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# Spermatophores in *Iolaea scitula* (A. Adams, 1860) (Gastropoda, Heterobranchia, Pyramidellidae)

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Spermatophores of *Iolaea scitula* (A. Adams, 1860), described for the first time, have an oblong shape with a tapering tube, are attached to the shell, and resemble previously reported spermatophores of *"Chrysallida" obtusa* and *Fargoa* species. Since these taxa are similar also in other soft part characters, it may be possible that they are closely related.

Key words: Gastropoda, Orthogastropoda, Heterobranchia, Pyramidellidae, *Iolaea scitula*, spermatophore

## INTRODUCTION

The Pyramidellidae are a group of minute to small marine gastropods that are known to be simultaneous hermaphrodites. Dozens of species of pyramidellids have been observed to have an invaginable penis with diverse configurations (Fretter & Graham, 1949; Fretter, 1951; Maas, 1963; Brandt, 1968; Hori & Tsuchida, 1996; Wise, 1996). On the other hand, several pyramidellids have been known to produce spermatophores and deposit them in species-specific positions. Høisaeter (1965) first discovered oblong club-like spermatophores with a tapering tube, attached to the shell of *"Chrysallida" obtusa* (Brown, 1827) in Norway. Later, Robertson (1978) found ovate spermatophores with a stalk, emerging from the penial papilla beneath the mentum and sticking in the pallial cavity in a few Northeastern American species of the genus *Boonea*. Robertson (1978, 1996) recognized a few Northeastern American species of the genus *Fargoa* to have oblong spermatophores with a tapering tube, which attach to the body whorl of the shell. In the two above-stated reports by Robertson (1978, 1996), the transferring of the spermatophores between individuals by using the anterior part of the foot and the mentum, was also observed. More recently, Schander et al. (1999) recorded an ellipsoid spermatophore with a stalk and bag-like extension, which sticks to the head of *Odostomella doliolum* (Philippi, 1844).

In 2000, we discovered spermatophores on living specimens of a Japanese pyramidellid *Iolaea scitula* (A. Adams, 1860), which is the type species of the little-known genus

*Iolaea* A. Adams, 1867. The morphology of the soft parts and most of the biology of this species have not been described due to the fact that few live specimens have been collected. The only published information related to its biology was that living specimens were found among aggregations of a serpulid polychaete, *Pomatoleios kraussi* (Baird) on stones in the intertidal zone in Japan (Hori & Iizumi, 1997; Hori, 2000: 729). Therefore, the present findings are significant in increasing biological knowledge of the genus *Iolaea,* and in assessing its possible phylogenetical relationship among the Pyramidellidae.

## MATERIAL AND METHODS

Observations on the specimens were all made at the Banda Marine Laboratory, Tokyo University of Fisheries, Tateyama City, Chiba Prefecture, central Japan, on May 17, 2000. A total of 13 specimens of *Iolaea scitula* were found alive on the seashore around the laboratory, and their shell, operculum and external soft parts were observed and photographed with a stereomicroscope (Nikon SMZ-800; H-III). Of these specimens, four were observed to carry spermatophore(s). Their spermatophores were examined with a compound microscope (Nikon ECLIPSE TE300).

Abbreviations. – BMNH, British Museum (Natural History), London; MNHN, Muséum National d'Histoire Naturelle, Paris; NSMT, National Science Museum, Tokyo; VM, Museum of Victoria, Melbourne.

## SYSTEMATICS AND DESCRIPTION

Superfamily Pyramidelloidea Gray, 1840
Family Pyramidellidae Gray, 1840

Genus *Iolaea* A. Adams, 1867 (nom. nov. for *Iole* A. Adams, 1860, not Blyth, 1844).
Type species: *Iole scitula* A. Adams, 1860, by monotypy.

*Iolaea scitula* (A. Adams, 1860) (figs 1-10)

*Iole scitula* A. Adams, 1860: 2.
*Iolaea scitula*; A. Adams, 1868, 45, pl. 4 fig. 3; van Aartsen & Hori, 1999: 73-75, fig. 1.
*Miralda scitula*; Hori & Iizumi, 1997: 35-37, pl. 2 figs 6-8, 13.

Material examined. – Seashore around Banda Marine Laboratory, Tokyo University of Fisheries, Tateyama City, Chiba Prefecture, central Japan, among calcareous tubes of *Pomatoleios* spec. (fig. 2) under stones in the intertidal zone; S. Hori leg., 17.v.2000 (NSMT-Mo 73050/13 specimens).

