

Three new species of deep-sea Mollusks of the genus *Aforia*

(Gastropoda, Toxoglossa, Turridae)

A.V.Sysoev and Yu.I.Kantor

A.N.Severtzov Institute of Animal Evolutionary Morphology and Ecology of the
USSR Academy of Sciences,
Lenin Avenue, 33, Moscow, 117071, USSR.

ABSTRACT. Three new species of the genus *Aforia* (*A.inoperculata* n.sp., *A.tasmanica* n.sp., *A.indomaris* n.sp.) found at abyssal depths near Japan, Tasmania and Seychelles, respectively, are described. Morphology of the soft parts of *A.inoperculata* n.sp. was studied. The absence of operculum in this species is an unique case both within the genus and the subfamily Turriculinae.

RESUME. Les trois nouvelles espèces abyssales du genre *Aforia* décrites dans le présent article (*A.inoperculata* n.sp., *A.tasmanica* n.sp., *A.indomaris* n.sp.) ont été récoltées respectivement dans les eaux japonaises, en Tasmanie et aux îles Seychelles. La morphologie du corps de *A.inoperculata* est étudiée. L'absence d'opercule chez tous les représentants étudiés de cette espèce peut être considérée comme un fait unique, tant pour le genre *Aforia* que pour la famille Turriculinae dans son ensemble.

KEYWORDS: Gastropoda, Turridae, *Aforia*, n.spp., morphology.

MOTS-CLEFS: Gastropoda, Turridae, *Aforia*, n.spp., morphologie.

Recently we have published a review (SYSOEV & KANTOR, 1987) of world-wide deep-sea species of *Aforia*. Since then, three new species have become available. These new species considerably extend our knowledge of the geographical distribution and morphology of the genus.

The descriptions of the species are presented below. Type specimens are stored in the collection of the Zoological Museum of the Moscow State University.

Family **TURRIDAE** Swainson, 1840
Subfamily **TURRICULINAE** Powell, 1942
Genus *Aforia* Dall, 1889

Aforia (Aforia) inoperculata sp.n.
(Fig. 1 A-E; 2; 3)

Material: R/V "Vityaz", 52th cruise, station 6671, 40⁰12'N-143⁰35'E (off Eastern Japan), 2500m, Sigsbee trawl, 23.06.1972, 4 specimens (including holotype) and one empty shell. Holotype N Lc 5673, paratypes N Lc 5674.

Description of the holotype. The shell is medium-sized for the genus (Fig. 1 A,B), fusiform, very thin and fragile, grey, and consists of 5 preserved whorls. All the whorls, except the last one, are eroded. The sutures are weakly impressed. The whorls are convex and a very weak keel is visible on the eroded spire whorls. This keel is absent on the body whorl. Growth lines are thin, clear and thread-like. Spiral ribs are very low, flattened, and divided by interspaces which are 2 to 6 times wider than the rib width. The spiral sculpture on the whorl shoulder is very poorly developed. The ribs are placed most closely to each other on the whorl periphery and widely spaced on the shell base and on the canal. One to three weaker, slightly wavy riblets may be situated in interspaces between the ribs. Low and oblique fan-shaped threads are present on the whorl shoulder. These threads radiate from apices of traces of the anal sinus growth, opposite to the shell growth direction. They can be seen at rather high magnification. The aperture is rounded, the inner lip is covered by a wide callus. The anal sinus is wide, rounded and shallow. The canal is long and curved. The operculum is absent.

The shell height is 33.0 mm, the body whorl is 26.0 mm, the aperture height is 21.4 mm and the shell diameter is 21.0 mm.

Variations of the paratypes. The paratypes are conchologically similar to the holotype. The shell sculpture varies slightly, mostly in the number and the degree of prominence of the spiral ribs. These ribs can be somewhat more pronounced, numerous and placed close to each other. A slight spiral keel is present on the spire whorls. It becomes weaker to disappear on the body whorl. One paratype (Fig. 1 E) has an additional weaker keel on the shell base. The operculum is absent in all the paratypes. The shell height of the largest paratype is 38.0 mm.

