

SOME "SAND FAUNA" POLYZOA (BRYOZOA) FROM EASTERN AFRICA AND THE NORTHERN INDIAN OCEAN

by

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Résumé

Neuf espèces de Bryozoaires, toutes avec le zoarium caractéristique des formes associées avec des fonds marins sableux ou vaseux, sont décrites de la Mer Rouge et des côtes d'Arabie et d'Afrique Orientale. Quoique plusieurs collections étendues aient été constituées concernant ces aires géographiques et que leurs résultats aient été publiés, il est intéressant de constater qu'une forte proportion des espèces présentées ici ne paraissent pas avoir été encore décrites. Elles comprennent des espèces nouvelles des genres *Anoteropora*, *Cleidochasma* et *Conescharellina* et la première description faite récemment d'une espèce de *Batopora*. Un nouveau genre, *Lacrimula*, représenté par deux espèces est également décrit.

INTRODUCTION

In the course of examination of the John Murray Collection of Polyzoa from Eastern Africa and the Northern Indian Ocean, several interesting species were found, the majority of which was apparently undescribed. Supplementary material of several of these species had already been noted in a collection from Eastern South Africa made by J.D.F. Gilchrist, which is stored in the British Museum (Natural History). The Museum also possesses manuscript notes and drawings made on this collection by H.W. Burrows.

The feature in common to all the species described below, is that they were collected from localities where the sea-bottom was mud, or sand and shell. The colonies all show the adaptation most frequently found in Polyzoa living in this type of habitat, namely, a discoidal or conical shape, whether the colonies are entirely free-living, or attached to a substrate by rootlets. The adaptations of "sand fauna" Polyzoa have been recently discussed by Marcus & Marcus (1962), Lagaaij (1963 a) and Cook (1963 and 1965 c).

These specimens may be divided into 2 groups. In the first group, the orientation of the zooecia is similar to that found in encrusting colonies, i.e. the distal border of the orifices are directed

away from the ancestrular region. It comprises species of the genera *Actisecos*, *Anoteropora* and *Cleidochasma*. In the second group, the distal borders of the orifices are directed toward the ancestrular region. It comprises species of the genera *Conescharellina*, *Batopora* and *Lacrimula*. Whereas *Actisecos* and *Anoteropora* are apparently completely free-living, there is some evidence that all the other species may be attached to, or above, the substrate by rootlets.

The orientation of the living colonies is unknown. It has been arbitrarily assumed here, in order to use the terms "frontal" and "basal" consistently, that in each case the apex of the zoarial cone is uppermost.

The following measurements were made, where possible:

Lz	Length of zoecium	lz	Width of zoecium
Lor	Length of orifice	lor	Width of orifice
Lfo	Length of fertile orifice	lfo	Width of fertile orifice
Lov	Length of ovicell	lov	Width of ovicell
Lav	Length of avicularium	lav	Width of avicularium
Lm	Length of mandible		

ACTISECOS Canu & Bassler, 1927:11.

Actisecos regularis Canu & Bassler.

Actisecos regularis Canu & Bassler, 1927:11, pl. 1, fig. 13. Harmer, 1957:856, pl. 60, figs. 12, 16.

Material examined: Belcher Coll., New Guinea, 1842.11.30.15-16. Hickson Coll., Gulf of Oman, 106-156 fath., 1913.4.19.1. John Murray Coll., Gulf of Oman, Stn. 74, 155 m., sand and mud, and Stn. 75, 201 m., mud, 1963.8.10.23, with *Anoteropora latirostris*. Siboga Coll., Kangeang Is., Stn. 318, 88 m., 1964.3.2.26, 27.

Distribution. Philippines, New Guinea, East Indies, Gulf of Oman, 82-201 m.

Dimensions. Lz 0.50-0.80 mm, lz 0.45-0.60 mm, Lor 0.20-0.25 mm, lor 0.18-0.20 mm, Lov (from basal side) 0.20-0.30 mm, lov 0.25-0.35 mm.

Zooecia with large pores. Peristomes raised, tubular. Ovicells prominent, opening into the distal side of the peristome, finely tuberculate.

The 23 colonies examined measure from 2.4-5.6 mm, in diameter. *A. regularis* has smaller ovicells than *A. pulcher*, which was described by Harmer (1957:858, pl. 60, figs. 13-15, 17-20), from the East Indies. *A. pulcher* has not been found in the Indian Ocean, and the Gulf of Oman appears to be the most western limit of distribution known for *A. regularis*. Harmer expressed doubts as to the identity of the specimens from the Gulf which he examined (1913.4.19.1), but both these, and those from the John Murray Collection appear to

belong to this species. There is a tendency for the distal septulae to be placed in the centre of the distal wall in *A. regularis*, whereas in the more elongated wall of *A. pulcher*, they are placed basally.

ANOTEROPORA Canu & Bassler, 1927:10.

Zoarium free, discoidal or conical, unilamellar, concave basally. Orifice large, with condyles. Ovicells large, minutely porous, closed by the operculum.

Harmer (1957:888) fully discussed *Anoteropora*. The occurrence of a species without avicularia (*A. inarmata*, see below), has necessitated slight alterations in the generic description.

Key to species described here:

- | | | | |
|----|---|---|-------------------------|
| 1. | { | Avicularia present | 2 |
| | } | Avicularia absent | <i>A. inarmata</i> |
| 2. | { | Ovicelled zoecia without avicularia, articular condyles small | <i>A. magnicapitata</i> |
| | } | Ovicelled zoecia with a lateral avicularium, articular condyles large | <i>A. latirostris</i> |

Anoteropora magnicapitata Canu & Bassler.

Anoteropora magnicapitata Canu & Bassler, 1929:476, pl. 94, figs. G-K.
Harmer, 1957:888, pl. 59, figs. 18-21, text-fig. 96.

