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The Polyclad Flatworms of the Pacific Coast of North America: Additions and Corrections

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Hardly had my extensive article (Hyman, 1953) on the polyclad fauna of the Pacific coast of North America appeared than new species began to arrive and additional information about known species to accumulate. To date material of two undescribed species has come to hand, and as one of these species is of considerable economic importance as an oyster predator a scientific name is wanted for it as rapidly as possible by oyster workers. I also take this opportunity to correct a few errors that slipped into the 1953 article. The classificatory scheme of polyclads and definitions of the taxonomic categories in this group are given in the article cited and are not repeated here.

EXPLANATION OF SUBSIDIARY NUMBERS IN TEXT FIGURES

1, cerebral eyes; 2, tentacular eyes; 3, pharynx; 4, common sperm duct; 5, seminal vesicle; 6, prostatic vesicle; 7, penis papilla; 8, penis stylet; 9, penis sheath; 10, male antrum; 11, male gonopore; 12, female gonopore; 13, female antrum; 14, vagina; 15, entrance of common oviduct; 16, duct of Lang's vesicle; 17, Lang's vesicle; 18, uterus; 19, mouth; 20, cement glands; 21, adhesive folds of female antrum; 22, marginal tentacles; 23, spermiducal vesicles; 24, sucker; 25, main intestine; 26, uterine vesicles.

DESCRIPTIONS OF NEW SPECIES

FAMILY LEPTOPLANIDAE

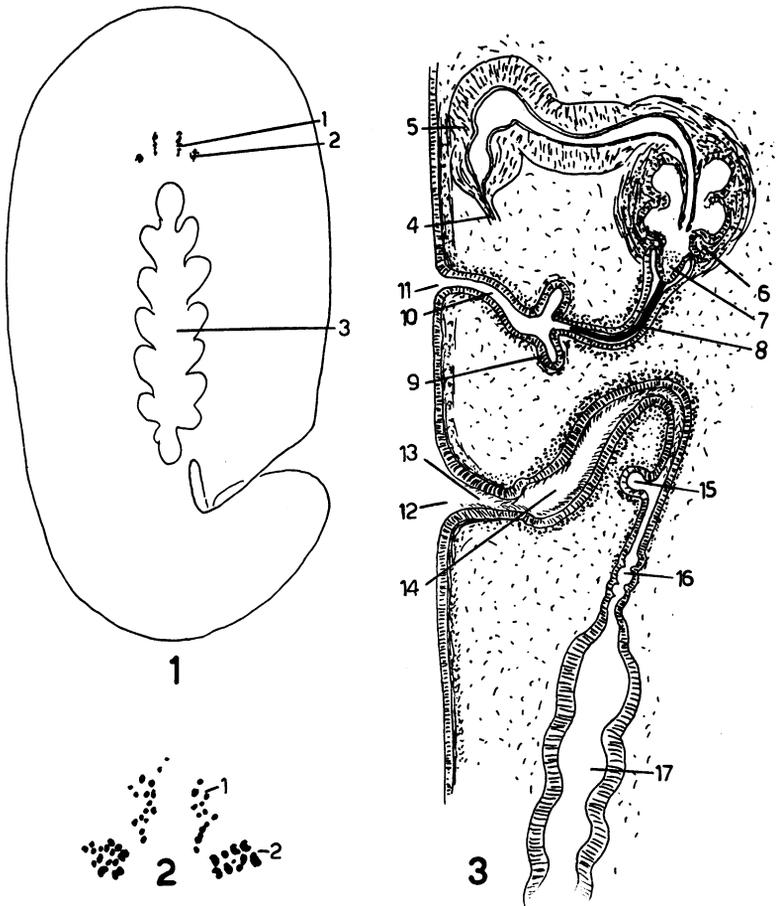
Notoplana inquilina, new species

Figures 1-3

Three specimens of this species were sent by Dr. Paul Illg who had collected them in Cowlitz Bay, Waldron Island, Puget Sound, August 12,

1952, on the inner surface of shells containing hermit crabs taken at 8 to 16 meters. All were damaged posteriorly.

