

SOME FOSSIL NEOCHEILOSTOMINE BRYOZOANS FROM THE HOLOCENE OF THE WEST COAST OF MAHARASHTRA AND GOA, INDIA

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ABSTRACT

Eleven species of neocheilostomine Bryozoa are described from the Holocene rocks of the West Coast of Maharashtra and Goa, India. *Scrupocellaria raigadensis* is a new species, and the remaining ten species are reported for the first time in these rocks. The bryozoan fauna is dominantly tropical to subtropical, warm water and indicates normal salinities. In both shell limestone and plastic muds cellariiform zoarial type dominates and is represented mainly by four species: *Scrupocellaria maderensis*, *Nellia tenella*, *Poricellaria ratoniensis*, and the cyclostome *Crisia elongata*. All of these species are considered to be shallow water forms tolerant of a wide range of salinities (33‰-56‰). As regards provincial relations, *Thalamoporella hamata*, *Poricellaria ratoniensis*, *Scrupocellaria ferox* and *Cabera transversa* have Indo-Pacific affinities; while *Cellaria punctata*, *Scrupocellaria diadema* and *S. maderensis* are Atlantic elements. *Thalamotreptos reversa* has a discontinuous record from eastern Gulf coast of Mexico to Sri Lanka; and *Thalamoporella falcifera* has been known dominantly from Atlantic and the Indian Oceans.

INTRODUCTION

Badve and Sonar (1995) have described malacostegan and pseudomalacostegan bryozoan from Holocene rocks exposed along the West Coast of Maharashtra. These rocks constitute mainly shell limestones, plastic muds and sandy clays, which abound in a variety of well preserved marine fossils (fig.1).

A great numerical abundance and diversity of neocheilostomine Bryozoa has been found in the Holocene rocks of Maharashtra. The present paper describes four coilostegoidean, one pseudostegoidean and six cellularioidean species belonging to the families Thalamoporellidae, Poricellariidae, Cellariidae, Farciminariidae and Cabereidae.

The systematic part of this paper follows, except where otherwise indicated, the bryozoan "Treatise on Invertebrate Paleontology" Bassler (1953), d'Hondt (1977) and Gordon (1989).

REPOSITORY

All the type and figured specimens described herein are preserved in the palaeontological collection of Geology and Palaeontology Museum, Agharkar Research Institute, Pune 411004, India.

Abbreviations for Measurements :

- Lz - Length of autozoid
- lz - Width of autozoid
- Lop - Length of opesia
- lop - Width of opesia
- Lav - Length of avicularia
- lav - Width of avicularia
- Lov - Length of ovicell
- lov - Width of ovicell

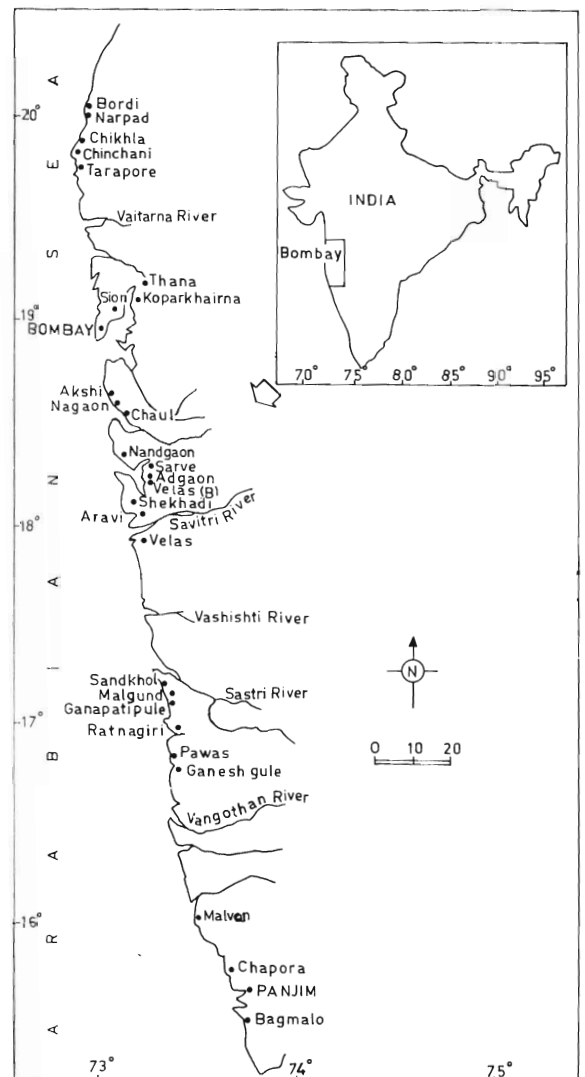


Fig. 1. Locality map of the West Coast of India.

