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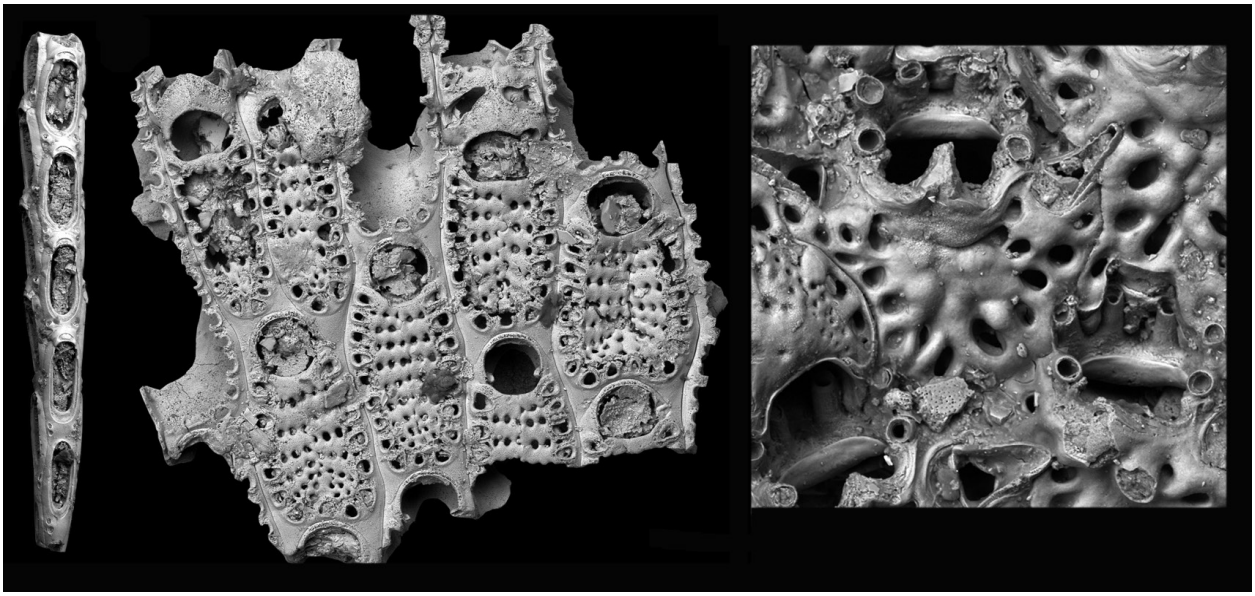
Emanuela Di Martino, Paul D. Taylor, and Roger W. Portell



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BRYOZOANS FROM THE LOWER MIOCENE CHIPOLA FORMATION, CALHOUN COUNTY, FLORIDA, USA

Emanuela Di Martino[1,*], Paul D. Taylor[1], and Roger W. Portell[2]

ABSTRACT

The first comprehensive study of the bryozoan fauna from the upper lower Miocene (Burdigalian) Chipola Formation was produced in 1968 by Reginald J. Scolaro in his Ph.D. dissertation but, unfortunately, has never been published. In the present work, based on museum as well as newly collected material, we review and revise the taxonomy of the Chipola Formation bryozoans. Sixty species, comprising five cyclostomes and 55 cheilostomes, are described. Twenty-five of the cheilostome species are new: *Nellia winstonae* n. sp., *Paralicornia interdigitata* n. sp., *Floridina subantiqua* n. sp., *Thalamoporella papalis* n. sp., *Thalamoporella hastigera* n. sp., *Thalamoporella polygonalis* n. sp., *Thalamoporella bitorquata* n. sp., *Thalamoporella ogivalis* n. sp., *Puellina quadrispinosa* n. sp., *Spiniflabellum jacksoni* n. sp., *Trypostega vokesi* n. sp., *Exechonella minutiperforata* n. sp., *Adeonellopsis sandbergi* n. sp., *Escharoides joannae* n. sp., *Stylopoma leverhulme* n. sp., *Stylopoma farleyensis* n. sp., *Margaretta pentaceratops* n. sp., *Cheiloporina clarksvillensis* n. sp., *Hagiosynodos simplex* n. sp., *Vix scolaroi* n. sp., *Cigclisula solenoides* n. sp., *Turbicellepora giardinai* n. sp., *Pleuromucrum liowae* n. sp., *Pleuromucrum epifanioi* n. sp., and *Schizolepraliella nancyae* n. gen. et n. sp. Of the previously described species, 13 are extant and characterized by a Western Atlantic or pantropical distribution, while 7 species are known only as fossils. In Florida, the Chipola Formation reflects the last truly tropical climatic conditions during the Miocene and also represents the last major transgression in the Western Atlantic before sea-level fell due to the onset of late Miocene glaciation.

Key words: taxonomy, Cyclostomata, Cheilostomata, new species, new genus, Burdigalian, Florida.

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INTRODUCTION

The first report of bryozoans from the Chipola Formation dates from 1923. In their monograph on North American later Tertiary and Quaternary bryozoans, Canu and Bassler (1923:6) reported five bryozoan species from the Chipola Formation: *Adeonellopsis coccinella* n. sp. [= *Triporula coccinella* n. comb.]; *Callopora dumerilii* Audouin, 1826 [= *Akatopora leucocypha* (Marcus, 1937)]; *Cupularia umbellata* Defrance, 1823 [= *Discoporella depressa* (Conrad, 1841)]; *Gemelliporella vorax* Canu and Bassler, 1923; and *Leiosella edax* Canu and Bassler, 1923 [= *Rhynchozoon edax* n. comb.]. They derived from an unspecified locality on the Chipola River, supposedly McClelland's Farm (Scolaro, 1968).

A comprehensive study of the bryozoan faunas of the Chipola Formation was made in 1968 by Reginald J. Scolaro in an unpublished Ph.D. dissertation, aiming to reconstruct the paleoecology of the depositional environment of the Chipola Formation in its type locality in Calhoun County, Florida, USA. A total of 47 species of bryozoans were identified by Scolaro, making them one of the more abundant components of the invertebrate assemblage. Several species recorded by Scolaro (1968) were indicated as new but not formally described. These include the subsequently described species *Metrarabdotos chipolanum* Cheetham, 1968 and *Pirabasoporella chipolae* Zágoršek et al., 2014.

Further occurrences of Chipola bryozoans were noted by Keij (1973) and Herrera-Cubilla and Jackson (2014). In his monograph on the enigmatic genus *Skylonia*, Keij (1973) described *Skylonia* sp. B, based on two specimens provided by Scolaro from Farley Creek (TU Loc. 823) and Chipola River (TU Loc. 548). Herrera-Cubilla and Jackson (2014) revised the occurrences of *Cupuladria* in the Neogene of tropical America, and identified Chipola specimens as *Cupuladria exfragminis* Herrera-Cubilla et al., 2006, a species apparently ranging from the early Miocene to the Recent.

The present paper aims to revise bryozoan diversity in the lower Miocene Chipola Formation based on both museum and new field collections, introducing new species, providing improved descriptions and illustrations, and updating the taxonomy of existing species.

GEOLOGICAL SETTING

The research area is located northwest of Blountstown in Calhoun County, Florida, USA (Fig. 1). In this area the Chipola Formation crops out patchily along the banks of the Chipola River and its tributaries, Tenmile Creek and Farley Creek.

The Chipola Formation is the oldest stratigraphic unit of the Alum Bluff Group, dated at approximately 18.3 mya based on $^{87}Sr/^{86}Sr$ isotopic data (Jones et al., 1993) making it late early Miocene (Burdigalian). It consists of blue-gray to yellowish-brown, highly fossiliferous marl or indurated limestones. The Chipola Formation contains one of the most ecologically diverse and species-rich faunas of Western Atlantic deposits of this age, with mollusks (Gardner, 1926–1950, 1936; Vokes, 1989 and references therein), scleractinian corals (Weisbord, 1971), foraminifera (Cushman and Ponton, 1932; Puri, 1954), and ostracods (Puri, 1954) as dominant groups. Basal beds along Chipola River are made of a flat-lying limestone containing mollusks (e.g., *Strombus* (now *Persististrombus*), oysters, *Amusium*, *Nodipecten*) and solitary corals (Vokes, 1989). Tenmile Creek beds have a higher percentage of silt and less lime than eastern outcrops, apparently deposited in quiet, perhaps lagoonal, waters at a shallower depth than localities on the Chipola River (Vokes, 1989). Moving downstream on Tenmile Creek the beds are more calcareous and paleodepth is inferred to be about 20–30 m. The Farley Creek facies is a bivalve-rich, miliolid limesand with abundant calcareous algae and coral-heads (Vokes, 1989). No true reefs are developed and the facies is inferred to be shallow back-reef.

The Chipola Formation accumulated during the last truly tropical climatic conditions of the Miocene, the overlying Shoal River Formation representing a more temperate climate. It was also deposited during the last major transgression in the Western Atlantic before sea level fell due to the onset of late Miocene glaciation.

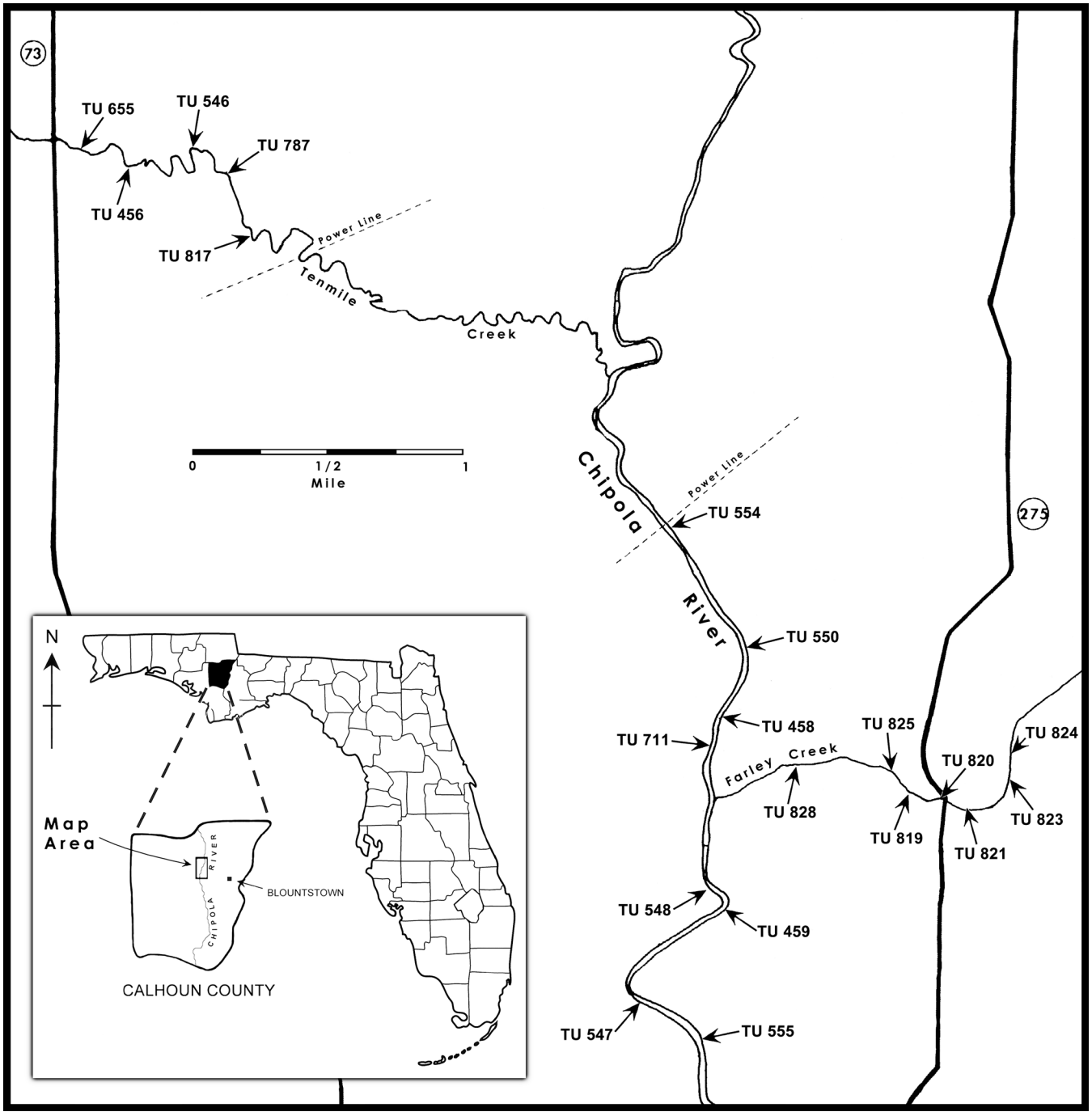

Figure 1. Collecting localities in Calhoun County, Florida, USA. Detailed information on TU localities can be found in the Appendix.

METHODS AND MATERIALS

Material from museum collections, including types, as well as newly collected specimens, were used for this study. Museum materials include: (1) specimens from R. J. Scolaro's collection, formerly housed at the Virginia Museum of Natural History, Martinsville (VMNH), and now housed at the Florida Museum of Natural History (FLMNH), University of Florida, Gainesville, described and figured in Scolaro's (1968) Ph.D. dissertation; (2) sediment samples collected by Scolaro and subsequently donated to the National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH), and the Natural History Museum, London, UK (NHMUK); (3) specimens collected by various researchers over the last 50 years and deposited at the FLMNH [e.g., the collections of Emily H. Vokes and Harold E. Vokes, Tulane University (TU), New Orleans, LA]. All the samples were collected as bulk from exposures along the banks of the Chipola River, Tenmile Creek, and Farley Creek (Fig. 1). Locality reference numbers cited herein represent collecting sites recorded in the Department of Geology at Tulane University (TU) (see Appendix for locality data). Also, new samples were collected by two of us (EDM and RWP) in March 2016 from two exposures along Farley Creek (30.46586, -85.14812; WGS84) just southeast of TU Loc. 825 (Fig. 1).

For further comparison, syntype specimens were studied of the Recent species *Margaretta buski* Harmer, 1957, and *Pleuromucrum gorgonensis* (Hastings, 1930). These are NHMUK 87.12.9.439, from the Challenger Expedition (1873−6), St. Paul's Rocks, and NHMUK 1929.4.26.137, from Gorgona, respectively. Through the kindness of JoAnn Sanner (USNM) we have been able to obtain new SEM images of the type material of *Thalamoporella biperforata* Canu and Bassler, 1923 (syntype USNM 68483A), and *Leiosella edax* Canu and Bassler, 1923 (syntype USNM 68636).

Scanning electron microscopy (SEM) was conducted on uncoated specimens using a low-vacuum scanning electron microscope (LEO VP-1455) at the NHMUK. Zooidal measurements were taken from SEM images using the image-processing program ImageJ. Each measurement is given in the text as the mean value +/– the standard deviation, observed range, number of specimens used and total number of measurements made (the latter two values enclosed in parentheses).

Measurements on cyclostomes use the following abbreviations: AD, diameter of equidimensional apertures; ADmin, minimum diameter of apertures; ADmax, maximum diameter of apertures; FWL, frontal wall length of single zooid; GL, gonozooid length; GW, gonozooid width. Measurements on cheilostomes use the following abbreviations: AvL, avicularium length; AvW, avicularium width; AvOL, avicularium opesia length; AvOW, avicularium opesia width; KL, kenozooid length; KW, kenozooid width; KOL, kenozooid opesia length; KOW, kenozooid opesia width; OL, orifice length; OW, orifice width; OL*, orifice length of maternal zooids; OW*, orifice width of maternal zooids; OvL, ovicell length; OvW, ovicell width; ZcL, zooeciule length; ZcW, zooeciule width; ZL, autozooid length; ZW, autozooid width.

This paper describes 60 bryozoan species, comprising five cyclostomes and 55 cheilostomes (20 anascan- and 35 ascophoran-grade cheilostomes). Twenty-five of the cheilostomes are described as new species; the remainder are either established species or identifiable only to the genus or family-level owing to preservational deficiencies. All figured and type specimens are registered in the paleontological collections of the FLMNH (acronym UF) or the NHMUK.

SYSTEMATIC PALEONTOLOGY

Order CYCLOSTOMATA BUSK, 1852
Suborder TUBULIPORINA MILNE EDWARDS, 1838
Family TUBULIPORIDAE JOHNSTON, 1838
Genus *TUBULIPORA* LAMARCK, 1816
TUBULIPORA SP.

Plagioecia sp. Scolaro (1968), p. 181, pl. 20, fig. 2.

Figured material.—UF 265688 (Fig. 2A–B), TU Loc. 458.

Description.—Colony small, encrusting, lobate (Fig. 2A). Autozooecial tubes diverging

from the colony axis, defined by narrow furrows, elongate, frontal wall convex, marked by thick undulose wrinkles and pierced by sparse small, teardrop-shaped pseudopores (Fig. 2B). Autozooidal apertures arranged in connate patches of 2–4 apertures, oval (Fig. 2B). Gonozooid large, ca. 475 μm long by 730 μm wide, with margins indented by neighbouring autozooids; the transversely ovoidal brood chamber roof slightly bulbous, with teardrop-shaped pseudopores, regularly spaced, more numerous and readily visible than those of the autozooids (Fig. 2B). Ooeciopore terminal, subcircular, smaller than an autozooidal aperture, ca. 80 μm in diameter; ooeciostome simple, short.

Measurements.—ADmin 96±6, 85–106 (1, 10); ADmax 125±35, 79–181 (1, 10).

Remarks.—Two incomplete specimens of *Tubulipora* sp. were found by Scolaro (1968), the specimen figured here from TU Loc. 458 at Chipola River, and an additional specimen from TU Loc. 824 at Farley Creek. The patches of connate apertures along with the lobate colony-form suggest this species fits better in *Tubulipora* rather than in *Plagioecia*. However, the scarcity of material and the poor preservation of available specimens precludes identification at species level.

Family DIAPEROECIIDAE CANU, 1918a
Genus NEVIANIPORA BORG, 1944
NEVIANIPORA SP.

Diaperoecia floridana Scolaro (1968), p. 179, pl. 19, figs. 1, 2.

Figured material.—NHMUK PI BZ 7811 (Fig. 2C–D, F–G), TU Loc. 458; NHMUK PI BZ 7812 (Fig. 2E), TU Loc. 787.

Description.—Colony encrusting or erect, dichomotously branched, erect branches semi-circular in cross-section, ca. 0.50–0.85 mm wide. Frontal surface convex, bearing about 3–5 series of autozooids marked by thick undulose wrinkles and with sparse small, circular pseudopores (Fig. 2C); dorsal surface flattened or concave, with similar undulose wrinkles and pseudopores as the frontal side (Fig. 2F–G). Autozooecial tubes opening only on the frontal side, defined by narrow furrows (Fig. 2C). Autozooidal apertures circular. Gonozooid large, ca. 1.1–1.3 mm long by 0.6–0.8 mm wide, variable in shape from sac-shaped to bilobate when placed at branch bifurcation (Fig. 2C, E), enclosing several autozooids; brood chamber roof bulbous, with circular pseudopores, regularly spaced, more numerous than those of the autozooids (Fig. 2C, E). Ooeciopore subcircular, smaller than an autozooidal aperture, ca. 90 μm in diameter (Fig. 2D); ooeciostome simple, short; the placement varies from subcentral to terminal.

Measurements.—FWL 404±20, 374–437 (1, 10); AD 136±17, 106–153 (1, 10).

Remarks.—This species occurs abundantly at nearly all of the sampled localities, although specimens consist solely of poorly preserved broken branches. It has been assigned to *Nevianipora* on account of the flattened shape of the branches with autozooids opening only on the frontal side. Species-level identification is difficult. The closest comparison is with the Recent species *Nevianipora floridana* (Osburn, 1940) and *N. rugosa* (Osburn, 1940). *Nevianipora floridana*, known from Gulf of Mexico and the Straits of Florida, shows a similar variability in the width of the branches (0.7–1.0 mm), while the gonozooid is much larger (2.5 mm long by 0.9 mm wide). *Nevianipora rugosa*, reported from Puerto Rico, is similar to the Chipola Formation species in having dichotomously branched colonies, and variable gonozooid shape; however, it differs in having a flared, trumpet-shaped ooeciostome.

Suborder ARTICULATA BUSK, 1859
Family CRISIIDAE JOHNSTON, 1847
Genus *CRISIA* LAMOUROUX, 1812
CRISIA CF. *CAROLINA* WINSTON, 2005

Crisia ramosa Scolaro (1968), p. 177, pl. 18, figs. 1, 2.

Figured material.—NHMUK PI BZ 7813 (Fig. 3), TU Loc. 458.

Description.—Colony erect, branched, jointed. Branches biserial, slender, slightly curved, 200–300 μm wide (Fig. 3A). Autozooids alternating, tubular, elongate, connected except at their tips, which are bent away from the branch axis. Frontal surface with sparse slit-like pseudopores. Autozooidal apertures subcircular to elliptical, facing laterally. Gonozooid pear-shaped, narrow proximally, dilated distally, flat-topped (Fig. 3B–C); surface densely covered by slit-like pseudopores.

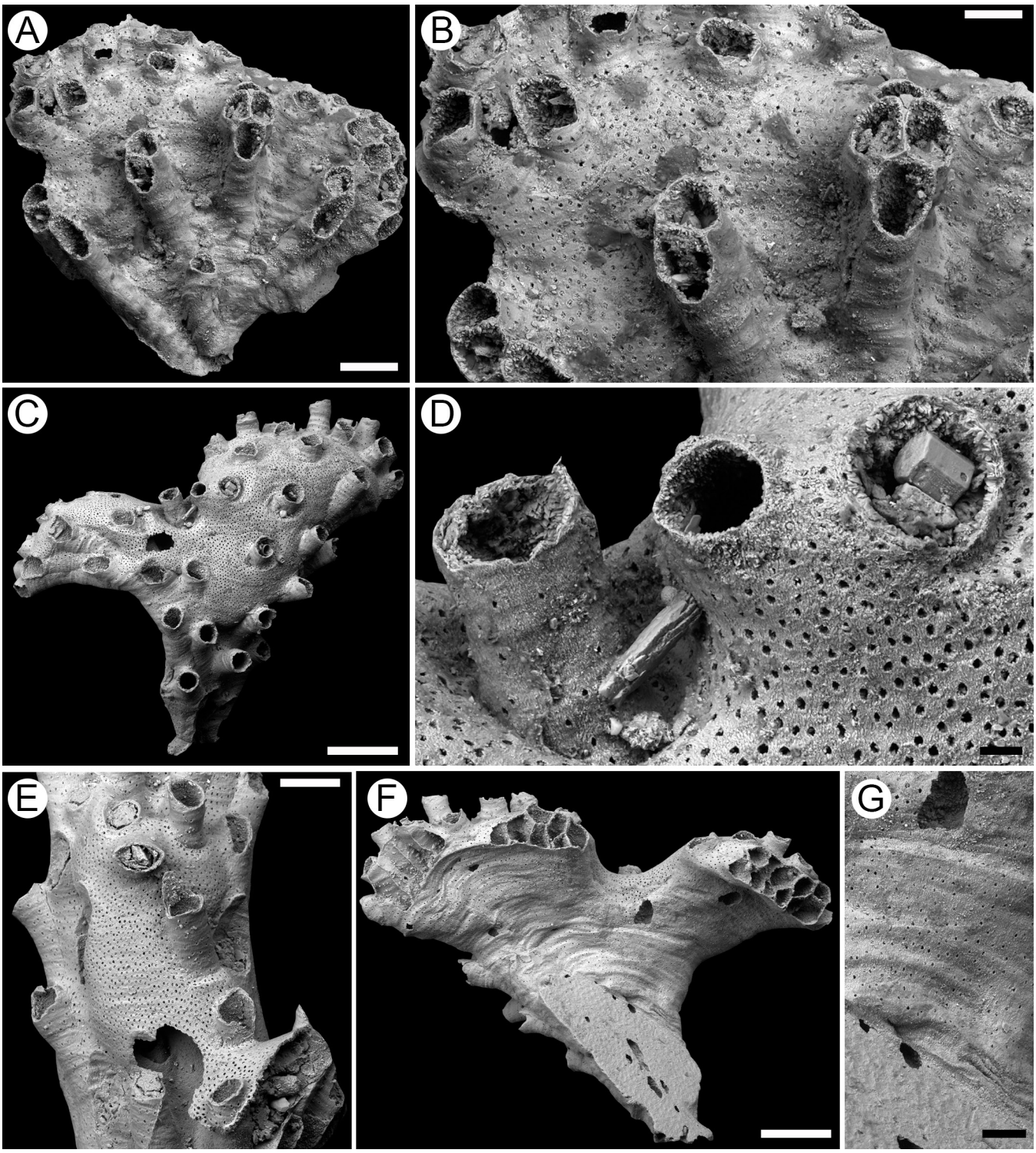

Figure 2. A, B. *Tubulipora* sp., UF 265688. **A.** general view of the colony; **B.** close-up of a gonozooid. **C, D.** *Nevianipora* sp., NHMUK PI BZ 7811. **C.** frontal view of a colony fragment with bilobate gonozooid; **D.** close-up of the ooeciopore. **E.** *Nevianipora* sp., NHMUK PI BZ 7812, close-up of a sac-shaped gonozooid. **F, G.** *Nevianipora* sp., NHMUK PI BZ 7811. **F.** dorsal view of the colony fragment in C; note the encrusting portion; **G.** close-up of the dorsal side showing the marked undulose wrinkles and pseudopores. Scale bars: A, E = 200 μm; B, G = 100 μm; C = 500 μm; D = 40 μm; F = 400 μm.

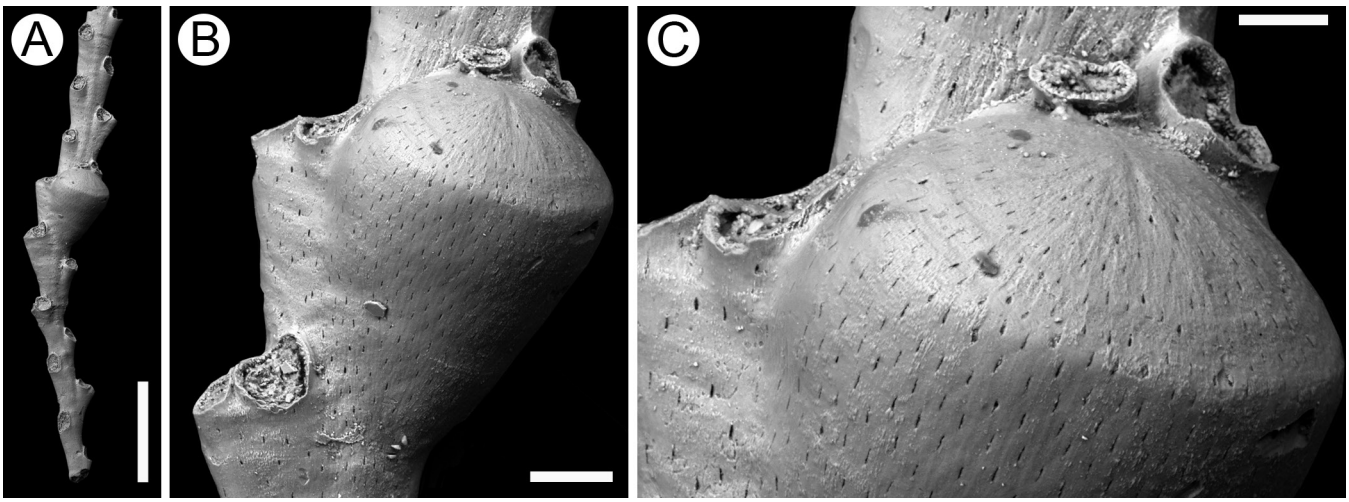

Figure 3. *Crisia* cf. *carolina* Winston, 2005, NHMUK PI BZ 7813. **A.** frontal view of a fertile internode; **B.** close-up of a gonozooid; **C.** close-up of an ooeciostome. Scale bars: A = 500 μm; B = 100 μm; C = 50 μm.

Ooeciostome short, opening in a flared, trasversely oval ooeciopore, about 20 μm long by 60 μm wide (Fig. 3C).

Measurements.—FWL 404±41, 328–469 (5, 18); AD 97±11, 83–118 (5, 18); GL 474±19, 447–491 (5, 5); GW 341±37, 283–382 (5, 5).

Remarks.—Internodes of *Crisia* cf. *carolina* are scattered abundantly in muddy-silty sediments from Chipola River and Tenmile Creek localities. The Chipola material resembles the Recent Western Atlantic species in having slender internodes and in the shape and size of the gonozooid. It differs in having consistently shorter autozooids (FWL 328–469 vs. 522–936 μm in Recent specimens). *Crisia* cf. *carolina* also shows some similarities with *C. pseudosolena* (Marcus, 1937), notably the sometimes flat-topped gonozooid, but this Brazilian species has a squatter gonozooid (see Ramalho et al., 2009:fig. 2F).

Suborder CANCELLATA GREGORY, 1896
Family HORNERIDAE SMITT, 1867
Genus *HORNERA* LAMOUROUX, 1821
HORNERA SP.

Hornera sp. Scolaro (1968), p. 182, pl. 20, fig. 1a, b.

Figured material.—UF 245590a, b (Fig. 4A–B), TU Loc. 547.

Description.—Colony erect, rigid, branched. Seven broken-off branches radiating from a slightly dome-shaped base (Fig. 4A). Branches subcircular in transverse section, robust. Autozooidal apertures closely spaced, rounded, separated by lozenge-shaped kenozooids ('cancelli'), ca. 40–60 μm long. Dorsal side convex, with pronounced longitudinal nervi, occasionally anastomosing, and sulci with oval 'cancelli' (Fig. 4B). Gonozooid not observed.

Measurements.—AD 109±7, 100–120 (2, 10).

Remarks.—Unfortunately, only two thickened basal parts were available for study, precluding a more exact identification. Scolaro (1968) described this species based on a single specimen found in the lower beds at Tenmile Creek (TU Loc. 817), which we were unable to locate. The specimens described and figured here were collected by H. Vokes in 1962 at Chipola River (TU Loc. 547).

Suborder RECTANGULATA WATERS, 1887
Family LICHENOPORIDAE SMITT, 1867
Genus *PATINELLA* GRAY, 1848
PATINELLA SP.

Lichenopora sp. Scolaro (1968), p. 184, pl. 20, fig. 3.

Figured material.—UF 265602a (Fig. 4C–D), b (Fig. 4E), c (Fig. 4F–G), TU Loc. 820.

Description.—Colony encrusting, simple, circular to elliptical in outline, flat to low domal, small in size, 0.9–2.2 mm in diameter including marginal border of basal lamina (Fig. 4C, E–F),

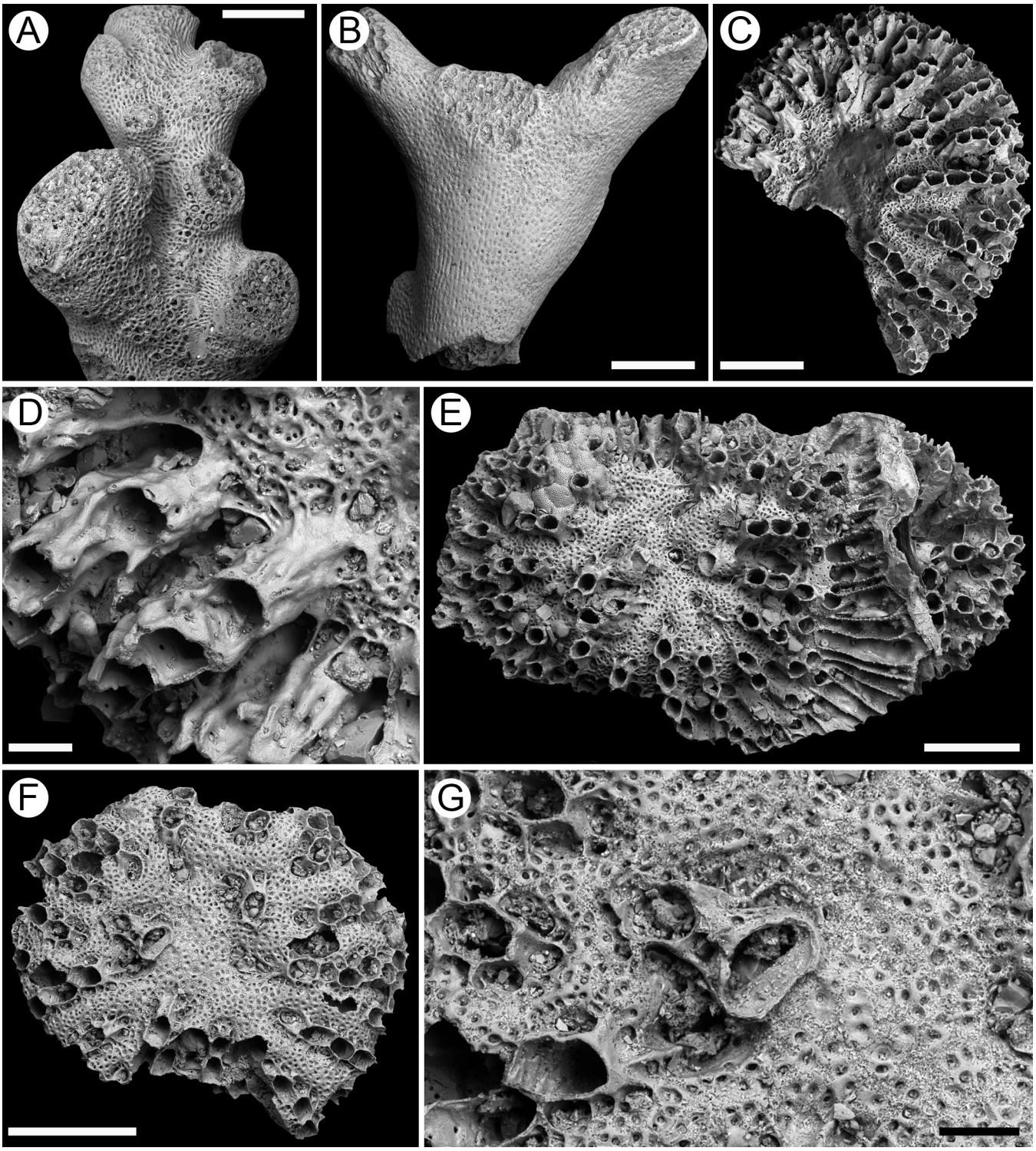

Figure 4. A, B. *Hornera* sp., UF 245590a, b. **A.** general view of the frontal side of a colony base; **B.** general view of the dorsal side of a colony base. **C–G** *Patinella* sp., UF 265602a–c. **C.** general view of a colony with autozooecial tubes arranged in fascicles of up to eight series of apertures; **D.** close-up of autozooecial peristomes with ridges protruding into spinose processes surrounding the aperture; **E.** general view of a fertile colony with well-developed marginal basal lamina; **F.** general view of a fertile colony with ooeciostome and ooeciopore; **G.** close-up of the flared ooeciostome. Scale bars: A, B = 1 mm; C, E, F = 500 μm; D, G = 100 μm.

which is sometimes upturned, granular (Fig. 4E). Autozooids arranged in well-defined alternating radial series of 3–8 autozooecial tubes (Fig. 4C–F); apertures connate, oval; peristomes short, up to ca. 200 μm above the colony surface, marked by ridges protruding as spinose processes around the aperture, and furrows with scattered circular pores (Fig. 4D). Adjacent autozooidal rows separated by alveoli. Infertile colonies with a flat central part occupied by autozooidal rows. Brood chambers occupying the entire central part of the colony, sometimes extending into interradial areas, with a porous frontal wall covered by polygonal ridges (Fig. 4E–F). Ooeciostome adnate to an autozooecial peristome, flared (Fig. 4F–G); ooeciopore oval, ca. 60–90 μm long by 105–150 μm wide.

Measurements.—ADmin 83±6, 75–90 (4, 20); ADmax 115±4, 110–120 (4, 20).

Remarks.—*Crisia* cf. *carolina* and *Patinella* sp. are the two most common cyclostome bryozoans present in the Chipola Formation. Several fertile and infertile specimens, likely to belong to a single species based on general appearance of the colony and measurements, were available for study from Farley Creek localities. The attribution to the genus *Patinella* rather than *Disporella* is based on the connate radial arrangement of the autozooids and the flared shape of the ooeciostome (Hayward and Ryland, 1985; note that *Patinella* is referred as *Lichenopora* in this paper).

Order CHEILOSTOMATA BUSK, 1852
Superfamily MEMBRANIPOROIDEA BUSK, 1852
Family MEMBRANIPORIDAE BUSK, 1852
Genus *ACANTHODESIA* CANU and BASSLER, 1919
ACANTHODESIA SP.

Membranipora tenuis Scolaro (1968), p. 69, pl. 1, figs. 1a, 1b.

Figured material.—NHMUK PI BZ 7814 (Fig. 5), (30.46586, -85.14812; WGS84), Farley Creek, USA, Florida, Calhoun County.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 5A). Autozooids distinct, boundaries marked by a fine fissure, arranged in parallel rows, subrectangular with a gently convex distal margin, elongate (mean L/W 1.84). Mural rim salient distally but indistinct elsewhere, narrow, pustulose (Fig. 5B). Gymnocyst absent. Cryptocyst narrow, broader proximally where it occasionally forms a shallow planar shelf, sloping steeply inwards, pustulose with granules aligned in radial rows projecting into the opesia (Fig. 5B–C). Opesia occupying nearly all frontal surface, ovoidal (Fig. 5B). Kenozooids not seen.

Measurements.—ZL 420±38, 370–485 (1, 6); ZW 229±10, 213–239 (1, 6); OL 313±16, 285–327 (1, 6); OW 147±10, 134–157 (1, 6).

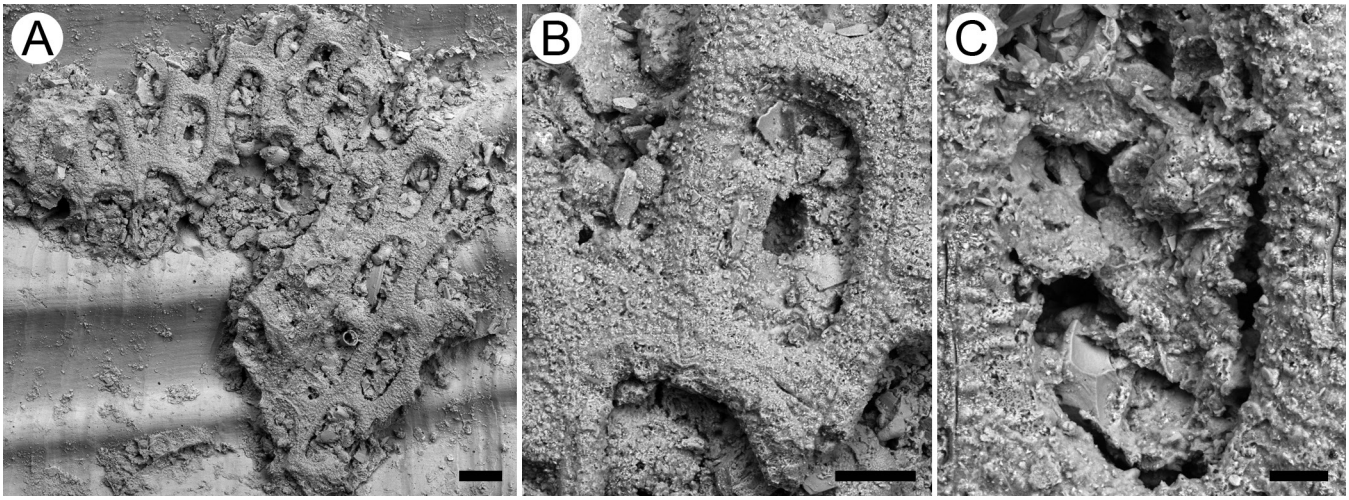

Figure 5. *Acanthodesia* sp., NHMUK PI BZ 7814. **A.** general view of the colony; **B.** close-up of an autozooid; **C.** close-up of an opesial margin. Scale bars: A = 200 μm; B = 100 μm; C = 40 μm.

Remarks.—Although reported as moderately abundant at Tenmile Creek and less common at the Chipola River and Farley Creek localities by Scolaro (1968), no specimens were found in his collection, while a single, poorly preserved colony was found encrusting a mollusk shell fragment in newly collected samples. Inadequate preservation and lack of diagnostic morphological characters prevent species identification. Its assignment to *Acanthodesia* Canu and Bassler, 1919 rather than to *Biflustra* d'Orbigny, 1852 is mainly based on the colony form, *Acanthodesia* having generally encrusting colonies rather than erect vincularian as in the type species of *Biflustra* (see Taylor and Tan, 2015).

Superfamily CALLOPOROIDEA NORMAN, 1903

Family CALLOPORIDAE NORMAN, 1903

Genus *CRANOSINA* CANU and BASSLER, 1933

CRANOSINA SP.

Figured material.—UF 265611 (Fig. 6), TU Loc. 821.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 6A). Autozooids distinct with deep interzooidal furrows, quincuncially arranged, lozenge-shaped with a broad convex distal margin, slightly longer than wide (mean L/W 1.17). Gymnocyst absent. Cryptocyst sloping steeply inwards, broader laterally, tapering proximally, extremely reduced distally, surrounded by a smooth to finely granular margin, becoming more coarsely granular inwardly with granules aligned radially (Fig. 6B). Opesia longer than wide, occupying almost the entire area of the frontal wall, elliptical to egg-shaped (Fig. 6B, D). Avicularia situated at the distal end of each autozooid, transversely teardrop-shaped, slightly asymmetrical (Fig. 6B); gymnocyst absent, cryptocyst smooth or finely granular; rostrum rounded, laterally directed; condyles or pivotal bar not seen. Ovicells not observed. Intramural buds present (Fig. 6C). Three communication pores are visible in the distal vertical walls, one small, median circular pore flanked by two larger pores (Fig. 6D).

Measurements.—ZL 432±40, 383–514 (1, 10); ZW 369±41, 310–464 (1, 10); OL 322±21, 287–355 (1, 10); OW 241±26, 203–278 (1, 10); AvL 146±13, 124–172 (1, 10); AvW 79±13, 60–110 (1, 10).

Remarks.—There is no mention of this species in Scolaro (1968), probably because only a single, poorly preserved colony was available to him. A further fossil species, tentatively referred to *Cranosina*, *C.*? *laxa* (Canu and Bassler, 1917), was recorded at Chipola River from Eocene strata. It differs from the Miocene species in having

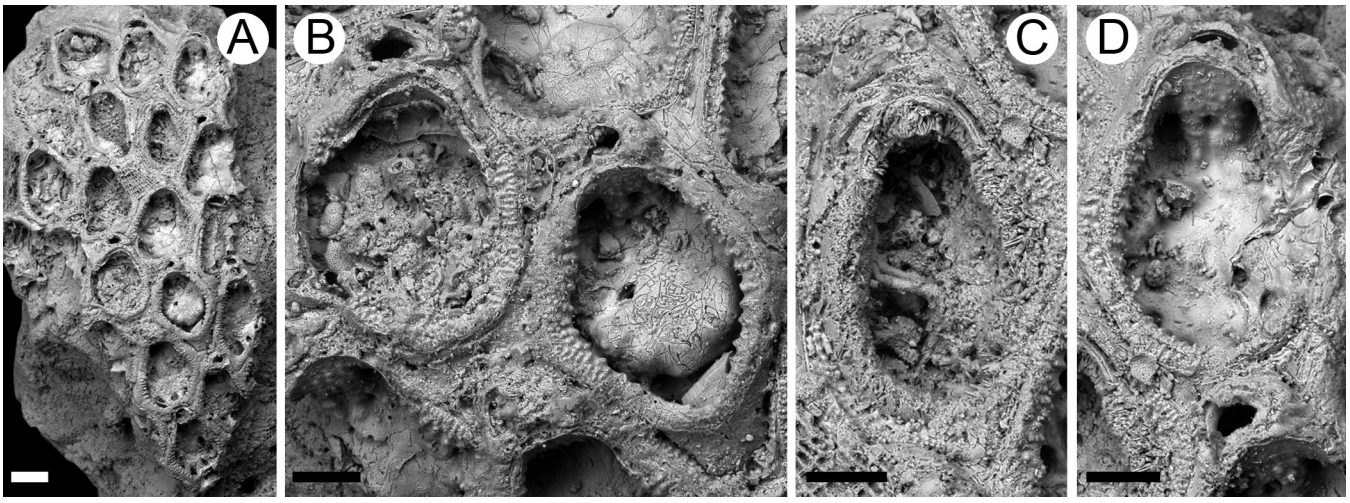

Figure 6. *Cranosina* sp., UF 265611. **A.** general view of the colony; **B.** close-up of two autozooids and associated avicularia; **C.** close-up of an autozooid with intramural bud; **D.** close-up of an autozooid with communication pores visible in the distal vertical walls. Scale bars: A = 200 μm; B, C, D = 100 μm.

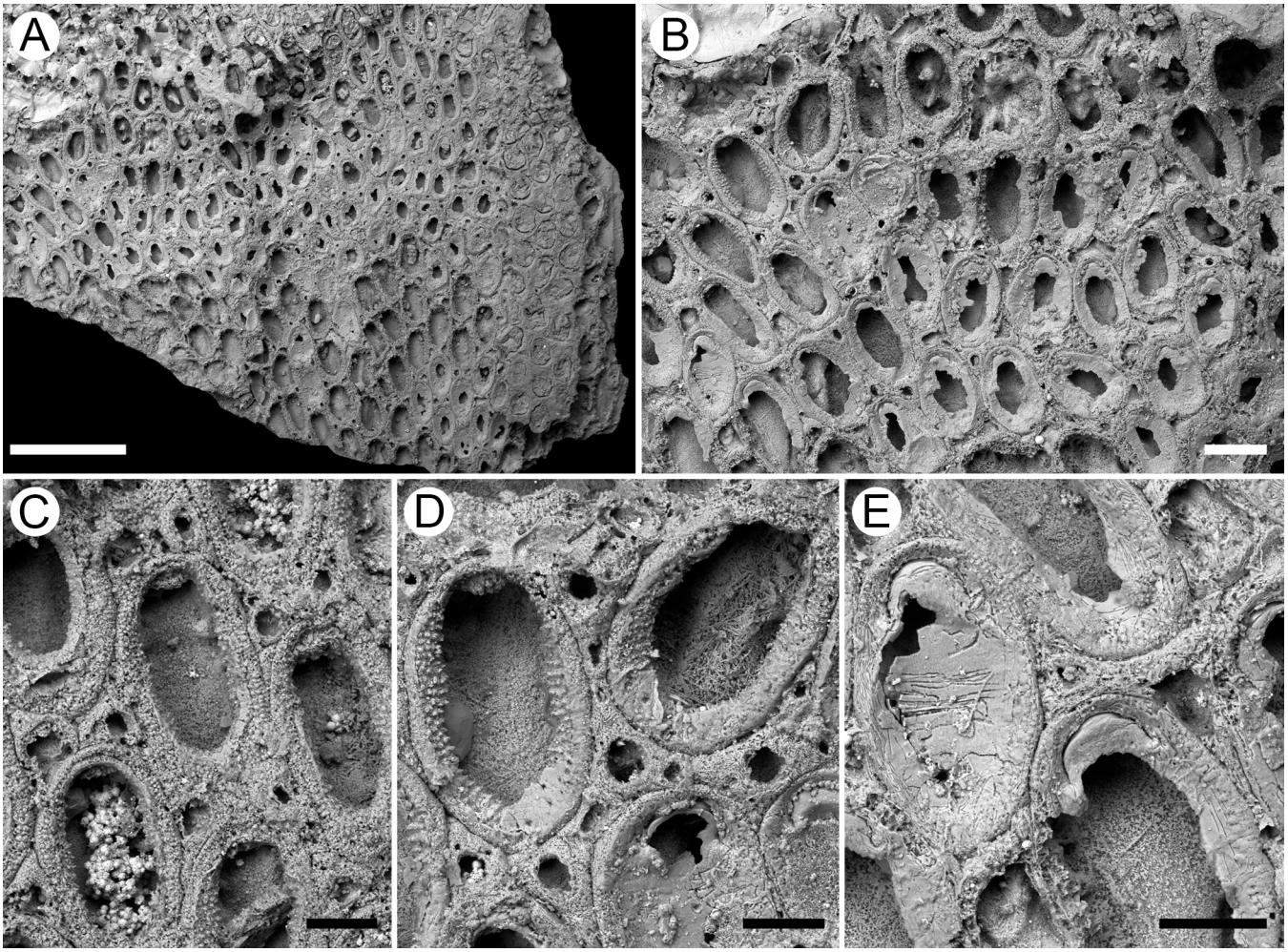

Figure 7. *Akatopora leucocypha* (Marcus, 1937), UF 265767. **A.** general view of the colony; **B.** group of autozooids and kenozooids; **C.** close-up of autozooids and triangular kenozooids; **D.** tubular kenozooids between the autozooids; **E.** autozooids with closure plates and opercular scars. Scale bars: A = 1 mm; B = 200 μm; C, D, E = 100 μm.

an extremely reduced cryptocyst and triangular avicularia.

Family ANTROPORIDAE VIGNEAUX, 1949
Genus *AKATOPORA* DAVIS, 1934
AKATOPORA LEUCOCYPHA (MARCUS, 1937)

Callopora dumerilii Canu and Bassler (1923), p. 40, pl. 12, fig. 12.

Crassimarginatella leucocypha Marcus (1937), p. 46, pl. 8, fig. 20A, pl. 9, fig. 20B–C; Cheetham and Sandberg (1964), p. 1017, text-fig. 4; Scolaro (1968), p. 73, pl. 1, fig. 3A–B.

Antropora leucocypha Winston and Håkansson (1986), p. 9, figs. 14–16.

Akatopora leucocypha Winston and Vieira (2013), p. 110, fig. 7; Winston (2016), p. 20, fig. 9.

Figured material.—UF 265767 (Fig. 7), TU Loc. 655.

Description.—Colony encrusting, multiserial, uni- or multilaminar (Fig. 7A). Autozooids distinct with shallow interzooidal furrows, quincuncially arranged, elliptical (Fig. 7B), longer than wide (mean L/W 1. 71). A smooth, narrow gymnocyst edging a broader, reduced distally, beaded crenulated, inwardly sloping cryptocyst; granules of the cryptocyst aligned in rows. Opesia irregularly oval or elliptical, occupying almost the entire frontal surface. Single or paired triangular kenozooids, sometimes fused, placed proximally to each autozooid, sharing with them a similarly

patterned cryptocyst (Fig. 7C); additional tubular kenozooids occurring between zooids (Fig. 7D). Kenozooidal aperture placed centrally, subcircular, small, 25–45 μm in diameter. Intramural buds and closure plates showing opercular scars are common (Fig. 7C, E). Avicularia and ovicells not observed.

Measurements.—ZL 338±27, 293–385 (1, 20); ZW 199±15, 170–224 (1, 20); OL 246±20, 202–287 (1, 20); OW 124±16, 94–162 (1, 20); KL 104±17, 78–130 (1, 15); KW 97±16, 77–128 (1, 15).

Remarks.—*Akatopora leucocypha* (Marcus, 1937) apparently ranges from the early Miocene to Recent. Canu and Bassler (1923:40) first reported the species from the fossil record, describing a specimen from the Chipola River doubtfully as *Callopora dumerilii* (Audouin, 1826). Subsequently, Cheetham and Sandberg (1964) reported *A. leucocypha* from Quaternary mudlumps at the mouth of the Mississippi River on the Louisiana coast. Scolaro (1968) reported this species as moderately abundant at numerous localities along Tenmile Creek and in the lower beds on the Chipola River, also noting a single colony from Farley Creek. However, only a single specimen from Tenmile Creek was found in Scolaro's collection during the current study. The distribution of *A. leucocypha* at the present day includes the Gulf of Mexico, from 9–110 m depth, the Caribbean, from the shore to 42 m, and Brazil at 20 m depth. Floridan specimens from *Oculina* reefs (Winston, 2016), collected at 70–90 m depth, have larger zooids (288–486 μm long by 216–360 μm wide) than Brazilian specimens (306–396 μm long by 180–270 μm wide) (Winston and Vieira, 2013), while Capron Shoal specimens (Winston and Håkansson, 1986) have the smallest zooids (252–306 μm long by 180–234 μm wide). Autozooidal size-range of the Chipola fossil specimen studied here falls within the range of measurements given for Recent colonies.

Genus *ANTROPORA* NORMAN, 1903
ANTROPORA PARVICAPITATA (CANU and BASSLER, 1923)

Membrendoecium parvicapitatum Canu and Bassler (1923), p. 36, pl. 12, figs. 1, 2.

Hincksina parvicapitatum Scolaro (1968), p. 76, pl. 1, fig. 2.

Antropora parvicapitatum Taylor and Foster (1998), p. 66, figs. 5, 6.

Figured material.—UF 189094 (Fig. 8), TU Loc. 821.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 8A). Autozooids distinct with deep interzooidal furrows, quincuncially arranged, oval to elliptical, longer than wide (mean L/W 1.69). Slender, club-shaped zooids (mean L/W 2.08), with an extensive gymnocyst placed at row bifurcations (Fig. 8B). Gymnocyst most extensive proximally, tapering laterally, reduced distally, occasionally including a single median tubercle (Fig. 8B–C); cryptocyst pustulose, generally narrow, slightly broader and sloping inwards proximally, reduced to a thin, raised rim outlining the opesia distally (Fig. 8C–D). Opesia occupying almost the entire frontal surface, oval to elliptical (Fig. 8B–C). Ovicell endozooidal, small, barely salient, cap-like, visible as a constriction of the distal portion of the zooid, smooth (Fig. 8D). Avicularia not seen.

Measurements.—ZL 342±41, 286–452 (1, 20); ZW 202±18, 165–229 (1, 20); OL 253±29, 187–312 (1, 20); OW 156±16, 125–186 (1, 20).

Remarks.—The type specimen of this rare species was reported by Canu and Bassler (1923) from the Miocene Choctawhatchee Marl cropping out at Ocklocknee River, near the city of Tallahassee in Florida (interpreted here as the late Pliocene Jackson Bluff Formation). Further occurrences were reported from the late Pliocene Bowden shell bed, Bowden Formation in Jamaica by Canu and Bassler (1923) and Taylor and Foster (1998). Canu and Bassler's (1923) original description pointed out the rare occurrence of small pointed interzooidal avicularia. Taylor and Foster (1998) interpreted the small polymorphic zooids found between the autozooids as kenozooids rather than avicularia, which are apparently absent in the Bowden material as well as in our Chipola specimen. Poorly preserved oval structures seen in the Chipola specimen (see arrows in Fig. 8B–C) appear similar to the above-mentioned kenozooids. Although *Membrendoecium* was regarded as a synonym of *Antropora* by Bassler (1953), the correct generic attribution of this species remains uncertain owing to the apparent absence of avicularia (Taylor and Foster, 1998).

