



## A new species of the genus *Benthonellania* (Gastropoda, Rissooidea) from the Cape Verde archipelago

### Una nueva especie del género *Benthonellania* (Gastropoda, Rissooidea) del archipiélago de Cabo Verde

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#### RESUMEN

Se describe una nueva especie procedente de las islas de Cabo Verde, que se asigna al género *Benthonellania* y se compara con otras de éste género. Se comenta sobre el tipo peculiar de microescultura en zig-zag que caracteriza la nueva especie, y sobre su ocurrencia en otras especies de la familia Rissoidae, concluyendo que se trata de una convergencia evolutiva en varios grupos de especies de esta familia.

#### ABSTRACT

A new species collected in the Cape Verde Islands is described, assigned to the genus *Benthonellania* and compared with other species of that genus. Comments are made on the peculiar kind of zig-zag microsculpture found in the new species, and on its occurrence in other species of the family Rissoidae, reaching the conclusion that it is an evolutionary convergence among several groups in this family.

#### INTRODUCTION

The microscopic examination of some shells of an apparently undescribed rissoid from the Cape Verde archipelago, has revealed a series of intermediate characteristics between the genera *Benthonellania* Lozouet, 1990 and *Alvania* Risso, 1826. Despite the small number of shells studied, we have considered that its description was of interest and that it could be placed in the genus *Benthonellania*.

LOZOUET (1990) described the genus *Benthonellania* to include several species of rissoids from deep water, both fossil and Recent, which, judging from their shells, had been considered by some authors as *Rissoa* or *Alvania*. The type

species of the genus was designated as the Recent species *Benthonella gofasi*. In this same work the Atlantic species *Rissoa xanthias* var. *acuticostata* Dall, 1889 (treated as *Alvania acuticostata* by ABBOTT, 1974) and *Rissoa xanthias* Watson, 1885 were relocated as *Benthonellania acuticostata* (Dall, 1889) and *Benthonellania xanthias* (Watson, 1885) respectively. Two fossil species, *B. antepelagica* and *B. praexanthias* were also described.

MOOLENBEEK & FABER (1991) described and provided photographs for *Benthonellania donmoorei*, a new species from the Caribbean. In this same work, they incorporated to *Benthonellania* two additional species: *Rissoa*

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*pyrrhias* Watson, 1886 and *Rissoa neottia* Dall, 1927, illustrating the latter with the drawing of a syntype. They also discussed the case of *Alvania colombiana* Romer & Moore 1988, a species which they considered should also be included in *Benthonellania*, a view on which we agree as discussed below.

BOUCHET & WARÉN (1993) described and photographed two new Atlantic species: *Benthonellania oligostigma* and *B. agastachys* and placed within this genus *Rissoa fayalensis* Watson, 1886 as *Benthonellania fayalensis* (Watson, 1886). In this same work they presented illustrations of the type species *Benthonellania gofasi*, which in our opinion, and coinciding with ABSALÃO & SANTOS (2004), are not the same species as will be discussed below.

BOSCH ET AL. (1995) considered as *Benthonellania charope* the Indian species *Rissoa charope* Melvill & Standen, 1901.

GOFAS (1999) examined and illustrated again *Benthonellania gofasi* providing original data on the animal (which already had been anticipated the work of LOZOUET, 1990) as well as on its distribution.

ABSALÃO & SANTOS (2004) described and illustrated two new Atlantic species: *B. coronata* and *B. multicostata*. They also illustrated and commented on *B. donmoorei*, *B. xanthias* and *Alvania colombiana* Romer & Moore, 1988.

As a result, as recorded in the WoRMS database (WoRMS editorial board, 2016), twelve extant species of *Benthonellania* are considered valid:

*Benthonellania acuticostata* (Dall, 1889)

*Benthonellania agastachys* Bouchet & Warén, 1993

*Benthonellania charope* (Melvill & Standen, 1901)

*Benthonellania coronata* Absalão & Santos, 2004

*Benthonellania donmoorei* Moolenbeek & Faber, 1991

*Benthonellania fayalensis* (Watson, 1886)

*Benthonellania gofasi* Lozouet, 1990

*Benthonellania listera* (Dall, 1927)

*Benthonellania multicostata* Absalão & Santos, 2004

*Benthonellania oligostigma* Bouchet & Warén, 1993

*Benthonellania pyrrhias* (Watson, 1886)

*Benthonellania xanthias* (Watson, 1886)

Three of these would be present within the scope of CLEMAM database: *B. agastachys*, *B. fayalensis* and *B. oligostigma*.

