

## RECENT BRYOZOANS FROM SOUTHERN SAFAGA BAY, RED SEA COAST, EGYPT

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### ABSTRACT

Twenty-eight bryozoan species have been identified for the first time from the Recent coral reefs and sediments of the southern Safaga bay, Red Sea coast, Egypt. Among the identified taxa, twenty-six species belong to the order Cheilostomata and the rest to the order cyclostomata. *Schizosmittina safagaensis*, *Smittina avicularis*, *S. regularis* and *Celleporina abbassi* are believed to be new. Sixteen bryozoans are encrusting and have membraniporiform and celleporiform zoarial growth-forms, and twelve are erect and are vinculariiform, cellariiform and catenicelliform. Nearly all identified bryozoans are of Indo-Pacific affinity, and very rare elements are also recorded from the Atlantic-Mediterranean realm.

### INTRODUCTION

The main target of the present work is to study the taxonomy of Recent bryozoan fauna of southern Safaga bay, Red Sea coast, Egypt (Fig. 1), as well as, their ecological and biogeographical implications.

The studied area lies in the southern flank of Wadi Safaga. The shoreline of the studied area is dominantly made up of terrigenous, arenaceous sand mixed with rubbish materials. The Safaga area is occupied by relatively low hills of sedimentary rocks surrounded by a mountainous area of igneous and metamorphic rocks. The low sedimentary hills form a strip twelve kilometers in length extending from north to south. This strip is formed of a number of hills separated by different wadis as Wadi Wasif and Wadi Gasus.

Most erect bryozoans were picked up from the samples were collected along three profiles perpendicular to the Southern Safaga bay by free diving (Fig. 1). Depth of samples along each profile ranges from beach sediments (0 m) to 37 m depth (Tab. 1). Most of the encrusting bryozoans were collected from the surfaces of the igneous cobbles and boulders of rhyolite, basalt and porphyritic dacite. Also some bryozoans were collected from cement pipes, corals and other biogenic fragments in situ (Figs. 2, 3) or drifted in the supratidal zone.

The studied bryozoan fauna is deposited in the Geological Museum, Zagazig University, El-Sorogy's collection, Zagazig, Egypt.

Table 1: Depths of the studied samples.

Sample no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Depth/m	0	1	2	5.3	10	23	30	30	31.5	34	0	1	3.5	7	16
Sample no.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Depth/m	22	27	30	34	35	0	1	6.5	14	30	29	36	32	37	32

### SYSTEMATIC DESCRIPTION

The present taxonomy is based on the classification of Bassler (1953) and other later modifications. Micrometric measurements, occurrence, habit and information

on geologic distribution (if available) are given for each identified species. Full description is given only for taxa not recorded in Egyptian published literature. The following abbreviations are used in the measurements of the taxa: Lz=zooecial length, lz=zooecial width, ho=length of orifice, lo=width of orifice, Lov=length of ovicell, lov=width of ovicell, Lav=avicularian length, and lav=avicularian width.

Phylum: Bryozoa Ehrenberg, 1831

Order: Cyclostomata Busk, 1852

Genus: *Crisia* Lamouroux, 1812

*Crisia hörnesii* Reuss, 1847

(Pl. 1, Figs. 1, 2, 3)

1848 *Crisia hörnesii* Reuss: 54, pl. 7, fig. 21.

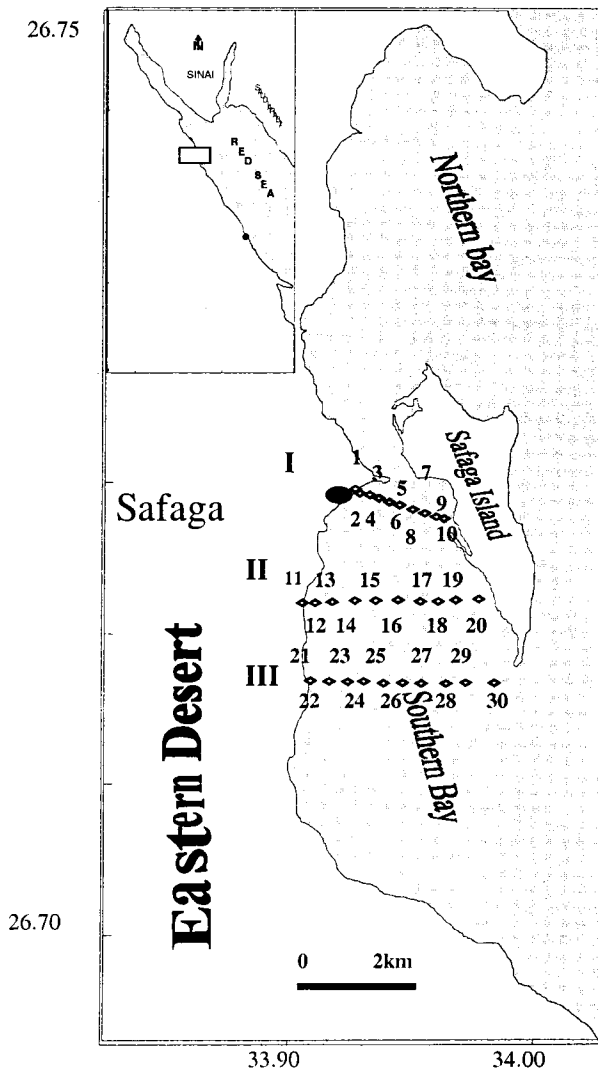


Fig. 1: Location map of the studied profiles.



**Fig. 2: Sampling process from coral heads of different types on muddy floor.**



**Fig. 3: Wastes of solid nature on the floor of Safaga bay provide a hard substrate for many encrusters such as corals, algae and bryozonas.**

1907 *Membranipora savartii* (Audouin): Canu: 252, pl. 2, figs. 5, 6.

- 1929 *Membrendoecium savarti* Mackgillivray: Canu & Bassler: 74, pl. 6, figs. 1, 2.  
 1972 *Biflustra savartii* (Audouin): David, Mongereau & Pouyet: 10, pl. 8, fig. 8.  
 1976 *Membranipora savartii* (Savigny-Audouin): Abbas & El-Senoussi: 157, pl. 1, fig. 4.  
 2000 *Membranipora savartii* (Savigny- Audouin): Ziko, El-Sorogy, Zalat, Eweda & Saber: 1474, pl.2, fig.6.

(For more synonymy see Ziko *et al.*, 2000)

**Measurements:** Lz= 0.22 0.40 mm. lz= 0.10 0.22 mm.  
 ho= 0.40-0.47 mm. lo= 0.20-0.27 mm.

**Occurrence:** In friable sample no. 17 (27 m depth) and encrusting on dead shells, rocks and pipes. Southern Safaga Bay.

**Distribution:** In Egypt: Middle Eocene, late Eocene, Miocene, Post Pliocene, Pleistocene. Eocene of France, Belgium, North America, Oligocene of Germany. Miocene of Tunisia, Algeria, Morocco, France, Australia, Italy, England, Spain, Portugal and central America. Pliocene of Tunisia, Morocco, Spain, Portugal, England, Italy, Argentina, Venezuela, Australia, Japan. Pleistocene of Algeria, Italy, Argentina, USA and China. Miocene of Australia (Canu & Bassler, 1929).

**Habitat:** Equatorial and Tropical zones of the Atlantic, Pacific, Indian Ocean and the Red Sea near shore in depths ranging between 10-15 m.

**Range:** Eocene-Recent.

*Membranipora nobilis* Reuss, 1847  
 (Pl. 1, Figs. 7, 8)

- 1848 *Membranipora nobilis* Reuss: 98, pl. 11, fig. 26.  
 1874 *Membranipora elliptica* Hag: Reuss, 179, table 9, fig. 1, 2.  
 1974 *Membranipora nobilis* Reuss: David & Pouyet: 98, pl. 2, fig. 6.  
 1979 *Membranipora nobilis* Reuss: Vávra: pl. 1, fig. 1.

**Description:** Zoarium encrusting. Zooecia radiating from the ancestrula region. Zooecia elliptical, elongate, separated from each other by deep furrows. Zooecia arranged in longitudinal rows. Opesia occupying most of the zooecium area, gymnocyst reduced. Zooecium wall ornamented by rims. Ovicell hyperstomial, small, rounded. Ancestrula differs from the rest of the zooecia in that the opesia is reduced, semicircular, gymnocyst occupying most of the zooecium area.

