

Genostoma kozloffii sp. nov. and *G. inopinatum* sp. nov.
(Turbellaria : Neorhabdoceola : Genostomatidae)
from leptostracan crustaceans of the genus *Nebalia*

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Résumé : Deux nouvelles espèces de *Genostoma*, symbiontes trouvées sous la carapace des crustacés leptostraces du genre *Nebalia*, sont décrites. L'hôte pour *G. kozloffii* est *N. pugetensis*, recueilli à l'Archipel San Juan, Washington ; *G. inopinatum* est hébergé par *N. bipes* à Roscoff, sur la côte Atlantique de France. La forme générale, les proportions du pharynx et l'appareil reproductif sont à la base des distinctions entre *G. kozloffii* et *G. inopinatum*, et entre ces mêmes espèces et *G. tergestinum* et *G. marsiliense*, hébergés par *N. bipes* dans la Méditerranée. Dörler (1900) et von Graff (1903) ont placé *Genostoma* dans l'ordre des Rhabdoceola (remplacé maintenant par Neorhabdoceola) ; Reisinger (1924), par contre, l'a placé dans l'ordre des Alloeoceola (Proleciophora d'aujourd'hui les premiers auteurs s'appuient sur l'arrangement des organes génitaux et la morphologie des spermatozoïdes. De plus, il faut rejeter la proposition de Reisinger de synonymiser *Genostoma* avec *Hypotrichina*, genre décrit par Calandruccio (1897), car l'espèce type de *Hypotrichina* appartient aux Otoplanidae (Proleciophora).

Abstract : Two new species of the turbellarian genus *Genostoma*, living under the carapace of leptostracan crustaceans of the genus *Nebalia*, are described. *Genostoma kozloffii* is a symbiont of *N. pugetensis* in the San Juan Archipelago of Washington State ; *G. inopinatum* is associated with *N. bipes* at Roscoff on the Atlantic coast of France. The two species differ from one another, and also from *G. tergestinum* and *G. marsiliense*, both found on *N. bipes* at Mediterranean localities, in the shape of the body, relative pharynx size, and the structure of the reproductive system. The arrangement of the reproductive organs and sperm morphology in species of *Genostoma* suggest that Dörler (1900) and von Graff (1903) were correct in placing the genus in the order Rhabdoceola (now usually Neorhabdoceola), rather than in the Alloeoceola (now Proleciophora) as proposed by Reisinger (1924). Reisinger's synonymizing of *Genostoma* with Calandruccio's (1897) genus *Hypotrichina* is rejected, because these symbionts of *Nebalia* are decidedly different from the type species of *Hypotrichina*, which is a free-living member of the Otoplanidae (Proleciophora).

INTRODUCTION

Until now, only two species of the genus *Genostoma* have been described. The first report of a turbellarian of this type was that of Repiachoff (1884), who found it in *Nebalia bipes* at Trieste, Italy. In 1888, he reported a second species occurring in this host at Marseille, France. Calandruccio (1897), using Repiachoff's brief descriptions, named the worms from Trieste and Marseille *Hypotrichina tergestina* and *H. marsiliensis*, respectively. Otherwise, however, the genus *Hypotrichina*, as proposed by Calandruccio, consisted of free-living worms not closely related to those from *N. bipes*.

Dörler (1900), after making a detailed morphological study of both worm species that Repiachoff had reported, transferred the two symbionts of *N. pipes* to a new genus, *Genostoma*. He also reported that both *G. tergestinum* and *G. marsiliense* could be found in

N. bipes at Trieste, sometimes in the same host individual. Von Graff (1903) asserted that a new family (Genostomatidae) was required to accommodate the genus *Genostoma*. He placed the family into the old order Rhabdozoa. Von Graff's study is essentially a duplication of Dörler's effort, but his interpretation of certain reproductive structures in *G. tergestinum* differed from the conclusions reached by Dörler. Thus, some aspects of the anatomy of *G. tergestinum* remained problematic.

Reisinger (1924) attempted to resolve the ambiguities concerning *G. tergestinum*. His study was based upon one series of transverse sections and two series of longitudinal sections. The slides he used were from Dörler's collection and had been restained. Reisinger provided a rather detailed description based on this material.

In 1972, 1982 and 1983, Eugene N. Kozloff studied a species of *Genostoma* from *N. bipes* collected at Roscoff on the Atlantic coast of France. His unpublished observations showed that this species, while superficially similar to *G. tergestinum* differs from both *G. tergestinum* and *G. marsiliensis*. It has been assumed by researchers working with *Genostoma* that the *Nebalia* from Mediterranean localities is conspecific with *N. bipes* of the Atlantic and North Sea. Because two species have been found in the putative *N. bipes* in the Mediterranean, and another species in *N. bipes* on the Atlantic coast of France, the possibility exists that more than one species of *Nebalia* is involved.

In the present study, two new species of *Genostoma*, one from *N. pugettensis* in the San Juan Archipelago of Washington, the other from *N. bipes* at Roscoff, are described and compared to *G. tergestinum* and *G. marsiliense*. The systematic position of the genus is also discussed.

MATERIALS AND METHODS

Specimens of *N. pugettensis* were collected at two sites on San Juan Island, Washington. Most were obtained in North Bay, near the outflow of Argyle Lagoon; the rest were taken from tide pools on the south side of False Bay. Both sides can be reached at tide levels of 0.0 m or lower. The host crustacean is easily collected by vigorously disturbing the superficial layers of sediment in which it lives. Its cuticle is extremely hydrophobic; specimens that reach the surface tend to float and thus can be skimmed off easily.

The species of *Genostoma* in *N. pugettensis* lives in the space beneath the carapace. If the carapace is teased apart in a dish of sea water, the worms generally leave the host and can be picked up with an attenuated Pasteur pipette. This turbellarian was studied extensively while alive. For permanent preparations, specimens were relaxed in a mixture of sea water and an isotonic solution of magnesium chloride, then fixed in Bouin's fluid. Whole mounts were stained with borax carmine, dilute acidulated borax carmine, and alum cochineal. Paraffin sections were cut serially at 5 μm , and stained with iron hematoxylin.

At Roscoff, *Nebalia bipes* was found among decaying algae that had accumulated under rocks. The specimens given to me by Kozloff had been fixed in Bouin's fluid. Whole mounts were stained with borax carmine.

