A new *Orbitestella* (Gastropoda: Heterobranchia: Orbitestellidae) from Tierra del Fuego, Argentina

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ABSTRACT

A new species of *Orbitestell* is described from Tierra del Fuego, Argentina. The morphology of the jaws is the main character used for the generic allocation. *Orbitestella patagonica* new species is characterized by a widely umbilicated shell with low spire, ornamented with numerous, regularly distributed, spiral threads and weak sinuous commarginal growth lines. The entire surface of the protoconch is covered with crisp spiral threads. Examination ol the anatomy revealed the presence of a relatively small stomach and the posterior region of genital system bulging into aemocoel space as main distinguishing characters.

INTRODUCTION

The Orbitestellidae are extremely minute, discoid, and widely umbilicated gastropods, living mainly in the Southern Hemisphere (Ponder, 1967, 1990": Powell, 1979). The genus *Orbitestella* Iredale, 1917 has a virtually worldwide distribution, although most of the known speeies occur in Australia and New Zealand (Ponder. 1990; Ponder and Keyzer, 1998). In the north Atlantic, two speeies have been described by Rolán and Rubio (1992): *O. similis* from Cape Verde and *O. cubana* from Cuba. The only species of the genus presently known from off South America is *Orbitestella ponderi* Linse. 2002. a species described from the East Beagle Channel (Tierra del Fuego). Linse (2002) identified as *O. ponderi* specimens from southern Chile previously reported by Ponder (1990) as *Orbitestella* sp.

Orbitestella has previously been placed in the Trochoidea or Truncatelloidea, either in the Omalogyridae or Orbitestellidae (Iredale, 1917; Thiele, 1929; Knight et al., 1960). Ponder (1967), based on the structure of the animals and radula, placed *Orbitestella* in the Rissooidea [as Rissoacea]. This point of view was followed by several subsequent authors' (Powell, 1979; Ponder, 1983; Marshall, 1988; Hickman and McLean, 1990). Later on, Ponder (1990) after having studied the anatomy of two orbitestellid species [*Orbitestella wareni* Ponder, 1990, and *Microdiscula charopa* (Tate, 1899)] suggested that Orbitestellidae should not be considered as rissooidean but as primitive Heterobranchia, related to the northern-hemisphere freshwater family Valvatidae. Ponder an Warén 11 (1988) placed Orbitestellidae in the Valvatoidea.

In the present paper a new species of *Orbitestella* from the Magellani Region is described on the basis of shell morphology and general anatomy.

MATERIALS AND METHODS

The studied specimens were collected at the Beagle Channel, Tierra del Fuego. Argentina (Figure 1). Samples were taken with a dragnet, Rxed in 10% buffered formalin and transported to the laboratory where mollusks were sorted from sediments using a stereoscopic microscope, and preserved in 70% ethanol. Shell, radula. jaws, and operculum morphology were studied and illustrated using scanning electron microscopy (SEM). For anatomical studies specimens were decalcified in Railliet-Henry's solution. Two specimens were processed for histology. Semi-thin sections (0.3 µm thick) were stained with Mallory's trichrome (Gabe. 1968). Additionally, 5 specimens were dissected under stereomicroscope. It: was not possible to study the right side of these specimens (i.e. pallial tentacle, penis, and propodial flap).

Voucher specimens were deposited in the Museo de La Plata (MLP) and Museu de Zoologia da Universidade de Sao Paulo (MZSP).

Abbreviations used in the figures: ad, anterior lobe of digestive gland; an, anus; **ca**, capsule gland; **cc**, cerebral ganglion; **cg**, pallial genital gland; cm, columellar muscle; cs, crystalline style sac; **dg**, digestive gland; es. esophagus; **ey**, eve; fs, foot sole; f(, foot; **h**, heart; go, hermaphrodite gonad; gp. pedal ganglion; **hy**, inner shell organic layer (hypostracum); in, intestine; jw, jaw plate; **mb**, mantle border; **mf**, mantle U-shaped fold; **mg**, mantle gland; mo. month; **od**, odontophore; ol,

