



Basteria

JOURNAL OF THE NETHERLANDS MALACOLOGICAL SOCIETY

VOLUME 82 (1-3) | 15 SEPTEMBER 2018

Xerotricha conspurcata
from Cadzand-Bad,
The Netherlands
(p.43)



Nederlandse
Malacologische
Vereniging

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ISSN-0005-6219

*The paper in this journal meets the guidelines for permanence and durability
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Printed by HIGH TRADE, Zwolle, The Netherlands

A note on the genus *Rubritrochus* (Gastropoda, Vetigastropoda, Trochidae), with descriptions of five new species

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Previously, confusion about the species of the genus *Rubritrochus* Beck, 1995 resulted in erroneous species concepts and distributional patterns for the two identified species, *R. declivis* (Forsskål in Niebuhr, 1775) & *R. pulcherrima* (A. Adams, 1855). Instead, a total of eight Recent species is recognized in this paper. Five of these are newly described: *R. moolenbeeki* spec. nov. from the southern Red Sea to the Persian Gulf, *R. ellenae* spec. nov. from near Rodrigues Island, *R. andamanensis* spec. nov. from the Andaman Islands, *R. lagerweijae* spec. nov. from Sri Lanka, and *R. simoni* spec. nov. from western Thailand, Phuket area.

Key words: Gastropoda, Trochidae, *Rubritrochus*, new species, taxonomy, distribution, Indian Ocean, Red Sea.

INTRODUCTION

The genus *Rubritrochus* from the Indian Ocean was introduced by Beck (1995), who separated it from the morphologically similar European *Gibbula* Risso, 1826, more specifically its synonym *Forskalena* Iredale, 1918. Iredale introduced *Forskalena* as a nomen novum for *Forskalia* H. & A. Adams, 1854, since that name is pre-occupied by *Forskalia* Kölliker, 1853 (Cnidaria). Iredale selected *Trochus fanulum* Gmelin, 1791 as type species (for a figure see Robin, 2008: 32, fig. 9). However, it would have made more sense to designate the type species as *Trochus declivis* Forsskål, 1775, since the generic name is clearly honouring Forsskål (at that time spelled with one s only).

Williams et al. (2010: 799) provisionally assigned *Rubritrochus* to the subfamily Trochinae Rafinesque, 1815, whereas *Forskalena* is the sister clade of *Gibbula* (type species *Trochus magus* Linnaeus, 1758); both belong in the Cantharidinae Gray, 1857. Uribe et al. (2017) showed that *Trochus fanulum* is closely related to *Trochus magus* and hence both belong in the same genus, making *Forskalena* a synonym of *Gibbula*.

Rubritrochus is restricted to the Indian Ocean. It was already present there in the Early Miocene (Aquitanian) of Tanzania, with *Rubritrochus africanus* Harzhauser, 2009. Two Pliocene species are known from southeast India, Karaikal (Cossmann, 1910). When Beck (1995: 68) introduced *Rubritrochus*, he regarded all specimens from the Red Sea as *R. declivis* and all from outside the Red Sea as *R. pulcherrimus*. This concept proved to be incorrect. In the northern Red Sea one finds indeed only *R. declivis*, but outside the Red Sea seven species occur. The revision is outlined in this article.

The following abbreviations are used:

H, height; HD, collection H. Dekker, Winkel, The Netherlands; MNHN, Muséum national d'Histoire naturelle, Paris, France; NBC, Naturalis Biodiversity Center, Leiden, The Netherlands; NHM, The Natural History Museum, London, United Kingdom; RMNH, Rijksmuseum van Natuurlijke Historie, now Naturalis Biodiversity Center, Leiden, The Netherlands; USNM, National Museum of Natural History, Smithsonian Institution, Washington, USA; W, width; ZMA, Zoological Museum Amsterdam, now incorporated in NBC; ZMUC, Zoological Museum, University of Copenhagen, Denmark; [x] defines the number of specimens studied.

- 1 - relatively narrow spiral rib at or close to the edge of the umbilicus 2
 - broad spiral rib present deeper inside, narrowing the umbilicus 6
- 2 - three spiral ribs around the umbilicus, black & white dotted 3
 - spiral ribs around the umbilicus with pink to dark red staining or dots 4
- 3 - spiral lirae in aperture absent or weakly present towards apertural edge, periphery bicarinated, axial ribs ending sharply *R. declivis*
 - spiral lirae present in aperture, periphery with strong groove, axial ribs ending rounded
 *R. moolenbeeki*
- 4 - periphery of shell rounded, with 2 strong spirals between 2 grooves *R. pulcherrimus*
 - periphery of shell nearly straight 5
- 5 - umbilicus stained with dark ruby red, periphery without strong groove *R. ellенаe*
 - umbilicus with light pink, periphery with strong spiral groove *R. sp. 1*
- 6 - without strong axial ribs adapically *R. simoni*
 - with strong axial ribs adapically 7
- 7 - eight strongly granulated spiral ribs on base, no additional small spiral ribs inside umbilicus, blotched spiral rib abapical from periphery is double
 *R. andamanensis*
 - six strongly granulated spiral ribs on base, two additional small spiral ribs inside umbilicus, blotched spiral rib abapical from periphery is single
 *R. lagerweijae*

SYSTEMATIC PART

Family Trochidae Rafinesque, 1815

Subfamily Trochinae Rafinesque, 1815

Rubritrochus Beck, 1995Type species: *Gibbula pulcherrima* A. Adams, 1855 (by original designation).

Genus characteristics. – Trochids with globose-conical shell, medium-sized, 10-25 mm high. Shell sculptured with many rather coarse spiral ridges. Adapical part of whorls with axial ribs, which end rounded or sharp just above the periphery, except in *R. simoni* spec. nov., which lacks the axial ribs. A denticle is present on the abapical part of the columella. The species from the north-eastern Indian Ocean (Bay of Bengal) differ from those from the western Indian Ocean by the possession of a broad spiral rib in the umbilicus, which partially fills it.

Rubritrochus pulcherrimus (A. Adams, 1855)

(Figs 8-16)

Gibbula (Forskålia) pulcherrima H. & A. Adams, 1854: 432 [nom. nud.].*Gibbula pulcherrima* A. Adams, 1855: 39, type locality “China Seas”.*Trochus fanuloides* P. Fischer, 1874: 373, type locality unknown; 1878: 333, pl. 103 fig. 3.*Gibbula (Gibbula) fanuloides* – Pilsbry, 1889: 200, pl. 31 figs 41-43 [figs copy of Fischer, 1878].*Gibbula (Gibbula) pulcherrima* – Pilsbry, 1889: 200 [in part].*Gibbula fanuloides* – Melvill & Standen, 1901: 348.*Gibbula pulcherrima* – Melvill & Standen, 1901: 349.*Rubritrochus pulcherrimus* – Beck, 1995 [in part]: 69, pl. 1 figs 1-4, 7-8, pl. 2 figs 1-2, 7-9; Bosch et al., 1995: 33, fig. 32; Herbert, 2015: 65; Fowler, 2016: 14, pl. 2 fig. 9.*Trochus pulcherrimus* – Robin, 2008: 35, fig. 10.

Description. – Turbiniform shell with a maximum observed height of 19.3 mm, apex somewhat flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery. Adapical part of whorl with strong spiral ribs, followed by a groove plus 2-3 stronger spiral ribs and a groove on the periphery. Just below periphery a strong spiral band and towards base first 4-5 medium-sized spiral ribs, followed by 4-5 broader spiral ribs towards umbilicus. Umbilicus narrow and deep, bordered by one thick spiral rib ending in a tooth at the abapical part of columella. Aperture white nacreous, inside outer lip with 17-21 strong spiral lirae reaching deep into aperture. Operculum round, multispiral, with concave outer surface and conical internal surface, brownish yellow. Colour. – Shell whitish, with fine red or blackish dots on the spiral ribs. Additional axial to oblique red streaks from suture to periphery, occasionally those streaks cross periphery. Peripheral stronger spiral ribs may be just finely dotted red, or some specimens may have larger red dots. Spiral band below periphery with large red dots, often as extension of the red streaks on base. Spiral ribs on base with finer to coarser red dots, which may be arranged in a kind of oblique streaks. Spiral rib bordering umbilicus has strong pink colour, inside umbilicus with weaker pink colour.