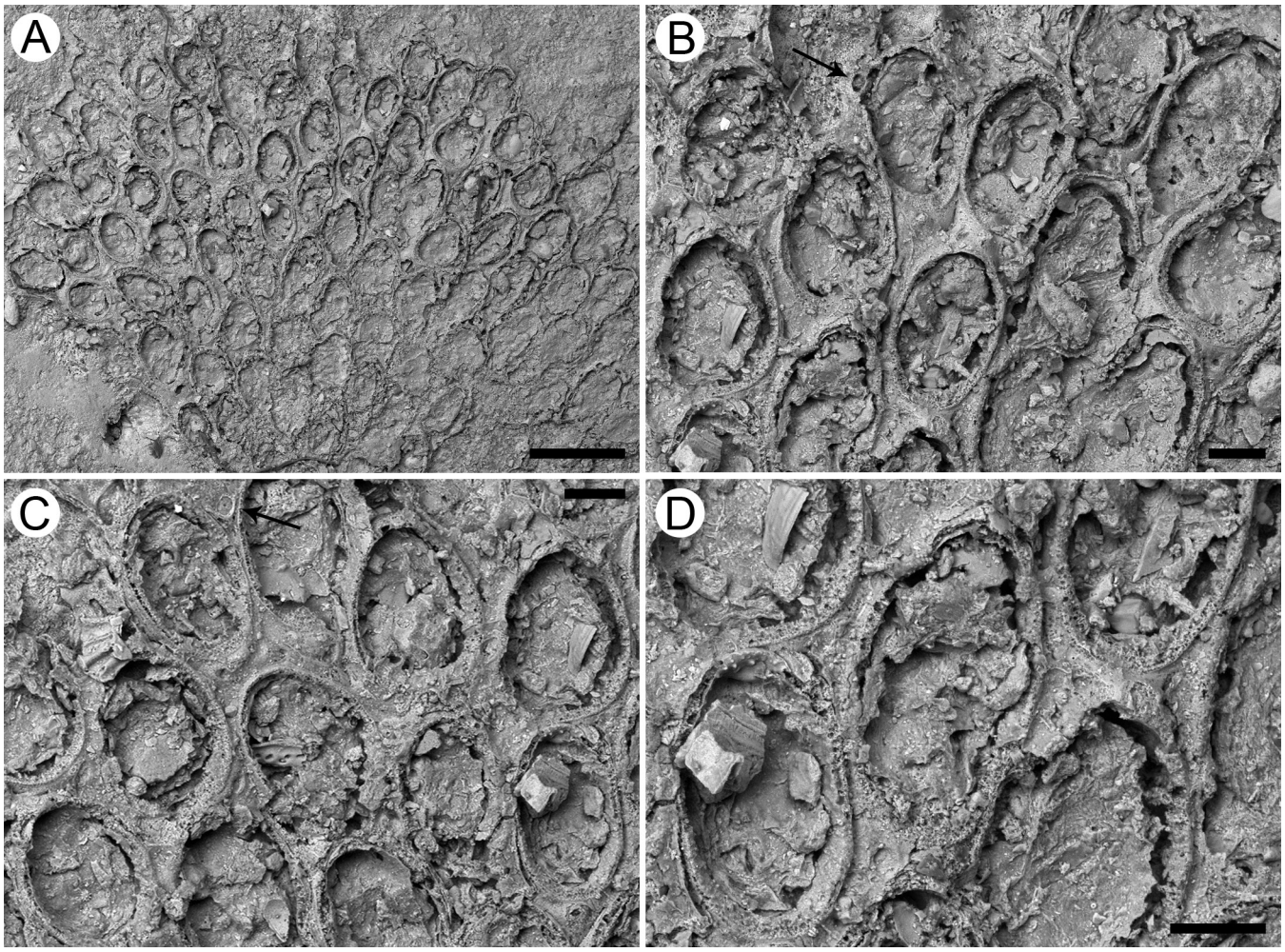

Figure 8. *Antropora parvicapitata* (Canu and Bassler, 1923), UF 189094. **A.** general view of the colony; **B.** group of autozooids with club-shaped zooids at row bifurcation and an oval (kenozooidal?) structure (arrowed); **C.** group of autozooids, one of which shows a median tubercle (bottom right); **D.** close-up of two ovicellate zooids. Scale bars: A = 500 μm; B, C, D = 100 μm.

Family QUADRICELLARIIDAE GORDON, 1984
Genus *NELLIA* BUSK, 1852
NELLIA TENELLA (LAMARCK, 1816)

Cellaria tenella Lamarck (1816), p. 135.

Nellia oculata Busk (1852), p. 18, pl. 64, fig. 6, pl. 65 (bis), fig. 4; Canu and Bassler (1923), p. 55, pl. 2, figs. 5–7; Lagaaij (1959), p. 482, text-fig. 1.

Nellia tenella Cheetham (1966), p. 48, text-fig. 28; Scolaro (1968), p. 95, pl. 3, fig. 5; Winston and Cheetham (1984), p. 257, figs. 1–2; Taylor and Foster (1998), p. 66, fig. 16; Winston et al. (2014), p. 161, fig. 13.

Figured material.—UF 265743 (Fig. 9A–B), UF 265745a (Fig. 9C–D), b (Fig. 9E–F), c (Fig. 9G), d (Fig. 9H), e (Fig. 9I), TU Loc. 823.

Description.—Colony erect, flexible, articulated (Fig. 9A, E–G, I). Internodes straight or slightly curved, quadrangular in cross-section, beginning with a short kenozooid, quadriserial with 4–6 zooids arranged in alternating back-to-back rows (Fig. 9A, G, I). Autozooids distinct with shallow interzooidal furrows, subquadrangular, elongate (mean L/W 2.27) (Fig. 9B–C). Gymnocyst smooth, extensive proximally, narrow laterally; cryptocyst shelf-like proximally, about 50 μm wide, tapering distally. Opesia elliptical to oval, centrally placed; two distolateral, oval, muscle scars, a medial deep pore chamber and two proximal, small, circular pores sometimes visible through the opesia

(Fig. 9C, H). A pair of small, teardrop-shaped avicularia, with complete cross-bar and a circular pore beneath, placed near the proximolateral corner of the gymnocyst of each zooid (Fig. 9D). Ovicells endozooidal, inconspicuous, cap-like with a central, lunate fenestra (Fig. 9B, I).

Measurements.—ZL 429±33, 386–501 (3, 10); ZW 188±21, 157–219 (3, 10); OL 294±27, 249–327 (3, 10); OW 110±13, 94–135 (3, 10); AvL 42±3, 36–45 (3, 8); OvL 55±9, 45–72 (2, 6); OvW 131±10, 122–145 (2, 6).

Remarks.—*Nellia tenella* has been considered as a 'living fossil', ranging from the Maastrichtian to the Recent (Winston and Cheetham, 1984). At the present day, *N. tenella* has a widespread tropical to subtropical distribution, and is found at a broad range of depths (4–1000 m) and salinities. Genetic data from the numerous populations are needed to confirm its 'living fossil' status or to reveal instead a cryptic species complex.

NELLIA WINSTONAE N. SP.

Figured material.—Holotype, UF 265750 (Fig. 10A–C), paratypes, UF 265748 (Fig. 10D), and UF 265749 (Fig. 10E), TU Loc. 823.

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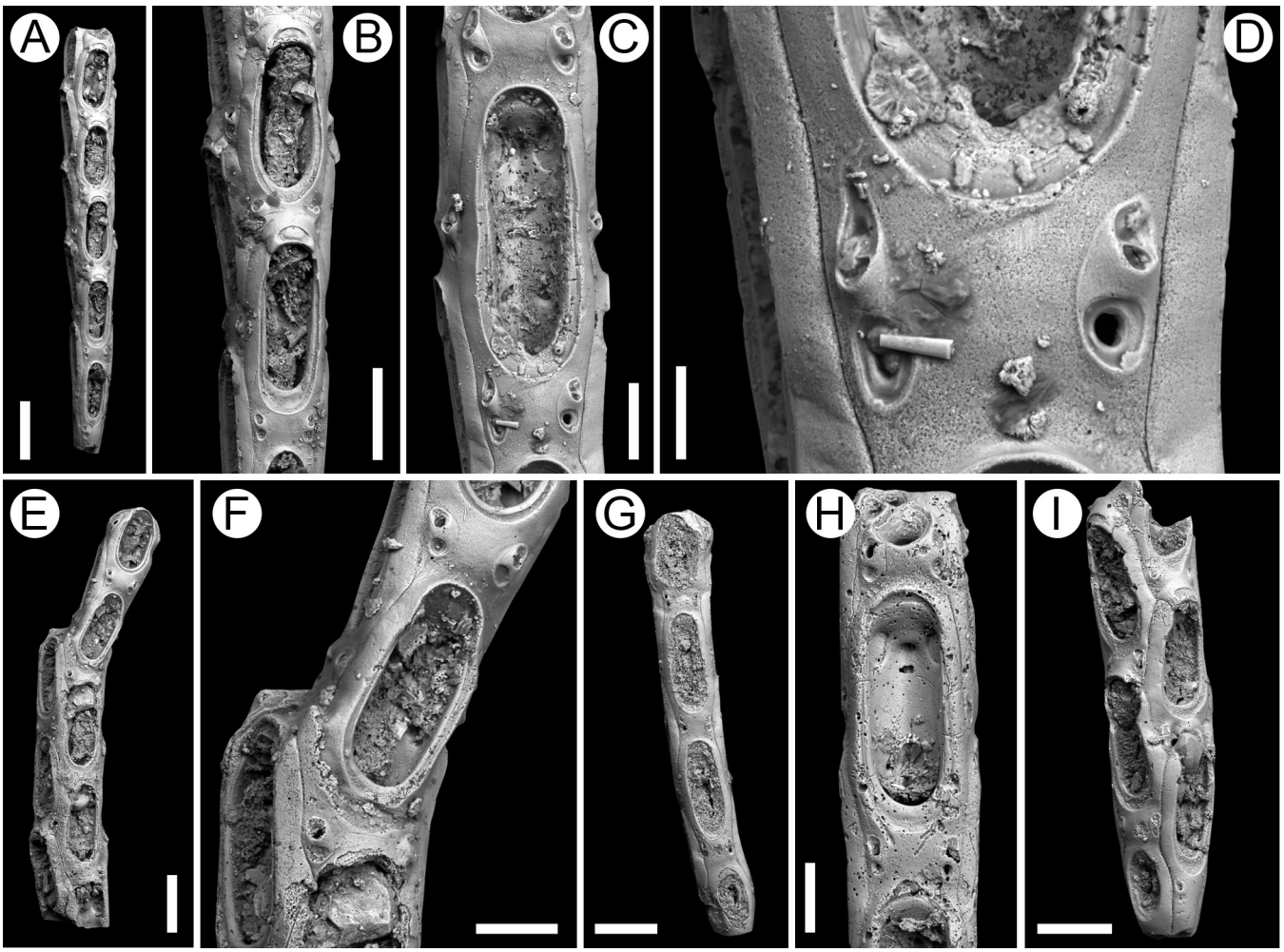

Figure 9. *Nellia tenella* (Lamarck, 1816). **A, B.** UF 265743. **A.** frontal view of an internode; **B.** close-up of two ovicellate zooids. **C–I.** UF 265745a–e. **C, G.** close-ups of autozooids with muscle scars and communication pores visible through the opesia; **D.** close-up of avicularia; **E, F.** frontal view and close-up of an internode with reparative bud; **G.** frontal view of a slightly curved internode; **H.** close-up of an autozooid; **I.** lateral view of an internode with ovicells. Scale bars: A = 300 μm; B, G, I = 200 μm; C, E, F, H = 100 μm; D = 40 μm.

3E00-4B6F-B820-433593087B72.

Etymology.—Named after Judith E. Winston (Smithsonian Marine Station, Fort Pierce, Florida) for her important contribution to the knowledge of Floridan bryozoans.

Diagnosis.—Colony erect, flexible. Autozooids with extensive gymnocyst proximally; cryptocyst narrow. Opesia oval. Paired avicularia, with associated kenozooids, distolaterally flanking each zooid.

Description.—Colony erect, flexible, articulated (Fig. 10A, D–E). Internodes straight or slightly curved, quadrangular in cross-section, tapering at the tips, quadriserial with 2–4 zooids arranged in alternating back-to-back rows, linked by short cylindrical joints (Fig. 10D–E). Autozooids distinct with shallow interzooidal furrows, claviform, elongate (mean L/W 2.17) (Fig. 10B). Gymnocyst smooth, extensive proximally; cryptocyst narrow proximally, tapering laterally. Opesia oval, centrally placed (Fig. 10C). A pair of small, lozenge-shaped avicularia, with complete cross-bar and up-curved rostrum, distolaterally flank each zooid (Fig. 10C); kenozooids associated with avicularia, tulip-shaped in lateral view (Fig. 10C), sometimes with closure plates (Fig. 10E). Ovicells not observed.

Measurements.—ZL 434±37, 375–473 (3, 6); ZW 199±17, 179–228 (3, 6); OL 217±13, 194–232 (3, 6); OW 119±5, 112–125 (3, 6); AvL 70±6, 61–77 (3, 6); AvW 48±5, 39–54 (3, 6).

Remarks.—*Nellia winstonae* n. sp. is similar in the general appearance to *Nellia tenuis* Harmer, 1926, a Recent species, originally described from off Indonesia and the China Sea, and subsequently reported from the Great Barrier Reef, Fiji, Samoa, Mauritius, and Vanuatu, as common in shallow reefal habitats (Tilbrook et al., 2001). The new Chipola Formation species differs from the Recent material in having a more extensive gymnocyst proximally, avicularia more obliquely directed, and a shorter avicularian chamber.

Family CUPULADRIIDAE LAGAAIJ, 1952
Genus *CUPULADRIA* CANU and BASSLER, 1919
CUPULADRIA EXFRAGMINIS HERRERA-CUBILLA ET AL., 2006

Cupuladria biporosa Scolaro (1968), p. 80, pl. 2, figs. 2, 3.
Cupuladria exfragminis Herrera-Cubilla et al. (2006), p. 259, fig. 9.

Figured material.—NHMUK PI BZ 7815 (Fig. 11), TU Loc. 787.

Description.—Colony free-living, discoidal,

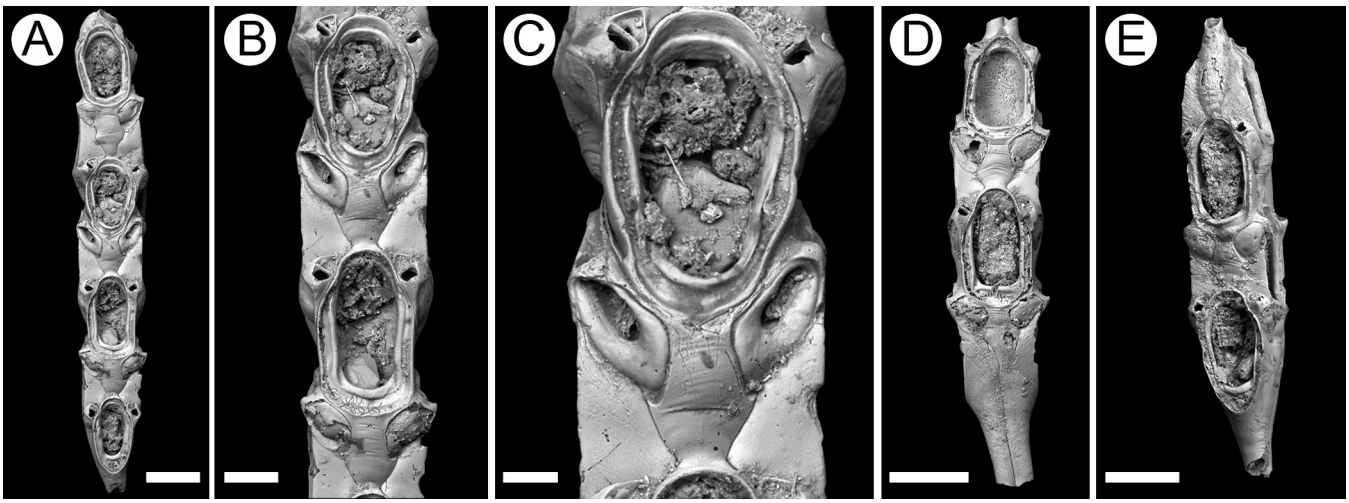

Figure 10. *Nellia winstonae* n. sp. **A–C.** holotype, UF 265750. **A.** frontal view of an internode; **B, C.** close-ups of autozooids, avicularia and associated kenozooids. **D.** paratype, UF 265748, internode with two autozooids and proximal cylindrical joint. **E.** paratype, UF 265749, internode with both proximal and distal joints, and kenozooids with closure plates. Scale bars: A, D, E = 200 μm; B = 100 μm; C = 50 μm.

cup-shaped. Autozooids distinct due to their raised margins, arranged in alternating, radial rows, rhomboidal to rounded pentagonal or hexagonal, longer than wide (mean L/W 1.37) (Fig. 11A–B). Gymnocyst smooth, reduced to a thin rim distally and distolaterally; cryptocyst narrow, developed proximally and laterally, reduced distally, gently sloping inwards, finely beaded. Opesia occupying nearly all frontal surface, elliptical to ovoidal; a variable number of circular, septular pores visible through the opesia. An auriform vibraculum distal to each zooid, asymmetrical, proximolaterally directed, oriented either to left or right, with rounded rostrum and a medial 'lobe' indenting the opesia on one side (Fig. 11B–C). Vicarious avicularia rare, same size as autozooids but with a well-developed gymnocyst and slightly smaller opesia (Fig. 11C, VaV). Dorsal side divided into subrectangular sectors bearing up to 8 depressions, usually 4–6, each having a small, circular pore at the center, sometimes sealed by calcification (Fig. 11D). Closure plates not observed.

Measurements.—ZL 398±53, 309–473 (2, 20); ZW 290±48, 225–424 (2, 20); OL 266±27, 237–335 (2, 20); OW 151±16, 124–189 (2, 20); AvL 158±18, 130–214 (2, 28); AvW 130±9, 112–151 (2, 28).

Remarks.—At localities in the Chipola, *Cupuladria exfragminis* always occurs in association with another free-living species,

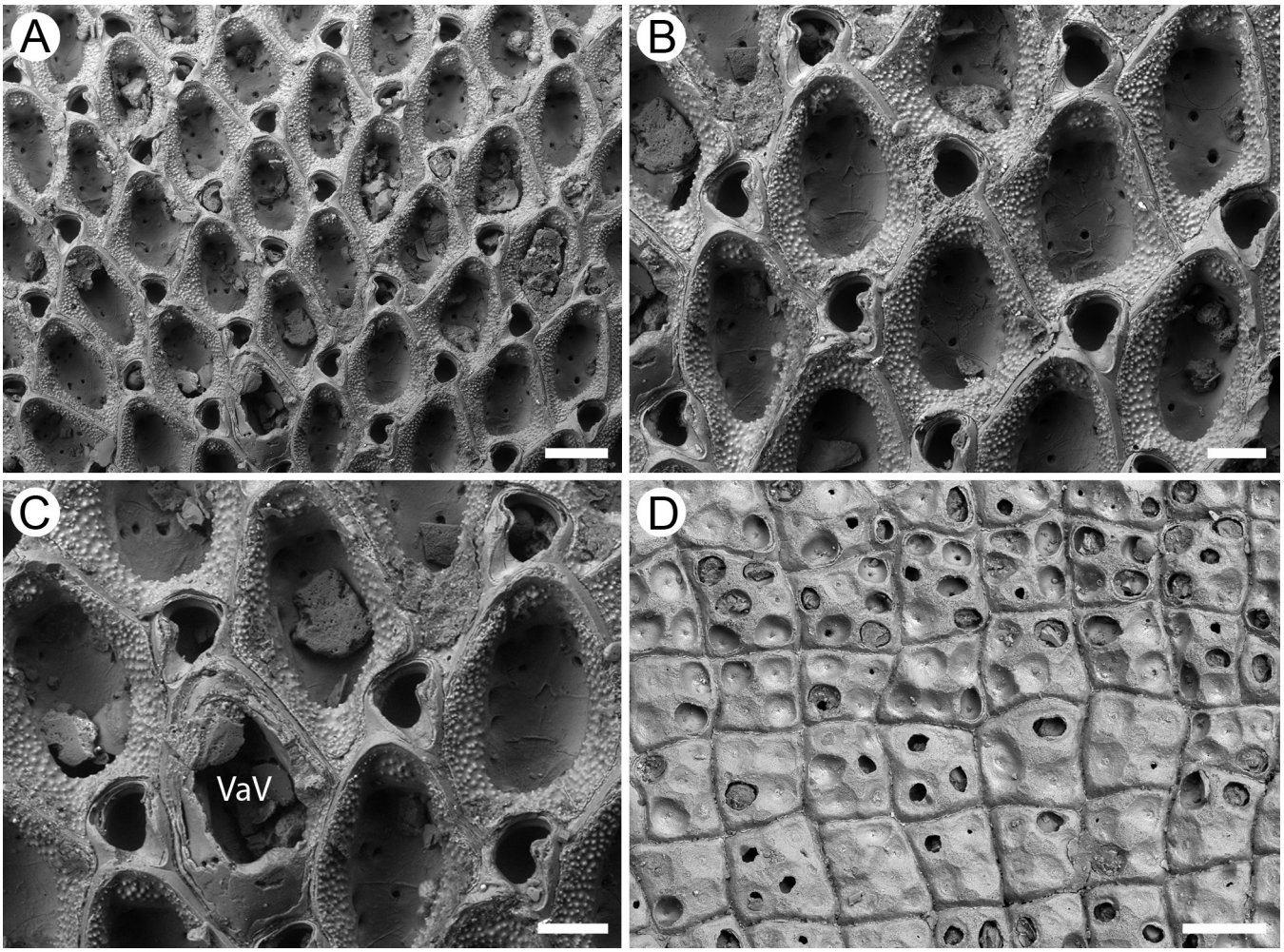

Figure 11. *Cupuladria exfragminis* Herrera-Cubilla et al. (2006), NHMUK PI BZ 7815. **A.** group of autozooids and associated vibracula; **B.** close-up of autozooids and associated vibracula; **C.** close-up of autozooids, vibracula and a vicarious avicularium (VaV) with well-developed gymnocyst; **D.** view of the dorsal side. Scale bars: A, D = 200 μm; B, C = 100 μm.

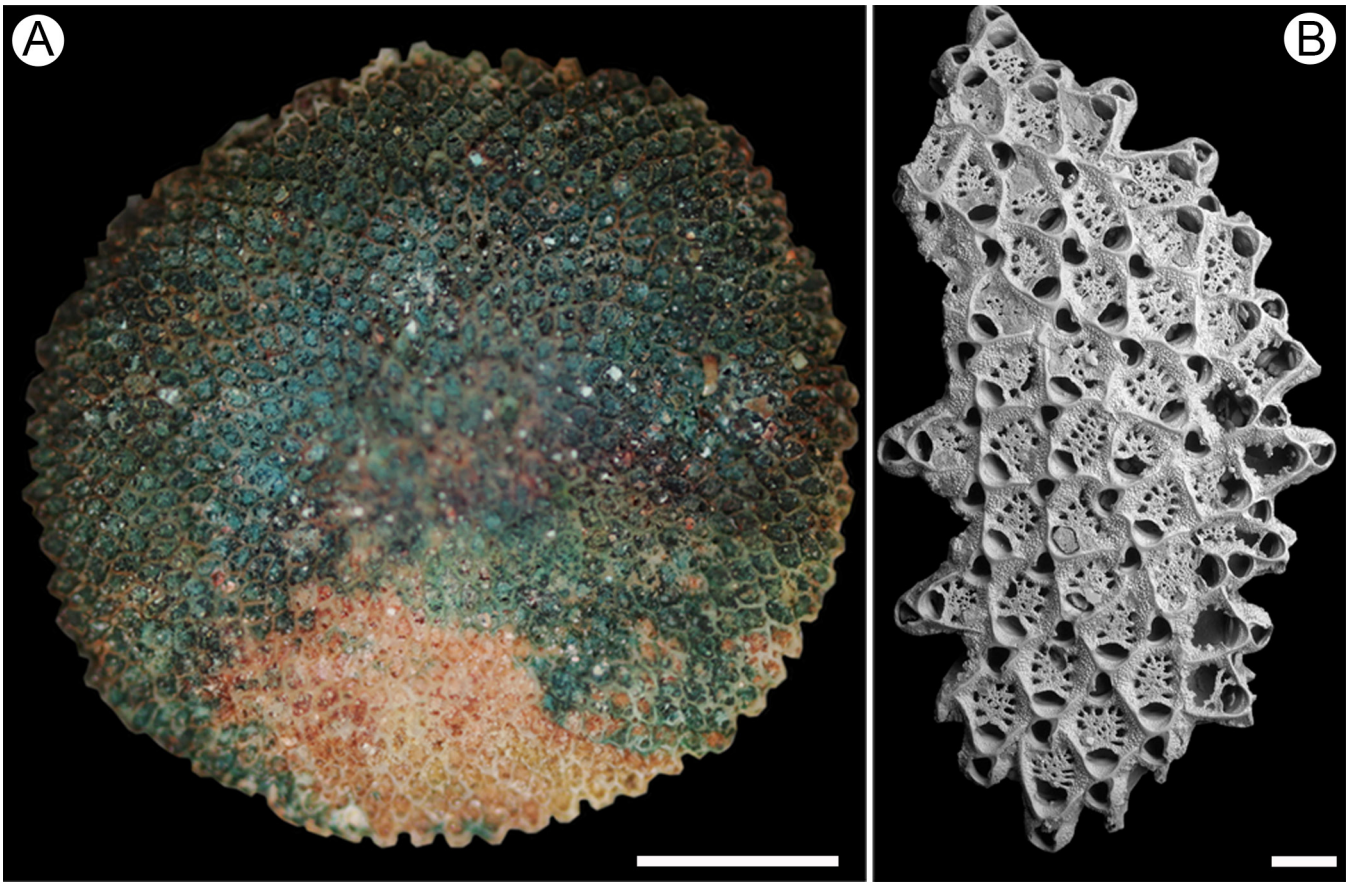

Figure 12. *Discoporella depressa* (Conrad, 1841). **A.** UF 265574, general view of a discoidal, cup-like colony. **B.** NHMUK PI BZ 7816, colony regenerated from a fragment. Scale bars: A, B = 250 μm.

Discoporella depressa (Conrad, 1841), which is consistently much more abundant. *C. exfragminis* ranges in age from early Miocene to Recent, living at the present day off the Pacific coast of Panama, in the Gulf of Panama and the Gulf of Chiriqui (Herrera-Cubilla et al., 2006). Fossil occurrences include also Panama and Costa Rica (Herrera-Cubilla and Jackson, 2014).

Genus *DISCOPORELLA* d'ORBIGNY, 1852
DISCOPORELLA DEPRESSA (CONRAD, 1841)

Lunulites depressa Conrad (1841), p. 348.
Discoporella umbellata subsp. *depressa* Cook (1965), p. 180, pl. 3, fig. 4.
Discoporella umbellata Scolaro (1968), p. 84, pl. 2, figs. 4, 5; Taylor and Foster (1994), p. 67, fig. 14.

Figured material.—UF 265574 (Fig. 12A), TU Loc. 825; NHMUK PI BZ 7816 (Fig. 12B), BZ 7817 (Fig. 13), TU Loc. 787.

Description.—Colony free-living, discoidal cup-like (Fig. 12A), irregularly shaped when regenerated from a fragment (Fig. 12B). Autozooids distinct, with raised margins, arranged in alternating, radial rows, rhomboidal to hexagonal, rounded distally, longer than wide (mean L/W 1.26) (Fig. 13A–B). Cryptocyst occupying nearly all frontal surface, sloping inwards laterally, depressed centrally, finely beaded, with 9–11 denticulate opesiules about 30 μm in diameter, and centrally perforated by 19–26 small, circular pores about 10–12 μm in diameter (Fig. 13A–B). Opesia transversely ogival, overarched by a reduced band of granular cryptocyst (Fig. 13B). An auriform vibraculum distal to each zooid, asymmetrical, proximolaterally directed, oriented alternatively to left and right, with rounded rostrum and a reduced, medial 'lobe' overhanging the opesia (Fig. 13B). Dorsal side with radial, anastomosing grooves, densely and coarsely tuberculate, with small, scattered, circular pores (Fig. 13C).

Measurements.—ZL 418±45, 357–528 (1,

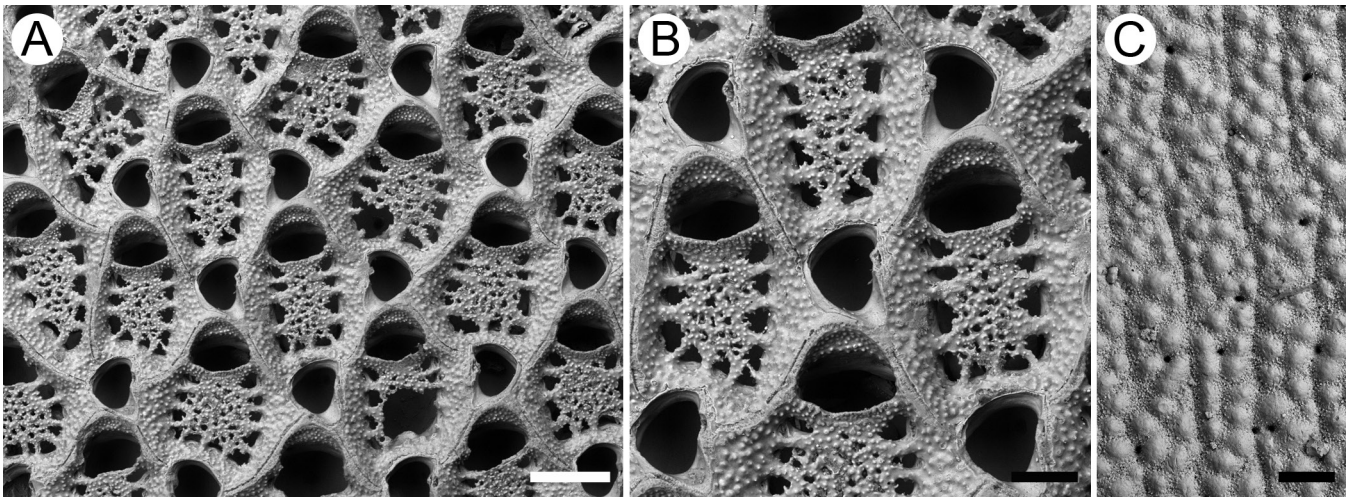

Figure 13. *Discoporella depressa* (Conrad, 1841), NHMUK PI BZ 7817. **A.** group of autozooids and associated vibracula; **B.** close-up of two autozooids and associated vibracula; **C.** view of the dorsal side. Scale bars: A, C = 200 μm; B = 100 μm.

20); ZW 331±43, 257–409 (1, 20); OL 96±5, 91–108 (1, 10); OW 152±4, 144–158 (1, 10); AvL 181±10, 164–197 (1, 20); AvW 135±12, 119–175 (1, 20).

Remarks.—Cook (1965) separated as *Discoporella umbellata* subsp. *depressa* American specimens originally attributed to the European *D. umbellata* (Defrance, 1823), the European form having wider zooids, a pair of opesial denticles, larger vibracular opesiae, and more numerous opesiules. *Discoporella depressa* apparently ranges in time from the early Miocene to the Recent, and has been recorded as a fossil from several states on the east coast of the USA (e.g., Florida, Louisiana, New Jersey, North Carolina,), Jamaica and Brazil, while Recent examples has been recorded from the Gulf of Mexico, Gulf of California, Hawaii, and along the coast of Brazil. However, some differences have been observed between fossil and Recent colonies, such as the lack of central cryptocystal pores in Recent specimens. A thorough revision is needed to prove that the fossil and Recent specimens are conspecific.

Superfamily BUGULOIDEA GRAY, 1848
Family CANDIDAE d'ORBIGNY, 1851
Genus *PARALICORNIA* VIEIRA ET AL., 2014
PARALICORNIA INTERDIGITATA N. SP.

Scrupocellaria regularis Scolaro (1968), p. 100, pl. 4, fig. 1a, b.

Figured material.—Holotype, NHMUK PI BZ 7818 (Fig. 14A–D, G–I) and paratype, UF 265687 (Fig. 14F), TU Loc. 458; paratype, NHMUK PI BZ 7819 (Fig. 14E), TU Loc. 825.

Zoobank Nomenclatural Act.—DE6253F9-6541-4F96-B3C4-DDE48509B5ED.

Etymology.—Referring to the interdigitating lobes of its closure plates.

Diagnosis.—Colony erect, jointed, with biserial branches. Autozooids with extensive gymnocyst proximally, and a narrow cryptocyst around the opesia. Opesia elliptical to oval. Closure plates with interdigitating lobes. Three spines on outer opesial margin and two on inner margin, plus base of scutum medially. Frontal avicularium monomorphic, triangular. Marginal lateral avicularia dimorphic. Ovicells globular, porous. Dorsal side occupied by triangular vibracular chambers, with a straight, transverse setal groove, and a small rhizoidal foramen.

Description.—Colony erect, flexible, jointed, dichotomously branched; branches biserial (Fig. 14A), flat, narrow, 385–480 μm in width, up to 520 μm at branch bifurcation. Autozooids alternating, distinct, separated by narrow grooves, subrectangular, elongate (mean L/W 2.42). Gymnocyst extensive proximally, tapering

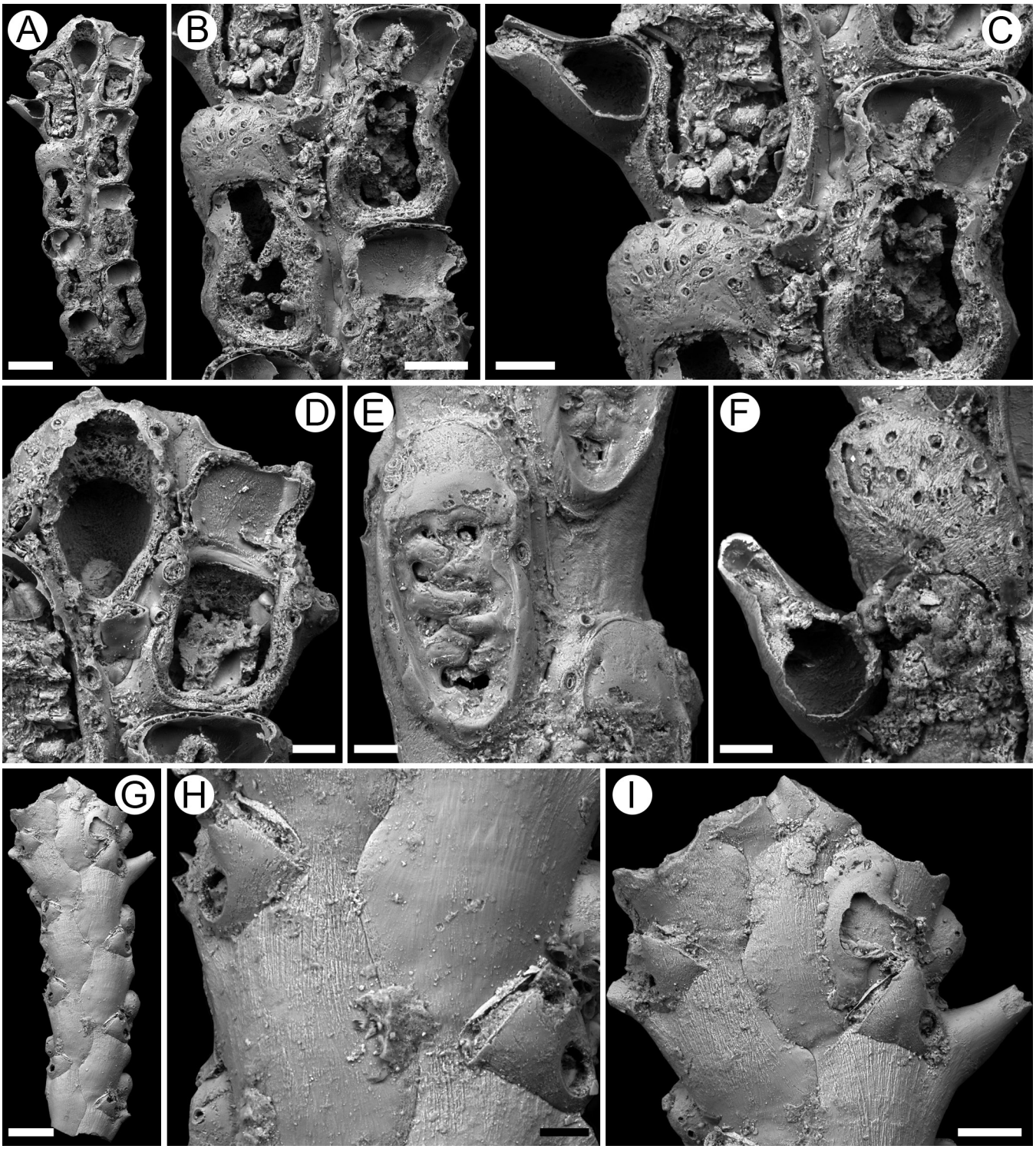

Figure 14. *Paralicornia interdigitata* n. sp. **A–D.** holotype, NHMUK PI BZ 7818. **A.** frontal view of an internode; **B.** close-up of ovicellate zooids; **C.** close-up of ovicell, small frontal avicularium and large lateral avicularium; **D.** close-up of two zooids, the one at branch bifurcation bearing a small frontal avicularium, the other with forming ovicell and small lateral avicularium. **E.** paratype, NHMUK PI BZ 7819, close-up of a zooid with interdigitating closure plate and opercular scars. **F.** paratype, UF265687, close-up of large lateral avicularium and ovicell. **G–I.** holotype, NHMUK PI BZ 7818. **G.** general view of the dorsal side; **H, I.** close-ups of vibracular chambers. Scale bars: A, G = 200 μm; B, I = 100 μm; C, D, E, F, H = 50 μm.

laterally and reduced distally, flat, smooth; cryptocyst forming a narrow border around the opesia. Opesia elliptical to oval with an undulate margin, occupying two-thirds of the frontal surface (Fig. 14A–B); closure plates may be present with interdigitating lobes growing towards the median line and opercular scars (Fig. 14B, E). Three spines on outer opesial margin and two on inner margin, plus base of scutum medially (Fig. 14D–E); spine bases about 25 μm in diameter. Frontal, adventitious avicularium present or absent, monomorphic, small, 55–65 μm long by 30–40 μm wide, prominent, leaning against the inner, proximal margin of the opesia (Fig. 14C–D); rostrum pointed triangular, directed outwardly and proximolaterally. Marginal lateral avicularia present or absent, dimorphic: small avicularia, 30–70 μm long (Fig. 14D), placed on the distolateral corner of the opesia, at the same level of the second proximalmost outer spine; large avicularia, about 180 μm long by 90 μm wide (Fig. 14C, F), skittle-shaped, facing frontally, distolaterally directed, placed below the proximalmost outer spine, indenting the opesia. Ovicells globular, broader than long, with circular, ectooecial pores (Fig. 14B–C, F), 10–15 μm in diameter, seemingly radially arranged. Dorsal side occupied by triangular vibracular chambers, 130–140 μm long by 120–150 μm wide, positioned on the margins with a narrow, about 20 μm wide, straight, transverse setal groove, and a small rhizoidal foramen, 35–40 μm in diameter (Fig. 14G–I); a median, shallow, sinuous furrow marks zooidal boundaries.

Measurements.—ZL 470±57, 402–566 (4, 16); ZW 194±19, 160–225 (4, 16); OL 306±45, 223–378 (4, 16); OW 143±14, 125–178 (4, 16); OvL 128±10, 112–144 (3, 12); OvW 188±16, 163–216 (3, 12).

Remarks.—The genus *Paralicornia* was introduced by Vieira et al. (2014a) for Candidae with short oval opesia, monomorphic frontal avicularia and dimorphic lateral avicularia (giant in some species), and triangular vibracular chamber with straight setal groove obliquely placed. Among species reassigned to *Paralicornia*, the Recent reef-associated species *P. pusilla* (Smitt, 1872) is known from Florida (Tortugas) and the Caribbean (Winston, 2005). *P. interdigitata* is distinguishable from *P. pusilla* in having gigantic lateral avicularia absent in the latter species, while frontal avicularia are small in *P. interdigitata*, and absent (Winston, 2005) or large and spatulate (Osburn, 1940) in Tortugas and Puerto Rico specimens of *P. pusilla*, respectively. Gigantic lateral avicularia have been also observed in *P. obtecta* (Haswell, 1880), and in an undescribed species of *Paralicornia* from Mauritius (see Vieira et al., 2014a:16, fig. 13G), but while giant avicularia of *P. interdigitata* are skittle-shaped, those of *P. obtecta* are lanceolate and those of the unnamed species are trifoliate.

CANDIDAE SP. 1

Scrupocellaria maderensis Scolaro (1968), p. 98, pl. 3, fig. 4.

Figured material.—UF 265682 (Fig. 15), TU Loc. 548.

Description.—Colony erect, flexible, jointed, dichotomously branched; branches biserial (Fig. 15A), flat, very narrow (200–320 μm in width). Ancestrula semi-erect, ovoidal, ca. 250 μm long by 140 μm wide, budding a single zooid distolaterally (Fig. 15A–B); gymnocyst extensive, smooth, cryptocyst reduced to a narrow rim surrounding the opesia, sloping inwards; opesia elliptical, ca. 150 μm long by 100 μm wide, occupying two-thirds of the frontal surface, encircled by seven, evenly spaced, oral spine bases about 18 μm in diameter. First budded zooid shorter and wider than later autozooids, about 205 μm long by 150 μm wide. Autozooids alternating, distinct, separated by narrow grooves, subrectangular, twice as long as wide (mean L/W 2.1). Gymnocyst extensive proximally, tapering laterally and reduced distally, flat, smooth; cryptocyst forming a narrow border around the opesia. Opesia elliptical or pear-shaped with an undulate margin, occupying about two-thirds of the frontal surface (Fig. 15B–D). Four spines on outer opesial margin and two on inner margin, plus base of scutum medially (Fig. 15C); spine bases 10–15 μm in diameter. Frontal, adventitious avicularium present or absent, monomorphic, extremely small, about 35 μm long, placed on a prominent cystid, leaning against the inner, proximal margin of the opesia (Fig. 15C);

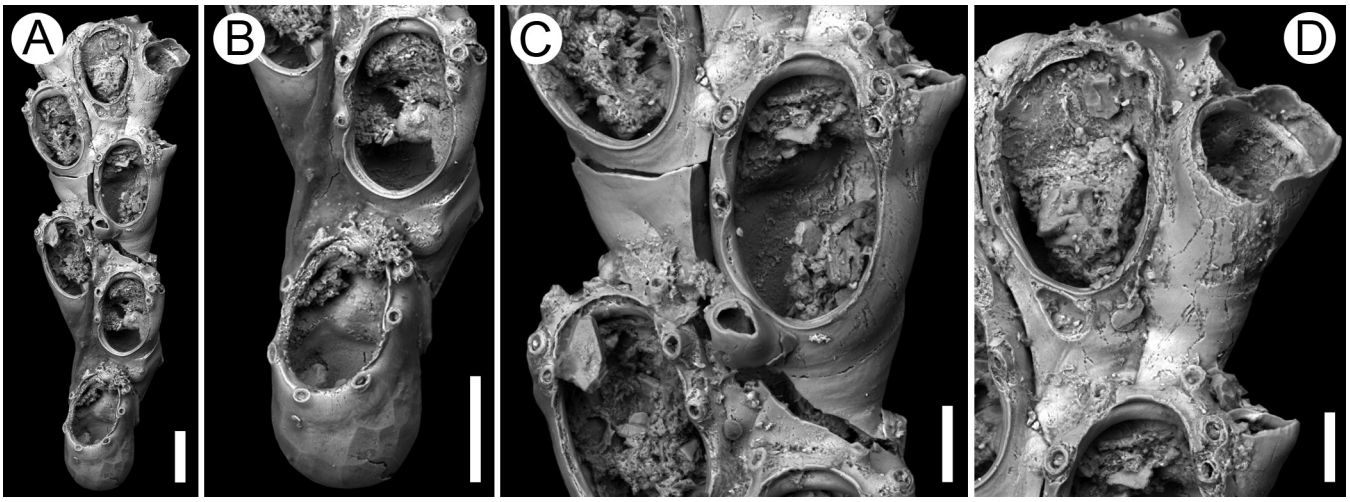

Figure 15. Candidae sp. 1, UF 265682. **A.** frontal view of the internode with ancestrula; **B.** close-up of the ancestrula and first budded zooid; **C.** close-up of an autozooid with small frontal and lateral avicularia; **D.** close-up of an autozooid at branch bifurcation. Scale bars: A, B = 100 μm; C, D = 50 μm.

rostrum arrow-shaped, directed proximolaterally and outwards; two small condyles. Marginal lateral avicularia present or absent, small, 30–70 μm long (Fig. 15C), placed on the distolateral corner of the opesia, at the same level of the second proximalmost outer spine; rostrum triangular, slightly up curved, rippled. Ovicells and dorsal side not observed.

Measurements.—ZL 267±15, 250–285 (1, 4); ZW 128±9, 118–139 (1, 4); OL 166±8, 155–176 (1, 4); OW 95±6, 87–102 (1, 4).

Remarks.—A single fragment of Candidae sp. 1 was found in Scolaro's collection. Scolaro (1968) identified this specimen as *Scrupocellaria maderensis* Busk, 1860, now placed in the genus *Scrupocaberea* following the revision of Vieira et al. (2014a). The scutal base of *Scrupocaberea maderensis* is stout and arises at the distal third of the inner part of the opesia, while in the Chipola Formation species it is thin and placed in the median region. Based on the general shape of the zooids and frontal avicularia, the position of the oral spine bases and scutum, limited by the inability to observe the vibracular chambers in frontal view, this specimen is likely to be a species of *Aspicellaria* or *Cradoscrupocellaria*. Unfortunately, most of the specimens of Scolaro (1968) are glued inside cavity slides, which prevents the observation of some basal features, in this case the basal vibracula that are essential for discriminating genera of Candidae.

CANDIDAE SP. 2

Figured material.—UF 265695 (Fig. 16), TU Loc. 458.

Description.—Colony erect, flexible, jointed; branches biserial, flat, narrow, about 450 μm in width. Autozooids alternating, distinct, separated by narrow grooves, subrectangular, elongate (mean L/W 1.98). Gymnocyst more extensive proximally, tapering laterally, reduced distally, flat, smooth; cryptocyst forming a narrow border around the opesia. Opesia elliptical, occupying two-thirds of the frontal surface. Oral spines and scutum absent. Scars left by a broken, frontal, adventitious avicularium below the proximal orificial margin, on the inner side of each autozooid. Marginal lateral avicularia placed on the distolateral corner of the opesia, small. Ovicells and dorsal side not observed.

Measurements.—ZL 450±21, 425–465 (1, 3); ZW 227±12, 214–236 (1, 3); OL 350±15, 326–364 (1, 5); OW 207±11, 190–215 (1, 5).

Remarks.—A single fragment of Candidae sp. 2 was available for study. This species is different from all the other candids from the Chipola Formation because of the lack of oral spines and scutal bases. Among known Candidae, four Recent species lack spines including scuta: *Scrupocellaria*

Figure 16. Candidae sp. 2, UF 265695, frontal view of the only available internode. Scale bar: 200 μm.

inermis Norman, 1867, which also lacks avicularia, *Pomocellaria inarmata* (O'Donoghue and O'Donoghue, 1926) and *P. talonis* (Osburn, 1950), which are cold-water species with longer gymnocysts and avicularia in different positions, and *Licornia jolloisi* (Audouin, 1826), in which the lateral avicularium is more proximally placed.

Superfamily MICROPOROIDEA GRAY, 1848
Family ONYCHOCELLIDAE JULLIEN, 1882
Genus *FLORIDINA* JULLIEN, 1882
FLORIDINA SUBANTIQUA N. SP.

Figured material.—Holotype, UF 49452 (Fig. 17A–D), TU Loc. 1048; paratype, UF 274573 (Fig. 17E), TU Loc. 547.

Zoobank Nomenclatural Act.—9F7B0996-0CDB-404F-9D0C-3E73EB68A12D.

Etymology.—Referring to its similarity with *Floridina antiqua* (Smitt, 1873).

Diagnosis.—Colony encrusting. Autozooids hexagonal. Gymnocyst vestigial. Cryptocystal shelf granular and depressed, surrounded by a raised margin. Opesia bell-shaped to trifoliate. A cryptocystal knob projects proximally from the distal margin of the opesia. Ovicellate zooids with elongated opesia and distal edge formed by the cryptocyst of the next distal zooid. Vicarious avicularia with pointed rostrum and elliptical opesia.

Description.—Colony encrusting, multiserial, multilaminar (Fig. 17A). Autozooids distinct with shallow interzooidal furrows, quincuncially arran-ged, hexagonal with proximal margin acute if budded distolaterally, broad and straight if budded distally, and rounded distal margin (Fig. 17A–B), slightly longer than wide (mean L/W 1.14). Gymnocyst vestigial. Cryptocystal shelf occupying about half of zooidal frontal length, granular, depressed, surrounded by a raised margin, 20–35 μm wide, that is more densely granulated with smaller granules aligned in radial rows. Opesia bell-shaped with straight or slightly concave proximal margin (Fig. 17A–D), to trifoliate with lateral opesiules and convex proximal margin (Fig. 17E), occupying the remaining half of the zooidal frontal surface, as long as wide at its widest point. A rounded, granular cryptocystal knob, up to 40 μm in length, projects proximally from the distal margin of the opesia. Opesia in ovicellate zooids generally larger than in autozooids and more elongate (mean L/W 1.14 vs 0.99 in autozooids). Oral spines absent. Distal edge of ovicellate zooids formed by the cryptocyst of the next distal zooid (Fig. 17C). Vicarious avicularia infrequent, longer than autozooids, lozenge-shaped or pentagonal, occasionally with distal lateral constrictions at about two-thirds of length (Fig. 17A–B, E); rostrum raised, triangular, pointed; opesia placed centrally, ovoidal to elliptical; cryptocyst as in autozooids. Intramural, reparative buds observed in some avicularia (Fig. 17A). Kenozooids absent.

Measurements.—ZL 414±40, 322–504 (2, 26); ZW 363±45, 291–469 (2, 26); OL 180±23, 143–222 (2, 12); OW 180±22, 143–222 (2, 12); OL* 228±10, 212–243 (1, 8); OW* 200±33, 149–243 (1, 8); AvL 457±59, 336–546 (2, 10); AvW 218±39, 155–295 (2, 10); AvOL 182±38, 127–248 (2, 10); AvOW 86±22, 43–111 (2, 10).

Remarks.—This species, overlooked by Scolaro (1968), is uncommon: a single colony was found in Scolaro's collection, while two relatively large, well preserved colonies were collected more recently. *Floridina subantiqua* n. sp. is similar in appearance to *F. antiqua* (Smitt, 1873), a widespread warm-water species reported from Africa and the Eastern Pacific, as well as the Western Atlantic from Cape Hatteras to Florida, the Caribbean and the Gulf of Mexico (Winston, 2016). The Chipola Formation specimens fall into the size range reported by Canu and Bassler (1928:61), as well as Winston (2016:27) for *F. antiqua* but characters such as the distal, lateral constrictions occasionally observed in the vicarious avicularia (Fig. 17A, E), together with the cryptocystal appendix projecting into the opesia (Fig. 17D), distinguish the fossil from the Recent species.

The genus *Floridina* is moderately diverse,

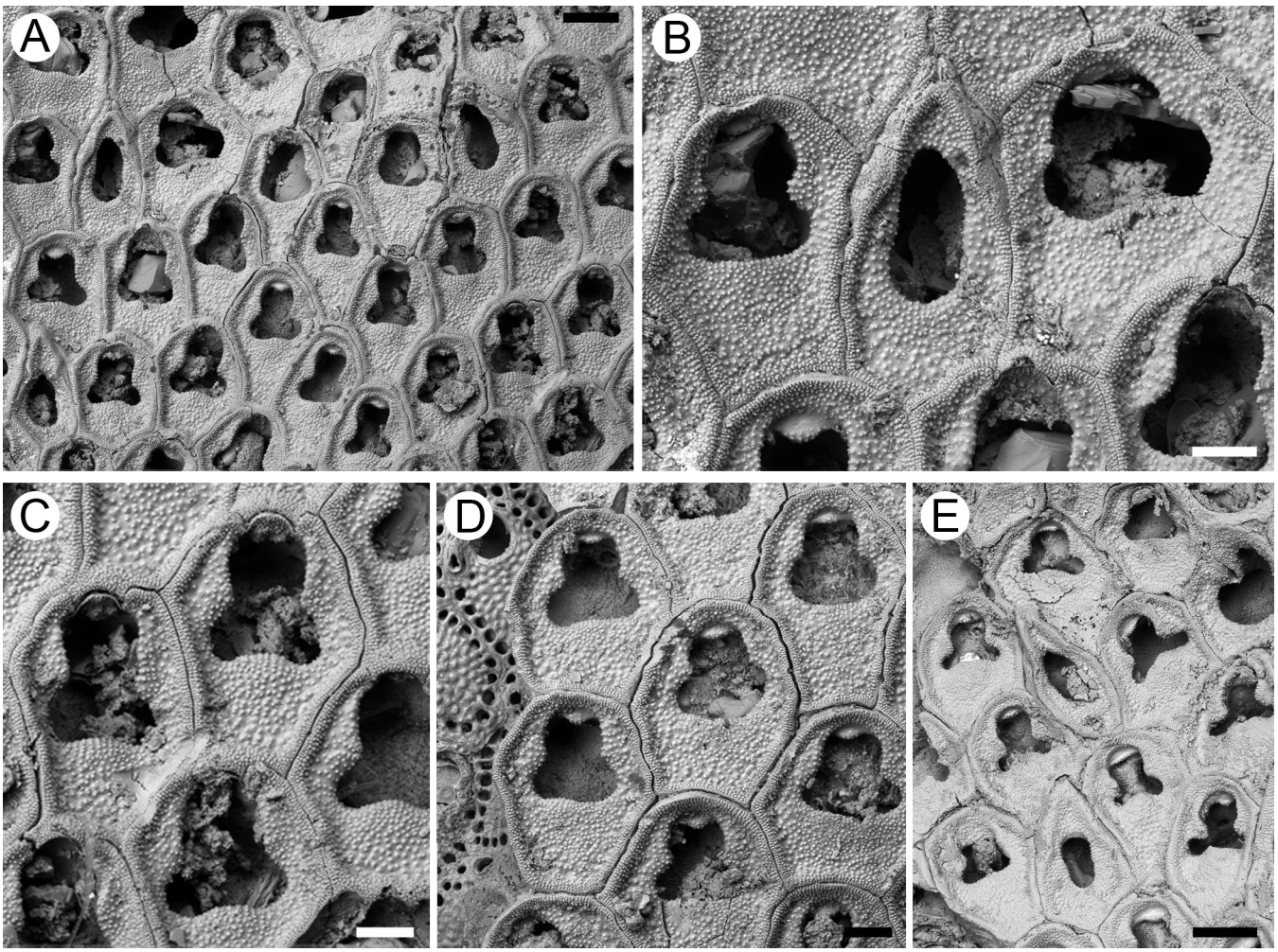

Figure 17. *Floridina subantiqua* n. sp. **A–D.** holotype, UF 49452. **A.** group of autozooids, ovicellate zooids and vicarious avicularia; **B.** close-up of two autozooids and a vicarious avicularium; **C.** close-up of two ovicellate zooids; **D.** group of autozooids overgrowing *Hippaliosina rostrigera* (Smitt, 1873). **E.** paratype, UF 274573, group of autozooids with trifoliate opesia and vicarious avicularia. Scale bars: A, E = 200 μm; B, C, D = 100 μm.

ranging from the Cretaceous to the Recent with several species reported from the Cenozoic of North America (Knowles, 2008). *Floridina asymmetrica* Canu and Bassler, 1920, from the Eocene of Georgia, differs from the new Chipola Formation species in having avicularia with triangular, denticulate opesia; *Floridina bifoliata* Canu and Bassler, 1920, from the Eocene of Florida, is bilamellar, has a smooth frontal surface and avicularia with spatulate rostra; *Floridina granulosa* Canu and Bassler, 1920, from the Eocene of Mississippi, is bilamellar and the frontal surface is coarsely tubercular; *Floridina laguncula* Canu and Bassler, 1920, from the Eocene of North Carolina, has avicularia with rounded tips; *Floridina minima* Canu and Bassler, 1923, from the Pliocene of Florida, has less pointed avicularia, and more rounded and smaller autozooids; *Floridina onydentata* Canu and Bassler, 1920, from the Oligocene of North Carolina, is characterized by a toothed avicularium with a triangular opesia; *Floridina parvicella* Canu and Bassler, 1923, from the Pleistocene of South Carolina and the Recent of Florida and the Gulf of Mexico, lacks markedly raised zooidal margins, but the interzooidal grooves are more obvious than in other species and tubercles are present among the zooids; *Floridina regularis* Canu and Bassler, 1923, from the Pliocene of North Carolina, lacks finely granulated margins in the avicularia; *Floridina subscutata* Canu and Bassler, 1933, from the Paleocene of New Jersey, has a smooth cryptocyst. In addition two Oligocene species were described by Canu and Bassler (1919) from Antigua, *Floridina fusifera* and *Floridina pyripora*, the former species differing in having small, fusiform avicularia, the latter in having a larger, poorly defined opesia.

Genus *SMITTIPORA* JULLIEN, 1882
SMITTIPORA LEVINSENI (CANU and BASSLER, 1917)

Onychocella sp. Levinsen (1909), pl. 22, fig. 3a–d.
Velumella levinseni Canu and Bassler (1917), p. 202, fig. 55C–G.
Smittipora levinseni Scolaro (1968), p. 89, pl. 3, fig. 1.

