NORTHERN ADRIATIC BRYOZOA FROM THE VICINITY OF ROVINJ, CROATIA

Authors: HAYWARD, PETER J., and McKINNEY, FRANK K.

Source: Bulletin of the American Museum of Natural History, 2002(270) : 1-139

Published By: American Museum of Natural History

URL: https://doi.org/10.1206/0003-0090(2002)270<0001:NABFTV>2.0.CO;2

NORTHERN ADRIATIC BRYOZOA FROM THE VICINITY OF ROVINJ, CROATIA

PETER J. HAYWARD

School of Biological Sciences, University of Wales
Singleton Park, Swansea SA2 8PP, United Kingdom
Honorary Research Fellow, Department of Zoology
The Natural History Museum, London SW7 5BD, UK

FRANK K. MCKINNEY

Research Associate, Division of Paleontology
American Museum of Natural History
Professor Emeritus, Department of Geology
Appalachian State University, Boone, NC 28608

BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, NY 10024
Number 270, 139 pp., 63 figures, 1 table
Issued June 24, 2002

 ISSN 0003-0090

CONTENTS

ABSTRACT

One hundred six species of Bryozoa collected from the northern Adriatic in the vicinity of Rovinj, Croatia, are distributed among the orders Ctenostomata (8 species), Cheilostomata (79 species), and Cyclostomata (19 species). Ctenostomes are underrepresented in the collections relative to the two orders with calcified colonies. Five of the cheilostome species are new: *Hagiosynodos hadros* n. sp., *Schizomavella subsolana* n. sp., *Cellepora adriatica* n. sp., *Celleporina siphuncula* n. sp., and *Rhynchozoon revelatus* n. sp. (previously referred to as *Rhynchozoon* sp. II Hayward). Seven species named by Heller (1867) are stabilized by selection of lectotypes (*Beania hirtissima*, *Adeonella pallasii*, *Hagiosynodos kirchenpaueri*, *Exidmonea triforis*, *Crisia recurva*) and neotypes (*Mollia circumcincta*, *Schizomavella cornuta*) from Heller's collection in the University of Innsbruck Institute of Zoology. Lectotypes are designated for the Adriatic species *Hippoporina lineolifera* (Hincks, 1886) and for *Schizomavella mamillata* (Hincks, 1880). *Beania cylindrica* (Hincks, 1886) and *Schizoporella asymetrica* (Calvet, 1927) are recognized as species rather than as subspecific units. The species-rich cheilostome genus *Schizoporella* Hincks, 1877, which contains some of the most widely known fouling bryozoans, is designated a *nomen protectum*. The species name *Smittina cheilostoma* (Manzoni, 1869) is preserved as established usage.

INTRODUCTION

The diverse and abundant Bryozoa of the Adriatic Sea have attracted attention since the mid-19th century, when Heller (1867) produced the first taxonomic account of the fauna, soon supplemented by Hincks (1886, 1887). Since then numerous publications have extended or modified the list of species present, reported new occurrences of species previously reported from the Adriatic, and increasingly during the latter part of the 20th century, used the bryozoans as subjects for ecological and geological studies.

Extended systematic description and illustration of the species described from the Adriatic has been limited. Very few species either in taxonomic works or in other studies of Adriatic bryozoans have been illustrated in sufficient detail that they can be recognized with confidence, other than the limited fauna inhabiting Italian lagoons (Occhipinti Ambrogi, 1981).

The present study is a monograph of the species known to occur in the vicinity of Rovinj, Croatia, along and just offshore of the Istrian Peninsula (fig. 1). Rovinj historically has been a center where bryozoans have been noted, including production of faunal lists (Friedl, 1925) and studies of recruitment (McKinney and McKinney, 1993, 2002), growth and reproduction (Friedl, 1925), ecology (Nikolić, 1954, 1959a, 1959b, 1960; Strenger and Splechtna, 1978; McKinney, 1992, 2000; McKinney and Jaklin, 1993, 2000), and functional morphology (McKinney, 1988, 1989, 1991a, 1991b; M. J. McKinney, 1997). The abundance and diversity of bryozoans in the Adriatic Sea along the Istrian coast north and south of Rovinj, as well as their central role in some of the benthic biocoenoses, has long warranted a monograph of the bryozoans of the region.

The fauna described and illustrated here is located within the northern Adriatic, which occupies a shallow platform north of two successively deeper basins in the middle and southern Adriatic (Buljan and Zore-Armanda, 1976). The northern Adriatic has a slightly less diverse fauna than may be found farther south (Gamulin-Brida, 1979). However, it is of great interest because of the increasing ecological stresses due to the interaction of variations in circulation and growing human impact on the small volume of water spread across the area (e.g. Degobbis et al., 1979; Degobbis, 1989; Marchetti et al., 1989; Stachowitsch, 1991). (The northern Adriatic as a whole averages only 35 m depth; Buljan and Zore-Armanda, 1976.) The shallow, usually oligotrophic environment of the northeastern Adriatic is an important model for understanding Cenozoic deposits to the north and west of the present Adriatic (Seneš, 1988), and its benthic communities, some of which are dominated by calcified bryozoans, are important in understanding what may be persistent differences between past and present benthic faunas in oligotro-

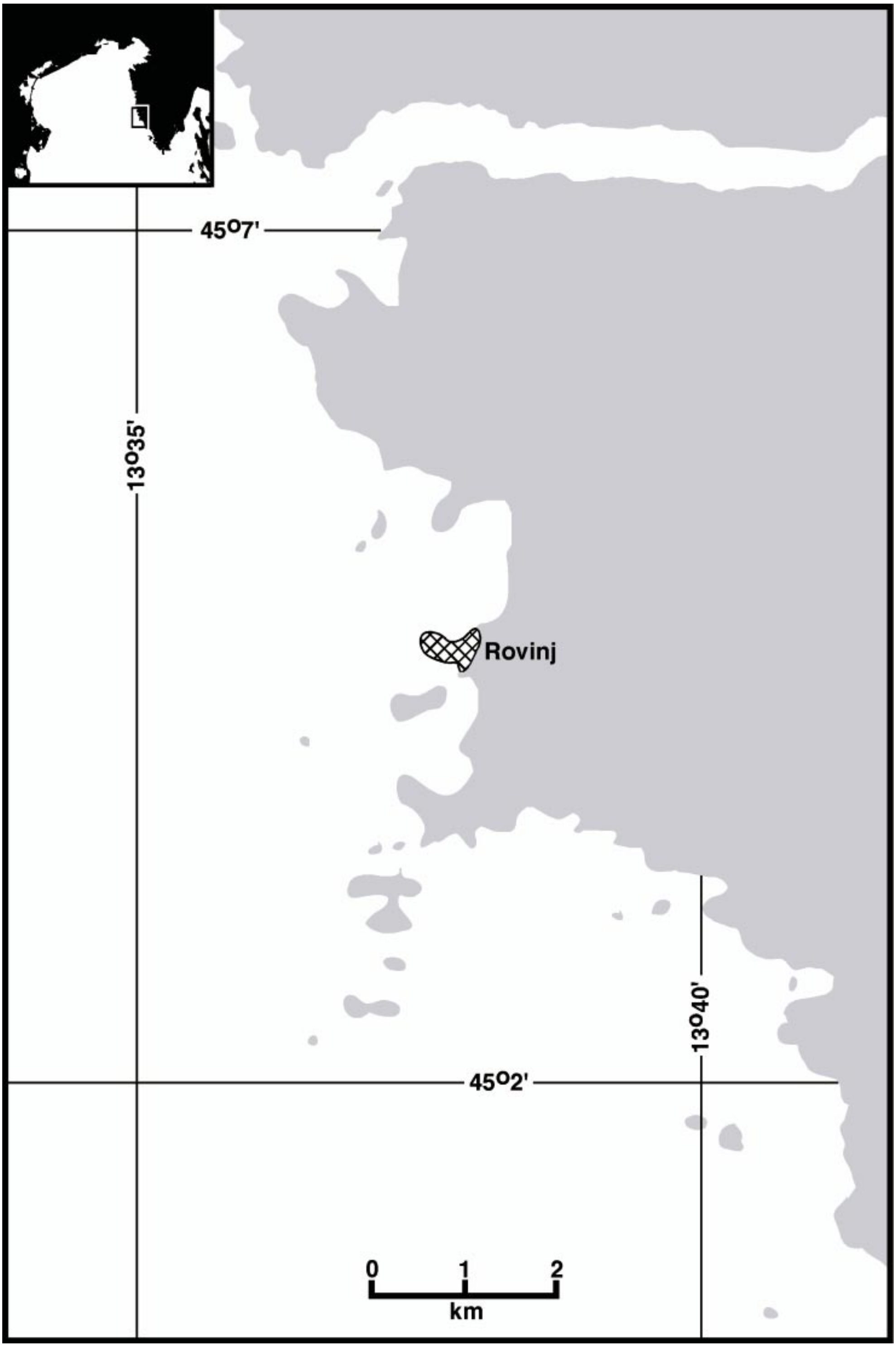

Fig. 1. Map of the northeastern Adriatic Sea in the vicinity of Rovinj, Croatia, encompassing the area from which specimens in this study were collected.

phic and in mesotrophic to eutrophic marine waters.

MATERIALS AND METHODS

Collection and Repository of Material

Bryozoan samples were collected by dredging and by hand collecting. Dredging was accomplished by towing a ‘‘Muslar’’ dredge behind the *Burin*, a boat operated by the Center for Marine Research–Rovinj (CMRR). The dredge was towed for approximately 20 minutes each time, sampling a path approximately 1 m wide by 500 m long. Most hand collections were made by SCUBA divers, led by Andrej Jaklin of the CMRR. Shore collections were made by F.K. McKinney and M.J. McKinney.

Collections are not equally representative of each site. Some sites were visited and collected intensely as many as eight times, others were visited only once. Some of the SCUBA collections were focused specifically on large, calcified colonies of certain species. Small and inconspicuous species that can be seen well only under a microscope would have been missed in such situations, whereas they were much more likely to be encountered during the close scrutiny of surfaces in the dredged material.

All material collected was examined live in the CMRR within a week of collection, then preserved in formalin, alcohol, or by drying. Other than the Heller types, which are in the University of Innsbruck Institute of Zoology (UIIZ), and specimens of *Hagiosynodos latus* and *Hippoporina lineolifera*, which are in the collections of the Natural History Museum, London (BMNH), each specimen illustrated here by scanning electron microscopy is in the Bryozoan Collections of the American Museum of Natural History (AMNH). Indicated paratypes of new species and other reference materials are deposited in the Ruđer Bošković Institute Center for Marine Research–Rovinj.

Collecting Localities

Two general types of natural environments were sampled. The underwater continuations of the shore and islands in the vicinity of Rovinj consist of limestone rock walls, boulders and cobbles derived from them, and, locally, caves extending into the rock. The other general natural environment consists of a gently sloping plain of sediment, largely sand but locally dominated by mud, that is at a water depth of only a few meters adjacent to some parts of the mainland but that declines westward to an extensive area of 30–40 m depth, with a few deeper depressions. In addition, surfaces of a few artificial substrata in the Rovinj harbor and in Lim Channel were sampled.

Locality 1. Shore near west end of north side of Punta Corrente, cobbles (hand collected), 0–1 m depth 45°03.8′N, 13°37.5′E). 23 September 1990, 12 June 1997

Locality 2. South side, mouth of Lim Channel, rock (SCUBA), 2–3 m depth (45°06.9′N, 13°37.0′E). 12 October 1990

Locality 3. Cave in south side of Sv. Ivan Island, near landing site on the island (SCUBA), 3–5 m depth (45°02.4′N, 13°37.1′E). 9 September 1987

Locality 4. West side of Banjole Island (top of boulder at entrance to cave (SCUBA), 3.5 m depth 45° 03.9′N, 13°36.5′E). 3 July 1998

Locality 5. West and south sides of Banjole Island, rock wall (SCUBA), 5–20 m depth (45°03.9′N, 13°36.5′E). 14 September 1987, 7 June 1988, 20 September 1990, 9 October 1990, 8 June 1995

Locality 6. Lim Channel, approximately 1 km from mouth, rock ledge (SCUBA), 5–10 m depth (45°07.5′N, 13°37.6′E). 24 September 1987

Locality 7. Northwest tip of Sv. Ivan Island, flanks and undersides of boulders (SCUBA), 8–10 m depth (45°02.4′N, 13°37.1′E). 2 October 1990

Locality 8. Northwest tip of Sv. Ivan Island, rock wall (SCUBA), 10–30 m depth (45°02.4′N, 13°37.1′E). 20 June 1988

Locality 9. Northwest corner of Pelago Island, rock (SCUBA), 10–20 m depth (45° 03.2′N, 13°36.6′E). 20 June 1988

Locality 10. Cave in west side of Banjole Island (SCUBA), 10–11 m depth (45° 03.9′N, 13°36.5′E). 7 June 1988

Locality 11. Lim Channel, approximately 5 km from mouth, rock (SCUBA), 12–20 m depth (45°07.4′N, 13°39.7′E). 10 June 1988

Locality 12. Approximately 100 m west of Sturago Island, flanks and undersides of boulders (SCUBA), 20 m depth (45°03.2′N, 13°36.8′E). 23 June 1988

Locality 13. West and south sides of Banjole Island, rock wall (SCUBA), 25–30 m depth (45°03.9′N, 13°36.5′E). 20 September 1990, 8 June 1995

Locality 14. Northwest corner of Pelago Island, isolated boulders on sand bottom (SCUBA), 30–50 m depth (45°03.2′N, 13°36.6′E). 20 June 1990

Locality 15. Leso Bay, Rovinj, midway between Figarola Island and mainland, sand bottom (dredge), 14–17 m depth (45°05.4′N, 13°37.4′E). 9 July 1998

Locality 16. West side of Banjole Island, sand platform (SCUBA), 17.5 m depth (45°03.9′N, 13°36.5′E). 3 July 1998

Locality 17. Approximately 1 km north of Figarola Island, 500 m off mainland, sand bottom (dredge), 20–22 m depth (45°05.6′N, 13°36.7′E). 3 June 1997, 13 November 1997

Locality 18. Approximately 200 m offshore of Rt Kriz, sand bottom (dredge), 20 m depth (45°03.8′N, 13°37.2′E). 26 May 1988

Locality 19. Channel between Banjole Island and Sv. Katarina Island, 150 m from S. Catarina, sand bottom (dredge), 22 m depth (45°04.1′N, 13°37.2′E). 20 June 1988

Locality 20. Approximately 3 km north of Rovinj, 300 m offshore, sand bottom (dredge), 25 m depth (45°05.7′N, 13°36.5′E). 29 September 1987, 21 September 1990, 6 June 1995

Locality 21. Approximately 1 km offshore of Rt Kriz, sand bottom (dredge), 29 m depth (45°03.8′N, 13°36.7′E). 15 June 1988, 4 October 1990, 12 October 1990

Locality 22. Channel between Sv. Ivan Island and Pelago Island sand bottom (dredge), 30–42 m depth (45°02.3N, 13°36.7′E). 15 June 1988, 2 October 1990, 8 June 1995, 9 July 1998

Locality 23. Sediment adjacent to west side of base of Banjole Island, sand bottom (SCUBA), 31 m depth (45°03.9′N, 13°36.5′E). 3 July 1998

Locality 24. Approximately 200 m southwest of Banjole, sand bottom (dredge), 32 m depth (45°03.8′N, 13°34.2′E). 23 June 1988

Locality 25. Approximately 3 km south of Sv. Ivan Island, sand bottom (dredge), 33–34 m depth (450°0.7′N, 13°37.1′E). 9 July 1998

Locality 26. Channel between Banjole Island and Sv. Katarina Island, midway; sand bottom (dredge), 33–35 m depth (45°04.1′N, 13°36.9′E). 2 October 1990, 4 October 1990

Locality 27. ''*Cellaria* meadow,'' west of Banjole Island, mud bottom (SCUBA), 35 m depth (45°04.0′N, 13°36.3′E). 29 September 1987, 7 June 1988, 9 October 1990, 3 June 1997, 18 November 1997, 3 July 1998, 7 July 1998, 15 July 1998

Locality 28. Approximately 4 km southeast of Sv. Ivan Island, sand bottom (dredge), 35 m depth (45°00.8′N, 13°39.2′E). 13 November 1997

Locality 29. Approximately 400 m north-northwest of Pelago Island, 44–61 m depth (45°02.4′N, 13°36.5′E). 13 November 1997, 9 July 1998

Locality 30. CMRR oceanographic station SJ-311, offshore from Pula, sand bottom (SCUBA), 45 m depth (44°37.2′N, 13° 40.0′E). 4–6 June 1988, 25 September 1990

Locality 31. Channel between Sv. Ivan Island and Pelago Island, sand bottom (dredge), 50–60 m depth (45°02.3N, 13°36.7′E). 3 June 1988, 23 June 1988, 3 June 1997

Locality 32. Harbor by CMRR, concrete wall (SCUBA), 0–5 m depth (45°04.9′N, 13°38.15′E). 3 July 1998

Locality 33. Mussel-culture station, Lim Channel, ropes, tiles, and wooden frame of platform (SCUBA), 0–2 m depth; pulsating salinity changes due to actively mixing marine and fresh spring waters (45°07.4′N, 13° 40.9′E). 24 September 1987, 10 June 1988

Locality 33a. Shell debris from mussel-culture station, collected from channel floor immediately below. 24 September 1987

Locality 34. Outer dock, Rovinj Harbor, concrete block (grapple hook), 4 m depth (45°04.4′N, 13°37.6′E). 12 November 1997

Locality 35. Approximately 9 km west of Istrian Coast, fine sand bottom (Van Veen grab), 24.5 m depth. Specimens provided by A. Jaklin. (45°26.1′N, 13°3.8′E). 25 September 1991

Locality 36. Mud with low proportion of skeletal detritus (probably SCUBA), 35 m depth (45° 01.1′N, 12°59.7′E). 30 October 1990

Locality 37. Approximately 560 m west of Figarola, fine sand bottom (dredge), 20–30 m depth (45°5.3′N, 36°36.8′E). 27 June 1984

Species Distributions

Any taxonomic survey risks incompleteness, and incompleteness in benthic marine surveys of topographically complex areas is virtually assured because sampling is limited and because locally unique environments may be missed completely. In addition, some organisms are simply more difficult to see than are others. It is likely that many ctenostome bryozoans are present in the region included in this paper but were not found by us because of their small size, inconspicuous growth habits, neutral color, and tendency to grow within tangled mats of algae and hydroids. Some were spotted in the laboratory when their tentacles were protruded to feeding positions above the mats, but any others within the mats that did not feed while in the field of view of the microscope would have been missed completely.

Meadows of the marine grass *Posidonia* were formerly present in the region of Rovinj but died off in the early 1970s (D. Zavodnik, 1977; N. Zavodnik, 1983). Such marine grasses carry a diverse bryozoan fauna further south in the Adriatic and elsewhere in the Mediterranean (Harmelin, 1973a; Nicoletti et al., 1995) and part of that fauna is restricted to growth on the grasses (e.g., *Electra posidoniae* Gautier, 1954) or occurs preferentially on them (e.g., *Platonea stoechas* Harmelin, 1976). *Posidonia* currently is extending its range back up the eastern Adriatic coast toward Rovinj (N. Zavodnik, personal commun.). Should fully developed meadows of *Posidonia* and other grasses again occur there, it is likely that locally absent epiphytic bryozoans will also reappear.

Our collections inevitably underrepresent environments and depth distributions of many of the bryozoan species that we found. Where species apparently have notable restrictions in depth or environment, we mention this in a note on Occurrence in the species descriptions. For all other species, occurrence data are summarized in appendix 1.

Measurements and Counts

Some zooidal measurements were made optically at ×50 using a Wild M8 stereomicroscope with an ocular micrometer. Optical measurements were made in units of 10 μm. Most measurements were made through stereomicroscopes fitted with a digital camera and recorded electronically with National Institute of Health image analysis software.

Each measurement or count is given in the text as mean plus or minus standard deviation, observed range, and (enclosed in parentheses) number of specimens used and total number of measurements or counts made. Except where noted, measurements are given in microns. Measurements and counts for cheilostome skeletons are identified by the following acronyms and abbreviations:

AAL: Adventitious avicularium length
AAW: Adventitious avicularium width
AL: Avicularium length (type defined in text of species description)
AW: Avicularium width (type defined in text of species description)
CL: Cauda length
DO: Distance between midpoints of adjacent orifices
KL: Kenozooid length
KW: Kenozooid width
LW: Lyrula width
ML: Mandible length (avicularia)
MW: Mandible width (avicularia)
OL: Orifice length
OOL: Ovicellate orifice length (where different from normal orifice width)
OOW: Ovicellate orifice width (where different from normal orifice width)
OpL: Opesia length
OpW: Opesia width
OvL: Ovicell length
OvW: Ovicell width
OW: Orifice width
PS: Distance between pores in frontal shield
SOD: Secondary orifice diameter
VAL: Vicarious avicularium length
VAW: Vicarious avicularium width
ZL: Autozooid length as seen on colony surface
ZW: Autozooid width as seen on colony surface.

Measurements on cyclostome skeletons are identified by these acronyms and abbreviations:

AD: Aperture diameter
ADMN: Minimum aperture diameter
ADMX: Maximum aperture diameter
AlvD: Alveoli diameter
AS: Distance between midpoints of adjacent apertures
ASW: Distance between midpoints of adjacent apertures within a row or fascicle
BrD: Branch diameter or width
Gap: Distance between edges of adjacent fascicles
GL: Length of inflated portion of gonozooid
GW: Width of inflated portion of gonozooid
OsD: Ooeciopore diameter
OsDMN: Ooeciopore minimum diameter
OsDMX: Ooeciopore maximum diameter
PD: Peristome diameter (exterior) at outer end
RS: Distance between centers of adjacent zooecial rows or fascicles.

Measurements and counts of polypide structures are identified by these acronyms:

IH: Introvert height
LD: Lophophore diameter
LDMn: Minimum lophophore diameter
LDMx: Maximum lophophore diameter
MD: Mouth diameter
MDMn: Minimum mouth diameter
MDMx: Maximum mouth diameter
TL: Tentacle length
TLMn: Minimum tentacle length
TLMx: Maximum tentacle length.

We have not provided complete synonymies for each species; reference to the original description is given, together with reference to significant sources relating either to the Adriatic or to the Mediterranean in general. More extended synonymies are provided for formerly taxonomically confused species, and for all species synonymic histories may be found in the major sources cited (e.g., Prenant and Bobin, 1956; Hayward, 1985; Hayward and Ryland, 1985a, 1998, 1999).

For the Cheilostomata, we follow the family to suborder working classification of Dennis P. Gordon (1989, personal commun.). This is the classification that is being developed for eventual use in the revised *Treatise on invertebrate paleontology*. Classification of the Ctenostomata and Cyclostomata is little modified from that of Hayward (1985) and Hayward and Ryland (1985a), respectively.

SYSTEMATIC ACCOUNTS

CLASS GYMNOLAEMATA ALLMAN, 1856

ORDER CTENOSTOMATA BUSK, 1852

FAMILY NOLELLIDAE HARMER, 1915

GENUS *NOLELLA* GOSSE, 1855

Nolella dilatata (Hincks, 1860)

Figure 2A

Farrella dilatata Hincks, 1860: 279.
Nolella dilatata Nordgaard, 1918: 14. Hayward, 1985: 90.

DESCRIPTION (AMNH 887; CMRR 2200): Colony encrusting. Autozooids clumped or diffuse, each consisting of an erect, cylindrical portion, 1.0–2.5 mm long in present material, of more or less constant width, ca. 0.25 mm, not narrowed at base, but instead broadened to an expanded, flat base adherent to substratum. Proximal, encrusting portion of autozooid slender, filiform, ca. 0.06 mm wide, of variable length, linked with preceding autozooid. Buds developed around edges of expanded base of tube, developing as filiform proximal portions of new autozooids.

Tentacles clear; number reported to vary between 16 and 20, but 18–22 in present material. Lophophores bell-shaped, radially symmetrical.

DISTRIBUTION: *Nolella dilatata* is common in shallow coastal waters throughout the northeast Atlantic and the Mediterranean, but it is inconspicuous and easily overlooked. It encrusts a variety of substrata but is most frequent on other sessile invertebrates, including bryozoans.

FAMILY WALKERIIDAE HINCKS, 1880
(emend. Bassler, 1953)

GENUS *WALKERIA* FLEMING, 1823

Walkeria tuberosa (Heller, 1867)

Figure 2B, C

Valkeria tuberosa Heller 1867: 128. Prenant and Bobin, 1956: 255.
Walkeria tuberosa: Zabala and Maluquer, 1988: 70.

DESCRIPTION (AMNH 888; CMRR 2201): Colonies thin, adherent kenozooidal stolons, 35–50 μm wide, with clumps of erect, cylindrical autozooids at intervals of 2–3 mm. At each such point the stolon buds on each side a fan of flat, quadrangular kenozooids, 50–100 μm diameter, each giving rise to a single autozooid; groups consist of up to 30 autozooids on each side of the stolon. Autozooids cylindrical, but with a square-sectioned distal portion; abruptly constricted proximally and thus appearing shortly stalked; up to 0.6 mm long in present material, with maximum width 0.2 mm. The small kenozooids also bud further stolonal kenozooids and the colony develops a ramifying form, creeping over the substratum.

Tentacles 8, clear; lophophores radially symmetrical, slightly concave-sided conical.

OCCURRENCE: Epizoic on other bryozoans, especially *Cellaria* and *Amathia*.

DISTRIBUTION: Originally described from the Adriatic, *W. tuberosa* has been recorded sporadically from elsewhere in the Mediterranean, from the Red Sea (Waters, 1910) and

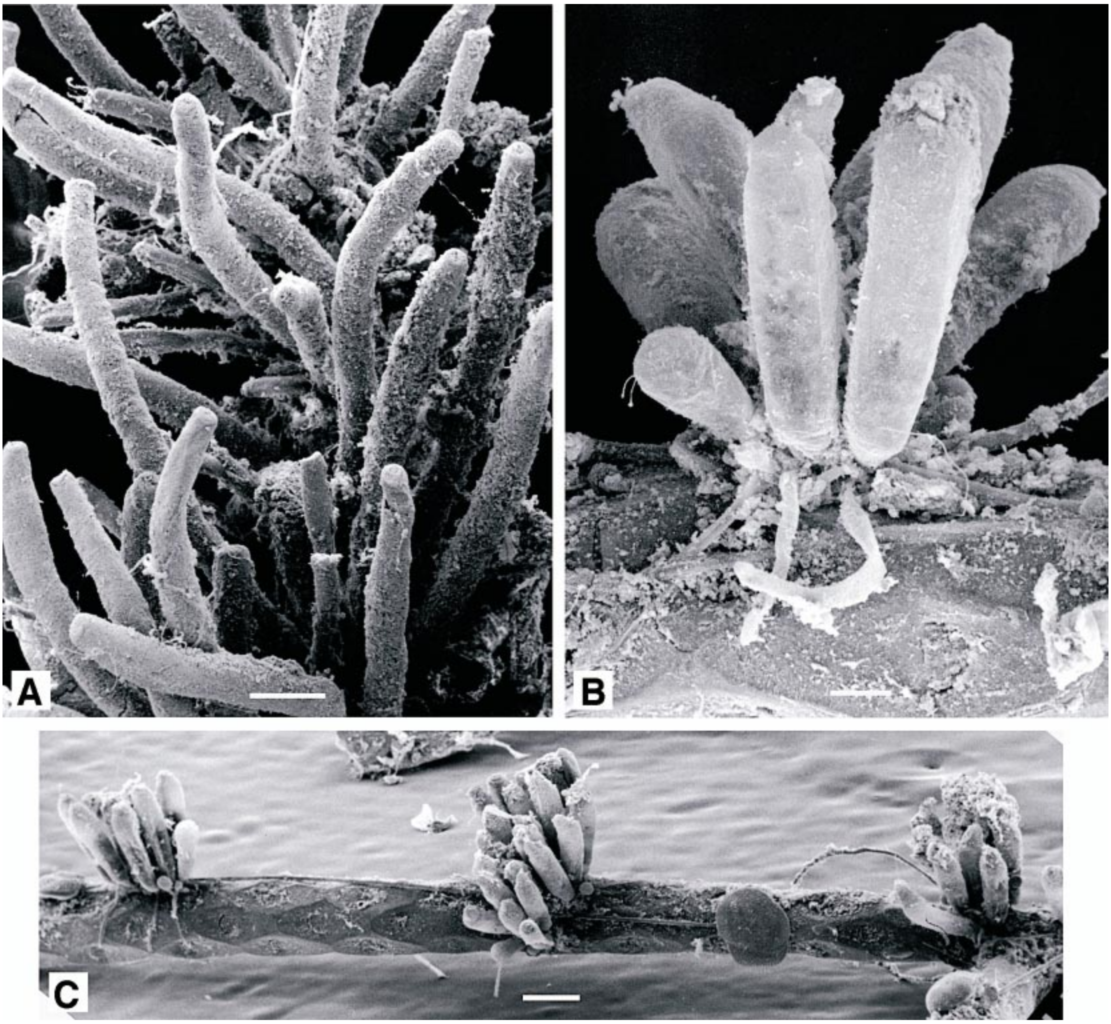

Fig. 2. **A.** *Nolella dilatata* (AMNH 887; 0.4 mm). **B, C.** *Walkeria tuberosa*. **B.** Single clump of zooids (AMNH 888; 0.1 mm). **C.** Three stolon-connected clumps of zooids on branch of *Cellaria* (AMNH 888; 0.3 mm). (In this and subsequent figures, length of the scale bar will be indicated in parentheses.)

from the Indo-Mayalan region (Harmer, 1915; Silén, 1942).

MEASUREMENTS (CYSTID): ZL 527 ± 42 μm, 480–560 (1, 7), LD 342 ± 20, 320–360 (1, 10), MD 20 (1, 1), TL 344 ± 18, 320–380 (1, 10).

FAMILY VESICULARIIDAE HINCKS, 1880

GENUS *BOWERBANKIA* FARRE, 1837

Figure 3

The taxonomy of *Bowerbankia* poses problems outside of the temperate north Atlantic region, and it is not certain even whether any of the five species known from north European coasts are the same as those recorded from northeast American coasts. Three species have been reported from Mediterranean localities, namely *Bowerbankia pustulosa* (Ellis and Solander, 1786) and *Bowerbankia imbricata* (Adams, 1798), both of which may develop dense shrubby colonies, and *B. gracilis* Leidy, 1855, which typically grows as diffuse, creeping colonies of small autozooids, individually spaced along

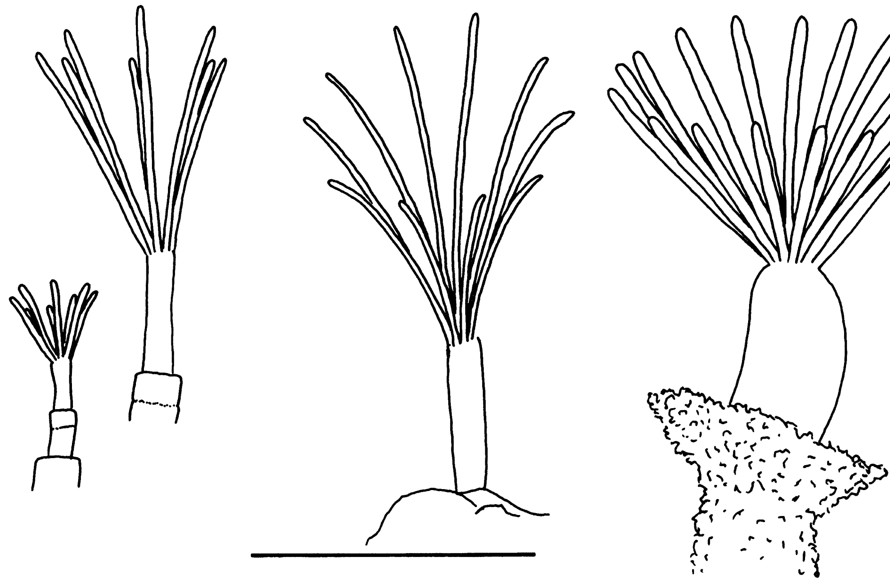

Fig. 3. Nonpreserved ctenostomes. **A.** Small *Bowerbankia* inhabiting *Tubulipora* skeleton. **B.** *Bowerbankia*-like form with large lophophore. **C.** Stolonate ctenostomate with campylonemidan lophophore of 10 tentacles. **D.** Robust stolonate ctenostomate with 16–17 tentacles. (0.5 mm)

a very slender, inconspicuous stolon. *Bowerbankia caudata* Hincks, 1880, characterized by proximally tapered, or ''caudate'' autozooids, has for long been synonymized with *B. gracilis*, yet two genetic species of ''*B. gracilis*'' are present in the Swansea region of South Wales (Hayward, 1985), and it is probable that several others exist within the wide geographic range accorded to this taxon. Pending the results of current molecular genetic investigations into the taxonomy of *Bowerbankia*, species can only be distinguished by such characters as the shape of the lophophore and the number of tentacles, embryo color, breeding period, and colony organization. Unfortunately, species with ''*B. gracilis*'' morphology are cryptic in habit and usually only become apparent during the later stages of sample sorting. Three small species of stoloniferan ctenostomates were present in the Rovinj collections; each was photographed, but for none is there sufficient morphological or other data to be certain of its taxonomic identity, and they are here attributed, tentatively, only to the genus *Bowerbankia*, as follows:

1. A small species with a short cylindrical collar, inhabiting empty zooid tubes of *Tubulipora* (fig. 3A). The lophophore was a radially symmetrical bell of eight tentacles; this is consistent with *B. gracilis*, but there are no other grounds for identifying it with this taxon.
2. A large species (fig. 3B) with a short cylindrical collar and an elongate radially symmetrical bell of eight tentacles.
3. A slightly larger epizoic species (fig. 3C) with a diffuse colony form of dispersed zooids on an unseen stolon. The lophophore was a bilaterally symmetrical, campylonemidan bell with 10 tentacles.

Finally, an unidentified stolonate ctenostomate (fig. 3D) with a large lophophore of at least 16 tentacles and a flared collar to which much debris adheres must remain completely unattributed: no species of *Bowerbankia* has such a large lophophore and it is unclear to which genus this species belongs.

GENUS *AMATHIA* LAMOUROUX, 1812

Amathia pruvoti Calvet, 1911

Figure 4A

Amathia pruvoti Calvet, 1911: 59. Hayward, 1985: 136. Chimonides, 1987: 336.

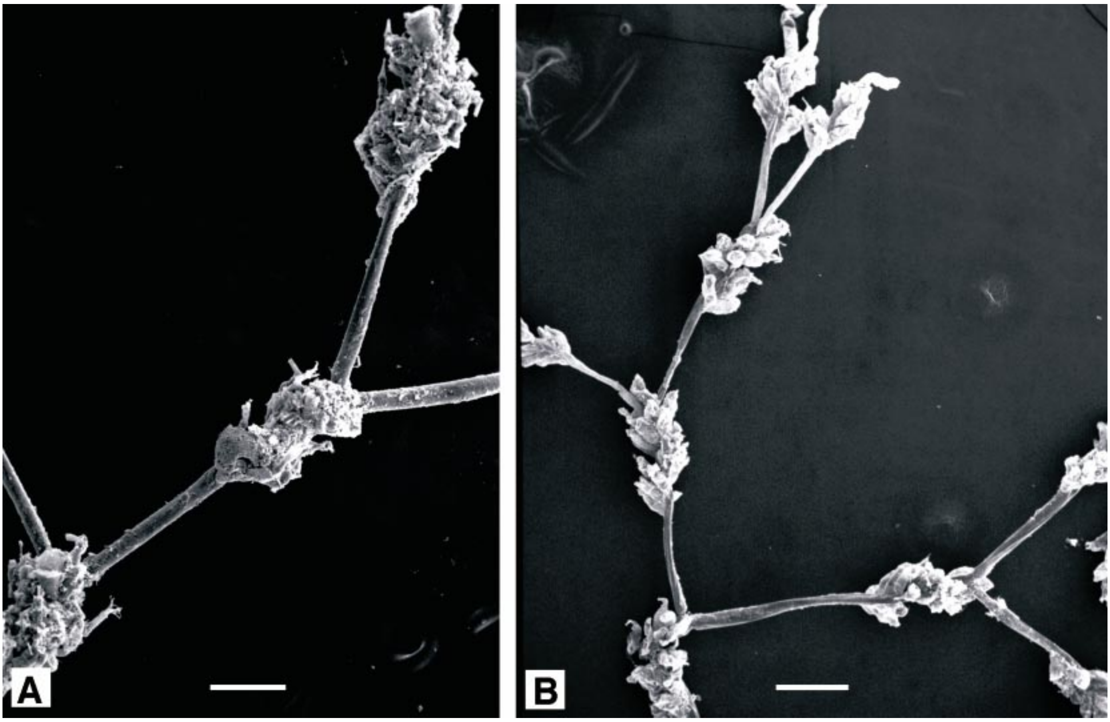

Fig. 4. **A.** *Amathia pruvoti* (AMNH 889; 0.5 mm). **B.** *Amathia vidovici* (UIIZ 366; 0.5 mm).

DESCRIPTION (AMNH 889; CMRR 2202): Colonies sparse, erect tufts, to 2 cm in present material, of stiff, kenozooidal stolons, colorless at extremities but light brown basally; attached by an encrusting portion of stolon, without additional rhizoids. Stolon of constant width, ca. 0.175 mm, not tapering distally, bifurcating at intervals of 3–6 mm; slightly curved prior to the dichotomy, one ramus deflected at approximately 40° to main axis, subsidiary ramus at ca. 60° and alternating left and right along the major axis. Autozooids cylindrical, closely adherent to stolon, arranged in tight biserial groups, each originating proximal to the dichotomy at one-third to one-half distance between it and preceding dichotomy. Six to 10 pairs of autozooids in each group, with a single, unpaired proximal autozooid; forming a half spiral of about 90° around stem, with autozooid length decreasing successively distally.

REMARKS: Chimonides (1987) provided a detailed analysis of colony morphology in this and several other species of *Amathia*, stressing the significance of growth pattern for discriminating between them.

DISTRIBUTION: *Amathia pruvoti* is widespread and common in shallow coastal waters throughout the Mediterranean, and on the southwest coasts of the British Isles.

Amathia vidovici (Heller, 1867)

Figure 4B

Valkeria vidovici Heller, 1867: 128.
Amathia vidovici: Prenant and Bobin, 1956: 283.

DESCRIPTION: A single small tuft of this species was collected, 7.5 mm high, comprising two stolon bifurcations and six autozooid groups. Stolon 0.2 mm wide; autozooid groups each consisting of a single proximal autozooid and about eight pairs, all about the same height. Each group forming a complete spiral of 360° around the stolon, usually commencing just proximal to a bifurcation and enclosing bases of the two daughter kenozooids; one group of autozooids was situated midway between two successive bifurcations, a characteristic of the species noted by Prenant and Bobin (1956). Basal attachment of *A. vidovici* remains quite unknown (Chimonides, 1987).

REMARKS: We could not locate any type material of *Valkeria vidovici* in the UIIZ collections; instead, we illustrate part of a specimen of *A. vidovici* from an unspecified locality in the Adriatic, in the collections of the University of Innsbruck Institute of Zoology (specimen 366). Although little material of this species was collected, its morphology is recognizably that of *A. vidovici*, which was named for material from the Adriatic (Heller, 1867).

DISTRIBUTION: *Amathia vidovici* is widely distributed in shallow coastal waters of the Mediterranean, and ranges north to Roscoff, Brittany. It has been recorded in the western Atlantic form Colombia to Massachusetts, from the Cape Verde Isles and from east Africa, a broad geographical range which perhaps requires reinvestigation.

ORDER CHEILOSTOMATA BUSK, 1852

SUBORDER INOVICELLATA JULLIEN, 1888

SUPERFAMILY AETEOIDEA SMITT, 1867a

FAMILY AETEOIDAE SMITT, 1867a

GENUS *AETEA* LAMOUROUX, 1812

Aetea sica (Couch, 1844)

Figure 5A–C

Hippothoa sica Couch, 1844: 102.
Aetea sica: Alvarez, 1990: 24. Hayward and Ryland, 1998: 102.

DESCRIPTION (AMNH 890, 891; CMRR 2203): Colonies forming delicate, branching traceries over biogenic substrata, especially shell, with autozooids in branching linear chains. Encrusting proximal portion of autozooid consisting of a filiform part of variable length, but just 0.05 mm wide, broadening abruptly to a substantial fusiform part 0.5 mm long and 0.2 mm wide, from which the erect distal portion arises. This also varies in length, to 1.5 mm in present material, with a basal width of 0.1 mm, gently broadening to about 0.15 mm at the distal end. Opesia occupying distal third of erect portion. Calcification thin and delicate, that of encrusting portion smooth and imperforate, erect portion finely but distinctly annulate.

Tentacles clear, 10; lophophores broadly conical, radially symmetrical.

DISTRIBUTION: Occurs on a wide variety of organic and inorganic substrata, in shallow coastal waters throughout the Mediterranean. *Aetea sica* has been recorded from most of the world's seas, but its actual Distribution is probably more limited.

MEASUREMENTS (POLYPIDE): IH 60 μm (1, 1), LD 200–280 (2, 2), TL 250–420 (2, 2).

Aetea truncata (Landsborough, 1852)

Figure 5D–F

Anguinaria truncata Landsborough, 1852: 288.
Aetea truncata: Gautier, 1962: 29. Hayward and Ryland 1998: 104.

DESCRIPTION (AMNH 892, 893; CMRR 2204): Colonies white, uniserial, continuously or intermittently encrusting. Adnate stoloniform portion of autozooid particularly slender, as is basal dilatation of erect distal portion. Relatively short distal portion of autozooid finely and densely punctate, lacking any annulations. Colonies collected 26 May 1988 offshore from Rt Kriz had irregular unattached growth form reported in other species of *Aetea* (Hayward and Ryland, 1998) when associated with hydroid and bryozoan turfs. They were loosely intergrown with a tuft of *Savignyella lafontii*. Stoloniform portions were up to 0.125 mm long but just 0.025 mm wide, broadening abruptly to 0.07 mm at base of distal portion, which was reflected at an angle of about 120° to long axis of stoloniform portion. Distal portion, accommodating the polypide, was 0.45–0.5 mm long, cylindrical proximally and slightly broadened to a maximum width of 0.12 mm at midlength. Opesia occupying about half of total length of this part of autozooid. Distally, autozooid abruptly truncate, bearing a terminal operculum. Branching varied: new stoloniform buds arising most frequently from basal dilatation of autozooid, either basally or laterally, or from basal (i.e., abfrontal) surface of distal portion of autozooid, or even from various points on stolonifom parts of autozooids.

Tentacles clear, 11–12, usually 12; lophophore broadly conical, radially symmetrical.

REMARKS: Geometry of adnate and erect portions of autozooids, together with punc-

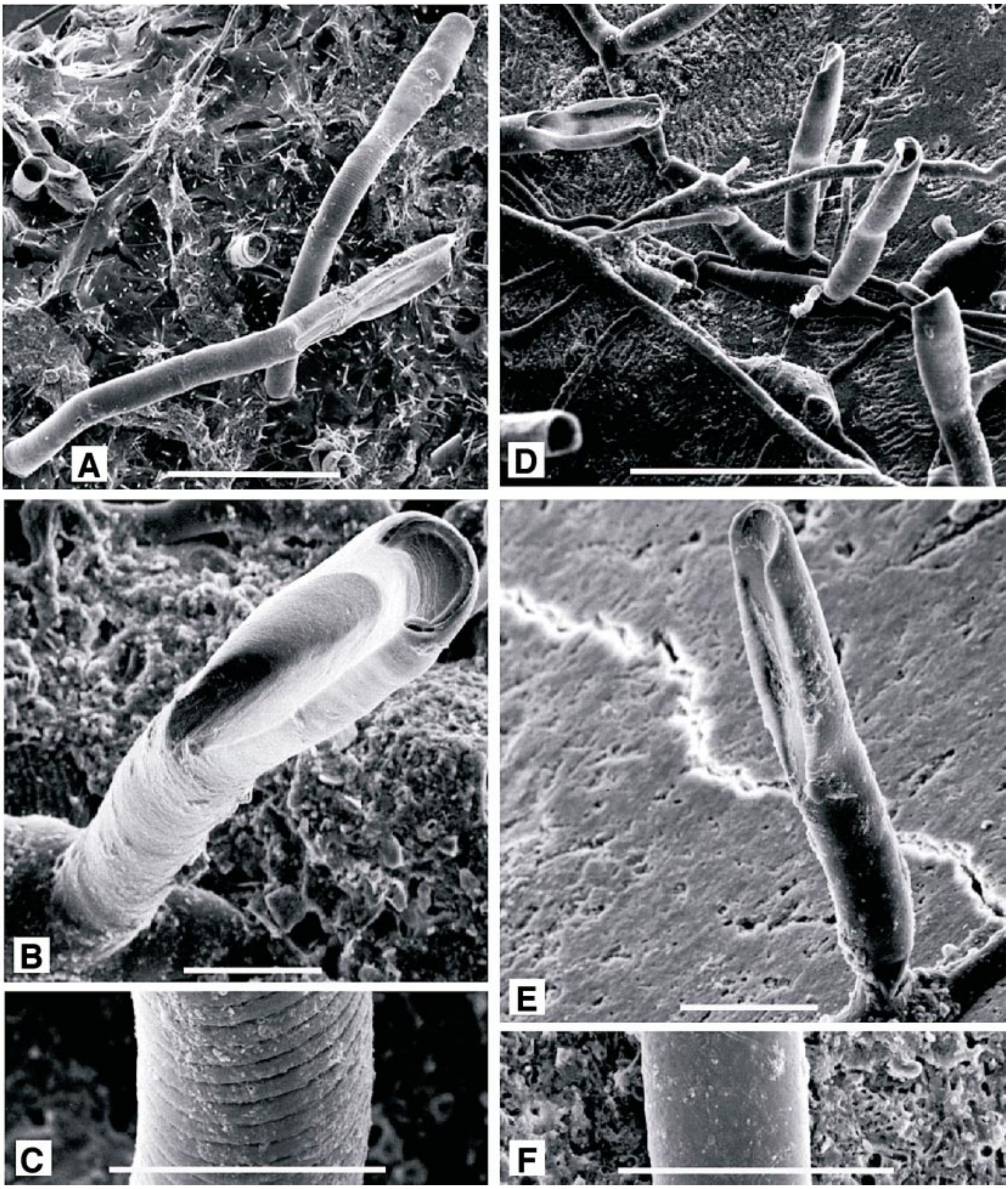

Fig. 5. **A–C.** *Aetea sica*. **A.** Group of zooids with adnate portion covered by thin sponge (AMNH 890; 0.5 mm). **B.** Erect portion of zooid, including opesia with terminal orifice (AMNH 891; 0.1 mm). **C.** Annulae around base of erect portion of zooid (AMNH 890; 0.1 mm) **D–F.** *Aetea truncata*. **D.** Group of zooids encrusting radula-scored shell surface (AMNH 892; 0.5 mm). **E.** Erect portion of zooid, including opesia and inclined terminal orifice (AMNH 893; 0.1 mm). **F.** Smooth base of erect portion of zooid (AMNH 893; 0.1 mm).

tuation and lack of annulations suffice to distinguish this species from all other Mediterranean species of *Aetea*. Balduzzi et al. (1991) noted that the superficially similar *A. lepadiformis* Waters has a very few, but distinct annulations immediately proximal to the opesia

OCCURRENCE: This species was common to abundant at most stations where it occurred, encrusting dead shell and as an epizooite, especially of other bryozoans.

DISTRIBUTION: *Aetea truncata* has been reported from temperate and tropical seas throughout the world but, especially following the work of Balduzzi et al. (1991), it must be considered probable that such a wide Distribution encompasses more than one species.

MEASUREMENTS (POLYPIDE): IH 46 ± 36 μm, 20–120 (4, 17), LD 421 ± 57, 280–530 (4, 29), MD 21.7 ± 2.5, 20–25 (3, 9), TL 299 ± 55, 160–440 (4, 27).

SUBORDER SCRUPARIINA SILÉN, 1941

SUPERFAMILY SCRUPARIOIDEA BUSK, 1852

FAMILY SCRUPARIIDAE GRAY, 1848

GENUS *SCRUPARIA* OKEN, 1815

Scruparia ambigua (d'Orbigny, 1841)

Figure 6A

Eucratea ambigua d'Orbigny, 1841: pl. 3, figs 13–17.
Scruparia ambigua: Hayward and Ryland, 1998: 108.

DESCRIPTION (AMNH 894): Colony erect, branching, uniserial chains of horn-shaped autozooids, budded from encrusting chains of identical autozooids. Frontal surface of autozooid with an oval opesia occupying half its length, bounded by a thin raised rim. Embryos brooded in dimorphic zooids with a distinctive bivalved brood chamber (absent from present material).

OCCURRENCE: A portion of one colony, comprising two encrusting autozooids and two erect shoots, of three and one complete autozooids, encrusting *Cellaria fistulosa* (Linnaeus, 1758).

DISTRIBUTION: This rather inconspicuous species is widely distributed throughout the Mediterranean, and has been reported from temperate and tropical seas worldwide. It is often epifaunal in habit, but is rather inconspicuous and frequently overlooked.

SUBORDER MALACOSTEGA LEVINSEN, 1902

SUPERFAMILY MEMBRANIPOIDEA BUSK, 1852

FAMILY ELECTRIDAE D'ORBIGNY, 1851

GENUS *PYRIPORA* D'ORBIGNY, 1852

Pyripora sp. (Fleming, 1828)

Figure 6B, C

DESCRIPTION (AMNH 895): Colony encrusting, runner-like, inconspicuous. Autozooids in uniserial chains, branching irregularly; clavate, with a slender, filiform proximal portion broadening at about half total length to an oval distal portion. Calcification gymnocystal, smooth; opesia oval, occupying three-quarters length of distal portion, bordered by a very narrow, indistinct cryptocystal rim. No spines or polymorphs. Each autozooid giving rise to a single distal bud, and may also produce paired lateral buds, allowing branching of the chains.

REMARKS: The single colony of *Pyripora* in our material differs from *P. catenularia* (Fleming, 1828), the species previously reported from the northeastern Atlantic and Mediterranean, in lacking a well-developed cryptocystal rim around the opesia, having a proportionally longer cauda, and having proximolateral rather than more distolateral budding.

MEASUREMENTS (SKELETAL): OpL 155 ± 12 μm, 29–168 (1, 10), OpW 81 ± 8, 70–93 (1, 10), ZL 548 ± 50, 480–621 (1, 10), ZW 155 ± 9, 141–170 (1, 10).

SUBORDER FLUSTRINA SMITT, 1867b

SUPERFAMILY CALLOPOROIDEA NORMAN, 1903

FAMILY CALLOPORIDAE NORMAN, 1903

GENUS *CALLOPORA* GRAY, 1848

Callopora dumerilii (Audouin, 1826)

Figure 6D–G

Flustra dumerilii Audouin, 1826: 240.
Callopora dumerilii; Hayward and Ryland, 1998: 160.

DESCRIPTION (AMNH 896–898; CMRR 2205): Colonies encrusting, multiserial, unilaminar patches. Ancestrula approximately 225–250 μm long, with 10 peripheral spines;

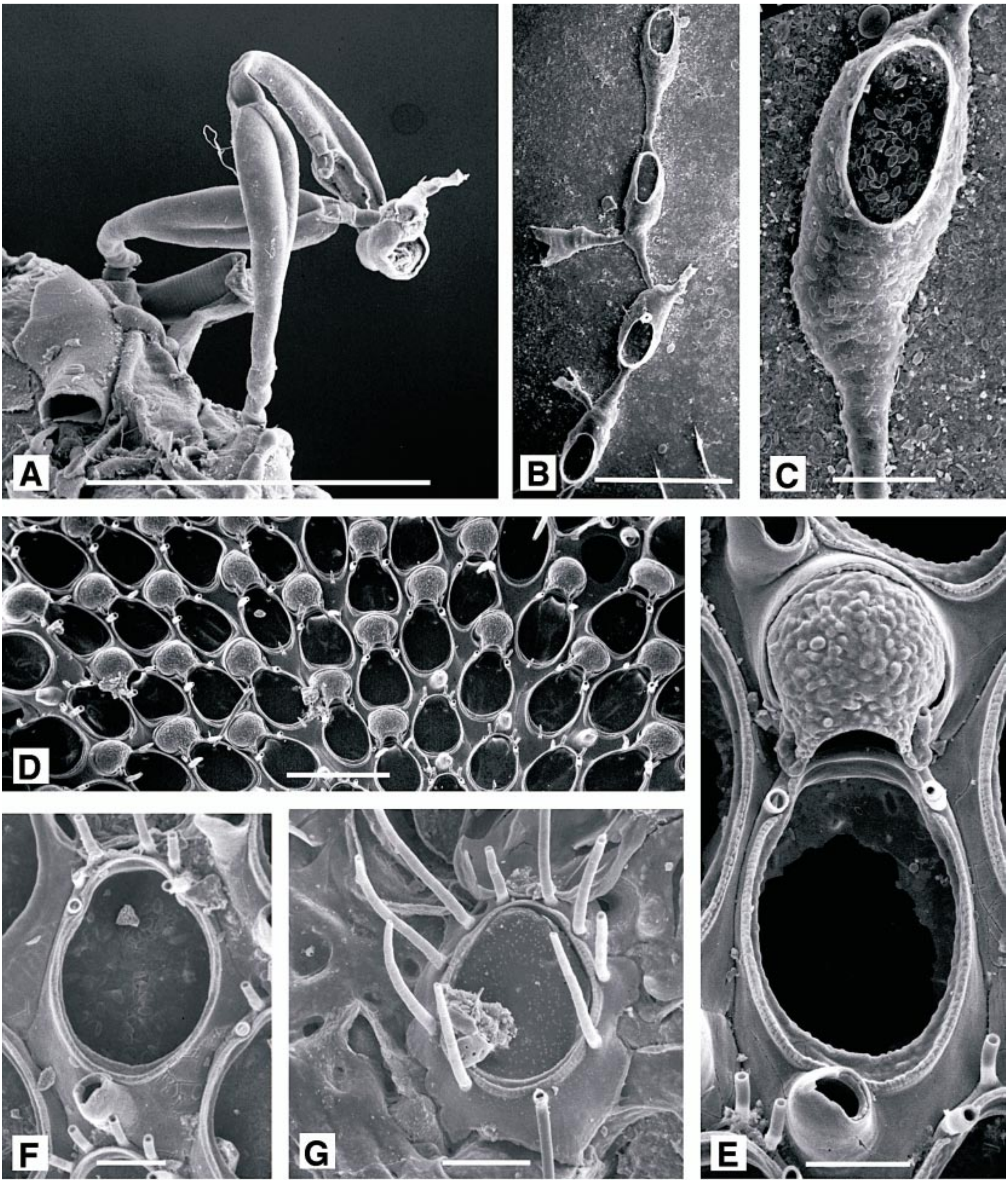

Fig. 6. **A.** *Scruparia ambigua* (AMNH 894; 0.5 mm). **B, C.** *Pyripora* sp. **B.** Group of zooids; note proximo-medial budding (AMNH 895; 0.5 mm). **C.** Single zooid (AMNH 895; 0.1 mm). **D–G.** *Callopora dumerilii*. **D.** General aspect (AMNH 896; 0.5 mm). **E.** Maternal zooid with ovicell (AMNH 897; 0.1 mm). **F.** Autozooid (AMNH 896; 0.1 mm). **G.** Ancestrula (AMNH 898; 0.1 mm).

number of spines reduced and autozooids enlarged over about 5–8 generations. Autozooids elongate oval, broadest proximally, separated by distinct grooves. Opesia oval, bordered by a thin crenulate mural rim, enclosing a narrow shelf of finely granular cryptocyst, widest at the proximal end; gymnocyst smooth, imperforate. Four distal oral spines present, the proximalmost pair robust and conspicuous. A single adventitious avicularium (rarely two) present on the gymnocyst of most autozooids, with short, columnar cystid; rostrum acute to frontal plane, triangular, distally hooked, usually directed proximally; with a narrow cryptocyst bordering the proximal opesia, but no crossbar. Ovicell hyperstomial, prominent, more or less spherical, but narrowed towards arched aperture; ectooecium membranous except for a basal peripheral rim, entooecium coarsely nodular. Distal to an ovicell, avicularium displaced laterally, with a distolateral orientation.

Tentacles clear, 11–12; lophophores bell-shaped, radially symmetrical.

DISTRIBUTION: Common throughout the temperate northeast Atlantic and Mediterranean, on stone, shell and other organic substrata, in shallow coastal habitats.

MEASUREMENTS (SKELETAL): DO 368 ± 52 μm, 285–497 (3, 30), OpL 294 ± 30, 222–350 (3, 25), OpW 208 ± 16, 180–240 (3, 25), OvL 177 ± 17, 156–226 (3, 20), OvW 172 ± 21, 129–216 (3, 20), ZL 507 ± 37, 424–590 (3, 25), ZW 307 ± 25, 260–357 (3, 25). (POLYPIDE): IH 30–80 μm (1, 2), LD 373 ± 31, 340–400 (1, 3), MD 20 (1, 1), TL 287 ± 23, 260–300 (1, 3).

GENUS *COPIDOZOUM* HARMER, 1926

Copidozoum tenuirostre (Hincks, 1880)

Figure 7A–D

Membranipora tenuirostre Hincks, 1880: 70.
Copidozoum tenuirostre: Prenant and Bobin, 1966: 257. Hayward and Ryland, 1998: 180.

DESCRIPTION (AMNH 899, 900): Colonies encrusting, multiserial, unilaminar. Autozooids elongate oval, distinctly separated by well-marked grooves. Frontal surface of autozooid almost entirely membranous; gymnocyst reduced to a smooth, proximal and proximolateral border; cryptocyst developed as a coarsely granular rim, narrowed slightly at distal end of autozooid, opesia constituting almost three-quarters total autozooid length. Spines absent, except in first three or four astogenetic generations. Avicularia interzooidal, about half length of autozooid; mandible slender, distally directed, lodged within a narrow, parallel-sided rostrum formed from incurved gymnocystal calcification, pivoting on two pronounced condyles, proximal to which there is a broad shelf of cryptocyst. Ovicell longer than wide, domed, with a distinctive coarsely nodular surface. Ancestrula oval, with minimal development of cryptocyst, bordered by (?) eight slender spines; autozooids of the first three or four astogenetic generations occasionally with single spines proximally, and two or more distally, all developed on the gymnocyst.

DISTRIBUTION: On stones and shells, in shallow coastal habitats; *C. tenuirostre* is widely distributed in the Mediterranean and north to the western English Channel.

MEASUREMENTS (SKELETAL): AL 229 ± 31 μm, 167–298 (2, 15), AW 123 ± 14, 94–155 (2. 15), DO 376 ± 63, 256–490 (3, 30), OpL 315 ± 29, 268–381 (3, 30), OpW 205 ± 24, 162–256 (3, 30), OvL 177 ± 9, 162–190 (2, 7), OvW 190 ± 14, 176–217 (2, 7), ZL 484 ± 56, 391–560 (3, 30), ZW: 322 ± 26, 279–379 (3, 30).

GENUS *ELLISINA* NORMAN, 1903

Ellisina gautieri Fernández Pulpeiro and Reverter Gil, 1993

Figure 7E–G

Ellisina gautieri Fernández Pulpeiro and Reverter Gil, 1993: 98. Hayward and Ryland, 1998: 192.

DESCRIPTION (AMNH 901): Colonies encrusting, multiserial, unilaminar patch. Autozooids oval, separated by distinct grooves. Frontal surface almost entirely membranous, the extensive opesia bordered by a very narrow rim of granular cryptocyst, and with a minimal area of smooth gymnocyst just visible at proximal end of autozooid. No spines. Avicularia interzooidal, budded from distal pore chamber of most autozooids; cystid rounded quadrangular, ca. 0.125 mm long, rostrum triangular, acute to frontal plane, directed distolaterally. Two or more avicularia may occur at the division of autozooid rows,

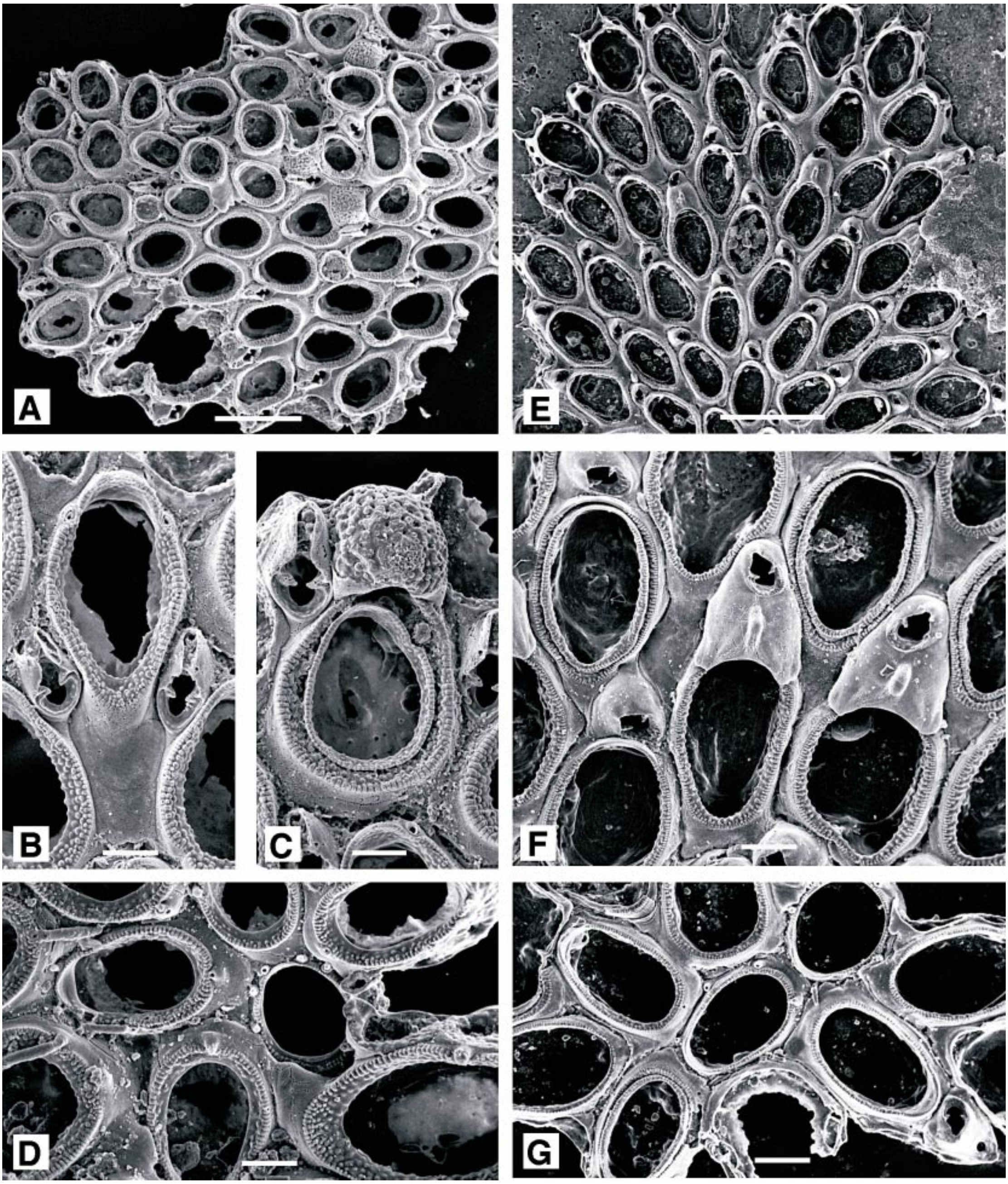

Fig. 7. **A–D.** *Copidozoum tenuirostre*. **A.** General aspect (AMNH 899; 0.5 mm). **B.** Autozooid (AMNH 899; 0.1 mm). **C.** Maternal zooid with ovicell (AMNH 899; 0.1 mm). **D.** Ancestrula and early autozooids (AMNH 900; 0.1 mm). **E–G.** *Ellisina gautieri* (AMNH 901). **E.** General aspect (0.5 mm). **F.** Autozooids (left) and maternal zooids with ovicells bearing distal avicularia (0.1 mm). **G.** Ancestrula and early autozooids (0.1 mm).

or where regular spacing of autozooids is disturbed. Ovicell slightly longer than wide, domed, recumbent on substratum between distally succeeding autozooids; smooth and imperforate, with a distinct, longitudinal frontal ridge and intimately associated with distal avicularium; closed by zooidal operculum.

REMARKS: This species was first noted from Marcella by Gautier (1962), as *E.* cf. *levata*, and its identity was only recently established by Fernández Pulpeiro and Reverter Gil (1993).

DISTRIBUTION: *E. gautieri* is known from the Atlantic coast of northwest Spain and from the western English Channel; the single small colony described here represents its first record from the eastern Mediterranean.

MEASUREMENTS (SKELETAL): AL 158 ± 22 μm, 131–198 (2, 20), AW 140 ± 20, 113–184 (2, 20), DO 359 ± 36, 296–424 (2, 20), OpL 346 ± 27, 304–387 (2, 20), OpW 205 ± 15, 182–246 (2, 20), ZL 521 ± 42, 465–596 (2, 20), ZW 296 ± 14, 274–325 (2, 20).

SUPERFAMILY FLUSTROIDEA FLEMING, 1828

FAMILY FLUSTRIDAE FLEMING, 1828

GENUS *CHARTELLA* GRAY, 1848

Chartella tenella (Hincks, 1887)

Figure 8A, B

Flustra tenella Hincks, 1887: 313.
Chartella tenella: Gautier, 1962: 48.
Terminoflustra tenella: Prenant and Bobin, 1966: 191.

DESCRIPTION (AMNH 902; CMRR 2206): Colonies erect, flabellate, bilaminar, lightly calcified, to 20 mm in present material; dividing irregularly at varying intervals, developing a narrowly lobed, frondose form. Autozooids rectangular, flat, 0.65 × 0.25 mm. Frontal surface entirely membranous, vertical walls lightly calcified; a short, thin and very inconspicuous spine present at each distal corner. Avicularia vicarious, at bifurcation of autozooid rows; cystid rectangular, 0.25 × 0.2 mm, thickly calcified, with semielliptical rostrum slightly acute to frontal plane, directed distally or just oblique to distal axis. Kenozooids filling spaces between autozooids where bifurcating branches diverge and developed as tubular extensions at distal tips of some branches. Ovicell hemispherical, completely immersed, conspicuous through its white calcification.

Tentacles colorless, 13–15; lophophores bell-shaped, radially symmetrical.

Light orange embryos present in material from locality 21, 15 June 1988.

DISTRIBUTION: *Chartella tenella* is an endemic Mediterranean species, common in shallow coastal habitats, and offshore to 200 m (Prenant and Bobin, 1966). It has been widely reported throughout the western Mediterranean and the Adriatic.

MEASUREMENTS (SKELETAL): AL 314 μm (1, 1), AW 221 (1, 1), DO 444 ± 84, 301–632 (2, 20), OL 76 ± 8, 62–92 (1, 10), OW 134 ± 8, 121–148 (1, 10), ZL 685 ± 81, 585–841 (2, 20), ZW 250 ± 36, 184–321 (2, 20). (POLYPIDE): IH 201 ± 74 μm, 60–340 (2, 24), LD 595 ± 94, 440–700 (2, 27), MD 20 (1, 1), TL 534 ± 62, 400–650 (2, 24).

SUPERFAMILY BUGULOIDEA GRAY, 1848

FAMILY BUGULIDAE GRAY, 1848

GENUS *BUGULA* OKEN, 1815

Bugula fulva Ryland, 1960

Figure 8C–E

Bugula fulva Ryland, 1960: 86. Hayward and Ryland, 1998: 218.

DESCRIPTION (AMNH 903, 904; CMRR 2207): Colonies erect, branching, developing as stiff, open fans, to 10 mm in present material but recorded up to 30 mm. Branches unilaminar, dividing by regular dichotomy, consisting of two longitudinal autozooid series, increasing to four just prior to each dichotomy. Autozooids elongate, narrow, frontal dimensions ca. 0.6 × 0.2 mm, slightly tapered proximally; frontal surface entirely membranous. Usually three large spines at each distal corner, sometimes five on enclosed autozooids proximal to a dichotomy, the distalmost spine on the outer corner especially robust. Most autozooids with a lateral avicularium, attached on outer edge of frontal membrane just below proximal-most spine; length slightly greater than the autozooid width, but variable and locally less than width on some autozooids; beak gently downcurved. Ovicell large, globular, with a wide, arched aperture; entooecium with fine

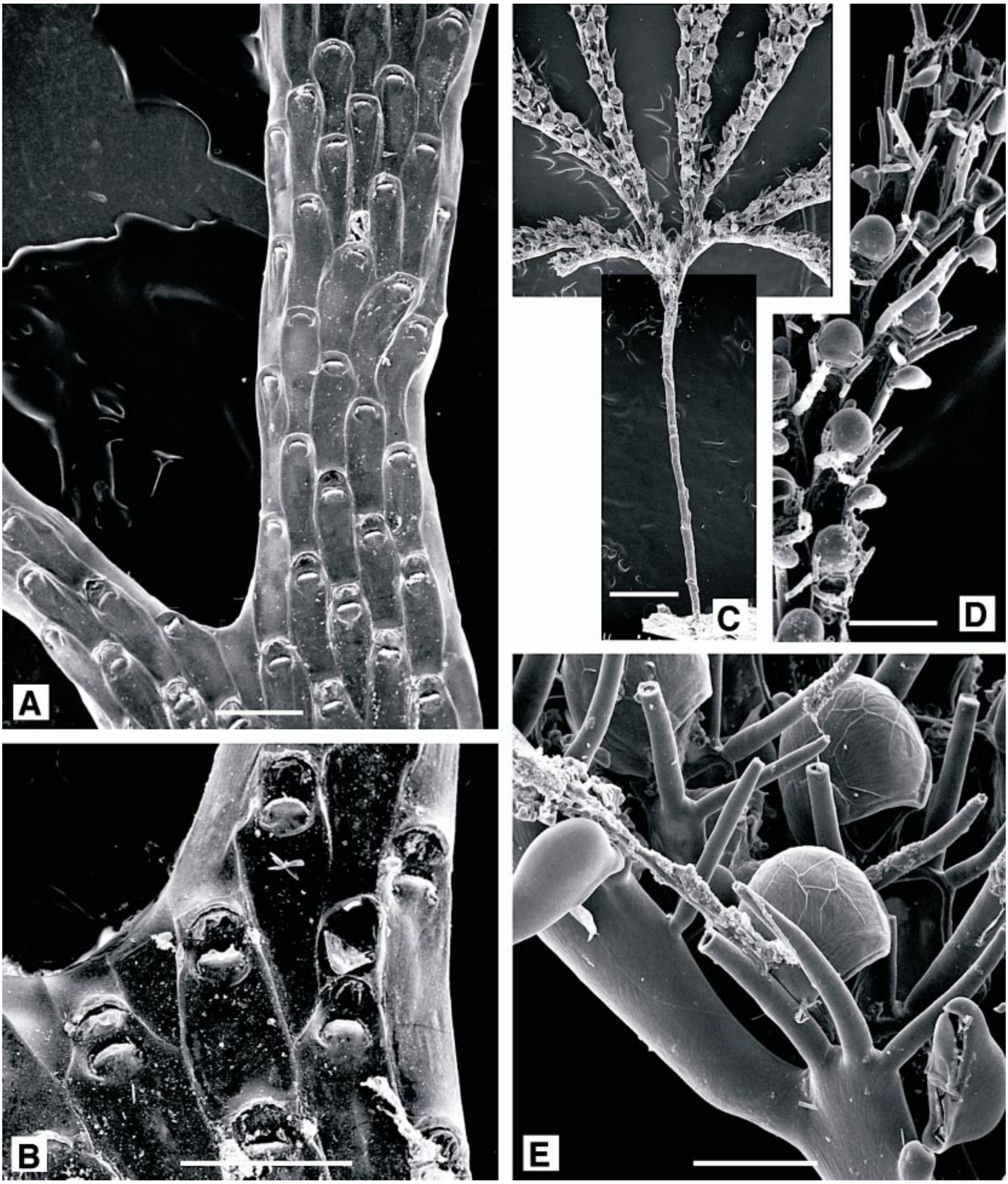

Fig. 8. **A, B.** *Chartella tenella*. **A.** General aspect (AMNH 902; 0.5 mm). **B.** Autozooids and vicarious avicularium (right center; AMNH 902; 0.5 mm). **C–E.** *Bugula fulva*. **C.** Entire colony (AMNH 903; 1 mm). **D.** Biserial branch (AMNH 904; 0.5 mm). **E.** Detailed view of avicularia, oral spines, and ovicells (AMNH 904; 0.1 mm).

radiating striations. Ancestrula distinctive: very elongate, slender, trumpet-shaped; tubular proximal portion to 2.5 mm in present material, with oval distal opesia bordered by six distal and three proximal spines, sometimes with an additional lateral pair between. Tubular rhizoids budded from proximal region of ancestrula anchor the colony.

REMARKS: Ancestrulae were present in every colony in 1997 and 1998 samples from the 35 m deep *Cellaria* meadow west of Banjole Island. They were remarkable for their length, resembling the basal kenozooids of colonies of *Caulibugula*, which caused this local population to be incorrectly identified in an ecological study (McKinney and Jaklin, 2000). Both Prenant and Bobin (1966) and Hayward and Ryland (1998) figured the ancestrula of *B. fulva*, and the former noted that it might be very much longer than an autozooid, although none was reported to be as long as those described here. In other respects, however, the morphology of the ancestrulae from Rovinj is identical to that described previously and the exceptionally elongate, tubular proximal portion apparently reflects a phenotypic response to microhabitat characteristics. The pattern of autozooids at a bifurcation mostly conforms to the Type 5 of Harmer (1923), with zooid F enclosed proximal to the bifurcation, and zooid G adjacent to the axil. However, Hayward and Ryland (1998) note that this is inconstant and that some dichotomies within a colony may be achieved by simple splitting of the four autozooid series. In one of the Rovinj specimens this had occurred immediately distal to the ancestrula, and the first bud developed as another very elongate autozooid, reinforcing the specimen's superficial resemblance to *Caulibugula*.