The species distinctly differs from all known species of the genus by the oblique threads on the whorl shoulder and by the absence of an operculum.

Remarks. The absence of an operculum has never been observed before neither in the genus *Aforia* nor in the subfamily Turriculinae. At present, as to the supraspecific level, we do not attach any taxonomic value to this feature because at the one hand it is an unique feature in the Turriculinae and on the other hand we have seen only 4 living specimens in our single sample. This may indicate an occasional mutation which has led to the loss of the operculum either in the species as a whole or only in a population of it.

Anatomy. The anatomy of a paratype having a shell of 27 mm height (a part of the canal is broken) was studied.

The molluscan body (Fig. 2 A,B) consists of 2 2/3 whorls. The mantle extends up to 1/3 of the last whorl, and the nephridium occupies no less than 1/4 of the whorl. The body lacks pigmentation. The mantle is moderately thick, and the osphradium and the gill are poorly visible through it. The mantle edge covers the base of the head. It is thickened, straight, with rather shallow notch which corresponds to the anal sinus of the shell. The head (Fig. 3D) is medium-sized and bears thick, short tentacles. The eyes are absent. The rhynchostome has poorly developed lips; its very large sphincter occupies almost the entire volume of the head. The foot of the specimen is short and broad; the propodium is narrow. The marginal cleft is not deep. A small but deep, rounded accessory pedal gland is situated in the central part of the cleft.

Mantle complex (Fig. 2 J). The gill is very large, its length is nearly equal to the mantle length. Lamellae are tall and triangular with a slightly thickened basal flagellum which adheres to the lamellae. This flagellum is lined by a cuticle. The osphradium is very large, long, wide and consists of approximately 40 tall triangular lamellae. There is a long slightly curved dark-brown line on each lamella. The siphon is thick, wide, without distributive valve. The hypobranchial gland is poorly developed; there are remnants of folds covered by a thick layer of mucus.

Fig. 1 (opposite page). Shells of *Aforia* spp.n.
A-E : *A. (Aforia) inoperculata*, A-B : holotype, shell length 33.0 mm. C-D : paratype, shell length 38.0 mm. E : paratype, shell length 35.5 mm.
F-G : *A. (Abyssaforia) tasmanica*, holotype, shell length 39.6 mm.
H-I : *A. (Dallaforia) indomaris*, holotype, shell length 50.0 mm.

