

Revision of the Australian species of Anatomidae (Mollusca: Gastropoda: Vetigastropoda)

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Abstract

The Australian members of the vetigastropod family Anatomidae are revised and two new species are described. The family has thus far been treated as a subfamily of Scissurellidae, but recent molecular evidence (Geiger & Thacker, unpubl. data) indicates that Scissurellinae plus Anatominae

is not monophyletic, and full family rank is warranted for a group containing the genera *Anatoma* and *Thielella*. Seven species from Australia belonging in Anatomidae are discussed and illustrated by SEM: *Anatoma aupouria* (Powell, 1937) mainly from New Zealand, though with some Australian records; *A. australis* (Hedley, 1903), *A. funiculata* n. sp., *An turbinata* (A. Adams, 1862), which has been misidentified in the past as the South African *A. agulhasensis* (Thiele, 1925), *A. tobeyoides* n. sp., *Thielella equatoria* (Hedley, 1899) with a second known specimen, and *T. gunteri* (Cotton & Godfrey, 1933). Other species that have been (erroneously) indicated from Australia are discussed. A neotype is designated for *A. agulhasensis* from South Africa for taxon stabilization.

Key words: microgastropods, classification, nomenclature, South Pacific, tropical, temperate

Introduction

The higher classification of Vetigastropoda (“Archaeogastropoda” partim) is still in flux. Although some families are well-known and clearly diagnosed (Haliotidae, Pleurotomariidae, Peltospiridae, Neomphalidae), others are of uncertain membership and phylogenetic placement (Lepetodrilidae, Clypeosectidae, Trochoidea, Scissurellidae). Scissurellidae sensu lato occurs in all oceans, from the shallow intertidal to the abyss, including hydrothermal vents, and has been segregated into six subfamilies: Scissurellinae Gray, 1847, Anatominae McLean, 1989, Temnocinclinae McLean, 1989, Sutilizoninae McLean, 1989, Larocheinae Finlay, 1927, and Depressizoninae Geiger, 2003. Diagnoses for the subfamilies were recently provided (Geiger, 2003). The family is traditionally diagnosed by their minute size of 1–6 mm, a slit or foramen and associated selenizone found in the shell (missing in Larocheinae), and a rhipidoglossate radula with a serrated rachidian tooth. These characters have questionable value for diagnosing a clade. Size in itself is a poor character. The slit or foramen plus selenizone in the shell is a general character in many Recent Vetigastropoda (Pleurotomariidae, Clypeosectidae, Fissurellidae: Emarginulinae, Haliotidae), as well as in some extinct groups (e.g. Bellerophontoidea: McLean, 1984; Wagner, 2002). The serrated rachidian is common to all vetigastropods of small size, including juveniles of larger forms (Warén, 1990; Dinamani & McRae, 1986). It suggests a peramorphic alteration of the radula in large bodied forms, and consequently, the serrated rachidian in Scissurellidae sensu lato can be interpreted as a shared primitive condition in all vetigastropods. In summary, none of the suggested diagnostic characters are unique for the family.

The monophyly of the family is questionable, as pointed out by Warén & Bouchet (2001), who consider the vent subfamilies Temnocinclinae and Sutilizoninae more closely related to Lepetodrilidae. Schwarzpaul (2002), on the other hand, found Temnocinclinae and Sutilizoninae more closely related to Fissurelloidea (Fissurellidae and Clypeosectidae) than to Lepetodrilidae using morphological data on a larger array of hydrothermal vent “archaeogastropods”. Recent molecular data (Histone 3, partial Cytochrome oxidase sub-

unit I, partial 18S rRNA: ~ 2000 base pairs: Geiger & Thacker, 2003; unpublished data) representing most vetigastropod lineages suggest that Anatominae plus Scissurellinae are not monophyletic; Scissurellinae is the sister group to Lepetodrilidae plus Clypeosectidae in a crown clade with Haliotidae, whereas Anatominae is amongst the most basal Vetigastropoda including Pleurotomariidae. A more detailed account of vetigastropod phylogeny is beyond the scope of this contribution and will be presented elsewhere. Accordingly, it is proposed that Anatominae be elevated to family rank as Anatomidae; this terminology will be used in the treatment below. The family rank is justified given the placement of *Anatoma* in between groups generally accorded family rank (Peltospiridae plus Neomphalidae, Fissurellidae). Placement and affinity of other scissurellid subfamilies is currently uncertain; as they are not further discussed here, we abstain of changing ranks of those subfamilies.

Anatomidae contains two genera: *Anatoma* Woodward, 1859, and *Thieleella* Bandel, 1998; other genus-level taxa proposed in Anatomidae have been discussed by Geiger (2003). The family has at present 52 described species (Geiger, 2003: Appendix 1). *Anatoma* contains 31 species, and an additional four species can be assigned to *Thieleella*. These two genera are diagnosed by differences in protoconch sculpture. Protoconch sculpture is unknown for a further 17 species; without this information the species cannot be properly classified and are referred to as *Anatoma* s.l. Anatomidae contains many deep water species. The shallowest record is from 21 m water depth (*A. funiculata* n. sp.), and the deepest from 6 km (*A. s.l. josephinae*: Odhner, 1960); 33 species are encountered on the upper continental slope from 100 m to 1000 m, and three species are known from greater than 1000 m depth; no vertical distribution information is currently available for nine species. Species of Anatomidae in Australian waters were first reported by Hedley (1902). The species were recently reviewed by Jansen (1999), who recognized some undescribed species with informal names, yet no scanning electron microscope (SEM) illustrations of Australian species of Anatomidae have been published.

Here we present a more detailed analysis of Australian members of Anatomidae, including extensive documentation of shell morphology with SEM. We also provide indications as to the intraspecific variability by illustrating multiple specimens from throughout their ranges. This contribution is based primarily on the holdings of the Australian Museum, Sydney, and was supplemented with selected specimens from other collections. Table 1 summarizes the distinguishing characters of the Australian species of Anatomidae. Two parts of the postembryonic shell are distinguished: teleoconch I refers to the first growth phase lacking a selenizone, teleoconch II is used for the second growth phase from the first occurrence of the selenizone.

TABLE 1: Discriminating characters of Australian Anatomidae.

Species	Shell shape	Protoconch sculpture	Teleoconch I whorls	Spirals on teleoconch I	Funiculus
<i>A. australis</i>	globular	flocculant	0.75	present	absent
<i>A. aupaoria</i>	wide	flocculant	0.25	absent	present
<i>A. funiculata</i> n. sp.	square	flocculant	<0.5	absent	present
<i>A. tobeyoides</i> n. sp.	globular	flocculant	0.33	absent	absent
<i>A. turbinata</i>	high	flocculant	>0.5	present	absent
<i>T. gunteri</i>	globular	reticulate	0.75	present	absent
<i>T. equatoria</i>	square	reticulate	>0.5	absent	absent

Materials and Methods

All specimens were first inspected and identified using light microscopy. Suitable specimens for SEM were cleaned in a sonicator in a mild detergent solution. Specimens were mounted on double sided carbon adhesives or with colloidal graphite. Shells were attached at the periphery opposite the aperture. This placement permitted imaging of the apertural view as well as the apical (including protoconch) and basal views of every specimen using tilt and rotation of the stage. All images were captured as digital .tif files and processed in Photoshop (Adobe, 1998). File manipulation was restricted to removal of background, local contrast adjustment, and unsharp masking; images of shells were not “improved” or cleaned.

Distribution maps were generated from raw maps obtained from the Xerox-Parc site (now defunct, see Geiger, 1998 for details), on which distribution data were plotted using iMap (Schols & Dessein, 2001).

Abbreviations

- A. s.l. *Anatoma*, sensu lato
 OD Original designation.
 M Monotypy.
 SD Subsequent designation.
 GBR Great Barrier Reef, Australia.
 NT Northern Territory, Australia.
 QLD Queensland, Australia.
 NSW New South Wales, Australia.
 VIC Victoria, Australia.
 TAS Tasmania, Australia.

- SA South Australia, Australia
WA Western Australia, Australia.
AMS Australian Museum Sydney, New South Wales, Australia.
BMNH The Natural History Museum, London, Great Britain.
LACM Natural History Museum of Los Angeles County, Los Angeles, California, USA
NMSA Natal Museum, Pietermaritzburg, Republic of South Africa.
SAM South Australian Museum, South Australia, Australia.
ZMB Museum of Natural History, Humboldt University (formerly Zoological Museum Berlin), Germany.
ZMUC Zoological Museum, Copenhagen, Denmark.

Conventions used in synonymy

Genus species Author date: pagination, figures. Denotes the original description of the species considered valid.

Genus species: Author, date: pagination, figures. Denotes a genus and species name given to a specimen by that author. If the species epithet is not identical to the species discussed, then it is a misidentification by the author given after the colon.

+ *Genus species* Author, date: pagination, figures. Denotes a synonym of the species discussed.

not *Genus species*: Author, date, pagination, figures. Denotes a misuse of the species name discussed.

Systematics

Anatomidae McLean, 1989

A diagnosis of the family has recently been provided by Geiger (2003), including radular and limited anatomical data. McLean (1989) introduced the subfamily Anatominae for *Anatoma* and *Sukashitrochus*. As discussed in Geiger (2003), the placement of *Sukashitrochus* with *Anatoma* has been controversial. Recent molecular work (Geiger & Thacker, 2003, unpublished data) has confirmed Geiger's (2003) assessment that *Sukashitrochus* is closely related to *Scissurella* and hence belongs in Scissurellinae. It is interesting to note that the previous subfamilies of Scissurellidae sensu lato occur in distinct types of habitats: Scissurellinae in shallow water, Anatominae from the upper continental slope to deep sea, Temnocinclinae and Sutilizoninae at vents, and Larocheinae in shallow water and caves. *Anatoma* is only distantly related to Scissurellidae within Vetigastropoda and the subfamily is here elevated to full family rank. The authority of the family remains McLean, 1989, following the ICZN principle of coordination.

The family Anatomidae contains two genera: *Anatoma* Woodward, 1859, and *Thielella* Bandel, 1998. *Hainella* Bandel, 1998, and *Pagodella* Bandel, 1998 [*nomen nudum*] are synonyms as discussed in detail elsewhere (Geiger, 2003).

Anatoma Woodward, 1859

Anatoma Woodward, 1859: 204.

+ (objective) *Schizotrochus* Monterosato, 1877: 416. Type species: *Scissurella crispata* Fleming, 1828 (M).

+ *Hainella* Bandel, 1998: 36–37. Type species: *Scissurella euglypta* Pelseneer, 1903 (OD).

not *Anatomus* Montfort, 1810 (Annelida: Polychaeta: Serpulidae. See McLean, 1967; Herbert, 1986).

Type species. *Scissurella crispata* Fleming, 1828 (M).

Etymology. Derived from *Anatomus* Montfort “spelled properly” (Woodward, 1859: 204; OD). Woodward’s spelling correction related to the Adams & Adams (1853–1858) assignment of *Scissurella crispata* to Montfort’s genus *Anatomus*. Woodward noted that *Anatomus* referred to a serpulid polychaete, and that *Scissurella crispata* should be distinguished from other members of *Scissurella*: “If it should still be considered desirable to have a subgeneric name for *Scissurella crispata*, I have no objection to the adoption of *Anatoma*, provided it be spelled properly, and not attributed to Montfort.”

Description. Shell large (to 6 mm), trochiform. Spire prominent. Slit deep, open. Slit and selenizone at periphery or slightly above; keels usually prominent, at right angle to shell axis. Umbilicus open, often very constricted, no carina. Protoconch smooth or with flocculent sculpture, varix absent or faint, not forming bridge to nucleus of embryonic shell. Operculum multispiral with central nucleus, corneous, thin. Radula n-5-R-5-n, fifth lateral little to strongly elongated, but not broadened.

Differential diagnosis. *Thielella* has a protoconch with sculpture of honeycomb pattern, whereas the protoconch of *Anatoma* is either smooth or has flocculent ornamentation. It is virtually impossible to distinguish members of these two genera under the light microscope.

***Anatoma agulhasensis* (Thiele, 1925)**

Scissurella agulhasensis Thiele, 1925: 41(7)–42(8), pl. 13, fig. 2.

Scissurella agulhasensis: Barnard, 1963: 301–302.

Scissurella agulhasensis: Kensley, 1973: 28, fig. 27.

Anatoma agulhasensis: Herbert, 1986: 611–613, figs. 3, 11–14.

not *Anatoma agulhasensis*: Bandel, 1998: 34–35, pl. 11, figs 4–6 [is *A. turbinata*].

not *Anatoma agulhasensis*: Jansen, 1999: 48, figs 1–3 [is *A. turbinata*].

Type material: SYNTYPES, 3 (ZMB uncatalogued, destroyed by Byne’s disease or glass disease: note Kiliias, 1973; Geiger, pers. obs. 2002). NEOTYPE (NMSA W181/T1916, separated from NMSA C7967, here designated: Herbert, 1986: figs. 12, 14), of Mtamvuna River, Transkei, 120–140 m, specimen collected alive.

Type locality. (35°16’S 22°26.7’E), 155 m (OD); off Mossel Bay [, South Africa] (Herbert, 1986).

Etymology. Agulhas- referring to the Agulhas Stream around South Africa, -ensis indicating a locality: from the Agulhas Stream region (OD).

Description. As the species is not part of the Australian fauna (see Remarks) we refer to the detailed discussion by Herbert (1986).

Remarks. *Anatoma agulhasensis* has been reported from the Australian fauna (Bandel, 1998; Jansen, 1999). Those specimens, however, represent misidentified *A. turbinata* (A. Adams, 1862), and are discussed under the latter species.

We designate here a neotype for *A. agulhasensis* in order to fix taxon identity. In lieu of selecting a topotype, we have selected the specimen illustrated in the revision of the South African Scissurellidae by Herbert (1986). Note that the illustrations of *A. agulhasensis* of Herbert (1986) were obtained from two different specimens: figs. 12 and 14 from the specimen here designated as the neotype (NMSA W181/T1916), figs. 3, 11, and 13, from a second specimen in the same lot (NMSA C7967) containing a total of 14 specimens, including the neotype. The neotype is catalogued under its original genus *Scissurella*.

***Anatoma aupouria* (Powell, 1937): Figures 1–2**

Schizotrochus aupouria Powell, 1937: 176, pl. 49, fig. 3.