Figured material.—UF 265673 (Fig. 18), TU Loc. 548.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 18A). Autozooids distinct with raised marginal rims and narrow shallow grooves, quincuncially arranged, hexagonal or irregularly polygonal, longer than wide (mean L/W 1.34). Cryptocyst concave, granular, occupying one-half to two-thirds of the frontal area (Fig. 18B–D). Opesia bell-shaped, almost equidimensional, surrounded by cryptocyst, distal margin rounded, proximal edge straight or slightly convex (Fig. 18C). Avicularia interzooidal, lanceolate with a rounded rostrum tip, smaller than autozooids, slightly asymmetrical (Fig. 18B–C); cryptocyst concave, granular; opesia centrally located, elliptical to oval. Fertile zooids similar to autozooids but with larger opesia (Fig. 18D).

Measurements.—ZL 336±34, 279–389 (1, 16); ZW 251±11, 236–273 (1, 16); OL 124±3, 119–127 (1, 5); OW 116±7, 107–123 (1, 5); OL* 158±13, 138–168 (1, 5); OW* 138±10, 127–150 (1, 5); AvL 317±22, 301–342 (1, 3); AvW 188±15, 171–199 (1, 3); AvOL 161±20, 138–174 (1, 3); AvOW 94±11, 87–107 (1, 3).

Remarks.—The Recent distribution of *Smittipora levinseni* includes the Gulf of Mexico, the Caribbean and western Africa, from 9–262 m depth (Winston and Maturo, 2009). Apart from the Chipola Formation, it has been found as fossil in the Pliocene of Panama (Cheetham et al., 1999).

Family THALAMOPORELLIDAE LEVINSEN, 1902
Genus *THALAMOPORELLA* HINCKS, 1887
THALAMOPORELLA PAPALIS N. SP.

Thalamoporella biperforata Scolaro (1968), p. 92, pl. 3, fig. 2.

Figured material.—Holotype, UF 265669 (Fig. 19A–B), TU Loc. 548.

Zoobank Nomenclatural Act.—9A329F7D-5B79-4B79-B032-288D92104F20.

Etymology.—Referring to its vicarious avicularia similar in shape to the Pope's hat.

Diagnosis.—Colony encrusting, multiserial. Autozooids with a pair of prominent, adoral tubercles and granular cryptocyst perforated medially. Opesiules variable in size and shape. Orifice semicircular. Vicarious avicularia

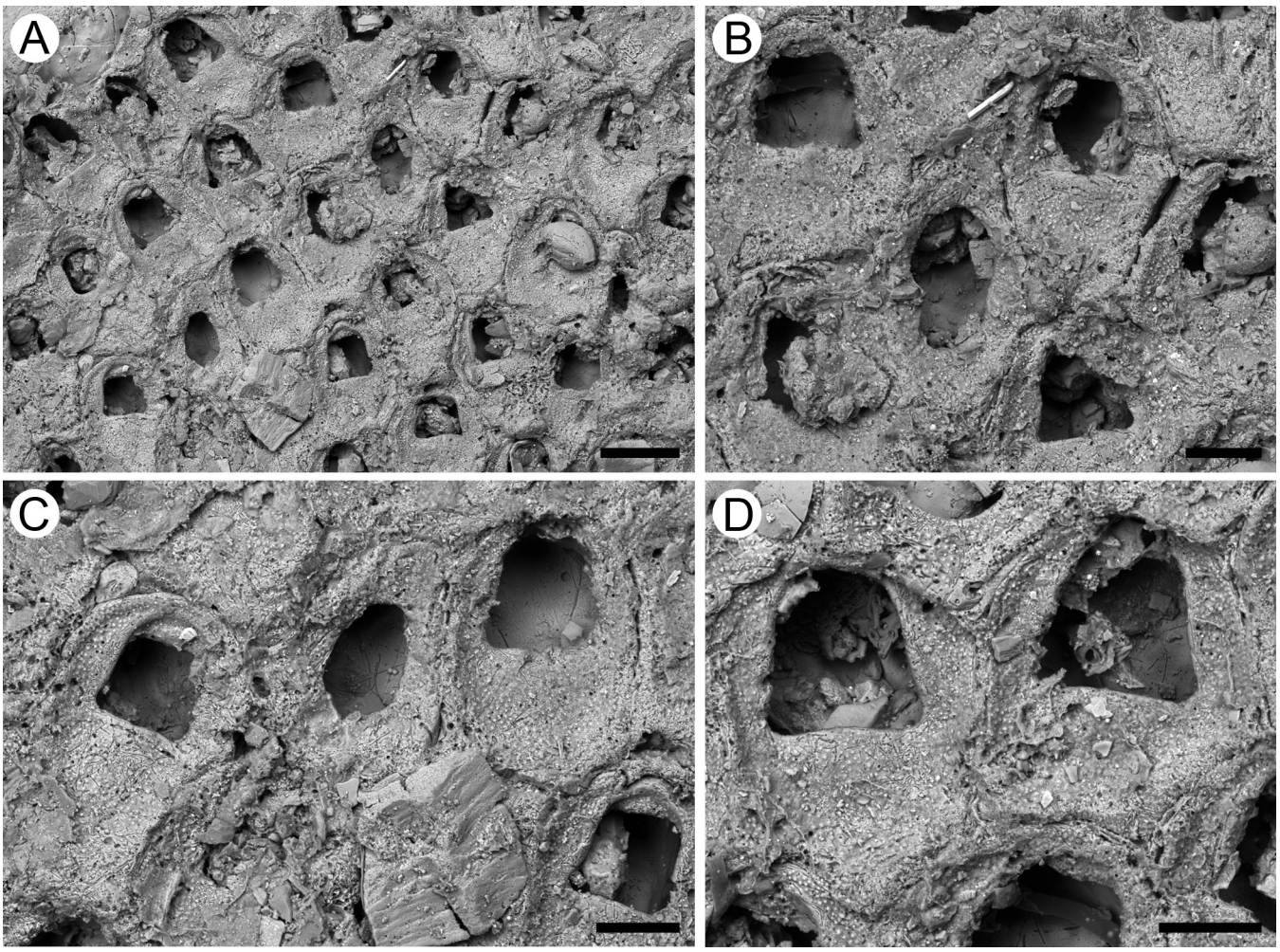

Figure 18. *Smittipora levinseni* (Canu and Bassler, 1917), UF 265673. **A.** group of autozooids and vicarious avicularia; **B, C.** close-ups of autozooids and avicularia; **D.** close-up of two maternal zooids. Scale bars: A = 200 μm; B, C, D = 100 μm.

symmetrical, with long ogive-shaped rostrum, rounded opesia and robust condyles; sibling zooids slightly torqued.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 19A). Autozooids distinct with interzooidal shallow grooves and raised, beaded margins, variable in outline from vase-shaped to hexagonal or rectangular, slightly curved, longer than wide (mean L/W 1.47). Gymnocyst visible only around distal orificial margin. Adoral tubercles always present, one on each side of the orifice, prominent, globular, smooth, 75–95 μm wide (Fig. 19B). Cryptocyst granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, depressed and flat below the opesiules, punctured medially by irregularly spaced, small, circular pores, less than 10 μm in diameter (Fig. 19A–B). Two round or oval opesiules, equal or unequal in size, large or small depending on the zooid (30–70 μm in diameter), located distally, ca. 40–50 μm below the proximal margin of the orifice (Fig. 19B). Orifice semicircular with a concave proximal margin. Vicarious avicularium symmetrical, slightly longer than autozooids, 475 μm long by 200 μm wide (mean ZL/AvL 0.84), Pope's hat-shaped; rostrum ogival, distally directed, indenting the proximal margin of the next distal autozooid (Fig. 19B); cryptocyst finely granular, imperforate; opesia rounded, 320 μm long by 130 μm wide, constrained proximally

by two robust, pointed condyles. Sibling zooid slightly torqued towards the avicularium, with the consequent reduction of one of its lateral tubercles (Fig. 19B). Ovicells not observed.

Measurements.—ZL 397±34, 347–441 (1, 7); ZW 271±34, 224–316 (1, 7); OL 97±9, 85–109 (1, 7); OW 117±13, 97–135 (1, 7).

Remarks.—The genus *Thalamoporella* is highly diverse in tropical Cenozoic sequences (e.g., Guha and Gopikrishna, 2004) and warm-water Recent assemblages (e.g., Harmer, 1926). Although a limited number of fragments have been found in the Chipola Formation, they belong to at least six different species (see descriptions below).

Scolaro (1968) first identified *Thalamoporella papalis* n. sp. as *T. biperforata* Canu and Bassler, 1923, a species described from the late Pliocene Bowden Formation in Jamaica and late Miocene-early Pliocene Gurabo Formation in the Dominican Republic (syntype USNM 68483A, Fig. 19C). *Thalamoporella biperforata* is distinguished from the Chipola Formation species in having much larger autozooids (540–600 μm long by 340–400 μm wide), and even larger vicarious avicularia (900 μm long by 300 μm wide). In addition, the extensive proximal cryptocyst of these avicularia are perforated by two opesiules (Fig. 19C). *Thalamoporella papalis* n. sp. differs also from other fossil and Recent congenerics with the same geographical distribution. The earliest representatives of the genus, the Eocene *Thalamoporella ocalana* Cheetham, 1963, from the Ocala Limestone in Florida, and the Oligocene *T. prima* Canu and Bassler, 1920, from the Byram Marl in Mississippi, have larger zooids (580–640 μm long by 310–400 μm wide and 550 μm long by 350–400 μm wide in *T. ocalana* and *T. prima*, respectively). Furthermore, *T. prima* is erect bilamellar. The Neogene *T. chubbi* Lagaaij, 1959, from Jamaica, is erect tubular, and the avicularium rostrum tip is rounded. The Recent *T. distorta* Osburn, 1940, and *T. mayori* Osburn, 1940, from Puerto Rico and Tortugas, have vicarious avicularia bearing opesiules; *T. floridana* Osburn, 1940, known from the same region, has much longer zooids (500–650 μm) and avicularia with a more extensive cryptocyst and oval opesia; *T. winstonae* Soule et al., 1999, from Singer Island, Florida, differs in having falciform avicularia. The avicularia of *T. lanceolata* Soule et al., 1999, from Fiji, are very similar in shape to those of *T. papalis* n. sp.; however, in the former species the cryptocyst is more extensive proximally, the rostrum is more slender, and the opesia narrows distally.

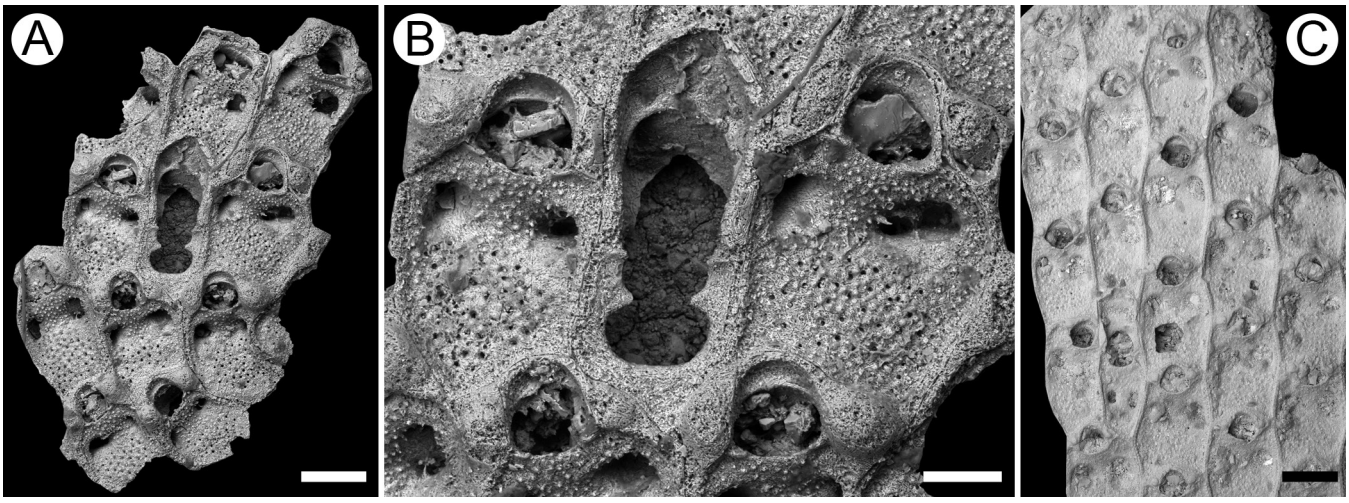

Figure 19. A, B. *Thalamoporella papalis* n. sp., holotype, UF 265669. **A.** general view of the colony fragment; **B.** close-up of two autozooids and vicarious avicularium. **C.** *Thalamoporella biperforata* Canu and Bassler, 1923, syntype, USNM 68483A, general view of the colony fragment including several autozooids and a vicarious avicularium with proximal cryptocyst perforated by two opesiules. Scale bars: A = 200 μm; B = 100 μm; C = 250 μm.

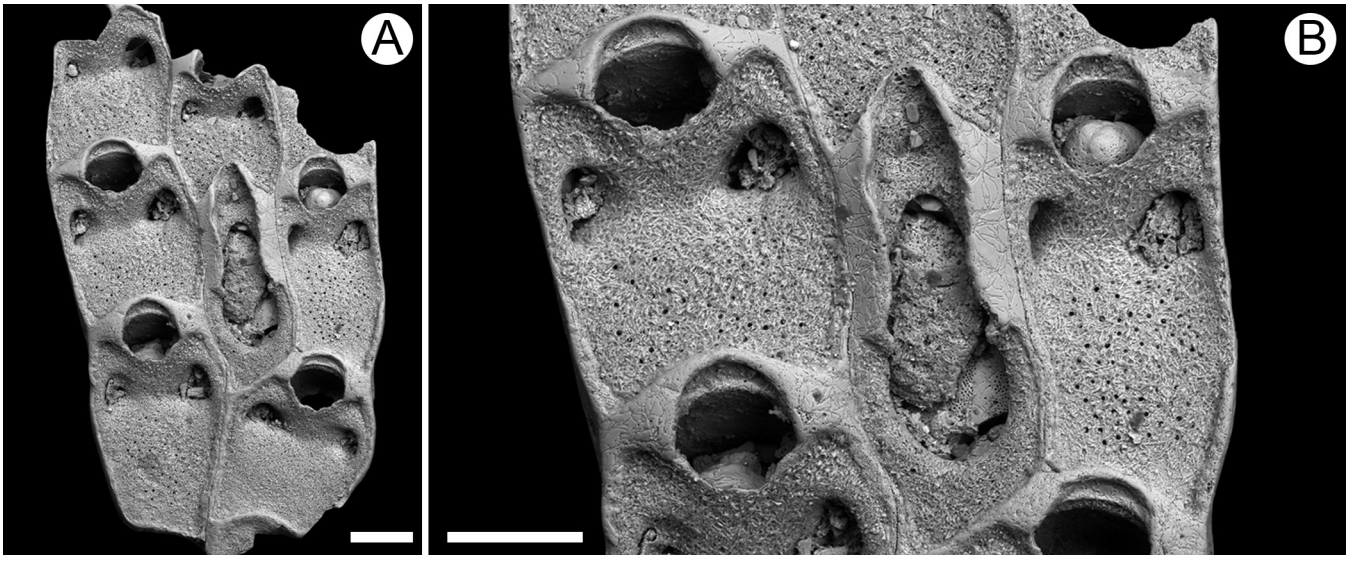

Figure 20. *Thalamoporella hastigera* n. sp., holotype, UF 265601a. **A.** general view of the colony fragment; **B.** close-up of two autozooids and vicarious avicularium. Scale bars: A, B = 200 μm.

***THALAMOPORELLA HASTIGERA* N. SP.**

Figured material.—Holotype, UF 265601a (Fig. 20), TU Loc. 820.

Zoobank Nomenclatural Act.—9E4C892C-7BF6-44EE-BA17-141E69B8A5F1.

Etymology.—Referring to its spear-shaped vicarious avicularium.

Diagnosis.—Colony encrusting, multiserial. Autozooids with smooth gymnocyst developed distolaterally to the orifice; frontal cryptocyst M-shaped, depressed, finely granular, medially perforated. Opesiules plectrum-shaped, variable in size. Orifice eye-shaped. Vicarious avicularium symmetrical; rostrum acutely ogival with raised sides; opesia sac-shaped. Sibling zooids not torqued.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 20A). Autozooids distinct with interzooidal shallow grooves and raised, smooth margins, rectangular, longer than wide (mean L/W 1.37). Gymnocyst developed distolaterally to the orifice, smooth. Frontal cryptocyst M-shaped, finely granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, depressed and flat below the opesiules, punctured medially by irregularly spaced, small, circular pores, less than 10 μm in diameter (Fig. 20B). Two asymmetrical plectrum-shaped opesiules, 80–100 μm long, located distally, ca. 50–80 μm below the proximal margin of the orifice (Fig. 20A–B). Orifice eye-shaped, gently arched distally, a shallow, concave arc proximally. Vicarious avicularia symmetrical, longer than autozooids, 720 μm long by 270 μm wide (mean ZL/AvL 0.85); rostrum acutely ogival, indenting the proximal margin of the next distal autozooid, sides raised (Fig. 20B); cryptocyst extensive proximally, finely granular, imperforate; opesia 390 μm long by 170 μm wide, sac-shaped. Sibling zooids not torqued (Fig. 20B). Ovicells not observed.

Measurements.—ZL 615±99, 524–748 (1, 4); ZW 430±80, 318–509 (1, 4); OL 130±7, 121–137 (1, 4); OW 178±14, 162–194 (1, 4).

Remarks.—*Thalamoporella hastigera* n. sp. is distinguished from *T. papalis* n. sp. in having much larger autozooids, the cryptocyst of the avicularia is more extensive proximally, rostra are more acutely ogival with raised sides, the avicularian opesia is sac-shaped and sibling autozooids are not torqued. Similar avicularia are found in *T. lanceolata*; however, they differ in the shape of the opesia, markedly constricted at about one-third of avicularian length, while in this new Chipola Formation species it narrows gradually

and condyles are located at about half-length. The two species further differ in the shape of the orifice, which is characterized by a well-defined bowl-shaped proximal edge in *T. lanceolata*.

THALAMOPORELLA POLYGONALIS N. SP.

Figured material.—Holotype, UF 265601b (Fig. 21), TU Loc. 820.

Zoobank Nomenclatural Act.—BBDD7C20-C8E8-493A-95D1-F5666186F1F3.

Etymology.—Referring to the polygonal shape of its kenozooids.

Diagnosis.—Colony erect, bilamellar. Autozooids elongated. Gymnocyst negligible; cryptocyst flat, finely granular, medially perforated. Opesiules variable in size and shape. Orifice semicircular with concave proximal margin. Vicarious avicularium with acutely ogival rostrum. Sibling zooids not torqued. Kenozooids irregularly polygonal, with a large, oval opesia.

Description.—Colony erect, bilamellar, flat (Fig. 21A–B). Autozooids distinct with interzooidal shallow grooves and raised, smooth margins, arranged in alternating, parallel rows, rectangular to hexagonal, elongated (mean L/W 1.78). Gymnocyst negligible, present distolaterally to the orifice, smooth. Frontal cryptocyst M-shaped, finely granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, flat below the opesiules, punctured medially by irregularly spaced, small, circular pores, less than 10 μm in diameter (Fig. 21A, D). Two rounded triangular or subcircular opesiules, 80–120 μm long by 25–100 μm wide, located distally, ca. 55–65 μm below the proximal margin of the orifice (Fig. 21C–D). Orifice semicircular with a concave proximal margin. Vicarious avicularium broken, seemingly symmetrical, slender, elongate, ca. 760 μm long by 200 μm wide (mean ZL/AvL 0.62); rostrum acutely ogival, distally directed, indenting the proximal margin of the next distal autozooid (Fig. 21B–C). Simbling zooids not torqued (Fig. 21C). Kenozooids frequent, rectangular to irregularly polygonal and curved, variable in size, with the frontal mostly occupied by a large, oval to elliptical, centrally placed opesia surrounded by a narrow, imperforate, finely granular cryptocyst (Fig. 21D–E). Ovicells not observed.

Measurements.—ZL 470±53, 406–569 (1, 14); ZW 266±38, 206–348 (1, 14); OL 105±4, 98–111 (1, 8); OW 143±7, 137–160 (1, 8); KL 423±97, 311–520 (1, 4); KW 327±35, 289–373 (1, 4); KOL 290±70, 234–382 (1, 4); KOW 204±52, 156–267 (1, 4).

Remarks.—*Thalamoporella polygonalis* n. sp. is distinguished from the two congeneric Chipola Formation species described here in having erect, bilamellar colonies, more slender autozooids (mean L/W 1.78 vs 1.37–1.47), and frequent kenozooids. Kenozooids are common in Recent encrusting species of *Thalamoporella*, such as *T. lanceolata* (Soule et al., 1999), to accommodate irregularities of the substrate. The common development of kenozooids in Recent species was also interpreted as the result of an evolutionary trend with the reduction in size of avicularia to their complete replacement by kenozooids (Soule et al., 1999). The Paleogene species *T. prima* shares with *T. polygonalis* n. sp. the erect, bilamellar colony morphology, but differs in having squatter autozooids (mean L/W 1.47), smaller vicarious avicularia, and a less extensive cryptocyst, apparently punctured by more numerous and larger pseudopores (Canu and Bassler, 1920).

THALAMOPORELLA BITORQUATA N. SP.

Figured material.—Holotype, UF 265601c (Fig. 22), TU Loc. 820.

Zoobank Nomenclatural Act.—820A9441-2844-4CAD-85D4-3A98DC1CCA6E.

Etymology.—Referring to sibling zooids from both sides torqued towards vicarious avicularia.

Diagnosis.—Colony encrusting, multiserial. Autozooids with a pair of prominent, adoral tubercles and granular, medially perforated cryptocyst. Opesiules present. Orifice semicircular with concave proximal margin. Vicarious avicularium symmetrical, with acute, ogive-shaped rostrum and raised margins. Sibling zooids torqued towards the avicularium.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 22A). Autozooids distinct with interzooidal shallow grooves and raised, beaded

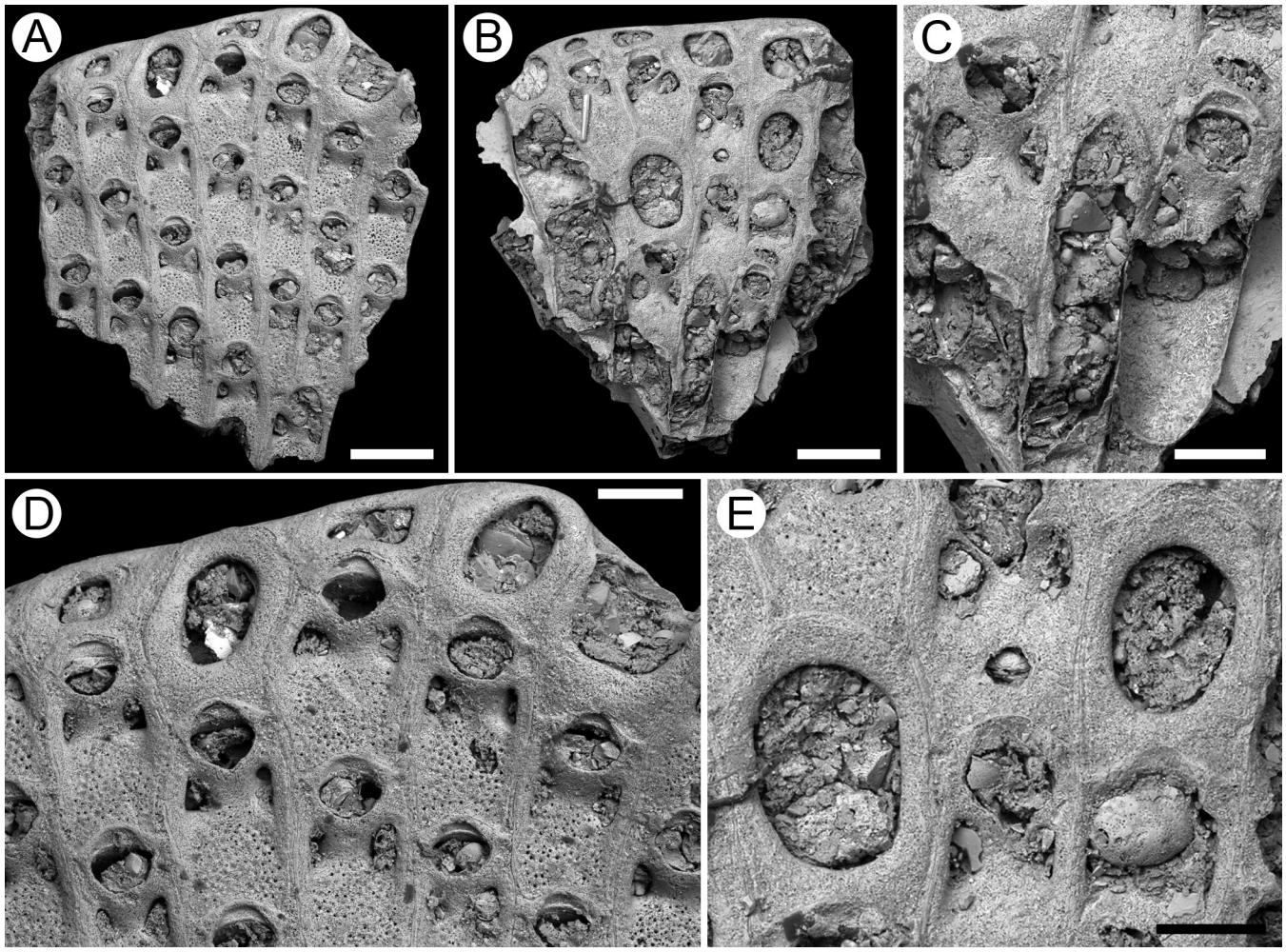

Figure 21. *Thalamoporella polygonalis* n. sp., holotype, UF 265601b. **A, B.** general views of the bilamellar colony fragment; **C.** close-up of the broken vicarious avicularium; **D.** group of autozooids and polygonal kenozooids; **E.** close-up of two polygonal kenozooids. Scale bars: A, B = 400 μm; C, D, E = 200 μm.

margins, hexagonal, slightly curved, longer than wide (mean L/W 1.48). Gymnocyst visible only around distal orificial margin. Adoral tubercles always present, one on each side of the orifice, prominent, globular, smooth, up to 100–130 μm wide (Fig. 22B). Cryptocyst finely granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, depressed and flat below the opesiules, punctured medially by irregularly spaced, small, circular pores, less than 10 μm in diameter (Fig. 22B). Opesiules obliterated by sediment infilling, located distally, ca. 60 μm below the proximal margin of the orifice (Fig. 22A). Orifice semicircular with a concave proximal margin, surrounded distolaterally by a raised, thick, smooth rim (Fig. 22B), cryptocystal granules giving a denticulate appearance to the proximal margin (Fig. 22B). Vicarious avicularium symmetrical, longer than autozooids, 595 μm long by 200 μm wide (mean ZL/AvL 0.73), lozenge-shaped; rostrum acute ogival, with raised, smooth margins, distally directed, indenting the proximal margin of the next distal autozooid (Fig. 22B); cryptocyst more extensive proximally, tapering laterally, coarsely granular, imperforate; opesia rounded, spatulate; condyles present. Sibling zooids torqued towards the avicularium, with the consequent reduction or loss of the related lateral

tubercle (Fig. 22B). Ovicells not observed.

Measurements.—ZL 433±31, 380–464 (1, 9); ZW 292±32, 232–335 (1, 9); OL 111±5, 106–120 (1, 5); OW 131±8, 118–140 (1, 5).

Remarks.—*Thalamoporella bitorquata* n. sp. is characterized by its acute vicarious avicularium with sibling zooids from both sides torqued towards it. Other Chipola Formation congenerics with acute vicarious avicularia were characterized by untorqued or a single torqued sibling zooid

THALAMOPORELLA OGIVALIS N. SP.

Figured material.—Holotype, NHMUK PI BZ 7820 (Fig. 23), (30.46586, -85.14812; WGS84), Farley Creek, USA, Florida, Calhoun County.

Zoobank Nomenclatural Act.—8FE75F0E-79E0-4963-B7E8-016D36EA79B2.

Etymology.—Referring to the ogival rostrum of its vicarious avicularium.

Diagnosis.—Colony encrusting, multiserial. Autozooids with prominent adoral tubercles and finely granular cryptocyst, punctured medially. Opesiules transversely oval, deeply immersed. Orifice semicircular with concave proximal margin. Vicarious avicularium with ogival rostrum, raised and inwardly bended distolateral margins, and bilobate opesia. Sibling zooids torqued towards the avicularium.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 23A). Autozooids distinct with interzooidal shallow grooves and raised, beaded margins, rectangular to hexagonal, slightly longer than wide (mean L/W 1.24). Gymnocyst visible only around distal orificial margin. Adoral tubercles always present, one on each side of the orifice, prominent, globular to transversely elliptical, smooth, 90–120 μm wide (Fig. 23B). Cryptocyst finely granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, depressed and flat below the opesiules, punctured medially by irregularly spaced, small, circular pores, less than 10 μm in diameter (Fig. 23B). Opesiules transversely oval, deeply immersed, located distally, ca. 50–60 μm below the proximal margin of the orifice (Fig. 23B). Orifice semicircular with a slightly concave proximal margin. Vicarious avicularium symmetrical, longer than autozooids, 528 μm long by 205 μm wide (mean ZL/AvL 0.74), polygonal; rostrum ogival, with smooth, raised distal and lateral margins, bending inwards slightly above mid-length, indenting the proximal margin of the

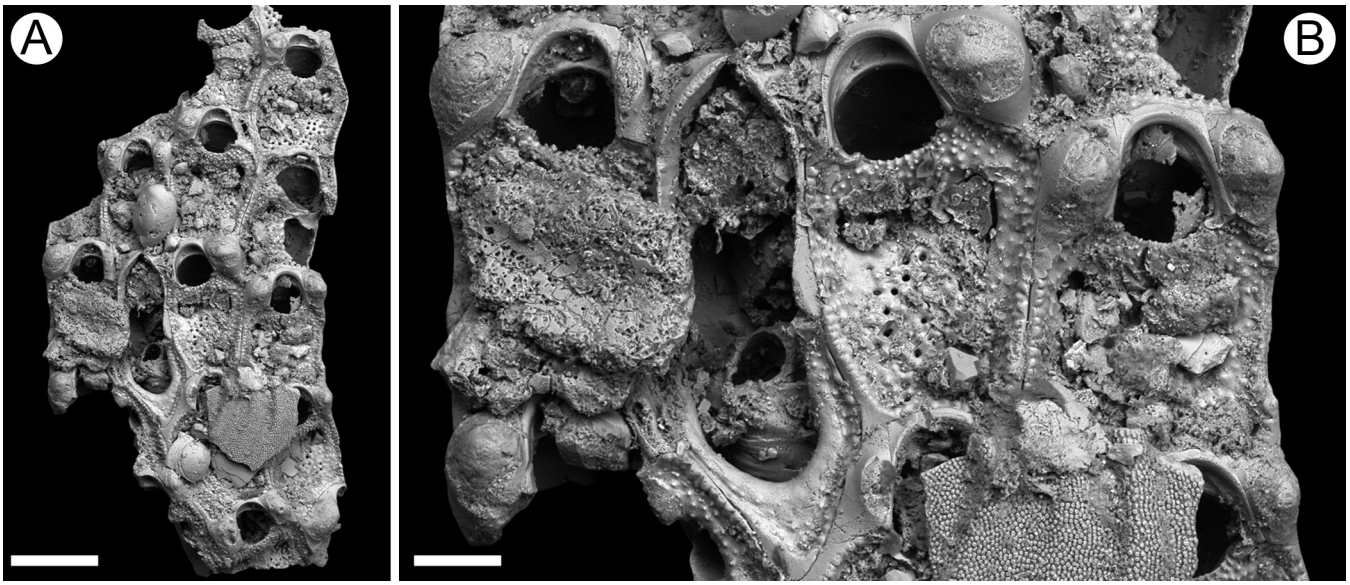

Figure 22. *Thalamoporella bitorquata* n. sp., holotype, UF 265601c. **A.** general view of the colony fragment; **B.** close-up of three autozooids and vicarious avicularium. Scale bars: A = 300 μm; B = 100 μm.

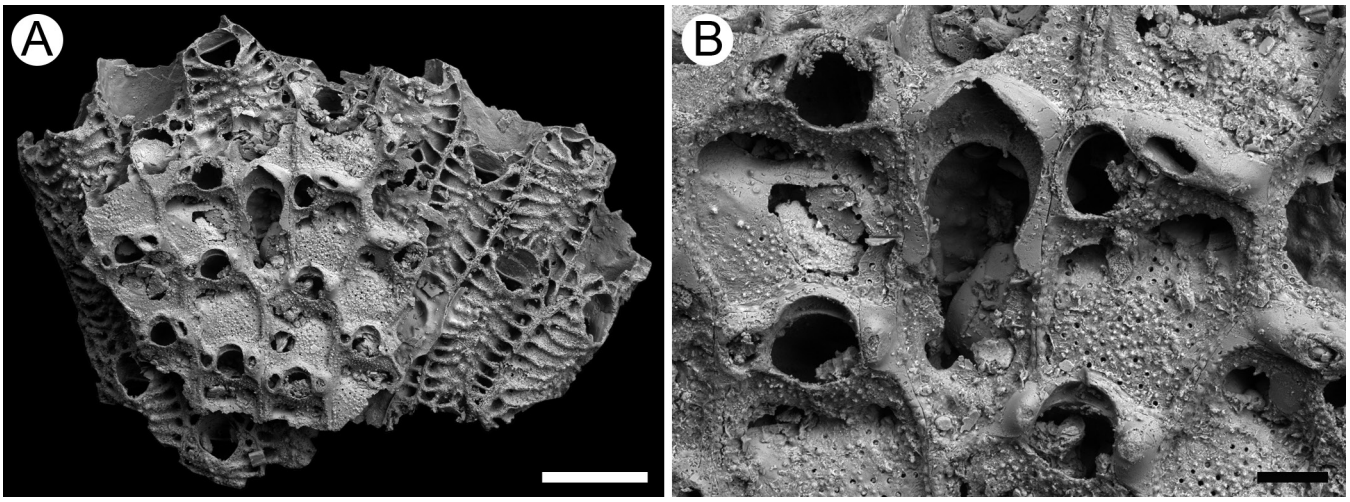

Figure 23. *Thalamoporella ogivalis* n. sp., holotype, NHMUK PI BZ 7820. **A.** general view of the colony fragment encrusting a broken branch of *Metrarabdotos chipolanum* Cheetham, 1968; **B.** close-up of two autozooids and vicarious avicularium. Scale bars: A = 200 μm; B = 100 μm.

next distal autozooid (Fig. 23B); cryptocyst more extensive proximally, tapering laterally, granular, imperforate; opesia bilobate; condyles present located proximally. Sibling zooids torqued towards the avicularium, with consequent reduction or loss of the related lateral tubercle (Fig. 23B). Ovicells not observed.

Measurements.—ZL 392±17, 375–422 (1, 6); ZW 316±17, 293–342 (1, 6); OL 103±7, 95–113 (1, 5); OW 127±10, 119–142 (1, 5).

Remarks.—*Thalamoporella ogivalis* n. sp. is characterized by its vicarious avicularium with raised and curved distolateral margins, and bilobate opesia. The single colony known encrusts a fragment of the erect bryozoan *Metrarabdotos chipolanum* Cheetham, 1968 (Fig. 23A).

THALAMOPORELLA SP.

Figured material.—UF 265601d (Fig. 24), TU Loc. 820.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 24A). Autozooids distinct with interzooidal shallow grooves and raised, beaded margins, arranged in alternating, parallel rows, rectangular to hexagonal, curved, slightly longer than wide (mean L/W 1.38). Gymnocyst visible only around distal orificial margin. Adoral tubercles always present, one on each side of the orifice, prominent, globular, smooth, 100–120 μm wide (Fig. 24B). Cryptocyst coarsely granular, raised along zooidal margins, convex distally, just between the orifice and the opesiules, depressed and flat below the opesiules, punctured medially by evenly spaced, circular pores, ca. 10 μm in diameter (Fig. 24B). Two transversely oval opesiules, equal in size or asymmetrical, 30 μm long by 40 μm wide, located distally, ca. 45–55 μm below the proximal margin of the orifice (Fig. 24A). Orifice semicircular with a slightly concave proximal margin. Vicarious avicularium broken, represented by beaded raised margin of cryptocyst visible proximally, as well as a robust, complete crossbar, ca. 50 μm wide, with a median triangular skeletal projection directed proximally (Fig. 24B). Ovicells not observed.

Measurements.—ZL 382±55, 317–482 (1, 9); ZW 277±44, 226–350 (1, 9); OL 107±9, 98–117 (1, 5); OW 120±5, 115–126 (1, 5).

Remarks.—The main morphological feature distinguishing this species from Chipola Formation congenerics is the presence of what appears to be the complete pivotal bar of an avicularium. In the other species avicularia were equipped with condyles. The pivotal bar observed in *T.* sp. bears medially a triangular skeletal projection directed proximally, opposite to the typical direction of a

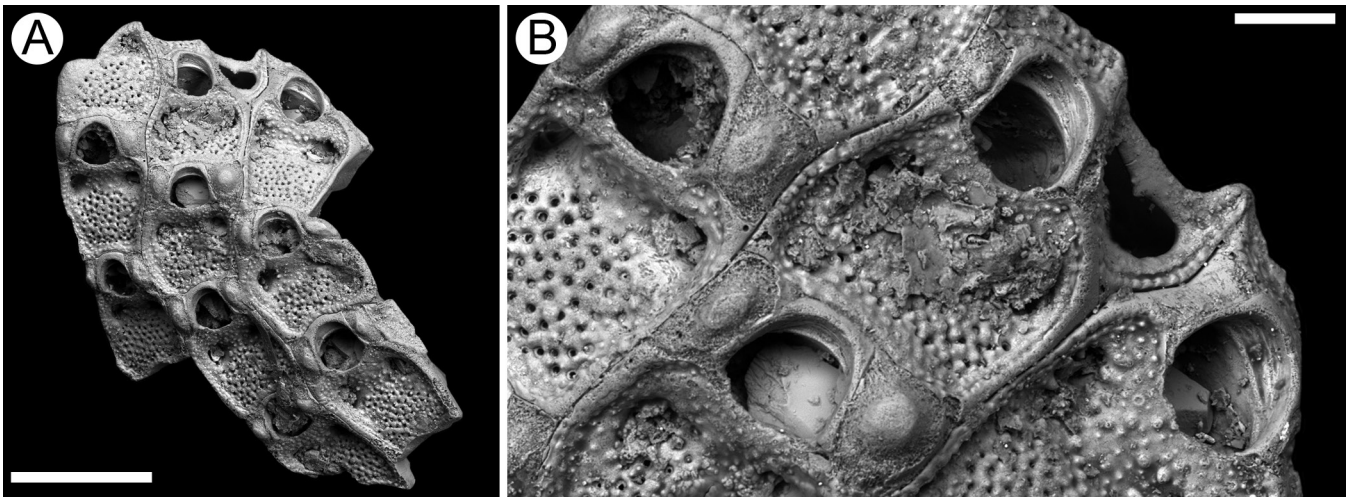

Figure 24. *Thalamoporella* sp., UF 265601d. **A.** general view of the colony fragment; **B.** close-up of autozooids and broken vicarious avicularium. Scale bars: A = 400 μm; B = 100 μm.

ligula projecting into the avicularian palate. Owing to the poor preservation of the putative avicularium, this species is left in open nomenclature.

INCERTAE SEDIS
Family SKYLONIIDAE SANDBERG, 1963
Genus *SKYLONIA* THOMAS, 1961
SKYLONIA SP.

Skylonia sp. B Keij (1973), p. 232, pl. 3, fig. 9.

Figured material.—UF 265747 (Fig. 25), TU Loc. 823.

Description.—Fragment 630 μm long with the distal end broken off, likely to be originally spindle-shaped, quadriserial. Three or four zooids preserved per row, total number of autozooids per vertical row unknown. Autozooidal boundaries defined by a thin groove, elliptical to rounded quadrangular, 112–120 μm long by 100–150 μm wide. Opesia varying from elliptical (78–84 μm long by 60–76 μm wide), vertically elongate, to subcircular (ca. 85 μm in diameter), surrounded by a ring of ?cryptocystal calcification, lacking closure plates.

Remarks.—Fragments of *Skylonia* sp. are rare in the Chipola Formation. The single fragment available for this study is from Scolaro's collection at Farley Creek. The same specimen was previously studied by Keij (1973), who also mentioned a heavily calcified fragment from TU Loc. 548 at Chipola River, a specimen that we have been unable to locate. Keij (1973:pl. 3, fig. 9) figured a rootlet frontal pore below the first zooid likely placed in the row back-to-back with the one figured here. Confirmation of this feature was prevented by the fragility of the unique specimen that is glued to a cavity slide. Keij (1973:224) stated that the Chipola Formation fragments belong to an undescribed species, but we prefer to retain this species in open nomenclature because of the paucity of available material.

Superfamily CRIBRILINOIDEA HINCKS, 1879
Family CRIBRILINIDAE HINCKS, 1879
Genus *FIGULARIA* JULLIEN, 1886
FIGULARIA SP.

Figularia 'A' n. sp. Scolaro (1968), p. 106, pl. 4, fig. 3.

Figured material.—Lost specimen, UF 265732 (Fig. 26), TU Loc. 817.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 26A). Autozooids distinct with shallow interzooidal furrows, rectangular, elongate, twice as long as wide (mean L/W 2.18) (Fig. 26A–B). Gymnocyst smooth, flat or faintly convex, mostly developed proximally, reduced laterally and distally (Fig. 26A–B). Frontal shield slightly raised relative to gymnocyst, consisting of 14–18 costae, 30–45 μm thick, fused medially (Fig. 26A–B). Costae separated along their length

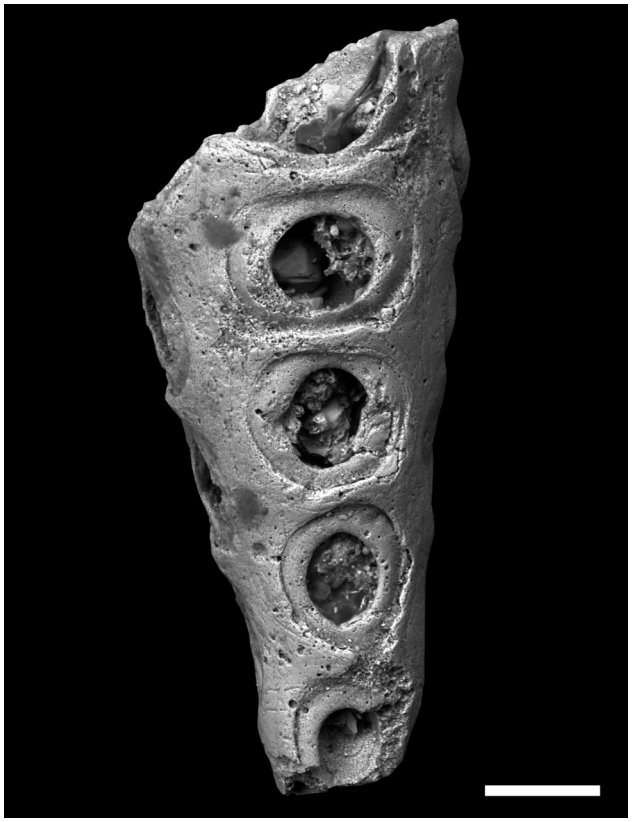

Figure 25. *Skylonia* sp., UF 265747, general view of the single colony fragment available. Scale bar: 100 μm.

by 3–4 subcircular lacunae, 12–25 μm in diameter. A large, teardrop-shaped lumen, 35–50 μm long by 50–75 μm wide, near the base of each costa. Orifice in non-ovicellate autozooids, slightly broader than long (mean L/W 0.96), subcircular with a pair of robust, rounded condyles, about 20 μm long by 20 μm wide, separating a rounded anter from a shallow, bowl-shaped poster (Fig. 26C); orifice in ovicellate zooids much broader than long (mean L/W 0.69), with pointed, narrower condyles and a convex proximal margin (Fig. 26D–E). Ovicells transversely elongate, 165 μm long by 280 μm wide, with elongate, drop-shaped, transverse frontal fenestra (50 μm long by 140 μm wide) on each side (Fig. 26D). Kenozooids and avicularia not seen.

Measurements.—ZL 630±85, 543–782 (1, 6); ZW 289±70, 192–365 (1, 6); OL 149±9, 137–156 (1, 5); OW 155±9, 149–171 (1, 5); OL* 121±2, 120–123 (1, 2); OW* 175±21, 160–191 (1, 2).

Remarks.—Scolaro (1968) proposed *Figularia* sp. as a new species but unfortunately the single colony fragment available was accidentally lost during SEM study. Therefore we describe the species based on our SEM images but leave it in open nomenclature. *Figularia*? *crassicostulata* Canu and Bassler, 1920 (pl. 43, fig. 9) from the Eocene Ocala Limestone at Chipola River differs in the shape of the zooids, elliptical instead of rectangular, and in the shape of the orifice with a straight instead of concave proximal margin.

Genus *PUELLINA* JULLIEN, 1886
PUELLINA QUADRISPINOSA N. SP.

Cribrilaria radiata Scolaro (1968), p. 103, pl. 4, fig. 2.

Figured material.—Holotype, UF 265772 (Fig. 27), TU Loc. 787.

Zoobank Nomenclatural Act.—B05817D0-E06B-4913-B8F1-5670060639A8.

Etymology.—Referring to the constant presence of four oral spines bases in both ovicellate and non-ovicellate zooids.

Diagnosis.—Colony encrusting. Autozooids with negligible gymnocyst and 14–16 costae forming the frontal shield. A bifid, pointed spike formed by the first pair of costae. Orifice D-shaped. Four oral spines in both ovicellate and non-ovicellate zooids. Ovicells with a median keel. Interzooidal avicularia with serrate rostrum and upwardly curved tip.

Description.— Colony encrusting, multiserial, unilaminar (Fig. 27A). Autozooids suboval or subhexagonal, longer than broad (mean L/W 1.62), distinct with deep interzooidal furrows, quincuncially arranged (Fig. 27B). Gymnocyst generally negligible but extensive proximally in some zooids. Frontal shield formed by 14–16 fused costae, 25–30 μm thick, with 3–5 elliptical, intercostal lacunae, 10–15 μm long. Distal pair of costae forming apertural bar joined medially to form a raised, bifid, pointed spike, 30–35 μm in height, and leaving centrally a small, circular lacuna, 10–15 μm in diameter (Fig. 27C–D, G). Orifice transversely D-shaped, broader than long, bearing four oral spines, two on each side, in both ovicellate and non-ovicellate zooids (Fig. 27D); oral spines robust at the base, tapering distally,

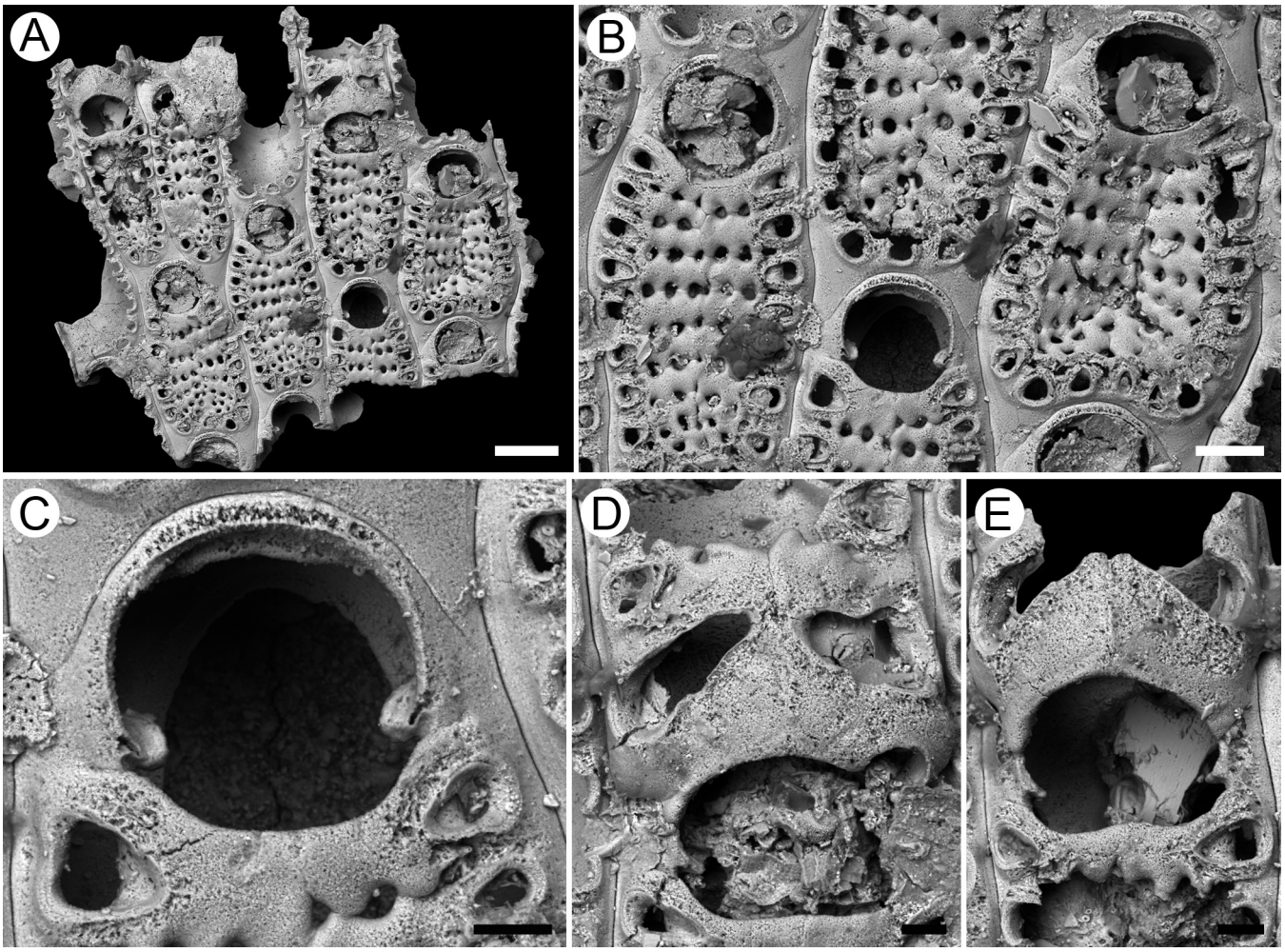

Figure 26. *Figularia* sp., UF 265732. **A.** general view of the colony fragment; **B.** close-up of two autozooids; **C.** close-up of the orifice; **D.** close-up of an ovicell; **E.** close-up of a broken ovicell. Scale bars: A = 200 μm; B = 100 μm; C, D, E = 40 μm.

10–12 μm in diameter. Ovicells helmet-shaped, broader than long, smooth with a faint median keel, resting on the proximal frontal shield of the next distal zooid (Fig. 27B–D). Avicularia interzooidal, rare, 120 μm long by 70 μm wide (Fig. 27E–F); cystid small, 140 μm long by 100 μm wide, rounded trapezoidal, with smooth, convex gymnocyst proximally and laterally; rostrum triangular, serrate, with upwardly curved tip, distolaterally directed, resting on the frontal shield of the next distal autozooid. Kenozooids not seen.

Measurements.—ZL 376±34, 331–446 (1, 10); ZW 232±33, 183–293 (1, 10); OL 61±4, 51–65 (1, 8); OW 84±7, 80–102 (1, 8); OvL 93±5, 84–99 (1, 10); OvW 147±15, 128–172 (1, 10).

Remarks.—Scolaro (1968) identified this Chipola Formation specimen as *Puellina radiata* (Moll, 1803), a species known to be restricted to the Mediterranean Sea, probably based on the number of oral spines. *Puellina quadrispinosa* n. sp. differs from its congenerics living in Floridan waters today. All of these species have 5 to 6 oral spines and differ also in other features: *Puellina capronensis* Winston, 2005 and *P.* (*Cribrilaria*) *parva* Winston and Håkansson, 1986 lack avicularia; *P. minervae* Winston, 2016 has a raised tubercle on each costa; *P. saginata* Winston, 2005 has a more extensive gymnocyst surrounding the margins of the zooids; *P. smitti* Winston, 2005 and *P. testudinea* Winston, 2005 have, respectively, flabellate and long, pointed

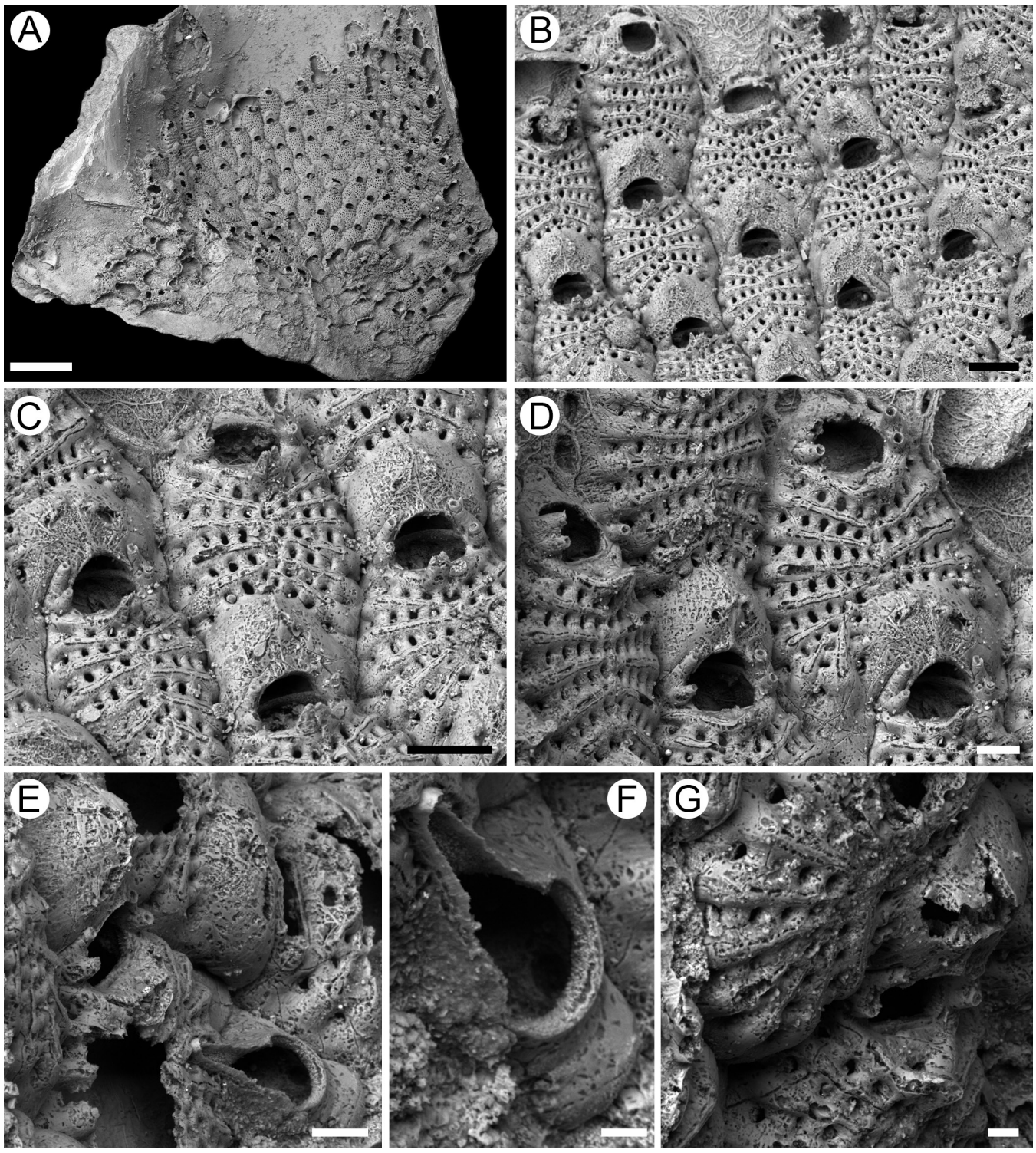

Figure 27. *Puellina quadrispinosa* n. sp., holotype, UF 265772. **A.** general view of the colony encrusting a bivalve shell; **B.** group of ovicellate and non-ovicellate zooids; **C, D.** close-ups of ovicellate and non-ovicellate zooids showing four oral spines and bifid, pointed apertural bar; **E.** oblique view of an autozooid with interzooidal avicularium resting on its frontal shield; **F.** close-up of the interzooidal avicularium; **G.** close-up of the apertural bar showing the central lacuna. Scale bars: A = 500 μm; B, C = 100 μm; D, E = 50 μm; F, G = 20 μm.

avicularia; *P. tutissima* Winston, 2016 has curved avicularia and costate ovicells. Cenozoic records of *Puellina* from the Western Atlantic are limited: *P. crassilabiata* Canu and Bassler, 1923, from the Pliocene of South Carolina, has only three oral spine bases and two small, adventitious avicularia lateral to the orifice; and *P. rosefieldensis* McGuirt, 1941, from the Oligocene of Louisiana, has interzooidal avicularia, with a very long, straight, distally directed rostrum.