SYSTEMATIC PALAEOONTOLOGY

Order **Cheilostomida** Busk, 1852

Suborder **Neocheilostonima** D'Hondt, 1977

Infraorder **Cellulariomorpha** Smitt

Superfamily **Coilostegoidea** Harmer, 1926

Family **Thalamoporellidae** Levinsen, 1902

Genus **Thalamoporella** Hincks, 1887

Thalamoporella falcifera (Hincks, 1880)
(Pl.I, fig.3)

Steginoporella rozieri forma *falcifera* Hincks, 1880, p.380, pl.16, fig.2.

Thalamoporella falcifera (Hincks); Levinsen, 1909, p.180, pl.6b, fig.6a-e.

Maturo, 1957, p.40, fig.34. - Winston, 1982 p.126, fig.2.

Material: Plesiotype No: MACS/G-4013.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	-0.610-0.700	0.648	4
Lz	-0.321-0.342	0.327	4
Lav	-0.287		1
Lav	-0.140		1

Description: Colony encrusting, unilaminar. Autozooids quadrangular, separated by thin raised mural rim. Adoral tubercles large, rounded, not much raised. Orifice semicircular distally, proximal edge slightly concave. Cryptocyst granular, depressed over the polypide tube, perforated by numerous small, evenly distributed pores. Opesiules unequal in size, both reaching the basal wall, the larger one reaching the basal side, closing along the lateral wall; the smaller one meeting the basal wall along an extremely short, closed or open, curved line. Avicularia vicarious, large, with elongate, curved, acute rostrum; cryptocyst one third of the total avicularian length, granular; avicularian length 80% to 85% of zooid length. Ovicells not observed.

Remarks: Indian material exhibits some differences when compared to *T. falcifera* (Hincks, 1880) in having the proximal edge of the orifice slightly concave, an absence of condyles and a shorter avicularian rostrum. According to D.F. and J.D. Soule (pers. comm., 1993), the Atlantic *falcifera* differs from the Indian *falcifera* in having wider avicularian mandibles. However, both populations show divergence of the daughter autozooid and its sibling avicularium distal to the parent zoecium.

Occurrence: Chikhla.

Distribution: Recent: Western Atlantic : Beaufort to Brazil; Carribean, Java, Australia and Sri Lanka.

Thalamoporella hamata Harmer, 1926
(Pl.I, figs.1, 4; Pl.IV, fig.2)

Thalamoporella hamata Harmer, 1926, p.301, pl.20, figs 17-20. - Canu & Bassler, 1929 p.151, pl.16, figs 4-5.

Material: Plesiotype No: MACS/G 4014-4023.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	-0.510-0.690	0.608	7
lz	-0.293-0.414	0.362	7
Lav	-0.441-0.500	0.471	2
lav	-0.172-0.196	0.184	2

Remarks: In some of the Indian specimens, avicularian opesia tend to become as wide as long with slightly concave proximal edge. In other specimens, they are extremely long and slightly pinched in the middle (Pl.I, fig.4). According to D.F. and J.D. Soule (pers. comm, 1993), these specimens fall within the range of variation of Harmer's *T. hamata*.

Occurrence: Bordi, Chikhla, Akshi, Dhewarkhadi, Nagaon.

Distribution: Recent : Malay Region, Sulu Archipelago, New Guinea, Australia.

Genus **Dibunostoma** Cheetham, 1963

Dibunostoma reversa (Harmer, 1926)
(Pl.I, fig.2; Pl.IV, fig.1)

Thalamoporella rozieri forma *falcifera* Thornely, 1905, p. 112.

Calpensia reversa Harmer, 1926, p. 302, pl. 20, figs. 13-14.

Cheetham, 1963, p.52; fig.27a.- Soule, Soule & Chaney, 1991, p.460, pl.4, fig.5.

Material: Plesiotype No: MACS/G4024-4030.