This is a small species of oval or slightly obovate shape (fig. 1) and of thick, opaque consistency. The largest specimen measures 7.5 mm. long by 3.5 mm. in width. The color is a pale drab, but minute dark dots appear under microscopic examination. Tentacles are wanting. The eyes occur in the usual tentacular and cerebral clusters (fig. 2), with about 10 to 17 larger eyes in the tentacular group and about 15 to 30 in a



FIGS. 1-3. *Notoplana inquilina*. 1. Entire animal as cleared whole mount. 2. Eye arrangement. 3. Sagittal view of the copulatory apparatus, anterior end above.

linear arrangement in the cerebral group. On account of their opacity scarcely anything could be distinguished of the internal structure in the cleared specimens. The pharynx as somewhat dimly discerned is depicted in figure 1.

Sections of the copulatory apparatus (fig. 3) showed that the species is new, thus adding one more member to the several species of *Notoplana* known to occur in Puget Sound. The male apparatus is found immediately behind the pharynx. Here the short common sperm duct enters the distal end of the elongated, curved, heavily muscularized seminal vesicle. This ascends dorsally and, curving posteriorly, enters the rounded prostatic vesicle, here cut somewhat diagonally so that its chambers are evident. The prostatic vesicle has the usual muscular wall and glandular lining; gland cells were not in evidence, but eosinophilous granulations appear between the muscle fibers. At its proximal end, the prostatic vesicle bears the penis papilla which supports a short curved penis stylet. This is housed in the narrow tubular proximal part of the male antrum which is separated by a penis sheath from the slightly wider distal part of the antrum; this opens below by the male gonopore. The entire male antrum from gonopore to penis papilla is somewhat muscular, having outside its lining epithelium a layer of circular muscles.

The female gonopore lies well behind the male pore and leads into a funnel-shaped female antrum that continues into the slightly widened vagina. This ascends with the usual forward slant and then turns abruptly posteriorly and continues backward with a slight downward slope. After receiving the common oviduct from below, the vagina continues as the duct of Lang's vesicle. The latter is an oval body of moderate length with sinuous walls. The vagina is well muscularized with circular fibers which diminish and disappear along the duct of Lang's vesicle, and the vesicle itself appears to lack a muscular investiture. Cement glands were not in evidence.

Notoplana inquilina differs from other *Notoplana* species of the Pacific coast of North America in the combination of small size, pale coloration, commensal habit, elongated seminal vesicle, short arched penis stylet, and the moderate length of Lang's vesicle. Two other species of this area are provided with a penis stylet, *N. inquieta* and *N. longastyletta*; in the former there is a common gonopore and a very large Lang's vesicle, and in the latter the penis stylet is exceptionally long whereas the Lang's vesicle is greatly reduced. Of the nine other species of *Notoplana* known from the North Pacific (listed with references in Kato, 1944) only *N. delicata* Yeri and Kaburaki, 1918, and *N. serica* Kato, 1938, are provided with a stylet. In the latter the ejaculatory duct runs in the ventral

part of the prostatic vesicle, not centrally as usual, and in the former, penis papilla and penis sheath are wanting, and a length of ejaculatory duct extends between the oval prostatic vesicle and the stylet base. The present species appears to be the only member of the genus living in association with another animal. To be sure, the finding of three specimens in shells with hermit crabs does not prove that the species always lives in this manner, but the small size and pale coloration are indicative of a secluded mode of life.

All specimens have been deposited in the American Museum of Natural History. The sagittal sections of the copulatory apparatus (two slides) are declared the holotype, and the remaining material is mounted whole on another slide.