Description. – Shell (fig. 1) small (height ( width: 2.9-3.5 ( 1.3-1.5 mm), ovate-conical, thick, shining and translucently white. Protoconch of ca. one smooth whorl, heterostrophic with its axis at 140°to teleoconch axis; adapical ca. 1/2 of protoconch submerged in first teleoconch whorl. Teleoconch of five to six whorls, with slightly convex sides, separated by distinct and indented sutures. Growth lines distinct, opisthocline (sensu van

Aartsen, 1987: 2, fig. 2C), shallowly sinuous posteriorly. All teleoconch whorls with conspicuous spiral ribs; three on earlier whorls but increasing to five on body whorl; base with seven ribs. Spiral ribs nearly equal in width; the interspaces deeply incised, marked with distinct and thin axial lirae at regular intervals. Spiral ribs nearly equal to their interspaces in width on earlier whorls, but becoming wider to reach twice that of the interspaces on body whorl. Periphery of body whorl convex. Umbilicus distinctly open; its width varies among specimens. Aperture tear-drop shaped. Columella thick, slightly concave, with a columellar fold at its posterior-most part. Columellar fold small and less elevated, not seen in ventral view. Outer lip thin, with no sculpture inside. Margin of outer lip with a shallow sinus posteriorly.

Operculum (fig. 3). – Thin, ovate, translucently yellow, paucispiral, with subcentric nucleus; completely closing aperture of shell. Surface with coarse growth lines. No peculiar sculpture or notch present.

External soft part (fig. 4). – Ground colour translucently pale gray. Head with cephalic tentacles situated antero-laterally. Basal to lateral parts of tentacles slightly tinged with pale brown. Tentacles elongate subtriangular, connate at base, ventro-laterally grooved. Tentacular pad (tpa) consisting of a cluster of long cilia, situated subterminally on inner side of tentacular apices. Eyes (e) black, subepithelial, on median side of tentacles. Mentum (m) tongue-like, truncated at anterior end. Anterior edge of foot (f) divided medially. Pedal pore on posterior to center of foot sole; a short longitudinal groove extends posteriorly from pedal pore, not reaching to posterior tip of foot sole. Pigmented mantle organ elongated ovate, bright yellow partly veneered with dark purplish brown; clearly visible through dorsal side of body whorl of shell. Digestive gland dark brown, visible through posterior portion of shell.

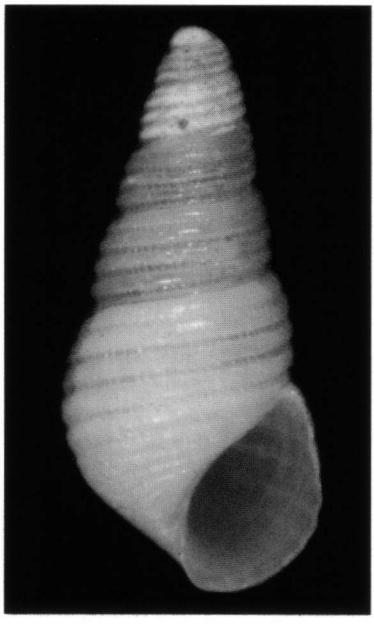
Spermatophore (figs 5-6). – Spermatophore oblong, C-shaped capsicum-like bag, with an overall length of 1.2-1.6 mm constituting 0.34-0.55 of shell length; consisting of a thin, smooth, lustrous and translucent wall. Attached end with an expanded, slightly concave adhesive basal disc (bd). At 1/4-1/6 from the base, swollen with a maximum width of 120-140 μm, and then gradually narrows and tapers toward unattached end (ue), forming a rather long, whip-like tube. Nowhere cuticularized, and unattached end not hooked or barbed. Tip of unattached end with terminal pore (tpo), from where spermatozoa (spz) emerge (fig. 6). Massed, fresh spermatozoa pale yellow.

Attaching position of spermatophore (figs 7-10). – Firmly attached to shell, difficult to remove from shell. Basal disc of spermatophore attached to left of (figs 7, 9) or a little distant to left of posterior end of columella, on ventral side of body whorl of shell. When animal withdrawn into shell, unattached end of spermatophore lies near to anterior margin of outer lip. When animal exposed and crawling, unattached end is on anterior part of right side of animal. Three of four specimens with a single spermatophore, but another specimen with two spermatophores situated close together (fig. 10).

Type locality. – Korea Straits (63 fathoms deep).

Type specimen. – The lectotype and three paralectotypes are deposited in MNHN. Additionally, two paralectotypes (BMNH 1878.1.28.553) and a single paralectotype (VM F31521 (Boyd & Philipps, 1985)) were located (van Aartsen & Hori, 1999).