Genus *SPINIFLABELLUM* DI MARTINO and ROSSO, 2015

SPINIFLABELLUM JACKSONI N. SP.

Figured material.—Holotype, UF 274574 (Fig. 28) and paratype, UF 274575 (Fig. 29), two colonies encrusting the same bivalve shell as *Floridina appendiculata* n. sp., TU Loc. 547.

Zoobank Nomenclatural Act.—1D30A79C-C7D4-4DC8-BBD1-460BDBDB6873.

Etymology.—Named in honor of Prof. Jeremy B. C. Jackson, Emeritus at the NMNH, Washington DC, who strongly encouraged our study of the bryozoan fauna from the Chipola Formation.

Diagnosis.—Colony encrusting. Ancestrula tatiform. Autozooids elliptical. Frontal shield formed by 16–21 costae separated by 4–6 intercostal pores. A prominent, tubular pelmatidium on costae forming the central part of the frontal shield. Distalmost pair of costae bifid and converging across orifice. Primary orifice semicircular. Two platy elements, terminating in two or three, coalescent oral spines. Adventitious avicularia rare, pedunculate, triangular, lacking a pivotal bar. Kenozooids sporadically present. Pore-chamber windows visible at colony edges.

Description.—Colony encrusting, multiserial, unilaminar (Figs. 28A, 29A). Ancestrula tatiform, 215 μm long by 180 μm wide, with an indeterminate number of spines owing to overgrowth, at least six visible on the available specimen, surrounded by seven autozooids (Fig. 28B). Autozooids distinct with deep interzooidal furrows, elliptical or rounded polygonal, longer than broad (mean L/W 1.47). Frontal shield convex, formed by 16–21 costae, variable in width (18–56 μm), each separated by 4–6 circular, minute (less than 10 μm in diameter) intercostal pores (Figs. 28C–D, 29A–C). Costae converging and fused at zooidal midline; a prominent tubular pelmatidium, 15–25 μm long, 8–12 μm in diameter, is located at about two-thirds of the total length of each costa (Figs. 28C–D, 29B), with the exception of the distalmost and proximalmost pairs of costae, which lack pelmatidia. Distalmost pair of costae bifid, the anterior bifurcations converging across orifice, forming a wide arch obscuring the primary orifice in frontal view (Figs. 28D, 29C), completely smooth or bearing two pelmatidia per costa. Primary orifice semicircular (Fig. 28E–F), slightly broader than long, with the proximal margin varying from straight to concave or convex. Two platy elements, each terminating in two or three, coalescent, hollow spines are placed distolaterally to the orifice (Figs. 28C, F, 29C). Adventitious avicularia rare, small, 50–60 μm long, pedunculate, single, on the distolateral corner of bifurcated costae; rostrum pointed triangular, distolaterally directed, pivotal bar absent (Figs. 28F, 29C). Sporadic, hollow, tubular kenozooids along zooidal margin, evident when broken (Fig. 28E). An uncertain number of oval pore-chamber windows visible at colony growing edge (Fig. 29A–B). Ovicells not observed.

Measurements.—ZL 395±23, 349–434 (1, 20); ZW 269±29, 216–321 (1, 20); OL 78±6, 70–87 (1, 7); OW 93±11, 78–107 (1, 7).

Remarks.—*Spiniflabellum jacksoni* n. sp. is the first fossil representative of this genus introduced by Di Martino and Rosso (2015) for a Recent species, *S. spinosum* (Canu and Bassler, 1928) that was originally placed in *Gephyrothes* Norman, 1903. *Spiniflabellum spinosum* has been recorded from northern Cuba and the Strait of Florida at depths of 102–262 m. The new fossil species differs from *S. spinosum* in having smaller autozooids (on average 395 μm long by 269 μm wide in *S. jacksoni* n. sp., vs 500 μm long by 324 μm wide in *S. spinosum*), a single pelmatidium instead of three per costa, fewer platy elements, coalescent oral spines, and in the presence of kenozooids. The shape, size, position and direction of the adventitious avicularia is similar in *S. jacksoni* n. sp. and *S. spinosum* but the frequency and distribution

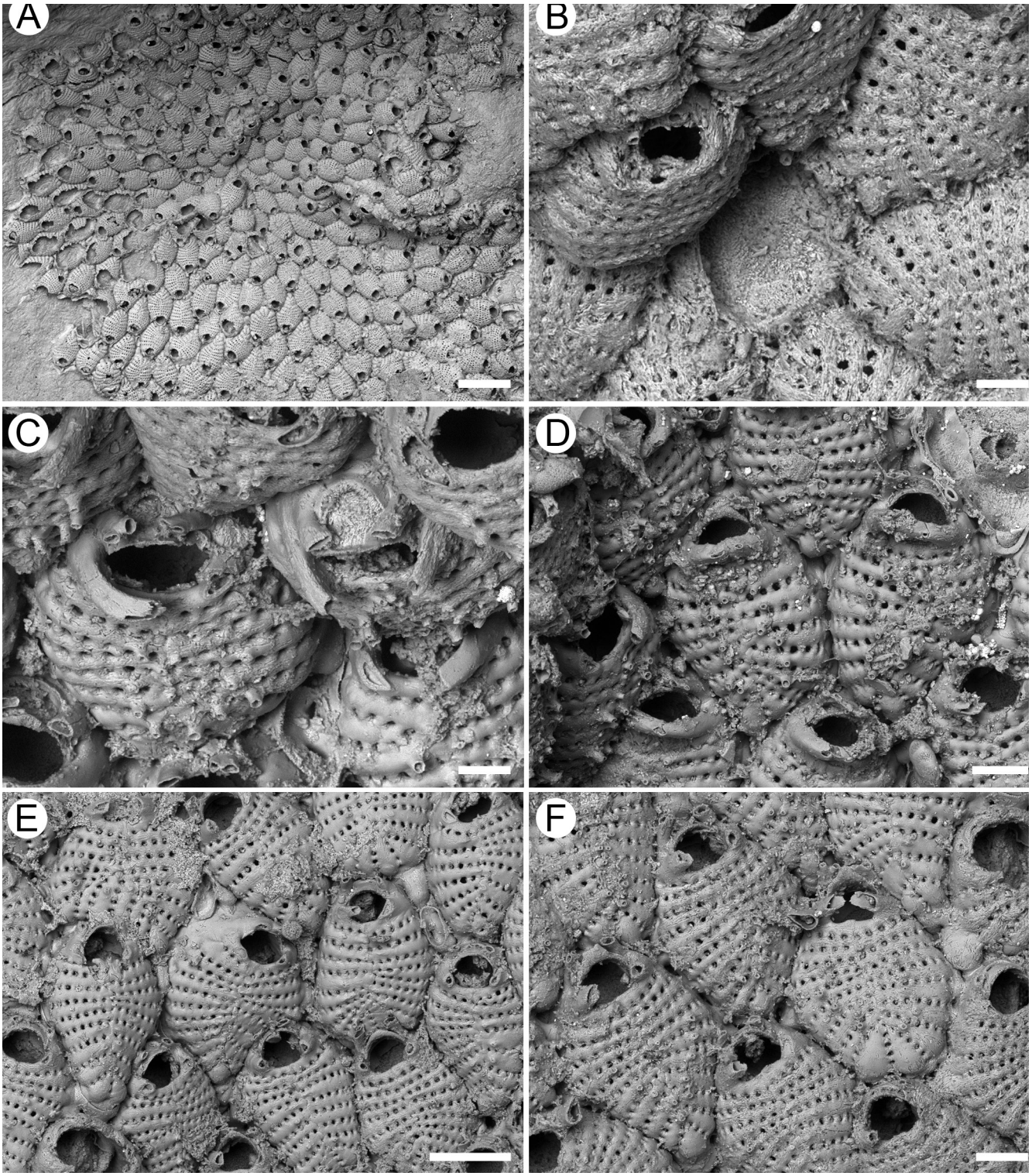

Figure 28. *Spiniflabellum jacksoni* n. sp., holotype, UF 274574. **A.** general view of the colony encrusting a bivalve shell; **B.** close-up of the tatiform ancestrula; **C, D.** close-up of autozooids showing the prominent tubular pelmatidia and the bifid distalmost pair of costae converging across the orifice; **E.** group of autozooids showing the semicircular orifice and tubular kenozooids along zooidal margins; **F.** group of autozooids with pedunculate adventitious avicularia; note the raised crest of calcification originating from the distal margin of the orifice and turning upwards in the two central zooids. Scale bars: A = 500 μm; B, C = 50 μm; D, F = 100 μm; E = 200 μm.

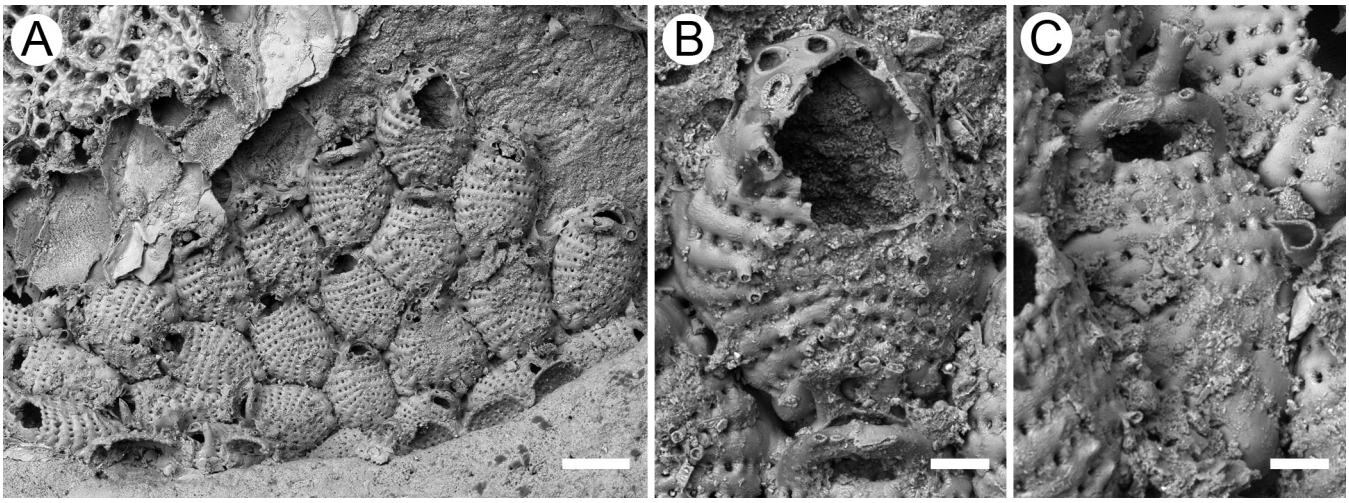

Figure 29. *Spiniflabellum jacksoni* n. sp., paratype, UF 274575. **A.** general view of the colony encrusting a bivalve shell; **B.** close-up of an autozooid at colony growing edge showing pore-chamber windows; **C.** close-up of an autozooid with the distalmost pair of costae converging across the orifice and distal platy elements terminating with coalescent spines; a pedunculate avicularium associated with the zooid on the bottom right is also visible. Scale bars: A = 200 μm; B, C = 50 μm.

of these polymorphs differs: avicularia are rare and single in *S. jacksoni*, while they are constantly present and paired in *S. spinosum*. A further Recent species, *Rosulapelta floridana* (Smitt, 1873), shares several features with *Spiniflabellum* spp., including all of the diagnostic characters of the genus, i.e., frontally projecting tubular pelmatidia, primary orifice obscured by a robust pair of bifurcations of the distalmost pair of costae, and coalescent, hollow spines distal to the orifice (see Winston, 2016:36, fig. 19), suggesting that this species may fit better in *Spiniflabellum* than in *Rosulapelta* Winston and Vieira, 2013. *Spiniflabellum jacksoni* differs from *S. floridanum* n. comb. in the number of costae, which are more numerous in the former species than the latter, and in its thinner pelmatidia. A raised crest of calcification, originating from the distal margin of the orifice and turning upwards, was observed in some zooids of *S. jacksoni* (Fig. 28F), but its function remains unknown.

Superfamily HIPPOTHOOIDEA BUSK, 1859
Family HIPPOTHOIDAE BUSK, 1859
Genus *HIPPOTHOA* LAMOUROUX, 1821
HIPPOTHOA SP.

Figured material.—UF 265668 (Fig. 30), TU Loc. 548.

Description.—Colony encrusting, uniserial. Ancestrula subcircular, ca. 210 μm long by 180 μm wide, orifice obliterated by sediment, frontal shield gymnocystal, convex and smooth, a low ridge containing a narrow median fissure present proximally to the orifice; two zooids budded distolaterally from the ancestrula (Fig. 30A). Autozooids oval, longer than wide (ca. 330 μm long by 200 μm wide; L/W 1.65), with a markedly wrinkled gymnocyst (Fig. 30B). Orifice as long as wide (ca. 60 μm), rounded distally and with a moderately deep U-shaped sinus proximally (Fig. 30B). Female zooids not observed.

Remarks.—*Hippothoa* sp. is very rare in the Chipola Formation. The specimens available for study were limited to those figured, the paucity of material possibly being the reason why Scolaro (1968) did not include the taxon in his work. A single species of *Hippothoa* was previously reported from Florida, *H. balanophila* Winston and Håkansson, 1986. This Recent species has very small, keeled autozooids and prefers barnacle plates as a substratum.

The fossil record of *Hippothoa* is sparse, undoubtedly because its colonies are extremely fragile. Four species have been recorded from the

Cenozoic of Europe, including the widespread *H. flagellum* Manzoni, 1870. Canu and Bassler (1920:327, pl. 44, fig. 5) mentioned the occurrence of a single zooid of an undetermined species of *Hippothoa* in the Chipola Formation at Chipola River.

Family TRYPOSTEGIDAE GORDON, TILBROOK and WINSTON *in* WINSTON, 2005
Genus *TRYPOSTEGA* LEVINSEN, 1909
TRYPOSTEGA VOKESI N. SP.

Trypostega venusta Scolaro (1968), p. 125, pl. 8, fig. 1.

Figured material.—Holotype, UF 189093 (Fig. 31A–D), TU Loc. 821; paratype, UF 189058 (Fig. 31E–F), TU Loc. 824.

Zoobank Nomenclatural Act.—26D46A54-A472-4C45-9655-37FA982E4CC7.

Etymology.—Named after Prof. Harold E. Vokes, formerly a malacologist and paleontologist at Tulane University, who collected the specimens in 1967.

Diagnosis.—Colony encrusting. Basal pore-chamber windows present. Autozooids rhomboidal or irregularly polygonal. Frontal shield gymnocystal, smooth, regularly perforated by ca. 50 pseudopores, smaller above the orifice. Suboral umbo developed only in early budded zooids. Orifice cleithridiate. Ovicell flattened, rounded, perforated, with a zooeciule embedded at the distal apex. Zooeciules randomly located within the colony.

Description.—Colony encrusting, multiserial, unilaminar, circular, 1–2 mm in diameter, thin, 80–90 μm in height. Basal pore-chamber windows visible in autozooids at the colony growing edge, circular or elliptical, small, 20–40 μm long by 10–30 μm wide, evenly spaced (Fig. 31A–B). Autozooids arranged quincuncially, distinct with shallow interzooidal furrows, elongate (mean L/W 1.40), rhomboidal or irregularly polygonal (Fig. 31A–B). Frontal shield flat or slightly convex, smooth, regularly perforated by 38–60, most commonly ca. 50, relatively large, round, funnel-shaped pseudopores; pores distal to the orifice smaller than those on the center of the frontal, 5–10 μm in diameter vs. 10–15 μm respectively, aligned in an arch; an imperforate suboral umbo is faintly developed in early budded zooids (Fig. 31A, C). Orifice keyhole-shaped (cleithridiate), slightly longer than broad (mean L/W 1.17), with a rounded to plectrum-shaped anter separated by small, medially directed, triangular condyles from a shallow, V-shaped poster, extended for one-third of orifice total length (Fig. 31E–F). Ovicell flattened around the margins, slightly convex centrally, rounded,

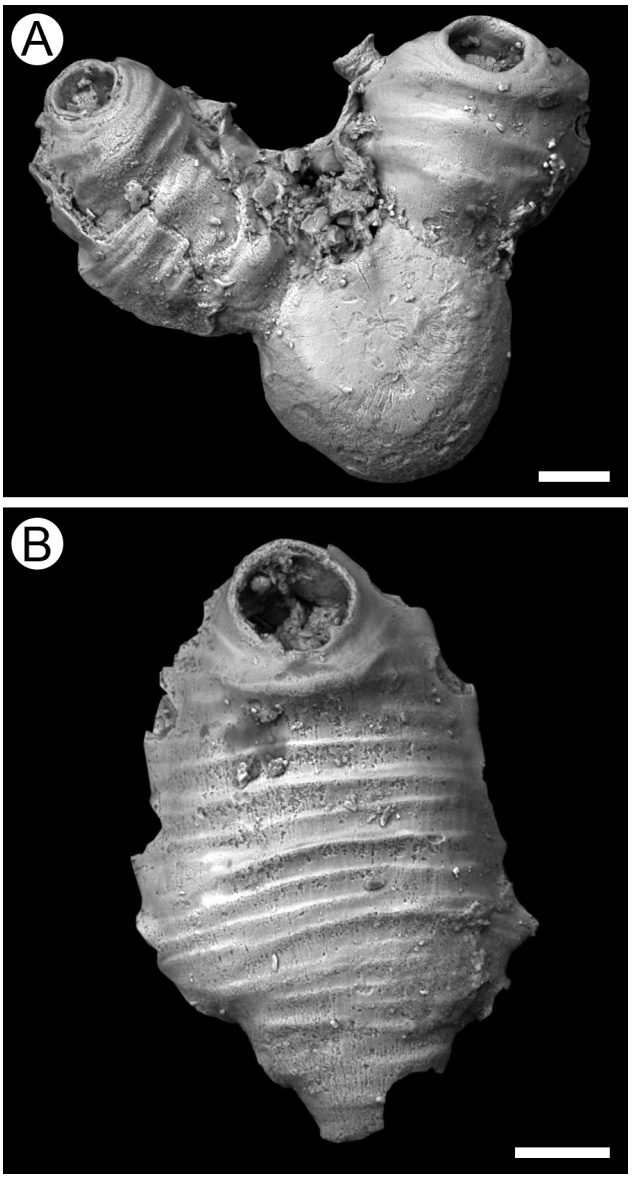

Figure 30. *Hippothoa* sp., UF 265668. **A.** ancestrula and a pair of distolaterally budded zooids; **B.** autozooid. Scale bars: A, B = 50 μm.

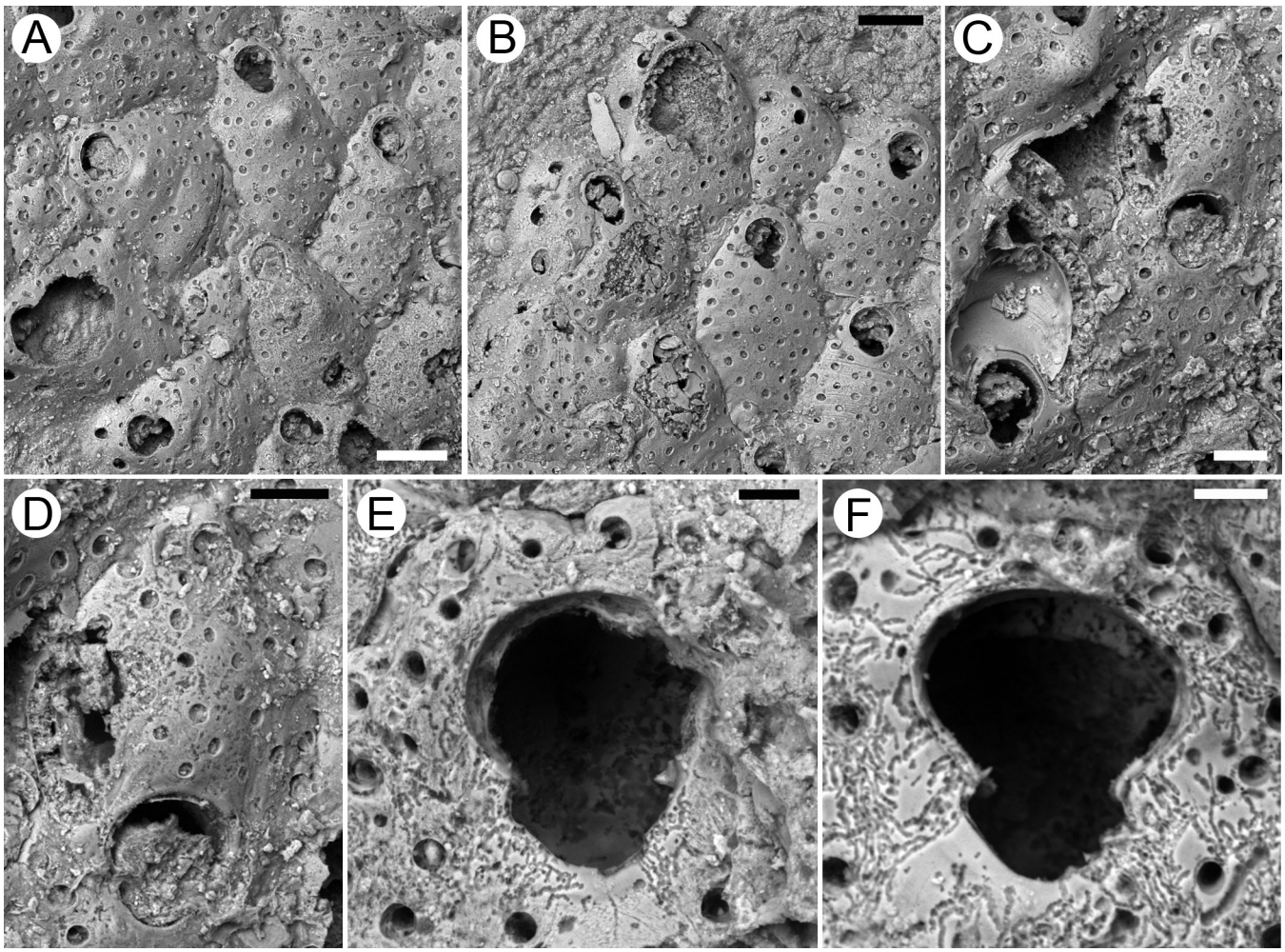

Figure 31. *Trypostega vokesi* n. sp. **A–D.** holotype, UF 189093. **A, B.** groups of autozooids and zooeciules; **C.** ovicellate zooids; **D.** close-up of an ovicell. **E, F.** paratype, UF 189058, close-ups of the orifice. Scale bars: A, B = 100 μm; C, D = 50 μm; E, F = 20 μm.

160–180 μm long by 175–180 μm wide, evenly perforated as frontal shield of zooids, with a zooeciule embedded in the distal center (Fig. 31C–D); orifice of ovicellate zooids as in non-ovicellate zooids. Zooeciules randomly placed within the colony, often distal to autozooids, but sometimes laterally, isolated or in clusters, rhomboidal to rounded pentagonal, variable in size, perforated by 8–22 pseudopores, with a small, sinuate opening (Fig. 31A–B). Closure plates and intramural reparative buds often occur (Fig. 31A–B).

Measurements.—ZL 310±32, 249–384 (2, 25); ZW 222±27, 167–293 (2, 25); ZcL 157±37, 107–239 (2, 11); ZcW 151±30, 106–225 (2, 11); OL 75±8, 66–93 (2, 13); OW 64±6, 55–74 (2, 13).

Remarks.—This new species, previously identified as the widespread Recent species *Trypostega venusta* (Norman, 1864) by Scolaro (1968), differs in the variable presence of the umbo, which is developed in all autozooids of *T. venusta*. The presence of the umbo in *T. vokesi* n. sp. seems to be restricted to early budded zooids, while in *T. venusta* the umbo increases in height through astogeny, often overarching the proximal edge of the orifice (Tilbrook, 2006). The present-day distribution of *T. venusta* is limited to the NE Atlantic Ocean, from southern Britain to Madeira and into the Mediterranean Sea (Tilbrook, 2006).

Six species of *Trypostega* have been described from the Western Atlantic, three from the Eocene of USA (*T. elongata* Canu and Bassler, 1920, *T. inornata* (Gabb and Horn, 1862) and *T. undulata* Canu and Bassler, 1920) and three from the Recent (*T. ilhabelae* Winston and Vieira, 2013, *T. striatula* (Smitt, 1873) and *T. tropicalis* Winston et al., 2014). All differ from *T. vokesi* n. sp. in various characters: *T. elongata* has slender zooeciules and prominent, carinated ovicells; *T. inornata* has very small zooeciules constantly placed distally to each autozooid and an imperforate frontal shield; *T. undulata* is characterized by distinct transverse undulations; *T. striatula* has marked longitudinal striations; *T. ilhabelae* has a large umbo; and *T. tropicalis* has sharply projecting orificial condyles.

Family PASYTHEIDAE DAVIS, 1934
Genus *PASYTHEA* LAMOUROUX, 1812
PASYTHEA SP.

Figured material.—UF 265677 (Fig. 32), TU Loc. 548.

Description.—Colony erect, flexible. Internodes formed by single or paired triads of zooids, 200–250 μm wide (Fig. 32A, C, E–F). The median zooid only is connected to the kenozooidal stem by a short (100–170 μm), tubular stalk, while the lateral zooids are budded off from the sides of the median zooid. Autozooids distinct, bounded by narrow furrows, club-shaped. Frontal shield

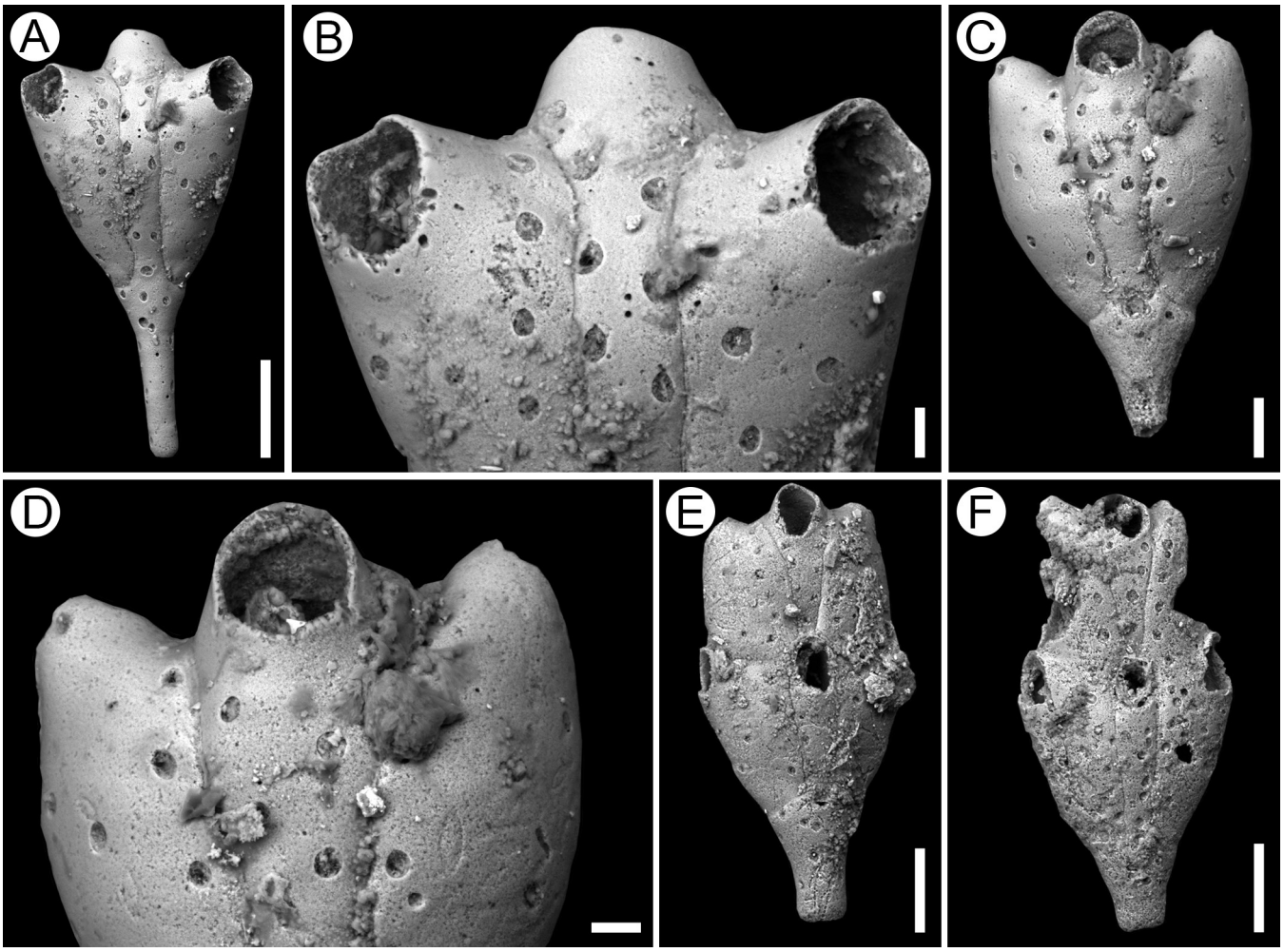

Figure 32. *Pasythea* sp., UF 265677. **A, C.** internodes formed by single triads; **B, D.** close-ups of autozooidal orifices; **E, F.** internodes formed by paired triads. Scale bars: A, E = 100 μm; B, D = 20 μm; C = 50 μm.

convex, smooth, with scattered, funnel-shaped pseudopores, 5–10 μm in diameter. Orifice small, as long as wide, rounded distally and with two faint lateral indentations defining a shallow bowl-shaped sinus (Fig. 32B, D). Orifice of the median zooid facing frontally, those of flanking zooids facing laterally or in the opposite direction (Fig. 32B, D). Avicularia and ovicells lacking.

Measurements.—ZL 209±23, 180–255 (3, 12); OL 50±8, 43–62 (3, 4); OW 48±3, 43–50 (3, 4).

Remarks.—There is no report of *Pasythea* sp. in Scolaro (1968), possibly because only a few internodes were available for study. Since its introduction by Lamouroux (1812), *Pasythea* has been confused and synonymised several times with the allied genus *Gemellipora* Smitt, 1873. *Pasythea* differs from *Gemellipora* in having a central axis formed exclusively of elongate kenozooids instead of autozooids, and internodes made up of triads of zooids instead of pairs (Osburn, 1940). Two species of *Pasythea* are currently known: the type species, *P. tulipifera* (Ellis and Solander, 1786), living today in the Caribbean, Brazil and western Africa, and *P. laevigata* (Waters, 1883), a fossil species from the Miocene of SE Australia. The morphological simplicity of this taxon, along with the scarcity of available specimens, impedes the recognition of clear distinctions between the Chipola Formation species and *P. tulipifera* and *P. laevigata* using published figures and descriptions. However, based on the SEM illustration published by P. Bock at bryozoa.net by (accessed 06.28.2016), *P. laevigata* differs from *P.* sp. in having pseudopores with a thick rim and a central, smaller opening, while *P. tulipifera* has a slightly larger orifice, 70–80 μm long by 60 μm wide (Osburn, 1940).

Superfamily ARACHNOPUSIOIDEA JULLIEN, 1888
Family ARACHNOPUSIIDAE JULLIEN, 1888
Genus *PORICELLA* CANU, 1904
PORICELLA MUCRONATA (SMITT, 1873)

Escharipora (?) *mucronata* Smitt (1873), p. 24, pl. 5, figs. 113–115.

Tremogasterina truncatorostris Canu and Bassler (1923), p. 244, pl. 47, fig. 6.

Tremogasterina granulata Canu and Bassler (1928), p. 45, pl. 13, figs. 3, 4, pl. 33, fig. 2, text-figs. 6B–F.

Tremogasterina ventricosa Canu and Bassler (1928), p. 47, pl. 13, figs. 1, 2.

Tremogasterina malleolus Canu and Bassler (1928), p. 48, pl. 13, figs. 5–8, pl. 33, fig. 8.

Tremogasterina sparsipora Canu and Bassler (1928), p. 50, pl. 33, fig. 3.

Tremogasterina mucronata Powell and Cook (1967), p. 9, pl. 1, figs. a, b; Scolaro (1968), p. 108, pl. 5, figs. 1, 2.

Figured material.—UF 265605 (Fig. 33A), UF 265604 (Fig. 33E–F), TU Loc. 820; NHMUK PI BZ 7821, (Fig. 33B–D), TU Loc. 828.

Description.—Colony encrusting or erect bilamellar from an encrusting base. Autozooids usually indistinct, confluent with adjacent zooids in the central part of the colony/branch (Fig. 33A, E); zooids at colony growing edge have a better defined oval outline, with deep interzooidal furrows occupied by a row of circular, marginal areolar pores (Fig. 33B, F). Frontal shield coarsely tuberculate, depressed centrally, perforated by 2–6, more often three, rarely 7–8, bean-shaped to subcircular foramina (Fig. 33A–B, E–F); foramina varying in size depending on number present, 50–130 μm long. Orifice subcircular with straight or slightly concave proximal margin, almost equidimensional (mean L/W 0.97). Four widely spaced oral spine bases (Fig. 33B–D); proximalmost pair the largest, ca. 25 μm in diameter, distocentral spine base ca. 15 μm in diameter; two oral spine bases remain visible in ovicellate zooids. A robust, pointed suboral mucro occurs medially (Fig. 33B–D, F), 90–100 μm high. A large, spatulate adventitious avicularium, placed laterally and parallel to the orifice, distally directed, with a flared, truncated, sometimes raised and upcurved rostrum, and a complete pivotal bar (Fig. 33B, D); a second, smaller, spatulate avicularium associated with the ovicell, obliquely, distally or proximally directed (see arrows in Fig. 33A, C). Ovicells prominent, globular, as coarsely tuberculate as the frontal shield, imperforate (Fig. 33C–D).

Measurements.—OL 196±14, 177–216 (2, 8); OW 203±22, 172–232 (2, 8); OvL 180±32, 134–215 (2, 12); OvW 264±22, 239–319 (2, 12); AvL 298±48, 205–371 (3, 25); AvW 127±14, 102–156 (3, 25).

Remarks.—*Poricella mucronata* is a common and abundant species at Chipola River and,

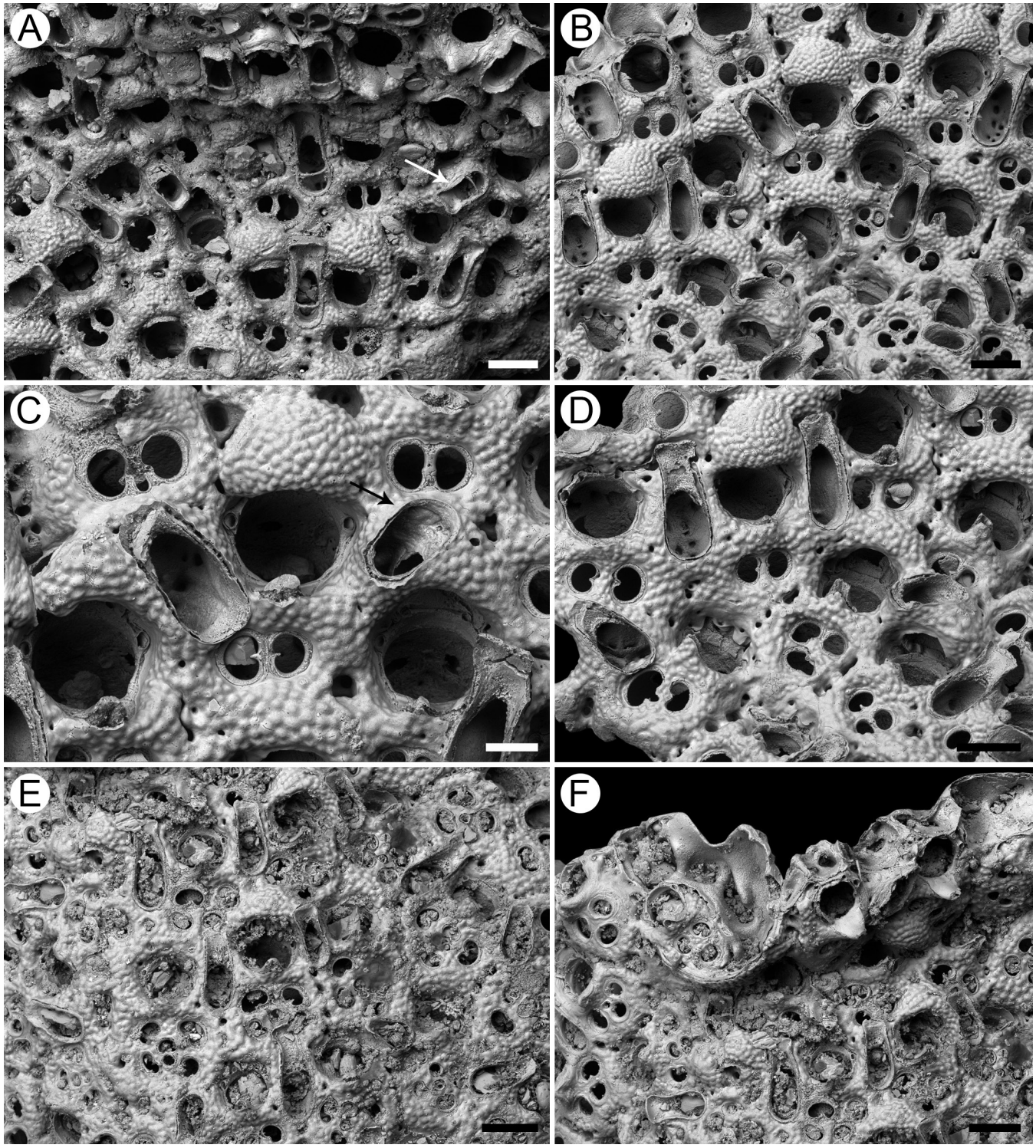

Figure 33. *Poricella mucronata* (Smitt, 1873). **A.** UF 265605, group of ovicellate zooids and spatulate avicularia; **B–D.** NHMUK PI BZ 7821. **B.** group of ovicellate and non-ovicellate zooids with two or three frontal foramina, suboral mucro and spatulate avicularia; **C.** close-up of an ovicellate zooid with paired spatulate avicularia; **D.** group of zooids and spatulate avicularia with flared, truncated rostrum. **E, F.** UF 265604, group of zooids with frontal shield perforated by numerous frontal foramina. Scale bars: A, B, D, E, F = 200 μm; C = 100 μm.

especially, at the Farley Creek localities. Study of the type material, coupled with the large intraspecific variability shown by this species (e.g., number of frontal foramina, presence/absence of avicularia, presence/absence of the suboral mucro), led Powell and Cook (1967) to synonymize *P. mucronata* with several species described as new by Canu and Bassler (1923, 1928) (see synonymy above). *Poricella mucronata* can be distinguished from other fossil and Recent congenerics known from the region: the Florida Miocene *P. horrida* (Canu and Bassler, 1923) differs in having pointed triangular and slightly curved avicularia, as well as an elongate orifice; the Plio-Pleistocene *P. lidgardi* (Taylor and Foster, 1994) from Tobago is characterized by a ropey pattern of calcification of the frontal shield; and the Recent *P. lanceolata* (Canu and Bassler, 1928) from Cuba differs in having lanceolate instead of spatulate avicularia. In addition to the Chipola Formation, *P. mucronata* has been recorded as a fossil in the late Pliocene Bowden Formation of Jamaica and in the Pliocene of Panama. Its present geographical distribution includes the Gulf of Mexico and the Caribbean, at depths of 66–507 m (Powell and Cook, 1967).

Family EXECHONELLIDAE HARMER, 1957
Genus *EXECHONELLA* DUVERGIER, 1924
EXECHONELLA ANTILLEA (OSBURN, 1927)

Lepralia antillea Osburn (1927), p. 128, fig. 6.

Exechonella pumicosa Canu and Bassler (1928), p. 70, pl. 14, fig. 1.

Exechonella antillea Osburn (1950), p. 95, pl. 10, figs. 9, 10; Scolaro (1968), p. 112, pl. 5, fig. 3.

Figured material.—UF 265570 (Fig. 34), TU Loc. 821.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 34A). Putative ancestrula similar to budded autozooids but smaller, 505 µm long by 350 µm wide (Fig. 34B). Small, numerous, marginal septular pores visible on the distal, inner margin of broken zooids (Fig. 34A). Autozooids distinct with shallow interzooidal furrows, quincuncially arranged, rhomboidal, large, longer than wide (mean L/W 1.30). Frontal shield convex, evenly perforated by 50–60 circular foramina, 15–30 µm in diameter, each surrounded by a thick rim of smooth calcification producing a mosaic pattern (Fig. 34C); adjacent rims are sometimes coalescent, becoming trifoliate, elliptical, or irregularly shaped, and enclosing two or more foramina. Orifice subcircular, nearly as long as wide, anter rounded, proximal border straight or slightly concave, condyles placed at about half-length, small, triangular, rounded, medially directed (Fig. 34D). Peristome widely flared, greatly developed laterally (Fig. 34C–D). Ovicells absent.

Measurements.—ZL 712±66, 628–868 (1, 15); ZW 547±77, 416–715 (1, 15); OL 157±6, 149–164 (1, 5); OW 152±8, 141–162 (1, 5).

Remarks.— The occurrence of *Exechonella antillea* in the Chipola Formation represents the first fossil record of this species. The species lives today at depths of 9–73 m in the Caribbean, from Curacao to Puerto Rico, Tortugas, and off Miami. Chipola Formation specimens were found associated with localities interpreted as reef environments (Scolaro, 1968).

EXECHONELLA MINUTIPERFORATA N. SP.

Dakaria sp. Scolaro (1968), p. 145, pl. 11, figs. 2, 3.

Figured material.—Holotype, NHMUK PI BZ 7822 (Fig. 35), (30.46586, -85.14812; WGS84), Farley Creek, USA, Florida, Calhoun County.

Zoobank Nomenclatural Act.—F2D13311-E636-4020-AF1C-99307F23DA6B.

Etymology.—Referring to the minute size of the foramina on the frontal shield.

Diagnosis.—Colony encrusting. Ancestrula flask-shaped. Marginal septular pores at zooidal margins. Autozooids rhomboidal. Frontal shield perforated by 80–100 minute foramina, each surrounded by a rim. Orifice elongate, with arched anter and deep sinus, surrounded by a thick, short peristome.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 35A). Ancestrula flask-shaped, 610 µm long by 320 µm wide, with a bell-shaped orifice, 170 µm long by 140 µm wide, occupying its entire distal part, frontal shield as in later autozooids (Fig. 35B). First budded zooid placed distolaterally, similar to later autozooids but smaller, 480 µm long by 330 µm wide (Fig. 35B).

Small, numerous, closely spaced, marginal septular pores at zooidal margins, subcircular to oval, 10–30 μm long (Fig. 35B–C). Autozooids distinct with shallow interzooidal furrows and a raised laminar border, quincuncially arranged, rhomboidal, large, longer than wide (mean L/W 1.39). Frontal shield convex, evenly perforated by 80–100 minute, circular foramina, less than 5 μm in diameter, each foramen surrounded by a thick rim of smooth calcification producing a mosaic pattern (Fig. 35C–D). Orifice slightly longer than broad, the arched anter separated from the deep, wide sinus by faint condyles appearing more like lateral constrictions at about half-length (Fig. 35E). Peristome thick, slightly raised proximally, greatly raised laterally and distally (Fig. 35C–E). Ovicells absent.

Measurements.—ZL 659±64, 535–733 (1, 8); ZW 474±35, 401–509 (1, 8); OL 155±8, 147–161 (1, 8); OW 131±8, 124–144 (1, 8).

Remarks.—The type specimen of *Exechonella minutiperforata* n. sp. was found in new samples collected during March 2016. Scolaro (1968) identified this species as *Dakaria* sp., which is now considered a junior synonym of *Watersipora* Neviani, 1896, although *Watersipora* lacks distinct marginal areolar pores, having occasional intrazooidal septulae proximolateral to the orifice and at the proximolateral corners of the frontal shield (Vieira et al., 2014b). *Exechonella minutiperforata* n. sp. is rare, only two colonies having been found

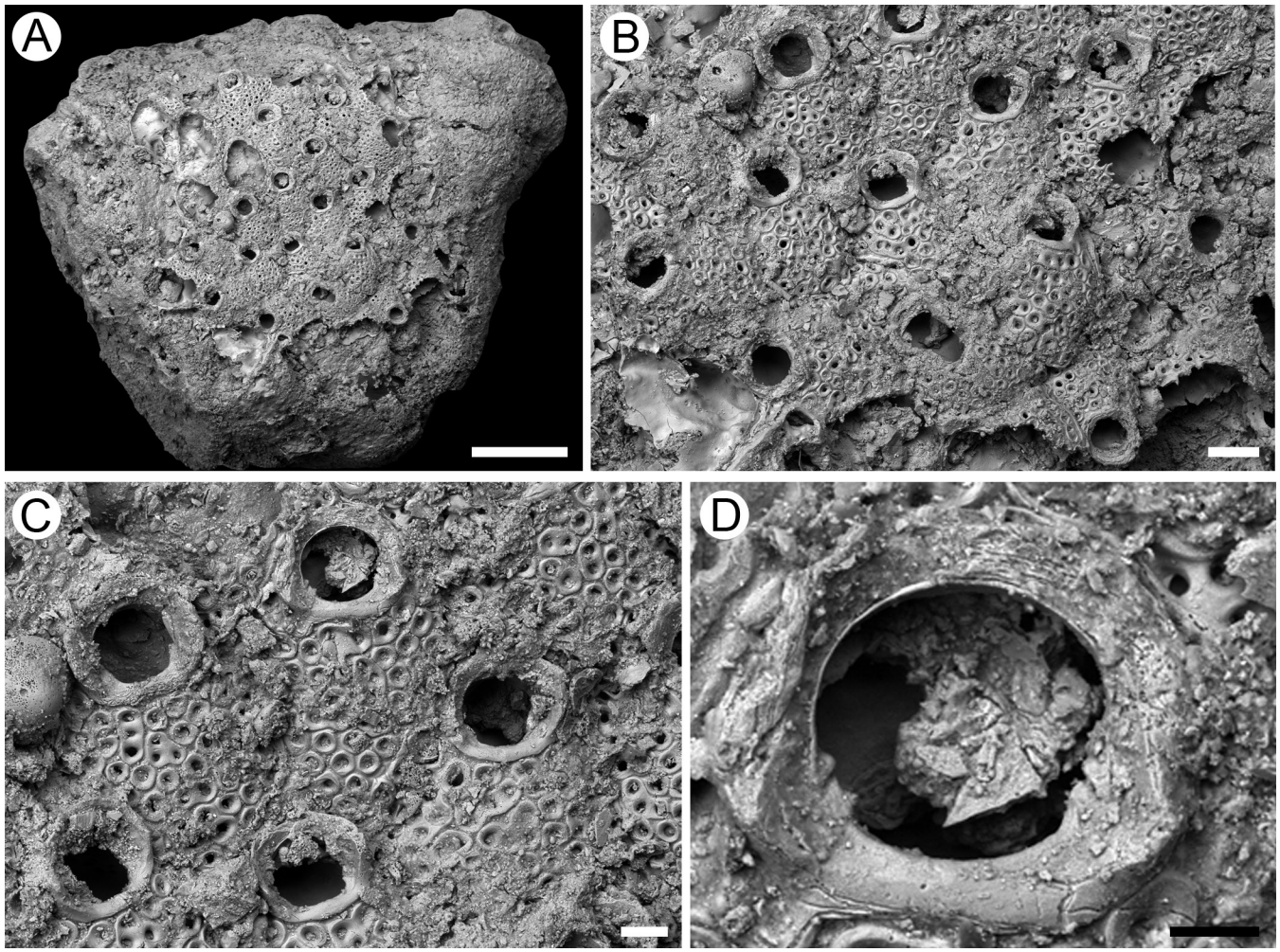

Figure 34. *Exechonella antillea* (Osburn, 1927), UF 265570. **A.** general view of the colony; **B.** group of autozooids including putative ancestrula (bottom right); **C.** close-up of three autozooids; **D.** close-up of an orifice. Scale bars: A = 1 mm; B = 200 μm; C = 100 μm; D = 50 μm.

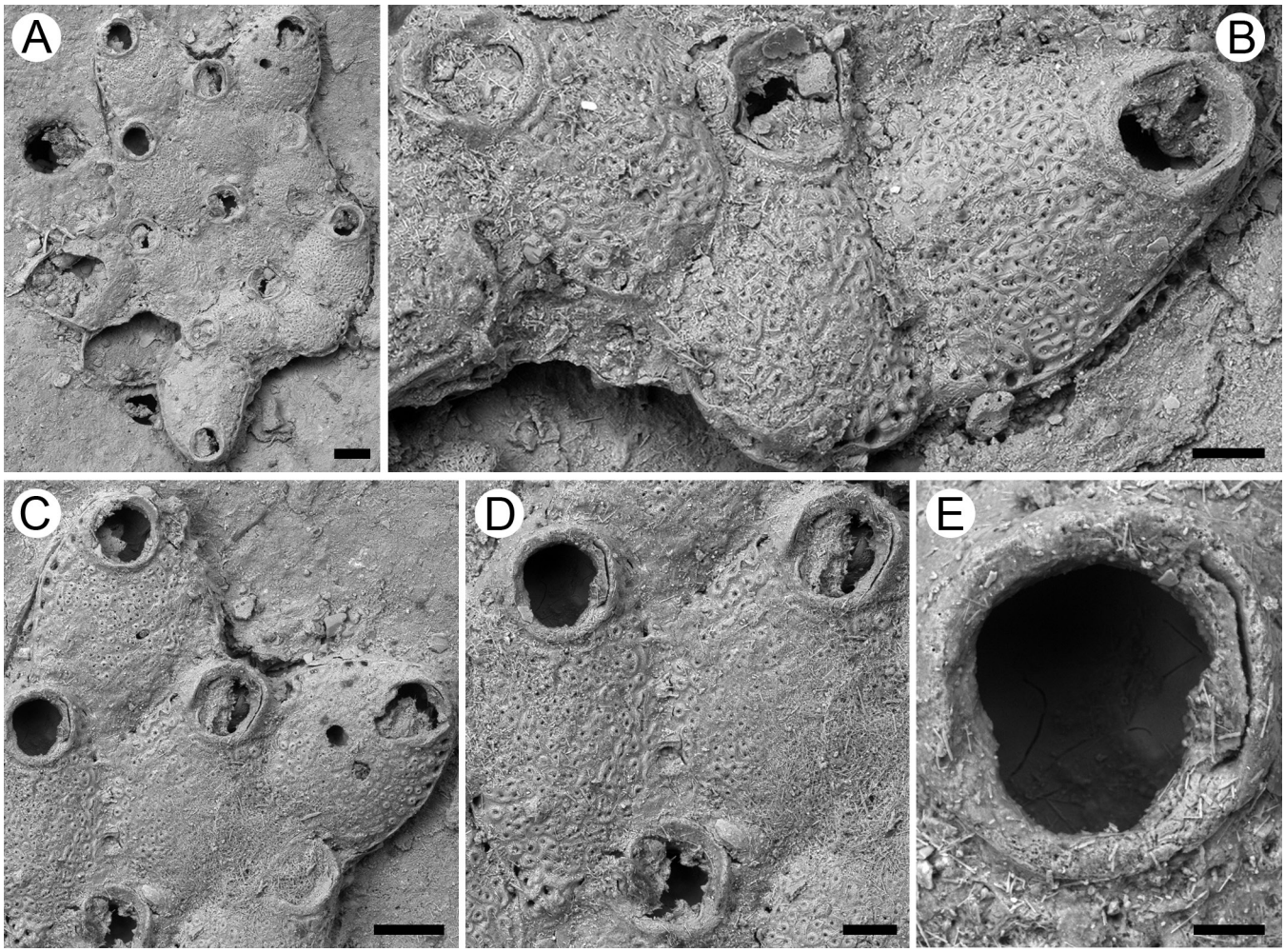

Figure 35. *Exechonella minutiperforata* n. sp., holotype, NHMUK PI BZ 7822. **A.** general view of the colony; **B.** close-up of the flask-shaped ancestrula and early budded autozooids; **C.** autozooids at the colony growing edge showing marginal septular pores along the margins; **D.** close-up of two autozooids; **E.** close-up of an orifice. Scale bars: A, C = 200 μm; B, D = 100 μm; E = 40 μm.

by Scolaro (1968), one at Chipola River (TU Loc. 547) and the other at Farley Creek (TU Loc. 825). The minute size of the foramina piercing the frontal shield distinguishes *E. minutiperforata* from *E. antillea*, the only congeneric species known from the region and present in the Chipola Formation.

Superfamily ADEONOIDEA BUSK, 1884
Family ADEONIDAE BUSK, 1884
Genus *ADEONELLOPSIS* MACGILLIVRAY, 1886
ADEONELLOPSIS SANDBERGI N. SP.

Adeonellopsis 'A' n. sp. Scolaro (1968), p. 169, pl. 16, figs. 3–4.

Figured material.—Holotype, NHMUK PI BZ 7823 (Fig. 36B–E) and paratype, NHMUK PI BZ 7824 (Fig. 36A), TU Loc. 828; paratype, UF 265694 (Fig. 36F–H), TU Loc. 458.

Zoobank Nomenclatural Act.—6ADEA842-F4C8-4527-BC81-FC8A3F505975.

Etymology.—Named to honor recently deceased Philip A. Sandberg, pioneer in the use of the SEM in the study of microscopic features of invertebrates, including Bryozoa, and their skeletal ultrastructure.

Diagnosis.—Colony rigidly erect, bilamellar, with strap-like branches. Autozooids elongate with

frontal shield centrally occupied by a U-shaped depression containing orifice, suboral avicularium and multiporous spiramen. Marginal, areolar pores present. Suboral avicularium touching the proximal margin of the secondary orifice, distally directed. Frontal avicularia occasionally present.

Description.—Colony erect, rigid, arising from an encrusting base (Fig. 36A–B, F). Branches bilamellar, flattened, strap-like, ca. 2 mm wide, bifurcating dichotomously (Fig. 36A–B, F). Autozooids distinct with shallow interzooidal furrows, arranged in alternating parallel rows, becoming less distinct in older branches with ontogenetic skeletal thickening, elliptical, more than twice as long as wide (mean L/W 2.16), apparently monomorphic. Frontal shield coarsely granular, inflated at the margins, with a U-shaped depression at its center containing the orifice, suboral avicularium and multiporous spiramen (Fig. 36C, F), tending to be completely occluded by frontal thickening later in ontogeny (Fig. 36D–E). Marginal, areolar pores subcircular to oval, 20–25 μm long, distributed in one complete row around periphery of young zooids (Fig. 36F), obliterated by secondary calcification in older zooids (Fig. 36D–E). Spiramen placed proximal to middle of the frontal shield, made up to four, small, stellate perforations, 15–20 μm in diameter (Fig. 36F–G). Secondary orifice semicircular with a serrated proximal margin not visible frontally (Fig. 36H). Suboral avicularium present on each autozooid, medially placed; rostrum pointed triangular, distally or distolaterally directed, touching the proximal margin of the secondary orifice or slightly below it (Fig. 36D–F); pivotal bar and condyles absent; a pair of small circular pores, placed just below the orifice, flanking the avicularium tip. An additional adventitious avicularium may originate from areolae on the proximal margin of the frontal shield (Fig. 36D–E), similar in shape to suboral avicularium but slightly smaller and with a somewhat curved rostrum, proximally or laterally directed. Fertile zooids and interzooidal avicularia not observed.

Measurements.—ZL 340±36, 288–416 (3, 25); ZW 158±15, 131–183 (3, 25); OL 58±6, 48–67 (2, 10); OW 76±4, 71–84 (2, 10); AvL (suboral) 97±9, 79–111 (3, 25); AvW (suboral) 57±7, 44–75 (3, 25); AvL (frontal) 83±11, 65–105 (1, 12); AvW (frontal) 61±7, 53–72 (1, 12).

