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New bryozoan records from the Pleistocene coral reefs, Red Sea coast, Egypt

By Abdelmohsen ZIKO & Abdelbaset S. EL-SOROGY
Department of Geology, Zagazig University, Zagazig

ABSTRACT. *Ten bryozoan species have been identified for the first time from the Pleistocene coral reefs of the Red Sea coast. Among them two species belong to order Cyclostomata and eight species to the order Cheilostomata.* Hippopleurifera hamzai *is believed to be new. Seven of the identified bryozoan species are incrusting and have the membraniporiform-A zoarial growth forms, while only three are erect flexible cellariiform. The membraniporiform species incrust the protected parts of the scleractinian corals* Fungia fungites, Acanthastrea echinata, Lobophyllia corymbosa, Coscinaraea monile *and act as accessory frame encrusters (hidden encrusters). The erect flexible cellariiform species act as sediment formers with other organisms. The studied bryozoans in combination with the associated scleractinian corals reflect upper reef slope to back reef environment.*

INTRODUCTION

Several authors have discussed the paleontology and sedimentology of the Pleistocene coral reefs of the Red Sea and gulfs (Cox 1929, El-Shazly 1982, Al-Rifaiy & Cherif 1988, Yousef 1988, Hamza et al. 1990, Ziko et al. 1991). Ziko et al. (1991) identified four Pleistocene and two Recent bryozoan species from Wadi Quseir El-Kadium area, these are *Callopora dumerilli, Aimulosia australis, Holloporella descostilsii, Hippopleurifera* sp., *Schizoporella unicornis, Echaroides* sp. The aim of this study is the identification of the bryozoan fauna associated with the scleractinian corals as well as their paleoecological roles in Pleistocene coral reefs of Wadi Quseir El-Kadium, 7 km north of the Quseir city (Fig. 1).

The Pleistocene sequence in the study area (Fig. 2) is composed of algal coralline limestone in the form of terraces, occurring at different elevations above the present sea level. These carbonates laterally change to carbonate- siliciclastic rocks. El-Sorogy (1994) recorded three major units of reef development in the form of four terraces. The vertical development within some terraces is difficult to see in the field, due to huge gravel accumulation.

The three reef units probably express major sea level highs which occurred between 85000-125000 years ago (lower), 200000-250000 years (middle) and more than 250000 years (upper), as indicated by comparison based on lithology, microfacies analysis, fossil content and field observations with similar terrace systems on the Sudanese coast (Berry et al. 1966) and the Sinai Peninsula, where an absolute age was obtained by Th dating (Gvirtzman & Friedman 1977).

The youngest (lower) unit is directly at the coastline, resting on 0.45 to 1.25 m thick hard, varicoloured conglomeratic band. It has an elevation of 3.5 m and rises to 6.5 m in horizontal distance above present sea level. The depositional sequence shows shallowing upward and is capped by beach sands and alluvial fans, 0.75 to 1.25 m thick.

The middle (intermediate) unit has an elevation of 9 m above present sea level, transgressive at the base and regressive at the top, capped with gravels of wadi sediments.

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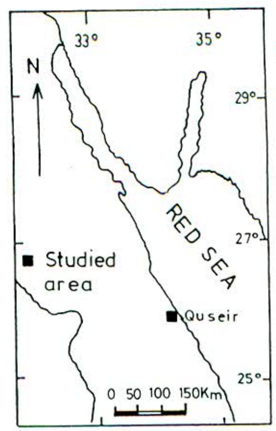

Figure 1. Location map.

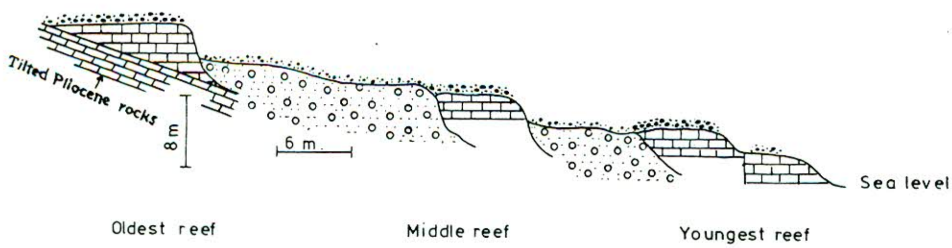

Figure 2. Diagrammatic sketch of the Pleistocene coral reefs at Wadi Quseir El-Qadium.

The oldest (upper) unit unconformably overlies tilted Pliocene rocks, which include frequent pectinids as *Chlamys senatoria* and sea urchins (*Clypeaster reticulatus, Laganum depressum*). It has an elevation of 14 m above present sea level and shows upward shallowing.

