

## Note on the freshwater Bryozoa (Ectoprocta, Phylactolaemata) of Tenerife

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(Aceptado el 2 de octubre de 1989)

MASSARD, J. A. & GEIMER, G. 1990. Note on the freshwater Bryozoa (Ectoprocta, Phylactolaemata) of Tenerife. *Vieraea* 19: 327-338

**ABSTRACT:** The freshwater Bryozoa *Plumatella repens* (Linné, 1758) and *Plumatella fungosa* (Pallas, 1768) have been found in 5 sites in Tenerife (Canary Islands). It's the southernmost definite occurrence of *Plumatella fungosa* in the palaeartic region.

**Key words:** Bryozoa, Phylactolaemata, *Plumatella repens*, *Plumatella fungosa*, Tenerife (Canary Islands), new records.

**RESUMEN:** Los Briozoos de agua dulce *Plumatella repens* y *Plumatella fungosa* han sido encontrados en la isla de Tenerife (Islas Canarias) en cinco lugares diferentes. En cuanto a *Plumatella fungosa* eso corresponde al lugar más meridional cuya presencia en la región paleártica está bien establecida.

**Palabras clave:** Briozoos, Phylactolaemata, *Plumatella repens*, *Plumatella fungosa*, Tenerife, Islas Canarias, primer encuentro.

### INTRODUCTION

Whereas an important part of the marine bryozoan fauna of Tenerife, i.e. the Cheilostomata, was treated some years ago by Javier ARISTEGUI RUIZ (1984), there have been no recent data available on the freshwater Bryozoa of the island. This lack has been confirmed to us by Prof. Dr. J.J. Bacallado (in litt., 1988), Director of the Museo de Ciencias Naturales and professor of zoology at the University of Laguna. The only reference we have found is due to Jules RICHARD (1898) who detected statoblasts of *Plumatella sp.* in the material collected from November 1889 to June 1890 by Alluaud and Chevreux in the artificial reservoirs of the Canary Islands. The precise origin of this material was not specified by Richard.

The present study is the result of the investigations which its authors made during a holiday on Tenerife in summer 1987 resp. 1988. In spite of the unfavourable time of the year — most rivulets and reservoirs had already run dry — it was possible to find statoblasts of *Plumatella fungosa* in four sites situated in the south of the island and

living colonies of *Plumatella repens* in one site in the south and another in the north. No Bryozoa were found in the rivulet of the «Barranco del Infierno» (barranco = ravin) fed by the spring of Roque Abinque, one of the rare important permanent springs of the island, nor were Bryozoa found in the rare stagnant or dwindling running waters that we encountered in other parts of the island (small pools in the inferior part of a «barranco» near La Rambla, fish-ponds near Aguamansa, ponds and basins in the botanical garden of Puerto de la Cruz and the town park of Santa Cruz de Tenerife, basins along the «Carretera del Sur», etc.).

Moreover no freshwater Bryozoa were found in the course of a short visit to the island of Gomera (August 1988), in spite of intensive searches in the «Barranco de la Villa» near El Atajo where the water leaving the «Embalse (= reservoir) de Llano de la Villa» was still forming a well-filled river with apparently ideal conditions for Bryozoa (running water and pools, abundance of water plants, stones and other suitable substrates). Our investigations in the «Barranco Sobre Agulo» in the neighbourhood of Agulo (outlet of the «Embalse de la Palmita») had no success either.

#### LIST OF THE SITES WHERE BRYOZOA WERE FOUND (fig. 1)

Nº 1 (TF5): Armeñime, Tenerife, (Aug. 4th 1987), reservoir near the road to Punta Los Gigantes (Presa Vieja), much garbage in the reservoir, remaining water rather dirty; numerous floatoblasts and sessoblasts on a kind of hard rubber receptacle. At some distance away from the reservoir sessoblasts were found on lava stones lying on the bottom of a small concrete basin fed with irrigation water by a canal coming from the reservoir.

