Molluscan Research 26(2): 108–112
http://www.mapress.com/mr/

ISSN 1323-5818
Magnolia Press

A new blind *Anatoma* species from the bathyal of the northeastern Pacific (Vetigastropoda: Anatomidae)

DANIEL L. GEIGER
Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, CA 93105 USA
Email: geiger@vetigastropoda.com

Abstract

Anatoma janetae n. sp. from the bathyal of the northeastern Pacific is described based on two incompletely preserved specimens, one including the animal. The new species is characterised by the marked switch in teleoconch sculpture from distinct raised axial cords to fine spiral steps. The species is compared to all north Pacific species. The eyes are absent in this and several other deep-water species of distinct genera, refuting the hypothesis that the character is taxonomically informative for the distinction between *Anatoma* and *Thieleella*. The radula shows a morphology of the marginal teeth that is unique among species of Anatomidae.

Key words: new species, deep sea, anatomy, gut content, morphology, vision

Introduction

Microvetigastropods in the families Scissurellidae and Anatomidae have received some attention over the past few years (Bandel 1998; Marshall 2002; Geiger 2003, 2006; Geiger and Jansen 2004a, b). A new species from the East Pacific Rise of the northeastern Pacific is described here. Although the material is limited and not ideally preserved, the specimens are sufficiently distinct to be recognized as a new species. Additional material is unlikely to be collected in the near future.

Materials and Methods

The broken shell of the holotype was carefully separated from the shell with fine artists' brushes and tungsten needles, and the animal was kept fluid-preserved. The shell fragments were not cleaned due to the fragility of the specimens. Fragments were placed onto double-sided carbon tabs (Ted Pella, Redding), and sputter-coated with gold. Scanning electron micrographs (SEM) were taken on Zeiss EVO 40 XVP (Zeiss, Cambridge). The fragments were aligned in Adobe Photoshop™ with limited distortion applied to compensate for residual lens distortion. No data were added (cloning tools, history brush or similar).

The animal was photographed with a stereomicroscope. Gut content was examined and photographed under a compound microscope in dark field. The anterior portion of the radula was pulled out through a short incision in the snout with sharpened forceps and tungsten needles. The radula was mounted on double sided carbon tabs, sputter coated with gold, and imaged in the SEM.

Abbreviation

FMNH: Field Museum of Natural History, Chicago, USA.

Taxonomy

Anatomidae McLean, 1989

Anatoma Woodward, 1859: 204.
Type species: *Scissurella crispata* Fleming, 1828: 385, pl. 6, fig. 3 (original designation).

Anatoma janetae new species

Figures 1–2.

Type material

Holotype. 2574 m, East Pacific Rise, North Pacific Ocean, DSV *Alvin* (Dive 3941), 12°42.702' N, 103° 54.452'W, 22 November 2003, manipulator arm grab, white biobox (FMNH 307218, broken shell on SEM stub[1], radula on stub; animal formalin fixed, stored in 75% ethanol).

Paratypes. 2606 m, Baby Bare Seamount, Cascadia Basin, USA, 47.710°N, 127.786°W (FMNH 282781, 1 shell only). 2567 m, East Pacific Rise, DSV *Alvin* (Dive 3925), 8° 37.101' N, 104° 12.168' W (FMNH 307212, 2 shells and animals, fixed and stored in 75% ethanol).

Etymology

Named for Janet Voight for providing the material along with other specimens used in ongoing work.

Description

Shell medium size (to 3.8 mm), trochiform biconical, shell very thin, fragile, white. Protoconch of 0.75 whorls, flocculent sculpture with spiral orientation, apparently no apertural varix, shape of apertural margin unknown. Teleoconch I of 0.66–0.75 whorls, with strong spiral cord in position of selenizone, approximately 32 distinct, raised axial cords forming nodules at intersection with axial cord;

---

[1] Although not ideal from a conservation point of view, the fragments have been retained on the stub, rather than risk breakage of the fragile pieces on removal.

interstices almost smooth with faint irregular growth lines, some indistinct crenulation. Teleoconch II of at least 2.25 whorls. Shoulder at start of selenizone with distinct, raised, axial cords, approximately 15 on first 0.5 teleoconch II whorl; axials becoming lower, less distinct, vanishing after 1.25 teleoconch II whorls. Spiral threads starting shortly after onset of selenizone, approximately 6 at 1 teleoconch II whorl, running over axials, not forming points or thickenings