It should be noted that whole mounts of these turbellarians, as prepared above, were of limited usefulness. In interpreting morphology, I depended mostly on living specimens and sections.

DESCRIPTIONS

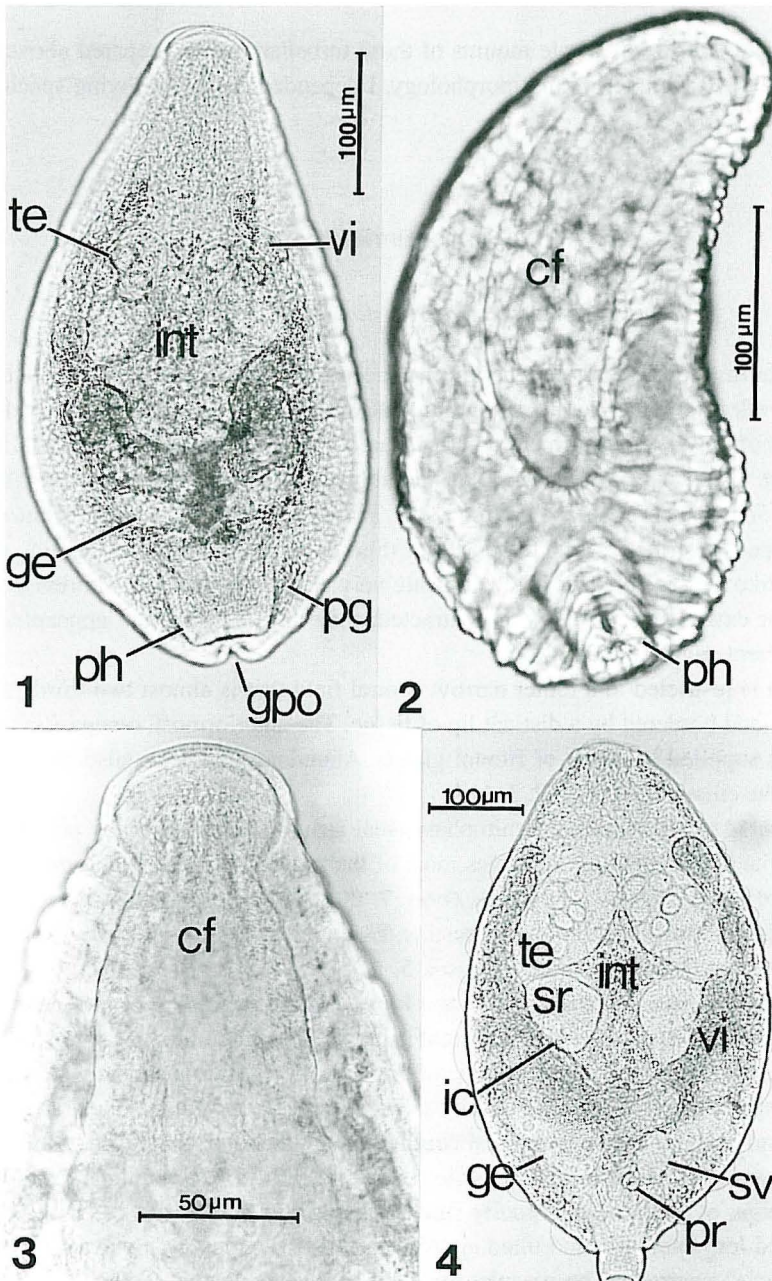
Genostoma kozloffii sp. nov. (Figs 1-15, 26)

Worms of this species are, in general, translucent, but the gut and germovitellaria appear whitish in reflected light. The largest individual, while it was extended and actively gliding across the bottom of the specimen dish, measured about 500 μm in length and 150 μm in width. Most mature specimens were considerably smaller than this, however. The widest part of the animal is near the beginning of the posterior third of the body. From this point the body tapers anteriorly, while the posterior third of the body is rounded, giving the worm a teardrop-like outline (Fig. 1). The worms are very contractile and may shorten to less than half of their extended length. When contracted, they have a leech-like appearance due to their prominent annulations (Fig. 2).

Ciliation is restricted to a rather narrow ventral field that is almost two-thirds the length of the body and bordered by a distinct lip of tissue. The anteriormost, omega-shaped part of this field is supplied by ducts of frontal glands. Abundant glands are also associated with the rest of the ciliary field (Figs 2, 3, 11).

The opening of the common genitopharyngeal atrium (Fig. 1) is at the posterior end of the body. The plicate pharynx occupies most of the space. The lateral margins of the atrial chamber are richly supplied by glands (Figs. 7, 26). A short esophagus succeeds the pharynx and passes into the five-lobed intestine. Essentially, the intestine occupies space not taken up by the reproductive organs (Figs 4, 5, 10).

The large, compact testes are paired and located at the beginning of the second third of the body, immediately posterior to the brain (Fig. 4). They are bound by a tunica, and separated from each other by the anterior lobe of the intestine. The testes contain several distinct masses of spermatogonia and are usually packed with sperm. Sperm ducts arise from the posterolateral margins of the testes and continue along the lateral margins of the body, and join the ventral part of the seminal vesicle (Figs. 8, 9, 12, 26). The seminal vesicle (Figs 6, 7, 8) is a large, ovoid structure usually situated slightly to the right of the midline, its long axis oriented longitudinally and tilted approximately 45 degrees from vertical; the anterior end is directed ventrally. The ejaculatory duct, after leaving the seminal vesicle, passes immediately into a large prostatic gland (or "granular gland" in the terminology of Dörler and von Graff). Granular filaments extend from this structure to the lateral margins of the body (Figs 6, 26). After passing through the prostatic gland, the ejaculatory duct continues for a short distance, then enters a sclerotized penis stylet (Fig. 8). The male gonopore is situated in the genitopharyngeal atrium dorsal to the pharynx (Figs 7, 15). The sperm are



Figs 1-4 : *Genostoma kozloffii* sp. nov. ; photomicrographs. 1. Dorsal view, showing the general shape of the body, the posterior position of the pharynx, and certain elements of the reproductive system. 2. Ventral ciliated field. 3. Anterior portion of the ventral ciliated field. 4. Flattened specimen showing the relationship of some of the reproductive organs. Abbreviations (for all figures) : ag, male accessory glands ; bc, bursal canal ; bp, bulbous penis ; br, brain ; cf, ciliated field ; ci, cilia ; ds, ductus spermaticus ; ed, ejaculatory duct ; fg, frontal gland ; ge, germarium of germovitellaria ; gpo, genitopharyngeal opening ; grf, granular filaments ; ic, insemination canal ; int, intestine ; ma, male antrum ; od, oviduct ; pg, pharyngeal glands ; ph, pharynx ; pr, prostatic gland ; ps, penis stylet ; sb, seminal bursa ; scd, sclerotized duct ; sd, sperm duct ; sr, seminal receptacle ; st, stalk of egg capsule ; sv, seminal vesicle ; te, testis ; vi, vitelline portion of germovitellaria.

filamentous and are more than 100 μm long, their terminal, motile portions being about 10 μm in length.