Anatoma aupouria: Powell, 1979: 35–36, pl. 4, fig. 2.

Type material. HOLOTYPE (BMNH 1962952: A. Campbell, pers. comm.), 1.25 x 0.9 mm (W x H).

Type locality. Off Three King Islands [, New Zealand], St. 933, 260 m (OD).

Etymology. Aupouri: Referring to a northern Maori tribe in New Zealand (Bruce Marshall, pers. comm.).

Description. Shell medium size (to 1.25 mm), somewhat turreted. Protoconch 3/4 whorls, with flocculant sculpture, no varix. Teleoconch I of 1/4 whorl, approximately 7 axials. Teleoconch II more than 1.5 whorls. Shoulder with many fine axials; axials variably internested, producing complex patterns. Axials intersected with approximately 6–8 spirals in central third of shoulder. Base with similarly complex pattern of axials and finer spirals. Underside of keel typically with supernumerary fine axials. Umbilicus open, deep, continuously sloping from base, with funiculus. Selenizone at periphery, keels strong, with strong growth increments. Margins of slit somewhat converging towards aperture. Aperture subquadratic, somewhat flared, particularly towards umbilicus where apertural margin fuses with funiculus. Animal unknown.

Differential diagnosis. *Thielella equatoria*, from Tonga and Christmas Island, shares the dense axial sculpture, but has a protoconch with reticulate sculpture, is more globular in general outline, and lacks the funiculus in the umbilicus. *Anatoma turbinata*, ranging from Japan to Australia, is much more turreted, has a proportionally smaller aperture, and lacks a funiculus in the umbilicus.

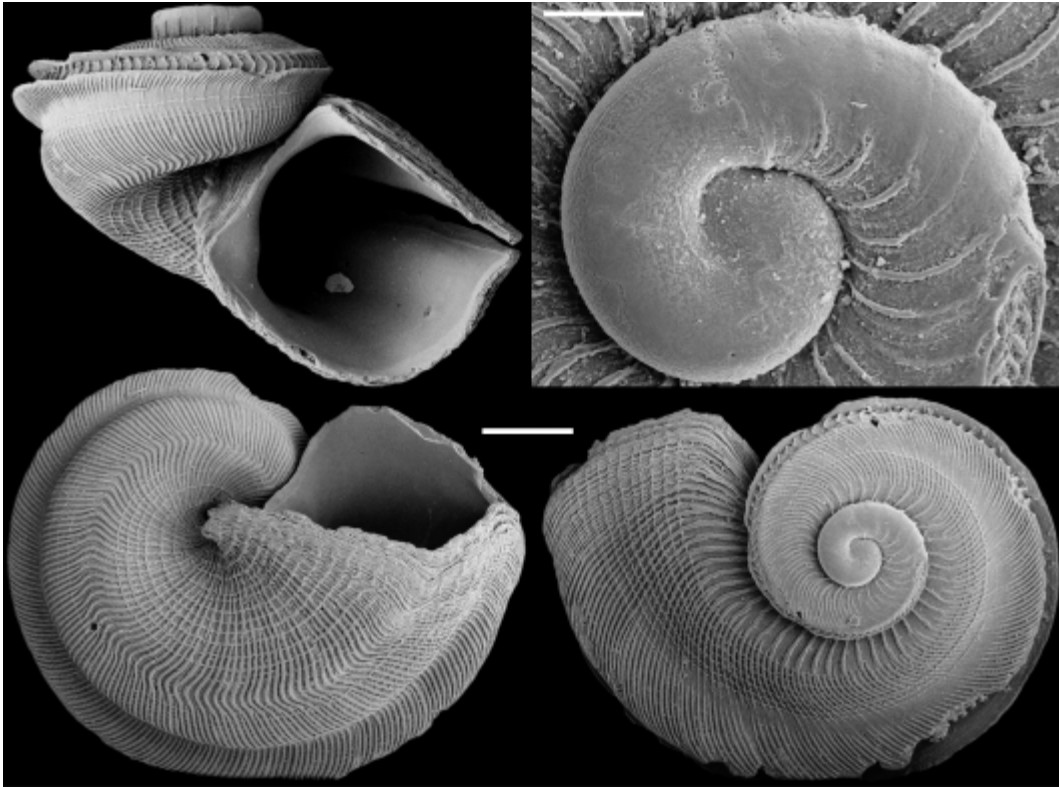


FIGURE 1. *Anatoma aupouria*. AMS C.402696. 805 m, N of Three Kings Islands, New Zealand. Scale bar shell = 200 μ m. Specimen identified by Bruce Marshall. Scale bar protoconch = 50 μ m.

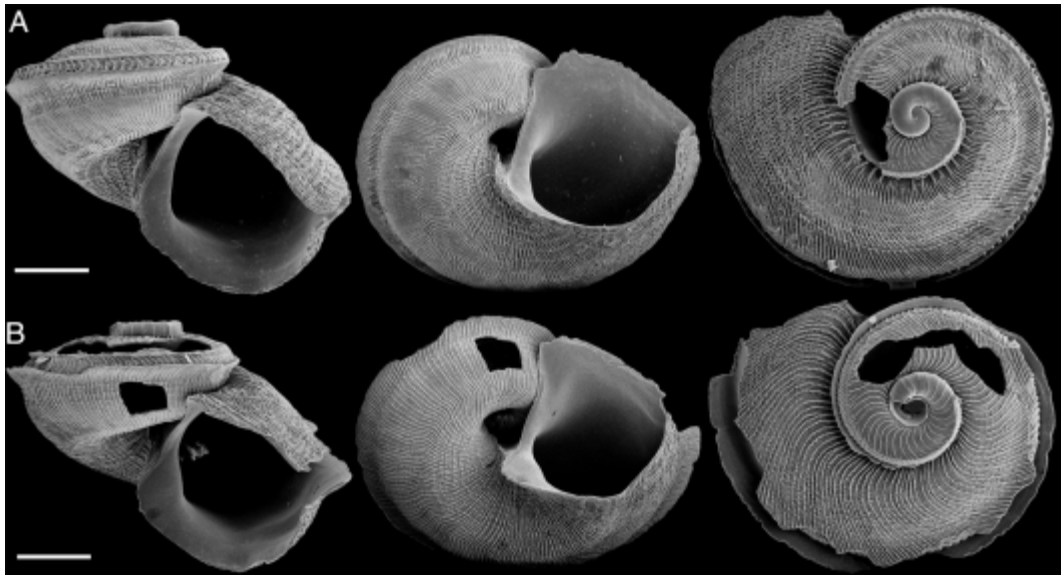


FIGURE 2. *Anatoma aupouria*. A. AMS C.378320. 31 m, off Duncombe Bay, Norfolk Island. B. AMS C.404151. 44 m, Lord Howe Rise, Lord Howe Island. Scale bars shell = 200 μ m.

Distribution: New Zealand, Lord Howe Island, and Norfolk Island, 31–805 m (shells only).

Specimen records.

Norfolk Island. 31 m, off Duncombe Bay, 29°S, 167.933°E (AMS C.378320, 1).

New Zealand. 805 m, N of Three Kings Islands, 34°S, 171.917°E (AMS C.402696, 1).

Australia. 44 m, Lord Howe Rise, Lord Howe Island, 31.637°S, 159.06°E (AMS C.404151, 1).

Remarks. The drawings of Powell (1937, 1979) show discrete spiral keels on the base, none of which are apparent on the shell; only excessive artistic license can explain the discrepancy. Most records of the species are from New Zealand, with only a few specimens have been recorded from Australian waters. Additional specimens and locality records are in the Museum of New Zealand, Te Papa Tongarewa, Wellington.

***Anatoma australis* (Hedley, 1903): Figures 3–5, 18**

Scissurella australis Hedley, 1903: 329–330, fig. 63.

Scissurella australis: Hedley, 1907: 288.

Scissurella australis: Verco, 1910: 115.

Scissurella australis: Thiele, 1912: 19, pl. 3, fig. 1 [copy of figure in Hedley, 1903].

Schizotrochus australis: Cotton & Godfrey, 1933: 22–23, pl. 1, fig. 10.

Schizotrochus australis: Iredale & McMichael, 1962: 30.

Schizotrochus australis: Macpherson & Gabriel, 1962: 34.

Scissurella (Anatoma) australis: Wilson, 1993: 46.

Anatoma australis: Jansen, 1995, 11.

Anatoma australis: Hickman, 1998: fig. 15.52 A–B.

Anatoma australis: Jansen, 1999: 48, figs. 4–6.

Anatoma “SWA”: Jansen, 1999: 50, figs. 16–18.

Type material. HOLOTYPE (AMS C.16223), 3 x 2.5 mm (W x H). PARATYPES: 3 (AMS C.170412).

Type locality. [5–8 mls.] off Port Kembla, [NSW,] 63–75 fms. [= 115–137 m; 34.465°S, 151.075°E] (OD).

Etymology. Most likely referring to the occurrence in the southern hemisphere.

Description. Shell globular, medium size to large (3.6 mm). Protoconch 3/4 whorls, with flocculant sculpture, varix present, varix not connected to embryonic cap. Teleoconch I with spiral cord in area of selenizone, often with additional spiral cords, but no centrifugal cords, more than 0.5 whorls. Teleoconch II with up to 2.5 whorls. Sculpture on shoulder consisting of 1–4 spirals at the start of teleoconch II, approximately 12 spirals at aperture of fully grown specimens (2.5 mm), spirals on early part of teleoconch II much weaker than axials, at aperture at most as strong as axials; approximately 70–75 axials on shoulder and base of body whorl in fully grown shell. Base with approximately a dozen spiral cords. Spirals on base as strong as axials; spirals running over axials forming weak

nodule. Umbilicus sloping continuously from base, narrow, deep. Selenizone at periphery, keels distinct, growth lines in selenizone not coordinated with axials; margins of slit converging towards apertural margin of shell. Aperture rounded, somewhat flared. Operculum multispiral, nucleus central, corneus, thin. Animal unknown.

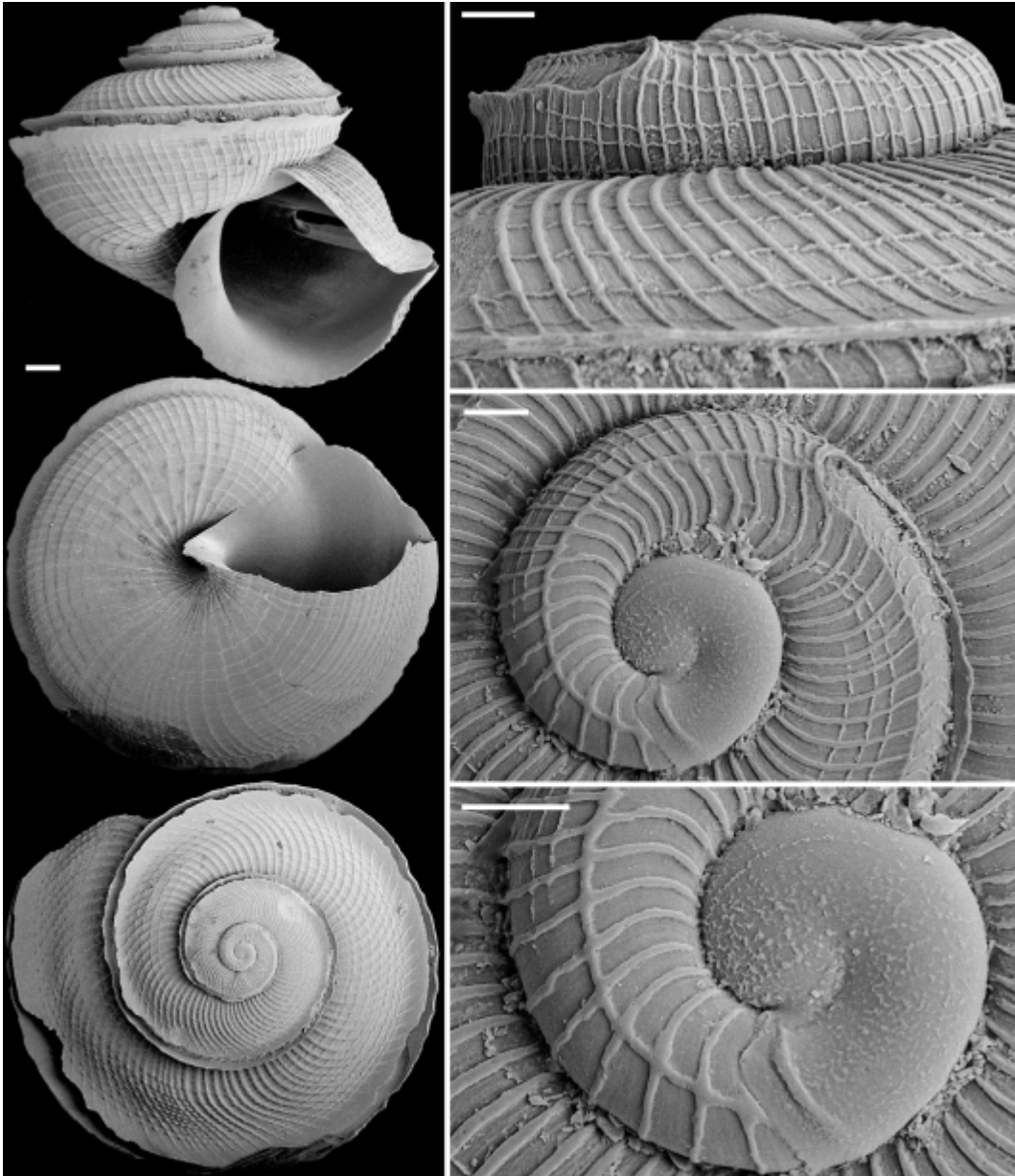


FIGURE 3. *Anatoma australis*. AMS C.400817. Capricorn Channel, 16.8 miles NE of North Reef, QLD, Australia. Scale bar shell = 200 µm. Scale bars spire and protoconch = 50 µm.

