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Hyaline Tintinnina (Protozoa-Ciliophora-Oligotrichida) from northeast Brazilian coastal reefs

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• *Abstract:* Seven species of hyaline Tintinnina were obtained from plankton samples collected near the coastal reefs of Ponta do Seixas (Lat. 7°09'16"S, Long. 34°47'35"W), Northeastern Brazil, from April 1981 to May 1982 and from April 1983 to May 1984: *Amphorellopsis acuta* (Schmidt, 1901), *Dadayiella ganymedes* (Entz Sr., 1884), *Epiplocyloides reticulata* (Ostenfeld & Schmidt, 1901), *Eutintinnus tubulosus* (Ostenfeld, 1899), *Favella ehrenbergi* (Claparède & Lachmann, 1858), *Metacylis mereschkowskyi* Kofoid & Campbell, 1929 and *M. perspicax* (Hada, 1938). The most frequent and abundant species were *M. mereschkowskyi* and *F. ehrenbergi*. Except *D. ganymedes, E. reticulata* and *F. ehrenbergi* all species are new records from Brazil. *Metacylis perspicax* is also the seventh world register. For all species we provide description, drawings, measurements, seasonal occurrence, world distribution and some systematic comments.

• *Descriptors:* Tintinnina, Protozoa, Ciliates, Systematics, New records, Microzooplankton, Reefs, Northeast Brazil.

• *Descritores*: Tintinnina, Protozoa, Ciliados, Sistemática, Ocorrências novas, Microzooplâncton, Corais, Nordeste do Brasil.

Introduction

The first studies regarding Brazilian Tintinnina were started by Brandt (1906;1907), based on samples gathered in the northern region during the "Plankton Expedition" of the Humboldt Foundation (Germany), and by Bresslau (1906), based on material gathered near the city of Rio de Janeiro. Brandt's paper is essentially a systematic account, with description of some new species from Brazil, while the paper of Bresslau shows details of the conjugation among specimens of *Tintinnopsis ventricosa (= Stenosemella ventricosa).*

After these two pioneer works, only very few studies were carried out along the Brazilian coast. Some species were cited for the south and southeast regions by Faria & Cunha (1917), Cunha & Fonseca (1918), Lutz *et al.* (1918), Carvalho (1939), Moreira Filho (1961), Seguin (1965) and Souto (1970 a,b). Nevertheless, only the papers of Souto (*op. cit.*, are the most complete for those regions.

For the northeastern coastal waters the only detailed study was conducted by Sassi & Melo (1982) in the Paraíba do Norte River estuary. Some species are also referred by Balech (1971a) (from shelf and oceanic waters off Ceará and Piauí States), by Paranaguá & Neumann-Leitão (1980) (from the State of Pernambuco) and by Singarajah (1978) (from the State of Paraíba).

Although reef formations are a commom feature from the northeastern Brazil, there is no studies regarding these pelagic protozoans in these environments. This paper is the first contribution to the systematics of Tintinnina found in these regions. Only the species with hyaline lorica are treated here.

Material and methods

Samples were gathered weekly from April, 1981 to May, 1982, and most scarcely from April, 1983 to May, 1984, in a fixed station near the reef formation of Ponta do Seixas (Lat. 7°9'16" S, Long. 34°47'35" W), State of Paraíba. The collections were made only at the surface using a standard plankton net with 50 μm mesh size. The material was preserved with 4% neutralized formaldehyde and analysed in several magnifications with a Zeiss phase contrast microscope. Five subsamples of each sample were studied. To give an idea of the abundance of each species along the studied period all specimens were counted. Selected individuals of each species were drawn with a camera lucida and measured with a calibrated ocular micrometer. All dimensions given for each species are in micrometers.

For the nomenclature and classification we follow Corliss (1977). Cases of doubtful allocation are indicated thus [?].

Results

Only seven species of hyaline Tintinnina were found during this study: *Amphorellopsis acuta* (Schmidt,1901), *Eutintinnus tubulosus* (Ostenfeld, 1899), *Dadayiella ganymedes* (Entz Sr., 1884), *Epiplocyloides reticulata* (Ostenfeld & Schmidt, 1901), *Metacylis mereschkowskyi* Kofoid & Campbell,1929, *Metacylis perspicax* (Hada, 1938), and *Favella ehrenbergi* (Claparède & Lachmann, 1858). For each species the following systematic treatment is presented:

Family Coxliellidae Kofoid & Campbell, 1929
Genus *Metacylis* Jörgensen, 1924
Metacylis mereschkowskyi Kofoid & Campbell, 1929
(Plate I, Figs 1-6)

Tintinnus mediterraneus var. *pontica* Mereschkowsky, Rossolimo, 1922, **partim**, p. 29, pl. 2, fig. 24, left figure only (right figure = *M. joergensenii*).

