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The lost vent gastropod species of Lothar A. Beck

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Abstract

Deep-sea hydrothermal vents host many endemic species adapted to these chemosynthesis-based ecosystems. The exploration of vent fields including those in the tropical Pacific is currently accelerating, due to the development of deep-sea mining for valuable minerals. Molecular evidence has shown that many vent endemic gastropod lineages include sibling species pairs in adjacent oceanic basins. While the fauna of the Manus Basin is relatively well described, many lineages in adjacent regions in North Fiji or Lau Basins are recognised as separate species, but unnamed. Valuable material from this fauna was studied by Lothar A. Beck in the 1990s, who fully drafted descriptions for these species, but did not publish them. Beck's manuscript names, prior to the present study, represented real species but *nomina nuda* without taxonomic validity. Here we present the descriptions of seven new species and one new genus, extracted from Beck's unpublished manuscript that was rediscovered after his death in 2020. The publication of these descriptions makes them taxonomically available and respects the scientific contributions of Beck. Providing valid descriptions of these species is critically important now to enable the recognition of species that may require conservation in the face of future environmental destruction.

Symmetriapelta Beck, **gen. nov**. is described as new genus. *Bathyacmaea nadinae* Beck, **sp. nov**., *Pyropelta ovalis* Beck, **sp. nov.,** *Pseudorimula leisei* Beck, **sp. nov.**, *Lepetodrilus fijiensis* Beck, **sp. nov.**, *Shinkailepas conspira* Beck, **sp. nov.**, *Symmetromphalus mcleani* Beck, **sp. nov.** and *Symmetriapelta wareni* Beck, **sp. nov.** are introduced as new species.

Key words: Hydrothermal vents, Deep sea, Gastropoda, North Fiji, Lau Basin

Introduction

A feature of most organisms is mortality. Since the relatively recent discovery of deep-sea hydrothermal vents in the 1970s (Corliss *et al.* 1979), hundreds of vent-endemic species have been named by the community of taxonomists (Chapman *et al.* 2019; Desbruyères *et al.* 2006). The discovery of chemosynthesis-based ecosystems in vents led to a major shift in the understanding of deep-sea ecology (Sogin *et al.* 2021), as well as to novel evolutionary studies of holobionts including especially gastropod molluscs (Chen *et al.* 2018; Laming *et al.* 2020). The relatively small number of scientifically active vent specialists and the comparatively short history of this field mean that there has so far been no need for posthumous publication of taxonomic works on vent molluscs, until now.

In this study, we present descriptions for seven previously unpublished species and one genus that were drafted by Lothar A. Beck, who died in 2020 at the age of 66. These are hydrothermal vent limpets from Lau and North Fiji basins in the southwestern Pacific, based on material sent to Beck by colleagues. This exchange followed the recognition that Beck's *Olgaconcha tufari* Beck, 1991 became a junior synonym of *Ifremeria nautilei* Bouchet & Warén, 1991 which was formally published only a few weeks earlier (Philippe Bouchet and Anders Warén, pers. comm.; Beck 1991; Bouchet & Warén 1991). Although we now realise that Beck completed the descriptions in the mid-1990s, they were never published. Some of these species names have been cited several times as *nomina nuda* (Schwarzpaul 2002; Schwarzpaul & Beck 2002; Warén & Bouchet 2001). Fragments of the 18S rRNA gene

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from these species were sequenced and uploaded to NCBI GenBank under these *nomina nuda* (accession numbers AF534975, AF534977, AF534979, AF534981, AF534983, AF534985, AF534989, AF534991, and AF534994) (Schwarzpaul 2002), generating confusion. In published works, these names were attributed to an article by Beck, "in press" in *The Veliger*, entitled 'New archaeogastropod limpets (Gastropoda) from hot vents at North-Fiji and Lau Basins (Southwest Pacific)' (Schwarzpaul 2002; Schwarzpaul & Beck 2002); however, this paper was never published and, evidently, was never submitted to *The Veliger* for review (David R. Lindberg and Terrence Gosliner, pers. comm.).

With further search, the complete manuscript (Supplementary Material) was recovered as part of Beck's habilitation thesis submitted in 1997 to the Philipps-University of Marburg, Germany. The thesis ("*Evolutionsbiologische Untersuchungen an hydrothermalen Tiefseegastropoden*"; Evolutionary biology of deep-sea hydrothermal gastropods) includes one chapter containing the original, complete taxonomic descriptions, but unpublished as defined by the 4th Edition of the International Code of Zoological Nomenclature ('the Code' hereafter; ICZN 1999). From Beck's thesis chapter (see Supplementary Material), it was clear that he intended to publish the material elsewhere as a journal article (at the time *Zoologica Scripta*, where it was never published; and later *The Veliger* to which it was never submitted). As Beck's habilitation thesis was clearly not issued to provide a public and permanent scientific record, it therefore must be considered unpublished (ICZN 1999: Article 8.1). The species descriptions contained herein have never been previously published.

Most of the names Beck intended to propose (Supplementary Material) still represent legitimate but unnamed taxa, and the original descriptions do indicate the intended designation of type specimens, which now have been deposited in public museums in the course of the present work. It is important that these names become available with valid descriptions to avoid further confusion. Ongoing research on hydrothermal vent gastropods over the last 25 years has changed the systematics of these taxa (Bouchet *et al.* 2017; Desbruyères *et al.* 2006); this is reflected in the revised and updated classifications presented here and explained in the discussion below.

We have also corrected the records of material examined and type material. All specimens were retained in University of Marburg, and after Beck's death, they were then fortunately returned to the Senckenberg Museum, Frankfurt (SMF) and Museum national d'Histoire naturelle, Paris (MNHN). In the course of this work, we found numerous discrepancies between the materials listed by Beck in his unpublished manuscript and the specimens actually recovered in SMF and MNHN. The 'materials examined' notes have therefore been entirely rewritten to reflect the recovered specimens and their new museum catalogue numbers, now all deposited in MNHN, SMF, or National Museum of Nature and Science, Tsukuba (NSMT).

In some cases, Beck had indicated potential paratypes from localities other than the type localities, but to ensure consistency we have only selected paratypes from the same locality as the respective holotype. Especially in this region, but as a general principle of taxonomic practice, it is important that the holotype and paratype lots have a clear common origin from a single population and ideally a single collecting event. 'Paratype' material from places other than the type locality (i.e. the locality of the name-bearing holotype) can run a high risk of representing an unrecognised cryptic species that would generate extreme confusion and frustration for future scientists.

Apart from modernising the systematic treatment and ensuring consistent and accurate representation of the material studied, most of the next sections of text in the present paper (Material and Methods, Abbreviations, and Systematics) were extracted directly from Beck's unpublished work. We have deliberately attempted to retain this text with minimal changes, to present it here as Beck originally intended. Additional modifications or clarifications other than typographic corrections are generally noted in square brackets.

The species described herein are restricted to hydrothermal vents of the North Fiji and Lau basins, and important to current work on the hydrothermal vents of the tropical Pacific. Exploration of this region is accelerating as hydrothermal vents host high-quality ores in the form of seafloor massive sulfide deposits and are being targeted for deep-sea mining (Van Dover *et al.* 2018). Many nations and companies are eyeing commercial exploitation despite major scientific gaps remaining as to the impact of such activities (Amon *et al.* 2022). This has sparked renewed interest in establishing clear and stable descriptions of vent endemic fauna. Superficially similar or plastic morphology across clades makes it difficult to separate species lineages in some vent gastropods (Poitrimol *et al.* 2022). Molecular data for several species in North Fiji and Lau and adjacent regions have shown that the species first recognised as new by Beck are indeed distinct, separate lineages without names (Poitrimol *et al.* 2022; Schwarzpaul 2002). Since Beck did recognise and describe these species, it is appropriate that his contributions are published and recognised.

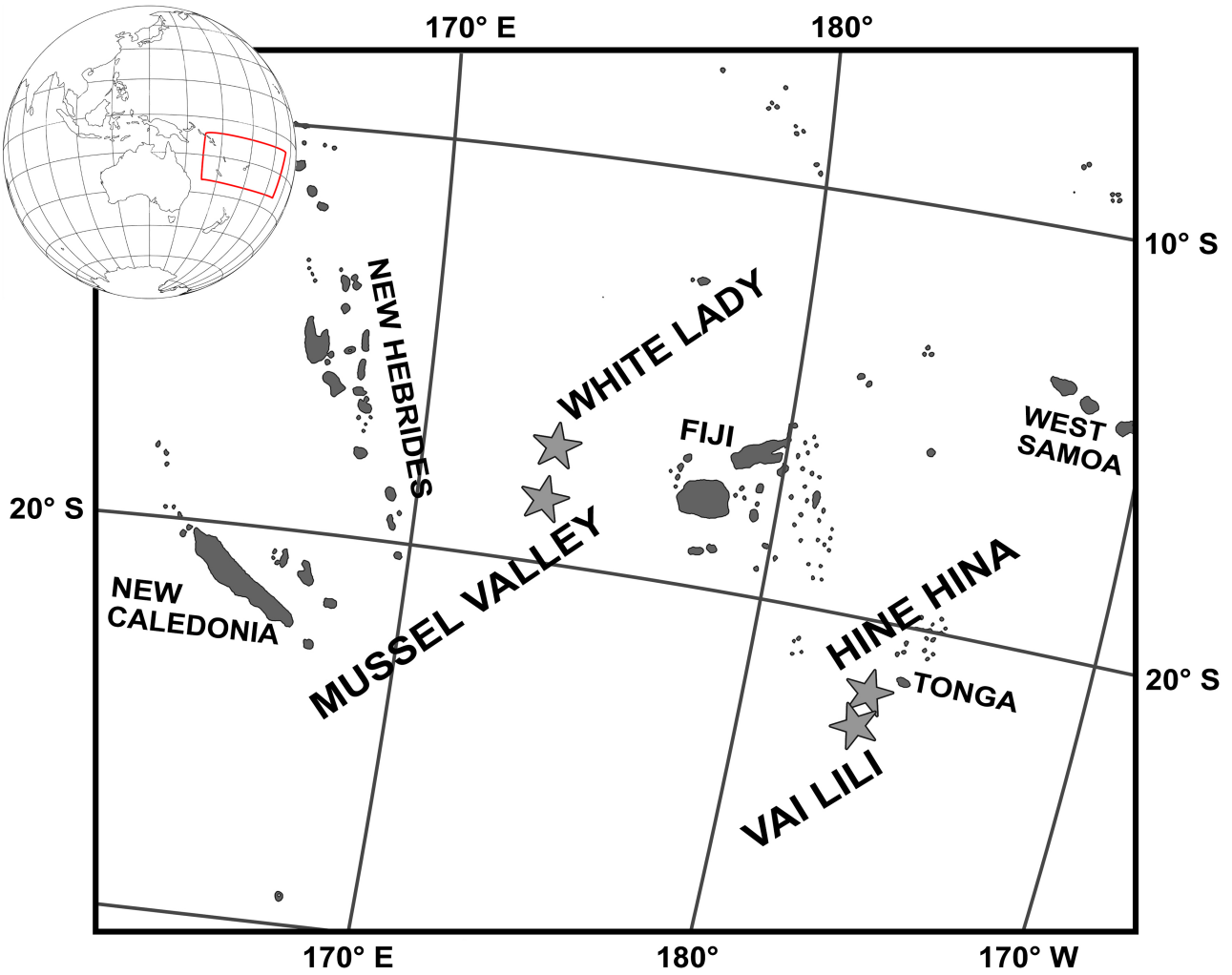

FIGURE 1. Map of the investigated areas. BIOLAU: Hine Hina (22° 32'S, 176° 43'W, ~1900 m) and Vai Lili (23° 13'S, 176° 38'W, ~1750 m); STARMER II: White Lady (16° 59.50'S, 173° 55.47'W, ~2000 m) and Mussle Valley (18° 50'S, l73°29'W, ~2750 m).

There is a new urgency to the description of vent endemic species, since naming the species is the first step towards them becoming visible and available for conservation efforts (Sigwart *et al.* 2019). More than 100 hydrothermal vent mollusc species have been recognised by the IUCN Red List as globally threatened with potential extinction from deep sea mining developments (Thomas *et al.* 2021). Taxonomic recognition of species is a critical first step to protecting them from extinction.

Material and methods

The specimens on which this study is based were collected during joint French-Japanese explorations of the hydrothermal activity in the [Lau and] North Fiji Basins (Fig. 1) (Auzende *et al.* 1989; Fouquet *et al.* 1991; Jollivet *et al.* 1989). The material examined mainly originates from the BIOLAU cruise (chief scientist: Anne Marie Alayse, from May 12-May 27, 1989, at the Ridge of Valufa, "Hine Hina" and "Vai Lili", Lau Basin, 22°S–177°W, ~1900 m) and the STARMER II cruise (chief scientists: D. Desbruyères & S. Ohta, from June 30–July 17, 1989, at "White Lady" and "Mussel Valley", North Fiji Basin l7°-19°S, l73°-174°W, 2000–2750 m [Table 1]).

[All specimens were originally fixed in formalin and subsequently transferred to 70% ethanol.] The specimens were sorted at CENTOB [Centre National de Tri d'Oceanographic Biologique, Brest] and were sent to [Beck] between 1993 and 1996 for taxonomical research. Furthermore, many specimens (including BIOLAU material from JAMSTEC [Japan Agency for Marine-Earth Science and Technology], Yokosuka) were provided by Anders Warén,

TABLE 1. Relevant localities and collecting data for specimens used. The sampling events for the 'BIOLAU' cruises were indicated 'BL'; the stations for the STARMER II expeditions were numbered with "PL" (*plongée*, dive), and these were numbered continuously for the STARMER I and STARMER II cruises though no material from STARMER I is included here.

Cruise	Submersible	Dive	Date	Basin	Site	Latitude	Longitude	Depth (m)
BIOLAU	Nautile	BL01	May 13, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1842
BIOLAU	Nautile	BL02	May 14, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1859
BIOLAU	Nautile	BL03	May 15, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1853
BIOLAU	Nautile	BL04	May 16, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1739
BIOLAU	Nautile	BL05	May 17, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1887
BIOLAU	Nautile	BL06	May 18, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1708
BIOLAU	Nautile	BL07	May 18, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1914
BIOLAU	Nautile	BL08	May 20, 1989	Lau	Hine Hina	22° 32′ S	176° 43′ E	1832-1907
BIOLAU	Nautile	BL09	May 21, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1728-1759
BIOLAU	Nautile	BL10	May 21, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1750
BIOLAU	Nautile	BL11	May 22, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1715-1760
BIOLAU	Nautile	BL12	May 24, 1989	Lau	Vai Lili	23° 13′ S	176° 38′ E	1750
STARMER II	Nautile	PL10	July 5, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL11	July 6, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL12	July 7, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL13	July 8, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL14	July 9, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL15	July 10, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL16	July 11, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL17	July 12, 1989	North Fiji	Mussel Valley	18° 50′ S	173° 29′ E	2750
STARMER II	Nautile	PL18	July 13, 1989	North Fiji	Mussel Valley	18° 50′ S	173° 29′ E	2750
STARMER II	Nautile	PL19	July 14, 1989	North Fiji	Mussel Valley	18° 50′ S	173° 29′ E	2750
STARMER II	Nautile	PL20	July 15, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000
STARMER II	Nautile	PL21	July 16, 1989	North Fiji	White Lady	16° 59′ S	173° 55′ E	2000

Swedish Museum of Natural History, Stockholm [and James McLean, Los Angeles County Museum of Natural History]. Selected type material and further specimens examined are listed under the respective heading that also includes the respective repository. Radulae were usually extracted from preserved specimens after dissolution of tissues in 10% KOH, washed in water, air-dried, and coated with gold (Baker Union Sputter) for examination with a SEM [Scanning Electron Microscope] (Hitachi S-530). Since parts of the radulae [for patellogastropods] dissolve in alkaline solutions, they were mounted without KOH dissolution. Soft parts of all species examined were critical-point-dried via acetone and CO_2, then sputtered with gold and examined with SEM. A dissecting microscope (Wild, Switzerland) with mounted drawing reflector [i.e. camera lucida] was used for the drawings.

[In the process of reconstructing Beck's work, we were able to access digital copies of the original SEM images but not the negatives of the original specimen photographs. New photographs had to be taken to prepare the present publication. Specimens over 10 mm in length were photographed in multiple focal points using a Canon EOS 6D digital single lens reflex camera and the image series was stacked using Helicon Focus v5.3. Those smaller than 10 mm were photographed using a DFK 33UX264 USB 3.0 CMOS camera (The Imaging Source Europe) mounted on a Nikon SMZ1270 dissecting microscope and automatically stacked using the Nikon software NIS Elements v5.30.06. In most cases the exact specimen Beck used in his original manuscript (Supplementary Material) was used, but in exceptional cases such as when the specimen had dried out and important anatomical details could no longer be seen, replacement specimens were photographed instead. In all cases, we attempted to reproduce Beck's original figures as closely as possible. All type specimens were measured with Vernier calipers (Table 2).]

TABLE 2. Shell measurements of type specimens.

