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A new genus and species of stoloniferous octocoral from the Azores Archipelago (Cnidaria: Anthozoa)

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Abstract.—A new genus and species of shallow-water octocoral is described from Terceira, one of the islands of the Azores Archipelago, *Azoria bayeri,* new genus, new species. The new taxon is placed in the stoloniferous octocoral family Clavulariidae, subfamily Sarcodictyiinae. Spicular and histological features of the new taxon are discussed and compared with that of other clavulariid genera. The presence of platelets and multiradiate plates in the polyps, anthosteles with sclerites in low densities, anthocodiae with sclerites but not forming any distinct crown or points, and the complete absence of sclerites in the stolons are the main characteristics of the new genus.

Stoloniferous octocorals inhabit a wide ecological spectrum of habitats, from intertidal zones to the bathyal zone. However, these octocorals are some of the most cryptic benthic organisms, they frequently have small polyps and reduced colonial sizes, often inconspicuously colored, and are often overlooked in general benthic research programmes. Furthermore, the taxonomy of this group has been a matter of discussion and confusion during the last century, producing a number of contributions with contradictory proposals on the classification and criteria to be used (e.g., Delage & Herouard 1901, Kükenthal 1925, Hickson 1930, Gohar 1940, Madsen 1944). In two important contributions, Bayer (1981a, 1981b) re-evaluated the taxonomic importance of many characters and established the present criteria in the taxonomy of stoloniferous octocorals. Subsequent authors have followed this classification.

Little is known about the stolonate octocorallian fauna of the Azores Archipelago (Wright & Studer 1889, Thomson 1927, Tixier-Durivault & d'Hondt 1975). Recently Dr. Peter Wirtz (Universidade dos Açores) sent us a sample of a stononiferous octocoral collected in shallow waters of Terceira, one of the islands of the Azores Archipelago. The present work deals with the description of a new genus and species based on this material. According to the diagnosis given by Bayer (1981a), the new genus should be placed in the subfamily Sarcodictyiinae (Family Clavulariidae).

The discovery of this new octocoral genus could provide a modest contribution to general theories related to the origin of the Azores fauna (Morton & Britton 2000a). Although the Azores Archipelago is geologically young, a period of 5–8 million years is recognized as sufficiently long for much faunal recruitment to have occurred (e.g., Morton & Britton 2000b). This relatively short period of faunal colonization may be responsible for the fact that marine endemism is not a widely reported feature of the Archipelago. But, perhaps this period has provided an adequate time span for natural faunal stabilization (Cornelius 1992a), and speciation processes to have progressed.

Material and Methods

The material studied in the present work was collected in the Azores Archipelago by

SCUBA diving. The octocoral colony was fixed (5% formalin in seawater) for three weeks, and subsequently preserved in 70% ethanol. The general morphology and anatomy were studied by means of a stereo dissecting microscope. Anatomical and histological details were studied following the Cajal method for topographic staining (see Gabe 1968). Sclerites were obtained by dissolution of the soft tissues in concentrated sodium hypochlorite, and examined with a light microscope and SEM. Nomenclature used for the sclerite categories follows that of Bayer et al. (1983). The holotype has been deposited in the Museu Municipal do Funchal, Madeira (MMF); some slides of sclerites, histological sections and fragments of the holotype are deposited in the Sección de Zoología, del Departamento de Fisiología y Biología Animal de la Universidad de Sevilla, Spain (SZ). In addition, a fragment of the holotype including a few polyps with stolons is deposited in the Department of Invertabrate Zoology, United States National Museum (USNM), Smithsonian Institution, Washington, U.S.A.

Systematics

Family Clavulariidae Hickson, 1894
Subfamily Sarcodictyiinae Bayer, 1981
Azoria, new genus

Diagnosis.—Sarcodictyiinae with polyps connected by flattened basal stolons that are strongly attached to the substratum, variable in length, irregularly elongate in cross-section, with several internal canals, and poorly developed mesogloea. Elevated stolonic bars or transverse platforms absent. Polyps cylindrical and numerous. Anthosteles low and conical. Anthocodiae tall. Sclerites free, mostly platelets and multiradiate plates. Stolons without sclerites. Anthosteles with sclerites in low densities. Anthocodiae with sclerites, but do not form any distinct crown or points. Anthosteles and stolons covered by weak periderm.

Type species.—Azoria bayeri, new species, by original designation and monotypy.