**Measurements:** Lz= 0.66-0.75 mm. lz=0.42-0.50 mm.  
 lop=0.33-0.50 mm. lop=0.21-0.33 mm.

**Occurrence:** Encrusting on dead shells.

**Distribution:** Miocene of Austria, Portugal, CSSR, Ireland (Vávra, 1977).

**Range:** Miocene-Recent.

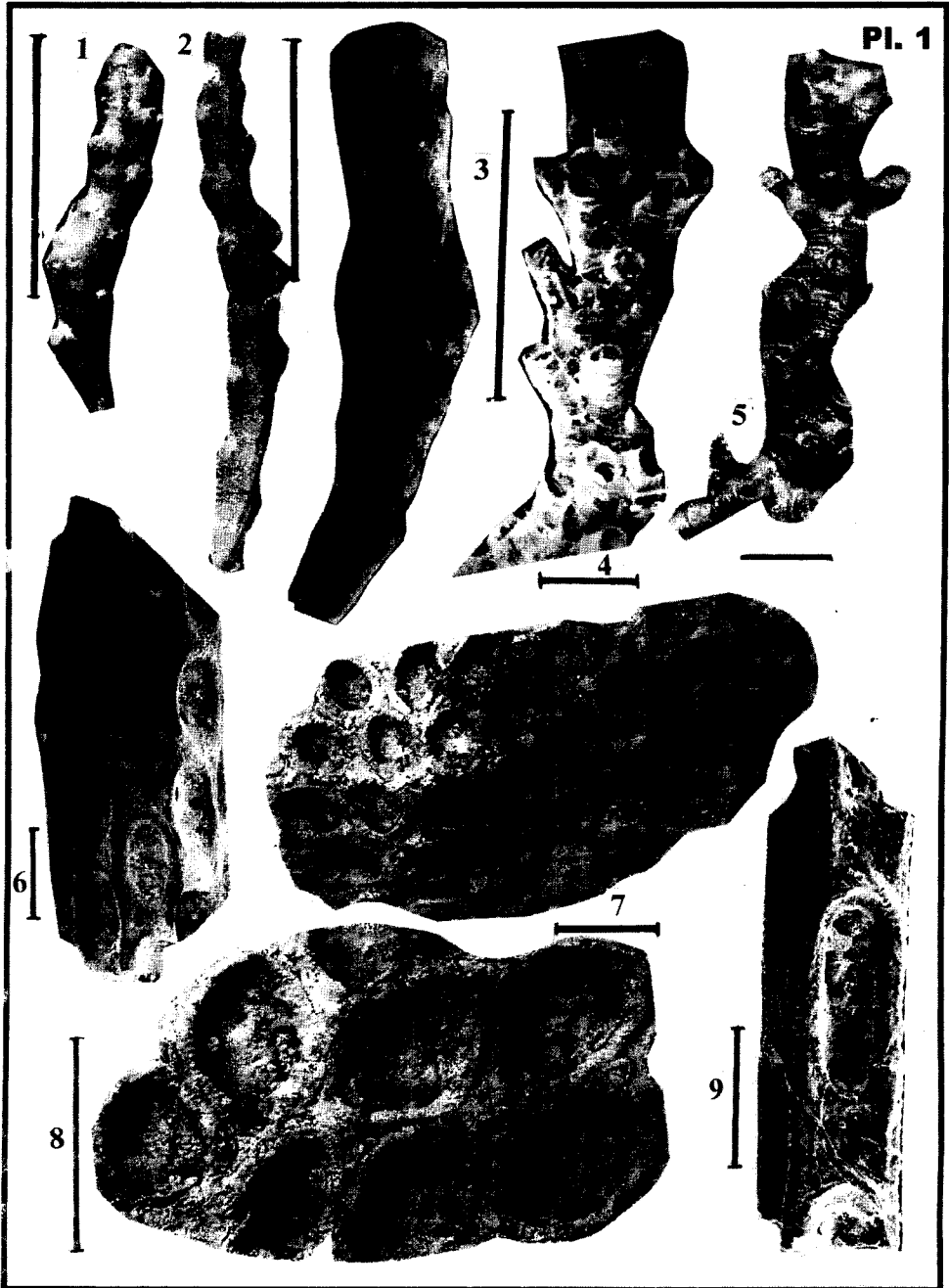
Family: Farciminariidae Busk, 1884  
 Genus: *Nellia* Busk, 1852  
*Nellia tenella* (Lamarck, 1816)  
 (Pl. 1, Fig. 9)

1816 *Cellaria tenella* Lamarck: 135.

1907 *Facimia tenella* (Lamarck): Canu: 76, pl. 1, figs. 26, 27.

1920 *Nellia oculata* Busk: Canu & Bassler: 195, pl. 82, fig. 6-10.

1966 *Nellia tenella* (Lamarck): Cheetham: 48, text. fig. 28.



1974 *Nellia oculata* (Busk): Debourle: 154, pl. 16, fig. 11.

1995 *Nellia oculata* (Busk): Ziko & El-Sorogy: 84, figs. 4, 5.

2000 *Nellia tenella* (Lamarck): Ziko, El-Sorogy, Zalut, Eweda & Saber: 1478, pl. 3, fig. 3.

(For more extensive synonymy see El-Sorogy *et al.* 2001)

**Measurements:** Lz=1.04 mm.

lz= 0.56 mm.

ho= 0.60 mm.

lo= 0.16 mm.

**Occurrence:** In friable sample no. 17 (27 m depth). Southern Safaga Bay.

**Distribution:** In Egypt: Late Eocene, Middle Miocene. Eocene & Oligocene of Europe, Africa & America. Miocene of Africa, Asia, Europe & America. Pliocene-Pleistocene of Asia & America ( Ziko *et al.*, 2000).

**Habitat:** Cosmopolitan in tropical regions, from depth ranging between 17-450 m, but much frequent from 20-28 ( Ziko *et al.*, 2000).

**Range:** Eocene- Recent.

Family: Scrupocellariidae Levinsen, 1909

Genus: *Scrupocellaria* Van Beneden, 1845

*Scrupocellaria elliptica* (Reuss, 1848)

(Pl. 2, Fig. 1)

1848 *Bactridium ellipticum* Reuss: 56, pl. 9, figs. 7, 8.

1920 *Scrupocellaria elliptica* (Reuss): Canu & Bassler: 184, pl. 32, figs. 4-7.

1974 *Scrupocellaria elliptica* (Reuss): David & Pouyet: 130, pl. 2, fig. 3.

1992 *Scrupocellaria elliptica* (Reuss): Pouyet & Moissette: 47, pl. 6, figs. 1, 2.

2000 *Scrupocellaria elliptica* (Reuss): Ziko, El-Sorogy, Zalut, Eweda & Saber: 1479, pl.3, fig.9

2002 *Scrupocellaria elliptica* (Reuss): El Safori: 441, pl. 5, fig. 8.

(For more extensive synonymy see Ziko *et al.*, 2000)

**Measurements:** Lz=0.26-0.35 mm

lz= 0.15-0.17 mm.

ho=0.14-0.17 mm.

lo=0.08-0.10 mm.

**Occurrence:** In friable samples no. 17, 18 (27-30 m depth). Southern Safaga Bay.

#### Explanation of Plate 1

Fig.

1, 2, 3: *Crisia hrnesi* Reuss, 1847

1. General view of erect zoarium showing alternating zooecia.

2. General view of another zoarium showing granulated frontal.

3. General view of another zoarium.

4, 5: *Filisarsa rugosa* Canu & Bassler, 1929

4. General view of zoarium.

5. General view of zoarium showing tubes wrinkled transversely.

6: *Membranipora savartii* (Savigny-Audouin, 1826). General view of erect zoarium showing large opesia.

7, 8: *Membranipora nobilis* Reuss, 1847

7. General view of encrusting zoarium showing ancestrular region.

8. Enlarged view of zoarium.

9: *Nellia tenella* (Lamarck, 1816). General view of erect zoarium showing very large zooecium.

(Bar scale = 500µ)

**Distribution:** In Egypt: Middle Miocene of Cairo-Suez, western side of the Gulf of Suez, Mersa Matruh; Pleistocene of the Red Sea coast. Eocene of Spain, France, Italy and USA. Oligocene of France and Italy. Miocene of France, Austria, Romania and Algeria. Pliocene of Portugal, Spain, England, Italy, Rhodes, Tunisia. Pleistocene of Italy and USA (Vavra, 1977).

**Habitat:** West Atlantic on the coast of Brazil and Canada, East Atlantic at Cap Verde Islands, Mediterranean, Pacific and Arctic (Saber, 2000).

**Range:** Eocene-Recent.

Family: Cabereidae Busk, 1852  
Genus: *Tricellaria* Fleming, 1828  
*Tricellaria monotrypa* (Busk, 1852)  
(Pl. 2, Fig. 2)

1852 *Cellularia monotrypa* Busk: 368

1943 *Tricellaria monotrypa* (Busk): Hastings: 356

1958 *Tricellaria monotrypa* (Busk): Macken: 104.

1986 *Tricellaria monotrypa* (Busk): Gordon: 61, pl. 20/ C, D.

**Description:** Zoaria erect, compressed branches, biserial except at internodes the zooids become three zooids. Oval or subrounded opesia. Ovicell reduced as a narrow cap like structure with acrescentic proximal rim. Cryptocyst smooth, depressed, slightly long, but short and small at the branches covered by ovicell of the proximal zooecia, smooth gymnocyst, frontal avicularia absent in this species. Ovicell surrounded by a smooth cryptocyst. Two spines are at the outer and the inner margins (distolateral to mural rim) of the zooid and a third spine at the mid distal rim of the axial zooid. There are no dorsal avicularia or vibracula.

**Measurements:** Lz= 0.19-0.38 mm.

Iz= 0.10-0.19 mm.

ho= 0.15-0.16 mm.

lo= 0.09-0.10 mm.

**Occurrence:** In friable samples. No 17, 18 (27-30 m depth). Southern Safaga Bay

**Habitat:** New Zealand, rocky substrate with encrusting corals and brachiopods. Depth 20-251 m.

*Tricellaria occidentalis* (Trask, 1857)  
(Pl. 2, Figs. 3, 4)

1857 *Menipea occidentalis* Trask: 113.

1950 *Tricellaria occidentalis* (Trask): Osburn: 122, pl. 13, figs. 6, 7.

1986 *Tricellaria occidentalis* (Trask): Gordon: 61, pl. 20/ E.

1992 *Tricellaria occidentalis* (Trask): Gordon & Mawatari: 25, pl. 2/ f; pl. 6/ f.

**Description:** zoarium erect, dichotomously branching, usually jointed at the bifurcations. Branches typically biserial in articulated segment of 7 or 9 zooids. Zooecia alternating or a branch begins with a single zooid; each branch jointed at its base, internodes typically consisting of 3 zooids or more, zooecia usually narrowed below the opesia. There are no dorsal vibracula, no frontal avicularia. Lateral avicularia present. The opesia elongate, oval, generally about two third of the zooecial length, with well developed smooth gymnocyst. Spines usually



present. From the inner margin of the proximal half of the opesia a scutal spine present, variously awl-like, bifid, trifid, or in ovicelled zooid a large lobate structure, it usually protect the opesia area. Typically three outer distolateral spines present, a median distal spine and a pair of inner distolateral spines on most non ovicelled zooids. Ovicell hyperstomial, globular, smooth with a dozen scattered pores.

**Measurements:** Lz= 0.28-0.44 mm. lz= 0.12-0.20 mm.  
Lo= 0.14-0.22 mm. lo= 0.08-0.12 mm.  
hov= 0.10-0.12 mm. lov=0.10-0.14 mm.

**Occurrence:** In friable samples no. 17, 18 (27-30 m depth). Southern Safaga Bay.

**Habitat:** New Zealand, British Colombia, U.S.A., Japan, China, South Australia, Victoria, New South Wales, Venice (Osburn, 1950; Gordon, 1986; Gordon & Mawatari, 1992).