Measurements :

	Range (mm)	Mean (mm)	N
Lz	-0.535-0.625	0.558	4
lz	-0.357-0.393	0.381	4
Lor	-0.107-0.125	0.121	4
lor	-0.143	0.143	4
Lav	-214		1
lav	-179		1

Description : Colony encrusting, unilaminar. Zooids more or less hexagonal, bordered by slightly raised, smooth mural rim. Cryptocyst granular, perforated by numerous small pores, slightly depressed in the opesiular region. Opesiules large and irregular, both reaching the basal wall. Orifices semicircular distally, proximal edge straight. Adoral tubercles large, distinct and rounded, placed on either side of orifice. Avicularia vicarious, rare, with narrow acute rostrum, directed proximally, apex reaching the orifice of the preceding

zooid; avicularian length 30% to 35% of zooid length, reaching the basal surface. Ovicells not observed.

Remarks: Harmer (1926) emended the generic description of *Calpensia* given by Levinsen (1909) to include species having opesiules reaching the basal wall, adoral tubercles, two lateral pores and avicularia. However, Cheetham (1963) erected a new genus *Dibunostoma* for species of Calpensidae which lacked spicules and referred *Calpensia reversa* Harmer to this new genus. Hence, *Thalamotreptes* is an objective junior synonym of *Dibunostoma*.

Occurrence : Akshi, Nagaon.

Distribution: Eocene: Eastern Gulf Coast Region; Recent : Sri Lanka

Family Poricellariidae Harmer, 1926

Genus Poricellaria d'Orbigny, 1852

Poricellaria ratoniensis (Waters, 1887);
(Pl.III, fig.3)

Micropora ratoniensis Waters, 1887, p.185, pl.6, fig.5.

Diptodidymia complicata Waters, 1913, p.490, pl.17, figs. 11-15.

Poricellaria ratoniensis (Waters); Harmer, 1926, p.314, pl.23, figs. 3-8. j,k.-Chhapgar & Sane, 1966 p.451, figs. j,k.- Li, Pouyet & David, 1988, p.243, pl.1, fig.8.

Poricellaria alata d'Orbigny; Lu, 1990, p. 14, pl. 16, fig. 1.

Poricellaria ratoniensis (Waters, 1887); Pouyet & Shareef, 1995, p. 418, fig. 2E,F.

Material: Plesiotype No : MACS/G4031-4050.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	-0.242-0.212	0.226	12
lz	-0.226-0.136	0.159	12
Lop	-0.76-0.61	0.069	12
lop	-0.61-0.45	0.052	12
Lav	-0.136-0.121	0.129	8
Lav	-0.61-0.45	0.051	8

Remarks : Indian specimens agree with *P. ratoniensis* (Waters) in having acuminate avicularian rostrum, with complete pivot bar and the proximal side bearing small perforation. The illustration of *P. alata* d'Orbigny given by Lu (1990) clearly belongs to *P. raton.* (Waters) because the specimens appear identical in all the above given characters. *P. alata* d'Orbigny described by Cheetham (1966, p.40, text figs 17-18) resembles the Indian material in having similar small perforation on the proximal side. However, the former differs in having rounded avicularian rostrum without pivot bar and sometimes two opesiules on the frontal side.

Occurrence : This species is common in all localities.

Distribution: Holocene : Nansha sea area; Recent : N. Guinea, Australia, Zanzibar, West Coast of India, Strait of Makassar, Indonesia.

Superfamily Pseudostegoidea Levinsen, 1909

Family Cellariidae Lamouroux, 1821

Genus Cellaria Ellis & Solander, 1786

Cellaria punctata (Busk, 1852)
(Pl.I, fig.5; Pl.IV, fig.4)

Salicornaria punctata Busk, 1852, p.366.

Salicornaria gracilis Busk, 1852, p.366, pl. fig.3.

Cellaria gracilis var. *tessellata* Waters, 1913, p.403, pl.68, fig.7.

Cellaria punctata (Busk); Harmer, 1926, p.337, pl.21, figs. 14-16, text-fig.17a.

Cellaria japonica Canu & Bassler, 1929, p.171, pl.20, fig. 9.

Cellaria punctata (Busk); Silen, 1941, p.70, figs 85-86.- Mawatari, 1952, p.275, fig.10, pl.12, fig.6.- Hayward & Cook, 1983, p.34, fig. 8B.

Cellaria gracilis (Busk); Li, Pouyet & David, 1988, p.1, fig. 5.

Cellaria punctata (Busk); Lu, 1989, p.32, pl.3, figs 5-8.