Specimen	Museum No.	Shell Length (mm)	Shell Width (mm)	Shell Height (mm)
***Bathyacmaea nadinae* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38676	23.0	18.9	8.3
Paratype 1	MNHN-IM-2000-38677	17.7	14.2	6.7
Paratype 2	NSMT-Mo 79402	16.0	12.5	5.9
Paratype 3	NSMT-Mo 79403	11.0	8.3	3.2
Paratype 4	SMF 370350	11.1	8.2	3.4
Paratype 5	SMF 370351	8.1	6.0	2.3
***Pyropelta ovalis* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38678	5.4	3.6	1.0
Paratype 1	MNHN-IM-2000-38679	5.2	3.7	1.2
Paratype 2	NSMT-Mo 79406	5.5	3.8	0.9
Paratype 3	NSMT-Mo 79407	5.1	3.6	1.0
Paratype 4	SMF 370354	3.1	2.2	0.9
Paratype 5	SMF 370355	Fragmented	Fragmented	Fragmented
***Pseudorimula leisei* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38680	4.2	3.0	1.6
Paratype 1	MNHN-IM-2000-38681	4.9	3.7	1.7
Paratype 2	NSMT-Mo 79410	3.2	2.6	1.2
Paratype 3	NSMT-Mo 79411	4.4	3.1	1.7
Paratype 4	SMF 370357	4.7	3.6	2.0
Paratype 5	SMF 370358	2.7	2.4	1.1
***Lepetodrilus fijiensis* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38682	11.0	8.3	4.0
Paratype 1	MNHN-IM-2000-38683	6.5	4.7	2.3
Paratype 2	MNHN-IM-2000-38684	8.4	6.5	3.1
Paratype 3	MNHN-IM-2000-38685	6.8	4.9	2.5

.....continued on the next page

TABLE 2. (Continued)

Specimen	Museum No.	Shell Length (mm)	Shell Width (mm)	Shell Height (mm)
Paratype 4	MNHN-IM-2000-38686	8.5	6.4	3.1
Paratype 5	MNHN-IM-2000-38687	7.2	5.2	2.8
Paratype 6	NSMT-Mo 79413	9.4	7.0	3.8
Paratype 7	NSMT-Mo 79414	8.6	6.5	3.7
Paratype 8	NSMT-Mo 79415	8.1	6.2	3.0
Paratype 9	NSMT-Mo 79416	7.1	5.5	2.5
Paratype 10	NSMT-Mo 79417	5.4	3.8	1.8
Paratype 11	SMF 370360	9.3	6.8	3.1
Paratype 12	SMF 370361	8.0	6.3	2.9
Paratype 13	SMF 370362	7.3	6.1	2.7
Paratype 14	SMF 370363	8.3	6.3	3.4
Paratype 15	SMF 370364	5.6	4.1	1.9
***Shikailepas conspira* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38688	21.3	19.0	9.0
Paratype 1	MNHN-IM-2000-38689	20.3	17.7	7.2
Paratype 2	NSMT-Mo 79422	16.8	14.5	6.7
Paratype 3	NSMT-Mo 79423	7.7	5.8	3.1
Paratype 4	SMF 370381	20.5	18.9	8.4
Paratype 5	SMF 370382	8.8	7.6	2.8
***Symmetromphalus mcleani* sp. nov. Beck**				
Holotype	MNHN-IM-2000-38690	7.1	4.2	2.0
Paratype 1	MNHN-IM-2000-38691	5.9	3.8	2.0
Paratype 2	MNHN-IM-2000-38692	1.3	1.0	0.4
Paratype 3	NSMT-Mo 79425	4.9	4.1	1.7
Paratype 4	NSMT-Mo 79426	3.5	2.5	1.3
Paratype 5	SMF 370385	6.8	4.3	2.3
Paratype 6	SMF 370386	3.7	2.8	1.5
***Symmetriapelta wareni* gen. et sp. nov. Beck**				
Holotype	MNHN-IM-2000-38693	4.1	2.8	1.5
Paratype 1	MNHN-IM-2000-38694	4.0	2.9	1.2
Paratype 2	MNHN-IM-2000-38695	Fragmented	Fragmented	Fragmented
Paratype 3	NSMT-Mo 79429	3.6	1.9	1.2
Paratype 4	NSMT-Mo 79430	3.3	2.2	1.3
Paratype 5	SMF 370390	4.1	2.8	1.7
Paratype 6	SMF 370391	3.2	2.0	1.1

Abbreviations used in the text

CENTOB	Centre National de Tri d'Oceanographic Biologique, Brest
EPR	East Pacific Rise
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
MNHN	Muséum national d'Histoire naturelle, Paris
NSMT	National Museum of Nature and Science, Tsukuba
SMF	Senckenberg Museum Frankfurt

Abbreviations used in the figures

a	anus
bu	buccal mass
ca	calcified part of operculum
co	conchiolin part of operculum
cpv	circum pallial vein
et	cephalic tentacle
dg	digestive gland
ebv	efferential branchial vein
ep	epipodial appendage
fgo	footgland opening [i.e. anterior pedal gland opening]
fs	foot sole
ga	gill axis
gl	gill lamella
gon	gonad
i	intestine
ja	jaw
lk	left kidney
nu	nucleus of operculum
ol	oral lobe
op	operculum
ov	ovary
p	pericard
pe	penis
pm	pallial margin
r	rachidian tooth of radula
ra	radula
re	rectum
rk	right kidney
rva	region of ventricle and auricle
s	shell
sg	seminal groove
sm	shell muscle
sn	snout
te	testis
tf	transverse furrow on oral lobe
trs	transition to radular sac
ugp	uro-genital papilla
vd	vas deferens

Systematics

Class Gastropoda

Subclass Patellogastropoda

Superfamily Lottioidea

Family Pectinodontidae

***Bathyacmaea nadinae* Beck, sp. nov.**
Figs 2–5
[ZooBank LSID: urn:lsid:zoobank.org:act:1F6BE1B6-5801-4BB6-B280-90CF4B1C44B9]

Type material. Holotype [MNHN-IM-2000-38676] and one paratype in MNHN [Paratype 1: MNHN-IM-2000-38677], two paratypes in NSMT [Paratype 2: NSMT-Mo 79402; Paratype 3: NSMT-Mo 79403], two paratypes in SMF [Paratype 4: SMF 370350; Paratype 5: SMF 370351].

Type locality. Lau Basin (Hine Hina) 22°32′S–l76°43′W; BIOLAU BL02.

Material examined. The type material and BIOLAU, BL02, 2 specimens [SMF 370352]; BIOLAU, BL08, 4 shells and 1 shell fragment, dry [NSMT-Mo 79404]; STARMER II, PL18, 3 specimens [NSMT-Mo 79405]; STARMER II, PL20, 10 empty shells, dry [SMF 370353]; STARMER II, PL21, 2 empty shells, dry [MNHN-IM-2022-12940].

FIGURE 2. *Bathyacmaea nadinae* **sp. nov.**, shells and soft parts. A–C. Holotype (shell length 23.0 mm). A. Apical view. B. Ventral view showing soft parts in retracted condition. C. Lateral view of left side. D–F. Shell of paratype 3 (shell length 11.0 mm). D. Apical view, apex eroded. E. Ventral view. F. Lateral view of right side showing conspicuous steps of growth.

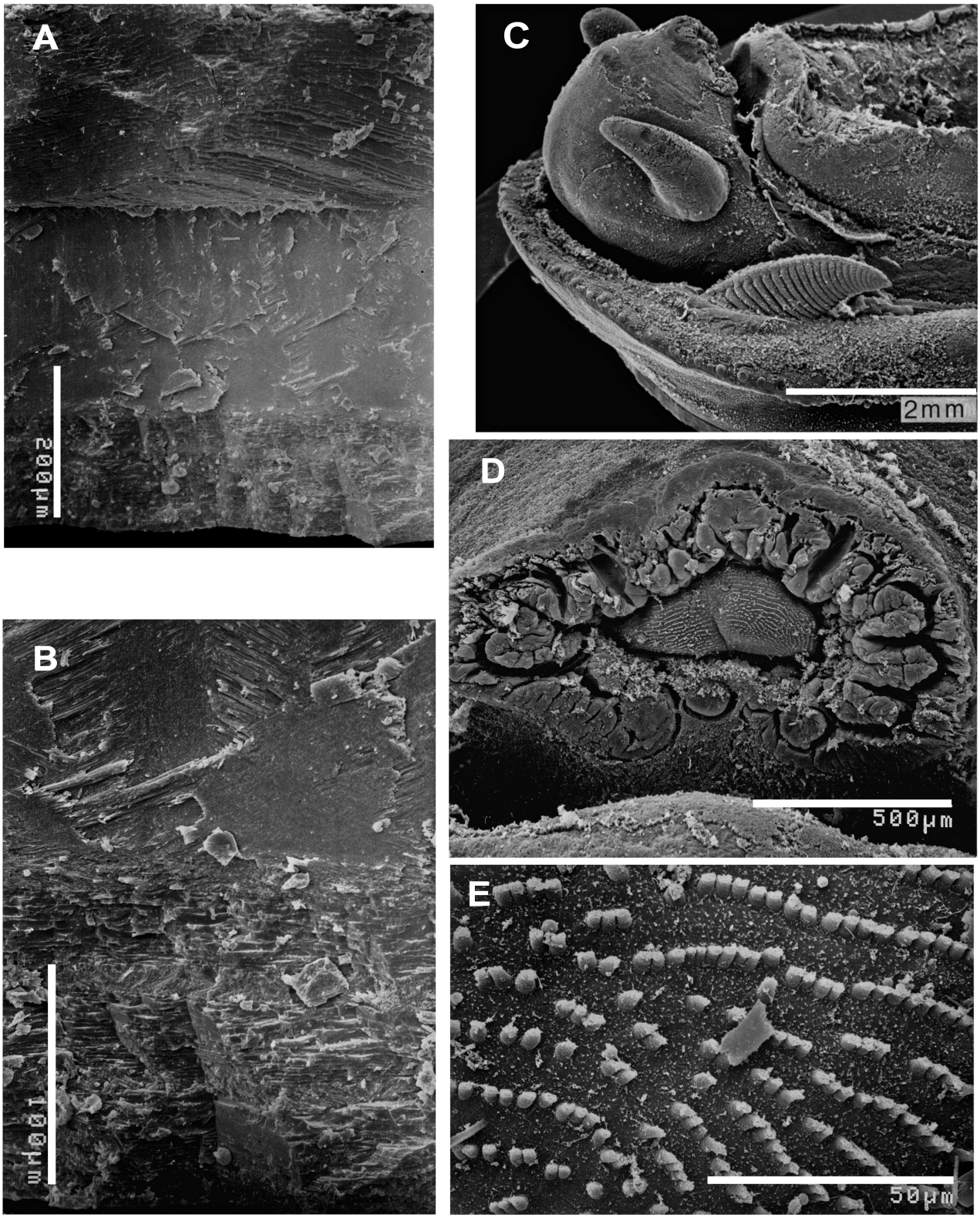

FIGURE 3. *Bathyacmaea nadinae* **sp. nov.**, SEM micrographs of shell and soft parts. A, B. Tangential shell fracture from the mid-point at the middle between apex and shell margin showing three layers: A. Shell layers (from top to bottom) concentric, crossed-lamellar and radial-lamellar prismatic. B. Concentric crossed-lamellar and radial crossed-lamellar layer. C–E. Soft parts. C. Anterior part, oblique view from right. D. Snout with mouth-opening, oral fringe and slightly protruded odontophore. E. Surface of odontophore equipped with rows of minute pins. [Scale bars: A, 200 µm; B, 100 µm; C, 2 mm; D, 500 µm; E, 50 µm.]

Distribution. Lau Basin and [North] Fiji Basin in bathyal areas of diffuse hydrothermal venting.

Etymology. Named after [Beck's] daughter Nadine who had to suffer from [his] time-consuming job. Species name refers to the latinized form of the name Nadine.

Description. *Shell* (Figs 2A–F, 3A, B). In adults: very solid, with oval outline, profile low to medium, anterior slope somewhat steeper than posterior slope, slopes with fine irregular growth-lines and up to three conspicuous steps of growth, apex on mid-line, strongly eroded, protoconch lost, external shell surface smooth except the effects of growth and hydrothermal black incrustations. Internal surface with transparent outer margin (parallel-lamellar prismatic layer) and barely marked muscle scar (myostracum). In juveniles: shell thin and fragile without an inner, radial, crossed-lamellar layer, external surface with irregular, weak, radial riblets; sporadically, the crescent shaped scar of the protoconch is preserved. Shell structure (Figs 3A–B) shows three layers: an outer, parallel—lamellar (foliated), a middle, concentric, crossed—lamellar and an inner, compact, prismatic layer with amorphous fillings. In the apical region, the foliated layer usually is eroded. The myostracum is not demonstrated here.

Dimensions. Holotype: length: 23.0 mm, width 18.9 mm, height 8.3 mm; paratype 1: 17.7 x 14.2 x 6.7 mm; paratype 2: 16.0 x 12.5 x 5.9 mm; paratype 3: 11.0 x 8.3 x 3.2 mm; paratype 4: 11.1 x 8.2 x 3.4 mm; paratype 5: 8.1 x 6.0 x 2.3 mm.

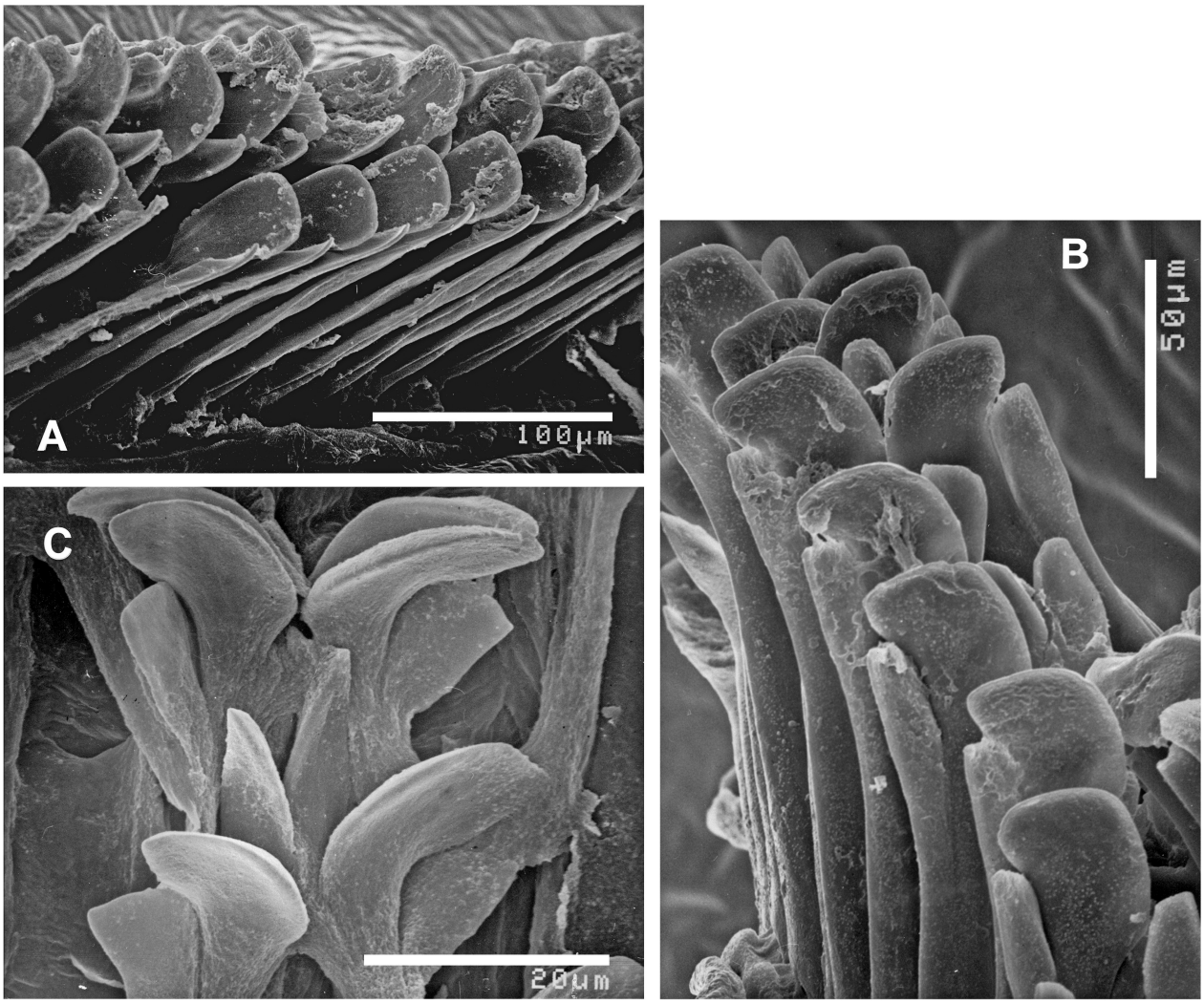

FIGURE 4. *Bathyacmaea nadinae* **sp. nov.**, SEM micrographs of radulae. A. Specimen from BIOLAU BL02. B. Specimen from STARMER II PL18. C. Juvenile specimen from BIOLAU BL07 (shell length 3 mm). [Scale bars: A, 100 µm; B, 20 µm; C, 50 µm.]