SYSTEMATIC DESCRIPTION

Based on the classification of Bassler (1953), the following is a systematic description of the bryofauna associated with the Pleistocene coral reefs of the study area. The studied materials are deposited in the Museum of the Geology Department, Zagazig University (El-Sorogy's collection). The arithmetic mean and standard deviation of each linear parameter of all studied species are calculated according to the standard formula; the number of specimens (zoaria and zooecia examined) and the observed variability of the dimensions are recorded, as in the following example:

Lz	(3, 10)	0.55 (±0.03) mm	0.50-0.60 mm
Parameter	Number of zoaria and zoecia	Mean standard deviation	Observed range

Abbreviations used in the micrometric dimensions are explained below:

ho = Oral or opesial length; Lav = Avicularian length; lav = Avicularian width; lo = Oral or opesial width; Lov = Ovicell length; lov = Ovicell width; Lz = Zooecial length; lz = Zooecial width.

Order Cyclostomata Busk, 1852
Family Crisiidae Johnston, 1847

Crisia elongata Milne-Edwards, 1838

(Fig. 3: 1-2)

Crisia elongata Milne-Edwards, 1838, p. 203, pl. 7, fig. 2.– Vavra, 1977, p. 12.– Ziko et al., 1992, p. 296, pl. 1, fig. 1-2.
Crisia edwardsi Reuss– Canu & Bassler, 1920, p. 705, pl. 141, fig. 5-7.– Ziko, 1973, p. 45, pl. 5, fig. 3, 5.

Description. Zoarial internode (fertile) slender, long, turned first outwards then inwards, up to 14 biserial alternating tubes, attains a height of 1.5 mm. Zooecia (tubes) cylindrical, indistinct, distal part bent upwards. Peristomes circular, thin salient. Ovicell large, inflated, isolated, sacciform, smooth, originated from the 7th zooid, oeciostome located on its distal part as a well developed bent out tube with transverse oval orifice.

Measurements

Diameter of peristomes (2,11) 0.05(± 0.059) mm 0.04-0.06 mm
Distance of peristomes (2,11) 0.17(± 0.023) mm 0.13-0.20 mm
Width of zoarial internode (1) 0.17 mm
Lov (1) 0.30 mm
lov (1) 0.16 mm
Diameter of oeciopore (1) 0.04 mm

Occurrence. The youngest coral reef, Wadi Quseir El-Kadium, Pleistocene.
Distribution. Eocene of France, North America; Oligocene of Germany, France, Italy; Miocene of Mersa Matruh (Egypt), France, Italy, Hungary, Poland, CSSR, Austria; Pliocene of Italy (Vavra 1977, Ziko et al. 1992).

Family Oncousoeciidae Canu, 1918

Proboscina boryi Audouin, 1826

(Fig. 3: 3-4)

Proboscina boryi Audouin, 1826, p. 620.– Bassler, 1953, p. 48, fig. 18/5.
Peristomoecia (Proboscina) boryii (Audouin) – Canu & Bassler, 1920, p. 693, fig. 228 A, B.

Description. Zoaria prostrate, branched, encrusting on *Microporella ciliata* and both encrust the dorsal surface of *Fungia fungites*, narrow especially in proximal parts of zoarium and becomes more wide distally, consists of 2 linear raws of zooecia, fine tubes fuse to form a bundle of zooids. Zooecia tubular, long, finely perforated, with progressive growth-striations, more than half of zooecial length bent up distally. Orifices circular. Peristomes thin and circular. Gonozoid (ovicell) inflated, located distally in the zoarium; oeciopore circular, slightly raised above gonozoidal surface, as large as zooecial orifices.

Measurements

Diameter of peristomes (4,15) 0.10(± 0.010) mm 0.08-0.14 mm
Distance between tubes (4,15) 0.34(± 0.052) mm 0.26-0.40 mm
Diameter of oeciopore (1) 0.08 mm

Occurrence. The Middle coral reef, Wadi Quseir El-Kadium Pleistocene.
Distribution. Recent of the Red Sea (Bassler 1953).

Order Cheilostomata Busk, 1852
Family Membraniporidae Busk, 1854

Membranipora savartii (Audouin, 1826)

(Fig. 4: 2)

Flustra savartii Audouin, 1826, p. 240, pl. 10, fig. 10.
Membranipora savartii (Audouin) – Canu, 1907, p. 6, pl. 1, fig. 1.– Canu, 1912, p. 192, pl. 10/1, fig.1-2.– Abbass & El-Senoussi, 1976, p. 157, pl. 1, fig. 4.– Ziko, 1985, p. 25, pl. 5, fig. 1-3.– Ziko et al., 1992, p. 301, pl. 2, fig. 3.
Acanthodesia savartii (Audouin) – Canu & Bassler, 1920, p. 100, pl. 21, fig. 2-4.– Canu & Bassler, 1923, p. 31, many varieties.– Canu & Bassler, 1929, p. 13, pl. 1, fig. 1.– Vigneaux, 1949, p. 38, pl. 2, fig. 10-14.– Bassler, 1953, p. 155, fig. 118/A.