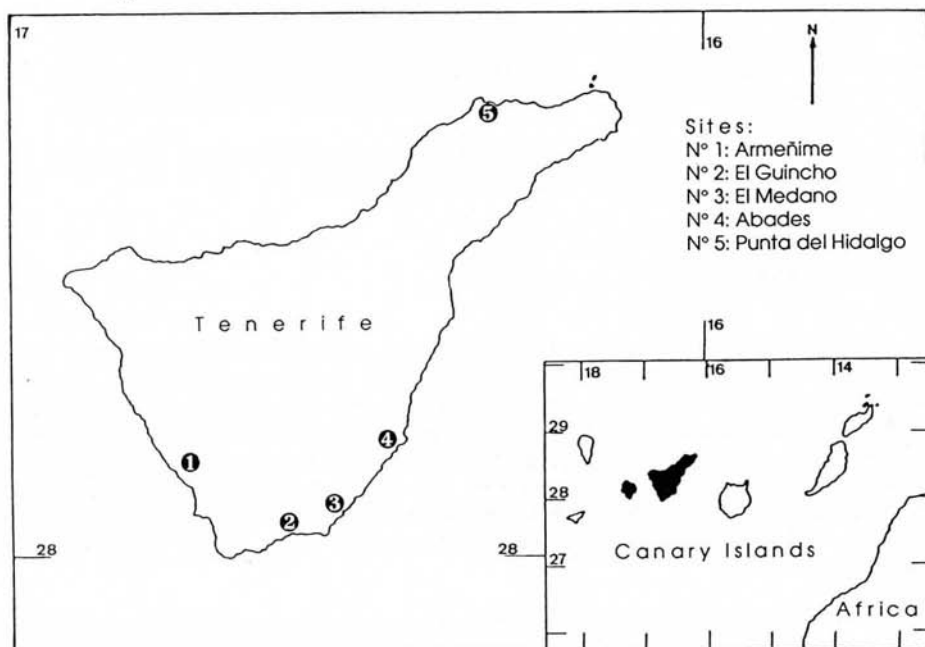


Fig. 1: General map of the Canary Islands showing the location of the studied Bryozoa sites (drawing inspired by ARISTEGUI, 1984, p. 29, fig. 6).

- N° 2 (TF4): east of El Guincho, Tenerife (Aug. 4th 1987), reservoir on the road to El Abrigo, 1,2 km from the exit of the motorway, partially filled with water; floatoblasts very abundant, numerous sessoblasts on a plastic bottle.
- N° 3 (TF1): El Medano, Tenerife (Aug. 3th 1987), reservoir with some remaining water in the lower part, maximal depth approximately 30 cm, very muddy, signs of putrescence near the border of the water; numerous floatoblasts and sessoblasts on heteroclite substrata (stones, wood, branches, bamboo stems, plastic bags etc.). Remnants of a colony on a plastic bag, one decaying colony on the bark of a dead branch.
- N° 4 (TF3): near Abades, Tenerife (Aug. 3th 1987), basin still filled to one third; floatoblasts and sessoblasts on branches and stems, some floatoblasts on muddy sediments; water rather clean.
- N° 5 (TF6): Punta del Hidalgo (Playa de Troches), Tenerife (Aug. 10th 1988), water pool remaining in the «barranco» where the bridge is crossing it; living colonies on various substrata (plastic bag, plastic bottle, board etc.); water relatively clean.

All the sites are situated in the inferior altitude zone of the island characterized by a mediterranean climate that is especially dry in the south of the island (sites n° 1 - n° 4) where the average annual precipitation lies under 200 mm whereas the average monthly temperature roughly ranges from 19 °C to 25 °C. Site n° 5 is situated in the north in a zone with an estimated average annual precipitation of 200-400 mm. The average annual precipitation of Tenerife (2.036 km<sup>2</sup>) is approximately 450 mm.

#### *PLUMATELLA FUNGOSA* (PALLAS, 1768) (figs. 4-8)

Numerous statoblasts (floatoblasts and sessoblasts) of *Plumatella fungosa* were found in the sites n° 1 (TF5), n° 2 (TF4), n° 3 (TF1), n° 4 (TF3).