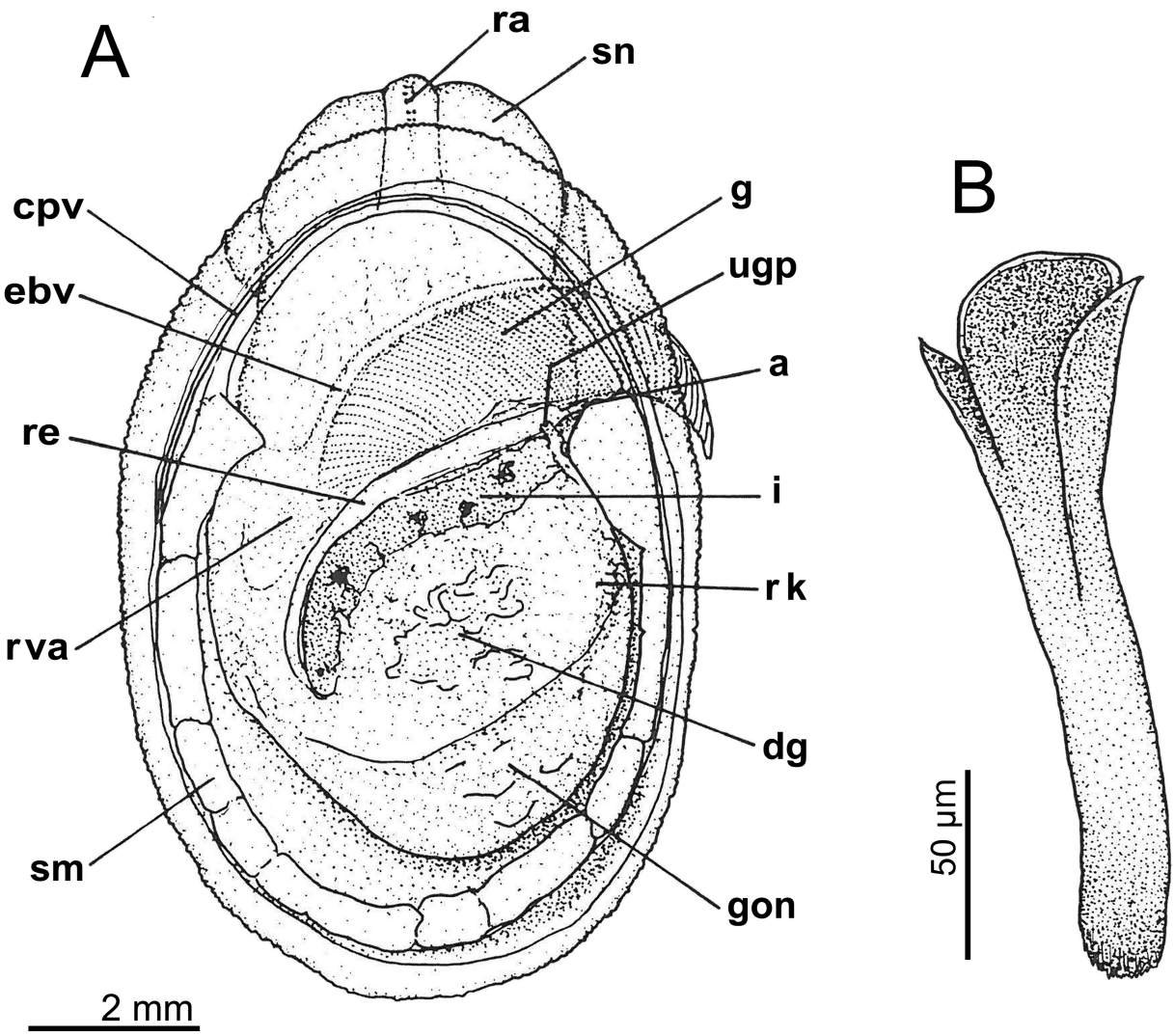

FIGURE 5. *Bathyacmaea nadinae* **sp. nov.** A. Dorsal view of soft parts, neck and gill seen by transparency. B. Single, right, lateral, trifid tooth of radula.

Radula (Fig. 4). Docoglossate, central teeth and marginal teeth completely lacking, formula 0.1.0.1.0, lateral teeth asymmetrically arranged within a transverse row, the distal third of each tooth is impregnated with ferrous oxides causing the dark brown colour that can be seen by using a microscope. Lateral tooth with long basal plate and a trifid distal part which shows a short and slender inner ramus, a broad, middle, non-determined ramus and a well-developed, outer ramus, the middle ramus towers somewhat above the inner and outer rami. In juveniles (specimen of 3.0 mm shell length), the basal plate appears to be weaker and the inner and outer rami appear to be stronger.

Soft parts (Fig. 3C–E). Operculum lacking. Animal of white colour. Head with small tapering cephalic tentacles, no eyes, snout tapering with a small mouth-opening, oral fringe folded in retracted condition and weakly papillated. Surface of odontophore (Figs 3D, E) equipped with rows of minute pins. Foot with a large, ciliated foot sole without a foot gland opening, no epipodial appendages; pallial edge with numerous, minute papillae, pallial skirt thin and transparent in the posterior two thirds but thicker and non-transparent in the anterior third; the pallial margin is attached to the shell. Shell muscle horseshoe-shaped, anterior ends bent to midline, while the end of the right arm is somewhat larger than the end of the left arm; shell muscle arranged in bundles of unequal size; pallial cavity shallow extending to about one third of animal length from anterior end; gill of moderate size, bipectinated, dorsal and ventral gill lamellae of equal size, gill on left side delimited by efferent branchial vein, on right side by the afferent branchial vein, finger-shaped anus papilla and urogenital-papilla on right dorsal side of the cavity; at nuchal region and pallial floor loops of oesophagus, intestine and oesophageal pouches can hardly be observed.

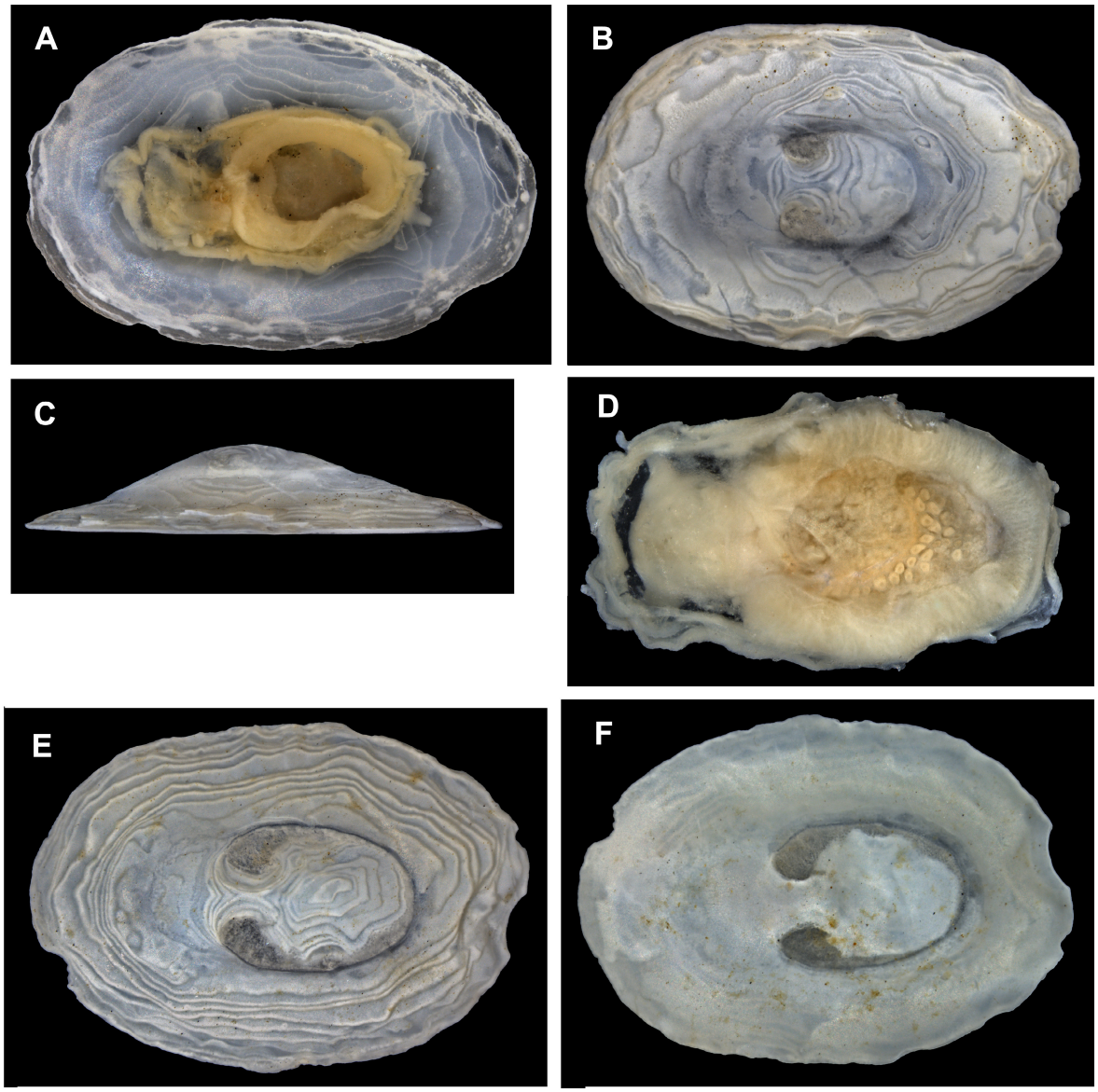

FIGURE 6. *Pyropelta ovalis* **sp. nov.**, shell and soft parts. A. Paratype 2 (shell length 5.5 mm; anterior to the left), ventral view. B–C. Holotype (shell length 5.4 mm; anterior to the left). B. Apical view. C. Lateral view. D. Paratype 3 (shell length 5.1 mm, anterior to the left), Soft parts removed from shell in dorsal view (cf. Fig. 8). E–F. Paratype 1 (shell length 5.2 mm; anterior to the left). E. Apical view on shell. F. Ventral view on shell; note the heavily marked horseshoe-shaped scar of shell muscle.

Visceral mass. The loops of the gut system continue into the visceral mass whereas the large intestine is recognizable by black mineral crystals and greyish flaky material, the stomach is covered by the digestive gland which is situated apically, the rectum crosses the visceral mass diagonally, running parallel to one loop of the intestine. The right kidney and its opening (the urogenital papilla) can be recognized in the excretory system, but the left kidney, which is usually situated anterior to the rectum in *Bathyacmaea*, is not clearly detectable without cross sectioning. The gonad lies under the digestive gland and reaches to the posterior end of the visceral mass. Of the circulatory system, the region of ventricle and auricle can be seen on left side at the base of the gill; a circumpallial vein as well as efferent and afferent branchial veins are clearly visible; capillary vessels could not be detected. Apparently, osphradia are not present.

Subclass Vetigastropoda

Superfamily Lepetelloidea

Family Pyropeltidae

***Pyropelta ovalis* Beck, sp. nov.**
Figs 6–8
[ZooBank LSID: urn:lsid:zoobank.org:act:C80CB17D-A870-4A2B-9CA7-008C93EE6D05]

Type material. Holotype [MNHN-IM-2000-38678] and one paratype in MNHN [Paratype 1: MNHN-IM-2000-38679], two paratypes in NSMT [Paratype 2: NSMT-Mo 79406; Paratype 3: NSMT-Mo 79407], two paratypes in SMF [Paratype 4: SMF 370354; Paratype 5: SMF 370355].

Type locality. North Fiji Basin (White Lady). STARMER II, PL21.

Material examined. The type material and: BIOLAU, BL08, 1 specimen, soft parts only [NSMT-Mo 79408]; STARMER II, PL14, 2 specimens [NSMT-Mo 79409]; STARMER II, PL20, 7 adults and 8 juvenile specimens [SMF 370356].

Distribution. North Fiji Basin [and Lau Basin] in bathyal, sulfide-rich areas.

Etymology. Species name refers to the oval form of the shell.

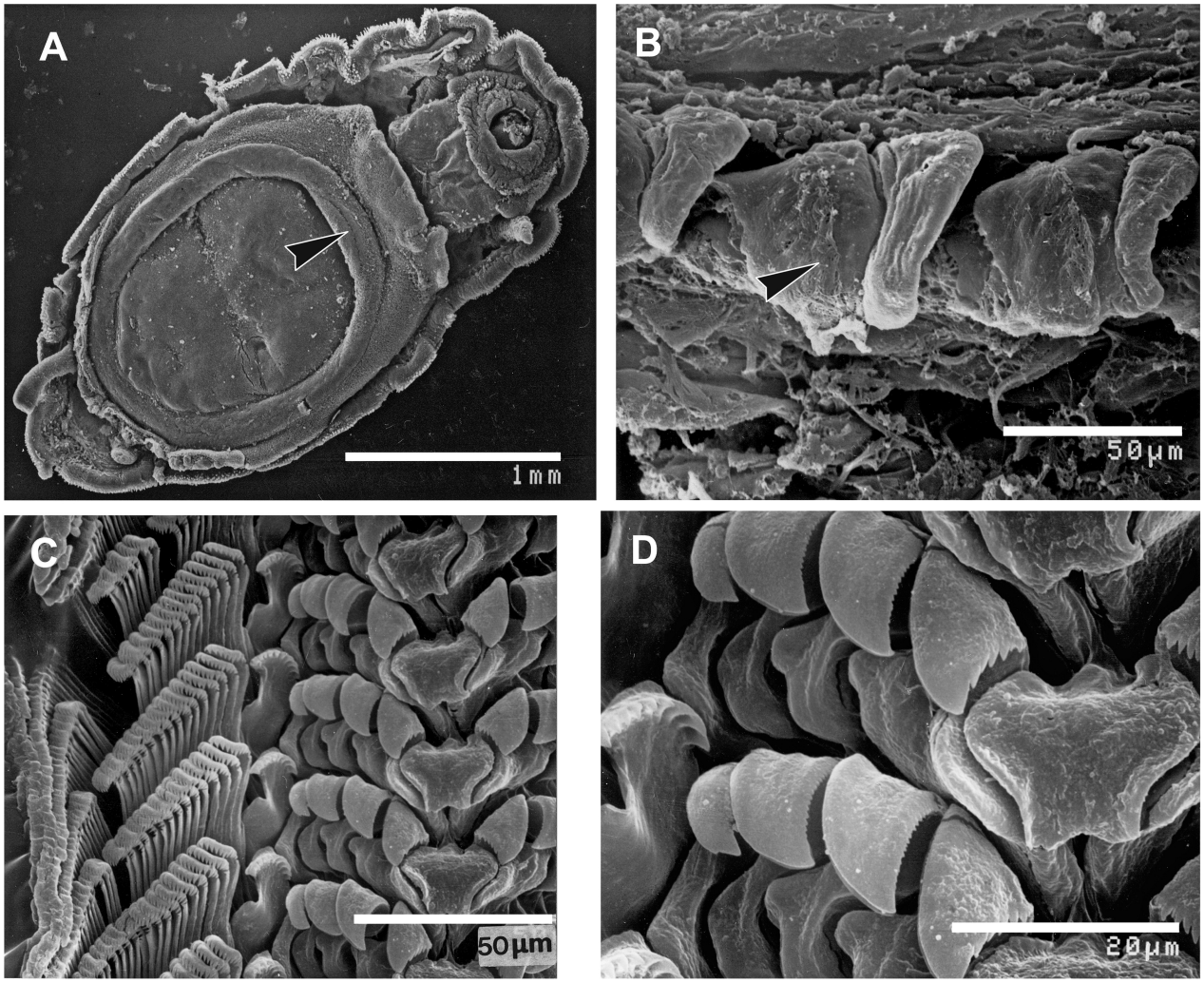

FIGURE 7. *Pyropelta ovalis* **sp. nov.**, soft parts and radula. A. Soft parts in oblique ventral view; arrow points to the opening of the anterior foot gland. B. Gill lamellae at ventral right side of soft parts (cf. Fig. 8), arrow indicates the ciliated and thickened base of gill lamella anterior to the non-ciliated flap. C. Radula. D. Half of the central field of radula. [Scale bars: A, 1 mm; B–C, 50 µm; D, 20 µm.]

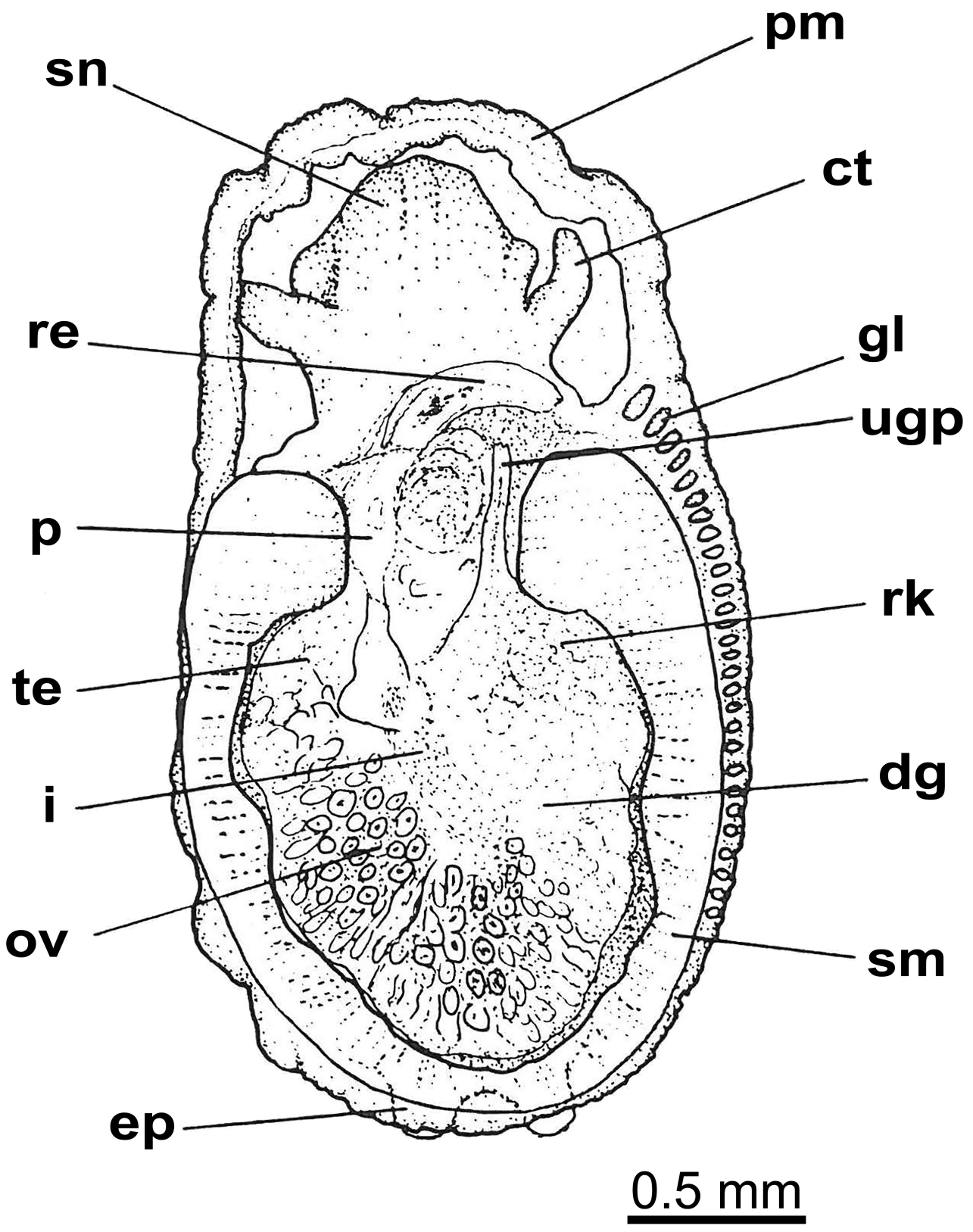

FIGURE 8. *Pyropelta ovalis* **sp. nov.**, soft parts depicted in dorsal view, gill lamellae shown by transparency. (Abbreviations cf. material and methods).