Material examined: Haddon Coll., Murray Island, 15-20 fath., 1890. 3.24.29. Canu & Bassler Coll., Philippines, Sulu Archipelago, Albatross Stn. 5147, 21 fath., 1931.12.30.168. Siboga Coll., Kangeang Is., Stn. 318, 88 m., 1964.3.2. 33, 34 and Hangsisi Is., Stn. 60, 303, 0-36 m., 1964.3.2.35, 36. Picard Coll., Tuléar, Madagascar, 9-10 m., coarse sand, 1964.3.8.1. John Murray Coll., N. Zanzibar, Stn. 105, 310 m., mud, 1963.8.10.10, 14, with *A. latirostris* and *Lacrimula pyriformis*. Stn., 126, 209 m., mud & shell, 1963.8.10.13, with *A. latirostris*.

Distribution. Philippines, N. Australia, East Indies, Zanzibar, Madagascar, 9-310 m.

Dimensions. Lz 0.50-0.65 mm, lz 0.50-0.60 mm, Lor 0.18-0.23 mm, lor 0.18-0.23 mm, Lfo 0.18-0.25 mm, lfo 0.22-0.32 mm, Lov 0.23-0.30 mm, lov 0.55-0.70 mm, Lav 0.20-0.25 mm, lav (at base) 0.08-0.10 mm, Lm 0.19-0.22 mm.

The 22 colonies examined range in diameter from 5-23 mm, those from Murray Island being the largest.

A. magnicapitata is distinguished by the absence of avicularia from ovicelled zoecia, and by the small size of the articular condyles. The distal end of the avicularium rostrum is straight and narrow, and the mandibles, which are delicate and slightly hooked, extend

beyond it. The orifices of the oviceledl zooecia are large and sub-triangular.

Harmer listed a specimen from Malacca, but it is referable to *A. latirostris*, as is Balavoine's record from the Red Sea (see below).

Anoteropora latirostris Silén.

Anoteropora latirostris Silén, 1947:58, pl. 5, figs. 25-27, text-figs. 49-50.

Anoteropora magnicapitata Canu & Bassler, Balavoine, 1959:278, pl. 6, fig. 2 (as Fig. 1 on p. 278).

Material examined: Malacca, 1842.11.28.49. Belcher Coll., Cape of Good Hope, 1842.12.2.21-26, with *Discoporella umbellata*. John Murray Coll., Gulf of Oman, Stn. 74, 155 m., sand and mud, 1963.8.10.16; Stn. 75, 201 m., mud, 1963.8.10.16.17,18, with *Actisecos regularis*; Gulf of Aden, Stn. 178, 91 m., sand, 1963.8.10.21, with *Cupuladria indica* and *Steganoporella buskii* (see p. 220); S. Red Sea, Stn. 10, 55 m., 1963.8.10.12; Stn. 206, 256 m., sand and mud, 1963.8.10.19; N. Zanzibar, Stn. 105, 310 m., mud, 1963.8.10.11, with *A. magnicapitata* and *Lacrimula pyriformis*; Stn. 126, 209 m., mud and shell, 1963.8.10.20, with *A. magnicapitata*. Burrows Coll., Eastern S. Africa, Nanquas Peak N. 3/4 W., 63 fath., 1964.3.6.1; Stalwart Point N.N.W., 53 fath., 1964.3.6.2; Glendower Beacon N. 1/2 W., 66 fath., 1964.3.6.3.

Distribution. Red Sea, Gulf of Aden, Gulf of Oman, Malacca, East and South Africa, 30-310 m.

Dimensions. Lz 0.40-0.60 mm, lz 0.40-0.50 mm, Lor 0.19-0.20 mm, lor 0.16-0.17 mm, Lfo 0.18-0.23 mm, lfo 0.23-0.26 mm, Lov 0.17-0.26 mm, lov 0.35-0.60 mm, Lav 0.23-0.27 mm, lav (at base) 0.12-0.19 mm, Lm 0.15-0.18 mm.

The 31 colonies examined range in diameter from 5-11 mm.

A. latirostris was originally described from the Gulf of Aden (30 m., mud). It is distinguished by the presence of a lateral, distally directed avicularium beside the ovicell. The dimensions are generally smaller than those of *A. magnicapitata*. The avicularia are wide at the base, and stouter and shorter than those of *A. magnicapitata*; the mandibles are curved and do not extend beyond the rostrum. In most specimens, the articular condyles are well-developed, but they are deficient in the specimens from the Gulf of Oman. The orifices of the oviceledl zooecia are rounded and wider in proportion than those of the autozooecia.

The dimensions given by Balavoine are very small, and do not match measurements made upon his figure, which give dimensions similar to those above: Lz 0.36-0.48 mm, lz 0.28-0.40 mm, Lor 0.18-0.20 mm, lor 0.18-0.20 mm, Lav 0.16-0.20 mm. His specimen was worn, but some orifices show condyles. Coupled with the geographical distribution, this indicates that Balavoine's specimens are referable to *A. latirostris*, not to *A. magnicapitata*.

Nearly all records of *Anoteropora* are from the Indo-Pacific region. One species is known from the Atlantic. This is *Mamillopora smitti*

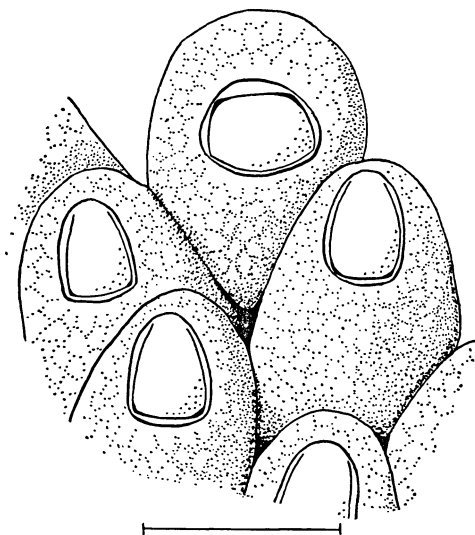
(1 specimen), which was referred to *Anoteropora* by Harmer (1957: 891). Recently, one further specimen has been found in the "Atlantide" Collections from West Africa (Stn. 40, Cape Verde Is, 60-100 m.). *A. smitti* is very similar to *A. latirostris*, as the ovicelled zoecia have Calvet (1906:158, 1907:424, pl. 27, figs. 4, 5, Cape Verde Is, 21 m., a distally directed, lateral avicularium. It differs in its narrower orifices (average dimensions Lor 0.20 mm, lor 0.14 mm), with more proximally placed condyles, and smaller, less raised avicularia (average Lav 0.14 mm).