Etymology.—The generic name is dedicated to the Azores Archipelago where the new genus was discovered. Gender feminine.

Azoria bayeri, new species
Figs. 1–4

Material.—Holotype: MMF 32884: Monte Brasil, Terceira, Azores Archipelago, 1 colony growing on the tube of the polychaete *Sabella* (*Spirographis*) *spallanzani* (Viviani, 1805), 15 meters depth, 14.Jul.2000; SZ(ANT-432) and USNM 100902: some polyps with stolons from the holotype colony.

Diagnosis.—As for the genus.

Description.—External anatomy (Fig. 1): Colonies small, up to 40 polyps in the holotype, preserved polyps up to 3 mm in height, connected by flattened stolons of variable length, and maximum width 0.8–1 mm. Anthocodiae completely retractile into anthosteles. Anthosteles low and conical, represented by the basalmost 0.8–1.6 mm of the polyps. Anthosteles and stolons covered by a thin dirty white periderm. Junctions of polyps and stolons wide. Tentacles 0.8–1 mm in length, with 12–14 pinnules on each side. Polyps translucent whitish in both living and preserved material.

Internal anatomy (Fig. 2): Outline of stolons irregularly elongate in cross-section. Each stolon containing 4–6 principal canals delimited by thin mesogloeal walls, 0.012 mm. Foreign particles adhere to external surface of periderm. Epidermis scarcely developed. Mesogloea, in general, very homogeneous, rarely with lacunae.

Retracted polyps conical or spherical. Periderm of anthosteles similar to that of stolons. Epidermis and gastrodermis scarcely developed. Mesogloea well-defined and homogeneous, reaching its maximum thickness in the anthostele, 0.025 mm. Lacunae filled by cells practically absent. Longitudinal musculature of tentacles strong, supported by mesogloeal processes, up to 0.008 mm thick in the axis of the tentacles. Circular musculature present but not well

