

Two new marine species from South Korea with remarks on the family Stylochidae (Acotylea, Polycladida, Plathelminthes)

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Abstract

Two new species of acotylean Polycladida are described from Korea, *Munseoma maculata* gen. et sp. nov., Callioplanidae, and *Crytostylochus koreensis* sp. nov., Stylochidae. *Munseoma maculata* is characterized by a small free prostatic vesicle but only indistinctly cut off from the ejaculatory duct; a Lang's vesicle is present. *Crytostylochus koreensis* possesses a prostatic vesicle with tubular lining of radial arrangement. Each papillate tube is connected via a glandular duct to a single extra-vesicular gland attached to the muscular wall of the prostatic vesicle. That morphological feature forces discussion of the relationships within the family Stylochidae. Consequently, type material of other stylochids deposited in the museums of Hamburg, Vienna, and Stockholm was borrowed to investigate the genital organs and, in particular, the interior lining of the prostatic vesicle. Based on these analyses, two new types of prostatic lining are defined, the polyglandular type and the monoglandular type. The monoglandular type is defined as having an oval to elongate prostatic vesicle with tubular lining and extra-vesicular glands. Each extra-vesicular gland is connected via a glandular duct with a single tube. The polyglandular type is defined as having a mostly roundish oval prostatic vesicle with long-fingered extensions, more or less horizontally directed distad, and numerous extra-vesicular glands. Each long-fingered extension is connected via several glandular ducts of extra-vesicular glands. Based on these new characters, the family Stylochidae is newly defined.

Keywords: *Description, Korea, Polycladida, revision, Stylochidae, taxonomy*

Introduction

In the recent past valuable revisions of the Polycladida have been published by Faubel (1983, 1984) and by Prudhoe (1985, 1989). The revision made by Faubel (1983, 1984) represents a new system based on anatomical characters. Greatest value was assigned to the relationship of the prostatic vesicle to the ejaculatory duct and to the outline of its interior lining. The revision made by Prudhoe deals mostly with additions of new taxonomic aspects and corrections of the system created by Lang (1884) and supplemented by Bock (1913).

Recently, polyclad specimens were collected by one of us from littoral areas of South Korea. The specimens represent two new species of the Stylochidae Stimpson, 1857 and

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Callioplanidae Hyman, 1953. A first analysis of the prostatic vesicle of the stylochid species, *Cryptostylochus koreensis* sp. nov., revealed the difficulty, which prevailed within the Stylochidae, with respect to the interior glandular lining of the prostatic vesicle. Since Meixner (1907), the structure of the prostatic vesicle has been of taxonomic significance for nearly a century. Meixner described the interior of the prostatic vesicle as lined with tubes disposed in a radial or diagonal/longitudinal direction. According to that interior lining of the prostatic vesicles, Meixner divided the stylochid species in groups having prostatic vesicles of *Stylochus djiboutiensis* type and species-groups of *S. neapolitanus* type. Later on, the lining of the prostatic vesicles, viewed in a medio-longitudinal section, was called tubular, chambered, ridged or folded (Hyman 1953; Faubel 1983; Prudhoe 1989; Newman et al. 1993; Jennings and Newman 1996a, 1996b).

Based on the specimens from Korea and type material borrowed from the Museum of Natural History, Vienna, and from the Swedish Museum of Natural History, Stockholm, species are newly described or re-described and a revision of the family Stylochidae is given below.

Material and methods

Specimens were collected from eulittoral beaches of muddy sand or coral rocky grounds in Jeollanamdo Province, South Korea, and immediately fixed in 100% ethanol. Observations on living individuals were not carried out. Therefore, morphological characters could be determined only on fixed specimens, and all measurements given in the text were made from the holotype. Measurements were made with the imaging analysis software AnalysisPro 3.2 (SIS Münster, Germany). For histological observation, individuals were embedded in Paraplast plus, cut sagittally at 9 µm, and stained with haematoxylin–eosin according to Mayer (Romeis 1968). Types are deposited in the Zoological Museum of the University of Hamburg.

Type specimens and voucher specimens were borrowed from the Swedish Museum of Natural History (SMNH), Sweden; Museum of Natural History, Vienna (MNHV), Austria; and Zoological Museum of the University of Hamburg (ZMUH), Germany.

The following abbreviations are used in the figures: b, brain; bmw, body muscle wall; cg, cement glands; cvd, common vas deferens; dvm, dorso-ventral muscles; e, eye; eg, extra-vesicular glands; fg, female gonopore; g, glands; gd, glandular duct; i, intestine; lv, Lang's vesicle; m, mouth; mg, male gonopore; mw, muscular wall; o, ovary; ov, oviduct; p, penis papilla; ph, pharynx; pi, pigments; pv, prostatic vesicle; s, secretion; sb spermiducal bulbs; sv, seminal vesicle; t, testes; te, tentacle; vb, vagina bulbosa; vd, vas deferens.

Taxonomic section

Superfamily STYLOCHOIDEA Poche, 1926

Family STYLOCHIDAE Stimpson, 1857

Diagnosis (emend. nov.)

Stylochoidea, most with great dorsal resemblance, namely a basic colour with irregularly reticulated darker spots or streaks. Tentacles lie rather forwards. Ruffled pharynx usually

highly folded, more or less centrally orientated in the body. Male copulatory apparatus directed backwards, prostatic vesicle with long-fingered extensions having polyglandular outlets or having tubes each with a central, monoglandular duct; prostatic glands extra-vesicular. Gonopores in the second body half.

Remarks

The species of the family Stylochidae are characterized by two different types of prostatic vesicle regarding the inner glandular lining and the appropriate extra-vesicular glands, namely the polyglandular type and the monoglandular type.

The *monoglandular type* (Figures 1A, 3D) represents a roundish to elongate prostatic vesicle surrounded by a strong muscular wall. The interior lining consists of either long, finger-like tubes (Figure 3D), arising from the proximal half of the vesicle or of short tubes radially arranged around the inner muscular wall (Figure 1A). Each tube has a central duct with single opening at the distal tip of the tube. The central duct is connected to a single extra-vesicular gland, therefore the number of extra-vesicular glands and inner tubes is identical. The extra-vesicular glands have small and rounded cell-bodies lying immediately on the external surface of the muscular wall.

The *polyglandular type* (Figure 1B) consists of a mostly roundish to oval vesicle with few, long, finger-like extensions of the proximal lining of the prostatic vesicle. The finger-like extensions are directed distad more or less horizontally. The whole interior glandular lining of the prostatic vesicle is supplied by glandular ducts of extra-vesicular glands which cross the well-developed muscular wall of the prostatic vesicle. The glandular cell-bodies of the extra-vesicular glands are localized more or less distant in the parenchyma surrounding the male apparatus. The number of finger-like extensions is considerably fewer than the number of extra-vesicular glands.