Anoteropora inarmata n. sp. (Text fig. 1).

Material examined: Holotype, and only specimen, John Murray, Stn. 122, N. Zanzibar, 732 m., mud, 1963.8.10.9.

Dimensions. Lz 0.45-0.65 mm, lz 0.45-0.60 mm, Lor 0.19-0.24 mm, lor 0.13-0.20 mm, Lfo 0.18-0.21 mm, lfo 0.19-0.24 mm, Lov 0.15-0.19 mm, lov 0.45-0.60 mm.

TEXT-FIG. 1
Anoteropora inarmata n. sp.,
1963.8.10.9, Zanzibar.
Zoecia, one with an ovicell,
from the growing edge of the
colony. (Scale = 0.40 mm).



Anoteropora without avicularia. Operculum of the ovicelled zoecia with a strong sclerite, straight and complete distally.

The colony, which is preserved in alcohol, is 4 mm in diameter and comprises 62 zoecia, of which 7 have ovicells. The articular condyles do not appear to be well-developed. The opercula of the ovicelled zoecia have a strong, dark brown sclerite, which is curved proximally, and straight distally (see Text-fig. 1). Beneath a fine ectocyst, the frontal surface appears to be reticulate, not finely tuberculate as in the other species.

A. inarmata differs from previously described species of *Anoteropora* in the absence of avicularia, and in the form of the opercular sclerite of the ovicelled zoecia. *Stichoporina* (?) *parvicapitata* Canu &

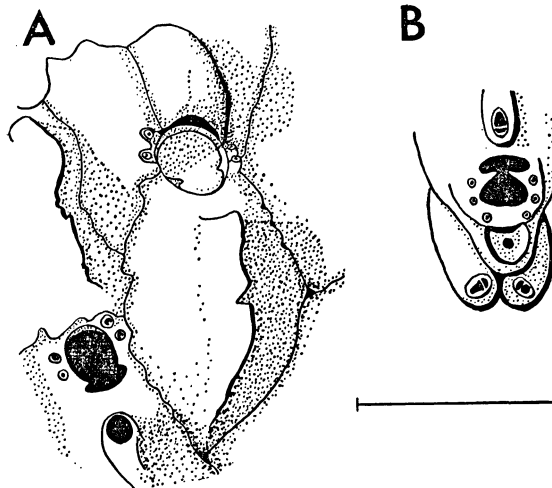
Bassler (1935:45, pl. 8, fig. 11, Tertiary, Muddy Creek, Victoria), which was also described without avicularia, had neither orifices nor ovicells like those of *Anoteropora*, although its zoarial form was similar.

CLEIDOCHASMA Harmer, 1957.

Cleidochasma Harmer, 1957:1038, Cook, 1964b:11.

Cleidochasma gilchristi n. sp. (Pl. I, 1 A, B; Text-fig. 2 AB).

Material examined: Burrows Coll., Umvoti River mouth, N. by 1/4 W., distant 15 1/2 miles, Stn. 11230, 56 fath., shell debris, 1949.11.10.144, with *Conescharellina africana* and *Lacrimula burrowsi*.



TEXT-FIG. 2

Cleidochasma gilchristi n. sp., 1949.11.10.144, S.E. Africa. A. Zoecia, one with an ovicell. B. One peripheral zoecium viewed from above at the distal end. Note the distal pore, and the paired chambers of the basal avicularia. (Scale = 0.40 mm).

John Murray Coll., N. Zanzibar, Stn. 103, 101 m., sand and shell, 1965.8.24.1,2, with *Lacrimula burrowsi* and *Discoporella umbellata*; Gulf of Aden, Stn. 179 B, 275 m., mud and sand, 1965.8.24.3.

Holotype, 1965.8.24.3 (see above).

Distribution. Gulf of Aden, Zanzibar, Eastern S. Africa, 101-275 m.

Dimensions. Lz 0.41-0.65 mm, lz 0.30-0.40 mm, Lor 0.12-0.15 mm, lor 0.08-0.13 mm, Lov (1 only) 0.22 mm, lov 0.18 mm, Lav (frontal) 0.05-0.06 mm, Lav (basal) 0.06-0.10 mm, Lav (frontal chamber) 0.20-0.30 mm, Lav (basal chamber) 0.18-0.32 mm.

Zoarium apparently free-living, discoid. Zoecia small, with marginal pores only. 1 distal and 3-4 lateral septulae, each surrounded

by a raised rim. Orifice with a pair of articular condyles, and a small, rounded sinus. Three pairs of oral spines, the most distal usually obscured by the development of the next distal zoecium. One frontal, median avicularium, proximal to the orifice, raised in a large sub-rostral chamber, mandible rounded, directed proximally; frequently replaced by a raised, hollow ridge. Paired avicularia on the basal surface of each zoecium, at the distal end of a raised chamber, mandibles rounded, directed laterally and basally. Ovicells hyperstomial, small, finely tuberculate, not closed by the operculum.

The 15 small zoaria (diameter 2-5 mm) are apparently free-living. The ancestrula and central region are usually obscured by calcification, but in one colony, which encrusts a zoarium of *Lacrimula burrowsi* (see below), the ancestrula can be seen. It is smaller than the other zoecia, but similar in all other characters, except that the orifice is proportionately larger. All the other zoaria encrust a small sand-grain or stone, diameter 2.4-8 mm. The ancestrular area of each colony is encrusting, the later-budded zoecia are free basally. The S. African specimens have dimensions at the larger end of the range of variation. The ovicells are rare, and only one (in 1949.11.10.144) has a complete frontal (see Text-fig. 2 A). The operculum of this ovicelled zoecium, and of several others without ovicells, appears to be calcified.

The frontal avicularian chamber is ridged and ends distally either in an avicularium or in a pore. In the S. African specimens, the chamber is greatly raised (height 0.40 mm), and acute, and there is rarely an avicularium. In those from Zanzibar, the chamber is lower, and occasionally may be absent.