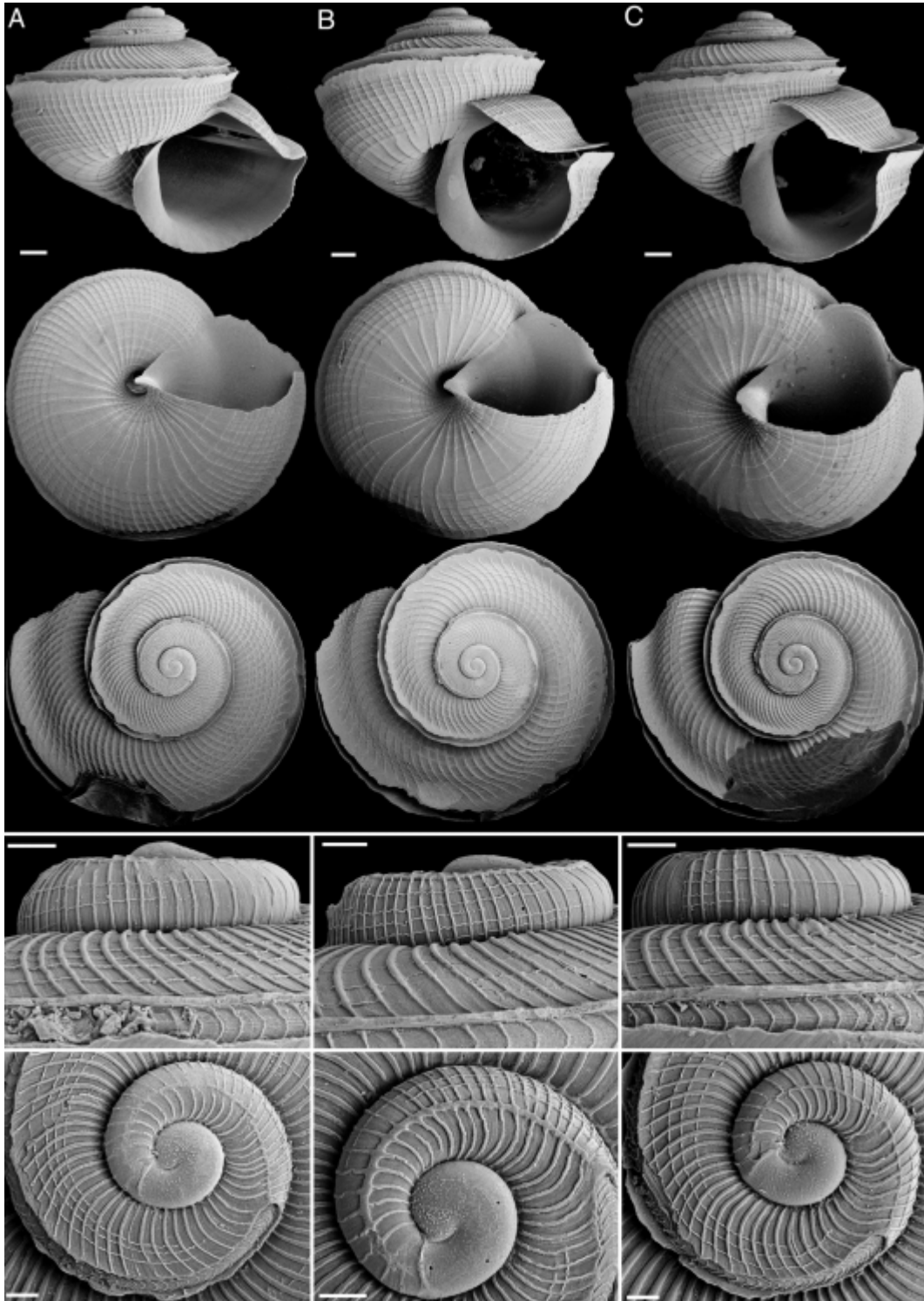


FIGURE 4. *Anatoma australis*. A. AMS C.400817. Capricorn Channel, 16.8 miles NE of North Reef, QLD, Australia. Second specimen from lot, see Figure 3. B. AMS C.400805. E of Caloundra, QLD, Australia. C. AMS C.400811. Capricorn Channel, E of Lady Musgrave Island, QLD, Australia. Scale bars shell = 200 μ m. Scale bars spire and protoconch = 50 μ m.

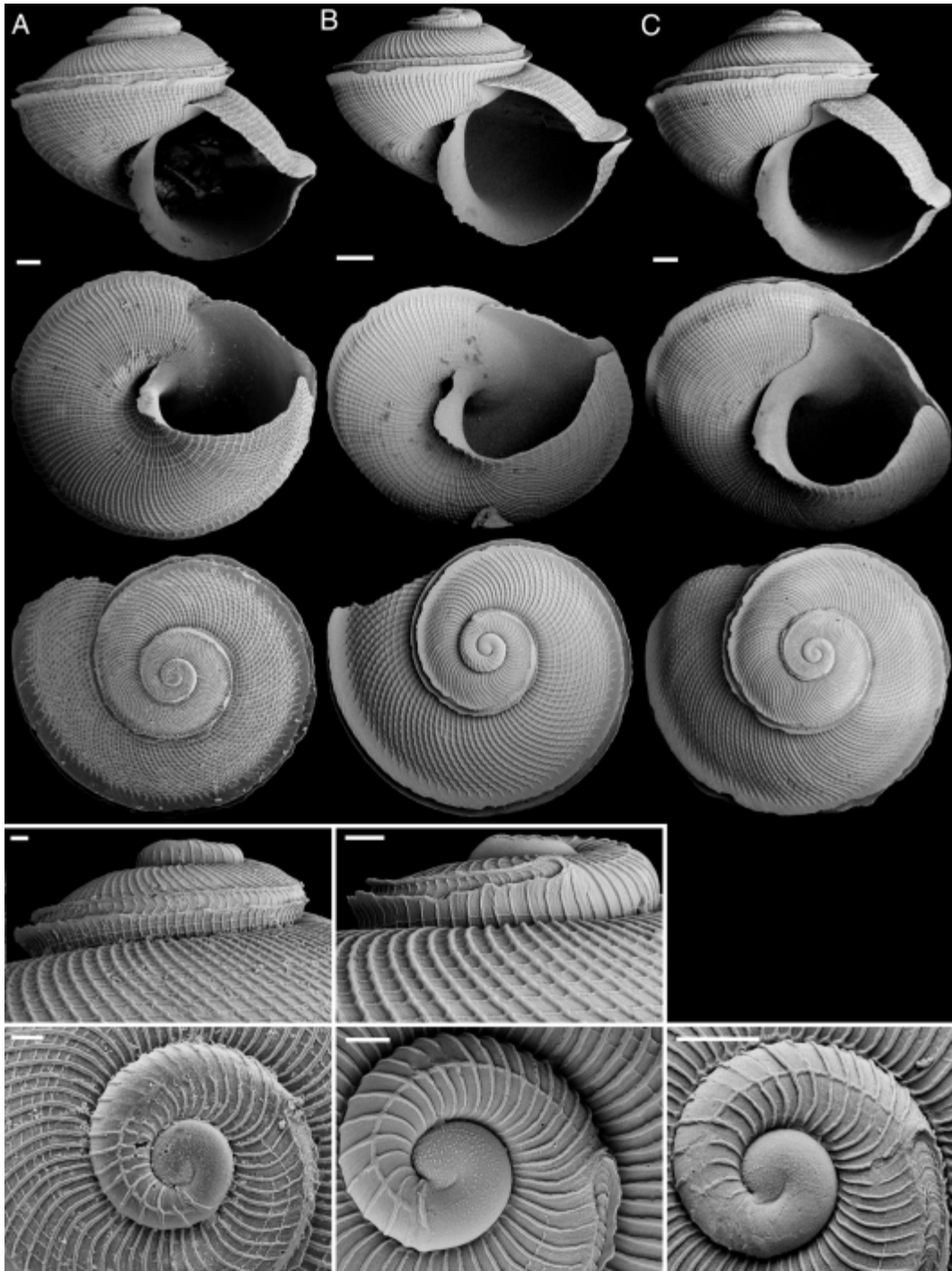


FIGURE 5. *Anatoma australis*. A. AMS C.402717. 238 m, SW of Cape Naturaliste, WA, Australia. B. AMS C.402720. 274 m, NW of Beagle Island, WA, Australia. C. AMS C.402721. 197 m, NW of Green Head, WA, Australia. Scale bars shell = 200 μm . Scale bars spire and protoconch = 50 μm .

Differential diagnosis. *Anatoma tobeyoides* n. sp. lacks the protoconch varix, on teleoconch I of fewer than 0.5 whorls, lacks a spiral cord in area of selenizone, and has fine centrifugal lines, but no true spiral sculpture.

Distribution. WA (Cape Naturaliste: 33.8°S to 11.5°S), NSW (Port Kembla: 34.5°S) and QLD (Swain's Reef: 22.5°S), 27–1,463 m depth shells only, 176 m live.

Specimen Records.

QLD. 201 m, off S end Fraser Island, 27.952S, 153.851E (AMS C.400802, 3). 128 m, off Cape Moreton, 27S, 153.583E (AMS C.400806, 17). 115 m, NE of Cape Moreton light, 26.925S, 153.558E (AMS C.400807, 17; AMS C.400810, 3). 183 m, NNE of Cape Moreton, 26.875S, 153.6E (AMS C.400809, 20+). 128 m, E of Caloundra, 26.8S, 153.583E (AMS C.400805, 20+). 200 m, off Maroochydore, 26.687S, 153.64E (AMS C.400808, 9). 128 m, ESE of Noosa Heads, 26.567S, 153.667E (AMS C.400804, 18). 210 m, off Fraser Island, 24.965S, 153.622E (AMS C.400818, 6). 150 m, NE of Lady Elliot Island, 24.062S, 152.823E (AMS C.400813, 4). 175 m, E of Lady Musgrave Island, 23.853S, 152.575E (AMS C.400814, 20+). 132 m, Capricorn Channel, E of Lady Musgrave Island, 23.835S, 152.535E (AMS C.400811, 21). 284 m, Capricorn Channel, E of North West Island, 23.253S, 152.402E (AMS C.400816, 4). 155 m, Capricorn Channel, 23.143S, 152.277E (AMS C.400815, 12). 115 m, Capricorn Channel, 16.8 ml NE of North Reef, 23.14S, 152.205E (AMS C.400817, 20+). 78 m, SE of Swain Reefs, 22.518S, 152.71E (AMS C.400812, 3). 187 m, SE of Swain Reefs, 22.438S, 153.285E (AMS C.400803, 20+).

NSW. 115 m, 5–8 mls off Port Kembla, 34.465S, 151.075E (AMS C.16223, 1; AMS C.170412, 3). 183 m, 16 mls E of Wollongong, 34.417S, 151.25E (AMS C.17988, 3). 161 m, off Port Kembla, 34.333S, 151.3E (AMS C.400796, 1). 205 m, S of Port Hacking, 34.16S, 151.438E (AMS C.346346, 1). 750 m, off Sydney, 34.083S, 151.727E (AMS C.402694, 11). 79 m, off Sydney, 34.05S, 151.617E (AMS C.400793, 3; C.402613, 1). 150 m, Off Sydney, 33.967S, 151.483E (AMS C.400792, 14). 200 m, off Sydney, 33.872S, 151.667E (AMS C.400798, 8). 1463 m, 35 mls E of Sydney, 33.85S, 151.967E (AMS C.26669, 4). 109 m, off Port Jackson, 33.833S, 151.45E (AMS C.400801, 1). 176 m, off Sydney, 33.767S, 151.717E (AMS C.400791, 20+, 2: complete). 174 m, off Sydney, 33.717S, 151.767E (AMS C.400794, 1). 143 m, off Broken Bay, 33.717S, 151.667E (AMS C.400795, 2; C.400797, 2). 146 m, 22 mls E of Narrabeen, N of Sydney, 33.7S, 151.717E (AMS C.25803, 11). 132 m, off Norah Head, 33.333S, 151.933E (AMS C.400799, 1). 183 m, NE of Port Macquarie, 31.383S, 153.2E (AMS C.37724, 2). 185 m, 24 km E of Ballina, 28.827S, 153.855E (AMS C.400800, 9).

TAS. 113 m, N of Great Oyster Bay, 41.758S, 148.517E (LACM 73–156, 2).

WA. 27 m, Sahul Banks, Timor Sea, 11.5S, 125.5E (AMS 377600, 1). Point Quobba, N of Carnarvon, 24.483S, 113.417E (AMS 379976, 1). 108 m, off North West Cape, 22.705S, 113.54E (AMS 402644, 1; AMS 402645, 1). 238 m, North West Shelf, ca 230ml W Roebuck Bay, 18.5S, 118.05E (AMS 402676, 1). 238 m, SW of Cape Naturaliste,

33.742S, 114.435E (AMS 402717, 8). 256 m, NW of Cervantes, 30.5S, 114.633E (AMS 402718, 10). 155 m, NW of Bunbury, 33.25S, 114.617E (AMS 402719, 1). 274 m, NW of Beagle Is, 29.717S, 114.283E (AMS 402720, 7). 197 m, NW of Green Head, 29.967S, 114.45E (AMS 402721, 1). 176 m, W of Garden Is, 32.262S, 115.112E (AMS 402741, 1). 146 m, W of Dongara, 29.35S, 114.117E (AMS 402742, 1). 183 m, W of Dongara, 29.142S, 113.913E (AMS 402743, 1). 219 m, W.of Dongara, 29.183S, 113.9E (AMS 402744, 1). 223 m, off Jurien Bay, 30.133S, 114.5E (AMS 402745, 1). 183 m, NW of Beagle Is, 29.725S, 114.333E (AMS 402746, 1). 200 m, NW of Bunbury, 33S, 114.617E (AMS 402747, 6). 237 m, W of Green Head, 30.75S, 114.767E (AMS 402748, 1). 160 m, off Rottneest Is, 31.65S, 115.08E (AMS 402749, 1). 732 m, W of Rottneest Is, 31.083S, 114.767E (AMS 402751, 1). 210 m, W of Garden Is, 32.25S, 115.117E (AMS 402750, 2). 238 m, off Cervantes Is, 30.533S, 114.683E (AMS 402752, 2).

Literature record. Off Wilson's Promotory (Macpherson & Gabriel, 1962).

Remarks. Jansen (1999) separated the Western Australian specimens of *A. australis* under the informal name *A. SWA*. SEM did not reveal any consistent differences between east and west coast specimens, hence, we reunite the Western Australian specimens under *A. australis*.

