

**Two Solenogaster Molluscs,  
*Ocheyoherpia trachia* n.sp. from Macquarie Island and  
*Tegulaherpia tasmanica* Salvini-Plawen from Bass Strait  
(Aplacophora: Neomeniomorpha)**

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ABSTRACT. *Tegulaherpia tasmanica* Salvini-Plawen is herein redescribed and illustrated from 22 individuals collected in Bass Strait and expands the original text diagnosis to include illustrations. Similarities between *Tegulaherpia*, which belongs to the Lepidomeniidae, and the written description and figures of *Lepidomenia hystrix* Marion & Kowalevsky, the nominate species for which there is no known type, suggests synonymy.

Nineteen individuals of *Ocheyoherpia trachia* n.sp. were collected at diving depths from Macquarie Island. It is the second species to be described in the previously monotypic subantarctic genus *Ocheyoherpia* Salvini-Plawen and differs from *O. lituifera* in its shorter epidermal spicules, dorsal carina, size of radula, number of copulatory spicules and their relationship to the large copulatory spicule glands, a large dorsal sinus, and thin cuticle. Familial status is shown to be uncertain.

In both *T. tasmanica* and *O. trachia* the morphology of hard parts (epidermal spicules, radula, and copulatory spicules) is emphasized. The reproductive system is described for *T. tasmanica* and remarks made on differences in the reproductive systems of the two *Ocheyoherpia* species.

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The continental shelf and offshore benthos of Australia affords numerous species of Aplacophora (Scheltema, 1998). This short contribution to the benthos of Bass Strait and Macquarie Island is part of a continuing series of descriptions of Australian aplacophoran species.

Seldom have neomenioid aplacophorans—those that creep about on a narrow, ventral ridgelike foot—been

described by placing emphasis on hard-part and external morphologies, although these are characters most readily available for identification. They are a focus of this paper in the certitude that the taxonomy of Aplacophora can be made available to more than the specialist.

## Materials and methods

The species described are from collections made during the Macquarie Island Expedition 1977–78 (Australian Museum) and Bass Strait Survey 1979–1984 (National Museum of Victoria). Holotypes, paratypes, and voucher specimens are deposited in or were borrowed from the Australian Museum (AM), Museum of Victoria (MV), Tasmanian Museum (TM), and the National Museum of Natural History, Washington, DC (USNM).

Holotypes were drawn under a dissecting microscope with the aid of an ocular drawing tube and then photographed. The drawings emphasize spicule attitude and details of the anterior and posterior ends. Measurements were made by a map wheel or by dividers on drawings: *length* is the axial midline of a specimen in lateral view, *height* is the dorsoventral diameter, and *width* the lateral diameter. Epidermal spicules and radulae were treated as in Scheltema (1989), with the exception that radulae were mounted in CMCP-10©, a water-miscible mountant. To obtain isolated copulatory spicules, the posterior end of an individual was cut off and the tissue dissolved in hypochlorite solution (household bleach). A permanent slide was prepared by washing spicules with distilled water and transferring them to a slide with the aid of a micropipetter. After air-drying, a mountant and coverslip were added. Measurements of radulae, epidermal spicules, and copulatory spicules were made with an ocular micrometer. Histologic sections were paraffin embedded and cut at 7 µm or epon embedded and cut at 1.5 µm. The former were stained by hematoxylin and Gray's double contrast or by Mallory-Heidenhain trichrome; epon sections were stained with azure II and methylene blue.

The general anatomy of Neomeniomorpha has been described by Salvini-Plawen (1985a), Scheltema *et al.* (1994), and Scheltema (1998). The arrangement of epidermal spicules are: (a) *skeletal*, lying within the cuticle at right angles to each other in one or more layers spiralled from ventroanterior to dorsoposterior and from dorso-anterior to ventroposterior; (b) *upright*, more or less erect in a single layer, or (c) *adpressed*, with a single layer of overlapping spicules flat against the body wall cuticle. Species may have one or more spicule arrangements and one to several spicule morphologies. Spicules are formed of aragonite; they may be hollow or solid throughout. The radula of neomenioids is *distichous* (two teeth per row), *monostichous* (one tooth per row), or *polystichous* (many teeth per row); it is lacking in 20 percent of known species. Neither distichous nor polystichous radulae have a central, median tooth like the rachidians in gastropod radulae. In distichous radulae the denticles may be borne on a bar attached entirely or partially to the radular membrane, or they may be denticulate hooks largely free of the membrane. In distichous bars, the largest denticles are lateral. During growth denticles are added to new teeth either medially or by bifurcation of a pre-existing denticle.

## Species descriptions

### Neomeniomorpha Pelseneer, 1906

Ventroplicida Boettger, 1956; Solenogastres Gegenbaur, 1878 [*partim*], Salvini-Plawen, 1967. *Non* Neomeniomorpha Salvini-Plawen, 1978.

**Diagnosis.** Aplacophoran molluscs with a narrow footfold in a ventral, longitudinal pedal groove and without a cuticular oral shield or mantle cavity ctenidia; midgut as a combined stomach and digestive gland; monoecious.