The basal side of each zoecium has a prominent central ridge. The paired basal avicularian chambers develop one on each side of the ridge, eventually covering it and leaving a groove between them. The rostra are at the distal end of these chambers, the mandibles are directed laterally and basally. At the distal end of each zoecium is a pore, surrounded by an open chamber (see Text-fig. 2 B). Succeeding zoecia appear to be budded from beneath this chamber and to communicate with the proximal zoecium through the pore, in a manner superficially similar to that found in the Cupuladriidae (see Cook, 1965 a). The next distal zoecial bud covers the distal end of the 2 nearest basal avicularian chambers as it grows, and its frontal calcification obscures the distal pair of spines of the proximal zoecium.

The distal pore and chamber resemble those described in *Fedora* by Lagaaij (1953b:206), who postulated the working hypothesis that this free-living genus might be attached by rootlets arising from the chamber. In *Fedora*, the chambers become successively occluded by calcification as the colony grows, and thus the rootlets would only be able to grow from those zoecia near the budding area. In *C. gilchristi*, the chambers at the growing edge are exposed, but are covered by the growth of succeeding zoecia. If these chambers fulfilled a similar function to those postulated for *Fedora*, rootlets would anchor the zoarium at the periphery of the colony only.

Cleidochasma gilchristi differs from species of *Fedora* in the form of the colony, and in the possession of ovicells. Harmer (1957:

1045, pl. 71, figs. 15, 17, 18, Text-fig. 113) described *Cleidochasma mirabile*, from Borneo Bank (Strait of Makassar, 59 m.), with free-living, conical zoaria. The zooecia had deep basal depressions, associated with the ovicells. No such depressions have been seen in *C. gilchristi*, which also differs in the form and position of the avicularia.

CONESCHARELLINA d'Orbigny, 1852:446.

The genus has been discussed by Canu & Bassler (1929:480) and, more recently, by Silén (1947) and Harmer (1957:726).

Zoarium conical, attached by rootlets. Zooecial orifices orientated with proximal sinus directed away from the ancestrular area. Avicularia present. Ovicells hyperstomial, prominent. Central basal area composed of cancelli (morphologically avicularia and kenozoecia).

The orientation of the zooecia of *Conescharellina* was discussed by Harmer (1957:722), who showed that it could be derived from that found in normally encrusting colonies. The same orientation occurs in *Batopora*, and in *Lacrimula*, which last genus has otherwise characters very similar to those of *Anoteropora* (see below).

Conescharellina africana n. sp. (Pl. I, 2 A, B; Text-fig. 3).

Material examined: Burrows Coll., Umvoti River mouth, N. by 1/4 W., distant 15 1/2 miles, Stns. 11229, 11230 and 11231, 56 fath., mud and shell debris, 1949.11.10.636,639 and 1965.8.24.4, with *Lacrimula burrowsi* and *Cleidochasma gilchristi*.

Holotype, Lower specimen on slide 1965.8.24.4 (see above), all other specimens paratypes.

Dimensions. Lz 0.31-0.45 mm, lz 0.32-0.40 mm, Lor (primary) 0.08-0.09 mm, lor 0.06-0.07 mm, Lor (secondary) 0.14-0.16 mm, lor 0.13-0.15 mm, Lov 0.32-0.35 mm, lov 0.36-0.42 mm, Lav 0.05-0.06 mm, Lm 0.02-0.03 mm.

Conescharellina with an apical cone of kenozoecia. Apical angle circa 70°. Orifices with peristomes raised laterally. Avicularia paired, one on each side of the orifice, directed proximally and laterally. Mandibles short, rounded. Ovicells large, wide, porous. Rootlet pores (=lunoecia) apparently absent.

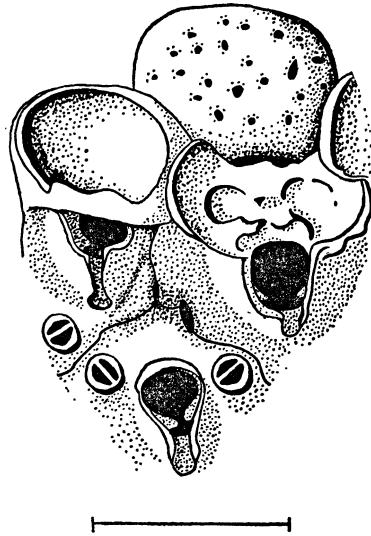
C. africana is represented by 13 zoaria (diameter 1.7-3 mm) and its characters are distinctive and consistent. The name is that used by Burrows, in his unpublished notes and drawings. He listed 3 records from the Umvoti River locality. *C. africana* seems to be the only species of the genus recorded from African waters. Two other free-living, conical forms, *Lacrimula burrowsi* and *Cleidochasma gilchristi*, occur from both the Umvoti River area and from Zanzibar, and it seems possible that the distribution of *C. africana* may also eventually be found to extend further to the North.

C. africana differs from other species of *Conescharellina* in the possession of a distinct cone at the apex of the zoarium. The cone is rugose and constructed of kenozoecia. It is similar in appearance to the apical kenozoecial tube found in *Lacrimula burrowsi* (see below), but is solid, not tubular. Rootlet pores (see Harmer, 1957: 724), marking the origin of rootlets, are not present in *C. africana* and it seems possible that rootlets for attachment may originate from the apical cone. These specimens are all dry, however, and no trace of rootlets has been seen. The cone is surrounded by irregular circles of avicularia and kenozoecia, followed by the first circle of zoecia (see Pl. I, 2 A, B).

TEXT-FIG. 3

Conescharellina africana n. sp.,
1949.11.10.639, S.E. Africa.

Zoecia and ovicells. The only complete ovicell belongs to the distal zoecium, the orifice of which is almost obscured by the basal wall of the ovicell proximal to it. (Scale = 0.40 mm).



The primary orifice is deeply sinuate, with well-developed condyles. The peristome is deficient distally and proximally, but raised laterally, with flaring expansions. There is a small avicularium at each distal corner of the orifice; the wide, rounded mandibles are directed proximally and laterally.