Type material. – *Gibbula pulcherrima*: two syntypes in NHM (1968.185), figured by Beck (1995: pl. 1 figs 1-4). *Trochus fanuloides*: lectotype in MNHN (MNHN-IM-2000-31147, Fig. 16), designated by Beck (1995: 67, pl. 2 figs 7-9).

Material studied. – **Mozambique**: Mozambique, HD 22938 [3, Figs 10-11]; Nacala Bay, 1999, HD 1951 [2, Figs 8-9]; Nacala Bay area, 3-5 m depth, 2010, HD 29572 [1]; Pemba, dredged offshore in rubble, 18-20 m, HD 10836 [6]. **Eastern Arabia**: Gulf of Oman, HD 34850 [1]; United Arab Emirates, Sharjah, Gulf of

Oman, Khor Fakkan, on shore, 15.ii.2004, HD 16171 [22, Figs 12-15]; United Arab Emirates, Sharjah, Gulf of Oman Lulayyah, on shore, 14.ii.2004, HD 16010 [2]; Oman, Musandam, Khasab, in sand from harbour construction, 6.ii.2004, HD 36910 [1]; Oman, off Seeb, dredged, 30 m, 1991, ZMA.MOLL.61216 [6].

Habitat. – Found in 34–110 m, living 34–70 m (Herbert, 2015: 66) in SE Africa; in Kenya obtained alive by dredge, no mention of depth (Fowler, 2016: 14); in the Gulf of Oman empty specimens were mostly found on the beach, but they originate from sediments dredged up by harbour construction activities, one sample was dredged at 30 m.

Distribution. – Mozambique south to South Africa, northern Zululand (Herbert, 2015: 66), Kenya (Fowler, 2016) and the Gulf of Oman.

Remarks. – This species is easy to recognize because of the pink spiral ribs on the base around the umbilicus in addition to the pink colour inside the umbilicus. The lectotype of *Trochus fanuloides*, described from an unknown locality, conforms to this species, the rounded whorls with strong axial ribs, the pinkish spiral rib along the margin of the umbilicus and the tiny black dots present on the abapical peripheral spiral rib are diagnostic.

The patchy distribution is probably a result of the deeper habitat of this species, making it less easy to obtain. Records from between the known locations are scarce, but some specimens recorded by Melvill (1909: 80) may turn out to be this species (see below under *Rubritrochus* species 1).

This species has been reported from the Philippines (Poppe, Tagaro & Vilvens, 2009: 6, pl. 2 figs 2-3), but the figured shells do not belong to *Rubritrochus*. Based on shell characteristics, they are a species of the genus *Monilea* Swainson, 1840, subgenus *Talopena* Iredale, 1918, belonging to the Trochidae subfamily Umboniinae.

Rubritrochus declivis (Forsskål in Niebuhr, 1775)
(Figs 1-7)

Turbo declivis Forsskål in Niebuhr, 1775: 126, nr. 72. Type locality: "Sués". Chemnitz, 1781: 104, pl. 171 figs 1663-1664.

Yaron et al., 1986: 189, figs 33-34.

Trochus aegyptius Gmelin, 1791: 3573, nr. 41 [refers to Chemnitz, figs 1663-1664]. Type locality: "rarior in mari rubro prope Suez".

Trochus declivis – Röding, 1798: 82, nr. 1063 [refers to Chemnitz, figs 1663-1664 & Gmelin]; Fischer, 1876: 126 [refers to Kiener, 1850: pl. 43 fig. 3].

Cidaris arabica Röding, 1798: 84, nr. 1092 [refers to Chemnitz, figs 1663-1664 & Gmelin].

Monodonta aegyptiaca Lamarck, 1822: 33, nr. 6. Type locality: "dans la mer Rouge, proche l'isthme de Suez".

Trochus aegyptius – Kiener, 1850: pl. 43 fig. 3.

Gibbula (Forskålia) declivis – H. & A. Adams, 1854: 432.

Gibbula (Gibbula) declivis – Pilsbry, 1889: 198, pl. 31 figs 47-48.

Gibbula (Forskålia) declivis – Horst & Schepman, 1908 [in part]: 464, nr. A; Bisacchi, 1931: 181.

Gibbula declivis – Abbott & Dance, 1983: 42, fig.. Sharabati, 1984: pl. 3 fig. 7, 7a-c. Robin, 2008: 32, fig. 7.

Turbo declivis – *Rubritrochus declivis* – Beck, 1995 [in part]: 71, pl. 3 figs 1-5. Dekker & Orlin, 2000: 18, nr. 26. Rusmore-Villaume, 2008: 20, 21 figs. Zuschin et al., 2009: 100, pl. 10 figs 1a-b, 2a-d, 3a-d.

Description. – Turbiniform shell with a maximum observed height of 27.2 mm, apex flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery in strong sharply pointed tubercle. Adapical part of whorl has 5-6 spiral ribs, periphery bears row of tubercles, then 1-2 small spiral ribs followed by sharp tuberculated spiral rib. On base 2 widely spaced spiral ribs with 3-4 broader spiral ribs towards umbilicus in different colour pattern. Umbilicus narrow and deep, bordered by one thick spiral rib ending in tooth at the abapical part of the columella. Aperture white nacreous, inside outer lip with weak spiral lirae near aperture, if present. Operculum round, multispiral, with concave outer surface and conical internal surface, brownish yellow.

Colour. – Shell whitish, with fine red, brownish or greenish dots on spiral ribs. Additional axial to oblique brown to dark greenish streaks from suture to periphery, occasionally adapical part of whorls brown between the axial ribs. Abapical strong peripheral spiral rib often has thin greenish to brown spiral rib in between the tubercles. Base has oblique brownish flames following tubercles, which in some specimens can be lacking, often with brownish to greenish fine dots added on outer spiral ribs. The 3-4 spiral ribs around umbilicus usually with alternating dots in white, yellowish and blackish-green. Spiral rib bordering umbilicus is white, inside umbilicus whitish to greenish.

Type material. – *Turbo declivis*: lectotype & 30 paralectotypes in ZMUC (F.198 & F.192), designated by Yaron et al. (1986: figs 33-34). Egypt, Suez. No effort has been done to locate type specimens of *Trochus aegyptius*, *Cidaris arabica* and *Monodonta aegyptiaca*.