Remarks.—The multiporous spiramen observed in *Adeonellopsis sandbergi* n. sp. is a feature shared by several late Paleogene species from the Gulf Coast deposits of the USA, while tropical American Neogene species usually possess a simple single pore (Cheetham et al., 2007). An exception is *A. cribrospiramen* Cheetham et al., 2007, from the early–middle Miocene Baitoa Formation of the Dominican Republic, which is most similar to the Chipola Formation species but differs principally in having a well-defined, subcircular disk enclosing up to five perforations forming the spiramen. Compared to the late Paleogene species described by Canu and Bassler (1920) (e.g., *A. magniporosa*, *A. porosa*, *A. quisenberryae*) the multiporous spiramen of *A. sandbergi* n. sp. is notably smaller. The serrated proximal margin of the orifice is a character shared with *A. subsulcata* (Smitt, 1873), a Recent species known from Florida, the Caribbean, Bermuda and Cape Hatteras (Winston, 2005). However, this particular feature in *A. subsulcata* appears visible only on young zooids in inclined view.

Genus *TRIPORULA* CANU and BASSLER, 1927

TRIPORULA COCCINELLA (CANU and BASSLER, 1923) N. COMB.

Adeonellopsis coccinella Canu and Bassler (1923), p. 161, pl. 24, figs. 5–8.

Anarthropora coccinella Scolaro (1968), p. 167, pl. 16, figs. 1, 2.

Figured material.—NHMUK PI BZ 7825 (Fig. 37A–D), TU Loc. 828; UF 265738 (Fig. 37E–F), TU Loc. 821.

Description.—Colony encrusting, multiserial, uni- or multilaminar (Fig. 37A). Autozooidal boundaries marked by narrow grooves or discontinuous, irregular channels in which a variable number of areolar pores are placed (Fig. 37B–C). Autozooids oval, lozenge- or irregularly shaped (Fig. 37B–C), longer than broad (mean L/W 1.48). Frontal shield flat, thickly calcified,

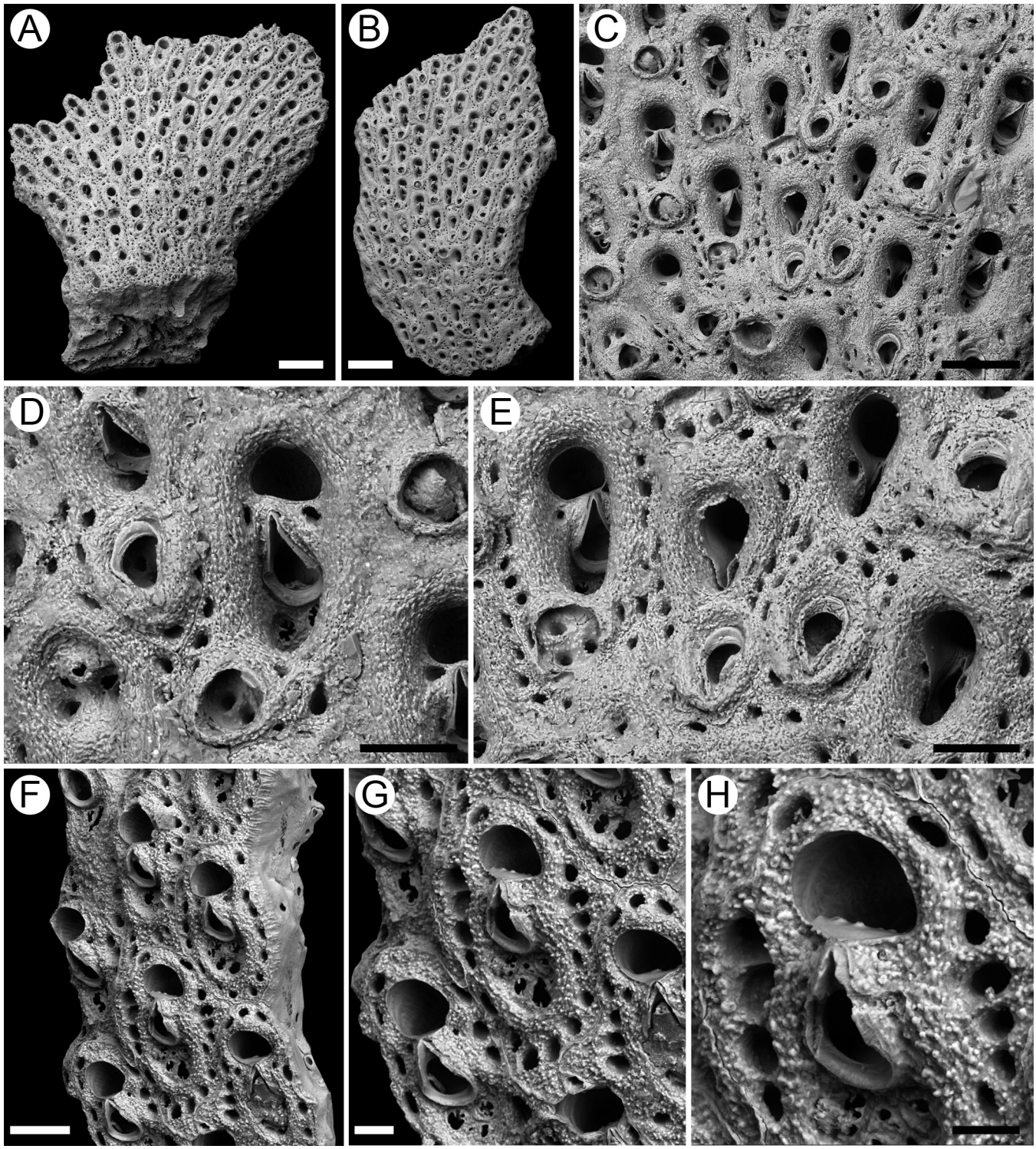

Figure 36. *Adeonellopsis sandbergi* n. sp. **A.** paratype, NHMUK PI BZ 7824, general view of a basal fragment. **B–E.** holotype, NHMUK PI BZ 7823. **B.** general view of a branch fragment; **C.** group of autozooids; **D.** close-up of an autozooid showing the stellate perforations of the multiporous spiramen; **E.** group of autozooids characterized by frontal thickening occluding the multiporous spiramen and suboral avicularium. **F–H.** paratype, UF 265694. **F.** group of autozooids showing the stellate perforations of the multiporous spiramen; **G.** close-up of an autozooid; **H.** close-up of the semicircular orifice with serrated proximal margin. Scale bars: A, B = 400 μm; C = 200 μm; D, E, F = 100 μm; G, H = 40 μm.

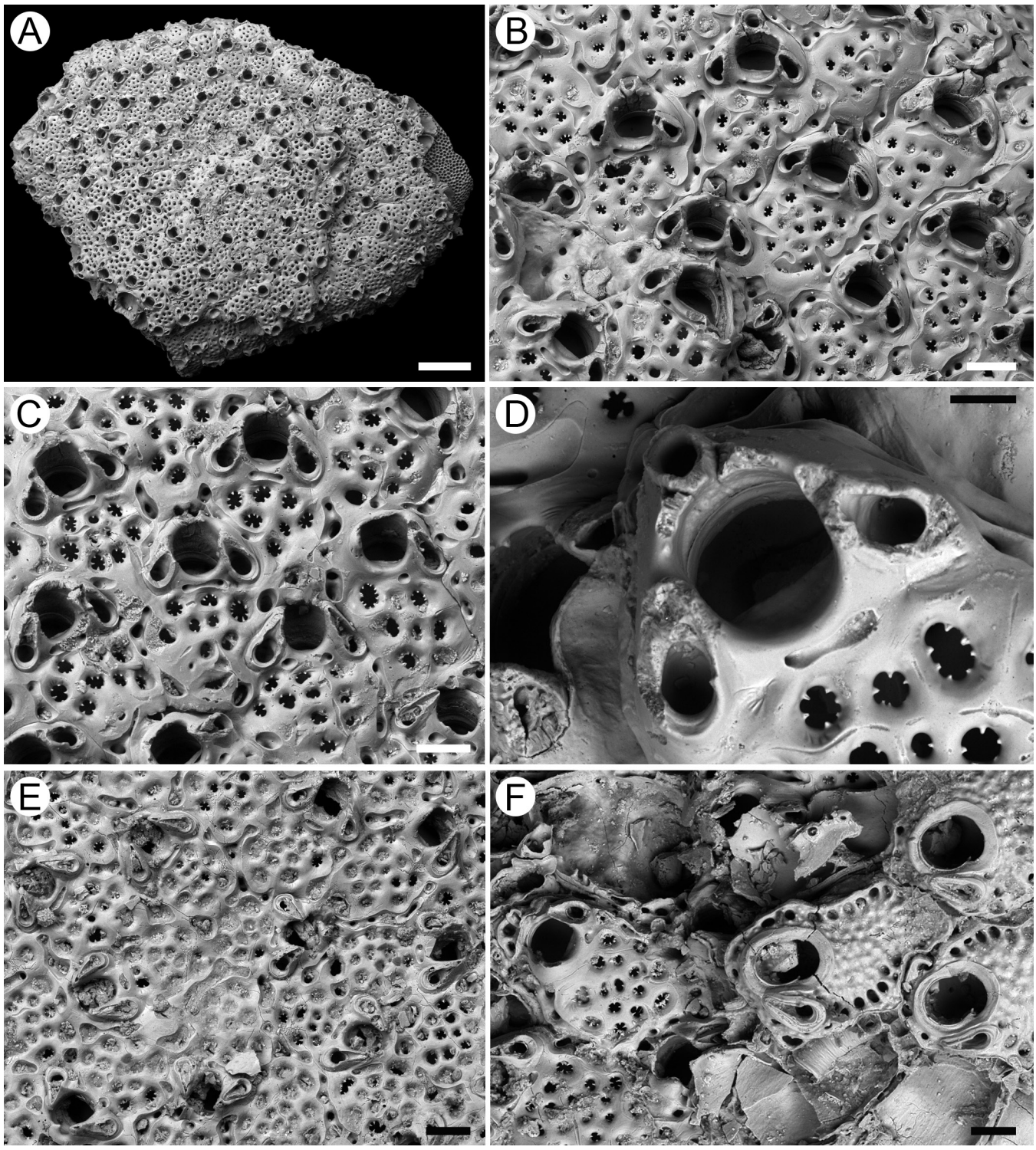

Figure 37. *Triporula coccinella* (Canu and Bassler, 1923) n. comb. **A–D.** NHMUK PI BZ 7825. **A.** general view of a bilaminar colony encrusting a fragment of *Halimeda*; **B.** group of overgrowing autozooids; **C.** group of autozooids with two or three avicularia surrounding the orifice; **D.** close-up of the primary orifice. **E, F.** UF 265738. **E.** ancestrula and early astogeny; **F.** zooids showing pore-chamber windows along the margins, overgrown by *Hippaliosina rostrigera* (Smitt, 1873). Scale bars: A = 500 μm; B, C, E, F = 100 μm; D = 50 μm.

smooth-textured, with 5–15 large stellate pores, 12–35 μm in diameter, each at the center of a depression. Areolar pores variable in size and shape from circular, to oval or slit-like. Primary orifice transversely D-shaped (Fig. 37D), broader than long, 52 μm long by 98 μm wide, immersed, surrounded by a slightly raised peristome, sloping sharply proximally and terminating in the proximal rim of the primary orifice. Secondary orifice rounded quadrangular, longer than broad (see measurements below). A pair of small, adventitious avicularia adjacent to the orifice, their bases below it, resting at an angle of approximately 45˚ to the frontal shield surface; rostrum pointed triangular, distally and inwardly directed, indenting the peristome laterally, pivotal bar lacking (Fig. 37B–D). Often, a third, smaller avicularium is inserted at the distal end of the peristome, pointing proximally, sloping steeply distally. Ancestrula similar to later autozooids but smaller, 285 μm long by 178 μm wide, surrounded by eight autozooids (Fig. 37E). Oval or subcircular pore-chamber windows, visible along zooidal margins (Fig. 37F). Ovicells absent.

Measurements.—ZL 364±30, 284–427 (2, 20); ZW 246±18, 212–289 (2, 20); OL 85±6, 76–94 (2, 12); OW 77±5, 70–86 (2, 12); AvL (adjacent to the orifice) 89±17, 67–138 (2, 25); AvL (distal to the orifice) 44±6, 32–58 (2, 10).

Remarks.—*Triporula coccinella* n. comb. was originally described from the Chipola Formation at Chipola River by Canu and Bassler (1923). This species is nearly ubiquitous and extremely abundant at the Chipola River and Farley Creek localities, almost always occurring in association with *Hippaliosina rostrigera* (Smitt, 1873). *Triporula coccinella* appears to be very similar to the Recent Floridan species *T. stellata* (Smitt, 1873). The Miocene species differs in having much smaller zooids (on average 364 μm long by 246 μm wide in *T. coccinella* vs 780 μm long by 510 μm wide in *T. stellata*), avicularia adjacent to the orifice oriented at a different angle, and in the shape of the secondary orifice, longer than broad (mean OL/OW 1.11) in *T. coccinella,* but broader than long (mean OL/OW 0.44) in *T. stellata*.

Superfamily LEPRALIELLOIDEA VIGNEAUX, 1949
Family LEPRALIELLIDAE VIGNEAUX, 1949
Genus *CELLEPORARIA* LAMOUROUX, 1821
CELLEPORARIA CF. *BICORNIS* (CANU and BASSLER, 1923)

cf. *Holoporella bicornis* Canu and Bassler (1923), p. 178, pl. 32, figs. 1–4.

Celleporaria bicornis Scolaro (1968), p. 119, pl. 6, figs. 4–6.

Figured material.—UF 265569 (Fig. 38A–D), TU Loc. 824; UF 265522 (Fig. 38E–G), TU Loc. 555.

Description.—Colony encrusting, multilaminar, mounded, often forming hollow tubes, ca. 4–5 mm in length by 2–3 mm in diameter (Fig. 38A, E). Autozooids irregularly polygonal, erect and jumbled (Fig. 38B, E). Frontal shield convex, pustulose imperforate except for a row of scattered, marginal areolar pores (Fig. 38B, E); areolae circular, small, about 35 μm in diameter. Orifice semicircular with a concave proximal margin bearing, medially or slightly off-centre, three delicate, pointed denticles (Fig. 38C–D). A subcircular avicularium (type 1, Fig. 38C–D), with a toothed rostral rim and complete pivotal bar, is enclosed in the low peristomial rim. On the distal peristomial rim, two robust, widely spaced, oral spine bases, 40–50 μm in diameter (Fig. 38C); a third oral spine base, usually smaller, occurs mediodistally in some zooids (Fig. 38D). Infrequent, large, interzooidal avicularia (type 2), elliptical (Fig. 38E, G) or spatulate (Fig. 38F) with complete crossbar, scattered throughout the colony. Ovicells hood-shaped, widely open, imperforate, and pustulose as the frontal (Fig. 38E, G).

Measurements.—OL 133±9, 124–156 (1, 10); OW 133±9, 119–149 (1, 10); AvL (type 1) 63±19, 45–102 (1, 8); AvW (type 1) 62±18, 49–94 (1, 8); AvL (type 2) 341±45, 286–390 (1, 6); AvW (type 2) 146±9, 135–158 (1, 6); OvL 109±9, 102–118 (1, 3); OvW 217±26, 193–246 (1, 3).

Remarks.—The genus *Celleporaria* is highly diverse: at least 19 Cenozoic and five Recent species have been described from the Western Atlantic/Caribbean region. *Celleporaria bicornis* was first described from the early Pleistocene Waccamaw Formation in South Carolina. The

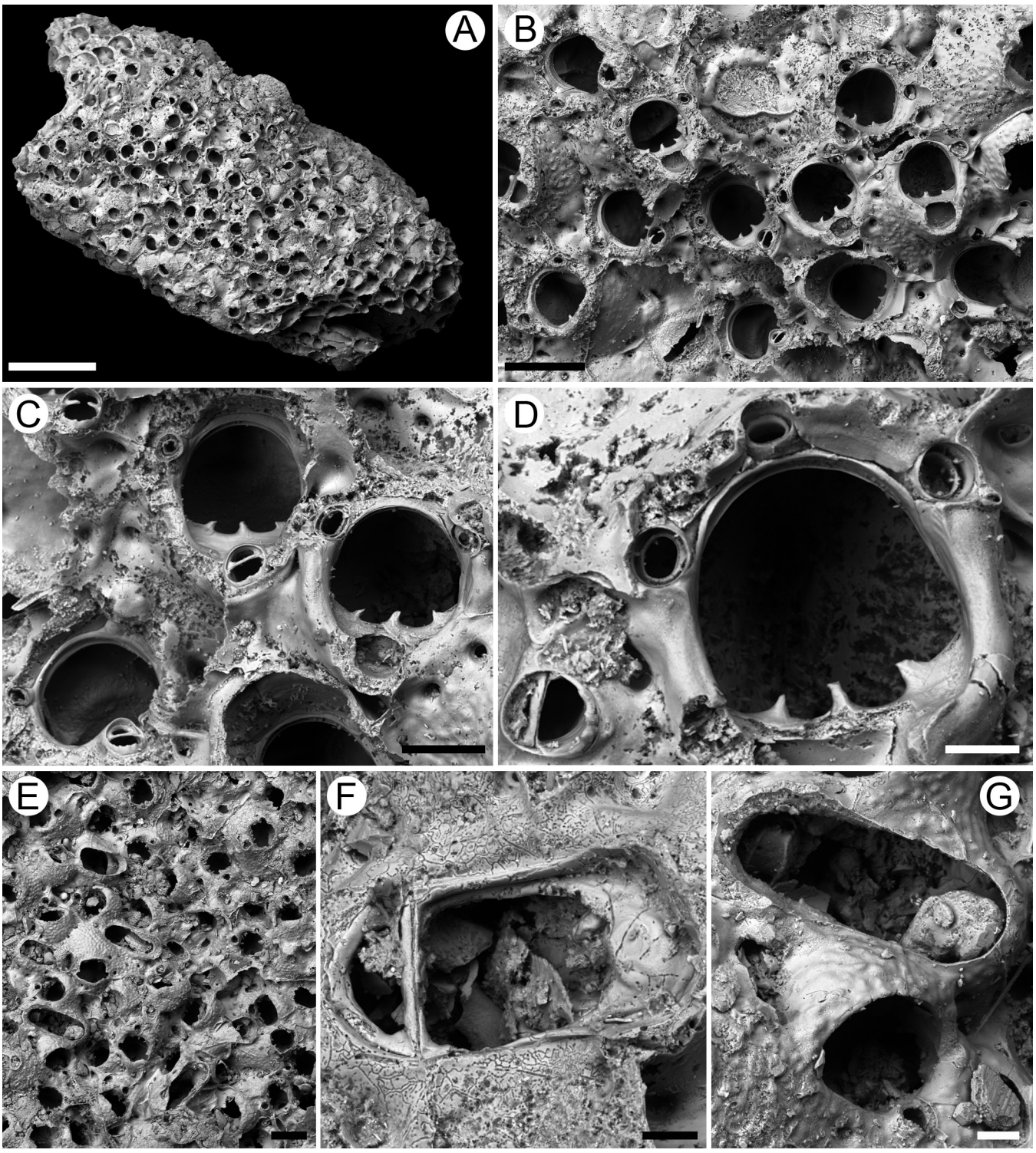

Figure 38. *Celleporaria* cf. *bicornis* (Canu and Bassler, 1923). **A–D.** UF 265569. **A.** general view of the hollow tubular colony; **B.** group of autozooids; **C.** close-up of autozooids showing suboral avicularia with toothed rostral tip; **D.** close-up of the orifice bearing three pointed denticles on the proximal margin. **E–G.** UF 265522. **E.** group of autozooids and large interzooidal avicularia; **F.** close-up of a spatulate avicularium; **G.** close-up of an ovicellate zooid and elliptical interzooidal avicularium. Scale bars: A = 1 mm; B, E = 200 μm; C = 100 μm; D, F = 40 μm; G = 50 μm.

Chipola Formation specimens of *C.* cf. *bicornis* differ from the nominal species in having a pustulose rather than smooth frontal surface, and in the occasional presence of an additional oral spine located mediodistally. The size of the orifice falls within the range given by Canu and Bassler (1923:178). The hollow, tubular form of some colonies, a common colony-form in the Chipola found also among species of *Turbicellepora* and *Rhynchozoon*, appears to be related to ephemeral substrates, such as seagrass stems or algae (e.g., Di Martino and Taylor, 2014; Reich et al., 2015).

CELLEPORARIA MAGNIFICA (OSBURN, 1914)

Holoporella magnifica Osburn (1914), p. 216, figs. 22, 23; Canu and Bassler (1928), p. 143, figs. 7, 8, text-fig. 32; Osburn (1940), p. 455; Osburn (1947), p. 44; Maturo (1957), p. 60, figs. 67, 68.

Celleporaria magnifica Scolaro (1968), p. 120, pl. 7, figs. 1, 2; Winston (1986), p. 13, figs. 23–26; Winston (2005), p. 49, figs. 136–140.

Figured material.—UF 265742 (Fig. 39), TU Loc. 823.

Description.—Colony encrusting, multilaminar, mounded (Fig. 39A). Autozooids irregularly shaped, erect and jumbled (Fig. 39A). Frontal shield convex, rough, imperforate except for a row of scattered, marginal areolar pores; areolae circular, small, about 30 μm in diameter. Orifice subcircular with a straight or slightly concave proximal margin (Fig. 39B); oral spine bases absent. An oval avicularium (type 1, Fig. 39B–C) placed on a massive suboral mucro, with a toothed rostral rim and complete pivotal bar. Infrequent, large, interzooidal avicularia (type 2), varying in size and shape, from narrowly spatulate (Fig. 39C) to broadly spatulate (Fig. 39D), with duck-beak shaped rostrum, complete crossbar and sometimes a median, triangular ligula (Fig. 39D), scattered throughout the colony. Ovicells not observed.

Measurements.—OL 189±10, 167–204 (2, 10); OW 215±17, 180–232 (2, 10); AvL (type 1) 70±20, 46–95 (2, 6); AvW (type 1) 79±42, 51–162 (2, 6); AvL (type 2) 546±54, 383–674 (2, 5); AvW (type 2) 230±54, 160–275 (2, 5).

Remarks.—*Celleporaria magnifica* was first described from the Tortugas, and subsequently reported from Cape Hatteras to Florida, the Caribbean and the Gulf of Mexico (Winston, 2005), at depths of 15–55 m. The Chipola Formation specimens represent the only fossil record of this species. *Celleporaria magnifica* is easily distinguished from its Chipola congenerics, *C.* cf. *bicornis*, by the lack of oral denticles and spines, and the morphology of avicularia.

Family ROMANCHEINIDAE JULLIEN, 1888
Genus *ESCHAROIDES* MILNE EDWARDS, 1836
ESCHAROIDES JOANNAE N. SP.

Escharoides costiferus Scolaro (1968), p. 116, pl. 6, figs. 2–3.

Figured material.—Holotype, UF 265576 (Fig. 40A–D) and paratype, UF 265575 (Fig. 40E–F), TU Loc. 825.

Zoobank Nomenclatural Act.—0FD96E95-ACAA-4A70-A232-E1E97A733203.

Etymology.—Named after JoAnn Sanner, curator of the bryozoan collection at NMNH, Washington DC, for her precious help essential to this and many of our other studies.

Diagnosis.—Colony encrusting. Autozooids rhomboidal to rounded polygonal. Frontal shield tuberculate with large marginal areolar pores and interareolar costae. A well-developed, pointed mucro hiding the orifice. Six oral spine bases in non-ovicellate, four in ovicellate autozooids. Adventitious avicularia paired, rostrum channelled or serrate, distolaterally and outwardly directed, overlapping the frontal shield of adjacent zooids; crossbar complete. Ovicells tuberculate, with a peripheral row of areolae and interareolar ribbing.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 40A). Autozooid distinct, boundaries marked by a fine fissure, quincuncially arranged, rhomboidal to irregularly polygonal, longer than wide (mean L/W 1.23). Frontal shield flat, slightly inflated mediodistally just below the orifice, irregularly tuberculate, with a single row of teardrop-shaped marginal areolar pores, 20–40 μm in length, on lateral and proximal margins, between prominent costae (Fig. 40B–C, E). Distal part of frontal shield projecting over the orifice as a short peristome with median groove on outer surface ending in a stout, pointed mucro, ca. 80 μm in length (Fig. 40C–E). Primary orifice deep. Secondary orifice poorly defined, nearly squared, occupying

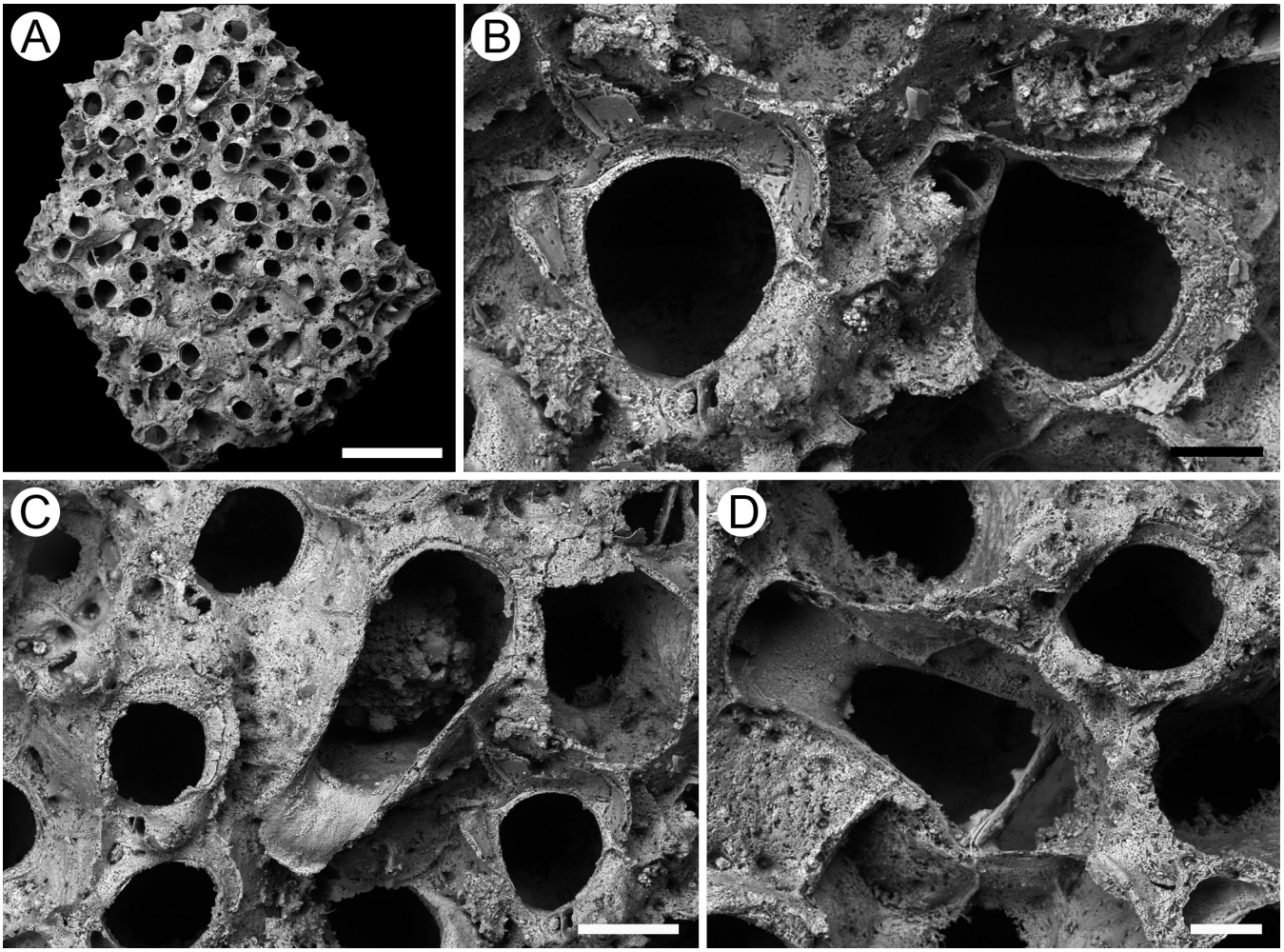

Figure 39. *Celleporaria magnifica* (Osburn, 1914), UF 265742. **A.** general view of the colony; **B.** close-up of orifices and suboral avicularium with toothed rostral rim; **C.** group of autozooids and large interzooidal avicularium with duck-beak shaped rostrum; **D.** close-up of a large interzooidal avicularium with complete crossbar and median ligula. Scale bars: A = 1 mm; B, D = 100 μm; C = 200 μm.

about one-fifth of zooidal frontal length, apparently broader than long, distal margin straight, proximal margin rounded hidden by the mucro, constricted proximolaterally by a pair of robust, rounded denticles (Fig. 40D, F). Six robust oral spine bases in non-ovicellate autozooids (Fig. 40D), four in ovicellate autozooids (Fig. 40E–F), 15–30 μm in diameter, evenly spaced, the proximalmost pair of spines resting on the lateral denticles. Avicularia adventitious, paired, occasionally single, placed on either side of the proximal lip of the orifice (Fig. 40C–F); an additional, inner row of small, subcircular areolae delimiting avicularian chamber from peristome; rostrum triangular and elongate or pear-shaped and squat, pointed or rounded and channelled, serrate or smooth, with distal rostral shelf, distolaterally or laterally directed, its tip overlapping the frontal shield of laterally adjacent autozooid; crossbar complete. Ovicells broader than long, frontal surface moderately convex, irreg-ularly tuberculate, with a peripheral row of teardrop-shaped areolar pores, interareolar ribbing, and scattered additional subcircular pores (Fig. 40C, E–F); ectooecium uncalcified, endooecium con-tinuous with the frontal shield of the next distal zooid.

Measurements.—ZL 416±46, 347–530 (2, 15); ZW 338±50, 272–449 (2, 15); AvL 153±17, 126–153 (2, 20); AvW 76±10, 64–107 (2, 20); OvL 215±20, 181–243 (2, 16); OvW 259±31, 211–313 (2, 16).

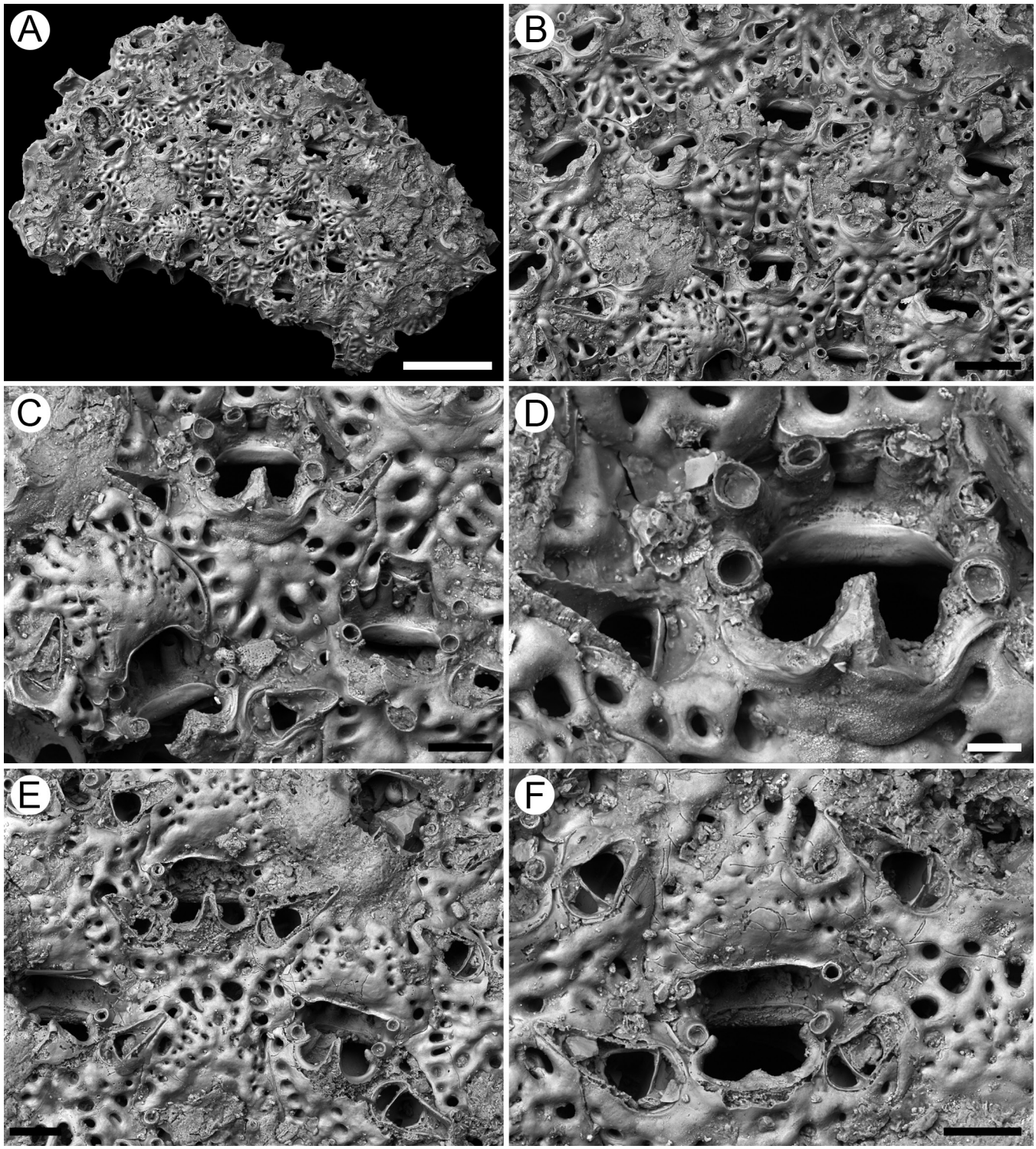

Figure 40. *Escharoides joannae* n. sp. **A–D.** holotype, UF 265576. **A.** general view of the colony fragment; **B.** group of ovicellate and non-ovicellate zooids; **C.** close-up of an autozooid and an ovicell; **D.** close-up of an orifice showing six oral spine bases, suboral mucro and adventitious avicularium with serrate rostrum. **E–F.** paratype, UF 265575. **E.** ovicellate zooids showing four oral spine bases; **F.** close-up of an ovicell. Scale bars: A = 500 μm; B = 200 μm; C, E, F = 100 μm; D = 40 μm.

Remarks.—Most of the specimens of *Escharoides joannae* n. sp. were found at the Farley Creek localities. This species differs from the Pleistocene to Recent Western Atlantic species *E. costifer* (Osburn, 1914) in having non-ovicellate autozooids with six oral spines instead of eight, ovicellate zooids showing four spines instead of six, fewer but larger areolar pores, and avicularia with channelled or serrate rostra. The two species have zooids of similar size. The coeval *E. guraboensis* Cheetham et al., 2007, described from the Gurabo Formation of the Dominican Republic, has six oral spines, like *E. joannae* n. sp., but the areolar pores are smaller and subcircular, and the avicularia are slightly curved and distally directed. Three further species of *Escharoides* were described by Canu and Bassler (1920) from the Eocene–Oligocene of USA: *E. erecta* differs in having up to 8 oral spines and very long, distally directed avicularia; *E. falcifera*, differs in having falciform avicularia; and *E. laticella* has four oral spines, smaller areolar pores and a smooth frontal shield.

Genus *HIPPOPLEURIFERA* CANU and BASSLER, 1925

HIPPOPLEURIFERA MUCRONATA (SMITT, 1873)

Hippothoa mucronata Smitt (1873), p. 45, pl. 8, fig. 169.
Hippopleurifera mucronata Scolaro (1968), p. 114, pl. 5, fig. 4, pl. 6, fig. 1.
Hippopleurifera mucronata Winston (2005), p. 54, figs. 143–145.

Figured material.—UF 265607 (Fig. 41), TU

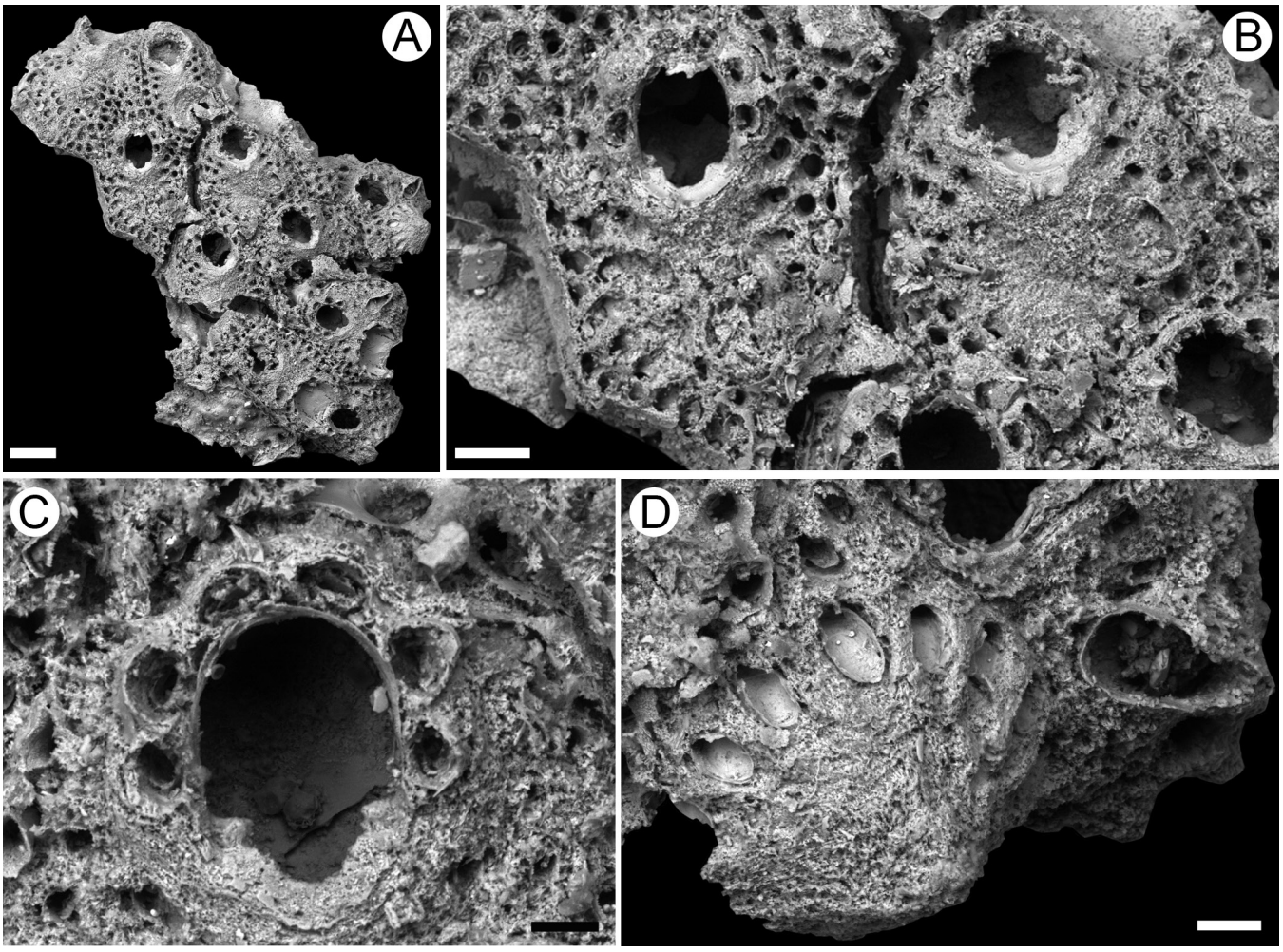

Figure 41. *Hippopleurifera mucronata*, UF 265607. **A.** general view of the colony fragment; **B.** close-up of two autozooids; **C.** close-up of the orifice with six oral spine bases; **D.** close-up of an ovicell and adventitious avicularium. Scale bars: A = 200 μm; B = 100 μm; C, D = 40 μm.

Loc. 820.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 41A). Autozooids distinct, with shallow interzooidal furrows and a very thin raised margin, rhomboidal to hexagonal, longer than wide (mean L/W 1.40). Frontal shield convex, granular, with an imperforate central area, a row of marginal areolar pores and one or two less complete inner rows of pores, giving a faintly ribbed appearance (Fig. 41B). Marginal areolar pores subcircular, 20–30 μm in diameter. Orifice cleithridiate; two rounded condyles, 15 μm long by 15 μm wide, divide a semielliptical anter from a U-shaped sinus (Fig. 41C). A raised collar surrounding the orifice bears six, stout, closely spaced oral spine bases, 35–40 μm in diameter (Fig. 41C). Avicularia occasionally present, adventitious, placed laterally on the frontal shield at about mid-length (Fig. 41A, D); rostrum rounded triangular, slightly curved, laterally directed; crossbar or condyles not observed. Ovicells globose, broader than long, ca. 195 μm long by 250 μm wide, with teardrop-shaped, marginal areolar pores, 40–50 μm long, between ribs of calcification radiating outward from a prominent, central tubercle (Fig. 41D).

Measurements.—ZL 567±67, 520–615 (1, 2); ZW 405±38, 378–432 (1, 2); OL 159±11, 143–167 (1, 4); OW 108±7, 102–118 (1, 4); AvL 123±14, 113–133 (1, 2); AvW 63±8, 57–69 (1, 2).

Remarks.—*Hippopleurifera mucronata* is one of the most common shelf species off the southeast coast of the USA from Cape Hatteras to Florida (Winston, 2005). It also occurs from Baja California to the Galapagos (Osburn, 1952), in the Gulf of California (Soule, 1961), and in the Caribbean (Osburn, 1947). The first mention of *H. mucronata* in the fossil record is from the Pliocene Duplin Formation of North Carolina (Canu and Bassler, 1923:99, pl. 16, fig. 2), in which the species seems to be very rare. Although Scolaro (1968) reported this species as moderately common at Farley Creek, TU Loc. 821, and less common at TU Loc. 820 and 824, only two colonies were found in the collection, the one figured from TU Loc. 820, and an additional colony from the Chipola River, TU Loc. 547. The latter colony is larger and better preserved but, unfortunately, in an adverse position to be imaged by SEM. The presence of the characteristic pointed suboral umbo, rising proximally from the collar around the orifice, is uncertain in the Chipola specimens, perhaps because it has been levelled-off in this corroded material.

Family METRARABDOTOSIDAE VIGNEAUX, 1949
Genus *METRARABDOTOS* CANU, 1914
METRARABDOTOS CHIPOLANUM CHEETHAM, 1968

Metrarabdotos 'A' n. sp. Scolaro (1968), p. 170, pl. 17, figs. 1, 2.

Metrarabdotos (*Biavicularium*) *chipolanum* Cheetham (1968), p. 79, pl. 6, figs. 1, 3, 4.

Metrarabdotos chipolanum Cheetham et al. (2007), p. 58, figs. 25.1–25.3.

Figured material.—UF 265769 (Figs. 42A, 43A), NHMUK PI BZ 7826 (Fig. 42B–C), UF 265770 (Fig. 42E–F), TU Loc. 787; UF 265608 (Figs. 42D, 43B–D), UF 265606 (Fig. 42G–H), TU Loc. 820.

Description.—Colony erect, rigid, arising from an encrusting base. Branches flat, bilaminar. Autozooids distinct with thin raised margins, arranged in alternating rows, irregularly rectangular to claviform in outline (Fig. 42A), more than twice as long as wide (mean L/W 2.27). Frontal shield slightly inflated and coarsely granular at the midline, with a row of 20–24 marginal areolar pores on the proximal and lateral margins, transversely oval or subcircular, 20–30 μm in diameter, separated by prominent ridges (Fig. 42A). Primary orifice subcircular, with a distal shelf, hidden in frontal view by a short, tubular peristomial prolongation of the frontal shield (Fig. 42B). Secondary orifice with a proximal U-shaped notch, bearing medially a short, narrow (ca. 15 μm long by 10 μm wide) denticle with a bifid tip (Fig. 42C–D). Adventitious avicularia usually paired, rarely single, absent in maternal zooids, developed from areolae at the distolateral margin of the peristome, unequal in size (ordinary avicularia *sensu* Cheetham et al., 2007; Figs. 42E–F, 43A); large avicularia 150–230 μm long by 100–130 μm wide, small avicularia 60–85 μm long by 35–60 μm wide, rostrum

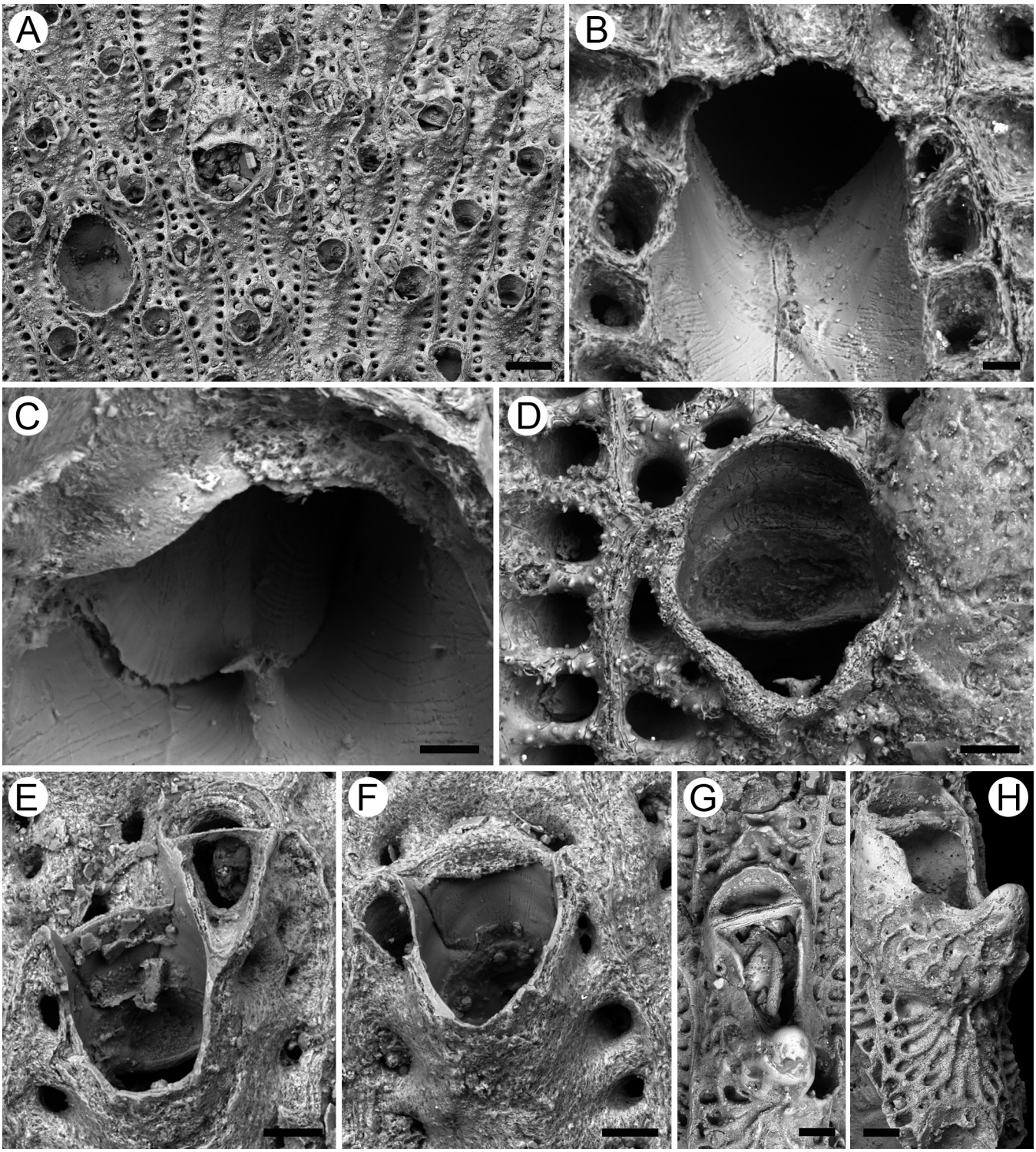

Figure 42. *Metrarabdotos chipolanum* Cheetham, 1968. **A.** UF 265769, group of ovicellate and non-ovicellate zooids; **B, C.** NHMUK PI BZ 7826. **B.** inner view of the primary orifice; **C.** inner view of the bifid denticle. **D.** UF 265608, close-up of the secondary orifice. **E, F.** UF 265770. **E.** close-up of an orifice with a single large adventitious avicularium; **F.** close-up of an orifice with a single small adventitious avicularium. **G, H.** UF 265606, close-ups of two giant lateral avicularia. Scale bars: A = 200 μm; B, C = 20 μm; D, E, F = 50 μm; G, H = 100 μm.

pointed triangular, slightly curved, proximally and inwardly directed, crossbar complete. Giant avicularia (620–730 μm long by 300–350 μm wide) developed on zooids on lateral margins of branches, single or paired with smaller avicularia, rostrum curved upwards proximally directed, crossbar complete (special avicularia *sensu* Cheetham et al., 2007) (Fig. 42G–H). Maternal zooids with dimorphic orifice, much larger than those of autozooids, lacking the proximal denticle and distal shelf; distal lip slightly upturned to form the proximal margin of the ovicell. Ovicells semicircular, broader than long (mean L/W 0.68), finely perforated between radial ribs and tubercles (Fig. 43B–C); evenly spaced marginal areolar pores along lateral and distal margins. Coarsely granular secondary calcification may conceal the ovicells in late ontogeny (Fig. 43D).

Measurements.—ZL 634±85, 456–765 (2, 23); ZW 279±26, 223–350 (2, 23); OvL 250±26, 221–284 (2, 6); OvW 368±18, 351–401 (2, 6).

Remarks.—With 22 species, *Metrarabdotos* Canu, 1914 is one of the most speciose and abundant bryozoan genera in deposits of Neogene age in tropical America (Cheetham et al., 2001). *Metrarabdotos chipolanum* is distinguished from all other species of *Metrarabdotos* by the lack of lateral denticles and the characteristic strongly bifid tip of its median denticle (Fig. 42C–D).

Superfamily SMITTINOIDEA LEVINSEN, 1909
Family SMITTINIDAE LEVINSEN, 1909
Genus *SMITTOIDEA* OSBURN, 1952
SMITTOIDEA CF. *RETICULATA* MACGILLIVRAY, 1842

Smittoidea reticulata Scolaro (1968), p. 128, pl. 8, fig. 2.

Figured material.—UF 265572 (Fig. 44A–D, F–G), TU Loc. 824; UF 265741 (Fig. 44E, H), TU Loc. 823.

Description.—Colony encrusting, multiserial, uni- to multilaminar (Fig. 44A). Autozooids distinct with shallow interzooidal sutures, ill-defined later in ontogeny owing to frontal budding and secondary calcification, arranged in parallel rows, rectangular to polygonal, longer than wide (mean L/W 1.31). Frontal shield flat or slightly convex, coarsely nodular, with a single series of large, conspicuous marginal areolar pores proximally and laterally (Fig. 44B–C); areolae subcircular to elliptical, ca. 40 μm long by 25 μm wide, with short ridges between them. Primary orifice subcircular, about 90 μm in diameter, with an anvil-shaped lyrula, occupying one-third of the proximal border (Fig. 44D–E); distal border rounded, smooth; condyles triangular, pointed, medially or downwards directed. Secondary orifice encircled by a raised peristome, which outlines a U-shaped medioproximal pseudosinus (Fig. 44B–C). Oral spines absent. Suboral avicularium single or absent, placed medially or slightly to one side of the midline on a small umbonate process (Fig. 44B–C); rostrum raised, rounded triangular, proximally directed; crossbar or condyles not observed. Ovicells globular, broader than long, 175 μm long by 220 μm wide; frontal area with scattered, small, circular pores, the base surrounded by a thick, nodular collar extending from the frontal shield of the next distal zooid, becoming completely immersed during later ontogeny (Fig. 44F–H).

Measurements.—ZL 348±36, 278–406 (2, 20); ZW 265±23, 221–309 (2, 20); AvL 83±6, 71–93 (2, 14); AvW 56±11, 40–74 (2, 14).

Remarks.—This rare species was found at three localities at Farley Creek and the Chipola River. *Smittoidea* cf. *reticulata* differs from the nominal Recent species in the lack of oral spines, which are reported as several by MacGillivray (1895:93), although there is no mention of them in his original description (MacGillivray, 1842:467), and as 2–4 small, evanescent spines by Osburn (1950:410). Specimens of *S. reticulata* from the northwestern Gulf of Mexico collected at 128 m depth lacked oral spines (Lagaaij, 1963). Furthermore, the suboral avicularium, which is inconstant in the fossil specimens, but seems to be persistent in the Recent specimens, is positioned close to the orifice in the fossils, but more proximally in Recent colonies. Zooidal length and orificial size are smaller in the fossil species compared to measurements of Recent material reported by Osburn (1950). It is possible that more than one species has been identified as *S. reticulata*.

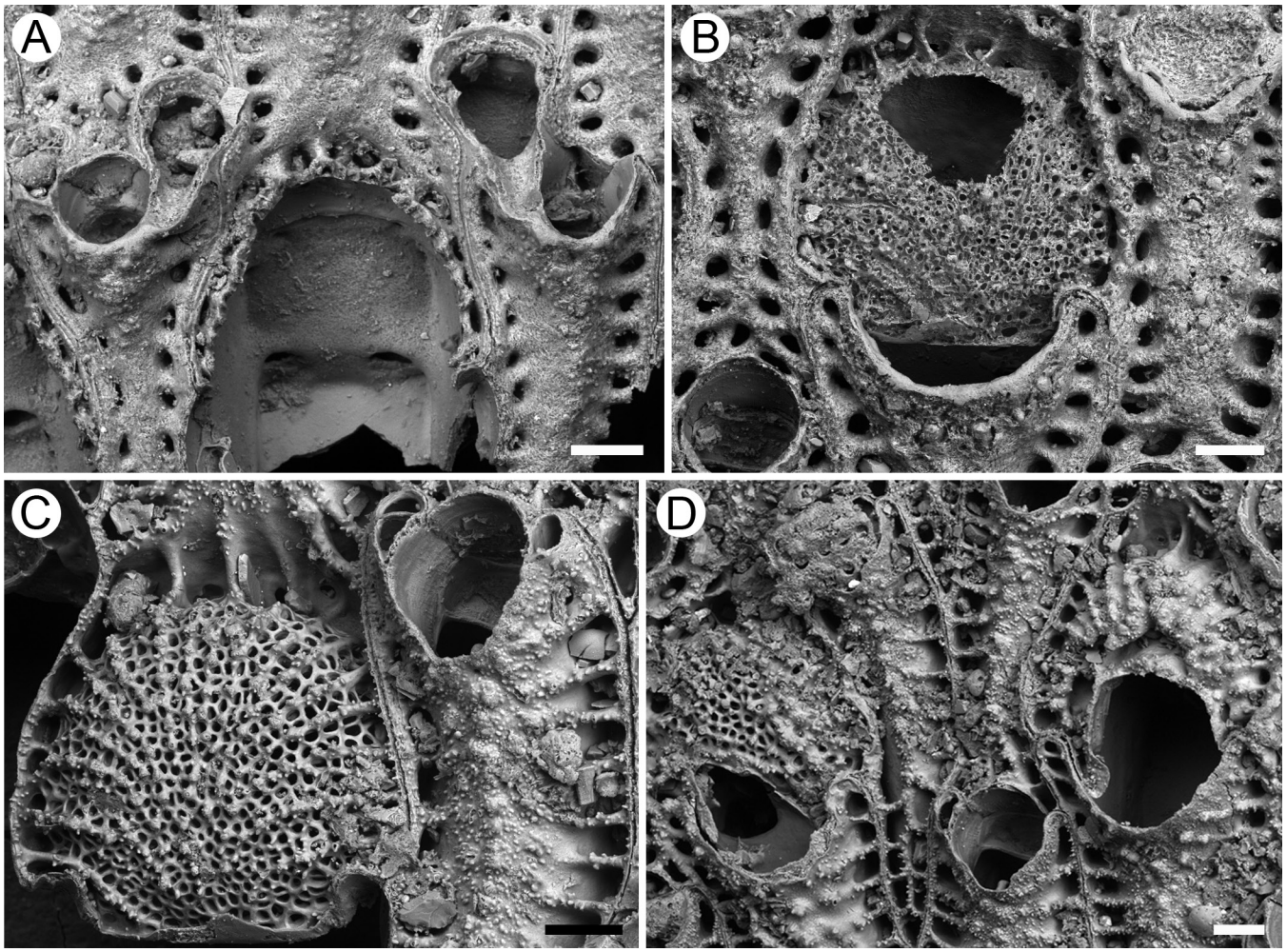

Figure 43. *Metrarabdotos chipolanum* Cheetham, 1968. **A.** UF 265769, close-up of two autozooids with paired avicularia unequal in size. **B–D.** UF 265608. **B, C.** close-ups of two ovicells; **D.** close-ups of ovicells concealed by secondary calcification. Scale bars: A, B, C, D = 100 μm.