Distribution. – Oshoro Bay, western Hokkaido, northern Japan (Hori & Iizumi, 1997); Boso Peninsula, central Japan (Hori & Iizumi, 1997; this paper); western part of Seto Inland Sea, western Japan (Inaba, 1982); northern Yamaguchi Prefecture, western Japan (Hori, 2000); Korea Straits (A. Adams, 1860).



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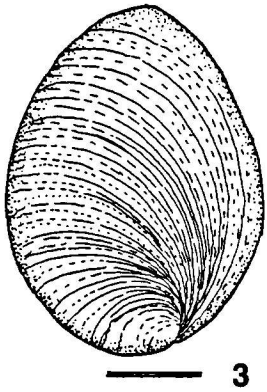

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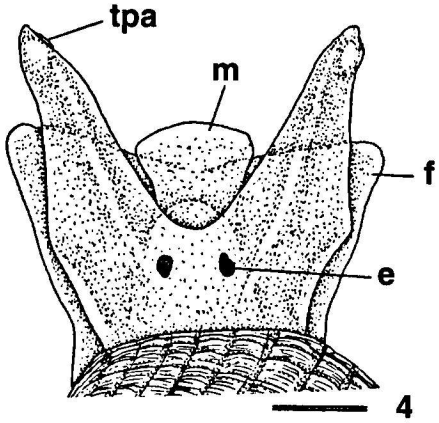


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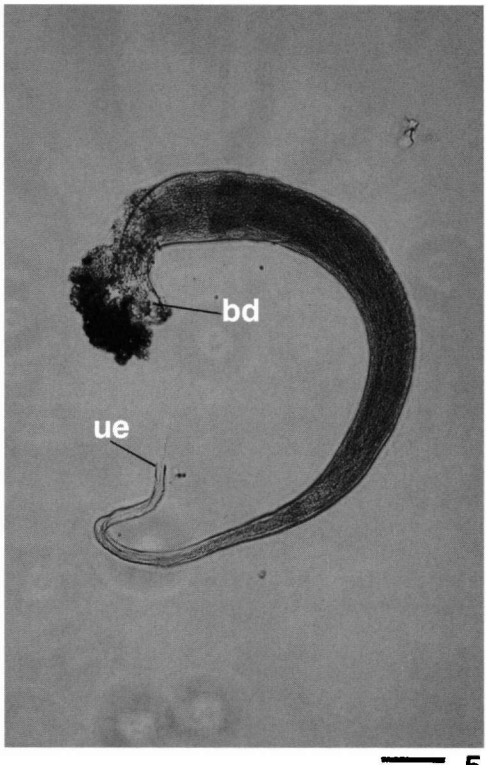
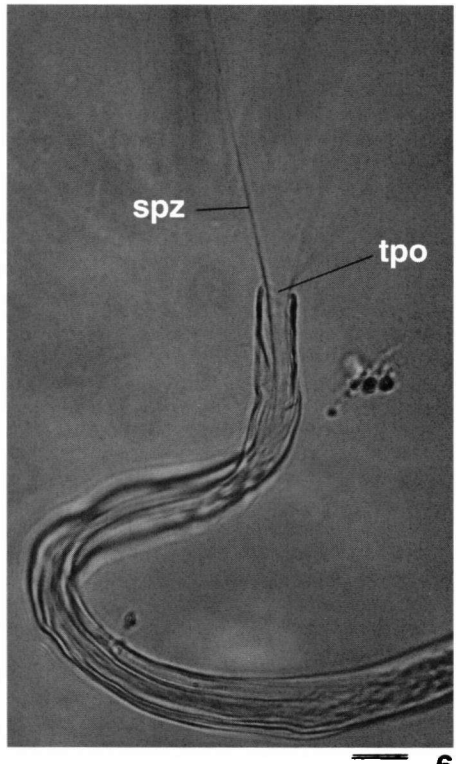
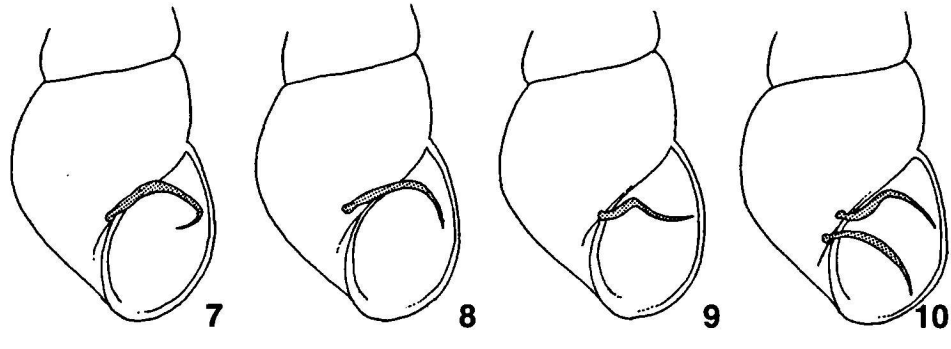
Figs 1-4. *Iolaea scitula* (A. Adams, 1860). 1, shell (2.9 ( 1.4 mm); 2, living specimens among an aggregation of tubes of a polychaete, *Pomatoleios* spec. (scale 1 mm);. 3, operculum (scale 0.2 mm); 4, head-foot: e, eye; f, foot; m, mentum; tpa, tentacular pad (scale 0.2 mm).