Description. *Shell* (Figs 6A–C, E, F) medium sized for genus, moderately thick, of opaque white colour; outer surface heavily eroded which is caused by acidic hydrothermal solutions. Surface characterized by concentric and irregular steps of thin shell layers; outermost layer, if present, with fine naps of irregular distribution (discernible by SEM only); in most specimens the horse-shoe-shaped scar of shell muscle is visible from outside due to the transparency of the shell; apex slightly posterior to the centre, shell profile low; protoconch lost in all specimens. Inner shell surface smooth except the heavily marked muscle scar. Shell structure consists of a multitude [of] thin prismatic layer[s].

Dimensions. Holotype: length 5.4 mm, width 3.6 mm, height 1.0 mm; paratype 1: length 5.2 mm, width 3.7 mm, height 1.2 mm.

Radula (Fig. 7C, D). Rhipidoglossate with about 45 transverse rows of teeth, formula 50-60 x 5 x 1 x 5 x 50-60, transverse rows of teeth roughly M-shaped; rachidian tooth with a broad base, laterally equipped with weak ridges, rachidian cusp reduced, rachidian shaft ends bluntly; rachidian base forms a hump with the bases of the first laterals; first laterals with overhanging cusps bearing 4–5 inner coarse denticles; cusps of second, third and fourth laterals with finely denticulated inner edges; fifth lateral claw-like and with 8–9 coarse denticles at cusps, base with distal flap, short pin-like first marginal teeth probably functions like a lateromarginal plate; marginal teeth with slender shafts and well-denticulated short and stiff cusps, outermost marginal teeth more flabelliform.

Soft parts (Figs 6A, D, 7A, 8). Cephalic lappets lacking, cephalic tentacles of equal size and equipped with micropapillae, snout with oral disc and small lateral lappets; foot with flat sole and a marginal bulge on which anteriorly the slit of the foot gland is discernible; foot sides bear a broad epipodial lobe which is posteriorly accompanied with two appendages and shows somewhat broadened area anteriorly, posterior appendages arise from areas above the epipodial lobe. Pallial margin thickened and entirely fused to the shell, outermost area densely covered with micropapillae (can be seen by SEM only); on right ventral side of the pallial margin, 25–28 small secondary gill leaflets are located, each leaflet consists of a basal (anterior), thickened, partly ciliated part and a distal (posterior), non-ciliated flap; pallial cavity shallow and short at left neck side (inhalant opening), ciliary bundles function as sensory control of incoming hydrothermal solutions, at right neck side, a densely ciliated area causes the exhalant flow of solutions, mantle skirt above neck extremely thin and translucent. Shell muscle horseshoe-shaped, with left and right arm of about equal size, inner bounds irregular. Half of the visceral mass is occupied by the hermaphrodite gonad whereas the ovary covers the testis in the posterior and left area; at the centre, a loop of the intestine shines through; the right area includes the digestive gland and a somewhat granular area interpreted here as the right kidney; the rectum penetrates the pericardium and ends at the right side of the pallial cavity; rectum contents include flaky material and some mineral particles; apparently, the ducts of the right kidney and the gonad are fused and end in a common uro-genital papilla towards the end of the right shell muscle arm. More detailed anatomical information requires dissections; therefore, data on the digestive system, left and right kidneys as well as the circulatory and nervous systems cannot be given here.

Remarks. *Pyropelta ovalis* **sp. nov.** is similar to *P. bohlei* (from Edison Seamount, West Pacific) with respect to the radular characters. However, *P. ovalis* **sp. nov.** is different to *P. bohlei* in the following characters: the shell is larger and not vitreous, the radula has a rachidian shaft that ends bluntly instead of tapering and the cusps of the marginal teeth have short and stiff denticles instead of long and flexible ones; with respect to soft parts, the diagnostic characters of *P. ovalis* are: arms of shell muscle of equal size, much higher number of secondary gill leaflets (up to 28), leaflets comparatively small and not reaching to the pallial cavity (Beck 1996).

Subclass Vetigastropoda

Superfamily Lepetodriloidea

Family Lepetodrilidae

Pseudorimula leisei Beck, sp. nov.

Figs 9, 10

[ZooBank LSID: urn:lsid:zoobank.org:act:41162F08-EFEE-43B1-9847-86D40085CC3F]

Type material. Holotype [MNHN-IM-2000-38680] and one paratype in MNHN [Paratype 1: MNHN-IM-2000-38681], two paratypes in NSMT [Paratype 2: NSMT-Mo 79410; Paratype 3: NSMT-Mo 79411], two paratypes in SMF [Paratype 4: SMF 370357; Paratype 5: SMF 370358].

Type locality. Lau Basin (Hine Hina) [BIOLAU, BL03].

Material examined. The type material and partly damaged specimens from BIOLAU BL03 [series of 5 specimens, SMF 370359] and 1 juvenile specimen from BIOLAU BL04 [MNHN-IM-2022-12941], 5 subadult specimens from STARMER II PL20 [NSMT-Mo 79412].

Distribution. North Fiji Basin and Lau Basin in bathyal, sulfide-rich areas.

Etymology. Species is named after Dr. Thorsten Leise, entomologist, in remembrance of the good times [he and Beck] shared at the Dept. of Biology/Zoology at the Philipps-University of Marburg.

Description. *Shell* (Figs 9A–E). Shell moderately large for genus, maximum length 5.1 mm. External surface coated with blackish and brownish mineral encrustations. Periostracum light brown, projecting slightly past the shell margin. Aperture oval in outline, margin of aperture not protruding. Profile relatively high, height of holotype 0.40 to 0.45 times length. Highest elevation of shell at about one-half its length. Protoconch not preserved. Juvenile shells with open slit, in adult shells slit open about one-third of the length of anterior slope, slit strongly deflected to the right; anteriorly, the slit is in adults sealed by the periostracum, posteriorly, it is sealed by a calcitic callus. Sculpture consists of numerous very fine radial ribs and small, sharp periostracum-lamellae, which occur sporadically in approximately 20 radial lines. Shell interior opaque, muscles scars (2 lateral, 1 posterior) and pallial attachments well marked by darker areas. Apical whorl contains parts of the visceral mass apparently also present in adults; adjacent to shell slit and surrounding the foramen, a thickened callus strengthens the shell. Suture with a zig-zagged outline.

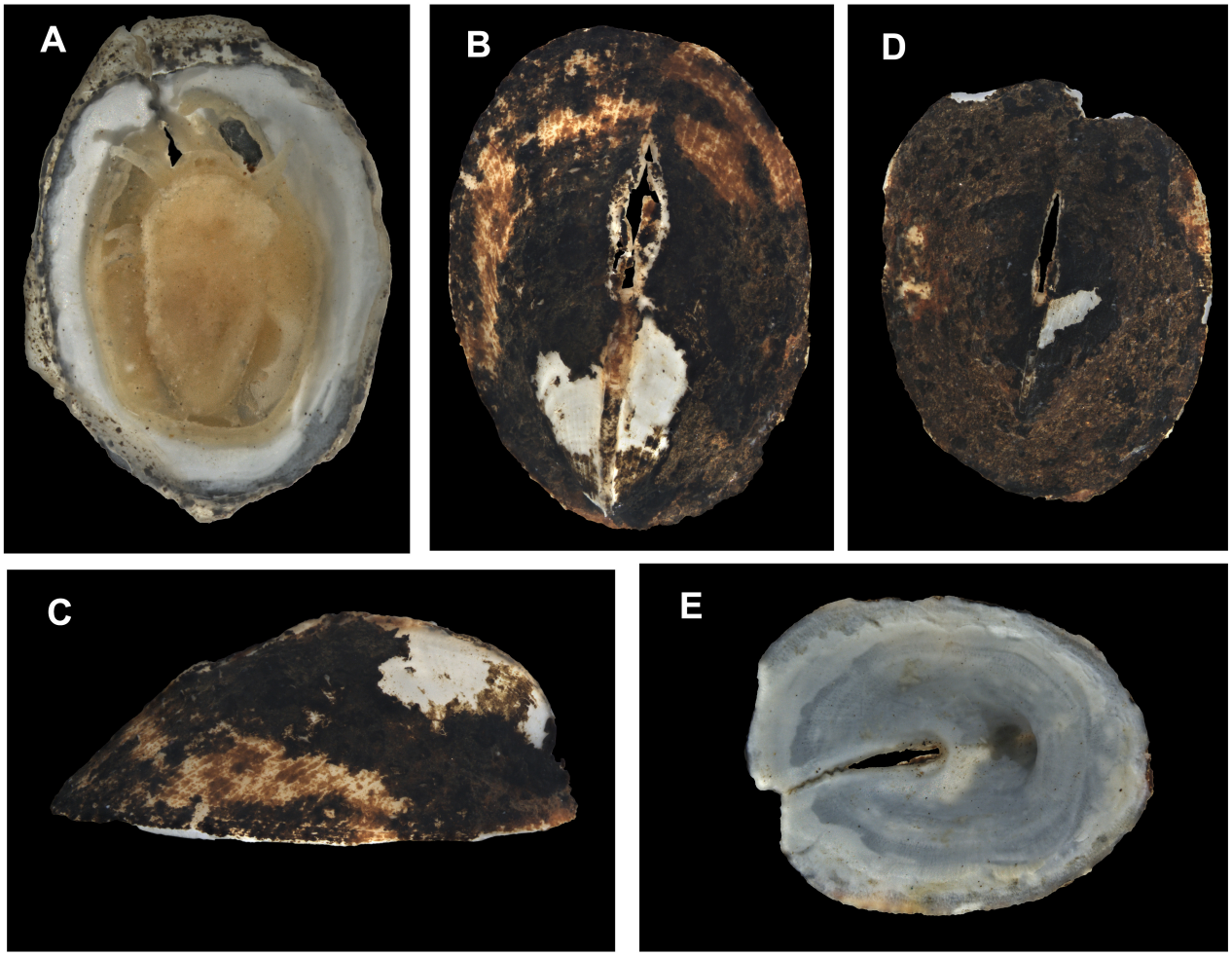

FIGURE 9. *Pseudorimula leisei* **sp. nov.**, shell and soft parts. A. Paratype 5 (shell length 2.7 mm), ventral view. B–C. Holotype (shell length 4.5 mm). B. Apical view. C. Lateral view from left. D–E Paratype 1 (shell length 4.9 mm). D. Apical view. E. Ventral view.

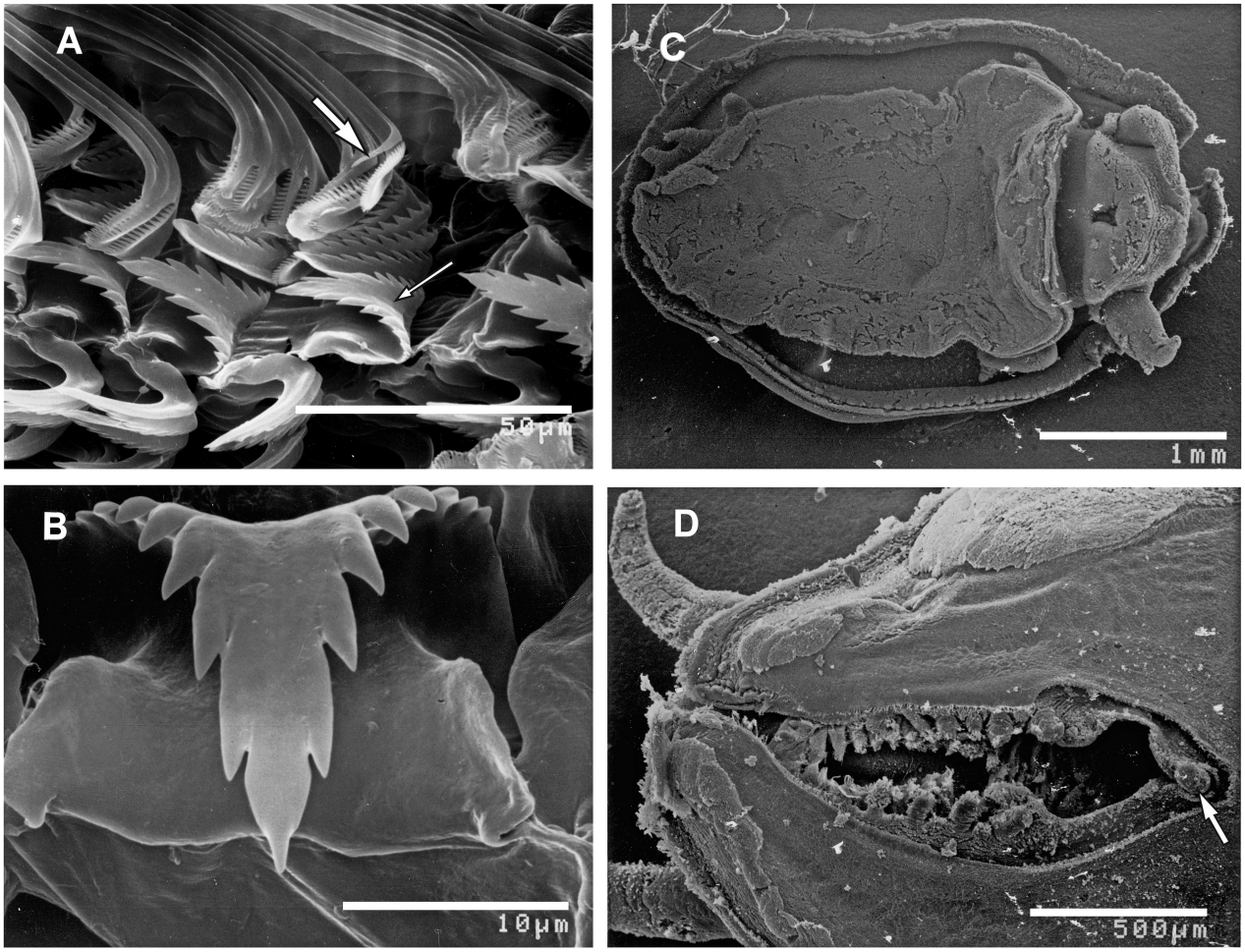

FIGURE 10. *Pseudorimula leisei* **sp. nov.**, radula and soft parts. A, B, C. Radula. A. Overview depicted in lateral view, thin arrow: rachidian tooth, bold arrow: tongue-like process at marginal tooth. B. Rachidian tooth with serrate, extremely overhanging cusp. C. Soft parts (critical-point dried). D. Oroficium (pallial slit) with many tentacles at the anterior slit, with thin membranes at opening, and a single tentacle (arrow) at its posterior end. [Scale bars: A, 50 µm; B, 10 µm; C, 1 mm; D, 500 µm.]

Radula (Figs 10 A, B). Rhipidoglossate, ribbon symmetrical, consisting of 60–70 rows of teeth in specimens of 4.3 mm shell length. Formula 10-12 x 4 x 1 x 4 x 10-12. Rachidian tooth with a broad base equipped with lateral ridges and with an extremely strong, overhanging cusp; cusp laterally with about 8 large denticles, at top acutely pointed. Lateral teeth similar in morphology to rachidian but somewhat narrower and denticulated at distal margins of cusps only. Marginal teeth relatively low in number, with broad tips, which are finely serrate, and have a long, tongue-like process distally.

Soft parts (Figs 9 A, 10 C, D). Anterior end of foot much broader in comparison to posterior end; anterior foot gland-opening represented by a very long, transverse slit. Three pairs of posterior epipodial tentacles with extended bases and two finger-like tentacles carrying micropapillae. Cephalic tentacles thickened and relatively long (in preserved condition) carrying micropapillae as well. Oral disc not folded and without clearly separated lappets, head without eyes. Pallial skirt deeply emarginated, which corresponds to the shell slit, oroficium has about 10–15 tentacles on each margin anteriorly, posteriorly the marginal membrane becomes the smooth, posterior end of the oroficium which is marked by a single tentacle directed outwards. Pallial margin slightly swollen, inner rim papillated, pallial skirt anteriorly attached to shell. One pair of lateral, equal-sized muscles and one isolated, posterior shell muscle present. Posterior muscle roughly in mid-line, covered on its left margin by the tip of the visceral mass. Arrangement of pallial cavity and visceral mass somewhat asymmetrical, reflecting a remnant of shell coiling which can be seen more clearly in juveniles. Pallial cavity deep, right ctenidium smaller than left. No sexual dimorphism detectable except granular ovary or somewhat striped testis. No operculum.

Remarks. Up to now, two species with an extremely disjunct distribution have been known, *Pseudorimula marianae* McLean, 1989 from Snail Pits vents, Mariana Back-Are Basin, and *P. midatlantica* McLean, 1992, from Snake Pit, Mid-Atlantic Ridge (McLean 1989, 1992). The new taxon, *P. leisei* **sp. nov.**, is separated from either of the former by the following diagnostic characters: shell with apex close to posterior margin and with a much steeper posterior slope; shell surface without strong radial ribs; rachidian and lateral teeth with very coarse denticulation and sharply pointed cusps.