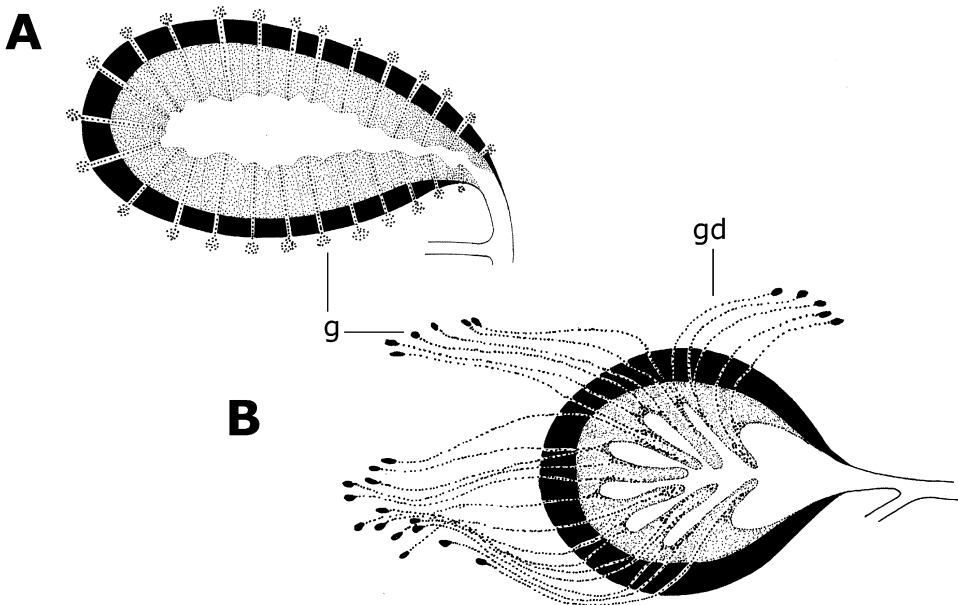


Figure 1. Diagrammatic reconstruction of types of prostatic vesicles of Stylochidae. (A) Monoglandular type; (B) polyglandular type.

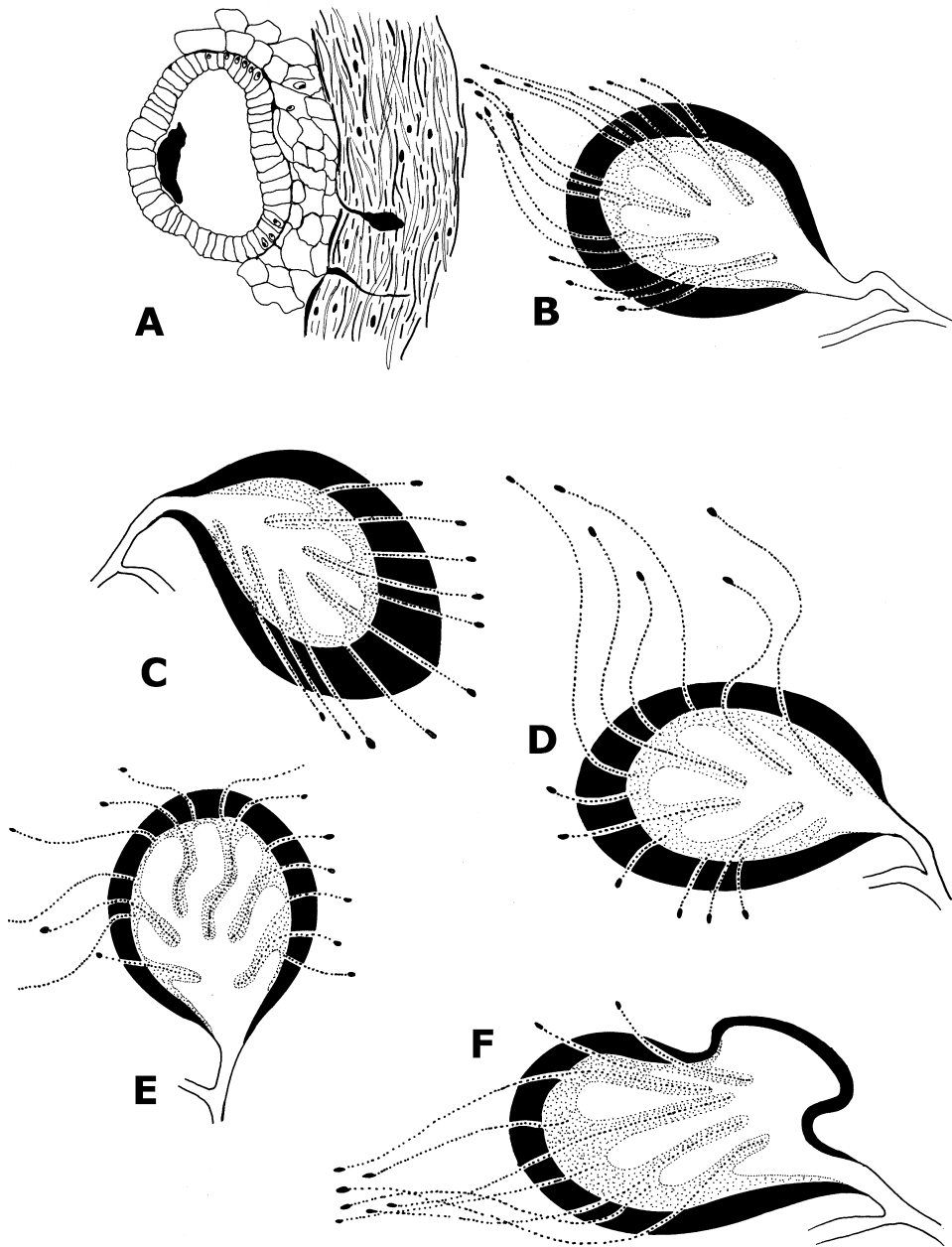


Figure 2. Diagrammatic reconstruction of prostatic vesicles of Stylochidae. (A) *Cryptostylochus coseirensis* (Bock) after Meyer, 1921; (B) *Imogine nebulosa* (Girard); (C) *Imogine oculifera* Girard; (D) *Stylochus alexandrinus* Steinböck; (E) *Stylochus frontalis* Verrill; (F) *Stylochus ellipticus* (Verrill).