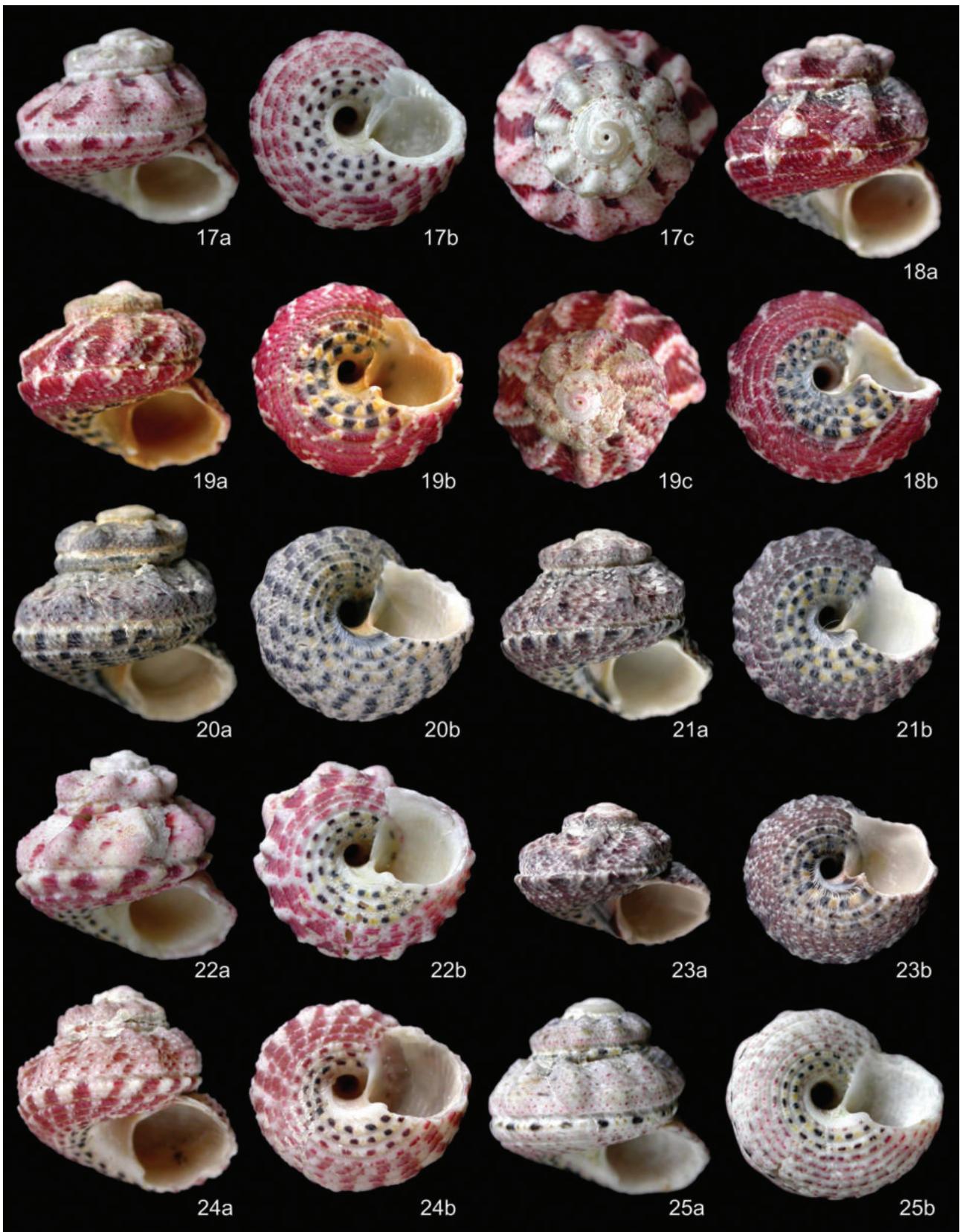
Material studied. – **Egypt**: Gulf of Suez, Sinai, at Sheraton hotel construction site, 29.vi.2006, leg. H. Dekker, HD 19636 [7, Figs 2-4]; Gulf of Suez, Ain al Suhkna, 28.vi.2006, leg. H. Dekker, HD 19448 [3]; 17 km S of Hurgada, 23.viii.1989, leg. H. & S. Dekker & C. Dekker-Rentenaar, HD 24579 [1, Fig. 1]; 4 km N of Safaga, 3.x.1999, leg. H. Dekker, HD 3145 [1]; 4 km N of Safaga, 2001, leg. H. & S. Dekker & C. Dekker-Rentenaar, HD 6801 [4, Fig. 7]; 10 km S of Safaga, 29.viii.1988, leg. H. Dekker, HD 24577 [1]; Sharm el-Naga, 28-31.viii.1988, leg. H. Dekker, HD



Figs 1-7. *Rubritrochus declivis*, Egypt, Red Sea. **1**, 17 km S of Hurghada, 23.viii.1989, leg. H. & S. Dekker & C. Dekker-Rentenaar, HD 24579, H 19.7 mm. **2-4**, Gulf of Suez, Sinai, at Sheraton construction site, 29.vi.2006, leg. H. Dekker, HD 19636; **2**, H 17.8 mm; **3**, H 21.9 mm; **4**, H 17.0 mm. **5-6**, Sharm el-Naga, 28-31.viii.1988, leg. H. Dekker, HD 24578; **5**, H 13.4 mm; **6**, H 5.6 mm. **7**, 4 km N of Safaga, 22.ix.-5.x.2001, leg. H. Dekker, HD 6801, H 15.8 mm.



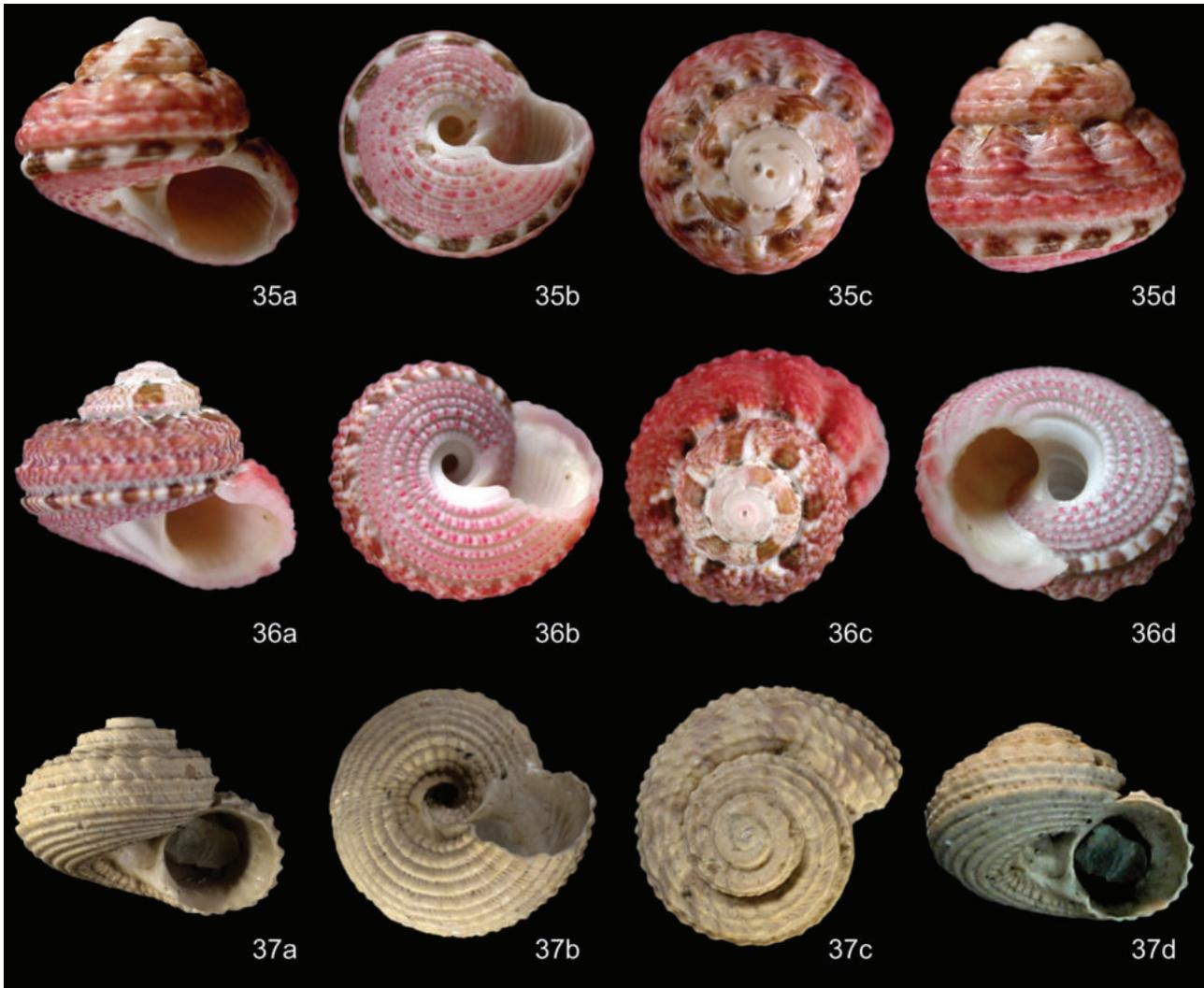
Figs 8-16. *Rubritrochus pulcherrimus*. 8-9, Mozambique, Nacala Bay, 1999, HD 1951; 8, H 15.5 mm; 9, 18.1 mm. 10-11, Mozambique, HD 22938; 10, H 16.8 mm; 11, H 18.1 mm; 11c operculum W 5.2 mm. 12-15, United Arab Emirates, Sharjah, Gulf of Oman, Khor Fakkan, 15.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16171; 12, H 15.8 mm; 13, H 11.9 mm; 14, H 10.4 mm; 15, H 9.9 mm. 16, lectotype of *Trochus fanuloides* Fischer, 1874, MNHN-IM-2000-31147, H 13 mm.