**Remarks.** A ventral groove in a spicule-covered, vermiform organism identifies it as a neomenioid mollusc.

### Family Lepidomeniidae Pruvot, 1902

**Type genus.** *Lepidomenia* Kowalevsky in Brock, 1883 (1992, *Bull. Zool. Nomen.* 49: 158, Op. 1676).

**Diagnosis.** Epidermal spicules thin, platelike, adpressed; cuticle thin; radula small, with distichous hooks (Fig. 3B); ventral salivary glands paired, tubular, opening through paired ducts.

**Remarks.** With three genera of small neomenioids, *Lepidomenia* Kowalevsky, 1883, *Nierstraszia* Heath, 1918, and *Tegulaherpia* Salvini-Plawen, 1983.

### *Tegulaherpia* Salvini-Plawen, 1983

**Type species.** *Tegulaherpia stimulosus* Salvini-Plawen, 1983, by monotypy [corrected to *T. stimulosa* (Salvini-Plawen, 1988)].

***Tegulaherpia* distribution.** Bass Strait (Australia), Mediterranean Sea, Irish Sea, Norwegian fjords, between 50 and 470 m (Salvini-Plawen, 1983, 1997).

**Diagnosis.** Slender, <5 mm long, shiny, epidermal spicules quadrate, foot not within groove, mouth separate from vestibule, without midgut sacculations, with seminal vesicles, without seminal receptacles, paired lower gametoducts either united or joined laterally to anterior extension of mantle cavity, paired copulatory spicules 2 per sac, dorsoterminal sense organ rudimentary above large, granule-filled epidermal cells.

**Remarks.** Species of *Tegulaherpia* were placed provisionally in the Lepidomeniidae on the basis of a thin cuticle with scales, a distichous radula, and what is here called tubular ventral salivary glands (Salvini-Plawen, 1988, as subepithelial-follicular glands). The nominate genus of the family is monotypic, based on the description of a single juvenile individual from the Mediterranean, *L. hystrix*

Marion & Kowalevsky. No Aplacophora has since been attributed either to *L. hystrix* or to the genus *Lepidomenia* with certainty, although six individuals of *L. hystrix* were reported, without description, from the type locality (Swedmark, 1956; Salvini-Plawen, 1985b). Suggested here is that the genus *Tegulaherpia* may be synonymous with *Lepidomenia* based on similarities between the written description and figures of *L. hystrix* (Kowalevsky & Marion, 1887) and those of *T. tasmanica*, described below, which in turn is similar to *T. stimulosa* from the Mediterranean (Salvini-Plawen, 1988).

***Tegulaherpia tasmanica*** Salvini-Plawen, 1988

Figs. 1, 2, 3A,B

*Tegulaherpia* sp.—Scheltema, 1998, fig. 2.8

**Type material.** Holotype (TM, E23218) and paratypes, Tasmanian Museum, Hobart.

**Type locality.** Off northern coast of Tasmania between Burnie and Penguin, 50–55 m.

**Vouchers.** Bass Strait, Australia, 39°48.6'S 146°18.8'E, 82 m (RV *Tangaroa* BSS-S 158 [epibenthic sled], 13.xi.81); MV 83492 (entire alcohol specimen, spicule slide); length 3.6 mm; anterior, midbody, and posterior height 1.0, 0.5, and 0.3 mm, respectively; width 0.3, 0.4, and 0.3 mm; MV 83493 (dissected alcohol specimen; radula, spicule slides).