There is a great resemblance between the floatoblasts of *P. fungosa* and *P. repens* and separating them correctly under the optical microscope is quite problematic. So the stereoscan electron microscope was used in order to identify the floatoblasts we had found and we applied the identification criteria that we have developed in earlier papers (GEIMER & MASSARD 1986, 1987): reticulated pattern of ridges with interstitial tubercles on both the capsule and the annulus, lack of alternating tubercles along the annulus suture. In fact fig. 6 shows an annulus suture forming a ridge flanked by buttress-like projections, the latter being more distinct on this photography than in those we have published hitherto (GEIMER & MASSARD 1986, pl. 11, fig. 3, GEIMER & MASSARD 1987, fig. F). The overall aspect of the floatoblasts matches also with the SEMs of *P. fungosa* floatoblasts published by POURCHER & D'HONDT (1987).

The collected material comprehends thousands of isolated floatoblasts. Chosen at random in the site n° 2 (TF4) material and studied under the SEM they belonged in each case to *P. fungosa*. Not a single floatoblast of *P. repens* was mingled with these isolated floatoblasts.

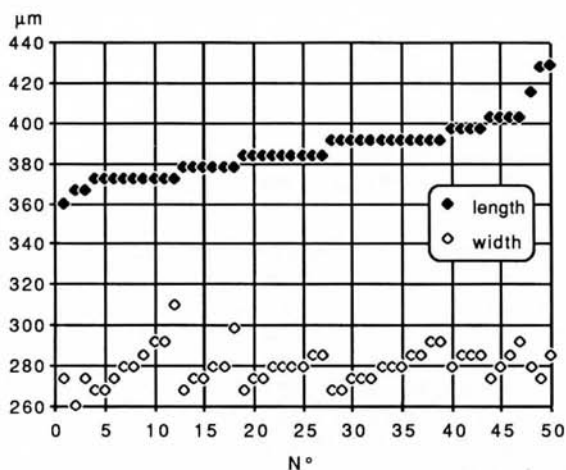
Tab. 1 shows that the floatoblasts of the Canarian *P. fungosa* are rather small in comparison with the values accounted from other regions (cf. GEIMER & MASSARD 1986, p. 98, tab. 10: average values ranging from 415-442 x 301-320  $\mu\text{m}$ ). It has been accounted on particularly big floatoblasts (average values: 445 x 315) from Norway (RADDUM 1970, p. 123).

The smaller dimensions of the Canarian floatoblasts may be due to the somewhat extreme ecological conditions that the species encounters in these regions forming the border of its distribution area. Their average length/width ratio (1,38) however corresponds rather well to the norm of 1,4 given by many authors (cf. LACOURT 1968, RADDUM 1970).

Tab. 1: Measurements of *Plumatella fungosa* floatoblasts from site 2, El Guincho (LO: total length, LA: total width):

	LO	LA	LO/LA
Maximum	429	310	1.57
Minimum	360	260	1.20
Average	387	279	1.38
Median	384	279	1.39
Std. Deviation	14.3	9.1	0.06
measures	50	50	50

Fig. 2: Individual measurements of *Plumatella fungosa* floatoblasts (site 2):



Many sessoblasts were found on the hard rubber receptacle in site n° 2 (TF4). They are disposed in numerous more or less parallel lines touching each other. This disposal pleads for a compact zoarium and matches rather well with *P. fungosa*. Their dimensions are given by tab. 2. The SEM (figs. 7-8) reveals that the capsule is densely covered with erect tubercles; these tubercles are also visible on the lateral wall. The annulus of the sessoblast is also covered with tubercles; they are less developed and are vanishing in the upper part of the annulus. There is a great resemblance with the SEMs of *P. fungosa*

sessoblasts published by MUNDY (1980, pl. IX, figs. a-b). Moreover if the criteria developed by RADDUM (1973, vol. 1, p. 137) in order to separate the sessoblasts of *P. fungosa* and *P. repens* are correct, than the analysed sessoblasts of site n° 2 belong without any doubt to *P. fungosa*.

Tab. 2: Measurements of *Plumatella fungosa* sessoblasts from site 2. (lo: capsule length, la: capsule width, ap: width of the polar part of the annulus, al: width of the lateral part of the annulus):

	lo	la	lo/la	ap	al
Maximum	558	415	1.48	37	37
Minimum	477	322	1.19	25	31
Average	515	392	1.31	32	33
Median	515	403	1.31	-	-
Std. Deviation	27.2	28.6	0.09	-	-
measures	10	10	10	6	7

#### *PLUMATELLA REPENS* (LINNÉ, 1758) (figs. 9-12)

*Plumatella repens* was found in site n° 3 (TF1): a small living colony on the bark of a branch, diameter about 2 cm; some remnants of decaying colony tubes on a plastic bag, floatoblasts and sessoblasts present; in site n° 5 (TF6): quite a lot of well developed living colonies.