Figs 17-25. *Rubritrochus moolenbeeki* spec. nov. 17-21, Oman, Musandam, Kumzar, 6.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle. 17, holotype RMNH.5004023, H 16.6 mm; 18-21, HD 17421, 18, H 18.4 mm; 19, H 13.6 mm; 20, H 17.6 mm; 21, H 13.8 mm. 22, United Arab Emirates, Fujairah, Gulf of Oman, Al Kubus, harbour, 13.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16144, H 15.1 mm. 23, Oman, Musandam, Lima, 10.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16647, H 11.9 mm. 24, Oman, Musandam, Khasab, 6.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 14444, H 15.3 mm. 25, Yemen, Red Sea, 3 km N of al-Faz-zah, 18.iv.1993, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 7530, H 17.7 mm.



Figs 26-34. *Rubritrochus* species. 26-27, *R. ellenae* spec. nov., circa 300 km SE off Rodrigues Island, R/VAnton Bruun cruise 2, station 124F, 24.vi.1963; 26, holotype, USNM 716609, H 12.3 mm; 26c operculum W 4.0 mm; 27, paratype, USNM 1299480, H 7.3 mm. 28, *R. species* 1, Seychelles, Anse de la Mouche, leg. D. Smits, 1999, ZMA.MOLL.37862, H 12.7 mm. 29-30, *R. andamanensis* spec. nov.; 29, Andaman Islands, holotype, ex Sowerby, ex coll. M.M. Schepman, ZMA.MOLL.425617, H 11.5 mm; 30, Andaman Islands, specimen figured by E.A. Smith, 1879: pl. 50 figs 22,22a. 31-34, *R. simoni* spec. nov., Thailand, Andaman Sea. 31, Racha Islands, paratype, HD 24263, H 11.4 mm; 32, Phuket Island, off Cape Phromthep, 20 m, paratype HD 977, H 17.2 mm; 33, Phuket Island, Le Phang Bay, Ban Bang Thao III, 27.i.1995, leg. H. & S. Dekker & C. Dekker-Rentenaar, paratype HD 24261, H 10.0 mm; 34, Phuket Island, Kamala Beach, 9.xi.1996, leg. H. & S. Dekker & C. Dekker-Rentenaar, holotype, RMNH.5004024, H 8.5 mm.



Figs 35-37. *Rubritrochus* species. 35-36, *Rubritrochus lagerweijae* spec. nov.; 35, Sri Lanka, Waikkal, beached, ii.2011, holotype, RMNH.MOL.277624, H 11.2 mm; 36, Sri Lanka, Mannar, dived 5-10 m, HD 38022, H 10.3 mm. 37, *R. bonneti* (Cossmann, 1910), one of two syntypes of *Solariella pachyozodes* var. *bonneti* Cossmann, 1910, Karaikal, Pliocene, MNHN.F.J08861, H 7.0 mm.

24578 [6, Figs 5-6]; Sharm el-Naga, 28-31.viii.1988, leg. J. Goud & W. van Dongen, RMNH.140624 [5]; Makadi Bay, 1999, leg. H. Dekker, HD 3289 [5]; Gulf of Aqaba, Sinai, Dahab, leg. H. & S. Dekker & C. Dekker-Rentenaar, HD 24580 [8 + 6 juveniles]; Marsa Alam area, Ras Baghdadi, 3-9.iii.2009, leg. H. Dekker, HD22832 [2]; Nuweiba, 15.x.1996, leg. H. van Rossum, ZMA.MOLL.61214 [3 juveniles]; Sharm el-Sheick, 1-2 m, 10.ix.1998, leg. E. Heiman, ZMA.MOLL.76670 [2]; Taba, iii.1980, leg. A.W. Burger, ZMA.MOLL. 307744 [3]; Gulf of Aqaba, xi.1996, don. H. Hopman, ZMA.MOLL. 307742 [2]. **Red Sea:** ZMA.MOLL. 307743 [2]; leg. Ruijsenaers, ZMA.MOLL. 307746 [3].

Habitat. – Found living in the intertidal zone, were they emerged from sand close to a reef flat at sunset (own observation, Sharm el-Naga, 1988); also found living on sandy reef flats with algae in shallow water.

Distribution. – Endemic for the northern part of the Red Sea, including the Gulfs of Suez & Aqaba. The

southernmost reported locality on the eastern Red Sea coast is Saudi Arabia, Jeddah (Beck, 1995: 67), on the western Red Sea coast this is Port Sudan (Mastaller, 1978: 129).

Remarks. – Juvenile specimens are quite different from adult specimens, they are more flattened and strongly bicarinate at the periphery. The blackish dotted spiral ribs around the umbilicus together with the sharply terminated axial ribs characterize this species.

***Rubritrochus moolenbeeki* spec. nov.**

(Figs 17-25)

Gibbula declivis – Melvill & Standen, 1901: 348.

Gibbula (*Forskålia*) *declivis* [in part] – Horst & Schepman, 1908: 464, nr. b.

Gibbula declivis – Green, 1994: 21, figs.; Hosseinzadeh et al, 2001: 9; Kohan et al., 2012: 36, pl. 2 fig. 1.

Gibbula (Forskalea) declivis – Dekker & de Ceuninck van Capelle, 1994: 125.

Rubritrochus pulcherrimus [in part] – Beck, 1995: 69, pl. 2 figs 5-6 [non Adams].

Rubritrochus pulcherrimus – Dupont & Altamimi, 2002: 35; 2008: 43.

Stomatia cf rubra – Dupont & Altamimi, 2002: 40; 2008: 48.

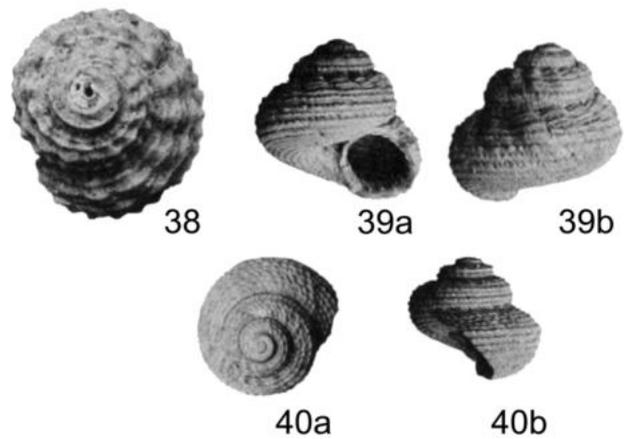
Description. – Turbiniform shell with a maximum observed height of 23.2 mm, apex flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery in rounded projection. Adapical part of whorl with 6-8 spiral ribs, periphery bears row of rounded tubercles. Then 2 small spiral ribs followed by a deep groove, which is obliquely striated by growth lines, and a broader spiral rib. On base 3-4 tuberculated spiral ribs, with further 3-4 tuberculated spiral ribs towards umbilicus in different colour pattern. Umbilicus narrow and deep, bordered by one thick spiral rib ending in tooth at abapical part of columella. Aperture white nacreous, inside outer lip with 16-20 strong spiral lirae. Operculum round, multispiral, with concave outer surface and conical internal surface, brownish yellow.