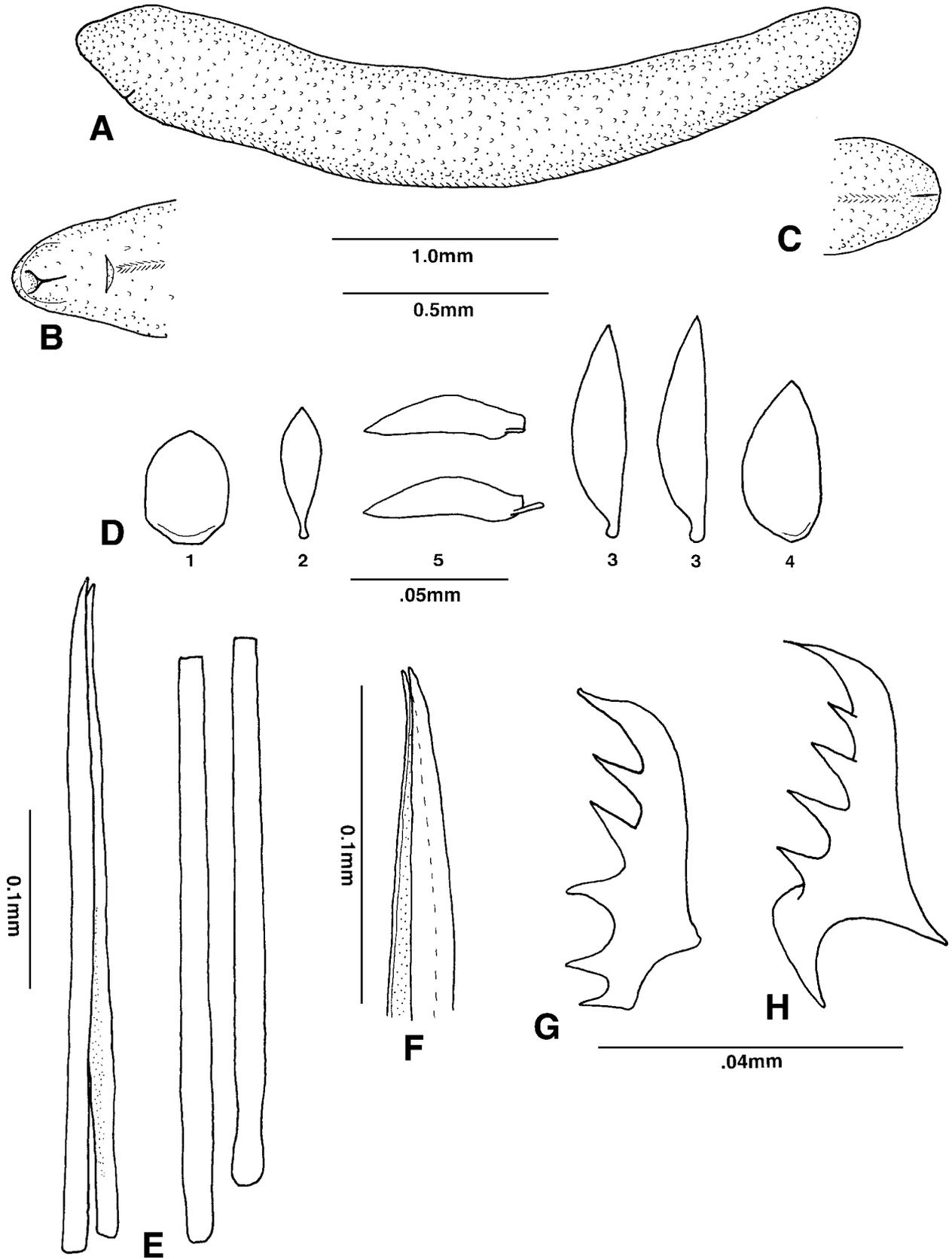
**Material examined.** 22 individuals, including 2 paratypes from off Tasmania and 20 individuals from Bass Strait Survey, RV *Tangaroa*, November 1981: 2, BSS-S 157 (epibenthic sled), 40°10.9'S 145°44.3'E, 75 m; 7, BSS-S 158 (epibenthic sled), 39°48.6'S 146°18.8'E, 82 m; 2, BSS-S 159 (epibenthic sled), 39°46.0'S 146°18.0'E, 80 m; 1, BSS-G 159 (Smith-MacIntyre grab), 39°43.5'S 146°18.8'E, 80 m; 5, BSS-S 165 (epibenthic sled), 40°13.8'S 148°39.6'E, 60 m; 3, BSS-S 169 (epibenthic sled), 39°02.4'S 148°30.6'E, 120 m.

**Description.** Up to 3.7 mm long, greatest height anterior, to 1.0 mm, tapered posteriorly, posterior height to 0.4 mm, somewhat compressed laterally, midbody height to 0.7 mm, width to 0.5 mm, anterior end rostrate, posterior end somewhat pointed to rounded, ventral line indicated by erect spicules on each side of foot (Figs. 1A, 3A); contracted mouth opening Y-shaped with a small knob in fork of the Y; contracted pedal pit opening distinct, laterally slit-shaped (Fig. 1B); mantle cavity opening terminal (Fig. 1C), dorsoterminal sense organ not externally obvious. Cuticle thinner than epidermis, 5 and 10 µm, respectively; epidermis with thickset, heavily granulated papillae. Epidermal spicules about 1 µm thick, of four types, all with small, sharp distal point; most numerous spicules quadrate (Fig. 1, spicule D1), widest at base, base laterally concave and medially straight, to 42 µm long by 29 µm wide; type 2 (spicule D2) short, symmetrical paddles to 42 µm long by