Measurements

Lz (2, 9) 0.54 (± 0.042) mm 0.48 - 0.65 mm
lz (2, 9) 0.36 (± 0.033) mm 0.34 - 0.44 mm
ho (2, 9) 0.35 (± 0.050) mm 0.24 - 0.40 mm
lo (2, 9) 0.19 (± 0.028) mm 0.16 - 0.24 mm

Remarks. The studied specimen encrusts *Acanthastrea echinata*. This species is one of the most frequent and widespread *Membranipora* spp., not only in Egypt but also worldwide from the Eocene to Recent. The material in hand is strongly recrystallized and in relatively bad state of preservation.
Occurrence. The middle and lower coral reefs, Wadi Quseir El-Kadium, Pleistocene.
Distribution. Eocene of France, Belgium, U.S.A., Egypt; Oligocene of Germany; Miocene of France, Italy Austria, Portugal, Spain, England, Egypt, Tunisia, U.S.A; Pliocene of Italy, Argentina, Tunisia, Portugal, the Netherland, (Ziko et al. 1992).
Habitat. Cosmopolitan: Atlantic, Indian, Pacific, Red Sea, common in depths between 10-15 m and down to 100 m (Vavra 1977, Ziko 1985).

Family Hincksinidae Canu & Bassler, 1927

Antropora ovatum (Canu & Bassler, 1929)

(Fig.4: 6)

Membrendoecium ovatum Canu & Bassler, 1929, p. 95, pl. 6, fig. 3-5.
Antropora claustracrassa (Canu & Bassler) – El-Sorogy, 1990, p. 93, pl. 7, fig. 4.

Description. Zoaria incrusting the back sides of Fungia fungites. Zooecia distinct, separated by deep furrows, arranged in quincunx, elongated oval, proximally wide, mural rim salient, thin, sharp proximally well developed and finely crenulated. Opesia entire, oval, anterior. Avicularia very common, placed in the interzooidal corners, erect, bent up, tubes with more or less triangular cross-section, without pivot, with rounded to oval opesia. Polypidian regeneration frequent, double and triple. Ovicell endozooecial, inflated, finally granulated. Ancestrula more rounded, smaller than zooecia.

Measurements

Lz (2,53) 0.36 (± 0.081) mm 0.30 - 0.44 mm
lz (2,53) 0.25 (± 0.047) mm 0.18 - 0.32 mm
ho (2,53) 0.21 (± 0.030) mm 0.16 - 0.22 mm
lo (2,53) 0.17 (± 0.044) mm 0.10 - 0.22 mm
(Avicularia) ho (2,18) 0.05 (± 0.023) mm 0.03 - 0.07 mm

Occurrence. The oldest coral reef, Wadi Quseir El-Kadium, Pleistocene.
Remarks. The present species is relatively of smaller micrometric dimensions, when compared with the holotype described by Canu & Bassler (1929). The mea-

surements given by these authors did not represent the range of the measured parameters except Lz which is close to that of the present species.
Distribution. Recent of the Philippines, Sulu Archipelago at 34-66 m depth (Canu & Bassler 1929).

Family Arachnopusiidae Jullien, 1888

Exechonella discoidea **Canu & Bassler, 1929**

(Fig. 5: 1)

Exechonella discoidea Canu & Bassler, 1929, p. 123, pl. 20, fig. 5-6.

Description. Zoarium incrusts Lobophyllia echinata, unilamellar, large, possesses the shape of the substrate (the coral). Zooecia large, distinct, flask shape, arranged in more or less alternated longitudinal raws, strongly inflated, coarsely perforated with large rounded pores. Opesia orbicular, located in deep peristomie. Peristomie long, smooth oblique. Peristomes thin, smooth, orbicular, with slightly pointed proximal margin. Ovicell not observed.
Measurements

Lz (1,14) 1.16 (± 0.050) mm 1.10 - 1.24 mm
lz (1,14) 0.91 (± 0.096) mm 0.79 - 0.98 mm
h-peristome (1,14) 0.40 (± 0.033) mm 0.34 - 0.42 mm
l-peristome (1,14) 0.36 (± 0.059) mm 0.28 - 0.42 mm

Occurrence. The middle coral reef, Wadi Quseir El-Kadium, Pleistocene.
Distribution. Recent of the Philippines at 80 m depth (Canu & Bassler 1929).

Family Fraciminariidae Busk, 1852

Nellia oculata **Busk, 1852**

(Fig. 5: 4)

Nellia oculata Busk, 1852, p. 18, pl. 64, fig. 6, pl. 65, fig. 4.– Canu & Bassler, 1920, p. 195, pl. 82, fig. 6-10.– Canu & Bassler, 1923, p. 55, pl. 2, fig. 555-7.– Canu & Bassler, 1929, p. 185, pl. 5, fig. 12-13.– Vigneaux, 1949, p. 32, pl. fig. 10-12.– Debourle, 1974, p. 154, pl. 16, fig. 11.– Vavra, 1977, p. 95.

Description. Zoaria free, erect, flexible slender, straight, composed of four identical alternating zooecial raws, cross section more or less quadrate. Zooecia distinct, elongated, rectangular, length more than twice the width. Gymnocyst short, smooth. Mural rim thin, elliptical elongated cryptocyst proximal, smooth flat. Opesia terminal, elongated elliptical distal wider than proximal. Avicularia adventitious, small, placed on the proximo-lateral corners of gymnocyet on each zooecium, directed proximally, with pointed proximal and rounded distal margins, with pivot.
Occurrence. The youngest coral reef, Wadi Quseir El-Qadium, Pleistocene.
Distribution. Eocene of Europe, Africa, North America; Miocene of Europe, Africa, North America; Pliocene, Pleistocene of Asia and North America (Vavra 1977).
Habitat. Cosmopolitan, in tropical regions near shore, Atlantic, Pacific, Indian, Red Sea (Canu & Bassler 1929).