Colour. – Shell whitish, sometimes dark grey, with fine reddish dots on spiral ribs. Additional axial to oblique reddish streaks from suture to periphery. Occasionally adapical part of whorls are brown-red between axial ribs. Abapical strong peripheral spiral rib alternates from white to red, following axial streaks on base. Base has oblique reddish flames following tubercles, which in some specimens is lacking, often with fine red dots added on outer spiral ribs. The 3(-4) spiral ribs around umbilicus usually have alternating dots in white and reddish-black. Spiral rib bordering umbilicus is white, inside umbilicus off-white.

Type locality. – Oman, Musandam, Kumzar.

Type material. – Holotype (Fig. 17): beached, leg. H. Dekker & F.G. de Ceuninck van Capelle, 6.ii.2004, RMNH.5004023, height 16.6 mm, width 17.4 mm.

Type material. – Paratypes (Figs 18-25): **Yemen:** Red Sea, 3 km N of al Fazzah, 18.iv.1993, HD 7530 [2] (Fig. 25); Red Sea, al Luhayyah, 11.iv.1993, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 7531 [2]. **Oman:** Oman, leg. D.T. Bosch, 1991, HD 31288 [2]; Oman, 2007, leg. D.T. Bosch, ZMA.MOLL.94454 [1]; Musandam, Khawr ash Shamm, Qanaha, 6.11.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 17458 [1]; Musandam, Khawr ash Sham, 1.2 km SW of Seebi, 7.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 7531 [9]; Musandam, Kumzar, 6.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 17421 [14] (Figs 18-21); Musandam, Lima, 10.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16647 [4] (Fig. 23); Musandam, Hanah, 5.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 17926 [2]; Musandam, W coast, 6.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD



Figs. 38-40. *Rubritrochus* species. 38-39, *R. pachyozodes* (Cossmann, 1910), original after Cossmann, 1910, pl. 5 figs 11-13. 40, *R. bonneti* (Cossmann, 1910), original after Cossmann, 1910, pl. 5 figs 14-15.

13809 [2]; Musandam, Khasab, in sand from harbor, 6.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 14444 [10] (Fig. 24); Masirah Island, leg. D.T. Bosch, ZMA.MOLL.307745 [3]. **United Arab Emirates:** Gulf of Oman, Fujairah, Al Kubus, 13.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16144 [1] (Fig. 22); Gulf of Oman, Sharjah, Khor Fakkan, 15.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16170 [18]. **Saudi Arabia:** Persian Gulf, Ad-Dammam, HD 21089 [1]. **Persian Gulf, Shell Research:** 24°53'30"N 51°40'00"E, 18 m, 15.xi.1966, RMNH.MOLL.140612 [1]; 25°10'10"N 53°21'00"E, 17 m, viii.1965, RMNH.MOLL.140616 [3]; 25°10'20"N 53°14'20"E, 15 m, viii.1965, RMNH.MOLL.140619 [1]; 25°10'20"N 53°15'40"E, 15 m, viii.1965, RMNH.MOLL.140620 [1]; 25°12'30"N 53°05'10"E, 15 m, viii.1965, RMNH.MOLL.140617 [1]; 25°14'50"N 54°00'40"E, 27 m, 29.ix.1966, RMNH.MOLL.140621 [1]; 26°36'40"N 50°53'00"E, 16 m, 26.x.1966, RMNH.MOLL.140618 [1]; 26°43'00"N 50°54'20"E, 21 m, 16.ix.1966, RMNH.MOLL.140623 [1]; 26°47'05"N 50°55'40"E, 19 m, 16.ix.1966, RMNH.MOLL.140622 [4].

Other material studied. – Oman, off Seeb, dredged, 30 m, 1991, ZMA.MOLL.425616 [4]; Yemen, Red Sea, al-Mukha, 22.iv.1993, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 7531 [1]; United Arab Emirates, Gulf of Oman, Sharjah, Lulayyah, 14.ii.2004, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 16009 [3]; Yemen, Red Sea, S coast as-Salif Peninsula, 13.iv.1993, leg. H. Dekker & F.G. de Ceuninck van Capelle, HD 7531 [1]; Oman, off Seeb, dredged, 30 m, 1991, ZMA.MOLL.162307 [2 juveniles]; United Arab Emirates, Sharjah, Dara wreck, 24 m, 1998, leg. M. Larkworthy, ZMA.MOLL.16215 [1 juvenile]; Daymaniyat Islands, 10-15 m, 17.xi.1998, leg. R.G. Moolenbeek, ZMA.MOLL. 61212.

Habitat. – Most specimens were found empty on the beach, but also recorded living in shallow water to 30 m on a sandy substrate.



Fig. 41. Distribution of *Rubritrochus* species. Living species indicated by dots, fossil species by squares. Yellow dots: *R. declivis*; pink dots: *R. moolenbeeki*; orange dots: *R. pulcherrimus*; purple dot: *R. species 1*; dark blue dot: *R. ellenae*; dark green dots: *R. lagerweijae*; dark yellow dot: *R. andamanensis*; brown dot: *R. simoni*; light blue square: *R. africanus*; green square: *R. pachyozodes* & *R. bonneti*.

Distribution. – From the southern Red Sea towards the Gulf of Oman and into the Persian Gulf.

Etymology. – Named after Robert G. Moolenbeek. For many years he was the collection manager of the former Zoological Museum, University of Amsterdam; the collection is currently stored at the NBC. He has a very large knowledge of many shells, especially the Conidae, Caribbean shells and microshells. His knowledge and positive attitude has encouraged many people to work on molluscs, like myself.

Remarks. – *Rubritrochus moolenbeeki* spec. nov. is similar to *R. declivis*, but differs in its roundly terminated axial ribs, the deep groove along the periphery, instead of being bicarinated, the more reddish impression of the shell and the prominent spiral lirae inside the aperture. Both species do not occur sympatrically as far is known.

***Rubritrochus ellenae* spec. nov.**
(Figs 26-27)

Rubritrochus pulcherrimus [in part] – Beck, 1995: 69, pl. 2 figs 3-4.

Description. – Turbiniform shell with a maximum observed height of 12.3 mm, apex flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery in tubercle. Adapical part of whorl with spiral ribs, periphery bears row of tubercles, then 4-5 small spiral ribs followed by finely

crenulated spiral rib. On base 4-5 spiral ribs, with 3 broader spiral ribs towards umbilicus in different colour pattern. Umbilicus narrow and deep, bordered by one crenulated spiral rib ending in tooth at abapical part of columella. Aperture white nacreous, inside outer lip without spiral lirae. Operculum round, multispiral, with concave outer surface and conical internal surface, brownish yellow.

Colour. – Shell whitish, with fine pink or yellowish dots on spiral ribs. Additional axial to oblique brown to dark greenish streaks from suture to periphery, occasionally adapical part of whorls are brown between axial ribs. Abapical stronger peripheral spiral rib has pinkish dots or stripes. Outer spiral ribs on base have yellowish dots, but one of them pinkish. The 3 spiral ribs around umbilicus have alternating dots or stripes in white and ruby red. Spiral rib bordering umbilicus is white with some red dots, inside umbilicus with ruby red colour.

Type locality. – Circa 300 km SE of Rodrigues Island, 21°21'S 65°52'E (but see remarks).

Type material. – Holotype (Fig. 26): R/V Anton Bruun cruise 2, station 124F, 24.vi.1963, USNM 716609, height 12.3 mm. Paratypes (Fig. 27): same as holotype, USNM 1299480 [5].

Habitat. – Dredged.

Distribution. – Only known from the type locality, off Rodrigues Island.

