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The morphology and assignment of Pseudohinnites levii Dijkstra, 1989 (Bivalvia: Pectinoidea)

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Two specimens of *Pseudohinnites levii* Dijkstra, 1989, hitherto known only from valves, are described, including an account of the gross morphology. It is concluded that *P. levii* has a well- developed capacity for swimming. It is a micropredator, feeding on minute crustaceans, and larval development is probably lecithotropic with a short, if any, pelagic stage. Morphological characters are compared with those of the representatives of Propeamussiidae and Pectinidae.

Key words: Bivalvia, Pectinoidea, Pectinidae, *Pseudohinnites levii*, morphology/anatomy, Indo-West Pacific.

The present study is based on two complete and well preserved specimens obtained by the French research vessel 'Nautile', Station SUBPSO, dive 7, sample 706. Locality: New Hebrides Trench, 15°49.8'S 166°41.7'E, depth 2000 m; March 10, 1989; collector B. Pelletier. The samples make it possible to supplement the original description of the species by Dijkstra (1989) and to study its anatomy and tissues.

The terms employed and the measurements taken are in accordance with Waller (1972, 1984).

Abbreviations:
MNHN - Muséum National d'Histoire Naturelle, Paris
ZMUC - Zoologisk Museum, Copenhagen

aq - quick adductor	olp - outer labial palp
as - slow adductor	ov - ovary
aso - abdominal sense organ	P I - prodissoconch I
bg - byssus gland	P II - prodissoconch II
c - ctenidium	pl - pallial line
ca - ctenidial axis	pm - postrectral muscle
ct - ctenolium	pr - pedal retractor
dd - digestive diverticula	pri - pedal retractor insertion
f - foot	r - rectum
ilp - inner labial palp	t - tentacles
k - kidney	td - terminal disc
lp - labial palps	v - velum
ol - outer lip	vr - velum retractor

Family Pectinidae Wilkes, 1810 (emend. Waller, 1978)
Genus *Pseudohinnites* Dijkstra, 1989
Pseudohinnites levii Dijkstra, 1989

Pseudohinnites levii Dijkstra, 1989: 29-33, figs. 1-3; 1990: 7, figs. 14, 15; 1995: 38-39, figs. 75-78.

Description. - The delicate shell is almost circular, slightly higher than long. It is strongly inequivalve; the right valve is either flat or slightly concave; the margin of the right valve is reflected against that of the left. The posterior auricles are continuous with the disc margins. The dorsal margin is shallowly V-shaped in cross-section. The umbonal angle is between 105° and 110°. The resilial insertions are acline, rather small and restricted to the dorsal half of the hinge plate. The interior of the valves is nacreous. Measurements of right valves (mm):

	specimen 1	specimen 2
Length of disc	36.1	34.4
Height of disc	35.0	-
Length of outer ligament	21.8	22.5
Length of anterior outer ligament	12.5	12.5
Depth of byssal notch	7.0	7.3

The right valve (fig. 1a) is thin and transparent. It has close-set, irregular and shallow radiating ribs most of which emerge some 100 mm from the umbo. About 45 ribs are present at the periphery, including those of the posterior auricle. Three irregular, shallow, commarginal undulations are present; a fine irregular commarginal striation is also present and the valve is irregularly battered. The anterior auricle (fig. 2a) is separated from the disc by a distinct suture. The ctenolium (fig. 2b) has 4-7 active teeth and numerous inactive ones. The byssal fasciole forms an angle of 22°. It has close-set irregular ribs which continue across the auricle to the dorsal edge, forming a crest of ribs which become more prominent distally. The dorsal section of the auricle has 5-7 radiating irregular ridges. The dorsal edge of the right valve is curved, overlapping that of the left. The posterior auricle is smaller, continuous with the disc and has an identical sculpture. Two indistinct resilial teeth are present; dorsal teeth (crura) are lacking.

The left valve (fig. 1b) is thicker, opaque and convex (convexity: about 6 mm); it is slightly larger than the right valve, overlapping it by about 1 mm along the whole periphery of the disc. The umbo is more prominent than that of the right valve. The sculpture of the disc and the auricles consists of irregular, close-set, radiating ribs; they emerge gradually 6-8 mm from the umbo. Towards the periphery, secondary ribs are intercalated; 56 ribs are present at the shell margin. Near the umbo the commarginal sculpture consists of regular fine ridges. At the point at which the radiating ribs emerge, they are transformed into close-set lamellae in the interstices between the ribs (fig. 3). On the ribs they develop into hollow vesicles, which are often broken, forming curved scales. The auricles are continuous with the disc and have the same sculpture. The valve has three shallow, irregular, commarginal undulations. No hinge teeth are present.

In terms of microstructure (fig. 4), the right valve comprises an irregular prismatic layer. The left valve has irregular, close-set, radiating folds crossed by more distant concentric folds, together forming an irregular reticulate sculpture. This sculpture appears to be unique in the Pectinoidea.