**Remark:** This spiecemen differs from that of (Gordon, 1986) that it has one or two avicularia on its ovicell (terminal, small, with short rostrum, triangle or elongate).

Genus: *Canda* Lamouroux, 1816  
*Canda arachnoids* Lamouroux, 1816  
(Pl. 2, Fig. 5)

1816 *Canda arachnoids* Lamouroux: 131.

1943 *Canda arachnoids* Lamouroux: Hastings: 364.

1972 *Canda arachnoids* Lamouroux: Uttley & Bullivant: 30.

1986 *Canda arachnoids* Lamouroux: Gordon: 63, pl. 22, F; 23, A.

2001 *Canda arachnoids* Lamouroux: El-Sorogy, Abd El-Wahab, Ziko & El Dera: 62, pl. 3, figs. 3, 4.

**Measurements:** Lz= 0.31-0.34 mm. lz=0.16-0.20 mm.  
ho=0.13-0.14 mm. lo=0.09-0.10 mm.

**Occurrence:** In friable sample no. 17 (27m depth). Southern Safaga Bay.

**Habitat:** New Zealand, Australia, Gulf of Aqaba (Red Sea, Egypt).

*Canda pecten scutata* Harmer, 1926  
(Pl. 2, Fig. 7)

1926 *Canda pecten scutata* Harmer: 389.

1984 *Canda pecten scutata* Gordon: 50, pl. 13/ D, E.

**Description:** zoarium erect, originally biserial, but easily split into two parts along mid-long axis. Therefore they appear as uniserial zoarium. Zooecia facing obliquely outward. Zooecia elongate, hexagonal to rectangular. Zooecium wide proximally and narrow distally. Frontal smooth, narrow. Opesia large, elliptical, occupying more than half of the zooecial length. Mural rim thin, a little salient. Opesia surrounded by three spines, two at the two sides of the opesia and one at the inner median side. Avicularia occurring in the distolateral part of the zooecia. Ovicell not preserved.

**Measurements:** Lz= 0.3-0.33 mm. lz= 0.17-0.19 mm.  
ho= 0.16-0.18 mm. lo= 0.08-0.10 mm.

**Occurrence:** In friable sample no. 18 (30 m depth). Southern Safaga Bay.

Family: Epistomiidae Gregory, 1903

Genus: *Synnotum* Pieper, 1881

*Synnotum aegyptiacum* (Audouin, 1826)  
(Pl. 2, fig. 6)



1826 *Loricaria aegyptiaca* Audouin: 243.

1926 *Synnotum aegyptiacum* (Audouin): Harmer: 398, pl. 27, figs. 3-4.

1953 *Synnotum aegyptiacum* (Audouin): Bassler: 184, fig. 140, 2.

1984 *Synnotum aegyptiacum* (Audouin): Gordon: 43, pl. 10, fig. E, F.

1988 *Synnotum aegyptiacum* (Audouin): Zabala & Maluquer: 100, fig. 171.

1991 *Synnotum aegyptiacum* Audouin: Scholz: 283, pl. 5, fig. 1.

**Description:** Colony erect, branching, articulated, supported by rootlets, arranged in single pairs constitute internode, with uncalcified joints. Each zooid of a pair facing laterally with a membrane covering the whole frontal area. Walls smooth, avicularia one adjacent to the orifice and the other sessile in the same basal position (not seen because of the bad preservation of the sample).

**Measurements:** Lz= 0.50 mm.

lz= 0.20 mm.

ho= 0.16 mm.

**Occurrence:** In friable sample no. 21 (beach sediments). southern Safaga Bay.

**Habitat:** Three Kings Island, Victoria, New South Wales, Indonesia, Timor, Singapore, Japan, Indian Ocean, Red Sea, Mediterranean Sea, Brazil, USA. Depth 95-210 m (Gordon, 1984).

Family: Hippopodidae Levinsen, 1909

Genus: *Hippopodina* Levinsen, 1909

*Hippopodina feegensis* (Busk, 1884)

(Pl. 3, Figs. 1, 2, 3)

1884 *Lepralia feegensis* Busk: 144, pl. 20, fig. 9.

1909 *Hippopodina feegensis* Busk: Levinsen: 353, pl. 24, fig. 3/ a-f.

1923 *Hippopodina feegensis* (Busk): Canu & Bassler: 163, fig. 29A.

1929 *Cosciniopsis feegensis* (Macgillivray): Canu & Bassler: 276, pl. 28, fig. 7.

1953 *Hippopodina feegensis* (Busk): Bassler: 196, fig. 147/ 2.

1991 *Hippopodina feegensis* (Busk): Scholz: 305, pl. 13, fig. 3.

**Description:** Zoarium encrusting, unilamellar, inflated, large (very wide), diameter may up to more than 20 mm. zooecia arranged in longitudinal parallel rows. Zooecia with thin wall, distinct, separated from each other by furrows, more or less rectangular and elongated. Frontal wall weakly arched or a little convex, with small round tremopores or ornamented by granulation. Aperture large, elliptical, with two

#### Explanation of Plate 2

Fig.

1: *Scrupocellaria elliptica* (Reuss, 1848). General view of erect, free zoarium.

2: *Tricellaria monotrypa* (Busk, 1852). General view of erect zoarium showing three zooids at internodes.

3, 4: *Tricellaria occidentalis* (Trask, 1857).

3. Frontal view of erect zoarium.

4. Enlarged view of zoarium showing bifid spine.

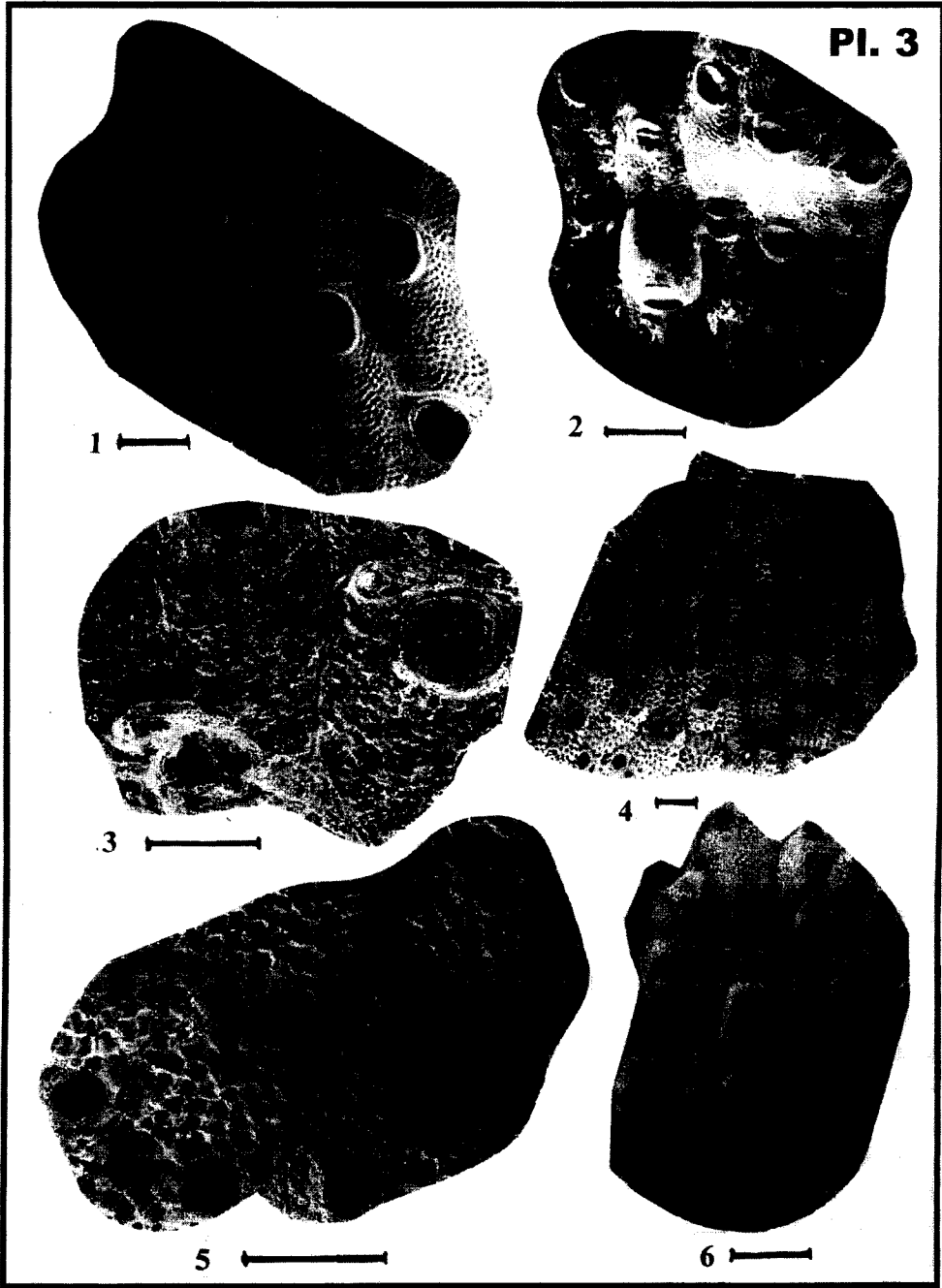
5: *Canda arachnoides* Lmoureaux, 1816. General view of erect zoarium.

6: *Synnotum aegyptiacum* (Audouin, 1826). General view of erect zoarium.

7: *Canda pecten scutata* Harmer, 1926. General view of erect zoarium.

(Bar scale = 250µ)

triangular cardless, covered, which provided the chitinous marginal ridge; separate a large anter from the small poster. Peristome thin and little salient. Avicularia present, it may be one or two on both sides of the aperture, it occurs distally to the aperture, triangular, vary in length, the longest with mandible. Beak usually pointed toward the median axis of the zooecia. Ovicell hyperstomial, highly inflated, large,



closed with porous operculum like the frontal.

**Measurements:** Lz= 0.94-1.13 mm. lz= 0.56-0.94 mm.  
 lo=0.25-0.38 mm. ho= 0.25-0.31 mm.  
 hov=0.75 mm. lov=0.813 mm.