Family BITECTIPORIDAE MACGILLIVRAY, 1895
Genus *HIPPOPORINA* NEVIANI, 1895
?*HIPPOPORINA* SP.

?*Hippoporina* 'A' n. sp. Scolaro (1968), p. 152, pl. 13, figs. 3a–c.

Figured material.—UF 265684 (Fig. 45), TU Loc. 547.

Description.—Colony encrusting, multiserial, unilaminar. Autozooids distinct, with shallow interzooidal furrows and a thin, raised thread of calcification, quincuncially arranged, hexagonal, slightly longer than wide (mean L/W 1.14). Frontal shield convex, nodular, perforated by numerous, evenly distributed, funnel-shaped pseudopores, 10–13 μm in diameter, each situated at the center of a polygonal mesh, as well as irregular, marginal, areolar pores (Fig. 45A). Orifice keyhole-shaped (i.e., cleithridiate), a horseshoe-shaped anter separated from a shallow, bowl-shaped sinus by two robust, downwardly directed, pointed condyles (Fig. 45B). Suboral area granular, imperforate, often with a large semicircular notch lateral to the midline, into which an avicularium may possibly be budded. Adventitious, suboral avicularium rounded triangular with two faint condyles, distolaterally directed, indenting the proximolateral margin of the orifice (Fig. 45C). Ovicells not observed.

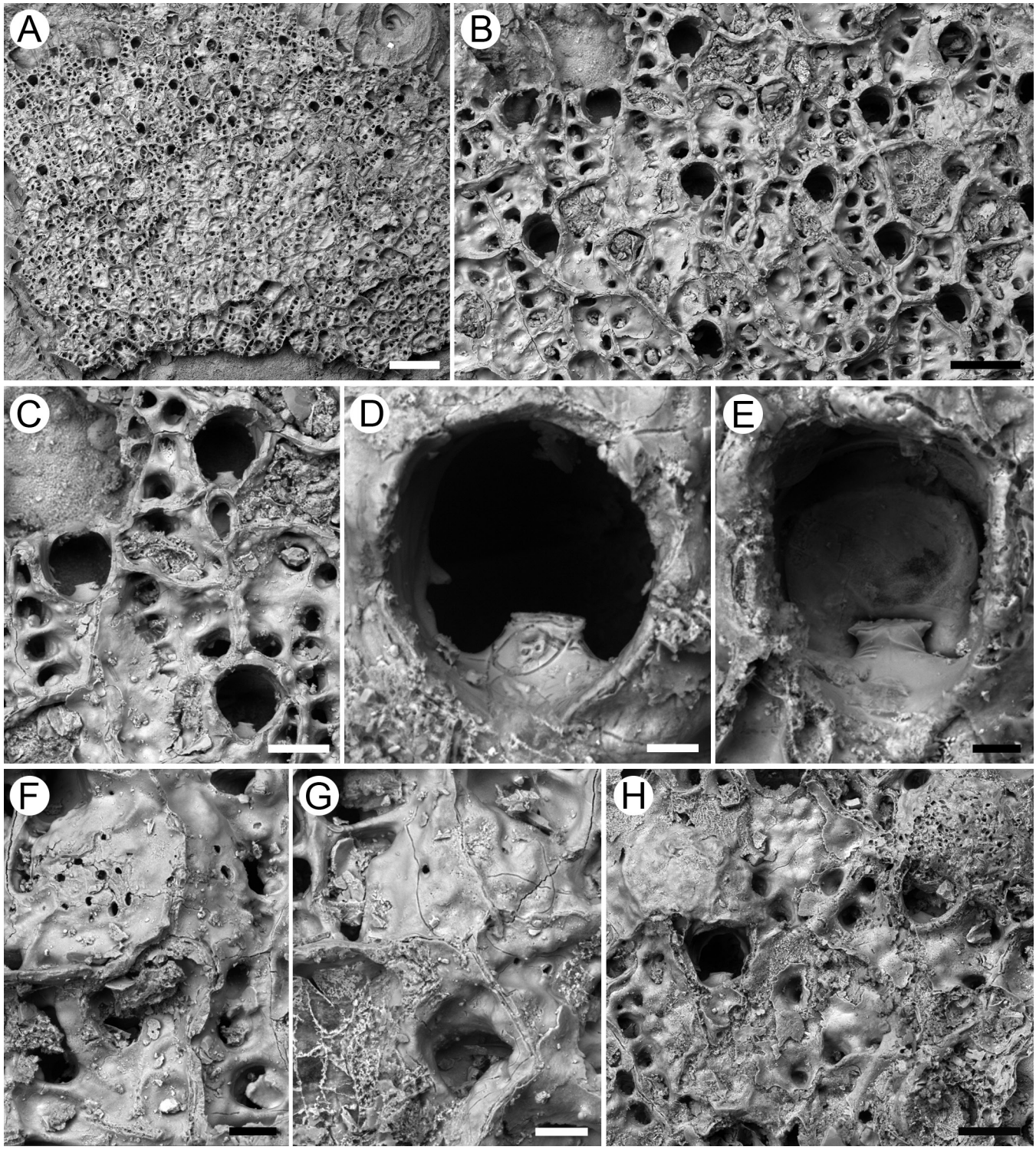

Figure 44. *Smittoidea* cf. *reticulata* MacGillivray, 1842. **A–D.** UF 265572. **A.** general view of a multilaminar colony; **B.** group of autozooids; **C.** close-up of autozooids, one of which shows the suboral avicularium; **D.** close-up of the orifice. **E.** UF 265741, close-up of an orifice showing the anvil-shaped lyrula. **F, G.** UF 265572, close-ups of ovicells. **H.** UF 265741, ovicellate zooids. Scale bars: A = 500 μm; B = 200 μm; C, H = 100 μm; D, E = 20 μm; F, G = 50 μm.

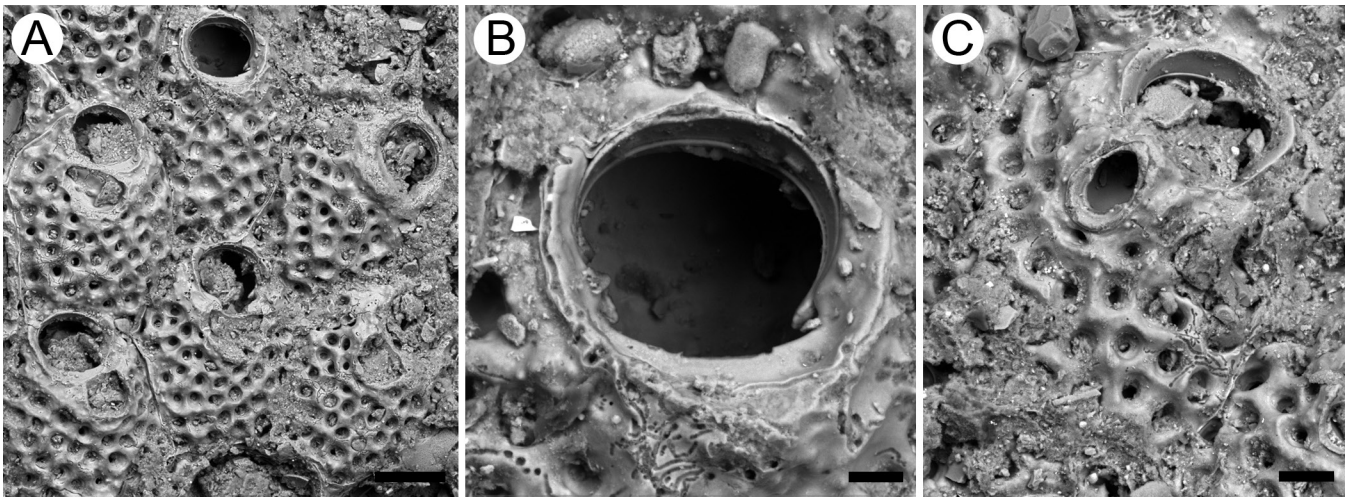

Figure 45. ?*Hippoporina* sp., UF 265684. **A.** group of autozooids; **B.** close-up of an orifice; **C.** close-up of an autozooid with suboral avicularium. Scale bars: A = 100 μm; B = 20 μm; C = 40 μm.

Measurements.—ZL 316±33, 262–371 (1, 10); ZW 276±39, 211–324 (1, 10); OL 90±6, 82–102 (1, 10); OW 100±4, 94–109 (1, 10).

Remarks.—A single, infertile colony of this rare Chipola Formation species was available for study. Scolaro (1968) described the ovicells as hyperstomial, moderately large and imperforate, a feature inconsistent with the diagnosis of the genus, which implies a pseudoporous ectoooecium typical of 'smittinoid' ovicells. Therefore, this species is only tentatively assigned to *Hippoporina*. Species of *Hippoporina* described from Cenozoic deposits of USA, – *H. biporosa* Canu and Bassler, 1920, *H. gibbosa* Canu and Bassler, 1923, *H. lucens* Canu and Bassler, 1920, *H. midwayanica* Canu and Bassler, 1920, and *H. vestita* Canu and Bassler, 1923 – are likely to belong to different genera and need to be revised.

Superfamily SCHIZOPORELLOIDEA JULLIEN, 1883
Family SCHIZOPORELLIDAE JULLIEN, 1883
Genus *STYLOPOMA* LEVINSEN, 1909
STYLOPOMA LEVERHULME N. SP.

Stylopoma spongites Scolaro (1968), p. 147, pl. 12, figs. 1, 2.

Figured material.—Holotype, UF 265610 (Fig. 46A–D) and paratype, UF 265737 (Fig. 46E–F), TU Loc. 821.

Zoobank Nomenclatural Act.—82E22F0E-3444-4B77-A5BB-D87C6FAB60EE.

Etymology.—Named after 'The Leverhulme Trust' for funding this research, as a name in apposition.

Diagnosis.—Colony encrusting, multilaminar. Autozooids with granular, perforated frontal shield. Pseudopores situated at the center of a polygonal mesh; marginal areolar pores present. Orifice transversely D-shaped with slit-like sinus and smooth condyles. A single adventitious avicularium, lateral of the orifice. Vicarious avicularia broadly spatulate. Ovicell globular, surface texture similar to the frontal shield.

Description.—Colony encrusting, multiserial, multilaminar (Fig. 46A, E). Autozooids with distinct interzooidal furrows and obvious lateral walls, rectangular to irregularly polygonal, quincuncially or irregularly arranged, slightly longer than wide (mean L/W 1.24). Frontal shield flat or slightly convex, granular, evenly and densely perforated, except around the orifice, by small circular pseudopores, 8–12 μm in diameter, situated at the center of a polygonal mesh (Fig. 46B–C); marginal areolar pores present, discontinuous and irregularly shaped. Primary orifice wider than long, transversely D-shaped, proximal edge straight sloping into a deep, slit-like sinus, about 30 μm long by 15 μm wide (Fig. 46D); condyles rectangular with rounded, slightly indented edges,

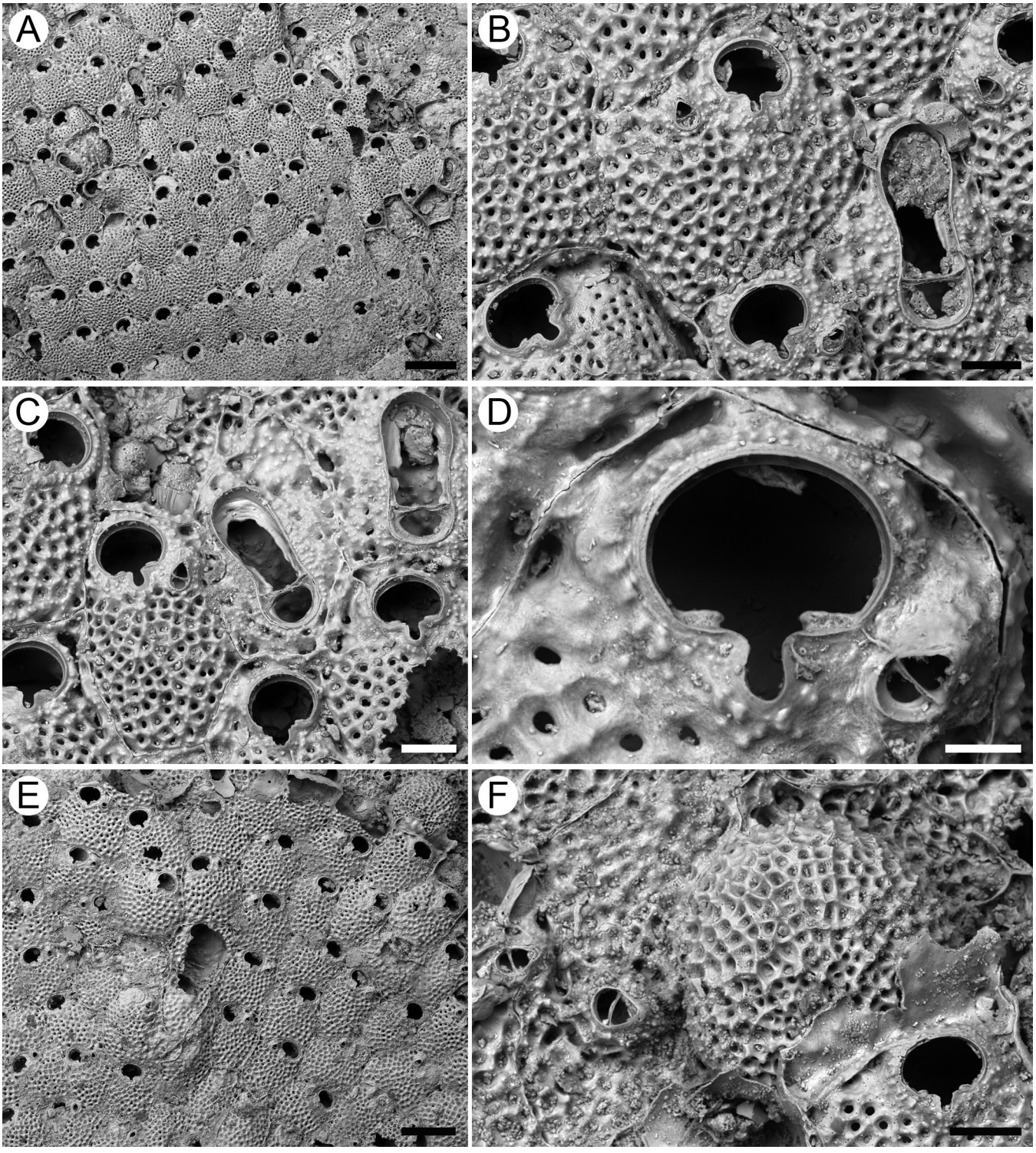

Figure 46. *Stylopoma leverhulme* n. sp. **A–D.** holotype, UF 265610. **A.** general view of the multilaminar colony; **B, C.** close-ups of autozooids and vicarious avicularia; **D.** close-up of the orifice. **E, F.** paratype, UF 265737. **E.** general view of the multilaminar colony; **F.** close-up of a partially overgrown ovicell. Scale bars: A = 400 μm; B, C, F = 100 μm; D = 40 μm; E = 300 μm.

occupying the majority of the proximal border on each side of the sinus, about 10 μm long by 25 μm wide, smooth. Adventitious avicularium single or absent, small, teardrop-shaped, located lateral of the orifice distally or distolaterally directed (Fig. 46B–D); rostrum pointed triangular, raised; crossbar complete. Vicarious avicularia having the same frontal area as an autozooid, granular, perforated only by marginal areolar pores, centrally placed (Fig. 46B–C); rostrum broadly spatulate, variously directed; crossbar complete. Ovicell globular, prominent, with a similar surface texture to the frontal shield (Fig. 46E–F).

Measurements.—ZL 421±43, 345–516 (2, 25); ZW 338±52, 258–528 (2, 25); OL 107±10, 93–123 (2, 18); OW 119±6, 110–127 (2, 18); OvL 347±6, 343–351 (1, 2); OvW 425±17, 413–437 (1, 2); AvL (adventitious) 50±6, 39–59 (2, 20); AvW (adventitious) 37±4, 31–45 (2, 20); AvL (vicarious; apertural length, not entire cystid) 265±28, 245–326 (1, 7); AvW (vicarious; apertural width, not entire cystid) 113±9, 103–123 (1, 7).

Remarks.—*Stylopoma* is a speciose genus, pantropical in distribution, generally associated with shallow, reefal habitats (Tilbrook, 2001, 2006). Two new species were found in the Chipola Formation, *Stylopoma leverhulme* n. sp. and *S. farleyensis* n. sp. (see description below). Scolaro (1968) identified the former species as *S. spongites* (Pallas, 1766), the type species of the genus, found at the present-day throughout the Caribbean Sea, from the Gulf of Mexico to the eastern side of the Atlantic Ocean (Tilbrook, 2001). The most diagnostic character of *S. spongites* is the denticulation of the inner rim of the anter, lacking in *S. leverhulme* n. sp. The Pleistocene to Recent *S. projecta* Canu and Bassler, 1923 and the Recent *S. smitti* Winston, 2005, both Western Atlantic species, share a similar orifice with slit-like sinus, but they have different, very distinctive condyles, which are beaded bar-shaped in the former species, and tab-shaped in the latter.

STYLOPOMA FARLEYENSIS N. SP.

Figured material.—Holotype, NHMUK PI BZ 7827 (Fig. 47A–D), TU Loc. 819; paratypes, NHMUK PI BZ 7828 (Fig. 47E), BZ 7829 (Fig. 47F), TU Loc. 828.

Zoobank Nomenclatural Act.—F3D628C1-11EE-4BD8-85FB-485AD3E211FC.

Etymology.— Referring to the type locality Farley Creek.

Diagnosis.— Colony encrusting, multilaminar. Autozooids with a granular, perforated frontal shield bordered by a row of marginal areolar pores. Primary orifice transversely D-shaped with U-shaped sinus and smooth condyles. Adventitious suboral avicularium variable in size and shape. Additional adventitious avicularia occasionally present. Broadly spatulate giant avicularia situated on frontal shields of autozooids. Ovicell globular, with a similar surface texture to the frontal shield.

Description.— Colony encrusting, multiserial, multilaminar (Fig. 47A). Autozooids with distinct interzooidal furrows and obvious lateral walls, irregularly polygonal, chaotically arranged, slightly longer than wide (mean L/W 1.24). Frontal shield convex, granular, evenly and densely perforated, except around the orifice, by small circular pseudopores, 10–15 μm in diameter (Fig. 47B, E–F), and a row of irregularly shaped marginal areolar pores. Primary orifice wider than long, transversely D-shaped, proximal edge straight sloping into a U-shaped sinus, about 30 μm long by 35 μm wide (Fig. 47C); condyles rectangular with rounded edges, occupying the majority of the proximal border on each side of the sinus, about 8 μm long by 20 μm wide, smooth. Adventitious suboral avicularium single or absent, varying in size and shape, from elliptical to oval or lozenge-shaped, with rounded or pointed rostrum, located proximal to the sinus, laterally directed (Fig. 47B–C, E–F); crossbar complete. Additional adventitious avicularia may occur either on the zooidal frontal shield or on the frontal area of the ovicell (Fig. 47B, D–F). Giant avicularia situated on frontal shields of autozooids, not replacing them (Fig. 47B); rostra broadly spatulate, variously directed; crossbar complete. Ovicell globular, prominent, with a similar surface texture to the frontal shield (Fig. 47B, D). Closure plates common (Fig. 47F).

Measurements.—ZL 401±31, 350–479 (4, 18); ZW 324±57, 228–476 (4, 18); OL 111±10, 98–129 (4, 12); OW 114±11, 103–132 (4, 12); OvL

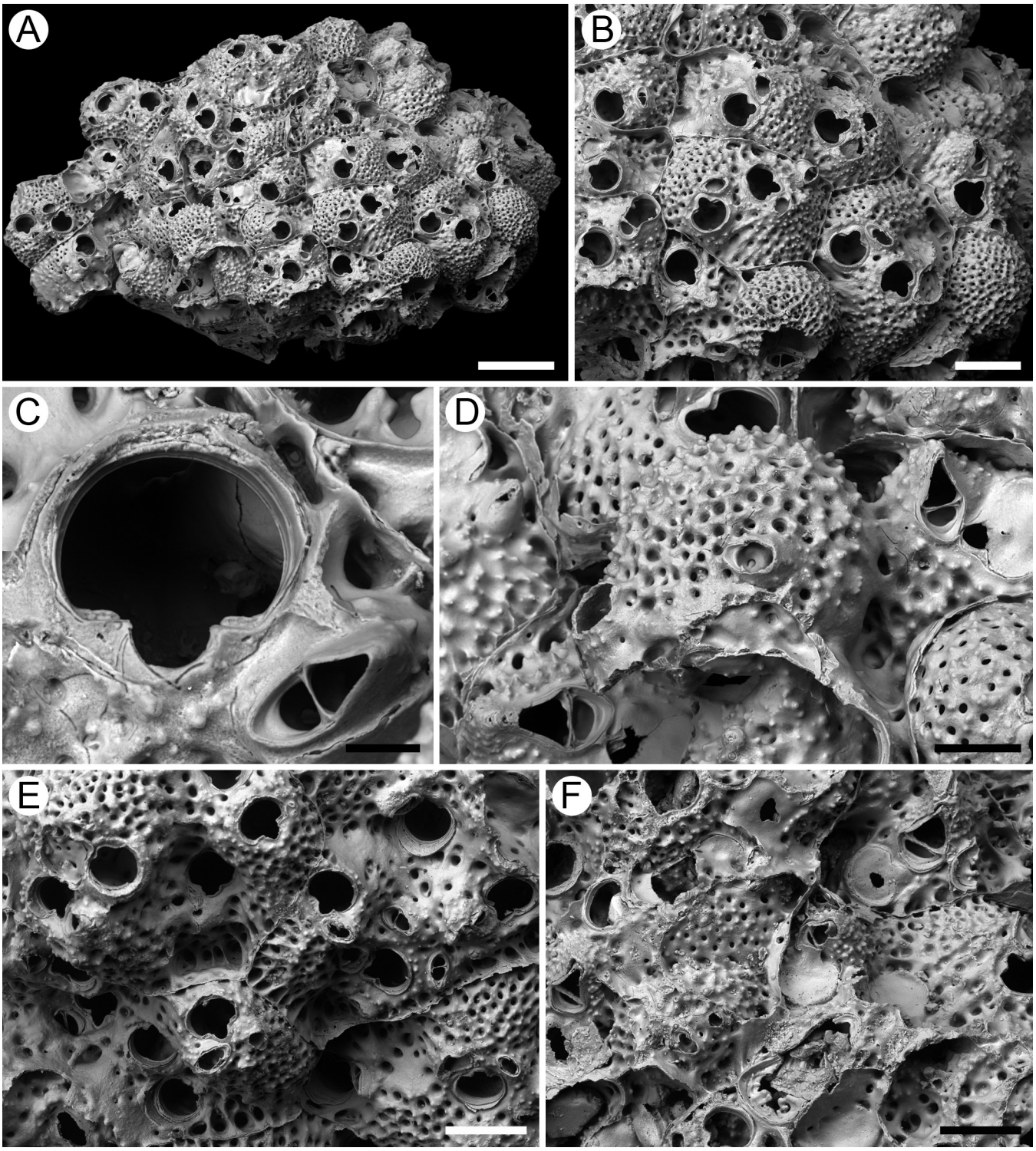

Figure 47. *Stylopoma farleyensis* n. sp. **A–D.** holotype, NHMUK PI BZ 7827. **A.** general view of the multilaminar colony; **B.** group of chaotically arranged zooids and giant avicularia; **C.** close-up of an orifice with lozenge-shaped suboral avicularium; **D.** close-up of an ovicell bearing a small adventitious avicularium. **E.** paratype, NHMUK PI BZ 7828, group of chaotically arranged zooids. **F.** paratype, NHMUK PI BZ 7829, autozooids with closure plates. Scale bars: A = 400 μm; B, E, F = 200 μm; C = 40 μm; D = 100 μm.

277±27, 254–317 (2, 4); OvW 327±21, 300–344 (2, 4); AvL (adventitious) 92±22, 61–139 (4, 22); AvW (adventitious) 52±11, 34–78 (4, 22); AvL (vicarious) 245±75, 151–352 (2, 7); AvW (vicarious) 116±28, 93–177 (2, 7).

Remarks.—*Stylopoma farleyensis* n. sp. differs from *S. leverhulme* n. sp. in having a much broader orificial sinus, suboral adventitious avicularia of different shape and placed proximal rather than lateral of the orifice, and spatulate avicularia situated on the frontal shield of the autozooids rather than replacing them. The latter feature has been previously observed in some other Recent species of *Stylopoma*, such as *S. thornelyae* Livingstone, 1926 from the Great Barrier Reef, which however differs, among other characters, in having a denticulate anter. *Stylopoma minuta* Canu and Bassler, 1923, originally described from the Bowden Formation of Jamaica, and subsequently recorded living off Florida and in the Caribbean (Cheetham et al., 1993, 1994; Winston, 2005), is most similar in appearance to the Chipola Formation species, but differs in having a narrower, teardrop-shaped sinus. The orifice of *S. novum* Tilbrook, 2001 shows a similar U-shaped sinus, but the ovicells are characterized by a proximal labellum with a distinct suture.

Family MARGARETTIDAE HARMER, 1957
Genus *MARGARETTA* GRAY, 1843
MARGARETTA PENTACERATOPS N. SP.

Margaretta buski Scolaro (1968), p. 165, pl. 15, figs. 4–6.

Figured material.—Holotype, UF 265600 (Fig. 48A–C), TU Loc. 820; paratype, UF 265670 (Fig. 48D–E), TU Loc. 548; paratype, UF 265520 (Fig. 48F–G), TU Loc. 550.

Zoobank Nomenclatural Act.—A2F35045-266A-4748-BF8C-76BD80561551.

Etymology.—Referring to the five spiniform processes forming prolongations of the peristome.

Diagnosis.—Colony erect, articulated. Internodes with six alternating zooidal rows and bipartite basis rami. Autozooids in whorls of three with perforated frontal shield; pores located at the centre of polygonal depressions. Ascopore located immediately proximally of the peristomial ridge, medial. Peristome with five robust ridges, terminating in spiniform processes, the proximalmost one the longest and upwardly curved. Brooding zooids with a swollen, upwardly curved, porous peristome.

Description.—Colony erect, articulated. Internodes cylindrical, straight or slightly curving, about 550–650 μm wide, with six alternating zooidal series (Fig. 48A, D). Basis rami bipartite (Fig. 48C), originating at the side of a peristome, raised. Autozooids in whorls of three, outline distinct, with shallow interzooidal furrows, elongate (mean L/W 2.60, including the peristome), flask-shaped, tapering proximally (Fig. 48A–B, D). Frontal shield convex in distal two-thirds, flat in proximal one-third, smooth to finely granular, regularly and evenly perforated by small (ca. 10 μm in diameter), circular pores arranged in longitudinal rows and located at the centre of polygonal depressions (Fig. 48C). Ascopore disto-medial, located immediately proximally of the peristomial ridge, circular, ca. 45 μm in diameter, surrounded by a raised rim, ca. 30 μm thick (Fig. 48C–E). Secondary orifice transversely elliptical (Fig. 48B, E), 120 μm long by 180 μm wide. Peristome moderately developed, 160–235 μm long, longer proximally than distally, angled at approximately 45˚ to the frontal plane, ridged; five robust and raised ridges, about 50–55 μm wide, terminating distally in pointed spiniform processes, the proximalmost one the longest (ca. 215 μm long), horn-like and upwardly curved (Fig. 48A–C); valleys between ridges smooth and imperforate apart from a single proximal pore at their bases (Fig. 48B–E); basal ridge distinct; small spiniform processes developed distally. Brooding zooids with porous peristome, longer than in autozooids, ca. 400 μm long, with the basal portion swollen and the distal portion upwardly curved (Fig. 48F–G).

Measurements.—ZL 1007±123, 799–1215 (2, 10); ZW 388±33, 335–434 (2, 10).

Remarks.—Infrequent at Tenmile Creek and the Chipola River localities, *Margaretta pentaceratops* n. sp. is one of the most common and abundant species at the Farley Creek localities. Scolaro (1968) identified Chipola Formation specimens as *M. buski* Harmer, 1957, a Recent

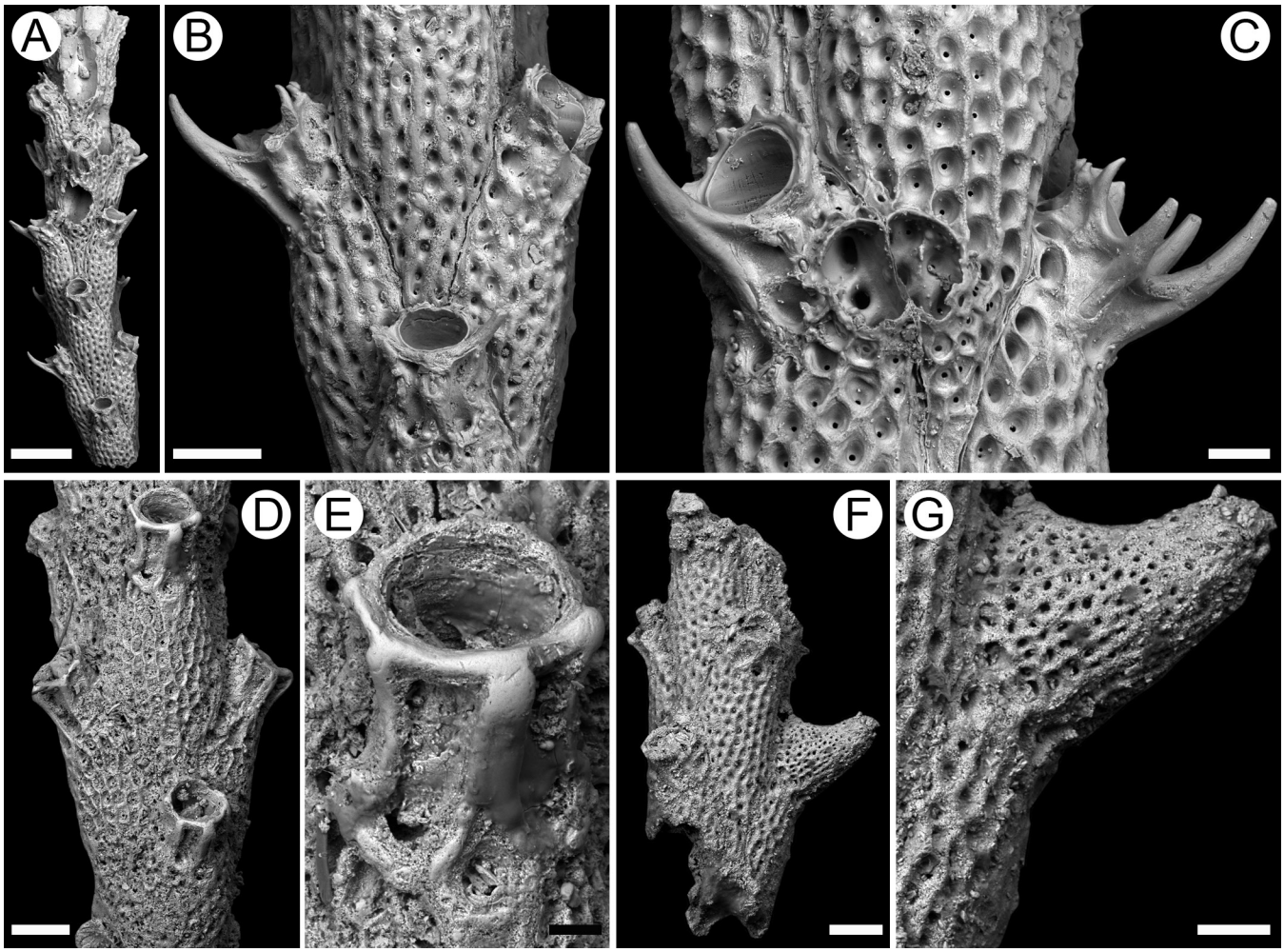

Figure 48. *Margaretta pentaceratops* n. sp. **A–C.** holotype, UF 265600. **A.** general view of the internode; **B.** close-up of a whorl of three autozooids; **C.** close-up of peristomes terminating distally in pointed spiniform processes; note the bipartite basis rami. **D, E.** paratype, UF 265670. **D.** close-up of a flask-shaped autozooid; **E.** close-up of an abraded peristome showing robust, raised ridges, but lacking the characteristic spiniform processes wich are likely to be levelled-off. **F, G.** paratype, UF 265520, brooding zooid with swollen and upwardly curved peristome. Scale bars: A = 500 μm; B, D, F = 200 μm; C, G = 100 μm; E = 50 μm.

species originally described from St. Paul's Rocks in the Western Atlantic, and recorded also off Florida (Osburn, 1914; Canu and Bassler, 1928). The two species have the same number of zooids in a whorl, share a bipartite basis rami and have frontal shields of similar general appearance. However, the examination by SEM of the type specimens of *M. buski* (NMHUK 87.12.9.439; Fig. 49) revealed some important differences: the ridges of the peristome are narrower, more numerous, closely spaced and granular (Fig. 49A), lacking the spiniform processes (Fig. 48A–C) diagnostic of *M. pentaceratops* n. sp., while the valleys between ridges are porous, and the fertile peristomes, although swollen, long and curved in both species, become inturned only in *M. buski* (Fig. 49B).

Five fossil species of *Margaretta* were previously known from the east coast of USA: *M. congesta* (Cheetham, 1963) and *M. nodifera* (Canu and Bassler, 1920) from the Eocene of Florida, *M. fallax* (Canu and Bassler, 1920) and *M. vicksburgica* (Canu and Bassler, 1920) from the Eocene and

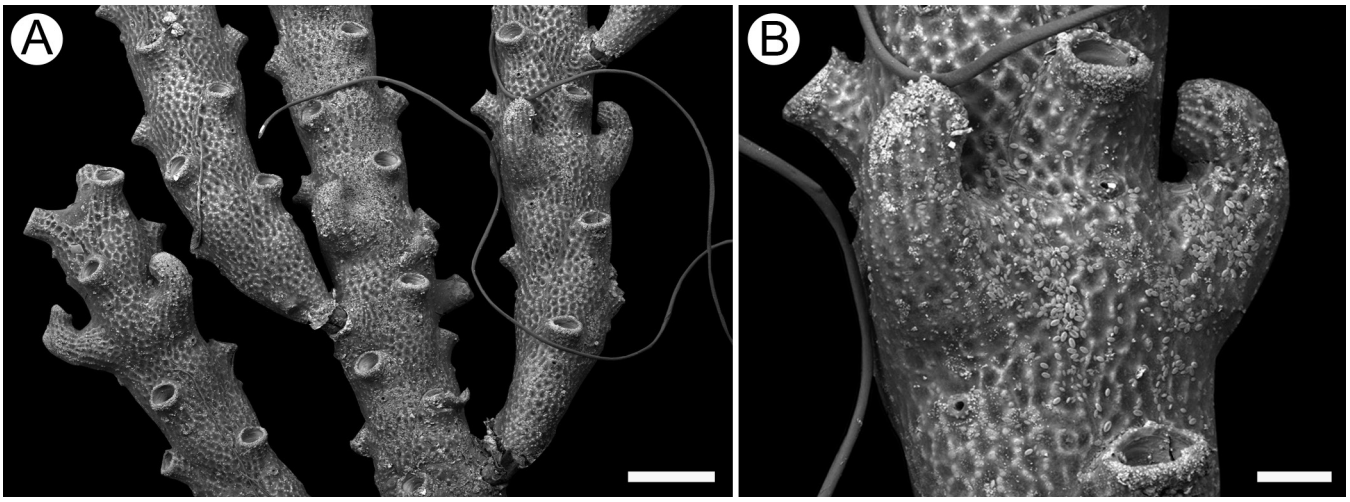

Figure 49. *Margaretta buski* Harmer, 1957, holotype, NMHUK 87.12.9.439, Recent. **A.** general view of part of the colony; **B.** close-up of brooding zooids with inturned peristomes. Scale bars: A = 600 μm; B = 150 μm.

Oligocene of Alabama, and *M. parviporosa* (Canu and Bassler, 1920) from the Eocene of South Carolina. The presence of the robust, peristomial ridges projecting frontally as spiniform processes distinguishes *M. pentaceratops* n. sp. from all of these species. In addition, *M. congesta* has bulbous fertile peristomes and four zooids instead of three per whorl, *M. nodifera* is characterized by nodiferous zooids with tuberosities, *M. fallax* has tripartite articulation and fertile zooids with a much larger aperture, and the aperture is also larger in *M. vicksburgica* and in *M. parviporosa*.

Occasionally, the characteristic spiniform processes of *M. pentaceratops* n. sp. may appear to be broken and levelled-off in abraded internodes (Fig. 48D–E); however, the species is still recognizable from the robustness of the peristomial ridges.

Family HIPPALIOSINIDAE WINSTON, 2005
Genus *HIPPALIOSINA* CANU, 1918b
HIPPALIOSINA ROSTRIGERA (SMITT, 1873)

Escharella rostrigera Smitt (1873), p. 57, figs. 203–205.
Hippaliosina rostrigera Scolaro (1968), p. 157, pl. 14, fig. 3; Winston (2005), p. 75, figs. 200–206.

Figured material.—UF 265736 (Fig. 50A–D), TU Loc. 821; UF 96358 (Fig. 50E–F), TU Loc. 825.

Description.—Colony encrusting, multiserial, uni- or multilaminar (Fig. 50A). Ancestrula similar to later autozooids but smaller, 260–370 μm long by 160–205 μm wide, with a single adventitious avicularium placed at about mid-length, proximally directed, a single zooid budded distally (240–285 μm long by 190–250 μm wide) and two zooids distolaterally (290–330 μm long by 170–225 μm wide), smaller than later autozooids (Fig. 50B). Autozooids distinct, bordered by narrow grooves, rounded hexagonal to polygonal in shape, longer than broad (mean L/W 1.66), 0.5 mm thick. Frontal shield slightly convex, coarsely granular, imperforate apart from a continuous row, exceptionally two, of marginal areolar pores, teardrop-shaped sloping outwards, 10–30 μm long (Fig. 50C). Orifices dimorphic, surrounded by a narrow, flat rim (Fig. 50D, F). Autozooids with a distally placed, key-hole shaped (i.e. cleithdriate) orifice, longer than broad (mean OL/OW 1.23) (Fig. 50D); two pointed, downwardly directed condyles separating a horseshoe-shaped anter from a bowl-shaped sinus. Orifices of maternal zooids larger, broader than long (mean OL*/OW* 0.88), and more proximally placed than those of autozooids (Fig. 50F). Adventitious avicularia lateral to the orifice, usually single, occasionally paired, their bases slightly above the proximal margin of the orifice in autozooids, more distally placed in maternal zooids, resting at a variable angle to the frontal

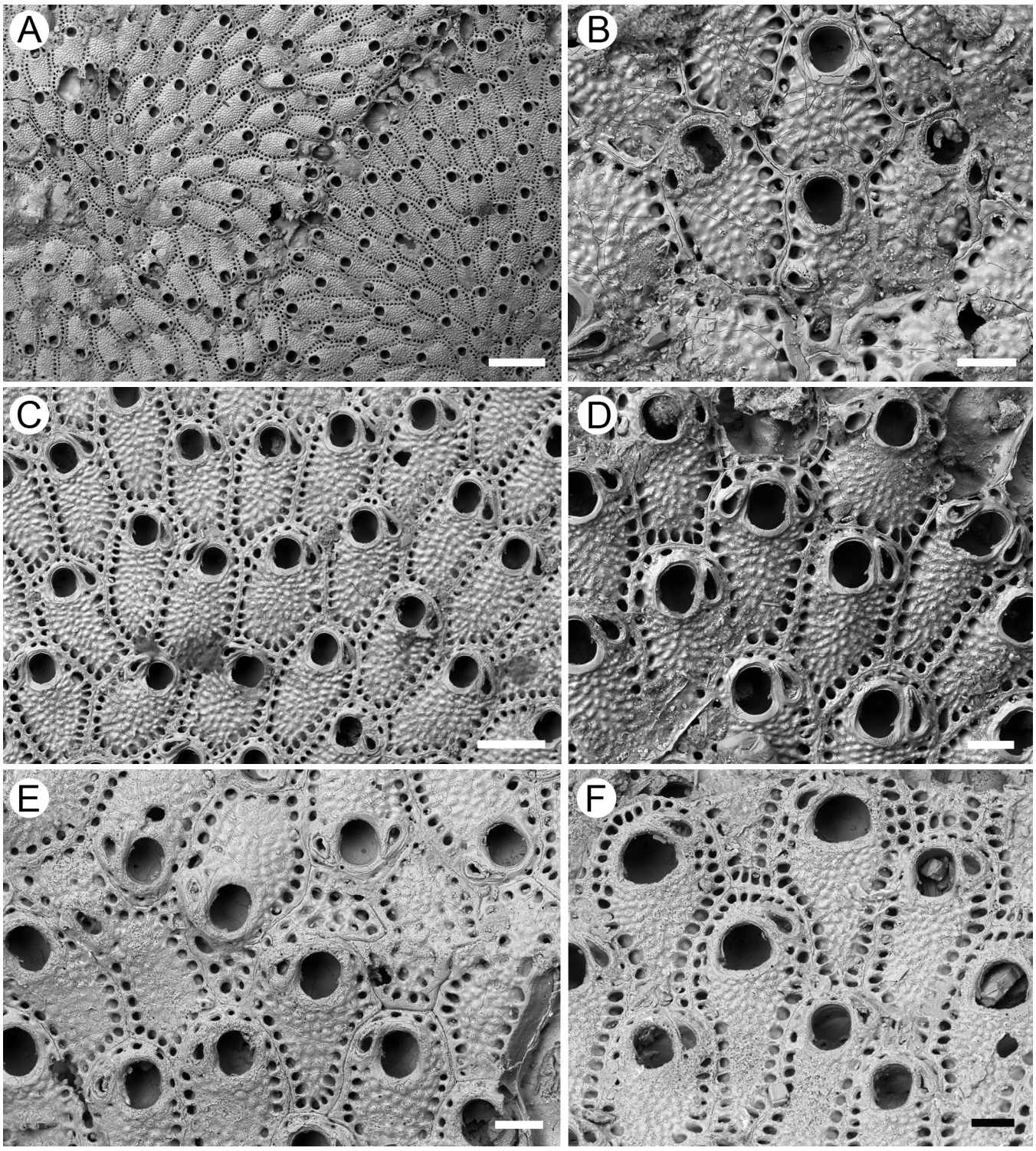

Figure 50. *Hippaliosina rostrigera* (Smitt, 1873). **A–D.** UF 265736. **A.** general view of two encountering colonies; **B.** close-up of the ancestrula and early astogeny; **C.** group of autozooids; **D.** close-up of autozooids with single or paired adventitious avicularia. **E–F.** UF 96358. **E.** kenozooids developed at colony edges at collisions between two colonies; **F.** maternal zooids. Scale bars: A = 500 μm; B, D, E, F = 100 μm; C = 200 μm.

shield surface (Fig. 50D); rostrum elongate, pointed triangular, distally and inwards directed, often slightly curved, pivot bar absent. Avicularium of the first budded zooid placed as in later autozooids or positioned below the orifice, almost horizontally and inwardly directed (Fig. 50B). Maternal zooids similar to autozooids but larger (ZL*/ZW* 1.52) (Fig. 50F). Kenozooids similar to autozooids but lacking an orifice, developed at colony edges at collisions with conspecifics (Fig. 50E). Oval pore-chamber windows, 15–25 μm long, visible along zooidal margins (Fig. 50D).

Measurements.—ZL 412±53, 301–514 (2, 25); ZW 249±29, 202–334 (2, 25); OL 95±8, 78–107 (2, 25); OW 77±6, 66–91 (2, 25); OL* 110±6, 98–118 (2, 9); OW* 123±8, 113–140 (2, 9); AvL 95±9, 80–115 (2, 25); AvW 57±11, 43–86 (2, 25).

Remarks.—*Hippaliosina rostrigera* (Smitt, 1873) apparently ranges from the early Miocene to Recent. In the Chipola Formation it is abundant at the Chipola River and Farley Creek localities but absent at Tenmile Creek. Additional fossil records include the Miocene of Virginia and North Carolina, as well as the Pliocene of South Carolina, Florida (Canu and Bassler, 1923) and Costa Rica (Cheetham et al., 1999). Recent records are from Cape Hatteras to Florida, the Gulf of Mexico, Caribbean, Galapagos, Panama and Gulf of California (Winston, 2005).

Chipola Formation specimens differ from Smitt's type specimen figured in Winston (2005) in having smaller zooids (301–514 μm long by 202–334 μm wide vs 486–660 μm long by 270–414), smaller orifices (78–107 μm long by 66–91 μm wide vs 117–180 μm long by 90–120 μm wide), and shorter avicularia (80–115 μm vs 70–306 μm) based on the measurements given by Winston (2005). They also differ in the appearance of the frontal shield: Recent colonies have a more heavily beaded frontal shield while fossil specimens have more closely spaced marginal areolar pores (see Winston, 2005:76, fig. 201). Differences, such as a shorter avicularium rostrum, have also been observed between Recent populations from the Eastern Pacific and Western Atlantic (Winston, 2005). *Hippaliosina imperfecta* (Canu and Bassler, 1928), living at the present-day in Brazilian waters, is very similar in morphology to *H. rostrigera*. Winston et al. (2014) indicated the position of the avicularia (above the orifice in *H. rostrigera*, at the side of the orifice in *H. imperfecta*), the shape of the rostrum (curved in the former species and straight in the latter), and the size of the orifice as diagnostic characters to distinguish one species from the other. However, avicularia in the Chipola specimens may be placed above or beside the orifice in the same colony (Fig. 50C, E–F), and the rostrum is curved only in those avicularia long enough to go over the orifice. Zooidal and orificial size-ranges are very similar in the Chipola Formation specimens and *H. imperfecta* as reported in Winston et al. (2014:210). Again, however, the frontal shield differs, being less densely granulated and with more closely spaced marginal areolar pores in the Chipola fossil compared to the Recent Brazilian species.

Family CHEILOPORINIDAE BASSLER, 1936
Genus *CHEILOPORINA* CANU and BASSLER, 1923
CHEILOPORINA CLARKSVILLENSIS N. SP.

Cheiloporina 'A' n. sp. Scolaro (1968), p. 155, pl. 14, fig. 4.

Figured material.—Holotype, UF 265693 (Fig. 51A–C) and paratype, NHMUK PI BZ 7830 (Fig. 51D–E), TU Loc. 458.

Zoobank Nomenclatural Act.—BC0D9619-D411-4929-91C8-24FDE5310217.

Etymology.—Named after the town closest to the type locality, Clarksville, Florida.

Diagnosis.—Colony encrusting. Autozooids in longitudinal rows. Frontal shield porous and coarsely granular. Orifice bell-shaped, dimorphic. Avicularia absent. Ovicells globular, granular and finely perforated.

Description.—Colony encrusting, multiserial, unilaminar. Autozooids distinct with shallow furrows or a raised rim, arranged in longitudinal rows, rhombic to rectangular, longer than broad (mean L/W 1.66). Frontal shield convex, evenly porous and coarsely granular (Fig. 51A–B); pseudopores circular, small (10–15 μm in diameter), numerous (35 to 55). Triangular marginal areolar pores sometimes distinguishable at zooidal corners (Fig. 51A–B). Orifice dimorphic: bell-shaped with straight proximal margin in autozooids (Fig.

51D–E), broader and with arched proximal margin in ovicellate zooids (Fig. 51A–C); condyles stout and downwardly directed (Fig. 51C, E). A smooth rim, 20 µm wide, surrounds the orifice with an imperforate, short peristome slightly raised distally. Oral spines absent. Ovicells prominent, globular, broader than long, granular and finely perforated like the frontal but with smaller, more numerous and closely spaced pseudopores (Fig. 51A–C). Avicularia lacking.

Measurements.—ZL 480±77, 379–593 (4, 12); ZW 290±36, 235–357 (4, 12); OL 129±20, 90–156 (4, 12); OW 157±13, 130–179 (4, 12); OL* 140±18, 118–172 (2, 10); OW* 186±26, 148–231 (2, 10); OvL 145±30, 99–190 (2, 8); OvW 248±29, 217–299 (2, 8).

Remarks.—*Cheiloporina clarksvillensis* n. sp. occurs rarely at Farley Creek. Fragile colony fragments, made of up to ten zooids, were found scattered in the sediment, detached from the original substratum, which is likely to have been perishable, such as algae or seagrasses (Scolaro, 1968). A further fossil species of *Cheiloporina* from Florida, *C. bellensis*, was described by Cheetham (1963). This Eocene species differs from *C. clarksvillensis* n. sp. in having paired adventitious avicularia on

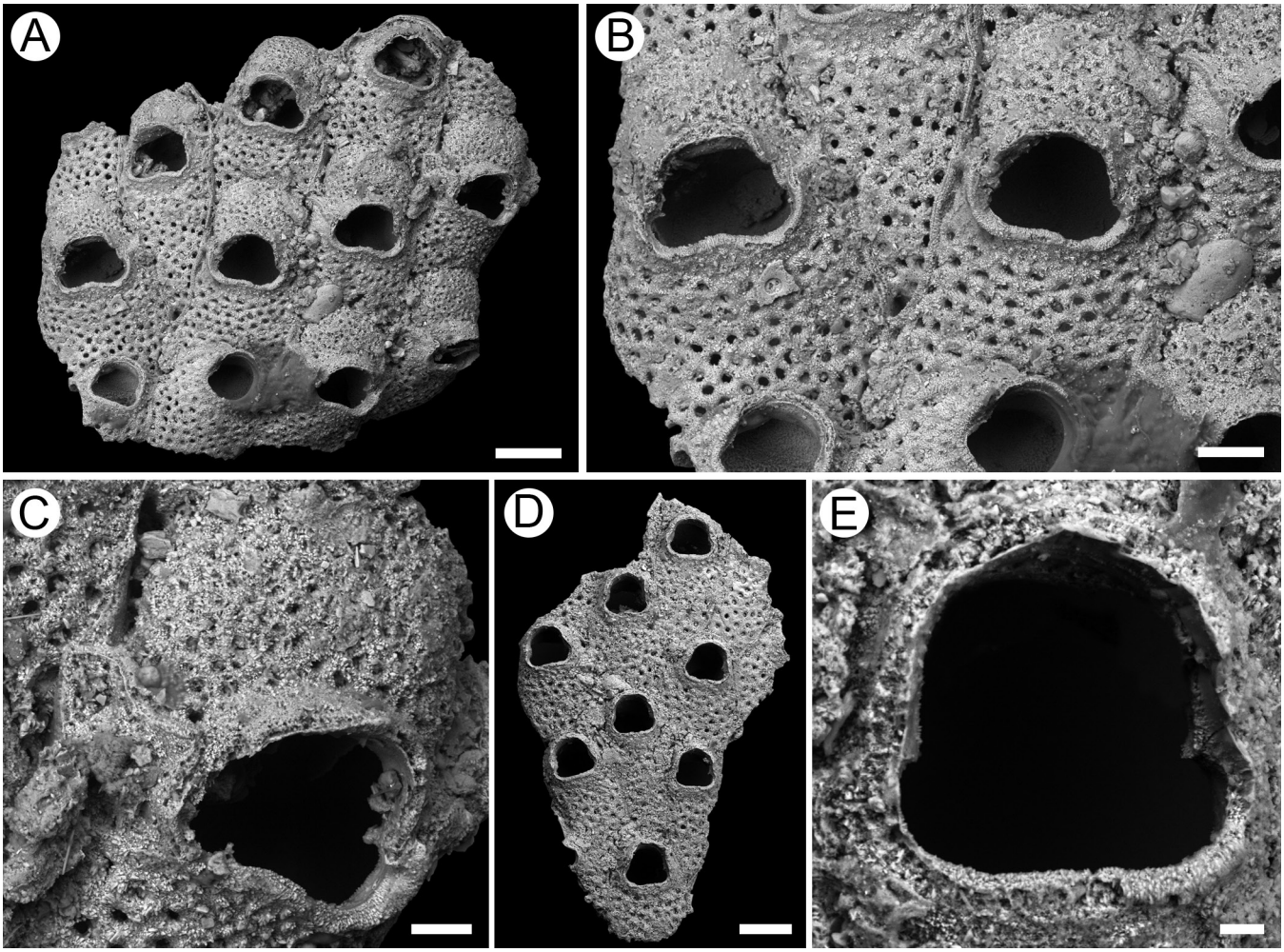

Figure 51. *Cheiloporina clarksvillensis* n. sp. **A–C.** holotype, UF 265693. **A.** general view of the colony fragment; **B.** close-up of two ovicellate zooids; **C.** close-up of an ovicell; note the robust orificial condyle visible in oblique view. **D, E.** paratype, NHMUK PI BZ 7830. **D.** general view of the colony fragment; **E.** close-up of the orifice. Scale bars: A, D = 200 µm; B = 100 µm; C = 50 µm; E = 20 µm.

the lateral margins of each zooid, proximal to the orifice. Several other species of *Cheiloporina* were described by Canu and Bassler (1920) from various Eocene formations in the USA: *C. grandis*, *C. orbifera*, *C. prelucidioides*, *C. saillans*, *C. specula*, *C. strictocella*, *C. sulcifera*, *C. transversa* and *C. transversoides*. All differ from the new Chipola Formation species, either in having adventitious or vicarious avicularia, in their bilamellar colony-form, or in the shape of the pseudopores.

Genus *HAGIOSYNODOS* BISHOP and HAYWARD, 1989

HAGIOSYNODOS SIMPLEX N. SP.

Hippopodinella 'A' n. sp. Scolaro (1968), p. 160, pl. 15, figs. 1, 2.

Figured material.—Holotype, UF 265573 (Fig. 52), TU Loc. 824.

Zoobank Nomenclatural Act.—3C05742B-18CB-4626-A591-7D5E93FC17CA.

Etymology.—Referring to its simple morphology.

Diagnosis.—Colony encrusting. Autozooids rhomboidal or irregularly polygonal with a nodular and sparsely perforated frontal shield. Orifice cleithdriate. Ovicells with marginal areolar pores and faint ridges in-between; central umbo occasionally present. Pore-chamber windows present.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 52A). Autozooids distinct, delineated by a thin, raised, smooth rim and with shallow grooves in-between, quincuncially arranged, rhomboidal to irregularly polygonal, longer than wide (mean L/W 1.33). Frontal shield gently convex, nodular, granular, sparsely perforated by 15–30, widely spaced, circular pseudopores, 5–12 μm in diameter (Fig. 52B, E, G). Marginal areolar pores irregularly placed along zooidal margins, circular to oval, same size as pseudopores. Orifice distally placed, key-hole shaped (cleithdriate), with a horseshoe-shaped anter separated from a small poster, with straight or slightly concave proximal margin, by a pair of strong, pointed, downwardly or medially directed, condyles (Fig. 52C–D, G). Ovicells relatively large, broader than long, globular to rounded polygonal, with one to three rows of circular, ovoidal or teardrop-shaped marginal areolar pores, 20–30 μm long, and additional, scattered pores on the frontal surface (Fig. 52E–F); faint ridges between areolae converge centrally, where occasionally an umbo is present (Fig. 52F). Pore-chamber windows visible at growing edges (Fig. 52G).

Measurements.—ZL 365±36, 302–425 (1, 20); ZW 275±40, 216–401 (1, 20); OL 107±10, 97–129 (1, 8); OW 89±12, 78–115 (1, 8); OvL 191±19, 165–214 (1, 6); OvW 232±21, 211–264 (1, 6).

Remarks.—*Hagiosynodos simplex* n. sp. represents the oldest geological record and the first occurrence of this genus in the tropical Western Atlantic. Previous fossil and Recent occurrences were restricted to Europe, including the Mediterranean Sea and the NE Atlantic. *Hagiosynodos campanulata* (Cipolla, 1921), from the Pliocene of Sicily, differs in having a thick, raised collar surrounding the orifice, as well as lateral tubercles. Lateral tubercles are also characteristic of the Recent species *H. latus* (Busk, 1856). *Hagiosynodos hadros* Hayward and McKinney, 2002, has a strongly nodular frontal surface and slightly larger zooidal size. A bib-like, proximally flared peristome is diagnostic of *H. strophiae* (Canu and Bassler, 1930), while a beaded, orificial contour is typical of *H. tregouboffi* (Gautier, 1952), which differs also in having larger zooids and orifices and a constantly present avicularium below the orifice.