Tentacles clear, 14–15; lophophores bell-shaped, all obliquely truncate.

DISTRIBUTION: *Bugula fulva* has been patchily recorded from the southwest British Isles and parts of the Mediterranean, low in the littoral zone and in shallow coastal waters. It is also associated with ports and harbors, and its wide occurrence in the western Atlantic, from Brazil to Maine, perhaps suggests an exotic origin as a fouling species.

MEASUREMENTS (CYSTID): AL 196 ± 19 μm, 170–235 (2, 19), DO 228 ± 34, 276–405 (2, 20), OvL 212 ± 16. 185–242 (2, 20), OvW 194 ± 9, 180–209 (2, 20), ZL 577 ± 40, 500–660 (2, 20), ZW 178 ± 20, 130–220 (4, 40). (POLYPIDE): IH 40 μm (1.10), LD 450 ± 54, 360–540 (1, 10), MD 20 (1, 1), TL 460 ± 51, 400–560 (1, 10).

FAMILY BEANIIDAE CANU AND BASSLER, 1927

GENUS *BEANIA* JOHNSTON, 1840

Beania cylindrica (Hincks, 1886)

Figure 9A, B

Diachoris hirtissima forma *cylindrica* Hincks, 1886: 263.
Beania hirtissima: Gautier, 1962: 95. Prenant and Bobin, 1966: 557.
Beania hirtissima forma *cylindrica*: Gautier, 1962: 96.

DESCRIPTION (AMNH 905; CMRR 2208): Autozooids elongate, narrow, commonly 1.0 × 0.25 mm; tapered proximally, truncate distally, with the terminal operculum orientated perpendicular to frontal plane. Frontal surface entirely membranous, bordered by long, thin spines: six erect spines evenly spaced around distolateral rim of operculum, eight to ten pairs of spines along margins of frontal membrane, slightly incurved; additional, equally long or longer, spines developed on lateral and basal surfaces of autozooids, aligned with those on frontal margins. Each autozooid linked to six neighbors by short, tubular connections: one proximal and two proximolateral, all closely spaced, and three on basal wall midway along the length of the autozooid.

Colonies are erect tufts, to 12 mm, loosely and irregularly branched. Primary branches of five to eight alternating autozooid series defining a convex frontal surface encompassing two-thirds circumference of branch. Primary branches divide dichotomously at irregular intervals; minor branches of two to three autozooid series originating at axil of dichotomies or along branch margins. Abfrontal surface concave, with the space it encloses crossed by basal spines of autozooids. Septula on basal autozooid walls give rise to tubular kenozooidal rhizoids which pass proximally to attach colony to substratum.

Tentacles clear, 26; lophophores bell-shaped, radially symmetrical.

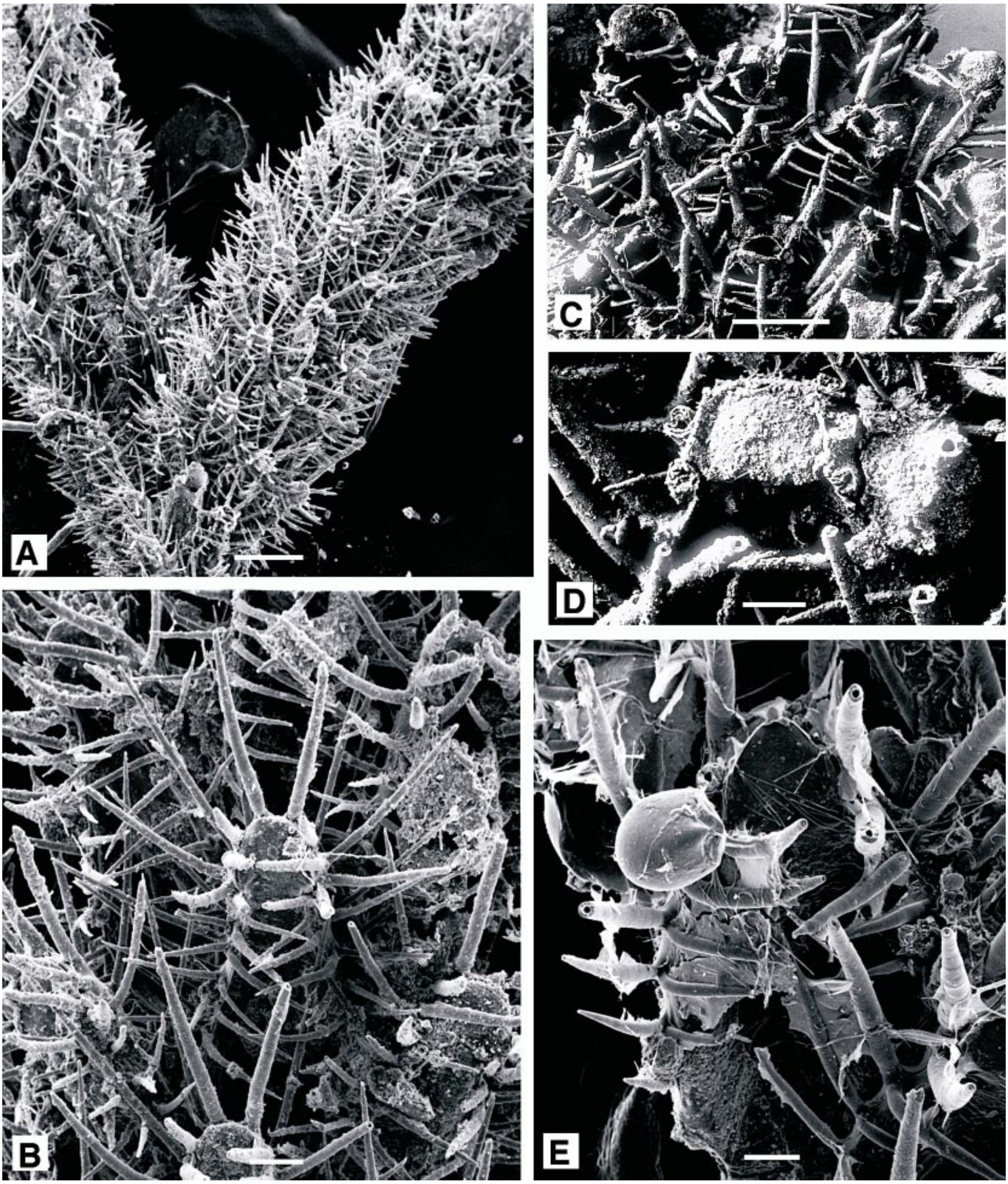

Fig. 9. **A, B.** *Beania cylindrica*. **A.** General aspect (AMNH 905; 0.5 mm). **B.** Zooid, with frontal-margin and basal spine rows (AMNH 905; 0.1 mm). **C–E.** *Beania hirtissima*. **C.** General aspect, autozooids and (lower left) avicularium (lectotype, UIIZ 34; 0.5 mm). **D.** Distal end of zooid, with horizontal operculum (lectotype, UIIZ 34; 0.1 mm). **E.** Autozooid with lateral stalked avicularium (AMNH 906; 0.1 mm).

REMARKS: Material described here conforms to the colony morphotype often denoted *Beania hirtissima* form or var. *cylindrica*. However, as discussed below, *B. hirtissima* has very different autozooid shape and orientation plus scattered vicarious avicularia, which are absent in *B. cylindrica*.

DISTRIBUTION: *Beania cylindrica* has been accorded a wide geographical Distribution, in shallow, warm temperate to tropical seas throughout the world, which possibly needs to be re-examined.

MEASUREMENTS (SKELETAL): DO 549 ± 92 μm,, 377–792 (2, 10), OL 139 ± 19, 117–176 (2, 7), OW 138 ± 8, 120–149 (2, 6), ZL 993 ± 97, 900–1204 (2, 10), ZW 381 ± 34, 327–443 (2, 10). (POLYPIDE): IH 602 ± 80 μm, 500–700 (1, 10), LD 995 ± 72, 880–1100 (1, 8), MD 40 (1, 1), TL962 ± 29, 920–1020 (1, 10).

Beania hirtissima (Heller, 1867)

Figure 9C–E

Diachoris hirtissima Heller, 1867: 94.
Diachoris hirtissima forma *robusta* Hincks, 1881: 133.
Beania robusta: Gautier, 1962: 99. Zabala and Maluquer, 1988: 101.

LECTOTYPE (chosen here): UIIZ 34.

DESCRIPTION (AMNH 906; CMRR 2209): Colonies multiserial, unilaminar sheets of closely spaced, suberect autozooids, each linked to six neighbors by a ring of six short connecting tubes around proximal end. Autozooids broadest proximally, narrowest at the distal end; 0.8–1.0 mm long. Membranous frontal surface bordered by stout spines: three in a line along distal edge of the terminal operculum and two on each side, all especially long and straight, to 0.5 mm; five erect spines on each lateral margin, straight and successively shorter proximally, each with a shorter, thinner spine at its base, curving medially over frontal margin. Basal surface of colony with three to eight irregularly tapered and curved, thin processes on each autozooid.

Avicularia infrequent; pedunculate, attached to lateral wall of autozooid level with proximal corner of operculum; globose, with a broadly triangular, distally hooked rostrum.

REMARKS: We designate as lectotype Heller's specimen illustrated here as fig. 9C and 9D (UIIZ specimen 34, one of two specimens in the collection indicated as Heller's types of the species). The lectotype has the features attributed to *B. robusta*, described originally from Algiers (Hincks, 1881) as *Diachoris hirtissima* forma *robusta*.

DISTRIBUTION: *Beania hirtissima* has been accorded a wide geographical Distribution, in shallow, warm temperate to tropical seas throughout the world, which needs to be re-examined in light of the characteristics of the lectotype. As *B. robusta*, this rather substantial *Beania* has been reported from a number of localities in the northwestern Mediterranean, and also from Tunisia (Gautier, 1962). It does not seem to have been recorded from east of the Adriatic.

MEASUREMENTS (SKELETAL): AL 216 ± 14 μm, 199–230 (1, 4), AW 170 ± 4, 166–176 (1, 4), DO 499 ± 65, 394–600 (1, 11), OL 161 ± 17, 141–194 (1, 10), OW 200 ± 13, 183–222(1, 10).

Beania magellanica (Busk, 1852)

Figure 10A, B

Diachoris magellanica Busk, 1852: 54.
Beania magellanica: Gautier, 1962: 97. Prenant and Bobin, 1966: 555.

DESCRIPTION (AMNH 907; CMRR 2210): Colonies forming repent sheets, supported above and anchored to substratum by short, tubular, kenozooidal rhizoids. Autozooids large, elongate oval, ca. 0.8 mm long in present material, membranous frontal surface with a smooth rim, lacking spines. Distal end of autozooid rounded, edge of the operculum fitting along distal rim; proximal end gently tapered. Autozooids disjunct, linked by tubular connecting processes, 0.2 mm long; each autozooid with six tubes: one midproximal, two proximolateral, and three distobasal, the latter equally spaced in an arc in distal third of the autozooid. Conspicuous, paired avicularia present, attached to lateral walls close to distal series of connecting tubes; pedunculate, with bird's head form, rostrum tapered, curved, and distally hooked. At rest mandible lying in frontal plane of autozooid, with rostrum directed distally. Ovicell an inconspicuous, partly immersed, distal cap, not seen in present material.

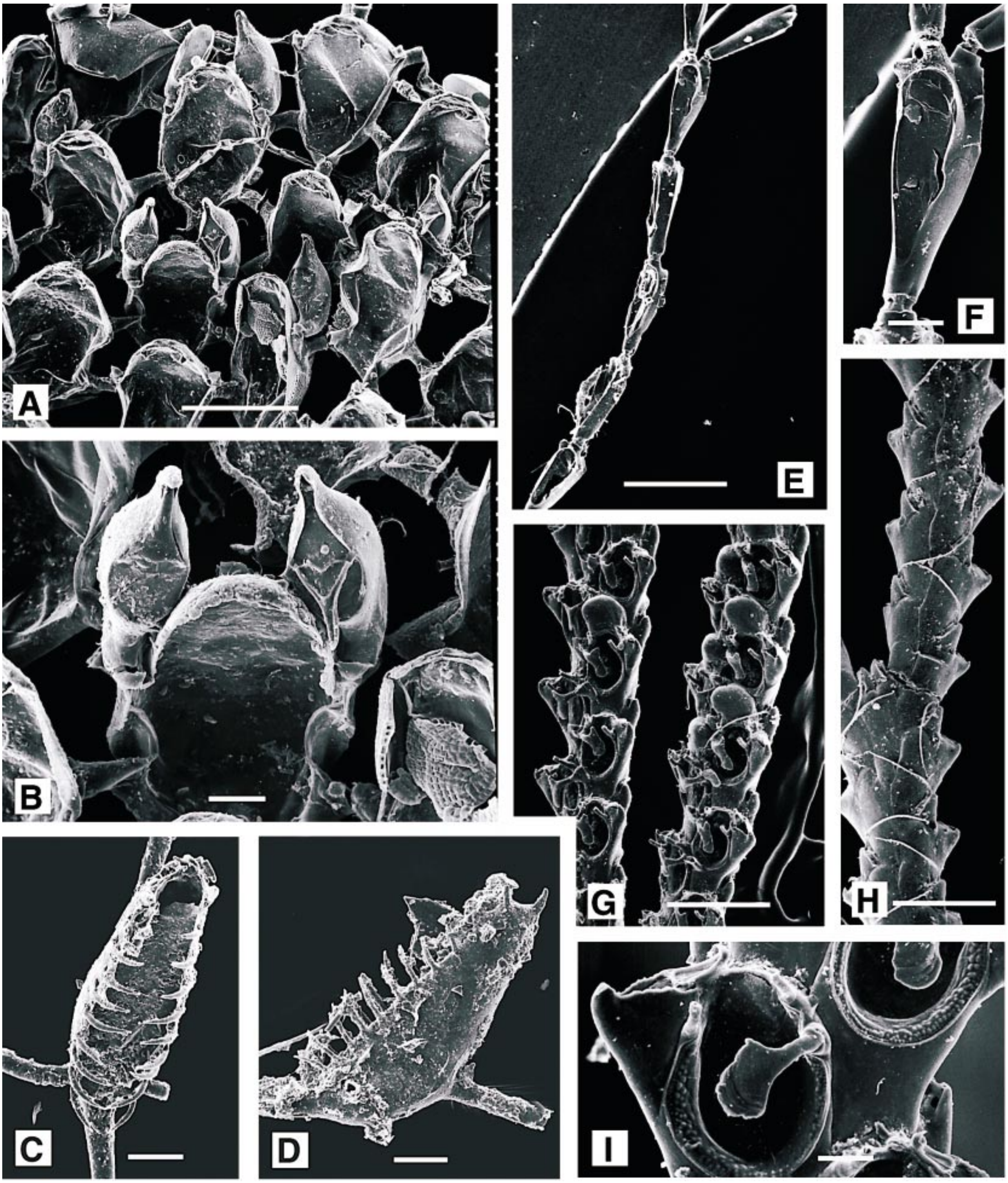

Fig. 10. **A, B.** *Beania magellanica* (AMNH 907). **A.** General aspect (0.5 mm). **B.** Autozooid with paired lateral stalked avicularia (0.1 mm). **C, D.** *Beania mirabilis*. (AMNH 908) **C.** Frontal view of single zooid (0.1). **D.** Lateral view of single zooid (0.1 mm). **E, F.** *Synnotum aegyptiacum* (AMNH 909). **E.** Uniserial erect branch (0.5 mm). **F.** Single zooid (0.1 mm). **G–I.** *Scrupocellaria delilii* (AMNH 910). **G.** Frontal surface of two biserial branches (0.5 mm). **H.** Reverse surface of untreated branch; vibracular setae visible (0.5). **I.** Autozooid with scutum, single outer and paired inner distal spines, and lateral avicularium (0.1 mm).

Twenty-seven tentacles (based on single count).

REMARKS: This is the most distinctive *Beania* species occurring in the Mediterranean region.

DISTRIBUTION: Widely distributed throughout the Mediterranean, in shallow coastal waters, most frequently on biogenic substrata. *Beania magellanica* has been reported from throughout the warm temperate to tropical Atlantic, as well as from the western Pacific.

MEASUREMENTS (SKELETAL): AL 439 ± 53 μm, 342–528 (3, 16), AW 151 ± 14, 118–173 (2, 15), DO 586 ± 88, 438–689 (2, 15), OL 110 ± 12, 95–126 (1, 5), OW 158 ± 16, 143–184 (1, 5), ZL 713 ± 55, 634–799 (3, 13), ZW 440 ± 33, 373–478 (3, 13). (POLYPIDE): LD 1140 μm (1, 1), TL 980 (1, 1).

Beania mirabilis Johnston, 1840

Figure 10C, D

Beania mirabilis Johnston, 1840: 272. Alvarez, 1990: 26. Hayward and Ryland, 1998: 244.

DESCRIPTION (AMNH 908; CMRR 2211): Colonies formed from uniserial chains of autozooids only lightly attached to substratum, often largely free. Each autozooid consisting of a filiform proximal portion comprising more than half its length, and a boat-shaped distal portion, broadest proximally and tapered towards the terminal operculum. Calcification thin and translucent, the frontal surface entirely membranous. Four short spines are spaced around the operculum and another 10 pairs of equally short, thin, and straight or only slightly curved spines distributed along the margins of the frontal membrane. Each autozooid budding its successor from the basal wall, in the proximal third of the broad portion. Between this budding point and the filiform portion is a pair of short, tubular processes; on rare occasions one of these may develop as a zooid bud, allowing colony to branch, but most autozooids uniserially arranged.

Tentacles clear, 19–21; lophophores bell-shaped, radially symmetrical.

DISTRIBUTION: Probably common in coastal habitats throughout the northeast Atlantic and the Mediterranean, on a wide variety of organic and inorganic substrata, but its inconspicuous colonies are easily overlooked. *Beania mirabilis* has been described also from Indo-Pacific localities, but these records require reexamination.

MEASUREMENTS (CYSTID): ZL (distal) 677 ± 45 μm, 620–780 (2, 13), ZW (distal) 280 (1, 1). (POLYPIDE): IH 295 ± 59 μm, 229–343 (2, 3), LD 642 ± 130, 491–806 (2, 4), TL 532 ± 128, 395–689 (2, 9).

FAMILY EPISTOMIIDAE GREGORY, 1893

GENUS *SYNNOTUM* PIEPER, 1881

Synnotum aegyptiacum (Audouin, 1826)

Figure 10E, F

Loricaria aegyptiaca Audouin, 1826: 243; Savigny, 1809: pl.13, figs 4(1)–4(5).
Synnotum aegyptiacum: Prenant and Bobin, 1966: 461. Zabala and Maluquer, 1988: 100.

DESCRIPTION (AMNH 909; CMRR 2212): Colony erect, branching, jointed, to 7.5 mm in present material. Autozooids slender, fusiform, narrowest proximally, broadest distally; arranged in back-to-back pairs, each separated from preceding pair by a slender, tubular chitinous node. Frontal surface entirely membranous, with a terminal operculum slightly acute to frontal plane. Squat, sessile avicularia present on disto-basal surfaces of some autozooids, others bearing larger, pedunculate, bird's head type with short, hooked mandible. Embryos brooded in distinctive globular, dimorphic zooids (not found in present material). Each autozooid of a pair giving rise to a single bud disto-basally, which traverses the basal wall junction of the succeeding autozooid pair as a slender tube, then expands distal to them to form broad distal portion of new autozooid. Autozooid thus consisting of a proximal tube comprising two-thirds its total length and a fusiform distal portion bearing the frontal membrane. The node between each autozooid pair, consequently, consisting of four closely juxtaposed tubes.

DISTRIBUTION: Widespread and common throughout the Mediterranean, in shallow coastal waters, and recorded from warm temperate and tropical seas worldwide.

MEASUREMENTS (SKELETAL): ZL 500 ± 41 μm, 430–577 (2, 21).

FAMILY CANDIDAE D'ORBIGNY, 1851

GENUS SCRUPOCELLARIA LEVINSEN, 1909

Scrupocellaria delilii (Audouin, 1826)
Figure 10G–I

Crisia delilii Audouin, 1826: 242. Savigny, 1809: pl. 12, fig. 3.
Scrupocellaria macandrei: Heller, 1867: 87.
Scrupocellaria delilii: Gautier, 1962: 86. Prenant and Bobin, 1966: 435.

DESCRIPTION (AMNH 910; CMRR 2213): Colonies erect, branching dichotomously, to 20 mm high in present material. Branching frequency variable, at 2-mm intervals in proximal regions of colony, to 4 mm or more towards distal portion; each ramus originating as a bipartite, tubular chitinous joint. Branches flat, consisting of two alternating longitudinal autozooid series; opesiae of adjacent autozooids overlapping for about one-fifth of total length. Autozooids ca 0.5 × 0.25 mm; opesia oval, comprising more than half total frontal length, bordered by finely granular cryptocystal rim. Two spines present, one on each distal corner of opesia, erect, slender and curved, converging medially above operculum. A small scutum present proximal to inner distal spine, with a slender stalk curving over frontal membrane; oval, or slightly crescentic, consisting largely of a proximal lobe, with only a minimal lobe distal to stalk. Each autozooid with a prominent lateral avicularium, its cystid half as long as opesia, rostrum 0.15 mm long, sharply hooked distally and projecting distinctly from branch margin. Small frontal avicularia present on some autozooids, proximal to opesia, with short, triangular rostrum perpendicular to branch axis. Ovicell short, broad, tilted towards branch axis, imperforate. A small vibraculum on abfrontal surface of each autozooid, with setal groove straight and extending halfway to middle of the autozooid; two such vibracula in axil of each dichotomy.

DISTRIBUTION: *Scrupocellaria delilii* has been reported from the Atlantic coasts of Spain, south to Madeira, and from numerous localities in the Mediterranean. It has also been recorded from the Red Sea, the Indian Ocean, Australia and the West Pacific, but this wider Distribution possibly encompasses the geographical ranges of more than one species.

MEASUREMENTS (SKELETAL): DO 323 ± 47 μm, 245–413 (2. 20), OpL 217 ± 21, 178–243 (2, 20), OpW 137 ± 15, 107–161 (2, 20), ZL 425 ± 31, 383–503 (2, 20), ZW 219 ± 16, 188–251 (2, 20).

Scrupocellaria scrupea Busk, 1851
Figure 11A–E

Scrupocellaria scrupea Busk, 1851: 83. Hayward and Ryland, 1998: 274.

DESCRIPTION (AMNH 911–913; CMRR 2214): Colonies to 18 mm in present material, dichotomously branching at frequent intervals, giving dense, bushy form. Opesia occupying half or less of total autozooid length; each autozooid with three spines on outer distal angle, two on the inner. Scutum arises close to base of proximal-most inner spine; lobe reniform, not pointed distally, covering almost half the area of the opesia. Prominent lateral avicularium present on each autozooid, with hooked rostrum, but no frontal avicularia. Basal vibraculum present at proximal end of each autozooid, aligned disto-proximally, and two at axil of each dichotomy. Ovicell broader than long, inclined towards median longitudinal axis of the branch; lightly calcified, with a single, irregular foramen close to aperture.

Tentacles clear, 11; lophophores bell-shaped, radially symmetrical.

DISTRIBUTION: In shallow coastal habitats throughout the Mediterranean, and north to the southwest British Isles.

MEASUREMENTS (SKELETAL): DO 319 ± 66 μm, 246–459 (2, 20), OpL 166 ± 16, 137–195 (2, 20), OpW 109 ± 9, 95–129 (2, 20), ZL 378 ± 31, 326–435 (2, 20), ZW 201 ± 17, 177–233 (2, 20). (POLYPIDE): IH 13 ± 23 μm, 0–40 (1, 4), LD 273 ± 31, 240–300 (1, 4), TL 327 ± 23, 300–340 (1, 4).

Scrupocellaria scruposa (Linnaeus, 1758)
Figure 11F–J

Sertularia scruposa Linnaeus, 1758: 815.
Scrupocellaria scruposa: Gautier, 1962: 92. Hayward and Ryland, 1998: 276.

DESCRIPTION (AMNH 909, 914–916; CMRR 2215): Colonies erect, branching

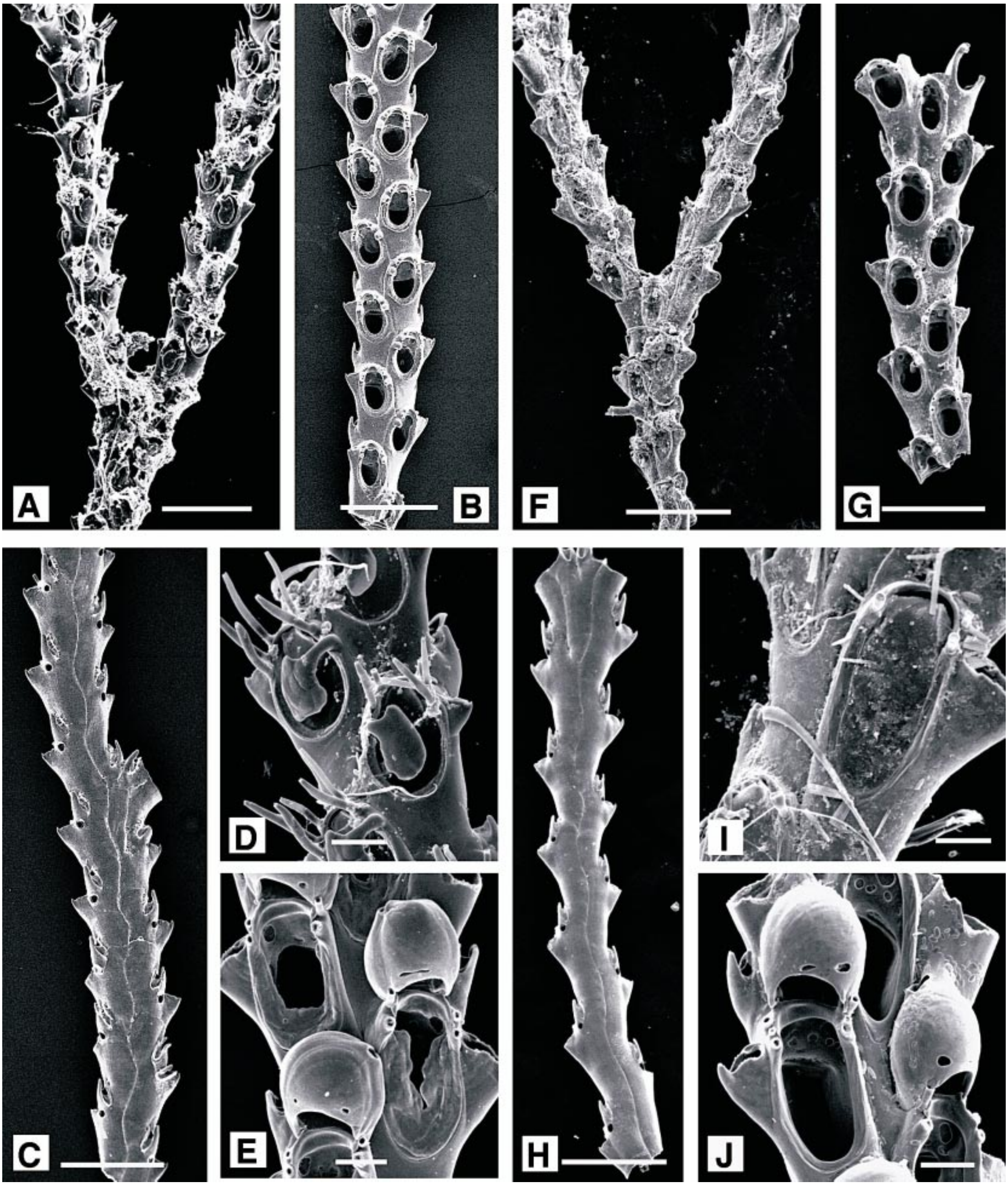

Fig. 11. **A–E.** *Scrupocellaria scrupea*. **A.** Frontal surface of untreated branches (AMNH 911; 0.5 mm). **B.** Frontal surface of bleached branch (AMNH 912; 0.5 mm). **C.** Reverse surface of treated branch (AMNH 912; 0.5 mm). **D.** Autozooids with scutum, distal spines, and lateral avicularia (AMNH 911; 0.1 mm). **E.** Maternal zooids with ovicells (AMNH 913; 0.1 mm). **F–J.** *Scrupocellaria scruposa*. **F.** Frontal surface of untreated branches (AMNH 914; 0.5 mm). **G.** Frontal surface of bleached branch (AMNH 909; 0.5 mm). **H.** Reverse surface of treated branch (AMNH 915; 0.5 mm). **I.** Autozooid with distal spines, lateral avicularium, and vibraculum with seta (AMNH 916; 0.1 mm). **J.** Maternal zooids with ovicells (AMNH 915; 0.1 mm).

tufts, to 20 mm in present material; branches dividing dichotomously, each ramus supported by a bipartite, chitinous joint. Branches flat, consisting of two alternating autozooid series, opesiae of adjacent autozooids not or scarcely overlapping. Autozooids elongate, slender, commonly 0.5 × 0.2 mm, with narrowly oval opesia occupying half or less of total frontal length; opesia with a narrow border of cryptocystal calcification. Three spines present at outer distal corner of autozooid, two at inner corner, all erect, straight and slender. No scutum. Lateral avicularia variably sized, from one-third to one-half length of opesia; rostrum perpendicular to longitudinal branch axis, projecting conspicuously, with pronounced distal hook. A small, distally directed frontal avicularium present distal to ovicell, which is globular, longer than wide, with a highly arched aperture and drop-shaped frontal fenestra. Basal vibraculum small, at outer proximal corner of autozooid; cystid parallel to longitudinal branch axis, with short setal groove only slightly oblique to it. Two vibracula present at axil between each dichotomy.

DISTRIBUTION: *Scrupocellaria scruposa* is common in shallow coastal waters in the entire northeast Atlantic region, from Iceland to the Cape Verde Islands, and throughout the Mediterranean.

MEASUREMENTS (SKELETAL): DO 364 ± 89 μm, 273–501 (2, 19), OpL 209 ± 29, 170–274 (2, 16), OpW 127 ± 20, 106–191 (2, 16), OvL 168 ± 17, 151–184 (2, 4), OvW 183 ± 9, 171–193 (2, 4), ZL 491 ± 37, 428–543 (2, 15), ZW 183 ± 20, 137–212 (2, 16).

GENUS *CABEREA* LAMOUROUX, 1816

Caberea boryi (Audouin, 1826)

Figure 12A–E

Crisia boryi Audouin, 1826: 242. Savigny, 1809: pl. 12 figs 4.1–4.6.

Caberea boryi: Gautier, 1962: 93. Prenant and Bobin, 1966: 449. Hayward and Ryland, 1998: 252.

DESCRIPTION (AMNH 917–919; CMRR 2216): Colonies stiff, erect fans, to 8 mm high in present material, with cylindrical branches dividing dichotomously at regular intervals; without visible joints at the dichotomies. Autozooids in two alternating longitudinal series, or three just prior to dichotomies, defining the frontal surface of the branch, commonly 0.35 × 0.2 mm. Frontal planes of the two autozooid series angled at about 90° to each other; longitudinal axis of each autozooid slightly oblique to branch axis, inclining medially. Frontal surfaces of alternate autozooids slightly overlapped; opesia and operculum together constituting four-fifths of total frontal length, bordered proximally and laterally by broad, finely granular cryptocyst, no frontal gymnocystal calcification present. Three distal oral spines present: two on inner distal angle of autozooid and one, very much longer, on the outer distal angle. Much of opesia obscured by thick, oval scutum, attached by a thick stalk just proximal to inner distal spines; its distal edge straight, abutting with a blunt process projecting from opposite, outer edge of the opesia, and defining the proximal border of the operculum, which is terminal in position and tilted basally at a marked angle to frontal plane. A small adventitious avicularium on the inner distal angle of many autozooids, with short triangular mandible, distally directed; frequently, a much larger avicularium proximal to dichotomy, with broadly triangular rostrum frontally directed and almost perpendicular to frontal plane. Ovicell recumbent on distally succeeding autozooid, inclined medially; broader than long, with highly arched aperture bordered by broad band of uncalcified ectooecium. Abfrontal surface of colony distinctive: basal wall of each autozooid obscured by a large, proximally tapered vibraculum; seta 1.5 mm long, finely toothed along one edge, fitting into a narrow groove extending from outer distal edge of vibraculum, proximally and medially, contributing to a pronounced ridge extending length of branch. Thin kenozooidal rhizoids arising from vibracular chambers, passing proximally along median abfrontal surface of each branch and coalescing as thick bundles at base of colony.

Tentacles clear, 13; lophophores campylonemidan.

DISTRIBUTION: *Caberea boryi* is widespread and abundant in shallow inshore waters throughout the Mediterranean, and ranges northwards to the southwest British Isles, and southwards to South Africa. It has been

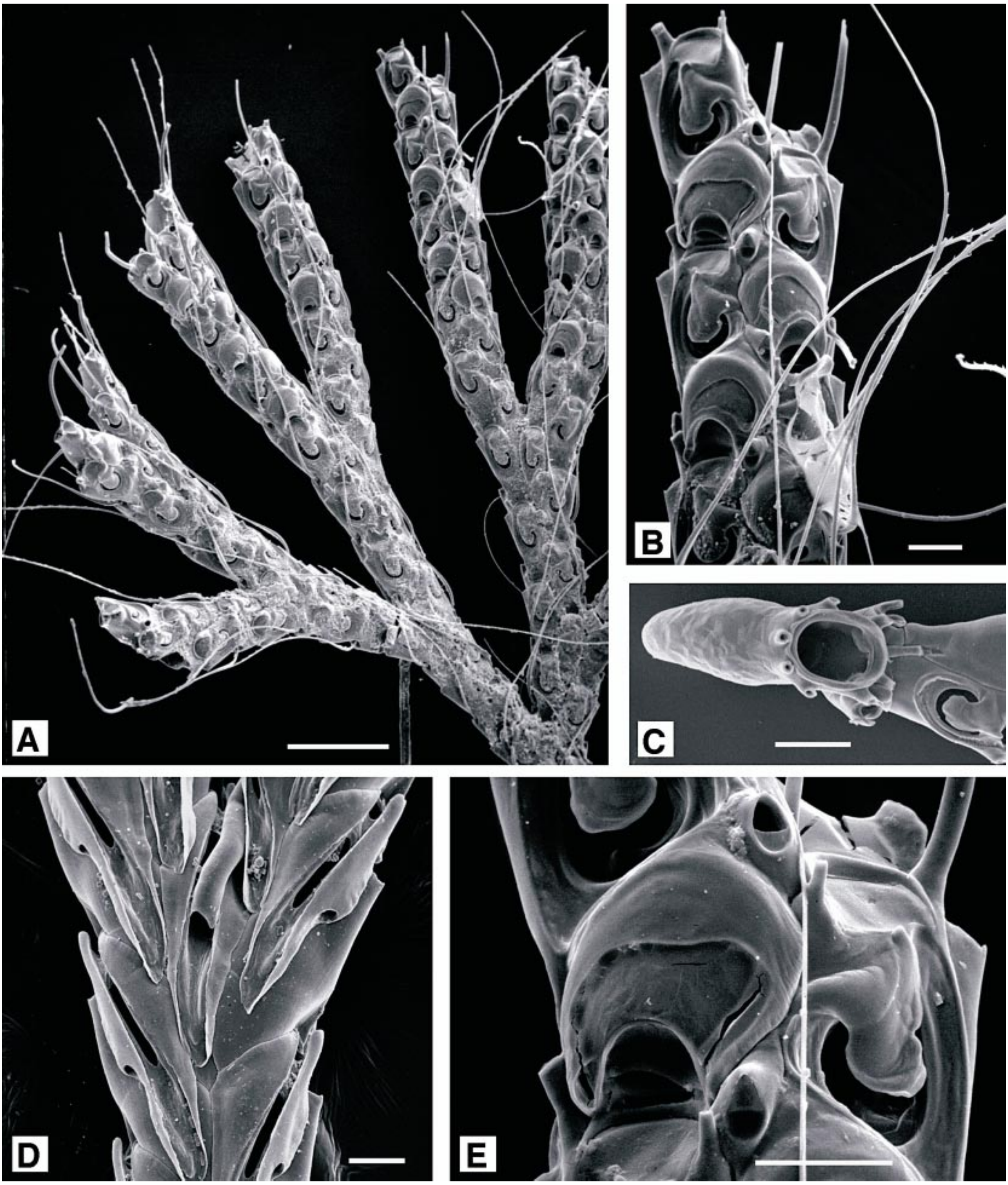

Fig. 12. **A–E.** *Caberea boryi***. A.** Frontal surface of untreated branches (AMNH 917; 0.5 mm). **B.** Serrated vibracular setae (AMNH 917; 0.1 mm). **C.** Ancestrula (AMNH 918; 0.1 mm). **D.** Reverse surface of treated branch with conspicuous proximally tapered vibraculae (AMNH 919; 0.1 mm). **E.** Frontal surface of branch, with autozooid (right) and (left) maternal zooid with ovicell and distal avicularium (AMNH 917; 0.1 mm).

recorded from the Red Sea and the Indian Ocean, and from the West Pacific.

MEASUREMENTS (SKELETAL): DO 223 ± 34 μm, 172–310 (3, 28), OvL 122 ± 9, 110–137 (1, 6), OvW 156 ± 14, 142–181 (1, 6), ZL 357 ± 40, 265–435 (3, 29), ZW 147 ± 11, 132–169 (1, 9). (POLYPIDE): IH 32 ± 7 μm, 20–40 (1, 9), LDMn 438 ± 27, 400–460 (1, 6), LDMx 497 ± 37, 440–540 (1, 9), MD 20 ± 0 (1, 5), TL 443 ± 55, 360–540 (1, 10).

SUPERFAMILY MICROPOROIDEA GRAY, 1846

FAMILY MICROPORIDAE GRAY, 1848

GENUS *CALPENSIA* JULLIEN, 1888

Calpensia nobilis (Esper, 1796)

Figure 13A–C

Cellepora nobilis Esper, 1796: 145.
Membranipora bifoveolata Heller, 1867: 95.
Calpensia nobilis: Gautier, 1962: 59. Zabala, 1986: 289. Zabala and Maluquer, 1988: 90. Hayward and Ryland, 1998: 292.

DESCRIPTION (AMNH 981, 1008; CMRR 2217): Colonies widely spreading, multiserial, flat, light-colored grayish-brown sheets, often exceeding 10 × 10 cm; through successive phases of regeneration and overgrowth may form thick cylinders and nodules on every kind of hard substratum. Autozooids simple rectangles or hexagons with a thick, densely perforated cryptocyst, a small terminal opesia, equivalent to about 12% total autozooid length and coincident with the operculum, and paired opesiules almost as large as opesia. Outer epitheca glistens in dried material. First asexual zooid budded from distal end of ancestrula but with growth direction oriented 120° with respect to ancestrula and lying beside ancestrula, establishing early colony growth in direction opposite the polarity of the ancestrula (fig. 13C). Occasional reparative autozooidal budding. No polymorphs.

Cystids are occupied by a succession of up to four generations of polypides, and the brown body remains of previous polypides are stored in the proximal portions of zooids. Proximal portions of large colonies are senescent and commonly are bright green in color due to a thin growth of chlorophyte algae.

Tentacles clear, 19–22; lophophores bell-shaped, radially symmetrical, supported on very long introverts, commonly overlapped with adjacent lophophores up to 300 μm.

REMARKS: This common and conspicuous Mediterranean species is sufficiently distinctive to be recognized with the unaided eye. Poluzzi and Coppa (1991) described growth and regeneration in *C. nobilis*, in relation to spatial competition. McKinney and Jaklin (1993) reported ephemeral populations of free-lying colonies composed of single zooid-thick sheets, up to several centimeters in diameter, off the Istrian Peninsula 30 to 50 km south-southwest of Pula. Ristedt (1991) described the ancestrula and early astogeny, but sexual reproduction has not been described.

OCCURRENCE: This species encrusts virtually every type of nontoxic firm to hard substratum, including rock, shell debris, pottery, glass, other bryozoans, thecate ascidians, and—elsewhere in the Adriatic and Mediterranean (Poluzzi and Coppa, 1991)—marine grasses.

DISTRIBUTION: The species is widespread throughout the Mediterranean and occurs sparsely northwards to the Gulf of St. Malo, and on the northwest African coast.

MEASUREMENTS (SKELETAL): DO 530 ± 93 μm, 366–684 (2, 20), OpL 96 ± 8, 80–107 (2, 20), OpW 150 ± 17, 119–174 (2, 20), ZL 817 ± 70, 719–935 (2, 20), ZW 383 ± 36, 322–439 (2, 20). (POLYPIDE): IH 495 ± 283 μm, 220–1200 (4, 21), LD 955 ± 128, 480–1140 (4, 40), MD 34 ± 8, 20–50 (3, 9), TL 654 ± 63, 560–820 (4, 18).

GENUS ROSSELIANA JULLIEN, 1888

Rosseliana rosselii (Audouin, 1826)

Figure 14A–E

Flustra rosselii Audouin, 1826: 240.
Membranipora rosselii: Hincks, 1880: 166.
Rosseliana rosselii: Canu and Bassler, 1925: 17. Hayward and Ryland, 1998: 294.
Rosseliana ''sp. nov.'' Gautier, 1962: 63.

DESCRIPTION (AMNH 1053–1055; CMRR 2218): Colonies multiserial encrusting, flat, beige colored. Autozooids arched oval distally and tapered proximally (proximal shape determined by shape of immediately preceding zooids), with boundaries marked by prominently raised lateral walls around

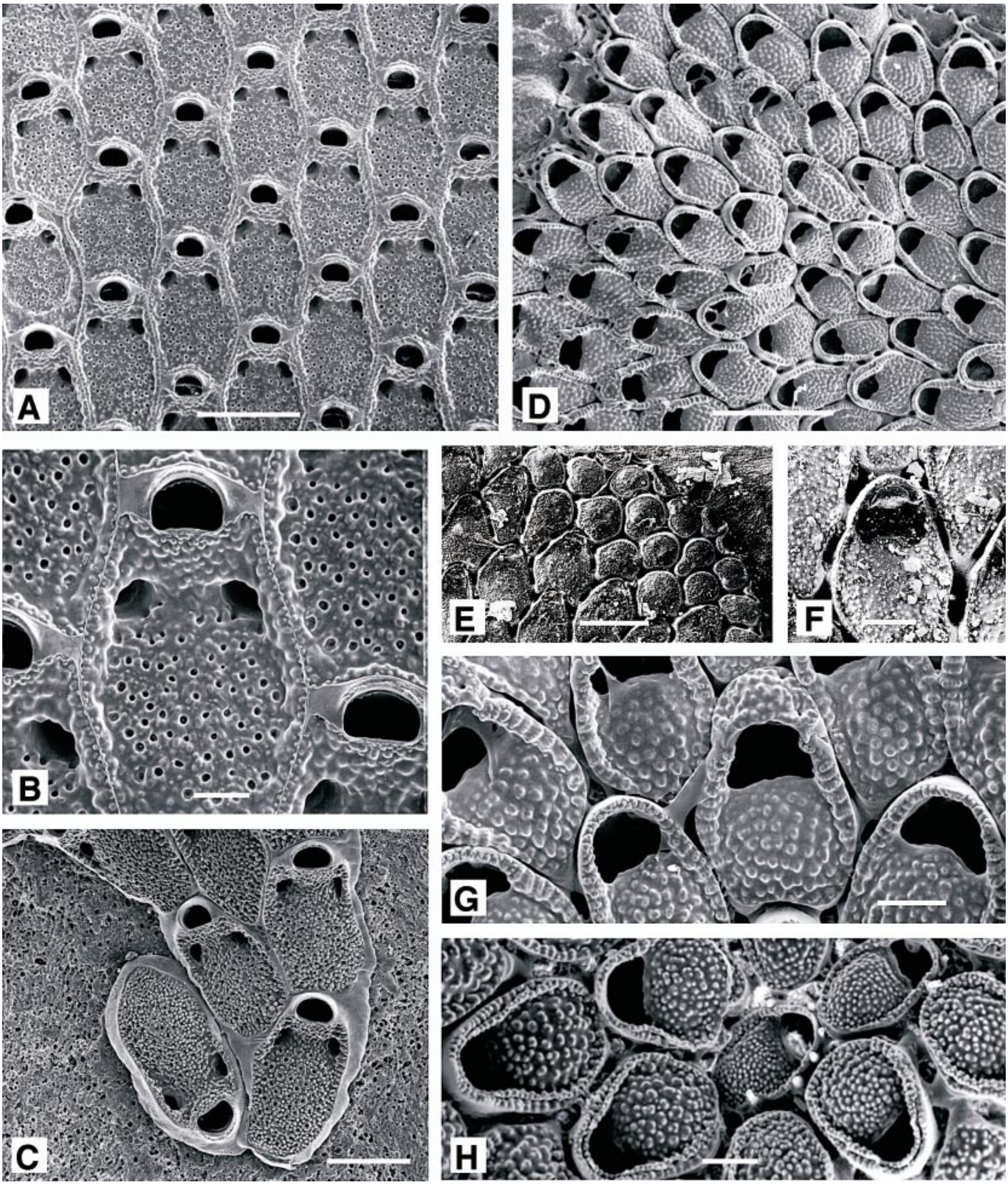

Fig. 13. **A–C.** *Calpensia nobilis*. **A.** General aspect (AMNH 981; 0.5 mm). **B.** Autozooid (AMNH 981; 0.1 mm). **C.** Ancestrula and early autozooids (AMNH 1008; 0.2 mm). **D–H.** *Mollia circumcincta*. **D.** General aspect (AMNH 920; 0.5 mm). **E.** Lectotype, untreated, with several kenozooids at colony margin (upper right; UIIZ 116; 0.5 mm). **F.** Lectotype, autozooid (UIIZ 116; 0.1 mm). **G.** Maternal zooid with ovicell, flanked by autozooids (AMNH 920; 0.1 mm). **H.** Ancestrula and early autozooids (AMNH 921; 0.1 mm).

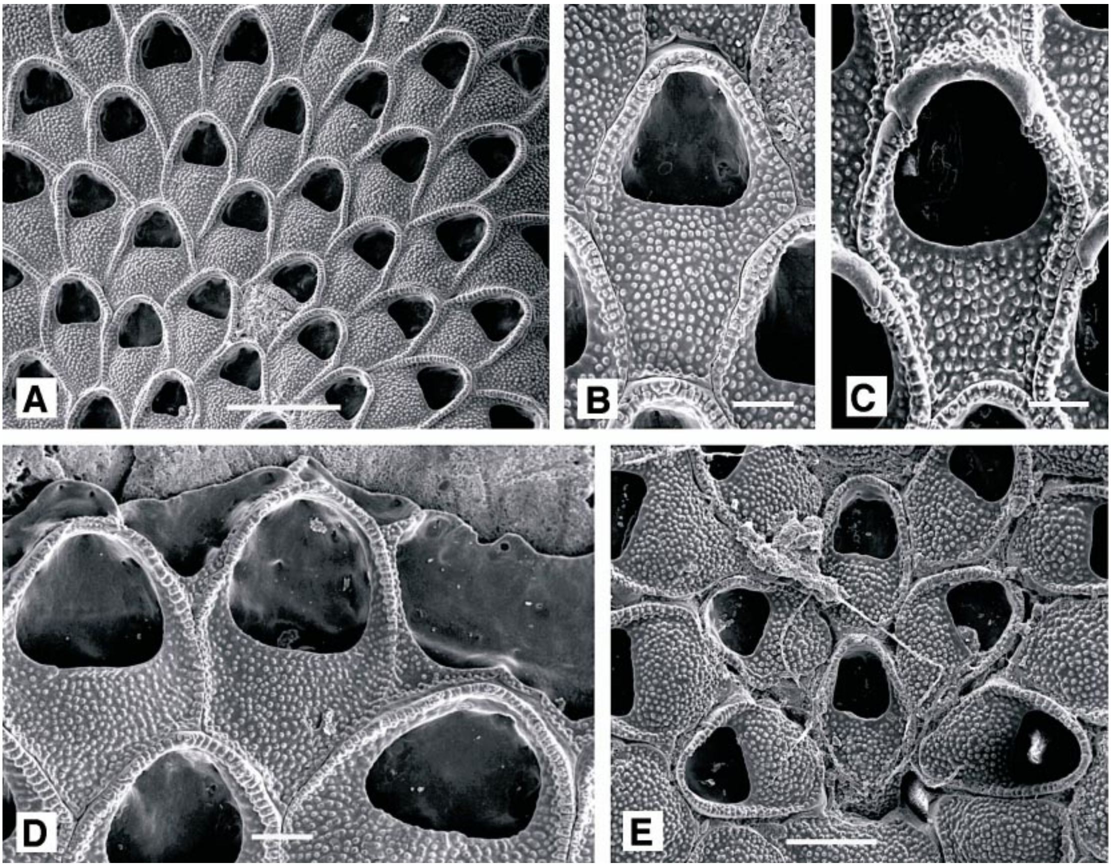

Fig. 14. **A–E.** *Rosseliana rosselii*. **A.** General aspect (AMNH 1053; 0.5 mm). **B.** Autozooid (AMNH 1053; 0.1 mm). **C.** Maternal zooid with largely immersed ovicell (AMNH 1054; 0.1 mm). **D.** Growing edge of colony (AMNH 1055; 0.10 mm). **E.** Ancestrula and early autozooids (AMNH 1055; 0.2 mm).

arched distal end. Gymnocyst absent; cryptocyst flat to gently arched transversely, with coarse-grained or finely tuberculate surface. Opesia terminal, semielliptical with very slightly concave proximal edge, equivalent to about 40% total autozooid length. Ancestrula similar to autozooids; first three asexually budded zooids distal and distolateral; primary astogenetic zone of change only three or four generations Ovicell small, largely immersed, apparent as shallow crescentic cap at distal end of zooid.

Tentacles clear, 15; lophophores bell-shaped, radially symmetrical away from colony margin between chimneys, obliquely truncate adjacent to chimneys and colony margin; introverts long.

REMARKS: Gautier (1962: 63–64) used *R. rosselii* for *Rosseliana* with large zooids (length 0.70–0.82 mm) and distinguished an unnamed new species for colonies with smaller zooids (length 0.40–0.68 mm). We encountered only colonies with the smaller zooids, essentially equivalent in size to the zooids of colonies attributed to *R. rosselii* around Britain (Hayward and Ryland, 1998: 294). Prenant and Bobin (1966: 346–348) noted the two forms recognized by Gautier but indicated that they seem to co-occur ecologically and geographically and could not at the time be separated into two distinct species. Although only one of the forms has been found by us in the northern Adriatic, suggesting that the geographic ranges of the two ‘‘forms’’ or perhaps species are not fully coincident, we have preferred to retain the name *R. rosselii* for the northern Adriatic specimens.

DISTRIBUTION: This species is widespread in the eastern temperate Atlantic, from the Cape Verde Islands to Shetland, and throughout the Mediterranean.

MEASUREMENTS (SKELETAL): DO 452 ± 46 μm, 363–520 (2, 20), OpL 246 ± 24, 218–308 (2, 20), OpW 227 ± 27, 185–277 (2, 20), ZL 591 ± 30, 533–668 (2, 20), ZW 375 ± 45, 307–457 (2, 20). (POLYPIDE): IH 366 ± 127 μm, 200–720 (2, 22), LDMn 560 ± 62, 400–630 (2, 13), LDMx 622 ± 72, 420–840 (2, 24), MD 24 ± 3, 20–30 (2, 10), TLMn 476 ± 62, 340–590 (2, 23), TLMx 588 ± 113, 400–790 (2, 25).

GENUS *MOLLIA* LAMOUROUX, 1816

Mollia circumcincta (Heller, 1867)

Figure 13D–H

Membranipora circumcincta Heller, 1867: 96.
Mollia circumcincta: Gautier, 1962: 61. Zabala and Maluquer, 1988: 92.

NEOTYPE (chosen here): UIIZ 116.

DESCRIPTION (AMNH 920, 921; CMRR 2219): Colonies light orange, encrusting, multiserial, unilaminar sheets. Autozooids oval, 0.375–0. 50 mm; disjunct, each linked to its neighbors by about 12 short, tubular communication organs. Frontal body wall membranous, underlain for about two-thirds of its extent by a vitreous, granular cryptocyst; opesia semielliptical, the proximal edge straight or slightly convex, and gently arched frontally, with indistinct opesiular indentations at each corner. Vertical walls of the autozooid develop a crenulate mural rim, which is especially raised distally, forming a cowl above the distal edge of the opesia. Spines absent, except in first two or three astogenetic generations. Ovicell hemispherical, partially immersed, with a crenulate vertical wall bordering a vitreous, nodular cryptocystal frontal surface. No polymorphs other than kenozooids, which may occur in clusters.

Tentacles clear, 15; lophophores bell-shaped, radially symmetrical away from colony margin between chimneys, obliquely truncate adjacent to chimneys and colony margin; introverts long.

REMARKS: Specimens of *Mollia circumcincta* collected from the Rovinj area are conspecific with bryozoan specimen 116 in the University of Innsbruck Institute of Zoology, labeled as ''*Caleschara patellaria* var. *circumcincta* Heller. Adria (S. Heller) 9837.'' There is no annotation that this specimen is one of Heller's original types, but we illustrate it here as at least an indication of long consistency in concept of the species and designate it as neotype for the species. If eventually discovered to be a specimen on which Heller originally described *Membranipora circumcincta*, it should be redesignated as lectotype.

DISTRIBUTION: This pretty species was first described from the Adriatic (Heller, 1867) and has been reported from very few additional localities. It is known from the Siculo-Tunisian shelf and the northwest Mediterranean (Gautier, 1962), but does not seem to range outside of the Mediterranean.

MEASUREMENTS (SKELETAL): DO 336 ± 36 μm, 264–412 (2, 20), OpL 86 ± 14, 62–107 (2, 20), OpW 120 ± 19, 84–159 (2, 20), OvL 102 ± 10, 82–115 (2, 17), OvW 174 ± 12, 156–206 (2, 17), ZL 410 ± 35, 371–479 (2, 20), ZW 267 ± 24, 234–338 (2, 20).

SUPERFAMILY CELLARIOIDEA FLEMING, 1828

FAMILY CELLARIIDAE FLEMING, 1828

GENUS *CELLARIA* ELLIS AND SOLANDER, 1786

Cellaria fistulosa (Linnaeus, 1758)

Figure 15A–E

Eschara fistulosa Linnaeus, 1758: 804.
Cellaria fistulosa: Hayward and Ryland, 1998: 306.

DESCRIPTION (AMNH 922; CMRR 2220): Colonies erect, branching, consisting of rigid, cylindrical internodes formed from alternating whorls of three to six autozooids, linked by flexible, chitinous nodes at which dichotomous branching occurs. Internodes 2–9 mm long, typically about 5 mm, in present material, with diameter 0.45–0.7 mm, typically about 0.55 mm. Colonies attach by bundles of tubular rhizoids developed from the frontal cuticles of the proximal autozooids of the colony. Autozooids diamond-shaped or hexagonal in outline; successive autozooids of longitudinal rows commonly but not always in contact along common transversely linear border and completely bounded laterally by the two adjacent offset rows of autozooids; less commonly succes-

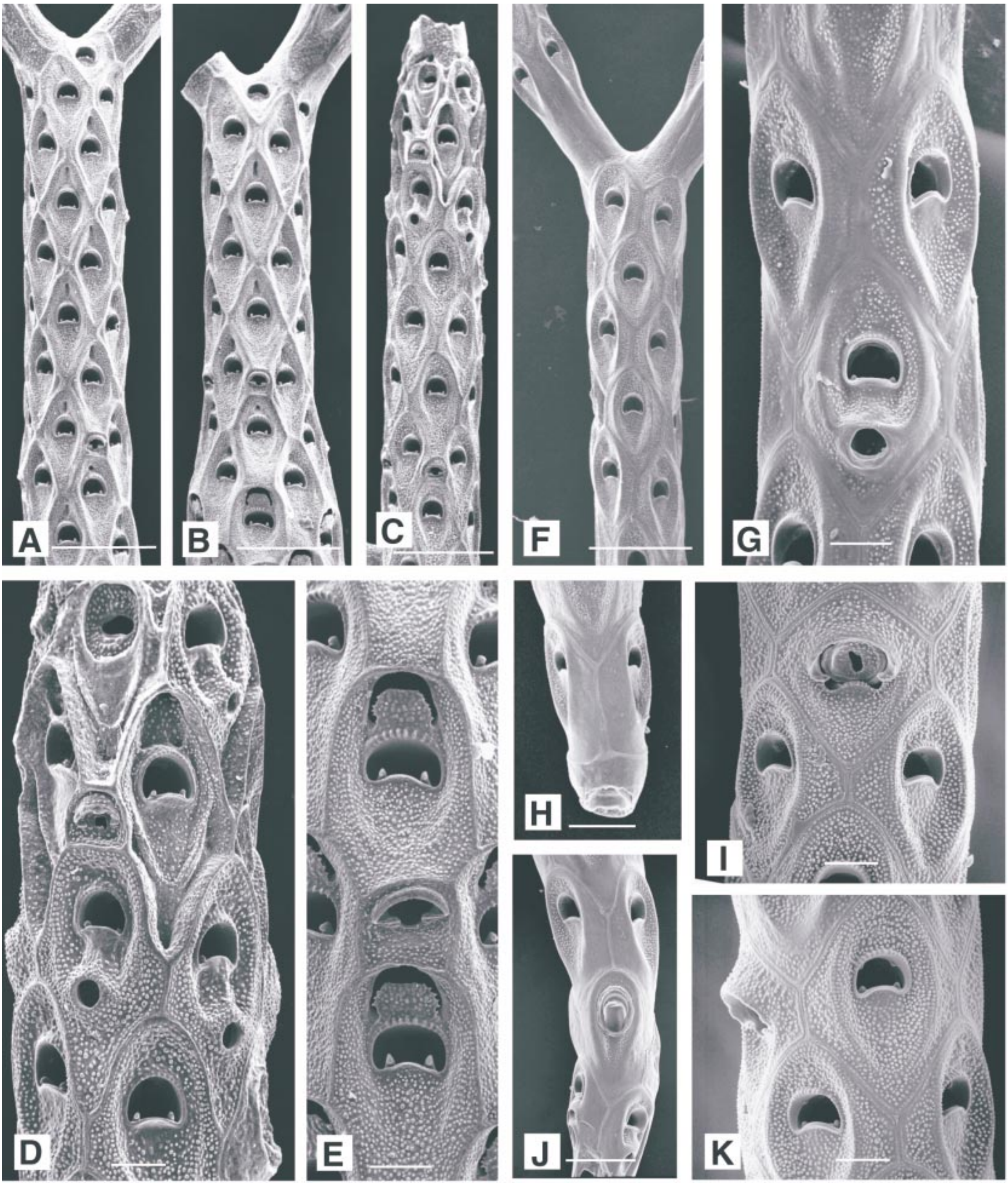

Fig. 15. **A–E.** *Cellaria fistulosa* (AMNH 922). **A.** Typical surface of young branch, distal joints not yet decalcified (0.5 mm). **B.** Branch with swollen area of maternal zooids (bottom of figure) and (top left) only one distal joint decalcified (0.5 mm). **C.** Branch segment with several distal autozooids with proximal perforations from which non-calcified rhizooidal kenozooids emerged (0.5 mm). **D.** Autozooids (bottom of figure) with proximal perforations for kenozooids, small avicularium (center), and maternal zooids with brood chambers (top of figure; 0.1 mm). **E.** Avicularium separating two maternal zooids with calcified plates restricting brood chamber apertures (0.1 mm). **F–K.** *Cellaria salicornioides*. **F.** Typical surface of young branch, distal joints not yet decalcified (AMNH 923; 0.5 mm). **G.** Autozooids, one with proximal perforation for kenozooid (AMNH 923; 0.1 mm). **H.** Base of laterally budded branch (AMNH 923; 0.2 mm). **I.** Avicularium (AMNH 924; 0.1 mm). **J.** Polymorphic zooid from which lateral branch arose (AMNH 923; 0.2 mm). **K.** Lateral profile of avicularium (left) (AMNH 924; 0.1 mm).

sive zooids in longitudinal rows separated by line marking contact between the two adjacent offset rows of autozooids. Frontal membrane distinct and glistening in living material; in cleaned specimens, cryptocystal frontal shield concave between prominent ridges marking boundaries of autozooids. Calcification finely nodular; opesia wider than long, equivalent to one-sixth zooid length, distal rim arched and finely beaded, proximal rim convex, with a blunt, frontally curved denticle in each proximal corner. A pair of well-marked longitudinal cryptocystal ridges apparent on each side of the opesia, extending proximal to it, converging but not meeting. Avicularia about one-third length of autozooids, rounded-quadrangular, with a narrow, semielliptical opesia; mandible narrowly crescentic, supported on an arched rostrum, directed distally or distolaterally. Ovicell aperture small and rounded, situated immediately distal to opesia, partially occluded in older parts of colonies by calcified plate extending from proximal edge, as has been noted elsewhere for *C. salicornioides* (Hayward and Ryland, 1998).

Tentacles clear, 13; lophophores bell-shaped, radially symmetrical.

DISTRIBUTION: Common in shallow, coastal waters throughout the Mediterranean, and northwards to the British Isles, western Norway and Iceland.

MEASUREMENTS (SKELETAL): DO 314 ± 23 μm, 252–345 (2, 16), OpL 71 ± 8, 60–87 (2, 20), OpW 107 ± 8, 97–126 (2, 17), ZL 564 ± 21, 510–601 (2, 20), ZW 262 ± 14, 241–283 (2, 15). (POLYPIDE): IH 67 ± 27 μm, 20–100 (1, 6), LD 534 ± 38, 490–580 (1, 7) MD 30 (1, 1), TL 437 ± 29, 400–480 (1, 6).

Cellaria salicornioides Lamouroux, 1816

Figure 15F–K

Cellaria salicornioides Lamouroux, 1816: 127.
Cellaria salicornioides: Hayward and Ryland, 1998: 308.

DESCRIPTION (AMNH 923, 924; CMRR 2221): Colonies erect and branching, with slender, cylindrical internodes consisting of alternating whorls of two to five autozooids. Colonies, branches, and internodes may be as long as those of *C. fistulosa*, but tend to be far more diffuse and delicate, so that the two species are readily separated by the unaided eye. Autozooids oval to hexagonal or almost rectangular, with regular quincuncial arrangement, so that commonly none is in contact with those autozooids immediately distal and proximal to it. Opesia in distal third of zooid, semicircular, with crenulate distal rim and convex, slightly projecting proximal rim; short, bluntly tapered denticles just visible in proximal corners. Cryptocyst deeply concave, with well-marked longitudinal ridges especially prominent lateral to the opesia, grading into the autozooid boundary distally, but converging proximally to define a complete rim distinct from the zooid margin. Avicularia sporadic, distinctive: as large as an autozooid, with semicircular rostrum projecting at acute angle from frontal plane, supporting a conspicuous, brown mandible. Ovicell aperture a simple round opening distal to the opesia.

DISTRIBUTION: In shallow coastal waters; widespread throughout the Mediterranean, ranging northwards along the western coasts of Britain and Ireland, to Shetland.

MEASUREMENTS (SKELETAL): DO 306 ± 47 μm, 224–399 (2, 20), OpL 59 ± 4, 53–68 (2, 20), OpW 81 ± 7, 71–99 (2, 20), ZL 439 ± 33, 383–532 (2, 20), ZW 213 ± 17, 175–240 (2, 20).

SUBORDER ASCOPHORA LEVINSEN, 1909

INFRAORDER ACANTHOSTEGA LEVINSEN, 1902

SUPERFAMILY CRIBRILINOIDEA HINCKS, 1879

FAMILY CRIBRILINIDAE HINCKS, 1879

GENUS *COLLARINA* JULLIEN, 1886

Collarina balzaci (Audouin, 1826)

Figure 16A–C

Flustra balzaci Audouin, 1826: 239.
Cribrilina punctata: Hayward and Ryland, 1979: 56.
Collarina balzaci: Zabala, 1986: 359. Zabala and Maluquer, 1988: 105. Bishop, 1988: 749. Hayward and Ryland, 1998: 318.

DESCRIPTION (AMNH 912, 925, 926; CMRR 2222): Colonies encrusting, multiserial, unilaminar, small, irregular patches. Autozooids small, oval, with indistinct boundaries; gymnocyst rarely visible frontally. Frontal shield of four to seven pairs of costae; each costa with a prominent tubae-

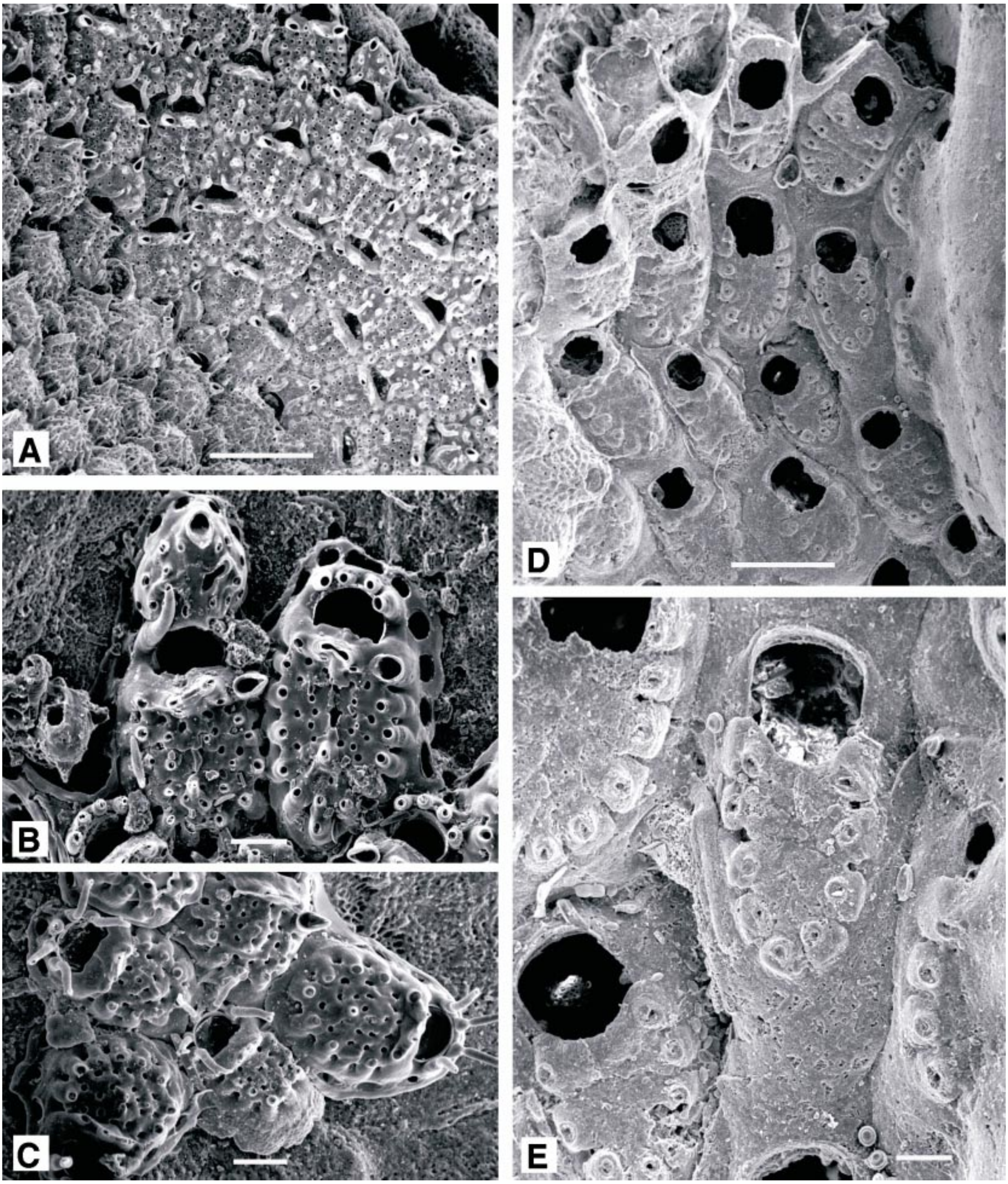

Fig. 16. **A–C.** *Collarina balzaci*. **A.** General aspect (AMNH 912; 0.5 mm). **B.** Autozooid (right) and (left) maternal zooid with ovicell (AMNH 925; 0.1 mm). **C.** Ancestrula and early autozooids (AMNH 926; 0.1 mm). **D, E.** *Figularia figularis*. (AMNH 925). **D.** General aspect (0.5 mm). **E.** Autozooid (0.1 mm).

form pelmatidium proximally, together forming a raised peripheral ring; two or three smaller pelmatidia along median fusion of costae. Intercostal pores large, typically one to three between each adjacent pair of costae. Apertural bar thickened, raised and mucronate. Orifice semicircular, wider than long; four oral spines, proximal pair elongate and curving over ovicell in fertile autozooids. Avicularia adventitious, single or paired, on each side of apertural bar, with short, triangular rostrum laterally directed. Ancestrula small, lacking adventitious avicularia, with fewer pairs of costae than subsequently budded autozooids. Ovicell recumbent on substratum, variably shorter or longer than wide, domed, with up to 20 tubaeform pores regularly distributed over its surface; a small avicularium at its distal edge, identical to the others, distally directed. Both autozooids and ovicell with large and conspicuous basal pore chambers.

REMARKS: The taxonomic status of this species was finally stabilized by Bishop (1988) through the selection of a neotype specimen.

DISTRIBUTION: The species is widely distributed throughout the Mediterranean, on stone, shell, red seaweeds and *Posidonia*, and ranges northwards to western Britain and the Faroe Isles.

MEASUREMENTS (SKELETAL): Al 79 ± 6 μm, 70–91 (1, 10), AW 53 ± 5, 47–61 (1, 10), DO 401 ± 61, 312–548 (4, 40), OL 59 ± 11, 38–80 (4, 32), OW 110 ± 14, 77–134 (4, 33), OvL 244 ± 27, 189–290 (3, 15), OvW 230 ± 12, 210–245 (3, 15), ZL 516 ± 51, 484–668 (4, 40), ZW 318 ± 32, 333–436 (4, 40).

GENUS *FIGULARIA* JULLIEN, 1886

Figularia figularis (Johnston, 1847)

Figure 16D, E

Lepralia figularis Johnston, 1847: 314.
Figularia figularis: Hayward and Ryland, 1998: 338.

DESCRIPTION (AMNH 925): Colonies encrusting, multiserial, unilaminar. Autozooids rectangular to irregularly polygonal, convex, separated by deep grooves. Primary orifice about as wide as long, proximal border shallowly concave and frontally arched, between small, rounded condyles. No oral spines. Frontal surface a costate shield, comprising two-thirds total autozooid length, with a broad area of proximal gymnocyst extending distally as a narrower band on each side. Shield formed from 10–12 short costae, fused medially and at intervals laterally, leaving small, slitlike intercostal pores; each costa, additionally, with a single thick rimmed pelmatidium at its broad proximal (peripheral) end. Large vicarious avicularia, with spoonshaped mandible, and globular ovicells with a pair of large lateral fenestrae characteristic of this species, but neither was present in the small colony collected.

DISTRIBUTION: *Figularia figularis* is common in shallow coastal habitats throughout the Mediterranean, encrusting shell and other hard substrata. It ranges north to the southwest British Isles.

MEASUREMENTS (SKELETAL): DO 624 ± 61 μm, 530–730 (1, 10), OL 185 ± 14, 166–210 (1, 10), OW 217 ± 19, 180–240 (1, 10), ZL 822 ± 64, 710–910 (1, 10), ZW 477 ± 51, 410–546 (1, 10).

GENUS *PUELLINA* JULLIEN, 1886

Puellina hincksi (Friedl, 1917)

Figure 17A–C

Cribrilina radiata var. hincksi Friedl, 1917: 236.
Cribrilaria hincksii (sic): Gautier, 1962: 111.
Puellina (Cribrilaria) hincksi: Zabala and Maluquer, 1988: 107. Alvarez, 1994b: 134.