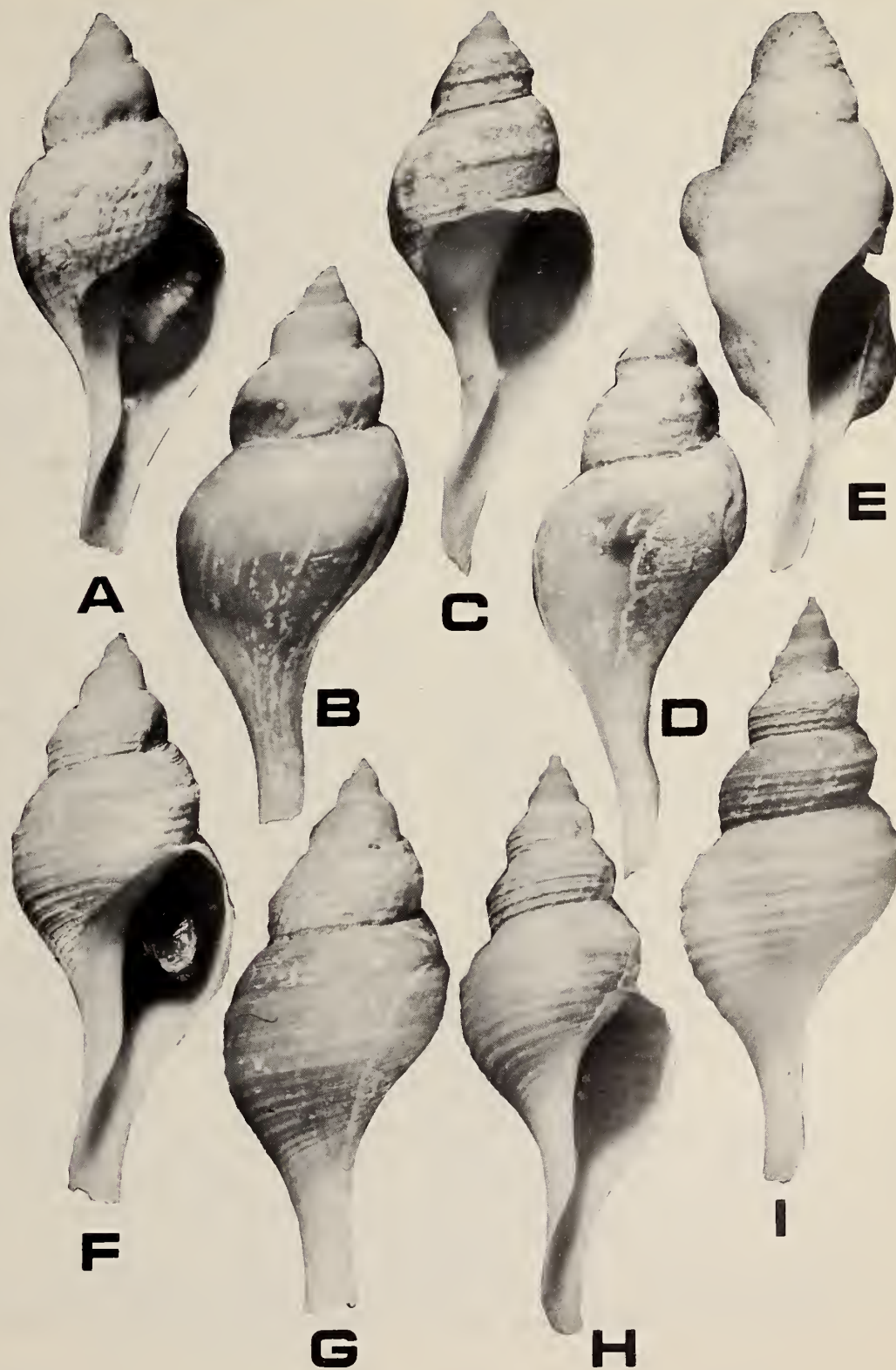


FIG. 1

The rectum is narrow, enlarged posteriorly. The anal gland is situated near this enlargement. The anal papilla is absent and the wall of the rectum forms two small finger-like projections near the anus.

Digestive system (Fig. 2 E, I; 3). The proboscis is short and cone-shaped. The mouth is narrow and rounded. The buccal mass is very large and has rather thick walls consisting of circular muscles (Fig. 3 A). The epithelium of the buccal cavity has tall, narrow and highly vacuolized cells which form longitudinal folds. The buccal tube is narrow and forms a small fold along the buccal mass. The radular sac opens into the bottom of the buccal cavity by a rather long and narrow duct. The odontophore is not large and consists of two odontophoral cartilages which are connected in their anterior parts by a transverse muscle.

The radula (Fig. 3 C) is short. The marginal tooth has short lower and long upper plate. The marginal tooth length is about 0.27 mm and the (shell height / marginal tooth length) ratio is about 133. The central tooth is crescent-shaped with one sharp cusp and thin slightly sclerotized blades. One marginal tooth was observed at the level of the sphincter at the proboscis tip (Fig. 3 B). The tooth point was not protruding outside. The most anterior part of the proboscis was invaginated. When the proboscis tip would be everted, the tooth point would protrude outside like in *A. aulaca alaskana* (see SYSOEV & KANTOR, 1987).

