vesicle as well as the glands are enveloped by a thin sheath, which in turn is connected to the basement membrane of the body wall just posteriorly to the pharynx. The ejaculatory duct leads posteriorly to the stylet. When the stylet is retracted, the ejaculatory duct has one loop just before the junction with the stylet of which the base is then situated anteriorly to the junction of vitellaries and ovaries. The basis of the stylet is funnel shaped and the total mean length of the stylet is $478 \mu\text{m} \pm 139$ (296-838, $n = 14$). The ratio to the body length is 1:4.1 (1:2.3-1:6, $n = 10$), the diameter 1.5 to $2.5 \mu\text{m}$. The penis stylet is enclosed in the elongated male antrum that opens in the common genital atrium the distal part of the stylet protruding into the common genital antrum and in living specimens even out of the genital pore when the animal is slightly compressed.

The vitellaries are posterior to the testes. The anteriormost branches overlap the posterior third of the testes. The 20 to 25 branches converge in five to eight main trunks, which open into the ootype. The lateral branches come very close to the lateral margins of the body. The paired ovaries, just posterior to the vitellaries, have two or three lobes. The uterus extends from the atrium to near the posterior edge of the pharynx where it is connected to the body wall by a thin ligament. In most specimens the uterus contains a fully developed amber egg capsule. The distal part of the long whip-like egg filament is tightly coiled and is to be found in the posterior part of the uterus where the egg filament glands open. These glands are ventrally in the posterior third of the body.

From the anterior wall of the common genital atrium the short female antrum or vagina originates, narrowing to a thin canal. This sclerotic bursal canal (diameter 2 to $3 \mu\text{m}$) is very long and coiled. It ends in an obvious bursal valve in the middle

Figs 3-7. — *Syndesmis longicanalis* sp. nov., micrographs — 3. Living specimen, slightly squeezed (scale bar : $500 \mu\text{m}$) — 4. Seminal vesicle (scale bar : $32 \mu\text{m}$) — 5. Bursal valve, bursal canal, bursa and seminal receptacle (scale bar : $35 \mu\text{m}$). — 6. Stylet (scale bar : $12 \mu\text{m}$) — 7. Vagina and bursal canal (scale bar : $20 \mu\text{m}$) ; (4, 5 in whole mount, Nomarski ; 6, 7 in living animal).

and at the ventral side of the bursa. This valve consists of a sclerotic flange that rises in a nipple like structure (13 μm long, 5 μm high) projecting into one of the cavities in the bursa. The seminal receptacle is oval and is close and anterior to the bursa. The posterior end of the seminal receptacle is connected to the bursal valve by a short sclerotic insemination duct. The anterior part of the seminal receptacle is filled with large secretory cells and is connected to the ootype which in turn is connected to the uterus by the thin walled female duct. The latter ends in the uterus just posteriorly to where the egg filament glands open.

The common genital atrium in which the male antrum, vagina and uterus end, opens to the exterior at the posterior tip of the body. The epithelial lining of the atrium consists of cells with apical villusities.

Statistical analysis

Measurements were taken from 52 whole mounts, 28 of specimens from *Toxopneustes pileolus* and 24 of specimens from *Tripneustes gratilla* (Table I). Not all structures could however be measured in all specimens.

Four methods of multivariate analysis of variance (Wilk's Lambda, Pillai's Trace, Hotelling-Lawley Trace, Roy's Graetest Root) indicate a significant difference between the populations from the two hosts ($P = 0,0022$). The univariate analysis indicates that the differences are to be found in the body width ($P = 0,0021$), width of the egg capsule ($P = 0,0038$) and the length of the bursal canal ($P = 0,00491$). In our opinion the populations in the two hosts can not be distinguished on a morphological basis and are hence considered as populations of one and the same species for the time being.

In order to check whether there is a correlation between the different measures, Pearson correlation coefficients were calculated (Table II). Most measures (26/36 = 75 %) are positively correlated, 9/36 (= 25 %) are negatively correlated. Only two of the correlation coefficients are slightly significant.

DISCUSSION

The comparison between the specimens from the two different species of hosts indicates that they most probably belong to the same species, though there is a statistically significant difference for three of the nine measures (body width and width of the egg capsule and the length of the bursal canal). Differences between populations can be caused by ecological factors, in this case the different hosts. Slight morphological differences between individuals from different hosts are also reported for *S. echinorum* (KOZLOFF and WESTERVELT, 1987). Unless infection experiments prove the contrary, we prefer to consider individuals in both hosts as belonging to the same species.

The anatomy of *Syndesmis longicanalis* n. sp. clearly indicates that it belongs to the genus *Syndesmis* SILLIMAN, 1881 or *Syndisyrix* LEHMAN, 1946. We compared it with the 20 species known in both these genera. The presence of the long coiled

TABLE I

Syndesmis longicanalis sp. nov. — Comparison of parameters of specimens of different hosts.