The vagina or vaginas are not obvious. Reisinger (1924) claimed that the vaginas are paired in *G. tergestinum* and that they open on the lateral margins of the genitopharyngeal atrium. Paired duct-like structures have been seen in this region of *Genostoma kozloffi*, but their complete course could not be determined. Two large seminal receptacles (Figs 4, 5, 9, 10, 12) are located just posterior to the testes and are separated from them by lateral lobes of the gut. The receptacles communicate with the germaria via a sclerotized insemination canal (Figs 9, 10, 13). The mouth of this duct is approximately funnel-shaped, but possesses a broad flange. There are usually four large cells, with dark-staining nucleoli, arranged symmetrically around the mouth of this structure. The funnel narrows sharply, forming a sigmoid tube with a pronounced hook at the terminus of the sclerotized portion.

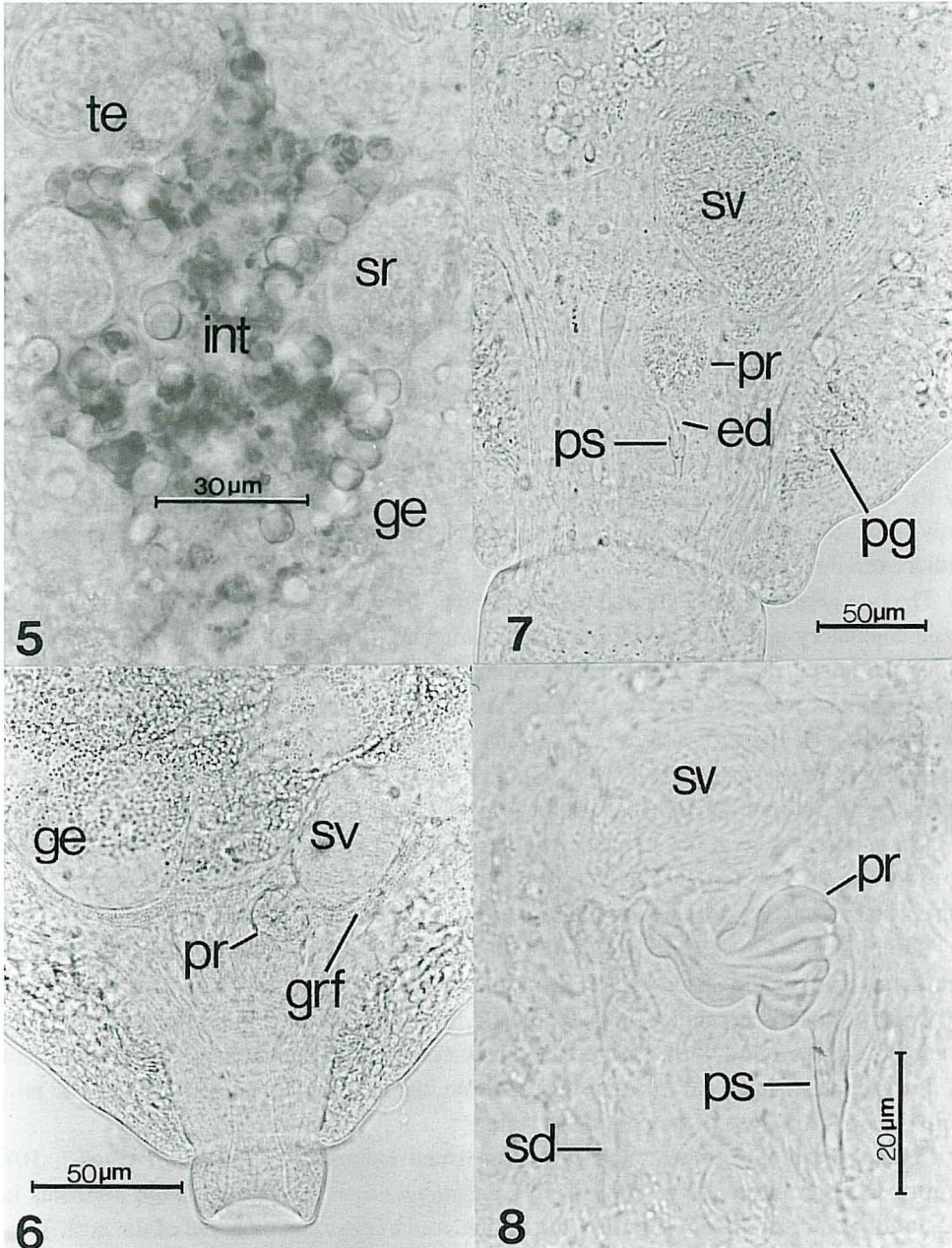
Two ciliated chambers occur lateral to the seminal receptacles. They are approximately in line with the position of the insemination canals and are just medial to the lateral margins of the body. These structures are not evident in any of the serial sections, and they have only been seen occasionally in living specimens. It is possible that they could function in either excretion or reproduction.

The two germovitellaria, united by a transverse duct just anterior to the pharynx and the male copulatory apparatus, form a U-shaped structure. Each arm of the U extends forward along the lateral margins of the body, terminating just anterior to a testis (Figs 1, 4, 26). Serial sections reveal germocytes concentrated in the posterior portion of each arm, with the largest ones situated posterolateral to the seminal receptacles (Figs 4, 6). The oviduct originates from the transverse duct at the base of the U and posteriorly along the midline, opening into the genitopharyngeal atrium above the male duct (Fig. 15).