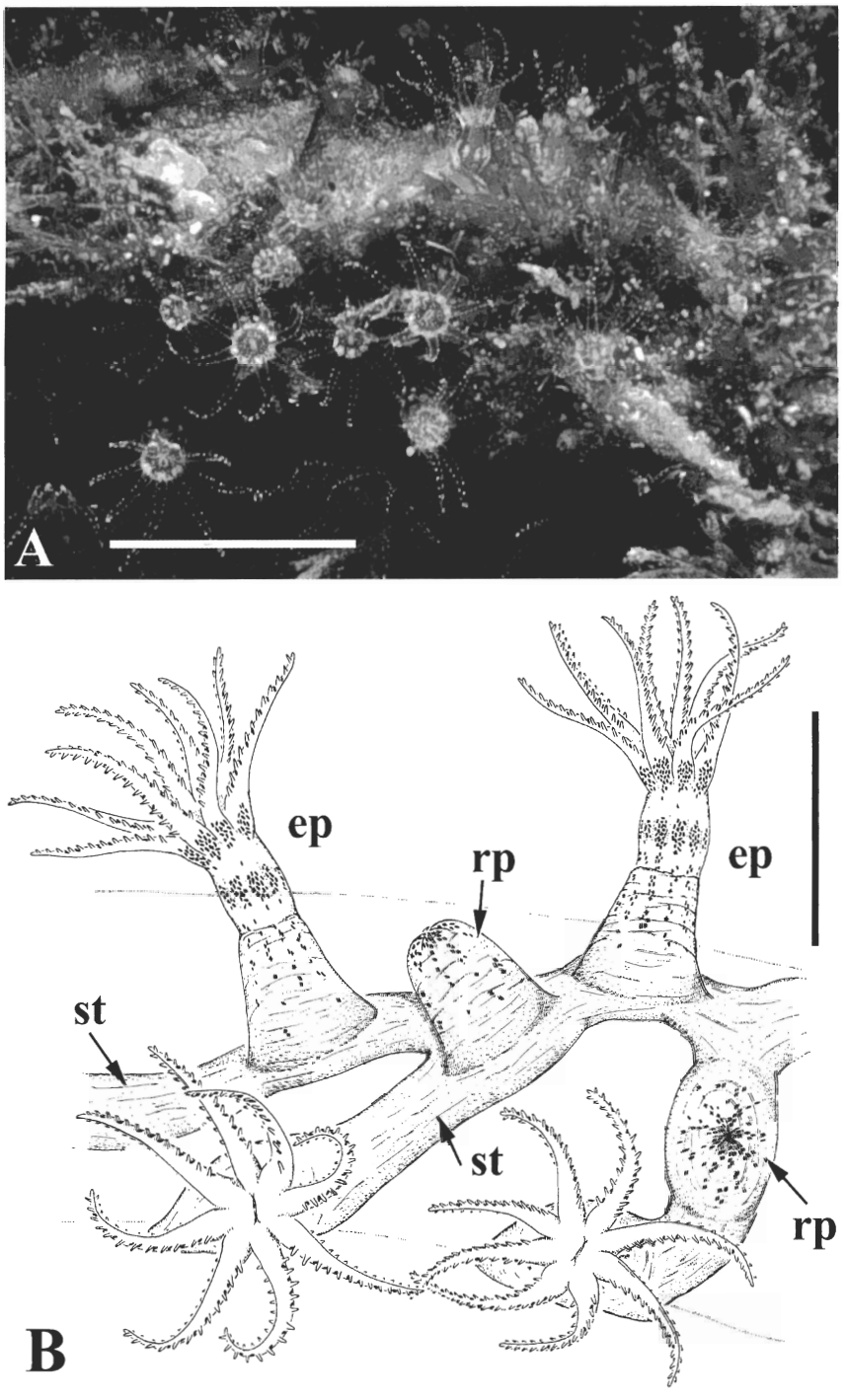

Fig. 1. *Azoria bayeri,* new genus, new species. Holotype: A, underwater photograph of the holotype, notice the translucent appearance of the colony, and the colorless sclerites on the introvert, base of tentacles and between the pinnules (Photo by Peter Wirtz); B, part of a colony, drawing based on the underwater photograph of the holotype and the same material in preserved stage. Abbreviations: ep, expanded polyp; rp, retracted polyp; st, stolon. Scale bars: A, 6 mm; B, 3 mm.