**Occurrence:** Encrusting on dead shells and pipes.

**Habitat:** St. Thomas, Singapore (Levinsen, 1909); Philippine Region, Nichol Bay, Northwestern Australia (Canu & Bassler, 1929); New Zealand, S. Pacific (Bassler, 1953).

**Range:** Eocene-Recent (Bassler, 1953).

Family: Schizoporellidae Jullien, 1903

Genus: *Schizoporella* Hincks, 1877

*Schizoporella violacea* Canu & Bassler, 1930

(Pl. 3, Figs. 4, 5)

1930 *Schizoporella violacea* Canu & Bassler: 40, pl. 4, figs. 1-14.

**Description:** Zoarium encrusting, multilamellar, wide. Zooecium convex, distinct, semi rectangular, separated from each other by deep threads represented as fine areolar pores, surrounding each zooecium. Frontal wall perforated by true coarse tremopores, of more than 12 pairs. Aperture semicircular, with large sinus and two large rounded cardless. Large avicularia present at one side of the zooecium. Avicularia have different shapes of mandibles, may be straight, little curved, long, short and triangular with closed channel. Opesia of avicularia small, semicircular with pivot.

**Measurements:** Lz= 0.60-0.84 mm. lz=0.48-0.60 mm.  
 ho= 0.16-0.20 mm. lo= 0.16-0.20 mm.  
 lav= 0.28 mm

**Occurrence:** Encrusting on dead shells. Southern Safaga Bay.

**Habitat:** Recent, Tunisia. Depth (4-30 m).

Family: Microporellidae Hincks, 1880

Genus: *Microporella* Hincks, 1877

*Microporella ciliata* (Pallas, 1966)

(Pl. 3, Fig. 6)

1766 *Eschara ciliata* Pallas: 38.

1953 *Microporella* (*Microporella*) *ciliata* (Pallas): Bassler: 207, fig. 155/9.

#### Explanation of Plate 3

Fig.

1, 2, 3: *Hippopodina feegensis* (Busk, 1884)

1. General view of encrusting zoarium.

2. General view of zoarium showing very large hyperstomial ovicell.

3. Enlarged view of zoarium showing single avicularium.

4, 5: *Schizoporella violacea* Canu & Bassler, 1930

4. General view of encrusting zoarium.

5. Enlarged view of zoarium showing large avicularia.

6: *Microporella ciliata* Linnaeus, 1759. General view of encrusting zoarium.

(Bar scale = 500µ)

1979 *Microporeela ciliata* (Pallas): Hayward & Ryland: 222, fig. 95

1988 *Microporeela ciliata* (Pallas): Moissette: 150, pl. 24. figs. 7-9.

1996 *Microporella* (*Microporella*) *ciliata* (Pallas): Ziko: 136, figs. 4-6.

2002 *Microporella* (*Microporella*) *ciliata*: El-Safori: 446.

(For more synonymy see Ziko 1996)

**Measurements:** Lz= 0.25-0.44 mm

lz= 0.24-0.30 mm

La= 0.04-0.06 mm

la= 0.08-0.10 mm

hov= 0.14-0.16 mm.

lov=0.16-0.2 mm.

**Occurrence:** Encrusting on dead shells. Southern Safaga bay.

**Distribution:** In Egypt Miocene of the western side of the Gulf of Suez. Pleistocene of the Red Sea coast. Miocene of Austria, CSSR, Germany, Portugal, Italy, Morocco, New Zealand, USA, Algeria. Pliocene of England, Netherlands, Spain, Italy, Rhodes, Tunisia, Algeria, New Zealand. Pleistocene of Italy, USA (Ziko, 1996).

**Habitat:** Recent, cosmopolitan (80° N-70° S), depth range 0-660 m in the Mediterranean, optimum depth more than 100 m and low rate of sedimentation (Ziko & El-Sorogy, 1995; Ziko, 1996).

**Range:** Miocene-Recent.

Family : Smittinidae Levisen, 1909

Genus: *Schizosmittina* Vig., 1949

*Schizosmittina safagaensis* n. sp.

(Pl. 4, Fig. 1)

**Etymology:** This species is named after its locus typicus as it has been found in Safaga area.

**Description:** Zoarium encrusting, unilamellar, zooecia arranged in irregular manner. Zooecia distinct, separated from each other by fine threads. Each zooecium surrounded by 5-6 pairs of small-very large areola which reach 0.05 mm in length. Frontal ornamented with fine-medium granulations. Orifice almost rounded with deep sinus, surrounded by salient peristome, which sometimes make a neck-like structure and in this case the sinus disappears. One spine occurs distally to the orifice. Avicularia present in two types, the first is medium in size and occurs to the left of the orifices, triangular, with pointed rostrum; the second is large, very long, median, a little to the left of the orifice, with curved and very long rostrum. Ovicell recumbent, almost small to medium sized.

**Measurements:** Lz=0.30-0.42 mm.

lz=0.20-0.26 mm.

ho=0.08-0.10 mm.

lo=0.08-0.10 mm.

Lav=0.12-0.16 mm.

**Occurrence:** Encrusting on shells.

Genus : *Smittina* Norman, 1903

*Smittina trispinosa* Johnston, 1838

(Pl. 4, Figs. 2, 3)

1923 *Smittina trispinosa* Johnston (Canu & Bassler): 143, pl. 22, figs. 7-14

1929 *Smittina trispinosa* Johnston: Canu & Bassler: 340, pl. 41, figs. 1-3.

2001 *Smittina trispinosa* Johnston: El-Sorogy, Abd El-Wahab, Ziko & El Dera: 70, pl. 5, fig. 1.

**Measurements:** Lz= 0.46-0.64 mm. lz= 0.36-0.43 mm.  
 ho= 0.15 mm. lo= 0.15 mm.  
 Lav=0.38-0.39 mm. lav= 0.1 mm.

**Occurrence:** Encrusting on dead shells, other bryozoans and pipes.

**Habitat:** Philippine region, Gulf of Aqaba (Red Sea), coarse sand with shells, depth 23-88 fathoms (Canu & Bassler, 1929; El-Sorogy *et al*, 2001).

*Smittina avicularis* n. sp.  
 (Pl. 4, Figs. 4, 5; Pl. 5, Fig. 1)

**Etymology:** This species is named because of its great variety in avicularian shapes and positions.

**Description:** Zoarium encrusting, unilamellar, thick, arranged in alternating longitudinal rows, making a costule in between; reaching the median axis of the zooecium. Zooecia distinct, rectangular-fusiform. Each zooecium surrounded by 7-8 pairs of areola, of median to large size; make a salient thin thread. Frontal wall granulated with thick granulations. Aperture rounded to semirounded, with well-developed lyrula and two small rounded cradles proximally to the aperture. Aperture surrounded by thick peristome. Two spines occur distally to the peristome, not prominent. Avicularia adventitious, vary in size, positions and directions; it may be small in size, medium or large. It may be also directed in all directions, upward or downward, it may be located at the frontal part of the ovicell, it may also have one or two proximal or lateral avicularia. Ovicell hyperstomial, globular, semirounded, granulated, of two layers; the outer one is solid and the inner one is perforated.

**Measurements:** Lz= 0.50-0.67 mm. lz=0.33 0.42 mm.  
 ho= 0.13-0.15 mm. lo=0.13-0.16 mm.  
 Ovicelled zooecium reach 0.83 mm.

**Occurrence:** Encrusting on dead shells and other bryozoans. Southern Safaga Bay.

**Remarks:** This species differs from *Smittina rosacea* (Gordon, 1984) in having types of avicularia.

*Smittina regularis* n. sp.  
 (Pl. 5, Figs. 2, 3)

**Etymology:** This species is named after its very regular arrangement of the zooecia.

**Decription:** Zoarium encrusting, unilamellar, zooecia arranged in very regular alternating longitudinal rows. Zooecia longitudinally, distinct, rectangular, very regular. Zooecia separated from each other by fine threads represented by areolar pores, which exhibited 7-8 areola on each side. Frontal wall granulated by fine to

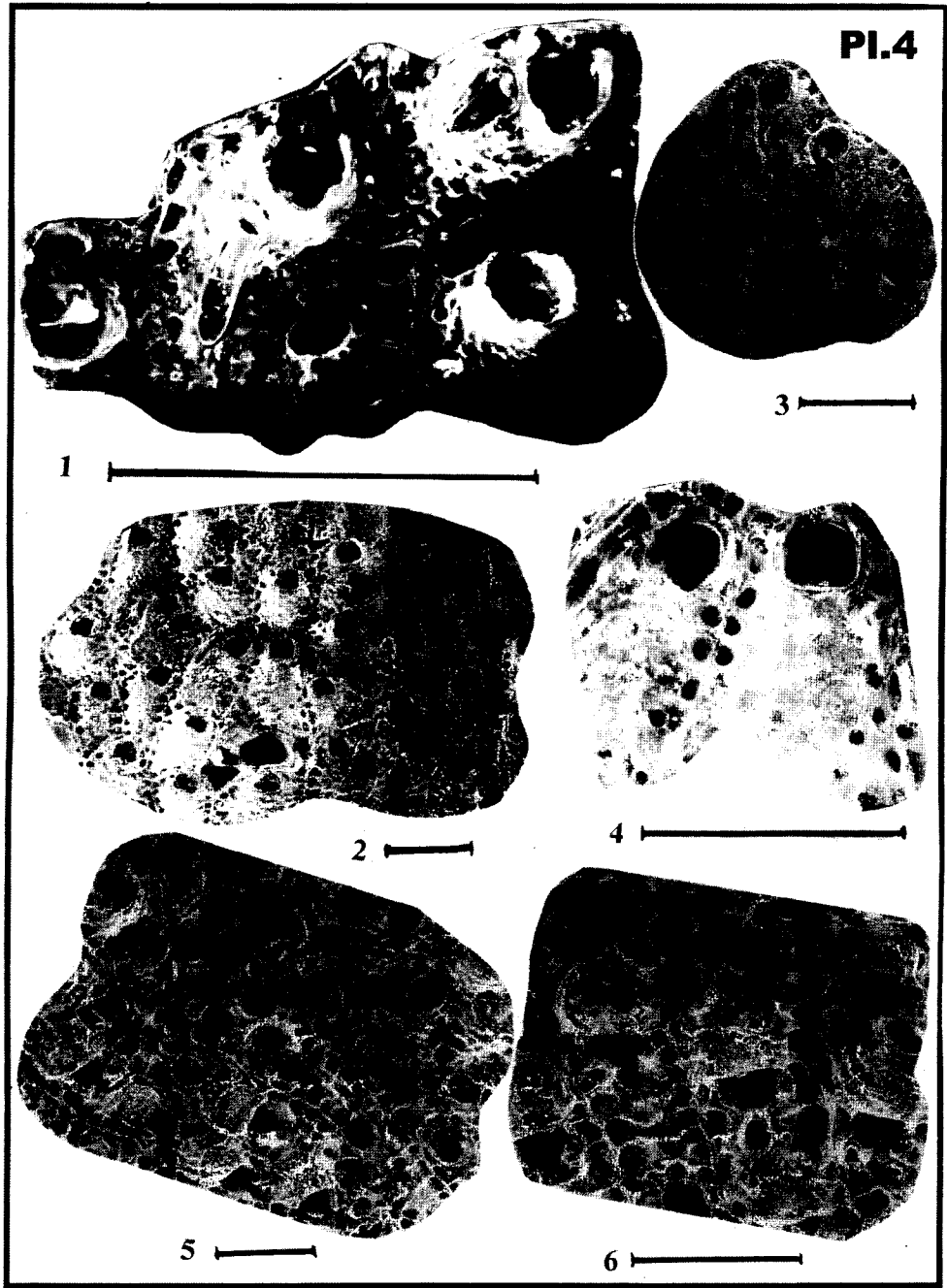
medium granulations. Aperture semi-rounded with lyrula proximal to the orbicular aperture. Avicularia single, very small, on one side, with pivot; and very short spatulated rostrum. Ovicell not seen in the specimen.