Family VICIDAE GORDON, 1988

Genus *VIX* GORDON, 1988

VIX SCOLAROI N. SP.

New genus 'B' n. sp. 'y' Scolaro (1968), p. 174, pl. 17, figs. 4, 5.

Figured material.—Holotype, UF 71860a, b (Fig. 53A–E), TU Loc. 1048; paratype, UF 265612 (Fig. 53F–H), TU Loc. 819.

Zoobank Nomenclatural Act.—B53D0F29-4868-435E-9443-43A497CEDEC4.

Etymology.—Named after Dr. Reginald J. Scolaro for his important contributions to the knowledge of fossil bryozoans from the Chipola Formation.

Diagnosis.—Colony erect, rigid, branching at

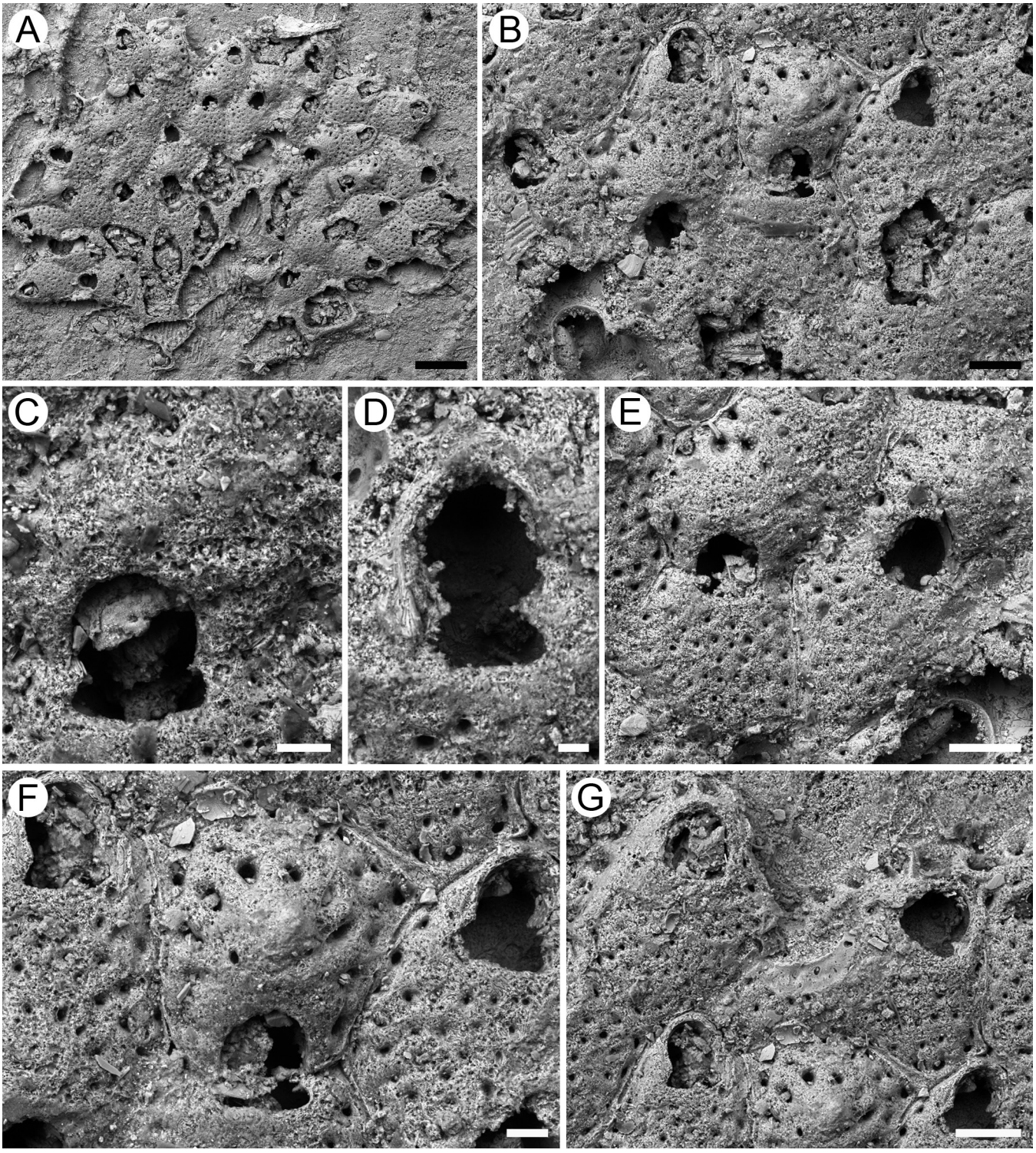

Figure 52. *Hagiosynodos simplex* n. sp., holotype, UF 265573. **A.** general view of the colony; **B.** group of ovicellate and non-ovicellate zooids; **C, D.** close-ups of the orifice; **E.** close-up of two ovicellate zooids; **F.** close-up of an ovicell with central umbo; **G.** zooids at growing edges showing pore-chamber windows. Scale bars: A = 300 μm; B, E, G = 100 μm; C, F = 40 μm; D = 20 μm.

right angle to the parent branch or dichotomously. Branches quadriserial. Autozooids in alternating longitudinal rows, elongate. Frontal shield with ridges, furrows and pores in-between. Orifice semicircular, bearing a small avicularium. Ovicells appear as coarsely tuberculate bulges.

Description.—Colony erect, rigid, branching at right angles with new branches forming as two lateral stems located almost opposite one another on the parent branch (Fig. 53A–B), or dichotomously at an angle of ca. 45˚ (Fig. 53C–D). Branches cylindrical, 0.4–0.5 mm in diameter, quadriserial, straight or undulant. Autozooids distinct with a very thin, slightly raised rim, arranged in alternating longitudinal rows on two faces of the branch, rounded polygonal, elongate (mean L/W 1.77). Small-sized autozooids, or kenozooids lacking an opening, present at branch bifurcations (Fig. 53B). Frontal shield flat, raised distally, characterized by smooth to finely granular, longitudinal, irregularly anastomosing ridges and furrows with slit-like pores, 15–30 μm long, unevenly spaced (Fig. 53A–D). Primary orifice deeply immersed; secondary orifice semicircular (Fig. 53E). A small, triangular to elliptical avicularium placed medially on the proximal rim of the secondary orifice, apparently lacking crossbar or condyles (Fig. 53E); rostrum rounded, inwardly and proximally directed; zooids in which the suboral avicularium is missing have a pseudosinus in the secondary orifice. Ovicells appear as bulges, highly variable in size, recumbent, broader than long, coarsely tuberculate, ?porous (Fig. 53F–H). Reparative budding common (Fig. 53C).

Measurements.—ZL 488±70, 365–637 (4, 25); ZW 275±61, 193–400 (4, 25); OL 109±9, 96–128 (4, 20); OW 119±17, 94–154 (4, 20); OvL 198±71, 146–301 (1, 4); OvW 264±66, 205–342 (1, 4); AvL 64±13, 47–64 (2, 10).

Remarks.—*Vix scolaroi* n. sp. occurs most commonly in the Farley Creek localities. In addition to the Chipola Formation, this species is also common in the Dominican Republic (Baitoa, Cercado and Gurabo Fms). Another fossil species of *Vix*, *Vix* sp., was described from the Burdigalian–Langhian of East Kalimantan but left in open nomenclature because the few available fragments were poorly preserved and lacked ovicells (Di Martino and Taylor, 2015). The Kalimantan species differs from *V. scolaroi* n. sp. in having longer and more slender zooids (mean L/W 2.35 vs 1.77). The genus *Vix* was introduced for the Recent *Bifaxaria vagans* Thornely, 1912, recorded initially from the Seychelles and the Amirante Islands and subsequently from east Africa and Zanzibar (Waters, 1913). The Chipola Formation species differs from *Vix vagans* in having shorter zooids, in the position of the suboral avicularium (horizontally placed in the fossil, vertically placed in the living species), and the direction of the rostrum (distolaterally directed in *V. scolaroi*, proximally directed in *V. vagans*). Ovicells, previously unknown for this genus, are observed here for the first time.

Family MICROPORELLIDAE HINCKS, 1879
Genus *MICROPORELLA* HINCKS, 1877
MICROPORELLA SP.

Microporella ciliata Scolaro (1968), p. 162, pl. 15, fig. 3.

Figured material.—UF 265768 (Fig. 54), TU Loc. 655.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 54A–B). Ancestrula tatiform (Fig. 54A), 250 μm long by 140 μm wide, with a smooth gymnocyst extended proximally, reduced laterally, almost disappearing distally, and a narrow rim of cryptocyst sloping steeply inwards around the opesia; opesia elliptical, 135 μm long by 110 μm wide, with nine oral spine bases, about 8 μm in diameter, distantly spaced proximally, closely spaced distally, the proximalmost spine spike-like. Two autozooids budded distolaterally from the ancestrula; first budded zooids similar to later autozooids but smaller, 220–230 μm long by 170–180 μm wide. Autozooids distinct with deep interzooidal furrows, rounded hexagonal, longer than broad (mean L/W 1.29). Frontal shield convex, evenly porous and coarsely tubercular (Fig. 54B); pseudopores circular, small (about 10 μm in diameter), numerous (35 to 45). Marginal areolar pores sometimes distinguishable at zooidal corners. Orifice transversely D-shaped (Fig. 54B), ca. 50 μm long by 70–80 μm wide, with five oral

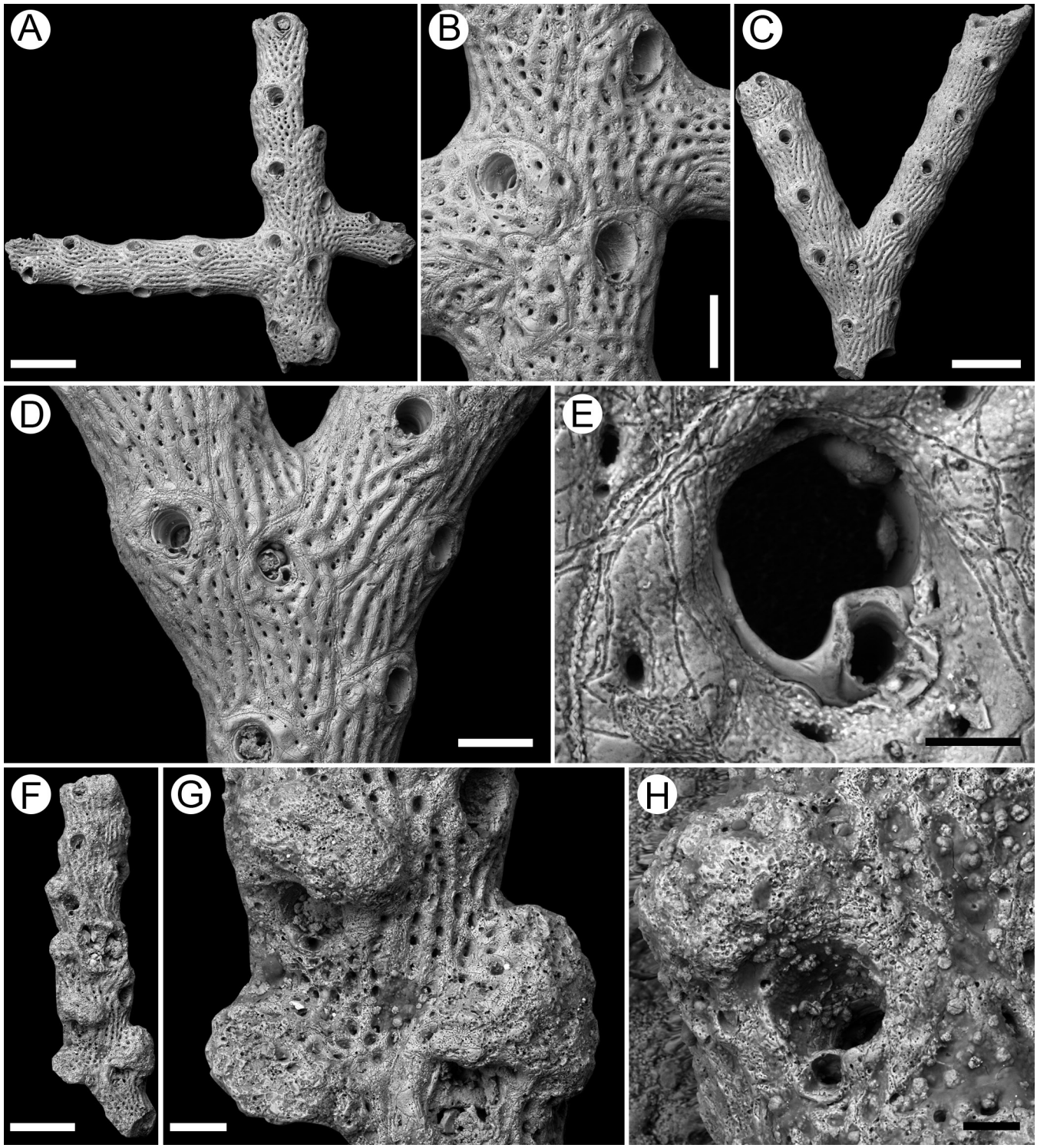

Figure 53. *Vix scolaroi* n. sp. **A–E.** holotype, UF71860a, b. **A.** branch fragment (a) with two lateral stems located at right angle; **B.** close-up of the bifurcation with small-sized zooids and kenozooids; **C.** branch fragment (b) bifurcating dichotomously at an angle of 45˚; **D.** close-up of the bifurcation; **E.** close-up of the secondary orifice bearing an avicularium on the proximal rim. **F–H.** paratype, UF 265612. **F.** fertile branch fragment; **G.** ovicellate zooids; **H.** close-up of a bulbous ovicell. Scale bars: A, C, F = 500 μm; B, D = 200 μm; E, H = 50 μm; G = 100 μm.

spine bases, 12–15 μm in diameter. A crescentic, denticulate ascopore is located about 20 μm below the orifice, surrounded by a slightly raised collar (Fig. 54B). A single, oval avicularium is located at two-thirds or half-way along the zooid and is directed laterally (Fig. 54B); crossbar or condyles not seen. Slit-like, pore-chamber windows visible along zooidal margins (Fig. 54A, B). Ovicells not observed.

Measurements.—ZL 319±24, 299–354 (2, 5); ZW 248±20, 224–274 (2, 5); AvL 72±4, 68–77 (2, 3); AvW 56±2, 54–57 (2, 3).

Remarks.—Tentatively referred to *Microporella ciliata* (Pallas, 1766) by Scolaro (1968), this species is here left in open nomenclature owing to the scarcity of material available for study, limited to two specimens with a pair of zooids each. Scolaro (1968) figured a specimen from Farley Creek (TU Loc. 821), but the specimens we found in his collection are all from Tenmile Creek (TU Loc. 655). Although superficially resembling *M. ciliata* (see Kuklinski and Taylor, 2008), *Microporella* sp. lacks the distinct pair of condyles at the outer proximal edge of the orifice. Among the numerous species that have been described of *Microporella*, the Chipola Formation specimen shares with the Recent *M. protea* Winston, 2005 various features, such as the appearance of the frontal shield, and the shapes and positions of the ascopores and avicularia. The two species differ in the number of oral spine bases, 3–4 in *M. protea* vs 5 in *Microporella* sp.

Family JACULINIDAE ZABALA, 1986
Genus *PIRABASOPORELLA* ZÁGORŠEK ET AL., 2014
PIRABASOPORELLA CHIPOLAE ZÁGORŠEK ET AL., 2014

New genus 'A' n. sp. 'x' Scolaro (1968), p. 129, pl. 8, figs. 3, 4, pl. 9, fig. 1.
Pirabasoporella chipolae Zágoršek et al. (2014), p. 107, fig. 6.

Figured material.—UF 265507 (Fig. 55A–B), TU Loc. 711; UF 265751 (Fig. 55C–E), TU Loc. 823; UF 265678 (Fig. 55G), TU Loc. 548; NHMUK PI BZ 7831 (Fig. 55F, H–I), (30.46607, -85.14838; WGS84), Farley Creek, USA, Florida, Calhoun County.

Description.—Colony erect, rigid (Fig. 55A, C). Branches narrow, 300–650 μm wide, biserial, bifurcating at an angle of 50˚, connected by kenozooidal tubules, 150–330 μm wide, smooth or faintly ridged with a circle of teardrop-shaped areolar pores at each branch contact (Fig. 55A, C). Kenozooidal tubules budded at irregular intervals,

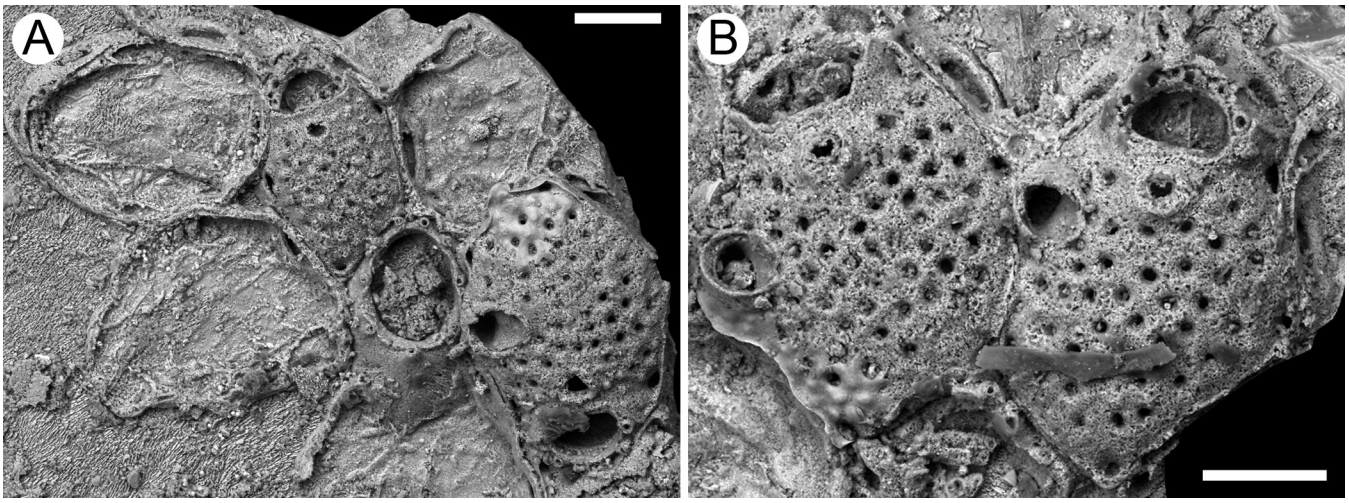

Figure 54. *Microporella* sp., UF 265768. **A.** ancestrula with one of the first budded zooid and an additional autozooid; **B.** two autozooids with adventitious avicularia, crescentic denticulate ascopore and five oral spine bases. Scale bars: A, B = 100 μm.

forming irregularly oval, rounded triangular to rectangular fenestrae (Fig. 55A–C), 625–690 μm long by 260–325 μm wide. Autozooids opening only on one side of the branch, arranged in two alternating longitudinal rows, indistinct on the frontal side, defined by a low, thin rim with a median furrow on the dorsal side, subrectangular, almost twice as long as wide (mean L/W 1.93). Frontal shield with circular pseudopores, closed during ontogeny, becoming smooth or sculptured by furrows and ridges (Fig. 55D–E). Orifice as long as wide (mean L/W 1.05), subcircular, with a bowl-shaped sinus defined by two acute lateral denticles, rarely preserved; two large, circular spine bases at the lateral margins of the orifice, 25–45 μm in diameter (Fig. 55D–F). A suboral avicularium on each autozooid, small, 60–85 μm long; rostrum pointed or spatulate, proximally and inwardly directed, crossbar complete (Fig. 55D). Ovicell globular, flattened frontally, occupying most of the frontal shield of the next distal zooid, 310 μm long by 345 μm wide; ectooecium uncalcified, endooecium tubercular and evenly perforated by numerous, small pores except for a smooth, imperforated band of calcification extended proximally (Fig. 55A–B). Dorsal side relatively smooth, marked by zooidal boundaries; a kenozooid, probably representing a rhizoidal pore, variable in shape, from round to oval, and size (70–300 μm in length), is located distolaterally on each autozooid (Fig. 55G–H). A multiporous, teardrop-shaped plate, 190–220 μm long by 85–120 μm wide, with 9–15 small, circular pores along the margins, is visible on the internal, dorsal wall of each autozooid in connection with the kenozooid (Fig. 55I).

Measurements.—ZL 521±48, 421–598 (3, 20); ZW 270±36, 201–337 (3, 20); OL 170±16, 154–192 (3, 7); OW 162±7, 155–176 (3, 7).

Remarks.—Aside from *Pirabasoporella chipolae*, this genus includes two other early Miocene species from tropical Western Atlantic, *P. atalaiensis* Zágoršek et al., 2014, from the Pirabas Formation in Brazil, and *P. baitoae* Zágoršek et al., 2014, from the Baitoa Formation in the Dominican Republic. *Pirabasoporella chipolae* mainly differs from *P. atalaiensis* and *P. baitoae* in having oral spines. The ovicell of *P. chipolae* is described and figured here for the first time. It is very similar in appearance to that of *P. atalaiensis* but slightly larger (310 μm long by 345 μm wide vs 266 μm long by 255 μm wide in *P. chipolae* and *P. atalaiensis*, respectively).

Superfamily MAMILLOPOROIDEA CANU and BASSLER, 1927
Family MAMILLOPORIDAE CANU and BASSLER, 1927
Genus *MAMILLOPORA* SMITT, 1873
MAMILLOPORA TUBEROSA (CANU and BASSLER, 1919)

Stichoporina tuberosa Canu and Bassler (1919), p. 98, pl. 1, figs. 20–23, pl. 6, figs. 16–19, pl. 7, figs. 1–8.

Mamillopora cupula Canu and Bassler (1923), p. 192, pl. 6, figs. 16–19, pl. 7, figs. 1–8; Scolaro (1968), p. 172, pl. 17, fig. 3.

Figured material.—UF 265762 (Fig. 56A–B, E), TU Loc. 456; UF 265765 (Fig. 56C–D), TU Loc. 546.

Description.—Colony lunulitiform, discoidal or cup-shaped. Autozooids distinct with deep interzooidal furrows, quincuncially arranged, erect, hexagonal, broader than long (mean L/W 0.90) (Fig. 56A–C). Frontal surface mostly occupied by an elliptical orifice, placed centrally, surrounded by a salient, tuberculate peristome (Fig. 56A–B). Orifice longer than wide, with distinct lateral condyles, placed at about mid-length and medially directed, separating an arched anter from a bowl-shaped poster (Fig. 56C–D). Subcircular, marginal areolar pores visible at zooidal lateral corners, 15–40 μm in diameter. Avicularia infrequent, adventitious, single, located laterally, ovoidal to elliptical, distally directed (Fig. 56B–C); condyles or pivotal bar not seen. Ovicells not observed. Dorsal side concave, coarsely nodular with circular pores and figure of eight-shaped kenozooids scattered throughout (Fig. 56E).

Measurements.—ZL 261±17, 232–298 (2, 20); ZW 289±21, 229–316 (2, 20); OL 152±9, 131–166 (2, 10); OW 126±6, 112–133 (2, 10); AvL 131±4, 127–134 (2, 3); AvW 94±6, 88–100 (2, 3).

Remarks.—Two small fragments of *Mamillopora tuberosa* were recovered from

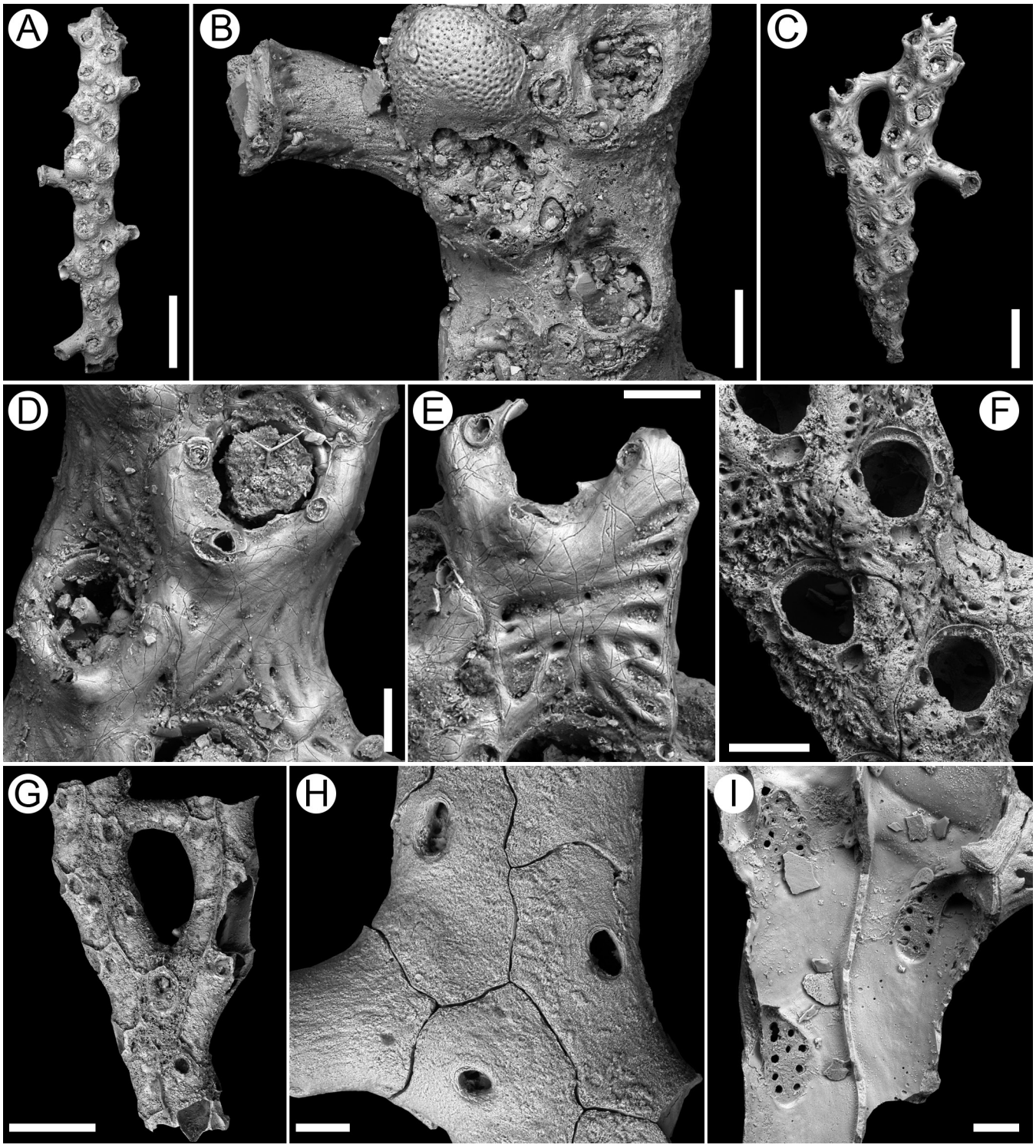

Figure 55. *Pirabasoporella chipolae* Zágoršek et al., 2014. **A, B.** UF 265507. **A.** branch fragment; **B.** close-up of an ovicellate zooid. **C–E.** UF 265751. **C.** colony fragment with a small fenestra; **D.** close-up of an autozooid with suboral avicularium and sculptured frontal shield; **E.** close-up of an autozooid showing the bowl-shaped sinus of the orifice. **F.** NHMUK PI BZ 7831, three autozooids with two oral spines bases each. **G.** UF 265678, dorsal side with rhizoidal pores. **H, I.** NHMUK PI BZ 7831. **H.** close-up of the dorsal side with rhizoidal pores; **I.** multiporous plates on the internal, dorsal wall of autozooids. Scale bars: A = 1 mm; B, F = 200 μm; C, G = 500 μm; D, E, H, I = 100 μm.

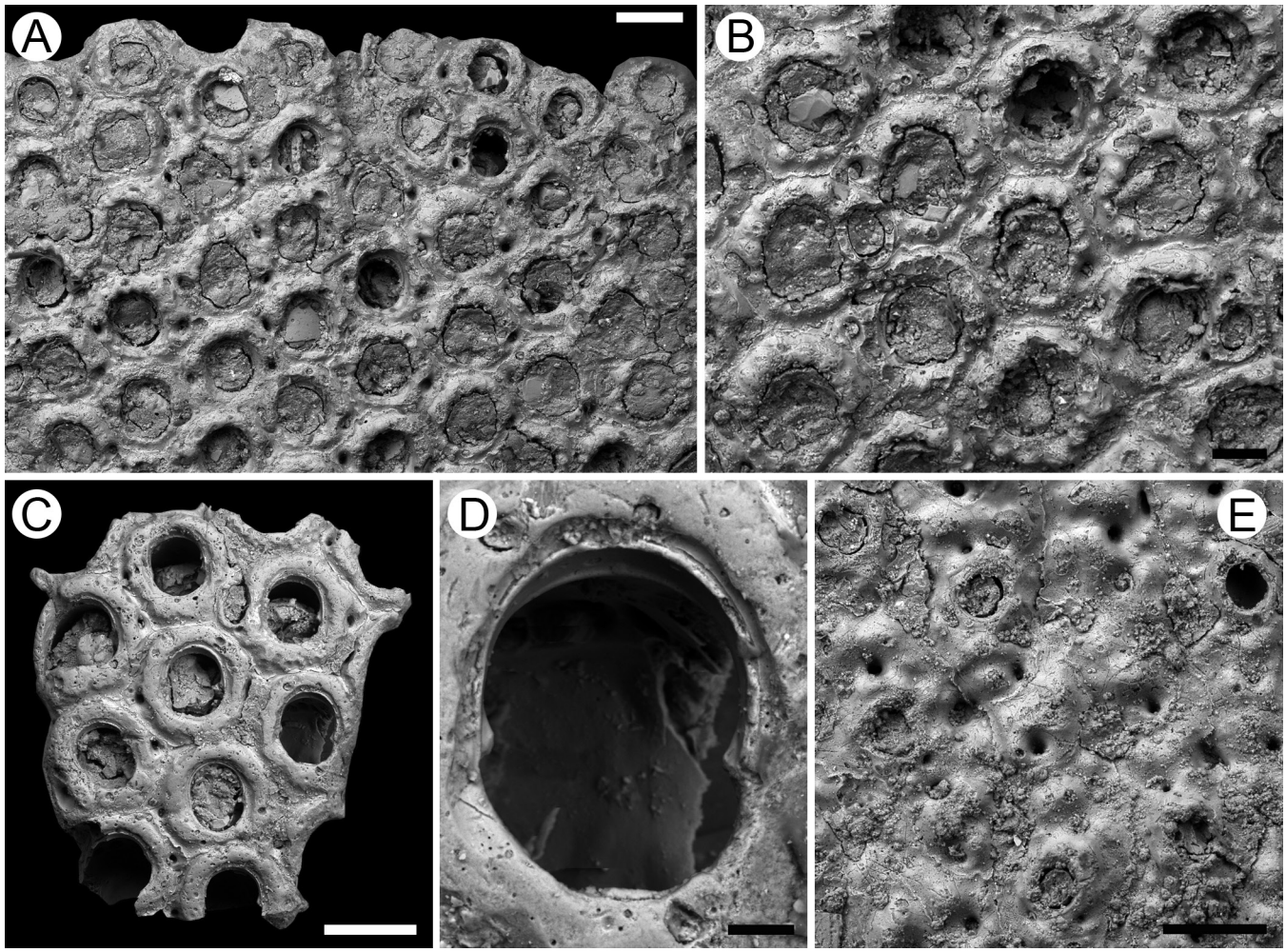

Figure 56. *Mamillopora tuberosa* (Canu and Bassler, 1919). **A, B.** UF 265762. **A.** view of part of the colony; **B.** group of autozooids and two adventitious avicularia. **C, D.** UF 265765. **C.** colony fragment; **D.** close-up of an orifice. **E.** UF 265762, porous dorsal side with kenozooids. Scale bars: A, C, E = 200 μm; B = 100 μm; D = 30 μm.

two localities at Tenmile Creek. Scolaro (1968) identified them as *M. cupula* Smitt, 1873, a Recent species known from Cape Hatteras to Florida, the Caribbean and the Gulf of Mexico (Winston, 2005). However, the peristomial tuberosities observed in the Chipola Formation specimens are characteristic of *M. tuberosa*, a Miocene to Pliocene species known from Costa Rica, Jamaica and the Dominican Republic. This identification is also supported by the zooidal dimensions, with the fossils being similarly sized, ca. 230–300 μm long by 230–315 μm wide vs 300 μm long by 300 μm wide in the Chipola and the Dominican Republic specimens respectively, as reported by Canu and Bassler (1923), while colonies of the Recent species have much larger zooids, on average 350 μm long by 370 μm wide (Winston, 2005). Furthermore, avicularian openings in *M. tuberosa* are elliptical, while in *M. cupula* they are hoof-shaped.

Superfamily CELLEPOROIDEA JOHNSTON, 1838

Family COLATOOECIIDAE WINSTON, 2005

Genus *CIGCLISULA* CANU and BASSLER, 1927

CIGCLISULA SOLENOIDES N. SP.

Gemelliporella glabra Scolaro (1968), p. 154, pl. 14, figs. 1, 2.

Figured material.—Holotype, UF 265753 (Fig. 57), TU Loc. 823.

Zoobank Nomenclatural Act.—2176B517-

BFB1-46C6-920D-BB2005E95F9A.

Etymology.—From the Greek 'cylinder', referring to the subcylindrical form of the branches.

Diagnosis.—Colony erect. Branches subcylindrical. Autozooids in alternating longitudinal rows with extensively perforated frontal shield. Orifice deeply immersed, elliptical, hidden by the peristome. Avicularia suboral, single or paired. Ovicells with pores arranged in a radial pattern.

Description.—Colony erect, rigid, dichotomously branching at an angle of ca. 70˚ (Fig. 57A). Branch fragment subcylindrical; main branch ca. 2 mm in width, including 5–6 zooids per side, branches narrowing after bifurcation, 1.0–1.5 mm in diameter, including 2 or 3 zooids per side (Fig. 57A). Autozooids arranged in alternating longitudinal rows, outline indistinct to faintly distinct because of slightly raised margins, polygonal, longer than wide (mean L/W 1.88). Frontal shield flat or depressed centrally, perforated by 15–20 large, circular to oval pores, varying in size (Fig. 57B). Marginal areolar pores indistinguishable. Primary orifice deeply immersed, elliptical, longer than wide, about 150 μm long by 130 μm wide, arched distally with rounded condyles and narrower proximal margin with a shallow, bowl-shaped sinus (Fig. 57C). Peristome incorporating one or two lateral tubercles hiding the orificial proximal rim (Fig. 57B). Avicularia suboral, single or paired, small, 100–120 μm long by 60–100 μm wide, teardrop-shaped with complete crossbar, enclosed in the peristome, sloping, randomly directed (Fig. 57C–E, H). Ovicells immersed and inclined proximally, longer than wide, convex, porous; pores small, oval to subcircular, 15–20 μm long, arranged in a radial pattern (Fig. 57F–G). Large interzooidal avicularia not observed.

Measurements.—ZL 590±50, 514–640 (1, 10); ZW 314±45, 284–391 (1, 10); OvL 206±12, 189–219 (1, 5); OvW 158±22, 124–177 (1, 5).

Remarks.—A single branch fragment of *Cigclisula solenoides* n. sp. was found in Scolaro's collection. The specimen, originally identified by Scolaro (1968) as *Gemelliporella glabra* (Smitt, 1873), a species now accepted as *Gemelliporina glabra* (Smitt, 1873), fits within the genus *Cigclisula* based on the revised diagnosis of Almeida et al. (2014), except for the arrangement of the pseudopores in the ectooecium, which are supposed to be longitudinally arranged and show instead a clear radial pattern in the new species. The Chipola Formation species differs from *G. glabra* in having an evenly porous frontal shield (pores on the frontal shield of the Recent, Western Atlantic species are limited to two rows of marginal areolae), an orifice with a shallow, bowl-shaped sinus that is instead deep and V-shaped in *G. glabra*, and in the lack of oral spines. A further five species of *Cigclisula* are known from the Pleistocene to Recent of the tropical Western Atlantic but have encrusting colonies.

Family CELLEPORIDAE JOHNSTON, 1838
Genus *TURBICELLEPORA* RYLAND, 1963
TURBICELLEPORA GIARDINAI N. SP.

Turbicellepora 'A' n. sp. Scolaro (1968), p. 123, pl. 7, figs. 3, 4.

Figured material.—Holotype, UF 71853 (Fig. 58B–H), TU Loc. 1048; paratype, UF 265685 (Fig. 58A), TU Loc. 459.

Zoobank Nomenclatural Act.—6CDADDB7-8785-466B-9753-08B97441781D.

Etymology.—Named after a good friend of the first author, Carmelo Giardina.

Diagnosis.—Colony forming hollow tubes. Autozooid commonly erect with nodular frontal shield perforated only by marginal areolar pores. Orifice semicircular, sloping to a V-shaped sinus. Suboral spatulate interzooidal avicularia large, with complete crossbar. Ovicells with 7–17 pores.

Description.—Colony encrusting, multilaminar, forming hollow tubes, ca. 2–4 mm in length by 2–3 mm in diameter. Autozooid recumbent (Fig. 58A), with ovoid to rounded polygonal distinct outline only at colony growing edge or in new, frontally budded laminae, longer than wide (mean L/W 1.30), otherwise erect (Fig. 58B), irregularly arranged. Frontal shield convex, nodular to granular, perforated only by a row of transversely elongate marginal areolar pores, 20–50 μm long, with ridges in-between (Fig. 58A, C). Orifice sunken, located at the base of a moderately developed, flared peristome, longer

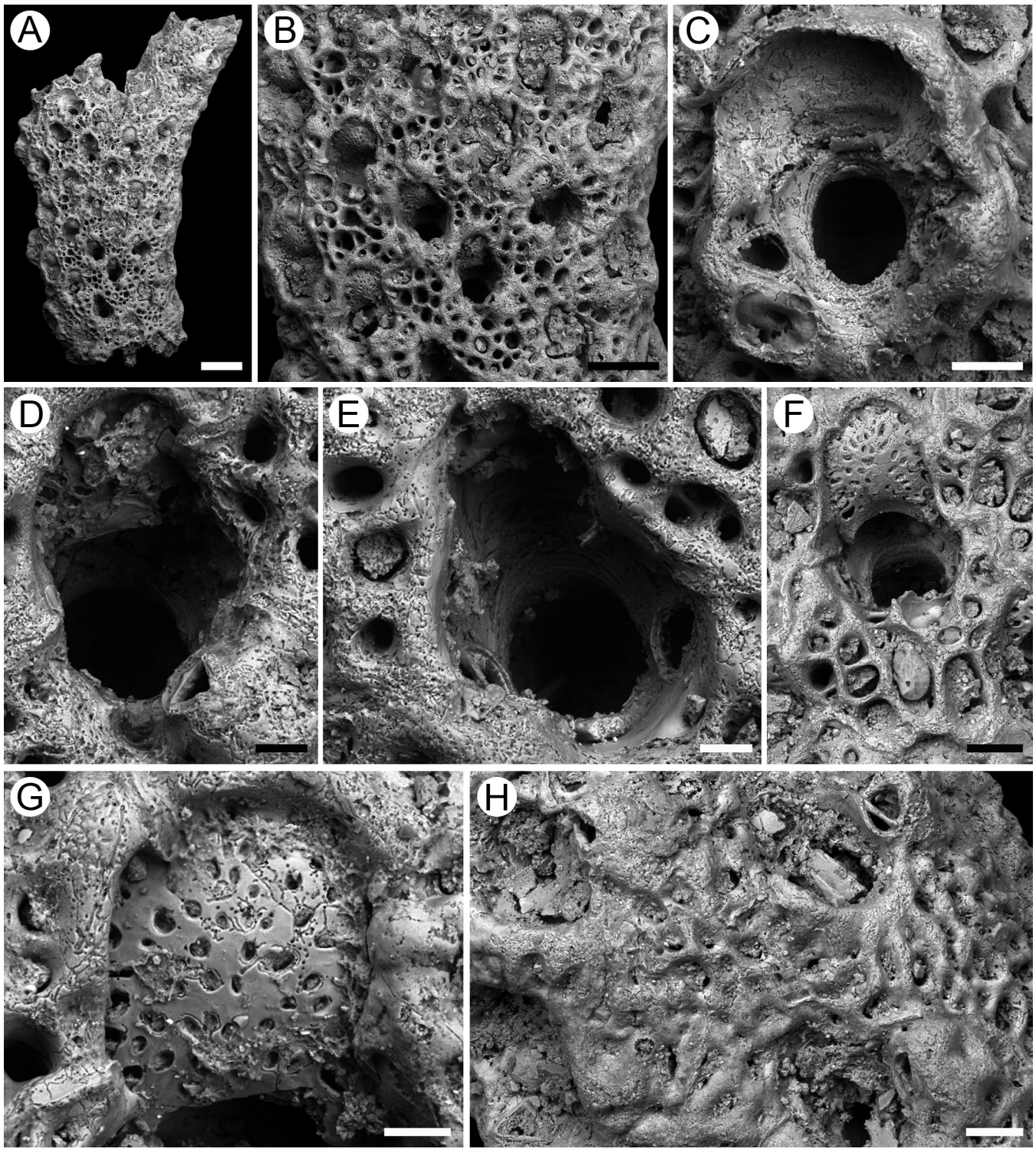

Figure 57. *Cigclisula solenoides* n. sp., holotype, UF 265753. **A.** branch fragment; **B.** group of ovicellate and non-ovicellate zooids; **C.** close-up of the orifice; **D.** ovicellate zooid with single suboral avicularium; **E.** zooid with paired suboral avicularia enclosed in the peristome; **F.** ovicellate zooid; **G.** close-up of an ovicell; **H.** autozooid with single avicularium showing the complete crossbar. Scale bars: A = 500 μm; B = 300 μm; C, F, H = 100 μm; D, E, G = 50 μm.

than wide; anter semicircular, slightly narrowing proximally to form a deep, V-shaped proximal sinus (Fig. 58D). A suboral avicularium may occur in the lateroproximal part of the peristome, slightly variable in size and shape, from oval to elliptical, upwardly slanted with a complete crossbar (Fig. 58B–C). Larger interzooidal avicularia uncommon; rostrum broadly spatulate, crossbar complete (Fig. 58E–F). Ovicells hood-like, broader than long, with a frontal area coarsely perforated by 7–17 pores, large, 15–60 μm in diameter, scattered, irregularly shaped (Fig. 58B, G–H), becoming immersed in secondary calcification distally and laterally.

Measurements.—ZL 452±46, 355–522 (1, 12); ZW 347±34, 286–410 (1, 12); OL 151±7, 137–162 (3, 18); OW 135±10, 118–152 (3, 18); OvL 197±34, 151–248 (3, 12); OvW 241±25, 208–284 (3, 12); AvL (suboral) 127±13, 102–151 (3, 12); AvW (suboral) 87±15, 70–132 (3, 12); AvL (interzooidal) 273±52, 201–326 (2, 4); AvW (interzooidal) 143±14, 124–158 (2, 4).

Remarks.—*Turbicellepora giardinai* n. sp. is a common and abundant species at the Farley Creek localities, forming hollow tubular encrustations that may have grown around algae, seagrass stems or gorgonians. Fossil Western Atlantic species of *Turbicellepora* all differ from the Chipola species. The Plio-Pleistocene *T. brevincisa* (Canu and Bassler, 1923), from Florida, differs in having elliptical interzooidal avicularia lacking a pivotal bar. The late Eocene *T. globosa* (Canu and Bassler, 1920) from Mississippi, and *T. orbicularis* (Canu and Bassler, 1920) from Georgia, lack interzooidal avicularia. The late Eocene *T. umbonata* (Canu and Bassler, 1920), as well as the Recent *T. pourtalesi* Winston, 2005 from Florida, are characterized by a large, suboral umbo projecting diagonally from the zooid surface and obscuring the orifice, the umbo being provided with an avicularium in the modern species.

Family HIPPOPORIDRIDAE VIGNEAUX, 1949
Genus *HIPPOPORIDRA* CANU and BASSLER, 1927
HIPPOPORIDRA EDAX (BUSK, 1859)

Cellepora edax Busk (1859), p. 59, pl. 9, fig. 6, pl. 22, fig. 3; Duvergier (1924), p. 46, pl. 6, figs. 5–10.

Hippoporidra edax Lagaaij (1952), p. 147, pl. 15, fig. 13, pl. 16, fig. 6; Buge (1957), p. 320, pl. 11, fig. 2, pl. 12, figs. 3–6; Cook (1964), p. 26, pl. 3, figs. 5–7; Taylor and Cook (1981), p. 246.

Hippoporidra janthina Scolaro (1968), p. 140, pl. 9, figs. 3, 4.

Figured material.—UF 265730 (Fig. 59A–E), TU Loc. 817; UF 190509 (Fig. 59F–G), TU Loc. 1098.

Description.—Colony encrusting, multiserial, multilaminar (Fig. 59A). Autozooids distinct with shallow, interzooidal furrows, frontally budded, chaotically arranged, irregularly polygonal, longer than wide (mean L/W 1.35). Frontal shield convex, nodular and smooth, granular in some zooids, perforated by one or two rows of marginal, circular to oval, areolar pores, and scattered pseudopores, 15–25 μm in diameter (Fig. 59B–C, F–G). Orifice almost equidimensional, cleithridiate, a horseshoe-shaped anter separated from a slightly narrower, shallow bowl-shaped sinus by a pair of rounded triangular condyles, ca. 10–12 μm long (Fig. 59D); a low, medial umbo commonly occupies the imperforate, suboral area. Frequent interzooidal avicularia scattered throughout the colony, having almost the same frontal area as an autozooid: interzooidal avicularia 'type 1' are large, with a thin, long, pointed rostrum, laterally raised wings, complete crossbar doubly constricted laterally and with a median, robust ligula (Fig. 59B–C), while interzooidal avicularia 'type 2' are similar in shape to avicularia 'type 1' but reduced in size (Fig. 59C, E; see measurements below). Rarely, small adventitious avicularia 'type 3' with a rounded triangular rostrum and a complete crossbar are budded from marginal areolar pores in variable orientation (Fig. 59C, F– G). Ovicells not observed.

Measurements.—ZL 350±58, 253–455 (2, 20); ZW 260±37, 188–327 (2, 20); OL 82±6, 74–95 (2, 20); OW 78±6, 71–95 (2, 20); AvL (type 1) 151±15, 127–181 (2, 20); AvW (type 1) 106±7, 94–119 (2, 20); AvL (type 2) 96±9, 75–111 (2, 12); AvW (type 2) 72±7, 60–84 (2, 12); AvL (type 3) 77±5, 71–82 (2, 4); AvW (type 3) 53±6, 44–56 (2, 4).

Remarks.—*Hippoporidra edax* is moderately common at Tenmile Creek, less so at the Chipola River localities. It forms multilaminar, cylindrical colonies, which possibly are tubular extensions

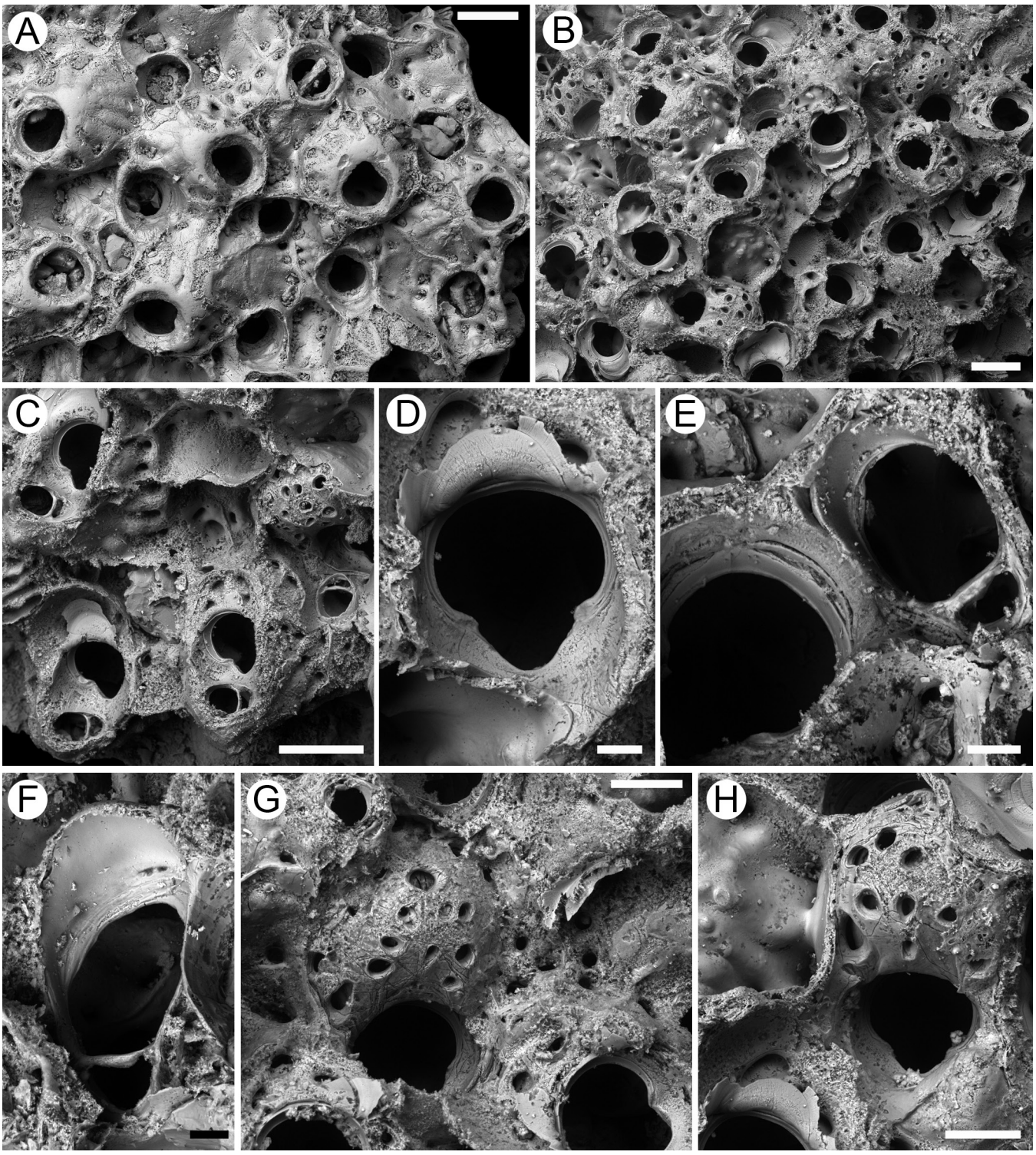

Figure 58. *Turbicellepora giardinai* n. sp. **A.** paratype, UF 265685, group of autozooids, some of which with a distinct polygonal outline. **B–H.** holotype, UF 71853. **B.** group of erect zooids; **C.** close-up of ovicellate and non-ovicellate zooids with suboral avicularium enclosed in the peristome; **D.** close-up of the orifice; **E, F.** close-ups of two interzooidal avicularia; **G, H.** close-ups of two ovicells. Scale bars: A, B, C = 200 μm; D, E, F = 40 μm; G, H = 100 μm.

from encrusting colonies symbiontic with hermit crabs, as it is the case for the great majority of *Hippoporidra* species. Some *Hippoporidra* species are characterized by the presence of ?male polymorphs, i.e., 'cortical zooids', which in *H. edax* are supposed to be larger than autozooids, with more numerous frontal pseudopores and a reduced orifice. In the Chipola Formation specimens, some zooids show a greater number of frontal pseudopores than others (Fig. 59F–G), as well as a granular instead of a smooth frontal shield (Fig. 59B–C), but no significant variation has been observed in orifice size. However, based on Taylor and Cook (1981:247) orifice size ranges in autozooids and 'cortical zooids' of *H. edax* may overlap. One of the most obvious differences among species of *Hippoporidra* is in the morphology of the interzooidal avicularium (see Taylor and Schindler, 2004:793, fig. 3). In *H. edax*, interzooidal avicularia have a characteristic distally tapering aperture associated with a thin pointed rostrum, and a doubly constricted pivotal bar provided with a ligula. In the inferred hermit-crab symbiont *H. portelli* Taylor and Schindler, 2004, from the Eocene Ocala Limestone of Florida, interzooidal avicularia have a parallel-sided to slightly spatulate-shaped aperture with a broad, rounded rostrum; *H. maculata* (Ulrich and Bassler, 1904), recorded in several Miocene deposits along the east coast of USA, and the Recent *H. dictyota* Ryland, 2001, from the 'Black Rocks' off North Carolina, have interzooidal avicularia with subtriangular rostrum.

Scolaro (1968) identified the Chipola Formation specimens as *Hippoporidra janthina* (Smitt, 1873). As pointed out by Cook (1985:175) and subsequently by Winston (2005:109), *Lepralia edax* forma *janthina* Smitt, 1873 is a species of *Hippotrema*. *Hippotrema janthina* differs from *Hippoporidra edax* in having an imperforate frontal shield with a suboral umbo supporting a sharp, pointed triangular, adventitious avicularium, but lacks interzooidal avicularia. Species of *Hippotrema* also lack dimorphic zooids, an important feature of *Hippoporidra*, although these were not obvious in the Chipola Formation specimens.

Hippoporidra edax had a pan-Atlantic distribution during the Miocene and Pliocene, but seems to be restricted to the western side of the Atlantic at the present-day (Taylor and Cook, 1981).

Family PHIDOLOPORIDAE GABB and HORN, 1862

Genus *PLEUROMUCRUM* VIGNEAUX, 1949

Remarks.—Following a revision (Di Martino and Taylor, in review) of the material described by Vigneaux (1949), this genus is revived and considered as a senior synonym of *Lifuella* Gordon and d'Hondt, 1997.

PLEUROMUCRUM LIOWAE N. SP.

Hippoporella gorgonensis Scolaro (1968), p. 137, pl. 10, figs. 1–3.

Figured material.—Holotype, UF 265521 (Fig. 60), TU Loc. 554.

Zoobank Nomenclatural Act.—1A8640E9-D4FB-4481-A425-334D0444C868.

Etymology.—Named after Dr. Lee Hsiang Liow (Oslo Museum of Natural History) for her important contributions to the study of bryozoans.

Diagnosis.—Colony encrusting. Autozooids with a granular, imperforate frontal shield apart from a single row of marginal areolar pores. Orifice bell-shaped; two distal, oral spines; suboral umbo squat. Adventitious avicularia single, paired or absent, placed at distolateral zooidal corners. Ovicells granular with a central umbo and a widely arched opening.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 60A). Autozooids distinct, delineated by shallow interzooidal furrows, quincuncially arranged, subrectangular to hexagonal, longer than wide (mean L/W 1.40). Frontal shield convex, granular, imperforate apart from a single row of subcircular to elliptical, marginal areolar pores along proximal and lateral zooidal margins, 15–20 μm long (Fig. 60B–C). Orifice bell-shaped, slightly wider than long, with an arched anter separated from a shallow, broader, slightly concave or straight poster by two faint condyles (Fig. 60D–E); two distal, oral spine bases, about 10 μm in diameter (Fig. 60D). Suboral umbo stout, squat with a rounded tip (Fig.