The pallial line (fig. 5a) is deeply recessed from the shell margin, furthest at the

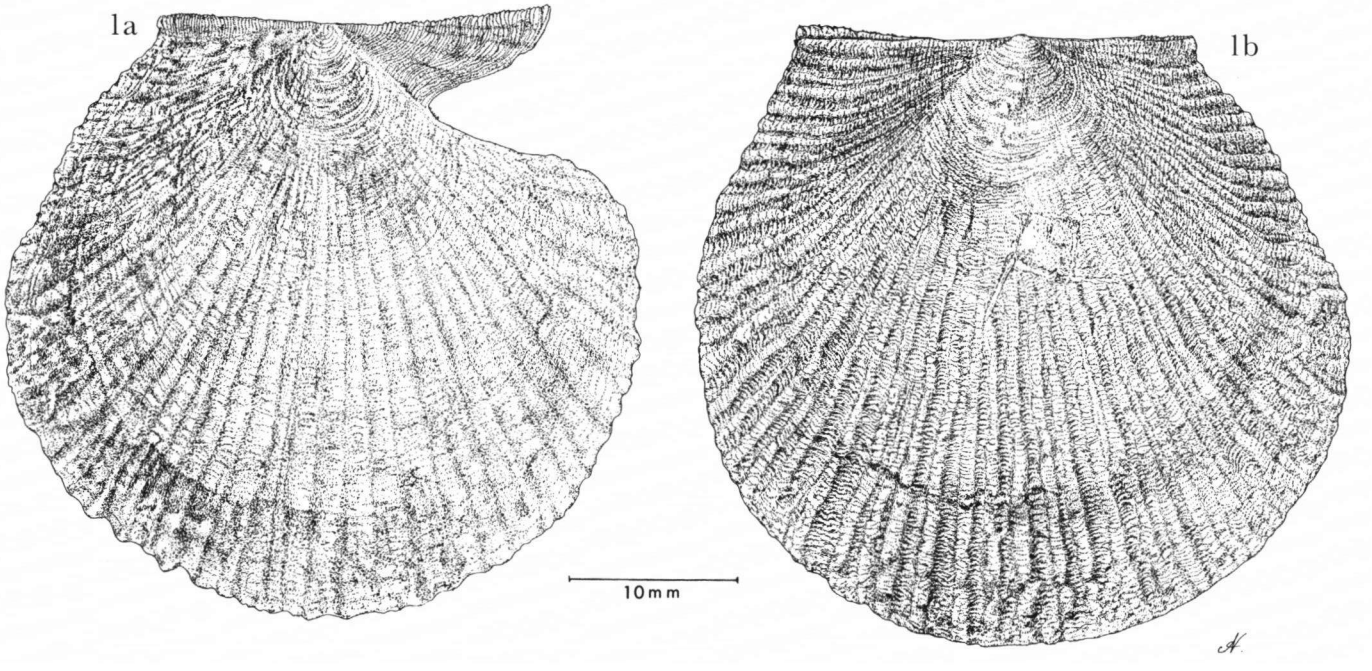
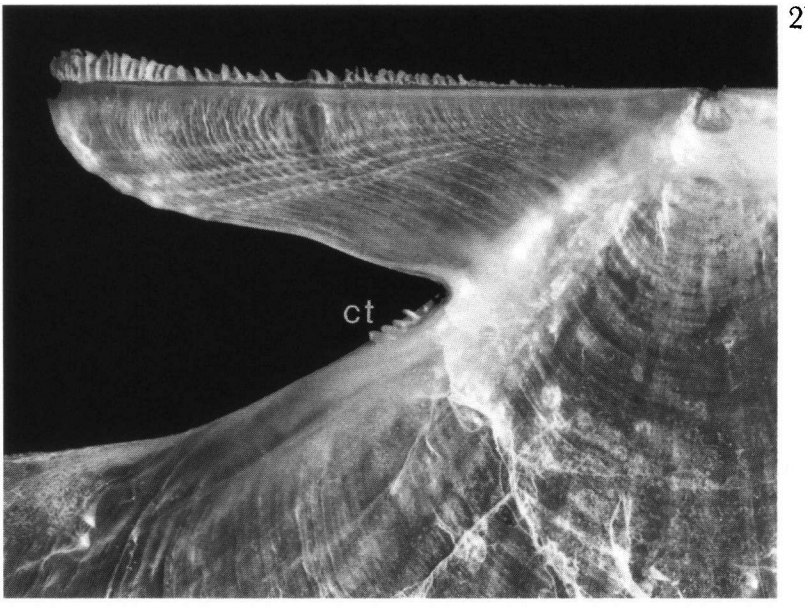


Fig. 1. *Pseudohinnites levii*, specimen 1. a, external view of right valve; b, external view of left valve.

2a



2b

Fig. 2. *Pseudohinnites levii*, right valve. a, external view of anterior auricle; b, internal view of anterior auricle.