The ovicells are complete in one specimen only. They are prominent and wide. The peristomes of the ovicelled zoecia are very raised, with a small, slit-like proximal sinus. Harmer described the ovicells of the species he examined as imperforate; those of *C. africana* have large frontal pores (see Text-fig. 3).

BATOPORA Reuss, 1867.

The genus was discussed by Waters (1919) and by Canu & Bassler (1920:629 and 1923:187). All the species previously described have been fossils and the occurrence of *B. murrayi*, a Recent species, is remarkable.

The zoecia are orientated in the same manner as those of *Conescharellina*, but the ancestrular region is occupied by a pit, which

may be surrounded by kenozoecia and perhaps marks the origin of attached rootlets. Harmer (1957:746) described a central rootlet foramen in *Trochosodon radiatus* (Canu & Bassler, 1929), which has conical zoaria with zooecia orientated in the same manner as those of *Batopora* and *Conescharellina*.

Specimens of three fossil species in the British Museum, which are referred to *Batopora*, have been compared with the zoaria of *B. murrayi*.

B. conica Seguenza (1879:42, pl. 4, fig. 10), B3724, Buda, Szaboi beds, Hantken Coll., has large conical zoaria measuring 5.5 mm high and 4 mm wide. The apical pit is unlike that of *B. murrayi*; it is surrounded, and almost filled, by kenozoecia.

B. multiradiata Reuss (1869:265, 292, pl. 31, figs. 1-4), B3729, as above, has a small, flattened zoarium, measuring 3.0-3.5 mm in diameter. Avicularia are present, as are central basal cancelli, as in *Conescharellina*.

B. scrobiculata Koschinsky (1885:63, pl. 6, figs. 2a-c, 3a-c), D31117, Lutecian, Götzreuth, Bavaria, the type locality, Voigt Coll., has a zoarium measuring 2.5 mm high and 2 mm wide. The arrangement of the zooecia is very similar to that of *B. murrayi*, but no avicularia or kenozoecia are present.

Batopora murrayi n. sp. (Pl. I, 3 A, B).

Material examined: John Murray Coll., Stn. 125, Zanzibar, 805 m, mud over clay, 1965.8.24.5,6.

Holotype, 1965.8.24.5 (see above), rest of material paratypes.

Dimensions. Lz 0.25-0.30 mm, lz 0.40-0.60 mm, Lor 0.11-0.13 mm, lor 0.10-0.11 mm, Lav 0.05-0.06 mm, lav 0.07-0.09 mm.

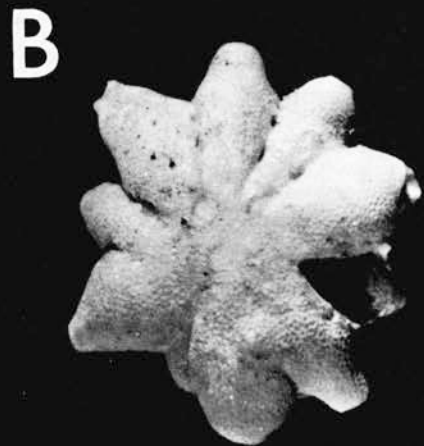
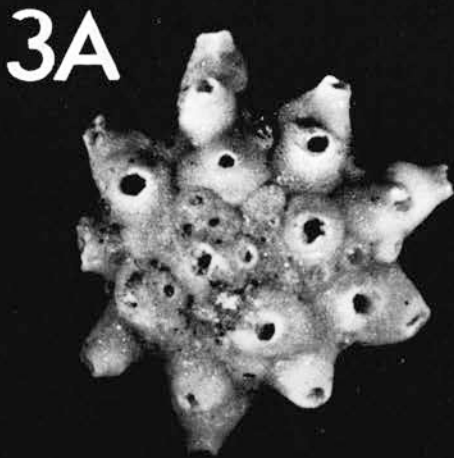
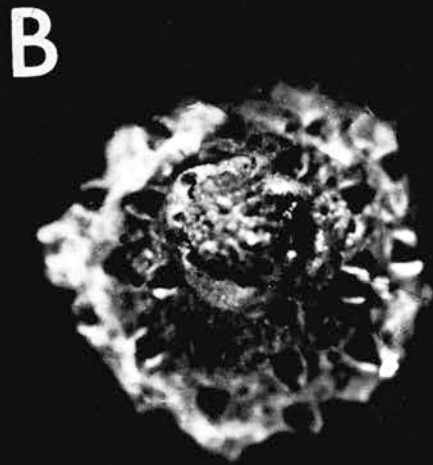
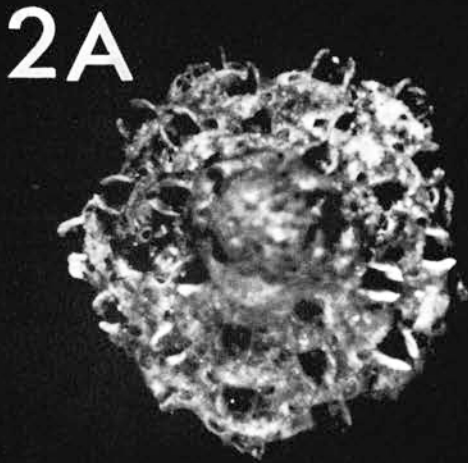
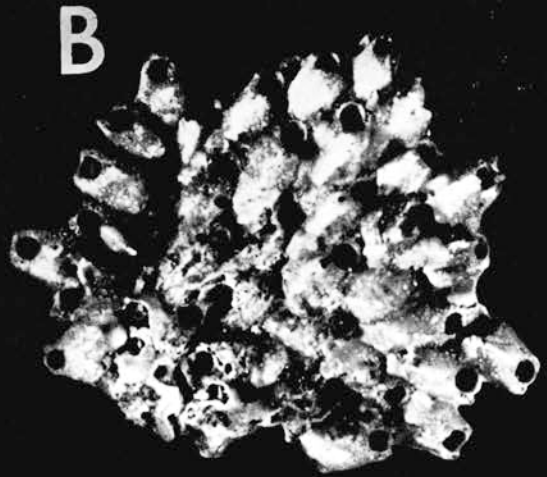
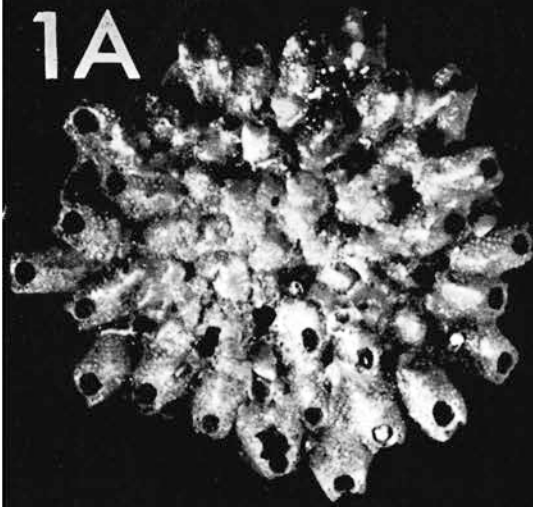
Zoarium small, 1.6-2.5 mm in diameter, the largest with 20 zooecia.