Family Scrupocellariidae Levinsen, 1909

Scrupocellaria elleptica **(Reuss, 1848)**

(Fig. 4: 3-5)

Bactridium ellipticum Reuss, 1848, p. 56, pl. 9, fig. 7-8.
Scrupocellaria elliptica (Reuss) – Vigneaux, 1949, p. 33, pl. 1, fig. 13-16.– Souaya, 1965, p. 1137, pl. 137, fig.7-8.– Ziko, 1973, p. 81, pl. 11, fig. 4,5,7,8.– Debourle, 1974, p. 160, pl. 17, fig. 6-7.– David & Pouyet, 1974, p. 130, pl. 2, fig. 3.– Vavra, 1977, p. 100.– Vavra, 1979, p. 598, pl. 1, fig. 1.– Moissette, 1988, p. 106, pl. 16, fig. 5,8.– Ziko et al., 1992, p. 308.

Description. Zoaria erect, straight. Zooecia articulated, distinct, dorsally completely distinct by deep narrow furrows, with well developed convex and smooth gymnocyst. Exterior opesia large, elongated. Interior opesia small, deep, oval, elongated, Scutum present. Mural rim with two circular spines at midline of interior opesia. Axial avicularia triangular, with pointed peak, with pivot on dorsal side of zoaria. Zooecia more distinct, tubular, exteriorly oblique. Vibracula erect, elongated, distally with sharp beak, with marginal narrow groove. Radicular pore large and rounded.

Measurements

Lz (3, 10) 0.29 (± 0.027) mm 0.26 - 0.33 mm
lz (3, 10) 0.14 (± 0.018) mm 0.12 - 0.16 mm
Internal opesia:
ho (3, 6) 0.08 (± 0.011) mm 0.06 - 0.09 mm
lo (3, 6) 0.06 (± 0.043) mm 0.05 - 0.07 mm
External opesia:
ho (3, 6) 0.125 (± 0.047) mm 0.12 - 0.13mm
lo (3, 6) 0.110 (± 0.011) mm 0.10 - 0.12mm

Occurrence. The middle coral reef, Wadi Qusier El-Kadium, Pleistocene.
Distribution. Miocene of Egypt, Cairo-Suez District, Mersa Matruh, (Ziko et al. 1992); Oligocene of France, Italy; Miocene of France, Austria, Poland, Portugal, Algeria; Pliocene of Portugal (Moissette 1988, Ziko et al. 1992).

Family Umbonulidae Canu, 1904

***Hippopleurifera hamzai* n. sp.**

(Fig. 3: 5)

Diagnosis. Hippopleurifera having very long, lateral suboral avicularia with pivot and long open channelled rostrum, pointed distally.
Etymology. This species is named in the honor of the late Dr. Fawzi Hamza, Faculty of Science, Ain Shams University.
Holotype. Specimen figured, plate 1, Fig.5, Zagazig Univ.
Description. Zoarium incrusting on coral, Coscinaraea monile, unilamellar and multilemellar. Zooecia distinct, elongated, inflated, flask shape, separated by deep furrows, arranged on longitudinal alternating rows. Zooecial length nearly twice width. Orifice orbicular, slightly elongated with conspicuous condyles. Frontal pleurocyst, umbonate, imperforate except with 9-12 areolar pores. Ovicell hyperstomial, inflated, smooth. Avicularia very long, adventitious, often single, rarely paired, placed on lateral corners, proximal to orifice, pointed distally to the exterior, with thin salient pivot; rostrum long, open chanelled.

Measurements

Lz (2, 21) 0.67 (± 0.031) mm 0.64 - 0.72 mm
lz (2, 21) 0.38 (± 0.069) mm 0.30 - 0.48 mm
ho (2, 21) 0.26 (± 0.043) mm 0.20 - 0.32 mm
lo (2, 21) 0.16 (± 0.022) mm 0.12 - 0.18 mm
Avicularia
Lav (2,21) 0.49 (± 0.010) mm 0.36 - 0.72 mm
lav (2,21) 0.19 (± 0.024) mm 0.16 - 0.24 mm