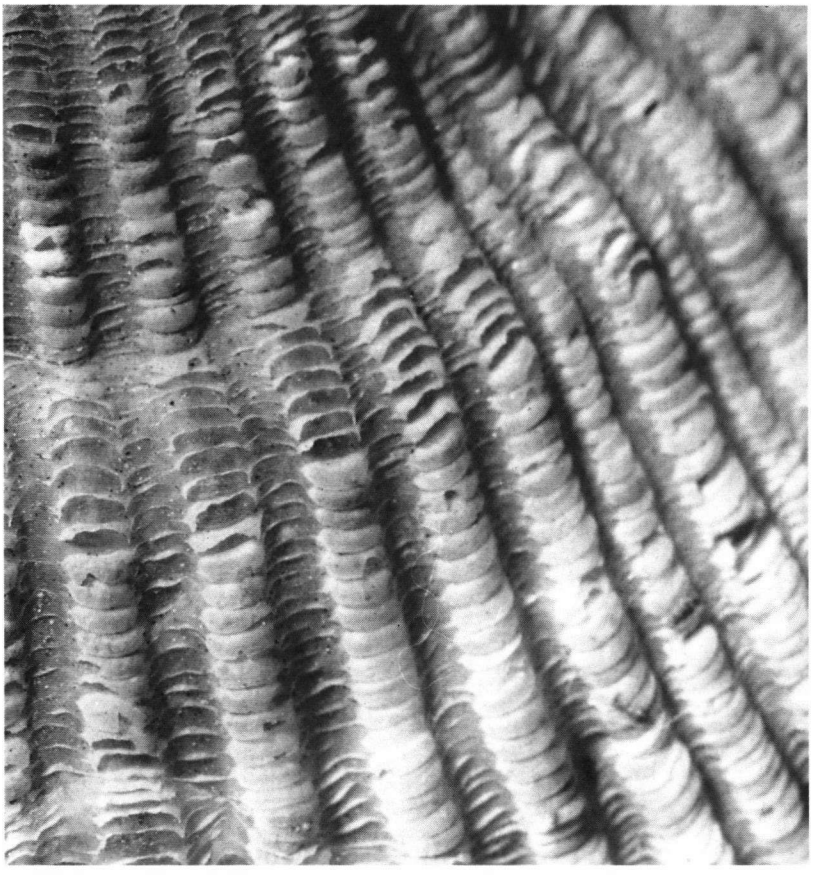


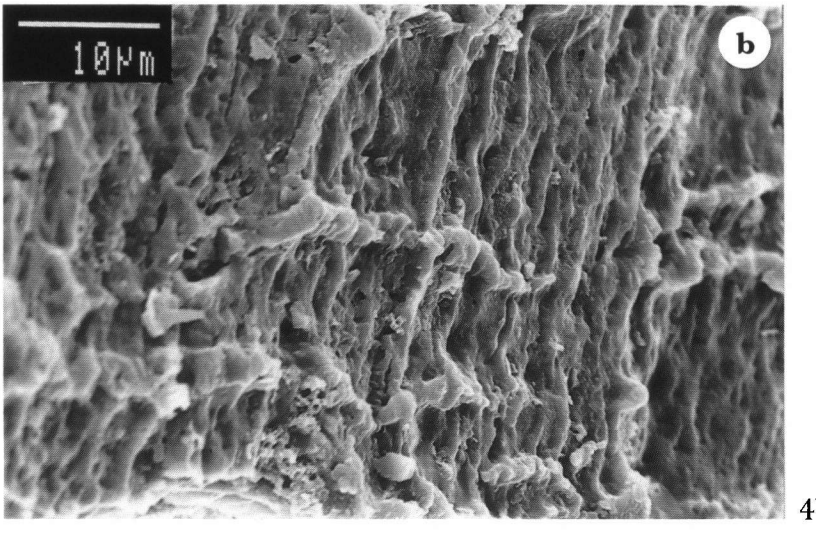
Fig. 3. *Pseudohinnites levii.* Sculpture of the central part of left valve. x about 9.

ventral edge, approaching it anteriorly and posteriorly. The mantle edge (fig. 6) is solid, whereas the central part of the mantle is extremely thin. The middle fold carries distinct tentacles, with 3-5 fringing tentacles interspaced. There are no eyes. The inner mantle fold, or velum, is extremely well-developed; ventrally it measures up to 10 mm across, gradually becoming lower towards the dorsal side.

The free edge of the velum lacks tentacles. The velum has distinct, regularly radiating, muscles extending from the mantle edge to the free edge, and positioned at regular intervals of about 1 mm. The exhalant component of the mantle edge is not morphologically demarcated.

In the ctenidia, the proximal attached part of the ctenidial axis is broad, whereas the free distal part is acute. The ctenidial filaments were entangled to such an extent that they could not be studied in detail. It could be ascertained, however, that both demibranchs have fully developed descending and ascending lamellae.

4a



4b

Fig. 4. *Pseudohinnites levii*. a, micrograph of prismatic layer of right valve; b, micrograph of microsculpture of left valve. - Both micrographs were taken near the prodissoconch. The specimen originates from 'Siboga' expedition, stn 300 (Dijkstra, 1990).