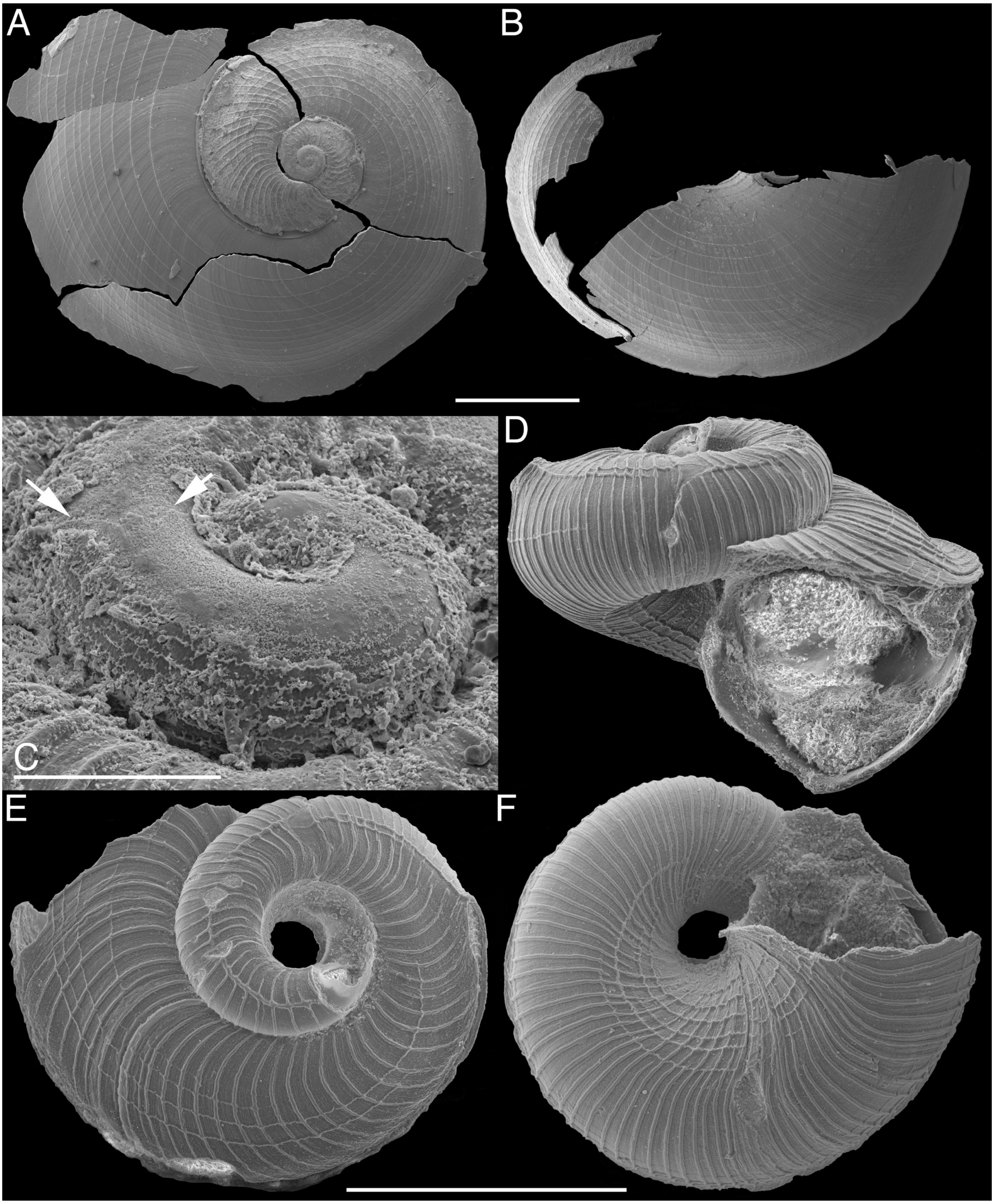

FIGURE 1. Shell of *Anatoma janetae* n. sp. **A–C**, fragmented holotype (FMNH 307218). Fragments aligned in Photoshop. The arrows highlight the end of the protoconch (C). Scale bar shell = 1 mm. Scale bar protoconch = 100 µm. D–F, paratype (FMNH 282781). Scale bar = 500 µm.

at intersections with axials; with disappearance of axials, spirals turning into low steps, somewhat irregularly spaced between selenizone and moderately impressed suture, approximately 12 at apertural margin. Interstices with finest axial growth lines. Base of early teleoconch with axials of similar strength, spacing as on shoulder, spirals starting adumbilically, increasing in number to 6 at 0.5 teleoconch II whorls; with onset of selenizone additional fine spiral thread starting below selenizone, increasing in number with growth; base of last whorl with approximately 20 irregularly spaced spiral steps, finest axial growth lines. Umbilicus open, moderately wide, continuously sloping with base; weak funiculus in paratype. Selenizone at periphery, keels moderately elevated, thin; slit open. Aperture rounded.