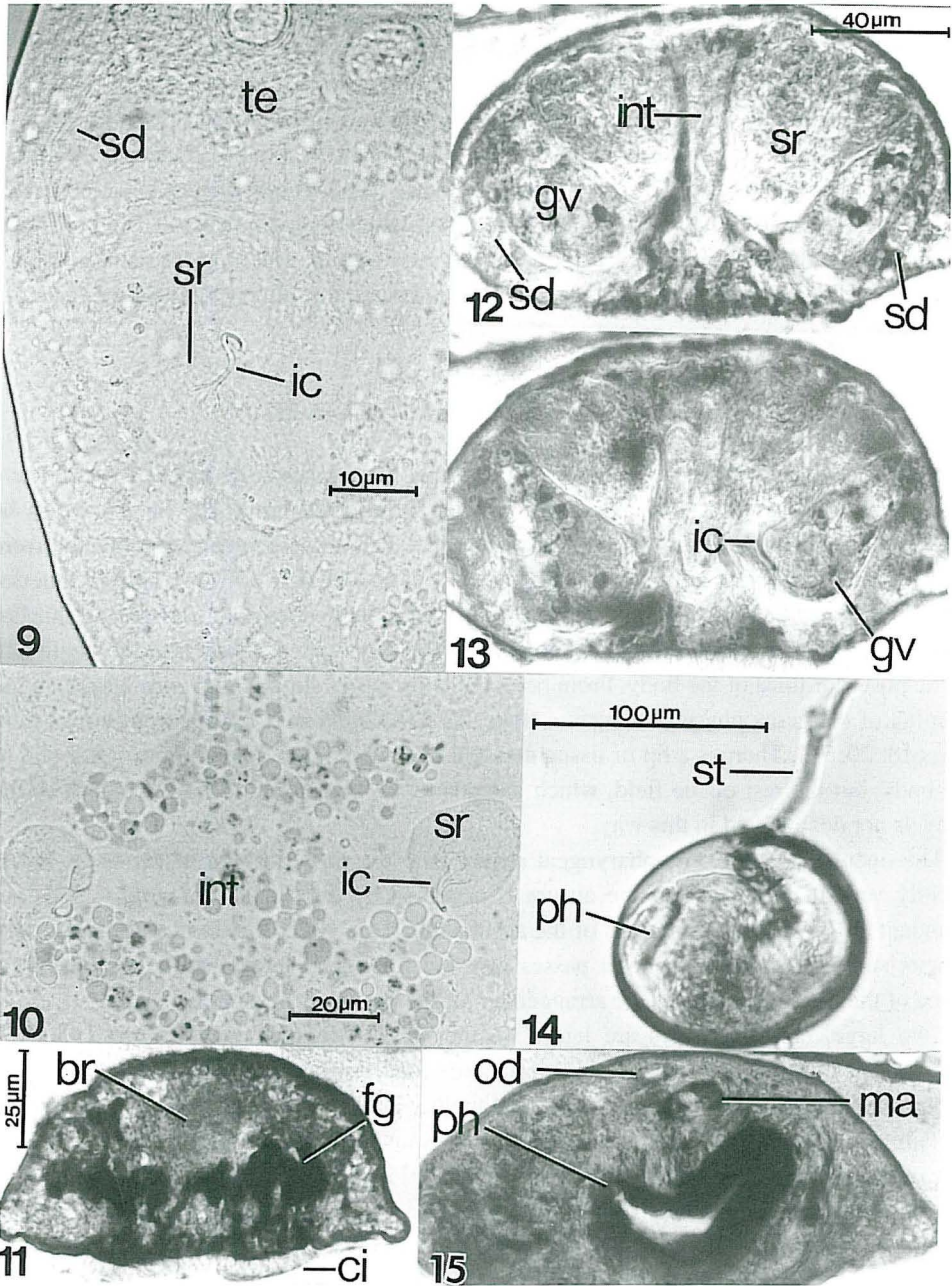
The almost spherical or lenticular egg capsules laid by *G. kozloffi* (Fig. 14) have been seen to contain from one to three worms. The capsules are thin-walled but refractile and have a stalk by which they are attached to the inner surface of the host's carapace.

Observations of *G. kozloffi* *in situ* indicate that these symbionts can usually be found in the dorsal part of the space enclosed by the carapace of *N. pugettensis*. The worms are generally oriented perpendicular to the host's long axis, the posterior end being directed dorsally. They are usually contracted and show conspicuous annulations. My observations of live specimens removed from the host indicate that the pharynx is more likely to be protruded when the body is in the contracted state.

Lipid droplets constitute much of the intestinal contents in *G. kozloffi* (Figs 5, 10). Worms taken from brooding females of *N. pugettensis* have bright carotenoid pigments in the gut, the color of these being the same as that seen in eggs and embryos of the host. Thus it is likely that *Genostoma kozloffi* feeds opportunistically on eggs and embryos (Rotifers of the genus *Seison*, also commonly found on brooding *Nebalia*, acquire the same carotenoid coloration). The mode of nutrition in worms found in males and nonbrooding females of *N. pugettensis* is unknown. It is possible, however, that *Genostoma* feeds on host tissues, at least to a considerable extent.



Figs 5-8 : *Genostoma kozloffii* sp. nov. ; photomicrographs. 5. Portion of a flattened specimen showing the testes, seminal receptacles, and germaria, and their position relative to the intestine, which is filled with ingested material, mostly lipid droplets. 6. Posterior portion of a flattened worm. 7. Elements of the male reproductive system in a flattened animal. 8. Penis stylet, prostatic gland, seminal vesicle and sperm ducts.



Figs 9-15 : *Genostoma kozloffii* sp. nov. ; photomicrographs. Fig. 13 is to the same scale as Fig. 12 ; Fig. 15 is to the same scale as Fig. 11. 9. Flattened worm, showing testis, sperm duct, seminal receptacle and insemination canal. 10. Portion of an extremely compressed worm, showing the testes, paired seminal receptacles, insemination canals, and contents of the intestine. 11. Transverse section showing the brain, frontal gland, and ventral cilia. 12. Transverse section through the intestine, seminal receptacles, germovitellaria, and sperm ducts. 13. Transverse section showing the insemination canal. 14. Egg capsule, containing one worm. 15. Transverse section through the pharynx, male antrum, and oviduct.