Cellaria gracilis (Busk); Lu, 1989, p.32, pl.5, figs 8-9.- Lu, 1990, p.44, pl.6, fig.5.

Cellaria punctata (Busk); Lu, 1990, p.44, pl.6, fig.1.

Material: Plesiotype No: MACS/G4051-4064.

Measurement :

	Range (mm)	Mean (mm)	N
Lz	-0.228-0.500	0.325	8
Lz	-0.161-0.290	0.257	8

Remarks: Indian specimens can be easily distinguished from *C. tenuirostris* (Busk) (1852, p.17, pl.63, fig. 4) which is characterised by a prominent apertural tongue, lateral teeth and vicarious avicularia with long, slender acutely pointed rostra. They differ from *C. adamantina* Brown (1952, p.163, fig.112) from the Landon Series, Whaingaroan (Oligocene), New Zealand, which has small vicarious avicularia and ovicells not occluded by a median denticle.

Occurrence : Narpad, Akshi, Velas, Malgund.

Distribution : Pliocene: East China Sea; Holocene: Nansha sea area-China; Recent : India, Sri Lanka, Indonesia, Philippines, Japan, Queensland, Torres straits, New Guinea, Zanzibar.

Superfamily Cellularioidea Smitt, 1867

Family Farciminariidae Busk, 1884

Genus Nellia Levinsen, 1909

Nellia tenella (Lamarck, 1816)
(Pl.III, figs.4,9)

Nellia oculata Busk; 1852 p.18, pl.64, fig.6, pl. 65, fig. 4.- Harmer, 1926 p.240, pl.14, figs 18-20.

Nellia oculata var. *quadrilatera* (Busk); Chhapgar & Sane, 1966, p.451.
Nellia tenella (Lamarck); Cheetham, 1966, p.48-52, fig.58.
Nellia oculata Lagaaij, 1969, p.167, pl.1, fig.1-6.
Nellia tenella Lamarck; Braga & Barbin, 1988, p.519, pl.7, fig.2.- Pouyet & Shareef, 1995, p. 420, fig. 3C,D.

Material: Plesiotypes No.:MACS/G4065-4089

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.302-0.698	0.493	7
lz	0.209-0.256	0.236	7
Lop	0.209-0.628	0.461	7
lop	0.093-0.209	0.173	7
Lav	0.047-0.093	0.077	7
lav	0.035-0.070	0.058	7

Description: Colony erect, quadriserial, tapering proximally, zooids elongated, more or less equal in size, 3 to 6 zooids in each row. Orifice elliptical, bordered by smooth, thin and slightly raised mural rim. Cryptocyst well developed along proximal side, crescent shaped, smooth and slightly dipping inward. Gymnocyst smooth, reduced. Avicularia adventitious, paired, small, occupying basal corners of gymnocyst, rostrum directed outward, pivot bar lacking, proximal perforation observed in some specimens. Ovicells endozoecial, occasionally with small cap.

Occurrence : This species is present in all sampled localities.

Distribution : Palaeocene: Surinam; Eocene:France, Spain; Senegal; Eocene-Oligocene: Gulf Coast of U.S.A.; Miocene: Egypt, Jamaica, Australia; Pleistocene: Gulf of Guinea; Holocene: Nansha sea area-China; Recent: Cosmopolitan in tropical and warm-temperate zones of all oceans.

Family Cabereidae Busk, 1852b

Genus *Scrupocellaria* van Beneden, 1845

Scrupocellaria raigadensis n. sp.
(Pl.II, figs.1-6)

Material: Holotype No: MACS/G4090; Paratype : 4090-5004.

Measurements :

	Range (mm)	Mean(mm)	N
Lz	- 0.302-0.372	0.343	12
lz	- 0.209-0.256	0.224	12
Lop	- 0.070-0.209	0.140	12
lop	- 0.047-0.163	0.094	12

Lav	- 0.047-0.093	0.074	12
lav	- 0.047-0.070	0.062	12

Diagnosis : Erect, biserial colony with robust zooids. Cryptocyst barely developed. Gymnocyst absent. Oral spine bases indistinct, frequently one, rarely four, two internal and two external. Lateral avicularia small. Single axial vibraculum. Ovicell large, globular with numerous small perforations.