## MATERIAL AND METHODS

The shells studied were collected in a Portuguese expedition in 1949 to Cape Verde, in the islands of Santo Antão and Sal, and were communicated to the second author. The shells were examined with Scanning Electron Microscopy, mainly for details of their microsculpture.

## RESULTS

### Genus *Benthonellania* Lozouet, 1990

Type species: *Benthonellania gofasi* Lozouet, 1990, by original designation.

#### *Benthonellania alvanioides* spec. nov. (Figures 1A-E, 2A-H, 3A-F)

**Type material:** Holotype (Figs. 1A-E) in Muséum national d'Histoire naturelle, Paris (IM-2000-32691). Paratypes (all from Santo Antão, dredged at 350 m): one paratype in Museo Nacional de Ciencias Naturales, Madrid (15.05/60182); one in Museo de Historia Natural, Santiago de Compostela (100625) and two in Centro de Zoología, Lisbon. One more shell from the type locality was destroyed during the study (Fig. 1B).

**Type locality:** Cape Verde Archipelago, Palmeira, Sal Island, dredged at 50 m.

**Etymology:** The specific name makes reference to the similarity with a species of the genus *Alvania*.

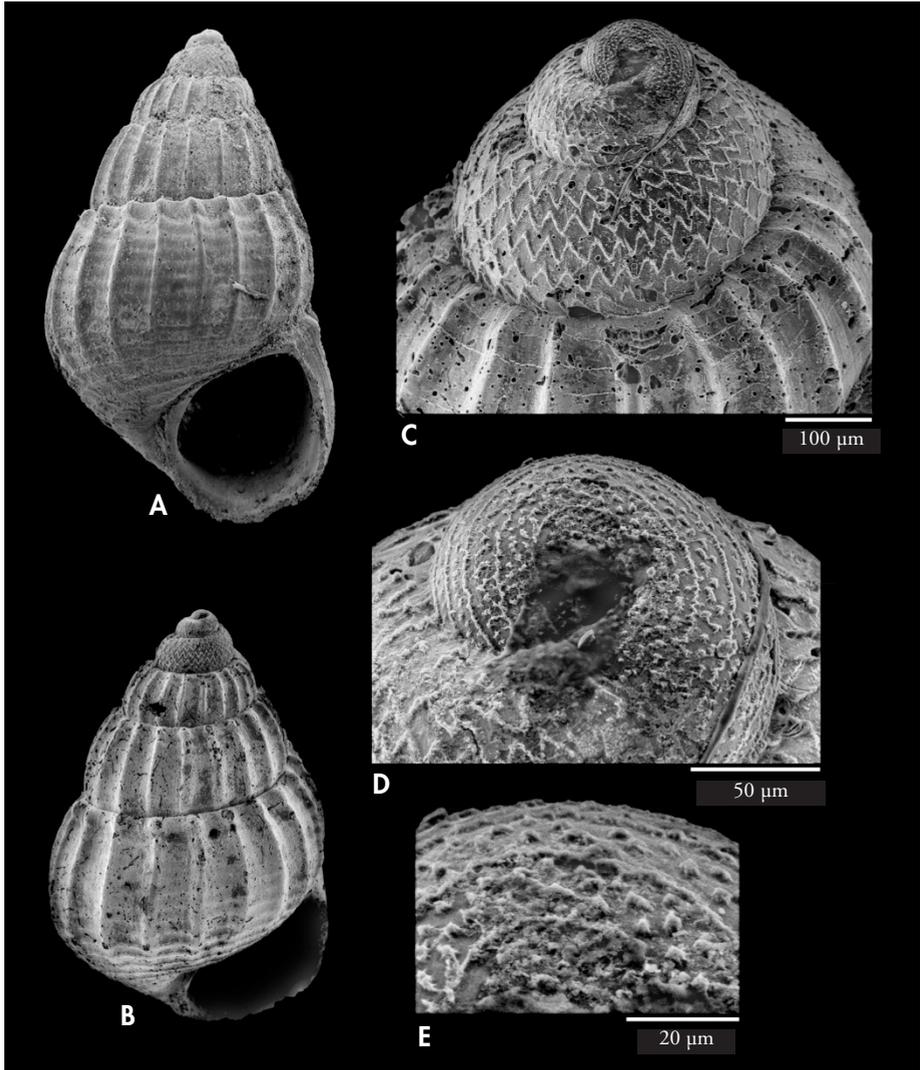


Figure 1. *Benthonellania alvanioides* spec. nov. A: holotype, 2.25 mm (MNHN), Palmeira, Sal I., Cape Verde Islands; B: shell, 2.2 mm, same locality (broken accidentally); C-E: protoconch of the holotype, microsculpture and detail.