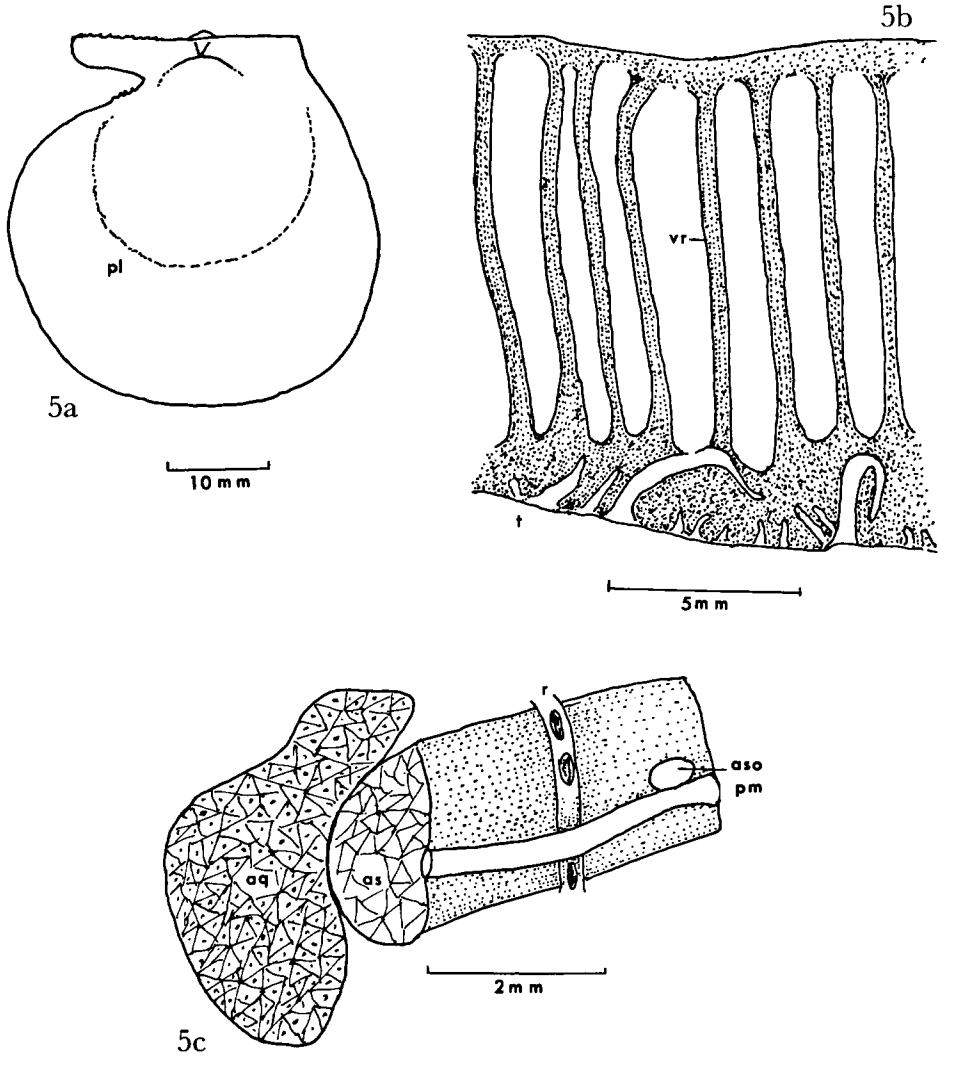
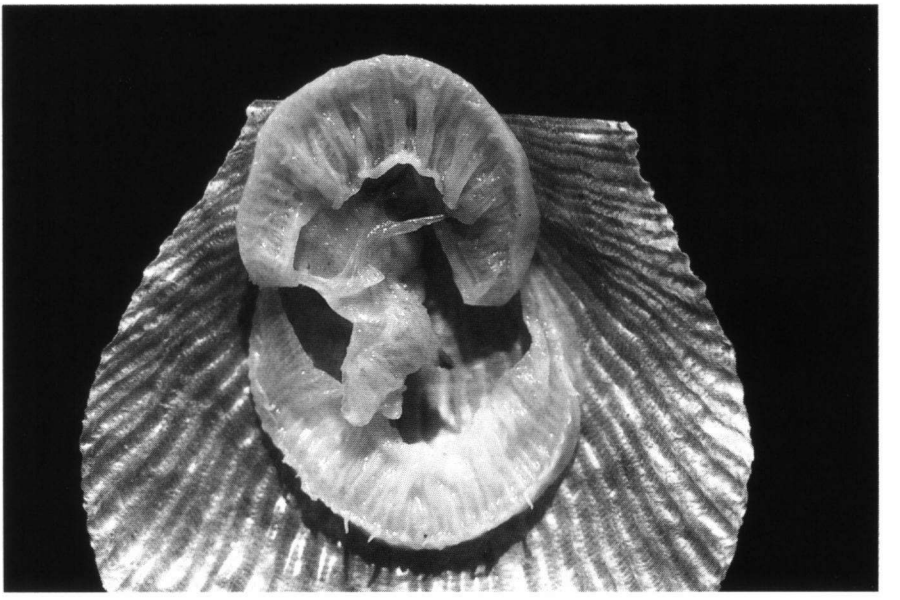
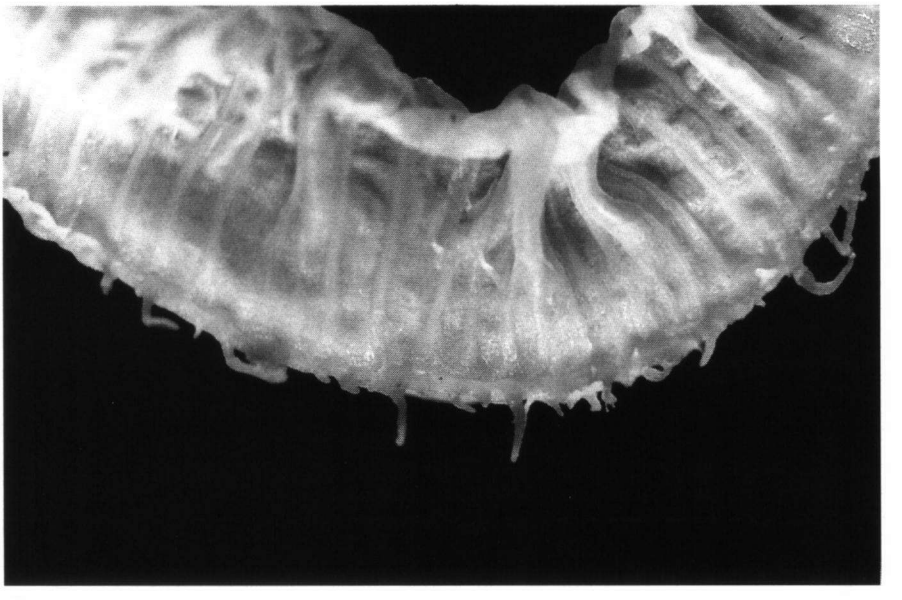