In site n° 1 (TF5) sessoblasts have been found on the lava stones mentioned above; they are relatively numerous but isolated and very dispersedly fixed on the substratum. Their general aspect and the ecological characteristics of the biotope (not eutrophic) suggest their belonging to the species *P. repens*.

The colonies of site n° 5 (TF6) growing on plastic bags are repent and branching, intimately adhering to the substratum, with the zoecial tips obliquely rising; here and there small erect branches form a bunch of close but not fused zooecia. In some parts of the colony the repent tubes are parallel and locally agglutinated for a short distance. The ectocyst colour ranges from light to dark yellow-brown; it is moderately incrustated, rather transparent, locally striated. The septa are present, but rare. There is no keel nor furrow or emargination. The diameter of the cystides ranges from 500 to 670 µm. The repent tubes contain numerous mature floatoblasts per cystid. Certain tubes contain young sessoblasts; the majority of the sessoblasts is fixed on the substratum, the tubes being disintegrated.

The colonies growing in the same site on a plastic bottle are numerous but less developed in size. They are repent with antler like branching tubes.

Floatoblasts have been retrieved from both substrata. In each case the SEM reveals the same structures (figs. 9-11): capsule with ridges in a reticulated pattern and interstitial tubercles, annulus with an essentially smooth surface which is irregularly studded with small nodules (diam. about 1,7 µm).

On the contact area with the capsule the inner contour of the floatoblast annulus bears one complete and one uncomplete row of tubercles comparable to those that are

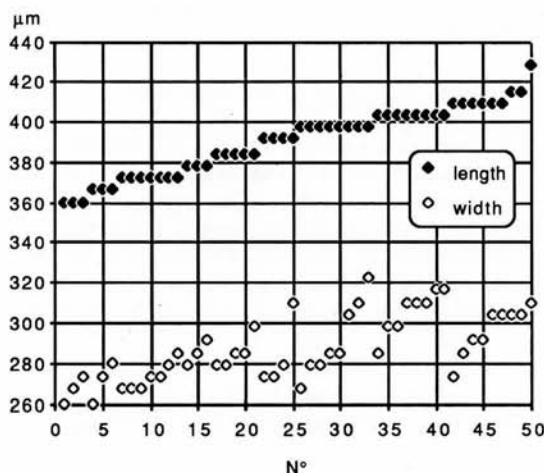
present on the capsule. The annulus suture is formed by an equatorial ridge flanked by alternating tubercles.

This floatoblast structure fairly well matches with the description that we have given in earlier papers (GEIMER & MASSARD, 1986, pp. 83ss, pl. 9, figs. 1-5; GEIMER & MASSARD, 1987, figs. A-C). It may be noted that the density of the nodules beared by the annulus is greater in this material as in the European material. In the latter respect it is reminiscent of the annulus surface observed on Australian *P. repens* floatoblasts retrieved from a colony from Torrens River (Underdale, 9.3.1983) that Prof. B. J. Brook (South Australian College of Advanced Education) sent us for control.

Tab. 3: Measurements of *Plumatella repens* floatoblasts from site 5, Punta del Hidalgo (LO: total length, LA: total width, lo: fenestra length, la: fenestra width, ap: width of the polar part of the annulus, al: width of the lateral part of the annulus, d: dorsal, v: ventral):

	LO	LA	LO/LA	lo-d	la-d	ap-d	al-d	lo-v	la-v	ap-v	al-v
Maximum	428	322	1.49	242	192	105	68	291	242	74	50
Minimum	360	260	1.23	174	155	68	43	236	205	50	25
Average	390	288	1.35	199	169	90	56	265	219	65	37
Median	397	285	1.36	198	167	93	56	267	217	68	37
Std. Deviation	16.8	16.5	0.06	13.4	10.8	8.2	5.9	15.9	10.9	6.0	6.8
Measures	50	50	50	28	28	28	28	20	20	20	20