Numerous (more than 20) juvenile worms have been found on single specimens of female *N. pugettensis* that were brooding young. It is conceivable that reproduction in *G. kozloffii* is synchronized with reproduction in *Nebalia*. Association of worms with juvenile *N. pugettensis* in brooding females is perhaps the way that the symbiotic relationship is established.

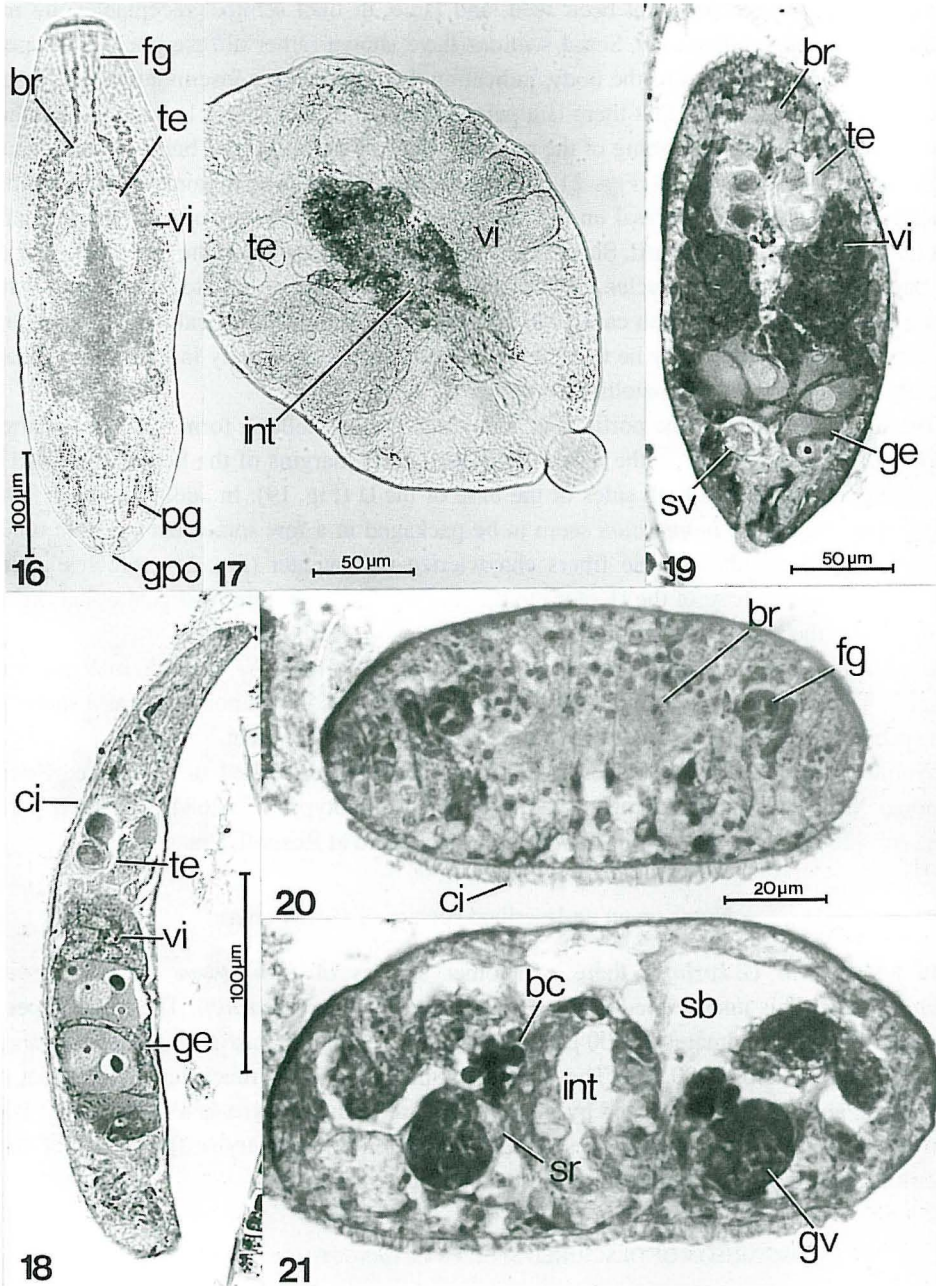
Whole mounts have been deposited in the United States National Museum, Helminthological Collection. The holotype (n° 82686), from *Nebalia pugettensis* collected in North Bay, San Juan Island, Washington, USA, was stained with dilute acidulated borax carmine. Three paratypes (n° 82687) from *N. pugettensis* were collected at the same locality ; two of these were stained with dilute acidulated borax carmine, alum cochineal was used for the third.

Genostoma inopinatum sp. nov. (Figs 16-25, 27)

Kozloff (unpublished observations) reported that the worms collected at Roscoff were similar in coloration to *G. kozloffii* when viewed in reflected light. The largest worm he observed was about 650 μm long and 220 μm wide. This measurement was obtained from his photomicrograph of an unflattened animal. In an extended worm, the narrow anterior end broadens gradually, reaching its widest point near the beginning of the second third of the body. From this region the body narrows slightly, then widens again near the beginning of the posterior third of the body. From here, the body tapers slightly and ends bluntly at the opening of the genitopharyngeal atrium (Figs 16, 27). Ciliation is limited to a ventral field (Figs 18, 20, 21). There is a lip of tissue that delimits the ciliated field at the anterior end of the body, but the rest of the field, which extends to the beginning of the last fourth of the body, is not demarcated in this way.

The opening of the genitopharyngeal atrium is at the posterior end of the body, but is slightly ventral. Nearly all of the atrium is occupied by the plicate pharynx. Glands are abundant along the lateral margins of the atrial walls (Figs 16, 27). A long and narrow esophagus succeeds the pharynx and passes into the five-lobed intestine. The characteristic shape of the intestine is due to the arrangement of the reproductive organs.

Two large, compact testes are lateral to the anterior lobe of the intestine (Figs 16, 17, 18). They are elliptical, beginning near the second third of the body, behind the brain (Figs 16, 20), and diverge slightly from one another as they extend posteriorly. Each testis contains several masses of spermatogonia, and is bound by a tunica. Observations made by Kozloff (unpublished) indicate that the sperm ducts (Fig. 23) arrive separately at the ventral portion of the seminal vesicle. Their complete course and exact point of origin could not be discerned in sections. The seminal vesicle (Figs 19, 23) is a large, ovoid structure oriented lengthwise. It is on the right of the midline, and is tilted approximately 45 degrees from vertical ; its anterior end is directed ventrally. The ejaculatory duct passes through a large, nongranular prostatic gland, then continues for a short distance before it enters a sclerotized penis stylet located within a muscular antrum (Fig. 23). The male gonopore (Fig. 25) opens into the genitopharyngeal atrium above the pharynx.