*Figura 1. Benthonellania alvanioides spec. nov. A: holotipo, 2,25 mm (MNHN), Palmeira, Isla de Sal, Islas de Cabo Verde; B: concha, 2,2 mm, la misma localidad (rota accidentalmente); C-E: protoconcha del holotipo, microescultura y detalle.*

*Description:* Shell rissoiform, small (up to 2.6 mm), solid, whitish, with 5-6 whorls, a sharply pointed apex and shallow suture; the last whorl occupies about 67% of the shell height, and the aperture about 34%.

Protoconch multispiral reaching 460  $\mu\text{m}$  in width with 2.25 whorls. It presents an embryonic protoconch I of a little more than half whorl, ornamented by spiral lines and irregular granules between those lines. The microsculpture

of the protoconch II consists of about six lines in a rather irregular zig-zag pattern. The transition of the protoconch with the teleoconch is quite vertical, not presenting a clear sinuosity.

Teleoconch with 3 to 3 ½ whorls of quick growth, with a sculpture consisting of axial ribs and spiral cordlets. The ribs are quite regular, orthocone (sometimes slightly opisthocline in the first whorls), little prominent, separated by interspaces twice as wide, and they fade out on the last whorl below the periphery; they are variable in number, between 16 to 20 in the early whorls and between 18 and 24 in the last one. The spiral cordlets are flattened, little prominent, separated by interspaces of equal or smaller size, except on the basis where they are wider. The subsutural cord is more marked, in some specimens raised above the suture line forming a slight shelf. There is also a microsculpture of spiral threads, visible at the beginning of the teleoconch, and subsequently restricted to the interspace of the spiral cords.

Aperture oval somewhat narrowing apically. Umbilical notch obsolete. Peristome continuous and narrow. No visible denticulation inside the outer lip.

Dimensions: the holotype is 2.25 mm in height x 1.27 in diameter. The last whorl is 1.5 mm. The largest paratype reaches 2.6 mm in height.

### Remarks

Despite that only five shells were available for study, we believe that they present genuine characteristics which support their description as a species new to science, and belonging to the genus *Benthonellania*. As LOZOUET (1990) pointed out, this genus was erected to accommodate both Recent and fossil species which were hitherto considered either as *Rissoa* or as *Alvania*. Common traits of these species are slightly opisthocline axial ribs rising above a canaliculate suture and forming a subsutural row of knobs, and a spiral sculpture mostly conspicuous towards the base of the shell. The type species, as well as two Recent species described in

the same work have a multispiral protoconch with a rather strong ornamentation formed by spiral cords with irregular strokes. Of the twelve species currently assigned to *Benthonellania*, only three (*Benthonellania agastachys*, *B. fayalensis* and *B. oligostigma*) have a paucispiral protoconch. The rest, except perhaps *B. listera* and *B. charope*, for which details of the protoconch are not known, have multispiral protoconchs.

The generic assignment has been mainly suggested by the characters of the protoconch:

- The type species *Benthonellania gofasi* has a multispiral protoconch with an irregular cross-linked reticle that fades at the end of the protoconch, leaving two bands free of sculpture (LOZOUET, 1990, fig. 23 and GOFAS, 1999, fig. 68).

- *B. acuticostata* also features an irregular cross-linked pattern with a tendency to be set in zig-zag (LOZOUET, 1990, fig. 16) but in this case it persists over the entire surface until the end of the protoconch.

- *B. xanthias* presents two elevated spiral cords which are crenulated at their lower edge, as well as a few weak subsutural ribs (ROMER & MOORE, 1988, figs. 3-4; LOZOUET, 1990, fig. 18 and ABSALÃO & SANTOS, 2004, fig.8).

- *B. donmoorei* presents three cords with a weak zig-zag (MOOLENBEEK & FABER, 1991, figs. 2 and 3; ABSALÃO & SANTOS, 2004, fig.11). In this species the transition with the teleoconch forms a strong sinus which would indicate a phase of planktotrophic life.

- *B. coronata* and *B. multicostata* have protoconchs with a sculpture very similar to that of *B. xanthias* although in the case of *B. multicostata* it seems to be somewhat more elevated (ABSALÃO & SANTOS, 2004, figs. 9 and 10).