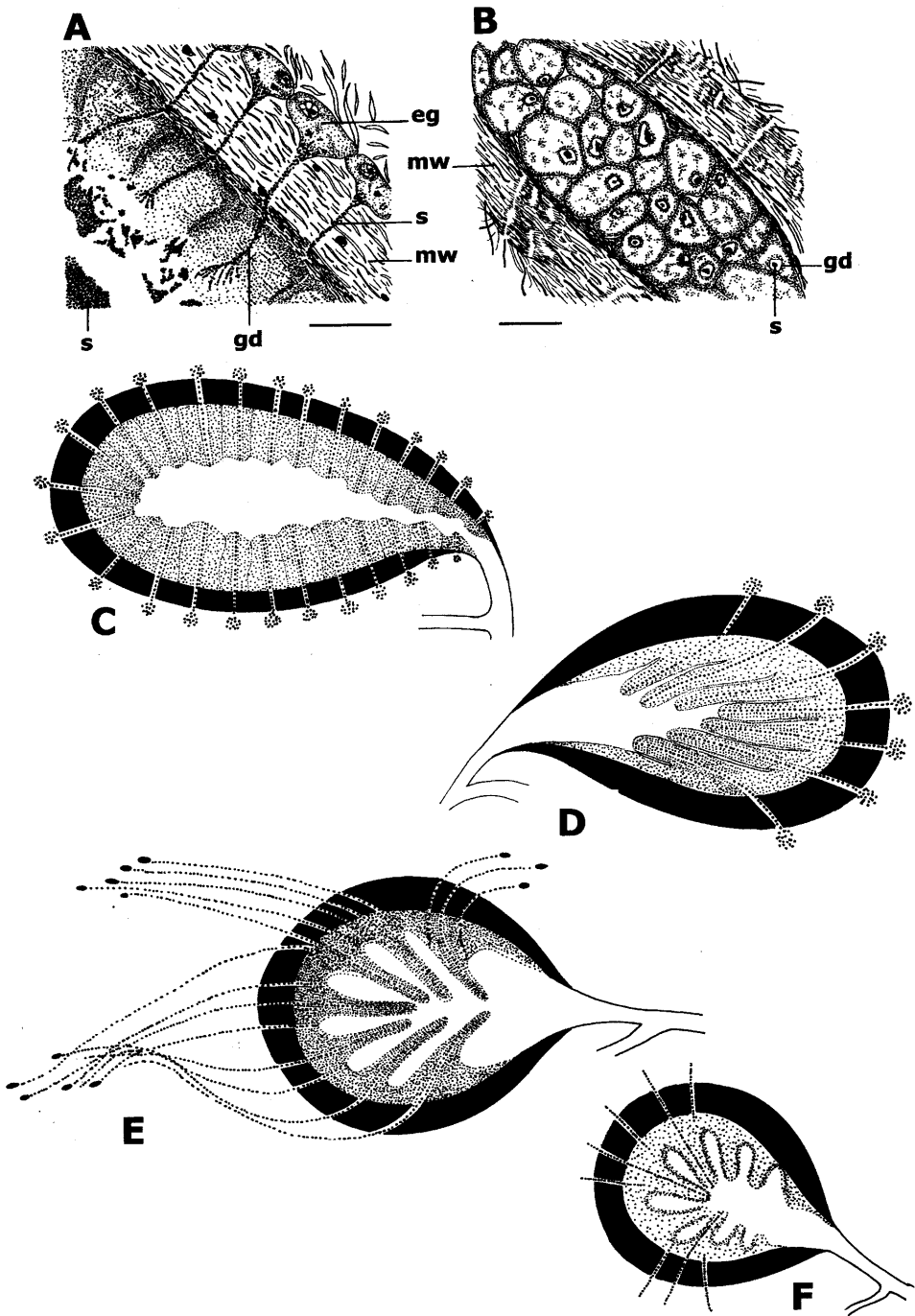


Figure 3. Diagrammatic reconstruction of prostatic vesicles of Stylochidae. Monoglandular types: (A–C) *Cryptostylochus koreensis* sp. nov.: (A) medio-sagittal section through the prostatic vesicle, (B) peripheral section through the prostatic vesicle, (C) diagrammatic reconstruction of the prostatic vesicle; (D) *Cryptostylochus hullensis* Faubel and Gollasch. Polyglandular types: (E) *Stylochus neapolitanus* (Delle Chiaje); (F) *Distylochus pusillus* Bock. Scale bars: 70 μ m.

Genus *Stylochus* Ehrenberg, 1831

Diagnosis (emend. nov.)

Stylochidae with large, highly ruffled pharynx. Tentacular, cerebral, marginal, and often frontal eyespots present. Male copulatory apparatus with seminal vesicle not anchor-shaped, prostatic vesicle, and unarmed penis papilla. Lang's vesicle absent. Prostatic vesicle with polyglandular lining. Body often with intensively undulated margins.

Type of the genus: *Stylochus suesensis* Ehrenberg, 1831.

***Stylochus neapolitanus* (Delle Chiaje, 1841) Lang, 1884**
(Figure 3E)

Planaria neapolitana Delle Chiaje 1841, Volume III, p 133; Volume V, p 112, Plate 109
Figures 13–15, 22.

Material examined

Voucher specimen. No. 67550, one specimen sagittally sectioned, locality: Naples, Gulf of Naples, Tyrrhenian Sea, deposited in SMNH.

Morphological notes

In the following, only morphological characters which deviate from the description of Meixner (1907, p 422–425) are added or re-described.

Reproductive system. Male genital system with ventral testes follicles, separate entrance of vasa deferentia into the voluminous, elongate seminal vesicle, prostatic vesicle and penis papilla housed in a small male atrium. Male and female gonopores separate. Prostatic vesicle (Figure 3E) oval, with finger-like extensions; inner glandular lining is connected to many extra-vesicular glands lying rather distant from the muscular wall of the prostatic vesicle (polyglandular type).

***Stylochus alexandrinus* Steinböck, 1937**
(Figure 2D)

Material examined

Holotype: No. 3624, one sagittally sectioned specimen, locality: Alexandria, Egypt, leg. 8 August 1933, deposited in MNHV.

Morphological notes

In the following, only morphological characters which deviate from the description of Steinböck (1937, p 1–5) are added or re-described.

Reproductive system. Male copulatory apparatus directed backwards with elongate seminal vesicle, oval and muscular prostatic vesicle, and distal penis papilla. A common vas deferens joins the seminal vesicle from anterior. The prostatic duct joins the ejaculatory

duct at the base of the penis papilla. Interior lining of prostatic vesicle with few finger-like extensions attached to the proximal half; finger-like extensions directed distad. Along the glandular epithelium of the prostatic vesicle, the ducts of the extra-vesicular glands open through multiple outlets into the lumen of the prostatic vesicle. Extra-vesicular glands numerous, positioned dorsally and ventrally in the parenchyma, surrounding the anterior part of the male complex (Figure 2D). Male and female gonopores separate. Oviducts entering vagina from dorsal. From this junction the vagina continues frontad, then turns ventrad and opens via a female atrium to the exterior. Female tract non-ciliated; cement glands open into the distal part of the vagina.

Stylochus frontalis Verrill, 1892

(Figure 2E)

Stylochus inimicus Palombi 1931, p 218–222, Figures 1–4, Plate 4.

Stylochus tenax Palombi 1936, p 4–10, Figures 1–7, Plate I Figures 1, 2.