**Measurements:** Lz= 0.48-0.75 mm.

lz= 0.28-0.40 mm.

ho= 0.1-0.13 mm.

lo= 0.15-0.13 mm.





**Occurrence:** Encrusting on shells, pipes and in rubbish.

**Remarks:** this species differs from *Smittina trispinosa* (Canu & Bassler, 1929) in that it has no spines distally to the aperture.

Genus: *Parasmittina* Osburn, 1952

*Parasmittina delicatula* (Busk, 1884)

(Pl. 5, Fig. 4, 5)

1884 *Mucronella delicatula* Busk: 156.

1929 *Smittina unispinosa* (Busk): Livingstone: 90.

1973 *Parasmittina delicatula* (Busk): Soule & Soule: 401.

1984 *Parasmittina delicatula* (Busk): Gordon: 95, pl. 35, A.

2001 *Parasmittina delicatula* (Busk): El-Sorogy, Abd El-Wahab, Ziko & El Dera: 69, pl. 5, fig. 5.

**Measurements:** Lz = 0.48-0.83 mm.

Iz = 0.30- 0.43 mm.

ho=0.13-0.17 mm

lo=0.13-0.17 mm.

**Occurrence:** Encrusting on dead shells or other bryozoans, Southern Safaga Bay.

**Distribution:** Three kings Island, Hauraki Gulf, Wanganui (Upper Pliocene-Recent), Gulf of Aqaba (Red Sea), Cook Strait; Also Victoria, New South Wales, Hawaii, Japan, New Zealand (Gordon, 1984; El-Sorogy *et al.*, 2001).

**Habitat:** Encrusted on boulders and pebbles; mollusks, coral fragment. Depth 104-106 m. (Gordon, 1984).

**Range:** Upper Pliocene-Recent.

Family: Margarettidae Harmer, 1956

Genus: *Margaretta* Gray, 1848

*Margaretta cereoides* (Ellis & Solander, 1786)

(Pl. 6, Figs. 1, 2)

1786 *Cellaria cereoides* Ellis & Solander: 26, pl. 5, figs. B-E

1974 *Margaretta cereoides* (Ellis & Solander): David & Pouyet: 169, pl. 10, fig. 7.

1988 *Margaretta cereoides* (Ellis & Solander): Moissette: 165, pl. 26, fig.5.

1991 *Margaretta cereoides* (Ellis & Solander): Schmid: 406, pl. 2, fig.5.

1996 *Margaretta cereoides* (Ellis & Solander): Ziko: 136, fig. 4/5.

2000 *Margaretta cereoides* (Ellis & Solander): Ziko, El-Sorogy, Zalat, Eweda & Saber: 1486, pl. 5, fig. 5.

2002 *Margaretta cereoides* (Ellis & Solander): El Safori: 450, pl. 7, fig. 6.

#### Explanation of Plate 4

Fig.

1: *Schizosmittina safagaensis* n. sp. Enlarged view of zoarium showing neck-like peristome  
2, 3, 4: *Smittina trispinosa* Johnston, 1838

2. General view of zoarium.

3. Enlarged view of zoarium showing large avicularium.

4. Enlarged view of zoarium showing two spines and large avicularium.

5, 6: *Smittina avicularis* n.sp.

5. General view of zoarium showing different sizes of avicularia.

6. Enlarged view of zoarium showing different positions of avicularia.

(Bar scale = 500µ)

(For more synonymy see Ziko *et al.* 2000)

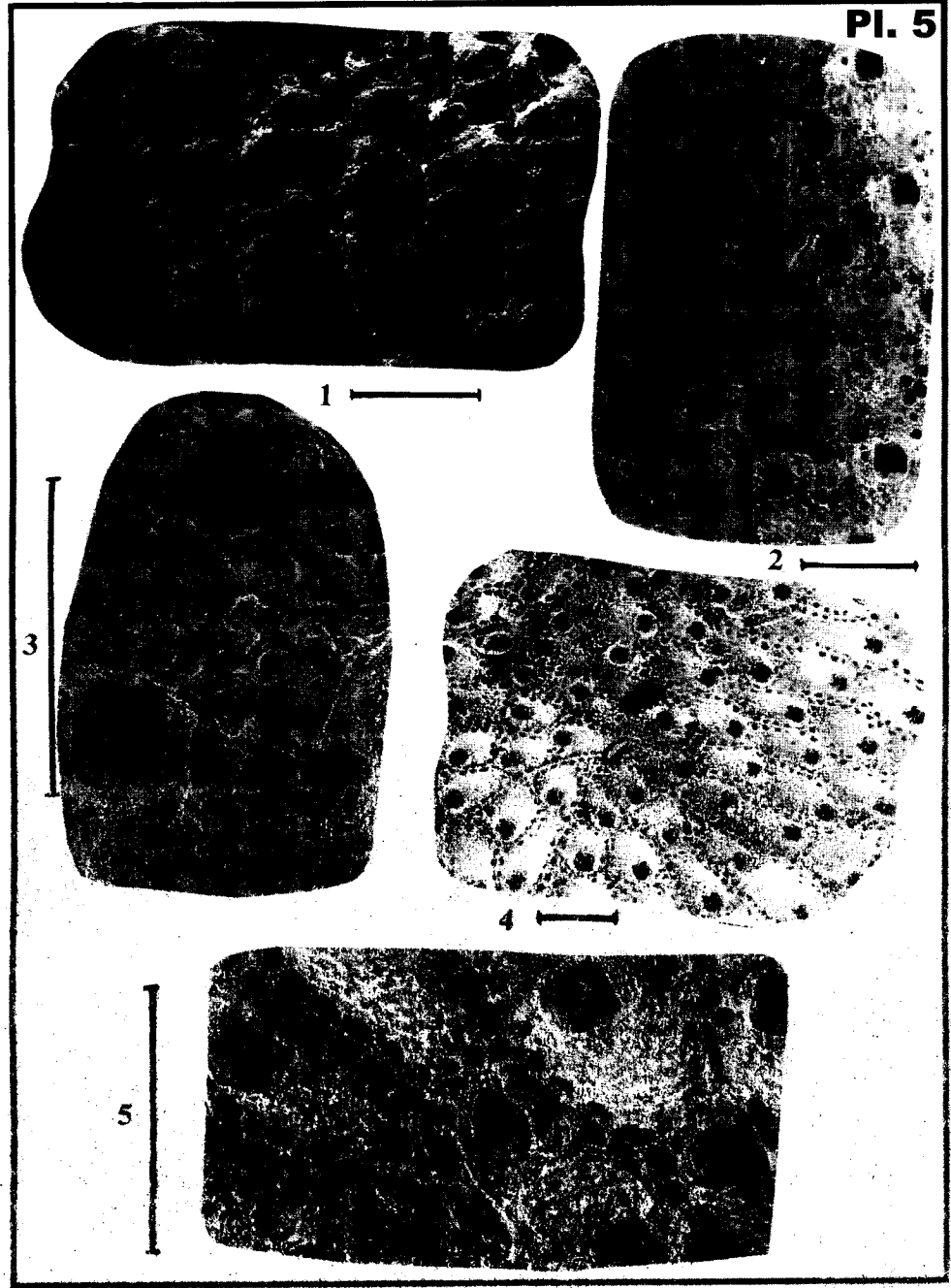
**Measurments:** Lz= 0.53-0.82 mm.

lz= 0.19-0.31 mm.

ha= 0.06-0.08 mm.

la= 0.06-0.08 mm.

**Occurrence:** Friable samples no. 14, 17 & 23 (6.2-27 m depth). Southern Safaga



Bay.

**Distribution:** In Egypt Middle Miocene, Post Pliocene and Pleistocene. Eocene of Paris Basin, Spain and Italy. Oligocene of Germany, Italy, Poland, Rumania, CSSR; Miocene of France, Poland, Rumania, CSSR; Pliocene of Italy, North America, Central America and Vienna (El-Sorogy *et al.*, 2001).

**Habitat:** Indian Ocean, Mediterranean, Adriatic, Pacific, Red Sea. In Atlantic, only in Tropical and subtropical regions. Mostly distributed in the shallow sublittoral waters from 10-45 m (El-Sorogy *et al.*, 2001).