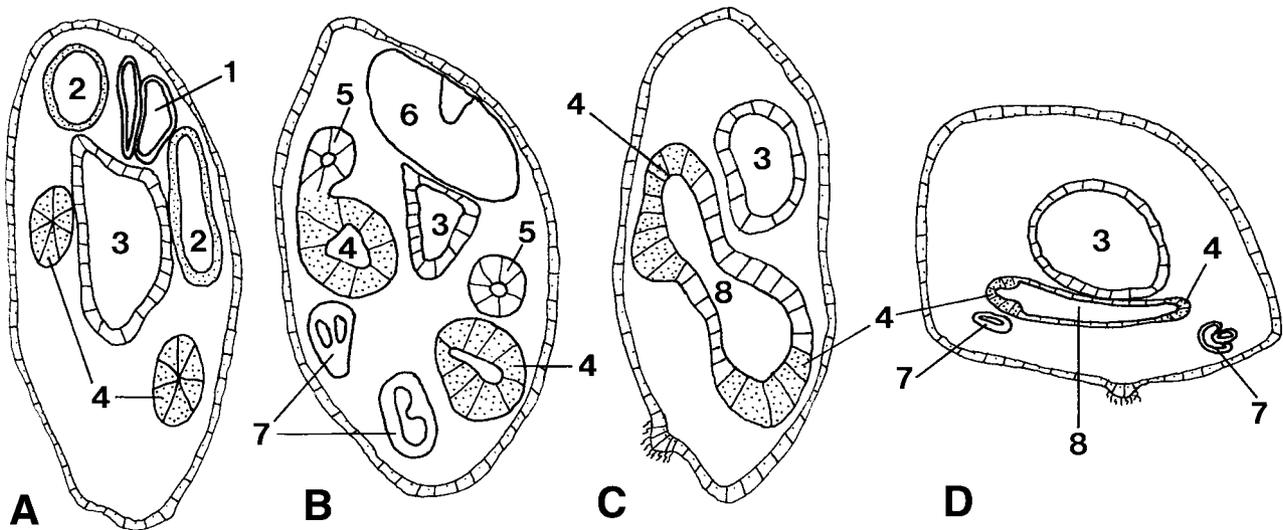
14 µm wide, ending basally in a small knob; type 3 (spicules D3) large, asymmetrical paddles, convex on one side, flat to slightly convex on the other, with basal knob, to 75 µm long by 15 µm wide; and type 4 (spicule D4) large, asymmetrical ovoid spicules lateral to foot spicules, base narrow, straight, to 57 µm long by 26 µm wide; variation within each spicule type slight; spicules from beside foot (spicules D5) both with and without narrow handle on truncated base, spicule convex next to handle, becoming concave distally, convex on opposite side, to 52 by 15 µm not including handle. Radula (2 examined) with about 15 rows; teeth with 4 median denticles and distal hook, base produced into additional denticle-like protuberance, to 53 µm long (Figs. 1G,H, 3B). Copulatory spicules examined from one individual with 2 long, slender spicules of about equal length per sac, one fitting into a groove in the other, sharply pointed and slightly curved distally, proximally rounded and, in one of the two spicules, slightly bulbous; 700 µm long, greatest width 20 µm (Fig. 1E,F).

**Reproductive system.** *Tegulaherpia tasmanica*, like *T. stimulosa*, has paired seminal vesicles opening off the anterior end of the gonopericardial ducts but no seminal receptacles (Fig. 2A,B). The lower gametoducts remain paired, opening laterally onto a dorsoventrally compressed tubular extension of the mantle cavity, as indicated by cell contents (Fig. 2C,D); further posteriorly the epithelium of the gametoducts joins ventrally but not dorsally. Copulatory spicules are formed before maturation of gonad primordium in juveniles (Fig. 2D).

**Remarks.** The illustrated description here expands the original written diagnosis of the species (Salvini-Plawen, 1988); identifications were made by comparisons with paratype material. For differences between *Tegulaherpia tasmanica* and the two other *Tegulaherpia* species, *T. stimulosa* and *T. myodoryata* Salvini-Plawen, I have relied on the original descriptions. In body shape, the anterior end of *T. tasmanica* is pointed, not rounded (cf. Figs. 1A, 3A with Salvini-Plawen, 1988, figs. 7, 8). The description of *T. stimulosa* from the Mediterranean, which *T. tasmanica* most closely resembles, does not include illustrations of all types of epidermal spicules or the copulatory spicules. According to the written description, in *T. stimulosa* the spicules from beside the foot are smaller and pedal glands less distinct than I observed in *T. tasmanica*, and ducts of the salivary glands are ampulla shaped, rather than tubular as in *T. tasmanica*. According to the written description of *T. tasmanica* (Salvini-Plawen, 1988, p. 385) there are anatomical differences between the two species in the relationships of the rectum and copulatory spicule sheaths and their openings into the mantle cavity. The statement that there is an unpaired portion of the lower gametoduct longer than in *T. stimulosa*, however, is not in accord with my observations, that the lower gametoducts remain paired and open laterally onto an extension of the mantle cavity (Fig. 2C,D). It is perhaps the mantle cavity extension that is longer in *T. tasmanica*.



**Figure 1.** *Tegulaherpia tasmanica* Salvini-Plawen. A–C, voucher specimen (MV 83492): A, anterior to left, upper scale; B, C, ventral views of anterior and posterior ends, respectively, lower scale. D, epidermal spicules of A, types 1–5. E, F, copulatory spicules, basal portions to right in E broken off from pointed distal portions to left; stippling indicates groove. G, H, oldest and second newest radular teeth. E–H from dissected voucher specimen (MV 83493).



**Figure 2.** *Tegulaherpia tasmanica* Salvini-Plawen, reproductive system; semischematic drawings of sectioned material. A–C, mature individual from same location as voucher specimen. D, paratype, immature individual. Foot indicated in C and D only; missing copulatory spicule sacs in section C an artifact of sectioning. 1 gonopericardial duct, 2 seminal vesicle, 3 intestine, 4 lower gametoduct (blind ends shown in section A), 5 upper gametoduct, 6 pericardium with heart, 7 copulatory spicule sac, 8 anterior extension of mantle cavity.

#### Family incertae sedis

#### *Ocheyoherpia* Salvini-Plawen, 1978

**Type species.** *Ocheyoherpia lituifera* Salvini-Plawen, 1978, by monotypy.

***Ocheyoherpia* distribution.** Off subantarctic islands (South Sandwich, South Shetland, and South Georgia) at depths less than 250 m; Macquarie Island at less than 15 m depth.