DESCRIPTION (AMNH 901, 927; CMRR 2223): Colonies encrusting, multiserial, unilaminar, small rounded patches. Autozooids oval to irregularly hexagonal, separated by deep grooves; gymnocyst clearly visible, smooth, imperforate; frontal shield of usually six or seven pairs of costae, each broadest and slightly umbonate proximally, the umbo bearing a minute pelmatidium; intercostal pores large and distinct, peripheral papilla pores the largest. Suboral lacuna transversely oval, large and conspicuous; apertural bar slightly thickened, first pair of costae often with a prominent umbo proximal to suboral lacuna. Primary orifice wider than long, bordered by five evenly spaced spines. Avicularium with small cystid wedged between autozooids; rostrum elongate, narrowly triangular, up to three-quarters length of auto-

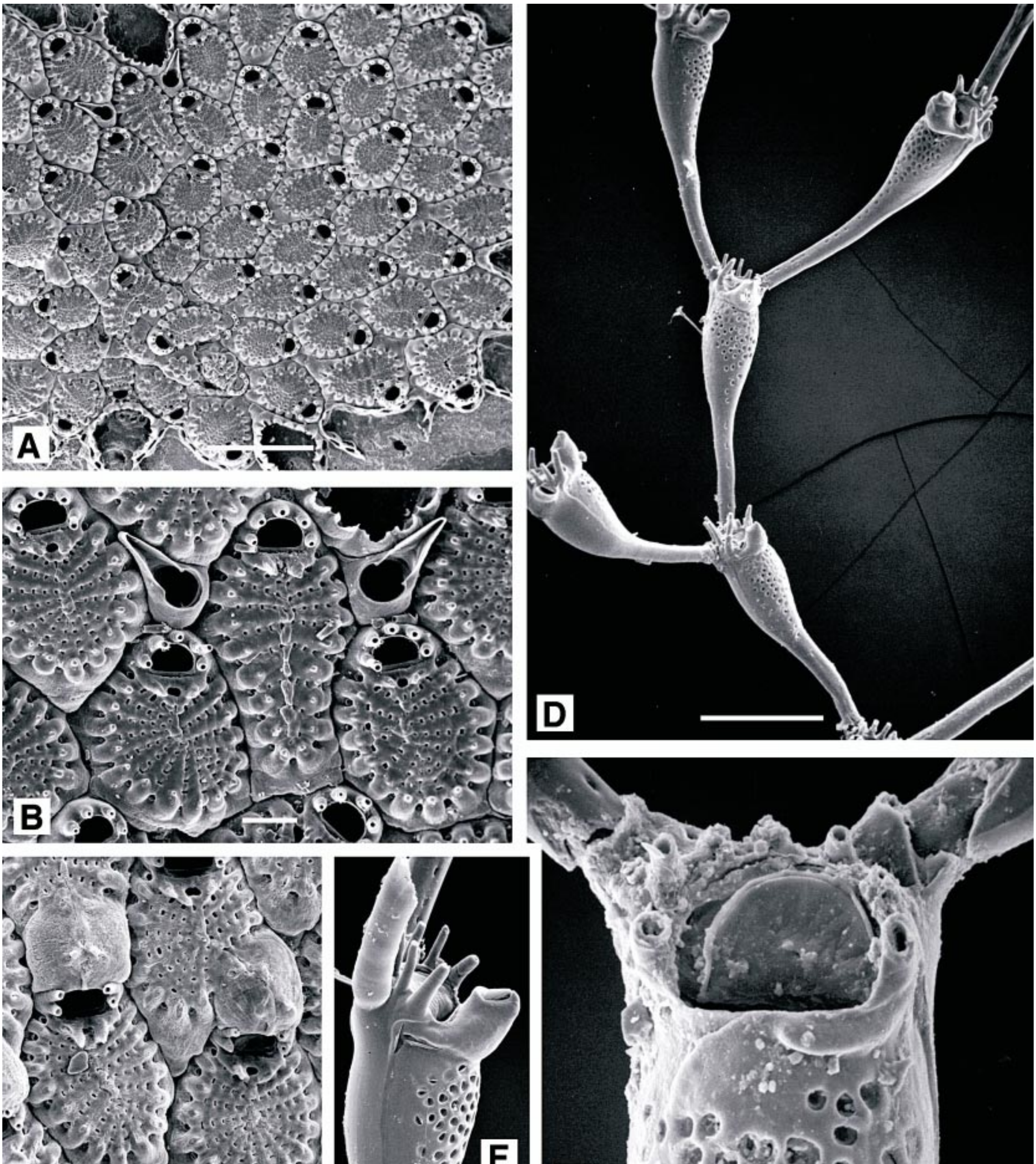

Fig. 17. **A–C.** *Puellina hincksi*. **A.** General aspect (AMNH 901; 0.5 mm). **B.** Autozooid flanked by avicularia (AMNH 901; 0.1 mm). **C.** Two maternal zooids with ovicells (AMNH 927; 0.1 mm). **D–F.** *Savignyella lafontii* (AMNH 928). **D.** General aspect (0.5 mm). **E.** Distal portion of autozooid with aberrant, elongate, twisted suboral avicularium (0.1 mm). **F.** lateral view of distal end of zooid with intact oral spines and normal suboral avicularium (0.1 mm).

zooids. Ovicell smooth, domed, with indistinct longitudinal ridge. Kenozooids sporadic.

REMARKS: First described from the Adriatic, this species was for long confounded with *P. radiata* (Moll, 1803) and *P. innominata* (Couch, 1844), but its specific identity was finally confirmed by Gautier (1962), who reported it from the Marseilles region.

DISTRIBUTION: *Puellina hincksi* was described from Tunisia by Canu and Bassler (1930) and has recently been described and figured from west of Gibraltar (Alvarez, 1994b). It is probably widely distributed within the Mediterranean.

MEASUREMENTS (SKELETAL): AL 323 ± 20 μm, 311–346 (1, 3), AW 153 ± 20, 130–168 (1, 3), DO 317 ± 39, 253–398 (2, 20), OL 47 ± 2, 41–50 (2, 17), OW 74 ± 3, 67–79 (2, 17), OvL 193 ± 14, 170–215 (1, 10), OvW 175 ± 14, 158–201 (1, 10), ZL 431 ± 49, 350–523 (2, 20), ZW 278 ± 35, 218–337 (2, 20). (POLYPIDE): IH 0 μm (1, 1), LD 560–700 (1, 2), MD 20 (1, 1), TL 480–500 (1, 2).

SUPERFAMILY PATENICELLOIDEA BUSK, 1852

FAMILY SAVIGNYELLIDAE LEVINSEN, 1909

GENUS *SAVIGNYELLA* LEVINSEN, 1909

Savignyella lafontii (Audouin, 1826)

Figure 17D–F

Eucratea lafontii Audouin, 1826: 242. Savigny, 1809: pl.13, figs. 21–25.

Savignyella lafontii: Gautier, 1962: 102. Zabala and Maluquer, 1988: 145.

DESCRIPTION (AMNH 928; CMRR 2224): Colonies brown, erect, bushy tufts to 10 mm high in present material, of branching, uniserial chains of clavate autozooids. Autozooids 1–2 mm long, the proximal portion cylindrical, 0.08 mm wide, broadening to 0.12 mm at one-half to two-thirds total length; remaining distal portion 0.25 mm wide. Primary orifice terminal, D-shaped, with straight proximal edge, and seven short spines equally spaced around lateral and distal margins. A prominent median suboral avicularium partly obscuring orifice, its cylindrical cystid perpendicular to frontal plane; rostrum triangular, sharply hooked, orientated proximodistally and frontally directed. Frontal shield of broad distal portion of autozooid closely perforated by numerous round pores; a few smaller pores in single linear series on tubular proximal portion. Ovicell borne on distal rim of orifice, globular; ectooecium membranous except for a smooth, calcified disto-basal rim, entooecium calcified, with a coarsely reticulate surface. Each autozooid develops paired disto-basal buds from conspicuous tubular projections; new autozooids develop distal to a distinct chitinous joint. An additional septulum situated medially between the two daughter autozooids giving rise to delicate, cylindrical rhizoid.

Tentacles light brown, 18–22; lophophores bell-shaped, radially symmetrical, introverts short.

DISTRIBUTION: *Savignyella lafontii* has been reported on numerous occasions from the Adriatic, and its wider Distribution in the western Mediterranean was detailed by Gautier (1962). It has a practically circumglobal Distribution in warm temperate to tropical waters.

MEASUREMENTS (POLYPIDE): IH 96 ± 22 μm, 60–120 (1, 9), LD 772 ± 96, 650–960 (1, 11), MD 30–40 (1, 2), TL 741 ± 135, 440–920 (1, 9).

INFRAORDER HIPPOTHOOMORPHA GORDON, 1989

SUPERFAMILY HIPPOTHOOIDEA BUSK, 1859

FAMILY HIPPOTHOIDAE BUSK, 1859

GENUS *HIPPOTHOA* LAMOUROUX, 1821

Hippothoa divaricata Lamouroux, 1821

Figure 18A–E

Hippothoa divaricata Lamouroux, 1821: 82. Ryland and Gordon, 1977: 19. Hayward and Ryland, 1999: 86.

DESCRIPTION (AMNH 929): Colony encrusting. Autozooids in branching, uniserial chains, diffuse or closely intergrown; clavate, with tubular proximal cauda and oval distal portion. Primary orifice longer than wide, poster comprising one-fifth total length, forming a short triangular sinus between distinct angular condyles. No spines. Frontal shield smoothly calcified, imperforate, with pronounced longitudinal median ridge, most prominent just proximal to the sinus. Dimor-

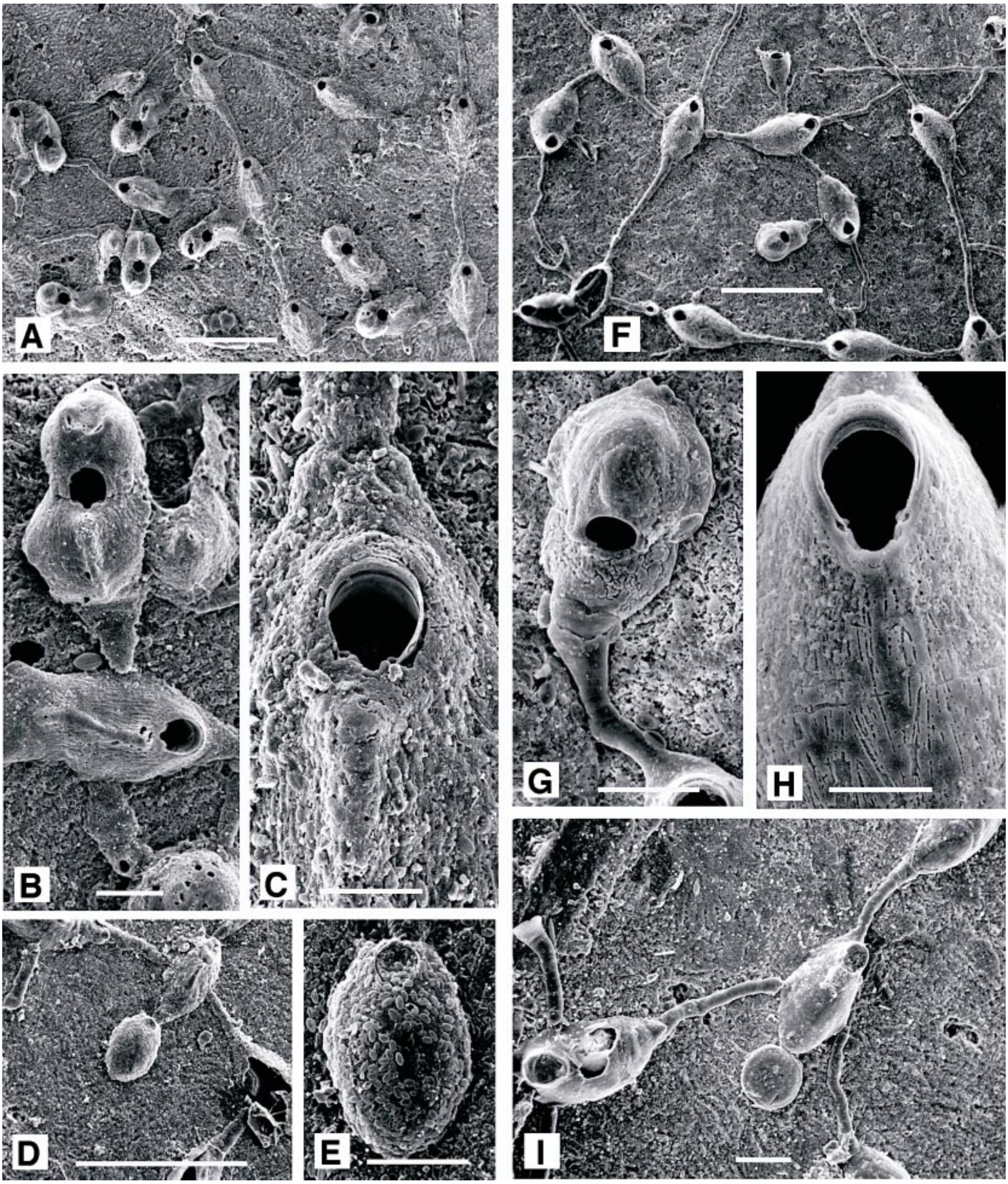

Fig. 18. **A–E.** *Hippothoa divaricata* (AMNH 929). **A.** General aspect (0.5 mm). **B.** Maternal zooid with ovicell (top) and (bottom) zooeciule budded from central autozooid (0.1 mm). **C.** Autozooidal orifice (0.05 mm). **D.** Ancestrula and early autozooids (0.5 mm). **E.** Ancestrula with D-shaped orifice (0.1 mm). **F–I.** *Hippothoa flagellum*. **F.** General aspect (AMNH 930; 0.5 mm). **G.** Maternal zooid with ovicell (AMNH 930; 0.1 mm). **H.** Autozooidal orifice (AMNH 931; 0.05 mm). **I.** Ancestrula and early autozooids (AMNH 929; 0.1 mm).

phic female zooids with slightly shorter cauda than autozooid, and broader orifice; ovicell hemispherical, imperforate, often with an umbo. Zooeciules of unknown function sporadic, with narrow, tubular cystid and minute elliptical orifice. Each autozooid producing a single distal bud; branching achieved by lateral budding, a maximum of two on each side, giving an X pattern when all four develop. Female zooids and zooeciules may arise at any of the five budding positions. Ancestrula oval, domed, with a complete gymnocystal frontal shield, and a small D-shaped orifice.

DISTRIBUTION: *Hippothoa divaricata* is widely distributed throughout the northeast Atlantic and the Mediterranean, on stones and shells, in shallow coastal habitats.

MEASUREMENTS (SKELETAL): CL 208 ± 33 μm, 163–256 (1, 7), OL 63 ± 4, 60–67 (1, 3), OW 52 ± 4, 49–56 (1, 3), ZL 503 ± 48, 421–577 (1, 7), ZW 169 ± 10, 151–183 (1, 7).

Hippothoa flagellum Manzoni, 1870

Figure 18F–I

Hippothoa flagellum Manzoni, 1870: 328. Hayward and Ryland, 1999: 88.

DESCRIPTION (AMNH 929–931; CMRR 2225): Colonies uniserial traceries encrusting shell and other organic carbonates, form and extent dictated by space available and competition from other sessile organisms. Autozooids slender, clavate, with filiform proximal portion, or cauda, constituting up to three-quarters total length, and distal oval portion the rest. Primary orifice pear-shaped, broadest in its distal third, narrowest at proximal rim, which forms a deep, U-shaped sinus between short, pointed condyles. Branching a right-angled cross, each autozooid producing a single distal bud and paired lateral buds; female brooding zooids dimorphic, developed at lateral budding sites and rarely giving rise to further buds; broadly oval, abruptly tapered proximally, without a cauda, entire length slightly less than that of distal clavate portion of autozooid; orifice almost twice as wide as long, with broad, shallow sinus; ovicell imperforate. Ancestrula a circular, domed, kenozooidal structure, 0.3 mm diameter, budding a single oval autozooid, lacking the distinctive cauda.

DISTRIBUTION: This inconspicuous species has been reported from temperate to tropical seas throughout the world, in shallow coastal waters, almost invariably on shell and other biogenic carbonates.

MEASUREMENTS (SKELETAL): CL 244 ± 65 μm, 128–385 (2, 15), GL 255 ± 29, 227–292 (1, 4), GW 157 ± 21, 125–169 (1, 4), OL 43 ± 7, 29–52 (2, 10), OW 41 ± 3, 37–46 (2, 10), OvL 142 ± 8, 136–154 (1, 4), OvW 157 ± 21, 125–169 (1, 4), ZL 559 ± 67, 437–705 (2, 15), ZW 192 ± 17, 150–222 (2, 15).

FAMILY CHORIZOPORIDAE VIGNEAUX, 1949

GENUS *CHORIZOPORA* HINCKS, 1879

Chorizopora brongniartii (Audouin, 1826)

Figure 19A–C

Flustra brongniartii Audouin, 1826: 240. Savigny, 1809: pl. 10, fig. 6.

Chorizopora brongniartii: Hincks, 1880: 224. Marcus, 1940: 214. Gautier, 1962: 126. Hayward and Ryland, 1979: 240. Zabala, 1986: 516. Zabala and Maluquer, 1988: 141. Hayward and Ryland, 1999: 100.

DESCRIPTION (AMNH 930, 932; CMRR 2226): Colonies clear, encrusting, multiserial, unilaminar, glassy, and often only apparent once dried. Autozooids oval, fusiform or irregular, only slightly convex; disjunct, adjacent autozooids linked by tubular extensions of basal pore chambers. Primary orifice D-shaped, with straight proximal border and indistinct condyles. No oral spines or peristome. Frontal shield finely granular, imperforate, transversely ridged or striated, and sometimes with a small median suboral umbo. Ancestrula with peristome and two spines on distal margin of orifice. Avicularia vicarious, monomorphic, typically one at distal end of each autozooid; cystid small and rounded, mandible triangular, acute to frontal plane, directed distally. Ovicell elongate, semielliptical, recumbent on substratum between distally succeeding autozooids; finely granular, imperforate, often developing a longitudinal frontal keel; partly incorporated within cystid of avicularium.

Autozooids may be closely packed, with linking tubules only just visible, or widely

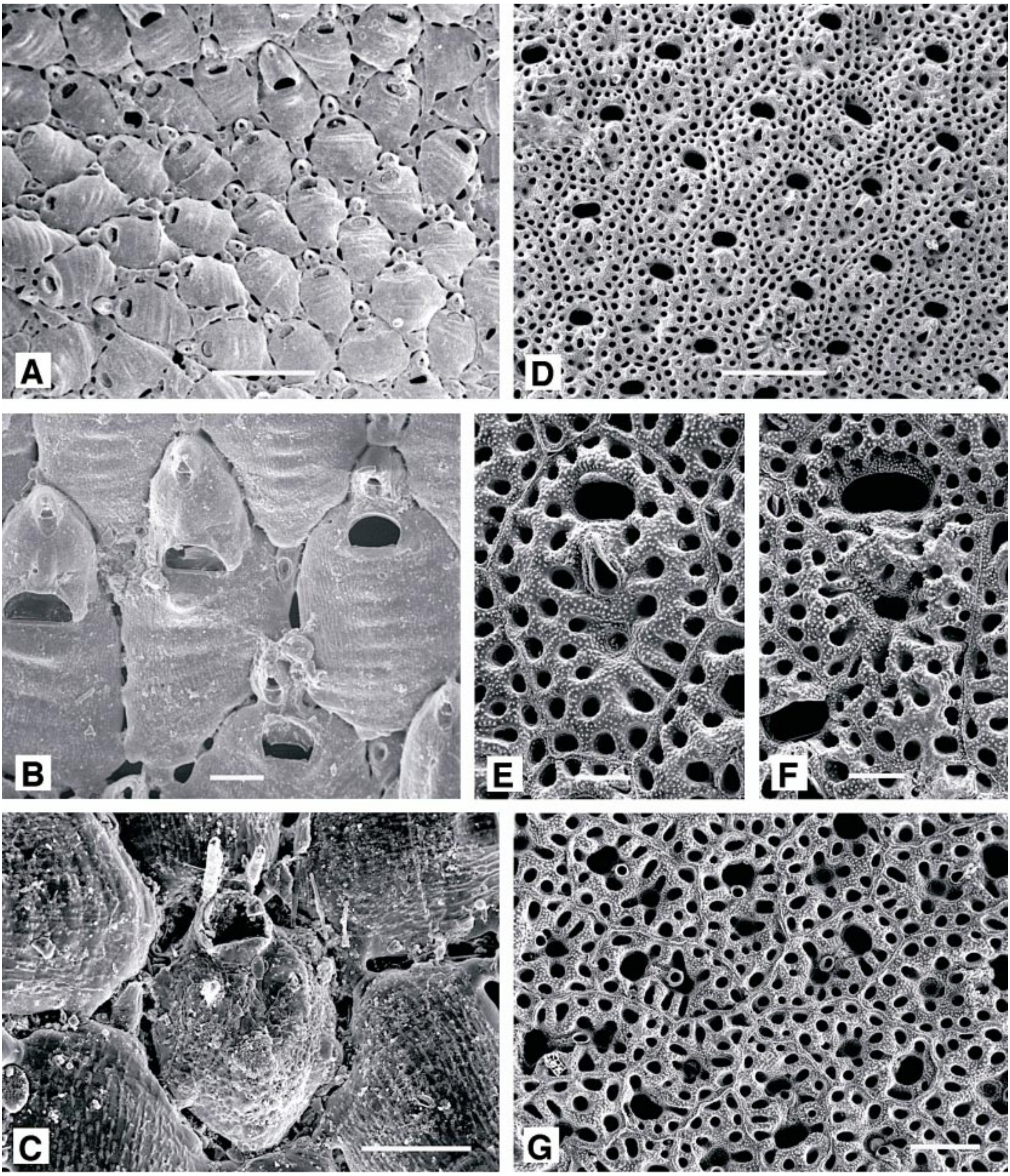

Fig. 19. **A–C.** *Chorizopora brongniartii*. **A.** General aspect (AMNH 930; 0.5 mm). **B.** Autozooid (right) and (center) maternal zooid with ovicell (AMNH 930; 0.1 mm). **C.** Ancestrula (AMNH 932; 0.1 mm). **D–G.** *Reptadeonella violacea* (AMNH 933). **D.** General aspect (0.5 mm). **E.** Autozooid with suboral avicularium (0.1 mm). **F.** Maternal zooid (0.1 mm). **G.** Ancestrular complex of six zooids diverging from center of figure (0.2 mm).

disjunct with intervening spaces infilled by a mosaic of irregular kenozooidal units, each linked to neighboring kenozooids or autozooids by tubular connections, and each with a small round frontal opesia.

Tentacles clear, 12–13; lophophores bell-shaped, radially symmetrical; introverts long.

Embryo color bright orange.

DISTRIBUTION: *Chorizopora brongniartii* is a very common species in the Mediterranean, and on north European coasts, and is often abundant on every kind of organic substratum. It is possibly one of the few almost cosmopolitan species of cheilostomate bryozoans, having been reported, described, and illustrated from shelf environments throughout the world, with the exception of polar regions.

MEASUREMENTS (SKELETAL): AL 105 ± 14 μm, 80–130 (4, 20), AW 102 ± 14, 80–130 (4, 20), DO 367 ± 49, 300–380 (4, 20), KL 125 ± 25, 80–170 (4, 20), KW 90 ± 26, 50–120 (4, 20), OL 57 ± 7, 40–70 (4, 20), OW 99 ± 10, 80–120 (4, 20), OvL 268 ± 27, 220–320 (4, 16), OvW 217 ± 17, 200–260 (4, 16), OOW 130 ± 20, 200–260 (4, 16), ZL 429 ± 23, 390–460 (4, 20), ZW 331 ± 33, 280–380 (4, 20). (POLYPIDE): IH 261 ± 41 μm, 200–320 (1, 11), LD 527 ± 51, 430–580 (1, 11), MD 26 ± 3, 20–30 (1, 11), TL 457 ± 23, 420–500 (1, 11).

INFRAORDER UMBONULOMORPHA GORDON, 1989

SUPERFAMILY ADEONOIDEA BUSK, 1884

FAMILY ADEONIDAE BUSK, 1884

GENUS *REPTADEONELLA* BUSK, 1884

Reptadeonella violacea (Johnston, 1847)

Figure 19D–G

Lepralia violacea Johnston, 1847: 325.
Reptadeonella violacea: Hayward and Ryland, 1999: 186.

DESCRIPTION (AMNH 933; CMRR 2227): Colonies encrusting, multiserial, extensive unilaminar sheets, deep purple when living, with a pale border of actively growing autozooids. Autozooids pyriform to regularly hexagonal, with distinct boundaries, flat or with a slight median concavity; 0.5–0.62 × 0.3–0.5 in present material. Primary orifice semicircular, with straight or slightly convex proximal edge; surrounded by a short, thick peristome surmounted by a transversely oval secondary orifice. No oral spines. Frontal shield finely granular, thickening through ontogeny, with a single series of slit-like marginal pores; a small round spiramen medially, distal to it a single adventitious avicularium, with short, triangular rostrum acute to frontal plane, distally directed and extending onto proximal part of peristome. No ovicells; embryos brooded in modified gonozooids, broader than autozooids, with proportionately larger, broader orifice. On settlement larva metamorphoses into a radially symmetrical complex of six ancestrular zooids, readily seen in young colonies.

Tentacles colorless, 17–18; lophophores slightly obliquely truncate.

DISTRIBUTION: This is a warm temperate species, distributed in the east Atlantic from the southwest British Isles to West Africa, and abundantly throughout the Mediterranean. Also present in the warm temperate to tropical west Atlantic, and on the Pacific coasts of North America.

MEASUREMENTS (SKELETAL): AL 112 ± 21 μm, 75–146 (2, 15), AW 64 ± 11, 48–84 (2, 15), DO 439 ± 53, 283–490 (2, 20), OL 70 ± 9, 58–93 (2, 15), OW 102 ± 8, 91–115 (2, 15), OOL 86 ± 20, 63–99 (1, 3), OOW 151 ± 3, 148–154 (1, 3), ZL 633 ± 64, 516–737 (2, 15), ZW 367 ± 41, 312–449 (2, 15). (POLYPIDE): IH 210 ± 78 μm, 60–280 (1, 6), LD 606 ± 132, 400–740 (1, 10), MD 28 ± 4, 20–30 (1, 6), TL 520 ± 51, 440–560 (1, 5).

FAMILY ADEONELLIDAE GREGORY, 1893

GENUS *ADEONELLA* BUSK, 1884

Adeonella pallasii (Heller, 1867)

Figure 20A–E

Eschara pallasii Heller, 1867: 115.
Schizoporella pallasii: Hincks, 1886: 268.
Adeonella polystomella: Zabala and Maluquer, 1988: 144.
Adeonella pallasii: Ünsal and d'Hondt. 1979: 622. Hayward, 1988: 171.

LECTOTYPE (chosen here): UIIZ 169.

DESCRIPTION (AMNH 934–936; CMRR 2228): Colonies light orange, erect, bilaminar, branching dichotomously, developing a flat, two-dimensional structure; to 20 mm

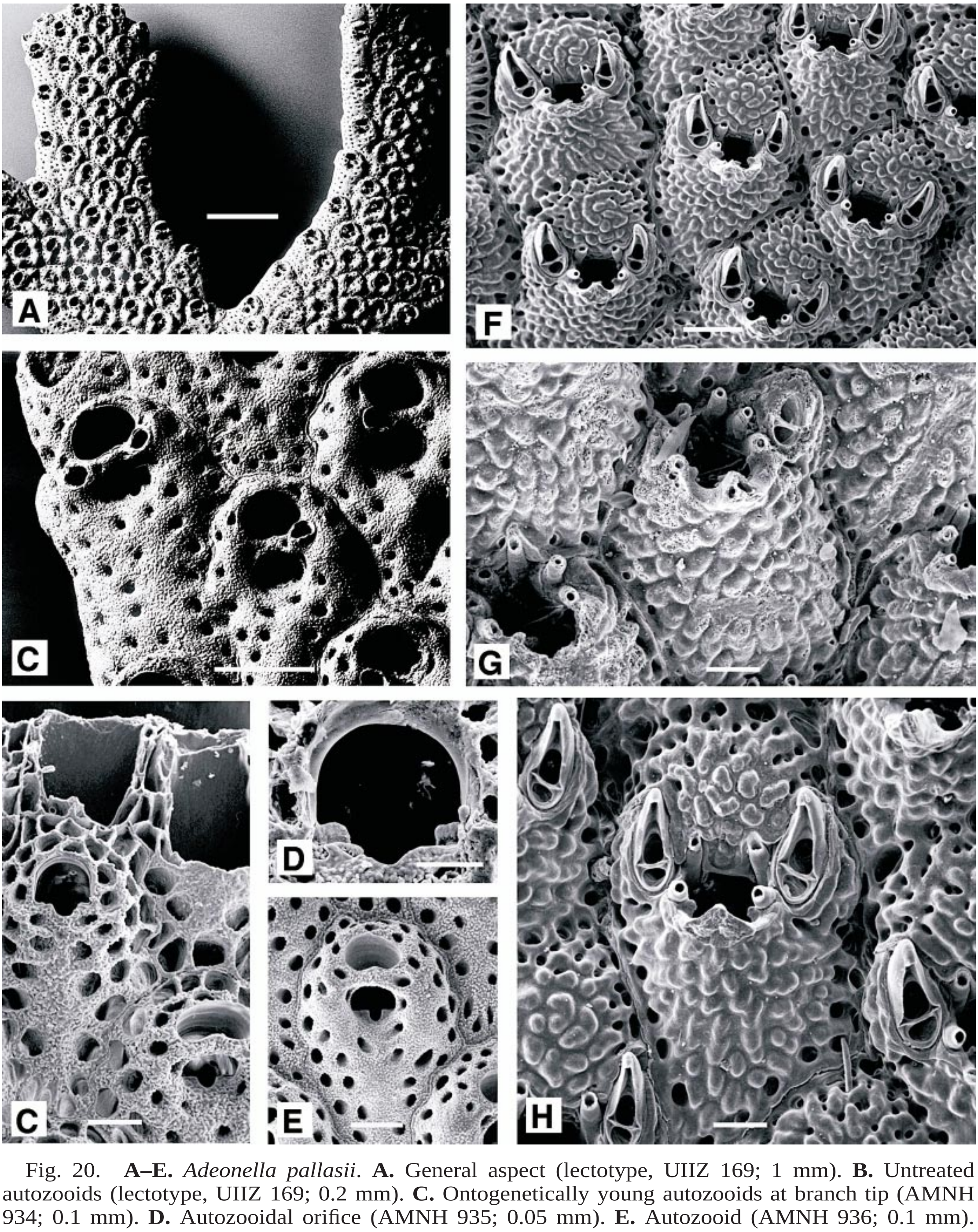

Fig. 20. **A–E.** *Adeonella pallasii*. **A.** General aspect (lectotype, UIIZ 169; 1 mm). **B.** Untreated autozooids (lectotype, UIIZ 169; 0.2 mm). **C.** Ontogenetically young autozooids at branch tip (AMNH 934; 0.1 mm). **D.** Autozooidal orifice (AMNH 935; 0.05 mm). **E.** Autozooid (AMNH 936; 0.1 mm). **F–H.** *Escharoides mamillata* (AMNH 895). **F.** General aspect (0.2 mm). **G.** Autozooid (0.1 mm). **H.** Maternal zooid with ovicell, flanked by two avicularia (0.1 mm).

high in present material; maximum branch width 2.5 mm. Autozooids oval to hexagonal, broadest distally, tapered proximally; bordered by distinct raised sutures. Frontal shield convex, finely granular; pores large and distinct in early ontogeny, later confined to margins of shield. Primary orifice as wide as long, proximal edge with two pronounced cusps defining a narrow, U-shaped sinus. Secondary orifice transversely oval, becoming more nearly circular in later ontogeny; peristomial bridge slender, defining proximally a broad oval spiramen through which the primary orifice is clearly visible. Avicularia small, single or paired, proximolateral to secondary orifice, with bluntly triangular rostrum directed medially onto peristomial bridge. Ontogenetic thickening of frontal shield producing a prominent umbo proximolateral to secondary orifice on each side, and another proximal to spiramen.

REMARKS: Heller's specimen chosen here as lectotype and illustrated as Figure 20A and 20B is one of two specimens in the collections of the UIIZ indicated as Heller's types of the species.

DISTRIBUTION: This distinctive species is perhaps endemic to the eastern Mediterranean. It is common in the eastern Adriatic and the Aegean. Its most westerly record seems to be that of Hincks (1886), from Naples, which has still to be substantiated.

MEASUREMENTS (SKELETAL): AL 71 ± 9 μm, 54–82 (2, 16), AW 45 ± 8, 32–58 (2, 16), DO 379 ± 27, 331–419 (2, 20), OL 96 ± 7, 84–108 (1, 10), OW 82 ± 6, 70–89 (2, 13), ZL 537 ± 30, 471–583 (2, 20), ZW 399 ± 36, 326–462 (2, 20).

SUPERFAMILY LEPRALIELLOIDEA VIGNEAUX, 1949

FAMILY ROMANCHEINIDAE JULLIEN, 1888

GENUS *ESCHAROIDES* MILNE EDWARDS, 1836

Escharoides mamillata (Wood, 1844)

Figure 20F–H

Lepralia mamillata Wood, 1844: 19.
Escharoides mamillata: Hayward and Ryland, 1999: 118.

DESCRIPTION (AMNH 895; CMRR 2229): Colonies spreading, multiserial, unilaminar sheets. Autozooids oval to hexagonal, steeply convex, separated by well-marked grooves. Aperture slightly broader than long; distally with a broad, straight-edged suboral shelf, bordered by four to six short thick spines; proximally with a tall, medially pointed mucro, with a short, square denticle on its inner face, flanked on each side by a short pointed denticle. Frontal shield thick, with distinctive nodular surface, bordered by densely spaced, round marginal pores. Avicularia adventitious, lateral oral, paired, with acute triangular rostrum, slightly acute to frontal plane, distally directed and with a gentle lateral curve towards the autozooid midline. Ovicell hemispherical, with arched, straight-edged aperture; surface finely nodular, identical to that of frontal shield, with small, indistinct pores scattered around its periphery.

DISTRIBUTION: *Escharoides mamillata* is common in Pliocene deposits of southeast England and the Low Countries but has been reported on only few occasions from Recent habitats. It is known from two localities off northwest Britain, and from the Gulf of Marseille, but has not been reported from elsewhere in the northeast Atlantic or the Mediterranean.

MEASUREMENTS (SKELETAL): AL 188 ± 19 μm, 151–228 (2, 20), AW 111 ± 7, 97–121 (2, 20), DO 607 ± 55, 510–704 (2, 20), OL 125 ± 14, 92–149 (2, 19), OW 150 ± 9, 135–65 (2, 19), OvL 286 ± 34, 224–335 (2, 20), OvW 410 ± 38, 354–478 (2, 20), ZL 664 ± 60, 560–795 (2, 20), ZW 514 ± 47, 438–625 (2, 20).

FAMILY UMBONULIDAE CANU, 1904

GENUS *UMBONULA* HINCKS, 1880

Umbonula ovicellata Hastings, 1944

Figure 21A–C

Umbonula ovicellata Hastings, 1944: 280. Hayward and Ryland, 1999: 106.

DESCRIPTION (AMNH 937): Colonies orange encrusting, multiserial, unilaminar sheets. Autozooids hexagonal to irregularly polygonal, strongly convex, separated by thin raised sutures. Aperture slightly longer than wide, large, operculum clearly visible within, its rim developed as a thin, wavy peristome, especially prominent laterally. Midproximally each autozooid with a small suboral avicularium, the oval rostrum orientated perpendicularly to plane of aperture and

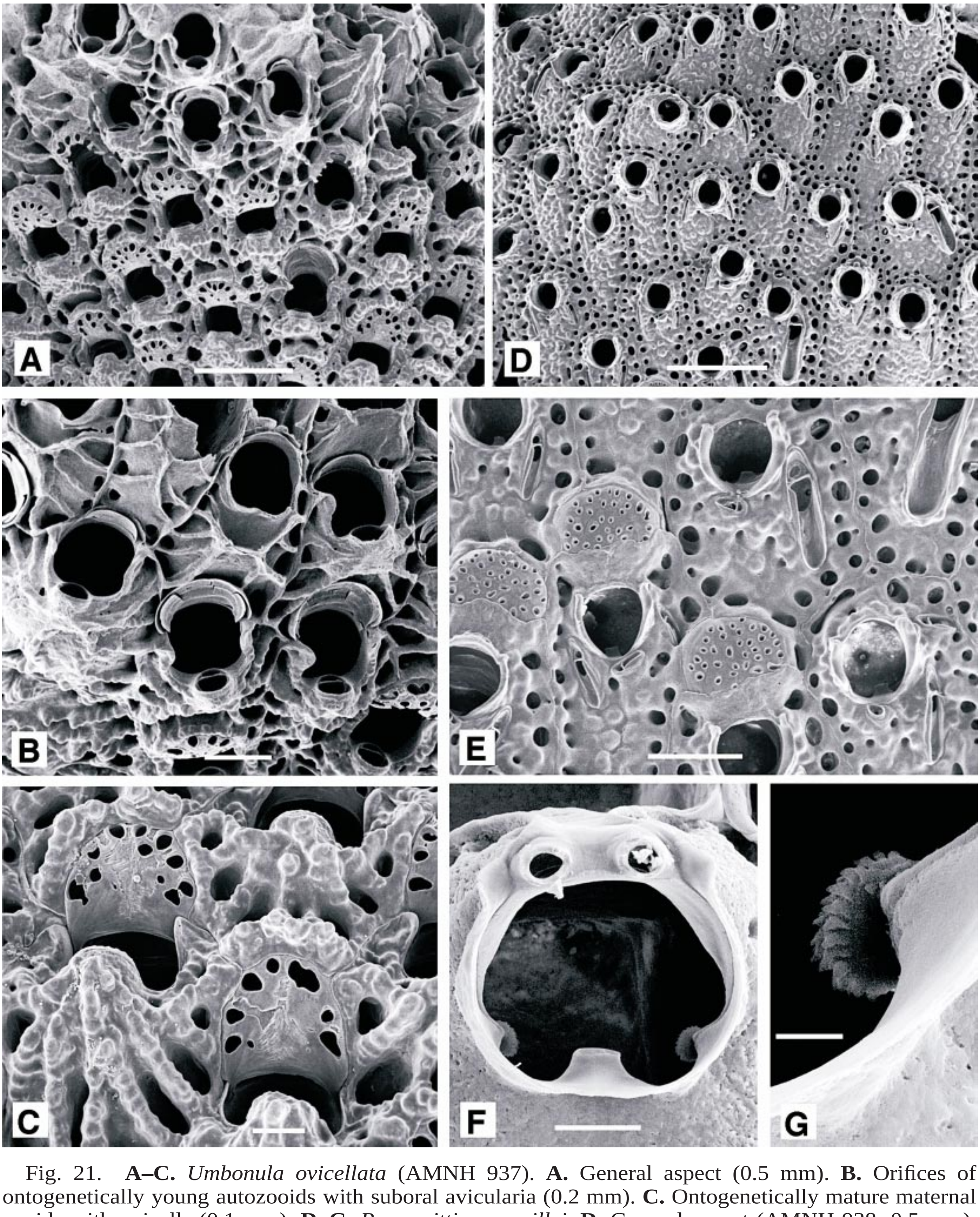

Fig. 21. **A–C.** *Umbonula ovicellata* (AMNH 937). **A.** General aspect (0.5 mm). **B.** Orifices of ontogenetically young autozooids with suboral avicularia (0.2 mm). **C.** Ontogenetically mature maternal zooids with ovicells (0.1 mm). **D–G.** *Parasmittina rouvillei*. **D.** General aspect (AMNH 938; 0.5 mm). **E.** Autozooids (upper right), maternal zooids with ovicells (lower left), and variable-sized vicarious avicularia (AMNH 938; 0.2 mm). **F.** Autozooidal orifice (AMNH 939; 0.05 mm). **G.** Orificial condyle (AMNH 939; 0.01 mm).

facing distally. Frontal shield imperforate centrally, but with about a dozen deep, marginal areolae, from between which prominent ribs converge on the suboral avicularium, the cystid of which becomes distinctly umbonate as calcification thickens. Ovicell (absent in present material) broader than long, flattened frontally, with numerous pores.

Tentacles light orange, 18; lophophores bell-shaped, radially symmetrical to slightly obliquely truncate.

Embryos bright yellow, observed 7 June 1988.

DISTRIBUTION: Lower shore and shallow sublittoral, on algae, sea grasses and shells. Widely distributed in the Mediterranean, ranging north to southwest England.

MEASUREMENTS (SKELETAL): AL 109 ± 14 μm, 84–131 (2, 20), AW 111 ± 15, 92–140 (2, 20), OL 181 ± 17, 156–215 (2, 20), OW 194 ± 14, 162–219 (2, 20), OvL 179 ± 24, 127–203 (1, 10), OvW 210 ± 16, 187–242 (1, 10), ZL 617 ± 52, 536–701 (2, 20), ZW 407 ± 41, 328–489 (2, 20). (POLYPIDE): IH 118 ± 35 μm, 60–180 (1, 9), LD 924 ± 134, 640–1080 (1, 9), TLMn 782 ± 200, 400–960 (1, 6), TLMx: 886 ± 190, 400–1050 (1, 9).

INFRAORDER LEPRALIOMORPHA GORDON, 1989

SUPERFAMILY SMITTINOIDEA LEVINSEN, 1909

FAMILY SMITTINIDAE LEVINSEN, 1909

GENUS *PARASMITTINA* OSBURN, 1952

Parasmittina rouvillei (Calvet, 1902)

Figure 21D–G

Smittia rouvillei Calvet, 1902: 57.
Parasmittina rouvillei: Gautier, 1962: 199.
Parasmittina tropica: Hayward, 1974: 384.

DESCRIPTION (AMNH 938, 939; CMRR 2230): Colony light yellow to orange, encrusting, multilaminar. Autozooids hexagonal to polygonal, in orderly arrangement at unilaminar growing edges, without common orientation in successive laminae; convex, separated by distinct ridges. Primary orifice about as wide as long; proximal border with short, anvil-shaped lyrula occupying about half its width; condyles conspicuous, rounded, downcurved, with denticulate, laminate structure, revealed by SEM, visible as a faint burr with light microscopy. Two or three distal oral spines present. Peristome developed proximal to spine bases, later extending over them, forming low, flared rim, produced mid-proximally resulting in pear-shaped secondary aperture. Frontal shield nodular, with single or double series of large marginal pores; in later ontogeny ridges of calcification extending between pores onto center of shield, the periphery then appearing reticulate. Avicularia adventitious, polymorphic, often abundant: small, triangular or parallel-sided avicularia proximal or proximolateral to orifice, directed proximally, triangular type potentially present elsewhere around peristome, often directed towards aperture; large avicularia, with distally rounded, parallel-sided rostrum half as long as autozooid frequent, budded proximolateral to orifice and directed proximally. Ovicell slightly longer than broad, globular, with a dense group of variably sized pores distally, the proximal frontal surface imperforate.

Tentacles light yellow, 12–15; lophophores bell-shaped, radially symmetrical between chimneys to obliquely truncate bordering chimneys.

REMARKS: The Mediterranean species of *Parasmittina* are in need of thorough taxonomic revision, including a review of type and other published materials, and this present attribution may have to be reconsidered. However, the material described here is the same species as that described from Chios (Hayward, 1974) as *P. tropica* (Waters, 1909), a taxon then unrecorded for the Mediterranean.

It is almost certainly the species described by Gautier (1962) as *P. rouvillei* and is probably the same as that described by Canu and Bassler (1930) as *Smittina rouvillei*. Zabala and Maluquer (1988) considered that these and other citations referred to a single, variable species which they denoted *P. tropica,* referring to Harmer's (1957) redefinition. However, it must be pointed out that *Smittia tropica* Waters, 1909 was described from the Sudanese Red Sea coast. Harmer's (1957) concept of the species was based on specimens from Ghardaqa, India, Ceylon, the Torres Straits, Victoria, Adelaide, and the Siboga collections from the Indo-Malayan region, and it is clear that he did not reexamine

Waters' original material. Harmer's (1957) illustrations of ''*Smittina tropica*'' depict four specimens from the Siboga collections, one from India and one from Victoria. It is doubtful that any of these corresponds to Waters' species, or to any species present in the Mediterranean.

MEASUREMENTS (SKELETAL): AL (large) 290 ± 60, 175–398 (2, 12), AW (large) 104 ± 27, 65–154 (2, 12), AL (small) 109 ± 7, 101–122 (1, 8), AW (small) 73 ± 15, 49–93 (1, 8), DO 523 ± 74, 386–676 (2, 20), LW 52 ± 5, 47–62 (1, 9), OL 120 ± 14, 92–143 (2, 21), OW 119 ± 16, 81–143 (2, 21), ZL 687 ± 69, 566–816 (2, 20), ZW 411 ± 58, 323–569 (2, 20). (POLYPIDE): IH 120 ± 51 μm, 40–180 (1, 10), LD 640 ± 78, 560–800 (1, 10), MD 30–40 (1, 2), TL 646 ± 123, 440–820 (1, 10).

GENUS *SMITTINA* NORMAN, 1903

Smittina cervicornis (Pallas, 1766)

Figure 22A–C

Millepora cervicornis Pallas, 1766: 252.
Eschara cervicornis: Milne Edwards, 1836: 19.
Smittia cervicornis: Calvet in Jullien and Calvet, 1903: 151.
Porella cervicornis: Canu and Bassler, 1930: 54. Lagaaij, 1952: 97. Gautier, 1962: 204.
Smittina cervicornis: Cook, 1968: 210. Zabala and Maluquer, 1988: 121.

DESCRIPTION (AMNH 940; CMRR 2231): Colonies orange, erect, branching, to 30 mm in present material, narrow: maximum branch width 3 mm. Branches bilaminar, flat-sectioned, twisting around long axis; each face of five or six alternating autozooid rows. Autozooids at growing tips of colony elongate, rectangular, convex, with distinct boundaries; commonly 0.625–0.75 x 0.375 mm. Primary orifice about as wide as long; proximal border straight, a deep lyrula, with straight edge and rounded corners, occupying nine-tenths of proximal width; condyles rounded quadrangular, conspicuous in early ontogeny. No spines. Frontal shield thickening steadily from earliest ontogeny, evenly pierced by large round pores. Peristome developing within one ontogenetic generation from growing edge, thickly calcified, cylindrical and projecting from colony surface, quite hiding primary orifice. Proximally it incorporates a prominent avicularium, with rounded rostrum, complete crossbar bearing a ligula, and supporting a semicircular mandible, proximally directed and normal to frontal plane. Ovicell not seen in present material; hyperstomial, hemispherical, perforate; obscured by peristome and completely immersed. In late ontogeny, frontal shield thickened to extent that frontal surface of colony becomes quite flat, peristomes and avicularia are immersed, and peristomial rims form circular secondary orifices; autozooids then have a broadly lingulate outline, each bordered by a distinct suture.

Tentacles light orange or yellowish orange, 14–16; lophophores bell-shaped, radially symmetrical across most of branch surface, obliquely truncate adjacent to elongate chimney along branch margin.

DISTRIBUTION: Common throughout the Mediterranean in shallow coastal waters, ranging south to the Cape Verde Islands and Ghana.

MEASUREMENTS (SKELETAL): AL 111 ± 12 μm, 95–130 (2, 17), AW 101 ± 23, 72–159 (2, 17), DO 543 ± 67, 423–669 (2, 20), OL 164 ± 10, 149–181 (2, 17), OW 134 ± 9, 121–150 (2, 17), ZL 872 ± 54, 811–977 (2, 20), ZW452 ± 51, 386–543 (2, 20). (POLYPIDE): IH 158 ± 70 μm, 40–280 (1, 23), LDMn 556 ± 83, 460–620 (1, 3), LDMx 610 ± 79, 400–780 (1, 28), TLMn 462 ± 76, 340–560 (1, 16), TLMx 588 ± 114, 340–820 (2, 23).

GENUS *PRENANTIA* GAUTIER, 1962

Prenantia cheilostoma (Manzoni, 1869b)

Figure 22D–H

Lepralia cheilostomata Manzoni, 1869b: 942.
Smittia cheilostoma: Hincks, 1880: 349.
Smittina cheilostoma: Gautier, 1962: 192. Hayward and Ryland, 1999: 258.
Prenantia cheilostoma: Gautier, 1962: 193.

DESCRIPTION (AMNH 932, 941, 942; CMRR 2232): Colonies orange, encrusting, multiserial, unilaminar sheets, light reddish purple when living. Autozooids hexagonal, gently convex in early ontogeny, later rather flat following ontogenetic thickening of the frontal shield; separated by shallow grooves. Primary orifice wider than long, proximal border with an anvil-shaped lyrula occupying

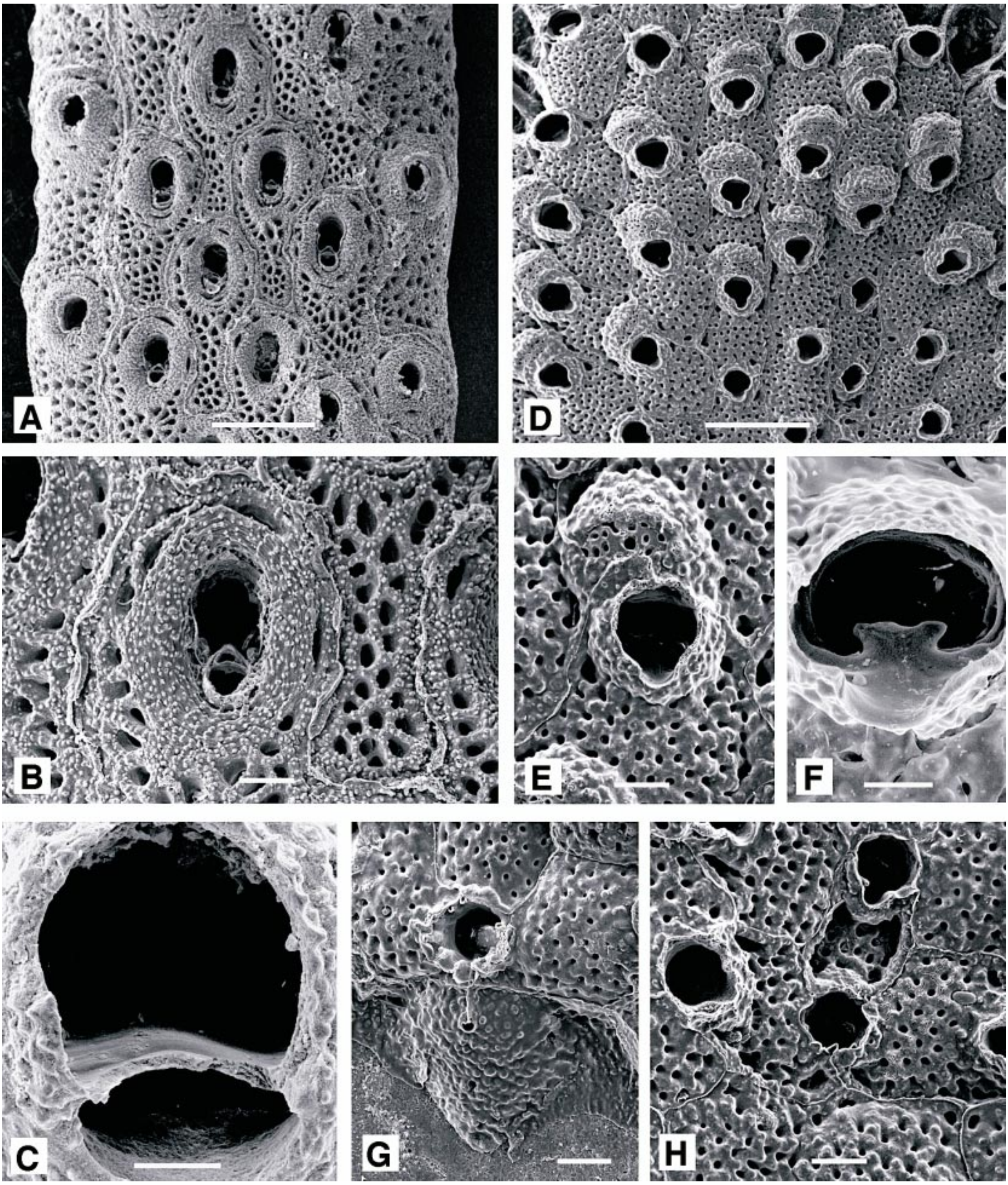

Fig. 22. **A–C.** *Smittina cervicornis* (AMNH 940). **A.** General aspect (0.5 mm). **B.** Autozooid (0.1 mm). **C.** Autozooidal orifice (0.05 mm). **D–H.** *Prenantia cheilostoma*.**D.** General aspect (AMNH 941; 0.5 mm). **E.** Maternal zooid with ovicell (AMNH 941; 0.1 mm). **F.** Autozooidal orifice (AMNH 942; 0.05 mm). **G.** Ancestrula (AMNH 932; 0.1 mm). **H.** Early autozooids surrounding orifice (center) of ancestrula covered by autozooids (AMNH 941; 0.1 mm).

about one-third total width; condyles small, rounded, indistinct. No oral spines. Peristome developing from earliest ontogeny, forming a low thickened rim completely encircling orifice, mid-proximal portion deeply U-shaped and channeled on its inner face. Frontal shield thick, vitreous, densely perforated with numerous small pores. Ancestrula with acute proximal end, spiramen, and circular orifice slightly smaller than orifice of autozooids and encircled by approximately 12 oral spines; all but apertural peristome covered when ancestrula is completely encircled by ring of autozooids. Ovicell wider than long, smooth surfaced, with many small frontal pores; developing a granular, peripheral ooecial cover continuous with the peristome.

REMARKS: Hincks (1880: 349) used the trivial name *cheilostoma*, which Manzoni, (1869b, p. 942) had originally spelled *cheilostomata* in the text when describing the new species, although the name as given by Manzoni on the plate (1869b: pl. 4, fig. 22) was *cheilostoma*. Hincks (1880) did not mention both spellings, and therefore his use of *cheilostoma* does not satisfy Article 24.2.3 of the ICZN Code for selection of one from among two or more spellings in an original work, but *cheilostoma* has become established in the literature to the virtual exclusion of *cheilostomata* for the species, which allows its preservation as ''established usage'' under Article 33.3.1 (Ride et al., 1999).

DISTRIBUTION: Shallow sublittoral and offshore, often encrusting shell. Common throughout the Mediterranean, ranging northwards to the western English Channel and the Isle of Man.

MEASUREMENTS (skeletal): DO 474 ± 66 μm, 370–627 (2, 20), LW 62 ± 7, 54–81 (2, 20), OL 132 ± 19, 101–169 (2, 20), OW 142 ± 14, 120–171 (2, 20). OvL 214 ± 26, 178–268 (1, 10), OvW 295 ± 20, 260–333 (1, 10), ZL 596 ± 49, 519–709 (2, 20), ZW 375 ± 30, 314–414 (2, 20).

GENUS *PHOCEANA* JULLIEN AND CALVET, 1903

Phoceana tubulifera (Heller, 1867)

Figure 23A–D

Eschara tubulifera Heller, 1867: 116.
Smittina tubulifera: Harmelin, 1969b: 299. Hayward, 1974: 382.

DESCRIPTION (AMNH 943; CMRR 2233): Colonies light cream-tinted orange, erect, slender, branching dichotomously, the branches oval-sectioned, to 2 mm wide in present material. Each branch face with five alternating, longitudinal series of autozooids, broadening to seven prior to a dichotomy. Autozooids elongate, rectangular, separated by distinct grooves; frontal shield gently convex, finely granular, with few evenly scattered pores, each in a shallow pit. Primary orifice slightly longer than wide; a short, straight-edged lyrula, with cusped corners, occupying most of proximal edge. No spines. A deep tubular peristome developing in early ontogeny, curving frontally and projecting from frontal plane, completely hiding primary orifice. Secondary orifice more or less circular, with a thickened, slightly crenulate rim; a short, pointed tooth apparent mid-proximally within rim marks edge of a ridge descending inner, proximal face of peristome. No ovicells in present material.

DISTRIBUTION: This delicate species was described from the Adriatic (Heller, 1867) and has been recorded on very few occasions since. It was reported from the coast of Tunisia by Canu and Bassler (1930), and has been described and illustrated from the Aegean on two occasions. It is perhaps restricted to the eastern Mediterranean; neither Gautier (1962) nor Zabala and Maluquer (1988) recorded it from the western Mediterranean.

MEASUREMENTS (SKELETAL): DO 513 ± 64 μm, 430–689 (2, 20), OL 148 ± 12, 118–166 (2, 20), OW 149 ± 16, 128–190 (2, 20), ZL 784 ± 47, 725–892 (2. 20), ZW 357 ± 31, 314–438 (2, 20).

GENUS *SMITTOIDEA* OSBURN, 1952

Smittoidea reticulata (J. Macgillivray, 1842)

Figure 23E–H

Lepralia reticulata J. Macgillivray, 1842: 467.
Smittoidea reticulata: Hayward and Ryland, 1999: 264.

DESCRIPTION (AMNH 913, 944): Colonies encrusting, multiserial, unilaminar sheets. Autozooids oval to hexagonal, convex, separated by distinct grooves; 0.35–0.5 × 0.25–0.3 mm in present material. Primary orifice wider than long, distal rim with fine dentic-

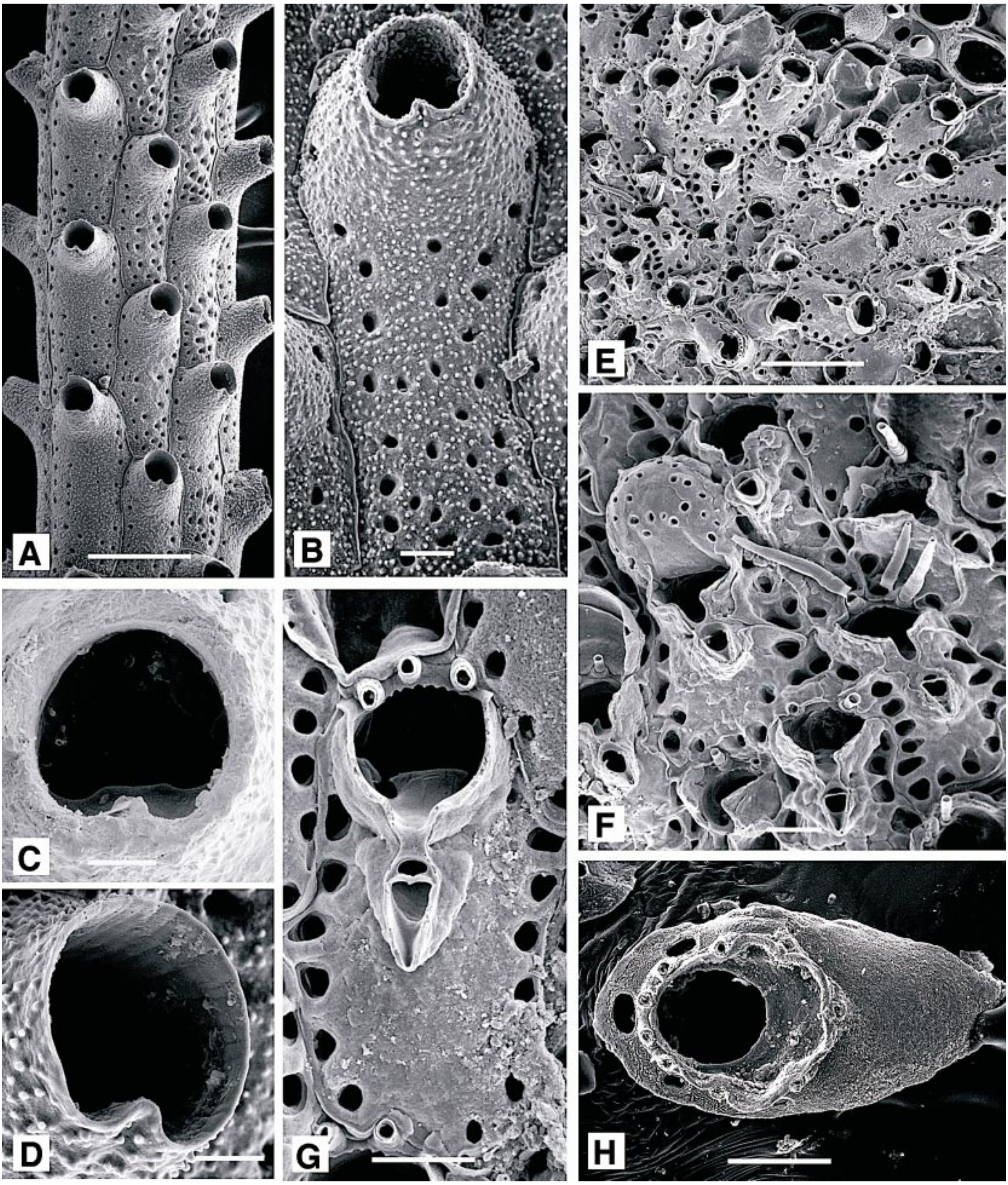

Fig. 23. **A–D.** *Phoceana tubulifera* (AMNH 943). **A.** General aspect (0.5 mm). **B.** Autozooid (0.1 mm). **C.** Autozooidal primary orifice (0.05 mm). **D.** Oblique view of autozooidal secondary orifice with internal proximal ridge (0.05 mm). **E–H.** *Smittoidea reticulata*. **E.** General aspect (AMNH 944; 0.5 mm). **F.** Maternal zooid with ovicell (left) and (right) autozooid with orificial spines in place (AMNH 944). **G.** Autozooid with suboral avicularium (AMNH 944; 0.1 mm). **H.** Ancestrula (AMNH 913; 0.1 mm).

ulation revealed by SEM, proximal edge with anvil-shaped lyrula occupying about half total width, condyles conspicuous, angular, downcurved. Two to four, most frequently three, distal oral spines. A single median suboral avicularium, with acute triangular rostrum, normal to frontal plane, proximally directed; crossbar slender, complete, palate with extensive foramen. Frontal shield nodular, bordered by a single series of large, distinct pores. Ovicell slightly longer than broad, aperture arched, with straight distal edge; about 20 small pores on distal and lateral surfaces. Ancestrula elongate oval, smoothly convex, tapered proximally; gymnocyst smooth; membranous frontal wall occupying half total length, surrounded by oval, crenulate rim bordered by four closely spaced distal spines and five spines uniformly spaced proximally; cryptocyst broadest proximally, opesia almost circular, two-thirds length of membrane.

REMARKS: The material described and illustrated here has a proportionately broader lyrula and longer avicularium than north European material figured by Hayward and Ryland (1999), but consists of small colonies only, in which ontogenetic variation may not be fully expressed.

DISTRIBUTION: This species is distributed in the eastern Atlantic from Arctic Norway to Morocco, and throughout the Mediterranean.

MEASUREMENTS (SKELETAL): AL 102 ± 14 µm, 70–128 (2, 20), AW 55 ± 10, 41–74 (2, 20), DO 349 ± 46, 276–449 (2, 20), OL 93 ± 11, 73–111 (3, 26), OW 106 ± 15, 79–141 (3, 26), OvL 224 ± 26, 192–273 (1, 10), OvW 209 ± 17, 183–230 (1, 10), ZL 506 ± 40, 443–618 (2, 20), ZW 288 ± 34, 223–348 (2, 20).

FAMILY BITECTIPORIDAE MACGILLIVRAY, 1895

GENUS *HIPPOPORINA* NEVIANI, 1895

Hippoporina lineolifera (Hincks, 1886)

Figure 24

Schizoporella lineolifera Hincks, 1886: 267, 1887: 315.
? *Schizoporella marsupifera*: Gautier, 1962: 144.

LECTOTYPE (chosen here): BMNH reg. no. 1899.5.1.1072, Hincks collection, Adriatic; The Natural History Museum, London.

DESCRIPTION: Lectotype consisting of two fragments from single colony; the larger, mounted in wooden cavity slide, totaling 24 autozooids and an ancestrula; the smaller, Canada balsam mount of seven autozooids, prepared in 1929; all zooids damaged to some degree. Autozooids oval, convex, with distinct boundaries; frontal shield densely perforated by large round pores with thickened rims. Primary orifice slightly wider than long, proximal border shallowly concave between small condyles. No oral spines; proximal rim of orifice thickened, with median suboral umbo bearing small avicularium with semielliptical, proximally directed mandible. Ovicell, damaged in all examples, globose, recumbent upon distally succeeding zooid, with frontal pores evident in undamaged areas. Oval ancestrula with raised mural rim bordering membrane and indeterminate number of spines; broad, flat cryptocyst defining semielliptical opesia. Substratum apparently an alga frond.

REMARKS: We did not encounter this species; the lectotype is the only extant specimen. It is labeled in Hincks' hand with its original taxonomic designation, and also '' = *S. marsupifera* Busk''. The curious synonymy with the latter, described from a Challenger station off Marion Island, South Indian Ocean, may thus have originated with Hincks. Gautier (1962) had a single specimen, which he lost; he then repeated Hincks' description of the species, attributing it to Busk's taxon.

MEASUREMENTS (SKELETAL): OL 110 ± 10 µm (1, 10), OW 130 ± 8 (1, 10), ZL 470 ± 50 (1, 10), ZW 310 ± 40 (1, 10).

GENUS *PENTAPORA* FISCHER, 1807

Pentapora fascialis (Pallas, 1766)

Figure 25A–E

Eschara fascialis Pallas, 1766: 42.
Millepora foliacea Ellis and Solander, 1786: 133.
Eschara foliacea: Busk, 1854: 89.
Lepralia foliacea: Hincks, 1880: 300.
Hippodiplosia foliacea: Canu and Bassler, 1930: 50.
Pentapora fascialis: Zabala, 1986: 401. Hayward and Ryland, 1999: 200.

DESCRIPTION (AMNH 945–947; CMRR 2234): Colonies red, erect, rigid, heavily cal-

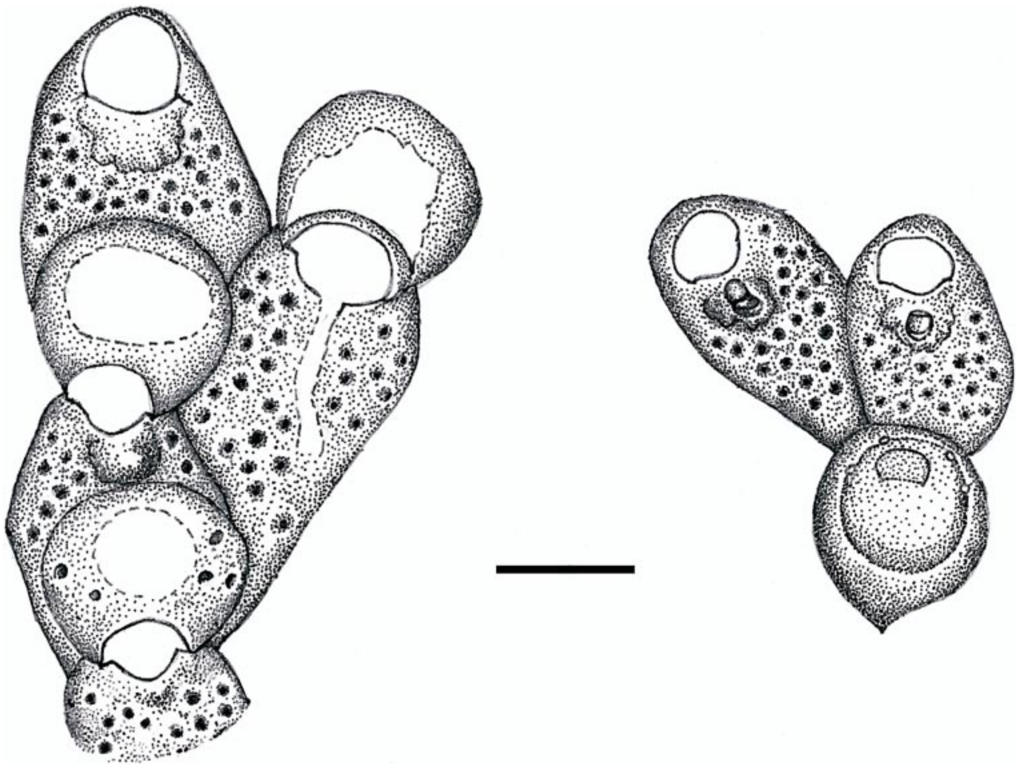

Fig. 24. *Hippoporina lineolifera*. Autozooid and maternal zooids with ovicells (left) and (right) ancestrula with early autozooids. (lectotype, BMNH reg. no. 1899.5.1.1072; 0.2 mm).

cified; consisting of bilaminar plates, dividing and anastomosing at irregular intervals, forming a three-dimensional coralliform structure. Deep orange to red-orange when living. Autozooids elongate, oval to hexagonal; distinct when newly budded, each separated by thick, raised ridges. Primary orifice narrowly bell-shaped, longer than wide, with straight or slightly convex proximal margin between small, triangular, downcurved condyles. No oral spines. A small suboral avicularium sporadically present, missing from many autozooids; rostrum short, oval, slightly acute to frontal plane, proximally directed; occasionally replaced by a dimorphic avicularium with slightly spatulate rostrum, 0.2 mm long, normal to frontal plane, proximally directed. Frontal shield convex, evenly perforated; thickening rapidly from earliest ontogeny, with ridges developing between the pores, fusing to form a reticulate shield which continues to thicken through later ontogeny, when individual autozooid boundaries become obscured. Ovicell elongate oval, with scattered frontal pores, visible only in early ontogeny, soon obscured by thickening calcification.

Tentacles light orange, 17–19; lophophores bell-shaped, radially symmetrical away from colony edge, obliquely truncate along colony margins and locally (at chimneys?) on colony surface.

REMARKS: The colony habit is the narrow fronded, open form characteristic of Mediterranean populations. This is the largest and most conspicuous calcified bryozoan in the Adriatic, with colonies up to 0.5 m high and 0.3 m in diameter in the vicinity of Sv. Ivan Island before the anoxic events of the late 1980s. Colonies established after the anoxic event had grown to exceed 15 cm in diameter by summer 1998, although reestablishment of large colonies may require many more years due to exponential decrease in

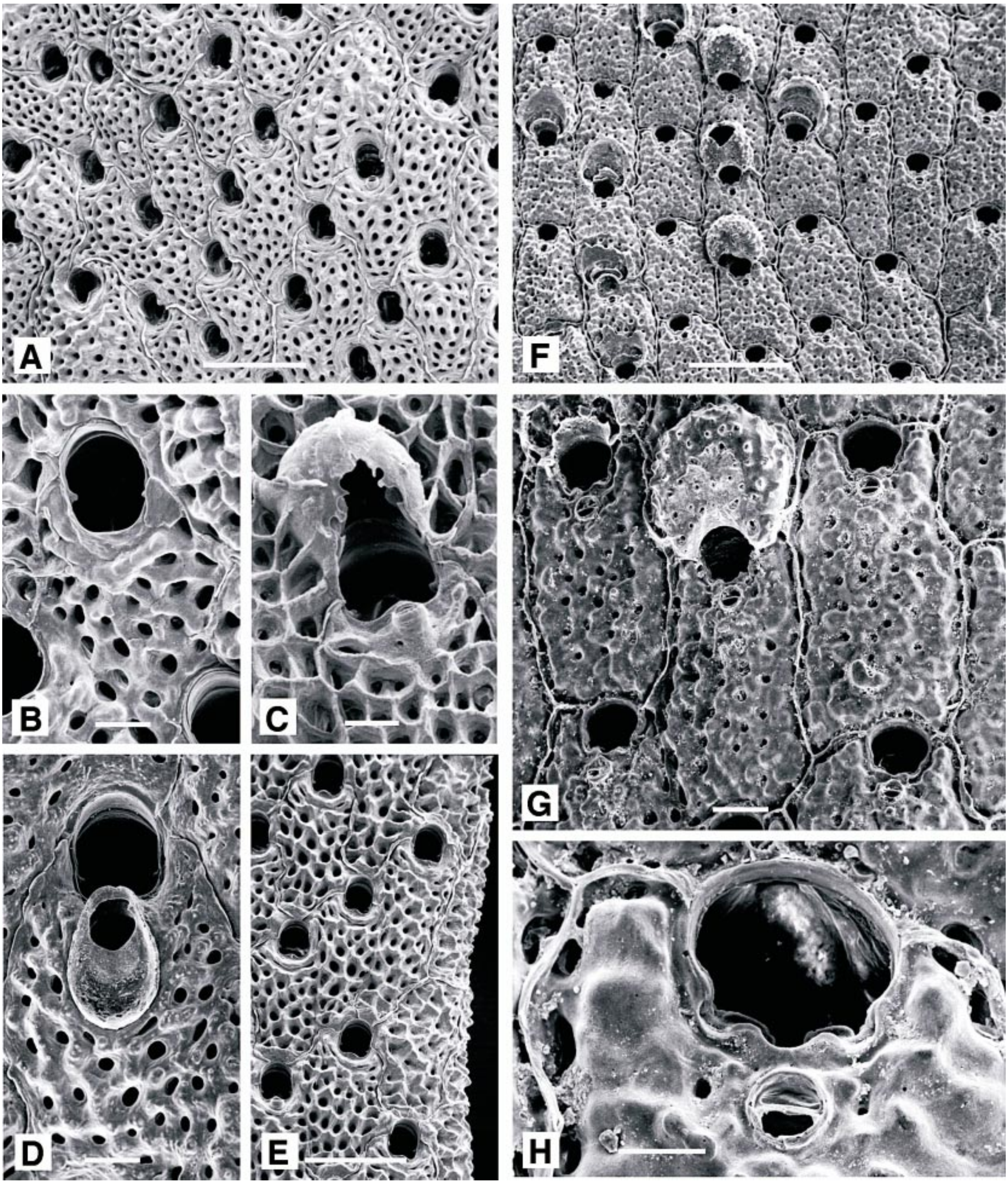

Fig. 25. **A–E.** *Pentapora fascialis*. **A.** General aspect (AMNH 945; 0.5 mm). **B.** Autozooid (AMNH 946; 0.1 mm). **C.** Maternal zooid with partially calcified ovicell and small suboral avicularium (AMNH 945; 0.1 mm). **D.** Autozooid with large suboral avicularium (AMNH 947; 0.1 mm). **E.** straight colony margin generated by kenozooids (AMNH 945; 0.5 mm). **F–H.** *Schizomavella asymetrica* (AMNH 948). **F.** General aspect (0.5 mm). **G.** Autozooid (right) and (center) maternal zooid with ovicell (0.1 mm). **H.** Autozooidal orifice (0.05 mm).

growth rate with increased size of colonies (Cocito et al., 1998a). Recovery of *P. fascialis* from the northern Adriatic anoxic events of the late 1980s has been much slower than 3.5-year recovery of the species at a shallower site in the Ligurian Sea following a severe storm in the early 1990s (Cocito et al., 1998b). Where little disturbed by humans, *P. fascialis* normally grows in exposed positions; large colonies offshore of Rovinj commonly are found attached to gorgonians or flexible bryozoans, which reduces wave and current fragmentation. In other areas of the Mediterranean, *P. fascialis* grows in exposed positions on rock in depths as shallow as 11 m, although single severe storms can eliminate such shallow populations (Cocito et al., 1998b). In areas frequented by divers, colonies are less frequent, smaller, and more cryptic (Sala et al., 1996).

OCCURRENCE: With the exception of two localities (18, 19) approximately 20 m deep where colony fragments were dredged, *Pentapora fascialis* was found at 29 m and greater depths (summer thermocline is at about 29 m depth; Marinković, 1959), growing on rock walls or more commonly on cobbles or on gorgonian stalks. Large colonies, over 30×20×20 cm, were especially common on gorgonian stalks attached to cobbles and boulders on the sand floor northeast of Pelago Island at 30 m and greater depth.