Figs 5-10. Spermatophores of *Iolaea scitula* (A. Adams, 1860). 5, with attached end oriented to the left: bd, basal disc; ue, unattached end (scale 0.1 mm); 6, unattached end of spermatophore, with spermatozoa emerging from terminal pore: spz, spermatozoa; tpo, terminal pore (scale 20 μm); 7-10, diagrams showing four instances of spermatophore(s) attached to shells, with animal withdrawn into shell.

Remarks. – The specimens examined in this study were identified as *Iolaea scitula* on the basis of the original description of the shell (A. Adams, 1860) and by comparison with the photograph of the lectotype (van Aartsen & Hori, 1999).

## DISCUSSION

The spermatophores of *Iolaea scitula* found in this study are largely different from the kind described in *Boonea* species by Robertson (1978) and *Odostomella doliolum* by Schander et al. (1999), because the letter two have small and ovate spermatophores sticking in the pallial cavity or to the head. While, the spermatophores of *I. scitula* are similar to those of *"Chrysallida" obtusa* described by Høisaeter (1965) and *Fargoa* species by Robertson (1978, 1996) in the fact they have an oblong shape with a tapering tube and are attaching to the shell. However, there are a few detailed differences as follows: in the structure, the spermatophore of *I. scitula* is more slender and has a more gradual narrowing of the tube than in *Fargoa dianthophila* (Wells & Wells, 1955) (Robertson, 1978), and has no cuticularized hook and barb on the unattached end unlike *F. bushiana* (Bartsch, 1909) (Robertson, 1978) and *F. bartschi* (Winkley, 1909) (Robertson, 1978, 1996). The attaching position of the basal disc of the spermatophore on the shell is almost adjacent to the posterior end of the columella in *I. scitula,* while in *"C." obtusa* it is the right side of the body whorl, halfway between the aperture and the penultimate whorl (Høisaeter, 1965). In *Fargoa* species the position is posterior and to the right of the posterior end of the aperture (Robertson, 1978, 1996).

As mentioned above, *Iolaea scitula* is similar to *"Chrysallida" obtusa* and *Fargoa* species in the fundamental configuration of spermatophore and the attaching of the spermatophore to the shell. Also, *I. scitula* is identical with *Fargoa* species (Robertson, 1978, 1996) in the following soft parts characteristics: medially cleft anterior edge of the foot, the longitudinal groove on the foot sole not reaching to posterior tip, the pigmented mantle organ in yellow partly veneered with brownish color, and dark brownish digestive gland. In the relation to *"C" obtusa,* the fundamental configuration of the head-foot briefly described by Fretter et al. (1986) mostly agrees with that of *I. scitula,* with the only exception in the profile of the anterior edge of the foot (i.e. truncate in *"C" obtusa*). These facts may suggest that the genus *Iolaea* is phylogenetically close to the genus *Fargoa* and to at least a part of *"Chrysallida"* complex including *"C." obtusa.* To clarify the details of their phylogenetical relationships, the investigation on unstudied characters and their comparative analysis, are required.

Robertson (1978) noted that *Fargoa* species are scare (in comparing with *Boonea* species) and have large, elaborate shell-attached spermatophores, which may be adapted to fertilize rarely encountered individuals. This hypothesis may also be applied to *Iolaea scitula.* Actually, *I. scitula* has rarely been found in the field and are much more scarce than other pyramidellids in the similar habitats (e.g. *Odostomia hirotamurana* Nomura, 1938, *Babella caelatior* (Dall & Bartsch, 1906), *Egilina mariellaeformis* (Nomura, 1938), etc.).

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