Description: Colony erect, biserial, branching. Zooids robust, arranged in alternate longitudinal rows. Opesia oval, occupying nearly entire frontal area, bordered by slightly raised, thin and smooth mural rim. Cryptocyst barely developed, when present, descending into the opesia. Gymnocyst absent. Distal oral spine bases indistinct, rarely 4, 2-external and 2-internal; frequently only one spine base at the top of the zooid. Lateral avicularia small, oval with tiny pivots. A single vibraculum placed in the axil. Other vibracula placed basolaterally, visible from frontal side, broader than lateral avicularia with a wide and a slightly oblique setal groove; a broad rootlet foramen placed proximally. Ovicells, large, globular, frontal wall perforated with 26-30 small pores.

Remarks : Horowitz (1993) listed nearly one hundred species and varieties of *Scrupocellaria* so far described from various parts of the world. Among them this form appears to be distinctive (D. P. Gordon pers. comm., 1993).

S.raigadensis differs from *S. curvata* Harmer (1926, p.26, figs.11-15) in not having frontal avicularia.

Caberea boryi (Audouin), described by Lu (1990,p.47, pl.7, fig.5) from the Holocene rocks of the Nansha sea area, in fact belongs to *Scrupocellaria*. Lu's specimens are similar to the present species except that a pendunculate frontal avicularium arises from the proximolateral corner of the cryptocyst and is directed towards the main axis of the branch. In all probability Lu's specimens belong to *Scrupocellaria curvata* Harmer.

The Indian species exhibits a close resemblance to *S. ferox* Busk (1852, p.25, pl. 22, figs 1-5) in the number of spines and presence of vibracula in the axillary position but differs in having broad, raised lateral vibracula and very small pores on the ovicells. It can be easily distinguished from *S. diadema* Busk because Busk's species is characterised by the presence of a giant frontal avicularium and small ovicells with large tubular pores. *S. obtecta* Haswell (1880, pl.26, figs.16-18) differs from *S. raigadensis* in having five oral spines which are stout and in the presence of frontal avicularia and a rather elongated ovicell.

Scrupocellaria aff. *delilii* (Savigny-Audouin, 1826) described by Pouyet and Shareef (1995, p. 422, fig. 4A & B) from Karnataka, West Coast of India, in all probability, may belong to *S. raigadensis*; however, characters of the spine bases and ovicell could not be observed in the Karnatak material.

Etymology: The species is named after the district Raigad.

Occurrence: Narpad, Akshi, Nagaon, Dhewarkhadi, Chowli, Adgaon, Velas, Diveagar, and Malgund.

Scrupocellaria diadema Busk, 1852
(Pl.III, fig.5-6)

Crisia ciliata Audouin, 1826, p. 241.

Scrupocellaria diadema Busk, 1852, p.24, pl.28, figs 1-8.

Scrupocellaria annectans Macgillivray; 1887, p. 184, pl. 11, figs 1,1a.

Scrupocellaria diadema Busk; Harmer, 1926, p.315, pl.25, figs 20-25.- Canu & Bassler, 1929, p.211, pl.9, figs 4,5.- Menon, 1972, p. 920, figs 19-20.- Hayward, 1988, p.285, fig. 3c.

Scrupocellaria ferox Busk, Lu, 1990, p. 46, pl. 7, fig. 1a,b.

Scrupocellaria diadema Busk; Ryland & Hayward, 1992, p.236-237, fig. 7.

Material: Plesiotype No: MACS/G 5005-5009.

Measurements:

	Range(mm)	Mean(mm)	N
Lz	0.375-0.417	0.411	7
lz	0.250-0.271	0.261	7
Lop	0.313-0.333	0.316	7
lop	0.188-0.229	0.200	7
Lov	0.083	0.083	7
lov	0.188-0.208	0.192	7

Remarks: Harmer (1926) observed great variation in the number of distal oral spines. Menon (1972) also remarked on the range of variation and some of the specimens even totally lack spines. Present material falls well within the range of variation, having no spines to a maximum of five spines. Specimens described as *S. ferox* Busk by Lu (1990) clearly belong to *S. diadema*. They show remarkable resemblance to the latter in the shape and dimensions of the zooids, length of opesia, absence of scutum and vestigial cryptocyst. Lu's specimens have 3-distal oral spine bases.

Occurrence: Akshi, Nagaon.

Distribution: Holocene: Nansha sea area - China. Recent: Japan, Philippine, Burma, Bay of Bengal, Sri Lanka, New Guinea, N.W. Australia, Queensland, Mauritius.