Anatoma crispata (Fleming, 1828): Figure 6

Remarks. *Anatoma crispata* described from Europe is a species that is listed from virtually the entire globe. It is likely that the use of this species name has been overly extended (Herbert, 1986: 616). A possible Australian listing was given by Hedley (1902) from Challenger Station 164b off Sydney. Hedley (1902) discussed the problematic locality data associated with the lot and concluded that this specimen is actually from Challenger Station 64, a mid North Atlantic station. The remarks by Hedley (1902) were repeated by Herbert (1986). Iredale & McMichael (1962: 4) cast further doubt unto the Australian origin of that sample. Both *A. australis* and *A. crispata* are variable in shell morphology and have some overlapping morphological characters, although the disjunct geographic distribution suggests that both are distinct species. The Challenger specimen (BMNH 89.10.26.33) was investigated by SEM and has morphological characters that apply to both species, hence, can not be positively identified as either of the species (Fig. 6). Hedley (1903) did not refer to this specimen in his description of *A. australis*, the holotype of which is at AMS.

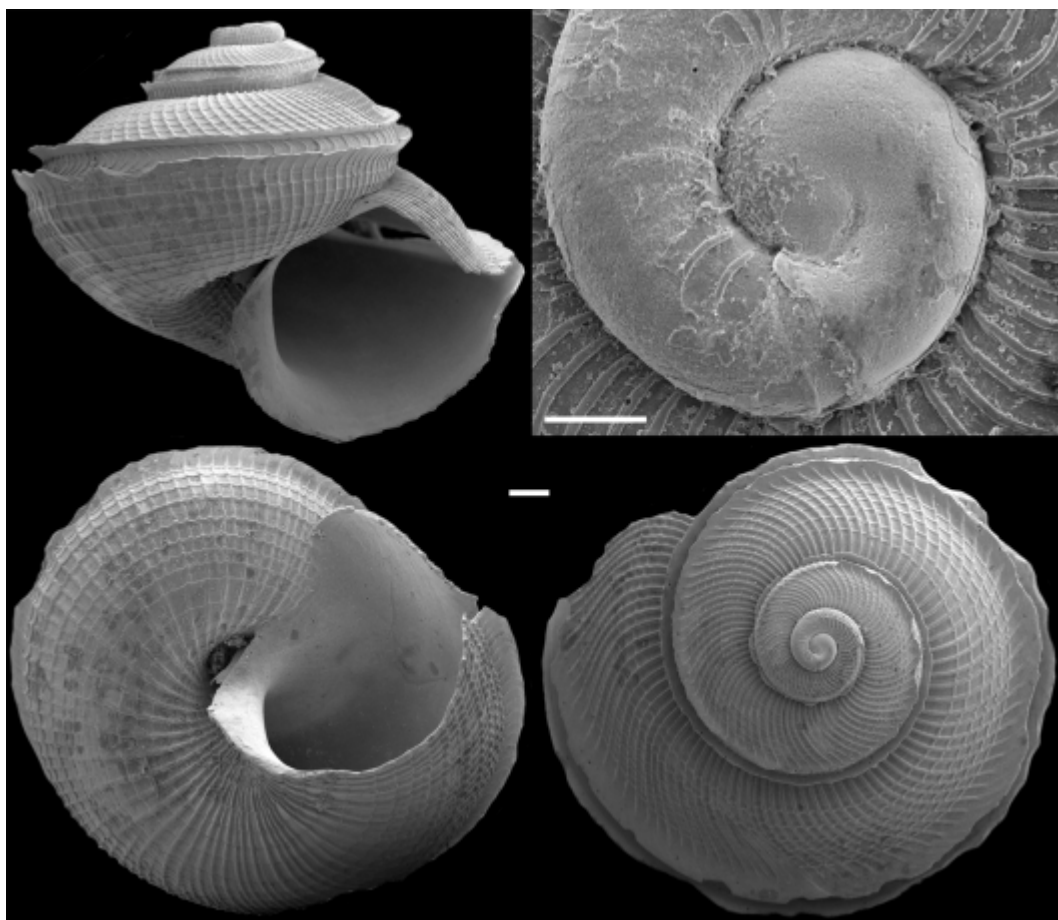


FIGURE 6. *Anatoma crispata/australis*. BMNH 89.10.26.33 from Challenger station 164b/64; see under *A. crispata* for discussion of provenance and identity of specimen. Scale bar shell = 200 µm. Scale bar protoconch = 50 µm.

***Anatoma funiculata* new species: Figures 7–8, 18**

Type material. HOLOTYPE (AMS C.403660). PARATYPES (AMS C.205271 [ex AMS C.403660], 1. AMS C.402656, 1).

Type locality. 21 m, SW side Euston Reef, GBR, QLD, Australia, 16.667°S, 146.217°E.

Etymology. Funiculus, Latin: strand of material, referring to the thick spiral cord in the umbilicus.

Description: Shell globular, small to medium size (to 1.28 mm width: holotype). Protoconch 3/4 whorl, with flocculant sculpture, one or two faint spiral streaks, no varix. Teleoconch I 1/3 whorl, 8 axials, no spirals, interaxials smooth. Teleoconch II up to two whorls (holotype), axials 75 on body whorl of holotype; shoulder with 7 spirals, base with

15 spirals, both forming points at intersection with axials. Umbilicus open, deep, sloping continuously from base; funiculus in umbilicus fusing with apertural margin. Selenizone at periphery, keels distinct. Slit parallel, open anteriorly. Aperture rounded, somewhat flared, with shelf towards umbilicus fusing with umbilical funiculus. Animal unknown.

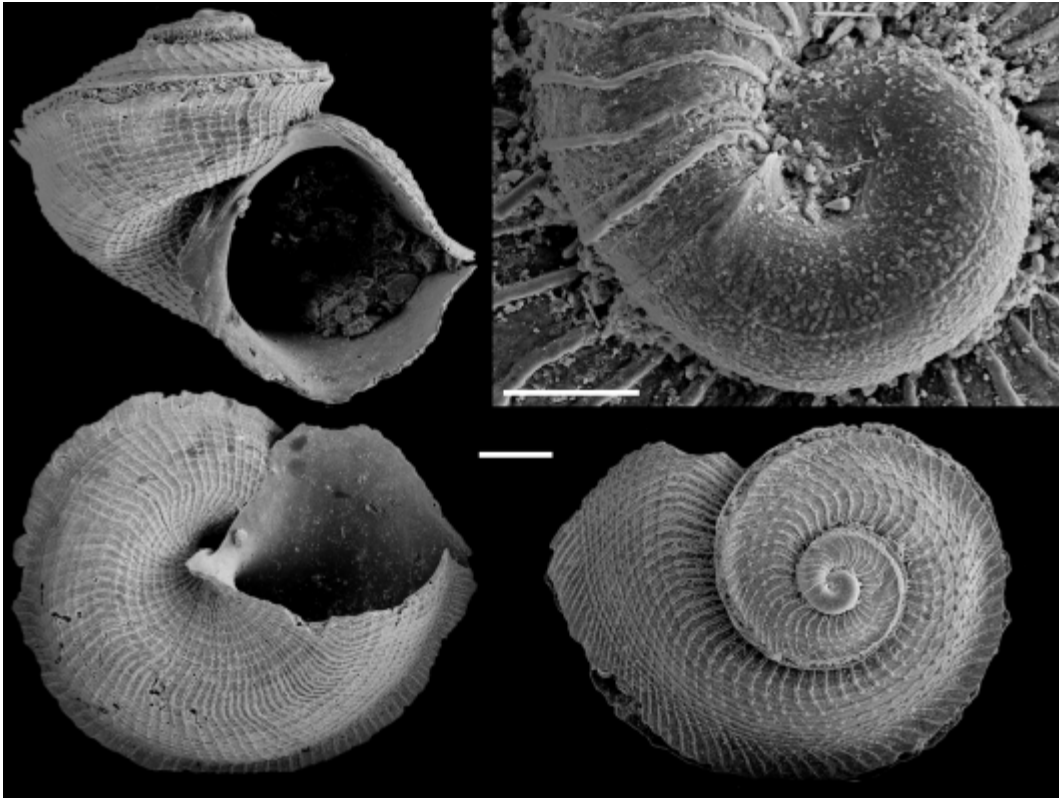
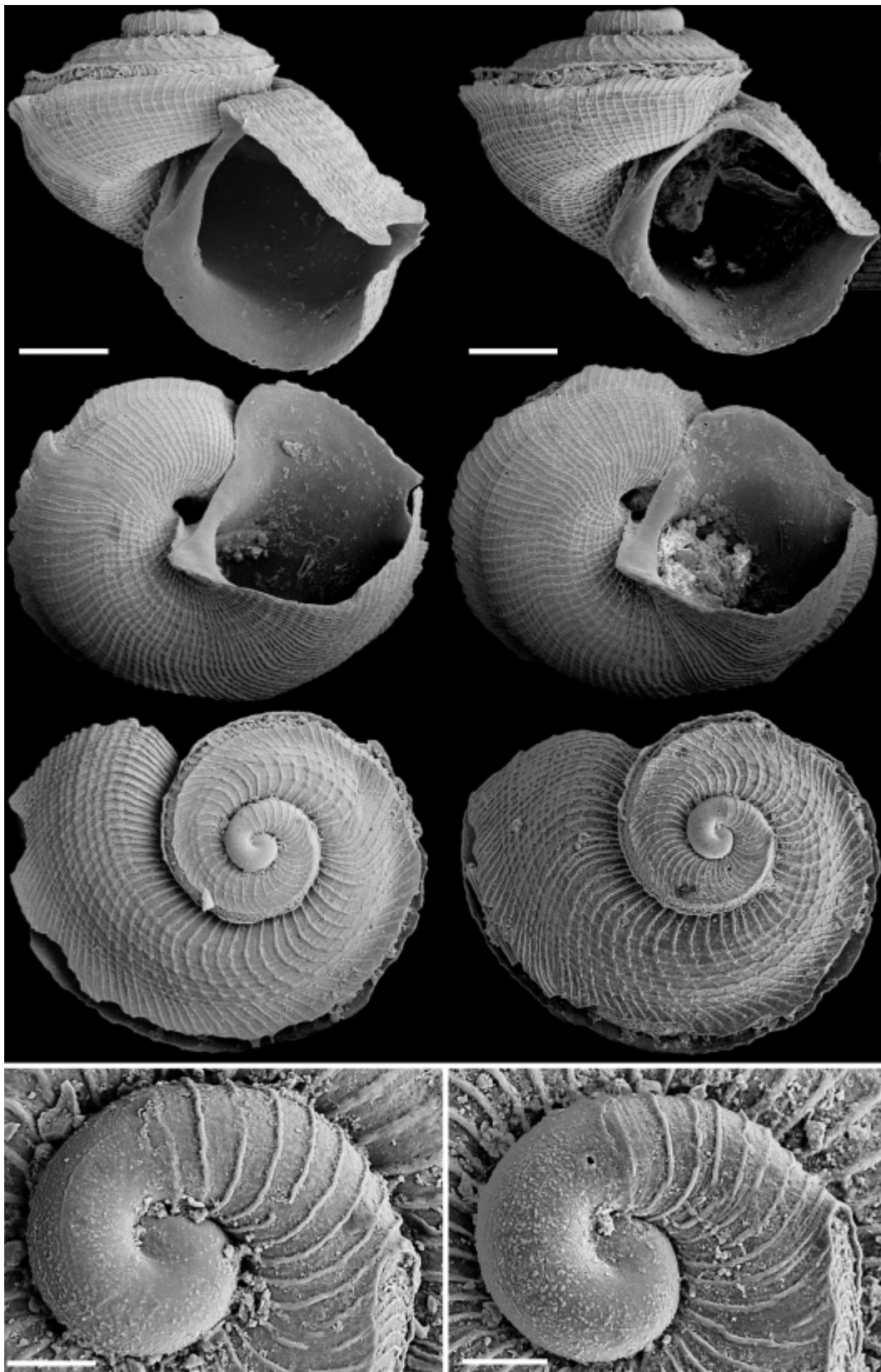


FIGURE 7. *Anatoma funiculata* n. sp. Holotype AMS C.403660. 21 m, SW side Euston Reef, GBR, QLD, Australia. Scale bar shell = 200 μ m. Scale bar protoconch = 50 μ m.

FIGURE 8. *Anatoma funiculata* n. sp. Paratypes. Left: AMS C.402656. 27 m, N end Carter Reef, GBR, QLD, Australia. Right: AMS C.403660. 21 m, SW side Euston Reef, GBR, QLD, Australia. Scale bar shell = 200 μ m. Scale bar protoconch = 50 μ m.



Differential diagnosis. *Thielella equatoria* is similar in overall shape and sculpture, however, *T. equatoria* has a protoconch with reticulate sculpture, teleoconch I of more than 0.5 whorls, a wider umbilicus, and more numerous and stronger axials. *Anatoma australis* is more globular in overall shape, has a teleoconch I of more than 0.5 whorls and with spiral sculpture, and lacks the funicular strand in the umbilicus. *Anatoma tobeyoides* n. sp. is more globular in outline, has the irregular centrifugal markings on teleoconch I, less pronounced keels on the selenizone, and lacks the funicular strand in the umbilicus. *Anatoma aypouria* is wider in overall outline of the shell, has more numerous spirals on the shoulder, more axials on the base, the base axials showing the characteristic opisthoclinal loops/embayments. *Anatoma turbinata* is much more high-spined, has a teleoconch I of more than 0.5 whorls with spiral sculpture, and lacks the funicular strand in the umbilicus.

Distribution. Only known from the type locality (GBR, QLD, Australia).

Specimen records. 27 m, N end Carter Reef, GBR, QLD, Australia, 14.55°S, 145.6°E (AMS C.402656: paratype).

***Anatoma turbinata* (A. Adams, 1862): Figures 9–10, 18**

Anatomus turbinata A. Adams, 1862: 347, not illustrated.

Scissurella turbinata: Crosse, 1863: 109.

Anatomus turbinatus: Pilsbry, 1890: 59.

Scissurella turbinata: Thiele, 1912: 15, pl. 2, figs. 9–10 [after a specimen in the British Museum: type?].

Schizotrochus turbinatus: Habe, 1951: 68, pl. 11, figs. 12–13.

Anatoma turbinata: Habe & Kosuge, 1964: 4.