**Diagnosis.** Thick-bodied, small neomenioids with solid epidermal spicules in the form of spines, barbed spicules, and serrated spicules; skeletal spicules lacking; cuticle thick or thin; with two pairs of pharyngeal salivary glands, one of them acinar; radular teeth with several denticles on a bar incompletely attached to radular membrane, outer denticles fused to a curved process swung from beneath tooth base; dorsal midgut coecum paired; midgut sacculate; copulatory spicules 2 or more per pair; paired seminal receptacles and accessory copulatory glands present; gametopore single; respiratory folds low, few; dorsoterminal sense organ absent.

**Remarks.** Assignment of the genus *Ocheyoherpia* to the Phyllomeniidae (Salvini-Plawen, 1978) seems untenable on these grounds: (a) *Ocheyoherpia* spp. do not have true gametoducts as uniquely held by species of *Phyllomenia* (Salvini-Plawen, 1978); (b) both barbed epidermal spicules and spines are solid and, in contradistinction to the original description and unlike Phyllomeniidae, skeletal spicules are lacking (Fig. 3D); and (c) the radular teeth have the form of a bar with denticles, unlike the distichous hooks of Phyllomeniidae.

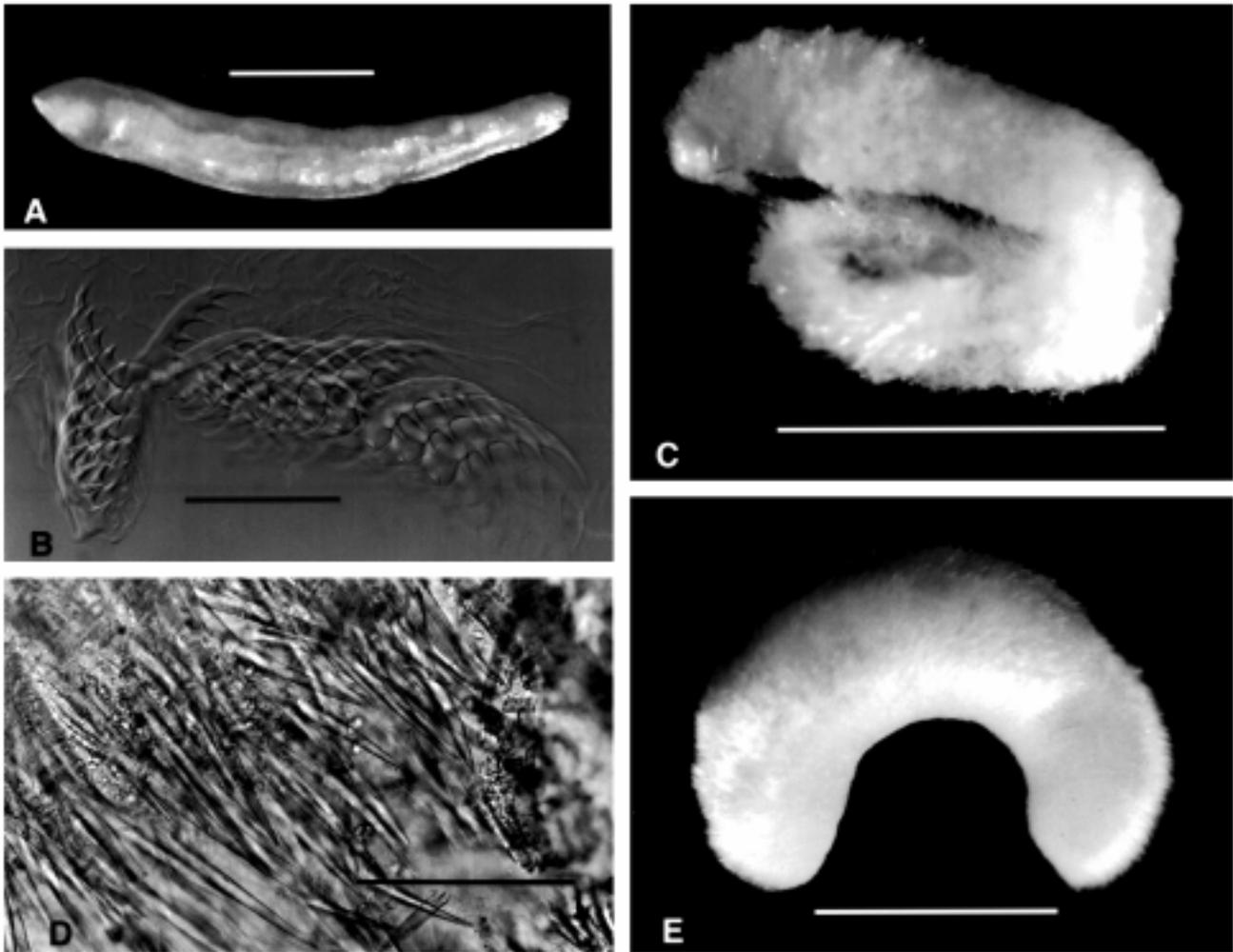
#### *Ocheyoherpia lituifera* Salvini-Plawen, 1978

Figs. 3C, 5A,B

**Type material.** HOLOTYPE: USNM 749738 (alcohol specimen, spicule slide). 3.7 mm long, midbody height 0.7 mm. PARATYPE: USNM 749739 (histologic sections); off South Shetland Island, 62°41'S 54°43'W, 210–220 m (U.S. Antarctic Res. Pgm. stn 12-1003, 15.iii.64).