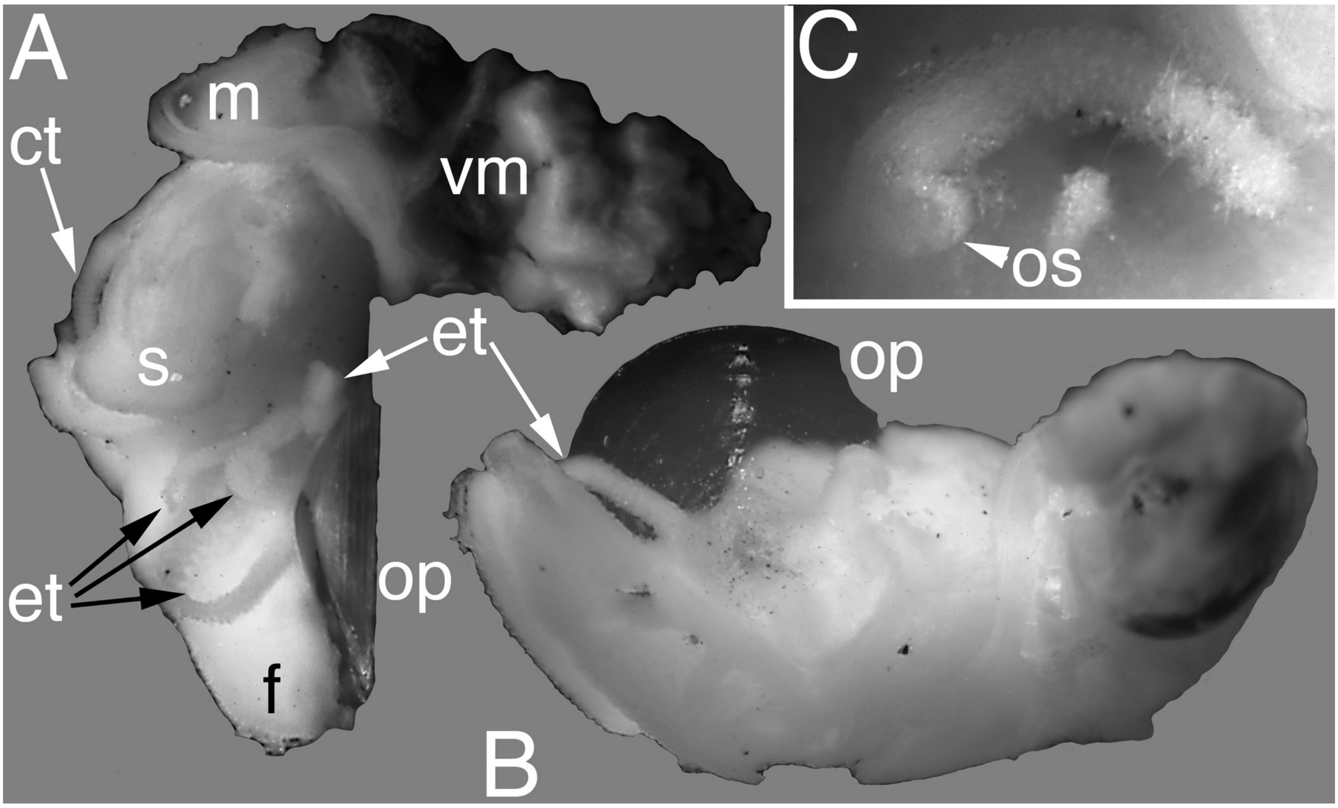

FIGURE 2. Animal of *Anatoma janetae* n. sp. **A**. Anterior view. **B**. Posterior view. C. Cephalic tentacle with optic stalk. Whole animal length = 3.2 mm. Abbreviations: ct—cephalic tentacle, et—epipodial tentacle, f. foot, m—mantle, op—operculum, os - optic stalk, s—snout, vm—visceral mass.