The oesophagus leaving the buccal cavity is narrow (about 1.0 mm) but widens abruptly just behind the nervous ring (up to 3.5 mm), where it becomes laterally compressed. A deep groove is formed between the widened part of the oesophagus and the upper part of the buccal mass. A nervous ring and ventrally an unpaired salivary gland are situated in this groove (Fig. 2 G).

The salivary gland is rather small and surrounds the oesophagus ventro-laterally. The paired salivary glands are lined with a ciliary epithelium; they open into the radular sac near its entrance into the buccal cavity. The poison gland is relatively long and thick. Its length is about 25 mm and its diameter about 0.4-0.5 mm. It opens ventrally in the narrowed part of the oesophagus. The small muscular bulb of the poison gland is oval and elongated (Fig. 2 H). It is inserted on the right side of the oesophagus. The inner cavity of the bulb is rather small like in other *Aforia* spp. and its thick walls consist of two muscle layers. The outer one is longitudinal and the inner one is circular. The layers are not separated by connective tissue.

The stomach (Fig. 2 I) is typically U-shaped. Two ducts of the digestive gland enter the stomach. The stomach is large and gradually narrows towards the intestine. Folds run along the stomach.

The nervous ring is small but with very large ganglia (Fig. 2 F).

Reproductive system. The vesicula seminalis is very large. It occupies about 1/2 of the whorl adjoining the nephridium length and its width 3/4 of the inner part of this whorl. The vesicula seminalis is formed by a tightly convoluted flagellum consisting of numerous tiny loops of the seminal duct. The posterior part of the vesicula seminalis, shown on Fig. 2 D, is partly disentangled. The penis (Fig. 2 C) has slightly wrinkled walls. It is long and occupies nearly the whole mantle length. The male gonopore opens on a large low conical papilla surrounded by a circular fold.

The morphology of the new species is generally similar to that of other species studied (SYSOEV & KANTOR, 1987). It differs only in details, the most prominent of which are the existence of the anal

Fig. 2 (opposite page). Morphology of the soft parts of *A. inoperculata* n.sp., paratype.

A, B : the body removed from the shell; C : distal part of the penis; D : posterior part of the vesicula seminalis, partially disentangled; E-G : organs of the haemocoel (E : view from the left, F : from below, G : from the right); H : muscular bulb of the poison gland; I : internal view of the stomach; J : mantle complex. (A, B, I, J : same scale; C, D, E, F, G : same scale).

ag : anal gland; ao : anal opening, dd : ducts of the digestive gland; dg : digestive gland; g : gill; h : head; hg : hypobranchial gland; mb : muscular bulb of the poison gland; n : nephridium; nr : nervous ring; oe : oesophagus; os : osphradium; pg : poison gland; pr : proboscis; r : rectum; s : siphon; sg :