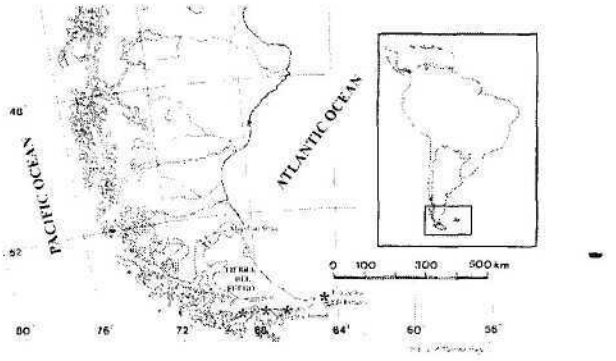


Figure 1. Map showing the *type* locality (⊗) of *Orbitestella tagoni* now species and new findings of *O. ponderi* (*).

periostracum; **op,** operculum; **os**, osphradium; pa. posterior lobe of pedal gland; **pe,** periostracum; **pg,** posterior mucous gland; **po,** pigmented mantle organ; **pr**, propodium; **pt,** prostate; **ro**, renal organ; sg, salivary gland; **st**, stomach: sv, seminal vesicle; sy, statocyst; te, cephalic tentacle.

SYSTEMATICS

Genus *Orbitestella* Iredale, 1917 (Type species: *Cyclostrema bastowi* Gatliff. 1906, by original designation)

Orbitestella patagonica new species
(Figures 2-18)

Diagnosis: Shell minute, discoid, with low spire, widely umbilicated, ornamented with weak sinuous commarginal growth lines and numerous, regularly distributed spiral threads. Protoconeh with crisp spiral threads covering entire surface. Radula with wide, pectinated rachidian tooth with sharply pointed cusps; lateral tooth plate-tike, with a main cusp and sparsely serrated outer margin; marginal tooth slender, sickle-like. Stomach relatively small.

Description: SHELL (Figures 2-6, 8-10): Minute (maximum diameter 1.1 mm), discoid, widely umbilicated, thin, translucent, shiny, up to 2.75 rounded and regularly expanding whorls; spire depressed, slightly raised (Figures 2-5). Color yellowish-buff. Periostracum thin, colorless. Protoconeh formed by 0.75 whorl, about 200 m wide; initially only sculptured with low granulations, followed by 10–12 spiral threads (Figure 6). First 0.25 whorl weakly marked by straight growth disruption (Figure 6). Teleoconch of up to 2 rounded whorls, suture incised. Umbilicus deep, wide, representing about 32 % of maximum shell diameter (Figure 5). Shell surface with weak, sinuous con marginal growth lines and numerous, regularly distributed and fine spiral threads (Figure 8), also visible inside umbilicus (Figure 5); first whorl of teleoconch with about: 10 spiral threads, last whorl with 85-37. Shell aperture nearly circular (about 240 µm high by 270 m wide) with sinuous peristome (Figures 4, 5).

SHELL ULTRASTRUCTURE: Only one well-defined crossed-lamellar layer, about 25 m thick (Figure 9). Organic layer (hy), a third of periostracum thickness, made more evident in decalcified shell (Figure 1.6).

HEAD-FOOT (FIGURES 11, 16): Color cream-yellowish, uniform in preserved specimens. Head inlaid into foot (Figure 11). Pair of cephalic tentacles well developed. Eyes relatively large, sunken into integument medially between bases of cephalic tentacles: lens solid, volume about half that of eyes (Figure 16). A pair of tentacle-like flaps (sometimes referred to as a "snout") lying between tentacle bases, flanking mouth. Foot somewhat massive, cylindrical when retracted, occupying 1/4 whorl; sole entirely covered by long cilia. Columellar muscle thick. Posterior mucous gland occupying posterior and middle region ol foot.