Subclass Vetigastropoda

Superfamily Lepetodriloidea

Family Lepetodrilidae

***Lepetodrilus fijiensis* Beck, sp. nov.**
Fig. 11
[ZooBank LSID: urn:lsid:zoobank.org:act:2B534AA8-C250-4267-B0A8-2B6B437C4408]

Type material. Holotype [MNHN-IM-2000-38682], five paratypes in MNHN [Paratype 1: MNHN-IM-2000-38683; Paratype 2: MNHN-IM-2000-38684; Paratype 3: MNHN-IM-2000-38685; Paratype 4: MNHN-IM-2000-38686; Paratype 5: MNHN-IM-2000-38687], five paratypes in NSMT [Paratype 6: NSMT-Mo 79413; NSMT-Mo 79414; Paratype 8: NSMT-Mo 79415; Paratype 9: NSMT-Mo 79416; Paratype 10: NSMT-Mo 79417], five paratypes in SMF [Paratype 11: SMF 370360; Paratype 12: SMF 370361; Paratype 13: SMF 370362; Paratype 14: SMF 370363; Paratype 15: SMF 370364].

Type locality. Lau Basin, BIOLAU BL12, Vai Lili, 23°13′S–176°38′W.

Material examined. The type material and: BIOLAU, BL01, >10 specimens [MNHN-IM-2020-12942]; BIOLAU, BL02, >100 specimens [NSMT-Mo 79418]; BIOLAU, BL03, >100 specimens [SMF 370365]; BIOLAU, BL04, >10 specimens [SMF 370366]; BIOLAU, BL05, 1 specimen [SMF 370367]; BIOLAU, BL06, 6 specimens [SMF 370368]; BIOLAU, BL08, >10 specimens [SMF 370369]; BIOLAU, BL09, 1 specimen [SMF 370370]; BIOLAU, BL11, 1 specimen [SMF 370371]; BIOLAU, BL12, >100 specimens [NSMT-Mo 79419]; STARMER II, PL10, >100 specimens [MNHN-IM-2020-12943]; STARMER II, PL11, >100 specimens [NSMT-Mo 79420]; STARMER II, PL12, >10 specimens [SMF 370372]; STARMER II, PL13, >10 specimens [SMF 370373]; STARMER II, PL14, >10 specimens [SMF 370374]; STARMER II, PL15, 6 specimens [SMF 370375]; STARMER II, PL16, >100 specimens [SMF 370376]; STARMER II, PL17, 1 specimen [SMF 370377], STARMER II, PL18, >100 specimens [SMF 370378]; STARMER II, PL19, >100 specimens [NSMT-Mo 79421]; STARMER II, PL20, >100 specimens [SMF 370379]; STARMER II, PL21, >10 specimens [SMF 370380].

Distribution. Lau Basin and North Fiji Basin in bathyal hot-vent fields.

Etymology. Name refers to the distribution at North Fiji Basin and Lau Basin.

Description: As the new taxon is very similar in conchological, anatomical and radular characters to *Lepetodrilus schrolli* Beck, 1993 (Beck 1993), only diagnostic characters are given here.

Shell (Fig. 11). Dimensions much higher, largest specimen: length 12.0 mm, width 8.3 mm, height 4.0 mm; apex in slightly more right-posterior position.

Radula. Rhachidian with long tapering cusp.

Soft parts. Pallial cavity deeper and shell muscles slightly shorter than in *Lepetodrilus schrolli*.

Dimensions. Holotype shell length 11.0 mm, width 8.3 mm, height 4.5 mm.

Remarks. No evident morphological-anatomical diagnostic character was found to separate North Fiji specimens from Lau specimens.

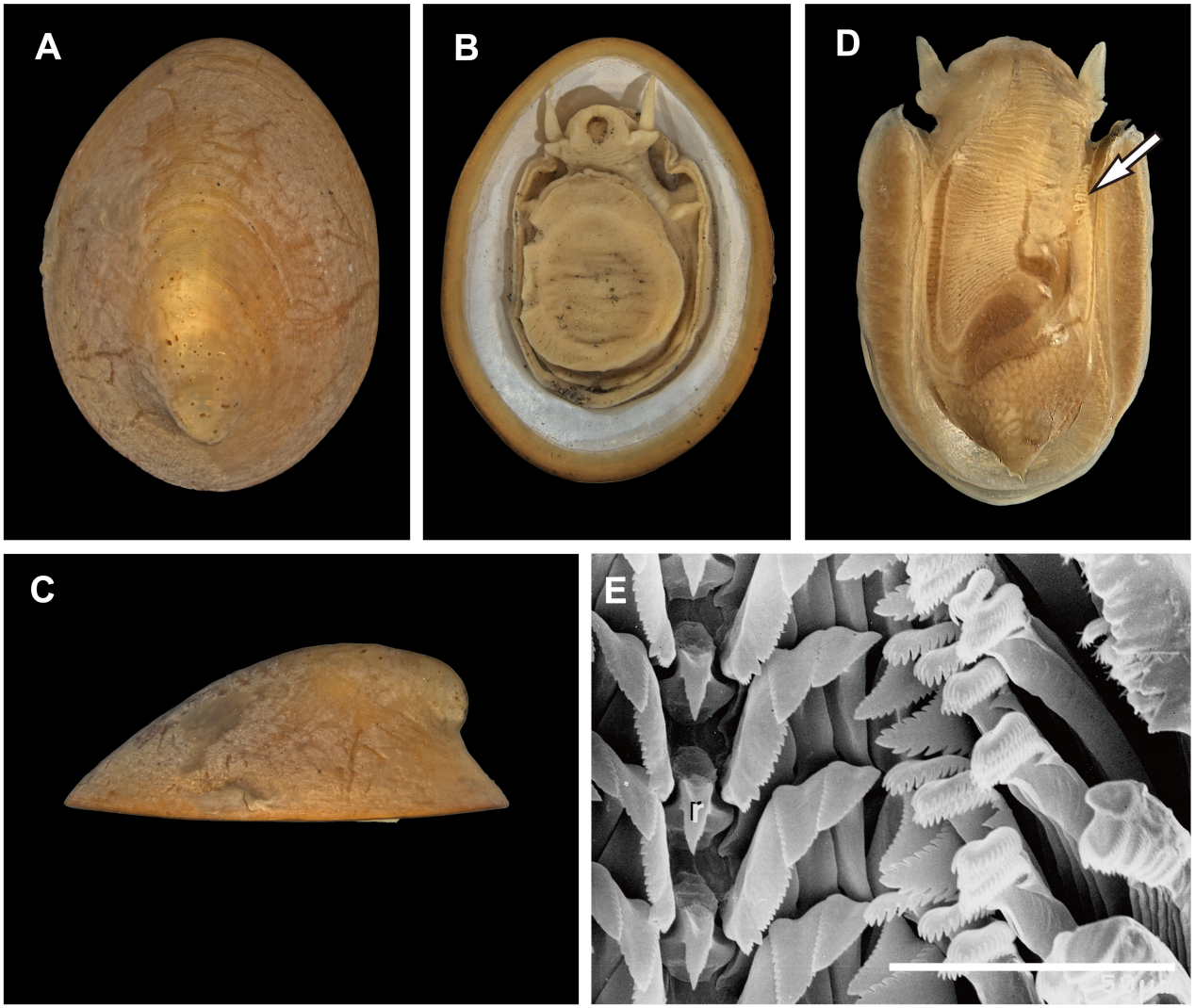

FIGURE 11. *Lepetodrilus fijiensis* **sp. nov.** Shell, soft parts and radula. A–C. Holotype (shell length 11.0 mm). A. Dorsal view. B. Ventral view. C. Lateral view. D. Paratype 14 (shell length 8.3 mm) removed from shell, anterior part of mantle skirt dissected, arrow points to the rudimentary right gill. E. Radula, detail of right half-row. [Scale bar: E, 50 μm.]

Subclass Neritimorpha

Superfamily Neritoidea

Family Phenacolepadidae

***Shinkailepas conspira* Beck, sp. nov.**
Figs 12, 13
[ZooBank LSID: urn:lsid:zoobank.org:act:D928F6D9-3542-496A-9162-A5A239720FA3]

Type material. Holotype [MNHN-IM-2000-38688] and one paratype in MNHN [Paratype 1: MNHN-IM-2000-38689], two paratypes in NSMT [Paratype 2: NSMT-Mo 79422; Paratype 3: NSMT-Mo 79423], two paratypes in SMF [Paratype 4: SMF 370381; Paratype 5: SMF 370382].

Type locality. Lau Basin (Hine Hina) [BIOLAU BL01].

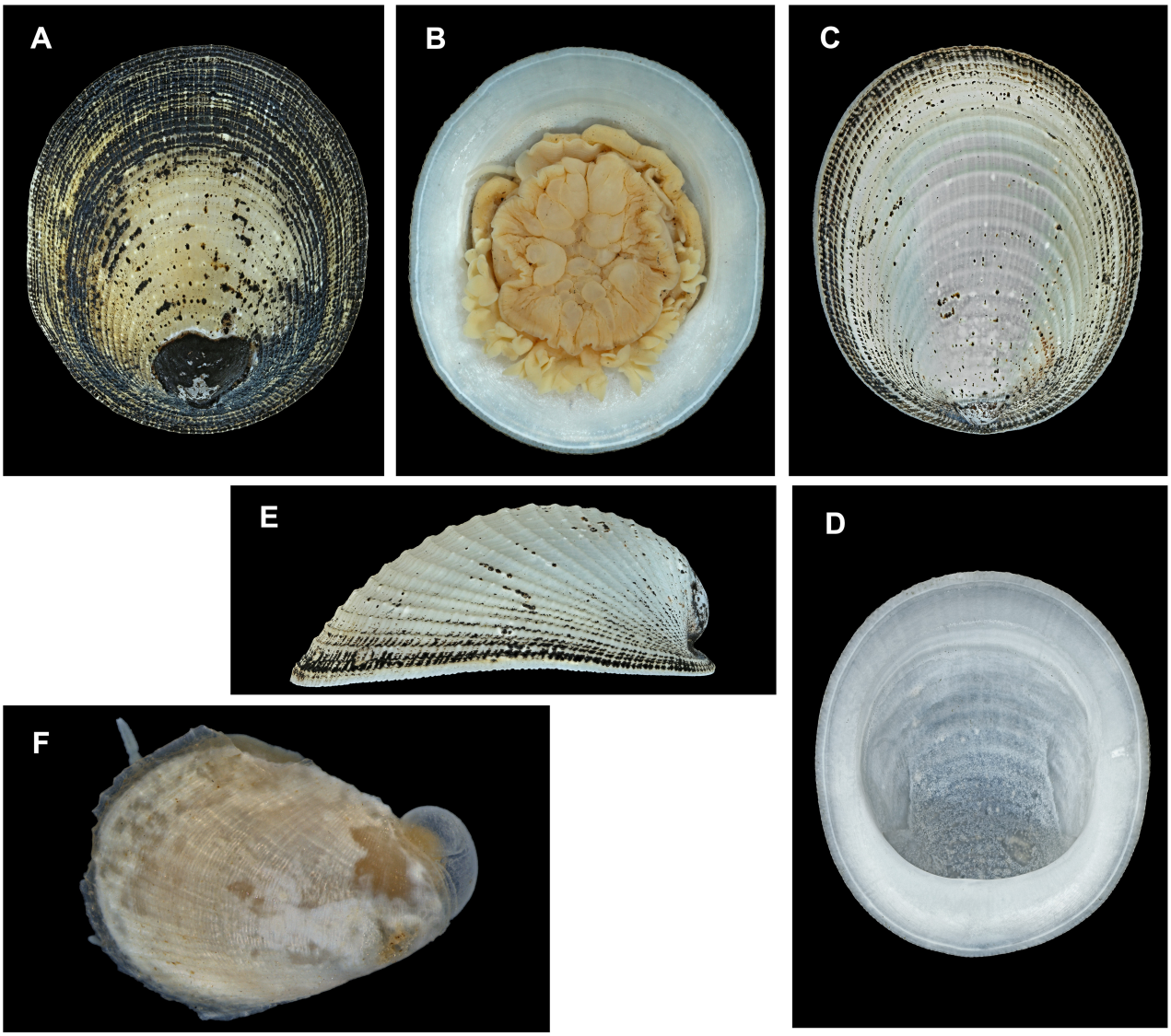

FIGURE 12. *Shinkailepas conspira* **sp. nov.** A–B. Holotype (shell length 21.3 mm). A. Dorsal view. B. Ventral view. C–E. Paratype 2 (shell length 16.8 mm). C. Dorsal view. D. Ventral view. E. Lateral view. F. Juvenile specimen from BIOLAU, BL06 (shell length 4.0 mm) with coiled protoconch.

Material examined. The type material and BIOLAU, BL03, 9 specimens [NSMT-Mo 79424]; BIOLAU, BL06, 1 specimen and several shell fragments [SMF 370383], BIOLAU, BL09, 3 specimens and 1 shell fragment [MNHN-IM-2020-12944]; BIOLAU, BL11 [SMF 370384].

Distribution. Lau Basin at bathyal hydrothermal vents.

Etymology. Species name from Latin roots, *con* for with, and *spira* for coiled.

Description. Shell (Fig. 12). Shell large for genus, almost limpet-shaped in adults but with conspicuous remnants of shell-coiling in juveniles; aperture oval in outline; shell margin not in plane, anterior margin clearly overhanging causing an arched line of the margin in a lateral view; apex (oldest shell stages) at posterior shell margin, mostly eroded in adults but intact in juveniles up to about 4 mm; diameter of protoconch about 0.8 mm, coiled several times, reflecting the planktotrophic development; shell surface with fine radial and strong concentric riblets, surface (periostracum) usually of whitish colour, some specimens with large irregular black encrustations (mainly at apex), old shells from Lau Basin completely black; shell interior opaque-white, inner margin of aperture slightly denticulated in juvenile and subadult specimens, otherwise smooth; no overhanging periostracum; at posterior part of shell-interior a strongly marked and thickened septum is evident; left and right muscle scars marked by oval, reniform smooth patches at otherwise rough interior of shell, roughness caused by numerous shell-pores which are concentrated particularly at the interior of the apex.

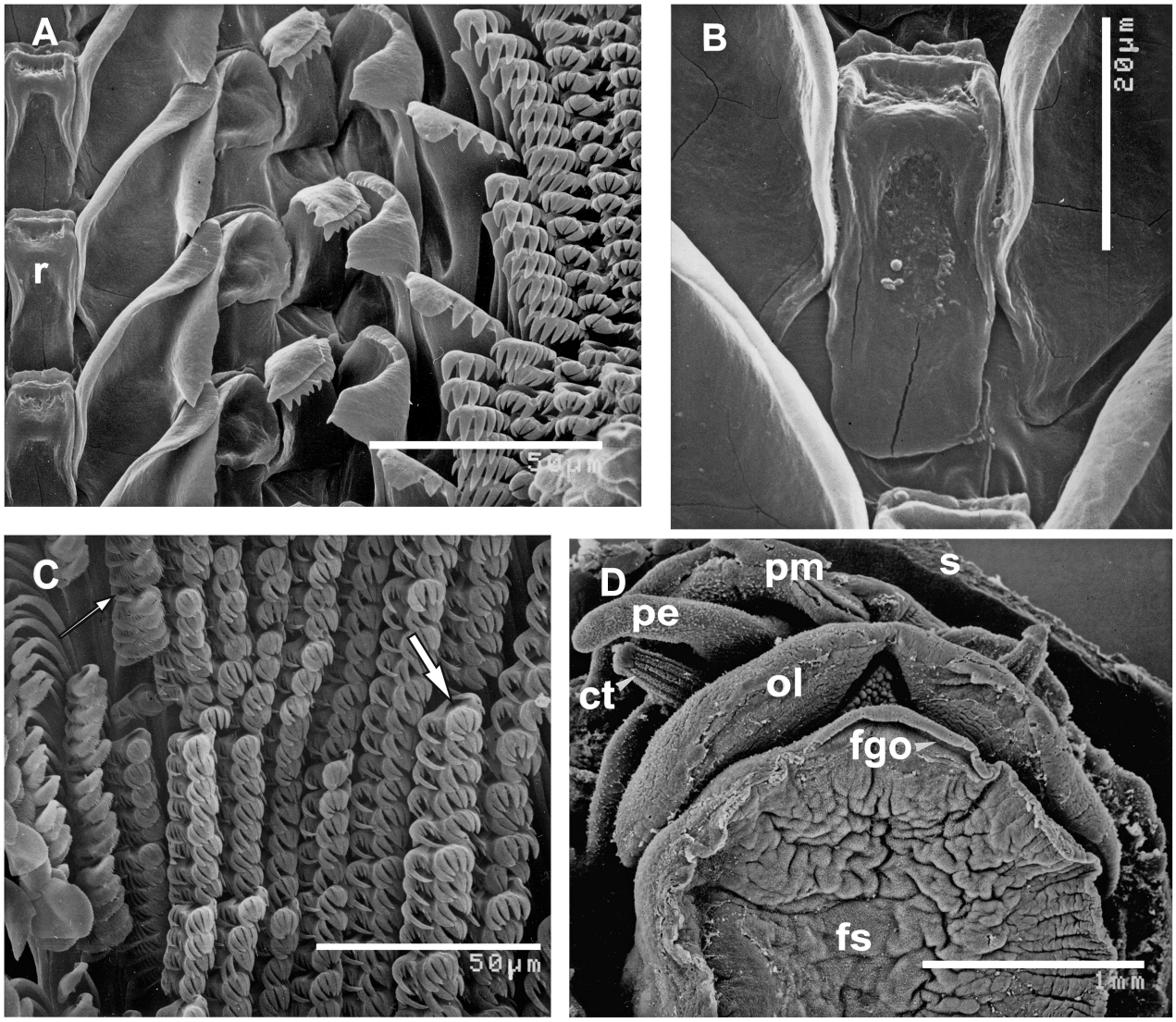

FIGURE 13. *Shinkailepas conspira* **sp. nov.** A–C. Radula. A. Detail, right half-row. B. Rachidian tooth with anterior, horseshoe-shaped ridges. C. Detail of marginal teeth, small arrow points to the tooth-type with distal tongue-like process, large arrow points to the tooth-type defining *Shinkailepas.* D. Soft parts. Male, anterior part, viewed from ventrally. [Scale bars: A, 50 µm; B, 20 µm; C, 50 µm; D, 1 mm.]