Scrupocellaria ferox Busk, 1852;
(Pl.III, figs.7-8)

Scrupocellaria ferox Busk, 1852 p.25, pl.22, figs 1,2,5.- Waters, 1913, p.476, pl.68, figs. 11-15, pl.69, figs. 7-20.- Harmer, 1926, p.367, pl.25, figs. 1-6.- Canu & Bassler, 1929, p.210, pl.9, figs. 6-7.

Scrupocellaria diadema Busk; Lu, 1990, p.46, pl.4, fig.4.

Material: Plesiotype No: MACS/G 5010-5013.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.383-0.417	0.392	6
lz	0.167-0.250	0.214	6
Lop	0.233-0.250	0.247	6
lop	0.125-0.089	0.107	6

Description: Colony erect, biserial, branching. Zooids coarse, alternately arranged in longitudinal rows. Opesia oval, occupying two-thirds of the frontal area. Distal oral spine bases stout, usually four, two external and two distal. Cryptocyst narrow. Gymnocyst less than half the length of the zooid. Frontal avicularia moderate, raised, elongate, without cross-bar; lateral avicularia extremely small, placed at the base of the vibraculum chamber. A single vibraculum in the axil, other vibracula placed dorsolaterally, large, elongate with obliquely directed setal groove, a single rootlet foramen lateral in position. Ovicells not seen.

Remarks: The illustration of *S. diadema* Busk given by Lu (1990) belongs to *S. ferox* Busk judging from the number of spines and the nature of the ovicells.

Occurrence: Akshi and Malgund.

Distribution: Holocene: Nansha sea area - China; Recent: Zanzibar, China sea, Singapore, Malay region, Lousiade Archipelago.

Scrupocellaria maderensis Busk, 1860;
(Pl.III, figs. 1-2)

Scrupocellaria maderensis Busk, 1860, p. 280.- Harmer, 1926, p.372, pl.25, figs. 16-19.- Menon, 1972, p.914-916, figs. 1-6.- Gordon, 1984, p. 47, pl.12, figs. F,G.

Tricellaria occidentalis (Trask); Lu, 1990, p.50, pl.4, fig.3.

Scrupocellaria maderensis Busk; Ryland & Hayward, 1992, p.237, fig 8

Material: Plesiotype No: MACS/G 5014-5038.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.333-0.333	0.333	5
Lz	0.167	0.167	5
Lop	0.178-0.200	0.178	5

lop	0.120-0.106	0.111	5
Lav	0.133-0.167	0.160	5
Lav	0.111	0.111	5
Lov	0.111-0.133	0.128	4
Lov	0.144-0.167	0.161	4

Remarks: *Tricellaria occidentalis* (Trask) of Lu (1990) belongs to *S. maderensis* Busk because the illustration given by Lu clearly shows the scutum occupying the complete opesia. In *T. occidentalis* (Trask); (Kubota & Mawatari, 1985 p.85, figs 8,9), the position of attachment of the scutum is well below the middle of the opesia and the scutum has a branched structure. Moreover, the ovicell is one of the most important distinguishing characters between these two species; however, ovicells are not preserved in Lu's specimens from the Nansha Sea area - China.

Occurrence : Common along Maharashtra and Goa coasts.

Distribution : Pleistocene : Gulf of Guinea. Holocene: Nansha sea area - China; Recent : Indonesia, China sea, West Coast of India, Japan, Sri Lanka, Madagascar, New Zealand, Cape Verde Islands, Heron Islands, Great Barrier Reef, Mauritius.

Genus Caberea Lamouroux, 1816

Caberea transeversa Harmer, 1926
(Pl.II, figs. 7-8; Pl.IV, fig.3)

Caberea transeversa Harmer, 1926, p.363, pl. 24, figs 5,10.- Canu & Bassler, 1929, p.214, pl.38, figs 9-10.