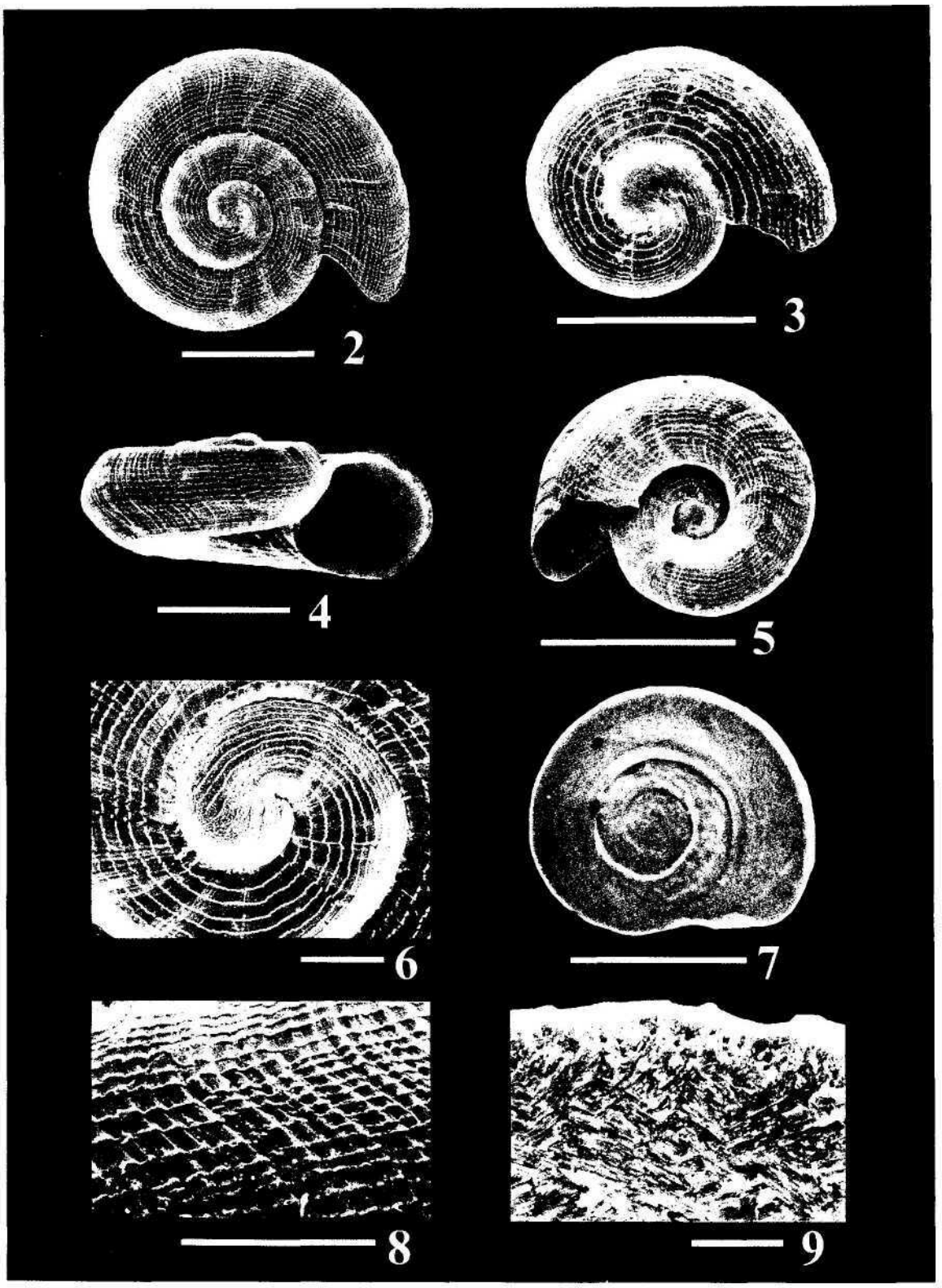
OPERCULU (FIGURE 7): Nearly circular, paucispiral, up to 3.5 slightly overlapping whorls, horny, thin, translucent, yellowish; nucleus subcentral.

PALLIAL CAVITY (FIGURES 16, .17): Expanded by 1/4 whorl, with thin, simple mantle border Gill absent. U-shaped low fold, sometimes described as "a short, partially ciliated lobe", dorsally located (Figure 17, mf). Osphradium small, fold-like. ciliated, located on left side. Pigmented mantle gland (seen by transparency) circular. thin, relatively small. color dark brown, surface uniform. located at middle-posterior part of roof of pallia cavit (Figure 9, po).