Figs 16-21 : *Genostoma inopinatum* sp. nov. ; photomicrographs. Fig. 21 is to the same scale as Fig. 20. 16. Dorsal view of an unflattened worm, showing frontal gland, brain, testes, germovitellaria, intestine and genitopharyngeal opening. 17. Flattened specimen showing the deeply lobed vitellaria. 18. Longitudinal section, showing a testis and germovitellarium. 19. Frontal section ventral aspect. 20. Transverse section, showing the brain and ventral cilia. 21. Transverse section showing the seminal bursae, bursal canals, seminal receptacle, germovitellaria, intestine and ventral cilia.

Vaginal ducts have been not been seen, and large, distinct seminal receptacles are not evident in the material studied. Serial sections have shown rather diffuse pockets of spermatozoa in various regions of the body, indicating that hypodermic insemination is a possibility. It appears, however, that there is a pair of seminal bursae (Fig. 21) located on either side of the gut near the beginning of the posterior third of the body. The bursae communicate by short, sclerotized ducts (Figs 21, 22) with what appear to be a pair of small seminal receptacles (Fig. 21). The bursal end of each duct supports a cluster of pear-shaped cells that have dark-staining nucleoli. Short filaments radiate outward from the receptacle end of the duct. The seminal receptacles are directly adjacent to the germovitellaria ; I have not seen a sclerotized insemination canal. My interpretation of the anatomical relationships just described is tentative ; it may be that the sclerotized ducts are actually insemination canals leading directly to the germovitelline complex.

The deeply lobed vitelline portions of the paired germovitellaria form most of the arms of a U and extend anterior to the testes along the lateral margins of the body (Figs 16, 17, 19). The germaria are on both sides of the base of the U (Fig. 19). In addition, the developing germocytes in *G. inopinatum* seem to be packaged in a few somewhat separate units. Well-developed circular muscle fibers characterize the oviduct (Fig. 24), which extends posteriorly from the base of the U, close to the midline, and opens into the genitopharyngeal atrium above the male duct (Fig. 25).

Kozloff had hoped to find either *G. tergestinum* or *G. marsiliense*, or both, in *N. bipes* at Roscoff. The occurrence of another, still undescribed species in this host came as a surprise. The species name *inopinatum* alludes to this unexpected development.

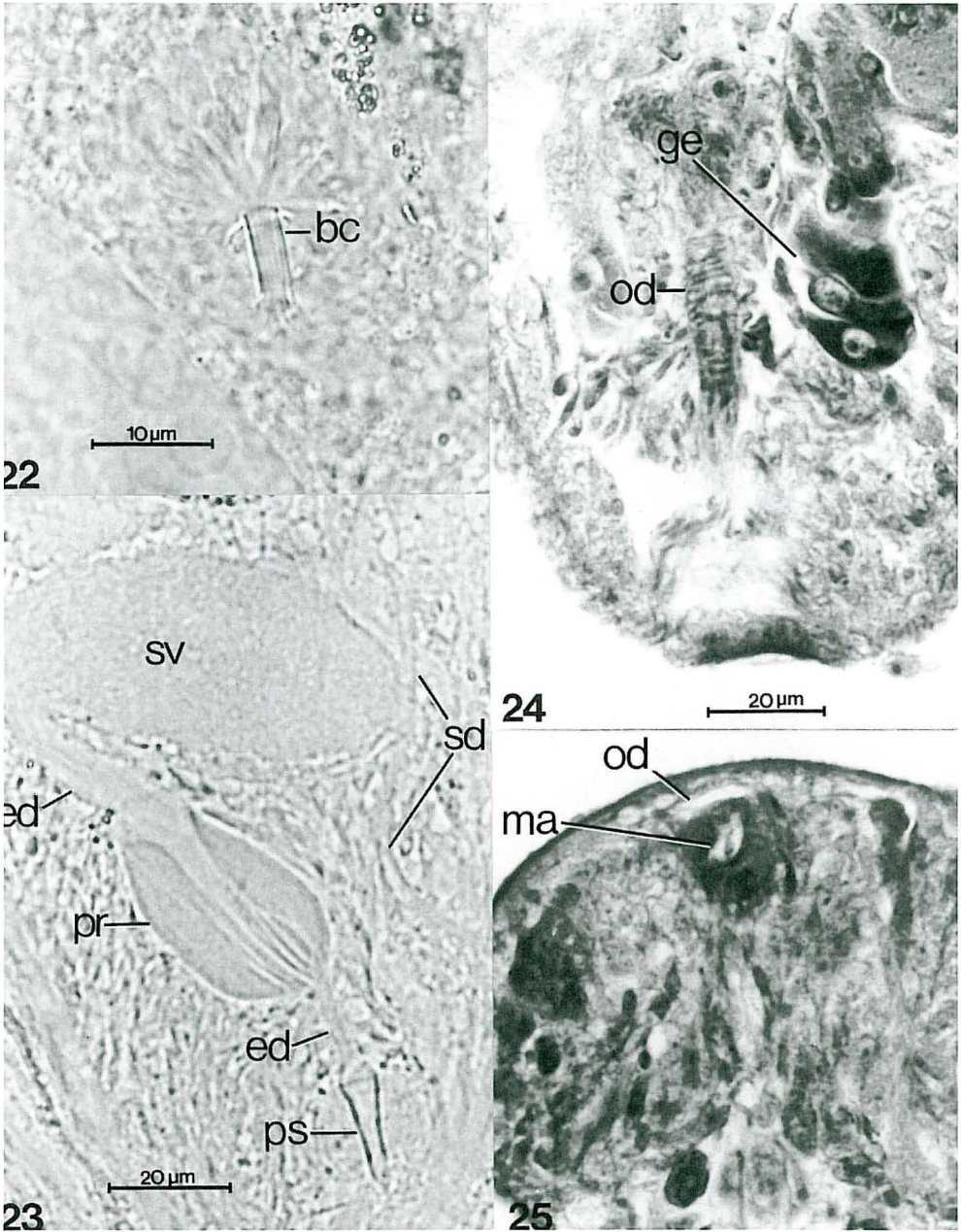
Whole mounts, stained with borax carmine, have been deposited in the United States National Museum, Helminthological Collection. The holotype (n° 82684), and two paratypes (n° 82685) were taken from *Nebalia bipes* collected at Roscoff, France).