DISTRIBUTION: Found from the Hebrides and the western coasts of Britain and Ireland southwards, and throughout the Mediterranean. Characteristic of current-swept coarse grounds.

MEASUREMENTS (SKELETAL): AL(normal) 93 ± 19 μm, 63–132 (2, 20), AW(normal) 71 ± 15, 43–101 (2, 20), AL(spatulate) 335 ± 29, 287–372 (1, 6), AW(spatulate) 188 ± 15, 163–206 (1, 6), DO 532 ± 102, 383–757 (2, 20), OL 197 ± 26, 164–247 (2, 20), OW 165 ± 20, 132–199 (2, 20), OvL 363 ± 20, 320–383 (1, 10), OvW 315 ± 17, 294–345 (1, 10), ZL 815 ± 70, 658–966 (2, 20), ZW 451 ± 40, 383–539 (2, 20). (POLYPIDE): IH 152 ± 95 μm, 60–440 (3, 19), LD 735 ± 121, 540–920 (3, 25), MDMn 28 ± 5, 20–35 (2, 11), MDMx 34 ± 7, 20–40 (2, 11), TLMn 639 ± 135, 380–920 (3, 23), TLMx 694 ± 116, 400–920 (3, 24).

GENUS *SCHIZOMAVELLA* CANU AND BASSLER, 1917

Schizomavella asymetrica (Calvet, 1927)

Figure 25F–H

Schizoporella auriculata var. *asymetrica* Calvet, 1927: 20. Gautier, 1962: 134.

Calyptotheca triarmata Hayward, 1974: 381, fig. 5b.

Schizomavella cuspidata (in part): Reverter-Gil and Fernández-Pulpeiro, 1995: 265 (fig. 4G only). Hayward and Ryland, 1999: fig. 131D only.

DESCRIPTION (AMNH 948): Colonies encrusting sheets, multiserial, unilaminar or with frontally budded patches. Autozooids rectangular to irregularly polygonal, rather flat, separated by distinct, raised sutures. Primary orifice wider than long, its greatest width at midlength; proximal border with a shallow, U-shaped median sinus, occupying one-fifth of its width, accentuated by raised shoulders and broad, deep condyles which extend from the edges of the sinus, almost to lateral rim of orifice. Two or three indistinct distal oral spine bases visible in some autozooids, but most apparently lack spines entirely. Frontal shield thick, nodular, perforated by large, well-spaced pores, the marginal pores especially conspicuous. Avicularium median suboral, on a small prominence, close to proximal orifice rim but distinct from it; monomorphic, the rostrum parallel to frontal plane, proximally directed, small, broadly oval, with a complete crossbar but no palate. Ovicell distinctive: hyperstomial, recumbent on distally succeeding autozooid but projecting well above frontal plane; broader than long, the frontal surface pierced by as many as 20 small pores, developing a spiky, distal ooecial cover.

REMARKS: Elevation of Calvet's (1927) variety *asymetrica* to full species rank is prompted by Reverter-Gil and Fernández-Pulpeiro (1995), who published a micrograph showing the primary orifice in a specimen which they stated to be identical to material labeled ''var. *asymetrica*'' in Calvet's hand. It is unquestionably the same species as that described and figured here. Reverter Gil and Fernández Pulpeiro (1995) considered var. *asymetrica* to fall within the range of variation displayed by *S. cuspidata* (Hincks,

1880) as recently redefined (Hayward and Thorpe, 1995). However, the primary orifice of that species differs subtly in shape from that of var. *asymetrica*, being more rounded laterally, and the avicularia are dissimilar in the two species. In *S. cuspidata* the avicularium is always elongate oval and is polymorphic; the proximal rim of the rostrum is continuous with the proximal rim of the primary orifice; finally, in all avicularia there is a substantial palate with a characteristic trifoliate foramen. In *S. asymetrica* the avicularium is monomorphic, shortly oval and lacks a palate; further, it is distant from, and quite unattached to, the rim of the primary orifice. The frontal shield of *S. cuspidata* has fewer, smaller pores than that of *S. asymetrica*, and the ovicell is far less prominent, with fewer, larger pores, while the projecting ovicell of *S. asymetrica* bears up to 20 small pores frontally.

Calvet (1927) characterized var. *asymetrica* especially by the suboral avicularium, which he noted to be umbonate and laterally displaced with reference to the sinus. Gautier (1962) noted that in specimens from the western Mediterranean, the avicularium was either symmetrically or asymmetrically developed. In the present material the avicularium is consistently median suboral in position, but in specimens of what is certainly the same species from Chios, Aegean Sea, some autozooids display asymmetrical development of the avicularium, while in others a median avicularium may be accompanied by one or two lateral suboral avicularia. These specimens were described as *Calyptotheca triarmata* by Hayward (1974), and reexamination of the holotype specimen (NHM 1973.4.4.4) shows *C. triarmata* to be a junior subjective synonym of *Schizomavella asymetrica* (Calvet, 1927).

DISTRIBUTION: The species was first described from the vicinity of Monaco (Calvet, 1927); Gautier (1962) recorded specimens from the same region and also from the Gulf of Marseille and Tunisia. The specimen illustrated by Hayward and Ryland (1999, fig. 131D) is a Norman collection specimen (NHM 1911.10.1.1538) from an unknown British locality.

MEASUREMENTS (SKELETAL): DO 378 ± 46 μm, 330–445 (1, 10), OL 88 ± 5, 82–97 (1, 10), OW 98 ± 5, 86–104 (1, 10), OvL 278 ± 17, 250–306 (1, 10), OvW 280 ± 28, 240–320 (1, 10), SL 11 ± 2, 9–15 (1, 10), SW 20 ± 2, 18–26 (1, 10), ZL 511 ± 27, 472–548 (1, 10), ZW 359 ± 20, 324–382 (1, 10).

Schizomavella cornuta (Heller, 1867)

Figure 26A–D

Lepralia cornuta Heller, 1867: 110.
Schizoporella auriculata var. cuspidata Hincks, 1880: 261.
Schizomavella cuspidata: Hayward and Ryland, 1999: 286, fig. 131A–C (not 131D).

NEOTYPE (chosen here): UIIZ 270.

DESCRIPTION (AMNH 895, 949; CMRR 2235): Colonies cream-colored, encrusting, multiserial, unilaminar to multilaminar, often developing thick nodular formations. Autozooids rectangular in newly grown, unilaminar colonies, usually irregularly polygonal in multilaminar colonies developed through frontal budding; individual boundaries generally distinct, as narrow, raised ridges. Primary orifice characteristic: wider than long, with greatest width at midlength; proximal border with a short, symmetrical, U-shaped sinus defined by short lobes of the proximal orifice rim, proximal corners of orifice deeply notched; condyles short, broad and thick, extending from, and emphasizing, the sinus into the proximal corners of the orifice. Two to six distal oral spines present in early ontogeny, commonly obscured during later ontogeny. Ancestrula small, tatiform, opesia surrounded by nine marginal spines. Avicularium suboral, proximally directed, with rostrum almost parallel to frontal plane; dimorphic: short, oval, ca. 0.06 mm long, or ca. 0.2 mm long, narrowly spoon-shaped, with slightly concave sides and gently expanded distal end. In both types of avicularia, proximal rim of rostrum continuous with outer rim of sinus, and a thick cross bar with a stout columella divides proximal portion of narrow palatal foramen to form a distinctive Y shape. Ovicell broader than long, flattened frontally, with few (ca. 5) large, irregular pores immediately distal to the arched aperture; developing a nodular ooecial cover in later ontogeny.

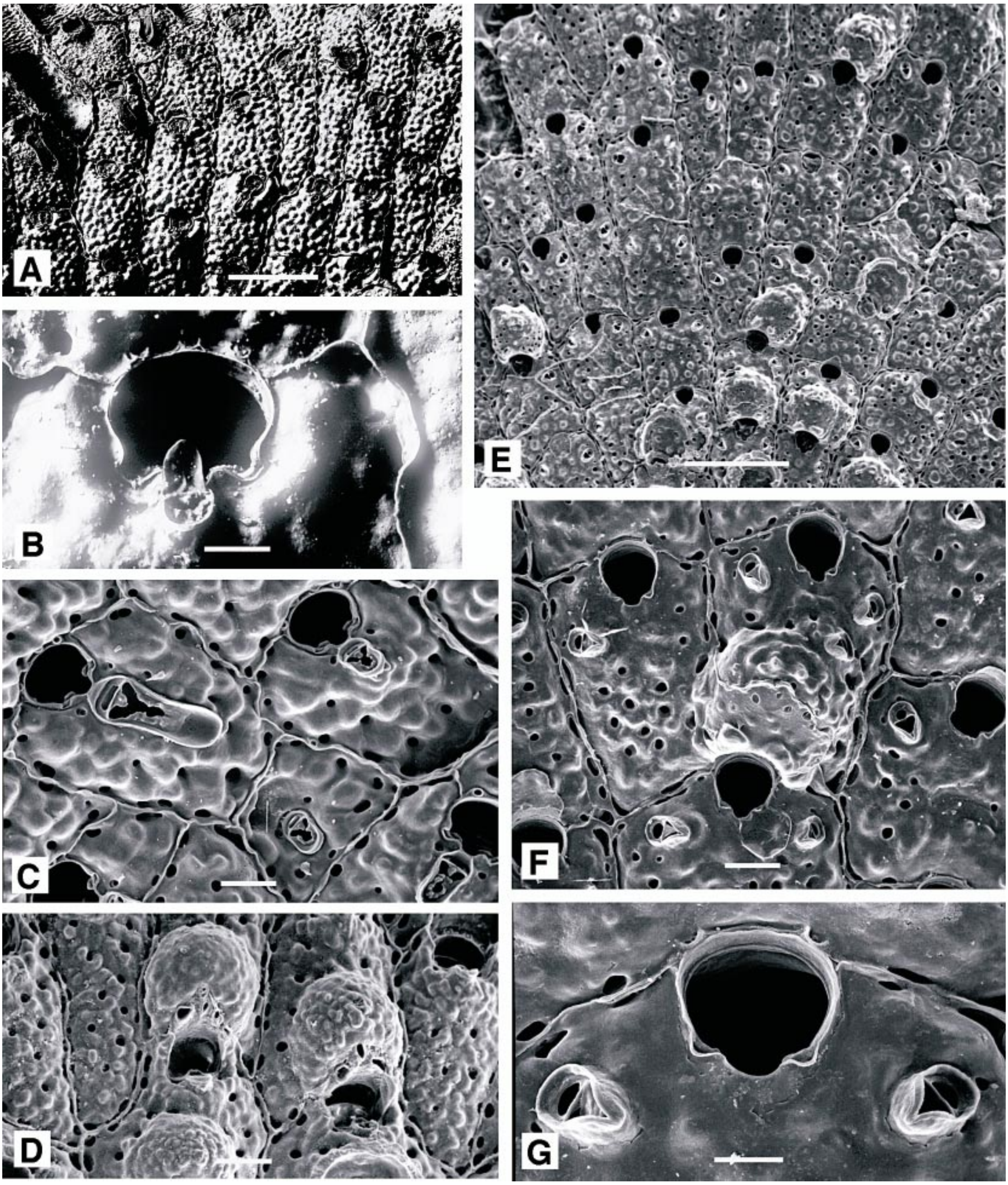

Fig. 26. **A–D.** *Schizomavella cornuta*. **A.** General aspect (neotype, UIIZ 270; 0.5 mm). **B.** Orifice of autozooid (neotype, UIIZ 270; 0.05). **C.** autozooids and kenozooid (bottom right), with variable-sized suboral avicularia (AMNH 949; 0.1 mm). **D.** Maternal zooids with ovicells (AMNH 895; 0.1 mm). **E–G.** *Schizomavella linearis* (AMNH 950). **E.** General aspect (0.5 mm). **F.** Autozooids and (bottom center) maternal zooid with ovicell (0.1 mm). **G.** autozooidal orifice (0.05 mm).

Embryo color medium orange to dark, brick-red.

REMARKS: As *Schizomavella cuspidata*, this species has only recently been redescribed and distinguished from *S. auriculata* (Hassall), with which it was for long confused (Hayward and Thorpe, 1995). However, as recognized by Friedl (1917: 272), part of Heller's material of *Lepralia cornuta* in the University of Innsbruck collections has affinities with *Schizomavella auriculata* (referred to as *Smittina auriculata* by Heller). We designate UIIZ specimen 270, illustrated here as fig. 26A and 26B, as neotype of *Lepralia cornuta* because it may not have been in Heller's possession when he named the species. If eventually discovered to be a specimen on which Heller originally described *Lepralia cornuta*, it should be redesignated as lectotype. UIIZ 270 is conspecific with *S. cuspidata*, and *Lepralia cornuta* is senior objective synonym of the two.

DISTRIBUTION: It is common on northwest European coasts, although its geographical and ecological Distribution is still incompletely known. In the Mediterranean its occurrence is even more imprecisely described through confusion with numerous other species of *Schizomavella*. The ovicell figured by Hayward and Ryland (1999, fig. 131D) is not that of *S. cuspidata*, but rather *S. asymetrica*, here redescribed for the first time.

MEASUREMENTS (SKELETAL): AL(normal) 63 ± 9 μm, 48–81 (2, 20), AW(normal) 68 ± 8, 54–84 (2, 20), AL(spatulate) 149 ± 16, 131–175 (1, 6), AW(spatulate) 65 ± 9, 55–76 (1, 6), DO 409 ± 66, 317–526 (2, 20), OL 86 ± 6, 75–98 (2, 20), OW 102 ± 4, 94–104 (2, 20), SL 20 ± 2, 16–24 (2, 20), SW 27 ± 4, 21–34 (2, 20), ZL 458 ± 39, 383–510 (2, 20), ZW 347 ± 52, 244–460 (2, 20).

Schizomavella linearis (Hassall, 1841)

Figure 26E–G

Lepralia linearis Hassall, 1841: 368.
Schizomavella linearis: Gautier, 1962: 140. Zabala, 1986: 473. Zabala and Maluquer, 1988: 132. Hayward and Thorpe, 1995: 671.

DESCRIPTION (AMNH 950; CMRR 2236): Colonies encrusting, multiserial, unilaminar to multilaminar sheets. Autozooids quadrangular to polygonal, rather flat, vertical walls distinct; frontal shield nodular, with conspicuous marginal perforations, and few, large pores medially. Primary orifice as wide as long, broadest at midlength; sinus short, U-shaped, occupying about half width of proximal border; condyles short, broad and rounded. Two or three slender distal oral spines present. Avicularia single or paired, lateroproximal to orifice; rostrum narrowly acuminate, typically directed medially or proximo-medially, occasionally distally. Large adventitious avicularia sporadic, characteristic: cystid domed, occupying entire frontal shield of bearing autozooid, mandible narrowly crescentic, 0.25 mm wide. Ovicells broader than long, flattened frontally, with numerous irregular pores and an umbonate ooecial cover.

DISTRIBUTION: This species is common on north European coasts. It has been recorded previously in the Mediterranean but is perhaps far less frequent on southern European coasts. It was the least common of the described species of *Schizomavella* found at Rovinj.

MEASUREMENTS (SKELETAL): AL(normal) 107 ± 9 μm, 88–121 (2, 21), AW(normal) 88 ± 10, 70–105 (2, 21), DO 412 ± 78, 315–576 (2, 20), OL 108 ± 10, 90–122 (2, 20), OW 91 ± 8, 81–106 (2, 20), OvL 256 ± 22, 236–301 (1, 10), OvW 297 ± 30, 282–329 (1, 10), SL 24 ± 4, 19–29 (2, 20), SW 26 ± 7, 16–38 (2, 20), ZL 491 ± 47, 426–586 (2, 20), ZW 333 ± 50, 265–461 (2, 20).

Schizomavella mamillata (Hincks, 1880)

Figure 27A–C

Schizoporella linearis var. *mamillata* Hincks, 1880: 248.
Schizomavella mamillata: Gautier, 1958: 199. Zabala, 1986: 475. Zabala and Maluquer, 1988: 132.
Schizomavella linearis var. *mamillata*: Gautier, 1962: 143. Harmelin, 1969a: 1201.

DESCRIPTION (AMNH 951, 952; CMRR 2237): Colonies orange, encrusting, multiserial, multilaminar, developing a massive mamillate form. Autozooids rectangular to irregularly polygonal, in regular series at unilaminar growing edges, randomly orientated in areas of vigorous frontal budding; boundaries always distinct, marked by thin raised

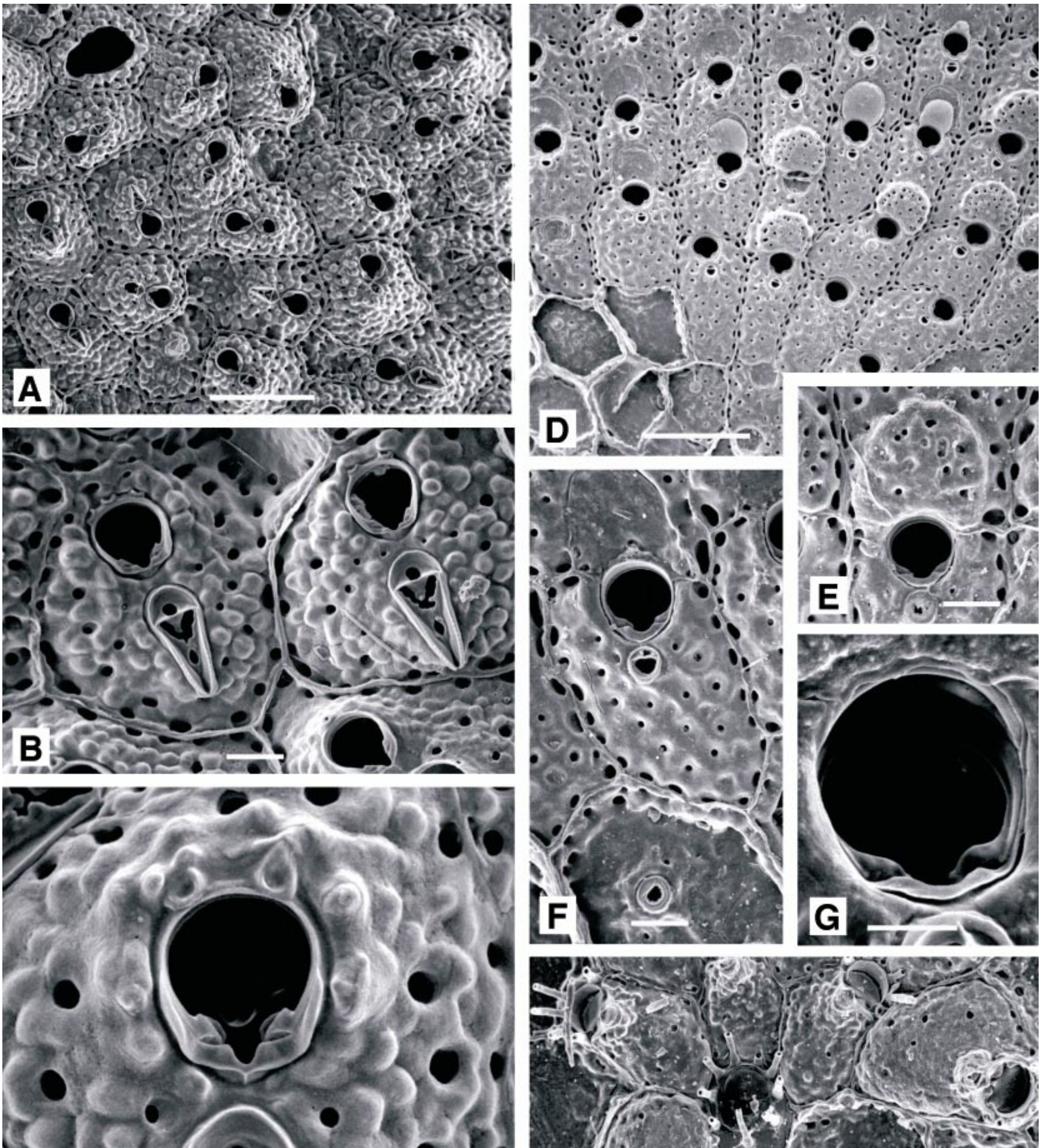

Fig. 27. **A–C.** *Schizomavella mamillata*. **A.** General aspect (AMNH 951; 0.5 mm). **B.** Autozooids (AMNH 952; 0.1 mm). **C.** Autozooidal orifice (AMNH 952; 0.05 mm). **D–H.** *Schizomavella rudis*. **D.** General aspect (AMNH 953; 0.5 mm). **E.** Maternal zooid with ovicell (AMNH 953; 0.1 mm). **F.** Autozooid (AMNH 953; 0.1 mm). **G.** Autozooidal orifice (AMNH 954; 0.05 mm). **H.** Ancestrula and early autozooids (AMNH 932; 0.1 mm).

sulci. Primary orifice longer than wide, tapered proximally, midproximal border with a short, symmetrical rounded notch; thick, faceted condyles on each side of notch define a deep, V-shaped sinus. Oral spines absent to four, most commonly two. Peristome developed as a thin, inconspicuous rim, most pronounced, and slightly flared, on each side of sinus. Frontal shield convex, nodular and vitreous, evenly perforated. Avicularium diagnostic: median suboral, monomorphic, directed proximally, slightly acute to frontal plane; rostrum elongate triangular, its tip downcurved and finely denticulate; crossbar complete, with median columella, palate with trifoliate foramen. Ovicell hyperstomial, prominent, about as wide as long, with 10–15 large pores frontally.

Tentacles light orange, 14–15; lophophores bell-shaped, radially symmetrical between chimneys and obliquely truncate adjacent to chimneys.

REMARKS: We here designate as lectotype BMNH specimen 1899.5.1.1059, Hincks Collection, from Algiers.

DISTRIBUTION: Apparently widespread and common throughout the Mediterranean, on shallow, coarse detrital grounds.

MEASUREMENTS (SKELETAL): AL 191 ± 26 μm, 153–247 (2, 210), AW 127 ± 17, 104–151 (2, 21), DO 520 ± 90, 351–664 (2, 20), OL 106 ± 11, 94–141 (2, 20), OW 100 ± 8, 88–116 (2, 20), SL 28 ± 6, 19–36 (2, 20), SW 32 ± 4, 25–42 (2, 20), ZL 690 ± 70, 563–822 (2, 20), ZW 398 ± 45, 351–502 (2, 20). (POLYPIDE): IH 110 ± 37 μm, 60–180 (1, 7), LDMn 478 ± 65, 420–660 (1, 12), LDMx 500 ± 68, 420–660 (1, 12), MD 26 ± 2, 25–30 (1, 4), TLMn 514 ± 38, 470–580 (1, 8), TLMx 540 ± 66, 480–680 (1, 8).

Schizomavella rudis (Manzoni, 1869)

Figure 27D–H

Lepralia rudis Manzoni, 1869a: 18.
Schizomavella rudis: Gautier, 1962: 146. Zabala, 1986: 478. Zabala and Maluquer, 1988: 132. Reverter-Gil and Fernández-Pulpeiro, 1995: 261.

DESCRIPTION (AMNH 932, 953, 954 CMRR 2238): Colonies cream-colored, orange, or red; multiserial, encrusting, unilaminar. Autozooidal frontal wall uniformly porous and with small areolae, lacking suboral umbo; autozooidal orifice roughly equidimensional, lacking distal spines and orificial peristome, proximal sinus relatively wide and defined by essentially smooth condyles. Suboral, small, oval, laterally or proximally orientated adventitious avicularium present on some autozooids. Ovicells prominent, emergent, perforated by pores distributed in a semi-lunar region partially encircling a proximal, pore-free region adjacent to the orifice.

Tentacles 13–15; lophophores bell-shaped, radially symmetrical midway between chimneys to strongly obliquely truncate (some campylonemidan) at chimneys and colony margins; adjacent lophophores overlapped up to at least 50 μm.

REMARKS: Reverter-Gil and Fernández-Pulpeiro (1995) characterized *S. rudis* as usually having pores on the ovicell confined to a central, essentially circular area, but occasionally having them distributed in a semilunar region partially encircling a proximal, pore-free region adjacent to the orifice. All specimens of *S. rudis* examined from the vicinity of Rovinj have the semilunar distribution of pores.

OCCURRENCE: Encrusts diverse bivalve substrata.

DISTRIBUTION: Gautier (1962) recorded this species from numerous localities in the western Mediterranean, from 20–80 m depth, most often encrusting biogenic carbonates.

MEASUREMENTS (SKELETAL): AL 57 ± 11 μm, 50–70 (3, 15), AW 52 ± 13, 40–90 (3, 15), DO 377 ± 64, 270–480 (3, 30), OL 101 ± 9, 80–110 (3, 15), OW 100 ± 10, 80–120 (3, 15), ZL 530 ± 62, 440–620 (3, 15), ZW 360 ± 55, 300–480 (3, 15). (POLYPIDE): IH 165 ± 74 μm, 100–310 (2, 15), LDMn 556 ± 82, 440–720 (2, 12), LDMx 608 ± 113, 460–780 (2, 18), MD 25.7 ± 2.6, 25–30 (2, 16), TLMn 462 ± 98, 300–600 (2, 13), TLMx 649 ± 134, 400–840 (2, 16).

***Schizomavella subsolana*, new species**

Figure 28A–D

HOLOTYPE: AMNH 955.

PARATYPES: AMNH 956, 901; CMRR 2239–2240.

DIAGNOSIS: Primary orifice nearly equidi-

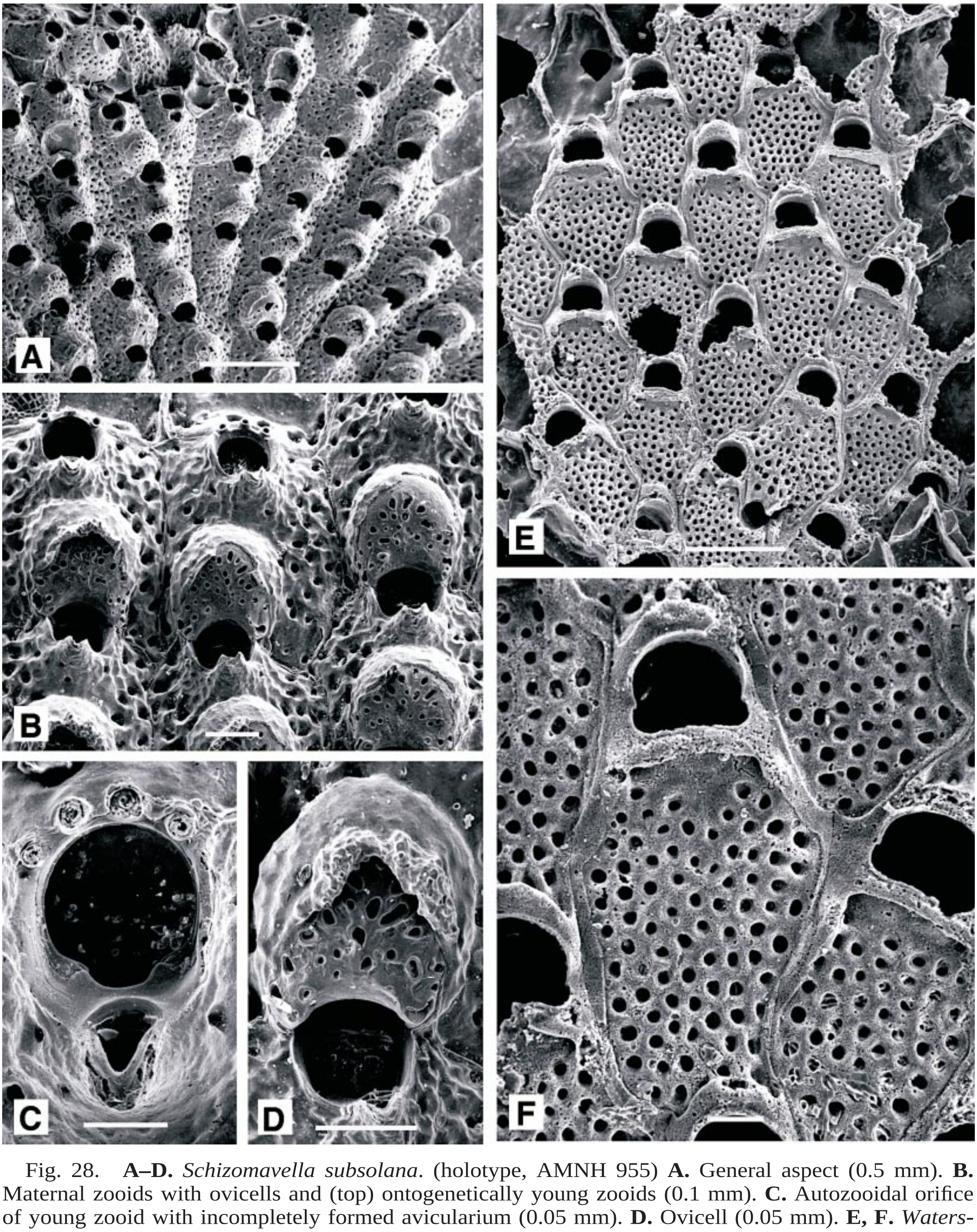

Fig. 28. **A–D.** *Schizomavella subsolana*. (holotype, AMNH 955) **A.** General aspect (0.5 mm). **B.** Maternal zooids with ovicells and (top) ontogenetically young zooids (0.1 mm). **C.** Autozooidal orifice of young zooid with incompletely formed avicularium (0.05 mm). **D.** Ovicell (0.05 mm). **E, F.** *Waters-ipora complanata* (AMNH 957). **E.** General aspect (0.5 mm). **F.** Autozooid (0.1 mm).

mensional, with shallow sinus; three to five distal oral spines; single small suboral avicularium with elongate triangular rostrum, steeply inclined to plane of orifice.

ETYMOLOGY: The species name is from the Latin *sub* (under) and *sol* (sun) in recognition of its discovery along a coast that is a popular summer holiday destination.

DESCRIPTION: Colonies cream-colored, small, rounded, multiserial, unilaminar patches. Autozooids in regular, radiating lines, oval to hexagonal, separated by deep grooves. Frontal shield steeply convex, distinctly umbonate distally, umbo incorporating median, suboral avicularium; rugose, evenly perforated by small, round pores. Primary orifice slightly wider than long, a shallow sinus occupying more than half its proximal width, between short, inconspicuous condyles. Three to five (commonly four) distal oral spines present; peristome developed as a low rim, extending, on each side, from proximal-most spine to avicularium, deepest proximally. Avicularium almost perpendicular to plane of orifice, rostrum elongate triangular. Ovicell slightly broader than long, flattened frontally, with 20–30 irregular pores; initially smooth, but developing a coarse ooecial cover, co-extensive with the frontal shield of distally succeeding autozooid.

REMARKS: The taxonomy of north European species of *Schizomavella* was reviewed and revised by Hayward and Thorpe (1995), who redescribed and illustrated five species. Subsequently, new species have been described from both north European and Mediterranean localities (Reverter-Gil and Fernández-Pulpeiro, 1995, 1997), and the taxonomy of some west Mediterranean species has also been clarified. However, the systematics of the genus in the Mediterranean as a whole remains in need of revision. This new species differs from all of those recently described or redescribed; its distinctive suite of characters includes the primary orifice, with an especially broad sinus, three to five oral spines, and the comparatively large, frontally directed avicularium. It does not seem to have been noted in any of the literature treating ''varieties'' of Mediterranean *Schizomavella* species (e.g., Gautier, 1962).

MEASUREMENTS (SKELETAL): AL 88 ± 11 μm, 74–115 (2, 20), AW 95 ± 12, 78–130 (2, 20), DO 366 ± 42, 274–433 (3, 30), OL 85 ± 6, 78–100 (2, 12), OW 88 ± 8, 78–104 (2, 20), OvL 201 ± 27, 155–248 (3, 30), OvW 205 ± 15, 178–239 (3, 30), SL 18 ± 7, 9–34 (2, 12), SW 50 ± 6, 35–56 (2, 12), ZL 431 ± 30, 386–490 (3, 30), ZW 309 ± 36, 275–339 (3, 30).

FAMILY WATERSIPORIDAE VIGNEAUX, 1949

GENUS *WATERSIPORA* NEVIANI, 1895

Watersipora complanata (Norman, 1864)

Figure 28E, F

Lepralia complanata Norman, 1864: 85.
Watersipora complanata: Hayward and Ryland, 1999: 192.

DESCRIPTION (AMNH 957; CMRR 2241): Colonies brown, spreading multiserial, unilaminar sheets. Autozooids oval to hexagonal, flat or slightly convex, separated by distinct raised ridges. Primary orifice as wide as long, more or less bell-shaped, with lateral rims curving inwards towards small, downcurved condyles just above the proximal border, which is straight-edged but arched frontally. No spines. Orifice rim thickens in later ontogeny, forming pronounced distal and proximal lips. Frontal shield smooth, vitreous, glistening, densely perforated by small round pores, except for a small area immediately proximal to orifice. No avicularia. No ovicells.

DISTRIBUTION: *Watersipora complanata* is probably widely distributed in the Mediterranean. although it has been reported on relatively few occasions. Outside of the Mediterranean, it is known only from the Scilly Isles, southwest England, where it is common on the lower shore, encrusting a wide range of substrata.

MEASUREMENTS (SKELETAL): DO 471 ± 75 μm, 344–709 (3, 30), OL 121 ± 13, 100–166 (3, 30), OW 171 ± 22, 135–211 (3, 30), ZL 692 ± 66, 588–813 (3, 30), ZW 390 ± 61, 277–503 (3, 30).

Watersipora subovoidea (d'Orbigny, 1852)

Figure 29A, B

Cellepora ovoidea Audouin, 1826: 238. Savigny, 1809: pl. 8, fig. 1.
Cellepora subovoidea d'Orbigny, 1852: 402.
Lepralia cucullata Busk, 1854: 81.

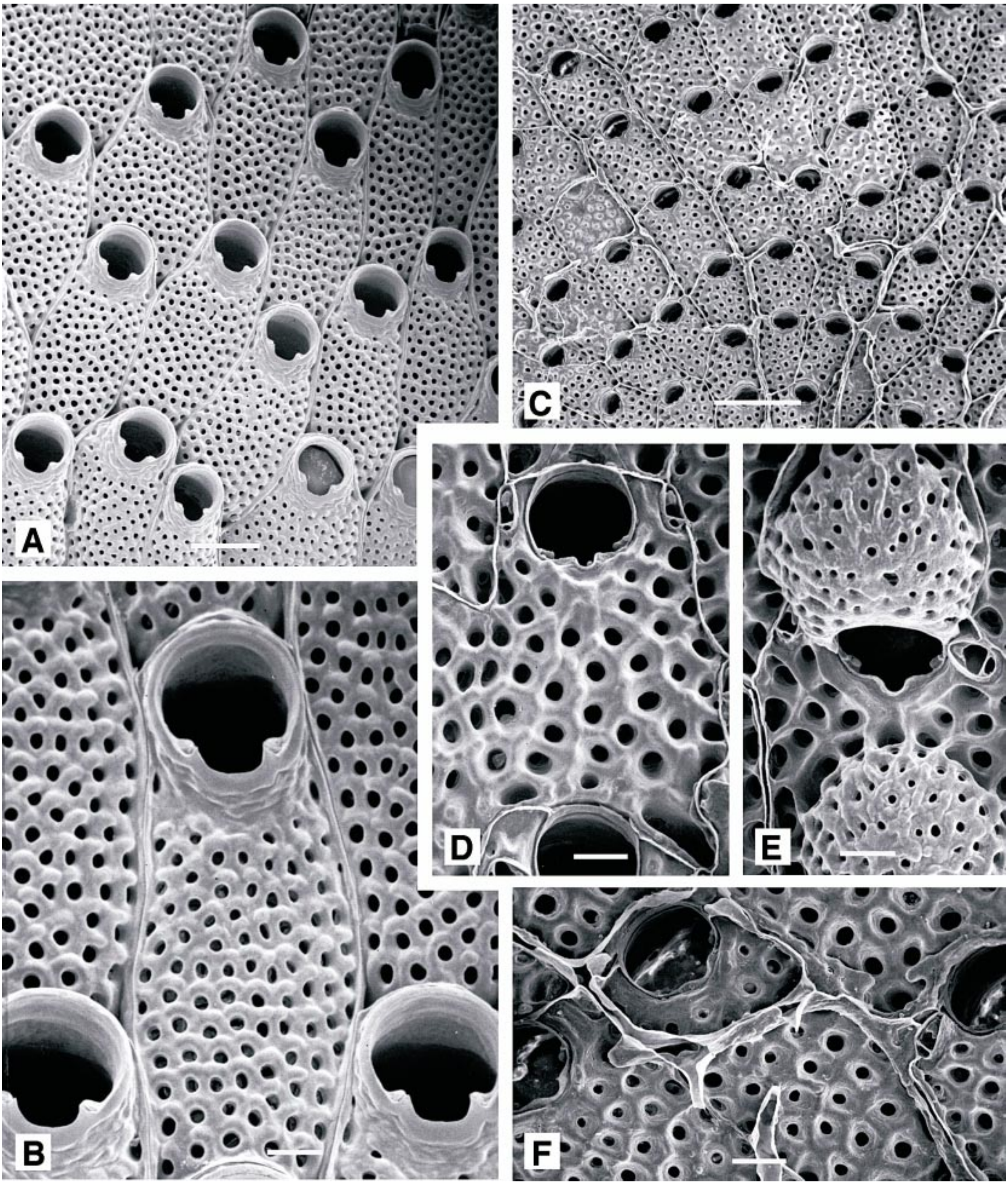

Fig. 29. **A, B.** *Watersipora subovoidea* (AMNH 958). **A.** General aspect (0.5 mm). **B.** Autozooid (0.1 mm). **C–F.** *Schizobrachiella sanguinea*. **C.** General aspect of surface with bryozoan-calcified tubes that enclosed commensal hydroid stolons along some colony boundaries (AMNH 959; 0.5 mm). **D.** Autozooid (AMNH 960; 0.1 mm). **E.** Maternal zooid with ovicell (AMNH 950; 0.1 mm). **F.** Calcified butes that enclosed stolons of commensal hydroid (AMNH 959; 0.1 mm).

Watersipora subovoidea: Gautier, 1962: 183. Zabala, 1986: 396.

DESCRIPTION (AMNH 958; CMRR 2242): Colonies spreading, multiserial, unilaminar, deep purple to black sheets to erect bilaminar plates (not seen in present material), often with zooidal boundaries and colonial organization difficult to recognize in living specimens. Autozooids with thick, deep purple to black epitheca, and deep black operculum. Autozooidal skeletons with densely and uniformly perforated cryptocystidean frontal shield. Primary orifice slightly wider than long, with robustly thickened rim and broad, U-shaped sinus occupying half of width of proximal edge between pointed, upturned condyles.

Tentacles bright red (carmine), 23–26; lophophores bell-shaped, radially symmetrical, supported on long introverts.

REMARKS: All of our material formed jet black, unilaminar sheets encrusting rock, with the black color extending all the way to the growing edge, and with zooidal boundaries and opercula indistinguishable under the microscope when alive. Soule and Soule (1975) and Gordon (1989) discussed some of the tortuous synonymy of a group of confused watersiporids that includes ''*W. subovoidea*.'' Gordon (1989) justified use of the epithet *subtorquata* in preference to *subovoidea* for the widespread fouling species that occurs in the Pacific ocean. Our specimens exhibit several differences from the characteristics of *W. subtorquata* as described and illustrated in Gordon (1989) and Gordon and Mawatari (1992). The New Zealand *W. subtorquata* has smaller (0.74–0.85 mm length), orange lophophores (very light-colored in Gordon and Mawatari, 1992, Plate 1D) comprising 24 tentacles; colonies grade from black or dark gray in colony centers to dull orange peripherally, with broad orange margins; and the species is a common fouler in harbors and marinas, whereas specimens that we assign to *W. subovoidea* were found only on rock in clean water well away from harbors. *W. subtorquata* and *W. subovoidea* may be two names applied to a single, widely distributed and variable species, or more likely, as implied by Soule and Soule (1975) they refer to an inadequately discriminated species complex.

DISTRIBUTION: Throughout the Mediterranean, and for some unknown distance beyond, depending upon resolution of the taxonomy of the species or species complex.

MEASUREMENTS (SKELETAL): DO 682 ± 91 μm, 500–820 (2, 20), OL 239 ± 1 2, 219–265 (2, 20), OW 249 ± 14, 216–266 (2, 20), SL 56 ± 11, 39–78 (2, 20), SW 127 ± 14, 96–148 (2, 20), ZL 998 ± 114, 772–1236 (2, 20), ZW 514 ± 65, 378–673 (2, 20). (POLYPIDE): IH 492 ± 81 μm, 340–700 (1, 17), LD 1261 ± 178, 1060–1620 (1, 12), MDMn 35 ± 6, 30–40 (1, 4), MDMx 42.5 ± 5, 40–50 (1, 4), TL 1154 ± 129, 900–1400 (1, 16), TN 25 ± 1.3, 23–28 (1, 16).

SUPERFAMILY SCHIZOPORELLOIDEA JULLIEN, 1882

FAMILY SCHIZOPORELLIDAE JULLIEN, 1882

GENUS *SCHIZOBRACHIELLA* CANU AND BASSLER, 1920

Schizobrachiella sanguinea (Norman, 1868)

Figure 29C–F

Hemeschara sanguinea Norman, 1868: 222.
Schizoporella sanguinea: Hincks, 1880: 252. Harmer, 1902: 303.
Schizobrachiella sanguinea: Canu and Bassler, 1930: 32. Gautier, 1962: 128. Zabala, 1986: 460. Zabala and Maluquer, 1988: 130. Hayward and Ryland, 1999: 222.

DESCRIPTION (AMNH 959, 960; CMRR 2243): Colonies with bright red cuticle, encrusting, multiserial, unilaminar to multilaminar, occasionally as erect, folded plates only partly attached to the substratum; deep red when living, dull brown when dead and dried. Autozooids rectangular to irregularly polygonal, flat or slightly convex, separated by thin, raised sutures. Primary orifice wider than long; proximal border with a short, U-shaped sinus occupying about one-third its width, defined by prominent shoulders which intersect on each side with broad, angular condyles, such that orifice appears proximally tridentate. No oral spines or peristome. Frontal shield densely perforated by large round pores, each bordered by a thickened, raised rim. Avicularia adventitious, monomorphic, sporadic: typically developed on autozooid margins, adjacent or distal to orifice; small, < 0.1 mm long, inconspicuous, rostrum acute or rounded, orientation variable. Ovicell recumbent on succeeding autozooid, domed and prominent, slightly wider than long; densely perforated by small round pores and appearing coarsely tuberculate, closed by autozooid operculum.

Tentacles bright red to purple, 14–20 but with smaller range within individual colonies; lophophores bell-shaped, radially symmetrical between chimneys, obliquely truncate adjacent to chimneys; adjacent lophophores overlapped up to 100 μm.

Embryos dark purple to black. Ancestrula and astogeny were described by Friedl (1925).

REMARKS: Many colonies are infested with a commensal stoloniferous hydrozoan (*Halocoryne epizoica* Hadzi, 1917, according to Gautier, 1962: 394). The relationship is apparently obligate for the hydrozoan (Gautier, 1962) but not for the host species.

DISTRIBUTION: This distinctive species is widespread throughout the Mediterranean, encrusting organic carbonates in particular, and ranges north to the western approaches to the English Channel, and to southwest Cornwall, where it is rare. Harmelin et al. (1989) note the similarity between *S. sanguinea*, type species of *Schizobrachiella* Canu and Bassler, 1920, and species of the warm temperate to tropical genus *Calyptotheca* Harmer, 1957. Three species of *Calyptotheca* have been described from Mediterranean localities in recent years (Hayward, 1974; Harmelin et al., 1989), although one, *C. triarmata* Hayward, is here shown to be a synonym of *Schizomavella asymetrica* (Calvet).

MEASUREMENTS (SKELETAL): DO 514 ± 78 μm, 410–715 (2, 20), OL 162 ± 15, 135–188 (2, 20), OW 182 ± 19, 153–209 (2, 20), OvL 318 ± 60, 236–392 (2, 6), OvW 364 ± 30, 327–400 (2, 6), SL 16 ± 3, 10–20 (2, 20), SW 31 ± 4, 25–37 (2, 20), ZL 474 ± 43, 386–548 (2, 20), ZW 670 ± 46, 598–759 (2, 20). (POLYPIDE): IH 108 ± 58 μm, 10–260 (4, 38), LDMn 674 ± 113, 500–900 (4, 43), LDMx 705 ± 131, 500–1080 (4, 51), MD 38 ± 2, 30–40 (4, 20), TLMn499 ± 95, 380–780 (4, 30), TLMx 596 ± 139, 380–1000 (4, 38).

GENUS *SCHIZOPORELLA* HINCKS, 1877
(*nomen protectum*)

Schizoporella Hincks, 1877, is apparently a junior subjective synonym of *Multiporina* d'Orbigny, 1852, but the younger name is valid according to section 23.9.1 of the International Code of Zoological Nomenclature (Ride et al., 1999: 28).

The genus *Multiporina* was established by d'Orbigny (1852: 445) for his new species *Multiporina ostracites* (d'Orbigny, 1852: 445) from Oligocene deposits of Montmartre, Paris, France as type species. d'Orbigny gave only a diagnosis with no illustration, and the diagnosis was considered subsequently to be insufficient for the genus to be recognizable, for example, Bassler (1935: 152, 1953: G235). The name *Multiporina* has not been used to our knowledge since 1899 (except to note that it should be suppressed: Canu, 1908; Buge, 1975; Gordon, 1989, or is unrecognizable: Bassler, 1935, 1953).

Schizoporella was established by Hincks (1877: 527), with *Lepralia unicornis* Johnston in Wood (1844: 19) from the Pliocene Crag deposits of East Anglia as type species. Johnston (1847: 320, pl. 57, fig. 1), often is cited as the publication in which *Lepralia unicornis* was named. Recognition of the 1844 publication is important not only for the date and any implications of priority with respect to other names, but also because the 1847 publication describes living, not fossil material, which potentially is of importance in characterizing the species.

The genus name *Schizoporella* has been used in many more than 25 works (probably thousands of works) published by at least 10 authors during the past 50 years. Species of *Schizoporella* are prominent among marine fouling faunas (e.g., Geraci and Relini, 1970; Occhipinti Ambrogi, 1981; Brock, 1985), and in many instances they cover a high proportion of the substratum (Sutherland, 1977, 1978). The genus is species rich, found widely in the Atlantic and Pacific Oceans, ranges from shallow equatorial waters (e.g., Cook, 1985) to the highest latitudes (e.g., Kluge, 1975), is diverse and abundant in temperate waters (e.g., Maturo, 1957; Gautier, 1962; Winston, 1982; Zabala, 1986; Zabala and Maluquer, 1988; Gordon, 1989; Hayward and Ryland, 1999) and has an abundant fossil record (e.g., Ziko, 1985; Spencer and Campbell, 1987; Poluzzi et al., 1988; Moissette and Saint Martin, 1995). Consequently it is among the most frequently identified and recorded bryozoan genera by marine biologists in general, not just by bryozoan specialists. *Schizoporella* is noted as an exemplar in studies of benthic ecology (e.g., Buss, 1981; Lindberg and Stanton, 1989; Hurlbut, 1991; McKinney, 1992; Herrera and Jackson, 1996; Cocito et al., 2000), in comparative studies of feeding and related functions (Winston, 1977, 1978; M. J. McKinney, 1997), in evolutionary research (Schopf and Dutton, 1976), and among diverse other topics.

Canu (1908: 86) examined d'Orbigny's holotype of *Multiporina ostracites* and placed it in synonymy with *Schizoporella unicornis*, giving preference to both the trivial name *unicornis* and the generic name *Schizoporella*. Buge (1975: 50, pl. 4, fig. 3) also examined, and illustrated, d'Orbigny's holotype of *Multiporina ostracites*, agreeing with Canu in considering it to be synonymous with *Schizoporella unicornis*. Probably *ostracites* is not the same species as *unicornis*, inasmuch as cheilostome species seldom have a geological range sufficiently long to encompass both the Pliocene and Oligocene. Even if *Multiporina ostracites* and *Schizoporella unicornis* are not synonymous, they are closely related within the same genus. This interpretation is based on similarity of zooidal characters such as texture of perforations of the frontal wall; placement and shape of the orifice; and placement, shape, size, and orientation of the single adventitious avicularium per zooid. We here accept that *Schizoporella* is the valid name, and *Multiporina* should be suppressed.

Schizoporella unicornis (Johnston in Wood, 1844)

Figure 30A–E

Lepralia unicornis Johnston, in Wood, 1844: 19.
Schizoporella unicornis Hincks, 1877: 320. Hayward and Ryland, 1999: 220.

Description (AMNH 961): Colony encrusting, multiserial, unilaminar to multilaminar, developing extensive sheets. Autozooids rectangular to irregularly polygonal, strongly convex, separated by deep grooves. Primary orifice slightly wider than long, with a deep V-shaped sinus occupying about half width of proximal border; condyles small but distinctive, with acute upturned corners. No spines. Frontal shield with conspicuous epitheca, glistening in dried material; densely perforated by numerous small pores. Adventitious avicularia lateral to orifice, single or paired, situated adjacent to sinus; cystid swollen, rostrum acute to frontal plane, distolaterally directed, supporting a triangular mandible. Ovicell hyperstomial, globose; imperforate centrally, but developing a reticulate secondary calcification which appears porous; small pores present marginally, associated with conspicuous basal fluting. Ancestrula oval, tatiform, about half size of normal autozooids, at least five spines around distal end of opesia, producing single distal bud.

Distribution: *Schizoporella unicornis* is distributed in the northeast Atlantic region from western Norway to the western Mediterranean, and does not appear to have been reported previously from the Adriatic. Around the British Isles it is common in littoral and shallow sublittoral habitats, especially among kelp holdfasts and on the undersides of boulders.

Measurements (skeletal): AL 119 ± 14 μm, 94–134 (2, 8), AW 90 ± 14, 73–111 (2, 8), DO, 370 ± 70, 250–445 (2, 20), OL 102 ± 9, 85–119, 2, 21), OW 104 ± 6, 98–111 (2, 20), OvL 259 ± 25, 218–3–19 (2, 14), OvW 282 ± 16, 264–321 (2, 14), SL 27 ± 6, 17–38 (2, 21), SW 49 ± 7, 33–62 (2, 21), ZL 488 ± 36, 421–550 (2, 20), ZW 327 ± 59, 244–428 (2, 20).

Schizoporella errata (Waters, 1878)

Figure 30F–I

Lepralia errata Waters, 1878: 11.
Schizoporella errata: Hayward and Ryland, 1999: 212.

Description (AMNH 962; CMRR 2244): Colonies purple-brown with orange growing margins, multilaminar predominantly through frontal budding, often substantial. Autozooids irregularly polygonal and extremely variable in both size and shape; orientation inconstant in multilaminar colonies.

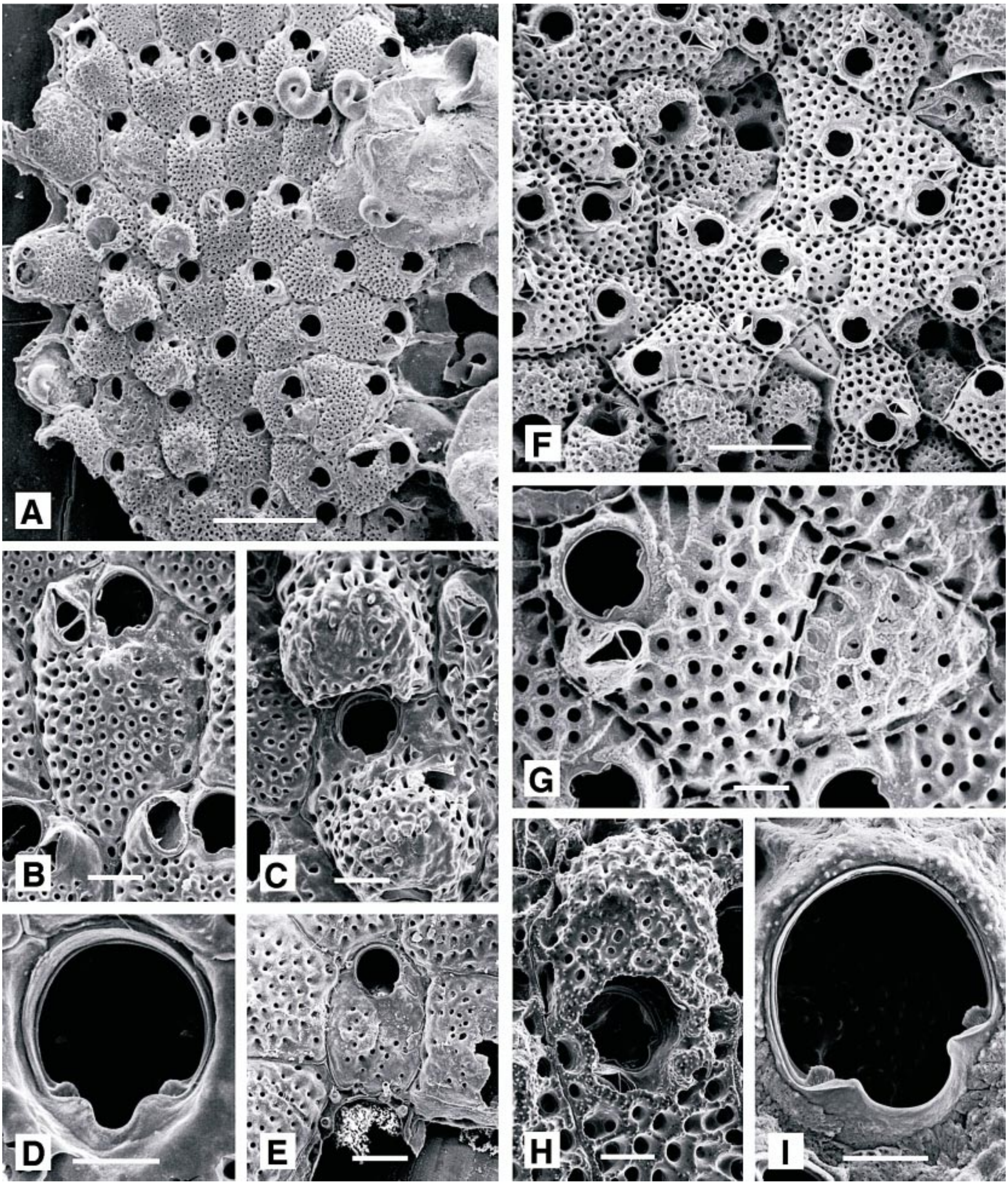

Fig. 30. **A–E.** *Schizoporella unicornis* (AMNH 961). **A.** general aspect (0.5 mm). **B.** Autozooid (0.1 mm). **C.** Maternal zooid with ovicell (0.1 mm). **D.** Autozooidal orifice (0.05 mm). **E.** Broken ancestrula (bottom) and first-budded autozooid (0.1 mm). **F–I.** *Schizomavella errata* (AMNH 962). **F.** General aspect of region with frontally budded autozooids (0.5 mm). **G.** Autozooid (left) and (right) kenozooid (0.1 mm). **H.** Maternal zooid with ovicell (0.1 mm). **I.** Autozooidal orifice (0.05 mm).

Orifice slightly longer than wide; the anter semielliptical, widest proximally; condyles short and rounded, lodged in proximolateral corners and rather inconspicuous; sinus a deep, symmetrical U-shape, occupying about half proximal width of orifice. No spines. Frontal shield convex, regularly and closely perforated by large, round pores, the intervening calcification thickening as sharp ridges. Avicularia sporadic, developed proximolaterally to the orifice, the rostrum sharply tapered, directed distolaterally. Ovicell globular, with scattered pores, calcification thickening and pores deepening in later ontogeny.

Tentacles light orange, 16–19; lophophores bell-shaped, radially symmetrical, slightly obliquely truncate bordering chimneys.

Embryos bright orange.

REMARKS: *S. errata* is a prolific fouling organism; it covers almost all the available hard human-constructed substrata in parts of the Rovinj harbor (locality 34) and the mussel-culture station in Lim Channel (locality 33). The structure in Rovinj harbor is exposed to vigorous hydrodynamic conditions, whereas the Lim Channel locality is protected, with very low kinetic energy conditions. Colony morphology at the harbor locality is massive, with irregular knobby surfaces and centimeter-wide, millimeter-high cavities in which sediment or other extraneous objects may be immured; colonies are more densely grown and lack such cavities at the mussel-culture station. At the mussel-culture station, two morphologies predominate: relatively smooth-surfaced multilaminar encrustations, and prolific, commonly hollow, erect branches. These differences in growth habits between the two localities parallel the morphologies that the species exhibits between high-energy and low-energy localities in the Ligurian Sea along the Italian coast (Cocito et al., 2000). However, the hollow centers of colonies found by Cocito et al. were generally very narrow and reflect growth around soft-bodied erect organisms such as hydroids. This may also be a cause for the initiation of erect growth at the Lim Channel mussel-culture station, but extensive portions of the erect branches there have broad, open centers that house vagrant organisms such as polychaetes and decapods. Movement of the inhabitants is the apparent cause of maintenance of the large hollow centers as branches extend and divide distally.

DISTRIBUTION: This is a readily recognized, widely distributed, and common fouling species. It is common throughout the Mediterranean and flourishes on man-made substrata as a persistent and sometimes troublesome fouling organism. It is present in similar situations in warm temperate to subtropical waters worldwide, and is a vigorously invasive species. Gordon and Mawatari (1992) record its recent spread in New Zealand ports.

MEASUREMENTS (SKELETAL): AL 181 ± 8 μm, 173–195 (1, 10), AW 137 ± 15, 117–164 (1, 10), DO 456 ± 85, 311–627 (2, 20), OL 124 ± 18, 103–151 (2, 20), OW 128 ± 10, 112–146 (2, 20), SL 29 ± 4, 22–36 (2, 20), SW 64 ± 5, 53–72 (2, 20), ZL 570 ± 48, 495–676 (2, 20), ZW 384 ± 78, 288–518 (2, 20). (POLYPIDE): IH 149 ± 82 μm, 40–320 (4, 35), LDMn 578 ± 128, 360–780 (1, 33), LDMx 648 ± 150, 360–900 (4, 49), TLMn 527 ± 81, 400–720 (4, 35), TLMx 576 ± 131, 400–900 (4, 40).

Schizoporella dunkeri (Reuss, 1848)

Figure 31A–E

Cellepora dunkeri Reuss, 1848: 90.
Schizoporella unicornis form *longirostris* Hincks, 1886: 266.
Schizoporella longirostris: Gautier, 1962: 151. Hayward and Ryland, 1979: 173 (part). Zabala, 1986: 489. Zabala and Maluquer, 1988: 133.
Schizoporella dunkeri: Hayward and Ryland, 1995: 39, 1999: 210.

DESCRIPTION (AMNH 891, 963; CMRR 2245): Colonies orange, multiserial, unilaminar to multilaminar, developing extensive, spreading sheets. Autozooids large, rectangular to irregularly polygonal; convex, separated by distinct, narrow sutures. Primary orifice about as wide as long, proximal border with a narrow sinus medially, its sides often straight and in parallel, proximal extremity more or less rounded; condyles massive, faceted, prominent and emphasizing sinus. No oral spines; peristome developed as a thickened ridge distally and laterally in later ontogeny. Frontal shield finely granular, densely perforated by small round pores, bounded by thickened rims; a low median

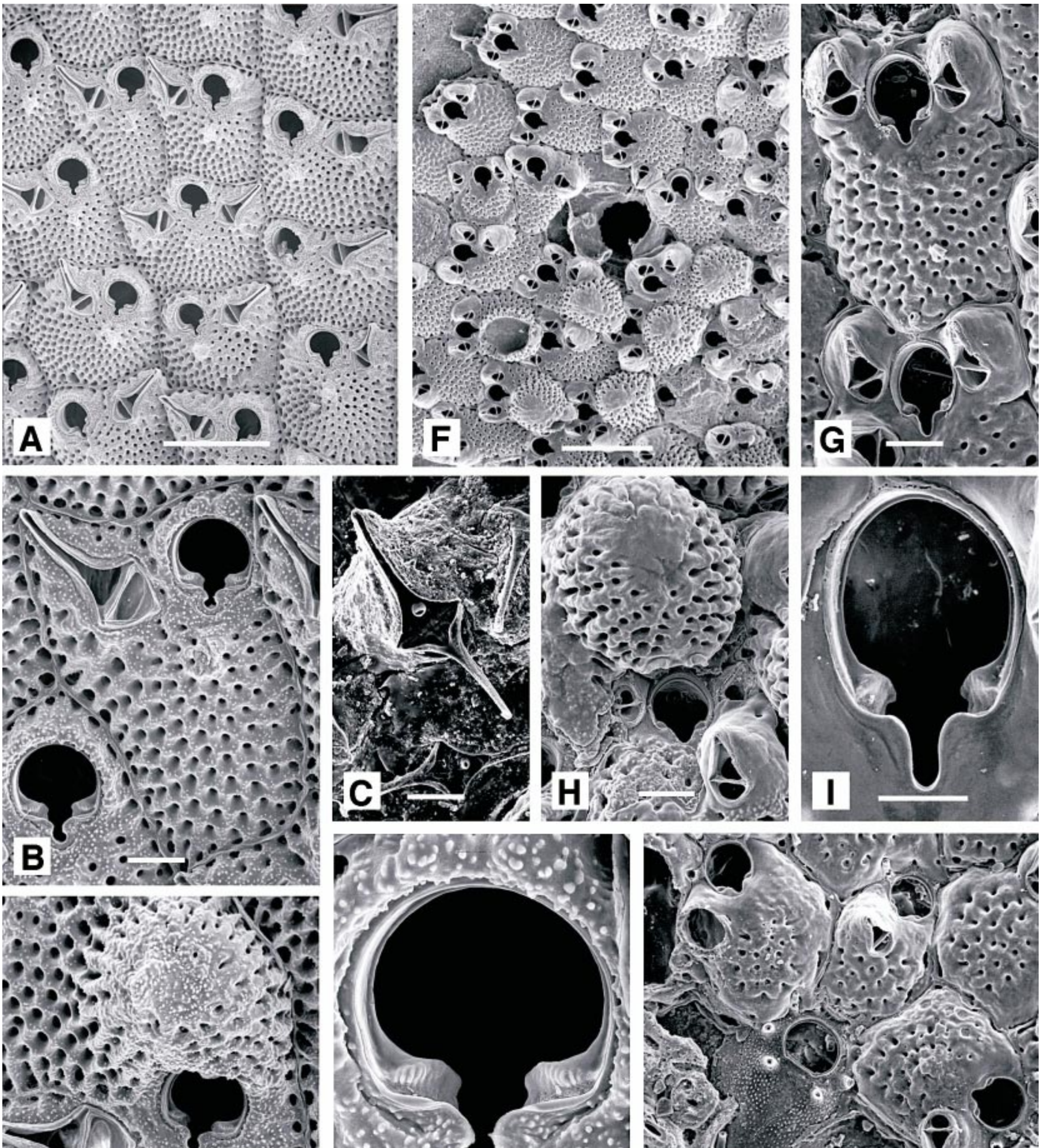

Fig. 31. **A–E.** *Schizoporella dunkeri*. **A.** General aspect (AMNH 891; 0.5 mm). **B.** Autozooid with large adventitious avicularium adjacent to orifice (AMNH 891; 0.1 mm). **C.** Untreated specimen with mandibles and polypide rudiment preserved in avicularia (AMNH 963; 0.1 mm). **D.** Maternal zooid with ovicell (AMNH 891; 0.1 mm). **E.** Autozooidal orifice (AMNH 963; 0.05 mm). **F–J.** *Schizoporella magnifica*. **F.** General aspect (AMNH 964; 0.5 mm). **G.** Autozooid (AMNH 964; 0.1 mm). **H.** Maternal zooid with ovicell (AMNH 964; 0.1 mm). **I.** Autozooidal orifice (AMNH 964; 0.05 mm). **J.** Ancestrula (lower left) and early autozooids (AMNH 965; 0.1 mm).

suboral umbo developing in later ontogeny. Avicularia characteristic: monomorphic, proximolateral to orifice, single or paired, generally distolaterally directed; broadest at the thickened crossbar, the rostrum abruptly narrowed distal to it and tapered to a thin, blunt tip; frequently >0.2 mm long; mandible slender, acuminate. Additional, larger avicularia may be budded elsewhere on autozooid frontal surface when frontal expansion of colony occurs. Ovicell recumbent on distally succeeding autozooid, globular and prominent, calcification and perforation uniform with that of the frontal shield, often developing a frontal umbo.

Tentacles light orange, 16–20; lophophores bell-shaped, radially symmetrical between chimneys, obliquely truncate and locally scalloped adjacent to chimneys; overlap between adjacent lophophores up to 200 μm.

Embryo color dark orange. Ancestrula and early astogeny first described by Friedl (1925).

REMARKS: The type specimen is a Miocene fossil from the Vienna basin. Hincks (1886) introduced the taxon *longirostris* as a variety of the north European species *S. unicornis* (Johnston in Wood) and as *S. longirostris* it was subsequently reported from all parts of the Mediterranean, and northwards to the Isles of Scilly. Hayward and Ryland (1995) finally established the synonymy of *S. dunkeri* (Reuss) and *S. longirostris* (Hincks).

DISTRIBUTION: In addition to the Distribution cited above (Remarks), *Schizoporella dunkeri* is abundant throughout the Adriatic, in shallow detritic environments.

MEASUREMENTS (SKELETAL): AL 301 ± 45 μm, 204–395 (3, 30), AW 138 ± 26, 97–182 (3, 30), DO 609 ± 97, 390–790 (3, 30), OL 160 ± 11, 133–176 (3, 29), OW 136 ± 13, 110–162 (3, 29), OvL 301 ± 19, 282–319 (1, 3), OvW 358 ± 23, 332–372 (1, 3), SL 42 ± 8, 31–53 (2, 9), SW 26 ± 8, 19–39 (2, 9), ZL 739 ± 69, 599–827 (3, 28), ZW 644 ± 94, 489–813 (3, 28). (POLYPIDE): IH 234 ± 59 μm, 140–350 (3, 20), LDMn 808 ± 100, 620–1000 (4, 39), LDMx 876 ± 116, 620–1200 (4, 43), MD 37 ± 4, 30–45 (3, 32), TLMn 718 ± 63, 600–850 (3, 12), TLMx884 ± 187, 680–1280 (4, 19).

Schizoporella magnifica Hincks, 1886

Figure 31F–J

Schizoporella magnifica Hincks, 1886: 268. Zabala, 1986: 491. Zabala and Maluquer, 1988: 133. Hayward and Ryland, 1999: 216.

DESCRIPTION (AMNH 964, 965; CMRR 2246): Colonies cream-colored, encrusting, multiserial, unilaminar to multilaminar. Autozooids hexagonal to irregularly polygonal, convex, separated by distinct grooves. Primary orifice longer than wide, sinus a narrow, U-shaped slit equivalent to one-third length of anter, occupying about half proximal width; condyles rounded, faceted and conspicuous. Oral spines generally absent except in earliest colony astogeny, decreasing in number distally from three or four in zooids budded from ancestrula; no peristome. Frontal shield thick, tuberculate, densely perforated by small round pores. Ancestrula finely perforate, with eight oral spines around large D-shaped orifice, with straight proximal margin; orifice wider than long, maximum width at about midlength. Avicularia paired (rarely, single), situated lateral to orifice, usually distal to the sinus, some autozooids with an additional distolaterally directed adventitious avicularium proximal to orifice; cystid rounded, prominent, rostrum narrowly triangular, acute to frontal plane, directed distally or slightly distolaterally; crossbar slender, complete. Ovicell recumbent on frontal shield of distally succeeding autozooid, elongate oval, domed and prominent; texture and perforation similar to that of frontal shield, but a median apical area imperforate, and often developed as a longitudinal ridge or umbo.

DISTRIBUTION: This species is widespread and common throughout the Mediterranean and reaches its northern limit off the southwest British Isles.

MEASUREMENTS (SKELETAL): AL 161 ± 19 μm, 131–194 (2, 20), AW 109 ± 15, 90–144 (2, 20), DO 436 ± 52, 325–575 (2, 20), OL 126 ± 9, 108–145 (2, 20), OW 97 ± 9, 74–111 (2, 20), OvL 380 ± 28, 334–446 (2, 20), OvW 304 ± 27, 243–334 (2, 20), SL 35 ± 6, 25–45 (2, 20), SW 24 ± 4, 15–32 (2, 20), ZL 540 ± 36, 494–641 (2, 20), ZW 389 ± 31, 330–442 (2, 20).

Schizoporella cf. *S. tetragona* (Reuss, 1848)
Figure 32A–D

Schizoporella tetragona: Ryland, 1968: 543.

DESCRIPTION (AMNH 966; CMRR 2247): Colony a broad, spreading, multiserial, unilaminar sheet in present material. Autozooids hexagonal to irregularly polygonal, large, convex, separated by deep grooves. Primary orifice as wide as long; poster equivalent to almost half total length, forming a broadly U-shaped sinus, occupying the whole proximal width of the anter below indistinct condyles. Two delicate, widely spaced, distal oral spines present in earliest ontogeny, lost as a low peristomial rim develops around distal and lateral borders of orifice. Frontal shield thick, vitreous, densely perforated by small round pores; thickening through ontogeny and becoming quite rugose as the rims of the pores are more pronounced; a prominent, stout, conical umbo developing immediately proximal to sinus, forming a large spike in some autozooids. Avicularia single or paired, the rounded, prominent cystid situated lateral or just distal to sinus; rostrum narrowly triangular, acute to frontal plane and directed distolaterally. Ovicell hyperstomial, prominent, about as wide as long, with highly arched aperture; imperforate centrally but with numerous pores laterally and around periphery; developing a low frontal umbo.

REMARKS: This appears to be the species described by Ryland (1968) from the Bosporus and attributed to. *Schizoporella tetragon*a (Reuss, 1848). The shape of the primary orifice, the disposition of the avicularia and the thickly calcified umbonate frontal shield, noted by Ryland, are evident in this material. However, the equivalence with Reuss' species needs reexamination, following the advent of SEM in bryozoan morphological research.

MEASUREMENTS (SKELETAL): AL 133 ± 10 µm, 112–145 (2, 12), AW 90 ± 8, 75–106 (2, 12), DO 428 ± 56, 310–507 (2, 20), OL 108 ± 8, 86–120 (2, 20), OW 114 ± 8, 95–132 (2, 20), OvL 285 ± 24, 245–314 (2, 16), OvW 294 ± 20, 258–325 (2, 16), SL 18 ± 3, 12–22 (2, 20), SW 53 ± 4, 46–61 (2, 20), ZL 558 ± 49, 473–671 (2, 20), ZW 387 ± 40, 315–451 (2, 20).

GENUS *ESCHARINA* MILNE EDWARDS, 1836

Escharina vulgaris (Moll, 1803)
Figure 32E–I

Eschara vulgaris var. a Moll, 1803: 55.
Lepralia botterii Heller, 1867: 106.
Escharina vulgaris: Hayward and Ryland, 1999: 236.

DESCRIPTION (AMNH 947, 967; CMRR 2248): Colonies irregular, multiserial, unilaminar patches. Autozooids oval to hexagonal, or irregularly polygonal, gently convex in early ontogeny, becoming rather flat as calcification thickens in later ontogeny, separated by shallow grooves. Primary orifice longer than wide, broadest at midlength; distal rim raised, thin; proximal border straight, with a short, rounded sinus medially, equivalent to one-quarter proximal width; condyles short and broad, tapering towards sinus, distinctly ridged. Five or six delicate oral spines present in periancestrular zooids, typically absent in later autozooids; peristome erect and thin, developed independently of the orifice rim, which remains distinct, extending distal to the spine bases, and proximally enclosing a smooth, cupped area below the sinus. Frontal shield finely granular, imperforate except for a few large, irregular marginal pores. Avicularia adventitious, single or paired, developed along lateral margins of autozooids; rostrum slender, acuminate, with a slight lateral curve, directed distally or distolaterally. Ovicell (not present in material described) spherical, finely granular, imperforate. Ancestrula about half the length of normal autozooids, oval, tatiform, with a narrow, smooth gymnocyst and indistinct cryptocystal rim bounded by about nine spines.

REMARKS: We can find no differences between *Escharina vulgaris* and the type specimen (UIIZ 217) of *Lepralia botterii* Heller, 1867, from the northern Adriatic, illustrated here as fig. 32G.

DISTRIBUTION: On stones and shells, in coastal and shelf environments. Widespread and common throughout the Mediterranean, ranging south to Madeira and north along the western coasts of Britain and Ireland. Unknown in the North Sea.