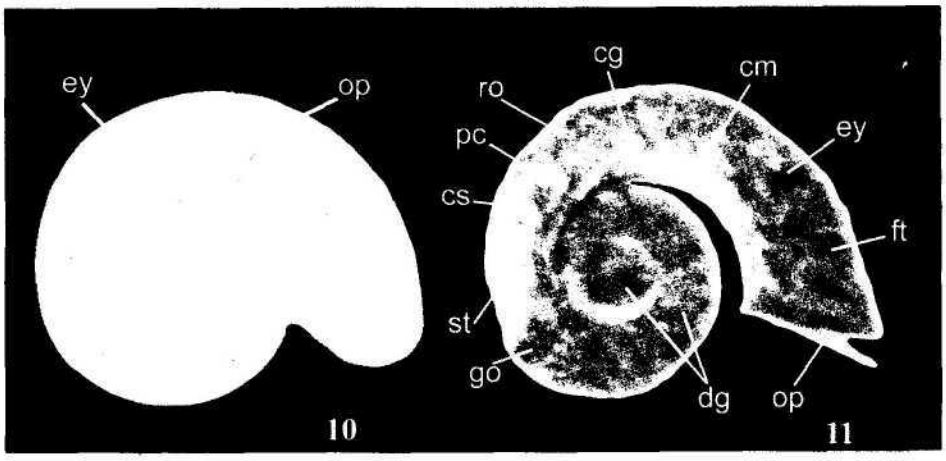
VISCERAL MASS (FIGURES 11, 1.6, .17): Comprising two whorls. Digestive gland almost fully developed on last whorl. Stomach and gonad located in first half of visceral whorls, stomach in right side, gonad in left (Figure 16).

CIRCULATORY AND XCRETORY SYSTEMS (FIGU 16): Heart small, located between stomach and renal organ, posterior to pallial cavity. Renal organ triangular in section.

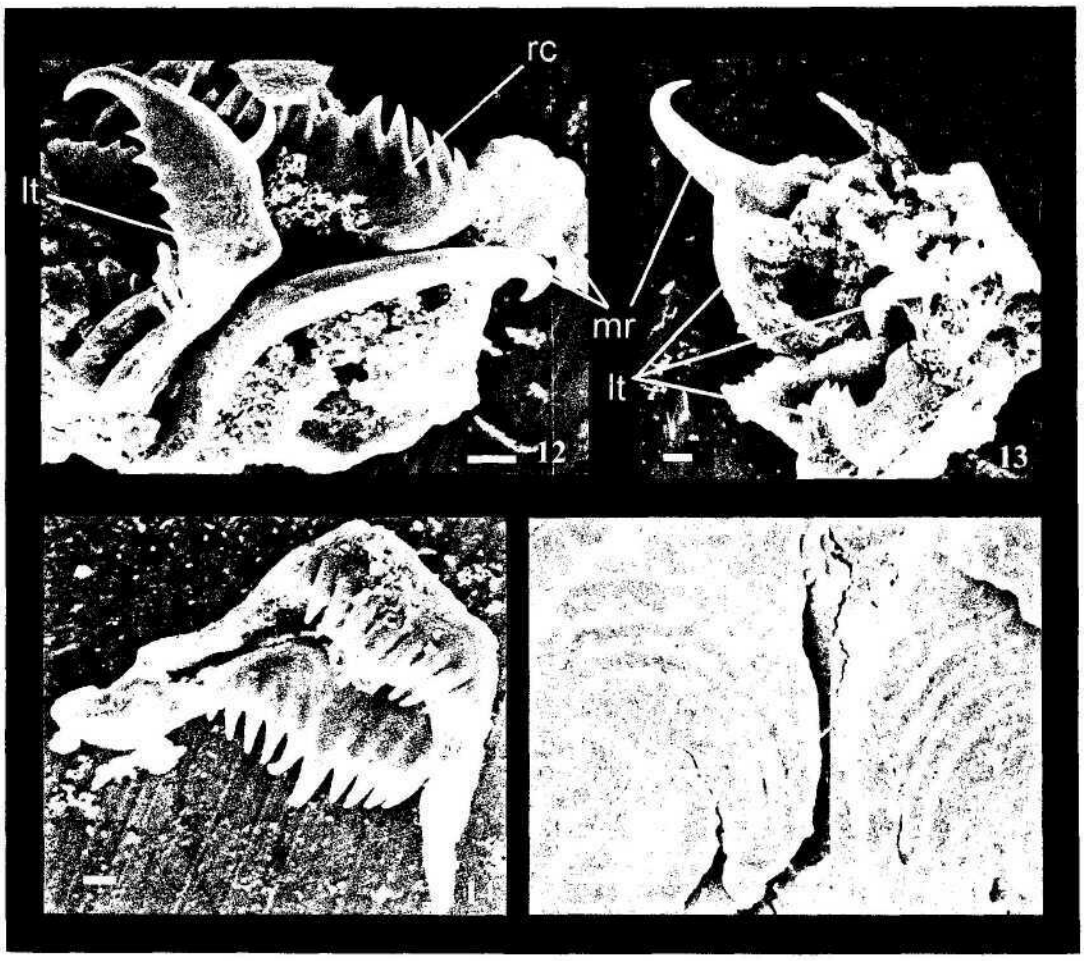
DIGESTIV SYSTEM: **Mouth** on a small protuberance, between tentacle-like flaps (Figure 16). Oral tube narrow, laterally expanded. Jaw plates large, rounded, laterally located and flanked by well-developed muscles (Figure 16); with five serrated rows of simple curved plates, posteriorly concave, on each side of inner surface (Figure 15). Odontophore similar to jaws in size, with several small muscles, but no cartilages (Figure 16). **Radula** 1:1:1:1:1, somewhat longer than odontophore. (Figure 12). **Rachidian tooth** large, trapezoidal,, with peg-like lateral edges and an excavated base: cutting edge pectinated, wide, strongly curved inwards, bearing 11 - 13 slender and sharply pointed cusps, gradually becoming smaller in outward direction; ntral cusp straight; lateral cusps somewhat curved, narrower than central one (Figure 14). **Lateral teeth** plate-like with straight base; cutting edge; with a large primary cusp, 4-5 smaller and regularly separated cusps on outer side, and a small inner side cusp, on base of primary cusp (Figure 12). **Marginal teeth** sickle-like, slender, gradually narrowing to sharply pointed tip; secondary cusps,