The ancestrular area marked by a pit, surrounded by zooecia and kenozoecia. Zooecial walls very thick, surface finely reticulate, entire. Primary orifice rounded, with a flattened proximal border, condyles absent. Peristome raised, tubular, decreasing in diameter towards the secondary orifice, with a small sinus on the basal side. Kenozoecia and avicularia arising between the zooecia at the surface. Mandibles rounded, variously orientated. Ovicells not seen.

Of the 10 zoaria present, only one shows the chitinous opercula.

PLATE I

- 1, A,B. *Cleidochasma gilchristi* n. sp., 1949.11.10.144, S.E. Africa, 2 zoaria. Note the spine bases, and the prominent frontal ridges. (× 23).
- 2, A,B. *Conescharellina africana* n. sp., 1965.8.24.4, S.E. Africa, 1 zoarium. A. Showing the prominent lateral flanges of the peristomes. B. Showing the rugose kenozoecial apex, with surrounding circle of avicularia. (× 33).
- 3, A,B. *Batopora murrayi* n. sp., 1965.8.24.6, Zanzibar, 2 zoaria. A. Frontal view, showing zooecia, kenozoecia and avicularia. B. Basal view, showing the reticulated surface. (× 21).



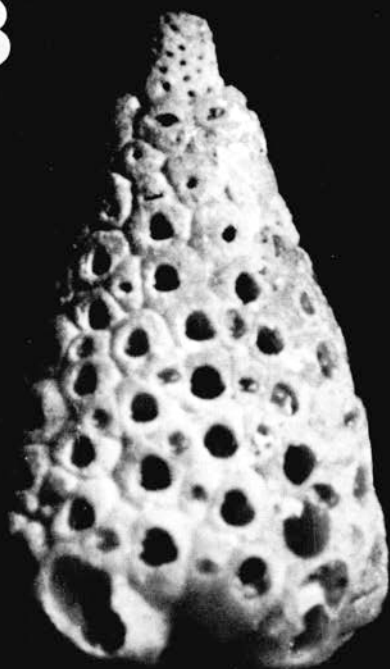
1



2



3



4



In some zoaria, the kenozoecia have a central pore, covered by a light brown membrane. The avicularia are rare; they have a complete bar. On the basal side the zooecia can be seen to be budded from the centre of the colony, curving upward. The average number of zooecia in the basal circle of a well-developed colony is five. The next circle to be budded alternates with the previous circle. Pores can be seen in the basal grooves between the zooecia. On the frontal side of the zoarium the kenozoecia appear to develop at the surface after the development of the zooecia.

B. murrayi greatly resembles *B. stoliczkai* Reuss (1867:224, pl. 2, figs. 2-4, Lower Oligocene, Germany), which also possesses small kenozoecia between the zooecia.

LACRIMULA n. gen.

Zoarium apparently free-living, probably attached by rootlets. Ancestrular area apical, with a hollow, tubular portion formed by kenozoecia. Zooecia orientated as in *Conescharellina*. Orifice central, large, with a pair of articular condyles; larger in ovicelled zooecia. Avicularia present. Ovicells hyperstomial, prominent at first, becoming immersed, closed by the operculum.

Type-species: *Lacrimula burrowsi* n. sp.

Lacrimula differs from *Conescharellina* in the tubular apex of the zoarium, in the shape of the orifice, in the lack of central basal cancelli, and in the relationships of the ovicell. It differs from *Anoteropora* principally in the orientation of the zooecia and in the form of the avicularia, but otherwise has similar zooecial characters. *Fedora* Jullien (1883:17) has a similar zoarial shape, but an entirely opposite orientation of zooecia to *Lacrimula* (see Lagaaij, 1963b). The fossil genus *Atactoporida* Canu & Bassler may have a zoarial form like that of *Lacrimula*. A specimen of *A. bredaniana* Canu & Bassler (1931:2, pl. 4, figs. 5,6, D33249-52, Bartonian, Wemmelsands) has an apical pore, but no apical kenozoecial tube and the arrangement of the zooecia is not regular, as in *Lacrimula*. It also differs in that the peristomes are tubular, the ovicells raised and small, and avicularia are absent.