MEASUREMENTS (SKELETAL): AL 106 ± 15 µm, 84–140 (2, 20), AW 67 ± 8, 54–83 (2,

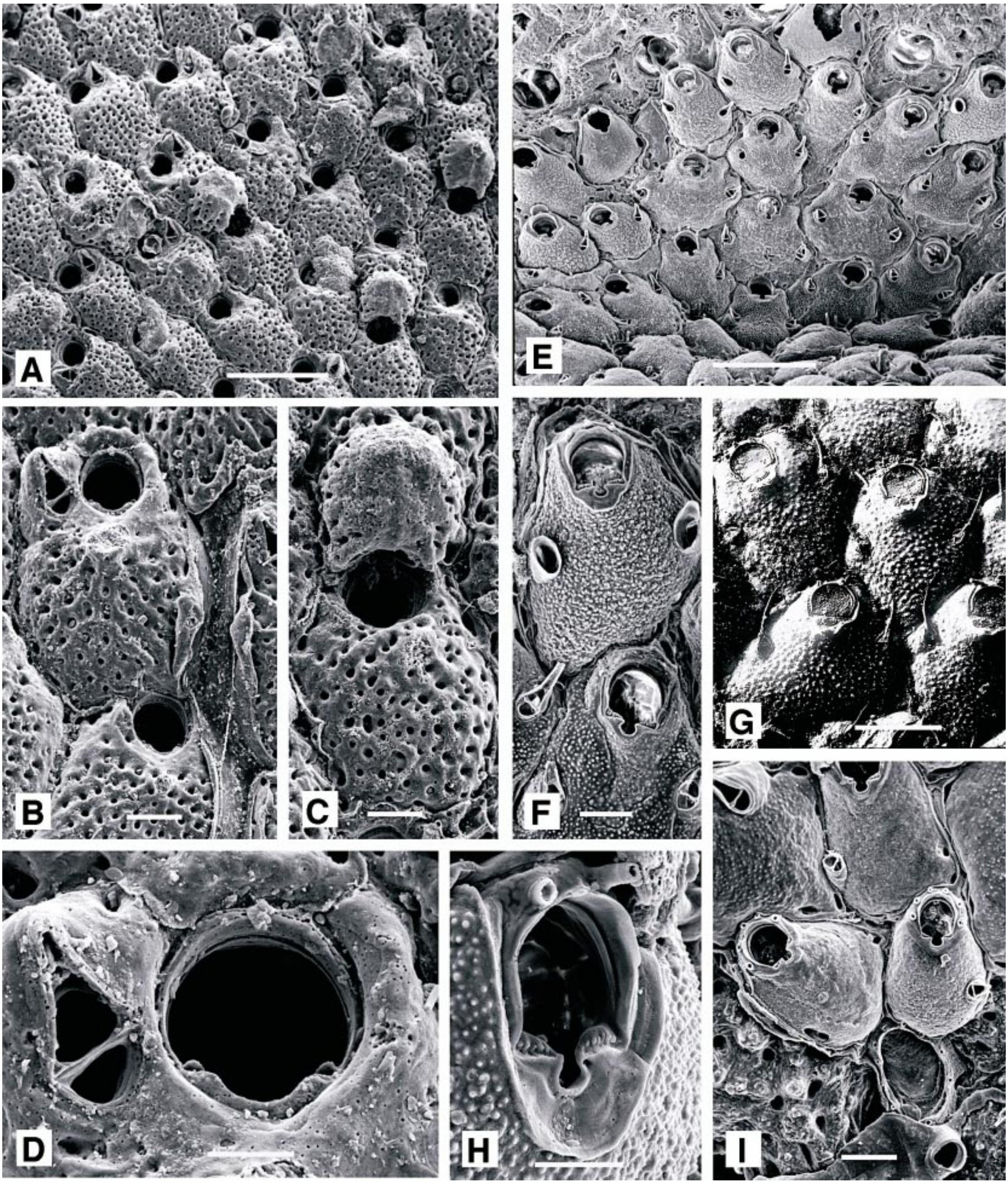

Fig. 32. **A–D.** *Schizoporella* cf. *S. tetragona* (AMNH 966). **A.** General aspect (0.5 mm). **B.** Autozooid (0.1 mm). **C.** Maternal zooid with ovicell (0.1 mm). **D.** Autozooidal orifice (0.05 mm). **E–I.** *Escharina vulgaris*. **E.** General aspect (AMNH 967; 0.5 mm). **F.** Autozooid (AMNH 967; 0.1 mm). **G.** Untreated autozooids with setae-like mandibles of avicularia (type specimen of *Lepralia botterii*, UIIZ 217; 0.1 mm). **H.** Oblique view of autozooidal orifice (AMNH 967; 0.05 mm). **I.** Ancestrula (lower right) and early autozooids (AMNH 947; 0.1 mm).

20), DO 431 ± 49, 349–513 (2, 20), OL 103 ± 14, 83–126 (2, 20), OW 88 ± 6, 75–104 (2, 20), SL 18 ± 6, 10–18 (2, 20), SW 17 ± 5, 12–30 (2, 20), ZL 544 ± 37, 471–616 (2, 20), ZW416 ± 40, 353–517 (2, 20).

Escharina dutertrei protecta Zabala, Maluquer and Harmelin, 1993

Figure 33A–C

Escharina dutertrei protecta Zabala, Maluquer and Harmelin, 1993: 73.

DESCRIPTION (AMNH 968): Colonies encrusting, multiserial, unilaminar sheets. Autozooids broadly hexagonal, convex, separated by distinct grooves. Primary orifice wider than long, poster a short, rounded sinus occupying just one-eighth of the proximal width of the anter; condyles short and broad, with denticulate edges. Six delicate spines around distal border of anter in early ontogeny, some or all of which become incorporated in development of conspicuous peristome, extending proximally from proximalmost spine pair, flaring outwards and frontally, enclosing and shielding the sinus. Close to proximal spine pair the peristome rim produced as stout, projecting processes, in many autozooids extending distally as a lobed rim, obscuring spine bases. Frontal shield nodular, vitreous, with indistinct marginal pores. Avicularia adventitious, paired, one each side of orifice, level with its distal half; cystid <0.05 mm long, with trough-like rostrum supporting base of a setiform mandible, 0.375 mm long, directed distomedially over frontal shield of distal autozooid. Ovicell wider than long, recumbent, with medially peaked aperture; imperforate, granular.

REMARKS: This taxon was only recently defined by Zabala et al. (1993), who distinguished it from the northeast Atlantic *E. dutertrei haywardi*. All previous Mediterranean records of *E. dutertrei* probably refer to this subspecies, which also occurs around the Azores, and it is probable that if *Escharina dutertrei* (Audouin) could be recognized, and a neotype accepted, the two subspecies introduced by Zabala et al. (1993), which appear to have distinct geographical Distribution patterns, could be accepted as full species.

DISTRIBUTION: See Remarks.

MEASUREMENTS (SKELETAL): DO 493 ± 40 μm, 422–611 (2, 20), OL 86 ± 13, 64–106 (2, 20), OW 86 ± 10, 69–106 (2, 20), OvL 170 ± 20, 150–190 (1, 3), OvW 276 ± 17, 263–301 (1, 4), SL 20 ± 3, 15–24 (2, 20), SW 13 ± 4, 8–23 (2, 20), ZL 565 ± 46, 503–659 (2, 20), ZW 408 ± 34, 351–500 (2, 20).

FAMILY MARGARETTIDAE HARMER, 1957

GENUS *MARGARETTA* GRAY, 1843

Margaretta cereoides (Ellis and Solander, 1786)

Figure 33D–G

Cellaria cereoides Ellis and Solander, 1786: 26.
Margaretta cereoides: Gautier, 1962: 216. Zabala and Maluquer, 1988: 155.

DESCRIPTION (AMNH 969; CMRR 2249): Colonies pink, erect, branching, jointed, to 8 cm high in present material; consisting of rigid, curving, round-sectioned internodes, each rising from a flexible, tubular, chitinous node (basis rami) with pronounced annulations. Each basis rami supporting single autozooid, which produces two zooid buds; thereafter, autozooids disposed in alternating whorls of four. Autozooids elongate, strongly convex, separated by distinct grooves. Primary orifice wider than long, D-shaped, visible at growing edge but in early ontogeny obscured by development of tall, cylindrical, longitudinally fluted peristome. Frontal shield thick, vitreous, densely perforated by large pores; distinctly larger ascopore just proximal to peristome base. In dried material, outer cuticle conspicuous. Reproduction and brooding not documented, except that reproductively active autozooids recognized by dimorphic peristomes, consisting of broad-based cone with tapered, distally curved apical aperture; chamber thus formed perhaps an external brood chamber. Branching adventitious, not dichotomous. Each basis rami arising from frontal surface of modified autozooid in which peristome sealed before complete development; basis rami budding at site of ascopore.

Tentacles light orange-pink, 25–28; lophophores bell-shaped, radially symmetrical, supported on long introverts.

DISTRIBUTION: Develops stiff clumps attached to a range of hard substrata, in shallow coastal waters, probably endemic to the Mediterranean.

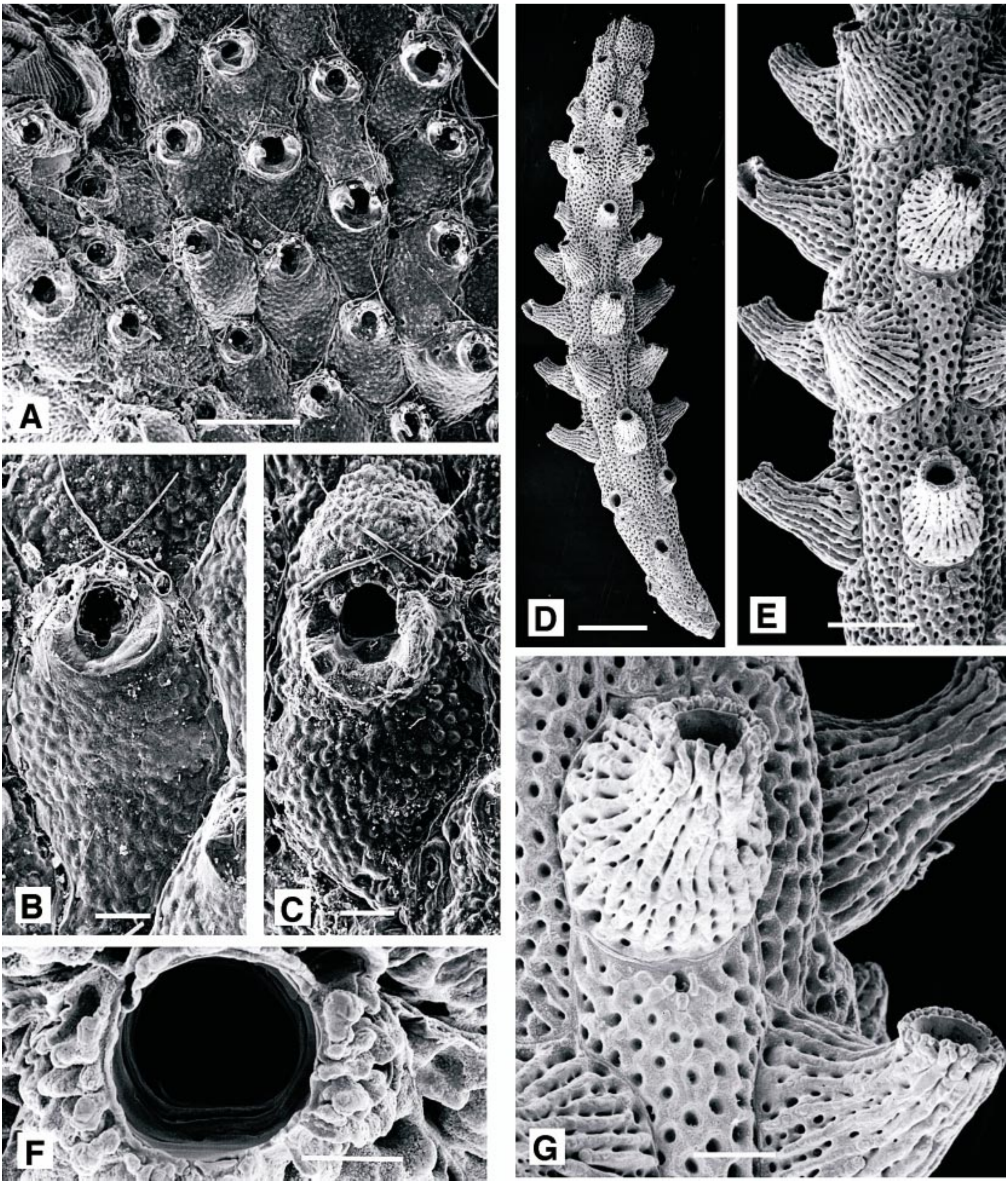

Fig. 33. **A–C.** *Escharina dutertrei protecta* (AMNH 968). **A.** General aspect of untreated colony (0.05 mm). **B.** Autozooid, with mandibular setae of vicarious avicularia crossed distal to orifice (0.1 mm). **C.** Maternal zooid with ovicell and setae as in Fig. 33B (0.1 mm). **D–G.** *Margaretta cereoides* (AMNH 969). **D.** Branch segment (1 mm). **E.** General aspect (0.5 mm). **F.** Autozooidal orifice (0.1 mm). **G.** Peristome-bearing zooid (0.2 mm).

MEASUREMENTS (SKELETAL): DO 903 ± 98 μm, 669–1097 (2, 23), OW 170 ± 23, 163–231 (2, 22), OOW 219 ± 13, 199–245 (2, 20), OvL 608 ± 42, 533–719 (2, 20), ZL 1456 ± 170, 1177–1759 (2, 20), ZW 581 ± 54, 458–660 (2, 20). (POLYPIDE): IH 362 ± 104 μm, 260–580 (1, 10), LD 886 ± 60, 740–960 (1, 11), MD 37.3 ± 2.5, 35–40 (1, 3), TL 793 ± 63, 680–872 (1, 10).

FAMILY MYRIAPORIDAE GRAY, 1841

GENUS *MYRIAPORA* DE BLAINVILLE, 1830

Myriapora truncata (Pallas, 1766)

Figure 34A–D

Millepora truncata Pallas, 1766: 249.
Myriapora truncata: Gautier, 1962: 268. Zabala and Maluquer, 1988: 163.

DESCRIPTION (AMNH 970; CMRR 2250): Colonies red, erect, rigid, attached by encrusting base, branching irregularly; branches thick, cylindrical, of constant width, to 4 mm diameter, except thicker at base of colonies. Living specimens deep red. Autozooids in alternating whorls of seven to eight; individual boundaries indistinct, even at growing tips. Colony surface appearing uniformly finely granular, regularly perforated by small, round pores, with primary orifices of autozooids regularly spaced in strict quincuncial order. Primary orifice slightly longer than wide; anter more or less semicircular, comprising two-thirds orifice length; poster a short semiellipse below prominent, bluntly triangular condyles. No spines or peristome. Ovicell semiimmersed, its frontal surface scarcely projecting from colony frontal plane; more finely punctate than frontal shields of adjoining autozooids; orifice of brooding zooids dimorphic, nearly twice length and width of autozooid, with a proportionately broader poster.

Tentacles red, 27–29; lophophores paraboloid, supported on long introverts.

DISTRIBUTION: Widely distributed throughout the Mediterranean, on shell and hard substrata, in caves, on coralligenous deposits, from 30 m to at least 130 m depth, probably endemic to Mediterranean.

MEASUREMENTS (SKELETAL): DO 627 ± 59 μm, 519–723 (3, 20), OL 265 ± 11, 250–283 (3, 25), OW 228 ± 11, 203–259 (3, 25), OOL 370 ± 25, 306–388 (2, 11), OOW 337 ± 15, 315–367 (2, 11), OvL 769 ± 55, 688–891 (2, 10), OvW 820 ± 79, 701–915 (2, 11). (POLYPIDE): IH 460 ± 24 μm, 440–500 (1, 5), LD 1107 ± 83, 1040–1200 (1, 3), TL 1030 ± 37, 960–1060 (1, 6).

FAMILY LANCEOPORIDAE HARMER, 1957

GENUS *CALYPTOTHECA* HARMER, 1957

Calyptotheca rugosa Hayward, 1974

Figure 34E–G

Calyptotheca rugosa Hayward, 1974: 379.

DESCRIPTION (AMNH 971): A single, small, multiserial, unilaminar colony of just 28 autozooids. Autozooids polygonal, convex, separated by distinct grooves. Primary orifice as wide as long; poster accounting for about one-quarter of total length and broadly triangular, occupying entire proximal width of anter. In absence of the operculum, very large, quadrangular condyles, orientated oblique to the disto-proximal axis, and a conspicuous inner shelf around the distal part of the anter, imparting distinctive outline to the orifice. Spines absent except in earliest-formed autozooids, diminishing in number away from ancestrula; low, thick peristomial ridge encircling orifice. Frontal shield thick, nodular and vitreous, densely perforated by small round pores. Avicularium adventitious, suboral, rare; ovicell large, sutured, perforate (neither found in present material). Ancestrula identical to later autozooids; producing paired distolateral buds.

DISTRIBUTION: This species has not been reported since its original description, based on specimens from Chios, Aegean Sea.

MEASUREMENTS (SKELETAL): DO 502 ± 75 μm, 408–650 (1, 10), OL 140 ± 10, 127–159 (1, 10), OW 143 ± 7, 135–154 (1, 10), ZL 654 ± 61, 550–742 (1, 10), ZW 442 ± 82, 362–635 (1, 10).

FAMILY CHEILOPORINIDAE BASSLER, 1936

GENUS *HAGIOSYNODOS* BISHOP AND HAYWARD, 1989

Hagiosynodos kirchenpaueri (Heller, 1867)

Figure 35E–H

Lepralia kirchenpaueri Heller, 1867: 105.
Hippopodinella kirchenpaueri: Gautier, 1962: 179. Zabala and Maluquer, 1988: 136.
Hippopodinella lata (Busk): Schmid, 1989: 47.

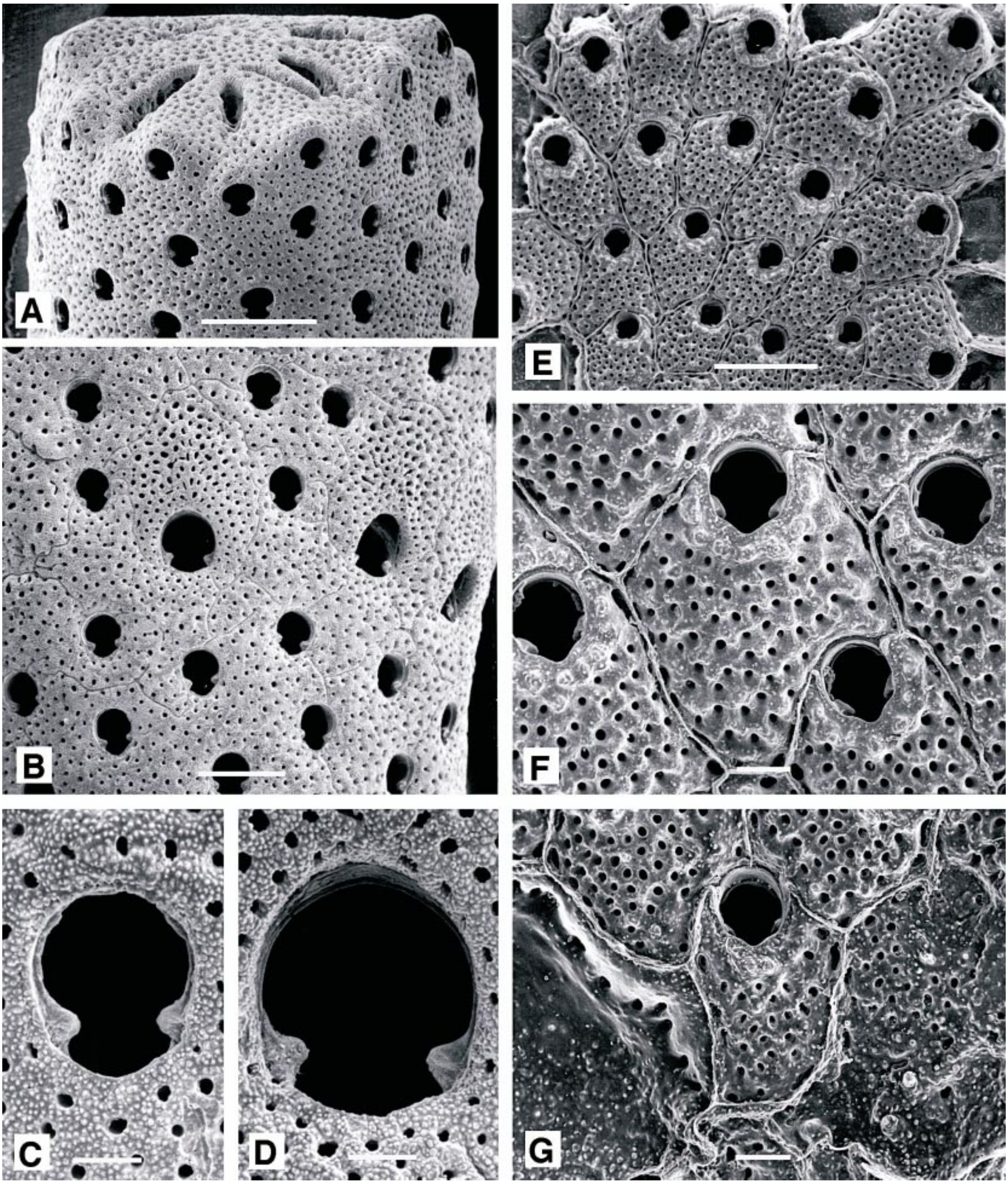

Fig. 34. **A–D.** *Myriapora truncata* (AMNH 970). **A.** Truncated branch tip (1 mm). **B.** General aspect with autozooids and maternal zooids with embedded ovicells (0.5 mm). **C.** Autozooidal orifice (0.1 mm). **D.** Maternal zooid orifice (0.1 mm). **E–G.** *Calyptotheca rugosa* (AMNH 971). **E.** General aspect (0.5 mm). **F.** Autozooid (0.1 mm). **G.** Ancestrula (0.1 mm).

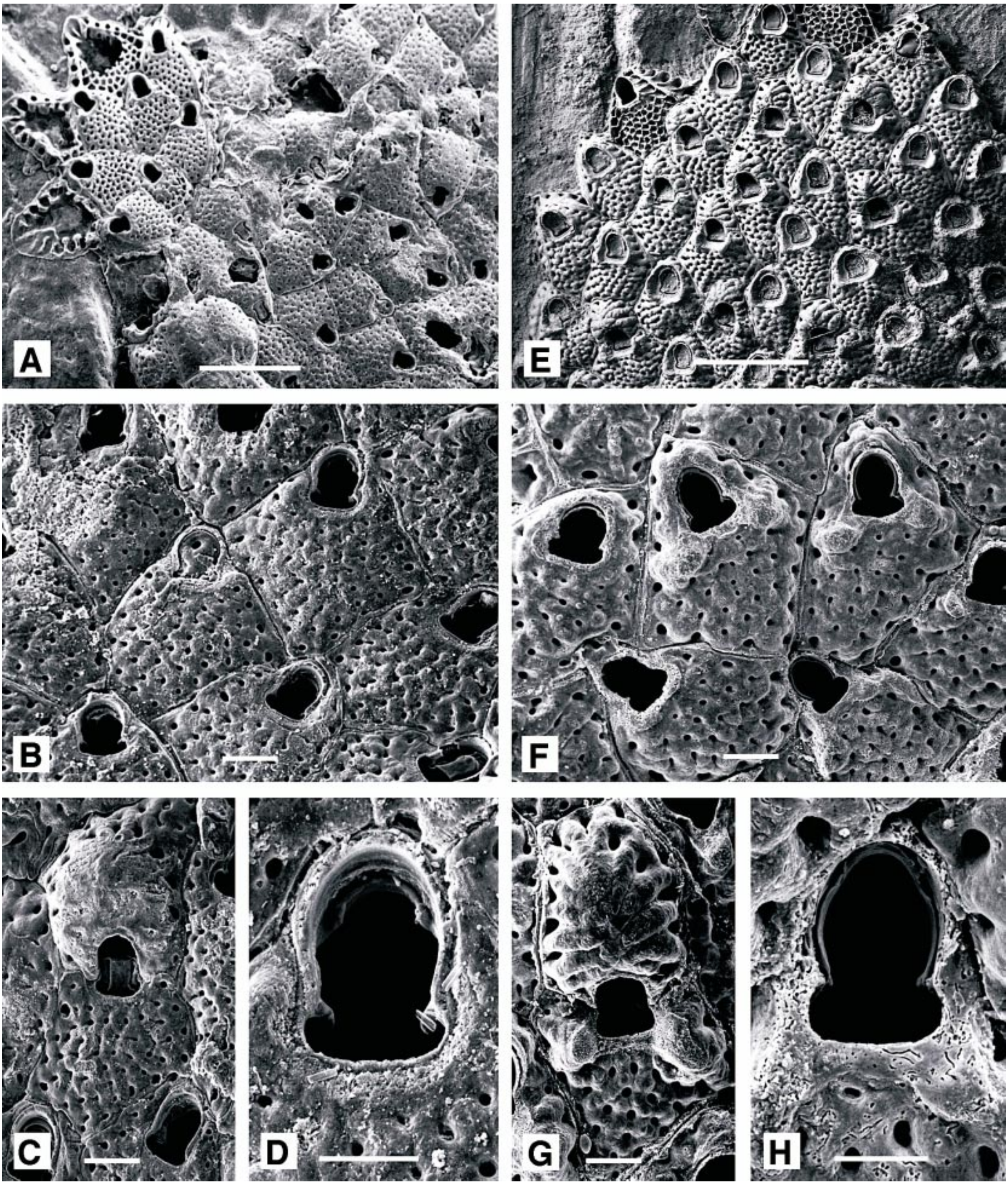

Fig. 35. **A–D.** *Hagiosynodos latus* (BMNH 2001.1.26.20; Western Channel, U.K.). **A.** General aspect (0.5 mm). **B.** Autozooids (0.1 mm). **C.** Maternal zooid with ovicell (0.1 mm). **D.** Autozooidal orifice (0.05 mm). **E–H.** *Hagiosynodos kirchenpaueri*.**E.** General aspect (lectotype, UIIZ 244; 0.5 mm). **F.** Autozooids (AMNH 966; 0.1 mm). **G.** Maternal zooid with ovicell (AMNH 966; 0.1 mm). **H.** Autozooidal orifice (AMNH 966; 0.05 mm).

NEOTYPE (chosen here): UIIZ 244, bleached specimen on small gastropod.

DESCRIPTION (AMNH 966): Colonies encrusting, multiserial, unilaminar with local areas of self-overgrowth associated with rejuvenation. Autozooids oval to irregularly polygonal, separated by indistinct grooves. Primary orifice longer than wide, distinctive: anter widest at midlength, its rim constituting three-quarters of a complete ellipse; condyles short and bluntly pointed, directed medioproximally; poster with almost straight proximal border, and width three times its length; usually conspicuously wider than anter; rugose umbones locally present at proximolateral margins of orifice. No spines. Frontal shield gently convex, with a rugose, nodular surface, evenly punctured by pores. Ovicell recumbent, only slightly convex, calcification and perforation identical to frontal shield; closed by zooidal operculum. Small dietellae clearly visible at growing edges.

Tentacles light carmine, 12; lophophores campylonemidan.

REMARKS: We designate as lectotype Heller's specimen illustrated here as fig. 35A, from syntype suite UIIZ 244. Through a comparison of morphology and biometrics, Schmid (1989) synonymised the type of *Lepralia kirchenpaueri* Heller, plus Miocene material from Austria, with Recent specimens of *Hippopodinella lata* from England. Although Schmid found similar ranges of measurements for autozooidal length and width, orifice length and width, and ovicell length and width, we prefer to retain *kirchenpaueri* and *lata* as separate species. Measurements for the two are generally similar, but we distinguish *Hagiosynodos kirchenpaueri* from *H. latus* (Busk, 1856) by *kirchenpaueri* having on average larger dimensions (see fig. 35A–D and measurements below for *H. kirchenpaueri* and for *H. latus* from the British Isles, BMNH 2001.1.26.18–2001.1.26.20), a proportionately broader poster, and the presence in *H. latus* of a prominent distal lip in the primary orifice on which the operculum rests when closed and its absence in *H. kirchenpaueri*.

Seven of the eight specimens in the type suite of *H. kirchenpaueri* (UIIZ 244) occur on gastropod shells; the eighth is on an echinoid spine. The specimens from near Rovinj encrust rock. *Hagiosynodos latus* is a facultative symbiont of hermit crabs inhabiting gastropod shells (review in Taylor, 1994); the prevalence of *H. kirchenpaueri* on gastropod shells suggests that it, too, may be a facultative symbiont of hermit crabs. However, we do not know if the gastropods were alive or if the shells were inhabited by hermit crabs when encrusted by *H. kirchenpaueri*.

DISTRIBUTION: The species is known only from the Mediterranean.

MEASUREMENTS (SKELETAL):

	Hagiosynodos kirchenpaueri	*Hagiosynodos latus*
DO:	342±53 µm, 257–461 (3, 30)	317±57 µm, 191–434 (3, 30)
OL:	125±12, 103–148 (3, 30)	107±10, 88–113 (3, 30)
OW anter:	78±8, 64–101 (3, 30)	74±8, 57–86 (3, 30)
OW poster:	95±10, 77–117 (3, 30)	75±8, 58–87 (3, 30)
OvL:	316±27, 266–352 (2, 11)	248±20, 212–281 (2, 13)
OvW:	309±36, 268–362 (2, 11)	239±18, 221–283 (2, 13)
PS:	41±7, 30–56 (3, 30)	36±4, 29–46 (3, 30)
ZL:	485±42, 414–570 (3, 30)	428±39, 350–517 (3, 30)
ZW:	350±35, 286–419 (3, 30)	293±30, 225–362 (3, 30)

***Hagiosynodos hadros*, new species**

Figure 36A–D

DIAGNOSIS: Encrusting colonies with relatively large autozooids, orifices, and spacing of pores in frontal shield; poster of orifice noticeably wider than anter.

HOLOTYPE: AMNH 972.

PARATYPES: AMNH 973; CMRR 2251–2254.

ETYMOLOGY: The species is named from the Latin *hadros* (well developed, bulky) because of the large dimensions or its zooids relative to those of *Hagiosynodos kirchenpaueri* and *H. latus*.

DESCRIPTION: Colonies encrusting, multiserial, unilaminar with local areas of self-overgrowth associated with rejuvenation. Autozooids oval to irregularly polygonal, separated by indistinct grooves. Primary orifice longer than wide, distinctive: anter widest at midlength, its rim constituting three-quarters of a complete ellipse; condyles short and bluntly pointed, directed medioproximally; poster with almost straight proximal border, and width three times its length. No

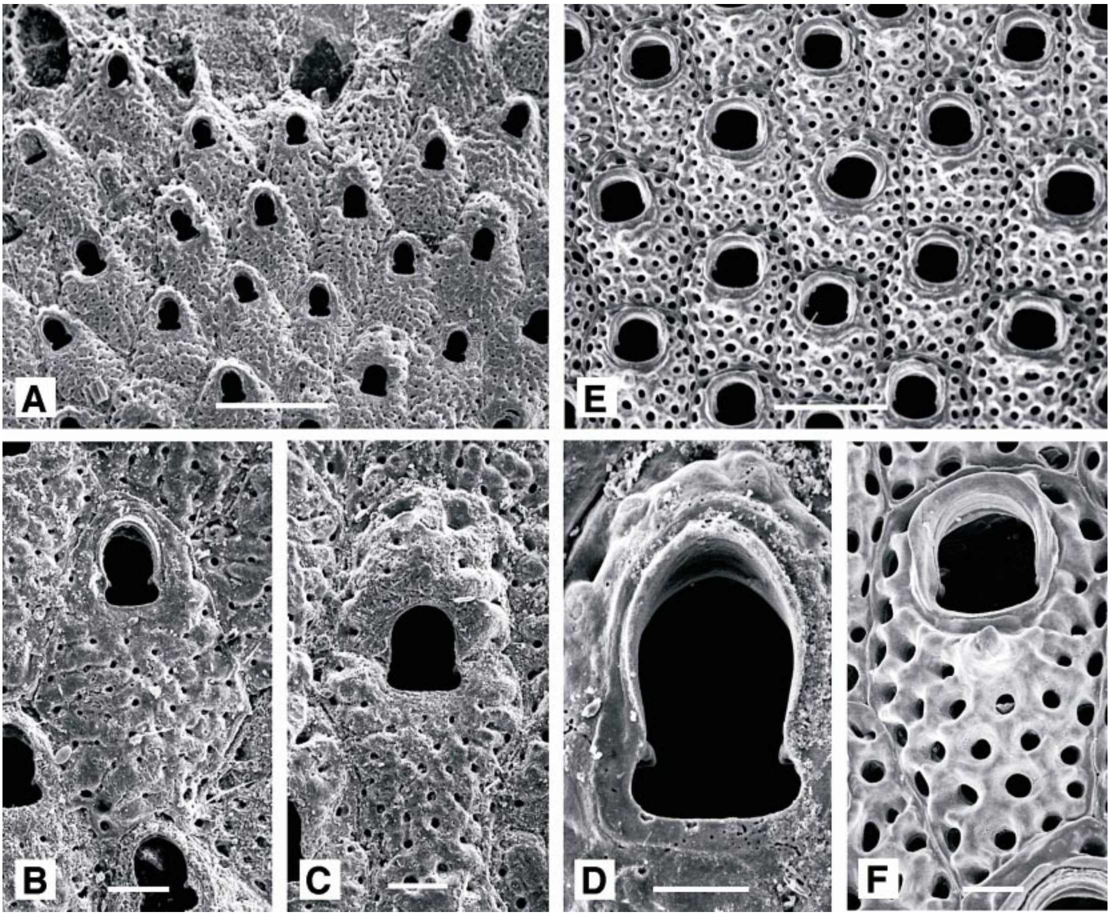

Fig. 36. **A–D.** *Hagiosynodos hadros*. **A.** general aspect (holotype, AMNH 972; 0.5 mm). **B.** Autozooid (holotype, AMNH 972; 0.1 mm). **C.** Naternal zooid with ovicell (holotype, AMNH 972; 0.1 mm). **D.** Autozooidal orifice (paratype, AMNH 973; 0.05 mm). **E, F.** *Cryptosula pallasiana* (AMNH 974). **E.** General aspect (0.5 mm). **F.** Autozooid (0.1 mm).

spines. Frontal shield gently convex, with a rugose, nodular surface, evenly punctured by relatively large pores. Ovicell recumbent, only slightly convex, calcification and perforation identical to frontal shield; closed by zooidal operculum. Small dietellae clearly visible at growing edges.

Tentacles light carmine, 12; lophophores campylonemidan.

REMARKS: This species has significantly larger autozooids, orifices, and spacing of pores in the frontal shield than do *H. kirchenpaueri* and *H. latus*. Also, rugose umbones at the proximolateral margins of the orifice, common in *H. kirchenpaueri* and *H. latus*, are absent in the available material of *H. hadros*. It was found on gastropod and dead bivalve skeletons. There is no indication that the gastropods were alive or the shells inhabited by hermit crabs when encrusted by *H. hadros*.

MEASUREMENTS (SKELETAL): DO 425 $\pm$ 76 μm, 250–563 (5, 50), OL 135 $\pm$ 14, 106–170 (5, 50), OW (anter) 88 $\pm$ 10, 66–114 (5, 50), OW (poster) 102 $\pm$ 11, 81–129 (5, 50), OvL 246 $\pm$ 26, 197–307 (5, 34), OvW 288 $\pm$ 22, 246–338 (5, 34), PS 48 $\pm$ 7, 32–73 (5, 50), ZL 559 $\pm$ 56, 471–745 (5, 50), ZW 351 $\pm$ 48, 240–472 (5, 50). (POLYPIDE): IH 114 $\pm$ 71 μm, 40–240 (1, 12), LD 510 $\pm$ 58, 440–600 (1, 10), MD 28.8 $\pm$ 2.5, 25–30 (1, 4), TL 520 $\pm$ 58, 440–640 (1, 10).

FAMILY CRYPTOSULIDAE VIGNEAUX, 1949

GENUS *CRYPTOSULA* CANU AND BASSLER, 1925

Cryptosula pallasiana (Moll, 1803)

Figure 36E, F

Eschara pallasiana Moll, 1803: 64.
Cryptosula pallasiana Canu and Bassler, 1925: 33. Hayward and Ryland, 1999: 194.

DESCRIPTION (AMNH 974; CMRR 2255): Colonies translucent white, encrusting, multiserial, unilaminar, developing thick, spreading, orange sheets. Autozooids rectangular to hexagonal, convex, separated by distinct sutures. Primary orifice longer than wide, poster shallowly concave below prominent, downcurved condyles, broader than anter and imparting a bell-shaped outline to the orifice. Operculum deep brown. Peristome developed as a low thickened rim, most prominent and slightly flared distally. Frontal shield thickly calcified, the epitheca glistening conspicuously in dried material; densely perforated by large round pores, with prominent nodular ridges developing between in later ontogeny. A stout median suboral umbo present in most autozooids; in some populations this position is occupied by an avicularium with broadly oval rostrum, acute to frontal plane and proximally directed, but it was not present in any of the Rovinj specimens. No ovicells, pale yellow embryos brooded internally.

Tentacles clear, 17; lophophores bell-shaped, radially symmetrical, overlapped with adjacent lophophores up to 80 μm.

OCCURRENCE: Found only in the harbor and adjacent shore of Rt Kriz, 0–5 m depth.

DISTRIBUTION: *Cryptosula pallasiana* is widely distributed in the North Atlantic, from northern Norway throughout the Mediterranean and into the Black Sea, and from Nova Scotia to North Carolina. Around the British Isles it is a common littoral and shallow sublittoral species, as a characteristic component of the sessile fauna of kelp holdfasts and undersides of boulders. It is also a successful fouling species; it has been part of the fouling community of New Zealand since at least the1890s (Gordon and Mawatari, 1992), and its presence in docks and harbors elsewhere around the world is probably attributable to ship borne dispersal. Schopf (1973) considered that populations lacking avicularia were characteristic of environmentally unstable habitats.

MEASUREMENTS (SKELETAL): AL 211 ± 14 μm, 191–240 (2, 20), AW 172 ± 10, 153–193 (2, 20), DO 501 ± 105, 338–684 (2, 20), ZL 670 ± 62, 591–838 (2, 20), ZW 449 ± 66, 372–581 (2, 20). (POLYPIDE): IH 147 ± 35 μm, 100–200 (1, 6), LD 673 ± 50, 600–740 (1, 6), MD 40 (1, 1), TL 650 ± 58, 560–700 (1, 6).

FAMILY MICROPORELLIDAE HINCKS, 1879

GENUS *FENESTRULINA* JULLIEN, 1888

Fenestrulina malusii (Audouin, 1826)

Figure 37A–D

Cellepora malusii Audouin, 1826: 239. Savigny, 1809: pl. 8, fig. 8.
Fenestrulina malusii: Nielsen, 1981: 109. Hayward and Ryland, 1999: 299.

DESCRIPTION (AMNH 975–977; CMRR 2256): Colonies silvery white, encrusting, multiserial, unilaminar patches. Autozooids oval to hexagonal, convex, separated by well-marked ridges. Primary orifice wider than long, proximal edge straight, four short distal oral spines present. Frontal shield smooth, with a prominent median ascopore, distance between it and proximal orifice rim equivalent to orifice length. Ascopore rim transversely oval to reniform, thickened and raised, lumen crescentic, partly occluded by delicate denticles. Large round pores with thickened rims, also partly occluded and appearing cribriform, in single or double series around autozooid margins, and extending medially between ascopore and orifice. Ancestrula tatiform, about two-thirds length of normal autozooids, with oval opesia occupying over half total length, bordered by very narrow cryptocyst and about 10 spines. Ovicell recumbent on distal autozooid, wider than long, prominent; ectooecium membranous except for a thickened peripheral rim; endooecium smoothly calcified, imperforate, with distinct basal fluting.

Tentacles colorless, 13–15; lophophores bell-shaped, radially symmetrical.

Embryo color lemon yellow to medium orange.

DISTRIBUTION: Shallow sublittoral, and offshore to about 100 m, on a wide range of

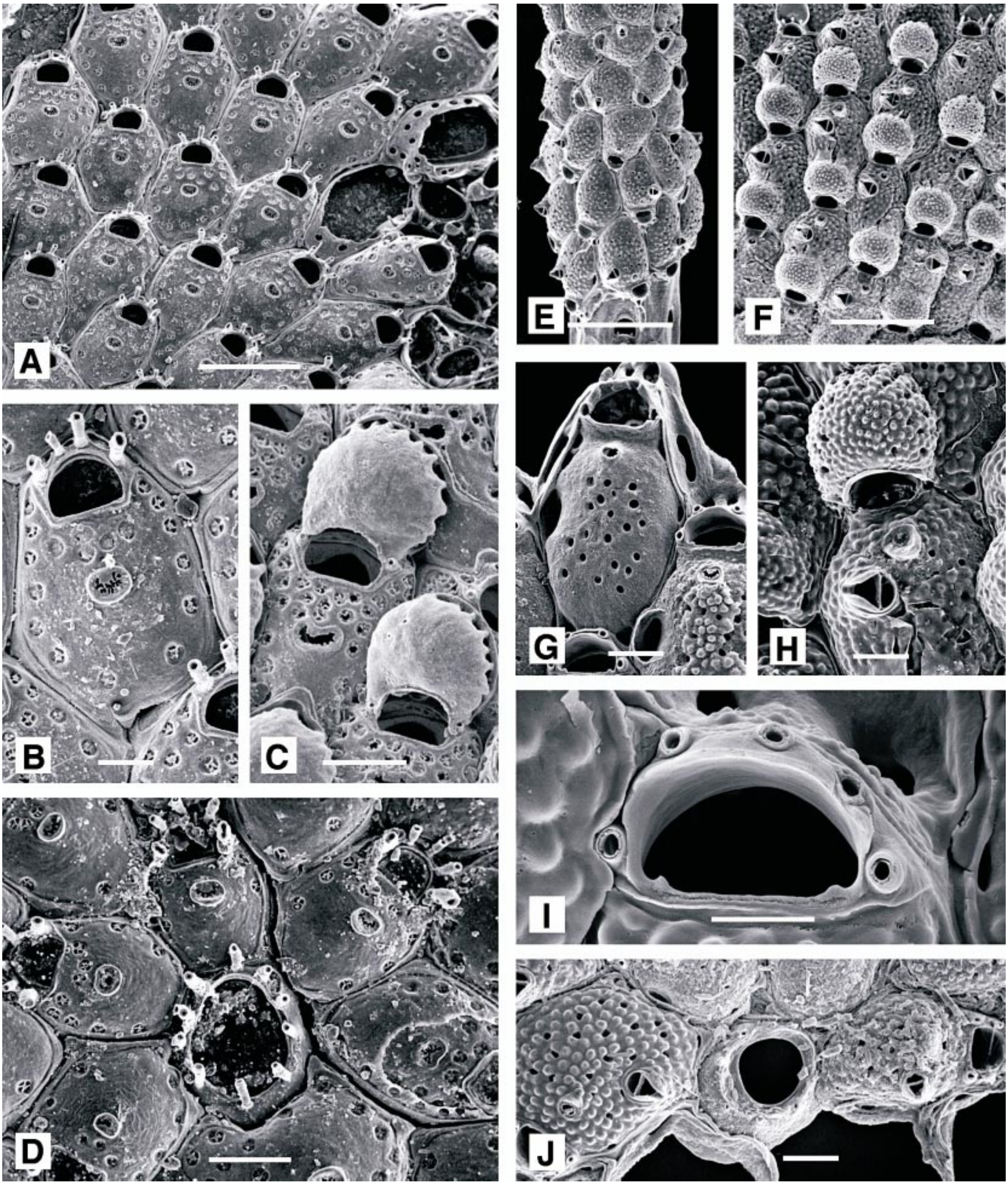

Fig. 37. **A–D.** *Fenestrulina malusii***. A.** General aspect (AMNH 975; 0.5 mm). **B.** Autozooid (AMNH 975; 0.1 mm). **C.** Maternal zooids with ovicells (AMNH 976; 0.1 mm). **D.** Ancestrula and early autozooids (AMNH 977; 0.1 mm). **E–J.** *Microporella ciliata*. **E.** Young colony encrusting *Cellaria* (AMNH 913; 0.5 mm). **F.** General aspect (AMNH 978; 0.5 mm). **G.** Ontogenetically young autozooid (AMNH 979; 0.1 mm). **H.** Maternal zooid with ovicell (AMNH 978; 0.1 mm). **I.** Autozooidal orifice (AMNH 980; 0.05 mm). **J.** Ancestrula (center) and early autozooids (AMNH 897; 0.1 mm)

organic and inorganic substrata. Distributed throughout the Mediterranean, and northwards to the British Isles and western Norway.

MEASUREMENTS (SKELETAL): DO 484 ± 54 μm, 383–613 (2, 20), OL 104 ± 12, 79–134 (2, 20), OW 142 ± 15, 120–181 (2, 20), ZL 625 ± 89, 490–851 (2, 20), ZW 401 ± 45, 325–511 (2, 20). (POLYPIDE): IH 167 ± 33 μm, 140–240 (1, 9), LD 765 ± 106, 640–900 (1, 4), MD 35–40 (1, 2), TL 660 ± 49, 600–700 (1, 4).

GENUS *MICROPORELLA* HINCKS, 1877

Microporella ciliata (Pallas, 1766)

Figure 37E–J

Eschara ciliata Pallas, 1766: 38.
Microporella ciliata: Gautier, 1962: 172. Hayward and Ryland, 1999: 296.

DESCRIPTION (AMNH 897, 913, 978–980; CMRR 2257): Colonies white though commonly colored by fouling algae, encrusting, multiserial, unilaminar sheets, typically silvery when dried. Autozooids oval to hexagonal, convex, separated by distinct grooves; 0.375–0.5 × 0.3 mm in present material. Primary orifice slightly wider than long, proximal border straight, with a minute condyle in each proximal corner; six slender spines equally spaced around distal and lateral rim. Frontal shield nodular, with few small, round pores, and fewer, more conspicuous marginal pores. Ascopore spaced from orifice by a distance equivalent to half orifice length; rim thickened, especially prominent in later ontogeny, lumen crescentic, with finely denticulate border. A single adventitious avicularium situated proximolateral to ascopore, on right or left; rostrum acute to frontal plane, directed distolaterally, broadly triangular with a distal groove to accommodate a setiform mandible, extending beyond tip of rostrum by twice its length; crossbar slender, complete, no columella or palate. Ovicell domed, hemispherical, aperture overarching primary orifice; surface uniformly nodular, imperforate. Vertical walls of autozooids with distinct basal pore chambers. Ancestrula tatiform, with oval opesia occupying about half total length, bordered by narrow cryptocyst and about nine spines.

Tentacles clear, 12–13; lophophores bell-shaped, radially symmetrical.

Embryo color light to bright orange.

DISTRIBUTION: *Microporella ciliata* is common in shallow coastal waters, and is distributed in the northeast Atlantic from northern Norway to the Mediterranean, where it is widespread. Records from outside this geographical range require reexamination.

MEASUREMENTS (SKELETAL): AL 126 ± 15 μm, 101–148 (2, 15), AW 88 ± 13, 72–117 (2, 15), DO 382 ± 44, 311–454 (2, 20), OL 57 ± 6, 42–67 (2, 20), OW 85 ± 12, 73–110 (2, 20), OvL 239 ± 8, 221–250 (1, 10), OvW 228 ± 9, 218–245 (1, 10), ZL 486 ± 35, 434–546 (2, 20), ZW 318 ± 38, 273–404 (2, 20). (POLYPIDE): IH 130 ± 12 μm, 120–140 (1, 4), LD 402 ± 42. 360–500 (1, 9), TL 394 ± 38, 340–440 (1, 7).

SUPERFAMILY CELLEPOROIDEA JOHNSTON, 1838

FAMILY CELLEPORIDAE JOHNSTON, 1838

GENUS *CELLEPORA* LINNAEUS, 1767

Cellepora adriatica, new species

Figure 38A–D

DIAGNOSIS: Primary orifice nearly circular, lacking condyles; peristome asymmetrical, suboral avicularium single, vertical; 1 to 3 pores on ovicell, close to apertural rim.

HOLOTYPE: AMNH 982.

PARATYPE: AMNH 983.

ETYMOLOGY: The species is named from its discovery in the Adriatic Sea.

DESCRIPTION: Colonies small, encrusting, unilaminar to multilaminar. Autozooids recumbent at unilaminar growing edge, erect elsewhere; broadly oval, convex, separated by distinct ridges. Frontal shield smoothly calcified, imperforate except for a few widely spaced marginal areolar pores. Primary orifice as wide as long, orbicular but not perfectly circular: the rim of the anter describing a flatter arc than the rim of the poster; no condyles visible. A single latero-proximal suboral avicularium present, with an inflated cystid tapered and umbonate distally; rostrum elliptical, perpendicular to plane of orifice, facing laterally; crossbar slender, complete, no palate. Peristome well developed, entirely enclosing the orifice and incorporat-

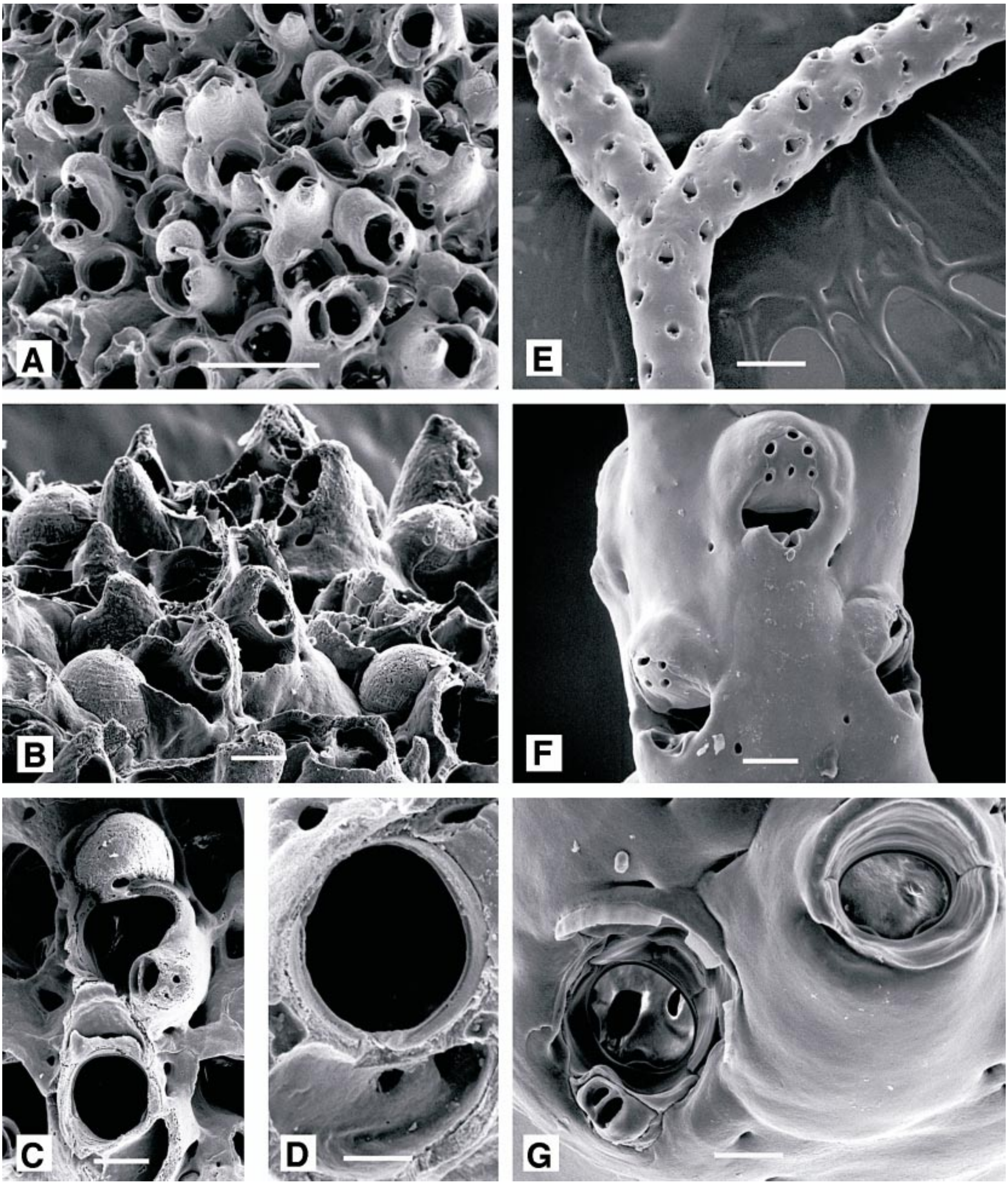

Fig. 38. **A–D.** *Cellepora adriatica*. **A.** General aspect (holotype, AMNH 982; 0.5 mm). **B.** Oblique view of colony surface (holotype, AMNH 982; 0.1 mm). **C.** Maternal zooids, upper one with complete ovicell, lower with partially formed ovicell (holotype, AMNH 982; 0.1 mm). **D.** Autozooidal orifice (paratype, AMNH 983; 0.05 mm). **E–G.** *Buskea nitida*.**E.** General aspect (AMNH 984; 0.5 mm). **F.** Maternal zooid with partially submerged ovicell (AMNH 985; 0.1 mm). **G.** Two autozooidal orifices (AMNH 984; 0.05 mm).

ing the avicularium, deepening in multilaminar parts of colony, where frontally budded autozooids are raised above peristomes of preceding autozooids; peristome rim characteristically asymmetrical, extending in a lobe around one side of the avicularium cystid. Ovicell prominent, raised above distal orifice rim; hemispherical, with a wide, highly arched aperture, close to the distal edge of which is a single large, round pore. The rim of the peristome extends across the frontal surface of the ovicell, encircling the pore. No vicarious avicularia. Vertical walls with small basal pore chambers.

REMARKS: Heller (1867) recorded *Cellepora pumicosa* from the Adriatic, together with two new species, *C. hincksii* and *C. corticalis*. It is possible that one of these may be the taxon described here as new, but Heller did not figure any of these three species. Hayward (1974) described a new genus and species, *Rhamphostomellina posidoniae*, encrusting *Posidonia* leaves, from Chios, Aegean Sea. It is very similar to *C. adriatica* in its asymmetrical peristome, vertically orientated avicularium, orbicular orifice, and in its ovicell, which has 1 to 3 pores close to its aperture rim. It is clear that *R. posidoniae* should be assigned to *Cellepora*; it differs from *C. adriatica* in its broader ovicell and smaller autozooids, and in the possession of a proximal process on the avicularium cystid, which defines a pseudospiramen within the peristome.

OCCURRENCE: Encrusting shells of dead gastropods.

MEASUREMENTS (SKELETAL): AL 128 ± 8 μm, 116–137 (1, 5), AW 87 ± 4, 83–94 (1, 5), DO 468 ± 87, 337–630 (1, 10), OL 148 ± 8, 134–158 (1, 10), OW 140 ± 11, 123–156 (1, 10), OvL 147 ± 21, 124–192 (1, 10), OvW 222 ± 13, 198–238 (1, 10).

GENUS *BUSKEA* HELLER, 1867

Buskea nitida Heller, 1867

Figure 38E–G

Buskea nitida Heller, 1867: 89.

Eschara quincuncialis Norman, 1867: 204; 1868: 222.

Buskea quincuncialis: Hayward and Ryland, 1979: 296; 1999: 350, figs. 162C, D, 164.

Buskea nitida: Zabala, 1986: 553. Zabala and Maluquer, 1988: 156.

DESCRIPTION (AMNH 984, 985; CMRR 2258): Colonies white, erect, branching, slender, to 4 mm in present material. Branches cylindrical, consisting of alternating whorls of three or four autozooids, with almost constant diameter. Autozooids at growing tips elongate oval, convex, small: less than 0.4 mm long, including peristome. Primary orifice terminal, orbicular, with minute, medioproximal sinus, obscured by development of peristome in early ontogeny. No spines. Peristome with smooth, thickened rim, slightly flared, with a symmetrical, rounded, midproximal notch adjacent to which, on right or left, is a small adventitious avicularium, with distally hooked, triangular rostrum, acute to frontal plane and directed distolaterally. Frontal shield smooth, porcellanous, with very few, small, irregular marginal pores. Ovicell wider than long, with straight edged aperture, perforated by <10, large, round pores; becoming immersed in smooth calcification, only perforate frontal area remaining distinct. Frontal calcification thickens through ontogeny and the colony develops a uniformly smooth surface; autozooid boundaries are quite obscured and only rims of immersed peristomes, and circular perforate area marking ovicell, remain distinct.

REMARKS: Zabala (1986) argued that *Buskea nitida* is clearly identical to the northeast Atlantic *B. quincuncialis* (Norman, 1867) but both taxa were introduced in the same year and taxonomic priority has not been decided.

DISTRIBUTION: *Buskea nitida* was described from the Adriatic and has been recorded subsequently from numerous northern and western Mediterranean localities, and from the Atlantic coasts of southern Europe; as *B. quincuncialis*, it is also known from the Minch, West Scotland.

MEASUREMENTS (SKELETAL): DO 400 ± 80 μm, 286–530 (2, 13), OW 113 ± 9, 00–126 (2, 11), OvL 146 ± 27, 119–211 (2, 12), OvW 186 ± 18, 161–220 (2, 20), ZL 529 ± 40, 481–640 (3, 21), ZW 212 ± 19, 169–238 (3, 15).

GENUS *CELLEPORINA* GRAY, 1848

Celleporina caminata (Waters, 1879)

Figure 39A–D

Cellepora retusa var. *caminata* Waters, 1879: 194.

Celleporina caminata: Gautier, 1962: 244. Harmelin, 1969b: 303. Zabala,1986: 563. Zabala and Maluquer, 1988: 158. Ristedt, 1996: 239.

DESCRIPTION (AMNH 986, 987; CMRR 2259): Colonies white to cream-colored, developing stout, frontally budded nodular or spherical growths. Autozooids erect with terminal orifice and tubular peristome, projecting visibly from colony surface. Frontal shield thickly calcified, vitreous and nodular; marginal pores developing tubular extensions to open around base of peristome. Primary orifice longer than wide, the deep, V-shaped sinus comprising about one-third its total length; peristome deep, tubular, rim lowest and broadly concave proximally, elsewhere often produced into short processes; three columnar avicularia traverse the length of peristome and project above rim: typically one middistally, two laterally; rostra terminal, acute to orifice plane, distal one directed distally, lateral pair distolaterally. Vicarious avicularia frequent, monomorphic, characteristic: cystid broadly conical, proximal portion of rostrum apical, spatulate distal portion directed basally, down side of the cystid; crossbar slender, without columella, palate with extensive foramen. Ovicell slightly wider than long, its frontal surface level with peristome rim, with a narrow, sickle-shaped area of membranous ectooecium, exposed entooecium vitreous, nodular, with a single series of large and irregular marginal pores.

Tentacles light orange, 14–16; lophophores bell-shaped, radially symmetrical with short introverts to obliquely truncate with long introverts adjacent to excurrent chimneys.

Embryo color deep, bright red. Ancestrula described and figured by Ristedt (1996).

REMARKS: *Celleporina caminata* is similar to *C. canariensis* Aristegui, 1989, but is distinguished by its larger, more robust colony form and larger autozooidal dimensions. The primary orifice, in particular, is larger than that of *C. canariensis*, with a proportionately deeper sinus, and the peristome rim of non-ovicellate autozooids bears three, distinctly tubular avicularia.

DISTRIBUTION: This familiar species is common throughout the Mediterranean in shallow, coarse detrital habitats, encrusting stone, shell, hydroids, and other bryozoans. It is probably endemic to the Mediterranean region.

MEASUREMENTS (SKELETAL): AAL 94 ± 10 μm, 77–123 (2, 20), AAW 65 ± 6, 52–77 (2, 20), DO 497 ± 87, 303–674 (2, 20), OL 195 ± 18, 169–229 (3, 30), OW 136 ± 14, 104–169 (3, 30), OvL 297 ± 21, 272–312 (1, 7), OvW 332 ± 27, 291–364 (1, 7), SL 23 ± 4, 17–33 (3, 30), SW 28 ± 4, 22–37 (3, 30), VAL 420 ± 42, 355–473 (2, 9), VAW 239 ± 29, 193–271. (POLYPIDE): IH 24 ± 37 μm, 0–120 (2, 19), LD 745 ± 74, 640–840 (2, 20), MD 30 (1, 1), TL 615 ± 80, 500–800 (2, 20).

Celleporina canariensis Aristegui, 1989

Figure 39E–G

Celleporina canariensis Aristegui, 1989: 147.

DESCRIPTION (AMNH 988; CMRR 2260): Colonies cream-colored or light yellow, encrusting, multilaminar, forming small pisiform nodules, to 3 mm diameter in present material. Autozooids small, with smoothly calcified frontal shield and large, conspicuous marginal pores. Primary orifice longer than wide, with a short, U-shaped sinus midproximally and rounded, prominent condyles. No oral spines. Peristome deep, tubular, obscuring orifice, its rim shallowly notched midproximally; peristomial avicularia paired, lateral, rostrum terminal, elliptical, ca. 0.09 mm long, with complete crossbar, bluntly triangular, directed distolaterally. Distal to each avicularium, peristome rim is produced as a short, blunt, medially directed process. Vicarious avicularia sparse, dimorphic: elliptical, 0.2 mm long, with complete crossbar, thickened columella, no palate; or larger, to ca. 0.4 mm, with broadly spatulate rostrum, lacking palate, angled at 45° to minute proximal opesia and directed basally. Ovicell about as wide as long, frontal surface level with peristome rim; entooecial tabula occupying most of the frontal surface, bordered by a single row of pores. Aperture edged by a broad band of smooth ectooecium, often produced medially into a short umbo.

Tentacles light yellow, 12; lophophores flaring conical, radially symmetrical.

REMARKS: This species is most similar to *C. caminata*, a common Mediterranean spe-

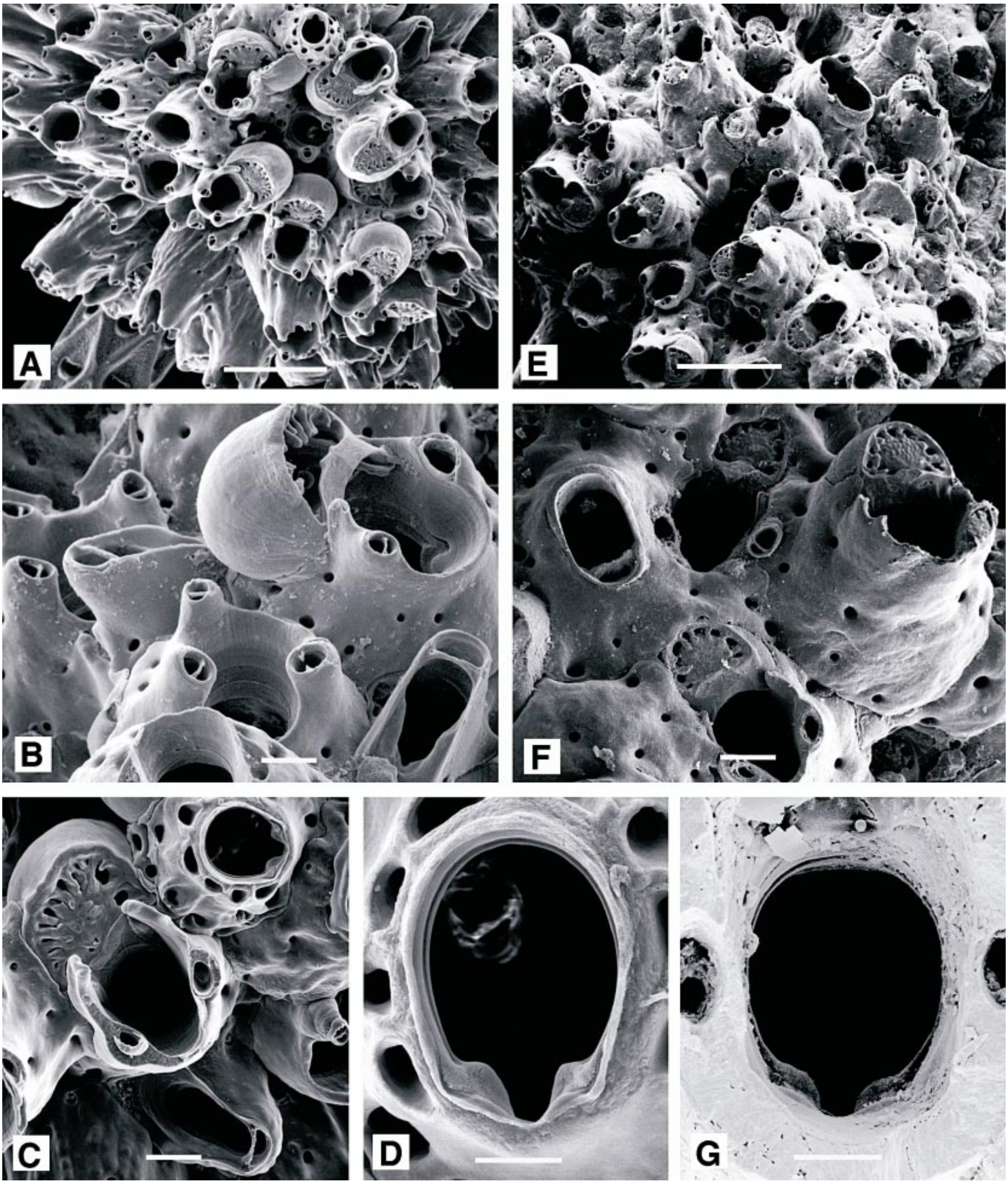

Fig. 39. **A–D.** *Celleporina caminata*. **A.** general aspect (AMNH 986; 0.5 mm). **B.** oblique view of colony surface (AMNH 987; 0.1 mm). **C.** ontogenetically young autozooid (top right), maternal zooid with ovicell (left) and (bottom right) vicarious avicularium (AMNH 986; 0.1 mm). **D.** autozooidal orifice (AMNH 986; 0.05 mm). **E–G.** *Celleporina canariensis* (AMNH 988). **E.** general aspect (0.5 mm). **F.** maternal zooids with ovicells and (top left) vicarious avicularium (0.1 mm). **G.** autozooidal orifice (0.05 mm).

cies which develops robust nodular colonies. It is distinguished from that species principally by its smaller orifice and proportionately shorter sinus. Further, the peristome rim in *C. caminata* typically bears three columnar avicularia with elliptical rostra. Aristegui (1989) described only spatulate vicarious avicularia in his type suite but both these and the smaller elliptical type occur in single colonies of the material described here.

DISTRIBUTION: *Celleporina canariensis* is presently known from several localities around the Canary Isles, and from caves along the Catalan coast.

MEASUREMENTS (SKELETAL): AAL 98 ± 10 μm, 77–113 (3, 28), AAW 55 ± 7, 47–72 (3, 8), DO 354 ± 53, 259–452 (3, 30), OL 130 ± 6, 119–139 (5, 22), OW 103 ± 5, 89–112 (5, 22), OvL 145 ± 18, 116–174 (3, 12), OvW 218 ± 18, 189–224 (3, 12), SL 23 ± 5, 15–36 (5, 22), SW 23 ± 4, 15–31 (5, 22), VAL 267 ± 49, 213–308 (2, 3), VAW 166 ± 41, 142–213 (2, 3). (POLYPIDE): IH 0 μm (1, 2), LD 880 (1, 10), TL 560–680 (1, 2).

Celleporina siphuncula, new species

Figure 40A–D

DIAGNOSIS: Colonies pisiform, small; orifice widely sinuate; peristome long, tubular; peristomial avicularium single, proximo-medial.

HOLOTYPE: AMNH 989.

PARATYPES: AMNH 990–994; CMRR 2261.

ETYMOLOGY: The species name is from the Latin *sipho* (bent tube) and *–culum* (suffix denoting diminutive) because of the shape of the small peristomial avicularium.

DESCRIPTION: Colonies cream colored, pisiform, to 4.5 mm diameter in present material. Autozooids closely packed, oval in outline with a smooth, convex frontal shield, with a few indistinct marginal pores; commonly 0.3 mm in length, with a cylindrical peristome up to 0.375 mm long. Autozooid boundaries distinct only in the smallest colonies, of fewer than 20 autozooids; subsequent astogeny proceeds through fronto-lateral budding, with peristomes projecting perpendicularly to colony surface. Primary orifice slightly wider than long; a shallow, u-shaped sinus occupies two-thirds of the proximal border, between short, broad condyles, its depth equivalent to one-fifth total orifice length. No oral spines. Peristome encircles whole of primary orifice, developing as a tall cylinder, its rim slightly flared and produced into a variable number of short lobes. A small avicularium present midproximally on peristome rim, originating from a septulum proximolateral to orifice, either right or left, traversing peristome as a slender tube and expanding into an ovate cystid on its distal edge; rostrum acute to orifice plane, proximally directed, oval, with a finely denticulate distal rim, crossbar complete, slender, mandible semielliptical. Vicarious avicularia frequent, 0.25–0.3 mm long; rostrum broadened distally and deeply cupped, but not spatulate, crossbar complete, slender, without a columella; palate simply a narrow shelf bordering a foramen occupying most of length and breadth of rostrum. Ovicell hemispherical; a broad tabula occupying most of visible frontal surface, with a thickened ectooecial rim and a single marginal series of large pores; aperture wide and arched, opening into proximal portion of peristome. Above the tabula lateral lobes of peristome curve medially and abut, forming a suture as peristome lengthens into a tube.

Tentacles cream-colored, 14–16; lophophores bell- to funnel-shaped, radially symmetrical between chimneys, obliquely truncate adjacent to chimneys.

Embryo color pale orange.

REMARKS: This tiny species is distinguished from other *Celleporina* species in the northeast Atlantic-Mediterranean region by its widely sinuate orifice, long tubular peristome and single, proximo-median peristomial avicularium.

OCCURRENCE: It was abundant on *Cellaria fistulosa* in the 35 m-deep meadow west of Banjole Island, together with *Celleporina caminata*.

MEASUREMENTS (SKELETAL): AAL 63 ± 9 μm, 51–82 (3, 11), AAW 45 ± 8, 34–65 (3, 10), DO 295 ± 47, 206–389 (3, 30), OL 89 ± 9, 79–101 (3, 5)m OW 93 ± 5, 86–101 (3, 6), OvL 136 ± 15, 116–167 (3, 18), OvW 215 ± 15, 194–242 (3, 18), SL 19 ± 2, 16–22 (3, 7), SW 54 ± 3, 50–59 (3, 7), VAL 244 ± 24, 216–272 (2, 4), VAW 159 ± 14, 142–176 (2, 4). (POLYPIDE): IH 202 ± 27 μm,

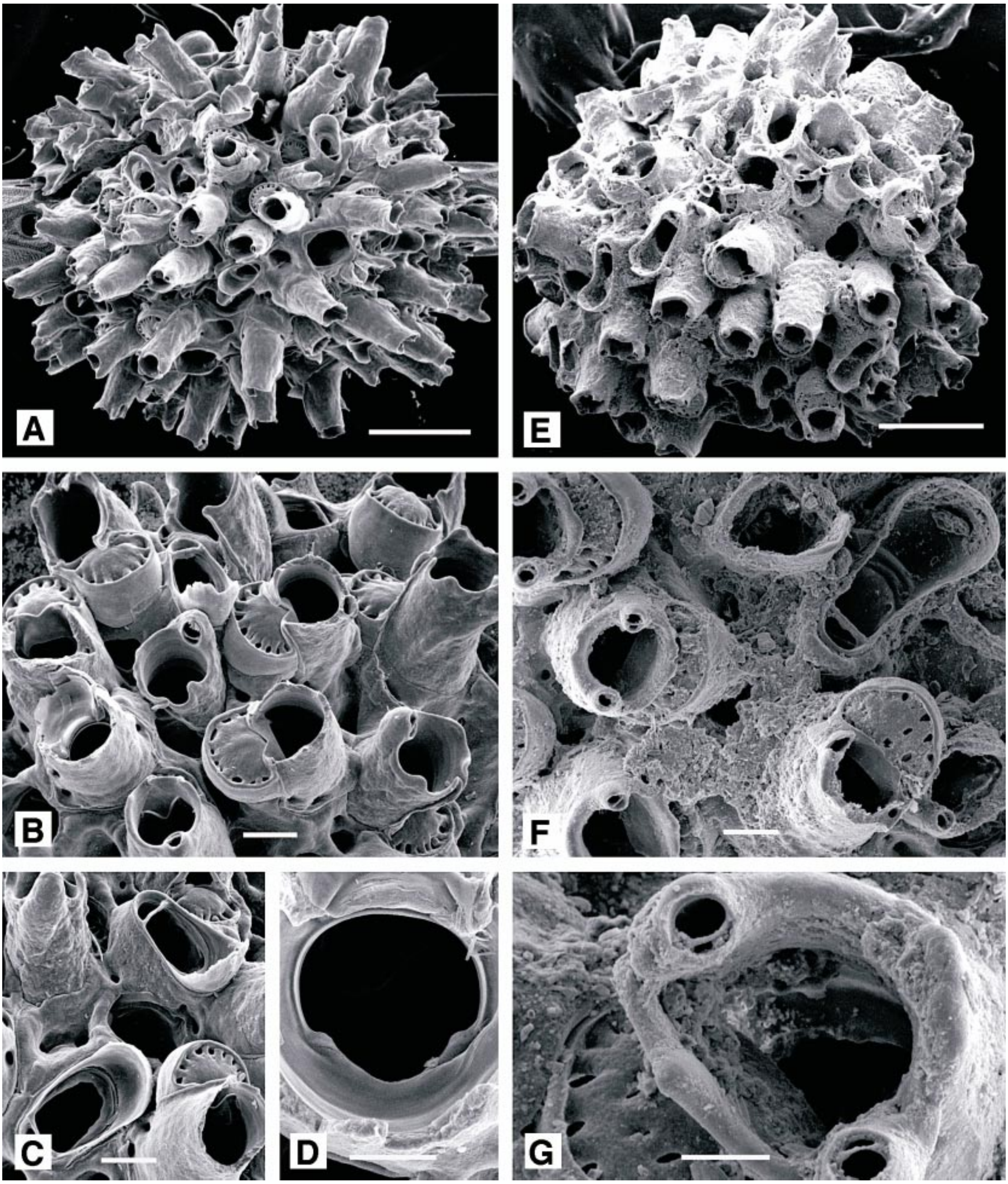

Fig. 40. **A–D.** *Celleporina siphuncula*. **A.** General aspect (paratype, AMNH 990; 0.5 mm). **B.** Autozooids and maternal zooids with ovicells (holotype, AMNH 989; 0.1 mm). **C.** Vicarious avicularia (holotype, AMNH 989; 0.1 mm). **D.** Autozooidal orifice (holotype, AMNH 989). **E–G.** *Celleporina tubulosa* (AMNH 995). **E.** General aspect (0.5 mm). **F.** Maternal zooids with ovicells and (top right) vicarious avicularium (0.1 mm). **G.** Autozooidal orifice (0.05 mm).

160–240 (1, 10), LD 634 ± 74, 500–740 (1, 10), MD 30 (1, 2), TL 610 ± 50, 540–680 (1, 10).