- It has not been possible to study microscopically the protoconch of *B. pyrrhias* but the original illustration shows a multispiral protoconch ornamented with zigzag lines.

- Finally, *Alvania colombiana* presents a smooth multispiral protoconch except for the presence of a conspicuous supra-

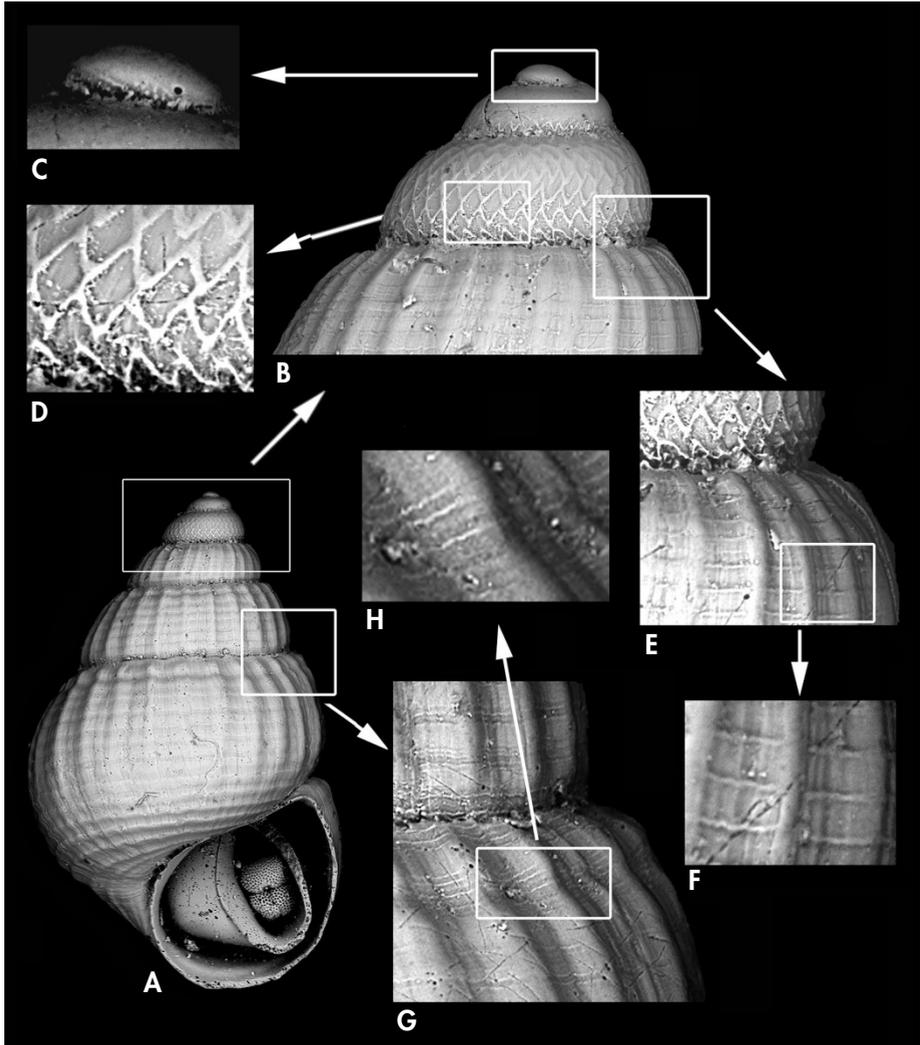


Figure 2. *Benthonellania alvanioides* spec. nov.: A: paratype, 2.3 mm, Santo Antão, 350 m (MNCN); B: protoconch; C: apex; D: microsculpture of the protoconch; E, F: microsculpture and detail of the teleoconch; G, H: microsculpture and detail of the subsutural groove.

Figura 2. *Benthonellania alvanioides* spec. nov.: A: paratipo, 2,3 mm, Santo Antão, 350 m (MNCN); B: protoconcha; C: ápice; D: microescultura de la protoconcha; E, F: microescultura y detalle de la teleoconcha; G, H: microescultura y detalle del canal subsutural.

subutural spiral cord which tends to be undulating in zig-zag (ROMER & MOORE, 1988), and dubiously could be considered a *Benthonellania*.

In the species where the embryonic protoconch has been illustrated, this consists of half a whorl and is orna-

mented by spiral lines and small granules intercalated between them, as also have many other Rissoidae with multi-spiral protoconch such as *Alvania*, *Onoba*, *Crisilla* and others.