FAMILY CALLIOPLANIDAE

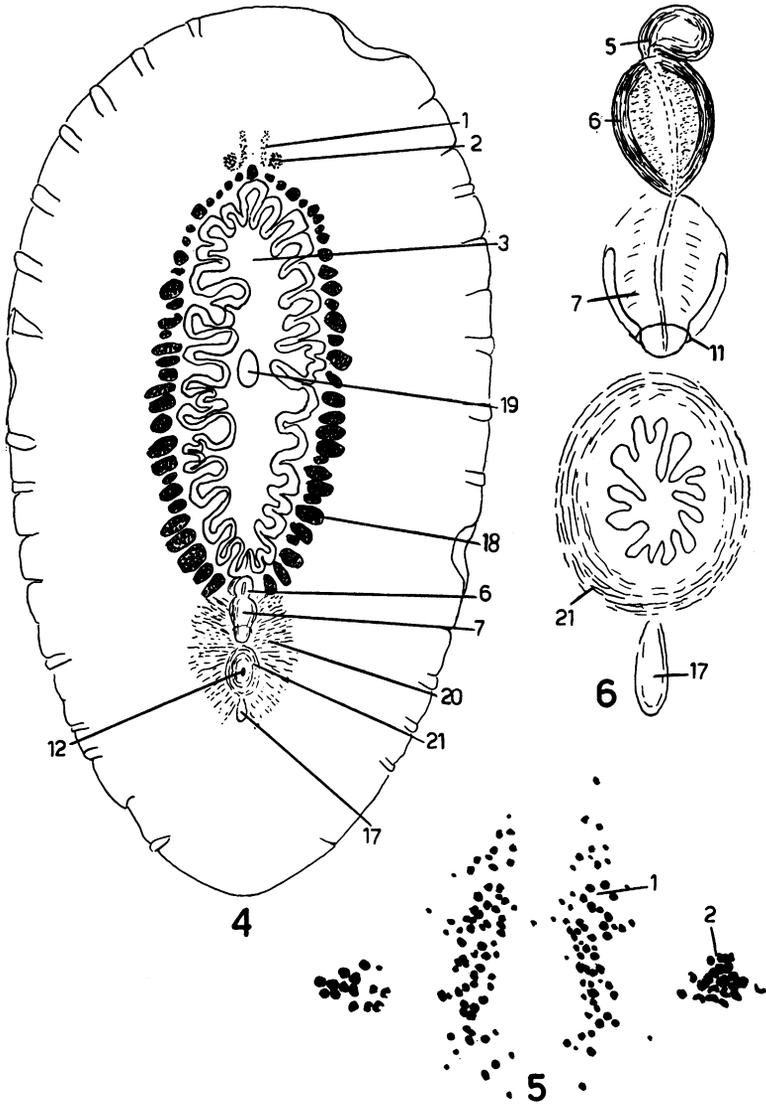
Pseudostylochus ostreophagus, new species

Figures 4-7

In November, 1953, Dr. Paul Illg of the University of Washington and Mr. C. E. Woelke of the state shellfish laboratory at Quilcene, Washington, began corresponding with me about a polyclad, suspected of having been imported from Japan, that had been found preying on young *Ostrea lurida* in Puget Sound. Examination of a specimen sent showed that it belongs to the genus *Pseudostylochus*, and, as I am not able to assign it to any of the 16 species of *Pseudostylochus* known from Japan, I must regard it as an undescribed species. In the spring of 1954 Mr. Woelke visited sites of oyster industry in Japan and found that there also seed oysters were being attacked by a polyclad, although Japanese biologists were unaware of this state of affairs. Mr. Woelke collected several of these polyclads and sent them to me; sections of one of them proves them to be identical with the Puget Sound polyclad oyster predator. Thus the original suspicion that the oyster polyclad came from Japan is shown to be correct. The Japanese specimens were collected early in April at the following localities: Miyagi Prefecture, village of Oginshama on the Osika Peninsula, and village of Sabusawa in the Urato Islands.

Pseudostylochus osterophagus is a worm of some size; the larger of the preserved specimens sent are 25 to 30 mm. long, but as the margins are ruffled (fig. 4) some contraction on preservation is evident. Woelke (1954) indicates a maximum length of 35 mm. in life. Outline sketches indicate that in life the worm is broadly obovate, about half as wide as long, with a broadly rounded anterior end and a slightly narrowed posterior half. Figure 4, although drawn from a preserved specimen, has retained approximately the shape in life. Other preserved specimens may

be perfectly oval with both ends rounded. The color of the dorsal surface is greenish or grayish brown speckled uniformly with darker brown. Definite tentacles are wanting.