Celleporina tubulosa (Hincks, 1880)

Figure 40E–G

Cellepora costazii var. *tubulosa* Hincks, 1880: 412.
Celleporina hassallii var. *tubulosa*: Zabala and Maluquer, 1988: 159.
Celleporina tubulosa: Hayward and Ryland, 1999: 330.

DESCRIPTION (AMNH 995): Colony pisiform. Primary autozooidal orifice transversely oval with broad, shallow sinus occupying entire proximal width of anter. Tall, tubular peristome slightly flared apically, narrowly transversely oval at aperture; avicularia paired, situated laterally on peristome rim, with small oval rostra acute to orifice plane, directed laterally and with mandibles facing each other. Ovicell with a peripheral row of large pores, opening into peristome at about halfway along its length. Vicarious avicularia broadly spatulate, with an extensive palatal foramen and a very slender crossbar lacking a columella.

REMARKS: A single specimen of this species was found, but it is sufficiently distinct from other European species of *Celleporina* to be readily recognized. It is especially distinguished by its primary orifice.

DISTRIBUTION: This rare species has been reported reliably on just three previous occasions. The type locality is unknown and the type specimen lost, but Hayward and Ryland (1999) described and figured a specimen from the Scilly Isles, southwest England, which closely matched Hincks' (1880) original description and figure. Zabala and Maluquer (1988) figured what is clearly the same species from the Catalan coast. The specimen listed by Gautier (1962) from Sicily was said to be identical in morphology and measurements to *C. hassallii* (Johnston) except for an elongate peristome; no mention was made of the distinctive primary orifice and the positioning of the peristomial avicularia, and it is thus not certain that the specimen belonged to *C. tubulosa*.

MEASUREMENTS (SKELETAL): AAL 78 ± 9 μm, 69–93 (1, 10), AAW 37 ± 3, 33–44 (1, 10), DO 354 ± 37, 301–405 (1, 10), OL 130 (1, 2), OW 103–109 (1, 2), AL 314–318 (1, 2), AW 238–258 (1, 2).

GENUS *TURBICELLEPORA* RYLAND, 1963

Turbicellepora avicularis (Hincks, 1860)

Figure 41A–D

Cellepora avicularis Hincks, 1860: 278, 1880: 406.
Turbicellepora avicularis: Hayward and Ryland, 1999: 336.

DESCRIPTION (AMNH 996–998; CMRR 2262): Colonies orange, with variable form, from low mounds and nodules to stout, irregularly lobed or erect forms with tapered branches; to 15 mm high in present material. Autozooids broad, convex, with boundaries visible only in few, frontally budded individuals; frontal shield smooth, with a single series of few, conspicuous marginal pores. Primary orifice slightly longer than wide, a deep, V-shaped proximal sinus comprising about one-quarter total length, flanked by thick, rounded condyles; no spines. Peristome low, absent midproximally, adjacent to lateral suboral avicularium with laterally directed, elongate triangular rostrum, hooked distally, oblique to orifice plane; crossbar stout, with distinct columella. Vicarious avicularia characteristic, to 0.6 mm long, broadly spatulate to more nearly parallel-sided, rounded distally; always with an extensive palate, and a thick crossbar with a stout columella often bifid distally. A second, less frequently occurring vicarious avicularium has a broadly triangular, distally hooked rostrum and thick crossbar with equally thick columella. Ovicell broader than long, smooth surfaced, with 10–15 small round pores.

Tentacles light orange, 16–18; lophophores bell-shaped, radially symmetrical midway between chimneys to obliquely truncate, supported by long introverts.

Embryo color bright, medium orange.

DISTRIBUTION: This is the most commonly occurring species of *Turbicellepora* in the northeast Atlantic region, distributed from northern Norway and southern Iceland southwards to the Mediterranean, where it is widespread in shallow coastal waters.

MEASUREMENTS (SKELETAL): AAL 140 ± 19 μm, 113–172 (3, 19), AAW 96 ± 13, 62–

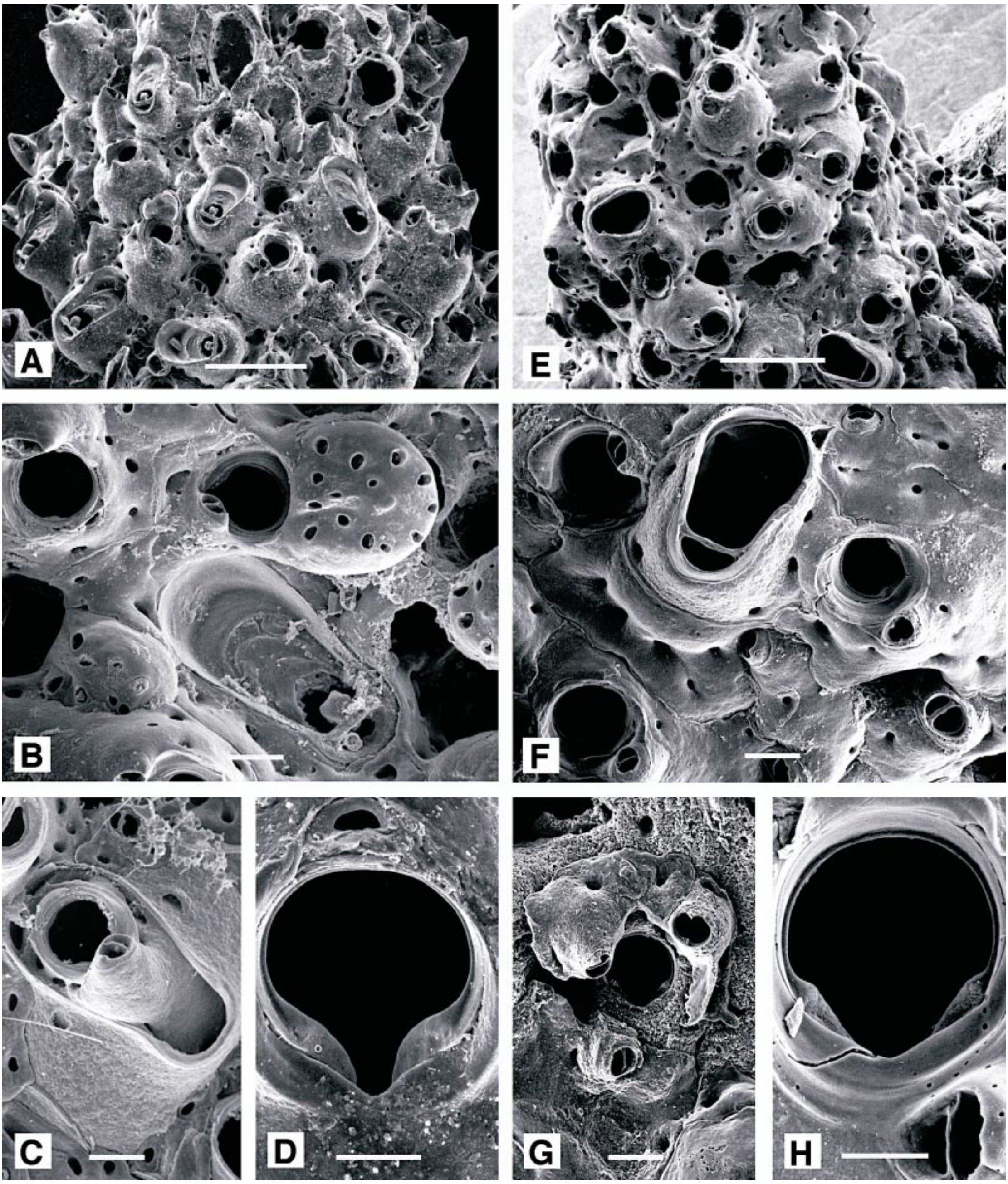

Fig. 41. **A–D.** *Turbicellepora avicularis***.** **A.** general aspect (AMNH 996; 0.5 mm). **B.** autozooid (top left), maternal zooid with ovicell (top center) and (bottom center) vicarious avicularium (AMNH 997; 0.1 mm). **C.** reparative budding of autozooid within vicarious avicularium (AMNH 998; 0.1 mm). **D.** autozooidal orifice (AMNH 996; 0.05 mm). **E–H.** *Turbicellepora camera* (AMNH 999). **E.** general aspect (0.5 mm). **F.** autozooids and (top center) vicarious avicularium (0.1 mm). **G.** ontogenetically old autozooid with multiple vicarious avicularia (0.1 mm). **H.** autozooidal aperture (0.05 mm).

120 (3, 19), DO 441 ± 102, 262–624 (3, 30), OL 132 ± 16, 110–167 (3, 26), OW 128 ± 10, 108–145 (3, 26), SL 43 ± 7, 26–54 (3, 26), SW 69 ± 16, 47–103 (3, 26), VAL 448 ± 40, 412–537 (3, 10), VAW 276 ± 26, 248–338 (3, 10). (POLYPIDE): IH 383 ± 51 μm, 320–460 (1, 10), LDMn 655 ± 74, 540–800 (1, 14), LDMx 695 ± 59, 600–800 (1, 17), MD 30 ± 3, 25–35 (1, 8), TLMn 554 ± 38, 500–620 (1, 10), TLMx 707 ± 140. 600–960 (1, 10).

Turbicellepora camera Hayward, 1978

Figure 41E–H

Turbicellepora camera Hayward 1978: 570, figs. 4N–P, 5T, 10.

DESCRIPTION (AMNH 999; CMRR 2263): Colonies orange, initially small, domed nodules, some of the present material developing the slender, cylindrical, branching growth characteristic of the species. Autozooids oval, convex, with boundaries visible only in newly budded individuals; smoothly calcified frontal shield bordered by few, small marginal pores. Primary orifice slightly longer than broad, with a deep, V-shaped proximal sinus comprising almost half total length; condyles broad and thick, no spines. A low, thickened peristome developing in early ontogeny; lowest midproximally, adjacent to proximolateral suboral avicularium, with elliptical, round-ended rostrum, oblique to orifice plane and laterally directed. Vicarious avicularia characteristic: rostrum broadly spoon-shaped, 0.25–0.3 mm long, cupped distally; crossbar slender, with an indistinct median columella; completely lacking a palate and in cleaned material appearing as an open chamber. Additional adventitious avicularia sporadic, abundant in some areas of colony, identical to suboral type. Ovicell hemispherical, smooth, with few (<10) large, irregular pores.

REMARKS: The present material does not differ from the Aegean type specimen (Hayward, 1978); the shape of the orifice, the distinctive vicarious avicularia and the proliferating adventitious avicularia together distinguish *T. camera* from all other Mediterranean species of *Turbicellepora*.

DISTRIBUTION: The species is apparently endemic to the Mediterranean and the adjacent Atlantic coast, described originally from the Aegean Sea (Hayward, 1978) and subsequently reported from the Bay of Cadiz and the Strait of Gibraltar (Harmelin and d'Hondt, 1992).

MEASUREMENTS (SKELETAL): AAL 155 ± 24 μm, 124–186 (2, 9), AAW 133 ± 22, 106–169 (2, 9), DO 389 ± 70, 252–503 (3, 29), OL 112 ± 8, 96–128 (3, 25), OW 119 ± 11, 101–136 (3, 25), SL 42 ± 5, 35–53 (2, 12), SW 88 ± 9, 74–105 (2, 12), VAL 456 ± 47, 394–518 (3, 7), VAW 320 ± 28, 267–394 (3, 7), ZL 483 ± 28, 446–512 (1, 5), ZW333 ± 28, 301–360 (1, 5).

FAMILY PHIDOLOPORIDAE GABB AND HORN, 1862

GENUS *RETEPORELLA* BUSK, 1884

Reteporella grimaldii (Jullien, 1903)

Figure 42A–F

Retepora grimaldii Jullien, in Jullien and Calvet, 1903: 62.

Sertella septentrionalis Harmer, 1933: 620. Gautier, 1962: 233. Geraci, 1975: 244. Zabala, 1986: 544. Zabala and Maluquer, 1988: 154.

Reteporella septentrionalis: Hayward and Ryland, 1996: 109, 1999: 374.

Reteporella grimaldii: Reverter-Gil and Fernández-Pulpeiro, 1999: 1416.

DESCRIPTION (AMNH 1000–1002; CMRR 2264): Colonies orange, erect, brittle, consisting of bilaminar fenestrate plates, complexly infolded and fused into rigid three-dimensional structure; inwards-facing surfaces bearing autozooids, outer faces consisting of sheets of kenozooids. Colony size and architecture variable, probably dependent upon microhabitat; a single colony from locality 12 measuring 18 × 14 × 13 cm, but larger in situ specimens reported up to about 70 cm diameter and 35 cm thick perhaps consisted of several closely intergrown colonies. Fenestrulae elongate oval, commonly 1.5 × 0.5 mm; trabeculae of three to five alternating longitudinal autozooid series. Autozooids at growing edge elongate, rectangular, convex, with indistinct boundaries. Frontal shield smooth, with few, large marginal pores around proximal margins. Primary orifice broader than long; distal border finely denticulate, proximal border shallowly concave between indistinct condyles. Single pair of

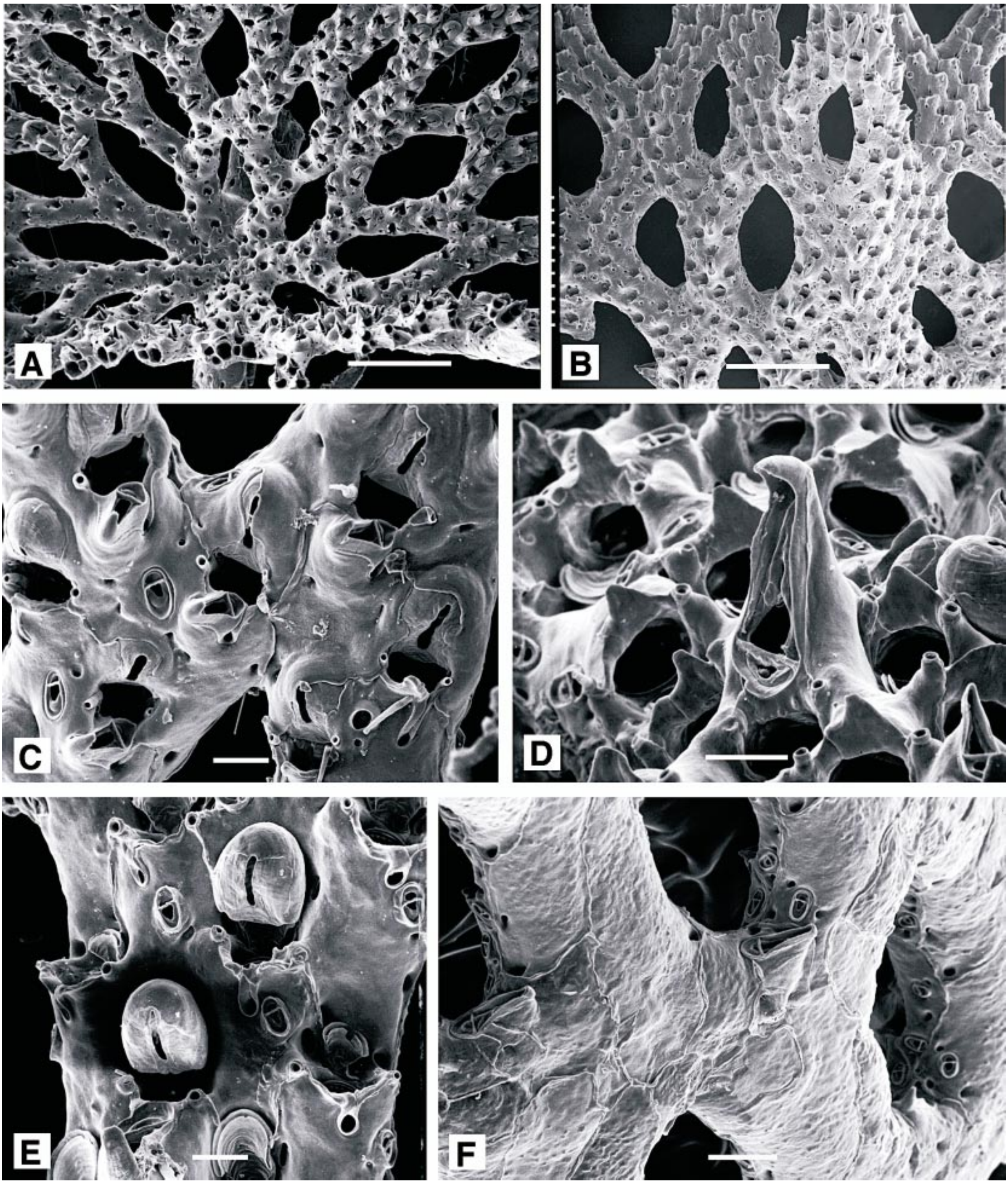

Fig. 42. **A–F.** *Reteporella grimaldii*. **A.** Delicate colony from within *Cellaria* meadow (AMNH 1000; 1 mm). **B.** Robust colony from more exposed locality (AMNH 1001; 1 mm). **C.** Maternal zooids with partially immersed ovicells (AMNH 1000; 0.1 mm). **D.** Oblique view of colony surface with autozooids and dimorphic adventitious avicularia (AMNH 1002; 0.1 mm). **E.** Autozooids (right) and maternal zooids with incompletely formed ovicells (AMNH 1002; 0.1 mm). **F.** Reverse surface with kenozooids and dimorphic avicularia (AMNH 1001; 0.2 mm).

oral spines present, one on each side of orifice, persisting in late ontogeny. Peristome developing in early ontogeny, obscuring primary orifice; deep, slightly flared frontally, with conspicuous medio-proximal pore, linked to peristome rim by clear groove. Inner face of peristome coarsely denticulate, thickened spine bases prominent in each proximal corner. Avicularia adventitious. Frontal avicularia dimorphic: short, elliptical, 0.06 mm long, normal to frontal plane, with varying orientation; or larger, with narrowly triangular, distally hooked rostrum, ca. 0.3 mm long, orientated perpendicular to frontal plane and very conspicuous. Single large, transversely orientated avicularia in proximal, abfrontal axils of fenestrulae while short elliptical type are common across abfrontal surfaces. Ovicell slightly longer than wide, flattened frontally, with narrow fissure extending for about half its length; aperture overhung by short, straight-edged labellum.

Tentacles light orange, 12; lophophores distally flaring conical, radially symmetrical to slightly obliquely truncate, commonly overlapped with adjacent tentacles up to 60 μm.

Embryo color deep, bright reddish-orange.

REMARKS: Colonies are small and delicate in quiet environments such as within the *Cellaria* turf west of Banjole Island (fig. 42A), but overall colony size and branch width are much more robust in more exposed, less confined environments (fig. 42B).

DISTRIBUTION: Offshore, typically on hard substrata. This species is common in the northeast Atlantic region, from the White Sea, the Kara Sea, Iceland, and western Greenland south to the Mediterranean, where it seems to occur in shallower habitats than to the north. Hayward and Ryland (1996) could not distinguish Mediterranean from North Atlantic specimens.

MEASUREMENTS (SKELETAL): AAL(large) 324 ± 77 μm, 192–494 (3, 30), AAW(large) 202 ± 45, 133–297 (3, 26), AL(fenestrulae) 248 ± 23, 331–386 (1, 10), DO 273 ± 41, 199–359 (4, 40), OW 97 ± 11, 79–122 (3, 30), OvL 193 ± 25, 149–248 (3, 24), OvW 173 ± 16, 143–208 (3, 24), ZL 353 ± 17, 331–386 (1, 10), ZW 187 ± 13, 160–202 (1, 10). (POLYPIDE): IH ~0 μm, LD 450 ± 35, 380–500 (1, 23), TLMn 324 ± 22, 300–360 (1, 5), TLMx 447 ± 25, 400–520 (1, 23).

GENUS *RHYNCHOZOON* HINCKS, 1895

Rhynchozoon neapolitanum Gautier, 1962

Figure 43A–E

Rhynchozoon neapolitanum Gautier, 1962: 243. Zabala, 1986: 531. Zabala and Maluquer, 1988: 149.

DESCRIPTION (AMNH 968, 1003; CMRR 2265): Colonies cream-colored to tan, encrusting, multilaminar; developing frontally budded, massive nodular forms, frequently exceeding 3 × 3 × 3 cm. Autozooids with vitreous, nodular frontal shield bordered by a single series of conspicuous marginal pores. Primary orifice as wide as long; distal and lateral rim with large, rounded, closely spaced denticulations; proximal border with short, narrow U-shaped sinus accentuated by stout, faceted condyles. No oral spines. Peristome thick, deepening through ontogeny; distal and lateral border developing short knobs; proximal border characteristically with a pair of stout columnar processes flanking a deep median embayment; at base of inner surface of one process, a thick angular uncinate lateral process projects into the lumen of the peristome. Median suboral avicularium present in some autozooids with uncinate process at its proximal end; rostrum broadly triangular, hooked distally, acute to plane of orifice and facing laterally. Frontal avicularia often frequent in later ontogeny; characteristic: with voluminous cystid occupying more than half frontal surface of bearing autozooid, rostrum elongate triangular, acute to frontal plane, directed proximally or proximolaterally. Ovicell short and broad; flat frontally, with a transversely oval area of membranous ectooecium; aperture straight edged, with a short notch in each corner.

Tentacles cream-colored, 13–15; lophophores distally flared conical, radially symmetrical to obliquely truncate.

Embryo color pale orange.

REMARKS: The largest colonies often incorporate tubular channels opening over the surface, suggesting they had grown in association with hydroids (as in *Rhynchozoon larreyi* Auct.; see Ristedt and Schuhmacher, 1985).

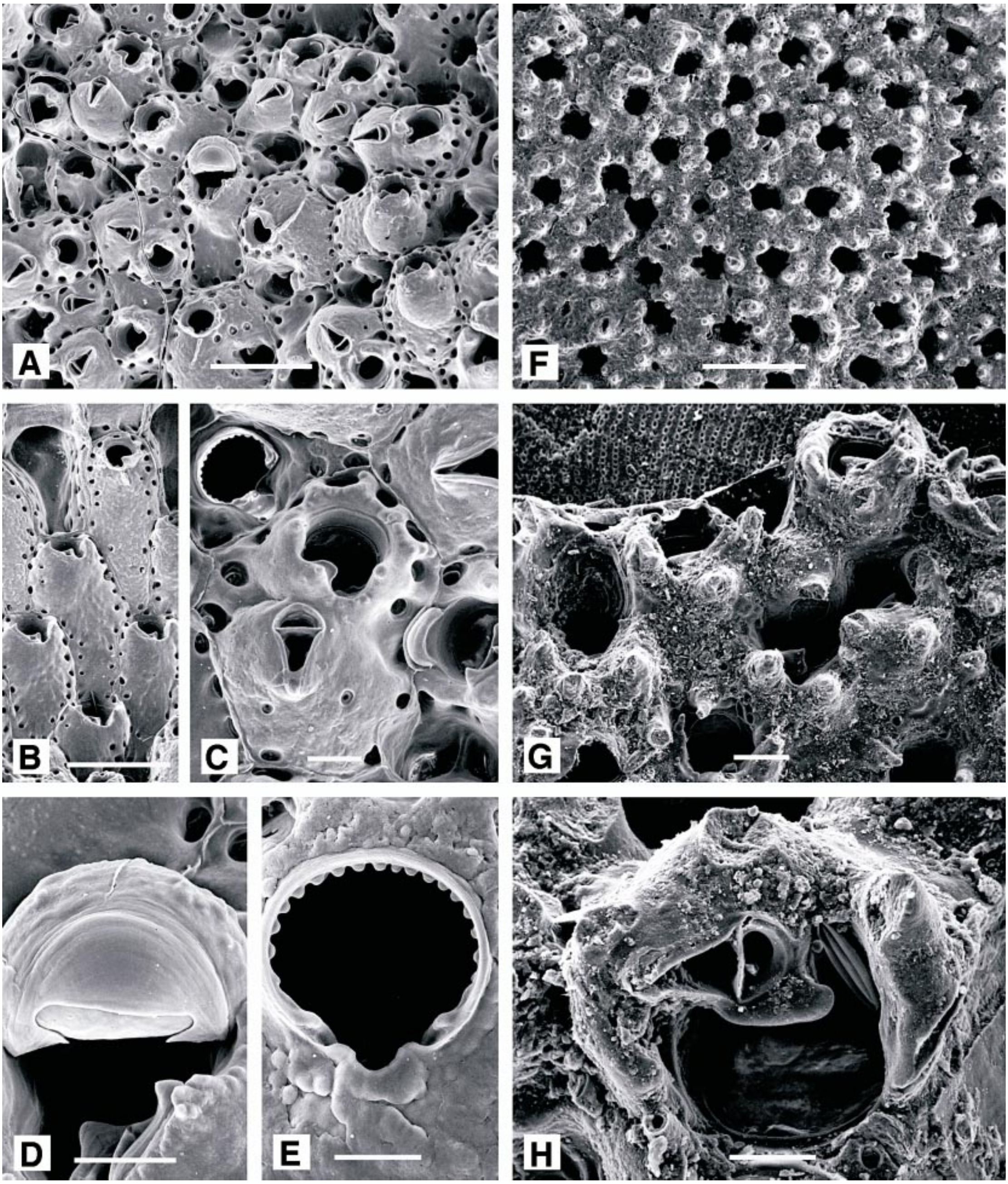

Fig. 43. **A–E.** *Rhynchozoon neapolitanum*. **A.** General aspect of frontally budded region (AMNH 1003; 0.5 mm). **B.** Colony margin with laterally budded zooids (AMNH 968; 0.5 mm). **C.** Ontogenetically young (top left) and (center) old autozooids (AMNH 1003; 0.5 mm). **D.** Ovicell (AMNH 1003; 0.05 mm). **E.** Autozooidal orifice (AMNH 1003; 0.05 mm). **F–H.** *Rhynchozoon pseudodigitatum* (AMNH 1004). **F.** General aspect (0.5 mm). **G.** Autozooids along colony margin (0.1 mm). **H.** Autozooidal orifice with orificial avicularium (0.05 mm).

DISTRIBUTION: This common and distinctive species is widely distributed throughout the Mediterranean.

MEASUREMENTS (SKELETAL): DO 447 ± 79 μm, 301–635 (2, 20), OL 106 ± 6, 93–117 (2, 20), OW 125 ± 4, 117–131 (2, 20), OvL 196 ± 16, 173–213 (2, 20), OvW 287 ± 20, 258–311 (2, 20), SL 14 ± 3, 11–20 (2, 20), SW 25 ± 5, 19–36 (2, 20), ZL 614 ± 54, 513–733 (2, 20), ZW 388 ± 50, 292–462 (2, 20). (POLYPIDE) IH 69 ± 42 μm, 1–120 (1, 10), LD 709 ± 61, 600–800 (1, 10), MD 30 ± 4, 25–35 (1, 4), TL 663 ± 61, 560–780 (1, 10).

Rhynchozoon pseudodigitatum Zabala and Maluquer, 1988

Figure 43F–H

Rhynchozoon lobulatum: Gautier, 1962: 242.
Rhynchozoon pseudodigitatum Zabala and Maluquer, 1988: 147.

DESCRIPTION (AMNH 1004): A single, small, encrusting, multiserial, unilaminar colony. Primary orifice wider than long, the anter denticulate and the poster shallowly concave between small, rounded condyles. Within the peristome is a broad, straight-edged uncinate process, the free corner of which is produced and may abut against opposing side of peristome wall, defining a pseudospiramen. Lateral suboral avicularium, with hooked rostrum acute to plane of orifice and laterally directed; soon obscured by a thickened peristome, with a lobed rim developing into knobbed processes projecting over the lumen. Frontal shield nodular, vitreous, with some nodules developed as pronounced knobs. Small adventitious avicularia with slender, triangular rostrum, distributed sporadically on frontal shields of autozooids, with variable orientation.

REMARKS: The shape of the primary orifice and the lobed peristome rim are typical of *R. pseudodigitatum* as described and figured by Zabala and Maluquer (1988), who considered that the single specimen from the Gulf of Marseille attributed to the poorly defined *R. lobulatum* Waters by Gautier (1962) was the same species.

OCCURRENCE: The single, small colony which appears to be attributable to this species was encrusting shell.

DISTRIBUTION: Mediterranean; this current record represents the first occurrence of the species in the eastern Mediterranean.

MEASUREMENTS (SKELETAL): AAL 85 ± 11 μm, 71–96 (1, 6), AAW 56 ± 11, 39–74 (1, 6), DO 284 ± 27, 229–317 (1, 11), SOD 134 ± 13, 112–163 (1, 22), ZL 401 ± 44, 330–471 (1, 11), ZW 273 ± 27, 229–317 (1, 11).

Rhynchozoon revelatus, new species

Figure 44A–D

Rhynchozoon species 2: Hayward, 1974: 389. Zabala, 1986: 528. Zabala and Maluquer, 1988: 149.

DIAGNOSIS: Primary orifice wide, D-shaped, with widely spaced, fine denticles along distal rim; oral spines lacking; median suboral avicularium with distally-facing rostrum acute to frontal plane, accompanied by blunt uncinate process; dimorphic suboral avicularium.

HOLOTYPE: AMNH 1005.

PARATYPES: AMNH 1006, 1007, 1056; CMRR 2266–2269.

ETYMOLOGY: The species name is from the Latin *revelatus* (unveil).

DESCRIPTION: Colonies cream-colored, encrusting, multilaminar, developing domed, mamillate nodules, with mammillae forming incipient erect branches. Autozooids with thick, vitreous frontal shield, bordered by a single series of large marginal pores. Primary orifice wider than long, D-shaped; distal rim with fine, widely spaced denticles, proximal rim straight, small rounded condyles just visible in proximolateral corners. No oral spines. Peristome a thick, low rim, not obscuring orifice; median suboral avicularium present on most autozooids, with distally hooked, triangular rostrum orientated acute to frontal plane and facing distolaterally. Adjacent to proximal part of avicularium, peristome rim is shallowly notched, and a short, blunt uncinate process projects from base of avicularium cystid; apical part of cystid variably developed as a stout umbo. Suboral avicularium dimorphic, in most autozooids rostrum length less than width of orifice; massive type with broadly triangular, distally hooked rostrum, >0.3 mm long. In smaller avicularia, crossbar complete and thickened, but larger type lacks a columella; there is no

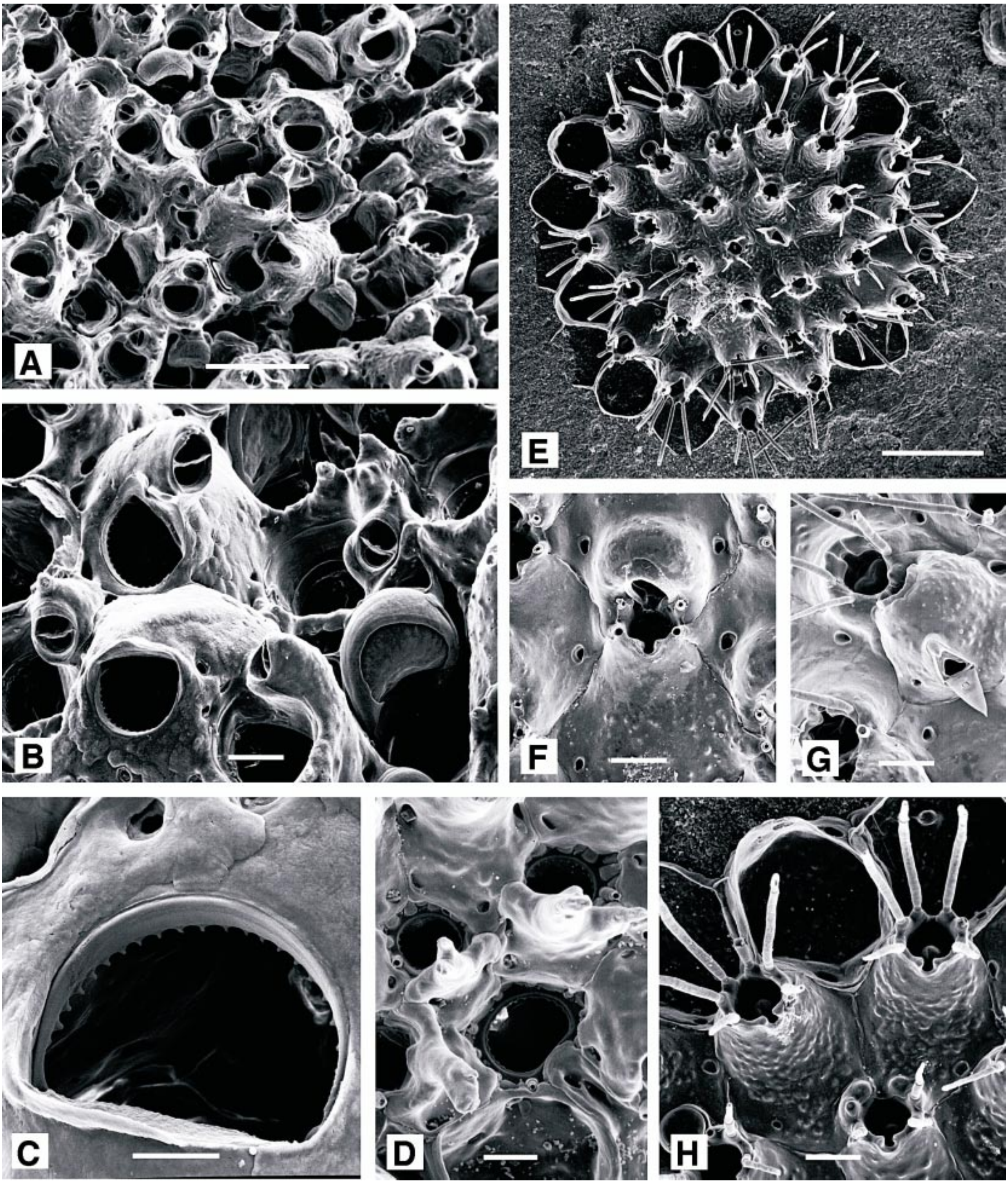

Fig. 44. **A–D.** *Rhynchozoon revelatus*. **A.** General aspect (holotype, AMNH 1005; 0.5 mm). **B.** Autozooids and (bottom right) maternal zooid with ovicell (holotype, AMNH 1005; 0.1 mm). **C.** Autozooidal orifice (holotype, AMNH 1005; 0.05 mm). **D.** Ancestrula (center) and early autozooids (paratype, AMNH 1056). **E–H.** *Schizotheca fissa*. **E.** Entire, untreated colony (AMNH 942; 0.5 mm). **F.** Maternal zooid with normal ovicell (AMNH 1009; 0.1 mm). **G.** Oblique view from distal end of maternal zooid with ovicell bearing distal adventitious avicularium (AMNH 1010; 0.1 mm). **H.** Ontogenetically young, untreated autozooids (AMNH 942; 0.1 mm).

palate. No frontal adventitious avicularia. Ovicell elongate oval, flat frontally, with a broadly arched aperture; projecting vertically above peristome rim; smooth surfaced, frontal ectooecium almost entirely membranous. In large colonies, greater than 2 cm high and wide, basal surfaces largely unattached to the substratum.

Ancestrula 0.25 mm long with transversely oval opesia occupying half frontal surface, bordered by undetermined number of spines. Two to four spines present in first three to four astogenetic generations only.

Tentacles clear, 12–13 in zooids closest to ancestrula, 14–15 in subsequent zooids; lophophores bell-shaped, radially symmetrical midway between chimneys, grading to strongly obliquely truncate, campylonemidan, in some instances scalloped adjacent to chimneys.

OCCURRENCE: Diverse shell substrata; common on the thecate ascidian *Microcosmus*.

DISTRIBUTION: Originally recorded from Chios, Aegean Sea, this species has remained undescribed although it has been reported from several other localities in the Mediterranean. It was extremely common in the Rovinj region.

MEASUREMENTS (SKELETAL): AL(large) 384 ± 7 2 μm, 222–474 (3, 12), AW(large) 257 ± 74, 136–386 (3, 10), AL(small) 146 ± 12, 132–167 (1, 10), AW(small) 102 ± 9, 92–117 (1, 10), DO 472 ± 97, 334–691 (3, 30), OL 118 ± 7, 106–133 (3, 30), OW 162 ± 12, 140–187 (3, 30), OvL 190 ± 24, 148–220 (3, 6), OvW 259 ± 34, 196–286 (3, 6), ZL 658 ± 83, 556–770 (1, 10), ZW 404 ± 19, 370–431 (1, 10). (POLYPIDE): IH 116 ± 59 μm, 40–300 (2, 24), LDMn 608 ± 70, 500–740 (2, 23), LDMx 692 ± 166, 500–1140 (2, 30), MD 25 (1, 1), TLMn 592 ± 55, 420–680 (2, 25).

GENUS *SCHIZOTHECA* HINCKS, 1877

Schizotheca fissa (Hincks, 1856)

Figure 44E–H

Lepralia fissa Busk, 1856: 308.
Schizotheca fissa Hincks, 1880: 284. Gautier, 1962: 223. Zabala, 1986: 543. Zabala and Maluquer, 1988: 150. Hayward and Ryland, 1999: 382.

DESCRIPTION (AMNH 942, 1009, 1010; CMRR 2270): Colonies translucent, encrusting, multiserial, unilaminar, small, rounded patches. Autozooids oval to hexagonal, slightly convex, with indistinct boundaries. Frontal shield thickly calcified, finely granular, becoming coarser in later ontogeny; with few (1–3) indistinct marginal pores. Primary orifice orbicular, with denticulate distal rim and small, U-shaped proximal sinus. Peristome well developed, cylindrical, projecting well above frontal shield; six long, slender spines evenly spaced around distal and lateral borders (four in ovicellate zooids); midproximally, rim bears short, U-shaped notch, continued on inner distal face of peristome as deep groove. Avicularia vicarious, cystid about as large as an autozooid; rostrum triangular, directed distally. Ovicell elongate oval, recumbent on distally succeeding autozooid, smooth surfaced, imperforate, with elongate frontal fissure; at first prominent, later immersed in thickened calcification; some with avicularium on distal surface.

DISTRIBUTION: Often common on biogenic carbonates, *S. fissa* is widespread throughout the Mediterranean, in shallow detritic environments. It ranges north to the southwest British Isles, and south to the Cape Verde Islands.

MEASUREMENTS (SKELETAL): AL 376 ± 106 μm, 207–528 (3, 9), AW 225 ± 52, 171–322 (3, 9), DO 333 ± 30, 293–395 (3, 25), OL 78 ± 5, 72–86 (1, 10), OW 83 ± 7, 74–92 (1, 10), OvL 183 ± 27, 149–242 (2, 16), OvW 211 ± 18, 189–249 (2, 16), ZL 436 ± 44, 364–510 (3, 22), ZW 290 ± 20, 251–322 (3, 22).

Schizotheca serratimargo (Hincks, 1886)

Figures 45A–H, 46

Schizoporella serratimargo Hincks, 1886: 268.
Schizotheca serratimargo: Zabala and Maluquer, 1988: 148.

DESCRIPTION (AMNH 1011–1013; CMRR 2271): Colonies orange, erect, bilaminate, branching and anastomosing, developing rigid, three-dimensional, reticulate structures; branches of variable width (3.6 ± 1.0 mm,

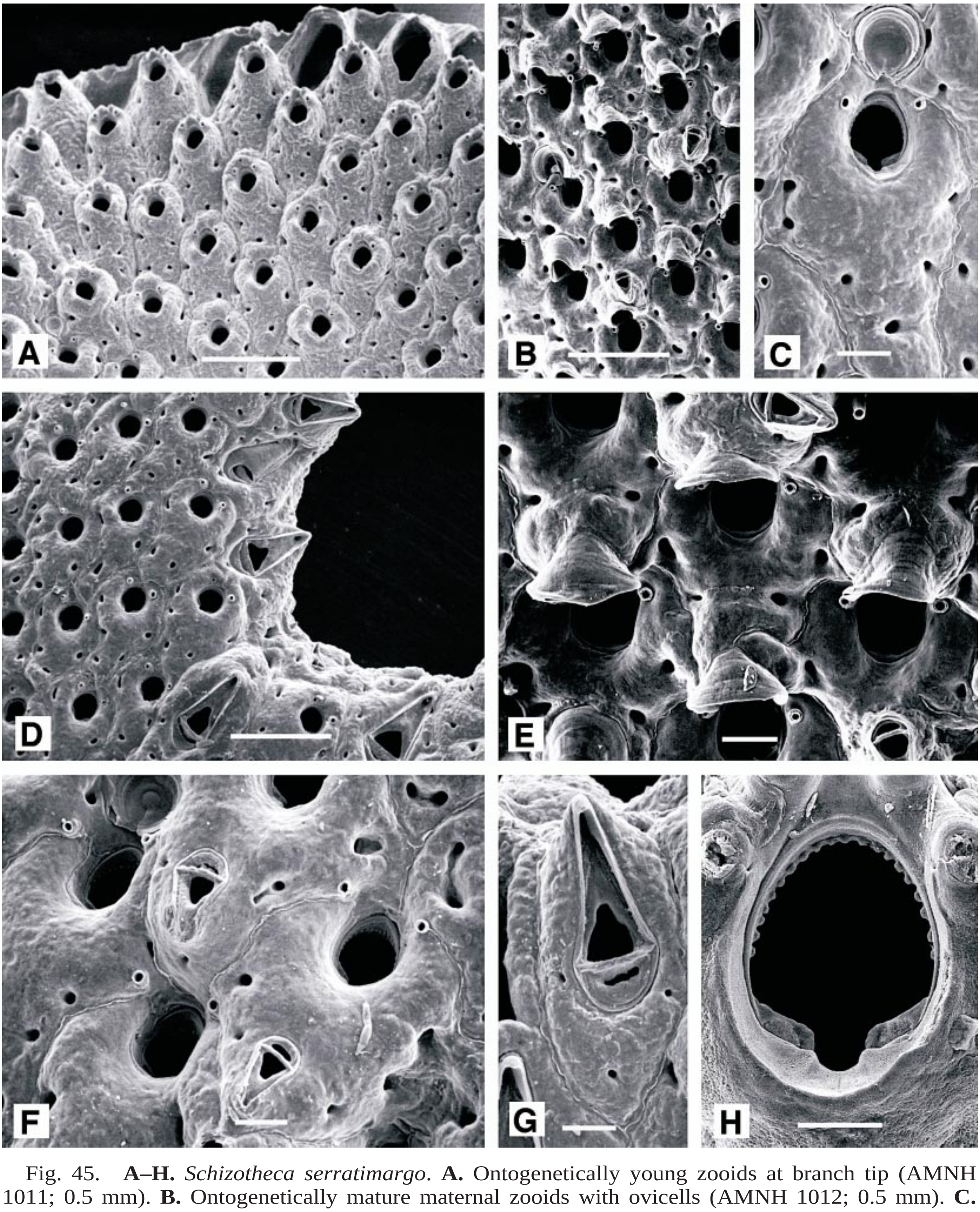

Fig. 45. **A–H.** *Schizotheca serratimargo*. **A.** Ontogenetically young zooids at branch tip (AMNH 1011; 0.5 mm). **B.** Ontogenetically mature maternal zooids with ovicells (AMNH 1012; 0.5 mm). **C.** Ontogenetically young maternal zooid with incipient ovicell (AMNH 1011; 0.1 mm). **D.** Branch margin with vicarious avicularia along edge (AMNH 1013; 0.5 mm). **E.** Completely formed ovicells of maternal zooids (AMNH 1012; 0.1 mm). **F.** Ontogenetically old autozooids with adventitious avicularia (AMNH 1011; 0.1 mm). **G,** Vicarious avicularium (AMNH 1011; 0.1 mm). **H.** Autozooidal orifice (AMNH 1012; 0.05 mm).

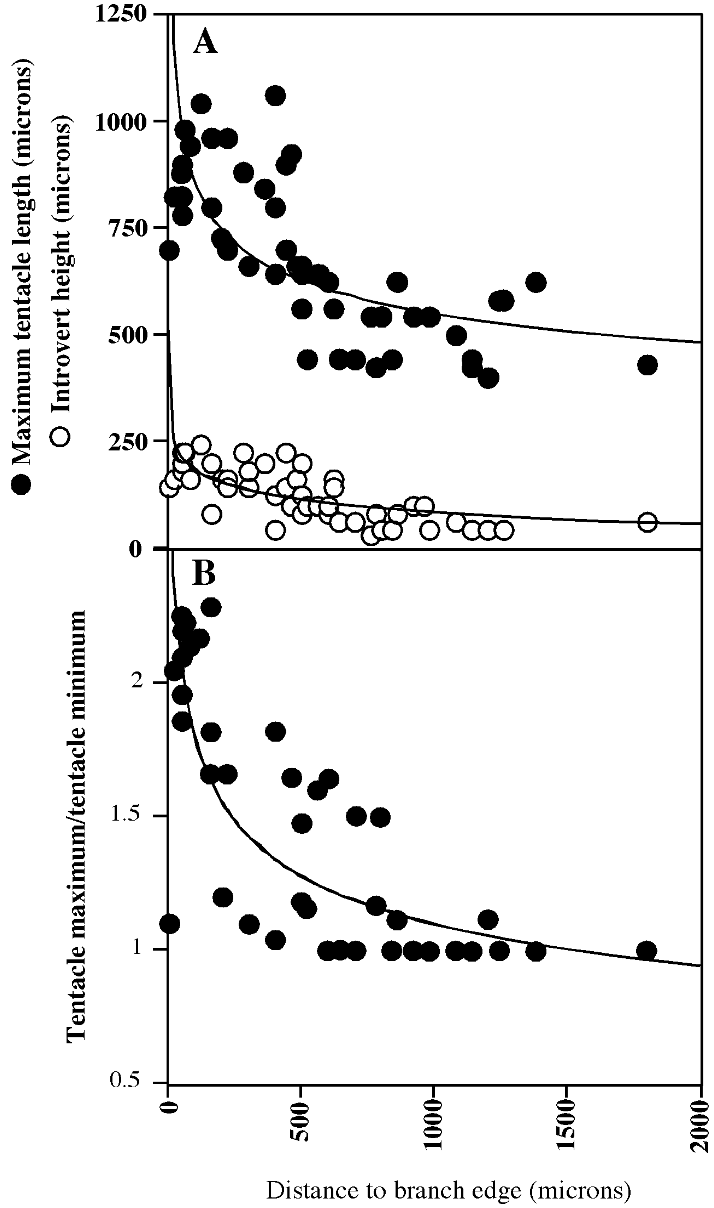

Fig. 46. *Schizotheca serratimargo*. **A.** Tentacle length and height of introvert with respect to distance from edge of branch. **B.** Lophophore asymmetry plotted as ratio of maximum tentacle length to minimum tentacle length with respect to distance from edge of branch.

N = 221), dividing frequently and irregularly. Autozooids hexagonal to irregularly polygonal, becoming more rounded in later ontogeny but remaining distinct, each bounded by thin, raised sutures. Primary orifice longer than wide; anter semielliptical, with finely denticulate inner rim; poster shallowly concave with an indistinct median sinus, emphasized and deepened by thick, prominent condyles extending on each side from proximolateral corner to edge of sinus. Two widely spaced distal oral spines present, persisting in late ontogeny. Frontal shield thickly calcified, convex, nodular with few (<6) irregularly distributed marginal pores. Adventitious avicularia sporadic, often absent over young areas of the colony while frequent on older portions; rostrum elongate triangular, distally hooked, acute to frontal plane and with variable orientation. Large vicarious avicularia present along branch margins, cystid as large as an autozooid, rostrum almost as long, elongate triangular and distally hooked; palate with a triangular foramen, crossbar thick but without a columella. Ovicell hyperstomial, longer than wide, rather small; aperture widely open, extending distally as a triangular fissure; ooecial cover obscures ovicell in later ontogeny.

Tentacles light orange, 12–15, usually 14; lophophores bell-shaped, radially symmetrical with uniform tentacle lengths away from branch margins, grading to strongly obliquely truncate with increasingly unequal tentacle lengths and longer introverts along branch margins (fig. 46), which serve as elongate excurrent strips; lophophores also obliquely truncate immediately adjacent to chimneys, which develop on broadest bifoliate surfaces (McKinney, 1989).

DISTRIBUTION: Described from the Adriatic, where it is common on hard substrata in shallow inshore habitats, *S. serratimargo* has also been found to be abundant on the Catalan coast (Zabala, 1986) and is probably widely distributed throughout the Mediterranean. There is a single record of it from the western English Channel (Hayward and Ryland, 1999).

MEASUREMENTS (SKELETAL): AAL 177 ± 37 μm, 134–252 (2, 15), AAW 103 ± 28, 73–177 (2, 15), DO 356 ± 36, 295–439 (2, 20), OL 110 ± 7, 99–125 (2, 20), OW 96 ± 5, 88–105 (2, 20), OvL 171 ± 13, 154–204 (2, 20), OvW 174 ± 10, 160–193 (2, 20), SL 11 ± 2, 7–17 (2, 20), SW 21 ± 4, 15–28 (2, 20), VAL 531 ± 58, 437–656 (2, 19), VAW 335 ± 38, 267–402 (2, 19), ZL 502 ± 55, 421–641 (2, 20), ZW 345 ± 19, 310–379 (2, 20). (POLYPIDE): IH 125 ± 63 μm, 30–240 (6, 52), LDMn 560 ± 107, 420–800 (4, 37), LDMx 638 ± 143, 380–940 (6, 62), TLMn 472 ± 88, 360–640 (6, 42), TLMx 689 ± 186, 400–1060 (6, 53).

CLASS STENOLAEMATA BORG, 1926

ORDER CYCLOSTOMATA BUSK, 1852

SUBORDER TUBULIPORINA MILNE EDWARDS, 1838

FAMILY TUBULIPORIDAE JOHNSTON, 1838

GENUS *TUBULIPORA* LAMARCK, 1816

Tubulipora liliacea (Pallas, 1766)

Figures 47A–D, 48

Millepora liliacea Pallas, 1766: 248.
Tubulipora liliacea: Harmer, 1898: 90. Harmelin, 1976: 171. Hayward and Ryland,1985a: 74. Zabala and Maluquer, 1988: 176.

DESCRIPTION (AMNH 1014–1016; CMRR 2272): Colonies encrusting to semierect, commonly extending as two multiserial lobes diverging laterally from axis of ancestrula, up to at least 8 mm in the vicinity of Rovinj; usually violet-colored. Autozooids with long peristomes, longest in the most cryptic microenvironments. Peristomes isolated in early astogenetic portion of colony, then organized into single-row fascicles radiating from centers of lobes. Peristomes contiguous and appressed within fascicles but in some, independent at distal ends. Individual fascicles constituted by 2 to 8 peristomes in present material and elsewhere in the Mediterranean (Harmelin, 1976), but up to 12 in British specimens (Hayward and Ryland, 1985a). Spacing between fascicles variable. Autozooidal apertures oval where isolated and elongate polygonal where connate.

Gonozooids distinctly inflated, centered in lobes, more densely perforated and with larger pseudopores than autozooids. More than one ooeciostome present in some lobes, suggesting multiple confluent or contiguous gonozooids. Ooeciostomes located distally, adjacent to base of second or third peristome, usually located against side of fascicle facing distal end of lobe, curved, opening laterally or downward, toward surface of gonozooid; ooeciostomes constricted at some point to about the diameter of autozooids, then terminating in a broadly flaring oval hood.

Protoecium hemispherical, about 120 μm diameter, giving rise to laterally oriented, elongate tubular portion of ancestrula. Protoecial cone gradually widening, generally curved right or left and consisting of about four generations of autozooids with isolated

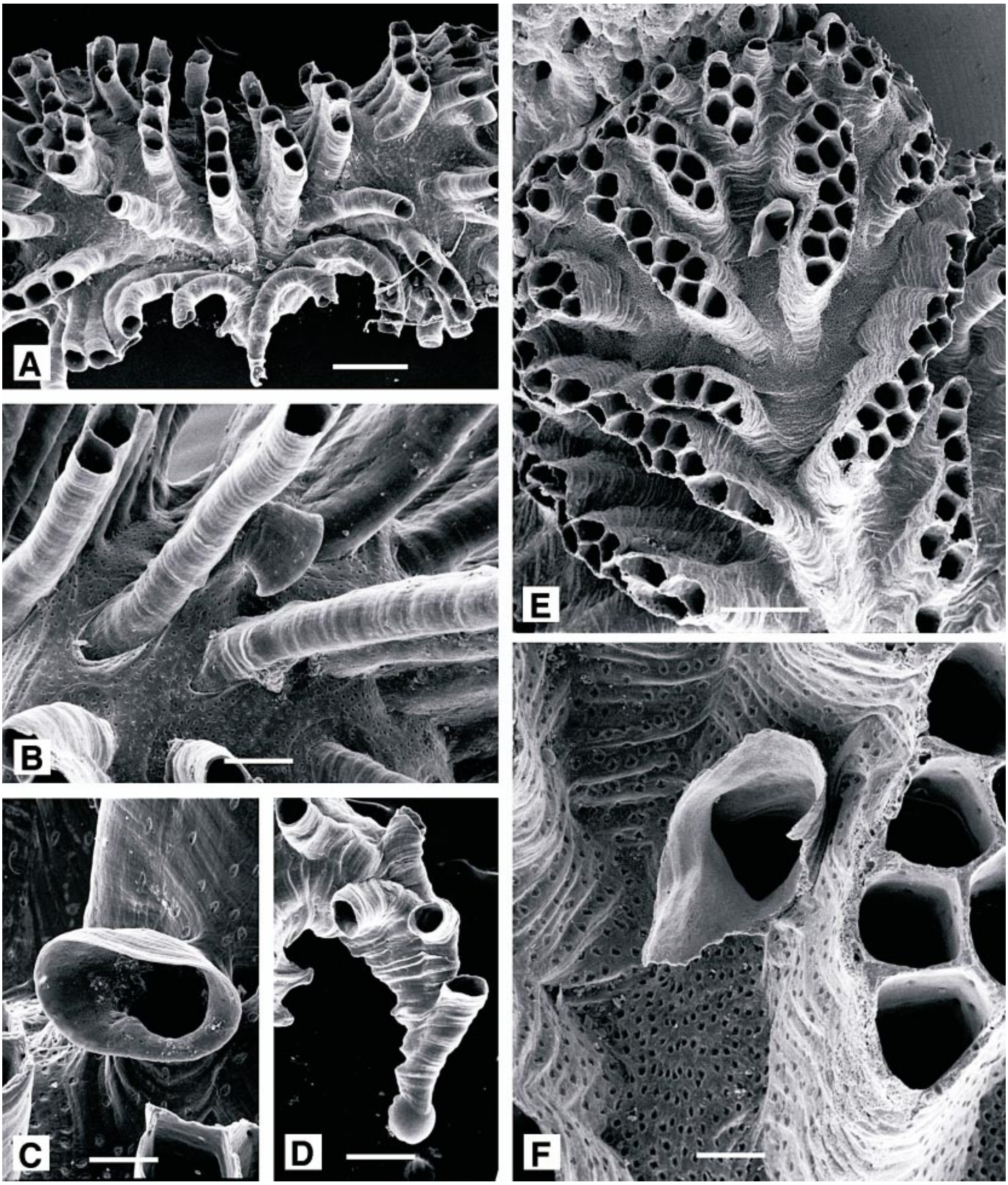

Fig. 47. **A–D.** *Tubulipora liliacea*. **A.** General aspect (AMNH 1014; 0.5 mm). **B.** Position of ooeciostome (center) (AMNH 1015; 0.2 mm). **C.** Ooeciopore (AMNH 1014; 0.1 mm). **D.** Ancestrula and early autozooids (AMNH 1016; 0.2 mm). **E, F.** *Tubulipora plumosa* (AMNH 1017). **E.** General aspect (0.5 mm). **F.** Damaged ooeciostome (center) and (right) fascicle of autozooids (0.01 mm).

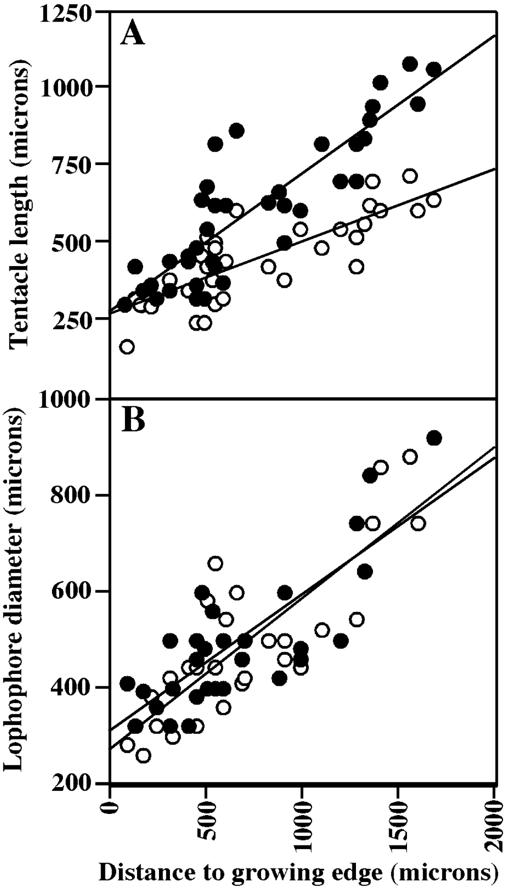

Fig. 48. *Tubulipora liliacea*. **A.** Ontogenetic increase in tentacle length: Filled circles plot maximum tentacle length within lophophores (Y = 277.244 + 0.445X) and open circles plot minimum tentacle lengths (Y = 266.548 + 0.235X). **B.** Ontogenetic increase in lophophore diameter: Filled circles plot maximum lophophore diameters (Y = 306.178 + 0.285X) and open circles plot minimum diameters (Y = 269.182 + 0.314X).

peristomes. At distal end of protoecial cone, budding rate increased rapidly, particularly along lateral margins (establishing two laterally diverging lobes), and transversely oriented fascicles of peristomes appearing abruptly, establishing astogenetic zone of repetition.

Tentacles clear but locally colored by purple or brown granules, 11; lophophores small, conical, radially symmetrical along growing margin to campylonemidan, progressively larger and more strongly obliquely truncate due to increasingly unequal tentacle lengths toward chimneys in colony centers (fig. 48A), although tentacles are arrayed to maintain roughly circular shapes (fig. 48B).

OCCURRENCE: The species is widely distributed, occurring on bivalve shells, bryozoans, rocks, and *Microcosmus*. In the present material, colonies on bivalve shells, rocks, and *Pentapora fascialis* usually are adnate, while those on *Cellaria* and *Microcosmus* usually are semierect. Specimens that occur on bivalve shells are overwhelmingly located on the shell interiors, indicating a strong preference for cryptic microenvironments (Harmelin, 1976; McKinney, 2000).

DISTRIBUTION: *T. liliacea* is widespread in the eastern North Atlantic and Mediterranean; it has also been reported from the Barents Sea (Kluge, 1962, 1975) and from the northeastern coast of North America (Osburn, 1912), though these more distant records need to be confirmed. Harmelin (1976) recorded the species at depths up to 60 m in the western Mediterranean, and found that variations in the robustness of colonies and orientation of the ooeciostome were related to the physical environment.

MEASUREMENTS (SKELETAL): ADMN 142 ± 17 μm, 120–180 (4, 40), ADMX 169 ± 19, 120–200 (3, 30), Gap 327 ± 35, 240–420 (4, 31), OsDMN 213 ± 23, 200–240 (2, 3), OsDMX 328 ± 32, 270–360 (3, 6). (POLYPIDE): IH 0 ± 0 μm (6, 67), LMN 503 ± 144, 260–880 (6, 41), LMX 520 ± 133, 320–920 (6, 43), MD 25 ± 0 (2, 2), TLMn 462 ± 121, 160–720 (6, 54), TLMx 601 ± 204, 300–1080 (6, 59).

Tubulipora plumosa Harmer, 1898

Figure 47E, F

Tubulipora plumosa Harmer, 1898: 105. Harmelin, 1976: 177. Hayward and Ryland, 1985a: 80. Zabala, 1986: 672. Zabala and Maluquer, 1988: 176.

Tubulipora flabellaris Johnston, 1847: 274. Busk, 1875: 25 (pars, fide Harmer).

Tubulipora fimbria: Hincks, 1880: 448.

DESCRIPTION (AMNH 1017): Colonies encrusting, white, extending as one or more short, multiserial lobes. Autozooids in one- to two-row fascicles; up to at least 18 completely connate autozooids per fascicle. Autozooids relatively large, elongate polygonal to semipolygonal in cross section. Autozooidal fascicles diverging to right and left from axis of lobe. Fascicles highest at inner ends, where composed of oldest autozooids, gradually diminishing to zero height at outer ends, in circum-colony budding zone.

Gonozooids located distally within lobes, their brood chambers ramifying between several adjacent fascicles. Ooeciopore located at distal end of a centrally located ramification. Ooeciopores adjacent to second or third peristome within fascicle, with broadly flared, highly elongate oval hoods oriented away from surface of brood chamber. Colony surfaces, including fascicles, finely but clearly corrugated, with abundant circular to distally tapered triangular pseudopores. Surfaces of brood chambers poorly corrugated, with very abundant pseudopores. Distance between pseudopores on roofs of brood chambers approximately equaling pseudopore diameter.

Tentacles clear, 11; lophophores bell-shaped, radially symmetrical to obliquely truncate and campylonemidan, grading from small along colony margin to largest and most strongly obliquely truncate bordering chimneys in colony centers.

REMARKS: Authorship of this species is commonly attributed to Thompson in Harmer (1898), because Harmer adopted the trivial name *plumosa* that was used by Thompson for specimens from Ireland sent to Johnston (cited in Johnston, 1847). However, Harmer (1898) based his description on specimens from the coast of Devon, leading Ryland (1963: 7) to designate one of Harmer's specimens from Devon, housed in the Museum of Zoology, Cambridge, as lectotype.

DISTRIBUTION: *T. plumosa* is known from the eastern North Atlantic, from Norway to the Mediterranean.

MEASUREMENTS (SKELETAL): ADMN 181 ± 20 μm, 160–220 (1, 10), ADMX 194 ± 21, 160–220 (1, 10), Gap 420 ± 85, 230–530 (1, 10), OsDMN 230 (1), OsDMX: 440 (1). (POLYPIDE): IH 0 ± 0 μm (1, 10), LD 424 ± 82, 320–556 (1, 10), TLMn 358 ± 112, 200–540 (1, 10), TLMx 402 ± 112, 200–600 (1, 11).

GENUS *EXIDMONEA* DAVID, MONGEREAU, AND POUYET, 1972

Mongereau (1969) introduced the name *Exidmonea* for erect idmoneid species that differ from the Middle Jurassic type species of *Idmonea* Lamouroux 1821, which is predominantly encrusting and has elliptical branch cross sections in the occasional erect portions. Additionally, species of *Exidmonea* lack proximally directed kenozooids on the flat abfrontal surface of the branches and therefore differ from *Idmidronea* Canu and Bassler, 1920, which has them. As noted by Taylor and Voigt (1992) Mongereau did not choose a type species from among the species that he listed for *Exidmonea* in 1969, so the first valid use of *Exidmonea* was by David et al. (1972), when the type species *Exidmonea atlantica* AUCT. was first specified.

Exidmonea triforis (Heller, 1867)

Figures 49A–H, 50

Idmonea triforis Heller, 1867: 120. Waters, 1879: 271. Waters, 1922: 12. Friedl, 1917: 276.
Idmonea meneghinii Heller, 1867: 120.
Idmonea concava: Waters, 1879: 271.
Idmonea marionensis: Waters, 1879: 270.
Tubulipora atlantica: Harmer, 1915: 124. Cook, 1968: 230.
Idmidronea atlantica: Osburn, 1947: 5. Harmelin, 1976: 182. Zabala, 1986: 658.
Exidmonea atlantica: David et al., 1972: 84. McKinney, 1991a: 264. McKinney, 1991b: 437.

LECTOTYPE (chosen here): UIIZ 321.

DESCRIPTION (AMNH 1018, 1019; CMRR 2273): Delicate erect planar or nearly planar fan-shaped, white colonies of dichotomous branches. Branches subtriangular in cross section, with flat abfrontal surface along which the zooids originated and keeled frontal surface. Autozooids divergent at low angle from abfrontal surface toward frontal surface; those emergent near branch midline being longest. Autozooids in single-row connate fascicles, each fascicle extending across half of frontal surface, from central keel to lateral edge. Typically four, less commonly three or five, autozooids within a row. Fascicles typically curved proximally near lateral branch margin. Peristomes curved, bending away from the branch midline. Peristomes near branch midline longer, usually extending laterally beyond those closer to lateral branch margin.

Gonozooids centered on frontal branch surfaces, most commonly situated immediately proximal to branch bifurcations Brood

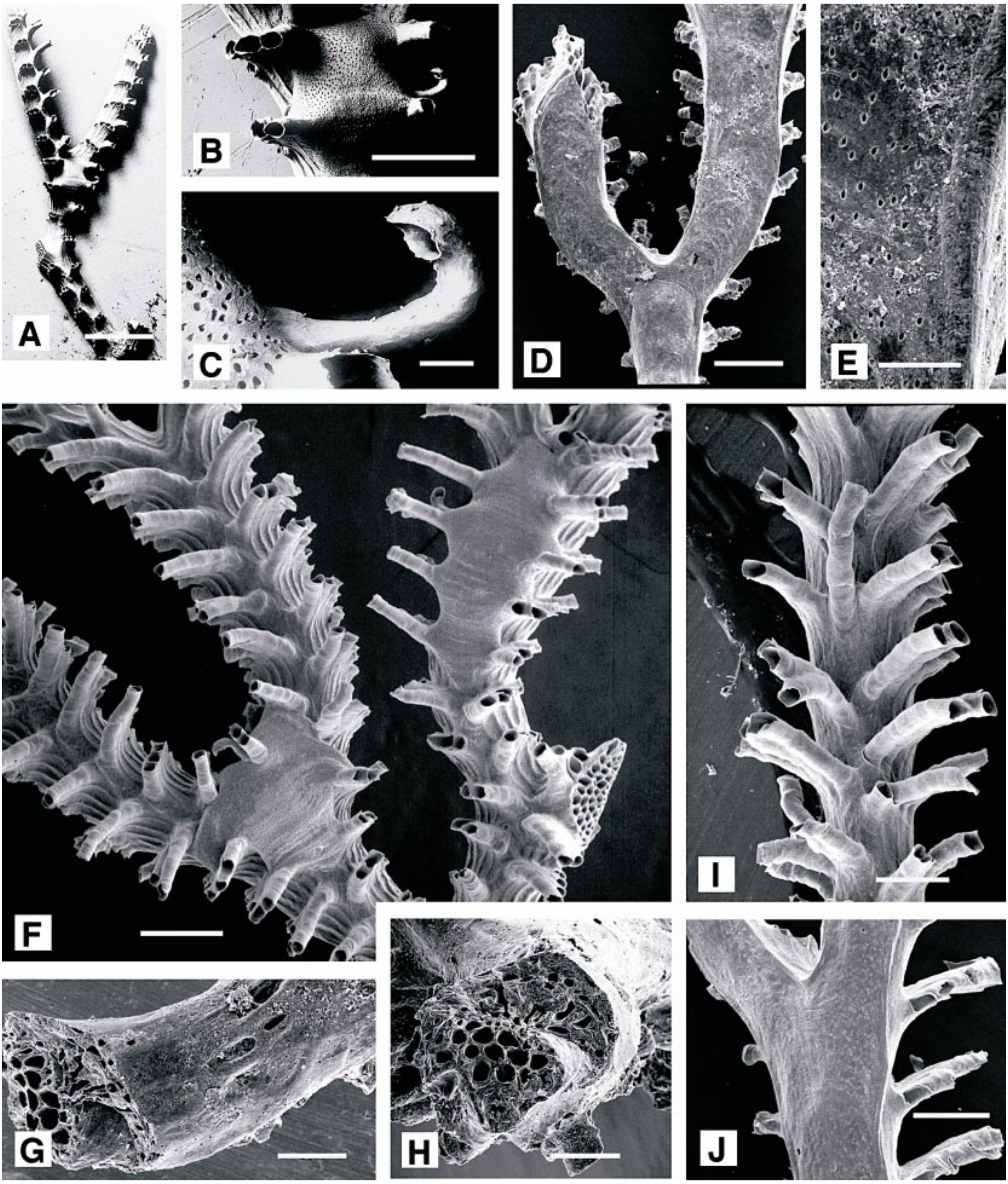

Fig. 49. **A–H.** *Exidmonea triforis*. **A.** General aspect (lectotype, UIIZ 321; 2 mm). **B.** Gonozooid (lectotype, UIIZ 321; 0.5 mm). **C.** Recurved ooeciostome and terminal ooeciopore (lectotype, UIIZ 321; 0.05 mm). **D.** Reverse surface of colony (AMNH 1018; 0.5 mm). **E.** Pseudopores and growth lines on reverse surface (AMNH 1018; 0.1 mm). **F.** Colony with two gonozooids at branch bifurcations (AMNH 1019; 0.5 mm). **G.** Reverse surface of broken colony base with kenozooids (AMNH 1018; 0.2 mm). **H.** Transverse break near colony base with kenozooids (above) and (below) autozooids (AMNH 1018; 0.02 mm). **I, J.** *Exidmonea coerula* (AMNH 1020). **I.** Frontal surface (0.5 mm). **J.** Reverse surface (0.5 mm).

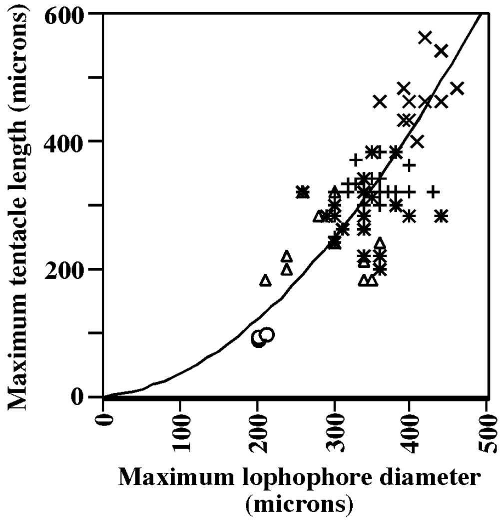

Fig. 50. *Eximonea triforis*. Relationship between maximum tentacle length and maximum lophophore diameters within autozooids. Autozooids in row closest to branch axis indicated by crosses, and those progressively farther from axis and closer to lateral margin of branch indicated successively by pluses, asterisks, triangles, and open circles. Relationship between tentacle length and lophophore diameter (marked by regression line) is $Y = 0.008X^{1.810}$, and is generated by change in lophophore shape from broadly flared, almost discoidal, at branch margin to more narrowly conical nearer branch axis, where lophophores are campylonemidian.

chambers engulfing lower portions of peristomes in two to four fascicles on each side of branch; ooeciopore situated at the end of short, approximately 180°-curved ooeciostome with smaller diameter than peristomes of typical autozooids. Ooeciopores typically opening downward, toward branch surface. Ooeciostomes typically located within distal portion of brood chamber, against distal side of a fascicle of autozooidal peristomes.

Tentacles clear, 10; lophophores of zooids located along branch keel highly asymmetrical and campylonemidian, with longest tentacles on the side closest to the branch center. Size of lophophores and constituent tentacles decreased, degree of asymmetry progressively decreased, and flare of the tentacles progressively increased, in autozooids closer to lateral branch margin (fig. 50). Due to the shapes, sizes, placement, and orientation of lophophores, those from branch center extending laterally farther than those at branch margins, with their highly obliquely truncate outer end oriented toward abfrontal side. They therefore generate a unified colonial feeding current that draws nutrient-bearing water from the abfrontal side of branches and ejects filtered water along the frontal surface (McKinney, 1991a, 1991b).

REMARKS: We designate as lectotype Heller's specimen illustrated here as fig. 49A–C (UIIZ 321). This species has long been referred to as *Idmonea atlantica* Forbes in Johnston, 1847, or as *I. atlantica* auctt. When David et al. (1972: 84) specified *Exidmonea atlantica* AUCT. as type species of *Exidmonea*, they established a new species, separate from *Idmonea atlantica* Forbes in Johnston, 1847. Although David et al. (1972) listed Miocene (Burdigalian) specimens as the material in hand when they established the new species, they did not designate a holotype. However, type material exists for two of Heller's (1867) species that have precedence for at least the Recent *Idmonea atlantica* auctt. of the Adriatic and probably beyond (Mediterranean, Atlantic). Specimens of *Exidmonea* from the vicinity of Rovinj encompass the attributes present in Heller's specimens of *Idmonea meneghinii* (UIIZ 320) and *Idmonea triforis*. We prefer to use the name *triforis* for the species, since most of our specimens are gracile rather than robust.

The lectotype of *E. triforis* has proximally directed kenozooids on the proximal end of its reverse surface. The proximal end of the specimen is slightly expanded and apparently is broken from just above its base of attachment, which is not preserved. In other specimens, the base of attachment is composed largely of kenozooids that lap a short distance up around the base of the erect portion. Beyond the short distance of kenozooidal thickening of the proximal end, the reverse side has no kenozooids.

Robustness of colonies is strongly influenced by environment and microenvironment. In a study of growth habits of *E. triforis* across several environments, from obscure parts of caves to relatively exposed shallow terrigenous and rocky substrata, Harmelin (1973b) found length between bifurcations to be highly variable, and bifurcation angle, width of ooeciostome, width of branches, and number of zooecia per fascicle to be moderately variable. Several of these variable branch characteristics interact to produce more irregular, delicate colonies in environments such as caves and more geometrically regular, though often smaller, colonies with more densely spaced, thicker branches in the more exposed environments. Size of gonozooids, and especially size of apertures and spacing between adjacent rows of apertures, were stable across environments.

DISTRIBUTION: *E. triforis* is widespread on rock and skeletal substrata in the Mediterranean Sea and cold temperate Atlantic Ocean.