Dimensions. Holotype: length 21.3 mm, width 19.0 mm, height 9.0 mm.

Radula (Fig. 13A-C). Rhipidoglossate, dentition typical for genus, formula 70–80 x 4 x 1 x 4 x 70–80, rachidian teeth rectangular in outline, anterior part equipped with a horseshoe-shaped inner ridge and a much weaker outer ridge; first lateral teeth enlarged and oblique, basal part with U-shaped cross-section, distal part ear-shaped, at transition from basal to distal part, the inner margin forms an overhanging flap. Second lateral small, hook-shaped, overhanging cusp doubled, with 5–7 irregular small denticles. Longish third lateral tooth with deformed cusp, into which the cusp of the second lateral tooth fits in. Fifth lateral tooth with divided base and broadened cusp, showing a broad inner terminal denticle and four more slender outer denticles. At the descending rows of marginal teeth, four types of cusps are recognizable: the innermost type (8 teeth) with long, slender shafts and heavily denticulated cusps, the second type (40–45 teeth) has a terminal slit and denticles of very different size, the third type (approx. 20 teeth) has a fine denticulation and a distal, tongue-like process, the outermost type is simply flabelliform.

Soft parts (Figs. 13D). Eyes lacking; cephalic tentacles moderately lang, ventrally equipped with 4–5 stripes of micropapillae; mouth-opening comparatively small, circular, and papillated; oral lobe huge, reaching to the foot sides; cephalic lappets usually small (in females), in males right cephalic lappet modified to function as a penis; foot sole large, only central third ciliated; opening of the anterior foot gland small, slit-like; epipodial lobe extremely

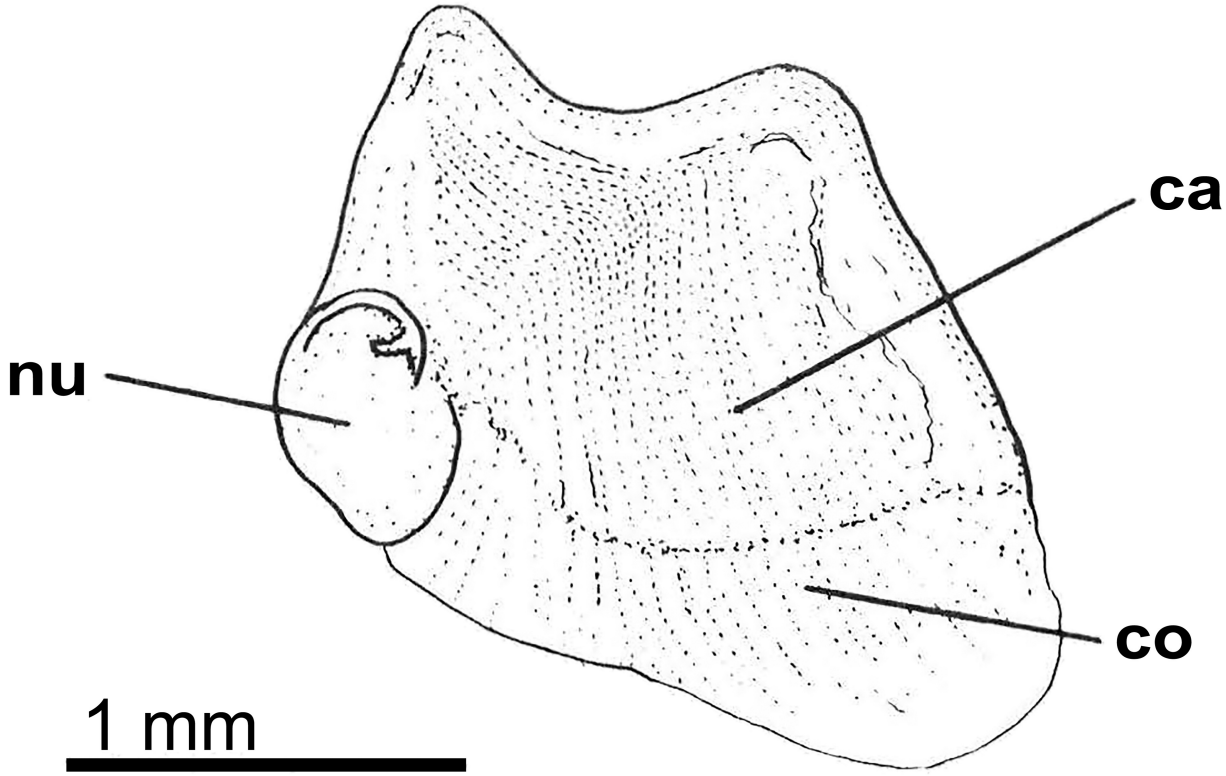

FIGURE 14. Operculum of *Shinkailepas conspira* **sp. nov.**, (shell length 10.1 mm) in dorsal view.

enlarged, particularly at the posterior end of foot, bearing up to 60 large, paddle-like flaps arranged in several lines. Pallial margin slightly swollen, pallium thin but not translucent, bearing numerous papillae which are concentrated at the apex; furthermore, minute reddish dots speckle the pallium as well as the neck and gill. In adults, males' neck extremely swollen forming a transverse ridge which contains spermatophores; pallial cavity deep at left side and shallow at right side; at right neck side, a small field of folds represents the osphradium; gill of moderate size, bipectinated. Operculum [(Fig. 14)] present at dorsal side of the foot, even in juveniles completely covered by the visceral mass; operculum with an anterior calcareous part, a posterior corneous part and a small paucispiral, corneous nucleus having a small inner process; overall asymmetric, anterior left comer and posterior right corner are lengthened.

Remarks. *Shinkailepas conspira* **sp. nov.**, is well separated from *S. kaikatensis* Okutani, Saito & Hashimoto, 1989 from Kaikata Seamount, Japan (Okutani *et al.* 1989) and *S. tufari* Beck, 1992 from Manus Back-Arc Basin, Papua New Guinea (Beck 1992b) by having the following characters: shell dimensions much larger, shell sculpture with conspicuous concentric riblets; operculum clearly asymmetric; oral and epipodial lobes strongly enlarged, epipodial lobe equipped with several rows of large paddle-like flaps (up to 60).

Subclass Neomphaliones

Superfamily Neomphaloidea

Family Neomphalidae

***Symmetromphalus mcleani* Beck, sp. nov.**
Figs 15–17
[ZooBank LSID: urn:lsid:zoobank.org:act:D1AFECE2-136D-4CFD-A32C-47B5B300DC17]

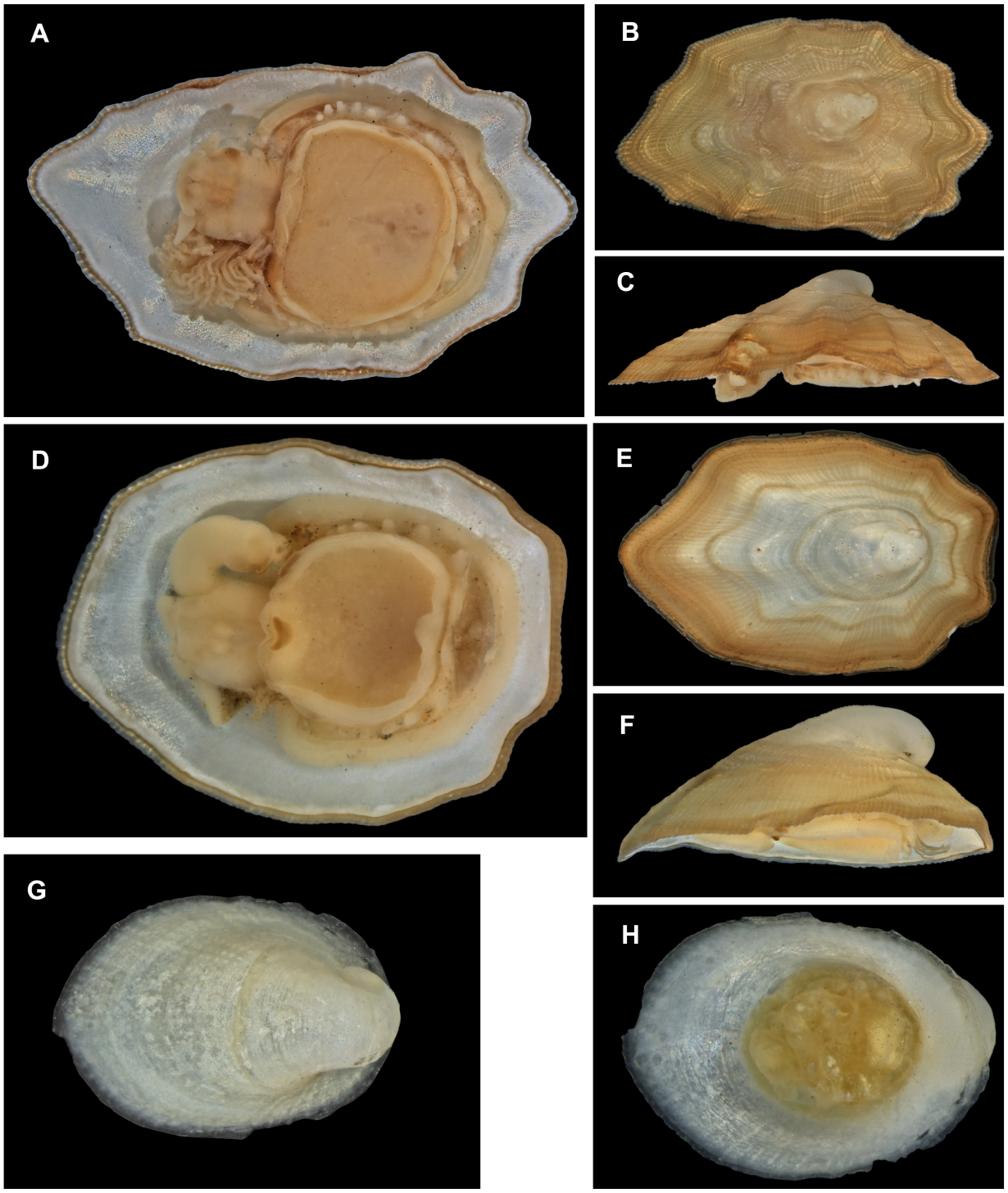

FIGURE 15. *Symmetromphalus mcleani* **sp. nov.** A–C. Holotype (shell length 7.1 mm), female. A. Ventral view. B. Dorsal view. C. Viewed from left. D. Paratype 4 (shell length 3.5 mm), male, ventral view. E. Paratype 1 (shell length 5.9 mm), male, ventral view. E. Paratype 4, male, viewed from left. G–H. Paratype 2 (shell length 1.3 mm), juvenile specimen. G. Dorsal view. H. Ventral view.

Type material. Holotype (female) [MNHN-IM-2000-38690] from STARMER II PL20 and two paratypes (male and juvenile) from STARMER II PL20 [Paratype 1, male: MNHN-IM-2000-38691; Paratype 2, juvenile: MNHN-IM-2000-38692] as well as two paratypes from [STARMER II, PL16] in NSMT [Paratype 3, female, NSMT-Mo 79425; Paratype 4, male, NSMT-Mo 79426], and two paratypes [from STARMER II, PL16] in SMF [Paratype 5, empty shell, SMF 370385; Paratype 6, empty shell, SMF 370386].

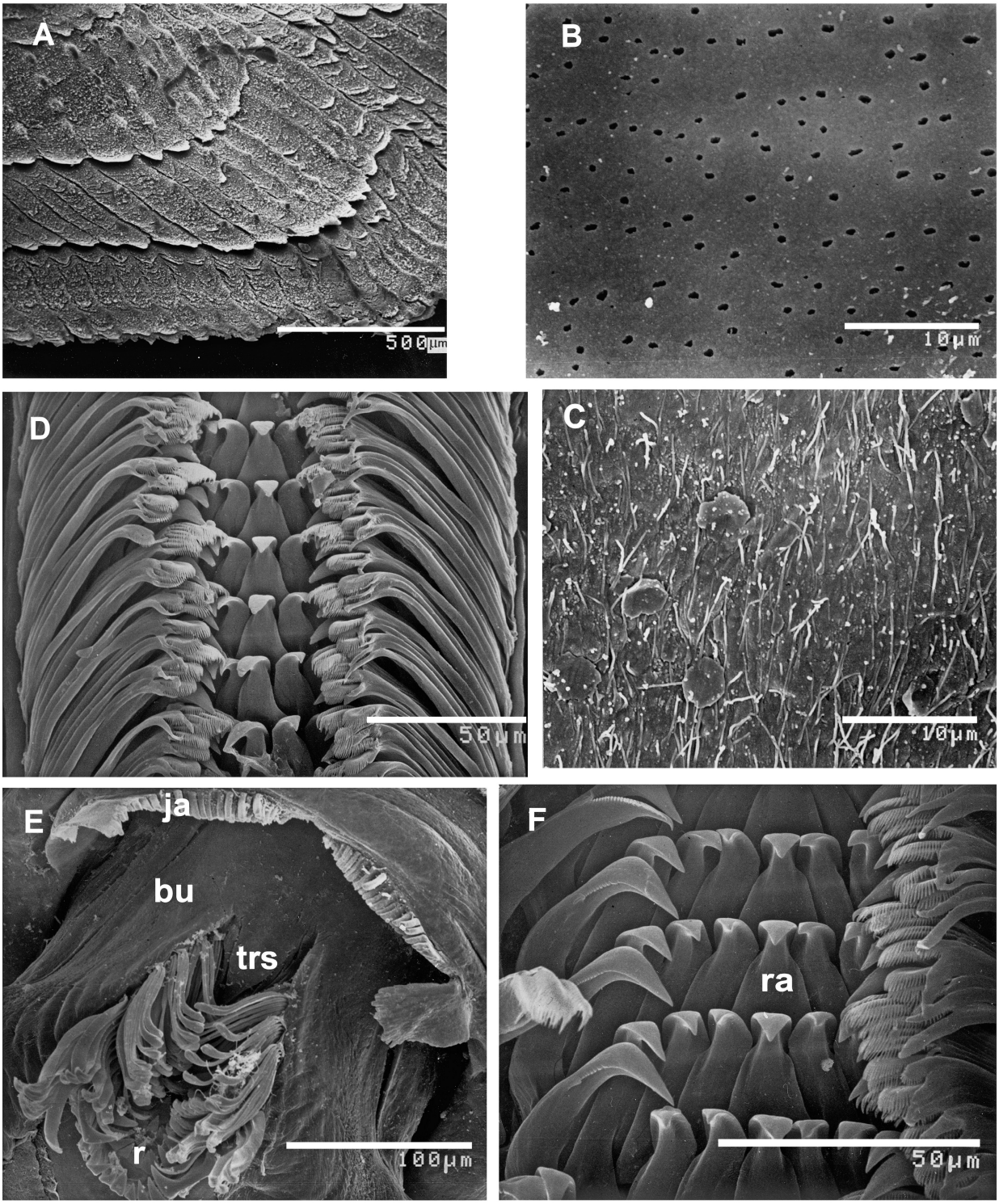

FIGURE 16. *Symmetromphalus mcleani* **sp. nov.** A. Periostracum at shell margin. B. Interior of shell with micropores. C. External surface of pallial skirt with filamentous papillae fitting to the shell micropores . D. Radula, overview. E. Dorsal jaws and protruded buccal mass with radula. F. Radula, close-up. [Scale bars: A, 500 µm; B–C, 10 µm; D, 50 µm; E, 100 µm; F, 50 µm.]

Type locality. North Fiji Basin, (White Lady) active hot vents, 16° 59.50′ S–173° 55. 47′ W.

Material examined. The type material and from Lau Basin: BIOLAU, BL03, 1 male and 6 juvenile specimens [SMF 370387]; BIOLAU, BL12, 4 males and 2 juvenile specimens [NSMT-Mo 79427]. From North Fiji Basin: STARMER II, PL16, 17 females, 2 males, and 19 juvenile specimens [SMF 370388]; STARMER II, PL18, 1 female and 12 juvenile specimens [NSMT-Mo 79428]; STARMER II, PL19, 8 empty shells and 1 juvenile specimen [MNHN-IM-2020-12945]; STARMER II, PL20, 13 females, 5 males, and 2 empty shells [SMF 370389].