If we consider all the species with multi-spiral protoconch previously dis-

cussed, some of them tend to have a sculpture based on elevated cords forming keels, crenulated and tending to undulate in a zig-zag shape. There are smooth areas on the protoconch of some species, such as *B. donmoorei*, in which there are three cords and two smooth spiral bands. Other species present a cross-linked reticle, also with a tendency to form zig-zag cords.

Conversely, in the *Alvania* species (presumably planktotrophic) with a multispiral protoconch having sinusoidal growth lines (with some exceptions like *A. cimicoides*, *A. rykeli* or *A. auberiana*, the latter a Western Atlantic species), the sculpture of the protoconch is weak and is formed by small granules with a tendency to be aligned to form spiral cordlets. They never present protoconchs such as previously referred (*A. zylensis* is a particular case which we will discuss later). For this reason, and with the intention to avoid inflating unnecessarily an already large genus such as *Alvania*, we have considered (although we lack data of the soft parts) our species as *Benthonellania* and not as *Alvania*. We believe that the same should also apply to *Alvania colombiana*.

The most similar species to *Benthonellania alvanioides* spec. nov. is *B. pyrrias* Watson 1886, a species described from material collected in 390 fathoms off Culebra island in the Caribbean Sea (Lat. 18°38'30"N, Long. 65°05'30" W, see WATSON, 1886), with both the drawing and the description of the shell approaching our species. It presents spiral cords over its entire surface and a protoconch decorated with a zig-zag microsculpture. The geographical distance between both species and some details of its description seems to indicate that they are not the same species. *Benthonellania pyrrias* presents about thirteen axial ribs which on the upper end mark clearly pointed tubercles. Our species has more ribs, about twenty which at the upper end are bluntly prominent. We believe, although we have not studied the type material, that this is enough to consider them distinct

species despite the possible resemblance of their protoconchs.

The species illustrated as *B. gofasi* in BOUCHET & WARÉN (1993, figs. 1583, 1589-90) is not, in our opinion, that species. It has a protoconch which resembles *B. alvanioides* spec. nov. and *B. pyrrias*, whereas the protoconch of *B. gofasi* has a very different reticulate sculpture, fading out on the last protoconch whorl. The species illustrated by BOUCHET & WARÉN (1993), possibly undescribed, nevertheless differs from our species in lacking the spiral sculpture covering all the shell.

### The zig-zag pattern in the protoconchs of the Rissooidea

There are not so many species of rissoids presenting a zig-zag pattern of sculpture on their protoconchs and, in addition to those previously mentioned and included in *Benthonellania*, the other (ten species) are currently included in the genus *Alvania*: *A. jeffreysi* (Waller, 1864), *A. imperspicua* (Pallary, 1920), *A. vermaasi* van Aartsen, 1975, *A. zylensis* Gofas & Warén, 1982, *A. nicolauensis* Moolenbeek & Rolán, 1988, *A. planciusi* Moolenbeek & Rolán, 1988, *A. denhartogi* Hoenselaar & Goud, 1998, *A. hoeksemai* Hoenselaar & Goud, 1998, *A. lavaleyeyi* Hoenselaar & Goud, 1998 y *A. stocki* Moolenbeek & Rolán, 1988.

All of them present a paucispiral protoconch (the case of *A. zylensis* will be discussed below) and this is surprising since this type of sculpture is present in at least two species of *Benthonellania*, but not in any other *Alvania* species with a definitely multispiral protoconch. It is also interesting to point out that the latter six species in the previous list are present in the Cape Verde Archipelago, as well as *Benthonellania alvanioides* spec. nov.

Morphologically these species are all very different. *Alvania planciusi* recalls a *Crisilla* species and *A. denhartogi* is more similar to the Mediterranean species *A. scabra* (Philippi, 1844). *Alvania nicolauensis* is the most similar to *Benthonellania alvanioides* spec. nov. with a marked sub-