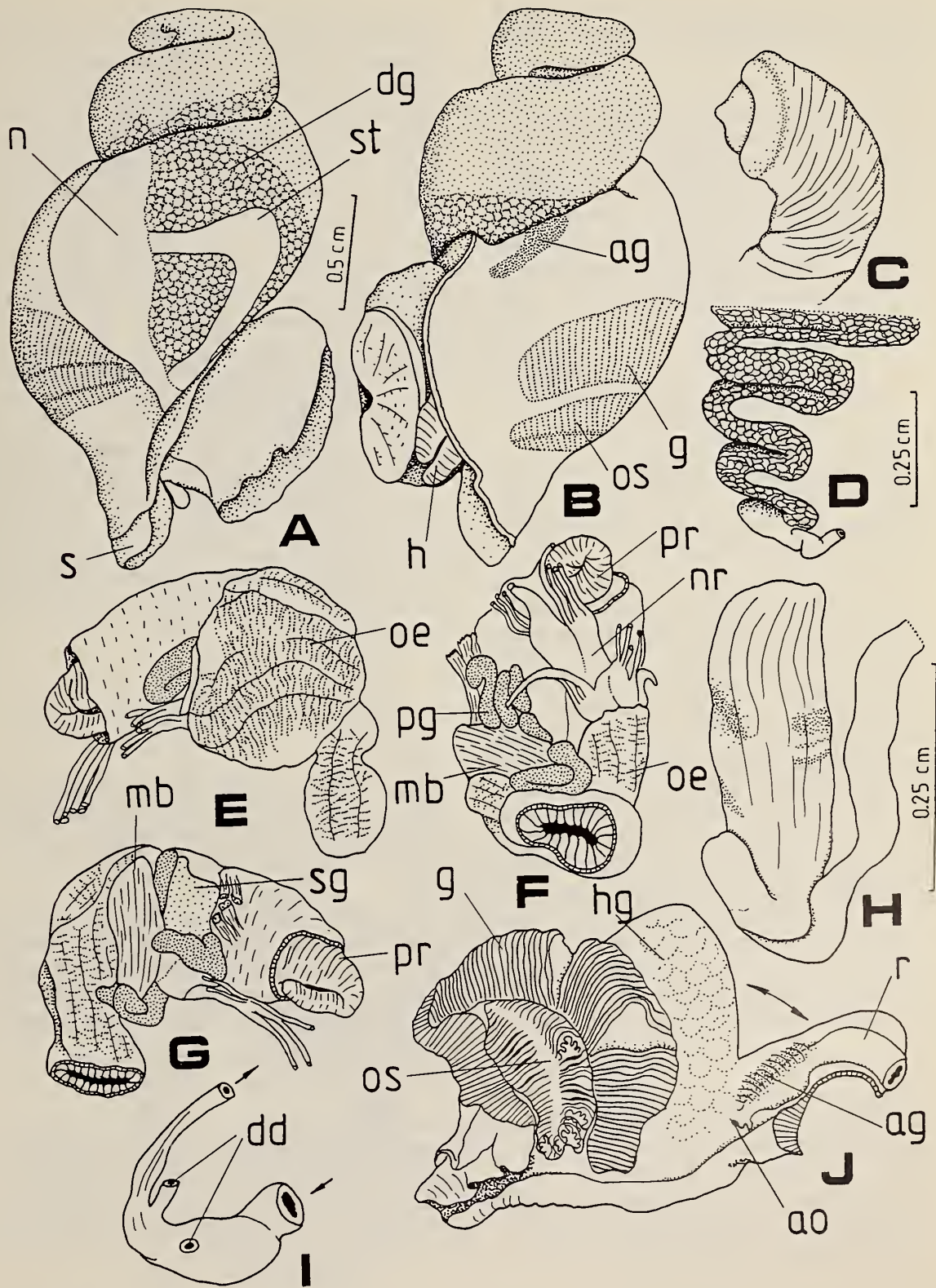


FIG. 2

gland and the salivary ducts passing through the nervous ring. These features were not found in other species.

Polychaete setae were found in the rectum of a studied specimen. A quite remarkable fact is the presence of parasitic nematodes *Astralonema* sp.n. (order Marimermitidae - determined by Dr. A.V.Chesunov) in two specimens. One specimen had a nematode in the body sinus near its wall while another specimen had it in the haemocoel where it was interlaced with the oesophagus and the muscular bulb.

Aforia (Abyssaforia) tasmanica n.sp.
(Fig. 1 F-G)

Material. R/V "Dmitry Mendeleev", 16th cruise, station 1335, 49°50'S - 148°24'E (South of Tasmania), depth 4335 m, Galathea trawl, 13.02.1976, 1 specimen (holotype, N Lc 5671).