Anatoma turbinata: Yu & Feng, 1996: pl. 1, figs 1–4.

Anatoma turbinata: Okutani & Hasegawa, 2000: 37, fig. 5.

Anatoma turbinata: Higo et al., 2001: G82 [holotype].

Anatoma agulhasensis: Bandel, 1998: 34–35, pl. 11, figs. 4–6. [misidentification]

Anatoma agulhasensis: Jansen, 1999: 48, figs 1–3. [misidentification]

not *Scissurella turbinata*: Yokoyama, 19??: Moll. Coral-Bed: 35–36, pl. 5, fig. 21 [is *Sci. staminea*.
Fide Oyama, 1973: 10).

? *Anatoma jacksoni*: Bandel, 1998: 33–34, pl. 11, fig. 1. [most likely a finer sculptured *A. turbinata*].

Type material. HOLOTYPE (BMNH 1874.5.19.62. Higo et al., 2001: G82), 2.5 mm.

Type locality. Mino-sima, [Japan] 63 fms. [= 115 m] (OD).

Etymology. Turbinatus: Latin adjective: that which whirls; whirlwind, tornado; spinning top; spiral. Referring to the high spired shell shape.

Description. Shell turreted, medium size (2.4 mm), as high as wide, or wider. Protoconch of 3/4 whorls, flocculant sculpture, varix present, not connecting to embryonic cap. Teleoconch I of slightly more than 0.5 whorls, axial sculpture strong, spiral rib in position of selenizone. Teleoconch II up to 3 1/4 whorls (1.7 mm shell), axials stronger than spirals,

approximately 85 axials on body whorl, 8 spirals on shoulder at aperture, at intersection of axials and spirals minute raised tubercles. Shoulder of undulating profile. On base spirals increase in strength from selenizone to umbilicus to become as strong as axials; intersections of axials and spirals form weak nodules; strong spiral groove beneath selenizone. Umbilicus continuously sloping from base, wide deep, with internal sill. Aperture subquadratic rounded, only flared toward umbilicus. Selenizone at periphery, above center of whorl, keels strong, growth marks not coordinated with axials.

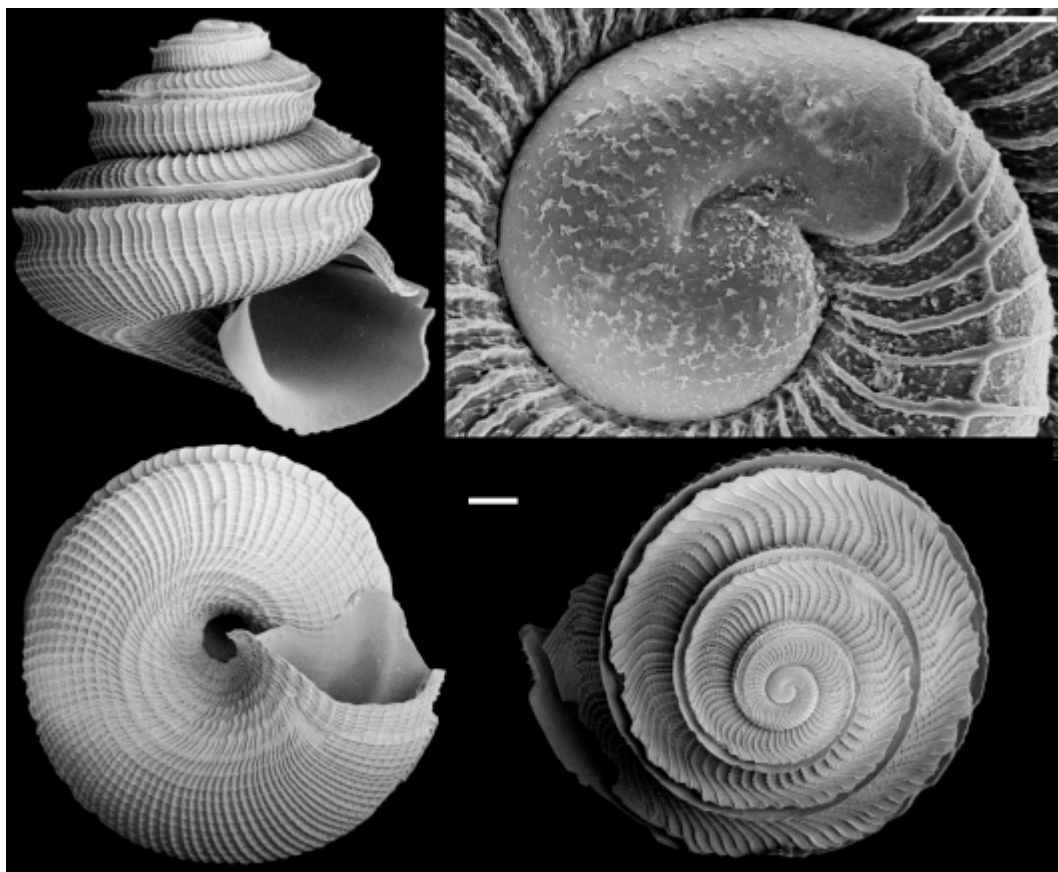


FIGURE 9. *Anatoma turbinata*. AMS C.402664. Direction Bank, off Rottnest Island, WA, Australia. Scale bar shell = 200 μ m. Scale bar protoconch = 50 μ m.

Differential diagnosis. *Anatoma turbinata* is the only high-spired member of Anatomidae in Australia. Additionally, *A. turbinata* lacks the funicular strand in the umbilicus found in *A. funiculata* n. sp. and *A. aypouria*. *Anatoma agulhasensis* from South Africa is distinctly higher than wide, has stronger spirals on the shoulder, has a less distinct spiral groove beneath the selenizone, and the aperture is more rounded. *Anatoma jacksoni* (Melvill, 1904) from the Indian Ocean has fewer axials, and is otherwise rather similar to

A. agulhasensis. In comparison to *A. turbinata*, *A. jacksoni* lacks the apertural varix of the protoconch and is less turreted, so that the suture is placed in the upper third of the previous whorl, whereas in *A. turbinata* the suture is placed in the lower half of the previous whorl, below a well-developed spiral rim.

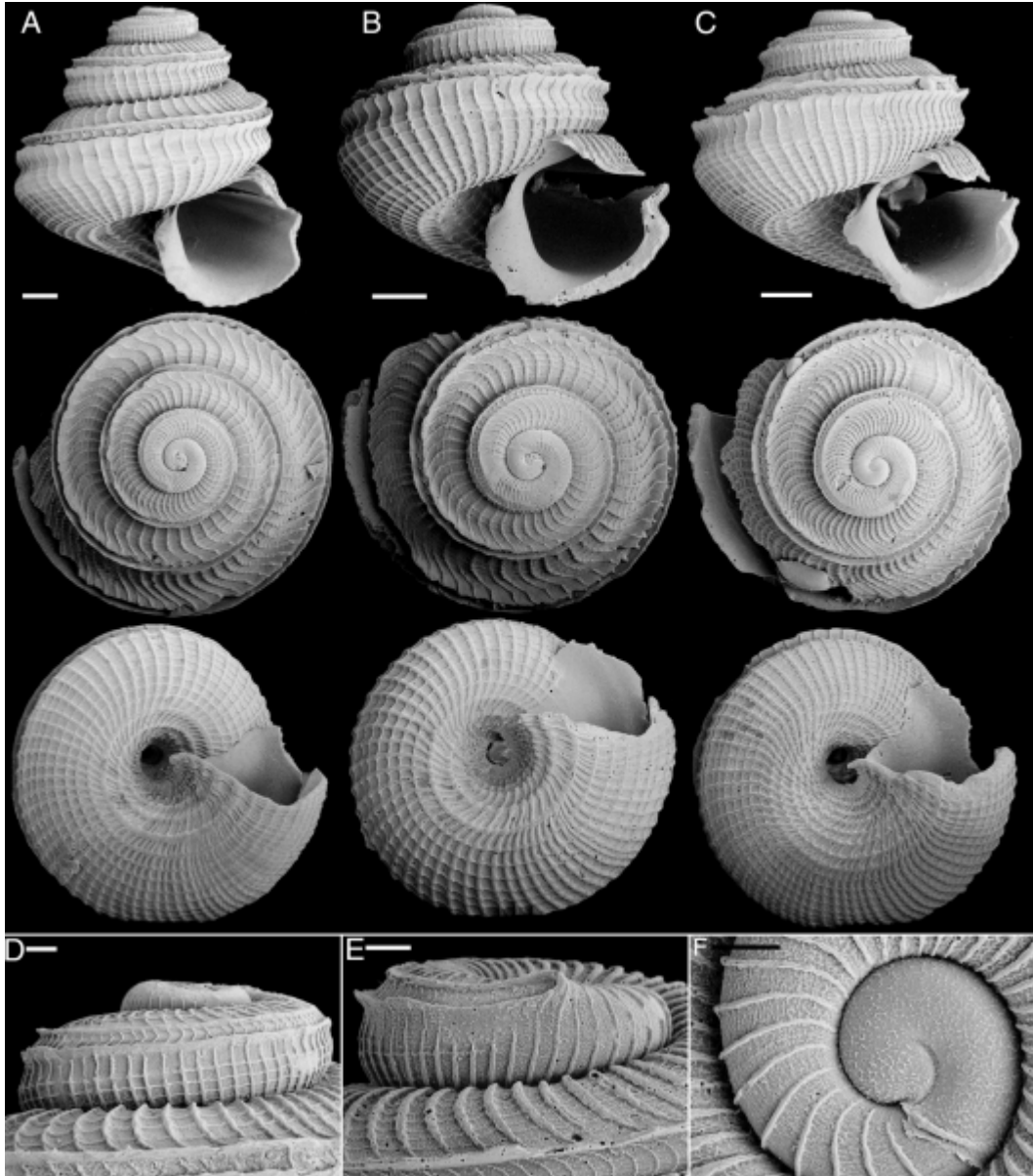


FIGURE 10. *Anatoma turbinata*. Protoconchs of A–C eroded, scale bars = 200 μ m. A. AMS C.402663. Arafura Sea, ca. 330 km NW of Wessel Island, NT, Australia. B. AMS C.402662. Arafura Sea, ca 210 miles NE Croker Island, NT, Australia. C. AMS C.402665. North West Shelf, ca 100 miles NW of Broome, WA, Australia. D. Protoconch profile of A. E–F. AMS C.402648. 260 m, SE of Tongatapu, Tonga. Scale bars D–F= 50 μ m.

Distribution. WA (Bunbury: 33°S, 114°E) to NT (Arafura Sea: 8°N, 135°E), Indonesia, South China Sea, southern Japan, Tonga, 75–274 m (shells only).

Specimen Records

NT. 108 m, Arafura Sea, ca 95 ml N Cobourg Peninsula, 9.75S, 132.067E (AMS C.402770, 2). 135 m, Arafura Sea, ca 110 ml N of Melville Island, 9.567S, 131.367E (AMS C.402769, 1; AMS C.402772, 1). 100 m, Arafura Sea, 365 km N of Milingimbi Island, Arnhem Land, 8.8S, 134.967E (AMS C.402771, 1). 82 m, Arafura Sea, N of Wessel Islands, 8.6S, 135.133E (AMS C.402668, 1; AMS C.402768, 2). 75 m, Arafura Sea, ca. 330 km NW of Wessel Islands, 8.433S, 135.367E (AMS C.402663, 1). 132 m, Arafura Sea, ca 210 ml NE Croker Island, 8.3S, 133.967E (AMS C.402662, 2).

WA. 156 m, W of Bunbury, 33.05S, 114.733E (AMS C.402763, 1). 146 m, W of Rottneest Is, 32S, 115.25E (AMS C.402767, 1). 150 m, Direction Bank, off Rottneest Island, 31.735S, 115.177E (AMS C.402762, 1). 155 m, off Rottneest Is, 31.732S, 115.158E (AMS C.402764, 1). 124 m, off Rottneest Is, 31.718S, 115.208E (AMS C.402765, 1). 150 m, off Rottneest Island, 31.703S, 115.137E (AMS C.402667, 1). 140 m, Direction Bank, off Rottneest Is, 31.627S, 115.133E (AMS C.402664, 1). 274 m, NW of Beagle Is, 29.717S, 114.283E (AMS C.402666, 2). 264 m, off North West Cape, 22.5S, 113.597E (AMS C.402766, 1). 190 m, off North West Cape, 22.387S, 113.677E (AMS C.402761, 2). 194 m, North West Shelf, ca 100 ml NW of Broome, 16.967S, 120.783E (AMS C.402665, 1).

Tonga. 260 m, SE of Tongatapu, 21.345°S, 175.042°W, (AMS 402648, 1).

Literature Records. Satonda, Indonesia [8.1°S, 117.75°E]. South China Sea (Bandel, 1998: misidentified as *A. agulhasensis*).

Remarks. The Australian specimens of *A. turbinata* have so far been misidentified as *A. angulhasensis*, a South African species. *Anatoma jacksoni* (Melvill, 1904) has been listed from Satonda, Indonesia, by Bandel (1998). The illustrated specimen does not agree with material from the Indian Ocean (Yaron, 1983: pl. 4), and most likely is *A. turbinata* with more tightly spaced and numerous axials and spirals, also misidentified by Bandel (1998) as *A. agulhasensis*. The common characters of Bandel's "*A. jacksoni*" and *A. turbinata* are the position of the suture in the lower half of the previous whorl and below a distinct spiral rim; the protoconch was not illustrated and no apical view was provided.

***Anatoma tobeyoides* new species: Figures 10–12, 18**

Anatoma "East coast": Jansen, 1999: 49, figs. 13–15.

Type material. HOLOTYPE AMS C.431072. 1.47 mm.

PARTAYPES: AMS C.29025, 8. AMS C.402671, 1. AMS C.402672, 1. AMS C.402673, 7. AMS C.402674, 1. AMS C.406337, 5.

Type locality. West of D'Entrecasteaux Channel, SE Tasmania, Australia, 43.045°S 147.347°E.

Etymology. The sculpture of fine, irregularly intersecting lines is reminiscent of the paintings of Mark Tobey (1890–1976: cf. Anonymous, 1997): tobey-: referring to the painter's surname; -oides: Latin: like, similar to.