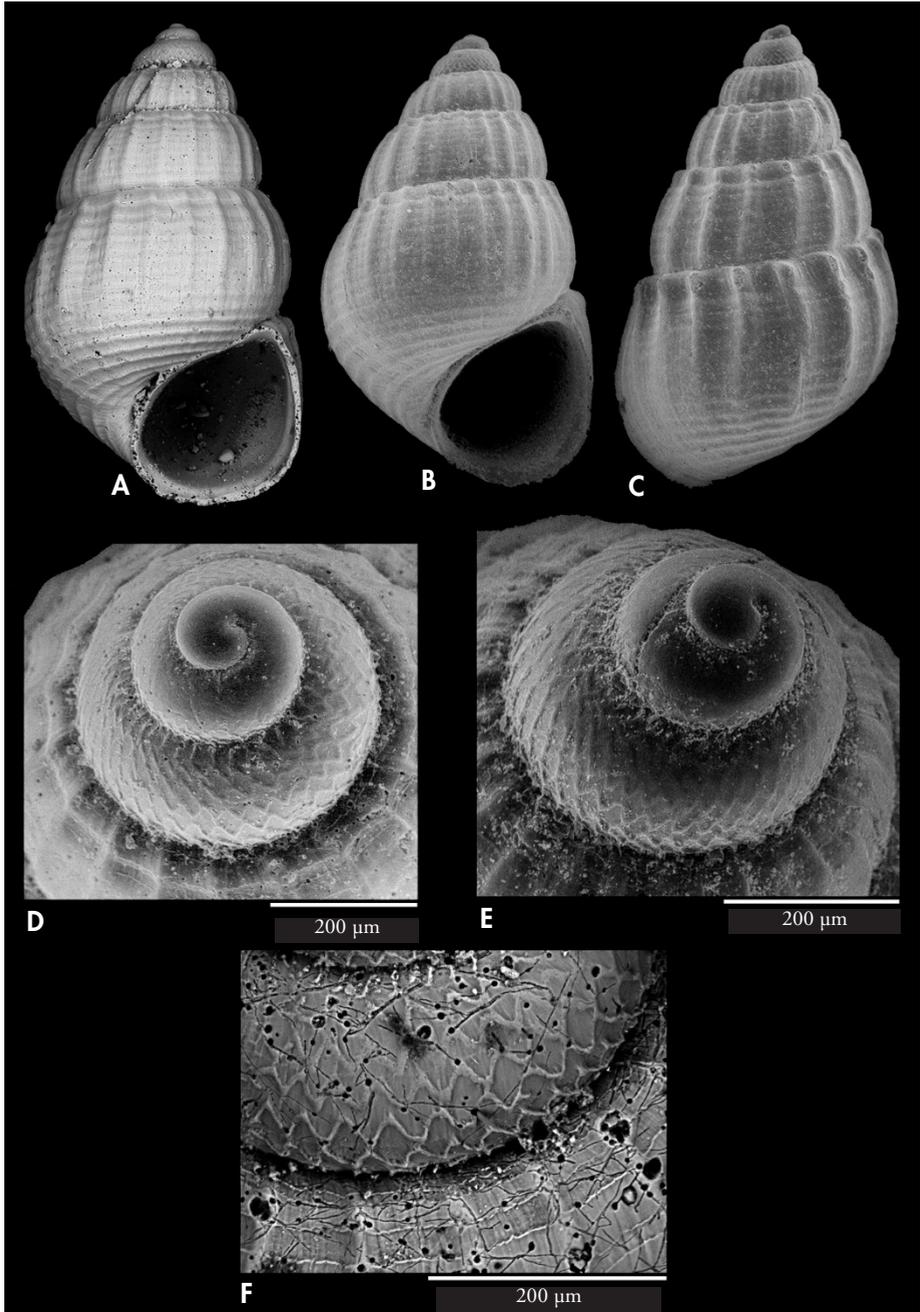


Figure 3. *Benthonellania alvanioides* spec. nov. A-C: paratypes, 2.4 mm (MHNS), 2.3 mm (CZL) and 2.6 mm (CZL), Santo Antão, 350 m; D: protoconch, same specimen as A; E: protoconch, same specimen as B; F: detail of the microsculpture, same specimen as C.

Figure 3. *Benthonellania alvanioides* spec. nov. A-C: paratipos, 2,4 mm (MHNS), 2,3 mm (CZL) y 2,6 mm (CZL); D: protoconcha, mismo ejemplar que A; E: protoconcha, mismo ejemplar que B; F: detalle de la microescultura, mismo ejemplar que C.

sutural cord and a microsculpture with cordlets. This microsculpture also is repeated in *A. denhartogi*, *A. hoeksemai* and in *A. lavaleyeyi*, species otherwise very different from each other morphologically (HOENSELAAR & GOUD, 1998). Still more different are *A. stocki* and *A. planciysi* by their general aspect, sculpture and microsculpture, although in *A. stocki*, spiral threads crossed by small axial lamellae can be seen between the spiral cords.