**Range:** Eocene - Recent

Family: Reteporidae Smitt, 1867

Genus: *Iodictyum* Harmer, 1933

*Iodictyum rubeschi* (Reuss, 1848)

(Pl. 6, Figs. 3, 4)

1848 *Retepora rubeschi* Reuss: 48, pl.6, figs. 35-37

1989 *Iodictyum rubeschi* (Reuss): Schmid: 54, pl. 16, figs.1-5.

1996 *Iodictyum rubeschi* (Reuss): Ziko: 139, fig. 5/2-3.

2000 *Iodictyum rubeschi* (Reuss): Ziko, El-Sorogy, Zalut, Eweda & Saber: 1487, pl. 5, fig. 8.

2001 *Iodictyum rubeschi* (Reuss): El-Sorogy, Abd El-Wahab, Ziko & El Dera: 71, pl. 5, figs. 2, 3.

(For more synonymy see El-Sorogy *et al.*, 2001)

**Measurements:** Lz= 0.31-0.36 mm.

lz= 0.20-0.24 mm

ho= 0.17-0.19 mm.

lo= 0.08-0.11 mm.

**Occurrence:** Friable sample no. 17 (27 m depth). Southern Safaga Bay

**Distribution:** Miocene of Cairo-Suez, western side of the Gulf of Suez, East central Sinai. Miocene of Austria, France (Vravy, 1977; Schmid, 1989 and Ziko *et al.*, 1992).

**Habitat:** Gulf of Aqaba (Red Sea), depth 0-15 m.

**Range:** Miocene-Recent

Family: Watersiporidae Vigneaux, 1949

Genus: *Watersipora* Neviani, 1895

*Watersipora subtorquata* (d'Orbigny, 1842)

(Pl. 6, Figs. 5, 6)

1842 *Escharina torquata* d'Orbigny: pl. 4, fig. 3.

1905 *Cellepora subtorquata* d'Orbigny: Waters: 6.

#### Explanation of Plate 5

Fig.

1: *Smittina avicularis* n. sp. General view of zoarium showing crowded zooecia with avicularia with different positions.

2, 3: *Smittina regularis* n. sp.

2. General view of zoarium showing regular arrangement of zooecia.

3. Enlarged view of zooecia show small avicularium and lyrula.

4, 5: *Parasmittina delicatula* (Busk, 1884)

4. General view of zoarium showing intrazooecial avicularium.

5. Enlarged view of zooecia showing large avicularium.

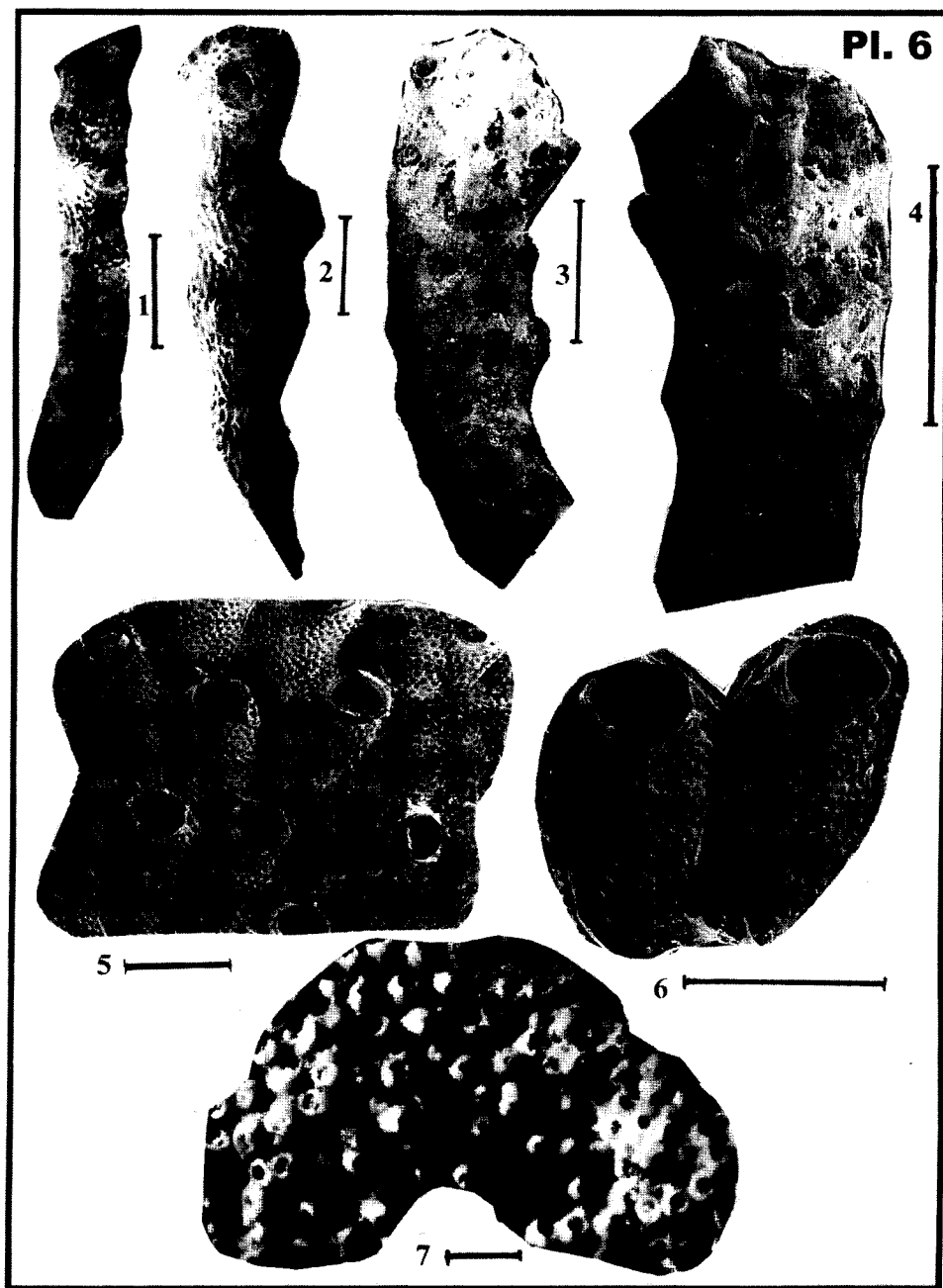
(Bar scale = 500µ)

1985 *Watersipora subtorquata* (d'Orbigny): Soule & Soule: 295.

1989 *Watersipora subtorquata* (d'Orbigny): Gordon: 40, pl. 20: B-H.

1992 *Watersipora subtorquata* (d'Orbigny): Gordon & Mawatari: 30, pl. 1, d, pl. 3, e, d.

2001 *Watersipora subtorquata* (d'Orbigny): El-Sorogy, Abd El Wahab, Ziko & El



Dera: 71, pl. 5, fig. 4.

**Measurements:** Lz= 0.78- 1.10 mm.

lz= 0.44-0.90 mm.

ho= 0.22-0.28 mm.

lo=0.22-0.28 mm.

**Occurrence:** Encrusting on rocks.

**Habitat:** Red Sea, New Zealand, Gulf of Aqaba, Brazil, Bermuda, West Indies, Japan, Great Barrier Reef in Australia (El-Sorogy *et al.*, 2001), Cape Verde Island, Torres strait (Gordon, 1989; Gordon & Mawatari, 1992).

Family: Celleporidae Busk, 1852

Genus: *Holoporella* Waters, 1909

*Holoporella polythele* Reuss, 1848

(Pl. 6, Fig. 7)

1848 *Cellepora polythele* Reuss: 77, pl. 9, fig. 18.

1883 *Cellepora polythele* (Reuss): Fusch: 33, pl. 19, figs. 1 & 2.

1965 *Holoporella polythele* (Reuss): Souaya: 1141, pl. 139, figs. 1 & 2.

1996 *Holoporella polythele* (Reuss): Ziko: 139, fig. 5/4, 5.

2001 *Holoporella polythele* (Reuss): El-Sorogy, Abd El Wahab, Ziko & El Dera: 74, pl. 6, fig. 6.

(For more synonymy see El-Sorogy *et al.*, 2001)

**Measurements:** Lz=0.25-0.53 mm

lz=0.26-0.54 mm.

ho=0.12-0.26 mm.

lo=0.12-0.26 mm.

**Occurrence:** Encrusting on shells, rocks & other bryozoans.

**Distribution:** Middle Miocene of Egypt. Miocene of Italy, Austria, CSSR, France and Hungary (Ziko, 1996; Li, 1990).

**Habitat:** Mediterranean, optimum depth 10-20 m (Ziko, 1996).

**Range:** Miocene-Recent.

*Holoporella avicularis* Canu & Bassler, 1929

(Pl. 7, Figs. 1, 2, 3)

1912 *Holoporella avicularis* (Hincks): Canu: 220, pl. 12, fig. 11.

2001 *Holoporella avicularis* (Hincks): El-Sorogy, Abd El Wahab, Ziko & El Dera: 73, pl. 6, fig. 5.

#### Explanation of Plate 6

Fig.

1, 2: *Margaretta cereoides* (Ellis & Solander, 1786)

1. General view of erect zoarium.

2. General view of another erect zoarium.

3, 4: *Iodictyum rubeschi* (Reuss, 1848)

3. General view of the zoarium.

4. Enlarged view showing alternating longitudinal rows of zooecia.

5, 6: *Watersipora subtorquata* d Orbigny, 1842

5. General view of encrusting zoarium.

6. Enlarged view showing curling edges.

7: *Holoporella polythele* Reuss, 1848. General view of encrusting zoarium.

(Bar scale = 500µ)

**Measurements:** Lz=0.36-0.41 mm.

lz= 0.34-0.41 mm.

ho=0.12-0.15 mm.