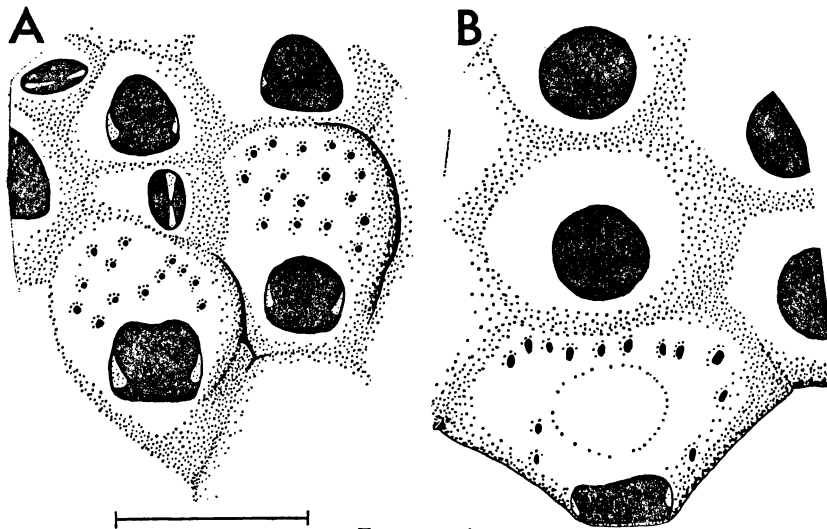
PLATE II

1. *Lacrimula pyriformis* n. sp., 1965.8.24.13, Zanzibar. Old, worn colony, showing large zooecia and orifices with no visible condyles. Note smooth apical tube, and cf. figure 2. (× 40). Photograph by P. Green.
2. *L. burrowsi* n. sp., 1965.8.24.8, Zanzibar. Young colony of similar size to that of *L. pyriformis*, see 1. Showing the smaller zooecia, orifices with well-developed condyles, and avicularia. Note base of broken ovicell. (× 35).
3. *L. burrowsi* n. sp., 1965.8.24.8, Zanzibar. Older colony, showing apical kenozoecia, and progressive closure of zooecia by secondary calcification. Note the frequency of avicularia. (× 35).
4. *L. burrowsi* n. sp., 1965.8.24.8, Zanzibar. Old colony, showing considerable secondary calcification. Note the comparative rarity of avicularia and the ovicells with frontal pores. (× 35).

Some of the more elongated zoaria of *L. burrowsi* (see below), superficially resemble the problematical *Skylonia*, from the Miocene of Kenya and the Dominican Republic (see Thomas, 1961, and Sandberg, 1962 and 1963). The zoarium of *Lacrimula* does not, however, appear to have a nodal structure and may, as is possible in *Conescharella africana*, be attached above the substrate by rootlets originating from the kenozoecial apex.

Lacrimula burrowsi n. sp. (Pl. II, 2, 3, 4; Text-fig. 4A).

Material examined: Burrows Coll., Umvoti River mouth, N. by 1/4 W., distant 15 1/2 miles, Stn. 11231, 56 fath., mud, 1949.11.10.642, with *Conescharella africana* and *Cleidochasma gilchristi*. John Murray Coll., Zanzibar, Stn. 103, 101 m., sand and shell, 1965.8.24.7-10,



TEXT-FIG. 4
Lacrimula n. gen.

- A. *L. burrowsi* n. sp., 1965.8.24.7, Zanzibar. Zoecia, avicularia and ovicells. Note large condyles and perforated central area of ovicells.
B. *L. pyriformis* n. sp., 1965.8.24.12, Zanzibar. Zoecia, one with an ovicell, from the growing edge for the colony. Note that the small condyles are not visible in frontal view. The orifice of the ovicelled zoecium is foreshortened, note the imperforate central area. (Scale = 0.40 mm).

with *C. gilchristi* and *Discoporella umbellata*; Stn. 104, 207 m., sand, 1965.8.24.11, with *D. umbellata*.

Holotype, 1965.8.24.7 (see above), all other John Murray specimens paratypes.

Dimensions. Lz 0.20-0.30 mm, lz 0.20-0.25 mm, Lor 0.12-0.15 mm, lor 0.11-0.15 mm, Lfo 0.13-0.17 mm, lfo 0.15-0.20 mm, Lov 0.25-0.27 mm, lov 0.38-0.40 mm, Lav 0.05-0.11 mm.

Lacrimula with elongated zoaria. Orifice with a curved proximal edge and large articular condyles. Avicularia with wide round mandibles. Ovicells large, with minute frontal pores.

There is a total of 34 specimens. Some have chitinous parts intact, but all are dry. The zoaria range from 2.8-3.2 mm in length and from 1.4-1.7 mm in width at the widest part.

The apex of the colony consists of a tube composed of small, rugose kenozoecia. This area is followed by 2 circles of small avicularia. The next 2-3 circles of zooecia are frequently occluded by secondary calcification in older zoaria (see Pl. II, 3, 4); a small pore remaining open in the centre. The dimensions of the zooecia increase towards the budding zone. Avicularia vary in occurrence, being regularly placed between the zooecia in some colonies, but rare in others (cf. Pl. II, 3 with 4). The avicularia are short and wide, placed in the centre of a large sub-rostral chamber; they have large condyles. The ovicells are large, and confined to the latest budded zooecia.

Lacrimula pyriformis n. sp. (Pl. II, 1; Text-fig. 4 B).

Material examined: John Murray Coll., Zanzibar, Stn. 105, 310 m, mud, 1965.8.24.12,13, with *Anoteropora magnicapitata* and *A. latirostris*.

Holotype, 1965.8.24.12 (see above), all other material paratypes.

Dimensions. Lz 0.28-0.40 mm, lz 0.30-0.40 mm, Lor 0.12-0.16 mm, lor 0.13-0.15 mm, Lfo 0.20-0.25 mm, lfo 0.17-0.20 mm, Lov 0.20 mm, lov 0.35 mm, Lav 0.07 mm, lav 0.08 mm.

Lacrimula with pear-shaped zoaria. Apex a long, smooth kenozoecial tube, orifice rounded, with very small articular condyles. Avicularia confined to one circle surrounding the base of the kenozoecial tube. Ovicells imperforate centrally, surrounded by a row of pores.

The 3 colonies of this species examined have an average length of 2.20 mm, and a width of 1.6 mm. The apical tube is long, measuring 0.30 mm.

L. pyriformis and *L. burrowsi* are similar in many characters, but show the following consistent differences. The zoaria are smaller, at comparable stages of development, than those of *L. burrowsi* (see Pl. II, 1, 2). The zooecia, however, are larger and the orifices more rounded, with very small articular condyles. Avicularia are restricted, occurring only round the base of the apical tube, which is very long, and not rugose. The ovicells are smaller than those of *L. burrowsi*, and marginal pores are present, the centre being imperforate.