The other four species of *Alvania* with a zig-zag sculpture on the protoconch are *A. jeffreysi*, an Atlantic bathyal species, *A. vermaasi* and *A. imperspicua*, two very similar coastal species, one of them from the Mediterranean area next to the Strait of Gibraltar and the other from the Moroccan Atlantic coast. Finally, *A. zylensis* is found in circalittoral bottoms of the Ibero-Moroccan Gulf and in Mediterranean near the Strait of Gibraltar. The latter is quite variable in relation to its shape and relevance of its sculpture, existing even practically smooth shells. It is whitish and some forms have a subsutural depression and an channeled suture which resembles some species of the genus *Crisilla*. Although its protoconch is sometimes considered as multispiral, because it may have a little more than a whorl and a half, we believe that it should not be considered so, because it lacks a distinct embryonic protoconch and the transition with the teleoconch shows no sinuosity. This may possibly

reflect that this species has a direct development without the planktrophic stage which characterizes the *Alvania* having a typical multispiral protoconch.

Curiously the lack of sinuous growth lines in the protoconch is something that also we have seen in *Benthonellania*, which could indicate a loss of the planktrophic life stage which persists in other *Benthonellania* such as *B. donmoorei* presenting a strong sinuosity in the transition from protoconch to the teleoconch (ABSALÃO & SANTOS, 2004). In this way, the zig-zag sculpture could have as objective the need to reinforce the shell during a benthic larval life phase.

The case of *Alvania auberiana* d'Orbigny, 1842, a common species, widely distributed in shallow water of the Caribbean Sea and the Atlantic South American coasts (SOARES DA SILVA, 2012), is noteworthy. This species has an embryonic protoconch with many spiral cordlets with hardly any interspaces, and a larval protoconch in which there are spiral cords arranged in a slight zig-zag separated by the smooth spaces, a sculpture which differs from the rest of *Alvania* and is more similar to some of the *Benthonellania*.

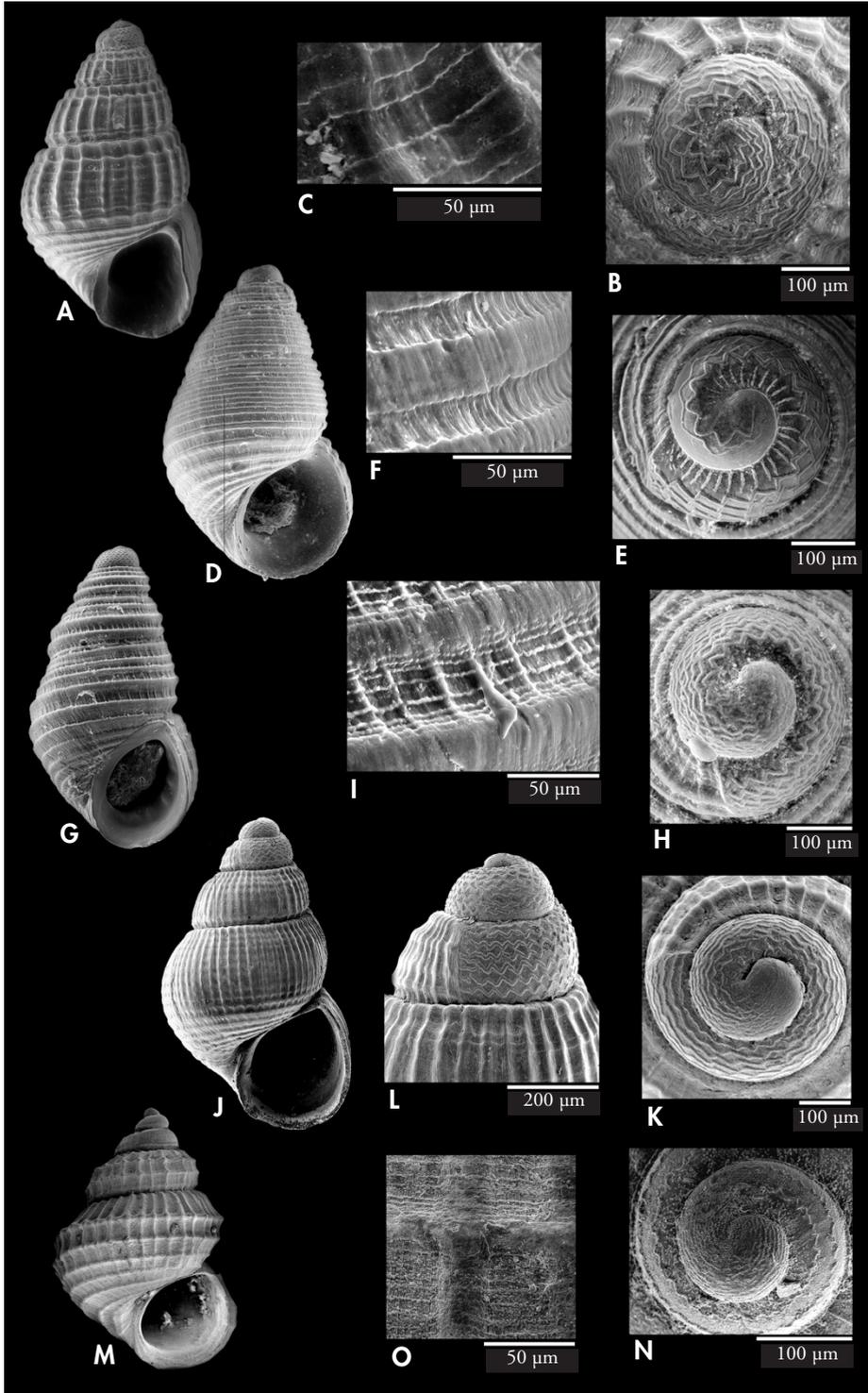
Therefore we think firstly that the zig-zag sculpture in the protoconch cannot be considered as a homologous character and therefore the *Alvania* species presenting a paucispiral protoconch with this character, cannot be