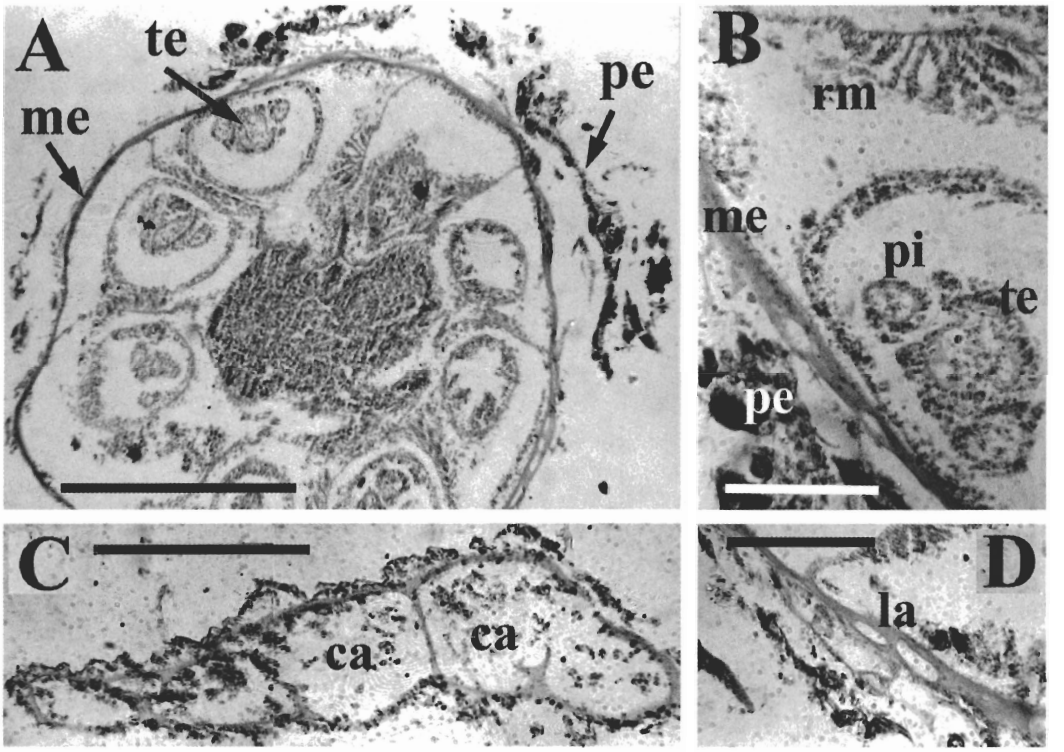

Fig. 2. *Azoria bayeri*, new genus, new species. Holotype: A, transverse section of a retracted polyp, showing the periderm (pe), the thin mesogloea (me) of the anthostele and mesenterial walls, and retracted tentacles (te); B, detail from A of the anthostelar wall, showing the retractor muscle (rm), the pinnules (pi) on both sides of the tentacular axis (te), the thin homogeneous mesogloea (me), and the periderm (pe); C, stolon in cross section, showing the wide principal canals (ca) and thin mesogloeal walls; D, similar to B, showing empty lacunae, probably occupied by sclerites (la). Scale bars: A, 0.50 mm; B, 0.10 mm; C, 0.20 mm; D, 0.10 mm.

marked. Mesenteries with a thin mesogloea and strong diffuse musculature supported by mesogloeal processes up to 0.055 mm.

Sclerites (Figs. 3–4): Sclerites are completely absent in the stolons (Fig. 1B). Sclerites occur scattered over the anthosteles, being more abundant at the distal portion (Fig. 1B). Sclerites of the anthosteles are mainly multiradiate plates [4–6(8)-radiate plates], 0.034–0.066 mm, oblique or perpendicular axes appear principally in high multiradiate sclerites (6–8 radius) (Fig. 3A). Anthocodial sclerites are well-represented in the proximal portion of the neck zone (introvert), basal part of the crown of tentacles, and between pinnules. Sclerites from the introvert are situated on the interseptal areas as eight white zones, and are also multiradiate plates and platelets 0.045–0.064 mm (Fig. 3B). Sclerites of the basal part of the crown of tentacles are densely but irregularly placed, multiradiate plates and platelets, 0.036–0.064 mm (Fig. 4A). Sclerites of the tentacles are placed transversally to the main axis, at the bases of the pinnules, usually one sclerite on each side is present in a very regular pattern (see these sclerites as white marks on the Fig. 1A, B). Sclerites of the tentacles are mainly platelets, 0.034–0.062 mm, although some crosses are also present, 0.051–0.062 mm (Fig. 4B). In general the relative frequency of platelets increases from the anthostele to the tentacles. All sclerites are colorless.

Etymology.—This species is dedicated to Dr. Frederick M. Bayer in recognition of his many relevant contributions to octocoral systematics.