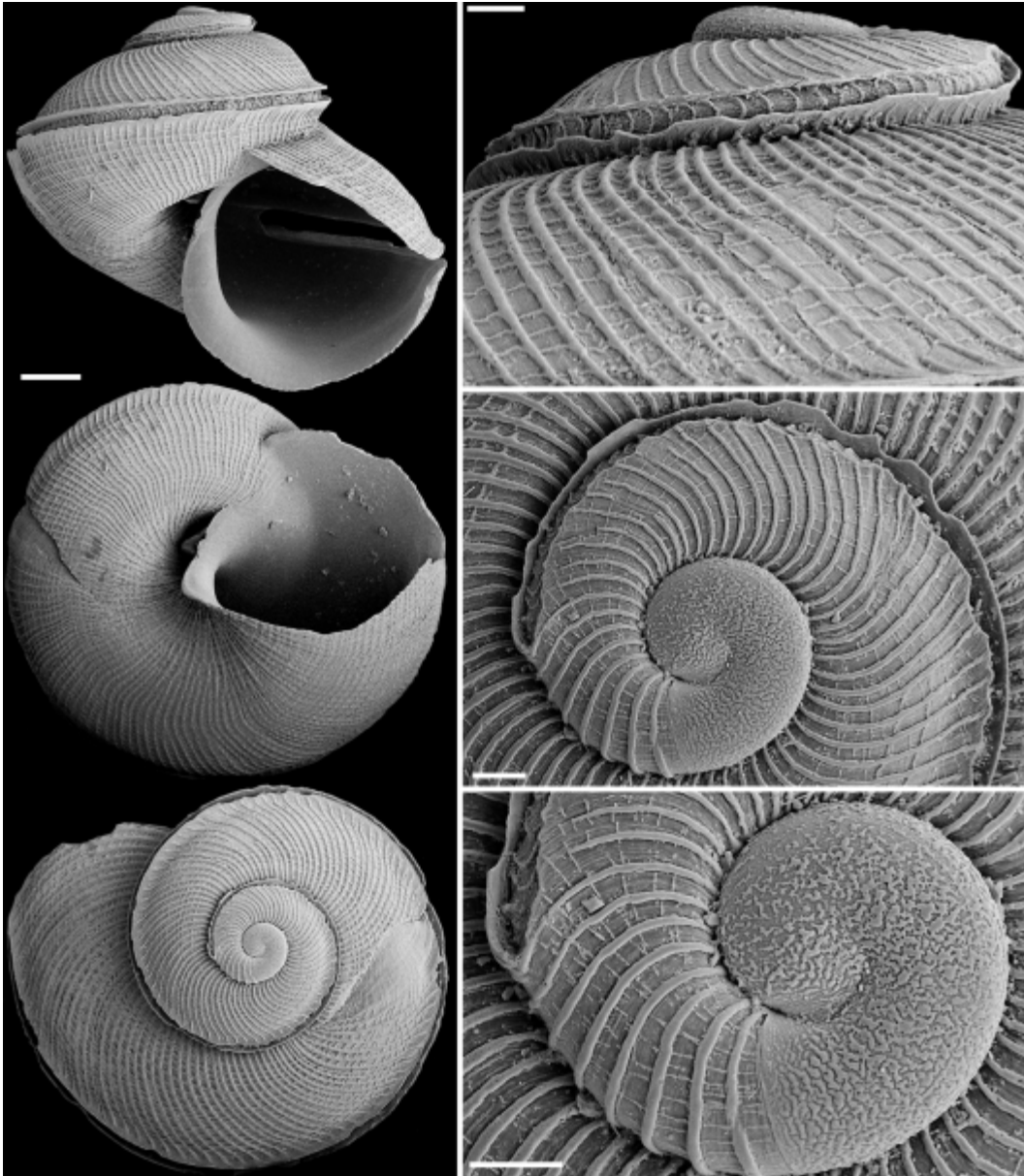


FIGURE 11. *Anatoma tobeyoides* n. sp. Holotype AMS C.431072. W of D'Entrecasteaux Channel, TAS, Australia. 1.47 mm. Scale bar shell = 200 μ m. Scale bars spire and protoconch = 50 μ m.

Description. Shell globular, medium size to large (4.2 mm). Protoconch 3/4 whorls, flocculant sculpture, no apertural varix. Teleoconch I fewer than 0.5 whorls, no spiral cord in position of selenizone, fine centrifugal markings, strong axials present. Teleoconch II up

to 2 1/4 whorls (1.6 mm shell). Sculpture with axials predominant, approximately 85 on body whorl on fully grown shell, approximately 15 spiral threads on shoulder at apertural margin. Approximately 25 spiral threads on base. Umbilicus continuously sloping from base, narrow, deep. Selenizone at periphery, keels distinct, growth marks poorly coordinated with axials. Aperture rounded, somewhat flared. Animal unknown.

Differential diagnosis. *Anatoma tobeyoides* n. sp. is most similar to *A. australis*. However, *A. tobeyoides* n. sp. lacks the protoconch varix found in *A. australis*, has a teleoconch I of less than half a whorl, whereas in *A. australis* it has more than half a whorl, *A. tobeyoides* n. sp. lacks a spiral cord on teleoconch I whereas *A. australis* has a prominent one, and *A. tobeyoides* n. sp. has much weaker spirals than axials and centrifugal spirals on teleoconch I and early teleoconch II, whereas *A. australis* has spirals and axials of equal strength and lacks the centrifugal spirals.

Distribution. South Australia, Tasmania (43.2°S) through Queensland (21.7°S), 27–1330 m shells only, 154 m live.

Specimen Records. West of D'Entrecasteaux Channel, SE Tasmania, Australia, 43.045°S, 147.347°E (holotype AMS C.431072, seven paratypes AMS C.402673).

QLD. 75 m, off Moreton Bay, 27.517S, 153.667E (AMS C.402674, 1: paratype). 77 m, off Moreton Bay, 27.456S, 153.65E (AMS C.402724, 18). Amity Point, Stradbroke Is, Moreton Bay., 27.4S, 153.433E (AMS C.402726, 1). 27 m, GBR, Swain Reefs, Bylund Gillett Cay, 21.717S, 152.417E (AMS C.402671, 1: paratype). 64 m, GBR, Swain Reefs, 3 km NE of W side of Bylund Gillett Cay, 21.7S, 152.433E (AMS C.402725, 7).

NSW. 219 m, E of Brush Is, 35.433S, 150.633E (AMS C.402672, 1: paratype). 40 m, N of Sydney, 33.757S, 151.36E (AMS C.402675, 1). 45.5 m, off Port Stephens, 32.708S, 152.25E (AMS C.402727, 1). 73 m, 9 ml NE of Coffs Harbour, 30.25S, 153.317E (AMS C.402730, 1). 13 m, E of Yamba, 29.5S, 153.367E (AMS C.402731, 1). 86 m, off Ballina, 29.17S, 153.728E (AMS C.402728, 1). 103 m, off Ballina, 29.167S, 153.783E (AMS C.402729, 1). 154 m, Taupo Guyot, off Newcastle, Tasman Sea, 33.103S, 156.155E (AMS C.404497, 1: complete).

VIC. 2000 m, Bass Strait, 30 mls S of Cape Nelson, 38.958S, 141.542E (AMS C.402739, 1). 60 m, Bass Strait, ca 40 km S of Lakes Entrance, 38.317S, 147.917E (AMS C.402740, 1). 165 m, Bass Strait, ca. 27 mls SE of Cape Everard, 38.25S, 149.2E (AMS C.402738, 8). 75 m, Between Cape Howe & Lakes Entrance, 37.917S, 149E (AMS C.404965, 1).

SA. 1330 m, *Galathea* station 554, Australian Bight, 3728'S 138°55'E (ZMUC, 1).

TAS. 212 m, S of Storm Bay, 43.783S, 147.808E (AMS C.402636, 6). 82 m, W of Port Davey, 43.338S, 145.803E (AMS C.402734, 1). 183 m, off Cape Pillar, 43.217S, 148.083E (AMS C.29025, 8: paratypes). 95 m, N of Cape Pillar, 43.167S, 148.023E (AMS C.402732, 1). 82.5 m, Maria Is, 2.5 ml NE Beaching Bay, 42.458S, 148.2E (AMS C.402733, 2). 205 m, off Cape Forestier., 42.167S, 148.578E (AMS C.402737, 6). 113 m, off Long Point, N of Bicheno, 41.758S, 148.517E (AMS C.402735, 1; AMS C.406337, 5).

88 m, S of West Point, 41.153S, 144.403E (AMS C.402736, 1). 399 m, off Cape Naturaliste, 40.843S, 148.775E (AMS C.402626, 11).

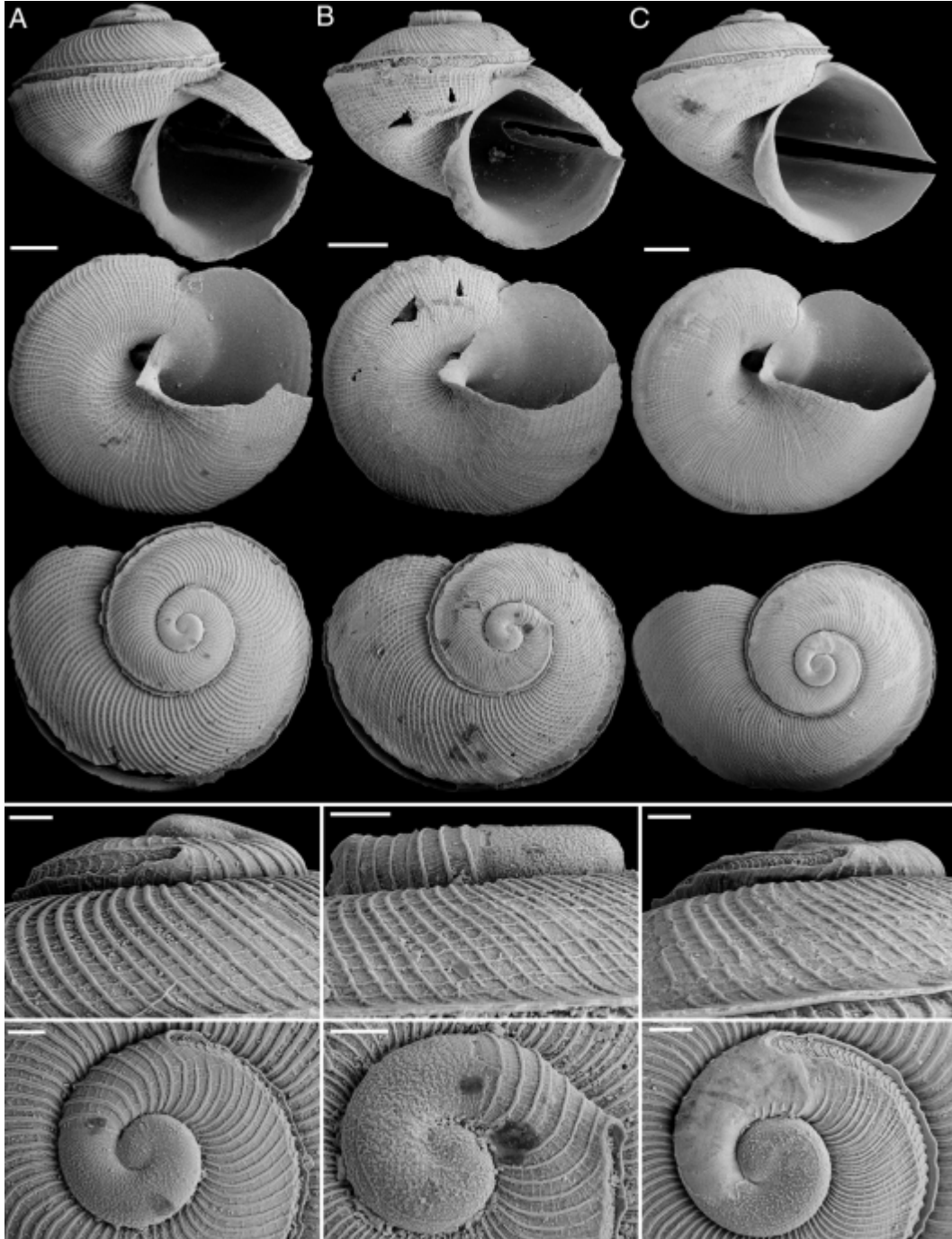


FIGURE 12. *Anatoma tobeyoides* Paratypes. A. AMS C.29025. 183 m, off Cape Pillar, TAS, Australia. B. AMS C.402671. 27 m, GBR, Swain Reefs, Bylund Gillett Cay, QLD, Australia. C. AMS C.402672. 219 m, E of Brush Island, NSW, Australia. Scale bars shell = 200 μ m. Scale bars spire and protoconch = 50 μ m.