Material examined

Voucher specimen. No. 67505, one specimen sagittally sectioned, locality: Piscadera Baai, Curacao, Caribbean Sea, leg. D. D. Correa, 18 December 1965; Nos 67506–07, two specimens sagittally sectioned, locality: Virginia Key, Florida, North America, leg. D. D. Correa; January 1959; deposited in SMNH.

Morphological notes

In the following, only morphological characters which deviate from the description of Palombi 1931 (p 218–222) and Hyman 1940 (p 461–462) are added or re-described.

Reproductive system. Male genital system with ventral testes follicles, seminal vesicle, prostatic vesicle of polyglandular type, and distal penis papilla. The prostatic duct joins the ejaculatory duct at the base of the penis papilla. Prostatic vesicle roundish oval, with few long finger-like extensions directed distad, attached to proximal half of vesicle. Extra-vesicular glands at some distance from prostatic vesicle, with very long glandular ducts which cross the muscular wall of the prostatic vesicle and open along the glandular lining of the prostatic vesicle (Figure 2E). Male atrium lined with glandular epithelium being completely ciliated. Female system as in Palombi (1936).

Stylochus ellipticus (Verrill, 1873) Hyman, 1939

(Figure 2F)

Planocera elliptica Girard 1850, p 251.

Planocera nebulosa Girard 1853, p 367.

Stylochopsis lateralis Girard 1893, p 194–195.

Stylochopsis littoralis Verrill 1873, p 632, Plate 19: Figure 99.

Stylochus littoralis: Lang 1884, p 453.

Eustylochus ellipticus: Verrill 1892, p 467, Plate 40: Figure 2, Plate 41: Figures 1, 1a, Plate 42: Figures 1, 1a.

Eustylochus meridionalis Pearse 1938: 73, Figure 25.

Stylochopsis ellipticus: Faubel 1983: 73.

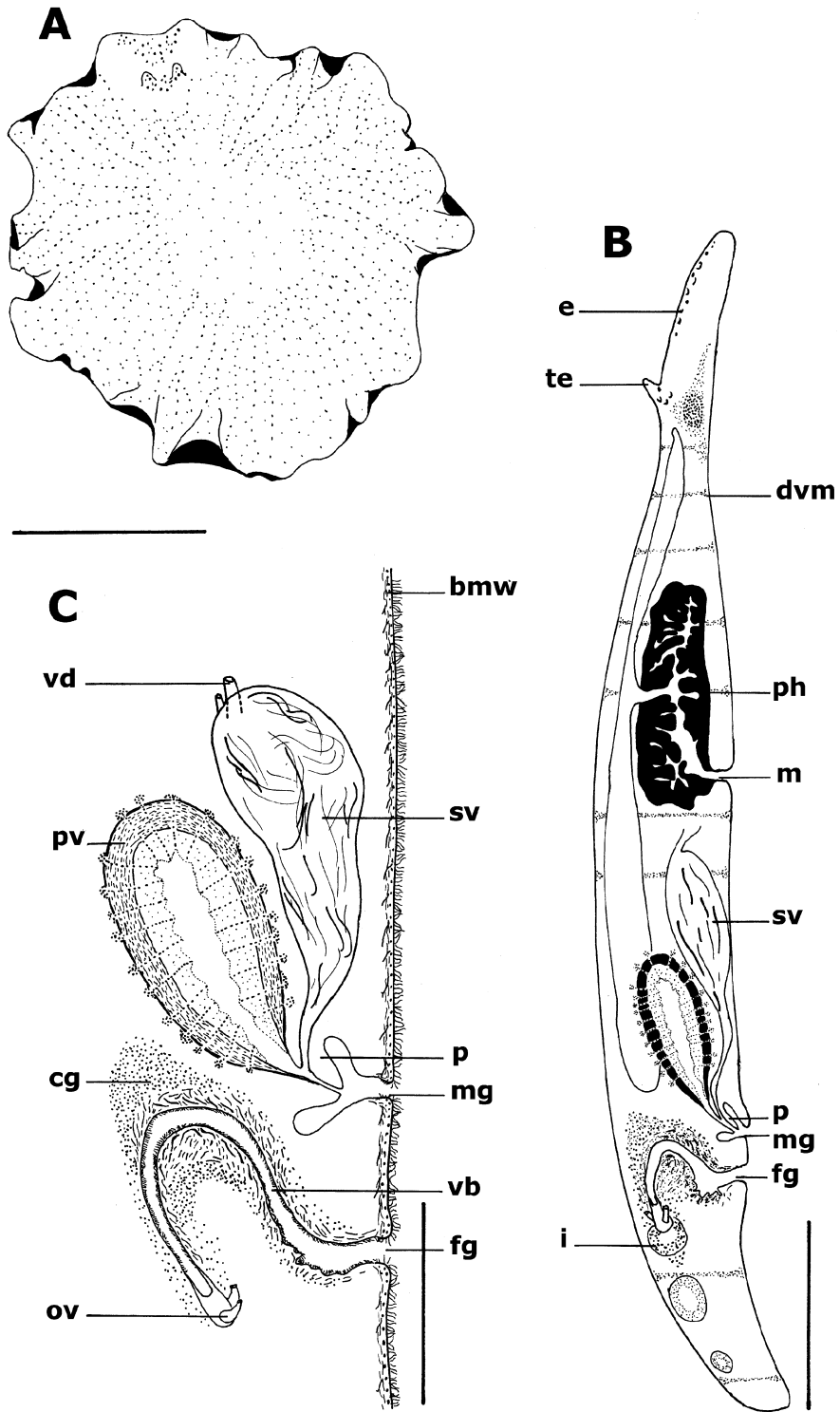


Figure 4. *Cryptostylochus koreensis* sp. nov. (A) Dorsal view of fixed specimen; (B) sagittal reconstruction of whole organism; (C) sagittal reconstruction of male and female apparatus. Scale bars: 20 mm (A); 8 mm (B); 4 mm (C).

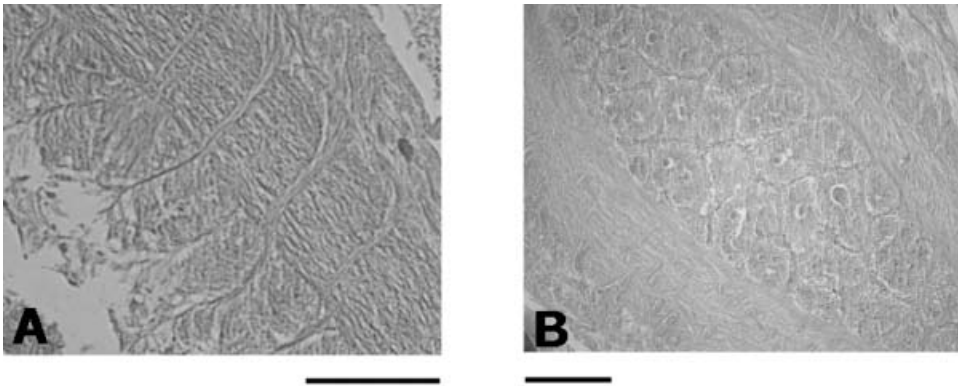


Figure 5. Photomicrographs of the prostatic vesicle of *Cryptostylochus koreensis* sp. nov. (A) Medio-sagittal section; (B) peripheral section. Scale bars: 70 μ m.