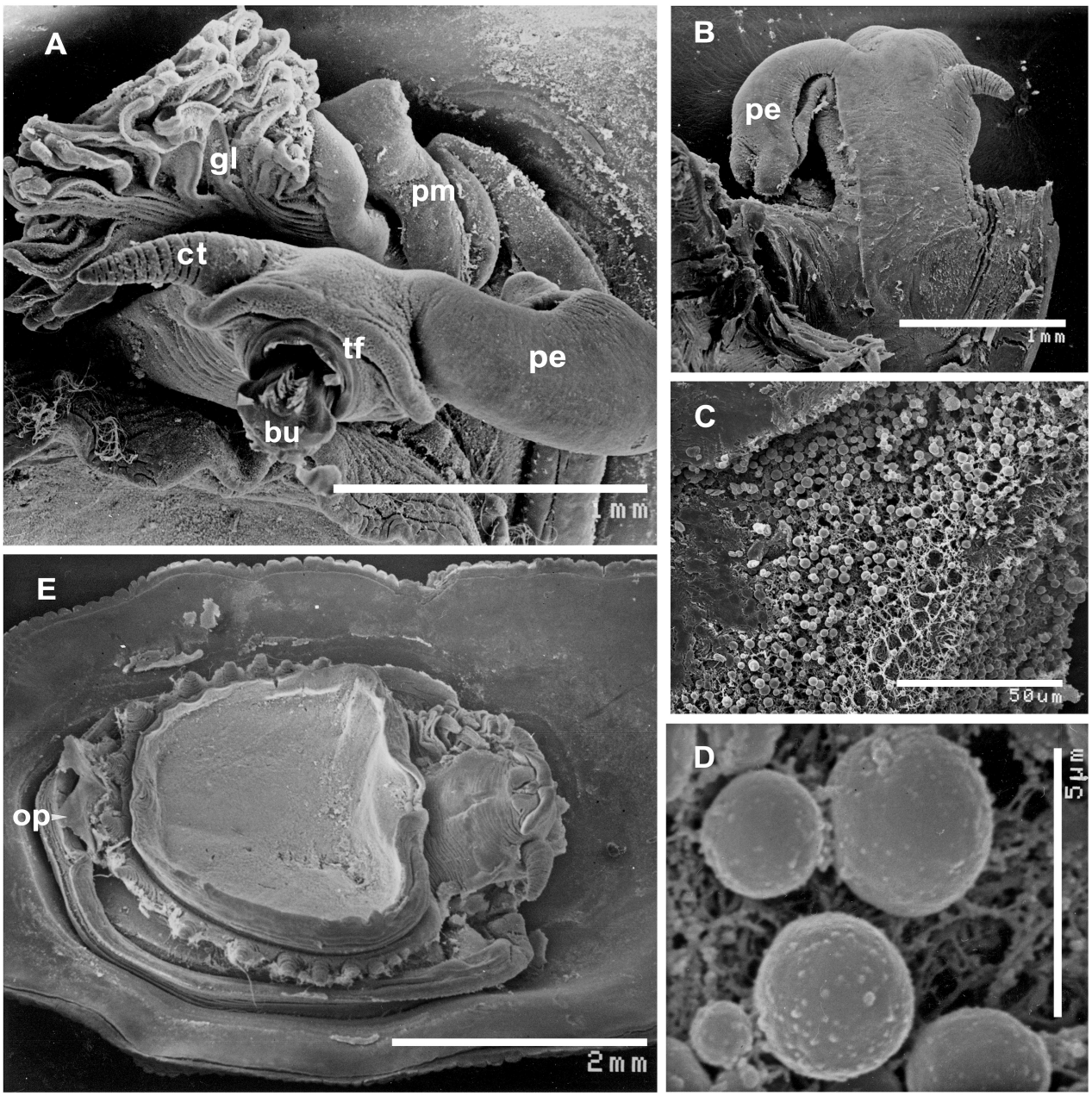

FIGURE 17. *Symmetromphalus mcleani* **sp. nov.** A–D. Male specimen. A. Front view of the head. B. Dorsal view of the head. C. Coccal bacteria in seminal groove. D. Coccal bacteria, close-up. E. Female specimen, ventral view. [Scale bars: A–B, 1 mm; C, 50 μm; D, 5 μm; E, 2 mm.]

Distribution. North Fiji Basin and Lau Basin at bathyal hydrothermal vents.

Etymology. Species is named after James H. McLean, Los Angeles County Museum of Natural History.

Description. *Shell* (Figs 15, 16A–B). Small for genus, almost limpet-shaped with remnants of shell-coiling at apex, even in adults, aperture irregularly oval in outline reflecting up to 12 radial broad ribs which appear not before 4-5 mm shell length; protoconch diameter 180 μm; juvenile teleoconch smooth, at shell length exceeding 1.0 mm with fine radial riblets (in adults more than 200 riblets present), which can only be seen by SEM, riblets finely knobbed; periostracum white to yellowish-brown, slightly overhanging and flexible at shell margin, in adults additionally slightly scaly at shell margin; apex approximately at mid-line, its position changes during shell growth from posterior shell margin to center of the shell; shell margin not in level but describing an irregular line corresponding to the surface of the substratum; interior of shell white, of silky brightness; horseshoe-shaped scars of shell muscles weakly marked; inner surface (except muscles scars) with numerous irregular micropores into which the filamentous papillae of the pallial surface fit, pores penetrate the ostracum but not the periostracum.

Dimensions. Largest specimen (empty shell) length 8.9 mm, width 5.1 mm, height 2.5 mm; holotype female 7.1 mm x 4.2 mm x 2.0 mm, paratype 1 (male) 5.9 mm x 3.8 mm x 2.0 mm.

Radula (Figs 16D–F). Rhipidoglossate, as is typical for genus, formula 10–12 x 4 x 1 x 4 x 10–12; rachidian and four lateral teeth of similar shape, rachidian cusp slightly larger than cusp of first lateral, cusps of laterals increasing in size distally, no serrations except at distal margin of cusp of fourth lateral; there, the lowermost serration is most prominent; only 10–12 marginal pairs of teeth present, bearing finely denticulated cusps with distal, tongue-like processes.

Soft parts (Figs 15A, D, H, 16C, E, 17A–E). Head with short tentacles directed posteriorly; in males, the left cephalic tentacle is transformed and enlarged to function as a penis, snout transformed, having no oral disc with marginal papillae but a large transverse furrow; neck elongated, in males with deeply marked seminal groove leading to the left cephalic tentacle; neck dorso-ventrally compressed with laterally thickened edges; eyes lacking; penis with longitudinal furrows and with a tubule at the tip. Footsole round in outline, anterior third broader than the rest, with minute slit-shaped opening of anterior foot gland; foot sides laterally and posteriorly with epipodial ridge bearing up to ten pairs of tentaculiform appendages, posterior appendages of approximately the same size as the cephalic tentacles; pallial margin smooth but pallial epithelium with numerous minute, filamentous papillae fitting into the shell micropores; pallial cavity deep containing the very large bipectinate gill which apparently is used for filter feeding, afferent membrane completely absent, massive efferent axis arises at posterior of pallial cavity on left side and reaches up to or beyond anterior margin of head, gill lamellae thin and elongate (curled in contracted condition) increasing in length from posterior to anterior; visceral mass comparatively small, gonad appears to be its essential part, rectum leads to the anus at anterior right comer of pallial cavity; shell muscle horseshoe-shaped with longish left arm and slightly shorter and broader right arm, both arms posteriorly connected by an extremely thin muscular ligament. Operculum present in all specimens examined, very thin and translucent, last [re]volutions enlarged rapidly.

Remarks. *S. mcleani* **sp. nov.** is the third species of the genus *Symmetromphalus* which lives at active hot vents in the western Pacific. The type species, *S. regularis* from Mariana vents, is reported to live in dense aggregations on basalt boulders in the path of hydrothermal effluents (McLean 1990). The same is true for *S. hageni* reported from the surface of active smokers at Manus vents (Beck 1992a). All morphological evidence [from gill and head-foot] of the new species described here point out that *S. mcleani* **sp. nov.** is also sessile and lives as a filter-feeder. The new species' morphology is clearly distinguished from the known species by the following characters: shell with up to 12 broad radial ribs and a slightly scaly periostracum at shell margin; shell dimensions smaller; number of marginal teeth reduced to 10–12 pairs. All specimens have intact shells with no mineral encrustations or damaged periostraca as is usual for other hot-vent taxa (e.g. species described earlier in this paper). However, as a consequence of a sessile mode of life, soft parts are in some places colonized by bacteria. At the epipodium threads of organisms similar to *Beggiatoa* are common. At seminal groove, coccal organisms were found to exist in dense colonies.

Subclass Neomphaliones

Superfamily Peltospiroidea

Family Peltospiridae

Symmetriapelta Beck, gen. nov.

Figs 18, 19

[ZooBank LSID: urn:lsid:zoobank.org:act:97289DCB-A600-4E88-8713-0984E32FFDFA]

Type species. *Symmetriapelta wareni* **sp. nov.**

Diagnosis. Rhipidoglossate ["]archaeogastropods["] with limpet-shaped shell of small size. Apex slightly left of mid-line, nearly at center of shell in adults, in juveniles near posterior margin of shell; in juveniles with the first teleoconch whorl present; in adults it is eroded at apex; sculpture of beaded radial ribs of varying thickness and number; aperture oval with lateral parts running almost parallel in adults; periostracum not overhanging; shell interior opaque to white with fine, coalescing, concentric lines corresponding to the shell structure, no nacre; muscle scars barely marked; depth of shell interior with minute remainder of teleoconch whorl even in adults with eroded

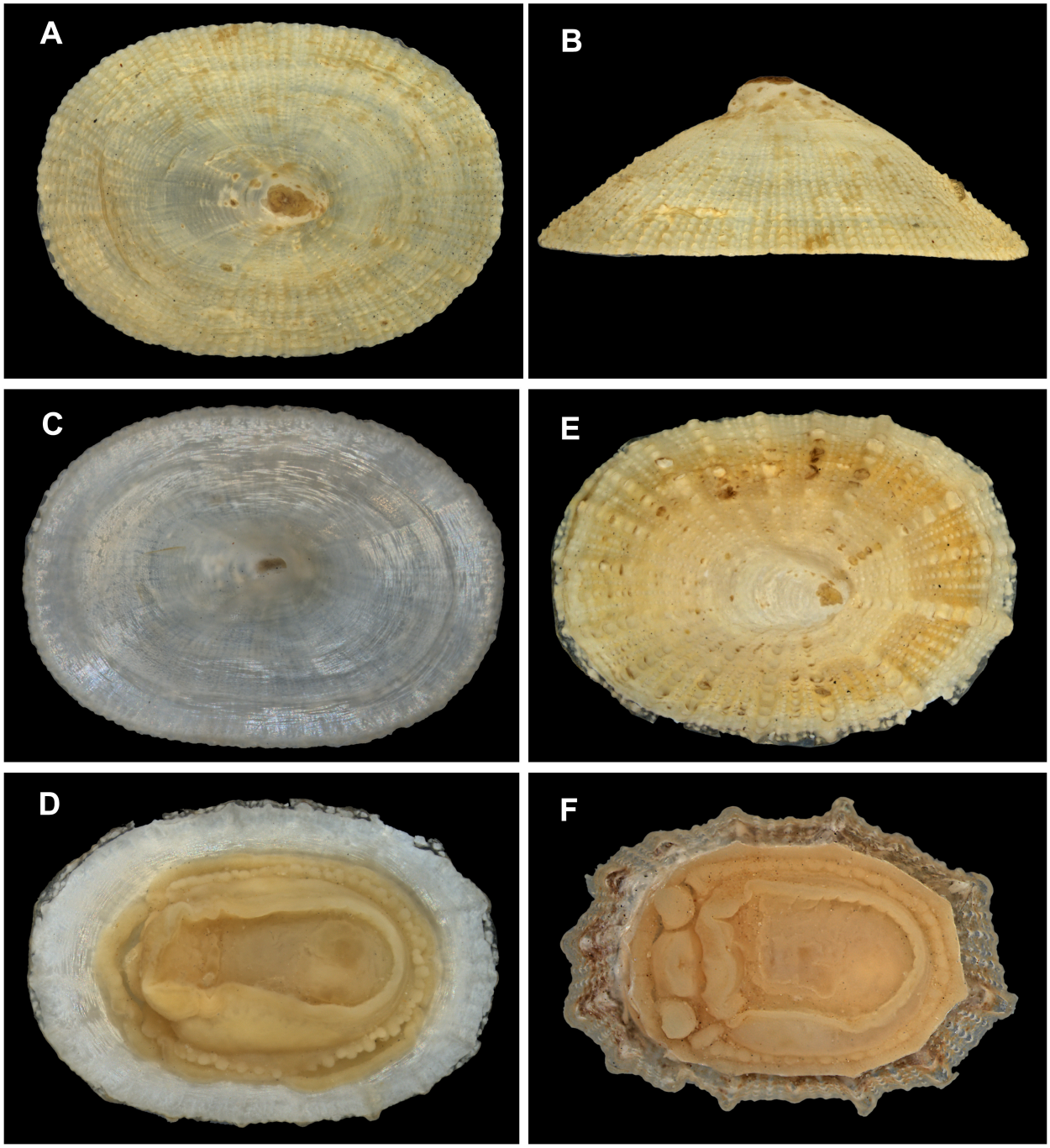

FIGURE 18. *Symmetriapelta wareni* **gen. et sp. nov.** A–C. Paratype 1 (shell length 4.0 mm). A. Dorsal view. B. Viewed from right. C. Shell interior; anterior on the left. D–E. Holotype (shell length 4.1 mm). D. Ventral view. E. Dorsal view. F. A specimen from BIOLAU, BL03 (shell length 2.2 mm) with extremely thick radial ribs; calcareous layers partly dissolved, ventral view.

apex. Radula with formula about 18 x 4 x 1 x about 18; of peltospirid type, first and second lateral tooth bases each with additional ridge (or node), cups of fourth lateral with delicate denticulation on inner side whereas outer side has four conspicuous denticles.

Animals with eyeless head, snout with greatly thickened circumoral roll which is divided ventrally, cephalic tentacles of equal size, very thick, directed anteriorly, extending beyond margin of snout; neck short, passing over to a deep and large concave depression in which the visceral mass is embedded; depression translucent as foot sole is very thin; foot sole oval, with continuous marginal flap that is broadened and elongated anteriorly and that bears a moderate-sized slit of the anterior foot gland; epipodium well developed, it consists of a continuous basal ridge which bears about 25 anterio-lateral epipodial tentacles and two slightly solitary posterior tentacles. Pallial cavity

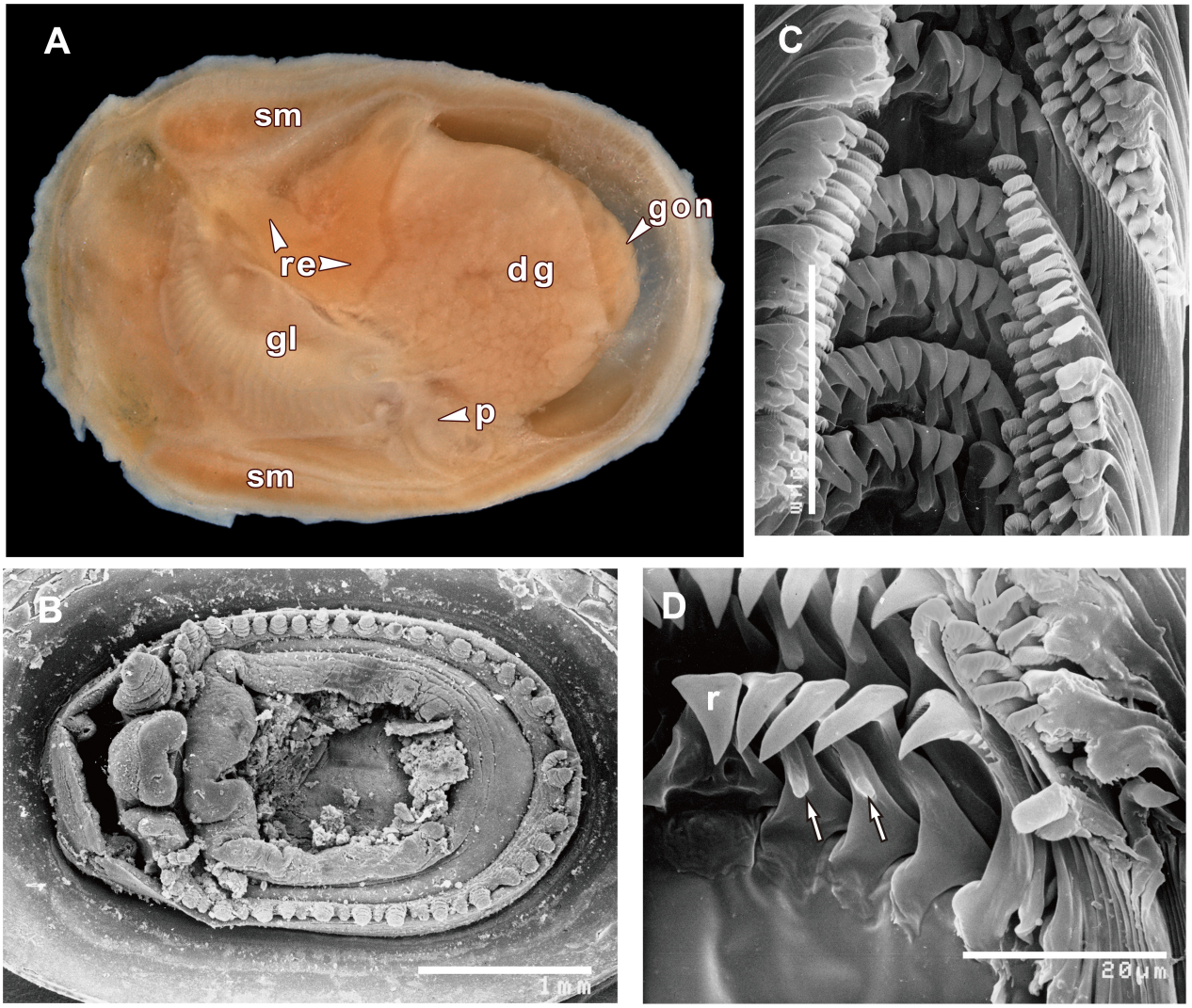

FIGURE 19. *Symmetriapelta wareni* **gen. et sp. nov.** A. Paratype 2 (body length 3.1 mm; shell fragmented), animal removed from shell, in dorsal view. B. Critical point dried specimen in ventral view. C–D. Radula. C. Overview. D. Half-row of radula teeth, arrows indicate nubs on the bases of first and second lateral teeth. [Scale bars: B, 1 mm; C, 50 µm; D, 20 µm.]

is of moderate depth reaching to the left on half of animal length; deeper and larger on left side where it contains the gill with long afferent membrane at ventral-right side; efferent membrane fused to the pallial skirt on 80% of gill length, free tip tapering; dorsal gill lamellae short but ventral lamellae large and triangular. Anterior right part of pallial cavity short, containing anus and openings of kidney and gonad. Pallial margin adhering to the shell throughout its length, pallial skirt with micropapillae that fit into the shell pores. Visceral mass small, not filling the concave depression on dorsal side of the foot. Gonad is mostly covered by the digestive gland. Operculum absent.

Etymology. Genus name has Latin roots, *symmetria* for symmetrical and *pelta* for shield.