Metacylis mediterranea var. *pontica* (Mereschkowsky), Jörgensen, 1924, p. 97, fig. 109b, **non** fig. 109a (= *M. joergensenii)*.

Metacylis mereschkowskii Kofoid & Campbell, 1929, p. 200, fig. 377; Hada, 1938, p. 134, fig. 21; Silva, 1952, p. 618, pl. 3, figs 6,7; Cosper, 1972, p. 407, fig. 25.

Metacylis mereschkowskyi Kofoid & Campbell, Balech, 1968, p. 176, pl. 2, fig. 16.

Metacylis sp. Silva, 1953, p. 109, fig. 7.

Metacylis sp. Gold, 1970, p. 269, fig. 9.

Metacylis sp aff. *mereschkowskyi*, Cao, 1986, p. 145, figs 2g, 3c.

Description: Lorica short and wide, vase shaped, very translucent, consisting of a collar with one or two annular rings and a convex conical bowl. Distinct shoulder below collar, where the wall is reinforced. Widest diameter in the shoulder region. Aboral end slightly acute or rounded. Bowl wall with small alveolate structures, more visible on the shoulder. Collar with very faint oblique lines.

Dimensions (35 specimens): Total length, 39.0-51.5; oral diameter, 37.1-42.0; greatest diameter, 44.9-49.7; height of the collar, 2.5-4.0.

Occurrence: 07/03/81 (16), 08/06/81 (1), 08/14/81 (2), 08/21/81 (1), 08/27/81 (4), 09/02/81 (30), 09/11/81 (4), 10/02/81 (4), 10/16/81 (9), 10/23/81 (1), 11/26/81 (1), 12/03/81 (3), 12/11/81 (1), 12/28/81 (1), 01/22/82 (2), 02/12/82 (2), 02/05/82 (10), 04/16/82 (3), 09/06/83 (6).

Distribution: Brazil (new record); Gulf of Mexico (Lackey & Hynes, 1955, **fide** Balech, 1968, p. 176; Balech, 1968; Cosper, 1972); Guinea Bissau waters (Silva, 1952); Portugal waters (Silva, 1953); Mediterranean Sea (Jörgensen, 1924); Black Sea (Rossolimo, 1922; Jörgensen, 1924; Mamaeva, 1980); Micronesian waters (Hada, 1938); Argentina waters (Cao, 1986).

Remarks: A mistake was perpetrated in the synonymic list furnished by Kofoid & Campbell (1929): in fact, the fig. 24 (left figure) of Rossolimo (1922) is *Tintinnus mediterraneus* var. *pontica* and not *T. mediterraneus* var. *neapolitana* as they wrote.

The assignment of *M. mereschkowskyi* by Kofoid & Campbell (*op. cit.*) and Hada (1938) for the European western coast, Florida and East China Sea constitutes a misinterpretation of Jörgensen's paper of 1924. In fact, Jörgensen *(op. cit.)* just refers for such regions *M. mediterranea* and its forma *neapolitana (= M. joergensenii)* but not the variety pontica *(= M. mereschkowskyi)*, which he observed only in waters from the southern Jonian Sea (station 152) and the Black Sea region (stations 171 and 172).

M. mereschkowskyi is very similar to *M. angulata* Lackey & Balech (1966) but differs from this species by its smaller dimensions and a most hyaline lorica always without an aboral tip. Also, it shows some similarity with *M. perspicax* Hada (1938), from which differs in the collar shape and by having the greatest diameter above the equatorial portion of the lorica, while in *M. perspicax* this diameter is near the middle portion.

Although *M. mereschkowskyi* frequently presents an almost triangular lorica, with accuminated aboral extremity, we found some specimens most globose and with an aboral end rounded (Pl. I, Fig. 6). We have also observed some specimens with a large oral aperture, with dimensions closest to the maximum diameter (Pl. I, Fig. 4). This variability led us to consider the specimens studied by Silva (1953), Gold (1970) and Cao (1986) as belonging to *M. mereschkowskyi.*

Metacylis perspicax (Hada, 1938).
(Plate I, Figs 7,8)

Metacylis corbula var. *perspicax* **Hada, 1938, p. 136, fig.** 53.

Metacylis corbula Kofoid & Campbell, Marshall, 1934, p. 646, fig. 26; Hada, 1938, p. 135, fig. 52a,b; Marrón-Aguillar & López-Ochoterena, 1969, p. 52, pl. 4, fig. 36; **non** *M. corbula* Kofoid & Campbell, 1929, p. 199, fig. 370.

Metacylis sanyahensis Nie & Ch'eng, 1947, p. 69, fig. 29.

Metacylis perspicax (Hada, 1938), Marrón-Aguillar & López- Ochoterena, 1969, p. 53, pl. 4, fig. 37.