Material examined

Voucher specimen. No. 2947, one sagittally sectioned specimen, locality: east coast of USA, deposited in MNHV.

Morphological notes

In the following, only morphological characters which deviate from the description of Hyman (1939, p 130–134) are added or re-described.

Reproductive system. Male genital system with dorsal testes follicles. Vasa deferentia ventral, coiling alongside pharynx, and becoming spermiducal bulbs just before joining the seminal vesicle. Spermiducal bulbs and seminal vesicle distinctly separate, therefore, a tripartite, anchor-shaped vesicle not present as developed in *Imogine* Girard. Seminal vesicle tapering gradually caudad into the distal ejaculatory duct beyond the prostatic vesicle. Roundish oval prostatic vesicle with finger-like extensions (polyglandular type). Extra-vesicular glands arranged radially at a short distance from the muscular wall of the prostatic vesicle (Figure 2F). The prostatic duct joins the ejaculatory duct at the base of the penis papilla. A solid, pointed plug of mucus lying distally just at the tip of the penis papilla, simulating a short, pointed sclerotized process (cf. Hyman 1939); however, a true stylet is absent.

Ovaries arranged ventrally; female genital organs as described by Hyman (1939).

Remarks

Stylochus ellipticus has had a diverse taxonomic history, being shuffled among four genera in the past 150 years. In 1873, Verrill described *Stylochopsis littoralis*, a synonym of *S. ellipticus*, as monotypic member of the genus *Stylochopsis* Verrill, 1873. More recently, Hyman (1939, 1940) re-described *Stylochus ellipticus* (Girard), emphasizing the identity of the structure of the male copulatory organ with the structure of the other species of the genus *Stylochus*. However, unlike other species in the genus, *S. ellipticus* was described as possessing a stylet. Meixner (1907), however, did not describe a stylet, and we did not find any in the voucher specimen. Evidently, Hyman misinterpreted the accumulation of hardened mucus solidifying during histological procedure at the tip of the penis papilla as

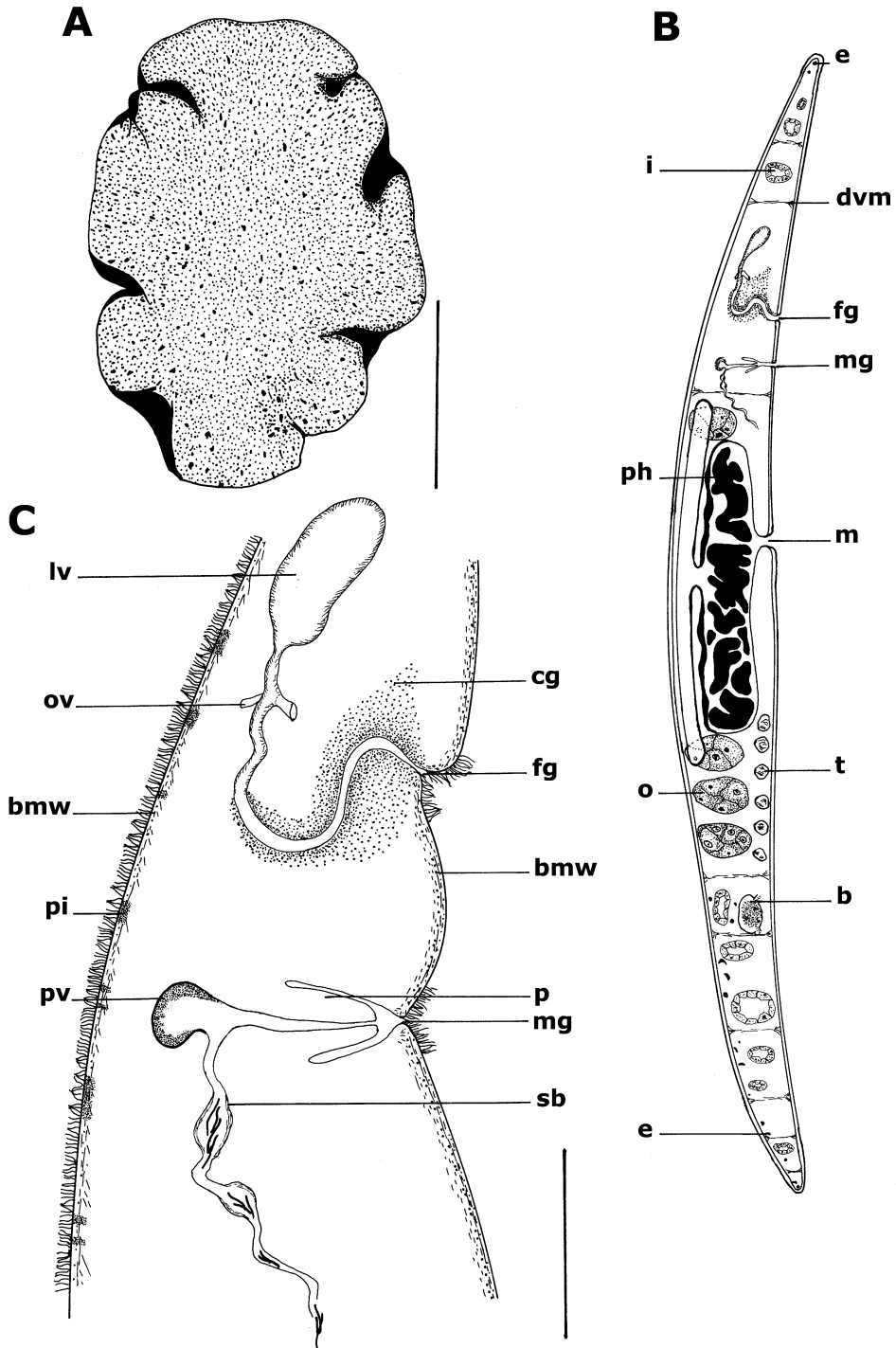


Figure 6. *Munseoma maculata* gen. et sp. nov. (A) Dorsal view of fixed specimen; (B) sagittal reconstruction of whole organism; (C) sagittal reconstruction of male and female genital system. Scale bars: 8 mm (A); 5 mm (B); 6 mm (C).

stylet. Therefore, on the absence of a stylet, the monotypic genus *Stylochopsis* Verrill, 1873 has to be rejected and *Stylochopsis ellipticus* is referred to the genus *Stylochus*.