**Type locality.** Off South Sandwich Island, 56°19–20'S 27°28–29'W, 148–201 m (U.S. Antarctic Res. Pgm. 1961–1972, stn 22-1581, 6.iii.1966).

**Diagnosis.** Spiny (Fig. 3C) (see also Salvini-Plawen, 1978, fig. 288), cuticle thick (56  $\mu$ m), epidermis thin (22  $\mu$ m); spinelike epidermal spicules thick, long and wide, many greater than 160  $\mu$ m long and up to 16  $\mu$ m wide with an untapered, flat base (Fig. 5A); barbs to 170 by 14  $\mu$ m; distally serrated spicules to 225  $\mu$ m (see Salvini-Plawen, 1978, fig. 92); short scimitar-like spicules common. Radular teeth approximately 40  $\mu$ m in length, tips of lateral, fused denticles curved in histologic sections (Fig. 5B). Form of copulatory spicules not known.



**Figure 3.** A, B, *Tegelaherpia tasmanica* Salvini-Plawen: A, voucher specimen (MV 83492); B, distichous radula from a Bass Strait individual (RV *Tangaroa* BSS-S 165). C, *Ocheyoherpia lituifera* Salvini-Plawen, holotype, with mantle cavity partially open (USNM 749738). D, E, *Ocheyoherpia trachia* n.sp.: D, epidermal spicules viewed from beneath cuticle; upright spicules only, without skeletal spicules; E, holotype (AM C203646). Anterior to left, dorsal above in A, C, E.

***Ocheyoherpia trachia* n.sp.**

Figs. 3D,E, 4, 5C–F

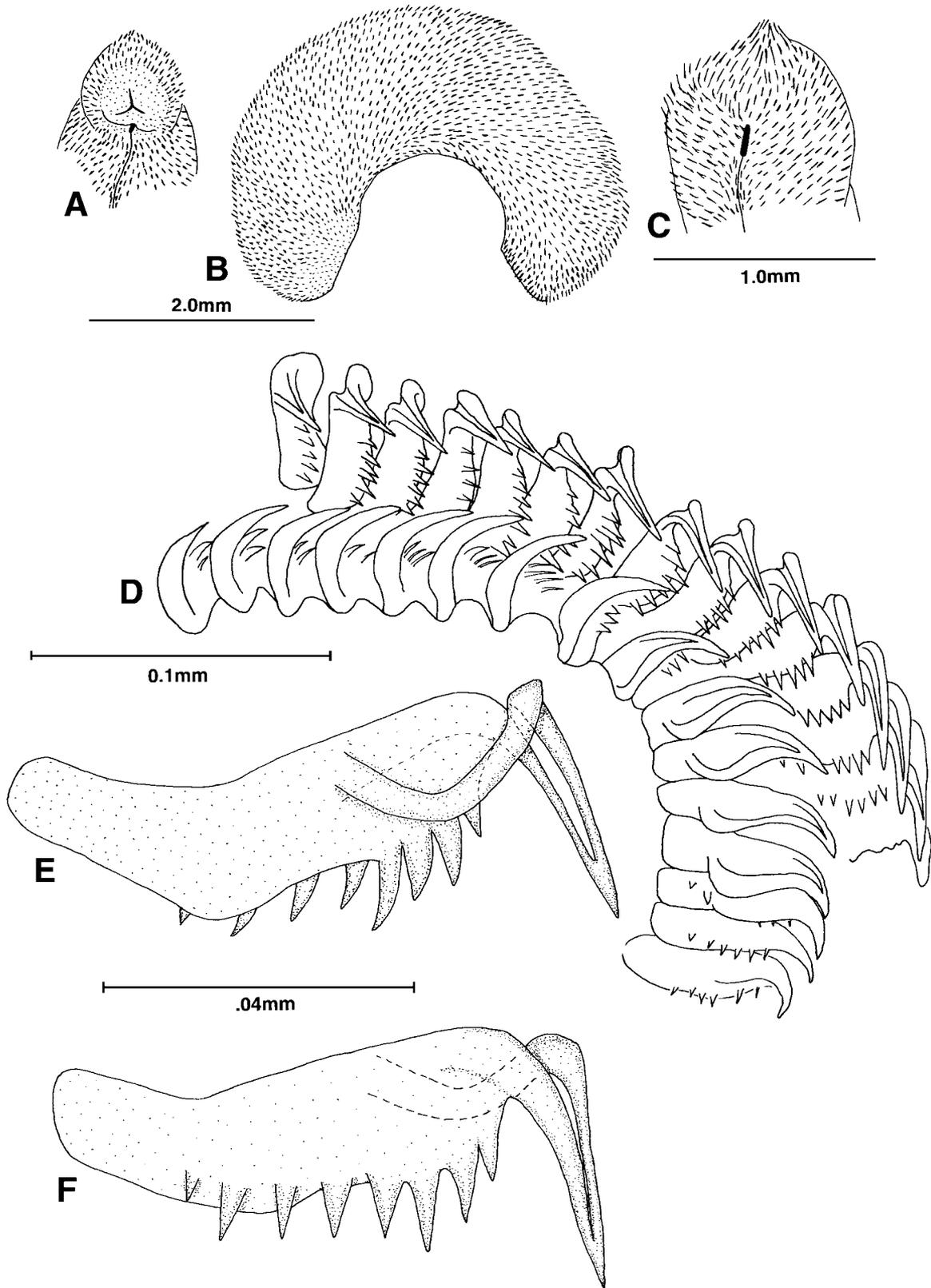
*Ocheyoherpia* sp.—Scheltema *et al.*, 1994, figs. 8A,C, 20G; Scheltema, 1998, fig. 2.15.