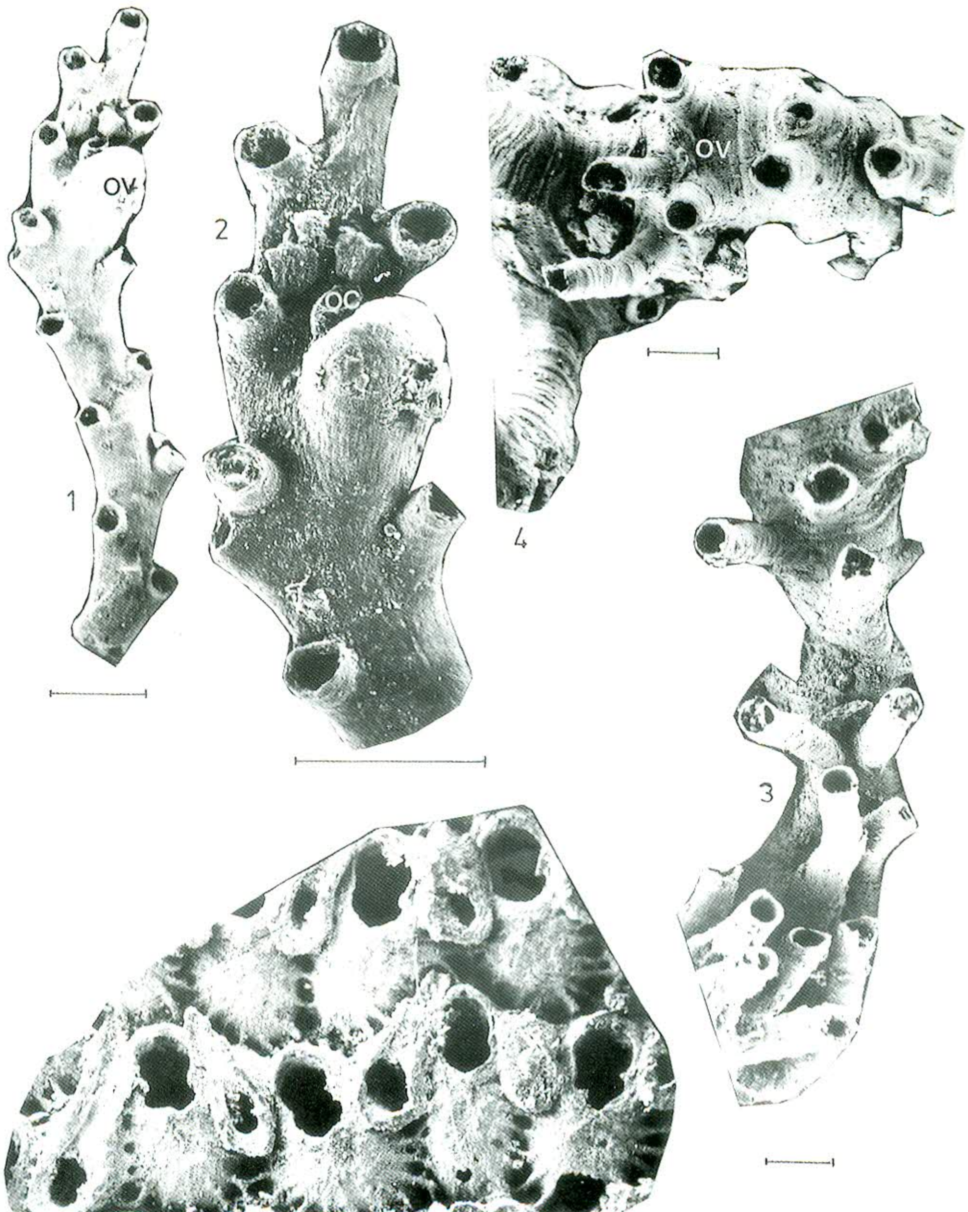

Figure 3. **1-2,** *Crisia elongata* Milne-Edwards, 1838. **1,** Frontal view of one zoarial segment with ovicell (ov); **2,** The ovicelled part enlarged showing the oeciopore (oc) in the distal part of the ovicell. **3-4,** *Proboscina boryi* Audouin, 1826. **3,** Part of zoarium with biserial zooecial arrangement. Notice the long and bent out tubes; **4,** other part of the same zoarium with ovicell (ov). Notice the fine perforations as well as the growth striations. **5,** *Hippopleurifera hamzai* n. sp. (Holotype), part of an encrusting unilamellar zoarium. Notice the large interzooecial avicularia with open channelled rostrum, the pleurocyst frontal and the orifices with condyles. Bar scale of SEM figures = 0.2 mm