Fig. 3: Individual measurements of *Plumatella repens* floatoblasts (site 5):



The dorsal side of the sessoblast capsule is covered with tubercles not quite as densely packed and not quite as pointed as in *P. fungosa* (cf. RADDUM 1973, vol. 1, p. 137; GEIMER & MASSARD, 1986, pl. 9, figs. 7, 10, pl. 13, figs. 4-5). The sessoblast annulus is well developed and bears ridges which form on the upper side a distinct reticulation with faint and discrete interstitial tubercles. The meshes of this reticulation may be trigonal,

tetragonal, pentagonal, mostly they are hexagonal. The outer margin of the sessoblast is irregularly serrated.

Tab. 4: Measurements of *Plumatella repens* sessoblasts from site 5, Punta del Hidalgo. (lo: capsule length, la: capsule width, ap: width of the polar part of the annulus, al: width of the lateral part of the annulus):

	lo	la	lo/la	ap	al
Maximum	484	391	1.45	56	62
Minimum	397	322	1.15	43	25
Average	451	359	1.25	48	48
Median	446	366	1.25	50	50
Std. Deviation	22.3	19.2	0.07	4.0	8.8
Measures	16	16	15	15	15

The colony found in site n° 3 (TF1) on a floating branch is repent and well adhering to the substratum. It has a diameter of about 2 cm. The tubes of the colony are practically colourless and transparent. The ectocyst is thick and swollen but it remains rigid and elastic; it is nowhere gelatinous. The ectocyst is not or only slightly incrustated. The zooecial tips are short; the cystids often show a basal narrowing. The diameter of the tubes of the colony amounts to 400-600  $\mu\text{m}$ . Although at first sight some of these peculiarities of the colony reminded us of *Hyalinella punctata*, it belongs without any doubt to *P. repens*. The presence of some septa excludes *Hyalinella* as it was emphasized by WIEBACH (1973). Moreover the floatoblasts are too small neither does the reticulation and tuberculation of their capsule match with *Hyalinella punctata* (cf. TORIUMI 1972, GEIMER & MASSARD 1986, pp. 129-130). In its elder partially destroyed parts the tubes of the colony show a light brownish coloration.

The length of the floatoblasts retrieved from the above colony varies from 341 to 415  $\mu\text{m}$  (average: 384  $\mu\text{m}$ ), the width varies from 267 to 304  $\mu\text{m}$  (average: 282  $\mu\text{m}$ ). The length/width ratio is 1,36. The visible part (fenestra) of the dorsal side of the capsule has an average length of 229  $\mu\text{m}$  and an average width of 192  $\mu\text{m}$ ; its form varies in individual cases from nearly round to distinctly oval. Dorsally the annulus has an average polar width of 86  $\mu\text{m}$  and an average lateral width of 43  $\mu\text{m}$ . The ventral fenestra has a length of about 273  $\mu\text{m}$  and a width of about 223  $\mu\text{m}$ ; the ventral annulus has a polar width of about 56  $\mu\text{m}$  and a lateral width of 25  $\mu\text{m}$ .

We also noted the presence of one nearly round and two oval sessoblasts with a strikingly dark brown annulus.

## DISCUSSION

It is well known that *P. repens* grows in running as well as in stagnant water, whereas *P. fungosa* prefers stagnant and eutrophic water. Both species are able to thrive in a fairly polluted habitat. The Canarian occurrences of both species correspond to this ecological pattern. J.H. BUSHNELL (1974, p. 170-171) reports that *P. repens* colonies found by K.S. Rao in a decidedly polluted location in the city of Indore (India) had «very wide zooecia and an unusually thick zooecial wall». These characteristics remind us of the *P. repens* colony which we found in site n° 3.

Considering the cosmopolitan distribution of *P. repens* its presence on Tenerife is not astonishing. LACOURT (1968, p. 66) assumed that the statoblasts noted as *Plumatella* sp. by RICHARD (1898) belong to *P. repens*. The same supposition was made by BUSHNELL (1973, p. 509, fig. 1). Concerning the topic of this paper, the following occurrences of *P. repens* are cited in the literature: Azores (RICHARD 1896); Algeria (SARS 1896, p. 25, LOPPENS 1908, p. 157, SEURAT 1922, p. 87, GAUTHIER 1928, pp. 21, 23, 46, BORG 1936b, p. 281); North Africa (PRENANT & BOBIN, 1956, p. 147). Concerning Tenerife and the Canaries as a whole the present paper gives for the first time definite evidence of the presence of *P. repens*.