Genus *Imogine* Girard, 1853

Diagnosis

Stylochidae with large, highly ruffled pharynx. Tentacular, cerebral, marginal, and often frontal eyespots present. Male copulatory apparatus with tripartite, anchor-shaped seminal vesicle enclosed in a strong muscular bulb, prostatic vesicle, and unarmed penis papilla. Lang's vesicle absent. Prostatic vesicle with polyglandular lining. Body often with intensively undulated margins.

Type of the genus: *Imogine oculifera* Girard, 1853.

***Imogine oculifera* Girard, 1853**
(Figure 2C)

Material examined

Voucher specimen. No. 67510, one specimen sagittally sectioned, locality: Piscaderabaai, Curacao, Caribbean Sea, leg. P. W. Hummelinck, deposited in SMNH.

Morphological notes

In the following, only morphological characters which deviate from the description of Hyman (1940) are added or re-described.

Reproductive system. Tripartite, anchor-shaped seminal vesicle. Free prostatic vesicle roundish oval, with inner finger-like extensions directed backwards. Extra-vesicular prostatic glands numerous lying at a short distance from the muscular wall in the parenchyma. Polyglandular type (Figure 2C). Male atrium ciliated.

***Imogine nebulosa* (Girard, 1853)**
(Figure 2B)

Planocera nebulosa Girard 1853, p 367.

Planocera (Planoceropsis) nebulosa: Verrill 1892, p 471–474, Plate XL: Figure 4.

Stylochus nebulosus: Meixner 1907, p 431, Plate XXV: Figure 3, Plate XXVI: Figure 14, Plate XXVII: Figure 7.

Material examined

Voucher specimen. No. 2948, one sagittally sectioned specimen, locality: New Haven, Connecticut, USA, deposited in MNHV.

Morphological notes

In the following, only morphological characters which deviate from the description of Meixner (1907, p 431–433) are added or re-described.

Reproductive system. Tripartite, anchor-shaped seminal vesicle. Free prostatic vesicle roundish oval with finger-like extensions and interior lining of polyglandular type. The extra-vesicular glands lie at a short distance from the muscular wall of the prostatic vesicle in the parenchyma (Figure 2B).

Genus *Distylochus* Faubel, 1983

Diagnosis

Stylochidae with marginal, tentacular, and few scattered cerebral eyespots. Male and female tracts open in a common pore, or the genital pores are very close together near the hind margin. Male copulatory apparatus with papilla-like unarmed penis and seminal vesicle which is developed as a double-vesicle-system. The proximal vesicle is separated by a constriction, the muscle wall of which is distinctly fainter than that of the distal one. Prostatic vesicle with finger-like extensions of inner glandular lining; polyglandular type. Lang's vesicle lacking.

***Distylochus pusillus* (Bock, 1913)**

(Figure 3F)

Stylochus pusillus Bock 1913, p 139–141, Figures 22, 23.

Material examined

Voucher specimen. Nos 5965–67, three specimens sagittally sectioned, locality: Hong Kong, China, leg. K. Koch, 9 March 1862, deposited in SMNH.

Morphological notes

In the following, only morphological characters which deviate from the description of Bock (1913, p. 139–142) are added or re-described.

Reproductive system. Prostatic vesicle (Figure 3F) free, roundish oval, with finger-like extensions of interior glandular lining (polyglandular type). The interior lining is densely packed with glandular cells. Sparse extra-vesicular glands present in the surrounding parenchyma.

Discussion

In 1907, Meixner presented an account of the Stylochidae with an in-depth analysis of the structure of the different male copulatory organs. In his analysis, he defined two types of prostatic vesicle for the genus *Stylochus*: the *neapolitanus* type and the *djiboutiensis* type. The prostatic vesicle of the *neapolitanus* type is roundish to oval and contains few finger-like extensions which are long, directed distad rather than parallel, and originate from the proximal wall of the vesicle. The prostatic vesicle of the *djiboutiensis* type is elongate and contains numerous short tubes that are more or less radially arranged around the whole inner muscle wall. These definitions were accepted by Bock (1913), Palombi (1931), Steinböck (1937), Faubel (1983), and Newman et al. (1993). In following years, the lining of the prostatic vesicle was termed either chambered, ridged, or tubular, and adopted for the family Stylochidae.

In view of a new interpretation of the interior lining of the prostatic vesicle attained with the description of *Cryptostylochus koreensis* sp. nov. (see below), the grouping of the Stylochidae in species of *djiboutiensis* type and species of *neapolitanus* type is unsustainable. On the basis of that perception, the interior lining of the prostatic vesicle of *Stylochus neapolitanus* (Delle Chiaje, 1841), *Stylochus alexandrinus* Steinböck, 1937, *Stylochus frontalis* Verrill, 1892, *Stylochus ellipticus* (Verrill 1873), *Imogine oculifera* Girard, 1853, *Imogine nebulosa* (Girard, 1853), and *Distylochus pusillus* Bock, 1913 were re-investigated. As a result of re-investigation of type material received from the Stockholm and Vienna museums, and reassessment of new and older descriptions, a completely new diagnostic interpretation of the glandular system of prostatic vesicles has been achieved.

The interior glandular lining of the prostatic vesicle in Stylochidae is composed of multiple finger-like extensions or tubes. Each tube contains a central glandular duct connected with a single extra-vesicular gland. Prostatic vesicles containing finger-like extensions, are supplied by several outlets of extra-vesicular glands along the epithelial glandular lining. These two types of prostatic vesicles within the Stylochidae, designated monoglandular type and polyglandular type, also differ with respect to the position of the glands relative to the prostatic vesicle. Monoglandular types generally have the glands in direct contact with the outer muscular wall of the prostate, where as the glands of polyglandular types are positioned at a distance from the prostate wall.

Within the Stylochidae, the genera *Stylochus* Ehrenberg, 1831 and *Imogine* Girard, 1853 remain separated on the basis of the presence or absence of a tripartite seminal vesicle, respectively. In most of the older descriptions of the Stylochidae, however, the structure of the inner lining of the prostatic vesicle was not, or inaccurately, described or only noted to belong to one of the types according to Meixner (1907). That means in most species described, the true glandular character of the prostatic vesicle is not to assess only on the study of the descriptions given in the literature.

Within the Stylochoidea, the families Stylochidae, Pseudostylochidae, Planoceridae, and Latocestidae are diagnosed by the possession of a fingered- or tubular-chambered interior lining of the prostatic vesicle. Among these families the Stylochidae appear most closely related to the Pseudostylochidae. The most conspicuous synapomorphies between these two taxa are the presence of a penis papilla, a ruffled pharynx varying in median parts of the body, and the absence of a cirrus. The autapomorphies of the Stylochidae and Pseudostylochidae lie in the presence or absence of extra-vesicular glands of the prostatic vesicle, respectively. This requires the emendation of the diagnosis of the Pseudostylochidae as follows: Stylochoidea with ruffled pharynx, more or less oblong in shape, and arranged in varying positions in the body but never at hindmost body end. Male copulatory apparatus directed backwards. Free oblong prostatic vesicle and with tubular chambered glandular lining, without extra-vesicular prostatic glands. Gonopores usually separate.