Notes on an undescribed species of *Genostoma*

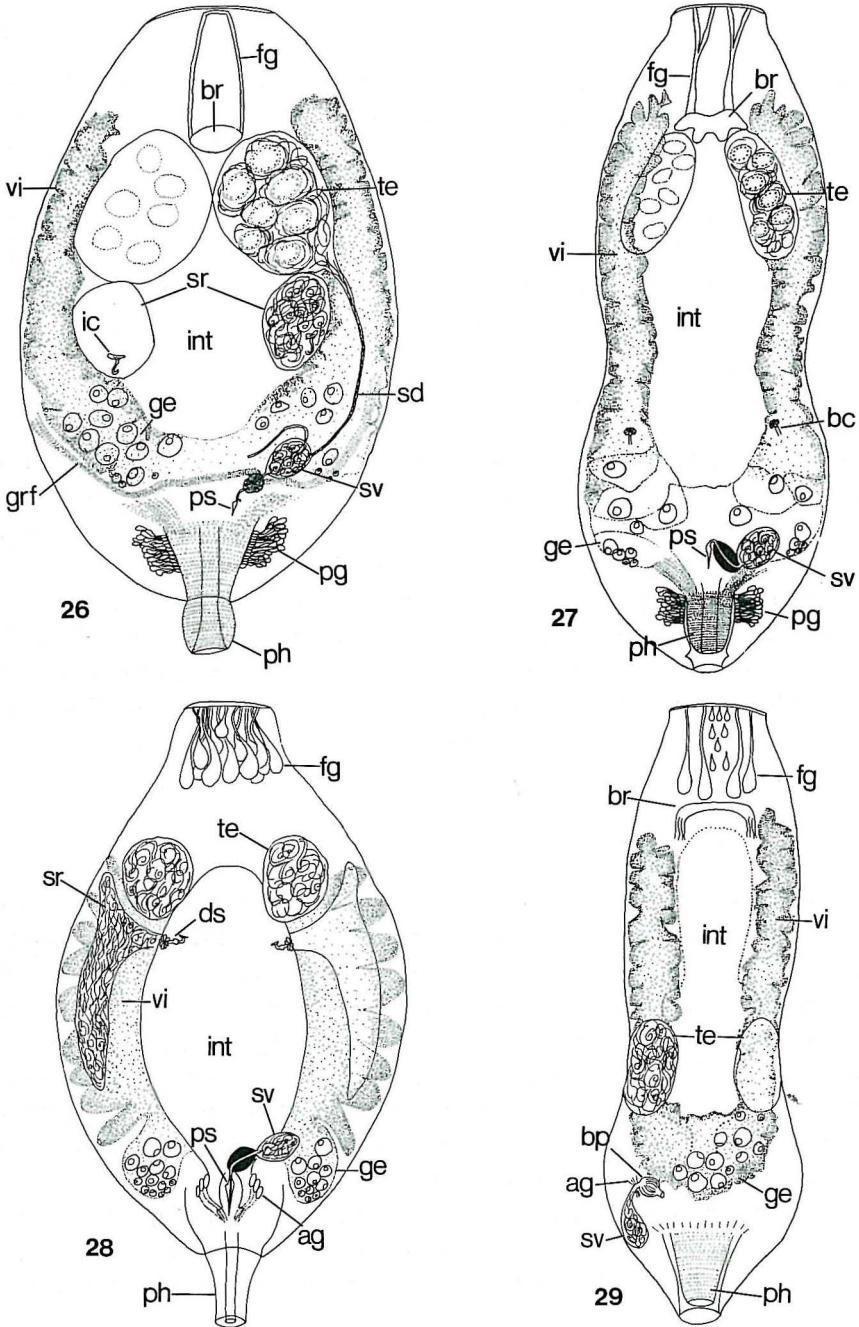
In addition to *G. kozloffii*, there is another species of *Genostoma* associated with *N. pugettensis*. This undescribed species is much larger than *G. kozloffii*. The largest specimen measured approximately 1 200 μm in length, exceeding the maximum observed length of *G. kozloffii* by about 700 μm . The pharynx is proportionately much larger than that of *G. kozloffii*, and the pattern formed by the musculature of the pharynx is also different. This worm is similar to *G. kozloffii* with respect to the position of the pharynx, the pattern of ventral ciliation, and the general structure of the reproductive system.

COMPARISON OF DESCRIBED SPECIES OF *GENOSTOMA* (Figs 26-29)

All species of *Genostoma* are symbionts living under the carapace of leptostracan crustaceans of the genus *Nebalia*. They are characterized by the presence of a common genitopharyngeal atrium opening at or near the posterior end of the body (Figs 26-29). The pharynx of all described species is protusible and of the plicate type. The pharynx of



Figs 22-25 : *Genostoma inopinatum* sp. nov. ; photomicrographs. Fig. 25 is to the same scale as Fig. 24. 22. Bursal canal of a flattened specimen. 23. Male copulatory organs in a flattened worm. The penis stylet, ejaculatory duct, prostatic gland, seminal vesicle and the sperm ducts are shown. 24. Frontal section through the posterior region, showing the oviduct and a germarium. 25. Transverse section just anterior to the pharynx.



Figs 26-29 : Freehand drawings of the described species of *Genostoma*, illustrating major anatomical features ; some structural detail has been omitted for clarity. 26. *Genostoma kozloffi* sp. nov., drawing based on observations of live material and sections. The worm is represented in a flattened state. 27. *Genostoma inopinatum* sp. nov., drawing based on photomicrographs and sections. 28. *Genostoma tergestinum*, flattened, after Dörler. 29. *Genostoma marsiliense*, after von Graff.