Fig. 5. *Pseudohinnites levii*. a, internal view of right valve; b, a section of ventral part of velum; c, adductor, postrectal muscle and abdominal sense organ.

6a





6b

Fig. 6. *Pseudohinnites levii*. a, right side view of animal and the left valve. The right mantle has been displaced towards the umbo of the left valve. x about 2.3; b, internal view of the ventral part of the left mantle. x about 3.8.

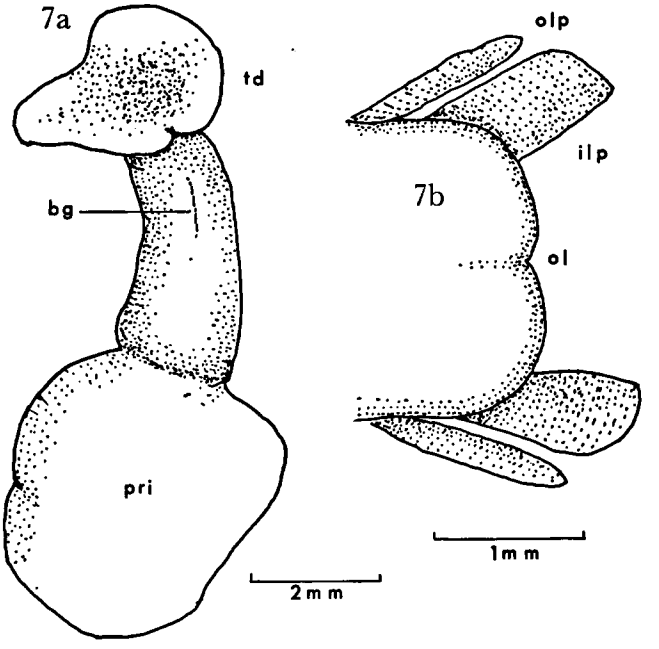


Fig. 7. *Pseudohinnites levii.* a, foot and pedal retractor; b, dorsal view of head.

The outer lip of the mouth (fig. 7) is a fleshy projection with a median indentation. The labial lips are small with poorly developed sorting ridges.

The foot (fig. 8) is cylindrical; distally it has a slightly funnel-shaped sole with a minute ventral indentation and a small rounded knob near the latter. The shaft of the foot is muscular; the byssal groove is a fine slit but no byssus is produced. The proximal part of the well-developed left foot retractor is expanded, forming a large insertion anterior to the antero-dorsal part of the centrally treated posterior adductor muscle. The adductor is well-developed. The 'quick' part comprises about two-thirds of the total muscle area and is obliquely oriented. The right muscule insertion is much closer to the umbo than the left.

A delicate, but distinct, postrectal muscle is present (fig. 8) and arches between de valves, dorsal to the rectum. A small bulbous abdominal sensory organ is present on the right dorsal side of the postrectal muscle.

Food. - One stomach was opened. It contained a small quantity of debris and remnants of minute crustaceans identified as copepods and ostracods.

Distribution. - Indo-West Pacific (fig. 9), 900-2040 m, living at 1567-2000 m (Dijkstra, 1995).