MEASUREMENTS (SKELETAL): AD 83 ± 8 μm, 70–100 (3, 30), PD 105 ± 9, 90–120 (3, 30), ASW 201 ± 24, 160–240 (3, 30), RS 405 ± 48, 300–500 (3, 30), GL 1408 ± 284, 1020–2120 (3, 12), GW 793 ± 253, 480–1340 (3, 12), OsD 76 ± 13, 60–100 (2, 7), BW 537 ± 126, 360–800 (3, 20). (POLYPIDE): IH 0 ± 0 μm (7, 70), MD 19 ± 2.5, 15–20 (2, 4), LDMn 309 ± 80, 200–420 (4, 22), LDMx 339 ± 63, 200–460 (7, 80), TLMn 203 ± 43, 95–320 (7. 64), TLMx 308 ± 96, 90–560 (7, 88).

Exidmonea coerula (Harmelin, 1976)

Figure 49I, J

Idmidronea coerula Harmelin, 1976: 185.

DESCRIPTION (AMNH 1020; CMRR 2274): Erect, fan-shaped colonies of dichotomous branches that curve gently laterally or frontally. Colonies less compact and branches more robust than for *Exidmonea atlantica*. Branch cross section subtriangular, with flat abfrontal surface along which zooids originated and with keeled frontal surface. Distally convex growth lines on abfrontal surface reflect former positions of branch tips. Peristomes of zooids arranged in well-developed to ragged transverse fascicles, each located within one half of the frontal surface. Complete rows consist of usually four, locally five, peristomes, with distal tips isolated and bent in various directions. Locally, autozooidal rows less well defined, with fascicles of three or two peristomes, and less commonly individual peristomes completely independent of others in their row. Fascicles typically curved proximally near the lateral branch margin. Most peristomes curved, bent away from branch midline. Proximal portions of autozooids and their peristomes longest for zooids along the central keel and shortest for those along lateral edge of branch. Individual peristomes may alternately expand or contract, and their diameters are less constant than are those in *E. atlantica*. Peristome and aperture diameters decreased slightly toward the abfrontal surface.

REMARKS: Harmelin (1976) reported typically five to six peristomes per fascicle, with a range from three to eight in the original specimens that he collected from the Mediterranean near Marseilles. No gonozooids were found in the Adriatic specimens examined, but Harmelin's (1976) specimens had frontally centered, elongate gonozooids, with inflated brood chambers that extended across three to five fascicles of zooids. Brood chambers most commonly are situated immediately proximal to branch bifurcations, though some extend from the parent branch onto the proximal portions of both descendant branches. Ooeciopores are located at about midlength of brood chambers, on the distal side of an autozooidal peristome, at the end of short, recurved, transversely compressed ooeciostome. The outer side of each recurved ooeciostome is prolonged as a short hood partially occluding the ooeciopore.

DISTRIBUTION: The species is previously known only from the Mediterranean.

MEASUREMENTS (SKELETAL): AD 126 ± 9 μm, 110–140 (2, 20), PD 144 ± 9, 130–160 (2, 20), ASW 270 ± 51, 180–400 (2, 20), RS 515 ± 46, 440–600 (2, 20), BW 635 ± 85, 480–780 (2, 20).

FAMILY ANNECTOCYMIDAE HAYWARD AND RYLAND, 1985b

GENUS *ANNECTOCYMA* HAYWARD AND RYLAND, 1985b

Annectocyma arcuata (Harmelin, 1976)

Figure 51A–D

Diaperoecia arcuata Harmelin, 1976: 89. Zabala, 1986: 620.

Annectocyma arcuata: Zabala and Maluquer, 1988: 167.

DESCRIPTION (AMNH 1021–1023): Colonies of undivided erect branches up to at

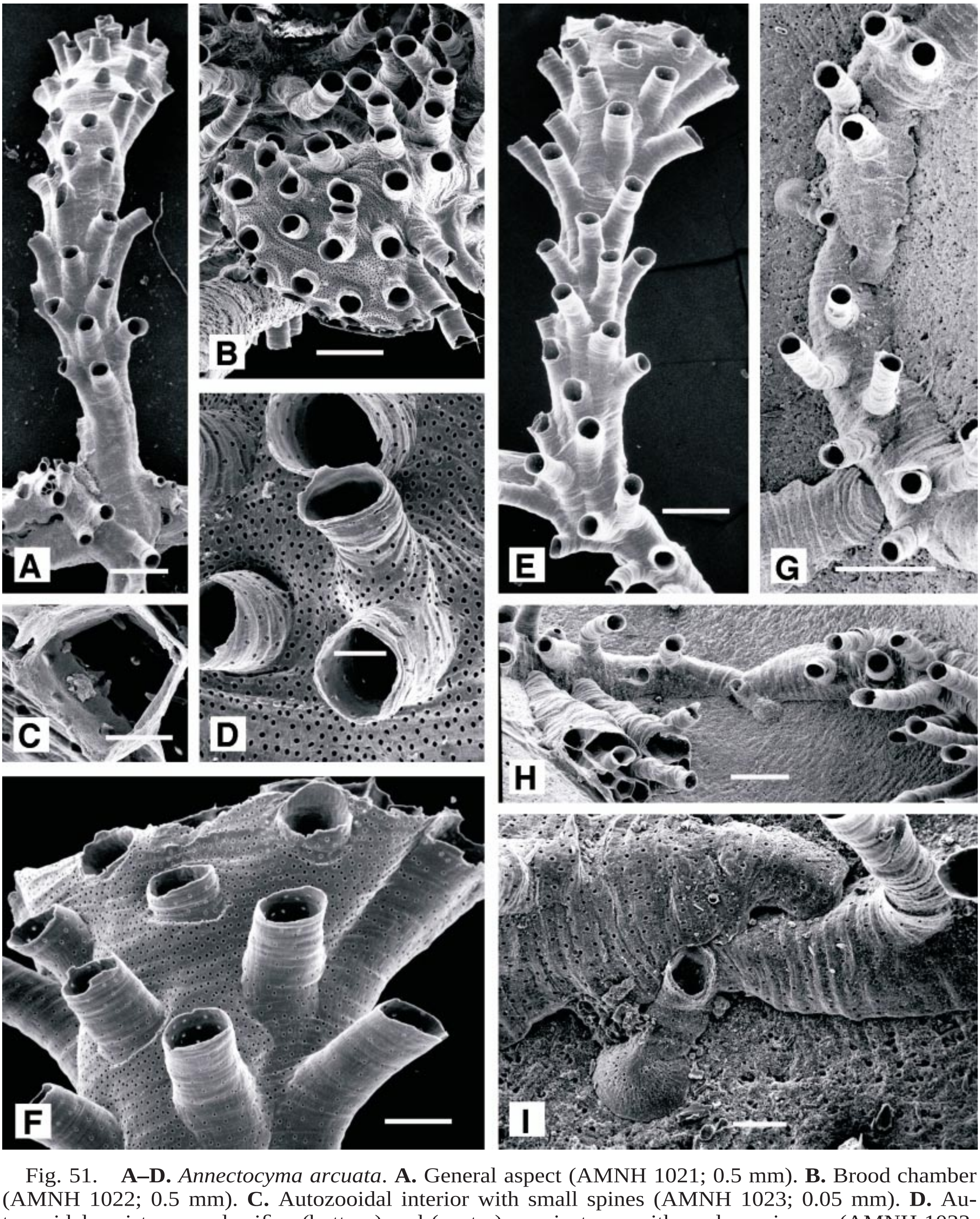

Fig. 51. **A–D.** *Annectocyma arcuata*. **A.** General aspect (AMNH 1021; 0.5 mm). **B.** Brood chamber (AMNH 1022; 0.5 mm). **C.** Autozooidal interior with small spines (AMNH 1023; 0.05 mm). **D.** Autozooidal peristome and orifice (bottom) and (center) ooeciostome with oval ooeciopore (AMNH 1022; 0.1 mm). **E, F.** *Annectocyma* cf. *A. major* (AMNH 1024). **E.** General aspect (0.5 mm). **F.** Incompletely formed brood chamber at branch tip (0.2 mm). **G–I.** *Annectocyma* sp. **G.** Colony origin with divergent branches and (bottom) lateral branch (AMNH 1025; 0.5 mm). **H.** Oblique view of colony origin (center) and (left) lateral branch with incipient brood chamber (AMNH 1026; 0.5 mm). **I.** Ancestrula and early autozooids (AMNH 1025; 0.1 mm).

least 4 mm long, narrow at base and broadening upwards, from 0.5 mm basally to 1 mm width at top. Individual branches gently arched, with distinct peristome-bearing convex frontal and zooid-barren concave abfrontal surfaces. Autozooidal peristomes with small diameter, distributed in regular quincuncical pattern over frontal surface. Brood chambers inflated, located distally in region of maximum branch width, occupying over half the branch width. Ooeciostomes more or less centrally placed in brood chamber with smaller diameter basally than peristomes of autozooids, then compressed into transversely elongated aperture with transverse length greater than peristomial diameter of autozooids. Several autozooidal peristomes penetrate brood chambers.

REMARKS: Colony morphology and zooidal measures of the Adriatic specimen correspond exactly with attributes determined by Harmelin (1976). All Harmelin's specimens were individual branches, as is the Adriatic specimen. However, the Adriatic specimen arises from a short section of a proximally broken adnate portion, leaving open the possibility that more than one branch arose from a linearly extended encrusting base.

DISTRIBUTION: This species is previously known from Sicily and the coast of Provence. Harmelin (1976) reported the species at depths of 60 to 150 m, growing on shells of dead molluscs on the coralligenous sea floor.

MEASUREMENTS (SKELETAL): AD 141 ± 7 μm, 133–150 (1, 10), PD 167 ± 23, 137–200 (1, 10), AS 343 ± 40, 283–417 (1, 10), GL 595 ± 21, 583–620 (1, 3), GW 417 (1, 1).

Annectocyma cf. *A. major* (Johnston, 1847)

Figure 51E, F

Alecto major Johnston, 1847: 281.
Stomatopora major: Hincks, 1880: 427.
Diaperoecia major: Harmelin, 1976: 79. Zabala, 1986: 623.
Annectocyma major: Hayward and Ryland, 1985b: 1077. Zabala and Maluquer, 1988: 167.
Entalophora proboscidea: Calvet, 1931: 33.

DESCRIPTION (AMNH 1024): Colony erect, single, gradually widening, arched branch with incomplete terminal brood chamber. Autozooids with moderately short, gradually divergent peristomes, with curvature increasing away from branch surface. Autozooidal aperture diameters and spacing relatively large. Brood chamber widening distally, incorporating bases of several autozooecial peristomes; ooeciostome not formed.

REMARKS: The single specimen has the same growth habit as *Annectocyma arcuata*. However, the autozooids and autozooidal spacing are distinctly larger and fall within the lower range of sizes of *A. major* as given by Harmelin (1976), which is greater than that for any of the other Mediterranean species of *Annectocyma*. Having only one specimen and in the absence of information on the ooeciostome, we are reluctant firmly to assign the specimen to *A. major*.

MEASUREMENTS (SKELETAL): AD 165 ± 10 μm, 150–180 (1, 10), AS 506 ± 86, 400–640 (1, 10).

Annectocyma sp.

Figure 51G–I

DESCRIPTION (AMNH 1025, 1026): Colonies encrusting, consisting of one or more lobe-shaped, multiserial branches. First-formed encrusting branch extending in same direction as ancestrula or diverging obliquely. In two of the three specimens, a second branch budded obliquely back from first asexual zooid, extending opposite growth direction of ancestrula and primary branch. Additional encrusting branches in these two specimens originating adventitiously about midway along length of primary branch and extending perpendicularly from branch margin. No erect branches present in available specimens. Autozooids with small diameters but relatively widely spaced. Peristomes in available specimens relatively short. Ancestrulae short, with the protoecial disc (233 ± 15 μm, N = 3) almost three times diameter of the peristome (833 ± 6 μm, N = 3) extending from it.

REMARKS: The specimens are more delicate than either of the two other species of *Annectocyma* found in the vicinity of Rovinj and have a different growth habit, but we have not assigned them to a species because of a lack of information on gonozooids.

MEASUREMENTS (SKELETAL): AD 119 ± 12

μm, 100–140 (3, 22), AS 445 ± 68, 320–560 (3, 22).

GENUS *ENTALOPHOROECIA* HARMELIN, 1976

Entalophoroecia deflexa (Couch, 1844)

Figure 52A–D

Tubulipora deflexa Couch, 1844: 107.
Pustulipora deflexa: Johnston, 1847: 279.
Pustolopora deflexa: Heller, 1867: 125.
Entalophoroecia deflexa: Harmelin, 1976: 108. Hayward and Ryland, 1985a: 113. Zabala, 1986: 630. Zabala and Maluquer, 1988: 168.
Entalophora gallica d'Orbigny, 1853: 781.

DESCRIPTION (AMNH 1027, 1028; CMRR 2275): Colonies light golden-brown, encrusting multiserial runners to erect, with bifurcating, radially symmetrical branches. Branch surfaces typically finely corrugated, zooidal boundaries not clear. Autozooidal peristomes bent at acute angles relative to the distal growth direction of the branches; distances between points of origin, and distances between outer ends, of peristomes highly variable.

Brood chambers only at branch tips, very long and incorporating bases of several autozooids, though their width may not exceed three or four zooids at any given place. Brood chambers progressively more swollen and wider nearer distal ends, near which their relatively narrow but elongate ooeciostomes are located. Ooeciostomes circular in cross section, variably tapered distally, except in some ending as a small flared lip.

Exterior walls perforated by round pseudopores with centripetally directed spines extending from surrounding wall. Pseudopores densely distributed on the surface of brood chambers, intermediate on exterior walls of recumbent portions of autozooids, and least abundant on peristomes.

Protoecia large (250 ± 26 μm, $N = 3$), hemispherical to domed button-shaped, with distal portion of ancestrula extending as a uniform tube with smaller diameter (117 ± 15 μm, $N = 3$) than in asexually budded autozooids. Distal-most portion of ancestrula elevated as a peristome, and first asexual autozooid budded from its undersurface and oriented either in the same direction as the ancestrula or diverging obliquely to right or left. Second generation of asexually budded autozooids originating against substratum, under distal end of first autozooid, then divergent to right and left. Each second generation autozooid establishing a gently curved, adnate multizooidal runner, generally three autozooids wide. Each divergent runner potentially dichotomously dividing into two distal, divergently curved, multizooidal runners as in parent generation. At irregularly distributed points on original or subsequent encrusting lobes of the colony, distal budding zone potentially dividing into two regions, one remaining encrusting and the other becoming completely encircled by exterior wall, establishing an erect portion of colony. Peristomes of autozooids in encrusting portions of colonies potentially much longer than on erect branches. Longest peristomes belonging to autozooids in deep recesses, such as interior surfaces of ridges in pectenids.

Tentacles clear, 14; lophophores small, distally flaring, conical; at maximum protrusion, bases of lophophores located within peristome, below level of aperture, in all material studied.

OCCURRENCE: This is a common, widespread, and highly variable species offshore of Rovinj. It occurs on a variety of hard substrata, from bivalve shells to *Cellaria*. Harmelin (1976) reported the species from shallowest waters to depths of at least 300 m and growing on a huge number of substrata from marine grasses to rock surfaces of caves.

DISTRIBUTION: *E. deflexa* is common in the eastern North Atlantic, from Arctic Norway southward and in the Mediterranean Sea.

MEASUREMENTS (SKELETAL): AD 130 ± 11 μm, 110–160 (8, 80), AS 676 ± 140, 400–960 (5, 50), BrD 553 ± 74, 400–720 (5, 26), GL 2216 ± 128, 2040–2400 (3, 5), GW 828 ± 125, 660–960 (3, 5), OsD 85 ± 7, 80–95 (3, 5). (POLYPIDE): IH 0 ± 0 μm (2, 12), MD 28 ± 3, 25–30 (2, 3), LD 609 ± 108, 380–720 (2, 14), TL 571 ± 85, 280–680 (2, 13).

Entalophoroecia robusta Harmelin, 1976

Figure 52E–G

Entalophoroecia robusta Harmelin, 1976: 116. Zabala, 1986: 636. Zabala and Maluquer, 1988: 168.

DESCRIPTION (AMNH 1029): Colony erect with bifurcating, radially symmetrical, rela-

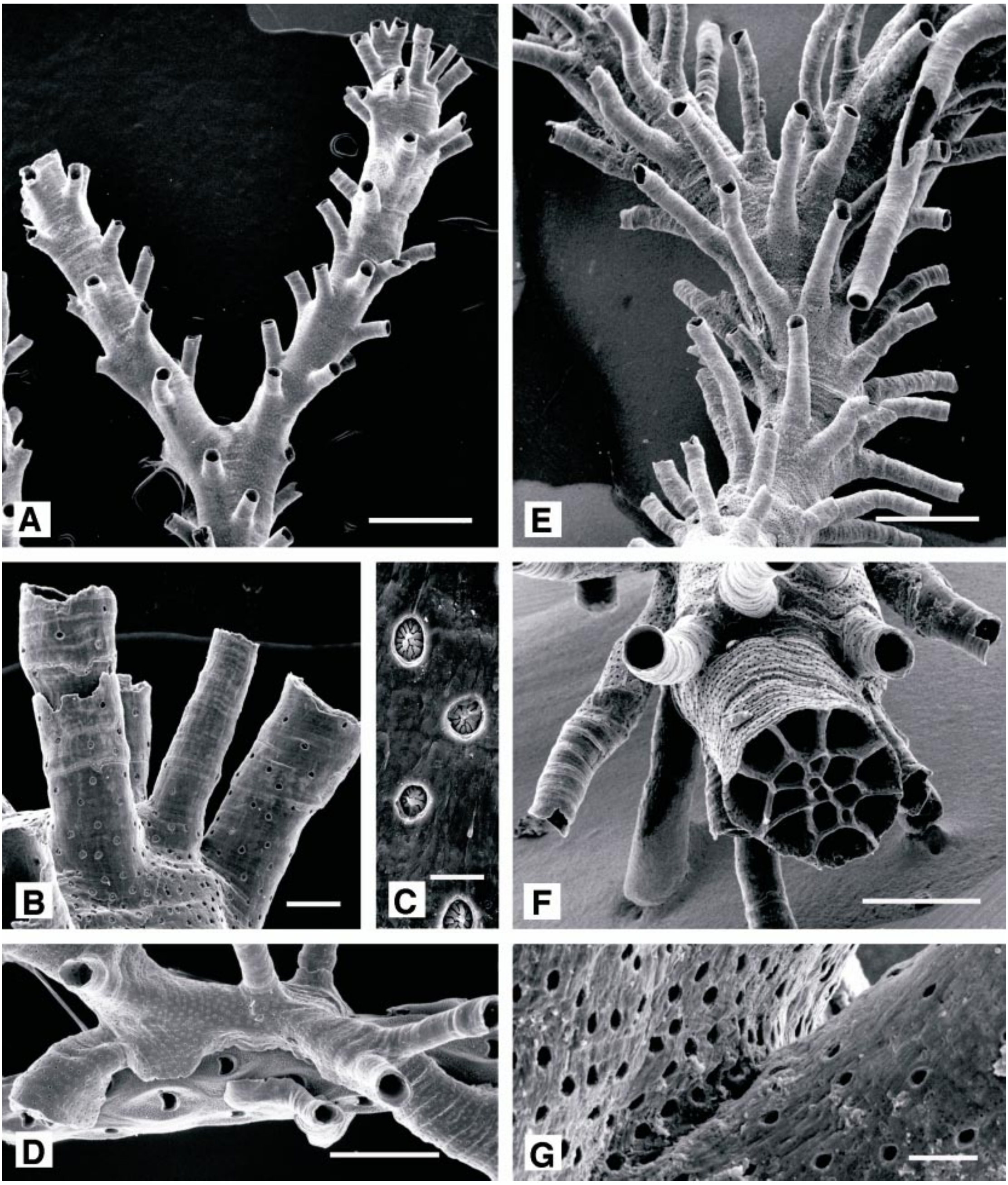

Fig. 52. **A–D.** *Entalophoroecia deflexa*. **A.** General aspect (AMNH 1027; 1 mm). **B.** Ooeciostome (center) (AMNH 1027; 0.1 mm). **C.** Pseudopores (AMNH 1027; 0.02 mm). **D.** Ancestrula (bottom center and early autozooids on *Cellaria* branch (AMNH 1028; 0.5 mm). **E–G.** *Entalophoroecia robusta* (AMNH 1029). **E.** General aspect (0.5 mm). **F.** Branch tip (0.5 mm). **G.** Pseudopores, more abundant on branch surface (left) than on (right) peristome (0.05 mm).

tively heavily calcified and robust branches. Autozooidal boundaries clearly visible on colony surface. Autozooidal peristomes long, curved abruptly away from axis of branch but oriented relative to neighboring autozooids, with apertures relatively uniformly spaced.

Gonozooids not restricted to branch termini; brood chambers incorporating the bases of several adjacent autozooids. Ooeciopores circular in cross section, slightly smaller in diameter than autozooidal peristomes, contiguous with base of autozooidal peristome, but shorter.

Exterior walls perforated by elongate oval pseudopores apparently lacking centripetally directed spines. Pseudopores least abundant on peristomes.

Primary zone of astogenetic change and encrusting portions of colonies not observed.

REMARKS: The species is much less abundant than *Entalophoroecia deflexa* in our material but can be readily distinguished because of its larger peristome diameters, the relatively wider and shorter ooeciopore, larger branches, and perhaps also by greater regularity in placement of peristomes relative to one another.

DISTRIBUTION: This species is at present known only from the Mediterranean Sea, identified from the French and Spanish coasts, but Harmelin (1976) considers that it is more widely spread, being confused with other species of *Entalophoroecia*.

MEASUREMENTS (SKELETAL): AD 186 ± 13 μm, 160–200 (2, 20), AS 759 ± 144, 600–1200 (2, 20), BrD 796 ± 107, 600–1000 (2, 20).

FAMILY PLAGIOECIIDAE CANU, 1918

GENUS *PLAGIOECIA* CANU, 1918

Plagioecia patina (Lamarck, 1816)

Figures 53A–F, 54

Tubulipora patina Lamarck, 1816: 163.
Diastopora patina: Hincks, 1880: 458.
Berenicea patina: Marcus, 1940: 73.
Plagioecia patina: Canu, 1918: 327. Harmelin, 1976: 129. Hayward and Ryland, 1985a: 97.
Diastopora simplex Busk,1875: 28.
Diastopora latomarginata: Waters, 1879: 272. Friedl, 1917: 277.
Discosparsa annularis Heller, 1867: 123.

DESCRIPTION (AMNH 947, 1030–1032; CMRR 2276): Colonies white, multiserial, discoidal, with basal wall extended as broad lamina (up to 1 mm) beyond colony-margin zooidal buds. Colonies typically several millimeters, occasionally over 1 cm, in diameter; adherent to the substratum or with elevated perimeter. One or more generations of secondary, ''daughter'' colonies commonly budded peripherally on large colonies.

Protoecial cone flared to overlap protoecium early in astogeny, establishing circular colony with autozooids radiating from colony center. Autozooids budded only in continuous budding zone around colony perimeter, first indicated by nearly parallel, radiating interior-wall ridges on inner portion of perimetrical basal wall lamina. Ontogenetically older autozooids developing exterior wall including short to long, isolated peristomes aligned in poorly organized radiating rows. Ontogenetically oldest autozooids (in colony center) capped by single, flat, slightly submerged terminal diaphragms.

Gonozooids with broad, strongly inflated brood chambers, parallel with colony margin and brood chambers laterally encompassing several rows of autozooecial peristomes. Ooeciostome on peripheral margin of gonozooid, short, recurved, usually slightly more slender than autozooidal peristomes. Ooeciopores may be circular or laterally elongate. Multiple gonozooids possible, with brood chambers formed simultaneously, usually in single band near colony perimeter.

Interior wall surfaces apparently lacking spines but with small, uniformly spaced bumps. Pseudopores in exterior wall partially occluded by centripetally converging spines. Pseudopores more densely spaced on brood chamber surface than on autozooids.

Tentacles clear, 10; tentacles short (fig. 54A) and lophophores small (fig. 54B), conical along colony margin, grading to campylonemidan and obliquely truncate in ontogenetically older autozooids; only marginal autozooids with functioning polypides. Short introverts (longest in ontogenetically oldest autozooids) visible in some colonies (fig. 54A).

REMARKS: Nielsen (1970) described embryology, settlement, and metamorphosis of *P. patina*, but either there is variation in ten-

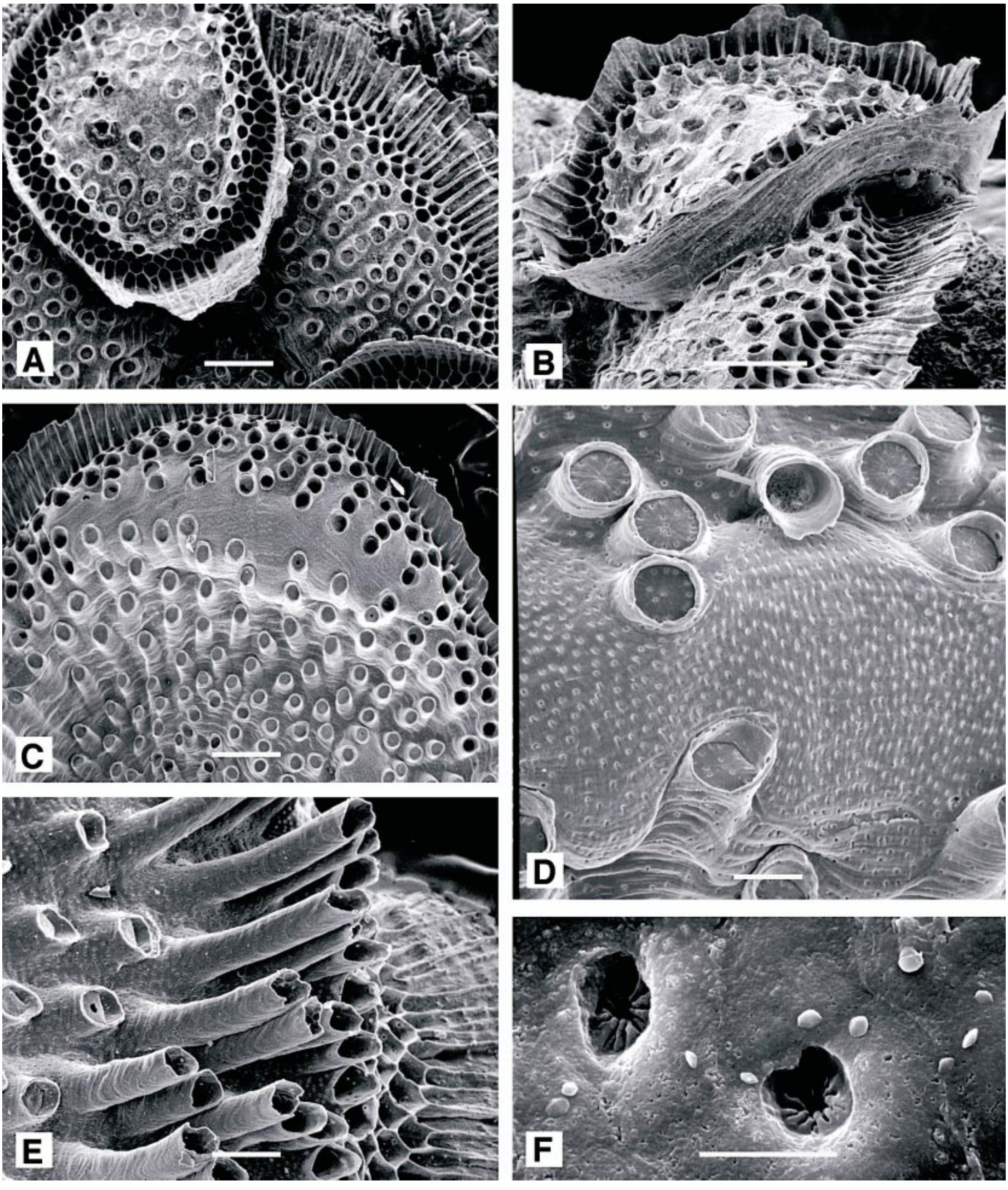

Fig. 53. **A–F.** *Plagioecia patina*. **A.** Colony with budded daughter colony (AMNH 947; 0.5 mm). **B.** Lateral view of colony with budded daughter colony (AMNH 947; 0.5 mm). **C.** Brood chamber (top) near colony margin (AMNH 1030; 0.5 mm). **D.** Brood chamber and (top center) distal ooeciostome with circular ooeciopore (AMNH 1030; 0.1 mm). **E.** Marginal zone of functional autozooids (right) and (left) nonfunctional autozooids with broken peristomes and terminal diaphragms (AMNH 1031; 0.2 mm). **F.** Pseudopores (AMNH 1032; 0.01 mm).

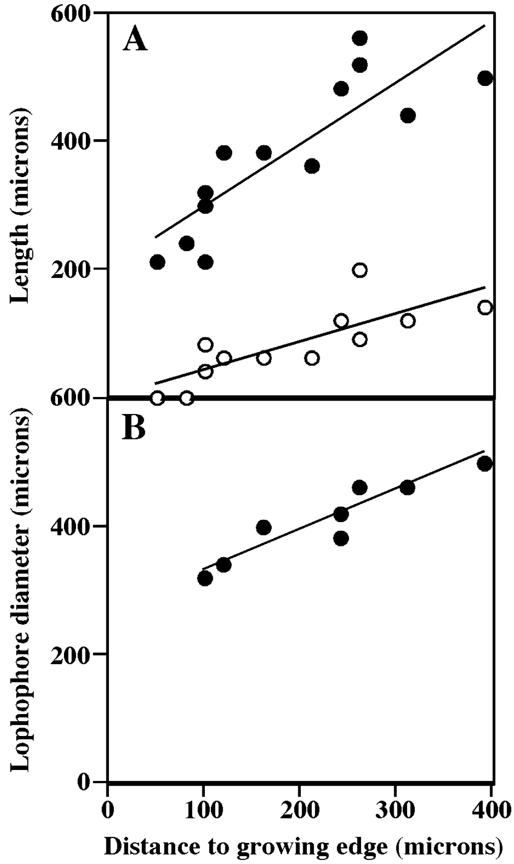

Fig. 54. *Plagioecia patina*. **A.** Ontogenetic increase in tentacle and introvert length: filled circles plot maximum tentacle length within lophophores ($Y = 198.490 + 0.975X$) and open circles plot lengths of exposed portions of introverts ($Y = 2.685 + 0.440X$). **B.** Ontogenetic increase in maximum lophophore diameter ($Y = 268.652 + 0.630X$).

tacle number between the Adriatic and the North Sea (Nielsen reported 8 tentacles; specimens studied here have 10), or two different species were studied by Nielsen and by us. Embryos were reported June–August for specimens from the Isle of Man (Eggleston, 1969), and embryos were seen in our specimens during June. Large, fertile colonies commonly have abundant small colonies within 2 cm of their margins, apparently offspring that settled near the maternal colony.

OCCURRENCE: *Plagioecia patina* ranges between 8 m and at least 75 m depth in the Mediterranean (Harmelin, 1976), where it is found in a range of orientations of substratum and intensities of light. In the Mediterranean and the northern Adriatic, diverse hard substrata are occupied, particularly bivalve shells (especially undersurfaces; McKinney, 2000), other calcified bryozoans, rocks from pebbles to cave surfaces and rock walls, and artificial substrata. It is also known to occur on rhizomes of *Posidonia* (Harmelin, 1976). *P. patina* is one of the more abundant bryozoan epibionts of *Cellaria* spp. within *Cellaria* meadows offshore of Rovinj (McKinney and Jaklin, 2000), where it is attached to the *Cellaria* branches only by the central part of the colony and typically radiates from the point of attachment as relatively planar disk.

DISTRIBUTION: *P. patina* is common in the northeastern Atlantic, from Arctic Norway southward, and in the Mediterranean Sea. It has been reported from many other parts of the world, but such reports are thought to be in error (Hayward and Ryland, 1985a).

MEASUREMENTS (SKELETAL): AD 102 ± 11 μm, 85–130 (4, 40), AS 207 ± 42m 110–280 (4, 40), GL 889 ± 137, 600–1100 (7, 14), GS 2511 ± 445, 1600–3100 (7, 14), OsDMN 85 ± 15, 60–120 (7, 14), OsDMX: 94 ± 17, 65–120 (7, 14). (POLYPIDE): IH 81 ± 58 μm, 0–200 (1, 12), LDMn 345 ± 45, 260–400 (1, 11), LDMx 407 ± 47, 320–500 (2, 30), MD 15 (1, 1), TLMn 289 ± 50, 200–340 (1, 11), TLMx 355 ± 77, 210–560 (2, 33).

Plagioecia sarniensis (Norman, 1864)

Figure 55A–E

Diastopora sarniensis Norman, 1864: 89. Hincks, 1887: 308.

Berenicea sarniensis:? Harmer, 1915: 114. Canu and Bassler, 1928: 65.

Microecia sarniensis: Canu, 1918: 326.

Plagioecia sarniensis:? Canu and Bassler, 1925: 65. Harmelin, 1976: 136. Hayward and Ryland, 1985a: 100.

DESCRIPTION (AMNH 1033): Colony white, completely encrusting, including marginal lamina, multiserial; irregularly discoidal with rejuvenated areas extending as lobes. Ancestrula and early astogenetic stage obscured by multiple small intracolony overgrowths.

Autozooids budded only in continuous

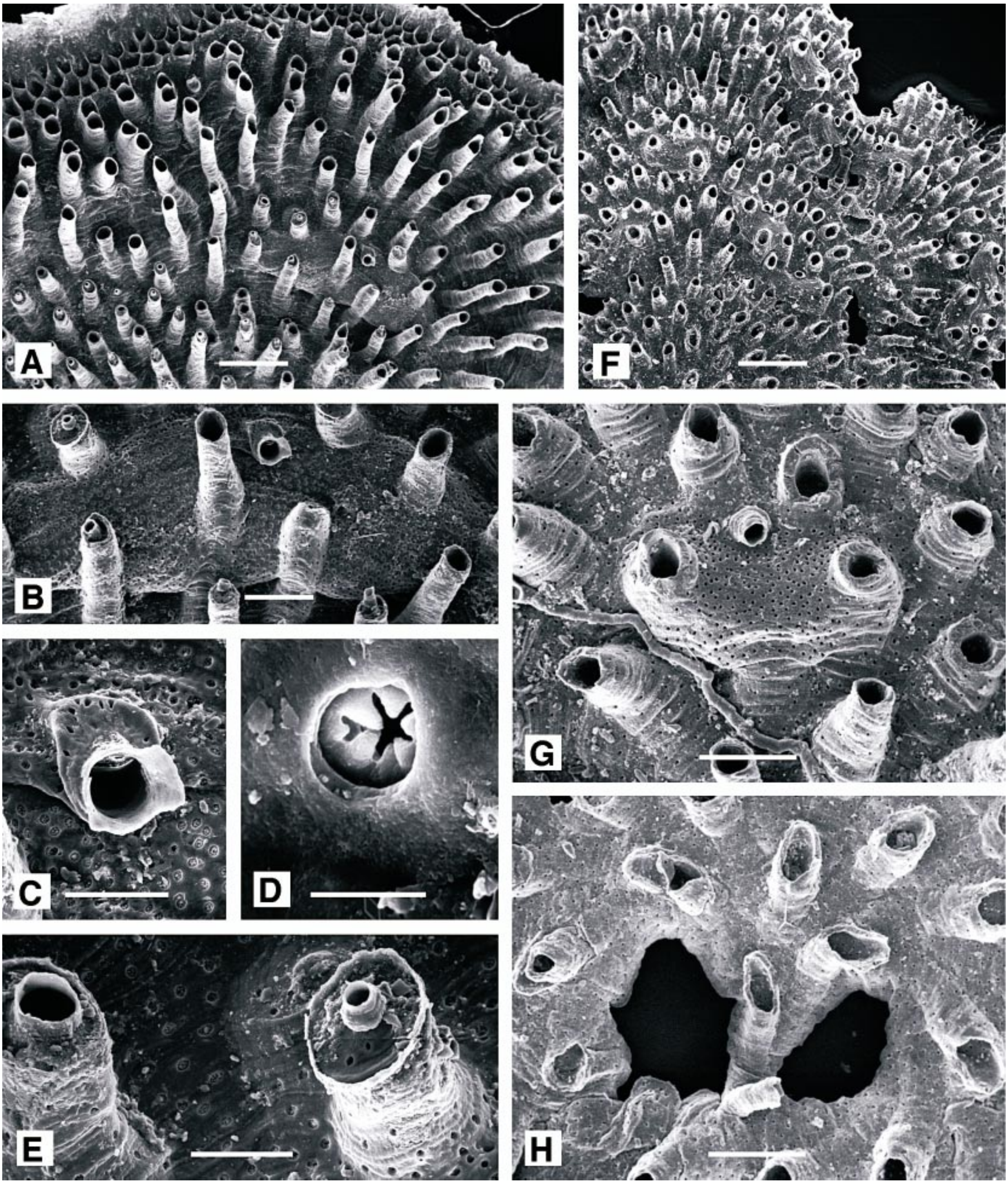

Fig. 55. **A–E.** *Plagioecia sarniensis* (AMNH 1033). **A.** General aspect (0.5 mm). **B.** Brood chamber (0.2 mm). **C.** Broken ooeciopore atop short ooeciostome (0.1 mm). **D.** Pseudopore (0.01 mm). **E.** Broken autozooidal peristomes transformed into secondary nanozooids by funnel terminal diaphragm (0.1 mm). **F–H.** *Eurystrotos compacta* (AMNH 931). **F.** General aspect (0.5 mm). **G.** Brood chamber (center) surrounded by peristomes of autozooids (0.2 mm). **H.** Distal end of ancestrula (small oblique tube, bottom center) and early autozooids (0.2 mm).

budding zone around colony perimeter. Ontogenetically older autozooids developing exterior wall including long, generally isolated peristomes aligned in poorly organized radiating rows, locally in short connate series. Peristomes commonly slightly tapered toward aperture. Ontogenetically oldest autozooids (in colony center) capped by single, slightly submerged terminal diaphragms perforated centrally or slightly distally by small pore at top of inverted, funnel-shaped extension. Locally, rim of aperture extended as slight peak at end of small keel on distal edge.

Rare nanozooids budded against basal lamina at growing edge of colony; peristomes as short as funnel-shaped extensions of autozooidal terminal diaphragms, with diameter approximately one-fourth that of autozooids.

Gonozooids with broad, strongly inflated brood chambers, parallel with colony margin and brood chambers laterally encompassing several rows of autozooidal peristomes. Ooeciostome located near peripheral margin of gonozooid; short, recurved, more slender than autozooidal peristomes. Ooeciopore may be capped by terminal diaphragm forming funnel, constricting diameter to one-half, then broadly flared along outer edge.

Pseudopores in nonperistomial exterior wall partially occluded by centripetally converging spines. Pseudopores more densely spaced on brood chamber surface than on autozooids. Pseudopores in peristomes smaller, apparently without partial occlusion by converging spines.

REMARKS: The centrally perforated terminal diaphragms atop peristomes provide egress for a single, nonciliated tentacle of a secondary nanozooid for which no function is obvious (Silén and Harmelin, 1974). They lack testes that would indicate male polymorphs, and their position and behavior do not indicate cleaning similar to nanozooids of *Diplosolen obelium*. Widely scattered primary nanozooids in *P. sarniensis* (and in *P. patina*) have been reported previously by Silén and Harmelin (1974).

DISTRIBUTION: The species is known in the eastern Atlantic from southern Britain to Angola and as far east in the Mediterranean as the Aegean Sea.

MEASUREMENTS (SKELETAL): ADMN 98 ± 7 μm, 80–110 (1, 10), ADMX 119 ± 3, 110–120 (1, 10), AS 244 ± 36, 180–300 (1, 10), GL 520 ± 28, 500–540 (1, 2), GW 1215 ± 244, 1000–1560 (1, 4), OsDMN 60–70 (1, 2), OsDMX 80 (1, 2).

GENUS *EURYSTROTOS* HAYWARD AND RYLAND, 1985b

Eurystrotos compacta (Norman, 1867)

Figure 55F–H

Alecto compacta Norman, 1867: 204.
Eurystrotos compacta: Hayward and Ryland, 1985a: 94, 1985b: 1075. Zabala and Maluquer, 1988: 171.
Diastopora suborbicularis Hincks, 1880: 464.
Berenicea suborbicularis: Marcus, 1940: 74.
Microecia suborbicularis: Harmelin, 1976: 122. Zabala, 1986: 644.

DESCRIPTION (AMNH 931): Colonies encrusting, multiserial, thin, up to 5.0 × 4.6 mm, with irregular outline; consisting of arc-shaped, laterally coalescent subcolonies originating by continued normal growth from a small group of ancestral zooids along edge of an older subcolony in which growth has ceased along most of arc-shaped perimeter. Autozooids small, budded in quincuncial series, with clearly visible adnate proximal portions and distal peristomes extending well above the general colony surface. (Peristomes of the available specimens are corroded, so length cannot be determined.) Colony surface corrugated by fine growth lines, especially visible on peristomes. Surface of colony abundantly perforated by circular pseudopores, less abundant on the peristomial skeleton but particularly dense on brood chamber surfaces.

Gonozooids abundant, with 17 fully formed brood chambers present in the larger specimen. Brood chambers located near the outer edges of subcolonies, averaging just over one zooid row distance from outer edges (250 ± 89 μm, $N = 16$). Brood chamber width about twice chamber length, extending as short lobes and without engulfing peristomes of adjacent autozooids. Ooeciostomes short, recurved, and are located on the distal edge of brood chambers, distinctly smaller than autozooidal peristomes; varying from circular to oval with maximum diameter transverse.

Ancestrula small, with peristomial diameter equal to diameter of ooeciostomes. A single autozooid budded from ancestrula, succeeded by a median distal autozooid and two laterally curved distolateral zooids, initiating a budding zone that widens and recurves rapidly. The lateral ends of the marginal budding zone meet and coalesce at approximately the fifth to sixth asexually budded generation, generating a continuous perimetrical budding zone, and leaving a small oval gap on either side of primary astogenetic zone of change.

REMARKS: Only two specimens of this species were found, neither of which was alive when observed in the laboratory. They have many features in common with shallow-water colonies of *Eurystrotos compacta* (Harmelin, 1976; Hayward and Ryland, 1985a), differing in having smaller brood chambers than normal for the species and that differ from British specimens in being transversely elongate rather than longitudinally elongate. They possibly belong to an undescribed species of *Eurystrotos*.

OCCURRENCE: On glass bottle, 25–30 m deep, west slope of Banjole.

DISTRIBUTION: *E. compacta* is known in the eastern North Atlantic from Denmark to southern Britain, the Mediterranean Sea, and the Adriatic Sea.

MEASUREMENT (SKELETAL): ADMN 60 ± 4 μm, 55–65 (1, 10), ADMX 65 ± 7, 60–80 (1, 10), AS 213 ± 18, 180–240 (1, 10), GL 266 ± 29, 220–320 (1, 16), GW 476 ± 58, 400–560 (1, 16), OsDMN 37 ± 3, 35–40 (1, 11), OsDMX 41 ± 3, 35–45 (1, 11).

GENUS *DIPLOSOLEN* CANU, 1918

Diplosolen obelium (Johnston, 1838)

Figures 56A–D, 57

Tubulipora obelia Johnston, 1838: 269.

Diastopora obelia: Johnston, 1847: 277. Heller, 1867: 123. Waters, 1879: 273.

Diplopora obelia: Jullien and Calvet, 1903: 116, 162.

Diplosolen obelia: Canu and Bassler, 1920: 745. Hayward and Ryland, 1985a: 102.

Diplosolen obelium: Harmelin, 1969a: 1183, 1976: 145. Zabala, 1986: 641.

DESCRIPTION (AMNH 1034, 1035; CMRR 2277): Colonies white, encrusting, thin, multiserial, usually adnate with peripheral basal lamina less than 1 mm wide. Small and most large colonies circular, some large colonies with lobes; typically a few millimeters in diameter, largest colonies slightly over 10 mm. Where growing on bryozoan substrata, growing edge may grow free and arch up into hemispherical blisters over zooidal orifices of underlying substratum.

Autozooids and nanozooids regularly alternating in both longitudinal and lateral rows, distributed in highly ordered quincuncial series. Autozooidal diameter small, proximal portion adnate, distal portion as free peristome with height coordinated with that of neighbors; peristomes very long where colony or local portion of colony located in depression.

Autozooidal tentacles colorless, 10, shortest at colony margins (fig. 57A); lophophores campylonemidan, grading from smallest along colony margin to largest away from colony margin (fig. 57B) within peripheral band of functioning autozooids; peristomes of autozooids in colony centers broken off and autozooids closed by terminal diaphragm.

Nanozooids regularly budded against basal lamina, in alternation with autozooids, at growing edge of colony. Peristomes shorter than, and diameter approximately one-fourth that of, autozooids. Nanozooids with one thin, colorless tentacle (devoid of cilia; Borg, 1926) approximately half the length of autozooidal tentacles.

Gonozooids with nearly equidimensional, inflated brood chambers, about same size as but less inflated than blisters where colony arches over zooidal orifices where growing on *Pentapora fascialis*. Brood chamber incorporating base of several peristomes of adjacent autozooids, with single curved, short ooeciostome about two-thirds the diameter of autozooidal peristomes and located in midregion of brood chamber.

Exterior walls about 50 μm thick, perforated by circular to elongate oval pseudopores. Brood chamber wall more densely perforated than exterior wall of other zooids; pseudopores fewer higher on peristomes.

REMARKS: The resting position of the single tentacles of the reduced nanozooid polypides is horizontal with the colony surface, ex-

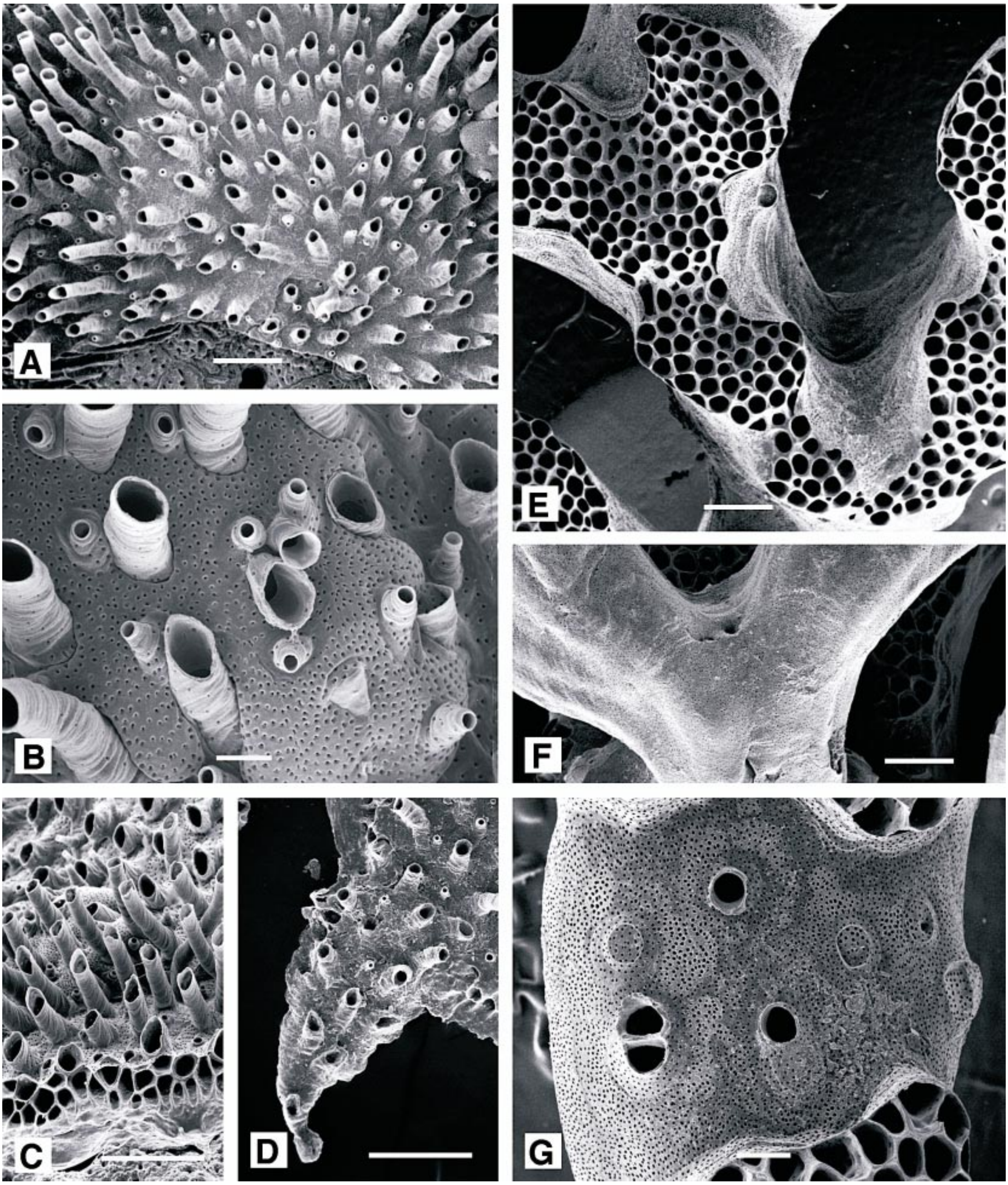

Fig. 56. **A–D.** *Diplosolen obelium*. **A.** General aspect (AMNH 1034; 0.5 mm). **B.** Brood chamber with ooeciostome (near center) intermediate in size between larger autozooidal peristomes and smaller nanozooid peristomes (AMNH 1034; 0.1 mm). **C.** Lateral view of growing edge of colony (AMNH 1034; 0.5 mm). **D.** Ancestrula and early autozooids followed by alternating autozooids and nanozooids (AMNH 1035; 0.5 mm). **E–G.** *Frondipora verrucosa*. **E.** General aspect of frontal surface (AMNH 1036; 0.5 mm). **F.** Reverse surface of branch (AMNH 1037; 0.5 mm). **G.** Brood chamber (AMNH 1036; 0.2 mm).

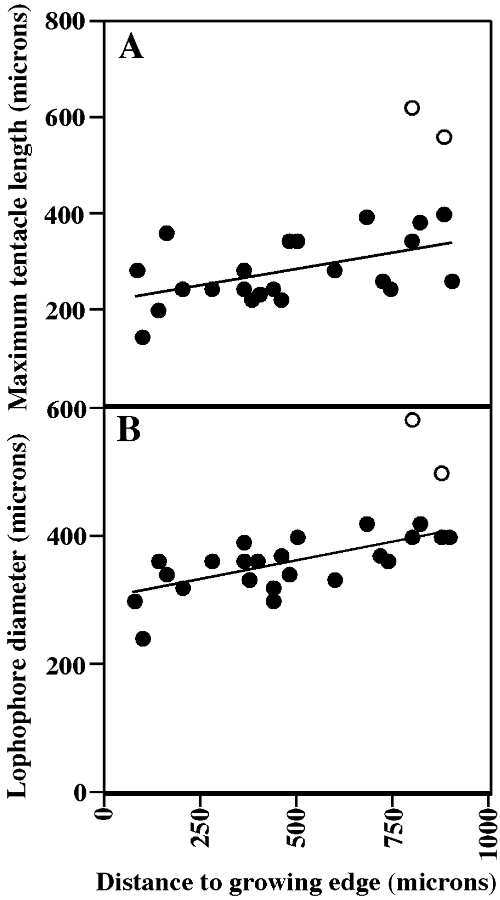

Fig. 57. *Diplosolen obelium*. **A.** Ontogenetic increase in maximum tentacle length ($Y = 213.782 + 0.135X$); open circles plot maximum tentacle lengths of anomalous lophophores adjoining excurrent chimney where colony folded sharply over edge of shell substratum; longest tentacles located on sides of lophophores adjacent to chimney. **B.** Ontogenetic increase in lophophore diameter ($Y = 300.205 + 0.118X$); open circles represent the two anomalous lophophores described for A. Regression lines exclude the lophophores adjoining substratum defined excurrent chimney.

tending from the nanozooid orifice toward the colony center, as if oriented by the colonial feeding current, which is centripetal and thin, adjacent to the colony surface (McKinney, 1992). Intermittently, the tentacle will either rotate rapidly forward and back to the normal position, or it will make a lateral, circular sweep that ends back at the normal position (Silèn and Harmelin, 1974), interpreted as a surface-cleaning behavior.

OCCURRENCE: Colonies grow on a variety of hard substrata, especially bivalve shells and the erect bilaminate bryozoan *Pentapora fascialis*. On disarticulated shells, they occur more commonly on interior surfaces but are larger and more commonly fertile on exterior surfaces (McKinney, 2000).

DISTRIBUTION: Found at inner shelf depths throughout the northeastern Atlantic from the Barents Sea to northwestern Africa and throughout the Mediterranean Sea.

MEASUREMENTS (SKELETAL): PD 82 ± 8 μm, 70–92 (3, 30), AS 277 ± 41, 220–400 (3, 30), NAD 14 ± 4, 10–24 (3, 21), GL 1172 ± 22, 980–1560 (3, 6), GW 1192 ± 27, 960–1320 (3, 6), OsD 39 ± 2, 35–40 (3, 5). (POLYPIDE): IH 0 ± 0 μm (2, 29), LD 372 ± 66, 240–580 (2, 29), MD 25–30 (2, 2), TLMn 277 ± 51, 140–240 (2, 14), TLMx 296 ± 104, 140–620 (2, 28).

FAMILY FRONDIPORIDAE BUSK, 1859

GENUS *FRONDIPORA* LINK, 1807

Frondipora verrucosa (Lamouroux, 1821)

Figures 56E–G, 58

Madrépore rameux, Marsigli, 1725: 105.
Krusensterna verrucosa Lamouroux, 1821: 41.
Frondipora verrucosa: Busk, 1875: 39. Waters, 1879: 279. Hincks, 1887: 308. Zabala, 1986: 654. Zabala and Maluquer, 1988: 173.
?Frondipora reticulata: de Blainville, 1834: 406.
Frondipora maderensis Johnson, 1897: 64.
Frondipora gracilis Canu and Bassler, 1930a: 87. Harmelin, 1969a: 1187.

DESCRIPTION (AMNH 1036, 1037; CMRR 2278): Colonies erect, highly branched, with local lobes and branch ends occupied by fascicles of interior-walled autozooids surrounded by extensive exterior wall areas interrupted locally by isolated or small groups of autozooids; usually canary yellow, some orange-tinted yellow. Branch widths variable, generally 1–2 mm, separated by spaces approximately equal in width; fascicles preferentially oriented on individual branches, producing a poorly to well defined frontal surface. Branches may anastomose locally. Colonies increasing in width more rapidly than in height so that larger colonies up to several centimeters across but usually extending no

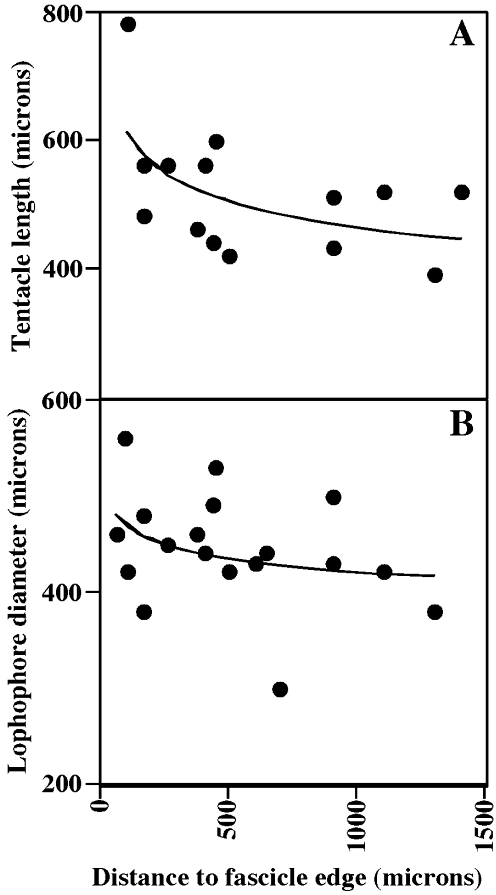

Fig. 58. *Frondipora verrucosa*. **A.** Increase in maximum tentacle length toward edge of fascicles ($Y = 1076.626X^{-0.123}$). **B.** Increase in maximum lophophore diameter toward edge of fascicles ($Y = 585.039X^{-0.048}$.

more than 2–3 cm from substratum. Autozooids closely packed within fascicles, elongate tubular parallel with branch axis, more abundantly originating in interior regions of fascicles than along the exterior-walled perimeter. Each fascicle a mosaic of small, newly budded autozooids and variably elongate autozooids with fully developed diameters. Some autozooid diameters very slightly larger along the perimeter of fascicles than within the centers.

Gonozooids located between fascicles, brood chambers spreading broadly across the colony surface, commonly enveloping several isolated autozooids with short peristomes projecting above the brood chamber surface. Single ooeciostome per brood chamber oval, slightly larger than autozooecial orifices, and atop a short, slightly flared tube.

Tentacles clear or white except for irregularly distributed brown segments, 11–12, longest and constituting largest lophophores along exterior-wall margin of fascicle (fig. 58A, B); lophophores campylonemidan, most strongly obliquely truncate along exterior-wall margin of fascicle.

OCCURRENCE: In the vicinity of Rovinj, this species occurs on diverse bivalves and occasionally on other calcified bryozoans such as *Cellaria* and *Pentapora*. It was very rare during the late 1980s but had become moderately common at depths over 35 m, especially in the vicinity of the islands Pelago and Sv. Ivan, by 1997 and 1998.

DISTRIBUTION: Common in the Mediterranean, less commonly reported from the eastern North Atlantic.

MEASUREMENTS (SKELETAL): ADMN 170 ± 21 μm, 120–200 (4, 40), ADMX 194 ± 19, 160–240 (4, 40), GL 1740 ± 108, 1600–1850 (1, 5), GW 1600 ± 162, 1450–1800 (1, 5), OsDMN 176 ± 17, 150–200 (1, 5), OsDMX 199 ± 20, 180–220 (1, 5). (POLYPIDE): IH 0 ± 0 μm (2, 32), LDMn 433 ± 73, 300–560 (2, 10), LDMx 503 ± 94, 300–660 (2, 27), MD 35 (1, 1), TLMn 387 ± 82, 240–500 (2, 14), TLMx 596 ± 151, 390–860 (2, 20).

SUBORDER ARTICULATA BUSK, 1859

FAMILY CRISIIDAE JOHNSTON, 1847

GENUS *CRISIA* LAMOUROUX, 1812

Crisia fistulosa Heller, 1867

Figure 59A, B

Crisia fistulosa Heller, 1867: 118. Waters, 1879: 268. Friedl, 1917: 275. Harmelin, 1968: 427.

DESCRIPTION (AMNH 1038): Colonies bushy, branches robust, articulated, biserial, flat, white. Colony fragments at least 4.5 mm high, generally highly branched. Branch internodes locally giving rise to at least one lateral branch as well as distally-formed descendant internode. Internodes flat, long, straight to gently curved, composed of three to six autozooids in available material. Lateral branches almost always at third zooid. Zooids long, particularly the second in each

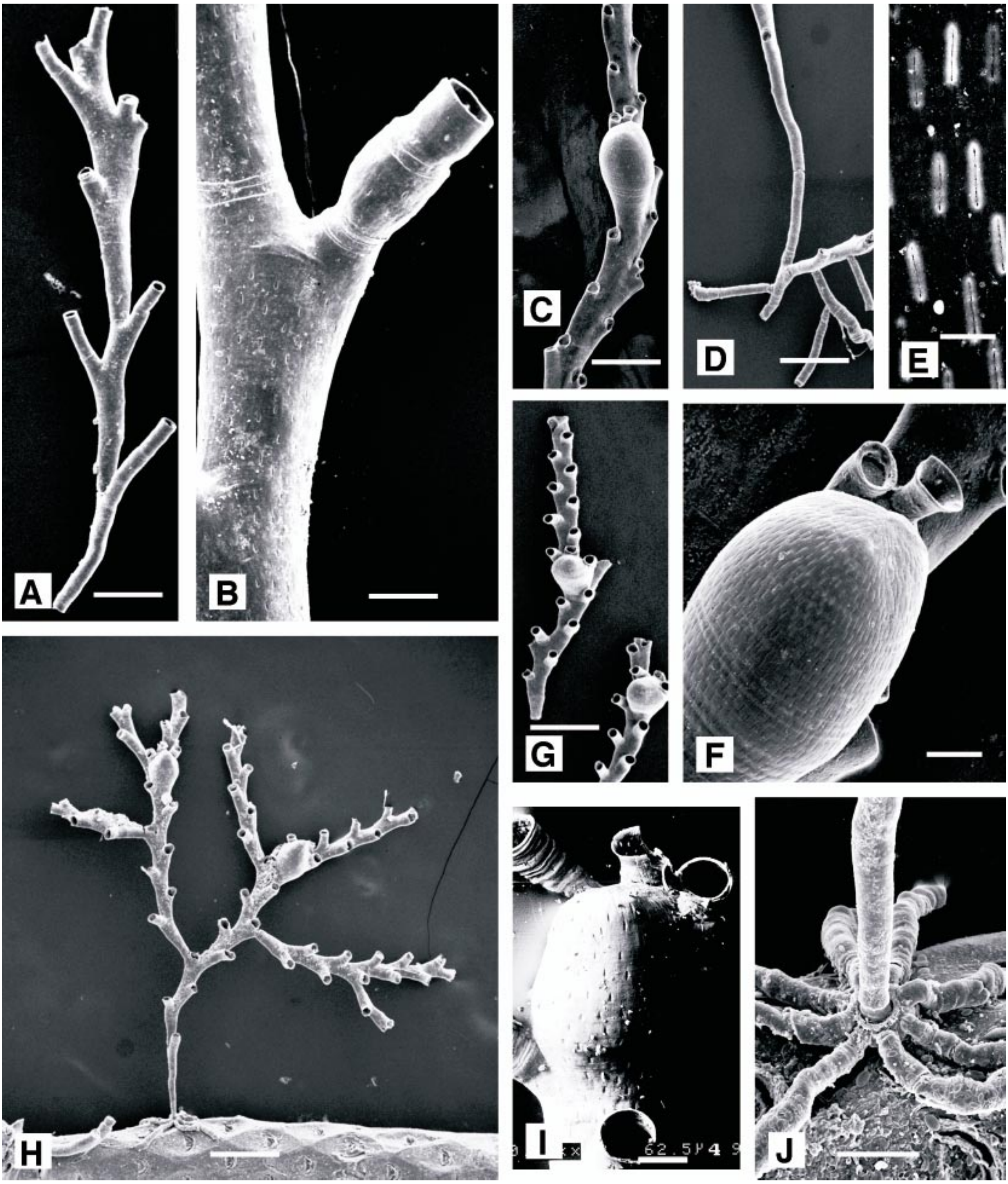

Fig. 59. **A, B.** *Crisia fistulosa* (AMNH 1038). **A.** Branch segment (0.5 mm). **B.** Peristome with annular constrictions (0.1 mm). **C–F.** *Crisia ramosa*.**C.** Portion of fertile branch segment (AMNH 1039; 0.5 mm). **D.** Kenozooids at colony base (AMNH 1040; 0.5 mm). **E.** Pseudopores of brood chamber (AMNH 1039; 0.02 mm). **F.** Brood chamber with distal ooeciostome flared to large circular ooeciostome (AMNH 1039; 0.1 mm). **G–J.** *Crisia recurva*. **G.** Fertile branch segment (AMNH 1041; 0.5 mm). **H.** Entire colony attached to *Cellaria* branch (AMNH 1042; 0.5 mm). **I.** Brood chamber with terminal ooeciostome and broken ooeciopore (lectotype, UIIZ 315; 0.062 mm). **J.** Base of attachment with radiating kenozooids (AMNH 1042; 0.1 mm).

internode, with orifices widely spaced along each side of branch. Circular autozooidal orifices alternating from side-to-side of branches, at end of short to extended peristomes only slightly curved toward frontal sides of branches.

Gonozooids absent in present material, but reported and illustrated by Harmelin (1968) as elongate cylindrical, slightly expanded proximally, with a distally placed, small ooeciopore on a short ooeciostome situated just distal to a small area lacking pseudopores.

DISTRIBUTION: First described from the Adriatic Sea, this species has been reported in relatively small numbers from the Adriatic and western Mediterranean, with a single report (Aguirrezabalaga et al., cited in Alvarez, 1994a) from the Atlantic coast of Spain.

MEASUREMENTS (SKELETAL): AD 90 ± 9 μm, 72–105 (1, 19), AS 615 ± 108, 403–816 (1, 23), ASW 812 ± 135, 616–1210 (1, 17), BrD 274 ± 42, 206–330 (1, 8), ZL (2^{nd} in fascicle) 1230 ± 120, 1030–1390 (1, 9).

Crisia ramosa Harmer, 1891

Figure 59C–F

Crisia ramosa Harmer, 1891: 134. Friedl, 1917: 275. Marcus, 1940: 45. Harmelin, 1968: 419. Hayward and Ryland, 1985a: 52. Alvarez, 1994a: 41.

? *Crisia eburnea*: Heller, 1867: 118. Friedl, 1917: 275.

DESCRIPTION (AMNH 1039, 1040; CMRR 2279): Colonies bushy, branches articulated, biserial, flat, white. Colonies up to 2 cm high, generally highly branched, with branch internodes commonly giving rise to one or more lateral branches as well as distally-formed descendant internode. Internodes flat, long, straight to gently curved, usually composed of 10 to 20 autozooids, except smaller number associated with rhizoids in basal segments. Lateral branches almost always at third zooid or higher, with second lateral branch, if present, about 5 zooids farther along. Circular autozooidal orifices alternating from side-to-side of branches, at end of short peristomes gently curved toward frontal sides of branches.

Gonozooids large, with distal inflated brood chambers. Ooeciopores circular, at end of frontally directed, flared ooeciostome approximately centered at distal end of brood chamber. Each gonozooid generally situated near middle of fertile internode, distal to first and commonly beyond second lateral branch, as previously noted by Ryland (2000). Fertile colonies collected from June to November (i.e., during all times of year when collections were made).

Adnate attachment zooids (‘‘rhizoids’’) abundant, giving rise to multiple erect branch systems. Some adnate zooids with terminal orifices giving rise to erect branch systems, while others are end-to-end kenozooids, as described by Silén (1977) for *Crisia cornuta*.

Tentacles clear, 8; lophophores conical to flaring conical, radially symmetrical. Base of lophophore generally at orifice or within peristome, but unusually may be up to 0.04 mm above the orifice.

OCCURRENCE: The species occurs in the northern Adriatic on bryozoans (especially *Cellaria* and *Pentapora*), shells, skeletalized and fleshy algae, *Microcosmus*, and firm human ejecta such as plastic and glass. *C. ramosa* was probably referred to by Heller (1867: 118) as *Crisia eburnea* (Linnaeus), the only one of the several species of *Crisia* that he noted to be abundant in the Adriatic.

DISTRIBUTION: *C. ramosa* ranges throughout the Mediterranean and in the Atlantic from northeast England to the Azores and Cape Verde Islands.

MEASUREMENTS (SKELETAL): AD 69 ± 9 μm, 60–80 (5, 52), AS 354 ± 38, 260–420 (3, 30), ASW 412 ± 63, 300–500 (3, 30), BrD 256 ± 37, 180–340 (4, 34), GL 655 ± 59, 580–740 (3, 6), GW 507 ± 59, 460–600 (3, 6), OsD 111 ± 14, 85–120 (3, 6). (POLYPIDE): IH 1 ± 7 μm, 0–40 (4, 35), LD 349 ± 51, 240–460 (4, 34), MD 22 ± 5, 20–30 (3, 4), TL 281 ± 54, 160–420 (4, 30).

Crisia recurva Heller, 1867

Figure 59F–J

Crisia recurva Heller, 1867: 118.

LECTOTYPE (chosen here): UIIZ 315.

DESCRIPTION (AMNH 1041, 1042): Small bushy colonies of biserial, articulated, flat branches, white, less than 1 cm high. Colonies generally highly branched, with branch internodes commonly giving rise to one or more lateral branches and, in some, a distally formed internode. Internodes flat, short, straight to gently curved, usually of 15 to 20 autozooids, except smaller number associated with attachment zooids in basal segments. Lateral branches almost always arising at third zooid or higher, with second lateral branch if present originating about 3 zooids farther along. Circular autozooidal orifices alternating from side-to-side of branches, at end of long strongly frontally curved peristome.

Gonozooids large, with conspicuously inflated brood chambers. Brood chambers typically with a short, broad, median keel along distal frontal surface and circular ooeciopore at end of frontally directed, slightly flared ooeciostome approximately centered at distal end of brood chamber. Each gonozooid generally near middle of fertile internode, at a point at which a lateral branch is formed. Fertile colonies collected in June, July, and November.

REMARKS: Heller's specimen chosen as lectotype is illustrated here as fig. 59I. This species has not been recorded since being named by Heller from sparse material found at Lesina, Croatia. The species is distinctive, easily recognized by the tiny branches, small zooids, strongly curved peristomes, and abundant and uniquely shaped brood chambers. Colonies of *C. recurva* commonly are attached to basal segments of *Cellaria* within the meadow west of Banjole (McKinney and Jaklin, 2000), the only locality in which we have found them.

DISTRIBUTION: Known only from the northeastern Adriatic Sea.

MEASUREMENTS (SKELETAL): AD 57 ± 7 μm, 45–70 (3, 39), AS 303 ± 44, 230–400 (3, 34), ASW 257 ± 31m 200–312 (3, 31), BrD 151 ± 21, 120–187 (3, 17), GL 351 ± 24, 310–380 (3, 15), GW 292 ± 39, 220–360 (3, 15), OsD 68 ± 14, 40–80 (3, 13).

SUBORDER RECTANGULATA WATERS, 1887

FAMILY LICHENOPORIDAE SMITT, 1866 (1867)

GENUS *DISPORELLA* GRAY, 1848

Disporella hispida (Fleming, 1828)

Figures 60A–J, 61, 62A, B

Discopora hispida Fleming, 1828: 530.
Tubulipora hispida: Johnston, 1847: 268.
Discoporella hispida: Busk, 1875: 30.
Lichenopora hispida: Hincks, 1880: 473.
Disporella hispida: Borg, 1944: 230. Hayward and Ryland, 1985a: 128. Alvarez, 1992: 204; 1994c: 493.
Lichenopora mamillata Lagaaij, 1952: 181.

DESCRIPTION (AMNH 1043–1049; CMRR 2280–2282): Colonies yellow or white, multiserial, flat discoidal to low moundlike, commonly with slightly depressed center in infertile colonies, to at least 5.6 mm diameter; usually completely adnate with peripherally extended basal wall. Margin locally elevated where nearing contact with other encrusting organisms. Compound colonies reported elsewhere (Hayward and Ryland, 1985a) not observed.

Autozooids budded only in continuous budding zone around colony perimeter. Ontogenetically older autozooids generally with isolated apertures aligned in single radiating rows, locally in short connate series. Younger zooids around perimeter of larger colonies generally in quincuncial pattern. Outer ends of ontogenetically oldest autozooids extended as peristomes, some with granules (more common on yellow colonies) or tiny spines (seen only on some white colonies) on upper surface. Small, blunt spines line the autozooidal chambers. Peristomes variable in length, generally short, diminishing in length toward perimeter, absent in youngest autozooids. Rim of peristomial apertures generally extended as paired spines on upper side, commonly with additional spines. Autozooidal apertures circular to oval, with long axis parallel with colony growth direction.

Autozooids separated by polygonal alveoli of equal to slightly smaller diameter. Ontogenetically older alveoli progressively filled centripetally, some closed entirely.

Brood chambers in central depressed area of colony, with domed roof of interior wall, extending as short lobes between proximal portions of inner portions of autozooidal rows. Ooeciostomes short, cylindrical, situated near perimeter of brood chambers; ooeciopores nearly circular, about 100 μm in diameter.