G. inopinatum is approximately one-seventh of the length of the body ; the pharynx of *G. kozloffii* is about one-fifth of the body length. *Genostoma inopinatum* possesses a relatively long, narrow esophagus with a nearly circular lumen, while the esophagus in *G. kozloffii* is proportionately much shorter, and the lumen is wide, with an irregular shape. The lobation of the intestine is remarkably similar in these two species, considering the apparent lack of large, well defined seminal receptacles in *G. inopinatum*. Descriptions of *G. tergestinum* and *G. marsiliense* also indicate the presence of a five-lobed intestine in these species (Repiachoff, 1884, 1888 ; Dörler, 1900 ; von Graff, 1903).

The male reproductive systems are generally similar in structure, except in the case of *G. marsiliense*. The female reproductive systems of *Genostoma* show more variability than the male systems ; *G. marsiliense* is the most divergent.

The germovitelline complex in *Genostoma* consists of anterior vitelline portions and posterior germaria. In *G. kozloffii*, *G. inopinatum* and *G. tergestinum*, the right and left germaria are united by a transverse duct dorsal to the esophagus. The condition in *G. marsiliense* is somewhat different, however. In this species, there is a single posterior germarium (Fig. 29).

Genostoma marsiliense apparently lacks seminal receptacles or bursa/receptacle complexes. *Genostoma tergestinum* (Fig. 28) possesses a large pair of "wing-shaped" seminal receptacles, whereas the seminal receptacles in *G. kozloffii* tend to be spherical. These two worms also differ in the structure of their insemination canals. The seminal bursae in *G. inopinatum* communicate with the seminal receptacles via short, sclerotized ducts. Table I summarizes species differences.

SYSTEMATIC POSITION OF THE GENUS *GENOSTOMA*

The systematic status of *Genostoma* within the Turbellaria needs to be re-examined. Von Graff (1903) characterized them as rhabdocoels, while Reisinger (1924) decided that they were cylindrostomatid "alloeocoels". The "Alloeocoela" was composed of diverse taxa that have either been allocated to other groups or given higher systematic rankings. Many members of this old group now reside in the Prolecithophora (Karling, 1940). Typically, prolecithophorans possess a plicate, protrusible pharynx (or a pharynx "variabilis", which is essentially of the bulbous type characteristic of neorhabdocoels) and a common genital pore. The pharynx and the genital opening may be completely separate (Separata) or they may occupy a common genitopharyngeal atrium (Combinata).

Much of the current confusion concerning the systematics of *Genostoma* is due to Reisinger's (1924) decision to make *Genostoma* synonymous with *Hypotrichina*, a genus proposed by Calandruccio (1897). Calandruccio included the symbionts of *Nebalia* in the genus *Hypotrichina* solely on the basis of the unillustrated descriptions of Repiachoff (1884, 1888). But *H. circinnata*, the type species of the genus *Hypotrichina*, is a free-living worm having no anatomical affinity with any of the species of *Genostoma*. Furthermore, *H. circinnata* has, among other features, a statocyst, serially arranged follicular gonads, and separate genital and pharyngeal openings. It has been classified as belonging to the genus

TABLE I

Comparison of selected characteristics of described species of *Genostoma*

Species	Host	Max. length	Body shape	Penis type	Prostatic gland	Germovitelline complex	Bursa/Receptacle complex	Insemination canal/bursal duct
<i>G. tergestinum</i>	<i>Nebalia bipes</i>	600 μ m	tear-drop	sclerotized stylet	non granular in appearance ; granular filaments present	paired ; united by a transverse duct	paired seminal receptacles	sclerotized insemination canal ; sigmoid shape
<i>G. marsiliense</i>	<i>Nebalia bipes</i>	380 μ m	distinct "waist"	"bulbous"	absent	anterior vitelline lobes ; single posterior germarium	absent	absent
<i>G. inopinatum</i>	<i>Nebalia bipes</i>	650 μ m	distinct "waist"	sclerotized stylet	non granular in appearance	paired ; united by a transverse duct	paired seminal bursae and receptacles	sclerotized bursal duct ; rod-shaped
<i>G. kozloffii</i>	<i>Nebalia pugettensis</i>	500 μ m	tear-drop	sclerotized stylet	non granular in appearance ; granular filaments present	paired ; united by a transverse duct	paired seminal receptacles	sclerotized insemination canal ; sigmoid shape

Otoplana (von Graff, 1913). Based on these facts, Dörler's (1900) placement of the symbionts of *Nebalia* in their own genus is justified, and the genus name *Genostoma* should be restored.

Von Graff (1903) perceived sufficient uniqueness in the genus *Genostoma* to place it in a new family, Genostomatidae. Unfortunately, because of Reisinger's (1924) acceptance of Calandruccio's genus for the worms in *Nebalia bipes*, these turbellarians eventually came to rest in the family Hypotrichinidae (Karling, 1940). The Genostomatidae, as proposed by von Graff, united the genera *Genostoma* and *Urastoma* under the old order Rhabdozoa. It is interesting to note that in a recent systematic scheme (Rieger, Tyler, Smith and Rieger, 1990), the family Urastomidae was tentatively included among the Neorhabdozoa. This reclassification of the Urastomidae is supported by ultrastructural analysis of the sperm (Ehlers, 1988), and the lens of the eye (Tyler & Burt, 1988) both indicating a possible affinity with neorhabdozoans.

One of the most notable characteristics of the species of *Genostoma* (excluding *G. marsiliense*) is the presence of a sclerotized insemination canal, or bursal canal. This structure in *G. tergestinum* was described as an "enigmatic organ" by both Dörler and von Graff. Generally speaking, sclerotized structures of this type are not common among prolecithophorans (Crezée, 1982). Members of the Neorhabdozoa, however, frequently have such structures. The similarity between the insemination canal of the kalyptorhynch *Diascorhynchus* (Ehlers & Ehlers, 1980) and *Genostoma kozloffii* is, in fact, striking.

The sperm in *G. kozloffii* are extremely slender and appear to be of the biflagellate, "9 + 1" type (unpublished observations). Ultrastructural analysis of *Urastoma cyprinae* has revealed that its sperm are also of the biflagellate type. Prolecithophoran sperm, however, are nonflagellate, and are relatively short and broad. Biflagellate sperm are common among turbellarians, but of those that have them, only the Proseriata, Tricladida and the Neorhabdozoa could be considered potential allies of *Genostoma*. Ultrastructural analysis of *Genostoma* will be necessary before a definite conclusion can be reached regarding its affinities to other turbellarian taxa, but I tentatively place the genus and family (Genostomatidae) among the Neorhabdozoa.

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