Epifauna. - The central part of the disc of the left valve of one specimen carried an individual of the scyphozoan *Stephanoscyphus* sp.; the branched base of a minute scleractinian coral was present in the same place on the other specimen.

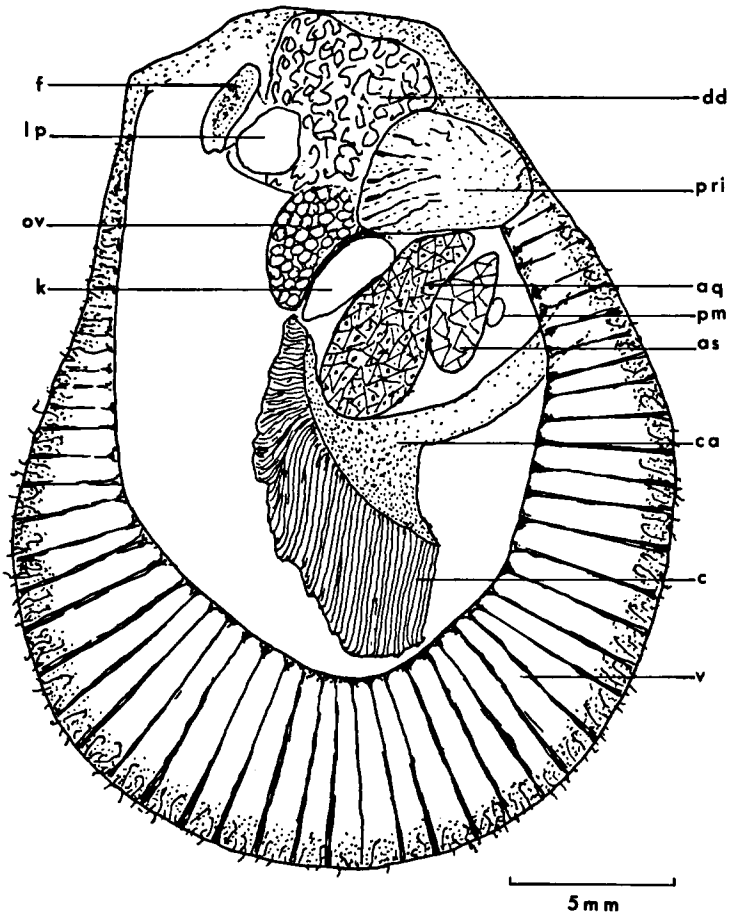


Fig. 8. *Pseudohinnites levii.* Animal viewed from left side. For key to abbreviations used in figures, see text.

Reproduction. - The gonad of one specimen contained oocytes measuring between 170-180 μm in diameter. This indicates a lecithotrophic larval development with a short, if any, pelagic stage. Prodissoconch I measures 260 μm across and there is a narrow prodissoconch II (fig. 10b).

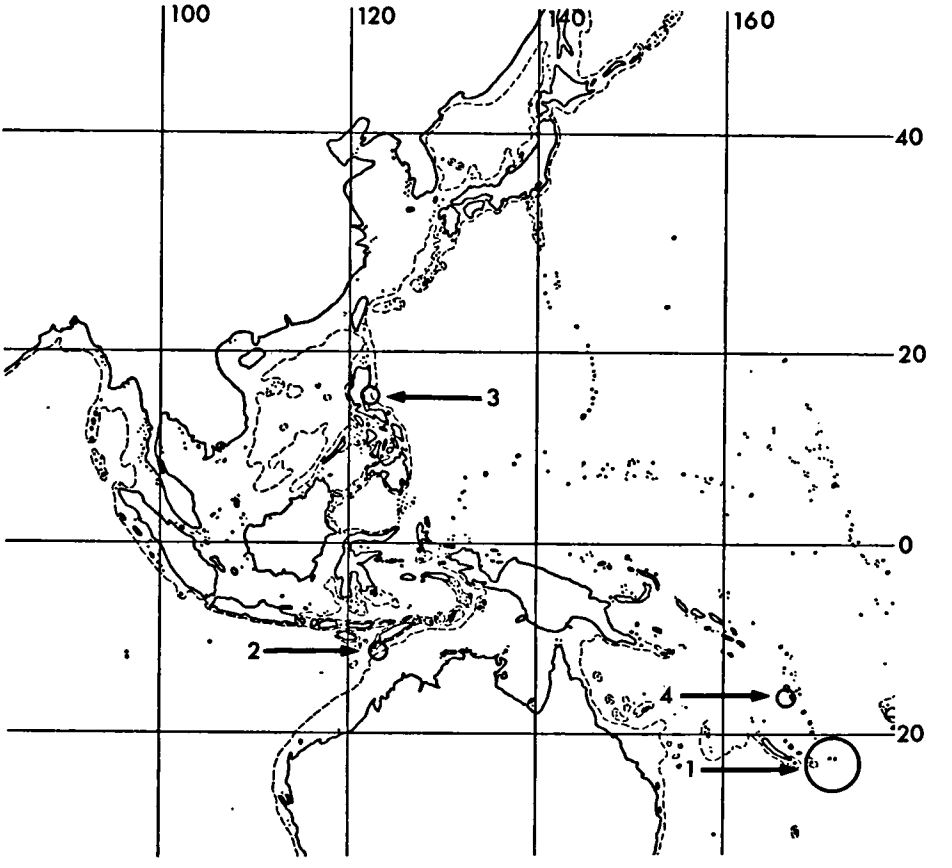


Fig. 9. *Pseudohinnites levii*. Geographical distribution. 1-3: Dijkstra (1989, 1990); 1: type locality; 4: present material.