FIGS. 4-6. *Pseudostylochus ostreophagus*. 1. Entire animal as cleared whole mount. 2. Eye arrangement. 3. Copulatory apparatus as seen from ventral side of cleared whole mount, anterior end above.

In cleared specimens the eyes are seen to occur in the usual four clusters. The rounded tentacular clusters contain 15 to 20 mostly large eyes in some specimens, 30 to 40 smaller eyes in other worms of equal size. The linear cerebral clusters, quite distinct from the tentacular clusters, usually contain around 60 eyes (fig. 5), although the number is fewer (40 to 50) in some of the available worms. The cerebral clusters are often widened anteriorly, although this is not the case in the individual illustrated in figure 5.

The pharynx of this species is voluminous, with numerous lateral folds that usually show subsidiary folds (fig. 4). It is slightly anterior in position in the body, with a central mouth.

The elongated copulatory apparatus is readily noticed immediately behind the pharynx in cleared specimens (fig. 4). Its main parts as seen in whole mounts are shown in figure 6, and a sagittal section is given in figure 7. The common sperm duct enters the proximal end of the arched muscular seminal vesicle, of which the lumen continues as an ejaculatory duct passing backward directly beneath the oval prostatic vesicle. The latter is a conspicuous body with thick muscular wall of interlacing fibers mostly paralleling the external contour of the vesicle and tall epithelial lining filled with eosinophilous granulations. The prostatic vesicle narrows distally into a prostatic duct that enters the ejaculatory duct and, after paralleling the duct from the seminal vesicle in close contact for a short distance, unites with the latter. Prior to this union the ejaculatory duct has already entered the penis papilla, notable for its massive form in this species. The large and muscular penis papilla has a general mammiform shape, and its nipple-like distal end is often seen bulging through the gonopore in preserved individuals.

The female gonopore is situated not far behind the male pore. In cleared whole specimens it is seen to be encircled by concentric ridges (fig. 6). Sections (fig. 7) show that these ridges consist of muscularized epidermal projections of the wall of the wide funnel-shaped female antrum. The encircling of the female gonopore with epidermal ridges is known for several other species of *Pseudostylochus*, and Kato (1937) suggests a sucking function for this ridged female antrum. From the center of the funnel-like female antrum the vagina ascends with a marked forward slant as a fairly wide ciliated tube, then turns abruptly backward, also narrowing, and shortly beyond the bend receives from below the common oviduct. It then continues posteriorly as a narrow duct of Lang's vesicle that enters the rather small oval Lang's vesicle.

Pseudostylochus ostreophagus is distinguished from all other species of the genus by the combination of massive penis papilla and broad

funnel-shaped female antrum provided with concentric epidermal ridges.

The genus *Pseudostylochus* appears limited to the North Pacific. Of the 17 species hitherto known, 16 are confined to Japan and Korea (listed with references in Kato, 1944); the present species adds one more to the list from Japan. One species, *P. burchami*, is found on the North American side of the Pacific, distributed from Puget Sound to Mexico (Hyman, 1953).

According to information received from Mr. Woelke, *P. ostreophagus* attacks small oysters by covering the shell with its body and boring a small hole about the size of a pin head through the shell. Such shells with a hole have been sent to me, and it is impossible to detect the hole except by holding up the shell to the light. The polyclad is then said to extrude pharyngeal folds through this hole and sever the oyster's adductor muscle. The oyster shell then gapes, and the worm enters between the valves and swallows the body of the small oyster. I may say I am unable to understand this account. It does not seem to me possible that a polyclad can bore a hole through a mollusk shell and I do not see how the pharynx can operate through such a minute hole. The polyclad, since being imported from Japan with seed oysters, has become so abundant in southern Puget Sound that in one locality Woelke (1954) estimated 600,000 worms per acre. The destructive effect of the polyclad on the oyster population is very great, ranging from 15 to 100 per cent.

A whole mount of one of the Japanese specimens, from Miyagi Prefecture, is deposited as holotype in the American Museum of Natural History. A set of serial sagittal sections of the copulatory apparatus of a specimen from the same locality is also deposited.