Etymology. – Named after Ellen E. Strong, research zoologist and curator of Mollusca at the USNM, Smithsonian Institution, Washington. She published a number of important papers on molluscs, especially based on molecular techniques. I was in the opportunity to meet her during the Panglao Expedition to the Philippines organized by Philippe Bouchet in 2004. I especially remember her cheerful attitude when preserving together with Yuri Kantor molluscs on alcohol for molecular studies.

Remarks. – *Rubritrochus ellenae* can be recognized by the flat periphery with fine spiral ribs on it, the ruby red coloured umbilicus, and the finely crenulated spiral rib bordering the umbilicus. The holotype has been figured before by Beck (1995: pl. 2 figs 3-4) as *Rubritrochus pulcherrimus*.

According to the co-ordinates given for the Anton Bruun station 124F, the Indian Ocean is circa 3 km deep at the locality in question. This is an unlikely depth for a *Rubritrochus* species. Station 124F is the first station after the cruise made a stop in Mauritius. In the list of stations (Anonymous, 1964) only the use of plankton nets is mentioned for it, but this bottom dwelling species will not be caught with a plankton net. The label accompanying the shells does not mention any depth and should be considered incorrect. Therefore, the exact location of the type locality of *R. ellenae* is unfortunately unknown. I was informed by

Dai Herbert (in litt., 22.xi.2016) that he observed a *Perrinia angulifera* (A. Adams, 1853) from this same station, which is also a species known to live at less than 100 m depth.

***Rubritrochus andamanensis* spec. nov.**
(Figs 29-30)

Trochus (*Forskählia*) *pulcherrimus* – Smith, 1879: 818, pl. 50 figs 22, 22a.

Gibbula (*Gibbula*) *pulcherrima* [in part] – Pilsbry, 1889: 200; 1890: pl. 61 figs 26-27 [figs copy from Smith, 1879].

Gibbula (*Forskählia*) *pulcherrima* – Horst & Schepman, 1908: 464, nr. a.

Rubritrochus pulcherrimus [in part] – Beck, 1995: 69, pl. 1 figs 5-6.

Gibbula declivis – Subba Rao & Dey, 2000: 17, nr. 50.

Gibbula pulcherrima – Subba Rao & Dey, 2000: 17, nr. 51.

Rubritrochus pulcherrimus [in part] – Subba Rao, 2003: 86, pl. 8 fig. 3.

Description. – Turbiniform shell with a maximum observed height of 11.5 mm, apex a little flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery. Adapical part of whorl with 4-6 spiral ribs, spiral rib on termination of axial ribs stronger, followed by 2 smaller granulated spiral ribs and 2 granulated strong protruding spiral ribs and a groove on periphery. Just below periphery strongly beaded spiral ribs towards umbilicus, last one smaller and a little inwards of umbilicus. Umbilicus very narrow and deep, with one thick spiral rib inside, closing it partially, ending in tooth at abapical part of columella. Aperture white nacreous, inside outer lip with 12 strong spiral lirae reaching deep into aperture. Operculum not observed.

Colour. – Shell whitish, with fine red or brownish dots on spiral ribs. Additional axial to oblique red streaks are present, occasionally whole shell is reddish. Peripheral stronger spiral ribs have fine red dots. Spiral ribs just below periphery with larger reddish to blackish dots. Spiral ribs on base have variable pattern of red dots, without striking contrast between outer and inner spiral ribs. Spiral rib bordering umbilicus has weak pink colour, similar to inside of umbilicus.

Type locality. – Andaman Islands.

Type material. – Holotype (Fig. 29): ex Sowerby, ex coll. M.M. Schepman, ZMA.MOLL.425617, height 11.5 mm, width 12.4 mm. Paratypes: Andaman Islands, RMNH [3] (figured Beck, 1995: pl. 1 figs 5-6).

Habitat. – Subtidal rocks (Subba Rao, 2003: 86).

Distribution. – Only known from the Andaman Islands.

Etymology. – Named after the type locality.

Remarks. – Subba Rao (2003) listed *Gibbula declivis* as synonym of *R. pulcherrimus*, indicating that the earlier record by Subba Rao & Dey (2000) of *G. declivis*

concerns *R. andamanensis* spec. nov.

Rubritrochus andamanensis spec. nov. is recognized by its axial ribs with a sharp edge formed by the spiral rib crossing its terminations and by the strongly beaded spiral ribs on the base, which do not show a marked difference between outer and inner colour as in most other species. Also characteristic is the broad spiral rib entering the umbilicus, which closes the umbilicus partially as seen from below. This feature is recognisable in the figure given by Smith (1879: pl. 50 figs 22, 22a).

***Rubritrochus simoni* spec. nov.**
(Figs 31-34)

Description. – Turbiniform shell with a maximum observed height of 17.2 mm, apex a little flattened. Suture impressed, adapical part of whorls without axial ribs. Adapical part of whorl with 6-8 strongly granulated spiral ribs, 2-3 granulated spiral ribs on periphery, only weakly set apart from other spiral ribs. Below periphery the strongly beaded spiral ribs continue towards the umbilicus, with last one smaller than the rest. Umbilicus narrow and deep, with one thick spiral rib inside, closing it partially, ending in tooth at abapical part of columella. Surface between umbilical cord and first spiral rib on base is finely striated by growth lines. Aperture white nacreous, inside outer lip with 11-13 strong spiral lirae reaching deep into aperture. Operculum not observed.

Colour. – Shell whitish, with fine red dots on spiral ribs. Additional axial to oblique red or brownish streaks, occasionally whole shell is red or yellow-brown. Peripheral spiral ribs have similar colour as adapical part of whorls. Spiral ribs just below periphery usually with larger reddish to blackish markings. Spiral ribs on base have variable pattern of red dots, without striking contrast between outer and inner spiral ribs. Spiral rib bordering umbilicus white, inside umbilicus off-white.

Type locality. – Thailand, Andaman Sea, Phuket Island, Kamala Beach, 7°56'55"N 98°16'40"E.

Type material. – Holotype (Fig. 34): beached, leg. H. & S. Dekker & C. Dekker-Rentenaar, 9.xi.1996, RMNH.5004024, height 8.5 mm, width 10.3 mm. Paratypes (Figs 31-33): Thailand, Andaman Sea: Phuket Island, Le Phang Bay, Ban Bang Thao III, 7°59'10"N 98°17'11"E, leg. H. & S. Dekker & C. Dekker-Rentenaar, 27.i.1995, beached, HD 24261 [10] (Fig. 33); Racha Islands, leg. local fishermen of Phuket, Rawai, HD 24263 [1] (Fig. 31); Phuket Island, off Cape Phromthep, dredged, ca. 20 m, don. Patamakanthin, 1998, HD 977 [4] (Fig. 32).

Habitat. – Living on sandy bottom, together with the coral *Heteropsammia cochlea* (Spengler, 1781) (Hoeksema & Best, 1991), ca. 20 m depth, locally beached as empty shells.

Distribution. – Thailand, Andaman Sea, Phuket and Racha Islands.

Etymology. – Named after my father Simon Dekker for his continuous help with shell collecting, sorting shell grit, keeping our shell collecting organized and to commemorate his 99th birthday on 9 December 2017.

Remarks. – This species is easily distinguished from the other living species by the absence of axial ribs, showing the many strongly granulose spiral ribs on the surface. This species is similar to the fossil species *R. bonneti* (Cossmann, 1910) from India, Karaikal (Figs 37, 40), as this species is also lacking the axial ribbing, but *R. simoni* spec. nov. has more equally-sized spiral ribs which are closer together and the ribs on the periphery consists of two close together spiral ribs.

***Rubritrochus lagerweijae* spec. nov.**
(Figs 35-36)

? *Gibbula fanuloides* – Standen & Leicester, 1906: 270.

? *Gibbula pulcherrima* – Standen & Leicester, 1906: 270.

? *Gibbula pulcherrima* – Hylleberg & Kilburn, 2002: 23.