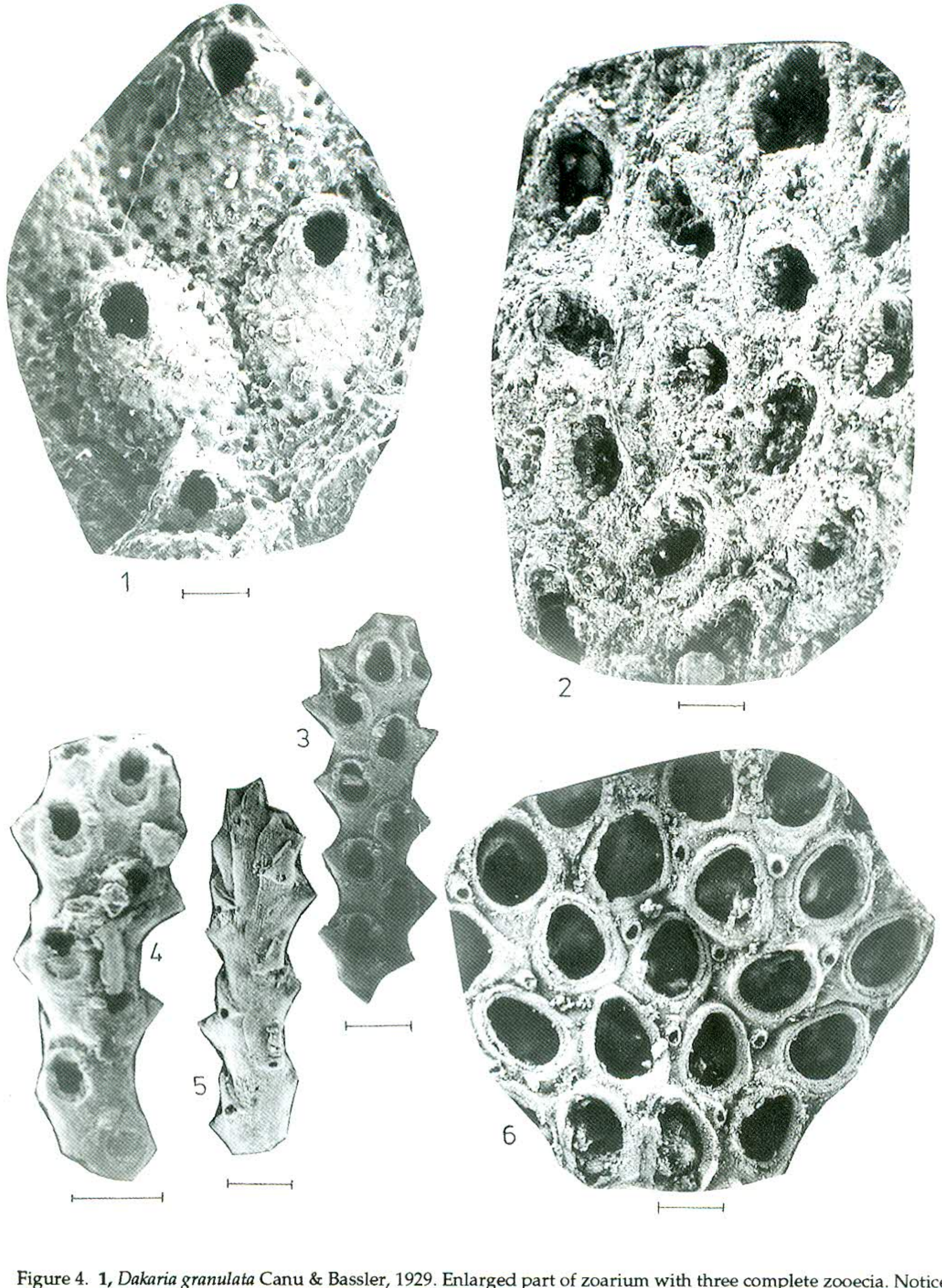

Figure 4. **1,** *Dakaria granulata* Canu & Bassler, 1929. Enlarged part of zoarium with three complete zooecia. Notice the granulated tremocystal frontal wall and the presence of median rimule on the distal border of orifice. **2,** *Membranipora savartii* (Audouin), 1826. Part of an encrusting zoarium. Notice the crenulated mural rims and the irregularity in shape and size of zooecia. **3-5,** *Scrupocellaria elliptica* (Reuss), 1848. **3-4,** celluliferous side of different zoaria; **5,** dorsal (non-celluliferous) side of third zoarium with avicularia and vibracute. **6,** *Antropora ovatum* (Canu & Bassler, 1929). Part of zoarium. Notice the ovicelled regenerated zooecia and the interzooecial tubular avicularia. Bar scale of SEM figures = 0.2 mm