Discussion. - Studies on the functional morphology of a number of species of Pectinoidea have made it possible to deduce some main features of the way of live. The following papers should be mentioned: Verrill (1897), Knudsen (1970), Stanley (1970), Thayer (1972), Bernard (1978), Yonge (1981), Waller (1984), Morton & Thurston

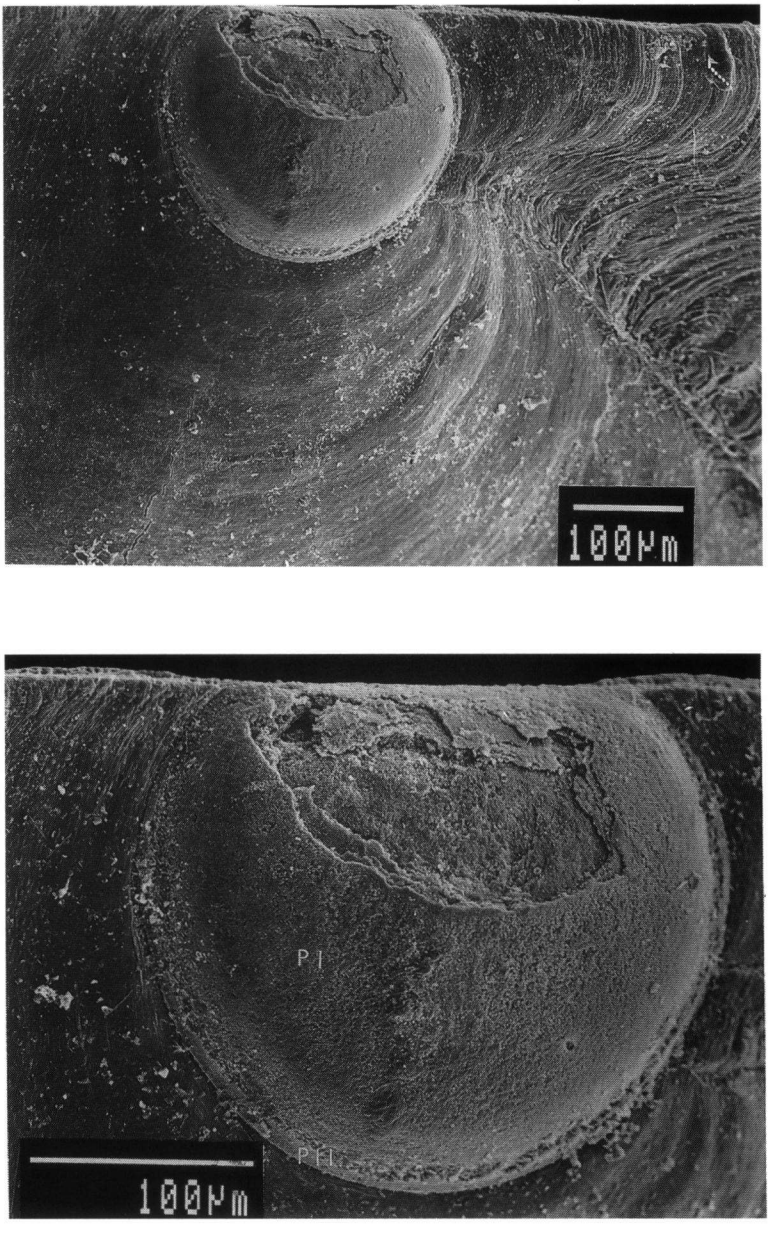


Fig. 10. *Pseudohinnites levii*. a (above), b (below). Micrographs of the prodissoconch of the right valve of the 'Siboga' specimen.