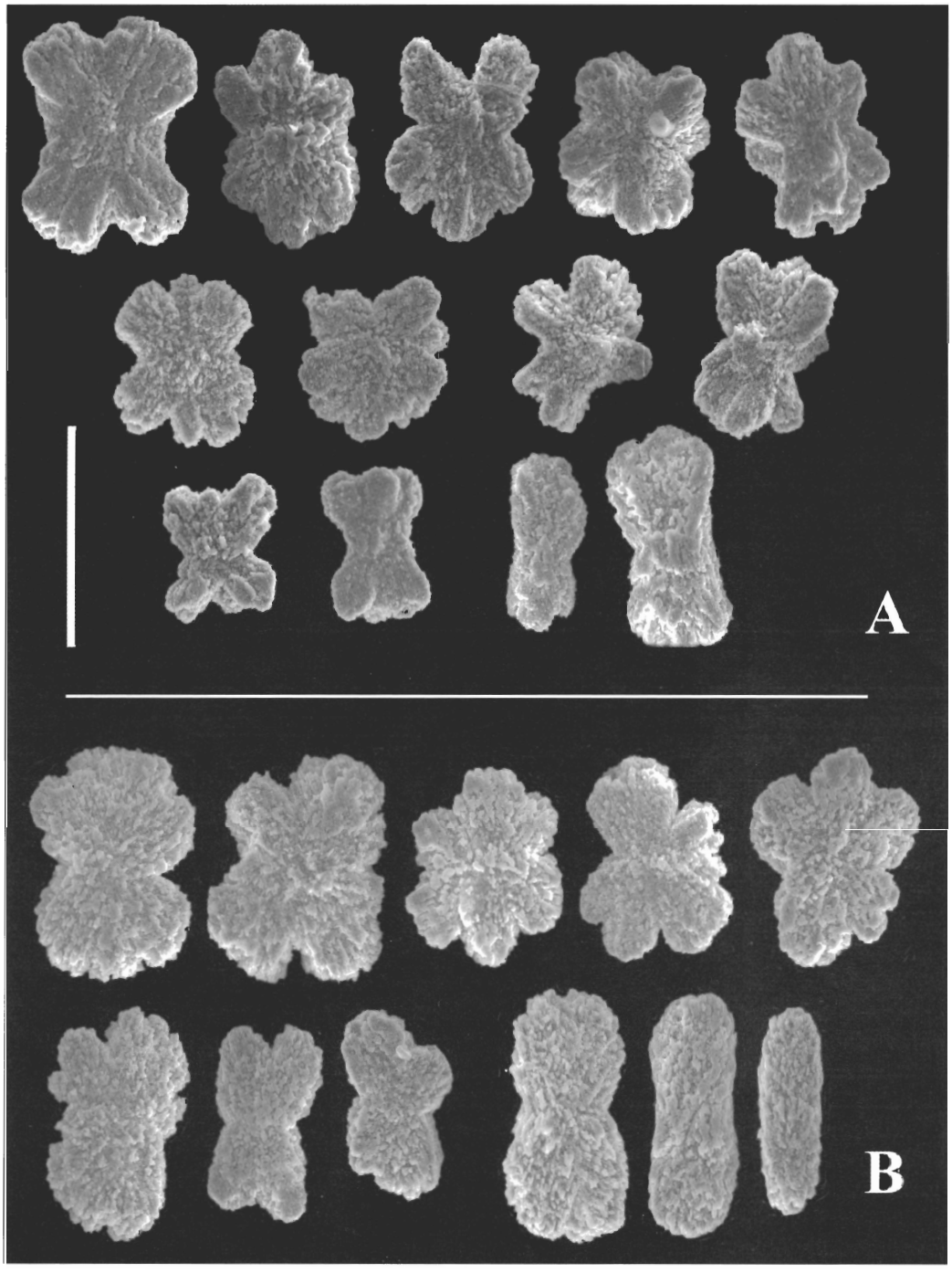

Fig. 3. *Azoria bayeri*, new genus, new species. Holotype: A, sclerites from the anthostele; B, sclerites from the proximal portion of the anthocodia (introvert). Scale bar, 0.06 mm.