Material: Plesiotype No : MACS/G 5039-5043.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.250-0.265	0.254	4
lz	0.162-0.206	0.180	4
Lop	0.147-0.176	0.154	4
lop	0.103-0.118	0.110	4
Lov	0.118-0.147	0.133	4
lov	0.132-0.147	0.140	4

Description : Colony erect, biserial, branching. Zooids moderately large, arranged in regular longitudinal rows. Opesia oval, occupies most of the frontal area. Cryptocyst well developed, descending into the zooidal cavity; distal oral spine bases three, two external, one internal. Scutum resting near middle of the opesia, stalk strong, transversely directed, without lamina. Gymnocyst little developed. Frontal avicularia small, oval, raised, placed proximolateral to cryptocyst, without cross-bar. Marginal avicularia small

and hollow. A single vibraculum in the axil, other vibracula placed basolaterally, broad, with oblique and long setal grooves, rootlet foramen present. Ovicells short, wider than long, ectoecium extending only to distal and lateral margins of the frontal surface.

Occurrence: Adgaon, Akshi, Malgund.

Distribution: Recent : Philippine, Malay Region, Singapore.

DISCUSSION

Table 1 shows the distribution of the neocheilostomine species studied in space and time. *Scrupocellaria raigadensis* n. sp. is the only species endemic to Holocene rocks of the West Coast of India. *Nellia tenella* (Lamarck) is a long ranging cosmopolitan species (Winston and Cheetham, 1984). It is known from the Palaeocene to the Recent and is widely distributed in tropical and warm temperate zones of all oceans. *Cellaria punctata* (Busk), *Scrupocellaria diadema* Busk, and *S. maderensis* Busk are Atlantic elements. *C. punctata* (Busk) is known to occur from the Pliocene to the Recent and is distributed in tropical to warm temperate waters. *S. diadema* Busk is known from the Holocene to the Recent, being distributed as far north as to Japan, throughout the Indo-Malayan region and westward to India and Mauritania. *S. maderensis* Busk ranges in age from the Pleistocene to the Recent and occurs widely in the warm temperate and tropical waters of the eastern Atlantic and the Indo-West Pacific Regions. *Thalamotreptos reversa* (Harmer) has a discontinuous record from the Eocene to the Recent. It occurs in the Eocene of the eastern Gulf Coast of Mexico, the Recent waters of Sri Lanka and now in the Holocene of the West Coast of India. *Thalamoporella falcifera* (Hincks) has an uneven distribution, being known dominantly from the Atlantic and the Indian Ocean tropical and subtropical belts. However, it also occurs in the Arctic region of the Beaufort Sea. *T. hamata* Harmer, *Poricellaria ratoniensis* (Waters), *S. ferox* Busk and *Caberea transversa* Harmer have restricted distributions in the Indo-Pacific. *T. hamata* and *C. transversa* are reported here for the first time as fossils from the Holocene rocks of the West Coast of India and have circumtropical to subtropical distribution.

In both shell limestone and plastic muds, celariiform zoarial type dominates and is represented mainly by four species : *Scrupocellaria maderensis*, *Nellia tenella*, *Poricellaria ratoniensis* and the cyclostome *Crisia elongata*. All of these species are considered to be shallow water forms tolerant of a wide range of salinities (33‰-56‰).

Table 1: Distribution of the documented bryozoan species and their affinities in the Cenozoic.

Name of species	Recent	Holocene	Pleistocene	Pliocene	Miocene	Oligocene	Eocene	Palaeocene
<i>Thalamoporella falcifera</i>	Western Atlantic : Beaufort to Brazil Caribbean Indian Ocean: Sri Lanka, Java, Australia	Arabian Sea: W. Coast of India.	—	—	—	—	—	—
<i>Thalamoporella hamata</i>	Atlantic Ocean : New Guinea, Indian Ocean : Malay region, Sulu archipelago	"	—	—	—	—	—	—
<i>Thalamotreptos reversa</i>	Indian Ocean : Sri Lanka,	"	—	—	—	—	—	—
<i>Porcellularia ratonensis</i>	Indian Ocean : Zanzibar, Indonesia, Strait of Makassar, Arabian Sea: W. Coast of India	Nansha Sea area & W. coast of India	—	—	—	—	—	—
<i>Cellularia punctata</i>	Pacific Ocean : Philippines, Japan, Indian Ocean : Indonesia, Sri Lanka, India	—	—	—	—	—	—	—
<i>Nellia tenella</i>	Cosmopolitan in tropical and warm temperate zones of all oceans	Nansha Sea area	Gulf of Guinea	—	Egypt, Jamaica, Australia	France, Spain, Senegal Gulf Coast of USA	Surinam	—
<i>Scrupocellaria ditadema</i>	Atlantic Ocean : New Guinea, Nansha Sea area	—	—	—	—	—	—	—
<i>Scrupocellaria raigadensis</i>	Indian Ocean : Burma, Bay of Bengal, Sri Lanka, Australia	—	—	—	—	—	—	—
<i>Scrupocellaria ferox</i>	Pacific Ocean : Japan, Philippines	W. Coast of India	—	—	—	—	—	—
<i>Scrupocellaria maderensis</i>	—	Nansha Sea area	—	—	—	—	—	—
<i>Caberea transeversa</i>	Indian Ocean : Zanzibar Pacific Ocean : China Sea, Singapore, Malay region, Lousiade archipelago Indian Ocean : Indonesia, W. coast of India, Sri Lanka, Madagascar Capeverde Pacific Ocean : China Sea, Japan, New Zealand.	Nansha Sea area	Gulf of Guinea	—	—	—	—	—
	Pacific Ocean : Philippines, Malay region, Singapore Atlantic Ocean : New Guinea	—	—	—	—	—	—	—