Genus *Cryptostylochus* Faubel, 1983

Diagnosis (emend. nov.)

Stylochidae with tentacles; tentacular, cerebro-frontal, and marginal eyes present. Male copulatory apparatus with seminal vesicle and unarmed penis papilla. Prostatic vesicle with monoglandular tubes. Lang's vesicle absent.

Type of the genus: *Stylochus coseirensis* Bock, 1925.

Cryptostylochus hullensis Faubel and Gollash, 1996
(Figure 3D)

Material examined

Holotype: V 13213, one sagittally sectioned specimen, locality: hull of the car carrier “Faust”, docked in harbour of Bremerhaven, Germany, deposited in ZMUH.

Morphological notes

In the following only morphological characters which deviate from the description of Faubel and Gollasch (1996) are added or re-described.

Reproductive system. Male complex directed backwards. Vasa deferentia terminate by joining the seminal vesicle. The copulatory organ consists of a voluminous seminal vesicle, a free tubular prostatic vesicle, and a penis papilla. Prostatic vesicle roundish to oval with tubes extending from the proximal half distad. Extra-vesicular glands are directly attached to the muscular wall, the ducts of which cross the vesicular muscle wall and pour secretion into the lumen of the prostatic vesicle. Number of extra-vesicular glands identical to number of inner tubes. The prostatic vesicle represents the monoglandular type (Figure 3D).

Cryptostylochus koreensis sp. nov.
(Figures 3A–C, 4, 5)

Material examined

Holotype: one specimen from tidepool of the intertidal zone from Geomundo Island, Jeollanamdo Province, Korea, 127°17'41"E, 34°1'45"N; leg. Dr Hyun Soo Rho, 16 October 2001; one specimen in sagittal serial section, deposited in ZMUH, V 13242.

Habitat. Eulittoral benthal, muddy sand, marine.

Etymology

The specific epithet refers to Korea where the species was found.

Description

Length of fixed, sexually mature specimen 47.2 mm by 42.7 mm width. Body square-shaped, oval, with numerous marginal folds. Colour of dorsal surface presumably brown or brownish red, visible by incident light, ventral surface pale, without any pigments. Nuchal tentacles anterior to bilobed brain. Tentacular, cerebral, and scattered frontal eyes present (Figure 4A); marginal eyes encircling the entire body. Epidermis completely ciliated, cellular, with intra-epithelial nuclei and rhabdites. Dorsal epidermis about 69 µm high, underlain by basal membrane, about 5 µm thick. Layer of granular pigmentation present between basal membrane and body muscle wall. Dorsal body muscle wall consists of an outer circular layer, followed inwards by longitudinal, diagonal and inner longitudinal muscle layers. Ventral body muscle wall reaches 95 µm thick, consisting of outer circular

muscle layer followed inwards by thick longitudinal, intermixed with diagonal muscular fibres, forming a loose, longitudinal cross-over texture. The transversal muscle fibres are numerous and well differentiated.

Ruffled pharynx mid-ventral, 15 mm long; mouth ventrally in the posterior half of the pharyngeal cavity (Figure 4B).

Reproductive system. Bilateral testes follicles ventral, and oogonia of bilateral ovaries extending from dorsal side ventrad between intestinal branches. The male copulatory apparatus (Figure 4C) consists of seminal vesicle, prostatic vesicle, and distal penis papilla housed in a ciliated atrium. The vasa deferentia, their distal courses displaying some loopings, enter the seminal vesicle from anterior via a single pore. Voluminous seminal vesicle, elongate, with thin muscular wall, ventrally of prostatic vesicle.

Prostatic vesicle 1.5 mm long, 0.68 mm diameter, the muscular wall of which well developed. The interior lining of the prostatic vesicle is tubular; it consists of numerous short tubes radially arranged close to each other along the inner border of the muscle wall. Each tube represents the distal ending of the ducts of the extra-vesicular glands which are closely attached to the outer edge of the muscle wall. The number of tubes, therefore, is identical with the number of extra-vesicular glands. Each tube seems to be unicellular with a monoglandular pore. The evidence, however, is only based on light microscopic observations. The distal ends of the tubes do not display a solid, firm lining, apparently, indicating an apocrine-secreting nature of the distal ending of the tubes (Figures 3A, B, 5).

The prostatic duct distally joins the ejaculatory duct at the base of the penis papilla. The ejaculatory duct opens at the tip of the penis papilla. The male copulatory organs are embedded within a reticulated network of muscular fibre but they do not form a compact, muscular, copulatory bulb.

The female system lacks a Lang's vesicle. The oviducts enter the vagina separately from antero-dorsal. The vagina continues backwards a short way, then turns ventrad, and opens ventrally via the female atrium and gonopore to the exterior. The vagina is developed as a vagina bulbosa surrounded by circular muscles, showing folds in the inner epithelium of the female channel, pierced by the ducts of the cement glands. The epithelium covering the inner walls of the female ducts is completely ciliated.

Male and female gonopore separate.

Discussion

In 1921, Frieda Meyer described a specimen of *Stylochus* from the Red Sea, noting that the species could be synonymous with *Stylochus reticulatus* Meixner, 1907. Meyer did not describe the male organ very meticulously and reproduced a detailed section of only a single tube of the prostatic vesicle (Figure 2A). Bock (1925) discussed this species according to the rules of nomenclature and created the new name *Stylochus coseirensis*. In the revision of 1983, Faubel transferred *Stylochus coseirensis* to the new, monotypic genus *Cryptostylochus* Faubel, 1983, Pseudostylochidae, mainly based on the apparently tubular-chambered interior of the prostatic vesicle. The true nature of the interior lining of the prostatic vesicle was not discerned. In 1996, Faubel and Gollasch described a second species, *Cryptostylochus hullensis*. Re-investigation of the holotype of *C. hullensis* confirms that the tubular glandular lining of the prostatic vesicle represents a prostatic vesicle of monoglandular type. The tubes arise proximally in the prostatic vesicle and extend distad. The same situation is evidently developed in *C. coseirensis* Bock. Therefore, the

monoglandular type of prostatic vesicle warrants the transfer of the genus *Cryptostylochus* from the family Pseudostylochidae to the family Stylochidae.

The genus *Cryptostylochus* is now characterized by the monoglandular type of prostatic vesicle, unarmed penis papilla, and absence of Lang's vesicle. The presence of an unarmed penis papilla and a non-tripartite seminal vesicle, and the absence of Lang's vesicle are in common with the genus *Stylochus*. *Cryptostylochus* differs distinctly from *Stylochus* in the presence of the monoglandular type of prostatic vesicle.