**Type material.** HOLOTYPE: AM C203646 (alcohol specimen, spicule slide); length 5.4 mm, anterior, midbody, and posterior height 1.1 mm. PARATYPES (21): AM C203647 (dissected alcohol specimen, radula slide, epidermal and copulatory spicule slides), type locality; AM C203648 (dissected alcohol specimen), type locality. A further 19 paratypes from Macquarie Island Expedition not dissected: 3, Green Gorge Reef, vertical rock wall, 6.1 m (stn MA-275, 54°38'S 158°55'E, AM C149632); 12, rocks, Garden Bay Peninsula, 11 m (AM C149633, type locality); 2, Green Gorge, boulders on sand-gravel

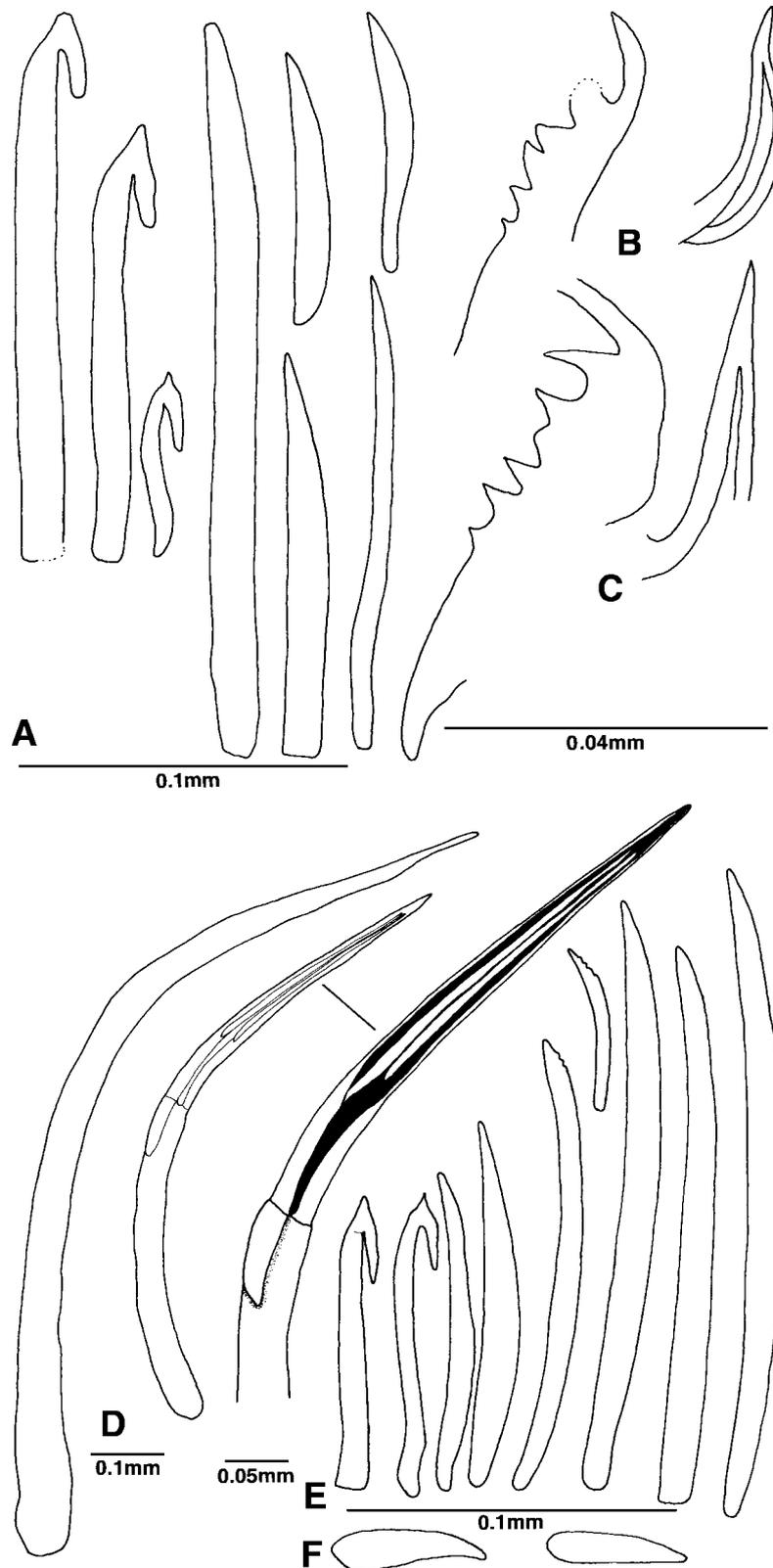
bottom, 14 m (stn MA-245, 54°38'S 158°55'E, AM C149634); 1, off Garden Bay Peninsula, rocks, 11–14 m (stn MA-128, 54°30'S 158°57'E, AM C149635); 1, Green Gorge, boulders on sand and gravel bottom, 13.7 m (stn MA-247, 54°38'S 158°55'E, AM C149636) (histologic sections).