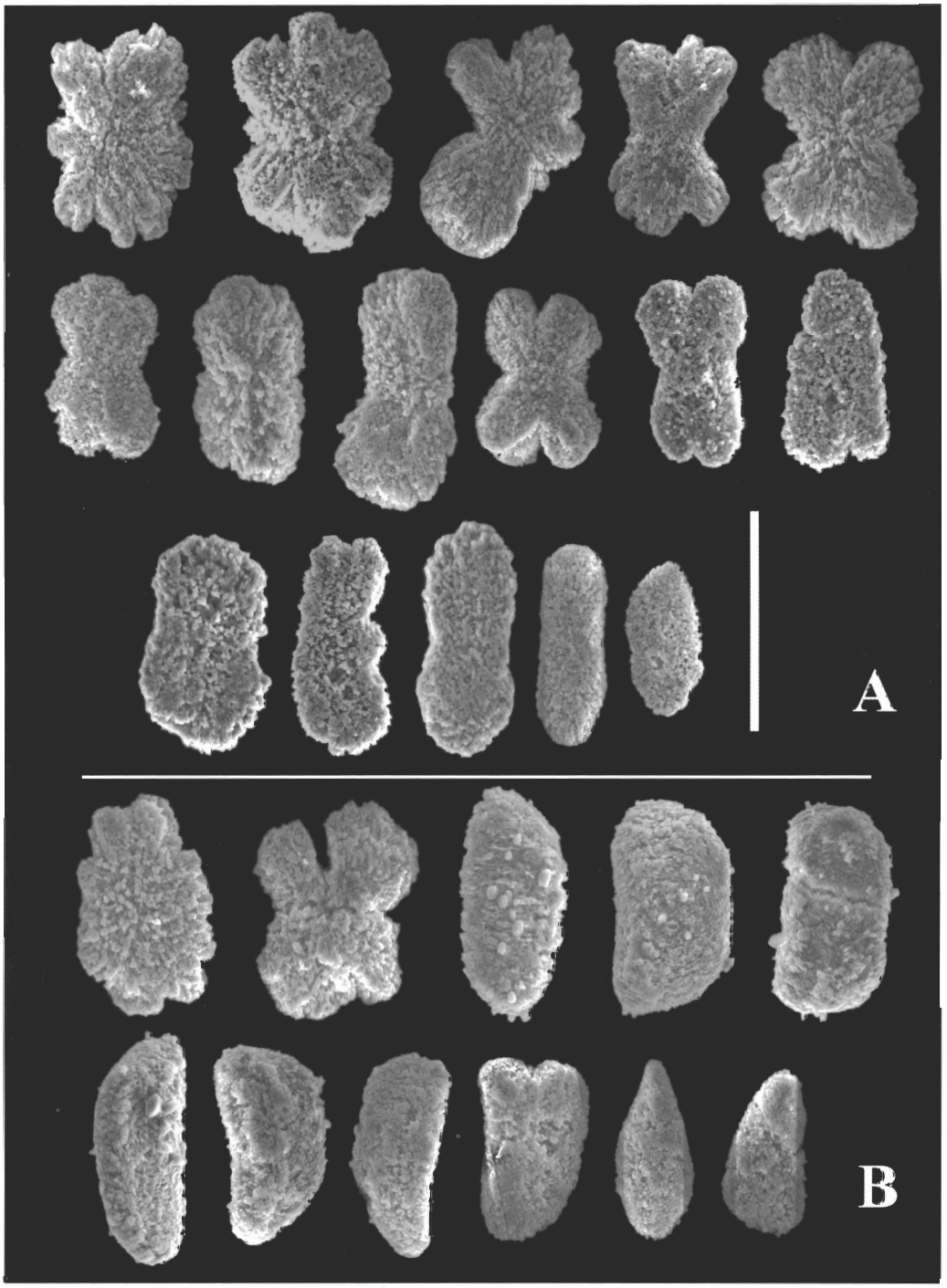

Fig. 4. *Azorina bayeri*, new genus, new species. Holotype. A, sclerites from the base of tentacles; B, sclerites from the tentacles. Scale bar, 0.06 mm.

Distribution.—*Azoria bayeri* is, so far, known only from Terceira Island, Azores Archipelago.

Discussion

Taxonomic comments.—In our opinion, the presence of non-fused sclerites, platelets and multiradiate plates, and their distribution in the colony are sufficient characters to erect a new genus to accommodate *Azoria bayeri.* According to the criteria given by Bayer (1981a), the new genus should be placed within the Sarcodictyiinae by its low anthosteles, and the absence of lateral transverse platform connecting polyps.

The sclerites present in *Azoria,* clearly distinguish it from other clavulariid genera such as *Clavularia* Blainville, 1830, *Trachythella* Verrill, 1922 or *Cryptophyton* Williams, 2000 which possess tuberculate spindles or rods (see Weinberg 1978, 1986; Bayer 1981b; and Williams 2000 for additional details of these genera).

Azoria is also easily differentiable from *Telesto* Lamouroux, 1812, *Carijoa* Müller, 1867, *Paratelesto* Utinomi, 1958, *Telestula* Madsen, 1944, *Stereotelesto* Bayer, 1981, *Rhodelinda* Bayer, 1981, *Bathytelesto* Bayer, 1981, and *Pseudocladochonus* Versluys, 1907 by the absence of secondary polyps, and its sclerite type (see Madsen 1944; Bayer 1961, 1981a, 1981b; Weinberg 1989; and Williams 1989 for additional details of these genera). In addition, in some of these genera (*Rhodelinda, Bathytelesto,* and *Stereotesto*) the sclerites are fused forming rigid anthostelar structures, which is not the case in *Azoria.*

The genera *Sarcodictyon* Forbes, 1847, *Scleranthelia* Studer, 1878, and *Tesseranthelia* Bayer, 1981, all included in the Sarcodictyiinae, also show different types of sclerites from those present in *Azoria. Sarcodictyon* sclerites are 6-radiates, shuttles, crosses, and minute stellate plates (see Bayer 1981a; Ocaña et al. 1992, 2000), in *Scleranthelia* are large stellate plates (see Carpine 1964, Bayer 1981a, Williams 1987, López-González et al. 1995a), while *Tesseranthelia* shows remarkably distinct spicular features, with calicular walls formed by 6–8 large plates, apertures closed by well-differentiated opercular scales, and stolons covered by arched plates as wide as the stolons (see Bayer 1981a, d'Hondt 1986).