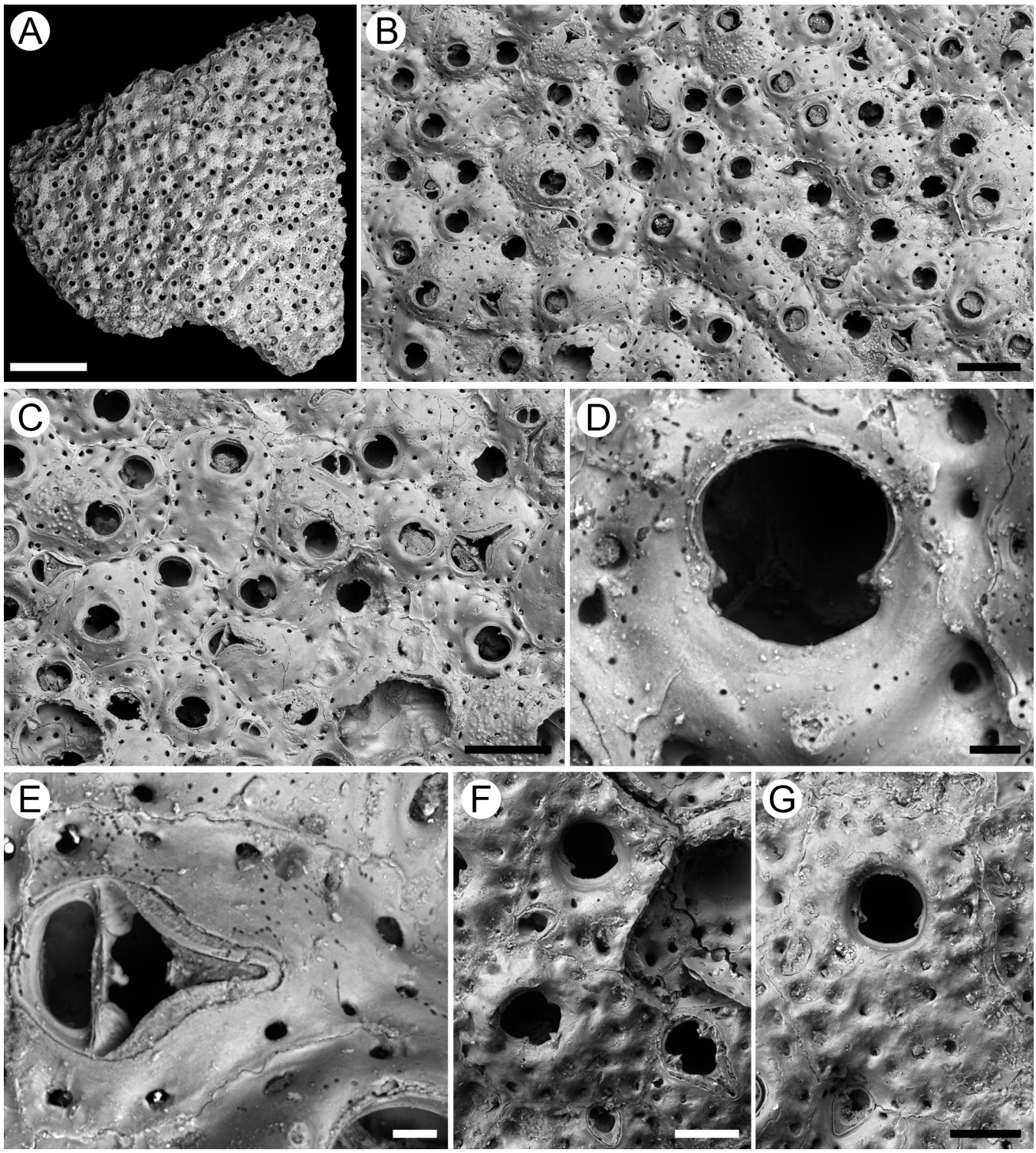

Figure 59. *Hippoporidra edax* (Busk, 1859). **A–E.** UF 265730. **A.** general view of a multilaminar colony fragment; **B.** autozooids and large interzooidal avicularia; **C.** autozooids and interzooidal avicularia of different sizes; **D.** close-up of an orifice; **E.** close-up of a large interzooidal avicularium with pointed rostrum, raised lateral wings and median ligula. **F, G.** UF 190509, autozooids with small adventitious avicularia. Scale bars: A = 1 mm; B, C = 200 μm; D, E = 20 μm; F, G = 100 μm.

60D–E). Adventitious avicularia single, paired or absent, placed at the distolateral zooidal corners, teardrop-shaped, distolaterally directed (Fig. 60C, E); crossbar not observed. Ovicells subimmersed, with the same granular appearance as the frontal shield, imperforate, with a relatively developed, stout, central umbo and a widely arched opening (Fig. 60B–C, F).

Measurements.—ZL 373±39, 317–460 (1, 16); ZW 266±29, 217–307 (1, 16); OL 90±7, 82–96 (1, 3); OW 106±13, 91–115 (1, 3); OvL 128±9, 117–145 (1, 12); OvW 158±15, 132–179 (1, 12); AvL 62±3, 58–65 (1, 5); AvW 45±3, 40–49 (1, 5).

Remarks.—Scolaro (1968) identified this specimen as *Pleuromucrum gorgonensis* (Hastings, 1930), a Recent species first described from the Pacific side of the Isthmus of Panama at about 2–27 m depth (Hastings, 1930), and subsequently reported from the eastern part of the Gulf of Mexico at about 12–50 m depth (Lagaaij, 1963). SEM examination of the type specimen of *P. gorgonensis* (NHMUK 29.4.26.137; Fig. 61) allowed a distinction to be made between the two species. Although similar in the general appearance of the frontal shield and in having two oral spines, *P. liowae* n. sp. differs from *P. gorgonensis* in: (1) the size of the zooids (on average 373 μm long by 266 μm wide in *P. liowae* n. sp. vs 260 μm long by 204 μm wide in *P. gorgonensis*); (2) the shape, position and direction of the adventitious avicularia, which are teardrop-shaped, distolaterally directed and located at the distolateral corners of zooids in *P. liowae* n. sp. (Fig. 60E), but elongate, either latero-oral and distally directed (Fig. 61B, D), or placed at about zooidal mid-length and laterally directed (Fig. 61C) in *P. gorgonensis*; (3) the size of marginal areolar pores, larger in the Recent species (20–35 μm long vs 15–22 μm long); (4) the shape of the suboral umbo, squat with a rounded tip in *P. liowae* n. sp. (Fig. 60B), slender and trifid in *P. gorgonensis* (Fig. 61B). Scolaro (1968) considered these differences as the effect of fluctuations in salinity and depth of the Chipola Formation paleoenvironment but he worked at a time of species lumping before genetic studies demonstrated the taxonomic significance of such differences among cheilostome bryozoans (Cheetham et al., 1994).

PLEUROMUCRUM EPIFANIOI N. SP.

Figured material.—Holotype, NHMUK 1968.1.6.3 (Fig. 62A–D), TU Loc. 548; paratype, NHMUK 1968.1.6.4 (Fig. 62E–F), TU Loc. 823.

Zoobank Nomenclatural Act.—6CBF3693-1D91-4CBD-90F0-8C61DFD82932.

Etymology.—Named after Epifanio Vaccaro, petrology curator at NHMUK, for stimulating discussions during SEM work.

Diagnosis.—Colony encrusting. Autozooids with a nodular, imperforate frontal shield apart from a single row of marginal areolar pores. Pore-chamber windows present. Orifice equidimensional, bell-shaped with robust condyles; six oral spines, at least four still visible in ovicellate zooids; suboral umbo conical. Adventitious avicularia single, paired or absent, latero-oral or at mid-length on the frontal shield. Ovicells nodular with a central umbo and a semilunar opening.

Description.—Colony encrusting, multiserial, unilaminar (Fig. 62A). Autozooids distinct, delineated by shallow interzooidal furrows, quincuncially arranged, hexagonal, longer than wide (mean L/W 1.21). Frontal shield convex mediodistally, nodular, imperforate apart from a single row of subcircular to elliptical, marginal areolar pores along proximal and lateral zooidal margins, 20–30 μm long (Fig. 62B–C). Elliptical pore-chamber windows visible along zooidal distal margins at colony growing edge (Fig. 62C). Orifice bell-shaped, almost equidimensional, with a horseshoe-shaped anter separated from a shallow, slightly broader, concave poster by two robust, rounded triangular condyles, about 12–14 μm long by 6–8 μm wide (Fig. 62D); six oral spine bases, about 20 μm in diameter (Fig. 62D). Suboral umbo stout, conical, 50–60 μm high, overhanging the primary orifice (Fig. 62E–F). Adventitious avicularia single, paired or absent, latero-oral, lanceolate, distally directed, crossbar complete (Fig. 62B, D); additional adventitious avicularia, the same size and shape as those lateral to the orifice, are occasionally placed transversely on the frontal shield at about mid-length, outwardly and laterally directed (Fig. 62E–F). Ovicells subimmersed, with the same nodular appearance

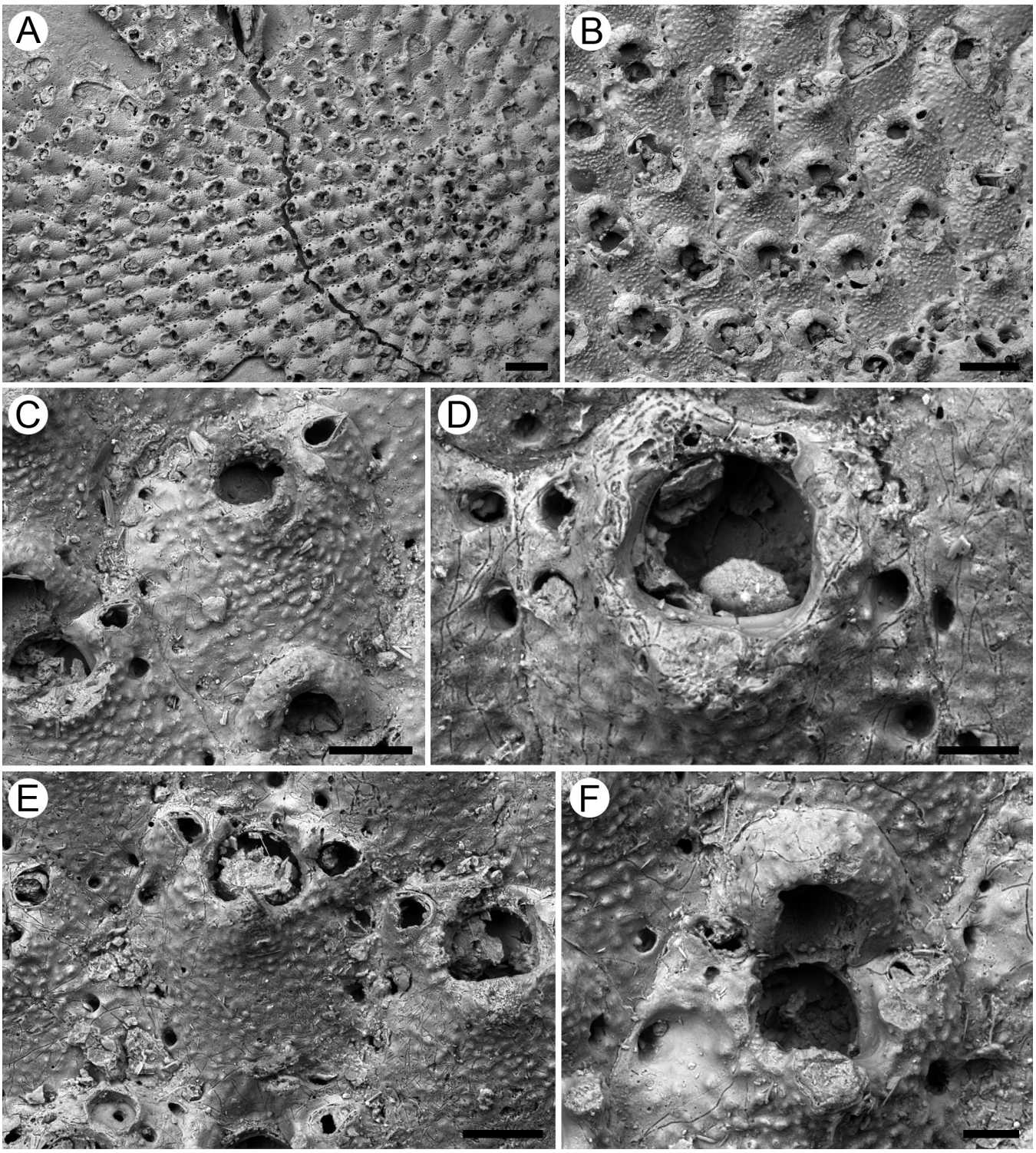

Figure 60. *Pleuromucrum liowae* n. sp., holotype, UF 265521. **A.** view of part of the colony; **B.** group of ovicellate and non-ovicellate zooids; **C.** autozooid with single distal adventitious avicularium; **D.** close-up of the orifice showing two distal oral spine bases and suboral umbo; **E.** autozooid with paired adventitious avicularia; **F.** close-up of an ovicell. Scale bars: A = 400 μm; B = 200 μm; C, E = 100 μm; D, F = 50 μm.

as the frontal shield, imperforate apart from a pair of marginal areolar pores usually at the proximal lateral corners or randomly placed, with a more or less developed, stout, central umbo and a semilunar opening (Fig. 62E–F); at least four spine bases visible in ovicellate zooids (Fig. 62B).

Measurements.—ZL 304±40, 225–415 (2, 30); ZW 252±38, 174–349 (2, 30); OL 85±6, 76–94 (2, 16); OW 83±7, 68–95 (2, 16); OvL 111±11, 94–129 (2, 22); OvW 164±10, 151–187 (2, 22); AvL 117±16, 91–143 (2, 20); OW 37±4, 25–45 (2, 20).

Remarks.—*Pleuromucrum epifanioi* n. sp. was most likely considered as conspecific with the above-described *P. liowae* n. sp. by Scolaro (1968), although no specimens of this, clearly distinct species were figured in his work. *Pleuromucrum epifanioi* n. sp. differs from *P. liowae* n. sp. in having slightly smaller autozooids, much larger adventitious avicularia, with a characteristic lanceolate form, placed lateral to the orifice instead of the teardrop-shaped avicularia located on the distolateral zooidal corners in *P. liowae* n. sp., and six instead of two oral spines. *Pleuromucrum epifanioi* n. sp. also lacks the trifid suboral umbo diagnostic of *P. gorgonensis*, differing further from the Recent species in having more elongate avicularia, robust orificial condyles, a squatter central umbo on the ovicells and more numerous

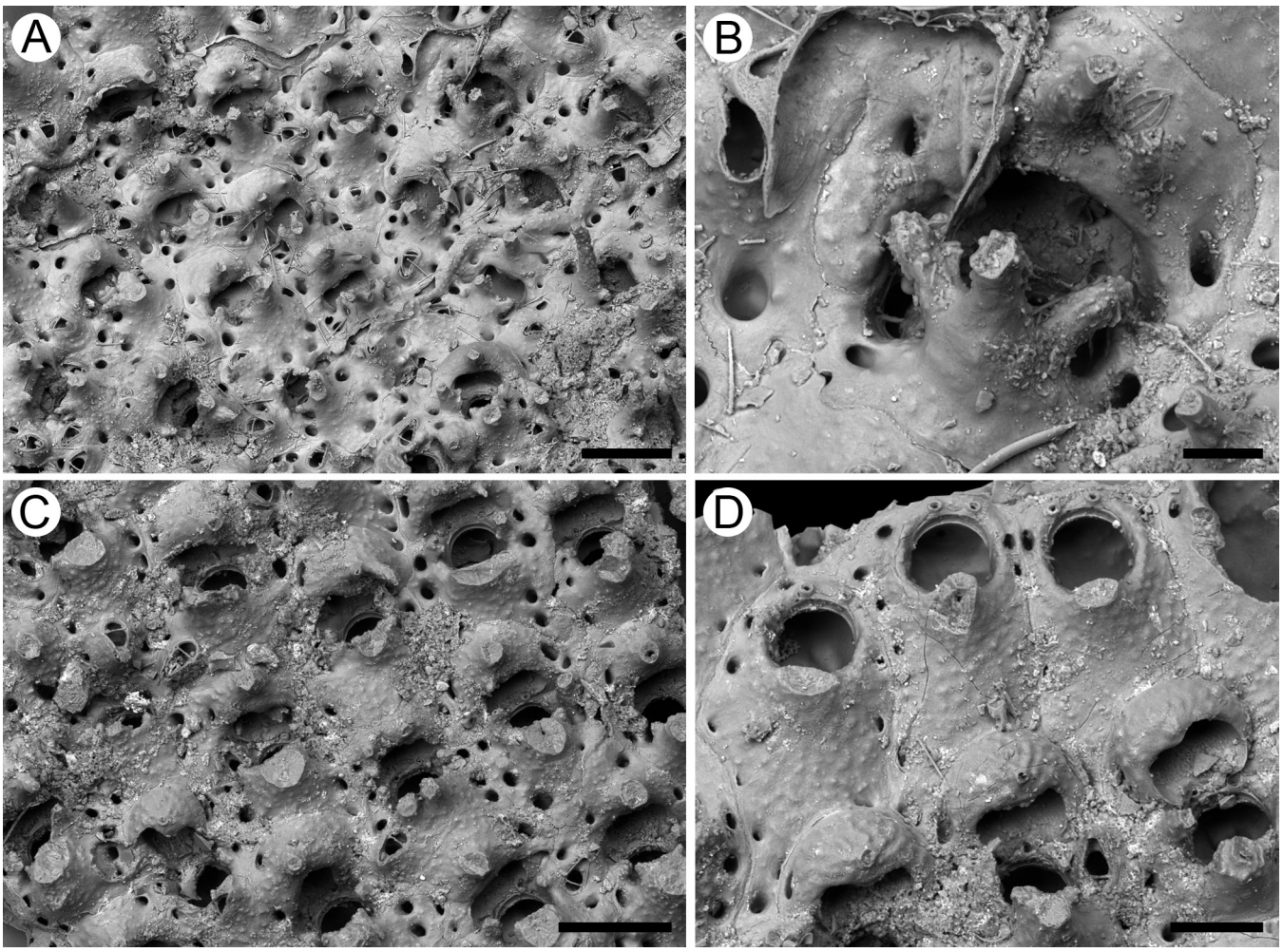

Figure 61. *Pleuromucrum gorgonensis* (Hastings, 1930), holotype, NHMUK 29.4.26.137, Recent. **A, C.** group of ovicellate zooids with adventitious avicularia placed at zooidal mid-length; **B.** close-up of the trifid suboral umbo; **D.** group of ovicellate and non-ovicellate zooids showing two oral spine bases. Scale bars: A, C = 200 μm; B = 50 μm; D = 100 μm.

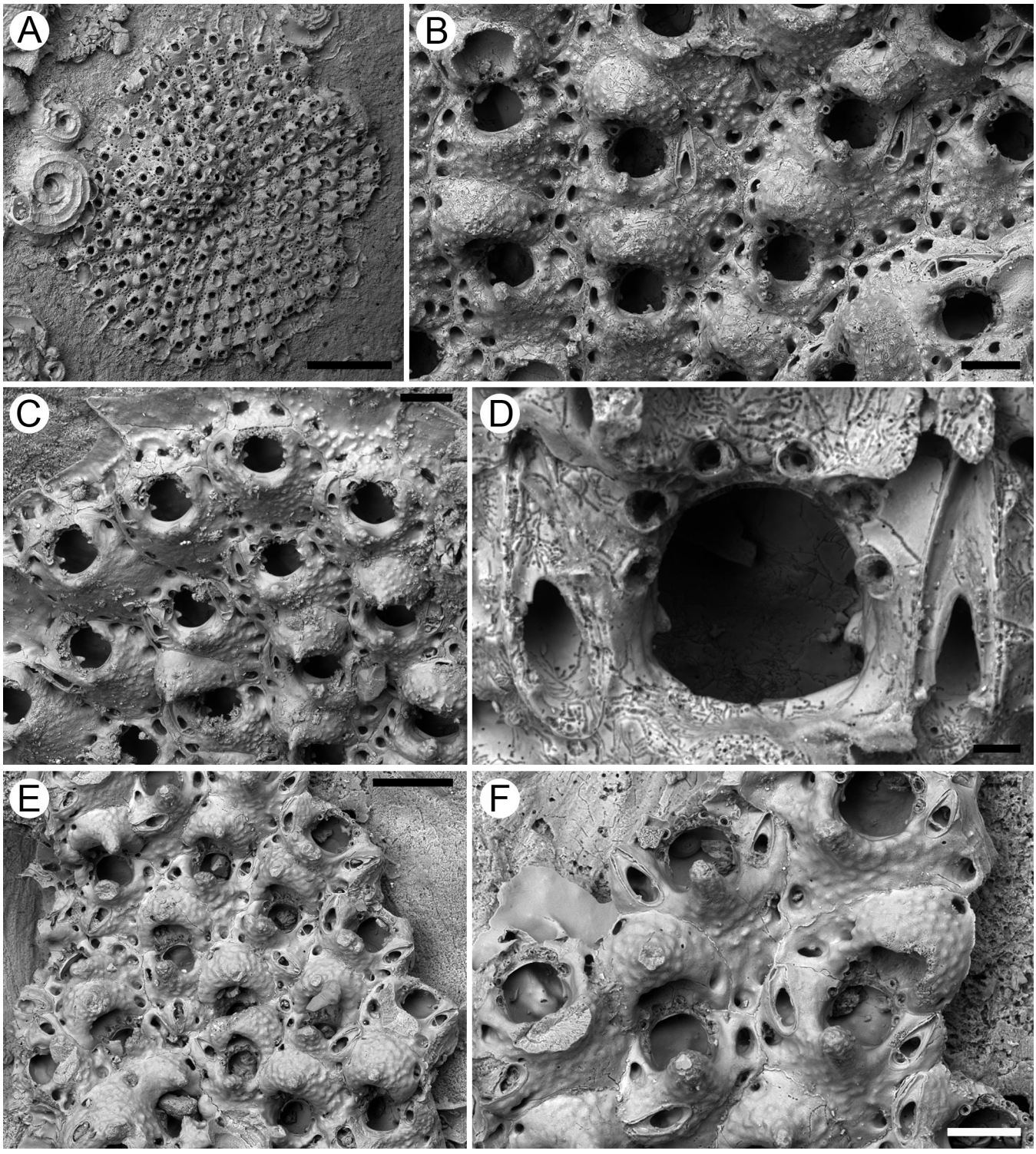

Figure 62. *Pleuromucrum epifanioi* n. sp. **A–D.** holotype, NHMUK 1968.1.6.3. **A.** general view of the colony encrusting a bivalve shell; **B.** group of ovicellate zooid; **C.** autozooids at colony growing edge showing pore-chamber windows along margins; **D.** close-up of an orifice with six oral spine bases flanked by a pair of adventitious avicularia. **E–F.** paratype, NHMUK 1968.1.6.4. **E.** group of ovicellate zooids with stout suboral umbo, additional frontal avicularia, and ovicells with central umbo; **F.** ovicellate and non-ovicellate zooids with adventitious avicularia variously placed. Scale bars: A = 1 mm; B, C, F = 100 μm; D = 20 μm; E = 200 μm.

and robust oral spine bases. Lagaaij (1963:192) observed Recent colonies of what he identified as *P. gorgonensis* bearing as many as six spine bases. He considered this variability to be intraspecific, owing to the age and position of zooids within the colony and, at some extent, correlating with variation in salinity and depth. Although a certain level of variability has been observed among the type specimens of *P. gorgonensis*, mainly related to the presence/absence of latero-oral as well as frontal avicularia, the presence of the trifid umbo, the number of oral spine bases and the slender appearance of the central umbo on the ovicells appear to be constant features. All of the colonies of *P. epifanioi* n. sp. available for study showed a constant number of oral spine bases (6) and a conical suboral process with a rounded tip, supporting the distinction of this species from both *P. liowae* n. sp. and *P. gorgonensis*. Lagaaij's specimens need to be restudied in order to ascertain whether any of them are conspecific with either the new fossil or the Recent species.

Genus *RHYNCHOZOON* HINCKS, 1895 *RHYNCHOZOON EDAX* (CANU and BASSLER, 1923) N. COMB.

Leiosella edax Canu and Bassler (1923), p. 142, pl. 22, figs. 1–6; Scolaro (1968), p. 150, pl. 13, figs. 1, 2.

Figured material.—UF 265667 (Fig. 63A), UF 265672 (Fig. 63B–C), TU Loc. 548; UF 41702 (Fig. 63D–F), UF 67384 (Fig. 63G), TU Loc. 1048.

Description.—Colony encrusting, multiserial, uni- or multilaminar, forming hollow tubes, ca. 3–5 mm in length by 2–3 mm in diameter. Autozooids distinct only at growing edge or in new, frontally budded laminae, irregularly arranged, hexagonal (Fig. 63A), longer than wide (mean L/W 1.30). Frontal shield convex, smooth or nodular, imperforate apart from a row of conspicuous marginal pores, oval to subcircular, 20–40 μm long (Fig. 63A–C). Orifice deep, subcircular, with a finely denticulate anter, a broadly concave proximal margin, and robust condyles (Fig. 63D). Two distolateral, oral spine bases occasionally present in some zooids (Fig. 63A, G). Peristome completely encircling the orifice, often obscuring it, with erect, cylindrical knob-like processes developed laterally (Fig. 63B–C). Suboral avicularium placed medially on the proximal side of the peristome, transversely or obliquely laterally directed, either small and oval with a rounded rostrum (type 1, Fig. 63F–G), or large and triangular with a hooked rostrum (type 2, Fig. 63D, F). Frontal avicularia numerous, either small and elliptical (type 3, Fig. 63B–C, F), or large and pear-shaped with a channelled rostrum (type 4, Fig. 63B, D, F). All types of avicularia have complete pivotal bars. Ovicells large, globular, deeply embedded in the peristome, with extensive exposure of the flattened, granular endooecium (Fig. 63B–C, F).

Measurements.—ZL 417±23, 380–449 (1, 10); ZW 321±27, 260–350 (1, 10); OL 134±12, 114–157 (2, 12); OW 128±6, 116–138 (2, 12); OvL 180±29, 141–235 (4, 14); OvW 195±16, 171–215 (4, 14); AvL (suboral, type 1) 76±11, 64–93 (2, 6); AvW (suboral, type 1) 71±10, 59–85 (2, 6); AvL (suboral, type 2) 148±25, 116–182 (3, 12); AvW (suboral, type 2) 86±15, 60–108 (3, 12); AvL (frontal, type 3) 235±27, 181–275 (4, 22); AvW (frontal, type 3) 116±10, 96–138 (4, 22); AvL (frontal, type 4) 107±9, 94–125 (4, 14); AvW (frontal, type 4) 79±4, 73–85 (4, 14).

Remarks.—This species was originally described from the Chipola Formation as *Leiosella edax* by Canu and Bassler (1923). Gordon (2009) replaced the genus *Leiosella* Canu and Bassler, 1917, with the early Oligocene *L. rostrifera* from Alabama as the type species, by *Leiosellina* nom. nov., as it is a junior homonym of the sponge *Leiosella* Lendefeld. Two further species of *Leiosella* were tentatively placed by Gordon in *Leiosellina* – *L. grandisora* (Canu and Bassler, 1920) and *L. orbicularia* (Canu and Bassler, 1920) – pending SEM examination of the type material. Although Gordon made no mention of the status of *L. edax*, the species is currently listed online as *Leiosellina edax* (www.bryozoa.net, compiled by Phil Bock, accessed 08.19.2016). Although poorly preserved, SEM examination of the type specimens of *L. edax* (syntype USNM 68636, Fig. 64), as well as Scolaro's (1968) specimens and more recently collected material, has allowed the transfer of this species to *Rhynchozoon*, which is characterized, among other features, by an orifice with denticulate

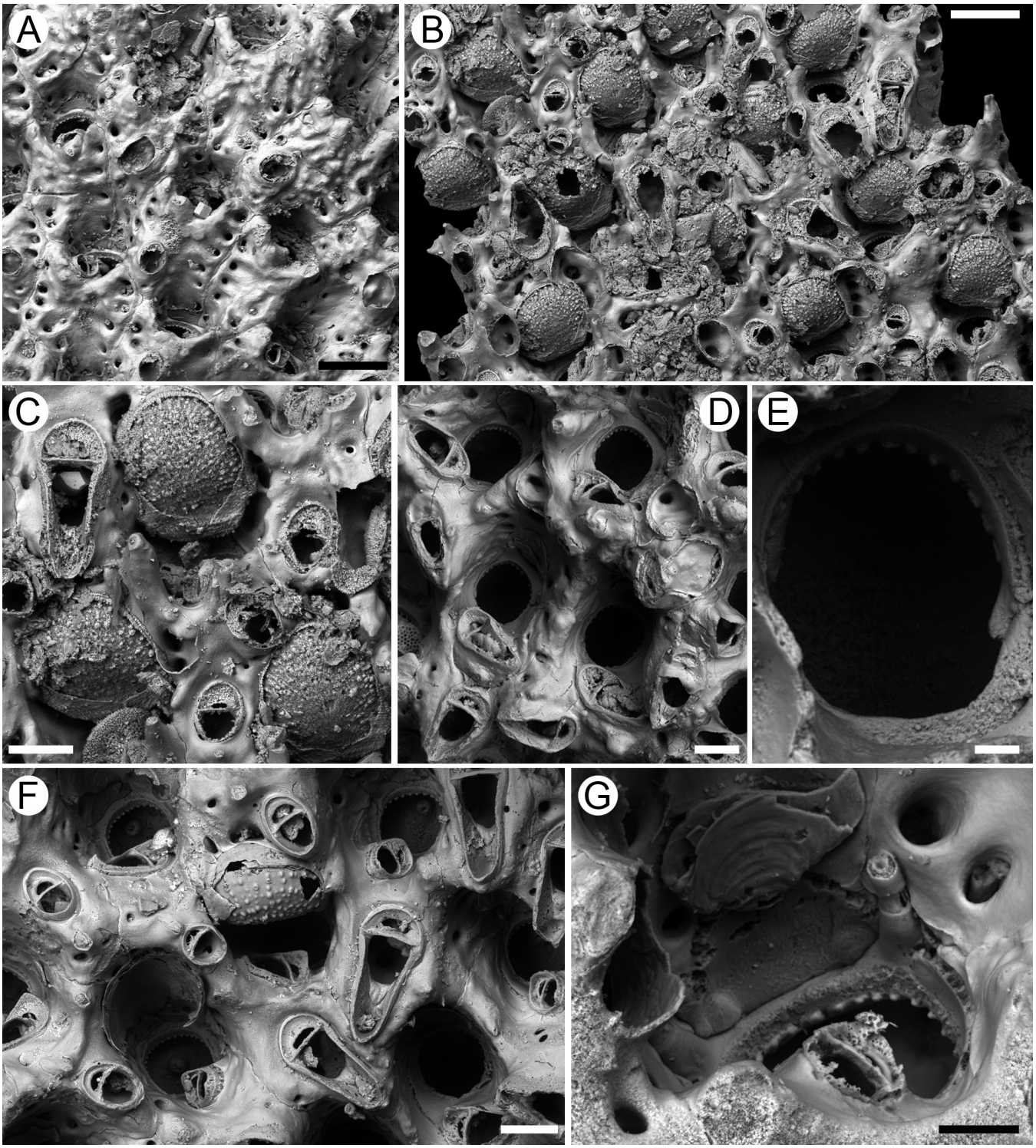

Figure 63. *Rhynchozoon edax* (Canu and Bassler, 1923) n. comb. **A.** UF 265667, autozooids with a distinct hexagonal outline. **B, C.** UF 265672. **B.** group of ovicellate zooids and numerous frontal avicularia; **C.** close-up of an ovicellate zooid with orifice obscured by the knob-like processes of the peristomes and adventitious frontal avicularia of different size and shape. **D–F.** UF 41702. **D.** autozooids with large suboral avicularia; **E.** close-up of the orifice showing the denticulate anter; **F.** group of ovicellate and non-ovicellate zooids with suboral avicularia differing in size and shape. **G.** UF 67384, oblique view of an orifice showing two oral spine bases. Scale bars: A, B = 200 μm; C, D, F = 100 μm; E = 20 μm; G = 40 μm.

anter and concave poster, dimorphic suboral avicularia, presence/absence of oral spines, and ovicells with an uncalcified ectooecium and exposed, granular endooecium (Tilbrook, 2006).

Species of *Rhynchozoon* are common and diverse in tropical reef habitats worldwide. *Rhynchozoon edax* n. comb. is extremely abundant at nearly all Chipola Formation localities sampled. Its hollow, tubular colony form, seen also among other bryozoan species in the assemblage, is typical of encrusters of algae and seagrass stems.

INCERTAE SEDIS
Genus *SCHIZOLEPRALIELLA* N. GEN.

Type species.—*Schizolepraliella nancyae* n. sp. (see details below).

Zoobank Nomenclatural Act.—FE57BA9D-C732-4BAB-AFE1-3CE0D1CF6F2A.

Etymology.—Referring to the lepraliellliform type of ovicells in a *Schizoporella*-like species.

Diagnosis.—Colony encrusting. Autozooids with evenly pseudoporous frontal shield. Marginal areolar pores present. Orifice semicircular with a broad sinus and robust condyles, surrounded by a flared peristome. Suboral umbo present. Avicularia adventitious, single, paired or absent, dimophic, lateral and adjacent to the orifice. Ovicells lepralielliform; ectooecium imperforate; endooecium calcified, imperforate, granulated, exposed through a central fenestra of the ectooecium.

Remarks.—*Schizolepraliella* n. gen. is a *Schizoporella*-like genus with lepraliellliform ovicell. As in *Schizoporella*, autozooids have an evenly perforated cryptocystidean frontal shield, an orifice with well-defined condyles, differentiated anter and poster forming a sinus, dimorphic adventitious avicularia, lateral and adjacent to the orifice, and a lack of oral spines. Furthermore, as observed in some species of *Schizoporella*, such as *Schizoporella japonica* Ortmann, 1890 and *S. unicornis* (Johnston, 1847), the Chipola species develops a suboral umbo, and orifices are occasionally closed by perforated closure plates. The main difference is in the ovicell type, which is lepraliellliform in *Schizolepraliella* n. gen. but microporelliform in *Schizoporella*.

Lepraliellliform ovicells are characteristic of some umbonulomorph (Arachnopusiidae, Lepraliellidae, Bryocryptellidae and Umbonulidae) and lepraliomorph families (Smittinidae, Bitectiporidae, Stomachetosellidae, Lanceoporidae, Cleidochasmatidae, Phidoloporidae, Hippoporidridae, Celleporidae, Lekythoporidae, Petraliidae and

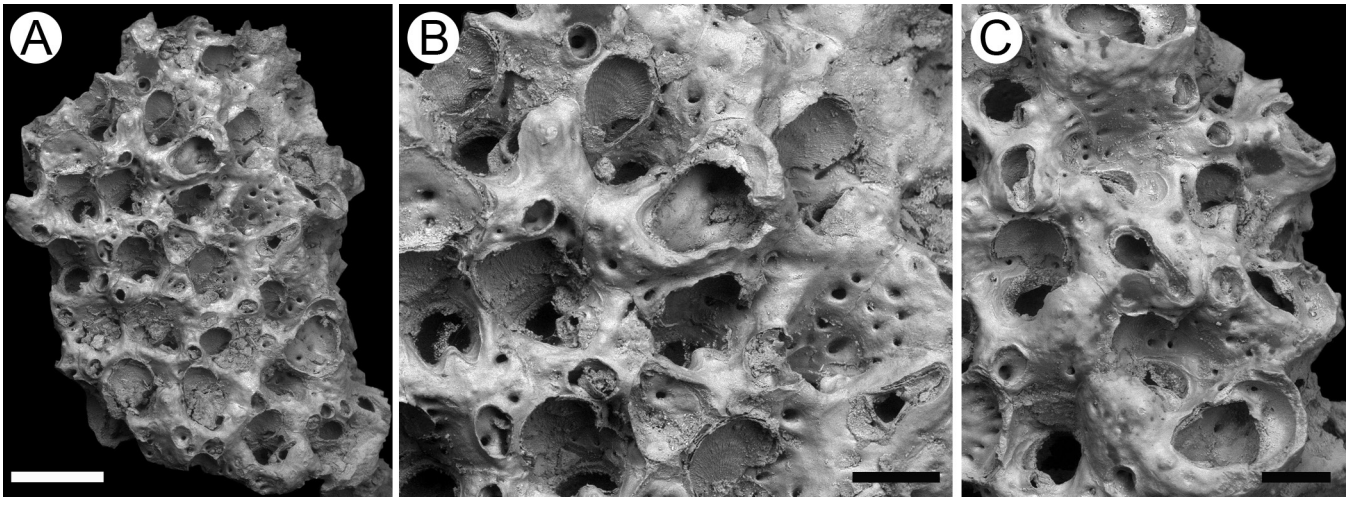

Figure 64. *Rhynchozoon edax* (Canu and Bassler, 1923) n. comb., syntype, USNM 68636, Early Miocene, Chipola Formation. **A.** general view of the colony fragment; **B, C.** groups of autozooids and frontal avicularia. Scale bars: A = 500 μm; B, C = 200 μm.

Petraliellidae) (Ostrovsky, 2013). The new genus shares a common suite of characters with representatives of Bitectiporidae (i.e., *Hippoporina* and *Schizomavella*) and Lanceoporidae (i.e., *Calyptotheca* and *Stephanotheca*), in terms of the frontal shield and sinuate orifice, but lacks the pseudoporous ectoooecium typical of 'smittinoid' ovicells and the associated dimorphic orifice. It also differs from *Schizomavella* in the lack of oral spines, from *Calyptotheca* in the absence of vicarious avicularia, and from *Stephanotheca* in having latero-oral instead of median adventitious avicularia. The celleporid genus *Pourtalesella* is similar in having a sinuate orifice lacking spines, adventitious avicularia adjacent to the orifice, and an imperforate ectooecium leaving partially exposed the underlying endooecium. However, in *Pourtalesella* the endooecium is marginally perforated, and the frontal shield has less numerous and scattered pores. Based on these observations, the choice of a family for *Schizolepraliella* n. gen. is difficult. Although very similar to *Schizoporella*, the lepraliomorph ovicell type prevents its placement in Schizoporellidae, while the absence of a 'smittinoid' ovicell structure precludes its placement in Bitectiporidae or Lanceoporidae, both belonging to the superfamily Smittinoidea.

SCHIZOLEPRALIELLA NANCYAE N. SP.

Schizoporella 'A' n. sp. Scolaro (1968), p. 143, pl. 11, figs. 1a–b.

Figured material.—Holotype, UF 265740 (Fig. 65), TU Loc. 821; paratype, UF 72094 (Fig. 66), TU Loc. 1048.

Zoobank Nomenclatural Act.—07E653E2-1153-400D-9FE0-947FBEE2C34A.

Etymology.—Named in honor of Prof. Nancy Knowlton, renowned coral reef biologist at the NMNH, Washington DC, for her kind support during visits of EDM to the NMNH.

Diagnosis.—See genus.

Descriptions.—Colony encrusting, multiserial, unilaminar (Figs. 65A, 66A). Autozooids distinct, with shallow interzooidal grooves, arranged quincuncially, hexagonal, slightly longer than wide (mean L/W 1.15). Frontal shield convex with marginal areolar pores and very numerous, evenly distributed pseudopores, except for an imperforate area corresponding to the prominent, smooth or granular, suboral umbo (Figs. 65B, 66B–C); marginal areolae discontinous, subcircular or slit-like, more distinguishable at zooidal corners; pseudopores circular, 8–12 μm in diameter, situated at the centers of a polygonal mesh of ridges. Orifice almost equidimensional, a semicircular anter separated by a shallow and broad sinus by two robust, rounded condyles, ca. 10 μm long by 15 μm wide (Figs. 65C, E, 66D); a flared, funnel-shaped peristome surrounds the orifice. Occasionally the orifice is sealed by a perforated closure plate (Fig. 65D). Avicularia adventitious, single, paired or absent, dimophic, lateral and adjacent to the orifice on an umbonate, granular process. Small avicularia (type 1) oval (Fig. 65C, E, G); rostrum raised, distolaterally directed; crossbar complete. Large avicularia (type 2) spatulate (Fig. 65F–G); rostrum truncated, channelled, distally directed; crossbar complete. Ovicells of the lepraliellform type, prominent, subglobular, imperforate, resting on the frontal shield of the next distal zooid (Fig. 65B–D, F–G); ectooecium calcified, except for a central, transversely elliptical fenestra, on average 85 μm long by 135 μm wide, through which is visible a granulated area of calcified endooecium; a slightly upturned gymnocystal ectooecial 'band' outlines the semicircular opening of the ovicell. A secondary calcified cover with sparse, pointed granulations overgrows the ectooecium but not the fenestra. Teratological twin ovicells observed (Fig. 65E–F).

Measurements.—ZL 403±46, 319–499 (2, 20); ZW 349±31, 283–408 (2, 20); OL 87±5, 76–95 (2, 20); OW 92±8, 81–102 (2, 20); OvL 143±7, 131–157 (1, 25); OvW 186±9, 171–214 (1, 25); AvL (type 1) 93±8, 81–102 (2, 10); AvW (type 1) 73±6, 59–82 (2, 10); AvL (type 2) 265±6, 254–270 (2, 10); AvW (type 2) 103±11, 86–122 (2, 10).

Remarks.—See genus.

DISCUSSION

The bryozoan fauna from the upper lower Miocene (Burdigalian) Chipola Formation, comprehensively described for the first time in this study, numbers 60 species and comprises five cyclostomes (ca. 8%),

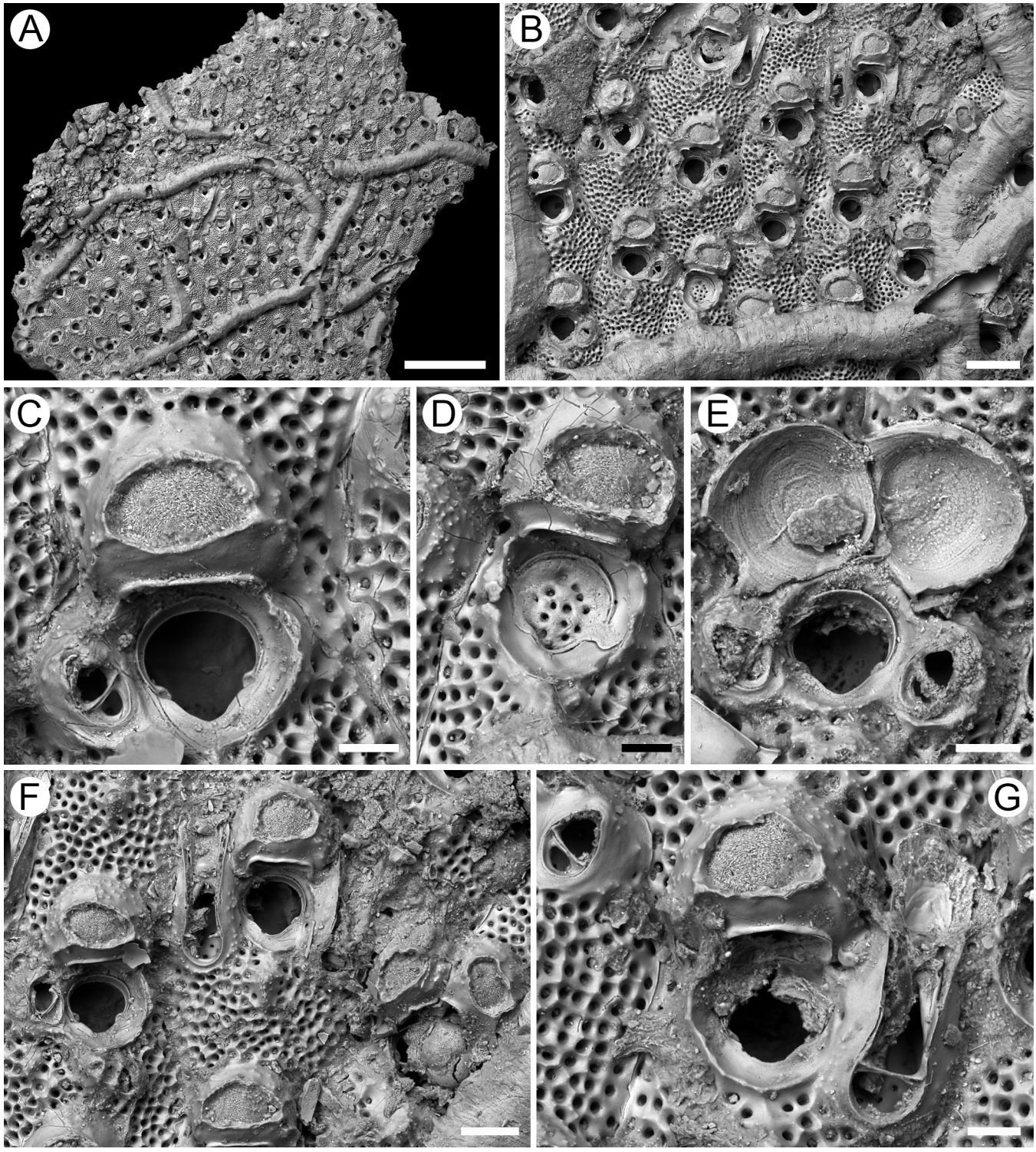

Figure 65. *Schizolepraliella nancyae* n. gen. et sp., holotype, UF 265740. **A.** general view of the colony fragment; **B.** group of ovicellate zooids; **C.** close-up of the orifice of an ovicellate zooid with flared peristome and single lateral avicularium; **D.** autozooid with orifice sealed by a perforated closure plate; **E.** autozooid with paired lateral avicularia and teratological twin ovicells; **F.** group of ovicellate zooids, the central zooid with a pair of large spatulate avicularia, the zooid on the bottom right with teratological twin ovicells; **G.** close-up of a large spatulate avicularium with truncated rostrum and complete crossbar. Scale bars: A = 1 mm; B = 200 μm; C, D, E, G = 50 μm; F = 100 μm.

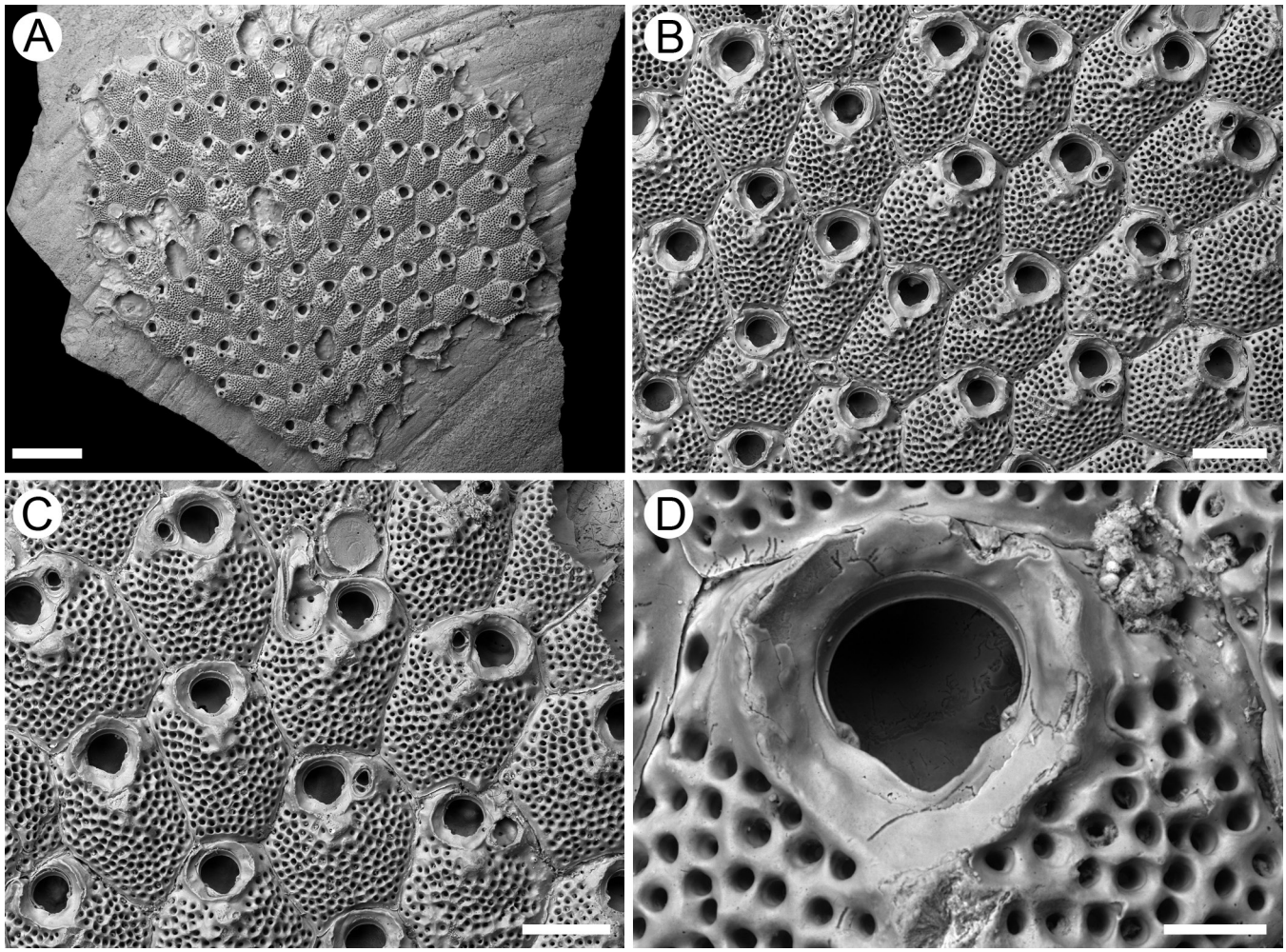

Figure 66. *Schizolepraliella nancyae* n. gen. et sp., paratype, UF 72094. **A.** general view of the colony; **B, C.** groups of autozooids with flared peristome, some zooids with small adventitious avicularia and a partially budded large spatulate avicularium; **D.** close-up of the orifice. Scale bars: A = 600 μm; B, C = 200 μm; D = 50 μm.

20 anascan-grade (ca. 33%) and 35 ascophoran-grade (ca. 59%) cheilostomes. The fauna includes 25 new species (ca. 42%), all cheilostomes. Eight of the new species are anascans belonging to the genera *Nellia* (1 species), *Paralicornia* (1 sp.), *Floridina* (1 sp.), and *Thalamoporella* (5 spp.), and 17 species are ascophorans classified in the genera *Puellina* (1 sp.), *Spiniflabellum* (1 sp.), *Trypostega* (1 sp.), *Exechonella* (1 sp.), *Adeonellopsis* (1 sp.), *Escharoides* (1 sp.), *Stylopoma* (2 spp.), *Margaretta* (1 sp.), *Cheiloporina* (1 sp.), *Hagiosynodos* (1 sp.), *Vix* (1 sp.), *Cigclisula* (1 sp.), *Turbicellepora* (1 sp.), *Pleuromucrum* (2 spp.), and *Schizolepraliella* n. gen. (1 sp.).

Twenty (ca. 34%) of the bryozoans are established taxa identifiable to the species level. Among these, 13 species (ca. 22%) are extant and have Western Atlantic or pantropical distributions, while seven species (ca. 11%) are known only from the fossil record, including four species (*Triporula coccinella*, *Metrarabdotos chipolanum*, *Pirabasoporella chipolae* and *Rhynchozoon edax*) found exclusively in the Chipola Formation and described in earlier works (Canu and Bassler, 1923; Cheetham, 1968; Zágoršek et al., 2014), two species (*Antropora parvicapita* and *Mamillopora tuberosa*) found in other Miocene formations in Florida and the Caribbean, and a single species

(*Celleporaria* cf. *bicornis*) originally described from the early Pleistocene of South Carolina. The remaining 15 species (25%) can be identified only at the level of genus (13 taxa) or family (two taxa of Candidae) owing to deficient preservation and/or scarcity of available material.

The 60 species from the Chipola Formation belong to 48 genera, including a newly erected genus, *Schizolepraliella*, within 38 families. Of these 38 families most contain only one species (25 families), two species in one genus (four families), or two species in two genera (five families). The remaining families are Candidae with three species, two of which identified only at the family-level, Thalamoporellidae with six species of *Thalamoporella*, and Cribrilinidae represented by three species in three genera.

The majority of bryozoan species (ca. 68%) from the Chipola Formation are encrusting, typically with two-dimensional colonies. However, 25% of species are erect, almost equally divided between erect rigid and articulated flexible, and 7% of species are free-living.

Compared to Scolaro (1968), this work raises the total number of bryozoan species found in the Chipola Formation from 47 to 60. The additional species come mainly from genera such as *Thalamoporella*, *Stylopoma*, and *Pleuromucrum* in which species became distinguishable after SEM examination. On the other hand, two species mentioned in Scolaro (1968) – *Electra* sp. A n. sp. and *Cleidochasma porcellanum* (= *Plesiocleidochasma porcellanum* (Busk, 1860)) – were not found in this study. As these species were reported as rare (fewer than five specimens) by Scolaro (1968), their absence in the present study is understandable. The modern bryozoan fauna from the entire Gulf of Mexico numbers 266 species (232 cheilostomes, 11 ctenostomes and 23 cyclostomes), with 174 species listed from the northeastern part of the Gulf, including the western Florida shore and shelf, and the Florida Keys (Winston and Maturo, 2009).

Studies on Cenozoic fossil bryozoans from Florida are limited. Canu and Bassler (1920) recorded 30 species from Alachua, 23 species from Ocala and 56 species from the Chipola River east of Marianna in Jackson County, all Jacksonian (= Priabonian, late Eocene) in age. Cheetham (1963) investigated the abundance and distribution of cheilostome bryozoans in the four major biofacies of the eastern Gulf Coast Jacksonian, including deposits of panhandle Florida and peninsular Florida. Taylor and Schindler (2004) described a new species of *Hippoporidra*, *H. portelli*, inferred to have been a symbiont of hermit-crabs from the upper Eocene Ocala Limestone. Regarding the Neogene, in addition to the works previously cited specifically relating to the bryozoan fauna of the Chipola Formation, Canu and Bassler (1923) listed 22 species from the upper Pliocene Jackson Bluff Formation in Leon County southwest of Tallahassee, and 20 species from the lower Pleistocene Caloosahatchee Formation in De Soto and Monroe counties. In his unpublished Masters thesis, Scolaro (1964) described the bryozoan assemblage, including 42 species, found within the units of the Choctawhatchee stage (Pliocene) at the Jackson Bluff, Alum Bluff and Red Bay localities.

As most of these studies of Floridan Cenozoic bryozoans antedate SEM, which has proved essential in the taxonomy of bryozoans, much further revisionary work needs to be done – and new samples collected – before these important significant components of the fossil biota in Florida are adequately known.

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Appendix 1. TU Locality Data

TU Loc. 456. Tenmile Creek, north bank, about 0.3 mile downstream from bridge of Florida Highway 73, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SE 1/4, NE 1/4.

TU Loc. 458. Chipola River, east bank, about 0.3 mile north of Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 20, NE 1/4, SW 1/4.

TU Loc. 459. Chipola River, east bank, about 0.4 mile south of Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SE 1/4, NW 1/4.

TU Loc. 546. Tenmile Creek, north bank, about 0.5 mile east of Florida Highway 73, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SW 1/4, NE 1/4.

TU Loc. 547. Chipola River, west bank, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1990), T1N, R9W, SEC. 29 NW 1/4, SW 1/4, sand ledge under coral reef.

TU Loc. 548. Chipola River, west bank, about 0.3 mile south of Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 29, NE 1/4, NW 1/4.

TU Loc. 550. Chipola River, east bank, about 0.6 mile north of Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 32, NW 1/4, NE 1/4.

TU Loc. 554. Chipola River, east bank, at power line crossing, USA,, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 17, SE 1/4, SW 1/4.

TU Loc. 555. Chipola River, east bank, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 29, E 1/4, SW 1/4.

TU Loc. 655. Tenmile Creek, north bank, about 0.14 mile downstream from bridge of Florida Highway 73, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SW 1/4, NW 1/4.

TU Loc. 711. Chipola River, west bank, about 0.2 mile north of Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 20, NE 1/4, SW 1/4.

TU Loc. 787. Tenmile Creek, south bank, about 0.8 mile east of Florida Highway 73, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SW 1/4, NE 1/4.

TU Loc. 817. Tenmile Creek, south bank, about five feet below the top of the section exposed in the upper reaches of the springhead gully on Sexton Farm, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SW 1/4, SE 1/4.

TU Loc. 819. Farley Creek, north and south bank, about 0.1 mile west of Florida Highway 275, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, SW 1/4, SW 1/4.

TU Loc. 820. Farley Creek, lower beds, north and south banks, immediate vicinity of Florida

Highway 275 bridge, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, SE 1/4, SW 1/4.

TU Loc. 821. Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, SE 1/4, SW 1/4.

TU Loc. 823. Farley Creek, north bank, about 0.3 mile east of Florida Highway 275, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, NW 1/4, SE 1/4.

TU Loc. 824. Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, SW 1/4.

TU Loc. 825. Farley Creek, north bank, at site of abandoned power dam, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, NW 1/4, SW 1/4.

TU Loc. 828. Farley Creek, north bank, about 0.6 mile west of Florida Highway 275, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 20, N 1/4, SE 1/4.

TU Loc. 1048. Farley Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R9W, SEC. 21, SW 1/4, NE 1/4.

TU Loc. 1098. Tenmile Creek, USA, Florida, Calhoun County, Clarksville Quadrangle USGS 7.5' Series (1945), T1N, R10W, SEC. 12, SE 1/4, SE 1/4.