Cephalic tentacles papillate (Fig. 2C), at base with optic stalk, no pigment in usual region of eye (Fig. 2C). Four papillate epipodial tentacle on either side (Fig. 2A), no cephalic lappet (Fig. 2A).

Operculum thin, round, multispiral, with central nucleus, most likely covering aperture (Figs 2A-B).

Radula rhipidoglossate, n + 5 + 1 + 5 + n. Rachidian tooth trapezoid with serrated cusp, denticles parallel to row, central one largest, 2-3 on each side (Fig. 3A). Lateral teeth 1–4 similar, decreasing in size from lateral tooth 1 to 4, number of denticles decreasing from 3–4 to 2 on outer surface of cusp (Fig. 3A). Lateral tooth 5 elongated enlarged, cusp with strong median denticle, three inner denticles larger than 2–3 outer denticles (Figs 3A, C). Inner marginal teeth similar to lateral tooth 5, but two prominent outer denticles, two small inner denticles (Figs 3B–C); outer marginal teeth spoon shaped, with many denticles on either side (Figs 3B, D); outermost marginal teeth flattened, with approximately 25 denticles mainly on inner edge (Figs 3D–E); terminal marginal tooth without denticles (Figs 3D–E).

Differential diagnosis

Anatoma janetae is characterised by the marked switch in teleoconch sculpture from distinct raised axial cords to fine spiral steps. Some species have markedly different sculpture on shoulder and base [e.g., *Thieleella flemingi* Marshall, 2002; *T. gunteri* (Cotton and Godfrey, 1933)] and in many species select sculptural elements are added or fade out with growth, but a full switch is thus far not known from any other species.

Thieleella baxteri (McLean, 1984) from the northeastern Pacific has a globular shell with strong axial lamellae over the entire teleoconch, and the protoconch has reticulate sculpture. *Anatoma keenae* McLean, 1970 [= *A. epicharis* McLean, 1970] from the Panamic has distinct reticulation on shoulder and base of the entire teleoconch. *Anatoma lyra* (Berry, 1947) from the northeastern Pacific also has distinct reticulation on shoulder and base of entire teleoconch, and teleoconch I has 0.33–0.5 whorls. What has been called *Anatoma crispata* (Fleming, 1828) in the northeastern Pacific (e.g., McLean 1996) is certainly not that north Atlantic species as revealed (Geiger, pers. obs.) by topotypical material of *A. crispata*. Although the taxonomy of the northeastern Pacific species has not been adequately resolved due to missing type material of relevant taxa and because too many northeastern Pacific *Anatoma* specimens have been uncritically referred to the epithet *crispata*, *A. janetae* is clearly distinct. Specimens assigned to *A. crispata* all have various degrees of reticulation on shoulder and base of the mature teleoconch. *Anatoma sagamiana* (Okutani, 1964) and *A. soyae* (Habe, 1951), both from Japan, have fine reticulate sculpture over the entire shell. *Anatoma disciformis* (Golikov & Sirenko, 1980) from Moneron Island, Russia, is described as having little ornamentation similar to *A. janetae*. However, the holotype is 1.3 mm wide and in *A. janetae* at that size the raised axial cords are very distinct even under a stereomicroscope. *Anatoma obtusa* (Golikov & Gublin, 1978) has prominent reticulate sculpture over the entire shell.