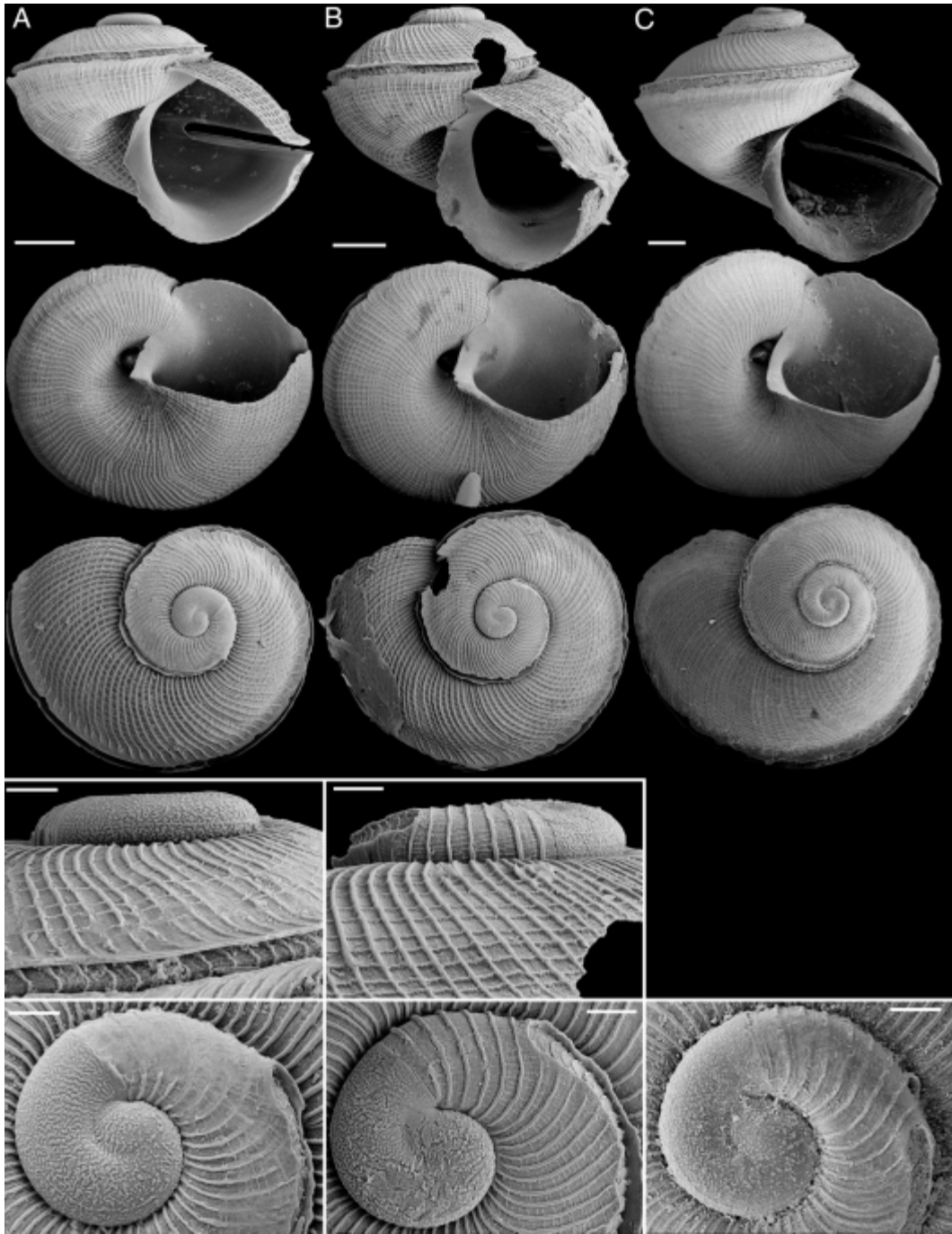


FIGURE 13. *Anatoma tobeyoides* paratypes. AMS C.402673. W of D'Entrecasteaux Channel, TAS, Australia. B. AMS C.402674. Off Moreton Bay, QLD, Australia. C. AMS C.406337. Off Long Point, N of Bicheno, TAS, Australia. Scale bars shell = 200 μ m. Scale bars spire and protoconch = 50 μ m.

***Thielella* Bandel, 1998**

Thielella Bandel, 1998: 35.
+ *Pagodella* Bandel, 1998: 2. [*nomen nudum*].

Type species. *Scissurella amoena* Thiele, 1912 (OD).

Etymology. Named after Johannes Thiele (1860–1935: Bieler & Boss, 1991).

Description. Identical to *Anatoma*, but protoconch with reticulate sculpture.

Differential diagnosis. *Thielella* has a protoconch with honeycomb pattern, whereas *Anatoma* is either smooth or with flocculent ornamentation. It is virtually impossible to distinguish members of these two genera under the light microscope.

The recognition of *Thielella* as distinct from *Anatoma* is debatable. There is only a single character, protoconch sculpture, that separates the two genera. In an exploratory phylogenetic analysis of shell and limited radular characters (no radular data available for any *Thielella* species), the *Thielella* species grouped together as a grade (Geiger, 2003). Additionally, in Scissurellinae, protoconch sculpture was demonstrated to be highly homoplastic, casting further doubt on the diagnostic value of protoconch sculpture used to recognize *Thielella*. *Thielella* is tentatively retained in agreement with actions taken by an other recent author (Marshall, 2002).

***Thielella equatoria* (Hedley, 1899): Figures 14, 18**

Scissurella equatoria Hedley, 1899: 551–552, fig. 61.
Scissurella aequatoria [sic]: Hedley, 1903: 330.
Scissurella equatoria: Thiele, 1912: 20, pl. 3, fig. 4 [copy of figure in Hedley, 1899].
Anatoma equatoria: Habe & Kosuge, 1964: 4.

Type material. HOLOTYPE (AMS C.5639), 3 x 2.68 mm (H x W).

Type locality. Tutaga Islet, Funafuti Atoll, 200 fms. [= 365 m, 8.617°S, 179.083°E,] (OD).

Etymology. Most likely named for its occurrence near the equator.

Description. Shell globular, medium size (to 3 mm: holotype). Protoconch almost 1 whorl, with reticulate sculpture, no varix. Teleoconch I slightly more than 1/2 whorl, with 15 axials, spirals not visible. Teleoconch II with up to 3.5 whorls (holotype: fide Hedley, 1899), axials 75 (1.83 mm specimen: figure 13) to 85 (3 mm specimen: holotype) on body whorl. Spirals on shoulder extremely faint, on base very fine, forming reticulate interstices with axials. Umbilicus open, deep, sloping continuously from base. Selenizone at periphery, strong keels, axials on keels finer and more numerous than axials on shell proper; margins of slit parallel. Aperture rounded, flared towards umbilicus. Animal unknown.

Differential Diagnosis. *Anatoma turbinata* has flocculant protoconch sculpture compared to a reticulated one, is more turreted, has a smaller aperture compared to overall shell size, has fewer axials, and more prominent spirals.

Specimen records. Off NE point, Christmas Island, Australia, 183 m (AMS C.405015, 1: shell only).

Remarks. This species is currently only known from two specimens, the holotype and the additional specimen figured here (Fig. 13).

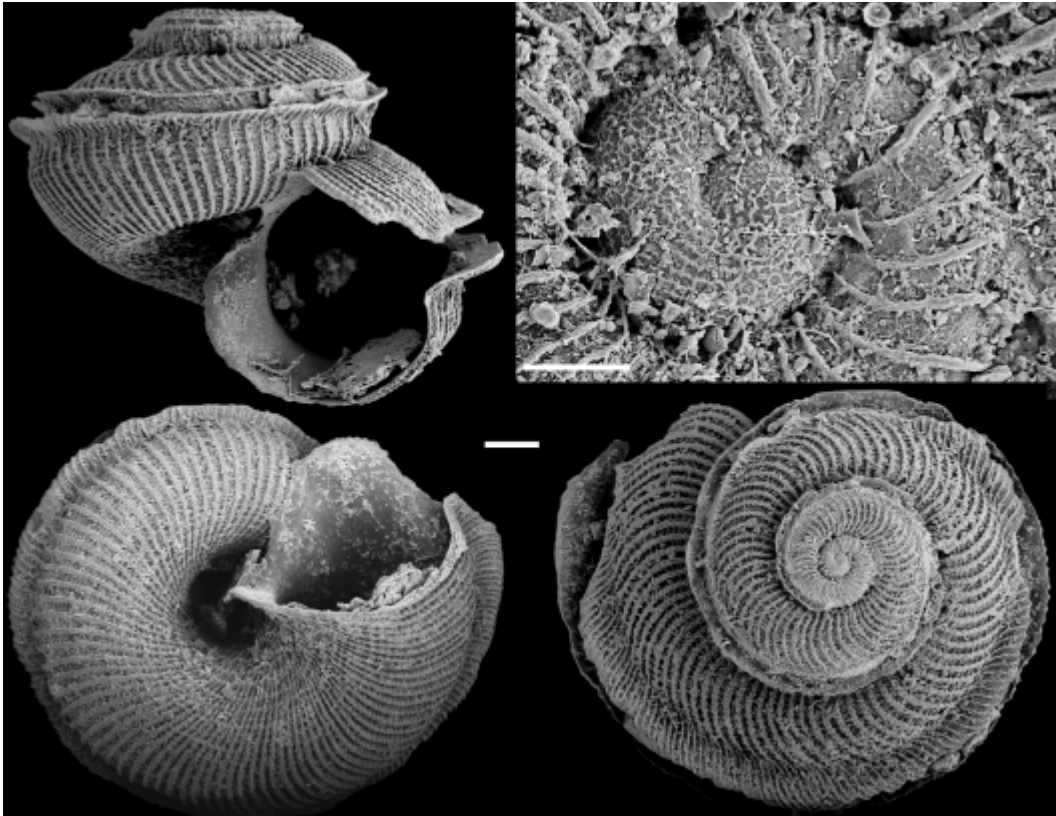


FIGURE 14. *Thieleella equatoria*. AMS C.405015. Off NE point, Christmas Island, Australia, 183 m. Scale bar shell = 200 μ m. Scale bars spire and protoconch = 50 μ m.

***Thieleella gunteri* (Cotton & Godfrey, 1933): Figures 15–18**

Schizotrochus gunteri Cotton & Godfrey, 1933: 23: pl. 1, fig. 11.

Schizotrochus gunteri: Cotton, 1945: 150.

Schizotrochus gunteri: Cotton, 1959: 41, fig. 15.

Scissurella (Anatoma) gunteri: Wilson, 1993: 46.

Anatoma guntheri [sic]: Jansen, 1999: 49, figs. 10–12.

Type material. HOLOTYPE (SAM D.10769: Cotton, 1959, Jansen, 1999), 1.5 x 1.1 mm (W x H).

Type locality. Beachport, South Australia, 150 fms. [= 275 m] (OD).

Etymology. Named after Rev. H. Gunter from South Australia (OD).

Description. Shell globular, medium sized to large (3 mm). Protoconch 3/4 whorls, reticulate sculpture, varix faint, not connecting to embryonic cap, aperture sinusoid. Teleoconch I 0.6–0.85 whorls, 16–22 axials, apical spiral in position of selenizone, interstices with fine growth lines. Teleoconch II 2 2/3 whorls, shoulder with strong axials, approximately 45 on body whorl, approximately 20 fine spirals running over axials. Base with more numerous but finer axials, spirals of equal strength to axials, base sloping continuously into umbilicus. Umbilicus narrow, deep, with indistinct funiculus. Selenizone at periphery, keels elevated but fragile, growth increments faint, not coordinated with axials on shoulder or base. Slit open, margins parallel. Aperture rounded, flared in lower adumbilical portion. Animal unknown.

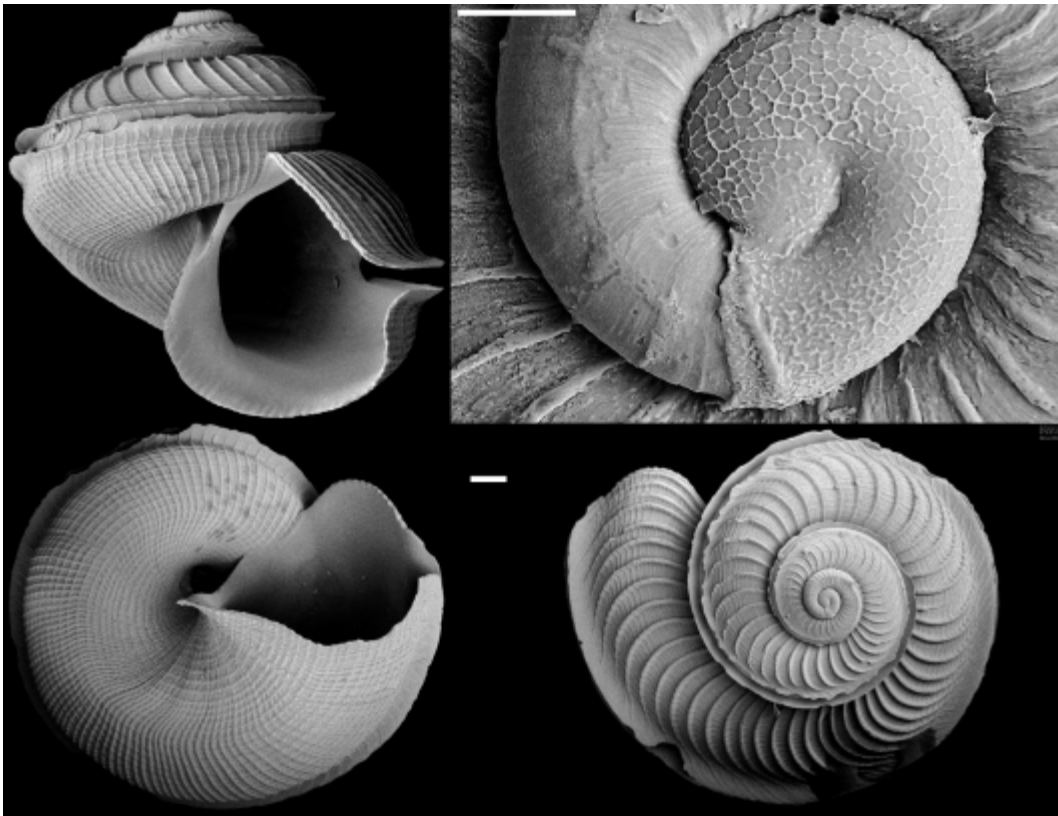


FIGURE 15. *Thielella gunteri*. AMS C.31845. 40 miles S of Cape Wiles, SA, Australia, 174–183 m. Scale bar shell = 200 μ m. Scale bar protoconch = 50 μ m.

Differential diagnosis. *Anatoma australis* from New South Wales, Queensland, and NW and SW Western Australia has axials on the shoulder and on the base of equal strength, while in *T. gunteri* the shoulder axials are markedly stronger. *Anatoma australis* also has flocculant protoconch sculpture whereas *T. gunteri* has a reticulate one. *Anatoma tobeyoides* from Tasmania, Victoria, New South Wales, and Queensland, also has axials of

equal strength on the shoulder and base, a protoconch with a flocculant sculpture, and a teleoconch I of fewer than 0.5 whorls.

Distribution. Tasmania and South Australia, 219–667 m (shells only), sandy and silty bottoms.

Specimen records.

SA. 667 m, off Cape Martin, 38.125S, 140E (AMS C.402691, 3). 174 m, 40 ml S of Cape Wiles, 35.65S, 136.667E (AMS C.402690, 20+; AMS C.31845, 20+).

TAS. 212 m, S of Storm Bay, 43.783S, 147.808E (AMS C.402634, 3). 570.5 m, 9.5 ml NE of Tasman Is, 43.208S, 148.229E (AMS C.402693, 6). 113 m, NE of Cape Pillar, 43.167S, 148.112E (AMS C.402723, 1). 399 m, off Cape Naturaliste, 40.843S, 148.775E (AMS C.402628, 22; AMS C.402692, 2).