**Type locality.** Macquarie Island, from Garden Bay Peninsula, vertical rock face, 11 m (Australia Museum Macquarie Island Expedition 1977–78, stn MA-125, 54°30'S 158°57'E, 16.xii.1977).

**Diagnosis.** Length to 6.5 mm; spicular coat rough, not shiny; with dorsal carina; barbed spicules few; serrated spicules few, anterior only; two deeply curved copulatory spicules per copulatory spicule sac, the shorter one with grooves and ridges on distal half; cuticle thin (22 m).



**Figure 4.** *Ocheyoherpia trachia* n.sp. A–C, holotype (AM C203646): A, anteroventral end with flattened mouth area stippled, dorsal carina evident. B, entire specimen, anterior to left. C, posteroventral end. D–F, radula of paratype (AM C203647): D, entire radula, distal end to left; one tooth missing, right row. E, single tooth viewed from beneath radular membrane showing supporting bar fused to lateralmost denticle. F, same tooth as if viewed from above.



**Figure 5.** A, *Ocheyoherpia lituifera* Salvini-Plawen, epidermal spicules from holotype; spicules with distal serrations not illustrated. B, *O. lituifera*, radular teeth drawn from sectioned paratype, distal end of fused lateral denticle curved (USNM 749739). C, *Ocheyoherpia trachia* n.sp., radular teeth drawn from sectioned specimen (AM C149636) at same scale as B. D–F, *O. trachia* n.sp., spicules from paratype (AM C203647) except left barbed spicule from paratype (AM C203648); D, copulatory spicules; E, epidermal spicules; F, spicules from beside pedal groove.

**Description.** Spicular coat rough; anterior and posterior ends of body not tapered, flattened ventrally (Figs. 3E, 4B); with dorsal carina; retracted mouth slit an inverted Y-shape, opening of mantle cavity axial, short (Fig. 4A,C); body length to 6.5 mm, height even throughout, to 1.4 mm. Epidermis and cuticle thin, to 18  $\mu\text{m}$  and 22  $\mu\text{m}$ , respectively. Epidermal spicules evenly curved, to 210  $\mu\text{m}$  long by 14  $\mu\text{m}$  wide and more than 10  $\mu\text{m}$  thick, bluntly pointed distally, base slightly tapered with end rounded to straight (Fig. 5E); serrated spicules few, from anterior body only, especially near mouth; few spicules with recurved base; barbed spicules to 128  $\mu\text{m}$  long by 9  $\mu\text{m}$  wide, not numerous; spicules from beside pedal groove nearly ovate but tapered and often curved proximally (Fig. 5F). Radula (3 examined) with about 16 rows of teeth (Fig. 4D); tooth base about 75 by 18  $\mu\text{m}$ , medial one-third attached to radular membrane, number of denticles 7 to 9 excluding lateral fused denticles (Fig. 4E,F); radula ending distally in two lateral pouches of pharynx. Copulatory spicules (1 specimen examined) deeply curved, two per copulatory spicule sac, 1.3 mm and 0.9 mm long, curve nearly 90° (Fig. 5D); longer spicule simple, shorter spicule with ridges and processes on distal half.

**Reproductive system.** The reproductive system and copulatory apparatus follows that of *O. lituifera* (Salvini-Plawen, 1978, figs. 95, 96) with these exceptions: (a) There are paired, large seminal vesicles opening off the ducts leading from the gonads to the pericardium (gonopericardioducts). (b) The paired copulatory glands, voluminous proximally and ending in narrow tubes as in *O. lituifera*, open into the grooved and ridged distal end of the ventral, smaller copulatory spicule shown in Fig. 5D and not into a triangular tube formed by 3 small copulatory spicules as in *O. lituifera*. (c) The copulatory spicules are deeply curved, not nearly straight as illustrated for *O. lituifera*. (d) One pair of copulatory spicules (the smaller?) opens into the mantle cavity on papillae (the sections were too poor in this area to ascertain where the second pair of copulatory spicules end).

**Remarks.** Besides the differences in the reproductive system noted above, *Ocheyoherpia trachia* differs from *O. lituifera* in being less spiny and in having a carina, a large dorsal sinus, a thinner cuticle, narrower and shorter epidermal spicules, fewer barbed spicules, and a larger radula (Fig. 5B,C).

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