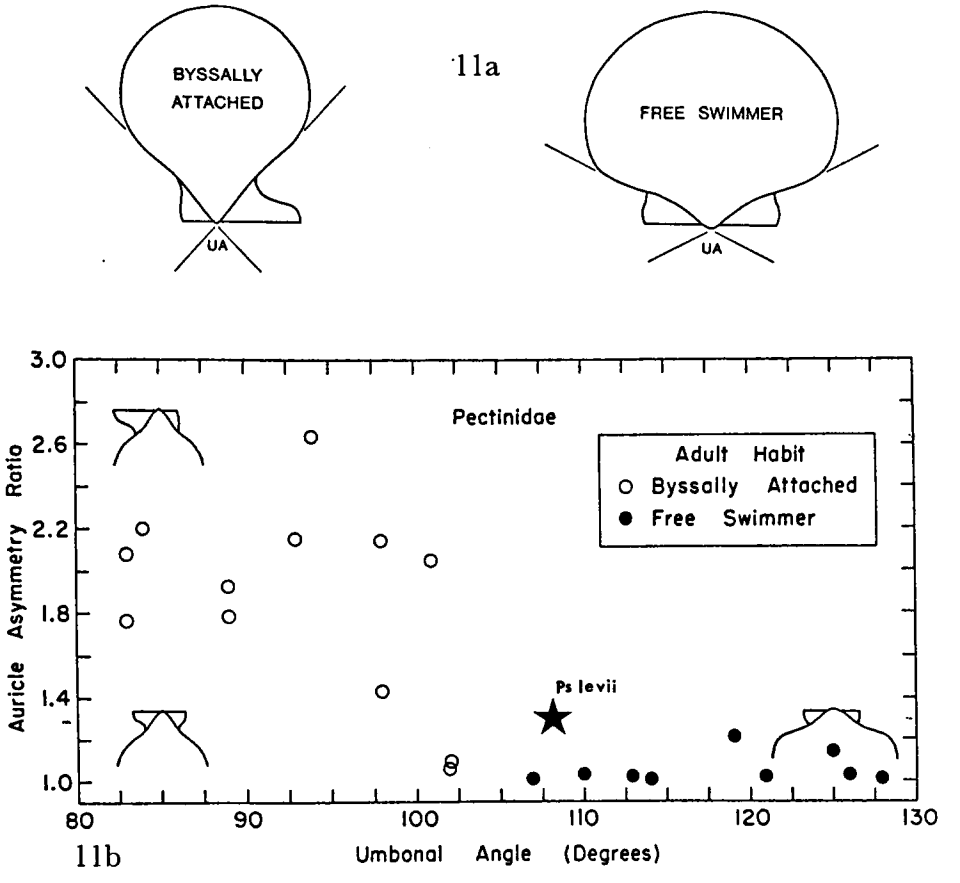


Fig. 11. a, Relation of swimming capacity and outline of valve in Pectinoidea; b, graph of auricle assymetry versus umbonal angle for byssally attached and free-swimming members of Pectinoidea. Auricle assymetry is the ratio between anterior and posterior auricle lengths. Modified from Stanley (1970).

(1989). Stanley (1970) constructed a graph of auricle asymmetry versus umbonal angle (fig. 11) for a number of byssally attached and free-swimming adult members of the Pectinidae. The graph shows a pronounced separation between byssally attached species with asymmetrical auricle ratios and a small umbonal angle (80°-100°) and species with roughly symmetrical auricles (ratio between the anterior and posterior auricle

lengths about 1) and umbonal angles exceeding 105°. The present species has an auricle ratio of 1.3 and umbonal angles of 105°-110°. This would indicate a free-swimming mode of life. This would also be indicated by the pronounced obliqueness of the 'quick' adductor muscle component, which can be compared to that of *Cyclopecten subimbrifer* Verrill & Bush in Verrill, 1897, examined by Thayer (1972). The round disc and the thin shell are also indicative of a well-developed swimming capacity. The well-developed ctenolium,on the other hand, is characteristic of byssally attached pectinids.

Table 1 summarizes the main characters of the Propeamussiidae, Pectinidae and *Pseudohinnites levii*. It appears that the latter shares seven characters with the Propeamussiidae and three with the Pectinidae, thus constituting a morphological and biological combination of the two families. This would seem to justify the establishment of a new subfamily, which will be discussed elsewhere. Schein (1989) attemped a classification of the main genera of bathyal and abyssal Pectinidae (s.l.) giving an identification key (table III) and instructive figures of shell morphology (figs. 3, 4 and 5). It has not been possible to group *Pseudohinnites* among the genera dealt with by Schein.

Hinnites adamsi Dall, 1886, may turn out to be closely related to *P. levii*. It has been recorded only once, from St. Vincent, West Indies, at a depth of 1050 m. The morphology is unknown. Dijkstra (1989) proposed that *Pecten fluctuatus* Bavay, 1904, from the Andaman Sea (depth unknown), could be a third representative of *Pseudohinnites*. It is known only from the type specimen in the Zoological Survey of India, New Alipore, Calcutta. A recent examination of this specimen by the first author shows it to be in very poor condition and, rather, a representative of *Delectopecten*.

	Propeamussiidae	*Pseudohinnites*	*Pectinidae*
Right valve with outer prismatic layer	+	+	-
Ctenolium	-	+	+
Guard tentacles on the free edge of the velum	-	-	+
Foot	well developed	well developed	reduced
Labial palps	without sorting ridges/grooves	without sorting ridges/grooves	with sorting ridges/grooves
Postrectal muscl	+	+	-
Pedal retractor	-	+	+
Eyes	-	-	+
Lower valve	left	right	right
Food	micropredator	micropredator	filter-feeder

Table 1. Comparison of characters of Propeamussiidae, *Pseudohinnites* and Pectinidae based on Bernard (1978), Waller (1978), Morton (1980), Morton & Thurston (1989).

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