Literature records. Beachport, 150 fms. [= 274 m], 200 fms. [= 365 m], SA; Cape Jaffa, 100, 130, 300 fms. [= 182, 237, 548 m], SA; Cape Wiles, 100 fms. [= 182 m], SA (Cotton, 1945).

Remarks. Cotton & Godfrey (1933) also cite Cape Pillar, Tasmania, 100 fms. [= 182 m] as a locality for this species. This could indicate paratypes, but the whereabouts of these specimens is currently unknown (SAM?).

The characteristic strong axial sculpture on the shoulder and the more numerous weaker axials on the base of *T. gunteri* is shared with *A. s.l. finlayi* (Powell, 1937) from Three King Is, New Zealand. If these two species should be synonymous, *T. gunteri* has priority. Although some species have been considered to be shared between continental Australia and New Zealand [e.g. *Incisura rosea* (Hedley, 1904) with nominate subspecies in New Zealand and Australian subspecies *remota* (Iredale, 1924)] such indications are dubious and may simply reflect our poor knowledge of microgastropods in general. *Anatoma aupouria* occurs in Australian territorial waters, though the area belongs to the New Zealand faunal province.

Possible other species from the Australian region

The following species of *Anatoma* may belong to the Australian Fauna but have not been recorded from Australia. This listing will provide guidance in case Australian specimen may not fit within any of the species known from Australia and discussed here.

Anatoma s.l. exquisita (Schepman, 1908: 83, pl. 6, fig. 10 [*Scissurella*]). Described from the Sulu-Sea (5° 43.5'N 119° 40'E, 522 m) and reported from Japan (Okutani, 1964).

Anatoma indonesica Bandel, 1998: 30–31, pl. 9, figs. 5–7. Described from Satonda, Indonesia [8.1°S, 117.75°E].

Anatoma s.l. maxima (Schepman, 1908: 83, pl. 6, fig. 9. [*Scissurella*]). Described from the Seram Sea (2°40'N 128°37.5'E).

Anatoma paucispiralia (Bandel, 1998: 41, pl. 14, figs. 2–4 [*Hainella*]), Described from Satonda, Indonesia [8.1°S, 117.75°E].

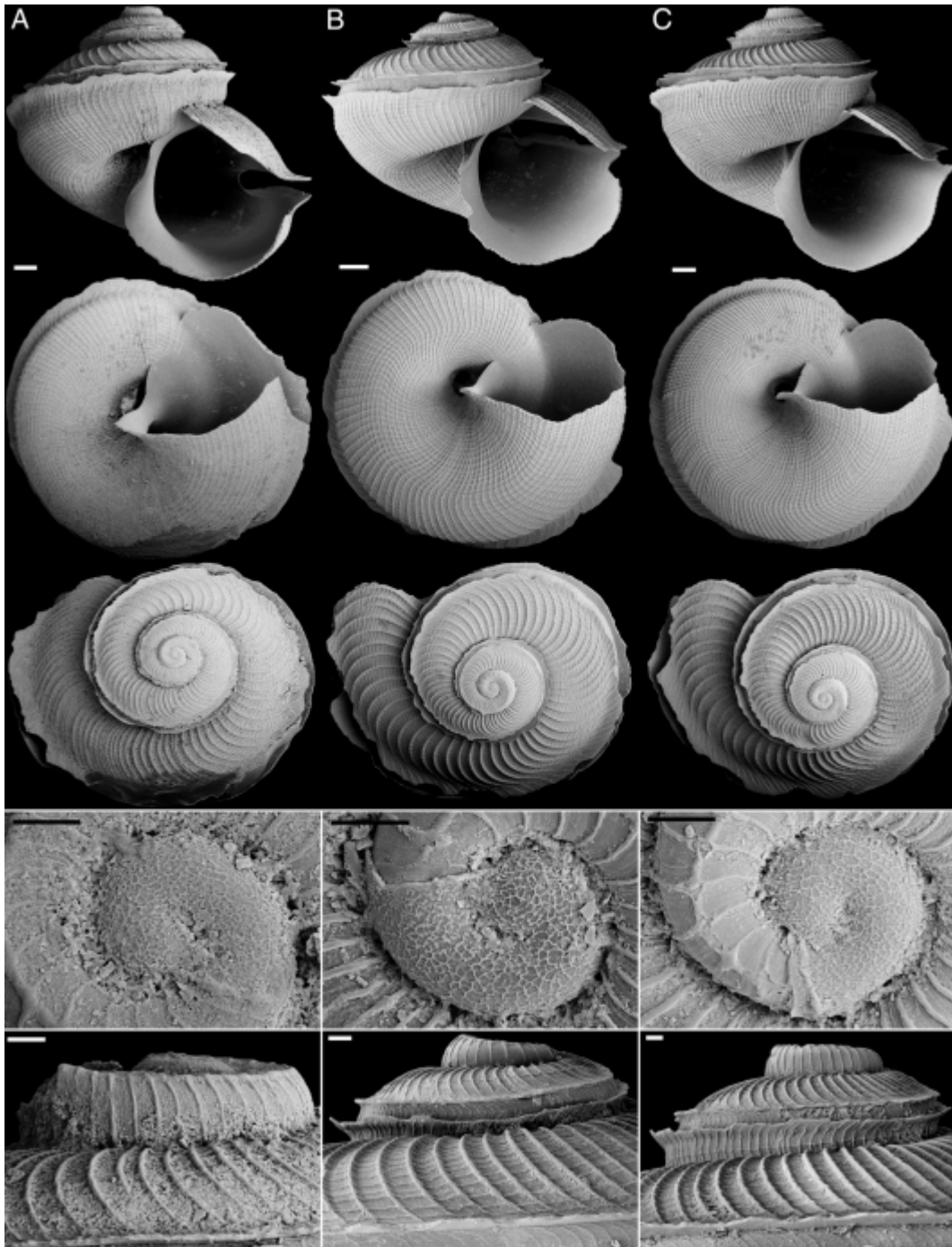


FIGURE 16. *Thielella gunteri*. A–B. AMS C.402690. 40 miles south of Cape Wiles, SA, Australia. C. AMS C.402691. Off Cape Martin, SA, Australia. Scale bars shell = 200 μm . Scale bars protoconch and spire = 50 μm .

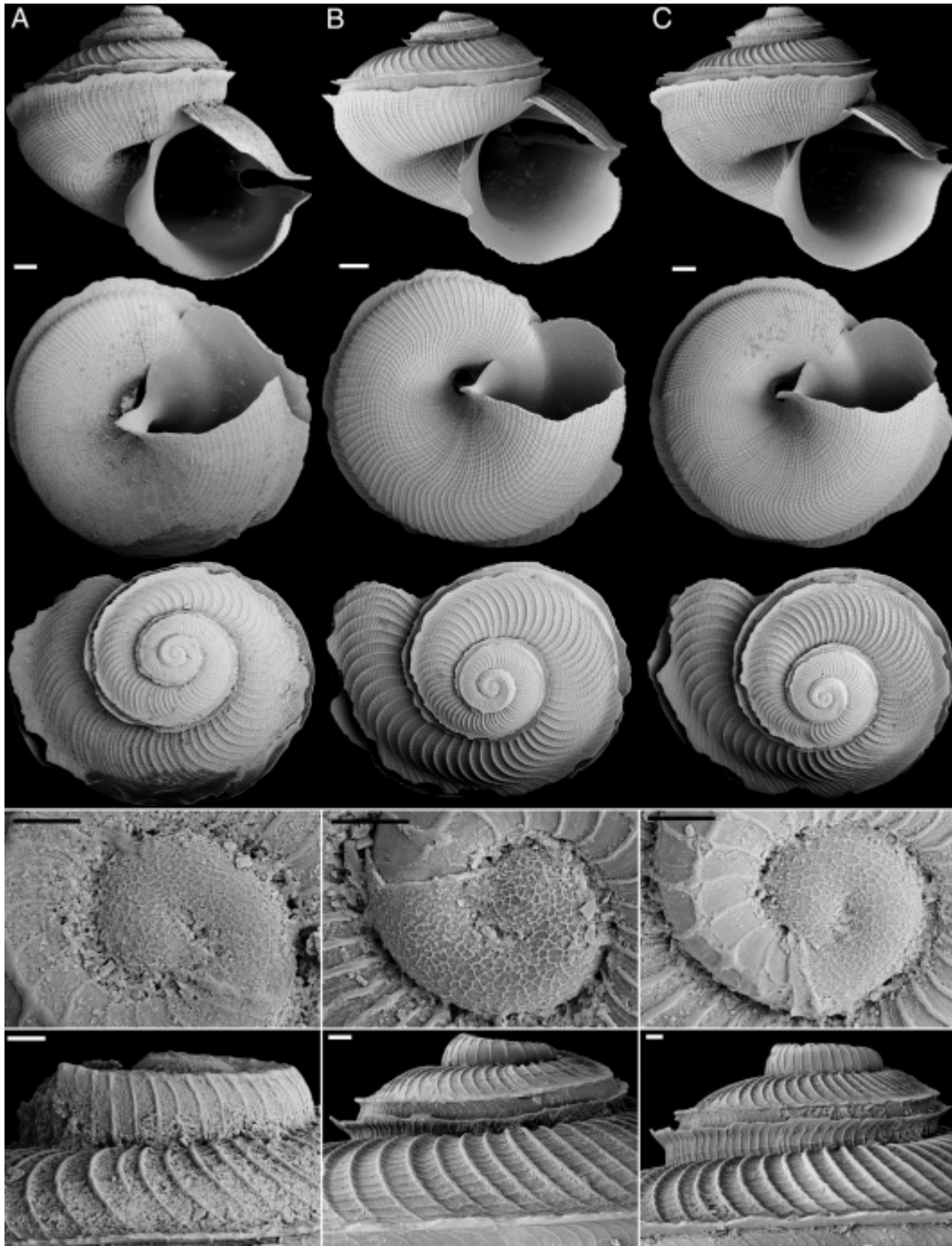


FIGURE 17. *Thielella gunteri*. A. AMS C.402628. Off Cape Naturaliste, TAS, Australia. B–C. AMS C.402692. Off Cape Naturaliste, TAS, Australia. Scale bars shell = 200 μm . Scale bars protoconch and spire = 50 μm .

Anatoma pulchella (Bandel, 1998:., pl. 14, figs. 5–7 [*Hainella*]). Described from Satonda, Indonesia [8.1°S, 117.75°E].

Thielella reticulata Bandel, 1998: 36, pl. 12, figs. 2–4. Described from Satonda, Indonesia [8.1°S, 117.75°E].

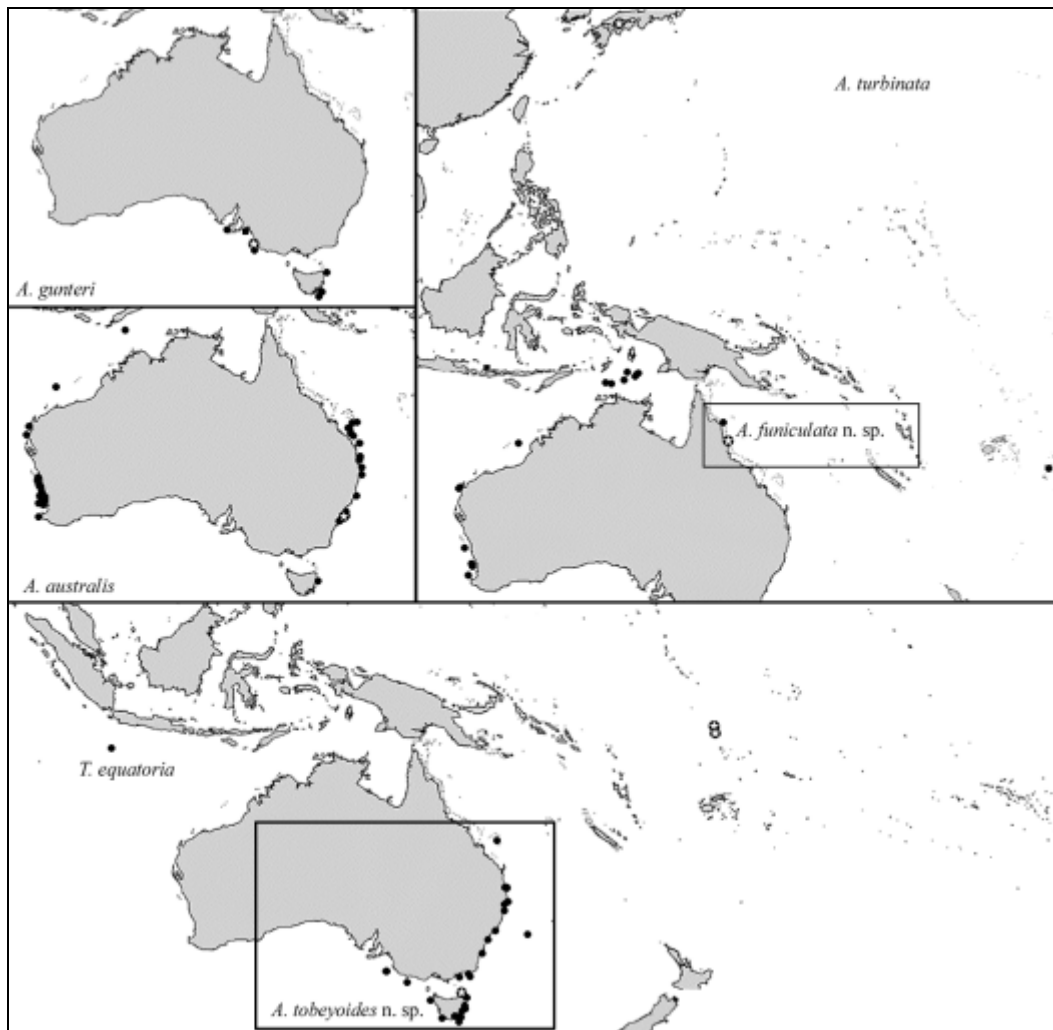


FIGURE 18. Distribution maps of Australian species of Anatomidae. Circle with star: type locality. Solid dots: specimen records. Squares: literature records.

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