Figures 2-9. *Orb patagonic* new species. 2. olotype. MLP 6367. 3-7. aratypes. MLP 6368. 3. Dorsal view. 4. ateral iew. 5. Ventral . 6. Detail of the protoconch. 7. Operculum. 8. Shell surface sculpture. 9. Shell ultrastructure. Scale bars: res 2- 4 = 300 µm: igures 5 = 500 µm: igures = 100 µm: igure 9 = 20 µm.



Figures Figure 10–11. *Orbi* *patagonica*. Paratypes, MZS ,38708. **10.** Dorsal view of a specimen seen by transparency. 11. Right view of a specimen removed ro shell. Scale bars = 600 µm.



Figures Figure 12–15. *Orbi* *patagonica*. SEM micrographs of the radula MZSP 70 12. achidia (re), lateral (lt) and marginal (mr) teeth dislodged **13.** Detail of lateral (lt) and marginal (mr) teeth. 14. Detail of rachidian teeth. **15.** Jaws. Scale bars = 1 µm.

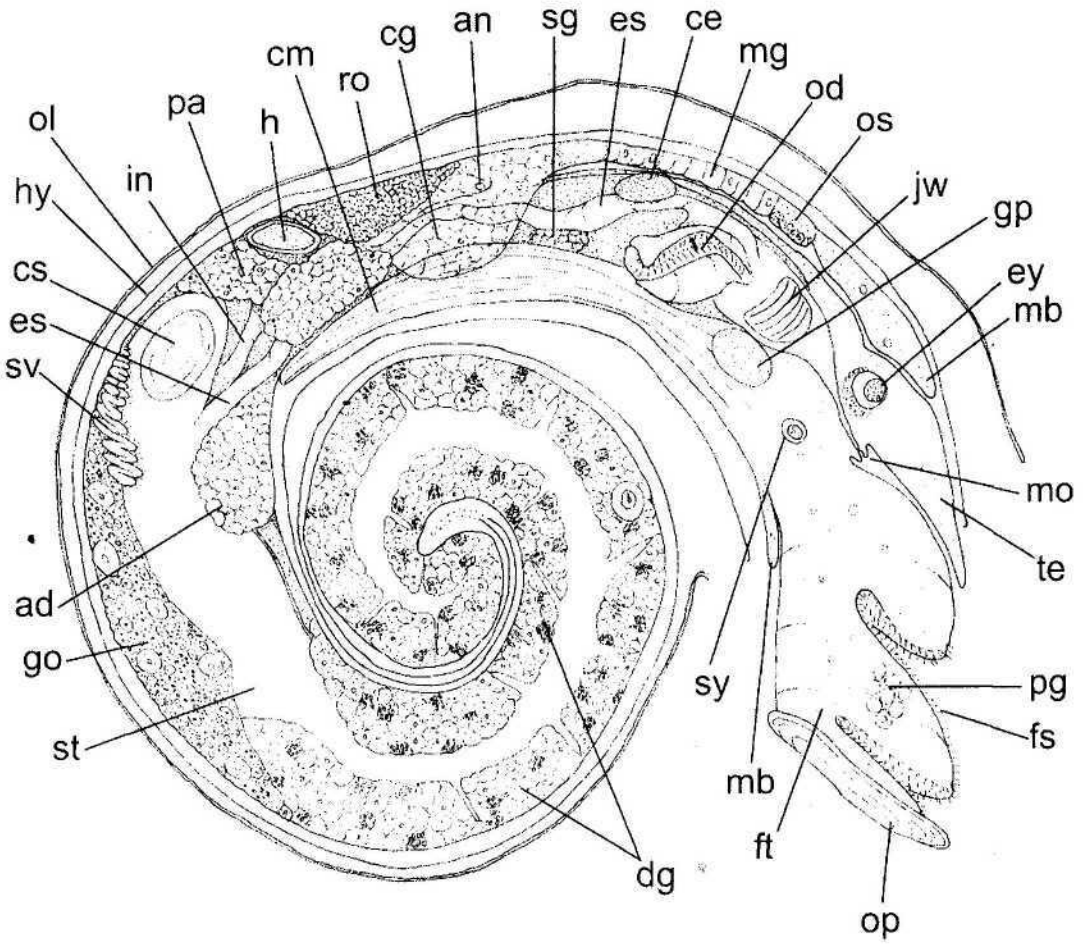
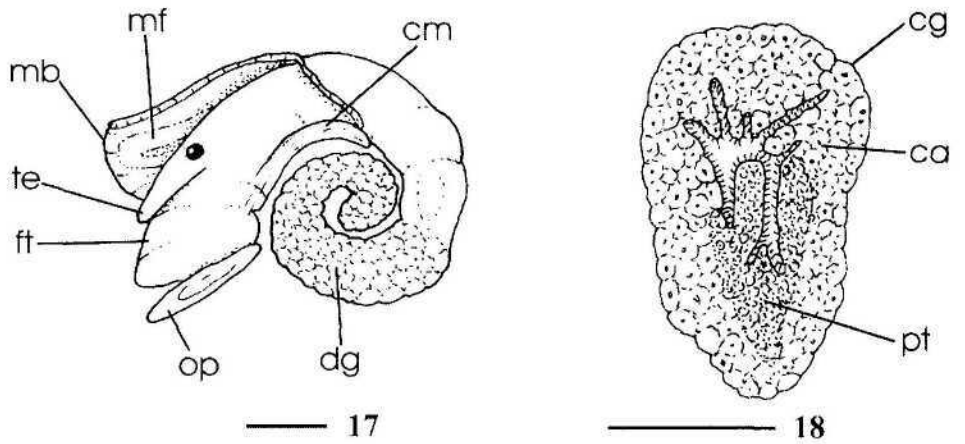


Figure 16. *Orbitestell patagonica.* Semi-diagrammatic longitudinal section. Scale bars = 100 µm. Abbreviations in Materials and Methods.



Figures 17–18. *Orbi patagonica.* Anatomical details. **17.** Le side view of a specimen with pallial avity sectioned and deflected: 18. Transversal section in middle region of common andular genital duct. Scale bars: Figure 17 = 100 µm; Figure 18 = 50 µm.

absent (Figures 12, 13). Esophagus originating from middle dorsal region of odontophore, initially narrow, wider posteriorly, entering stomach at anterior-ventral region at side of style sac (Figure 16); esophagus wall thick and undulated by presence of glands. Salivary glands small, ventral to esophagus and posterior to odontophore. Stomach large occupying about 1/4 whorl, somewhat flat, on right side of visceral mass (Figures 10, 16). Inner gastric surface covered by cuticle. Style sac small, located in antero-dorsal region of stomach, bearing an ovoid crystalline style. Stomach lumen continuous with digestive gland. Digestive gland composed by non-pigmented vacuolar cells. Intestine short (a half of esophagus length), originating between stomach and style sac, directed forward (Figure 16). Anus located on posterior end of pallial cavity.