DISCUSSION

The relationships of zoarial form with ecological conditions was first investigated by Stach (1936). Recently, considerably more work has been done, emphasizing the effects of depth, temperature, salinity and substrate in relation to the analysis of Polyzoan associations (see Gautier, 1962, Cheetham, 1963 and Lagaaij & Gautier, 1965).

Under suitable conditions (see Lagaaij 1963 a), the preponderance of Polyzoan species living where the bottom is of mud or sand, is of the conical type. Other forms of zoarium adapted to this type of substrate may be erect and branching, but these are usually equipped with anchoring rootlets, eg. *Adeona*. The occurrence of encrusting or erect forms without rootlets seems to be dependent upon the availability of other organisms, themselves capable of colonizing sand or mud, eg. hydroid or gorgonid stems. For example, the association of "*Retepora*" with the conical zoaria in groups 2 and 5 of the localities listed below, is interesting, in view of Harmer's detailed evidence (1934:532-3) showing the rarity of Retepores from localities with deep, muddy sea-bottoms. These large erect forms, with an encrusting base, almost certainly inhabit an area above the sea-bottom, originating upon other forms (see Cook, 1965 c).

The "silty sand" community of the coast of Ghana is an area where conical Polyzoa (almost exclusively belonging to the family Cupuladriidae, see Cook, 1965 b), are abundant. Nearly all the encrusting and erect species from this area are confined to an association with two other substrates. The first is with the large, foliaceous Foraminiferan, *Jullienella foetida* Schlumberger (see Nørvang, 1961), which has a rigid, argillaceous test. The second is with the gasteropod shells inhabited by Pagurids, which apparently occur in large numbers in this area (see Cook, 1964 b).

If the localities above are divided into geographical areas, some associations and distributions become evident. Two lunulitiform "sand fauna" species, not described above, are included, namely *Cupuladria indica* and *Discoporella umbellata* (see Cook, 1965 a).

Group 1. Red Sea (John Murray Stns. C, D, 10, 206). Bottom varying from coral, rock, sand and shell at 26 m, to mud and pteropod ooze at 256 m.

Two conical species occur from this area, accompanied by large numbers of erect and encrusting species, which are, however, principally associated with the rock and coral which occur at the shallower depths. These include species of *Thalamoporella*, *Celleporaria*, *Exechonella* and *Rhynchozoon*, with *Spiroporina vertebralis* and two species of "*Retepora*".

Group 2. Gulf of Aden (John Murray Stns. 178, 179 B, N. of Cape Guardafui). Bottom varying from coarse sand at 91 m, to mud and sand at 275 m.

The three conical species from this area are accompanied by one species of "*Retepora*", which probably originated on a hydroid or gorgonid stem; and by *Steganoporella buskii* Harmer. *S. buskii* is normally encrusting, or erect and foliaceous, arising from an encrusting base. These two colonies are extremely interesting because their zoaria are conical and apparently free-living (see Cook, 1964 a).

Group 3. Gulf of Oman (John Murray Stns. 74, 75, 77, 80). Bottom varying from coarse sand at 16 m, to mud at 411 m.

The three species from this area are not associated with records of any other Polyzoa. Even neighbouring Stations had no Polyzoa, sponges being one of the commonest forms present.

Group 4. Zanzibar (John Murray Stns. 103, 104, 105, 122, 125, 126). Bottom varying from coarse sand and shell at 101 m, to mud and clay at 805 m.

This area is very rich in conical "sand fauna" forms, seven species being present. Of the three associated species, one is also adapted to sandy conditions, it is an erect *Chaperia*, with rootlets. The remaining forms are species of encrusting *Celleporaria* and an erect, massive "*Adeonella*".

Group 5. Eastern South Africa (Burrows Coll., Stns. 11229, 11230, 11231, 13555, 13556, 13805, 13909). Bottom varying from mud and shelly debris at 96-100 m, to shell and coral debris at 120 m.

Five conical species are present from this area. The associated forms include species of *Cellaria*, "*Adeonella*", "*Retepora*" and *Hornera*.

The geographical distribution of the species shows that *Cupuladria indica* and *Actiseocos regularis* are confined to the northerly part of the African coast, and to the Arabian coast; *D. umbellata* to the south-east African coast; and that *Anoteropora latirostris* is generally distributed throughout the area. The bathymetrical distribution shows that 9 of the 11 "sand fauna" conical species are present within the depth range 100-310 m. The range 200-210 m has the highest frequency of species, namely seven.

Summary

Nine species of Polyzoa, all with the conical zoaria typical of forms associated with sandy or muddy sea-bottoms, are described from the Red Sea, and the Arabian and East African coasts. Although several comprehensive collections have already been made from these areas and their results reported, it is interesting that a high proportion of the present species do not appear to have been described before. Included are new species of the genera *Anoteropora*, *Cleidochasma* and *Conescharrellina*, and the first recent record of a species of *Batopora*. A new genus, *Lacrimula*, which is represented by two species, is also described.

Zusammenfassung

Neun Arten von Mooskorallen, jede mit kegelförmiger Kolonie, typisch der einheimischen Formen von sandigem oder sumpfigen Meeresgrund, aus dem Roten Meer in der Nähe der arabischen und ost afrikanischen Küste werden hier beschrieben. Obwohl einige und umfangreiche Sammlungen aus diesem Gebiete schon beschrieben wurden, ist es interessant zu sehen, dass die Mehrzahl der Arten hier beschrieben neu sind. Inbegriffen sind neue Arten der Genera *Anoteropora*, *Cleidochasma* und *Conescharrellina*, und der Erste Auftritt neuester Zeit von *Batopora*. Zwei Arten, eines neuen Genus, *Lacrimula* sind also beschrieben.

Acknowledgments

I should like to thank Dr. H.D. Thomas (Palaeontological Dept., British Museum) for the opportunity to examine specimens, and Dr. A. Cheetham (Louisiana University, Baton Rouge) and Dr. R. Lagaaij (Shell Exploratie en Productie Laboratorium, The Netherlands), for much helpful discussion. The photographs were taken by Dr. N.A. Powell (National Museum of Canada, Toronto) and by Mr. P. Green (British Museum), see Plates I and II for details.

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