(Right page) Figure 4: Shells and microsculpture of rissoid species with a zig-zag like pattern on their protoconch.

A-C: *Alvania nicolauensis* Moolenbeek & Rolán, 1988, Boavista, Porto Ferreiro (Cape Verde Is.): shell, 1.9 mm (MHNS); D-F: *Alvania planciysi* Moolenbeek & Rolán, 1988, Sal Rei (Cape Verde Is.): shell, 1.6 mm (MHNS); G-I: *Alvania stocki* Moolenbeek & Rolán, 1988, Sal Rei (Cape Verde Is.): shell, 1.1 mm (MHNS); J-L: *Alvania zylensis* Gofas, 1982, Alborán I. (Spain), 2.0 mm (MNCN); M-O: *Alvania auberiana*(d'Orbigny, 1842), Cienfuegos, Cuba, 1.8 mm (MHNS).

(Página derecha) Figura 4: Conchas y microescultura de especies de rissóidos con un patrón en zig-zag en su protoconcha.

A-C: *Alvania nicolauensis* Moolenbeek & Rolán, 1988, Boavista, Porto Ferreiro (Islas de Cabo Verde): concha, 1,9 mm (MHNS); D-F: *Alvania planciysi* Moolenbeek & Rolán, 1988, Sal Rei (Islas de Cabo Verde): concha, 1,6 mm (MHNS); G-I: *Alvania stocki* Moolenbeek & Rolán, 1988, Sal Rei (Islas de Cabo Verde): concha, 1,1 mm (MHNS); J-L: *Alvania zylensis* Gofas, 1982, Isla Alborán (España), 2,0 mm (MNCN); M-O: *Alvania auberiana*(d'Orbigny, 1842), Cienfuegos, Cuba, 1,8 mm (MHNS).



inferred as having a direct phylogenetic relationship.

The fact that the American species *A. auberiana* is the only *Alvania* with multi-spiral protoconch, in which, although not very definite, a zig-zag pattern appears with interspaces without sculpture like in *Benthonellania*, and not similar to other European or African *Alvania* provides more evidence for the probable polyphyly of the genus *Alvania*.

Finally we think that characters like the presence on the teleoconch of a raised subsutural cord and the lack of spiral sculpture, characteristic of the type species of the genus *Benthonellania*, have gone losing value as new species were incorporated, e.g. *B. donmoorei*, with clear spiral cords in the base of the shell, or *B. multcostata* without a clearly raised subsutural cord. This makes that, as a whole, the species of the genus *Ben-*

*thonellania* have some features that approach those of the genus *Alvania* and the closest one would be *B. alvanioides*.

As a result and elaborating on the possible polyphyly of *Alvania*, some species with little sculpture and with a zig-zag pattern on a paucispiral protoconch (such as *A. nicolauensis* or *A. zylensis*, among others) could be better interpreted as *Benthonellania* than as *Alvania*. Nevertheless, as long as the animal or molecular data are not taken or studies become more detailed on the microsculpture of the protoconch (both embryonic and larval) so as to clarify the possible phylogenetic relationships, we do not find appropriate to propose generic changes of some species but to highlight the need for a new revision (apart from the outstanding work of PONDER, 1984) of the family Rissoidae and the genus *Alvania* in particular.

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