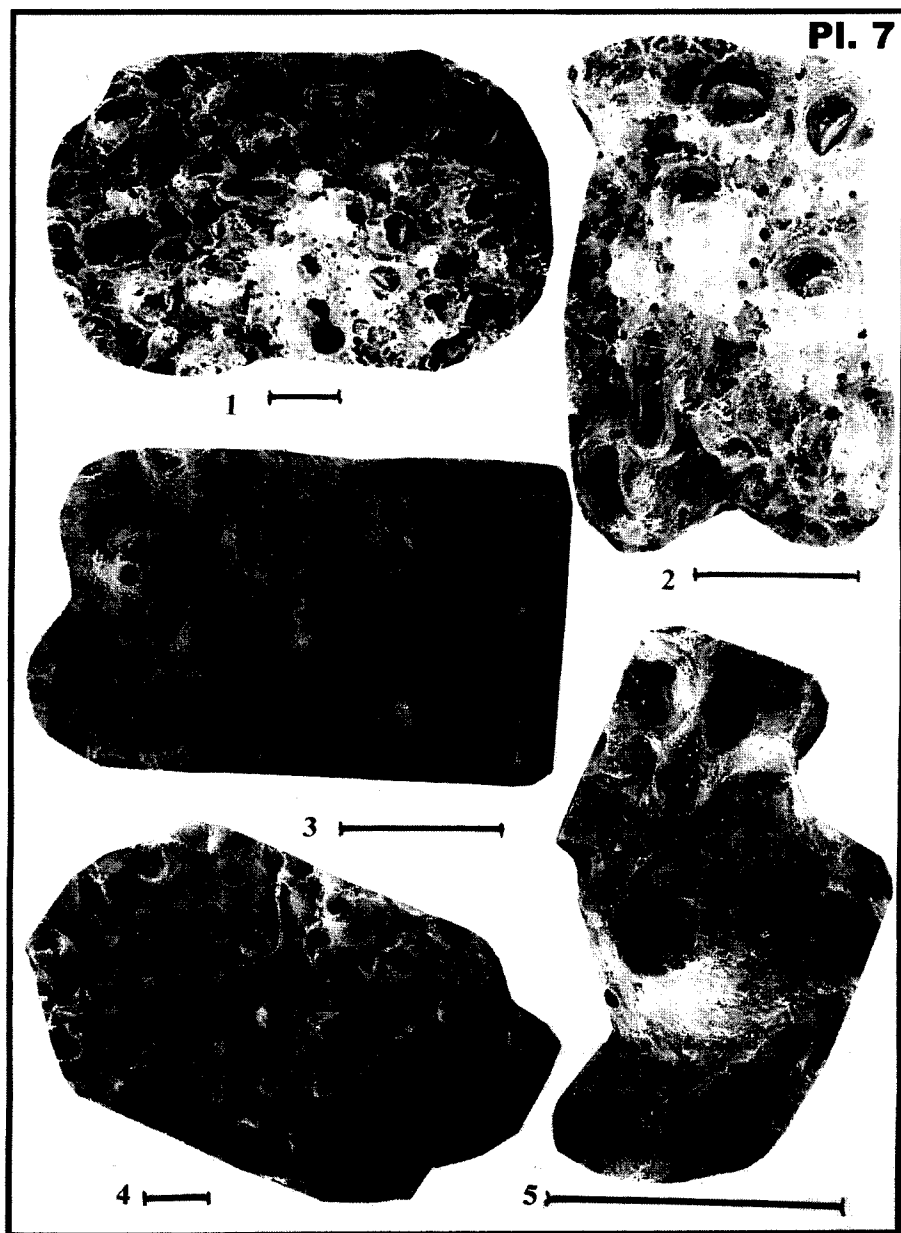
lo=0.17-0.18 mm.

**Diameter of the zooecium:** 0.34-0.41 mm.

**Occurrence:** Encrusting on dead shells.

**Distribution:** Miocene of Mersa Matruh, Egypt.

**Habitat:** Arctic, Atlantic, Mediterranean Sea & Gulf of Aqaba (El-Sorogy *et al.*,



2001).

Family: Celleporariidae Harmer, 1957

Genus: *Celleporaria* Lamouroux, 1821

*Celleporaria* sp.

(Pl. 8, fig. 6)

**Description:** Zoarium encrusting, unilamellar. Zooecia arranged randomly, separated from each other by very fine deep threads. Zooecia distinct, erect, oval-rectangular, surrounded by 4-5 pairs of small-medium areola. Frontal of fine to medium granulations. Aperure terminal, orbicular, semirounded, surrounded by thick peristome, raising up distally to the orifice making an umbo-like. Pairs of avicularia present, very small, triangular, with short rostrum.

**Measurements:** Lz= 0.43-0.67 mm.

lz= 0.37-0.43 mm.

ho= 0.12-0.13 mm.

lo=0.18-0.21 mm.

**Occurrence:** Encrusting on molluscan shells.

Genus: *Celleporina* Gray, 1848

*Celleporina tubulata* (Uttley & Bullivant, 1972)

(Pl. 7, Figs. 4, 5)

1972 *Haswellina tubulata* Uttley & Bullivant: 35.

1989 *Celleporina tubulata* (Uttley & Bullivant): Gordon: 71, pl. 40, B-D.

2001 *Celleporina tubulata* (Uttley & Bullivant): El-Sorogy, Abd El Wahab, Ziko & El Dera: 76, pl. 6, fig. 3.

**Measurements:** Lz= 0.50-0.64 mm.

lz=0.35-0.50 mm.

ho= 0.20 mm.

lo= 0.15-0.20 mm.

**Occurrence:** Encrusting on dead shells, Southern Safaga Bay.

**Habitat:** New Zealand region, Gulf of Aqaba (Red Sea), depth 69-205 m (El-Sorogy *et al.*, 2001).

*Celleporina abbassi* n. sp

(Pl. 8, Figs. 1, 2)

**Etymology:** This species is named in the honor of the great Professor Hussein Lotfy Abbass, Prof. of Paleontology, Geology Department., Faculty of Science, Ain Shams University.

**Description:** zoarium encrusting, unilamellar, thick, crowded. Zooecia distinct, erect, frontal smooth, arranged in irregular manner. Zooecia surrounded by 4-6 pairs of large areola. Orifice semirounded, large, width about twice as long; frontal

#### Explanation of Plate 7

Fig.

1, 2, 3: *Holoporella avicularis* Canu & Bassler, 1929

1. General view of encrusting zoarium.

2. Enlarged view of zoarium showing elongated intrazooecial avicularium.

3. Enlarged view of zooecium showing high oeristome.

4, 5: *Celleporina tubulata* (Uttley & Bullivant, 1972)

4. General view of encrusting zoarium.

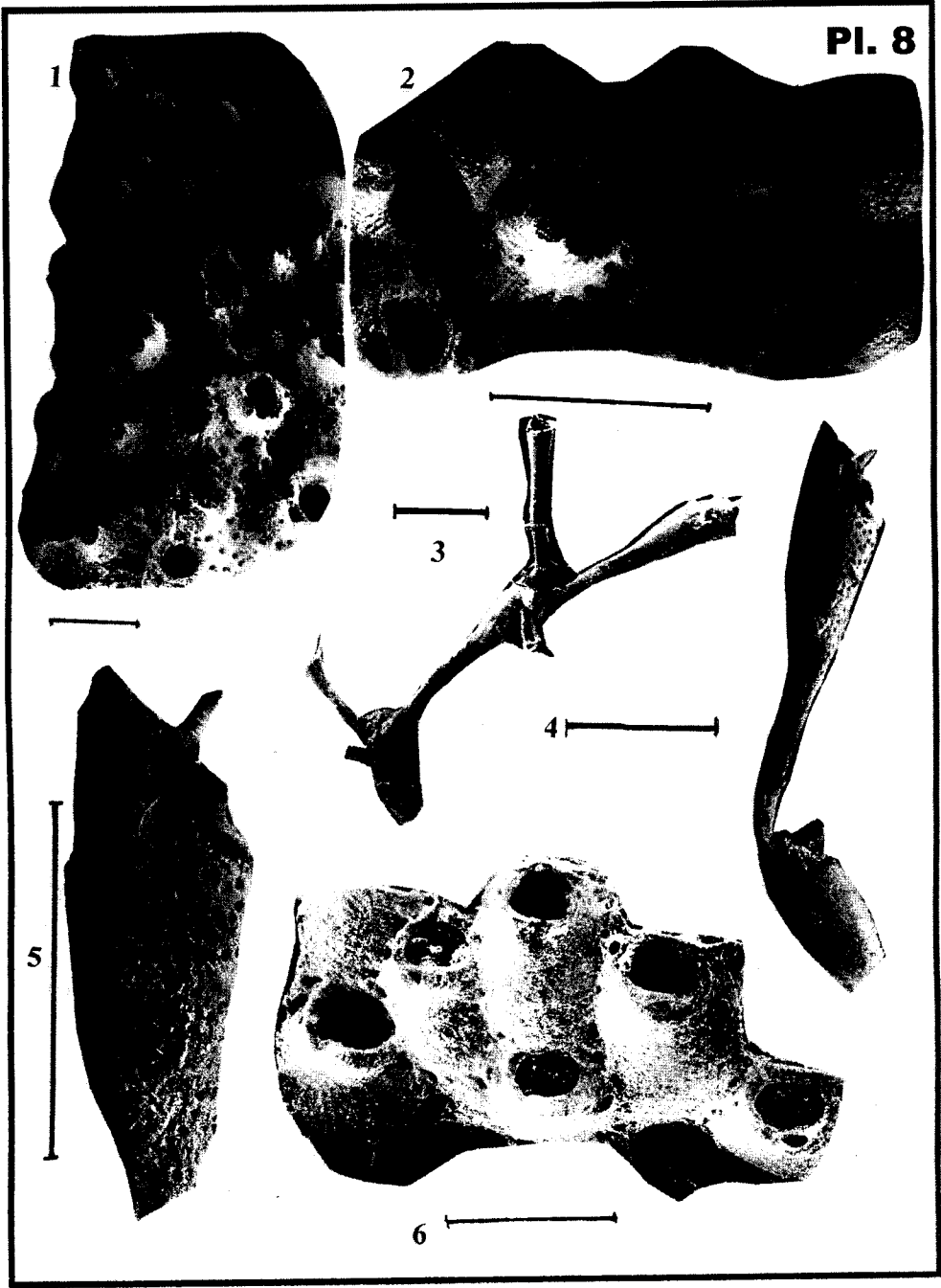
5. Enlarged view showing avicularium and two small spines.