GENITAL SYSTEM: Gonad hermaphrodite, located between stomach and digestive gland, at left side posterior to pallial cavity, occupying 0.5 whorl (Figures 10, 16). Male tissue intermingled between female acini. Seminal vesicle anterior to gonad, very convoluted, with narrow walls. Common glandular genital duct broad, located on right side of pallial roof, bulging ventrally into haemocoel space; lumen with few longitudinal glandular folds and short cilia. Prostatic gland well differentiated, ventrally located; capsule gland covering outer region of prostatic gland (Figure 18). Genital aperture and penis not observed. Oogonia and oocytes in various degrees of differentiation, randomly distributed (found in two dissected specimens).

CENTRAL NERVOUS SYSTEM: Pair of fused cerebro-pleural ganglia located posterior to buccal bulb; pedal ganglia located ventral to oral tube. Statocyst of about half eye volume, immerse anterior to pedal ganglia into pedal musculature, with a single and relatively large (similar to eye in diameter) statolith (Figure 16).

Type Material: Holotype (MLP 6367) (720 µm in diameter). Paratypes: 9 specimens (MLP 6368), 5 specimens (MZSP 38708 + 9 slides of serial section of 2 specimens), all from the type locality; March 1998.

Type Locality: 54°52′ S, 68°12′ W, Isla H. Beagle Channel, Tierra del Fuego, Argentina.

Distribution: Known only from type locality.

Etymology: The species name derives from Patagonia, region on southern part of South America.

DISCUSSION

Three species of Orbitestellidae were previously reported from the Magellanic region and adjacent subantarctic waters: *Microdiscula nalicula* (Smith, 1875) from South Georgia Islands and South Orkneys Islands (Ponder, 1983 and 1990), *Microdiscula anhoffeni* Thiele, 1912, from South Shetlands Islands (Dell, 1990) and *Orbitestella ponderi* from East Beagle Channel and southeastern Pacific Ocean, Chile (Linse, 2002). *Orbitestella ponderi* was also collected during this study along the Beagle Channel at Ushuaia Bay (= 54°50′ S, 68°W), Hable Island (54°54.6′ S, 67°21.4′ W) and San Pio Cape (55°5.6′ S, 66°28.8′ W); at Sloggelt Bay (55°00′ S, 66°20.6′ W) and Isla de los Estados (54°46′ S, 64°22′ W). These new records confirm that O. *ponderi* is partially sympatric with O. *patagonica*.

Orbitestella patagonica differs from O. *ponderi* Linse, 2002, by having a more depressed shell, with much weaker axial sculpture and rounded aperture. *Orbitestella patagonica* differs from the Antarctic species of *Microdiscula* Thiele (1912) by having a more depressed, spirally ornamented shell. The ratio of the umbilicus/last whorl diameter in O. *patagonica* is similar to that of *M. vanhoffeni* and greater than in *M. subcanaliculata*. *Orbitestella patagonica* also differs from the Australian and New Zealand congeneric species in having a more rounded shell aperture, more rounded last whorl, and weakly defined commarginal growth lines. *Orbitestella patagonica* also differs from the North Atlantic *O. similis* and O. *cuba* by lacking nodulose sculpture and by having a more rounded last whorl.

The South American species of *Orbitestella* (*O. ponderi* and *O. patagonica*) differ markedly from the Australasian *Orbitestella* species (including the type species) and the North Atlantic species, by having crisp spiral threads covering the entire shell surface, including the protoconch. However, based on jaw morphology and general shell shape, we prefer to expand the generic set of characters for *Orbitestella* instead of introducing a new generic taxon for the South American species. Beyond these two genera, only *Lurifax* Warén and Bouchet (2001) has also been reported to the family Orbitestellidae (Smriglio and Mariottini, 2002). *Lurifax* is very different from the other genera in having taller spire and multispiral protoconch.

Orbitestella patagonica shows the general anatomical features of the orbitestellids described by Ponder (1990). The main anatomical difference is the proportionally smaller stomach, occupying only the right side of the visceral mass. Radula morphology also show some differences with those previously described and figured by Ponder (1990) as characteristic for *Orbitestella*: the pectinated cutting edge of the rachidian tooth in *O. patagonica* is wider and not as triangular as in O. *arenicola* Ponder, 1990; the cutting edge of the lateral teeth were described by Ponder (1990) as a wide plate with numerous small cusps in the outer margin, while in O. *patagonica* they are narrower and having only few cusps; marginal teeth are wide and numerously cusped in the species described by Ponder (1990) and are narrow, hook-like and without additional cusps in O. *patagonica*. The jaws in O. *patagonica* have only five rows of serrated plates, while Ponder (1990) described six and seven rows for the species he studied. Both radula and jaws of O. patagonica are similar to those of *O. pondcri*.