The genera *Scyphopodium* Bayer, 1981 and *Cyathopodium* Verrill, 1868 display rigid anthosteles formed by fused sclerites (Bayer 1981a, 1981b; Williams 1989). As previously commented, this character is completely absent in *Azoria,* where sclerites are poorly represented in number and completely free from one another.

Azoria shares with the genus *Rolandia* Lacaze-Duthiers, 1900 the low densities of sclerites in the polyps (sclerites are absent in the stolons of *Azoria*), and a general similarity in the sculpture of the sclerites. However, crosses and 6-radiate sclerites of *Rolandia* are remarkably different from that of *Azoria* (see Weinberg 1978: plts. 17 and 18, and Ocaña et al. 2000: fig. 3 for *Rolandia*; and Figs. 3–4 of the present paper for *Azoria*). Therefore, the internal anatomy in both genera is also different. *Azoria* is more similar to the cornulariid genus *Cervera* (by the homogeneous mesogloeal layer in the anthostele and wide solenia canals in the stolons) than to *Rolandia* (with abundant lacunae filled by cells in the anthostele, and narrow solenia canals communicating polyps) (see López-González et al. 1995b: figs. 12–18 for *Cervera,* Ocaña et al. 2000: fig.: 4 for *Rolandia*; and Fig. 2 of the present paper for *Azoria*).

Although the genus *Cervera* was included in its original description within the Cornulariidae by the lack of sclerites (López-González et al. 1995), the anatomical features (development of the mesogloea at stolon and polyp levels) shown by this genus are more coincident with that observed in *Sarcodictyon* and other Clavulariidae than with those observed in *Cornularia* (Benke & Hündgen 1984, López-González et al. 1995). Final familiar placement of *Cervera*

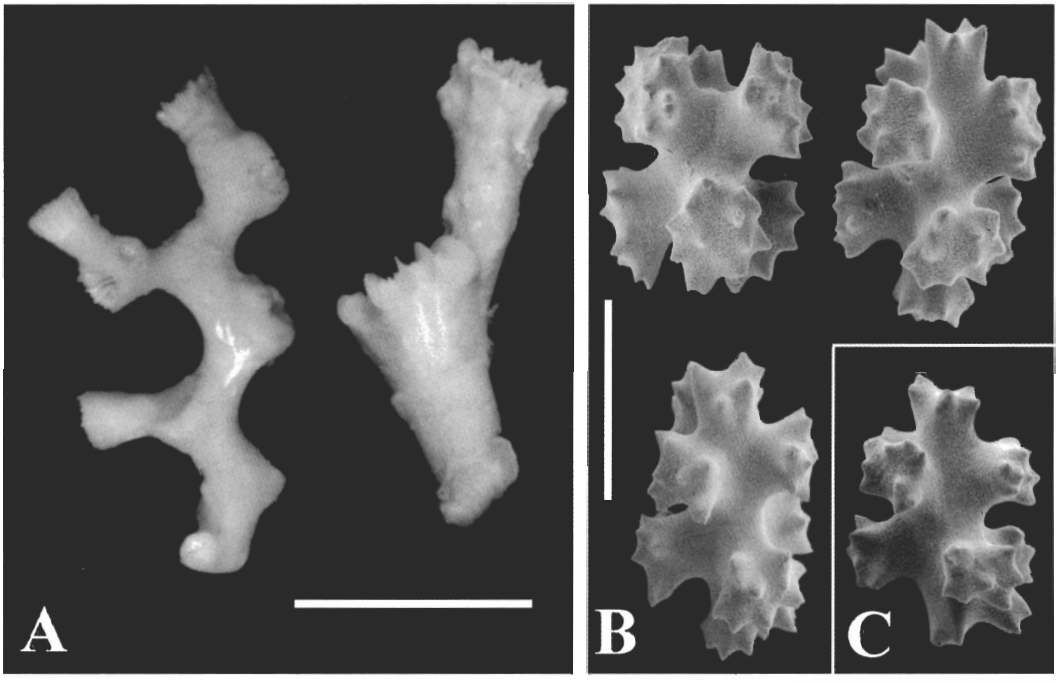

Fig. 5. Material examined and cited by Thomson (1927) as *Rhizoxenia rosea* Ehrenberg MOM(INV-6041): A, two scleractinian fragments with stoloniferous parts of colonies of *Corallium* sp., compare the two colonies here illustrated with those of Thomson (1927: pl.: III, figs 2 and 4); B, three sclerites from the cortex. *Corallium rubrun* (Linné) collected at the Strait of Gibraltar: C, cortical sclerite. Scale bars: A, 15 mm; B and C, 0.04 mm.

remains an open question, pending further studies, perhaps using molecular characters.