(Bar scale = 500µ)

reduced because of the peristome, which is became high making umbo-like. Avicularia when present take place within the top of the peristome. Ovicell hyperstomial, cap-like, with fine granulations.

**Measurements:** Lz= 0.45-0.55 mm.

lz=0.32-0.42 mm.





ho=0.11-0.15 mm.

lo=0.22-0.25 mm.

**Occurrence:** Encrusting on dead shells or other bryozoans and rocks, Southern Safaga Bay.

**Remarks:** This species differs from *Celleporina costazii* (Gordon, 1984) in the shape of the ovicell and having no side avicularia.

Family: Savignyellidae Levinsen, 1909

Genus: *Savignyella* Levinsen, 1909

*Savignyella lafontii* (Audouin, 1826)

(Pl. 8, Figs. 3, 4, 5)

1826 *Eucratea lafontii* Audouin: 242

1953 *Savignyella lafontii* (Audouin): Bassler: 224, fig. 168/1, a, b.

1991 *Savignyella lafontii* (Audouin): Scholz: 291, pl. 8, fig. 1.

**Description:** Zoaria erect, branched, chain like, jointed, segmented, each segment consists of one zooecium. Zooecia elongate, wide in the upper portion became narrow at the rest of the zooecium, slightly calcified, with frontal surface, numerous scattered pores. It is separated from the basal surface by more or less sharp boundary line. The distal wall has a number of septulae on its periphery. The aperture more or less rounded and surrounded with three or more spines, with concave poster and with no sinus. Ovicell recumbent, when present and proximally distal avicularium, not seen on the present specimen.

**Measurements:** Lz = 0.80-1.31 mm

lz = 0.25-0.375 mm

**Occurrence:** Friable sample no. 22 (1 m depth) and pipes, Southern Safaga Bay, Red Sea (Egypt).

**Habitat:** North Atlantic, Philippine region. Depth 20 (Scholz, 1991).

**Range:** Eocene-Recent.

## ECOLOGICAL and BIOGEOGRAPHIC IMPLICATIONS

The present ecological study is based on the study of the relationship between zoarial growth forms and the environmental conditions as well as the habits and habitats of the species.

### Zoarial growth forms: (Table 2)

The environmental parameters affect the relative distribution of the different colonial growth types of bryozoa (Stach 1936, Lagaaij & Gautier, 1965 and Schopf, 1969). The studied bryozoan species classified according to their zoarial growth forms include encrusting and erect forms.

### Explanation of Plate 8

Fig.

1, 2: *Celleporina abbassi* n. sp.

1. General view of encrusting zoarium

2. Enlarged view showing ovicell and high peristome.

3, 4, 5: *Savignyella lafontii* (Audouin, 1826)

3. General view of erect zoarium.

4. Enlarged view showing both wide and narrow portions of the zoarium.

5. Another enlarged view showing perforated frontal and spines.

6: *Celleporaria* sp. General view of encrusting zoarium.

(Bar scale = 500µ)

**Table 2: Zoarial growth form of the studied bryofauna**

	Encrust		Erect		
	Membraniporiform	Celleporiiform	Viculariiform	Cellariiform	Catenicelliform
<i>Membranipora savartii</i>					
<i>Membranipora nobilis</i>					
<i>Hippopodina feegensis</i>					
<i>Schizoporella violacea</i>					
<i>Microporella ciliata</i>					
<i>Schizosmittina safagaensis</i>					
<i>Smittina trispinosa</i>					
<i>Smittina avicularis</i>					
<i>Smittina regularis</i>					
<i>Parasmittina delicatula</i>					
<i>Watersipora subtorquata</i>					
<i>Holoporella polythele</i>					
<i>Holoporella avicularis</i>					
<i>Celleporaria sp.</i>					
<i>Celleporina tubulata</i>					
<i>Celleporina abbassi</i>					
<i>Filisarsa rugosa</i>					
<i>Scrupocellaria elliptica</i>					
<i>Tricellaria monotrypa</i>					
<i>Tricellaria occidentalis</i>					
<i>Canda arachnoides</i>					
<i>Canda pecten scutata</i>					
<i>Iodictyum rubeschi</i>					
<i>Crisia hörnesi</i>					
<i>Nellia tenella</i>					
<i>Margaretta cereoides</i>					
<i>Synnotum aegyptiacum</i>					
<i>Savignyella lafontii</i>					

### 1- Encrusting zoarial growth form:

It represents 57% of the whole studied bryofauna. Among the encrusting species, two zoarial growth forms are present:

**Membraniporiform:**

It forms unilamellar colonies, well represented in littoral and sublittoral environment with low rate of sedimentation ( $< 10$  cm/1000 year) and moderate hydrodynamics of (30 - 80 cm/sec). 11 identified species belong to this form representing 39% of the studied assemblage.

**Celliporiform:**

It forms massive and multilamellar colonies, chiefly distributed in littoral and sublittoral zones (30 m is the optimum depth), with low rate of sedimentation and moderate water turbulence. Five species belong to this type of forms representing 18% of the studied assemblage.

For both types, the most important environmental controlling factor is the availability of substratum. In the study area the cobbles and boulders of igneous nature, cement pipes, chips fractures and fragments of shells and corals offered the available substrate for most of the encrusting bryozoans.

**2- Erect zoarial growth form:**

The erect forms are those colonies attached only by their bases to hard substratum, while the rest of colony grows free from it. It represents 44% of the studied bryofauna. Most of the encountered free species from rigid colonies. Among the erect species, three zoarial growth forms are present:

**Vinculariiform:**

Zoarium erect, rigid, dichotomous subcylindrical branches, firmly attached to a solid substratum by a calcareous base. This form is adapted for deep or sheltered waters where wave and currents ( $< 20$  cm/sec) are inactive and the rate of sedimentation is low. 7 species are found belonging to this form and they represent 25% of the studied assemblage.

**Cellariiform:**

Zoarium erect, flexible articulated in cylindrical internodes, which consist of numerous zooecia and are attached to substrate by rootlets. This form is adapted for living in the littoral zone where algae usually constitute the base of attachment. Water currents and high rate of sedimentation ( $> 100$  cm/103 years) is overcomed by the articulation of the long narrow internods. Among the studied bryofauna 3 species belong to this type of forms and they represent 11% of the whole assemblage.

**Catenicelliform:**

Zoarium erect, articulated. 2 species belong to this form and they represent 7% of the whole assemblage.

**Biogeography:**

Of the 28 Recent bryozoans identified from the Southern Safaga bay, 14 of them live in the Pacific Ocean, 11 in the Red Sea, 8 in the Atlantic Ocean, 7 in the Mediterranean Sea, 2 in the Indian Ocean, 2 in the Arctic Ocean and 1 in the Adriatic Sea (Table 3).

Eight of the identified species are previously recorded from occurrences in Egypt: from the north of the Western Desert, the western side of the Gulf of Suez,

the Cairo-Suez district, Mersa Matruh and Red Sea Coast. The previously identified species were recorded from different geological ages beginning from the Late Eocene up to the Miocene, Pliocene and ending with the Pleistocene (Table 4).

Table 3: Biogeographic distribution of the studied bryozoans.

	Biogeography						
	Mediterranean	Arctic	Adriatic	Red sea	Pacific	Indian	Atlantic
<i>Membranipora savartii</i>				x	x	x	x
<i>Membranipora nobilis</i>							x
<i>Hippopodina feegensis</i>					x		
<i>Schizoporella violacea</i>	x			x			
<i>Microporella ciliata</i>	x						
<i>Schizosmittina safagaensis</i>				x			
<i>Smittina trispinosa</i>				x	x		
<i>Smitina avicularis</i>				x			
<i>Smittina regularis</i>				x			
<i>Parasmittina delicatula</i>					x		x
<i>Watersipora subtorquata</i>				x	x		
<i>Holloporella polythele</i>	x						
<i>Holloporella avicularis</i>	x	x		x			x
<i>Celleporaria sp.</i>				x			
<i>Celleporina tubulata</i>				x	x		
<i>Celleporina abbassi</i>				x			
<i>Filisparra rugosa</i>					x		
<i>Scrupocellaria elliptica</i>	x	x			x		x
<i>Tricellaria monotrypa</i>					x		
<i>Tricellaria occidentalis</i>	x				x		x
<i>Canda arachnoides</i>				x	x		
<i>Canda pecten scutata</i>				x	x		
<i>Iodictyum rubeschi</i>				x	x		
<i>Crisia hornesi</i>				x			
<i>Nellia tenella</i>	x		x	x	x	x	x
<i>Margaretta cereoides</i>	x			x	x		
<i>Synnotum aegyptiacum</i>							x
<i>Savignyella lafontii</i>							

Table 4: The stratigraphic ranges of the studied bryofauna

	Stratigraphic range					
	Eocene	Oligocene	Miocene	Pliocene	Pleistocene	Holocene
<i>Membranipora savartii</i>	-	-	-	-	-	-
<i>Membranipora nobilis</i>			-	-	-	-
<i>Hippopodina feegensis</i>	-	-	-	-	-	-
<i>Schizoporella violacea</i>						
<i>Microporella ciliata</i>			-	-		-
<i>Smittina trispinosa</i>						-
<i>Parasmittina delicatula</i>				-	-	-
<i>Watersipora subtorquata</i>						-
<i>Holoporella polythele</i>			-	-	-	-
<i>Holoporella avicularis</i>			-	-	-	-
<i>Celleporina tubulata</i>						-
<i>Filisarsa rugosa</i>						-
<i>Scrupocellaria elliptica</i>	-	-	-	-	-	-
<i>Tricellaria monotrypa</i>						-
<i>Tricellaria occidentalis</i>						-
<i>Canda arachnoides</i>						-
<i>Canda pecten scutata</i>			-	-	-	-
<i>Iodictyum rubeschi</i>	-	-	-	-	-	-
<i>Crisia hornesi</i>	-	-	-	-	-	-
<i>Nellia tenella</i>	-	-	-	-	-	-
<i>Margaretta cereoides</i>						-
<i>Synnotum aegyptiacum</i>	-	-	-	-	-	-
<i>Savignyella lafontii</i>						

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