Description. – Turbiniform shell with a maximum observed height of 11.5 mm, apex a little flattened. Suture impressed, adapical part of whorls with strong axial ribs ending just above periphery. Adapical part of whorl with 4-6 spiral ribs, spiral rib on termination of axial ribs stronger, followed by 2 smaller granulated spiral ribs and 2 granulated strong protruding spiral ribs and groove on periphery. Just below periphery strongly beaded spiral ribs towards umbilicus, last one smaller and a little inwards of umbilicus. Umbilicus very narrow and deep, with one thick spiral rib inside, closing it partially, ending in tooth at abapical part of columella. Aperture white nacreous, inside outer lip with 12 strong spiral lirae reaching deep into aperture. Operculum not observed.

Colour. – Shell whitish, with fine red or brownish dots on spiral ribs. Additional axial to oblique red streaks, occasionally whole shell reddish. Peripheral stronger spiral ribs have fine red dots. Spiral ribs just below periphery with larger reddish to blackish dots. Spiral ribs on base with variable pattern of red dots, without striking contrast between outer and inner spiral ribs. Spiral rib bordering umbilicus has weak pink colour, inside umbilicus with weak pink colour.

Type locality. – Sri Lanka, Waikkal (N of Negombo).

Type material. – Holotype (Fig. 35): beached, ii.2011, leg. W. Lagerweij & A. Krumperman, RMNH.MOL.277624, height 11.2 mm, width 11.7 mm. Paratypes: type locality, HD 39567 [1]; Sri Lanka, Mannar, dived at 5-10 m depth, HD 38022, Fig. 36 [1].

Habitat. – Empty shells beached, or dived at 5-10 m depth.

Distribution. – Only known from Sri Lanka.

Etymology. – Named after Wil Lagerweij, who collected two specimens of the type series. She organized many shell collecting trips, one of them was to Egypt in 1988. I was one of the participants and this trip was the start of my strong interest in the shells from the Red Sea and around Arabia.

Remarks. – This new species differs from specimens of *Rubritrochus andamanensis* spec. nov. in having only 6-7 strongly granulated spiral ribs on the base, additionally there are two small spiral ribs in the umbilicus, and the blotched spiral rib just below the periphery being single, not double. It differs from *R. simoni* spec. nov. in having strong axial ribs on the adapical part of the whorls. It differs from the fossil species *R. pachyozodes* (Cossmann, 1910) from India, Karaikal (Figs 38-39) in having much stronger protruding spiral ribs on the periphery.

The material reported by Standen & Leicester (1906) from Sri Lanka (Palk Bay; Gulf of Mannar, Arippe; off Galle) could be conspecific with this new species. Hylleberg & Kilburn (2002: 23) mentioned that *Gibbula fanuloides* as listed by Standen & Leicester (1906) is probably identical to *Gibbula pulcherrima* as mentioned by those authors, but without any arguments.

***Rubritrochus* species 1**
(Fig. 28)

? *Gibbula (Forskålia) pulcherrima* – Melvill, 1909: 80, nr. 27.

Remarks. – Only one specimen (ZMA.MOLL.37862, Fig. 28) from the Seychelles was available for study. It differs from typical specimens of *Rubritrochus pulcherrimus* in being more slender, not having a pink colour inside umbilicus, strongly granular ribs on the base, and the spiral rib in the umbilicus which is located more inside. It is more close to *R. ellenae* spec. nov. in form, but has more spiral ribs on the base, which are light pinkish near the umbilicus.

There are several Indian Ocean records of which the material has to be studied in order to verify their identity. The material reported by Melvill (1909) from the Saya de Malha Banks, Providence Island, Amirantes and Seychelles could be either *Rubritrochus pulcherrimus*, *R. ellenae* spec. nov., or a different species, similar to the one figured here from the Seychelles.

ACKNOWLEDGEMENTS

I thank Fred de Ceuninck van Capelle for making it possible to organize and join me on the Tibia-I (Red

Sea coast of Yemen, 1993) and the Tibia-III (United Arab Emirates & Musandam, 2004) Expeditions, which yielded much of the material used for this study. Rob Moolenbeek (curator of the Mollusca collection of ZMA) is thanked for his enthusiastic help with many shell determination problems, literature search and keeping company during the trips we made together to Oman and Thailand. I am very grateful to Ellen Strong (USNM) for making the photographs from specimens under her care. Wil Lagerweij & André Krumpferman (Ruinen, The Netherlands) are thanked for showing their collection and donating material for study. Manuel Caballer and Peter Massicard (MNHN), project e-ReColNat, are thanked for making the photographs available on the Museum's website. Ruud A. Bank is thanked for giving helpful comments on an earlier version of the manuscript. Dai Herbert and Bruce Marshall are thanked for their helpful suggestions to improve this paper and Richard J. Honeywell is thanked for improving the English.

REFERENCES

- ABBOTT, R.T. & DANCE, S.P., 1983. Compendium of seashells: i-xii, 1-411. E.P. Dutton, Inc., New York [second printing, revised].
- ADAMS, A., 1855. Further contributions towards the natural history of the Trochidae; with a description of a new genus, and several new species, from the Cumingian collection. – Proceedings of the Zoological Society of London 22: 37-41, pl. 27.
- ADAMS, H. & ADAMS, A., 1853-1854. The genera of recent Mollusca; arranged according to their organization. Volume 1: i-xi, 1-484. John van Voorst, London.
- ANONYMOUS, 1964. USA program in biology. International Indian Ocean expedition. Final report: r/v Anton Bruun, cruise 2. Woodshole Oceanographic Institution.
- BECK, L.A., 1995. *Rubritrochus*, a new genus name for *Gibbula pulcherrima* A. Adams 1855 and *Gibbula declivis* (Forsk. 1775). – Archiv für Molluskenkunde 124 (1-2): 65-85.
- BISACCHI, J., 1931. Alcuni *Trochus* del Mar Rosso. – Annali del Museo Civico di Storia Naturale di Genova 55: 176-182.
- BOSCH, D.T., DANCE, S.P., MOOLENBEEK, R.G. & OLIVER, P.G., 1995. Seashells of Eastern Arabia: 1-296. Motivate Publishing, Dubai, Abu Dhabi & London.
- CHEMNITZ, J.H., 1781. Neues Systematisches Conchylien-Cabinet. Volume 5: 1-324, pls 160-193. G.N. Raspe, Nürnberg.
- COSSMANN, M., 1910. Faune pliocénique de Karikal (Inde française), 3e article. – Journal de Conchyliologie 58 (1): 34-86, pls 2-5.
- DEKKER, H. & CEUNINCK VAN CAPELLE, F.G. DE, 1994. Survey of Yemen Red Sea shells collected by the Tibia-I Expedition 1993. – De Kreukel 30 (7-10): 79-147, pls. 1-3.
- DEKKER, H. & ORLIN, Z., 2000. Check-list of Red Sea Mollusca. – Spirula 47 (supplement): 1-46.
- DUPONT, C. & ALTAMIMI, A.G., 2002. Shells of the Qatari shores: 1-176. Dupont & Altamimi, Doha.
- DUPONT, C. & ALTAMIMI, A.G., 2008. Shells of the Qatari shores. Second edition: 1-184. Dupont & Altamimi, Doha.
- GMELIN, J. F., 1791. Caroli a Linne, systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima tertia, aucta, reformata. Volume 1 (6): 3021-3910. G.E. Beer, Lipsiae.
- FABER, M.J., 2011. The holy grail of Louis Charles Kiener's "Spécies général des coquilles vivantes". – Miscellanea Malacologica 5 (3): 61-70.
- FISCHER, P., 1874. Diagnoses specierum novarum. – Journal de Conchyliologie 22: 372-374.
- FISCHER, P., 1875-1879. Spécies général et iconographie des coquilles vivantes, comprenant la Collection du Muséum d'Histoire naturelle de Paris, la collection Lamarck, celle du Prince Masséna (appartenant maintenant à M. B. Delessert) et les découvertes récentes des voyageurs. Vol. 11. Genres *Calcar*, *Trochus*, *Xenophora*, *Tectarius* et *Risella*: i-iii, 1-480, pls 1-120. J.B. Bailliére, Paris [most of the first 56 plates by Kiener, 1849-1850, see Faber, 2011].
- FOWLER, O.M., 2016. Seashells of the Kenya coast: 1-170. ConchBooks, Harxheim.
- GMELIN, J. F., 1791. Caroli a Linne, systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima tertia, aucta, reformata. Volume 1 (6) : 3021-3910. G.E. Beer, Lipsiae.
- GREEN, S., 1994. Bahrain seashells: 1-183. Arabian Printing & Publishing House W.L.L., Bahrain.
- HARZHAUSER, M., 2009. Aquitanian gastropods of coastal Tanzania and their biogeographic implications for the early western Indo-Pacific. – Palaeontographica, Abteilung A 289 (4-6): 123-156.
- HERBERT, D. G., 2015. An annotated catalogue and bibliography of the taxonomy, synonymy and distribution of the Recent Vetigastropoda of South Africa (Mollusca). – Zootaxa 4049 (1): 1-98.
- HOEKSEMA, B.W. & BEST, M.B., 1991. New observations on scleractinian corals from Indonesia: 2. Sipunculan-associated species belonging to the genera *Heterocyathus* and *Heterosammia*. – Zoologische Mededelingen 65 (16): 221-245.
- HORST, R. & SCHEPMAN, M.M., 1908. Muséum d'Histoire Naturelle des Pays-Bas. Tome XIII. Catalogue systématique des mollusques, troisième partie, Leiden: 361-572.
- HOSSEINZADEH, H., DAGHOCHI, B. & RAMESHI, H., 2001. Atlas of the Persian Gulf molluscs: i-xi, 1-208. Iranian Fisheries Research Organisation, Tehran.
- HYLLEBERG, J. & KILBURN, R. N., 2002. Annotated inventory of molluscs from the Gulf of Mannar and vicinity. – Phuket Marine Biological Center Special Publication 26: 19-79.
- IREDALE, T., 1918. Molluscan nomenclatural problems and solutions. No. 1. – Proceedings of the Malacological Society of