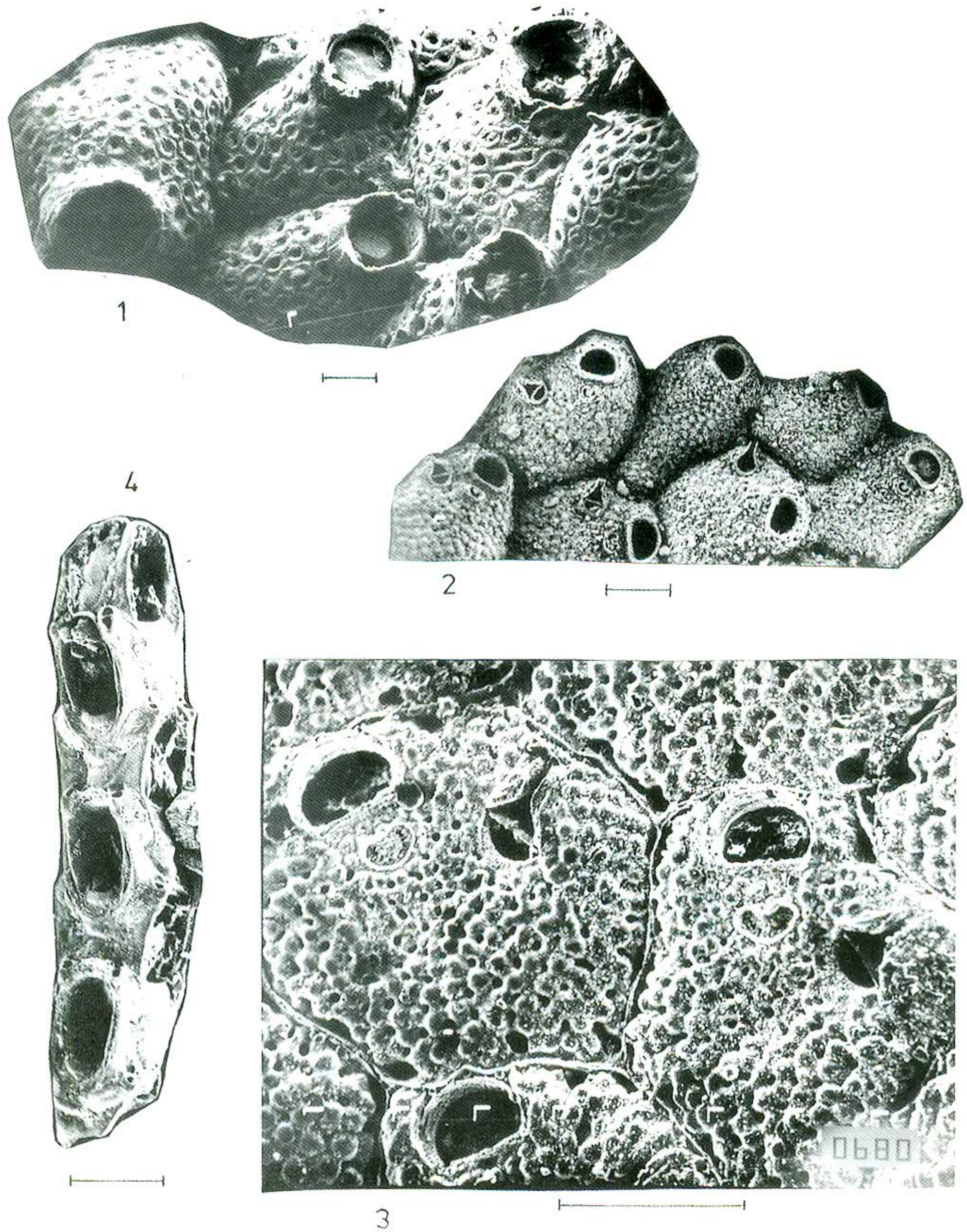

Figure 5. **1,** *Exchonella discoidea* Canu & Bassler, 1929. Part of an encrusting zoarium with 6 large flask shape zooecia. Notice the coarse rounded frontal pores. **2-3,** *Microporella ciliata* (Pallas), 1766. **2,** part of an encrusting zoarium with seven zooecia. Notice the presence of single avicularia (with pivot) on each zooecium and the spines around orifices. **3,** more enlarged part of the same zoarium. Notice the lunulate micropore distal to the semi-circular orifices and the open chanelled avicularia. **4,** *Nellia oculata* Busk, 1852. Zoarium internode showing two adjacent sides each one with 3 zooecia. Notice the pairs of avicularia (with pivot on the proximo-lateral corners of the well developed gymnocyst. Bar scale of SEM figures = 0.2 mm

lav (2,21) 0.19 (± 0.024) mm 0.16 - 0.24 mm

Occurrence. The middle and oldest coral reef, Wadi Quseir El-Kadium, Pleistocene.
Remarks. The present species differs from all known *Hippopleurifera* spp. by its very long avicularia, sometimes nearly as long as the autozoecia. It is similar to *H. biauriculata* (Reuss, 1848) in the micrometric dimension of zooecia but differs by its very long avicularia with open chanelled rostrum.

Family Microporellidae Hincks, 1880

Microporella ciliata (Pallas, 1766)

(Fig. 5: 2-3)

Eschara ciliata Pallas, 1966, p. 38
Microporella ciliata (Pallas) – Brown, 1952, p. 250, fig. 184.– David & Pouyet, 1974, p. 182, pl. 7 fig. 5.– Vavra, 1977, p. 134.– Hayward & Rayland, 1979, p. 222, fig. 95.– Moissette, 1988, p. 150, pl. 24, fig. 7-9.– Schmid, 1991, p. 406, pl. 2, fig.1-2.
Microporella (Microporella) ciliata (Pallas)– Bassler, 1953, p. 207, fig. 155/9.