Description of the holotype. The shell is medium-sized for the genus, fusiform, solid, light-brown and consisting of 4 preserved whorls. The upper whorls are strongly eroded. The whorls are moderately convex, angulated at the periphery, separated by deep canaliculate sutures. A wide, low fold is situated in the middle of the whorl shoulder approximately near the extremities of the anal sinus growth lines; the shoulder is flat above the fold and concave (up to the angled periphery) below it. The growth lines are numerous and clear; some of them are considerably thickened and raised. The spiral ribs are strong, narrow and rounded; they are cord-like, close-spaced and weaker on the shoulder. There are 10 ribs on the shoulder, two of which are wider, rounder and somewhat separated from those on the fold. Two large ribs are situated on the angle of the whorl periphery; there

are 3 ribs below the angle on the penultimate whorl and 32 on the body whorl including the canal. A thin, thread-like riblet and 5 to 6 wide, flattened, very poorly visible riblets may be situated in the interspaces between the ribs, especially on the whorl periphery. The aperture is oval, its inner lip is covered by a wide callus; the anal sinus is deep. The slightly curved canal is very long, and widens towards its end. The small and thin operculum is typical for the genus.

The shell height is 39.6 mm, the body whorl height is 31.0 mm, the aperture height is 26.5 mm, the shell diameter is 16.0 mm.

The new species differs from related species found in the same region (*A.lepta* (Watson, 1881) and *A.moskalevi* Sysoev & Kantor, 1987) mainly by its sculpture, particularly by the considerably stronger spiral ribs on the shoulder. The new species differs from the similar North-Pacific species *A.abysalis* Sysoev & Kantor, 1987 by its less convex shell angulated at the periphery of the body whorl, by the presence of a marked fold on the whorl shoulder, by deeper sutures, and by the form and number of the spiral ribs.

Aforia (Dallaforia) indomaris n.sp.
(Fig. 1 H, I)

Material. R/V "Academik Kurchatov", 2nd cruise, station 25, 43°33'S - 63°13'E (North-East of Seychelles), depth 4300 m, Galathea trawl, 17.05.1967, 1 specimen (holotype, N Lc 5672).

Description of the holotype. The shell is medium-sized for the genus, fusiform, slender, thin but solid, grey and consisting of 6 preserved whorls, the upper ones being strongly eroded. Whorls are angulated at the periphery, slightly convex, separated by shallow

Fig. 3 (opposite page). *A.inoperculata* n.sp.

A : semidiagrammatic longitudinal section of the anterior part of the digestive system. The salivary and poison glands are not shown. B : longitudinal section of the anterior part of the proboscis. C : radula (a : central tooth); D : anterior part of the head; ag : accessory pedal gland; bc : buccal cavity; bt : buccal tube; bm : buccal mass; ft : fold of the buccal tube; oc : odontophoral cartilages; oe : oesophagus; pp : propodium; ps : proboscis sphincters; rs : rhynchostome; rt : radular tooth located at proboscis tip; sd : salivary duct.