Tentacles clear, 9–10; lophophores obliquely truncate, broadly conical along colony margin to campylonemidan in ontogenetically older autozooids, increasing in size away from colony margin, youngest auto-

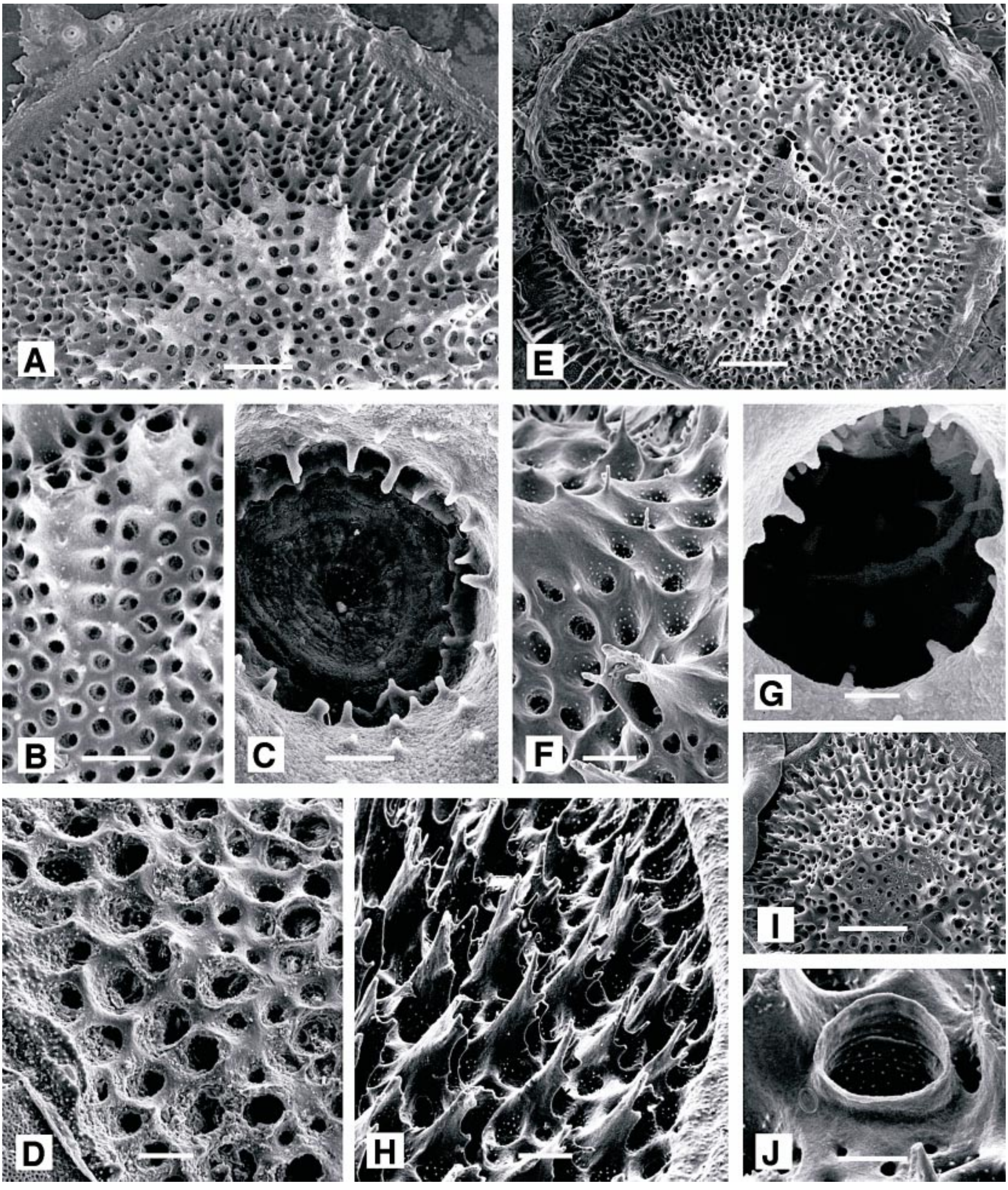

Fig. 60. **A–J.** *Disporella hispida*. **A–D.** Yellow variety. **A.** General aspect (AMNH 1043; 0.5 mm). **B.** Autozooids (orifices at top) largely buried below alveoli (AMNH 1044; 0.2 mm). **C.** Spines within autozooid closed by inset diaphragm (AMNH 1043; 0.02 mm). **D.** Growing edge of colony, with minimal orificial spines (AMNH 1043; 0.1 mm). **E–J.** white variety. **E.** Colony with incompletely formed central brood chamber (AMNH 1046; 0.5 mm). **F.** Spinose orifice of autozooid, and alveoli (AMNH 1046; 0.1 mm). **G.** Spines within autozooid (AMNH 1047; 0.01 mm). **H.** Growing edge of colony with spinose autozooidal orifices (AMNH 1048; 0.1 mm). **I.** Fertile colony with completely formed brood chamber and ooeciostome (AMNH 1047; 0.5 mm). **J.** Ooeciostome (AMNH 1047; 0.05 mm).

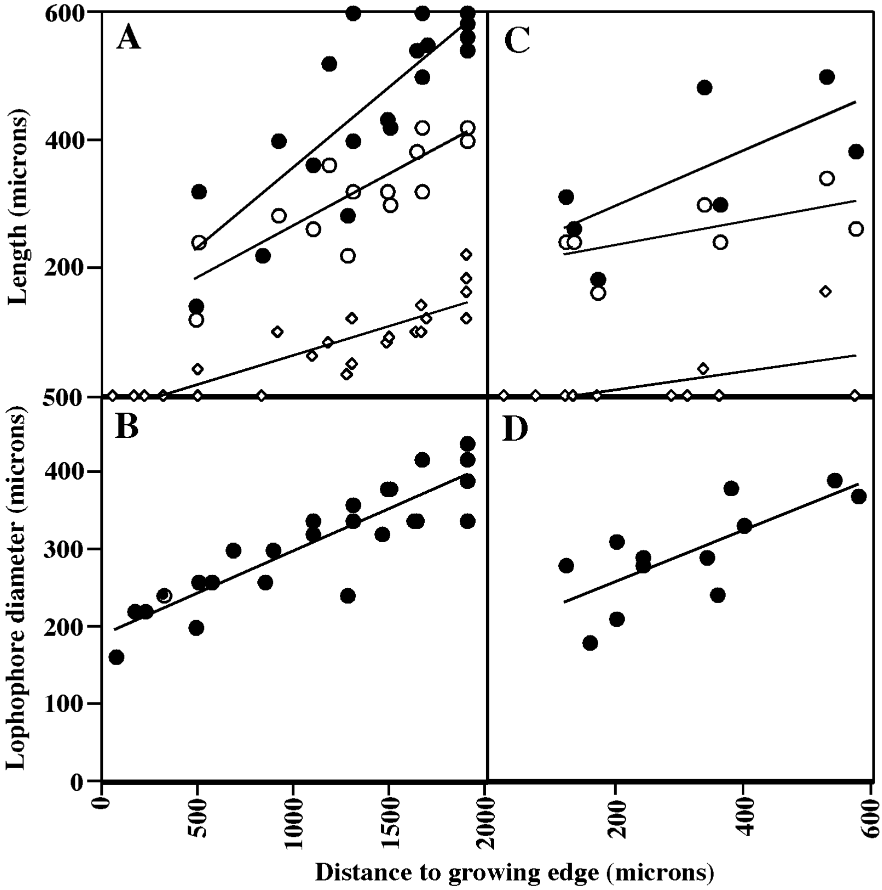

Fig. 61. *Disporella hispida*. **A, B.** Yellow colonies with 9 tentacles. **A.** Ontogenetic increase in tentacle and exposed introvert length: Filled circles plot maximum tentacle length within lophophores ($Y = 106.231 + 0.250X$), open circles plot minimum tentacle lengths ($Y = 106.340 + 0.159X$), and diamonds plot exposed introvert length ($Y = -27.526 + 0.090X$). **B.** Ontogenetic increase in lophophore diameter ($Y = 189.359 + 0.110X$). **C, D.** White colonies with 10 tentacles. **C.** Ontogenetic increase in tentacle and exposed introvert length: Filled circles plot maximum tentacle length within lophophores ($Y = 156.909 + 0.514X$), open circles plot minimum tentacle lengths ($Y = 172.051 + 0.226X$), and diamonds plot exposed introvert length ($Y = -35.225 + 0.166X$). **D.** Ontogenetic increase in lophophore diameter ($Y = 192.398 + 0.330X$).

zooids equitentacled but progressively more inequitentacled with age; ontogenetically older autozooids commonly with lophophores elevated on introverts.

REMARKS: Several species names have been proposed for specimens of *Disporella* from the North Atlantic and Mediterranean, yet the differentiating characteristics of the proposed species are not clear. Alvarez (1992) attempted to sort out the species of *Disporella* from the region, naming four new species, and Gordon and Taylor (2001) have also addressed the taxonomic confusion in the genus. Although Alvarez (1992: 209) chose a neotype for *D. hispida*, Gordon and Taylor (2001) point out that there are two problems with the neotype: it is not topotypic, and its orifices are neither ''expanded'' nor are they hispid, which are attributes originally indicated for the species by Fleming (1828).

It is not clear whether one or two species are included here in ''*Disporella hispida*''. Four of the species described by Alvarez

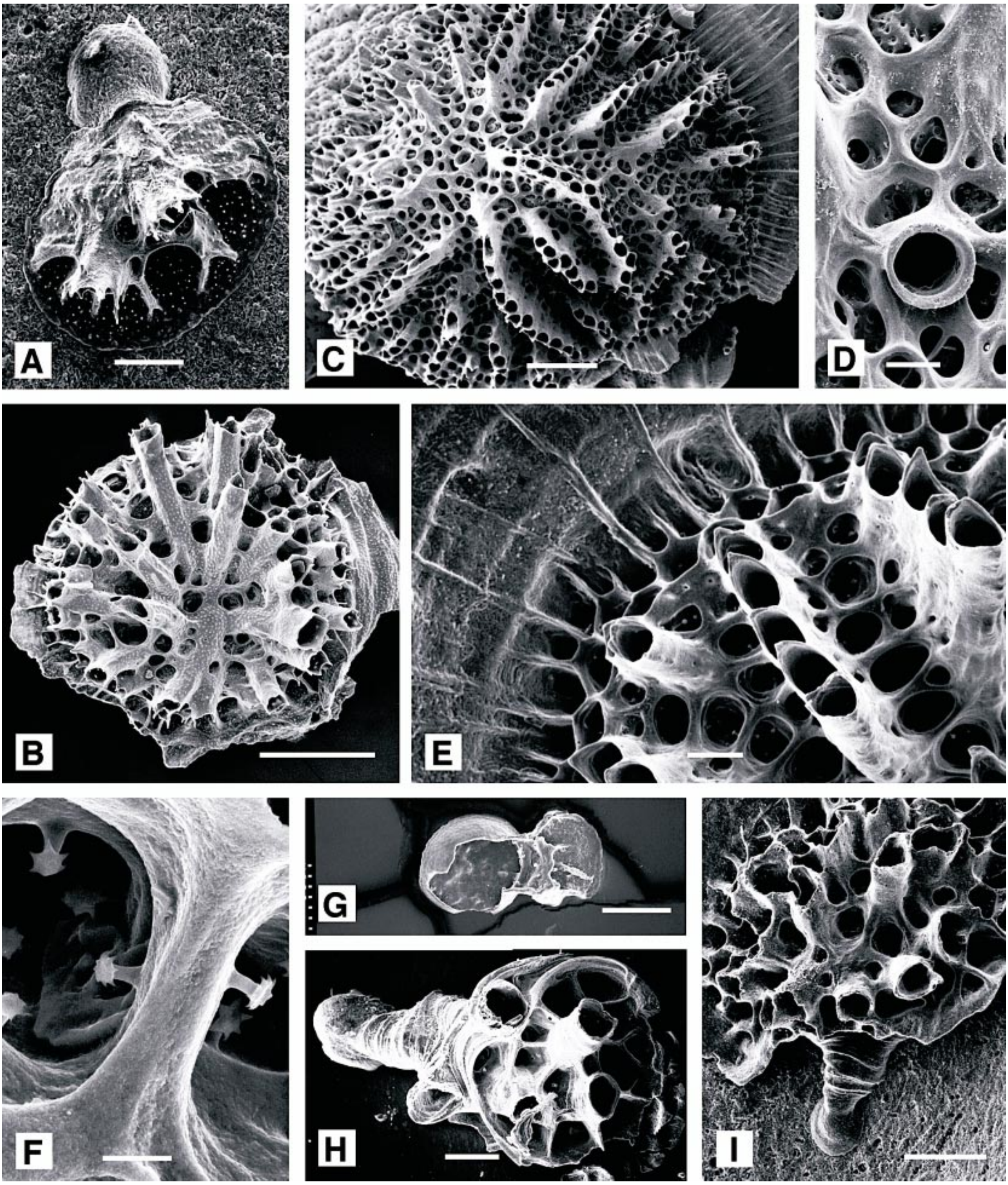

Fig. 62. **A, B.** *Disporella hispida*, yellow variety. **A.** Ancestrula and early autozooids (AMNH 1048; 0.1 mm). **B.** Young colony (AMNH 1049; 0.5 mm). **C–I.** *Patinella radiata*. **C.** Fertile colony (AMNH 1050; 0.5 mm). **D.** Short ooeciostome with circular ooeciopore (AMNH 1050; 0.1 mm). **E.** Radiating fascicles of autozooids separated by alveoli, and growing edge of colony (AMNH 1051; 0.1 mm). **F.** Stellate-headed spines within autozooids (AMNH 1051; 0.02 mm). **G.** Broken ancestrula (AMNH 1052; 0.1 mm). **H.** Ancestrula and first autozooids of young colony (specimen destroyed; 0.05 mm). **I.** Ancestrula and first zooids of young colony in early stages of reflection of basal lamina back over ancestrula, establishing radial growth (AMNH 1048; 0.2 mm).

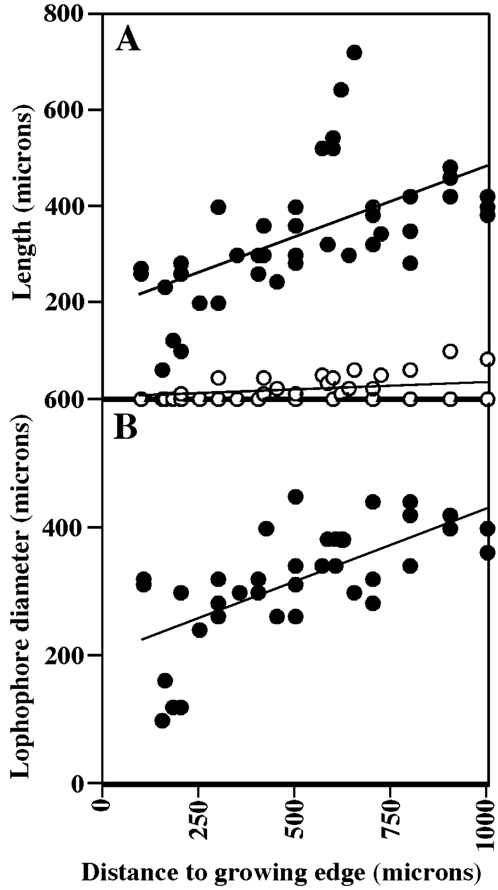

Fig. 63. *Patinella radiata*. **A.** Ontogenetic increase in tentacle and introvert length: Filled circles plot maximum tentacle length within lophophores ($Y = 182.581 + 0.300X$) and open circles plot lengths of exposed portions of introverts ($Y = -3.267 + 0.036X$). **B.** Ontogenetic increase in maximum lophophore diameter ($Y = 201.918 + 0.26X$).

(1992) are hispid, i.e. have spines projecting from the skeletal aperture [*D. hispida* (Fleming); *D. robusta* Alvarez, 1992; *D. zurigneae* Alvarez, 1992; *D. alboranensis* Alvarez, 1992]. Skeletally, the specimens from the Rovinj area fit only *D. hispida* among the six species of the genus that Alvarez (1992) described and illustrated (despite his choice of neotype, which was not illustrated). However, living colonies in our material fall into two discrete groups: yellow colonies with lophophores of 9 tentacles, and white colonies with lophophores of 10 tentacles. In addition, specimens from the Arctic that are identified as *D. hispida* by Shunatova and Ostrovsky (2001) have only 8 tentacles per lophophore, and none of the specimens have been seen with exposed introverts. More extensive documentation is needed in order to determine whether the various polypide morphologies of "*D. hispida*" are due to species differences or are ecophenotypes. However, both types of colonies are illustrated here. Fig. 58A–D portray yellow colonies; fig. 58E–J and 60A, B portray white colonies.

Brood chambers were found in some of the smallest colonies and were absent in the largest colonies, and where found, the colonies were fending off encroaching competitors for substratum space. This brood chamber occurrence pattern suggests that they are initiated when lethal environmental cues are encountered, previously suggested as common in encrusting cyclostomes (McKinney and Taylor, 1997).

DISTRIBUTION: "*D. hispida*" occurs throughout the Mediterranean Sea, the Barents Sea, and on both shores of the northern Atlantic Ocean.

MEASUREMENTS (SKELETAL): ADMN 78 ± 10 µm, 60–100 (8, 100), ADMX 102 ± 12, 70–130 (7, 90), AS 211 ± 31, 140–300 (7, 90), AlvD 97 ± 18, 60–190 (7, 90), Gap 434 ± 62, 350–540 (1, 10). (POLYPIDE): IN 41 ± 60 µm, 0–220 (3, 49), LD 297 ± 56, 160–440 (3, 46), MD 25 ± 5, 20–30 (2, 3), TLMn 292 ± 79, 120–420 (3, 31), TLMx 402 ± 132, 140–600 (3, 32).

GENUS PATINELLA GRAY, 1848

Patinella radiata (Audouin, 1826)

Figures 62C–I, 63

Melobesia radiata Audouin, 1826: 235.
Discoporella radiata: Busk, 1875: 32. Waters, 1879: 276.
Lichenopora radiata: Hincks, 1880: 476. Borg, 1944: 222. Hayward and Ryland, 1985a: 124. Alvarez, 1990: 28, 1993: 262, 1994c: 500.

DESCRIPTION (AMNH 1048, 1050–1052; CMRR 2283): Colonies encrusting, multiserial, discoidal, small (up to 5.2 mm diameter in present material), with perimeter of calcified basal wall extending as a sheet beyond zooidal budding zone. Colonies basically white, some with purple granules below outer cuticle, giving light, speckled violet appearance to colonies viewed without magnification. Autozooids budded against basal wall in continuous zone around colony perimeter, rapidly diverging from basal wall at roughly 30° angle, commonly increased further away from basal wall. Zooids budded in linear series, generating single-zooid rows separated by alveoli, many of which also originate against the basal wall in the budding zone. Outer ends of zooids extended as peristomes, longer in ontogenetically older zooids, organized in connate fascicles. Small, blunt spines with stellate heads abundant in autozooidal chambers. In larger colonies, peristomes of younger zooids near colony perimeter possibly isolated rather than continuing the connate fascicles. Skeletal apertures of zooids slightly elongate parallel with growth direction and extended into acute projection on distal side.

Brood chambers located in central depression of colony that results from the radial and obliquely upward growth of autozooids. Brood chambers developing a convex roof covered by alveoli, with ooeciostome located centrally to peripherally within area defined by inner ends of autozooidal fascicles. Ooeciopores about 140 μm in diameter, circular to slightly oval; ooeciostomes short, and gently flared.

Protoecia exterior-walled, low hemispherical,160–180 μm diameter, with low marginal rim. Ancestrula and initial asexually budded zooecia grow as an encrusting protoecial cone bounded by exterior wall, upper edge of which at some point bending back on itself, establishing radial growth of colony.

Tentacles clear, 8, shortest at colony margin (fig. 63A); lophophores campylonemidan, strongly obliquely truncate, grading from small and equitentacled along colony edge to largest and most inequitentacled adjacent to chimney at colony center (fig. 63B); lophophores closer to colony center supported on short extroverts in some colonies (fig. 63A).

REMARKS: Living species previously included in *Lichenopora* Defrance (1823) apparently can no longer be considered to be part of this genus, which has as its type the Eocene species *Lichenopora turbinata* Defrance, 1823 (designated by d'Orbigny, 1853: 963). Gordon and Taylor (1997) revised the concept of the genus, restricting it to species which are either turbinate as is the type species, or have a short central pedunculate attachment with continued disk-like expansion above the substratum. Both turbinate and pedunculate forms have large expanses of basal wall beyond the central point of attachment of the colony. The most recent known species of the *Lichenopora*, as redefined by Gordon and Taylor (1997), is Miocene. As suggested by Gordon and Taylor (1997), the generic name *Patinella* Gray, 1848, with type species *Madrepora verrucaria* Linnaeus, is available for many living species formerly placed into *Lichenopora*. *Patinell*a and *Disporella* are here treated as distinct genera, based on Schäfer's (1991) indication that the type species of the two genera (*Madrepora verrucaria* and *Disporella hispida* Gray, 1848) differ in skeletal microstructure and in shape and perforation of the brood chambers.

DISTRIBUTION: The species occurs throughout the Mediterranean Sea, and ranges in the Atlantic Ocean from the Mediterranean northwards to southern Britain; reports from more distant regions are suspect (Hayward and Ryland, 1985a).

MEASUREMENTS (SKELETAL): ADMN 83 ± 11 μm, 60–120 (5, 50), ADMX 110 ± 13, 80–140 (5, 50), Gap 215 ± 51, 100–340 (5, 46), GL 140–160 (2, 2), GW 120–160 (2, 2). (POLYPIDE): IH 15 ± 25 μm, 0–100 (3, 42), LD 324 ± 86, 100–450 (3, 41), MD 20 (1, 1), TLMn 193 ± 62, 60–320 (2, 26), TLMx 340 ± 133, 60–720 (3, 42).

ACKNOWLEDGMENTS

We thank the National Geographic Society and the US National Academy of Sciences–Yugoslavia Scientific Exchange Program for support of fieldwork (to FKM). Nenad Smodloka, Dušan Zavodnik, Andrej Jaklin, and the other staff of the Ruđer Bošković Institute Center for Marine Research–Rovinj for providing laboratory space and acquisition of specimens through dredging and diving. Rupert Riegel and Konrad Thaler kindly arranged the opportunity to examine and borrow Heller's available types from the University of Innsbruck Institute of Zoology. Mary Spencer Jones and Kevin Tilbrook arranged access to comparative specimens in The Natural History Museum, London. Marjorie McKinney served willingly and capably as general factotum during field and laboratory work and spent many hours in the darkroom processing photographs. Ruth Dewel, Appalachian State University Electron Microscopy Laboratory, maintained the scanning electron microscope (SEM) during hundreds of hours of usage and also spent many hours in the darkroom developing negatives. Paul Taylor assisted with SEM photography of the noncoated Heller types, and he, Dennis Gordon, and Judy Winston read and suggested improvements to the manuscript.

REFERENCES

Adams, J. 1798. Description of some marine animals found on the coast of Wales by the late John Adams Esq. Transactions of the Linnean Society 2: 7–13.

Allman, G. J. 1856. A monograph of the freshwater Polyzoa. London, Ray Society, 119 pp.

Alvarez, J. A. 1990. Una colección de briozoos procedentes de la costa de Alicante. Boletino Instituto Espanol de Oceanografia 6: 21–40.

Alvarez, J. A. 1992. Sobre algunas especies de la familia Lichenoporidae Smitt, 1866 (Bryozoa, Cyclostomida) en la región Atlántico-Mediterránea. Parte I: género *Disporella* Gray, 1848. Cahiers de Biologie Marine 33: 201–243.

Alvarez, J. A. 1993. Sobre algunas especies de la familia Lichenoporidae Smitt, 1866 (Bryozoa, Cyclostomida) en la región Atlántico-Mediterránea. Parte II: estudio preliminar del género *Lichenopora* Defrance, 1823. Cahiers de Biologie Marine 34: 261–288.

Alvarez, J. A. 1994a. Notas sobre la familia Crisiidae (Bryozoa, Cyclostomida) en la Bahia de Bilbao (N. de la Peninsula Iberica). Cuadernos de Investigación Biologica (Bilbao), 18: 37–44.

Alvarez, J. A. 1994b. Briozoos de la Campaña Fauna I (sur de la Península Ibérica). Parte II: Cheilostomida Ascophorina y Cyclostomida. Graellsia 50: 129–154.

Alvarez, J. A. 1994c. La famille des Lichenoporidae (Bryozoa, Cyclostomida) dans les provinces Atlantico-Méditerranéenne et Boréale. Partie III: étude des collections du Muséum National d'Histoire Naturelle de Paris. Cahiers de Biologie Marine 35: 491–509.

Arístegui Ruiz, J. 1989. Consideraciones sobre el género *Celleporina* Gray, 1848 (Ectoprocta: Cheilostomata) en Canarias y descripción de tres especies nuevas: *C. canariensis* sp. n., *C. fragilis* sp. n. y *C. labiata* sp. n. Cahiers de Biologie Marine 30: 143–165.

Audouin, J. V. 1826. Explication sommaire des planches de polypes de l'Égypte et de la Syrie. *In* J.C. Savigny, Description de l'Égypte, histoire naturelle 28: 225–244. Paris: C.L.F. Panckoucke.

Balduzzi, A., M. Barbieri, and M. Gristina. 1991. Morphology and life strategies of *Aetea* (Bryozoa: Cheilostomata) living on some western Mediterranean *Posidonia oceanica* meadows. Bulletin de la Société des Sciences Naturelles de l' Ouest de la France, Mémorie Hors Serié 1: 1–12.

Bassler, R. S. 1935. Bryozoa. *In* W. Quenstedt (editor), Fossilium Catalogus I: Animalia. Part 67. Den Haag: W. Junk N.V., 229 pp.

Bassler, R. S. 1936. Nomenclatorial notes on fossil and recent Bryozoa. Journal of the Washington Academy of Science. 26: 156–162.

Bassler, R. S. 1953. Bryozoa. *In* R.C.Moore (editor), Treatise on invertebrate paleontology, Pt. G: G1–G253. Lawrence: Geological Society of America and University of Kansas Press.

Bishop, J. D. D. 1988. A clarification of the type species of *Collarina* Jullien, 1886 (Bryozoa: Cheilostomata: Cribrilinidae). Journal of Natural History 22: 747–755.

Bishop, J. D. D., and P. J. Hayward. 1989. SEM atlas of type and figured material from Robert Lagaaij's 'The Pliocene Bryozoa of the Low Countries' (1952). Mededelingen Rijks Geologische Dienst 43(2): 1–64.

Borg, F. 1926. Studies on Recent cyclostomatous Bryozoa. Zoologiska Bidrag från Uppsala 10: 181–507.

Borg, F. 1944. The stenolaematous Bryozoa. Further Zoological Results of the Swedish Antarctic Expedition 1901–1903. Stockholm: P. A. Norstedt and Söner, 276 pp.

Brock, B. J. 1985. South Australian fouling bryozoans. *In* C. Nielsen and G.P. Larwood (editors), Bryozoa: Ordovician to Recent: 45–49. Olsen and Olsen: Fredensborg.

Buge, E. 1975. Les bryozoaires de l'Oligocène du Bassin de Paris et leurs relations avec les faunes des bassins oligocènes d'Europe. Mitteilungen Geologisches-Paläontologisches Institut Universität Hamburg 44: 45–58.

Buljan, M., and M. Zore-Armanda. 1976. Oceanographical properties of the Adriatic Sea. Oceanography and Marine Biology Annual Review 14: 11–98.

Busk, G. 1851. Notices of three undescribed species of Polyzoa. Annals and Magazine of Natural History (second series): 7: 81–85.

Busk, G. 1852. Catalogue of marine Polyzoa in the Collection of the British Museum, Part I.

Cheilostomata (part). London: British Museum. 1–54.

Busk, G. 1854. Catalogue of marine Polyzoa in the Collection of the British Museum, Part II. Cheilostomata (part). London: British Museum. 55–120.

Busk, G. 1856. Zoophytology. Quarterly Journal of Microscopical Science 4: 308–312.

Busk, G. 1859. A monograph of the fossil Polyzoa of the Crag. London: Palaeontographical Society. 1–136.

Busk, G. 1875. Catalogue of the cyclostomatous Polyzoa in the collection of the British Museum. London: British Museum 1–39.

Buss, L. W. 1981. Group living, competition, and the evolution of cooperation in a sessile invertebrate. Science 213: 1012–1014.

Calvet, L. 1902. Bryozoaires marins de la region de Cette. Travaux de la Institut de Zoologique de la Université de Montpellier et Station Zoologique de Cette Memoires (série 2) 11: 1–103.

Calvet, L. 1911. Sur deux especes nouvelles de bryozoaires de la Mediterranee: *Idmonea arborea* n.sp. et *Amathia pruvoti* n. sp. Archives de Zoologie Expérimentale et Générale (série 5) 9. Notes et Revue 3: 57–61.

Calvet, L. 1927. Bryozoaires de Monaco et environs. Bulletin de l'Institut. Océanographique, Monaco 503: 1–46.

Calvet, L. 1931. Bryozoaires provenant des campagnes scientifiques du Prince Albert 1er de Monaco. Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier 83: 1–152.

Canu, F. 1904. Bryozoaires fossiles d'Egypte, I. Bulletin del' Institut d'Égypte (série 4) 4: 223–229. [Not seen]

Canu, F. 1908. Bryozoaires des terrains tertiaires des environs de Paris (pars). Annales de Paléontologie, Paris 3: 61–104.

Canu, F. 1916 [1918]. Les ovicelles des Bryozoaires cyclostomes. Études sur quelques familles nouvelles et anciennes. Bulletin de la Société Géologique de France (série 4) 16: 324–335.

Canu, F., and R. S. Bassler. 1917. A synopsis of American early Tertiary cheilostome Bryozoa. United States National Museum Bulletin 96: 1–87.

Canu, F., and R. S. Bassler. 1920. North American Early Tertiary Bryozoa. United States National Museum Bulletin 106: 1–879.

Canu, F., and R. S. Bassler. 1925. Les Bryozoaires du Maroc et de Mauritanie. Mémoires de la Société des Sciences Naturelles du Maroc 10: 1–79.

Canu, F., and R. S. Bassler. 1927. Classification of the cheilostomatous Bryozoa. Proceedings of the United States National Museum 69(Article 14): 1–42.

Canu, F., and R. S. Bassler. 1928. Les Bryozoaires du Maroc et de Mauritanie (2me mémoire). Mémoires de la Société des Sciences Naturelles du Maroc 18: 1–85.

Canu, F., and R. S. Bassler. 1930. Bryozoaires marins de tunisie. Station Océanographique de Salammbô Annales 5: 1–91.

Chimonides, P. J. 1987. Notes on some species of the genus *Amathia* (Bryozoa, Ctenostomata). Bulletin of the British Museum (Natural History) (Zoology) 52: 307–358.

Cocito, S., S. Sgorbini, and C. N. Bianchi. 1998a. Aspects of the biology of the bryozoan *Pentapora fascialis* in the northwestern Mediterranean. Marine Biology 131: 73–82.

Cocito, S., S. Sgorbini, and C. N. Bianchi. 1998b. *Pentapora fascialis* (Pallas) [Cheilostomata: Ascophora] colonization of one sublittoral rocky site after sea-storm in the northwestern Mediterranean. Hydrobiologia 375/376: 59–66.

Cocito, S., F. Ferdeghini, C. Morri, and C. N. Bianchi. 2000. Patterns of bioconstruction in the cheilostome bryozoan *Schizoporella errata*: the influence of hydrodynamics and associated biota. Marine Ecology Progress Series 192: 153–161.

Cook, P. L. 1968. Bryozoa (Polyzoa) from the coasts of tropical west Africa. Atlantide Report 10: 115–262.

Cook, P. L. 1985. Bryozoa from Ghana, a preliminary survey. Musee Royal de l'Afrique Tervuren, Belgique, Sciences Zoologiques, Annales 238: 1–315.

Couch, R. Q. 1844. A Cornish fauna, being a compendium of the natural history of the country. Pt. III. Truro, 164 pp. [Not seen]

David, L., N. Mongereau, and S. Pouyet. 1972. Bryozoaires du Néogène du bassin du Rhône. Gisements burdigaliens de Mus (Gard). Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon: 52: 1–118.

De Blainville, H. M. 1830. Dictionnaire des sciences naturelles. Vol. 60. 546 pp. [Not seen]

De Blainville, H. M. 1834. Manuel d'actinologie ou de zoophytologie. Paris: Chez F. G. Levrault, 644 pp.

Degobbis, D. 1989. Increased eutrophication of the northern Adriatic Sea, Second Act. Marine Pollution Bulletin 20: 452–457.

Degobbis, D., N. Smodloka, I. Pojed, A. Škrivanić, and R. Precali. 1979. Increased eutrophication of the northern Adriatic Sea. Marine Pollution Bulletin 10: 298–301.

d'Orbigny, A. 1841–1847. Voyage dans l'Amerique meridionale. 5, Pt. 4, Zoophytes: 7–

28 (1847), pl. 1, 3, 5 (1841), 2, 4, 6–13 (1842). Paris and Strasbourg.

d'Orbigny, A. 1851–1854. Paléontologie française. Descriptions des Mollusques et rayonnés fossiles. Terrains crétacés, V. Bryozoaires. Paris: Victor Masson. [1–188 (1851); 185bis–472 (1852); 473–984 (1853); 985–1192 (1854); pls. 600–800. Dates of publication as given in Sherborn (1899)]

Eggleston, D. 1969. Marine fauna of the Isle of Man: revised lists of phylum Entoprocta (= Kamptozoa) and phylum Ectoprocta (=Bryozoa). Annual Report of the University of Liverpool Marine Biological Station, Port Erin 81: 57–80.

Ellis, J., and D. Solander. 1786. The natural history of many curious and uncommon zoophytes, collected . . . by the late John Ellis . . . systematically arranged and described by the late Daniel Solander. London: Benjamin White, 208 pp.

Esper, E. Johan C. 1794–1797. Fortsetzungen der Pflanzenthiere in Abbildungen nach der Natur. I. Nürnberg. 230 pp. (1794:1–64; 1795:65–116; 1796:117–168; 1797:169–230).

Farre, A. 1837. Observations on the minute structure of some of the higher forms of polypi, with views of a more natural arrangement of the class. Philosophical Transactions of the Royal Society, London 127: 387–426.

Fernández Pulpeiro, E., and O. Reverter Gil. 1993. Le genre *Ellisina* (Bryozoa, Cheilostomida) sur les côtes européennes. Description *d'Ellisina gautieri* sp. nov. Cahiers de Biologie Marine 34: 93–101.

Fischer, G. 1807. Museum Démidoff (Moscou) 3. Végétaux et Animaux, 330 pp.

Fleming, J. 1823, Observations on the *Sertularia Cuscuta* of Ellis; with a figure. Memoirs of the Wernerian Natural History Society 4: 485–491.

Fleming, J. 1828. A history of British animals, exhibiting their descriptive characters and systematical arangement of the genera and species of quadrupeds, birds, reptiles, fishes, Mollusca, and Radiata of the United Kingdom. Edinburgh: Bell and Bradfute, 565 pp.

Friedl, P. H. 1917. Bryozoen der Adria. Zoologischer Anzeiger 49: 225–240, 268–280.

Friedl, P. H. 1925. Koloniebildung, Besiedelung und Wachstum bei marinen Bryozoen. Arbeiten des Zoologische. Institut der Universität Innsbruck 2: 137–167.

Gabb, W. M., and G. H. Horn. 1862. Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America. Journal of the Academy of Natural Sciences of Philadelphia 5: 111–179.

Gamulin-Brida, H. 1979. Litoralne biocenoze na podrucju srednjodalmatinskih otoka. Acta Biologica 8: 27–63.

Gautier, Y. V. 1954. Sur l'Electra pilosa des feuilles de posidonies. Vie et Milieu 5: 66–70.

Gautier, Y. V. 1956. Résultats Scientifiques des Campagnes de la ''Calypso'', Fascicule II. V. Bryozoaires. Annales de l'Institut de Océanographie 32: 189–225.

Gautier, Y. V. 1958. Bryozoaires de la côte ligure. Annali del Museo Civico di Storia Naturale di Genova 70: 193–206.

Gautier, Y. V. 1962. Recherches écologiques sur les bryozoaires chilostomes en Mediterranée occidentale. Travaux de la Station Marine d'Endoume Bulletin 24: 1–434.

Geraci, S. 1975. I briozoi de Punta Manara (Sestri Levante—Golfo di Genova): le specie del genere *Sertella* (Cheilostomata Ascophora). Annali del Museo Civico di Storia Naturale di Genova. 80: 241–249.

Geraci, S., and G. Relini. 1970. Osservazioni sistematico-ecologiche sui briozoi del fouling Portuale di Genova. Bollettino dei Musei e degli Istituti Biologici del'Università di Genova 38: 103–139.

Gordon, D. P. 1989. The marine fauna of New Zealand: Bryozoa: Gymnolaemata (Cheilostomida Ascophorina) from the western South Island continental shelf and slope. New Zealand Oceanographic Institute Mememoir 97: 1–158.

Gordon, D. P., and S. F. Mawatari. 1992. Atlas of marine-fouling Bryozoa of New Zealand ports and harbours. Miscellaneous Publications of the New Zealand Oceanographic Institute 107: 1–52.

Gordon, D. P., and P. D. Taylor. 1997. The Cretaceous-Miocene genus *Lichenopora* (Bryozoa), with a description of a new species from New Zealand. Bulletin of the Natural History Museum, London (Geology) 53: 71–78.

Gordon, D. P., and P. D. Taylor. 2001. New Zealand Recent Densiporidae and Lichenoporidae (Bryozoa: Cyclostomata). Species Diversity 6: 243–290.

Gosse, P. H. 1855. Notes on some new or little-known marine animals. Annals and Magazine of Natural History (series 2) 16: 27–36.

Gray, J. E. 1840 [1841]. Synopsis of the contents of the British Museum. 42nd ed. London: British Museum, 370 pp.

Gray, J. E. 1843. Additional radiated animals and annelides. *In* Ernest Dieffenbach, Travels in New Zealand 2: 292–295. London: John Murray.

Gray, J. E. 1848. List of the specimens of British animals in the collection of the British Muse-

um. Part I. Centroniae or radiated animals. London: British Museum, 173 pp.
Gregory, J. W. 1893. On the British Palaeogene Bryozoa. Transactions of the Zoological Society, London 13: 219–279.
Harmelin, J.-G. 1968. Contribution a l'étude des bryozoaires cyclostomes de Méditerranée: les *Crisia* des Côtes de Provence. Bulletin du Museum d'Histoire Naturelle, Paris (série 2) 40: 413–437.
Harmelin, J.-G. 1968 [1969a]. Bryozoaires récoltés au cours de la campagne du Jean Charcot en Méditerranée orientale (août-septembre 1967).–I. Dragages. Bulletin du Museum d'Histoire Naturelle, Paris (série 2) 40: 1179–1208.
Harmelin, J.-G. 1969b. Bryozoaires récoltés au cours de la campagne du Jean Charcot en Méditerranée orientale (août-septembre 1967).–I. Dragages. (cont.) Bulletin du Museum d'Histoire Naturelle, Paris (série 2) 41: 295–311.
Harmelin, J.-G. 1973a. Bryozoaires de l'herbier de Posidonies de l'ile de Port-Cros. Rapports de la Commission Internationale de la Mer Méditerranée 21: 675–677.
Harmelin, J.-G. 1973b. Morphological variations and ecology of the Recent cyclostome bryozoan ''*Idmonea*'' *atlantica* from the Mediterranean. *In* Larwood, G. P. (editor), Living and fossil Bryozoa: 95–106. New York: Academic Press.
Harmelin, J.-G. 1976. Le sous-ordre des Tubuliporina (Bryozoaires Cyclostomes) en Méditerranée, écologie et systématique. Mémoires de l'Institut Oceanographique Monaco 10: 1–326.
Harmelin, J.-G., and J.-L. d'Hondt. 1992. Bryozoaires des parages de Gibraltar (campagne océanographique BALGIM, 1984). 1–Chéilostomes. Bulletin du Museum d'Histoire Naturelle, Paris (série 4) 14(A,): 23–67.
Harmelin, J.-G., C. M. López de la Cuadra, and J. C. García-Gómez. 1989. Description et variabilité de *Calyptotheca obscura* n.sp. (Bryozoa, Cheilostomata). Bulletin du Museum d'Histoire Naturelle, Paris (série 4) 11(A): 295–305.
Harmer, S. F. 1891. On the British species of *Crisia*. Quarterly Journal of Microscopical Science (new series) 32: 127–181.
Harmer, S. F. 1898. On the development of *Tubulipora*, and on some British and northern species of this genus. Quarterly Journal of Microscopical Science (new series) 41: 73–157.
Harmer, S. F. 1902. On the morphology of the Cheilostomata. Quarterly Journal of Microscopical Science (new series) 46: 263–350.
Harmer, S. F. 1915. The Polyzoa of the Siboga Expedition, Part I. Entoprocta, Ctenostomata and Cyclostomata. Siboga Expeditie 28a: 1–180.
Harmer, S. F. 1923. On Cellularine and other Polyzoa. Journal of the Linnean Society, London (Zoology) 35: 293–360.
Harmer, S. F. 1926. The Polyzoa of the Siboga Expedition. Pt. 2, Cheilostomata, Anasca. Siboga Expeditie 28b: 181–501.
Harmer, S. F. 1933. The genera of the Reteporidae. Proceedings of the Zoological Society, London 1933 (Pt. 3): 615–627.
Harmer, S. F. 1957. The Polyzoa of the Siboga Expedition, Part. IV. Cheilostomata Ascophora, II. Siboga Expeditie. 28d: 641–1147.
Hassall, A. H. 1841. Supplement to a catalogue of Irish zoophytes. Annals and Magazine of Natural History 7: 276–287, 363–373.
Hastings, A. B. 1944. Notes on Polyzoa (Bryozoa). I. *Umbonula verrucosa* auctt.: *U. ovicellata*, sp. n. and *U. littoralis*, sp. n. Annals and Magazine of Natural History (series 11) 11: 273–284.
Hayward, P. J. 1974. Studies on the cheilostome bryozoan fauna of the Aegean island of Chios. Journal of Natural History 8: 369–402.
Hayward, P. J. 1978. Systematics and morphological studies on some European species of *Turbicellepora* (Bryozoa, Cheilostomata). Journal of Natural History 12: 551–590.
Hayward, P. J. 1985. Ctenostome bryozoans. London: E. J. Brill/Dr. W. Backhuys, 169 pp.
Hayward, P. J. 1988. The Recent species of *Adeonella* (Bryozoa: Cheilostomata) including descriptions of fifteen new species. Zoological Journal of the Linnean Society 94: 111–191.
Hayward, P. J., and J. S. Ryland. 1979. British ascophoran bryozoans. London: Academic Press, 312 pp.
Hayward, P. J., and J. S. Ryland. 1985a. Cyclostome bryozoans. London: E. J. Brill/Dr. W. Backhuys, 147 pp.
Hayward, P. J., and J. S. Ryland. 1985b. Systematic notes on some British Cyclostomata (Bryozoa). Journal of Natural History 19: 1073–1078.
Hayward, P. J., and J. S. Ryland. 1995. The British species of *Schizoporella* (Bryozoa: Cheilostomatida). Journal of Zoology, London 237: 37–47.
Hayward, P. J., and J. S. Ryland. 1996. Some British Phidoloporidae (Bryozoa: Cheilostomatida). Zoological Journal of the Linnean Society 117: 103–112.
Hayward, P. J., and J. S. Ryland. 1998. Cheilostomatous Bryozoa. Part 1. Aeteoidea–Cribrilinoidea. Shrewsbury, U.K.: Field Studies Council, 366 pp.

Hayward, P. J., and J. S. Ryland. 1999. Cheilostomatous Bryozoa. Part 2. Hippothooidea–Celleporoidea. Shrewsbury, U.K.: Field Studies Council, 416 pp.

Hayward, P. J. and J. P., Thorpe. 1995. Some British species of *Schizomavella* (Bryozoa: Cheilostomatida). Journal of Zoology, London 235: 661–676.

Heller, C. 1867. Die Bryozoen des adriatischen Meeres. Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien 17: 77–136.

Herrera, A., and J.B.C. Jackson. 1996. Life history variation among ‘‘dominant’’ encrusting cheilostomate Bryozoa. *In* D.P. Gordon, A.M. Smith, and J.A. Grant-Mackie (editors), Bryozoans in space and time: 117–123. Wellington, New Zealand: NIWA.

Hincks, T. 1860. Descriptions of new Polyzoa from Ireland. Quarterly Journal of Microscopical Science 8: 275–280.

Hincks, T. 1877. On British Polyzoa.—Part II. Classification. Annals and Magazine of Natural History (series 4) 20: 520–532.

Hincks, T. 1879. On the classification of the British Polyzoa. Annals and Magazine of Natural History (series 5) 3: 153–164.

Hincks, T. 1880. A history of the British marine Polyzoa. London: Van Voorst. 2 vols., 601 pp.

Hincks, T. 1881. Contributions towards a general history of the marine Polyzoa. Part VI (cont.)–Part VIII. Annals and Magazine of Natural History (series 5) 8: 122–136.

Hincks, T. 1886. The Polyzoa of the Adriatic: a supplement to Prof. Heller’s ‘Die Bryozoen des adriatischen Meeres,’ 1867. Annals and Magazine of Natural History (series 5) 17: 254–271.

Hincks, T. 1887. The Polyzoa of the Adriatic: a supplement to Prof. Heller’s ‘Die Bryozoen des adriatischen Meeres,’ 1867 Annals and Magazine of Natural History (series 5) 21: 302–316.

Hincks, T. 1895. Index [to ‘‘Marine Polyzoa: contributions towards a general history’’]. London, Issued privately.

Hurlbut, C. J. 1991. Community recruitment: settlement and juvenile survival of seven co-occurring species of sessile marine invertebrates. Marine Biology 109: 507–515.

Johnson, J. Y. 1897. New cyclostomatous Bryozoa found at Madeira. Annals and Magazine of Natural History (series 6). 20: 60–65.

Johnston, G. 1838. A history of the British zoophytes. 1st ed. Edinburgh: W. H. Lizars, 341 pp.

Johnston, G. 1840. Description of a new genus of British zoophyte Annals and Magazine of Natural History (series 1) 5: 272–274.

Johnston, G. 1847. A history of the British zoophytes. 2nd ed. London: John Van Vorst. Vol. 1, 488 pp. Vol. 2, 74 pls.

Jullien, J. 1882. Dragages du Travailleur. Bryozoaires; espèces draguées dans l’océan Atlantique en 1881. Bulletin de la Société Zoologique de France 7: 497–529.

Jullien, J. 1886. Les costulidée, nouvelle familie de bryozoaires. Bulletin de la Société Zoologique de France 11: 601–620.

Jullien, J. 1888. Bryozoaires. Mission Scientifique du Cap Horn. 1882–1883. Zoologie 6: I.1–I.92.

Jullien, J., and L. Calvet. 1903. Bryozoaires provenant des campagnes del’Hirondelle 1886–1888. Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier 23: 1–188.

Kluge, G. A. 1962. Mshanki severnykh morey SSSR. Opredeliteli po faune SSSR 76: 1–584.

Kluge, G. A. 1975. Bryozoa of the northern seas of the USSR. New Delhi: Amerind Publishing Company, 711 pp. [English translation of Kluge, G. A. 1962]

Lagaaij, R. 1952. The Pliocene Bryozoa of the Low Countries. Maastricht: Uitgevers-Mij ‘Ernest van Aelst’, 233 pp.

Lamarck, M. le Chevalier de. 1816. Histoire naturelle des animaux sans vertèbres. Tome Second. Paris: Verdièr, 568 pp.

Lamouroux, J.V.F. 1812. Extrait d’un mémoire sur la classification des Polypiers coralligènes non entièrement pierreux. Nouveau Bulletin des Sciences de la Société Philomatique de Paris 3: 181–188.

Lamouroux, J.V.F. 1816. Histoire des polypiers coralligènes flexibles, vulgairement nommés zoophytes. Caen: F. Poisson, 560 pp.

Lamouroux, J.V.F. 1821. Exposition méthodique des genres de l’ordre des polypiers. Paris: Veuve Agasse, 115 pp.

Landsborough, D. 1852. A popular history of British zoophytes, or corallines. London: Reeve, 404 pp.

Leidy, J. 1855. Contributions towards a knowledge of the marine invertebrate fauna of the coasts of Rhode Island and New Jersey. Proceedings of the Academy of Natural Sciences of Philadelphia (series 2) 3: 135–152.

Levinsen, G.M.R. 1902. Studies on Bryozoa. Videnskabelige Meddelelser fra den Naturhistorisk Forening Kjobehavn: 1–31.

Levinsen, G.M.R. 1909. Morphological and systematic studies on the cheilostomatous Bryozoa. Copenhagen: Natl. Forfatteres Forlag, 431 pp.

Lindberg, W. J., and G. R. Stanton. 1989. Resource quality, dispersion and mating prospects for crabs occupying bryozoan colonies. Journal of Marine Biology and Ecology 128: 257–282.

Link. 1807. not seen; cited in Bassler. 1935: 116.

Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. 10th ed. Tomus I. Stockholm: Laurentii Salvii, 824 pp.

Linnaeus, C. 1767. Systema naturae. 12th ed. Tomus I. Regnum Animale. Stockholm: Laurentii Salvii.

Macgillivray, J. 1842. Catalogue of the marine zoophytes of the neighborhood of Aberdeen. Annals and Magazine of Natural History (series 1) 9: 462–469.

MacGillivray, P. H. 1895. A monograph of the Tertiary Polyzoa of Victoria. Transactions of the Royal Society of Victoria (new series) 4: 1–166.

Manzoni, A. 1869a. Bryozoi pliocenici Italiani. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathhematischen-Naturwissenschaftliche Classe 59: 17–28.

Manzoni, A. 1869b. Bryozoi fossili Italiani. Terza contribuzione. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathhematischen-Naturwissenschaftliche Classe 60: 930–944.

Manzoni, A. 1870. Bryozoi fossili Italiani. Quarta contribuzione. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathhematischen-Naturwissenschaftliche Classe 61: 323–349.

Marchetti, R., A. Provini, and G. Crosa. 1989. Nutrient load carried by the River Po into the Adriatic Sea, 1968–87. Marine Pollution Bulletin 20: 168–172.

Marcus, E. 1940. Mosdyr (Bryozoa eller Polyzoa). Danmarks Fauna 46. Copenhagen: G.E.C. Gads Forlag, 401 pp.

Marinković, M. 1959. Terminska hidrografska oprazHACEKanja kod Rovinja II. Thalassia Jugoslavica 1: 41–68.

Marsigli, L. F. Compte de. 1725. Histoire physique de la mer. Amsterdam: De'Pens de la Campagnie, 173 pp.

Maturo, F. J. S., Jr. 1957. A study of the Bryozoa of Beaufort, North Carolina, and vicinity. Journal of the Elisha Mitchell Scientific Society 73: 11–67.

McKinney, F. K. 1988. Elevation of lophophores by exposed introverts in Bryozoa: a gymnolaemate character recorded in some stenolaemate species. Bulletin of Marine Science 43: 317–322.

McKinney, F. K. 1989. Two patterns of colonial water flow in an erect bilaminate bryozoan, the cheilostome *Schizotheca serratimargo* (Hincks, 1886). Cahiers de Biologie Marine 30: 35–48.

McKinney, F. K. 1991a. Colonial feeding currents of *Exidmonea atlantica* (Cyclostomata). Bulletin de la Société des Sciences Naturelles de l' Ouest de la France, Mémorie Hors Serié 1: 263–270.

McKinney, F. K. 1991b. Phylogeny limits function. National Geographic Research 7: 432–441.

McKinney, F. K. 1992. Competitive interactions between related clades: evolutionary implications of overgrowth interactions between encrusting cyclostome and cheilostome bryozoans. Marine Biology 114: 645–652.

McKinney, F. K. 2000. Colony sizes and occurrence patterns among Bryozoa encrusting disarticulated bivalves in the northeastern Adriatic Sea. *In* A. Herrera Cubilla and J.B.C. Jackson (editors), Proceedings of the 11th International Bryozoology Association Conference: 282–290. Balboa, Republic of Panama: Smithsonian Tropical Research Institute.

McKinney, F. K., and A. Jaklin. 1993. Living populations of free-lying bryozoans: implications for post-Paleozoic decline of the growth habit. Lethaia 26: 171–179.

McKinney, F. K., and A. Jaklin. 2000. Spatial niche partitioning in the *Cellaria* meadow epibiont association, northern Adriatic Sea. Cahiers de Biologie Marine 41: 1–17.

McKinney, F. K., and M. J. McKinney. 1993. Larval behaviour and choice of settlement site: correlation with environmental distribution pattern in an erect bryozoan. Facies 29: 119–132.

McKinney, F. K., and M. J. McKinney. 2002. Contrasting marine larval settlement patterns imply habitat-seeking behaviours in a fouling and a cryptic species (phylum Bryozoa). Journal of Natural History 36: 487–500.

McKinney, F. K., and P. D. Taylor. 1997. Life histories of some Mesozoic encrusting cyclostome bryozoans. Palaeontology 40: 515–556.

McKinney, M. J. 1997. Fecal pellet disposal in marine bryozoans. Invertebrate Biology 116: 151–160.

Milne Edwards, H. 1836. Histoire des polypes. *In* G.P. Deshayes and H. Milne Edwards (editors), Histoire naturelle des animaux sans vertebres par J.- B.P.A. Lamarck, 2e edition revue et augmentee. Vol. 2, 684 pp. London: J.B. Bailliere.

Milne Edwards, H. 1838. Recherches anatomiques, physiologiques et zoologiques sur les polypes. Premier fascicule. Part 6, Mémoire sur les polypes du genre des tubulipores. Paris: Chez Crochard et C^{ie}, 18 pp.

Moissette, P., and J.-P. Saint Martin. 1995. Bryozoaires des milieux récifaux miocènes du sillon sud-rifain au Maroc. Lethaia 28: 271–283.

Moll, J. P. C. 1803. Eschara zoophytozoorum seu phytozoorum ordinae pulcherrima ac notata dignissima genus, etc. Vincobonae, 70 pp. [Not seen]

Mongereau, N. 1969. Le genre *Idmonea* Lamouroux, 1821 (Bryozoa—Cyclostomata) dans le tertiaire d'Europe. Geobios 2: 205–264.

Neviani, A. 1895. Briozoi fossili della Farnesina e Monte Mario. Palaeontographica Italica 1: 77–140.

Nicoletti, L., E. Faraglia, and C. Chimenz. 1995. Campagna ''Akdeniz '92' '': studio della fauna briozoologica epifita su Posidonia oceanica. Biologia Marina Mediterranea 2: 397–399.

Nielsen, C. 1970. On metamorphosis and ancestrula formation in cyclostomatous bryozoans. Ophelia 7: 217–256.

Nielsen, C. 1981. On morphology and reproduction of '*Hippodiplosia' insculpta* and *Fenestrulina malusii* (Bryozoa, Cheilostomata). Ophelia 20: 91–125.

Nikolić, M. 1954. Prispevek k problematiki ekoloskega proucevanja briozojev v Jadranu. Bioloski Vestnik 3: 167–171.

Nikolić, M. 1959a. Polyzoan colonies in fouling on floating vessels in the northern Adriatic (Rovinj). Proceedings and Technical Papers of the General Fisheries Council for the Mediterranean 5: 231–234.

Nikolić, M. 1959b. Doprinos poznavanju briozojskih asocijacija I. Thalassia Jugoslavica 1: 69–80.

Nikolić, M. 1960. *Hippodiplosia foliacea* Solander 1876 (Bryozoa) comme centre d'association sur un fond coralligène dans l'Adriatique. Rapports et Procès-verbaux des Réunions de la C.I.E.S.M.M. 15: 85–86.

Nordgaard, O. 1918. Bryozoa from the Arctic regions. Tromsø Museums Aarshefter 40 (1917) 1: 1–99.

Norman, A. M. 1864. On undescribed British Hydrozoa, Actinozoa, and Polyzoa. Annals and Magazine of Natural History (series 3) 13: 82–90.

Norman, A. M. 1866 [1867]. Report on the Crustacea, Echinodermata, Polyzoa, actinozoa, and Hydrozoa from the coasts of the Hebrides. Report of the British Association for the Advancement of Science 1866: 193–206.

Norman, A. M. 1868. Notes on some rare British Polyzoa, with descriptions of new species. Quarterly Journal of Microscopical Science 8: 212–222.

Norman, A. M. 1903. Notes on the natrual history of East Finmark. Annals and Magazine of Natural History (series 7) 12: 87–128.

Occhipinti Ambrogi, A. 1981. Bryozoi lagunari. Guide per il riconoscimento delle species animali delle acque lagunari e costiere italiane 7: 1–146.

Oken, L. 1815. Lehrbuch der Naturgeschichtes. Vol. III. Zoologie.

Osburn, R. C. 1912. The Bryozoa of the Woods Hole region. Bulletin of the United States Bureau of Fisheries 30: 201–266.

Osburn, R. C. 1947. Bryozoa of the Allan Hancock Atlantic Expedition, 1939. Allan Hancock Atlantic Expedition. 5: 1–66.

Osburn, R. C. 1952. Bryozoa of the Pacific Coast of America. Part 2, Cheilostomata-Ascophora. Allan Hancock Pacific Expedition 14: 271–611.

Pallas, P. S. 1766. Elenchus zoophytorum. Hagae-Comitum: Petrum van Cleef, 451 pp.

Pieper, F. W. 1881. Eine neue Bryozoe der Adria: *Gemellaria (?) avicularis*. Jahresberichte Westfalischen Provinzialvereins Wissenschaft und Kunst 9: 43–48.

Poluzzi, A., and M. Grazia Coppa. 1991. Zoarial strategies to win substratum space in *Calpensia nobilis* (Esper). Bulletin de la Société des Sciences Naturelles de l' Ouest de la France, Mémorie Hors Serié 1: 337–360.

Poluzzi, A., R. Capozzi, G. Giordani, and M. Venturini. 1988. I briozoi dello spungone nei terreni pliocenici della Romagna. Acta-Naturalia de ''l'Ateneo Parmense'' 24: 19–82.

Prenant, M., and G. Bobin. 1956. Bryozoaires, Première partie. Entoproctes, Phylactolèmes, Cténostomes. Faune de France 60: 1–398.

Prenant, M., and G. Bobin. 1966. Bryozoaires, Deuxième partie. Chilostomes anasca. Faune de France 68: 1–647.

Reuss, A. E. 1848 (1847). Die fossilen Polyparien des Wiener Tertiärbeckens. Haidinger's Naturwissenschaften Abhandlungen 2: 1–109. [Not seen]

Reverter-Gil, O., and E. Fernández-Pulpeiro. 1995. Some species of *Schizomavella* (Bryozoa, Cheilostomatida) from the Atlanto-Mediterranean region. Cahiers de Biologie Marine 36: 259–275.

Reverter-Gil, O., and E. Fernández-Pulpeiro. 1997. Two new species of *Schizomavella* (Bryozoa, Cheilostomatida). Cahiers de Biologie Marine 38: 1–6.

Reverter-Gil, O., and E. Fernández-Pulpeiro. 1999. Some little-known species of Bryozoa described by J. Jullien. Journal of Natural History 33: 1403–1418.

Ride, W. D. L., H. G. Cogger, C. Duuis, O. Kraus, A. Minelli, F. C. Thompson, and P. K. Tubbs. 1999. International Code of Zoological Nomenclature. 4th ed. London: International Trust for Zoological Nomenclature, 306 pp.

Ristedt, H. 1991. Ancestrula and early astogeny of some anascan Bryozoa: their taxonomic importance and possible phylogenetic implications. Bulletin de la Société des Sciences Na-

turelles de l' Ouest de la France, Mémorie Hors Serié 1: 371–382.
Ristedt, H. 1996. Initial frontal budding in some nodular cheilostomate Bryozoa. *In* D.P. Gordon, A.M. Smith, and J.A. Grant-Mackie (editors), Bryozoans in space and time: 237–242. Wellington, New Zealand: NIWA.
Ristedt, H., and H. Schuhmacher. 1985. The bryozoan *Rhynchozoon larreyi* (Audouin, 1826)–A successful competitor in coral reef communities of the Red Sea. P.S. Z. N. I: Marine Ecology 6: 167–179.
Ryland, J. S. 1960. The British species of *Bugula* (Polyzoa). Proceedings of the Zoological Society, London 134: 65–105.
Ryland, J. S. 1963. Systematic and biological studies on Polyzoa (Bryozoa) from western Norway. Sarsia 14: 1–59.
Ryland, J. S. 1968. On marine Polyzoa. III. *Schizoporella ansata* auctt. Journal of Natural History. 2: 535–546.
Ryland, J. S. 2000. Gonozooid placement and branching patterns in some species of *Crisia* (Cyclostomatida). *In* A. Herrera Cubilla and J.B.C. Jackson (editors), Proceedings of the 11th International Bryozoology Association Conference: 343–354. Balboa, Republic of Panama: Smithsonian Tropical Research Institute.
Ryland, J. S., and D. P. Gordon. 1977. Some New Zealand and British species of *Hippothoa* (Bryozoa: Cheilostomata). Journal of the Royal Society of New Zealand 7: 17–49.
Sala, E., J. Garrabou, and M. Zabala. 1996. Effects of diver frequentation on Mediterranean sublittoral populations of the bryozoan *Pentapora fascialis*. Marine Biology 126: 451–459.
Savigny, J. C. 1809. Description de l'Égypte. Polypes. [Plates only]
Schäfer, P. 1991. Brutkammern der Stanolaemata (Bryozoa): Konstruktionsmorphologie und phylogenetische Bedeutung. Courier Forschungsinstitut Senckenberg 136: 1–263.
Schmid, B. 1989. Cheilostome Bryozoen aus dem Badenien (Miozän) von Nußdorf (Wien). Beiträge zur Paläontologie von Österreich 15: 1–101.
Schopf, T. J. M. 1973. Ergonomics of polymorphism: its relation to the colony as the unit of natural selection in species of the phylum Ectoprocta. *In* R. S. Boardman, A. H. Cheetham and W. A. Oliver, Jr. (editors), Animal colonies: 247–294. Stroudsburg, PA: Dowden, Hutchinson and Ross.
Schopf, T. J. M., and A. R. Dutton. 1976. Parallel clines in morphologic and genetic differentiation in a coastal zone marine invertebrate: the bryozoan *Schizoporella errata*. Paleobiology 2: 255–264.
Seneš, J. 1988. Principles of study of Adriatic shelf ecosystems from the viewpoint of applications in geology. Geologica Carpathica 39: 285–300.
Shuatova, N. N., and A. N. Ostrovsky. 2001. Individual autozooidal behaviour and feeding in marine bryozoans. Sarsia 86: 113–142.
Silén, L. 1941. Cheilostomata Anasca (Bryozoa) collected by Prof. Dr. Sixten Bock's expedition to Japan and the Bonin Islands 1914. Arkiv für Zoologi 33A(12): 1–130.
Silén, L. 1942. Origin and development of the cheilo-ctenostomatous stem of Bryozoa. Zoologiska Bidrag från Uppsala, vol. 22, pp. 1–59.
Silén, L. 1977. Structure of adnate colony portions in Crisiidae (Bryozoa Cyclostomata). Acta Zoologica 58:. 227–244.
Silén, L., and J.-G. Harmelin. 1974. Observations on living Diastoporidae (Bryozoa Cyclostomata), with special regard to polymorphism. Acta Zoologica 55: 81–96.
Smitt, F. A. 1866 (1867). Kritisk förteckning öfver Skandinaviens Hafs-Bryozoer. II. Kongligen Vetenskaps-Akademiens Förhandlingar 23(1866): 395–534.
Smitt, F. A. 1867a. Kritisk förteckning öfver Skandinaviens Hafs-Bryozoer. III. Kongligen Vetenskaps-Akademiens Förhandlingar 24(1867, no. 5): 279–429.
Smitt, F. A. 1867b. Bryozoa marina in regionibus arcticis et borealibus viventia recensuit. Kongligen Vetenskaps-Akademiens Förhandlingar 24(1867, no. 6): 443–487.
Soule, D. F., and J. D. Soule. 1975. Species groups in Watersiporidae. Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon Hors Série 1: 299–309.
Spencer, R. S., and L. D. Campbell. 1987. The fauna and paleoecology of the late Pleistocene marine sediments of southeastern Virginia. Bulletin of American Paleontology 92: 1–124.
Stachowitsch, M. 1991. Anoxia in the northern Adriatic Sea: rapid death, slow recovery. *In* R.V. Tyson and T.H. Pearson (editors), Modern and ancient continental shelf anoxia. Geological Society Special Publication 58: 119–129. London: Geological Society.
Strenger, A., and H. Splechtna. 1978. Zum Auftreten und zur Ernährung von *Echinus melo* Lam. Zool. Anz., Jena 200: 374–378.
Sutherland, J. P. 1977. Effect of *Schizoporella* (Ectoprocta) removal on the fouling community at Beaufort, North Carolina, USA. *In* B.C. Coull (editor), Ecology of marine benthos: 155–176. Columbia: University of South Carolina Press.

Sutherland, J. P. 1978. Functional roles of *Schizoporella* and *Styela* in the fouling community at Beaufort, North Carolina. Ecology 59: 257–264.

Taylor, P. D. 1994. Evolutionary palaeoecology of symbioses between bryozoans and hermit crabs. Historical Biology 9: 157–205.

Taylor, P. D., and E. Voigt. 1992. Taxonomic status of the cyclostome bryozoan genus *Exidmonea*, with a redescription of *E. dorsata* (von Hagenow) from the Upper Cretaceous. Verhandlungen des Naturwisswissenschaftlichen Vereins in Hamburg 33: 121–130.

Ünsal, I., and J.-L. d'Hondt. 1979. Contribution a la connaissance des bryozoaires marins de Turquie (Eurystomata et Cyclostomata). Vie et Millieu 28–29(4, série AB): 613–634.

Vigneaux, M. 1949. Révision des bryozoaires néogenès du Bassin d'Aquitaine et essai de classification. Mémoires de la Société Géolofique de France (nouvelle série) 28(Mémoire 60): 1–155.

Waters, A. W. 1878. The use of the opercula in the determination of the chilostomatous Bryozoa. Proceedings of the Manchester Literary and Philosophical Society 18: 8–11.

Waters, A. W. 1879. On the Bryozoa (Polyzoa) of the Bay of Naples. Annals and Magazine of Natural History (series 5) 3: 28–43, 114–126, 192–202, 267–281.

Waters, A. W. 1909. Reports on the marine biology of the Sudanese Red Sea. . . . 12, The Bryozoa, Pt. 1, Cheilostomata. Journal of the Linnean Society, London (Zoology) 31: 123–181.

Waters, A. W. 1910. Reports on the marine biology of the Sudanese Red Sea. . . . 15, The Bryozoa, Pt. 2, Cyclostomata, Cetnostomata and Endoprocta Journal of the Linnean Society, London (Zoology) 31: 231–256.

Waters, A. W. 1922. On Mediterranean *Tervia* and *Idmonea* (Bryozoa). Annals and Magazine of Natural History (series 9) 10: 1–16.

Winston, J. E. 1977. Feeding in marine bryozoans. *In* Robert M. Woollacott and Russell L. Zimmer (editors). Biology of bryozoans: 233–271. New York: Academic Press.

Winston, J. E. 1978. Polypide morphology and feeding behavior in marine ectoprocts. Bulletin of Marine Science 28: 1–31.

Winston, J. E. 1982. Marine bryozoans (Ectoprocta) of the Indian River area (Florida). Bulletin of the American Museum of Natural History 173: 99–176.

Wood, S. V. 1844. Descriptive catalogue of the zoophytes of the Crag. Annals and Magazine of Natural History (series 1) 8: 10–21.

Zabala, M. 1986. Fauna dels briozous dels països Catalans. Institut d'Estudis Catalans Arxius de la Seccio Ciènces 84: 1–836.

Zabala, M., and P. Maluquer. 1988. Illustrated keys for the classification of Mediterranean Bryozoa. Treballs del Museu Zoologia Barcelona 4: 1–294.

Zabala, M., P. Maluquer, and J.-G. Harmelin. 1993. Epibotic bryozoans on deep-water scleractinian corals from the Catalonia slope (western Mediterranean, Spain, France). Scientia Marina 57: 65–78.

Zavodnik, D. 1977. Benthic communities in the Adriatic Sea: Reflects of pollution. Thalassia Jugoslavica 13: 413–422.

Zavodnik, N. 1983. Prilog poznavanju flore morskih alga i cvjetnica zapadne obale Istre. Biosistematika 9(1): 1–13.

Ziko, A. 1985. Eocene Bryozoa from Egypt. A paleontological and paleoecological study. Tübinger Mikropaläontologische Mitteilungen 4: 1–183.

APPENDIX 1

Species	Depth range (m)			Localities
	Rock	Sediment	Artificial	
Adeonella pallasi	3–20	25–61		3, 5, 10, 20, 21, 22, 26–29, 31
Aetea sica	12–21	20–45		11, 17–22, 26, 27, 30
Aetea truncata	0–20	14–60	0–5	1, 5, 7, 8, 11, 15, 18–23, 26–28, 30–32, 34
Amathia pruvoti		20–61		17, 22, 26–29
Amathia vidovici		14–61		15, 25, 29
Annectocyma arcuata		20–22		17
Annectocyma cf. *A. major*		25–60		20, 30, 31
Annectocyma sp.		25		20
Beania cylindrica		20–60		18, 21, 22, 26–28, 31
Beania hirtissima		30–42		22, 27
Beania magellanica	3–5	20–61	0–2	3, 17, 19, 22, 27–29, 33
Beania mirabilis	10–30	22–61		8, 19, 22, 29, 30
Bugula fulva		25–61		20, 22, 26–29
Buskea nitida	3–30	30–61		3, 8, 22, 25, 27–29
Caberea boryi	5–20	20–45		5, 17, 19–22, 25–28, 30, 31
Callopora dumerilii	5–30	25–45		5, 8, 20, 22, 27, 30
Calpensia nobilis	0–30	14–60		1, 5, 8, 11, 13, 15–17, 19–21, 26, 27, 30, 31
Calyptotheca rugosa		30–42		22
Cellaria fistulosa	5–30	22–61		5, 8, 19–23, 25–27, 29, 31
Cellaria salicornioides	12–20	30–61		11, 22, 27–29, 31
Cellepora adriatica		24.5–35		35, 36
Celleporina caminata	0–20	22–35		1, 3, 5 11, 19–21, 26, 27
Celleporina canariensis	5–20	20–42		5, 18–20, 22, 27
Celleporina siphuncula		22–61		19, 27, 29
Celleporina tubulosa		20–22		17
Chartella tenella	5–20	20–61		5, 17, 19–23, 25, 27–31
Chorizopora brongniartii	5–30	14–61		5, 6, 8, 11, 13, 15–17, 19–23, 25–31
Collarina balzaci	5–20	22–60		5, 19, 20, 22, 27, 30, 31
Copidozoum tenuirostre		14–45		15, 20, 22, 30
Crisia ramosa	25–30	20–61		13, 17, 18, 20–23, 25–31
Crisia recurva		35		27
Cryptosula pallasiana	0–1		0–5	1, 32
Diplosolen obelia	3–30	20–61		3, 5, 8, 18–22, 26, 27, 29, 31
Disporella hispida	5–30	20–61		5, 13, 18, 20–23, 25–31
Ellisina gautieri	5–20			4
Entalophoroecia deflexa	5–20	30–61		5, 22, 27–29
Entalophoroecia robusta		50–60		31
Escharina dutertrei protecta	5–20			5
Escharina vulgaris	5–20	20–45		5, 18–22, 27, 30
Escharoides mamillata	5–20	30–42		5, 22, 27
Eurystrotos compacta	25–30			13
Exidmonea coerula		35		27
Exidmonea triforis		20–60		19, 22, 25–27, 29, 31
Fenestrulina malusii	10–30	20–61		8, 17, 19–23, 25–31
Figularia figularis	5–20	30–42		5, 22
Frondipora verrucosa		25–42		20–22, 25–27
Hagiosynodos kirchenpaueri	10–30			8
Hagiosynodos hadros		25–45		20, 22, 26, 28, 30
Hippothoa divaricata		30–42		22
Hippothoa flagellum	5–30	22–60		5, 13, 19–22, 26, 28, 30, 31
Margaretta cereoides	5–20	50–60		5, 31

APPENDIX 1
(Continued)

Species	Depth range (m) Rock	Sediment	Artificial	Localities
Microporella ciliata	0–10	14–60		1, 6, 15, 20–23, 25–27, 30, 31
Mollia circumcincta		25–60		20, 22, 30, 31
Myriapora truncata	3–30	31–35		3, 5, 8, 23, 26
Nolella dilatata	5–20	22–61		5, 19, 22, 23, 25, 27, 29
Parasmittina rouvillei		17.5–60		16, 18, 21, 31
Patinella radiata	5–20	22–35		5, 19, 27
Pentapora fascialis	10–50	20–61		8, 14, 18, 19, 21, 22, 26, 27, 29, 31
Plagioecia patina	5–20	20–61		5, 17, 19–22, 26, 27, 29, 31
Plagioecia sarniensis	5–20			5
Puellina hincksi	5–20	22–42		5, 7, 19, 22, 27, 28
Pyripora sp.		30–42		22
Reptadeonella violacea	2–30	14–60		2, 5, 8, 11, 15, 17–22, 25–28, 30, 31
Reteporella grimaldii	3–30	22–61		3, 5, 8, 9, 12, 19, 20, 23, 26, 27, 29
Rhynchozoon neapolitanum	5–20	14–61		5, 6, 10, 11, 15, 18, 20, 22, 25, 27, 31
Rhynchozoon pseudodigitatum		22		19
Rhynchozoon revelatus		20–45		17, 19–22, 25–27, 30
Rosseliana rosselii	0–30	14–42		1, 8, 15, 17–20, 22
Savignyella lafontii	5–20	14–61		5, 15, 18, 20, 22, 26, 27, 29–31
Schizobrachiella sanguinea	5–20	14–61	0–5	5, 10, 11, 15, 18, 20, 21, 23, 30–33
Schizomavella asymetrica		35		27
Schizomavella cornuta	3–30	14–61		3, 5, 7, 8, 11, 15, 17, 19, 20, 22, 25, 27, 29, 31
Schizomavella linearis	2–30	20–42		3, 5, 18, 19, 22, 26, 27
Schizomavella mamillata	25–30	20–60		13, 19, 22, 30, 31
Schizomavella rudis		20–60		18–22, 26, 30, 31
Schizomavella subsolana	5–20			5
Schizoporella dunkeri	0–30	14–61	0–5	1, 2, 5, 8, 11, 13, 15–23, 25–29, 31, 32, 34
Schizoporella errata			0–5	32–34
Schizoporella magnifica	3–30	29–60		3, 5, 8, 21, 22, 26, 27, 29, 30
Schizoporella cf. *S. tetragona*	0–30	45		1, 8, 30
Schizoporella unicornis	0–1			1
Schizotheca fissa	5–20	25–45		5, 20, 22, 27, 30
Schizotheca serratimargo	3–30	22–60		3, 5, 8, 11, 12, 19, 22, 26, 27, 31
Scruparia ambigua	30–42			22
Scrupocellaria delilii	5–20	17.5–61		5, 11, 16, 22, 26, 27, 29
Scrupocellaria scrupea	12–20	22–61		11, 19, 20, 27, 29, 31
Scrupocellaria scruposa		20–61		18, 20–22, 25–27, 29, 31
Smittina cervicornis		35		27
Smittina cheilostoma		20–45		18–20, 22, 27, 30
Smittina tubulifera	30–42			22
Smittoidea reticulata	30–42			22, 27
Synnotum aegyptiacum	5–20	25–60		5, 20, 30, 31
Tubulipora liliacea	5–20	22–61		5, 19, 20, 22, 25–29
Tubulipora plumosa		22–61		19, 21, 22, 27, 29
Turbicellepora avicularis		20–6	1	17–22, 25–27, 29
Turbicellepora camera		25–45		20, 30
Umbonula ovicellata	5–20	20		5, 18
Walkeria tuberosa		22–61	4	19–21, 23, 26–29, 34
Watersipora complanata	10–30	20–60		8, 18, 31
Watersipora subovata	12–20			11