Description. Zoaria encrusting on *Fungia fungites* and *Lobophyllia corymbosa*, unilamellar, wide, hexagonal, elongated, distinct, separated by thin deep and sharp threads. Frontal flat to little inflated, finely perforated, coarsely granulated. Ascopore median, suboral, proximal to and near the orifice, lunulate, convex proximally and concave distally. Orifice semicircular with straight proximal and concave margins, terminal. Peristomes thin, salient, rarely raised, bearing 5-6 spines (traces of their basis). Avicularia single, lateral, proximal to orifice corners, large, with pivot and long open channlled rostrum. Ovicell hyperstomial, not prominent.
Measurements
Lz (3,44) 0.50 (± 0.064) mm 0.40 - 0.60 mm
lz (3,44) 0.400 (± 0.089) mm 0.30 - 0.50 mm
ho (3,44) 0.070 (± 0.010) mm 0.06 - 0.08 mm
lo (3,44) 0.110 (± 0.010) mm 0.10 - 0.12 mm
Avicularia:
Lav (3,20) 0.098 (± 0.013) mm 0.08 - 0.12 mm
lav (3, 20) 0.070 (± 0.013) mm 0.06 - 0.08 mm
Occurrence. The oldest coral reef, Wadi Quseir El-kadium, Pleistocene.
Distribution. Miocene of Austria, CSSR, (Vavra 1977); Tertiary and Quaternary, Cosmopolitan (Brown 1952); Recent, Cosmopolitan (Brown 1952).

Family Schizoporellidae Jullien, 1903

Dakaria granulata Canu & Bassler, 1929

(Fig. 4: 1)

Dakaria granulata Canu & Bassler, 1929, p. 297, pl. 32, fig. 2.

Description. Zoarium unilamellar, incrusting on Acanthastrea echinata. Zooecia distinct, large, separated by deep furrows, arranged on longitudinal alternating rows, lozenge-shaped. Frontal inflated, coarsely granular tremocyst. Tremopores rounded, numerous, clearly obvious near the margins. Aperture semicircular, located at the bottom of short peristomie, with proximal median slit-like sinus (rimule). Ovicell hyperstomial, of the same tremopores and granules of the frontal.

Measurements

Lz (1,11) 0.82 (± 0.017) mm 0.80 - 0.84 mm
lz (1.11) 0.76 (± 0.090) mm 0.60 - 0.80 mm
ho (1,11) 0.20 (± 0.016) mm 0.18 - 0.22 mm
lo (1,11) 0.17 (± 0.022) mm 0.14 - 0.18 mm

Occurrence. The oldest coral reef, Wadi Quseir El-Kadium, Pleistocene.
Distribution. Recent of the Philipines (Canu & Bassler 1929).

PALEOECOLOGY

Cuffey (1977) studied the bryozoan contribution to reefs and bioherms through geologic time and noted that the Cenozoic reefal bryozans act as hidden encrusters, cavity dwellers, cavity filters and occasionally as dead reef veneers. Based on Cuffey's classification the studied bryozoan species act as accessory frame-encrusters (7 species) and as sediment formers (3 species).

The accessory frame encrusters of the studied bryofauna are *Proboscina boryi, Membranipora savartii, Antropora ovatum, Exechonella discoidea, Hippopleurifera hamzai, Microporella ciliata* and *Dakaria granulata*. They inhabit sheltered or protected spots on, under, or within a reef framework (*Fungia fugites, Acanthastrea echinata, Coscinaraea monile* and *Lobophyllia corymbosa*). Such bryozoans contribute significant amounts of skeletal material to the reef frame and may thereby help to strengthen it. Most of them exist under coral heads occupying sheltered niches and can be termed according to Cuffey (1977) as hidden encrusters. The reasons for bryozoans to occupy such sheltered niches are to avoid either high energy conditions or the poisonous activity of living corals.

The studied byrozoans which act as sediment formers are less diverse; they are *Crisia elongata, Nellia oculata* and *Scrupocellaria elliptica*. In addition to their low diversity they were also very rare. In this role, broken and tumbled bryozoan skeletal debris accumulate on the bottom as carbonate gravel or sand in and around reefs, the byrozoan debris are mixed with ranging quantities of other skeletals as bivalves, gastropods, foraminifera, etc. The three identified species representing this group were obtained by washing of the associated scleractinian corals.

The studied bryofauna in combination with the associated scleractinian corals are believed to have grown in upper reef slope to back reef environments.

CONCLUSIONS

1. Ten bryozoan species have been described for the first time from the Pleistocene coral reefs of the Red Sea; one of them, *Hippopleurifera hamzai*, is proposed as new.

2. The studied bryofauna essentially acted as accessory frame encrusters (hidden encrusters) and occasionally as sediment formers.

3. According to the habits of the extant species and in combination with the associated scleractinian corals, the studied fauna is believed to have grown in the upper reef slope to back reef environment, where energy is very high and therefore only protected niches are available for growing of the accessory reef encrusters (hidden encrusters).

4. The low diversity and abundance of the studied bryofauna especially the sediment formers could be referred to diagenetic processes (recrystallization) and/or to the high energy environmental conditions of the forereef zone. High energy could have prevented or lowered the fixation ratios of bryozoan larvae.

5. The biogeographic distribution of the Recent elements of the studied bryozoans shows their Indo-Pacific and/or cosmopolitan affinities.

6. Two species, *Crisia elongata* and *Scrupocellaria elliptica* (Eocene-Pliocene) are recorded for the first time from Pleistocene sediments.

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