*P. fungosa* is considered as a holarctic (palaeartic + nearctic) species (BUSHNELL 1973, pp. 508; WIEBACH & D'HONDT 1978, p. 493). Although the Canarian fauna has an «eminently palaeartic character with a major dominance of mediterranean elements» (AFONSO 1980, p. 43), finding *P. fungosa* was rather a surprise for us, because LACOURT (1968, p. 71) emphasizes that *P. fungosa* occurs in Europe in the south as far as Lago Trasimeno in Italy, Sardinia, Croatia and the Danube, but «has not yet been found in the Iberian, Italian [?] and Balkan peninsulas, nor is it known from North Africa». A tabular resp. graphical presentation of the hitherto known distribution of the species is given by LACOURT (1968, p. 33, fig. 12), BUSHNELL (1973, p. 510, fig. 2) resp. WIEBACH & D'HONDT (1978, p. 493). As far as the Sardinian occurrence is concerned BUSHNELL (1968, p. 145) uttered some doubts: «Those colonies from Sardinia, pictured by CARRADA (1964) ... may not be, in each case, the exact form portrayed by ALLMAN (1856)». In our opinion, a reexamination of Carrada's material would be worthwhile.

Considering that «Annandale's supposition that the species occurs in the Indian region so far has not been confirmed» (LACOURT 1968, p. 71), the Tenerife habitats of *P. fungosa* presently represent the southernmost definitely known occurrence of this species. Let us remind that Tenerife and North Africa mark up the southern border of the palaeartic region. On the other hand according to the bryozoan literature it seems to be the first occurrence of this species noted on Spanish territory.

There are many theories on the origin of the Canary Islands. The theory of the former existence of a landbridge linking the islands to the African continent has been abandoned in favour of an oceanic origin (volcanism, uplift of fault blocks due to the compression of the oceanic ground). The Canary Islands mostly go back to the Tertiary and the age of the oldest geological datations of the major islands ranges from about 14 million years (La Gomera) to about 38 million years (Fuerteventura). The minimum distance from the northwest African mainland is 108 km between Fuerteventura and Cape Juby.

It must be assumed that the Bryozoa living on Tenerife have originated from statoblasts imported in geological or in more recent times from the African mainland, either by birds or by the wind. According to BUSHNELL (1973, p. 516) birds can transport statoblasts in their gut for 150 to 600 km. The same author accounts on statoblasts that could be carried in the feathers or in mud clinging to the feet or the bill. He reckons wind dispersal a possibility for the floatoblasts of the Plumatellidae, particularly *P. repens*, which would be most effectively distributed by this means. In this case the «levante» should be mentioned, the wind which one to three times a year brings hot air and sanddust from the Sahara to the Canary Islands. This idea is not new: authors like Barrois, de Guerne and Richard already considered transport by wind as one of the main factors in the colonization of the Canary Islands and the Azores with continental freshwater Invertebrates (ZSCKOKKE 1900, p. 376; THIENEMANN 1950, p. 154).



On the ground of the previous hypotheses, it can be assumed that *P. fungosa* is present in North Africa and that the other species hitherto found — besides *P. repens* — in North Africa i.e. *Fredericella sultana* (GAUTHIER 1928, p. 46, BORG 1936b, LACOURT 1968, p. 43, BUSHNELL 1973, p. 512), *Fredericella australiensis* (LACOURT 1968, p. 50), *Plumatella emarginata* (BORG 1940, LACOURT 1968, p. 79, PRENANT & BOBIN 1956, p. 155, BUSHNELL 1973, p. 509) are liable to be found in the Canary Islands.