Remarks. *Symmetriapelta* is the first limpet-shaped peltospirid from the western and southwestern Pacific. However, the main area of [neomphaloidean] distribution is at EPR, where 11 genera are recognized (with coiled shell: *Depressigyra*, *Lirapex*, *Melanodrymia*, *Pachydermia*, *Planorbidella;* with limpet-shaped shell: *Peltospira*, *Rhynchopelta*, *Hirtopelta*, *Ctenopelta*, *Nodopelta*, *Echinopelta*) (Warén & Bouchet 1993). *Symmetriapelta* gen. nov. differs from all these genera in having an almost central apex, however, there are some characters which point to a close relationship with *Nodopelta* and foremost, with *Echinopelta:* aperture of shell with lateral margins running parallel, anatomy of the epipodium, and the presence of ridges or nodes at the bases of lateral radular teeth. While *Symmetriapelta* gen. nov. is different from *Nodopelta* in having no vestige of an operculum and no glandular pallial margin, the new taxon substantially differs from *Echinopelta* in the following characters: apex of shell is almost positioned centrally (as opposed to being near the shell margin), shell margin smooth, following the line of the radial

ribs on the shell surface (compared with an undulating shell margin), number of epipodial tentacles about 50 (in contrast to of more than 100), periostracum with beaded radial ribs of different size (instead of hollow spines).

***Symmetriapelta wareni* Beck, sp. nov.**

Figs 18, 19

[ZooBank LSID: urn:lsid:zoobank.org:act:9D3FF7B3-B4E6-48B4-B3AA-5DB26555EC88]

Type material. Holotype [MNHN-IM-2000-38693], two paratypes in MNHN [Paratype 1: MNHN-IM-2000-38694; Paratype 2: MNHN-IM-2000-38695], two paratypes in NSMT [Paratype 3: NSMT-Mo 79429; Paratype 4: NSMT-Mo 79430], two paratypes in SMF [Paratype 5: SMF 370390; Paratype 6: SMF 370391].

Type locality. North Fiji Basin (White Lady).

Material examined. The type material and BIOLAU, BL03, >10 specimens [MNHN-IM-2020-12946]; BIOLAU, BL04, >10 specimens and 3 empty shells [SMF 370392]; BIOLAU, BL08, 9 specimens [NSMT-Mo 79431]; BIOLAU, BL09, 1 specimen [SMF 370393]; BIOLAU, BL12, >10 specimens [NSMT-Mo 79432]; STARMER II, PL10, 4 specimen [SMF 370394]; STARMER II, PL11, 7 specimens [MNHN-IM-2020-12947]; STARMER II, PL12, >10 specimens [NSMT-Mo 79433]; STARMER II, PL13, 5 specimens [SMF 370395]; STARMER II, PL14, 2 specimens [SMF 370396]; STARMER II, PL15, 1 empty shell [SMF 370397]; STARMER II, PL20, 4 specimens [SMF 370398]; No data, 4 specimens [SMF 370399].

Distribution. North Fiji Basin and Lau Basin at hot-vent fields.

Etymology. Species is named after Anders Warén, Swedish Museum of Natural History, Stockholm.

Description. The characters defining the genus also serve as the description of the species. In addition, the following characters are worth mentioning:

Shell (Figs. 18, 19B). Shell surface with three to five beaded, fine, radial riblets alternating with thicker, beaded radial ribs; these thicker ribs are extremely variable as comparison of Fig. 18A with Fig. 18E shows. There are both character states present at North Fiji and Lau vents with all possible states of transition.

Dimensions. Largest specimen length 5.7 mm, width 4.1 mm, height 1.8 mm; Holotype 3.9 mm x 2.6 mm x 1.5 mm.

Discussion

One new genus and seven new species are described herein using Beck's original 1997 text (Supplementary Material), and they are supported as valid species according to the modern understanding of vent gastropods, including previously published molecular evidence of geographically separated lineages. These taxa also shed light on a number of other species (Table 3), and here we provide some brief comments to clarify the taxonomic status of the relevant names.

Beck's original unpublished manuscript on vent gastropods also proposed descriptions for two further species and one other genus (Supplementary Material), which have been deliberately omitted here. One of these was the phenacolepadid "*Olgasolaris ethmoconcha* Beck MS" (*nomen nudum*) from Lau and North Fiji basins, which Beck considered to be distinct from *Olgasolaris tollmanni* Beck, 1992 from Manus Basin. This name appeared in the literature once as "*Olgasolaris ethmoconcha* Beck, in press" (listed in a table without further details, in Appendix 2 of Warén & Bouchet, 2001), but has never been published per definition of the Code and remains a *nomen nudum*. The genus *Olgasolaris* Beck, 1992 is now considered a junior synonym of *Shinkailepas* Okutani, Saito & Hashimoto, 1989, because the type species of *Olgasolaris*, *O. tollmanni* Beck, 1992 (= now *Shinkailepas tollmanni*) was found to be phylogenetically nested within *Shinkailepas* and no reliable morphological characters separate these genera (Fukumori *et al.* 2019). Population genetic studies of *S. tollmanni* have shown that specimens from across Manus Basin, Woodlark Basin, North Fiji Basin, Lau Basin, and Futuna Arc all represent one well-connected population genetically (Poitrimol *et al.* 2022; Yahagi *et al.* 2020). As such, we have no doubt that what Beck called "*Olgasolaris ethmoconcha* Beck MS" (*nomen nudum*) represents simply a local form of *S. tollmanni*, and therefore should not be published, so we have deliberately not included the description of this species.

TABLE 3. Summary of gastropod taxa and relevant taxonomic acts discussed in this work.

Subclass	Superfamily: Family	Valid taxa discussed herein	Junior synonyms and invalid names
Patellogastropoda	Lottioidea: Pectinodontidae	***Bathyacmaea nadinae*** Beck in Chen & Sigwart **sp. nov.**	"*Bathyacmaea nadinae* Beck, in press" listed in Appendix 2 of Warén & Bouchet, 2001 (*nomen nudum*)
		B. nipponica Okutani, Fujikura & Sasaki, 1993	*B. brevidentata* Zhang & Zhang, 2020; *B. austrina* Zhang & Zhang, 2020
		B. lactea Zhang, Zhang & Zhang, 2016	*Bathyacmaea becki* Zhang & Zhang, 2017
		Bathyacmaea jonassoni Beck, 1996	
Vetigastropoda	Lepetelloidea: Pyropeltidae	***Pyropelta ovalis*** Beck in Chen & Sigwart **sp. nov.**	
		Pyropelta yamato Sasaki, Okutani & Fujikura, 2003	
		Pyropelta ryukyuensis Sasaki, Okutani & Fujikura, 2008	
		Pyropelta elongata Zhang & Zhang, 2017	
	Lepetodriloidea: Lepetodrilidae	***Pseudorimula leisei*** Beck in Chen & Sigwart **sp. nov.**	"*Pseudorimula leisei* Beck, in press" listed in Appendix 2 of Warén & Bouchet, 2001 (*nomen nudum*)
		Lepetodrilus fijiensis Beck in Chen & Sigwart **sp. nov.**	"*Lepetodrilus* aff. *schrolli*" *sensu* Poitrimol *et al*. (2022) "*Lepetodrilus* aff. *schrolli* Fiji/Lau Basins" *sensu* (Johnson *et al*. 2008)
		Lepetodrilus schrolli Beck, 1993	
Neritimorpha	Neritoidea: Phenacolepadidae	***Shinkailepas conspira*** Beck in Chen & Sigwart **sp. nov.**	*"Shinkailepas* aff. *tufari* Lau" *sensu* Poitrimol *et al*. (2022) "*Shinkailepas conspira* Beck, in press" listed in Appendix 2 of Warén & Bouchet, 2001 (*nomen nudum*)
		Shinkailepas tollmanni (Beck, 1992)	*Olgasolaris tollmanni* Beck, 1992 "*Olgasolaris ethmoconcha* Beck MS" (*nomen nudum*, unpublished) The genus name *Olgasolaris* Beck, 1992 is a junior synonym of *Shinkailepas* Okutani, Saito & Hashimoto, 1989 (Fukumori *et al*. 2019)
		Shinkailepas tufari Beck, 1992	

.....continued on the next page

TABLE 3. (Continued)

Subclass	Superfamily: Family	Valid taxa discussed herein	Junior synonyms and invalid names
		Symmetromphalus hageni Beck, 1992	
Neomphaliones	Neomphaloidea: Neomphalidae	***Symmetromphalus mcleani*** Beck in Chen & Sigwart **sp. nov.**	"*Symmetromphalus* aff. *hageni* Lau/N Fiji" *sensu* Poitrimol *et al*. (2022) "*Symmetromphalus macleani* Beck, in press" listed in Appendix 2 of Warén & Bouchet, 2001 (*nomen nudum*)
		Lamellomphalus manusensis Zhang & Zhang, 2017	"*Fumocapulus alayseae* Beck MS" (*nomen nudum*, unpublished) "*Fumocapulus alayseae* Beck, in press" listed in Appendix 2 of Warén & Bouchet, 2001 (*nomen nudum*)
	Peltospiroidea: Peltospiridae	***Symmetriapelta wareni*** Beck in Chen & Sigwart **gen. et sp. nov.**	"*Mediapex diodoroides* Sasaki & Kano MS" (*nomen nudum*, unpublished) The genus name "*Mediapex" (nomen nudum)* has never been published, and is named herein as ***Symmetriapelta*** Beck in Chen & Sigwart **gen nov.**

The two other Beck manuscript names not included for publication here are the genus and species name of the neomphalid "*Fumocapulus alayseae* Beck MS" (*nomen nudum*) from Lau Basin, which was apparently very rare there (Supplementary Material). These also appeared in a table in the Appendix 2 of Warén & Bouchet (2001), but do not fulfill the requirement for establishing new taxa as defined by the Code and these names therefore remain unpublished. From the morphology it is clear that this represents the same species described in 2017 from Manus Basin as *Lamellomphalus manusensis* Zhang & Zhang, 2017, which has now also been recorded from both Tonga-Tofua Arc and Futuna Arc and confirmed to be the same species with molecular evidence (Poitrimol *et al.* 2022; Zhong *et al.* 2022). Though it has not previously been recorded from Lau Basin, this is within the range between Manus and Tonga-Tofua Arc and it is not surprising that this species also occurs in Lau Basin. As such, we have suppressed the description of the genus and species "*Fumocapulus alayseae* Beck MS" (*nomen nudum*) as this species has already been described as *Lamellomphalus manusensis* Zhang & Zhang, 2017 and there is no evidence from morphological feature nor molecular phylogenetic reconstruction that it represents a distinct taxon.

Recent studies have shown that *Bathyacmaea* species exhibit great plasticity in shell and radular characters (Chen *et al.* 2019). Beck's unpublished habilitation thesis (Supplementary Material) also originally intended to describe a genus ("*Nipponacmaea* Beck MS", *nomen nudum*) to separate *Bathyacmaea secunda* Okutani, Fujikura & Sasaki, 1993 from the type species of *Bathyacmaea*, *Bathyacmaea nipponica* Okutani, Fujikura & Sasaki, 1993, based on radular characters. However, these are now known to be within the very wide intraspecific variation displayed by *B. nipponica*, and integrative taxonomic analyses resulted in the synonymisation of *B. secunda* as a junior synonym of *B. nipponica* (Chen *et al.* 2019). We have therefore suppressed the genus name "*Nipponacmaea* Beck MS*"*. Previously published molecular data using the 18S gene fragment (Schwarzpaul 2002) supports *Bathyacmaea nadinae* Beck in Chen & Sigwart **sp. nov.** as distinct from other described species of *Bathyacmaea* with available molecular data. While this species stands as valid, the proposed additional genus "*Nipponacmaea* Beck MS" (*nomen nudum*) has no support.

Furthermore, we take this opportunity to note that *Bathyacmaea brevidentata* Zhang & Zhang, 2020 from South China Sea and *Bathyacmaea austrina* Zhang & Zhang, 2020 from Okinawa Trough were named based on shell and radular characters alone, despite also presenting data that clearly demonstrate a lack of genetic distinction between those two species or *B. nipponica* (Zhang & Zhang 2020). The morphology of these two proposed 'species' clearly fall within the variation seen in *B. nipponica* confirmed by both mitochondrial and nuclear markers (Chen *et al.* 2019). Both *B. brevidentata* and *B. austrina* are here synonymised with *B. nipponica*. Similarly, molecular data have shown that *Bathyacmaea becki* Zhang & Zhang, 2017 described from Manus Basin is not distinct from *Bathyacmaea lactea* Zhang, Zhang & Zhang, 2016 from South China Sea (Chen *et al.* 2019; Zhang *et al.* 2016; Zhang & Zhang 2017a, 2020), and therefore *B. becki* is here recognised as a junior synonym of *B. lactea*. Beck named *Bathyacmaea jonassoni* Beck, 1996 based on material from Edison Seamount near the Manus Basin (Beck 1996), and the rather wide range of *B. lactea* from Manus to South China Sea suggests that it may actually simply be a range extension of *B. jonassoni*. Edison Seamount does host several gastropod species not known elsewhere (Beck, 1996), however, so this warrants future studies.

After Beck drafted his original manuscript in 1997 (Supplementary Material) proposing *Pyropelta ovalis* **sp. nov.**, three species of *Pyropelta* have been described from the western Pacific including *P. yamato* Sasaki, Okutani & Fujikura, 2003 from a vent on the Izu-Ogasawara Arc, *P. ryukyuensis* Sasaki, Okutani & Fujikura, 2008 from Okinawa Trough vents, and *P. elongata* Zhang & Zhang, 2017 from a seep in the South China Sea. Though no molecular data are available to directly compare these species, *P. ovalis* **sp. nov.** is clearly morphologically distinctive from *P. yamato* and *P. ryukyuensis* in having an elongate oval shell shape (Sasaki *et al.* 2003, 2008). Though the shell form of *P. elongata* is similar to *P. ovalis* **sp. nov.**, they differ greatly in the radular characters in that the rachidian has a nearly square shape in *P. elongata* but broad and rounded in *P. ovalis* **sp. nov.** (Zhang & Zhang 2017b). These morphological differences, in addition to the geographic segregation, support *P. ovalis* **sp. nov.** as a distinct new species.

In 1997, Beck originally intended to describe *Lepetodrilus fijiensis* as a subspecies of *Lepetodrilus schrolli* Beck, 1993 which he had described from Manus Basin. However, DNA barcoding and population genetics has since shown that the Manus Basin *Lepetodrilus* are overall genetically distinct from those inhabiting North Fiji and Lau basins, with both lineages co-occurring in Woodlark Basin (Johnson *et al.* 2008; Poitrimol *et al.* 2022). Rare individuals potentially representing genetic intermediates between *L. schrolli* and *L. fijiensis* **sp. nov.** are known, bolstering the conclusion that these two species represent recently separated evolutionary lineages (Poitrimol *et al.*

2022). Based on currently available evidence, we have established this new taxon at the species level. Published population genetics data also indicate that *Shinkailepas conspira* **sp. nov.** (from Lau Basin) and *Symmetromphalus mcleani* **sp. nov.** (from North Fiji) are distinct evolutionary lineages from their closest relatives, *Shinkailepas tufari* Beck, 1992 and *Symmetromphalus hageni* Beck, 1992, respectively (Poitrimol *et al.* 2022). *Symmetromphalus mcleani* **sp. nov.** corresponds to "*Symmetromphalus* aff. *hageni* Lau/N Fiji", and *Shinkailepas conspira* **sp. nov.** corresponds to "*Shinkailepas* aff. *tufari* Lau" in the publication of Poitrimol *et al.* (2022).

Symmetriapelta wareni **gen. et sp. nov.** has had a convoluted taxonomic history. After Beck failed to publish his description prepared in the 1990s, the same species appeared in a later paper presenting genetic data from Lau Basin (Heß *et al.* 2008) but using a different *nomen nudum*: "*Mediapex diodoroides* Sasaki & Kano MS". The same species was also collected later from Tonga-Tofua Arc (Zhong *et al.* 2022), whose mitogenome and phylogeny was published under the *nomen nudum* used by Heß and colleagues (Heß *et al.* 2008), for consistency and lack of any better options (Zhong *et al.* 2022). As Beck's name was evidently earlier, and no description of the later *nomen nudum* has been published, here we have chosen to respect and retain Beck's name for the formal description of this genus and species. Any reference to "*Mediapex diodoroides"* (*nomen nudum*) should therefore correctly be called *Symmetriapelta wareni* Beck in Chen & Sigwart **gen. et sp. nov.** In Beck's original manuscript (Supplementary Material), he did not figure the holotype and it was unclear which specimen he had intended to select as the holotype. Here, we selected a specimen from the same lot as his figured specimens with typical sculpture for the species as the holotype and figured it (Figs 18D–E).

A number of molecular studies have clearly demonstrated that the vast majority of vent gastropod genera have pairs of sister species in Manus Basin and North Fiji or Lau Basins (Heß *et al.* 2008; Johnson *et al.* 2008; Poitrimol *et al.* 2022). While those in Manus Basin were described (Beck 1992a; Beck 1992b, 1993; Warén & Bouchet 1993, 2001), the lack of established valid names for the North Fiji and Lau Basin lineages has meant they were confusing, difficult to refer to accurately (Poitrimol *et al.* 2022), and invisible for species conservation.

Lothar A. Beck's descriptions of these species and the associated study material all narrowly escaped oblivion. Their recovery should largely be credited to the staff in Marburg and Senckenberg who saved both the specimens and the manuscript; this study also would have not been possible without the specialist malacological library at SMF. It is fortunate that these names can now be published, and Beck's legacy can provide a basis to ensure the survival of these species in the face of the push toward deep-sea mining.

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SUPPLEMENTARY MATERIAL

The original habilitation thesis chapter by Lothar A. Beck (1997): *Systematics and phylogenetic relationship of new archaeogastropod limpets from hot vents at North-Fiji- and Lau Basins (South West Pacific).* Available at:
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