		ALL					in <i>Toxopneustes</i>					in <i>Tripneustes</i>				
		\bar{x}	SD	max	min	n	x	SD	max	min	n	\bar{x}	SD	max	min	n
1	body length	1547	304	2444	908	43	1565	240	1931	908	26	1520	390	2444	1080	17
2	body width	861	159	1322	500	43	810	130	1008	500	26	939	171	1322	748	17
3	1/2	1.83	0.38	3.98	1.35	43	1.97	0.41	2.98	1.42	26	1.61	0.19	1.88	1.35	17
4	diameter pharynx	95.9	10.3	115	75	45	96.2	8.4	114	83	25	95.5	12.4	115	75	20
5	anterior-mouth	229	32.7	279	137	44	229	29.6	279	137	25	229	37.3	279	156	19
6	1/5	6.79	0.91	8.76	4.97	42	6.85	0.69	8.66	4.97	25	6.74	1.19	8.66	5.07	17
7	length egg c.	121	8.6	138	102	38	123	9.5	138	102	24	118	5.7	129	105	14
8	width egg c.	103	11	125	85	38	106	9.6	121	85	24	98	11	125	88	14
9	bursal canal	357	71.5	548	219	46	385	65	548	253	26	320	65	445	219	20
10	1/9	4.55	1.44	9.26	2.7	37	4.15	0.82	5.92	2.7	24	5.29	2.01	9.26	3.22	13
11	length stylet	478	139	838	296	14	546	217	838	317	4	451	97	585	296	10
12	1/11	4.11	1.23	5.98	0.17	10	3.94	0.7	3.34	4.71	3	4.19	1.45	5.98	2.31	7
13	insem. duct	74	19	102	33	17	83	17.2	102	57	7	67	17.3	87	33	10

TABLE II

Syndesmis longicanalis sp. nov. — Correlation between measurements (Pearson correlation coefficients ; figures between brackets is the number of observations).

	body length	body width	diameter pharynx	anterior- mouth	length egg	width egg	bursal canal	length stylet	insem. duct
body length	1 (43)								
body width	0.57 (43)	1 (43)							
diameter pharynx	0.39 (42)	0.42 (42)	1 (45)						
anterior- mouth	0.62 (42)	0.31 (42)	0.40 (44)	1 (44)					
length egg	-0.14 (36)	-0.37 (36)	-0.05 (38)	-0.11 (37)	1 (38)				
width egg	0.14 (36)	0.09 (36)	0.35 (38)	0.23 (37)	-0.01 (38)	1 (38)			
bursal canal	0.07 (37)	-0.14 (37)	0.08 (39)	0.03 (38)	0.19 (34)	0.20 (34)	1 (46)		
length stylet	0.17 (10)	0.25 (10)	0.43 (13)	-0.02 (12)	-0.15 (10)	0.09 (10)	0.15 (14)	1 (14)	
insem. duct.	0.05 (11)	0.05 (11)	0.57 (12)	-0.27 (11)	-0.09 (11)	0.05 (11)	0.15 (17)	0.72 (6)	1 (17)

sclerotic bursal canal together with the poorly developed midventral glandular papillae led us to the conclusion that the species we described is new.

Syndesmis philippinensis KOMSCHLIES and VANDE VUSSE, 1980, found in *Echinometra oblonga* de BLAINVILLE, 1825 has a long bursal canal of approximately the same length but the mean length is different (280 μ m, 120-560 mm), and most of all it is not sclerotic nor does this species have a bursal valve ; it does not possess glandular papillae. Glandular papillae have as yet only been found in *Syndesmis glandulosa* HYMAN, 1960, found in *Diadema setosum* LESKE, 1778 and *Echinotrix calamaris* PALLAS, 1774 (HYMAN, 1960 ; KOMSCHLIES and VANDE VUSSE, 1980B).

The validity of the genus *Syndisyrix* and the possible synonymy of both genera is since long a matter of debate. A more detailed historical review has been given by CANNON (1982), KOZLOFF and WESTERVELT (1987, 1990) and HERTEL *et al.* (1990).

MARCUS (1949) synonymized both genera, supported by STUNKARD and CORLISS (1951). The sclerotized bursal valve was not considered a valid distinctive character.

In 1982 Cannon proposed to reinstall the genus *Syndisyrix* considering the sclerotized bursal valve as a valid apomorphy. He did not consider the inadequate descriptions of the four new species by KOMSCHLIES and VANDE VUSSE (1980a, 1980b). Later on KOZLOFF and WESTERVELT (1987) describe a sclerotized bursal valve in *Syndesmis echinorum* FRANÇOIS 1886 the type species of the genus that should not have a valve! They nevertheless propose to conserve the genus *Syndisyrix* LEHMAN 1946 now based on other distinctive features : form and proportions of the parts of the ejaculatory duct, the male antrum and the stylet.

In further analyses of several species of both genera these same authors (WESTERVELT and KOZLOFF, 1990, 1992 ; KOZLOFF and WESTERVELT, 1990) come to the conclusion that only one decisive character remains : in *Syndisyrix* the male antrum is slender and narrow and the stylet slips freely back and forth in it, whereas in *Syndesmis* the male antrum is broad and the stylet seems to be bound tightly to the wall. However, in their study of four new species of *Syndesmis* (*S. albida* and *S. rubida* KOZLOFF and WESTERVELT, 1990, and of *S. inconspicua* and *S. neglecta* WESTERVELT and KOZLOFF, 1992) we think the description of the male antrum — penis stylet complex is incomplete. Indeed, there is no mention of any connection between the ending of the ejaculatory duct, bearing the basis of the penis stylet, and the male antrum in which the tip of the penis stylet protrudes. In our opinion it is very unlikely that there is no sheath around this thin stylet. In the species we described this sheath is the elongated male antrum. It is clear that in earlier descriptions this character has not been considered. Without a new thorough revision and re-assessment of several characteristics (including ultrastructure) of the *Syndesmis-Syndisyrix* species complex no final decision can be made on the validity of the genus *Syndisyrix*. We therefore prefer to provisionally include the new species in the oldest genus.

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Abbreviations to the figures

b : bursa
bc. : bursal canal
bv. : bursal valve
ga. : common genital atrium
de. : ejaculatory duct

ef : egg filament
fd : female duct
fg. : filament glands
gp : glandular papilla
id : insemination duct

in. : intestine	ut. : uterus
ma : male genital antrum	va. : vagina
o. : ovaries	vi. : vitellaria
s. : penis stylet	vs. : seminal vesicle.
rs. : seminal receptacle	

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