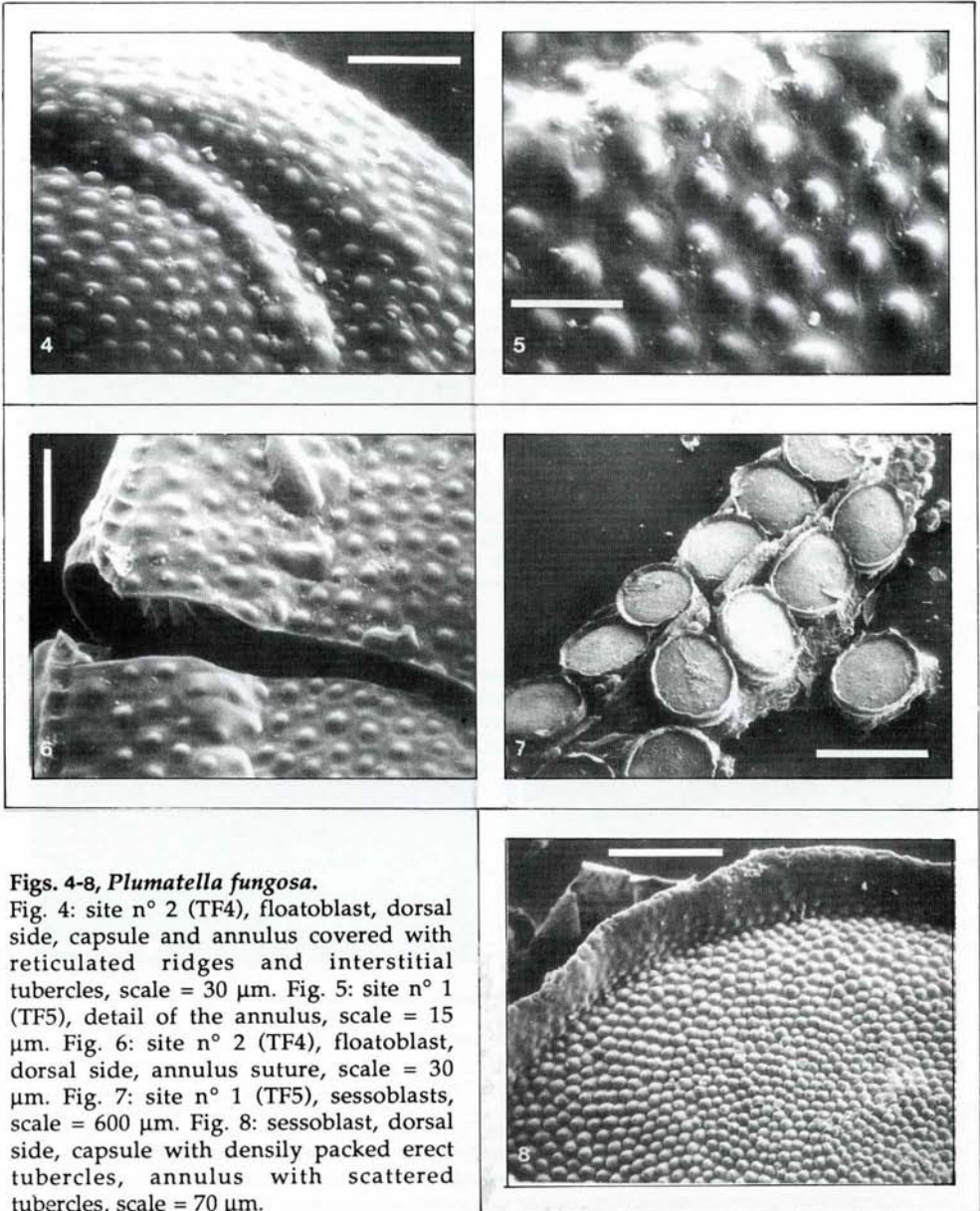
#### ACKNOWLEDGMENTS

Our thanks go as well to Miss Margot Diedling, ARBED-Recherches, for making the SEM photographs, to Prof. Dr. Juan José Bacallado and Dra. Fátima Hernández, Museo de Ciencias Naturales, Santa Cruz, for facilitating the present publication, to Dr. Carlos M<sup>a</sup> López de la Cuadra, Laboratorio de Biología Marina (Zoología), Universidad de Sevilla, for his enlightenments on the Spanish freshwater Bryozoa, and to our colleagues Joseph Simon, Centre Universitaire de Luxembourg, for amending our English manuscript and Paul Keilen, Lycée Classique de Diekirch, for the Spanish abstract.