In the Azores Archipelago only a few stoloniferous octocoral species have been reported (Wright & Studer 1889, Thomson 1927, Tixier-Durivault & d'Hondt 1975). Regarding the spicular features of *Azoria bayeri,* only the record of Thomson (1927) for *Rhizoxenia rosea* (considered by Weinberg 1978, Ocaña et al. 2000 as a synonym of *Rolandia coralloides* Lacaze-Duthiers, 1900) is relevant (see Thomson 1927: 9, pl. III, figs.: 2–4, 6, 12). The illustrations and the short description of the color ("colonies d'une brillante coleur rouge") and sclerite features ("courts cylindres avec deux verticilles de tubercules composes mousses et un bouton à chaque extrémité") given by the author are sufficient to recognise *Azoria bayeri* as a different species.

The rose stoloniferous colonies examined by Thomson were growing on some scleractinian fragments (see Fig. 5A). A close examination of the polyps and coenenchyme shows the presence of minute siphonozooids around the few autozooids, and a study of the sclerite morphology confirms Thomson's misinterpretation. The sclerites from these colonies correspond to those of the scleraxonian genus *Corallium* (see Fig. 5 B and C). Probably this material was only the basal stolonate parts of some *Corallium* colonies living on scleractinian skeletons. Thus, the supposed presence of *Rhizoxenia rosea* (junior synonym of *Rollandia coralloides*) in the Atlantic (see Weinberg 1978: 167, Ocaña et al. 2000: 419) should be abandoned. Currently *Rolandia coralloides* should be considered as a Mediterranean endemism.

Zoogeographical comments.—The Azores islands are a long way from the European, African and American coasts. This long distance promotes questions about how the

species might be able to cross the intervening abyssal plain from the nearest populations. Some of these questions could possibly be answered thanks to an important set of biogeographic studies (see Morton & Britton 2000a for a review). One of the explanations of how bottom and mid-water invertebrate species might arrive at the Azores, is by being transported by Mediterranean waters which flow westwards from the Strait of Gibraltar (Bigg 1990). Such oceanographic features facilitate the colonization of species from southern Europe and the Mediterranean Sea (e.g., Cornelius 1992b). The genus *Azoria* presents morphological characters similar to other Mediterranean and south European genera such as *Cervera* and *Rolandia.* These similarities together with the explanations given by Grasshoff (1989) about the origin of other octocorallian species such as the gorgonian *Isidella elongata* (larvae transported with the Mediterranean water outflow), lead to the hypothesis that this genus could have arrived in the Azores from regions of the south eastern Atlantic. But, the fact is that the genus *Azoria* could be endemic to this archipelago. Even though the number of shallow sublittoral marine invertebrates is considered small in the islands (Morton and Britton 2000b), many members of the marine fauna are so insufficiently documented, that it is almost impossible to generalize about endemism. Forthcoming studies about the not-so-well-known groups, such as the anthozoans in general, could help to increase knowledge of the endemic fauna because of the special ecological conditions in the Archipelago, even on the most recently formed of the islands.

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The material of *Scyphopodium, Clavularia* and *Telestula* from Icelandic waters examined for comparison was collected during the BIOICE project. We express our gratitude to Drs. Gudmundur Vidir and Gudmundur Gudmundsson, and the staff of the BIOICE project for making possible the study of the BIOICE octocoral material at the Sandgerdi Marine Centre in Iceland. One of us (P.J.L.-G.) acknowledges financial support for a visit to the Sandgerdi Marine Centre (Iceland) under the EC-funded TMR BIOICE Large-Scale Facility Programme.

Additional material of the genera *Scleranthelia, Cornularia* and *Clavularia* was kindly provided by Dr. Helmut Zibrowius from several Mediterranean localities. Part of the material of *Cornularia, Cervera, Rolandia, Sarcodictyon, Scleranthelia* and *Clavularia* for comparative purposes was collected by the "Fauna Ibérica II", "Fauna Ibérica III", and "Fauna Ibérica IV" projects (PB89-0081; PB92-0121; and PB95-0235, respectively). An anonymous referee and Mr. Tony Krupa are thanked for reviewing the English version.

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