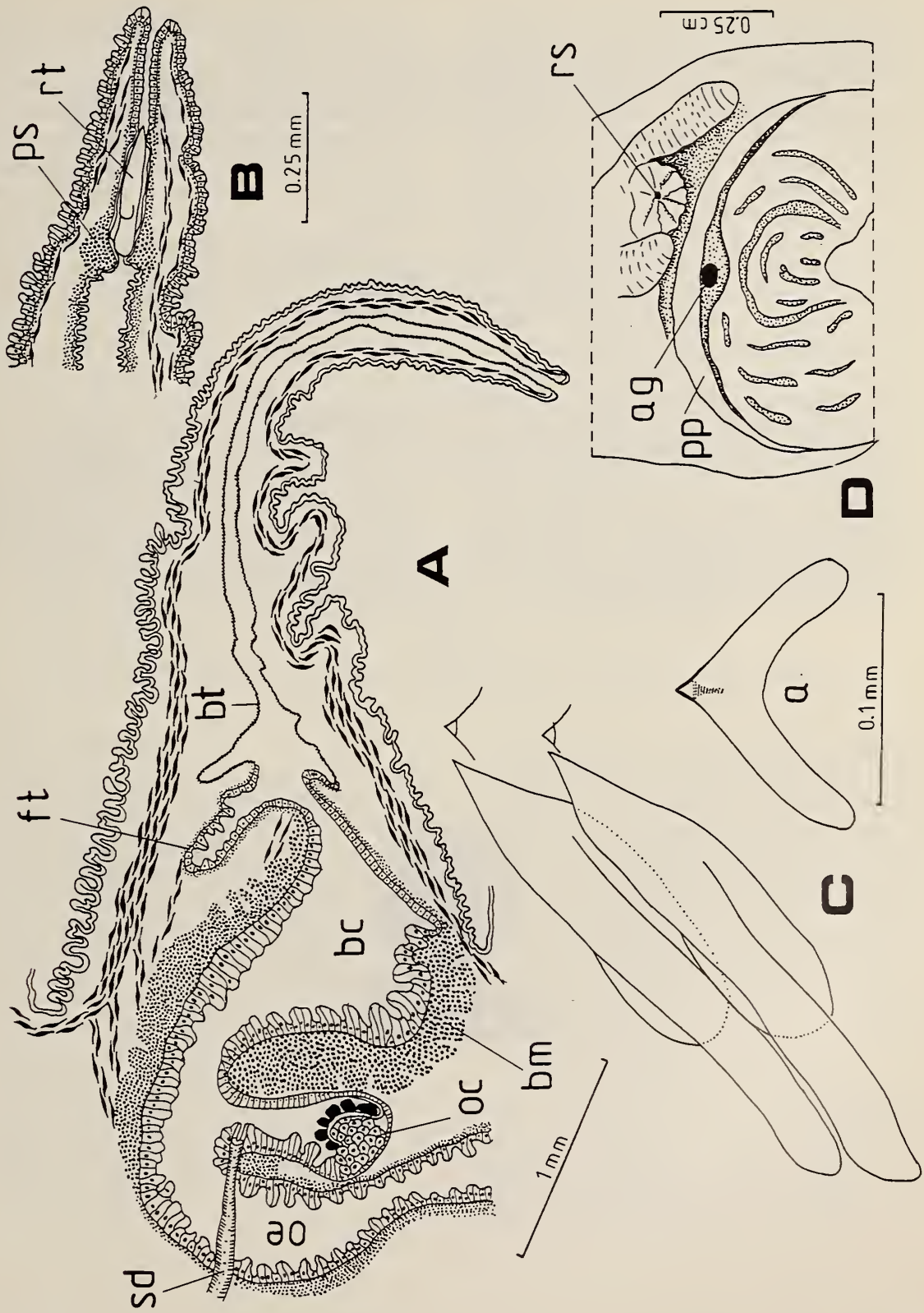


FIG. 3

impressed sutures. In the middle of the shoulder there is a low fold which follows the extremities of growth lines of the anal sinus. It is poorly visible on the spire whorls and markedly strengthens towards the aperture. The shoulder is concave at both sides of the fold. Growth lines are numerous, unclear and equally wide. The spiral ribs are low and cord-like on the shoulder, the widest ones being on the fold. There are 10 ribs on the two last whorls of the spire and 13 ribs on the body whorl. On the remaining surface of the shell, ribs are stronger, raised, and rounded; there may be one narrower and low riblet in each interspace between the ribs (except between those on the canal). The space between ribs is 2 to 4 times wider than the ribs themselves; the ribs are closer to each other on the canal. There are 4 ribs on the penultimate whorl and 31 on the body whorl, including the canal. The aperture is oval; its inner lip is covered by a rather narrow thin callus and in its upper part the spiral ribs are still visible under the callus. The canal is moderately long, slightly curved, rather narrow, open, and slightly widening toward its end. The anal sinus is deep, rather narrow.

The shell height is 50.0 mm, the body whorl height is 36.0 mm, the aperture height is 30.0 mm, the shell diameter is 19.0 mm.

The new species is conchologically related to *A.crebristriata* (Dall, 1908) from which it differs in having less deep sutures, a generally weakly convex subsutural band, more rounded and more widely spaced spiral ribs with accessory riblets in the interspaces.

A.indomaris n.sp. significantly extends the distribution of the genus *Aforia* since it is the first record of the genus in the equatorial part of the Indian Ocean.

REFERENCE.

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