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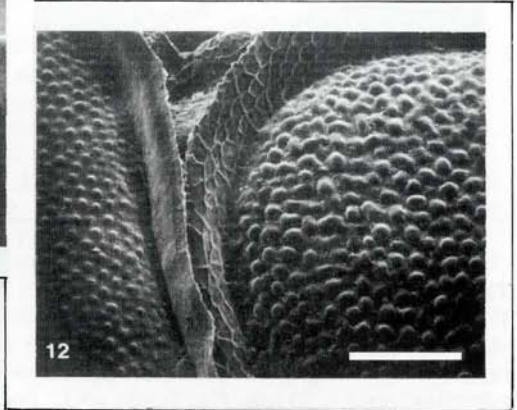
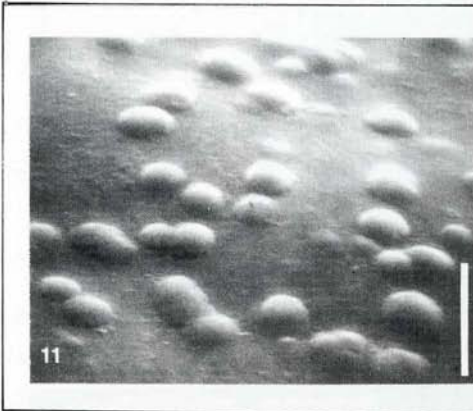
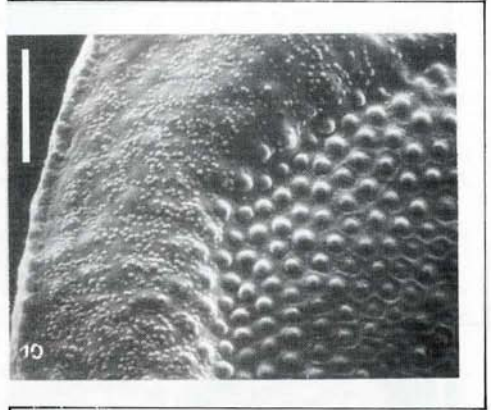
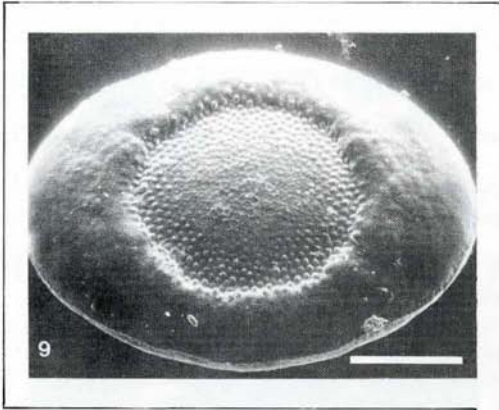
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**Figs. 4-8, *Plumatella fungosa*.**

Fig. 4: site n° 2 (TF4), floatoblast, dorsal side, capsule and annulus covered with reticulated ridges and interstitial tubercles, scale = 30  $\mu$ m. Fig. 5: site n° 1 (TF5), detail of the annulus, scale = 15  $\mu$ m. Fig. 6: site n° 2 (TF4), floatoblast, dorsal side, annulus suture, scale = 30  $\mu$ m. Fig. 7: site n° 1 (TF5), sessoblasts, scale = 600  $\mu$ m. Fig. 8: sessoblast, dorsal side, capsule with densely packed erect tubercles, annulus with scattered tubercles, scale = 70  $\mu$ m.



**Figs. 9-12, *Plumatella repens*.**

Fig. 9: floatoblast, dorsal side, capsule with reticulation and tuberculation, annulus essentially smooth, scale = 110  $\mu\text{m}$ . Fig. 10: site n° 5 (TF6), floatoblast, dorsal side, capsule with reticulation and tuberculation, annulus smooth with small nodules, scale = 40  $\mu\text{m}$ . Fig. 11: site n° 5 (TF6), floatoblast, dorsal side, detail of the annulus surface, nodules very enlarged, scale = 4  $\mu\text{m}$ . Fig. 12: site n° 5 (TF6), sessoblasts, capsule with slightly flattened and less densely packed tubercles, annulus with reticulation and an irregular and very faint tuberculation, scale = 80  $\mu\text{m}$ .