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EXPLANATION OF PLATES

Plate I

- 1, 4. *Thalamoporella hamata* Harmer
 1. Enlarged portion of autozooids and an avicularium, X 110, (Plesiotype No. MACS/G 4014).
 4. View of fragment, X 50, (Plesiotype No. MACS/G 4015).
2. *Dibunostoma reversa* (Harmer), enlarged portion of a colony with details of kenozooid and avicularia, X 100, (Plesiotype No. MACS/G 4021).
3. *Thalamoporella falcifera* (Hincks), avicularium. X 155, (Plesiotype No. MACS/G 4013).
5. *Cellaria punctata* (Busk) 5. Internode, X 60, (Plesiotype No. MACS/G 4051).

Plate II

- 1 - 6. *Scupocellaria raigadensis* n. sp.
 1. View of a complete internode, X 35, (Holotype No. MACS/G 4091).
 2. Dorsal view of internode, X 40, (Paratype No. MACS/G 4092).
 3. Enlarged portion of a broken colony showing details of ovicell, X 70, (Paratype No. MACS/G 4093).
 4. Dorsal view of internode. X 70 (Paratype No. MACS/G 4094).
 5. View of internode, X 35, (Paratype No. MACS/G 4095).
 6. Side view of internode, X 35, (Paratype No. MACS/G 4096).
- 7 - 8. *Caberea transeversa* Harmer
 7. View of a complete internode. X 70, (Plesiotype No. MACS/G 5039).
 8. Dorsal view of internode. X 80, (Plesiotype No. MACS/G 5040).

Plate III

- 1-2. *Scrupocellaria maderensis* Busk
 1. Enlarged portion of a colony showing details of zooids and ovicells. X 70, (Plesiotype No. MACS/G 5014).
 2. Dorsal view of a colony showing a pair of vibraculæ in the axil. X 100, (Plesiotype No. MACS/G 5015).
3. *Poricellaria ratoniensis* (Waters), enlarged portion of a colony showing details of zooids and avicularia. X 60, (Plesiotype No. MACS/G 4031).
- 4,9. *Nellia tenella* (Lamarck)
 4. View of complete internode X 20, (Plesiotype No. MACS/G 4065).
 9. Enlarged portion of a colony, showing details of zooids, avicularia and ovicells, X 50,
- 5-6. *Scrupocellaria diadema* (Busk)
 5. Frontal view of a colony, X 70, (Plesiotype No. MACS/G 5005).
 6. Dorsal view of a colony. X 45, (Plesiotype No. MACS/G 5006).

- 7-8. *Scrupocellaria ferox* (Busk)
7. Frontal view of a colony showing details of zooids and avicularia, X 40, (Plesiotype No. MACS/G 5010).
 8. Dorsal view of a colony, X 55, (Plesiotype No. MACS/G 5011).

Plate IV

1. *Dibunostoma reversa* (Harmer), enlarged view of autozooids and an avicularium, X 220, (Plesiotype No. MACS/G 4025).
2. *Thalamoporella hamata* Harmer, enlarged portion of avicularium showing acute rostrum, X 270, (Plesiotype No. MACS/G 4014).
3. *Caberea transversa* Harmer, enlarged view of zooids showing transverse bar of scutum, X 85, (Plesiotype No. MACS/G 5041)
4. *Cellaria punctata* (Busk), enlarged view of zooids and avicularia, X 120, (Plesiotype No. MACS/G 4052).