Orbitestella patagonica, as it was previously reported for O. *warén* by Ponder (1990), has the general anatomical features of a basal heterobranch, such as the lack of

ctenidium, the hermaphrodite genital system mostly bulging into the haemocoel. the lack of odontophoral cartilages and the presence of a pigmented mantle gland.

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LITERATURE CITED

Dell, R. K. 1990. Antarctic Mollusca with special reference to the fauna ol the Ross Sea. Bulletin ol the Royal Society of New Zealand 27: 1–311.

Gabe, M. 1968. Techniques histologiques. Masson Editeur, Paris, 1113 pp.

Hickman. C. S. and J. H. McLean. 1990. Systematic revision and suprageneric classification ol Trochacean gastropods. Natural History Museum of Los Angeles County. Science Series 35: 1 169.

Iredale, T. 1917. More molluscan name-changes. generic and specific. Proceedings of the Malacological Society of London 12: 322–330.

Knight. J. B. L. R. Cox, A. M. Kenn, I, R. Batten, E. L. Yockelson and R. Robertson. 1960. Systematic descriptions. In Treatise on Invertebrate Paleontology (R. C. Moore. Ed), [(Mollusca 1). pp. 1169 1310.

Linse, K. 2002. The shelled Magellani Mollusca: with special reference to biogeographic relations in the Southern Ocean. Theses Zoologicae vol. 74. A. K. A. Ruggell, Liechtenstein. 251 pp., 21 pls.

Marshall. B. A. 1988. Skeneidae. Vitrinellide and Orbitestellidae (Mollusca: Gastropoda) associated with biogenic substrata from bathyal depths off New Zealand and New South Wales. Journal of Natural History 22: 949 1004.

Ponder. W. K. 1967. The classification of the Rissoidae and Orbitestellida with descriptions ol some new taxa. Transactions of the Royal Society of New Zealand. Zoology 9 (17): 193–224 4 pls. 1–13.

Ponder. W. F. 1983. Eatoniellidae, Rissoidae, Cingulopsidae, Orbitestellidae and Rissoellidae (Mollusca: Gastropoda) of Signy Island, South Orkney Islands. with a review ol the Antarctic and Sub-Antarctic species. British Antarctic Survey. Scientific Report 108: 1–96.

Ponder. W. F 1990. The anatomy and relationships of the Orhitestellidae (Gastropoda: Heterobranchia). Journal ol Molluscan Studies 56: 515 532.

Ponder, W. F. and H. C. de Keyzer. 1998. Superfamily Valvatoidea. pp. 854–858 in P. L Beesley, G. J. B. Ross, and A. Wells (eds.) Mollusca: The Southern Synthesis. Fauna of Australia. Vol. 5. CSIRO Publishing. Melbourne. part B viii. pp. 565–1234.

Ponder. W. F. and A. Warén. 1988. Appendix. Classification ol the Caenogastropoda and Heterostropha a list ol the family-group names and higher taxa. In: W *E*. Ponder (ed.) Prosobrach Phylogeny. Malacological Review, Supplement 4, pp. 188–328.

Powell, A. W. B. 1979. New Zealand Mollnsca. Marine, Land and Freshwater shells. Auckland. Collins, 500 pp.

Rolán. E. and F. Rubio. 1992. Two new species of the germs *Orbi* Irelade. 19.17 from the Atlantic Ocean. La Conchiglia 23(262): 17-20.

Smriglio. C. and P. Mariottini. 2002. *Lurifaxvittreus* aren and Bouchet, 2001 Gastropoda, Orhitestellidae), first report from Western Mediterranean Sea. Bollettino Malacologico 38: 45-47.

Thiele,). 1929. Handbuch der systematischen ichtierkunde. Fisher, Jena 1: 1–1134.

Warén, A. and P. Bouchet. 2001. Gastropoda and Monoplacophora rom hydrothermal vents and seeps: new taxa and records. The Veliger 4 I: 116 231.