- London 13 (1-2): 28-40.
- KIENER, L.C., 1849-1850. *Spécies général et iconographie des coquilles vivantes, comprenant la Collection du Muséum d'Histoire naturelle de Paris, la collection Lamarck, celle du Prince Masséna (appartenant maintenant à M. B. Delessert) et les découvertes récentes des voyageurs*. Vol. 11. Genre Troque (*Trochus*. Linné): pls 2-27, 29-43, 45-46, 50-52, 55-56. J.B. Baillière, Paris [see Faber, 2011 for details; completed by P. Fischer].
- KOHAN, A., BADBARDAST, Z. & SHOKRI, M., 2012. The gastropod fauna along the Bushehr Province intertidal zone of the Persian Gulf. – *Journal of the Persian Gulf* 3 (9): 33-42.
- LAMARCK, J.-B.P.A. DE, 1822. *Histoire naturelle des animaux sans vertèbres, présentant les caractères généraux et particuliers de ces animaux...* Vol. 7: 1-711. By the author, Paris.
- MASTALLER, M., 1978. The marine molluscan assemblages of Port Sudan, Red Sea. – *Zoologische Mededelingen* 53 (13): 117-144.
- MELVILL, J.C., 1909. Report on the marine Mollusca obtained by Mr J. Stanley Gardiner, F.R.S., among the Islands of the Indian Ocean in 1905. – *Transactions of the Linnean Society of London* (2) 13 (1): 65-138, pl. 5.
- MELVILL, J.C. & STANDEN, R., 1901. The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the collections of Mr. F.W. Townsend, 1893-1900; with descriptions of new species. Part 1. Cephalopoda, Gastropoda, Scaphopoda. – *Proceedings of the Zoological Society of London* 1901: 327-460, pls 21-24.
- NIEBUHR, C., 1775. *Descriptiones animalium. Avium, amphibiorum, piscium, insectorum, vermium; quæ in itinere orientali observavit Petrus Forskål*: map, 1-19, i-xxxiv, 1-164. Officina Mölleri, Haunia.
- PILSBRY, H.A., 1889-1890. Family Trochidae. *Manual of conchology; structural and systematic* (1) 11: 1-208, pls 1-50 (1889); 209-519, pls 51-67 (1890).
- POPPE, G.T., TAGARO, S.P. & VILVENS, C., 2009. A new *Clanculus* (Trochidae) from the Philippines with additional notes and new records of Trochidae-species in the Archipelago. – *Visaya* 2 (4): 4-10.
- RUSMORE-VILLAUME, M.L., 2008. *Seashells of the Egyptian Red Sea: the illustrated handbook*: i-xii, 1-307. The American University in Cairo Press, Cairo.
- ROBIN, A., 2008. *Encyclopedia of marine gastropods*: 1-480. A.F.C. Xenophora & ConchBooks, Paris & Hackenheim.
- RÖDING, P.F., 1798. *Museum Boltenianum sive catalogus cimeliorum e tribus regnis naturæ quæ olim collegerat Joh. Fried. Bolten, M.D.p.d. per XL. annos proto physicus Hamburgensis. Pars secunda continens conchyliam sive testacea univalvia, bivalvia & multivalvia*: i-viii, 1-199. J.C. Trappii, Hamburgi.
- SHARABATI, D., 1984. *Red Sea shells*: 1-128. KPI, London, Boston, Melbourne & Henley.
- SMITH, E.A., 1879. On a collection of marine shells from the Andaman Islands. – *Proceedings of the Zoological Society of London* 1878: 804-821, pl. 50.
- STANDEN, R. & LEICESTER, A., 1906. Supplementary reports, No. 38. Report on the molluscan shells collected by Professor Herdman, at Ceylon, in 1902: pp. 267-294. In: W.A. Herdman (ed.), *Report to the government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar, with supplementary reports upon the marine biology of Ceylon, by other naturalists*. Part V: i-viii, 1-452. The Royal Society, London.
- SUBBA RAO, N.V., 2003. Indian seashells (part-1) Polyplacophora and Gastropoda. – *Records of the Zoological Survey of India, Occasional Paper* 192: 1-416, pls 1-96.
- SUBBA RAO, N.V. & DEY, A., 2000. Catalogue of marine molluscs of Andaman and Nicobar Islands. – *Records of the Zoological Survey of India, Occasional Paper* 187: 1-323.
- URIBE, J.E., WILLIAMS, S.T., TEMPLADO, J., BUGE, B., ZARDOYA, R., 2017. Phylogenetic relationships of Mediterranean and North-East Atlantic Cantharidinae and notes on Stomatellinae (Vetigastropoda: Trochidae). – *Molecular Phylogenetics and Evolution* 107: 64-79.
- Website of the Muséum national d'Histoire naturelle, Paris, France, accessed 12 August 2016. <https://science.mnhn.fr/institution/mnhn/collection/im/item/search>.
- WILLIAMS, S.T., DONALD, K.M., SPENCER, H.G. & NAKANO, T., 2010. Molecular systematics of the marine gastropod families Trochidae and Calliostomatidae (Mollusca: superfamily Trochoidea). – *Molecular Phylogenetics and Evolution* 54 (3): 783-809.
- YARON, I., SCHIÖTTE, T. & WIUM-ANDERSEN, G., 1986. A review of molluscan taxa described by P. Forskål and C. Niebuhr with citation of original descriptions, discussion of type-material available and selection of some lectotypes. – *Steenstrupia* 12 (10): 157-203.
- ZUSCHIN, M., JANSSEN, R. & BAAL, C., 2009. Gastropods and their habitats from the northern Red Sea (Egypt: Safaga). Part 1: Patellogastropoda, Vetigastropoda and Cycloneritimorpha. – *Annalen des Naturhistorischen Museum Wien* 111 A: 73-158.