ADDITIONAL INFORMATION ON KNOWN SPECIES

Kaburakia excelsa: At the time of publication of my 1953 article I believed this species occurs only from Puget Sound northward. However, shortly after the appearance of this article, Dr. G. E. MacGinitie sent me a number of specimens of a large stylochid from Newport Harbor, southern California, that was proved by sections of the copulatory apparatus to be *Kaburakia excelsa*. This species is therefore common in at least some areas of the California coast and is to be added to the list of polyclads distributed from California to Alaska. The color pattern of *K. excelsa* is ordinarily medium brown evenly dotted with dark brown spots, but at Newport Harbor not only this color pattern but also a color variant in the form of a uniformly brown background with a few dark brown polka dots occurs. It turns out that the righthand photograph on page 151 of "Natural history of marine animals" (MacGinitie and MacGinitie, 1949)

is this polka-dotted variant of *K. excelsa*; this pattern has never to my knowledge been seen in Puget Sound where *P. excelsa* is very common. The dozens of large stylochids recorded on page 153 of the MacGinitie

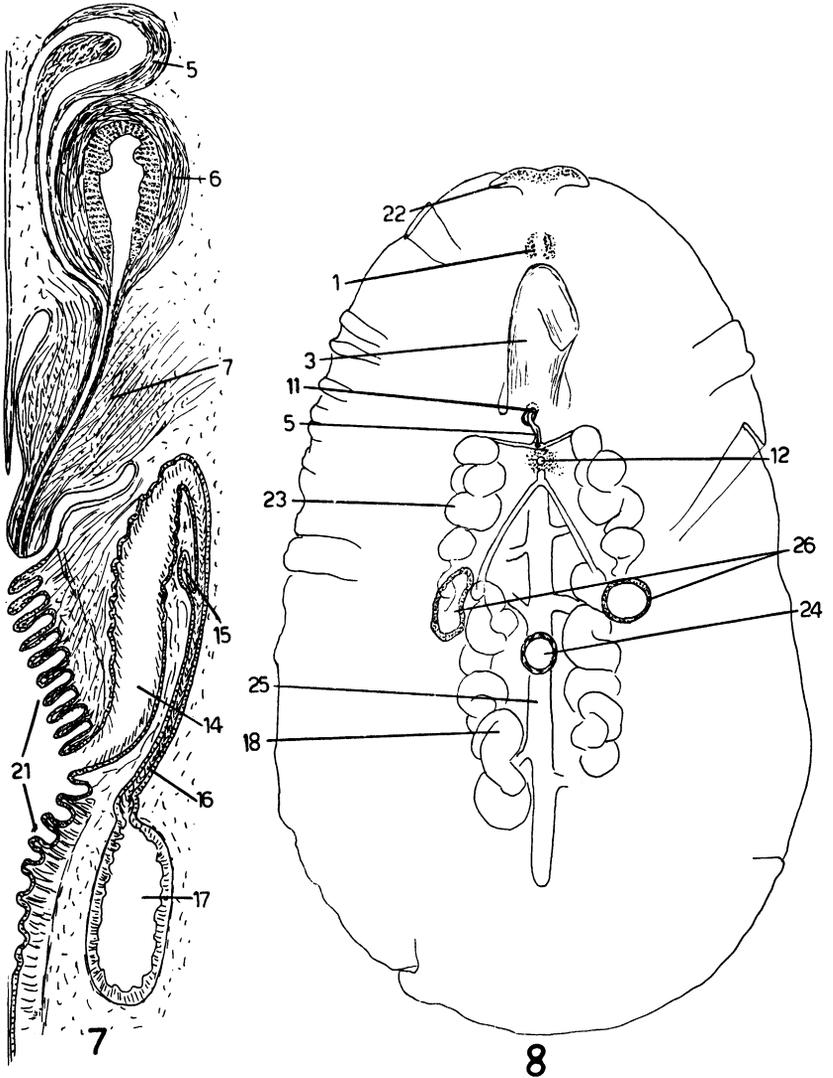


FIG. 7. *Pseudostylochus ostreophagus*, sagittal view of copulatory apparatus, anterior end above.