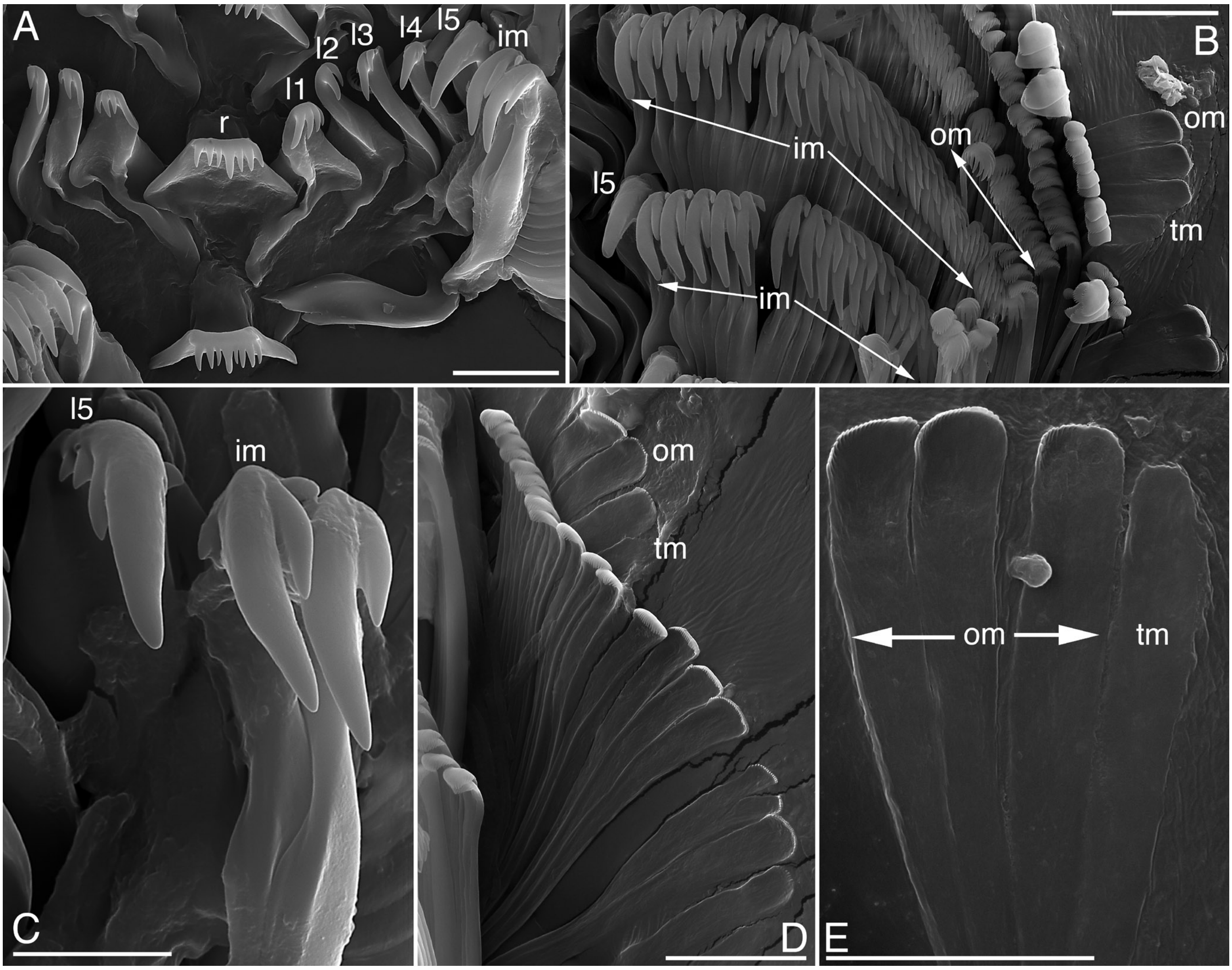

FIGURE 3. Radula of *Anatoma janetae* n. sp. **A**. Central field. **B**. Marginal teeth. **C**. Lateral tooth 5 and inner marginal teeth 1. **D**. Outer marginal teeth. **E**. Outer marginal teeth and terminal marginal tooth. Scale bars = 20 µm. Abbreviations: r—rachidian tooth, ln—lateral tooth number n, im—inner marginal teeth, om—outer marginal teeth, tm—terminal marginal tooth.

Remarks

All three known specimens are broken, with the holotype being close to mature, while one paratype consists of the early whorls only and is missing the protoconch, and the other paratypes have a broken aperture and strongly eroded protoconch and teleoconch. The four specimens are considered conspecific due to the very similar structure of the early teleoconch. Teleoconch I of the specimens differ slightly in whorl numbers (0.6 and 0.75), but intraspecific variation in the family is generally near 0.25 whorls (Geiger 2003); the observed difference of 0.15 whorls is unremarkable. The spacing of the fine axial lamellae, as well as the strength and number of the spiral threads are identical in all four specimens, as is the superimposition of axials and spirals. The protoconch of the holotype is mostly eroded, however sufficient ornamentation remains towards the suture to place it in *Anatoma*. To better show the remaining sculpture, the protoconch is illustrated not in the normal apical orientation but at an angle, and the end of the protoconch is highlighted with arrows (Fig. 1).