The new species, *Cryptostylochus koreensis* sp. nov., is characterized by the monoglandular type of the interior lining of the prostatic vesicle. Based on this character *C. koreensis* represents a member of the genus *Cryptostylochus* Faubel. The genus now contains *C. coseirensis*, *C. hullensis*, and *C. koreensis* sp. nov. Both *C. coseirensis* and *C. hullensis* differ distinctly from *C. koreensis*. The latter species is distinctly characterized by the autapomorphic feature of an interior lining of the prostatic vesicle, consisting of numerous short tubes arranged radially along the inner border of the prostatic vesicle in contrast to the few, long, interior tubes directed distad of the prostatic vesicles in *C. coseirensis* and *C. hullensis*. Additionally, the establishment of the new species *Cryptostylochus koreensis* is marked by the presence of a vagina bulbosa, the arrangement of tentacular, cerebral, frontal eyes, and marginal eyes encircling the whole body.

Family CALLIOPLANIDAE Hyman, 1953
Genus *Munseoma* gen. nov.

Diagnosis

Callioplanidae with centrally arranged pharynx. Cerebral, frontal and marginal eyes present. Male apparatus without seminal vesicle; small free prostatic vesicle with smooth glandular lining. Prostatic duct indistinct. Female apparatus with Lang's vesicle.

Type of the genus: *Munseoma maculata* sp. nov.

Etymology

The generic name *Munseoma* refers to Munseom Island, Korea, where the new species was found.

Munseoma maculata sp. nov.

(Figure 6)

Material examined

Holotype: one specimen from intertidal coral rocky ground of Munseom Island, Jeju-do Province, Korea, 126°34'08"E, 33°13'28"N; leg. Dr Hyun Soo Rho; one specimen in sagittal serial section, deposited in ZMUH, V 13243. Paratype: one specimen from intertidal coral rocky ground of Munseom Island, Jeju-do Province, Korea, 126°34'08"E, 33°13'28"N; leg. Dr Hyun Soo Rho, 16 October 2001; one specimen in sagittal serial section, deposited in ZMUH, V 13244.

Habitat. Eulittoral benthal, crevice of empty oyster shell attached on coral rocky ground, marine.

Etymology

The specific name refers to the maculated pattern of the body surface.

Description

Outline of preserved specimen with anterior slightly rounded, oval with elongated terminal end. Body 19.5 mm long and 14 mm wide. Opaque, compact, with 1–1.5 mm varying width. In incident light, basic coloration yellowish with specific dark brown pattern, ventral surface white. Cerebral and frontal eyes present; marginal eyes numerous and line the periphery of the body in clusters with an apparently random distribution, never forming a distinct band along the margin; on the dorsal surface eyes scattered more densely in the anterior half than in the posterior. Dorsal eyes are only to see when serial sections examined because of the dark brown pattern of the specimens (Figure 6A).

Brain encapsulated, bilobed, and located mid-ventrally below intestinal ramification.

Pharynx ruffled; mouth ventral, in posterior half of pharyngeal cavity, opens to the exterior posteriorly to mid-body. Intestine occupies most of the body, reaching the frontal and distal end, widely ramified.

Body completely ciliated; dorsal epidermis 80.26 µm thick and underlain by a well-developed basal membrane. Body muscle wall with outer circular layer, followed interiad by a longitudinal and a diagonal layer. Granular pigmentation inter-muscular, between layer of circular and longitudinal muscle fibres. Ventral body muscle wall thicker than dorsal, mean 173 µm. Epidermis underlain by a well-developed basal membrane followed by circular, longitudinal, circular and longitudinal muscle layers; the outer circular layer is very thin and the innermost longitudinal layer represents a loose texture of muscle fibres (Figure 6B).

Reproductive system. Bilateral testes follicles ventral, numerous in front of the pharynx and oogonia of bilateral ovaries between intestinal branches with dorsal orientation, well-developed, widely distributed. The male copulatory apparatus consists of spermiducal bulbs, small free prostatic vesicle, and penis papilla. True seminal vesicle absent. Paired vasa deferentia lead posteriad and combine to form a common vas deferens with numerous spermiducal bulbs containing sperm. The prostatic vesicle, an open, sac-shaped indentation of the ejaculatory duct, extends proximad from the entrance of the common vas deferens; its glandular lining is smooth. A prostatic duct is absent. The ejaculatory duct opens at the tip of the penis papilla. Penis papilla housed in small distal ciliated atrium. The female apparatus consists of female atrium, vagina and Lang's vesicle. From the female gonopore, the vagina arises dorsad, then curves posteriad and passes into Lang's vesicle. The duct of the vagina posteriad directed, is received by the oviducts from latero-dorsal. The proximal part of the vagina and Lang's vesicle ciliated; the distal part of the vagina and female atrium entered by cement glands, the lining of which is rich in glands (Figure 6C).

Discussion

After Hyman (1953), the Callioplanidae are Stylochoidea with a ruffled pharynx arranged centrally or somewhat anteriorly to the centre of the body. Male copulatory apparatus is directed backwards or perpendicularly; with true ejaculatory duct and free prostatic vesicle. The prostatic vesicle is provided with a smooth glandular lining. Considering the diagnostic characters of the Callioplanidae, the new species *Munseoma maculata* is a member of this family.

At present, 12 genera are placed within the Callioplanidae. The new genus *Munseoma* has been erected for the described species in this paper because the combination of characters is unknown for any existing genus of Callioplanidae. The absence of a true seminal vesicle, the nature of the prostatic vesicle, and therefore, the restriction of the prostatic duct to the ejaculatory duct, characterizes the new genus *Munseoma*. On the basis of the presence of Lang's vesicle and an unarmed penis papilla, *M. maculata* resembles most closely the species of the genera *Crassiplana* Hyman, 1955 and *Koinostylochus* Faubel, 1983. The most conspicuous autapomorphies of the genera are as follows: in species of *Crassiplana* the female copulatory apparatus is directed backwards, in species of *Koinostylochus* the female copulatory apparatus is directed forwards, and the seminal vesicle is absent in *Munseoma maculata*. That clearly justifies the establishment of the monotypic genus *Munseoma* within the Callioplanidae.

Conclusion

After reviewing the evidence provided by the new species and the revised museum material, we realized that two different types of prostatic vesicle occur within the Stylochidae. We set high value on these features for the classification of these Acotylea, as did Meixner. However, the definitions of *djiboutiensis* type and *neapolitanous* type given by Meixner have to be abandoned. Instead, two new concepts of prostatic construction related to Stylochidae and Pseudstylochidae are proposed. The monoglandular and polyglandular types are based on the glandular nature and structure of the prostatic vesicle and prove to be of great importance for the diagnostic classification of both families. In future descriptions and re-descriptions of Stylochoidea, it is important to verify the interior lining of the prostatic vesicle as we have done above.

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