FIG. 8. *Eurylepta aurantiaca*, whole mount of specimen from Newport Bay, California.

book as seen among mussels on a boat bottom were also *K. excelsa* and not *Stylochus californicus*, as I surmised on page 287 of my article. Further, the sketch on page 152 of the MacGinitie book is in fact (as they thought) *K. excelsa* and shows the typical color pattern of this species.

Mexistylachus tuberculatus and *levis*: In a collection of polyclads from the island of Saipan there were found two specimens assignable to the genus *Ommatoplana* Laidlaw, 1903. Study of these specimens revealed that *Mexistylachus* is congeneric with *Ommatoplana*—something that was impossible to determine previously because of the incomplete nature of the original description of *Ommatoplana*. *Ommatoplana* is thus a stylochid, not a cryptocelid as generally supposed. As the combination *Ommatoplana tuberculata* already exists, it becomes necessary to propose a new specific name for *Mexistylachus tuberculatus*, and I have suggested *mexicana* in my report, now in press, on polyclads from Polynesia and Micronesia. *Mexistylachus tuberculatus* thus becomes *Ommatoplana mexicana* and *Mexistylachus levis* becomes *Ommatoplana levis*. It is remarkable that the copulatory apparatus is identical in construction in all four known species of *Ommatoplana*, and hence these species can be distinguished only by the eye arrangement and other external characters. Three of the four species have a tuberculate dorsal surface. *Ommatoplana* furnishes another example of the spread of an Indo-Pacific genus to the Pacific coast of tropical America.

Notoplana acticola: During a brief stay at the Hopkins Marine Station, Pacific Grove, California, in February, 1953, I found that this species is extremely common under the rocks in shallow water adjacent to the laboratory. Twenty or 30 specimens may be collected in half an hour. The species may reach a length of 60 mm. when crawling extended. All specimens seen were pale gray with dark brown middorsal markings. The original description gives the background color as tan and the maximum length as 28 mm.

Freemania litoricola: On the same occasion two examples of this species were collected beneath rocks adjacent to the Hopkins Marine Station. It seems worthy of record that these two differed so much in color pattern that at first they were considered distinct species. One was colored a uniform reddish brown, with darker streaks outlining the pharynx and copulatory apparatus; the other bore dark brown, almost black, splotches on a pale, nearly white background, and also had dark streaks middorsally. These findings emphasize the unreliability of color as a specific character among acotylean polyclads.

Pseudoceros canadensis: This species was hitherto known only from the shores of Vancouver Island, but in July, 1952, a number of speci-

mens were taken in the San Juan Islands, Puget Sound, mostly crawling on *Ulva* and eelgrass. They were said to have kept well in the laboratory and to have laid eggs. The color pattern consists of fine brown dots on a paler ground, and the maximum length in life was given as 28 mm.

Eurylepta aurantiaca: I am able to add some further locality records for this species. One supposed it to occur in Puget Sound, but an exact record was wanting. A small specimen at the beginning of sexual maturity was sent by Dr. Paul Illg who had dredged it at about 40 meters in Peavine Pass, Puget Sound, July 15, 1952. The color in life was described as a warm brown peripherally, rose centrally. Two fully mature specimens and a kodachrome of *E. aurantiaca* were provided by Dr. G. E. MacGinitie who had collected the worms in Newport Harbor, southern California, one under a float on December 2, 1952, and the other under a rock at the shore on January 16, 1953. The kodachrome shows the color to have been a pinkish orange in life. One of these specimens made such an excellent whole mount that I cannot refrain from presenting a figure of it (fig. 8) as an aid to identification by others. This whole mount has been deposited in the American Museum of Natural History.

CORRECTIONS

The following corrections apply to Hyman (1953) :

Page 314 : *Limnoria* is of course an isopod, not a snail.

Page 336 : In the definition of *Freemania*, the phrase "with massive spermiducal vesicles" should read "with massive spermiducal bulbs."

Page 391 : The reference to Kato (1937) is incorrect. The correct reference concerning the sucking action of the area around the female gonopore in some species of *Pseudostylochus* is given in the References Cited of the present article.

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