The marginal teeth of the *A. janetae* show unique characteristics. In all examined anatomid species [*A.*

crispata, *A. euglypta* (Pelseneer, 1903), *Anatoma* sp. South Africa, *A. regia* (Mestayer, 1916), *Thieleella* n. sp. deep Argentina, *T. baxteri*, *T. flemingi* Marshall, 2002, *T.* cf. *kelseyi* (Dall, 1905), *T. reticulata* Bandel, 1998], the marginal teeth have multiple small denticles on either side, while in *A. janetae* the two enlarged denticles on the outer edge are unique among anatomids as well as scissurellids s.s. The sample of taxa investigated is far from comprehensive due to the lack of live-collected material, hence the potential value of marginal tooth shape for phylogenetic analysis cannot be properly assessed at this time. However, it highlights the fact that examination of morphological character for each species in a group is necessary to ascertain the range of morphologies that have evolved. At present, this unique morphology of the marginal teeth does not justify a taxonomic separation. Unique radular morphologies have been recorded in other species within well-defined genera, e.g., the central tooth of *Haliotis elegans* Philippi, 1844 is approximately twice as wide as in any other *Haliotis* spp., while lateral tooth 1 of *H. roberti* McLean, 1970 is only about one third as wide as in any other abalone species (Geiger and Poppe 2000). Neither of these species have ever been placed in any other genus than *Haliotis* s.s.

Gut content was examined and photographed (not shown) from a small portion of the intestine. It consists of small angular particles of red-brown color. No recognisable biogenic pieces such as diatom frustules were found. It suggests that the animal is a deposit feeder.

Collection of the holotype and two paratypes with the animal inside at 2574 m and 2567 m depth, respectively, documents that the species lives in the area rather than having been transported from shallower depths. The absence of pigment in the area where the eyes are usually located is consistent with the species living below the photic zone. In many scissurellid and anatomid species, the eyes are easily identified by the dark pigment in the retina; the pigment is not affected by preservation. In species with distinct eyes, it is impossible to confirm the presence of the lens or to see the optic nerve by external examination; it can only be assessed through histology. The lack of pigment strongly suggests that the animal is functionally blind, although details of the reduction of the eye complex could not be determined. Geiger (2003) discussed whether the lack of eyes may be considered a further character supporting the anatomid *Thieleella*. However, *A. janetae*, and other deep-water species of *Anatoma* (Zelaya and Geiger unpublished data), also lack eyes, suggesting that their absence correlates with depth, and is not useful for classification.

Acknowledgments

Vyacheslav Palchevskiy (University of Southern California) kindly translated some Russian texts. Janet Voight (FMNH) commented on an early draft and made valuable suggestions. Bruce Marshall provided constructive criticism that helped to improve the manuscript. Collection of the specimens was supported by NSF grants DEB-0103690 and DEB-0072695 to J. R. Voight. The SEM investigation was supported by NSF MRI 0402726 to Henry Chaney, Michael Caterino and Daniel L. Geiger.

References cited

Bandel, K. (1998) Scissurellidae als Modell für die Variationsbreite einer natürlichen Einheit der Schlitzbandschnecken (Mollusca, Archaeogastropoda). *Mitteilungen des Geologisch-Paläontologischen Instituts der Universität Hamburg* 81, 1–120.

Geiger, D.L. (2003) Phylogenetic assessment of characters proposed for the generic classification of Recent Scissurellidae (Gastropoda: Vetigastropoda) with a description of one new genus and six new species from Easter Island and Australia. *Molluscan Research* 23, 21–83.

Geiger, D.L. (2006) Eight new species of Scissurellidae and Anatomidae (Mollusca: Gastropoda: Vetigastropoda) from around the world, with discussion of two new senior synonyms. *Zootaxa* 1128, 1–33.

Geiger, D.L. & Jansen. P. (2004a) Revision of the Australian species of Anatomidae (Gastropoda: Vetigastropoda). *Zootaxa* 435, 1–35.

Geiger, D.L. & Jansen, P. (2004b) New species of Australian Scissurellidae (Mollusca: Gastropoda: Vetigastropoda) with remarks on Australian and Indo-Malayan species. *Zootaxa* 714, 1–72.

Geiger, D.L. & Poppe, G.T. (2000) Haliotidae. *In*: G.T. Poppe & K. Groh (Eds.), *Conchological Iconography.* Conchbooks, Hackenheim, pp. 1–135, pls. 1–82.

Marshall, B.A. (2002) Some Recent scissurellids from the New Zealand region, and remarks on some scissurellid genus group names (Mollusca: Gastropoda). *Molluscan Research* 22, 165–181.

McLean, J.H. (1996) Gastropoda, the Prosobranchia. In: Scott, P.H., Blake, J.A. & Lissner, A.L. (Eds.), *Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel, vol. 9*. Santa Barbara Museum of Natural History, Santa Barbara, pp. i–v, 1–160.