Description: A minute species with a hyaline, subspherical lorica, showing two differentiated portions: a truncate conical collar, with four annular rings, corresponding to about 0.20-0.25 of total length, and a hemispherical bowl, sometimes slightly acuminated in its aboral end. Maximum diameter almost equal to total length.

Dimensions (9 specimens): Total length, 36.4-44.3; oral diameter, 37.4-42.3; greatest diameter, 43.0-47.0; height of collar, 5.0-9.8.

Occurrence: A rare species in the studied region. Present only on 07/03/81 (2), 08/27/81 (4), 09/02/81 (2), 09/11/81 (5), 10/16/81 (1) and 04/07/82 (1).

Distribution: Brazil (new record); Caribbean Sea (Durán, 1957); Gulf of Mexico (Marrón-Aguillar & López- Ochoterena, 1969); Guinea-Bissau waters (Silva, 1952); Great Barrier Reef (Marshall, 1934); Philippine Sea (Hada, 1938); Hainan Region (China) (Nie & Ch'eng, 1947).

Remarks: *Metacylis perspicax* was studied for the first time by Hada (1938) from material collected near the Palao Island. In that region he found some specimens attributable to *M. corbula* Kofoid & Campbell, 1929, and apparently only one slightly different lorica which was considered as a new variety, *M. corbula* var. *perspicax*. In our oppinion the establishment of this new variety was very arbitrary as the only difference with the main form is in the collar shape. Moreover, his specimens (main form and variety) are very distinct of the true *M. corbula* and should be treated more properly as a new species. By the way, Nie & Ch'eng (1947), studying material from the Hainan region (China), have created a new species *(M. sanyahensis)*, and have considered *M. corbula* and *M. corbula* var. *perspicax* of the Japanese author as synonyms. According to the ICZN, this taxon was errouneously established since the name *perspicax* is prioritary. We think the variety *perspicax* was raised to the specific status by Marrón-Aguillar & López-Ochoterena (1969), as they presented for the first time the correct nomenclature, although without any comments.

Family Epiplocylididae Kofoid & Campbell, 1939
Genus Epiplocyloides Hada, 1938
Epiplocyloides reticulata (Ostenfeld & Schmidt, 1901)
(Plate I, Fig. 9)

Cyttarocylis reticulata Ostenfeld & Schmidt, 1901, p. 180, fig. 28.

Ptychocylis reticulata (Ostenfeld & Schmidt), Brandt, 1906, pl. 58, figs 1, 4; 1907, p. 208 (only description); Laackmann, 1909, p. 457 (only description).

Epiplocylis reticulata (Ostenfeld & Schmidt), Kofoid & Campbell, 1929, p. 184, fig. 325.

Epiplocylis curta Kofoid & Campbell, 1929, p. 178, fig. 319.

Epiplocylis healdi Kofoid & Campbell, 1929, p. 180, fig. 321; Marshall, 1934, p. 643, figs 16, 16a; Hada, 1935, p. 245.

Epiplocylis acuta Kofoid & Campbell, 1929, p. 175, fig. 322.

Epiplocylis brandti Kofoid & Campbell, 1929, p. 177, fig. 324.

Epiplocyloides reticulata (Ostenfeld & Schmidt), Hada, 1938, p. 130, fig. 47; Balech, 1962, p. 78, pl. 8, fig. 93; Durán, 1965, p. 21, pl. 3, figs 42, 44; Souto, 1970a, p. 219, fig. 4.

Epiplocyloides reticulata var. *acuta* (Kofoid & Campbell, 1929), Hada, 1938, p. 131, fig. 48; Balech, 1962, p. 79, pl. 8, fig. 94; Kuzmina & Rogachenko, 1980, p. 73, fig. 2e.

Epiplocyloides reticulata var. *curta* (Kofoid & Campbell), Hada, 1938, p. 129.

Epiplocyloides curta (Kofoid & Campbell), Durán, 1957, p. 116, fig. 17.

Epiorella brandti (Kofoid & Campbell), Kofoid & Campbell, 1939, p. 134; Campbell, 1942, p. 73 (only description).

Epiorella curta (Kofoid & Campbell), Kofoid & Campbell, 1939, p. 135, pl. 8, figs 7, 8; Campbell, 1942, p. 73 (only description); Silva, 1954, p. 204, pl. 3, fig. 4, 5; Komarovsky, 1959, p. 14, fig. 28.

Epiorella healdi (Kofoid & Campbell), Kofoid & Campbell, 1939, p. 136, pl. 8, figs 12-14; Campbell,1942, p.74, fig. 79.

Epiorella healdy (Kofoid & Campbell), Silva, 1956a, p. 362, pl. 4, fig. 10.

Epiorella acuta (Kofoid & Campbell), Kofoid & Campbell, 1939, p. 135, pl. 8, figs 2, 9, 11.

Epiorella reticulata (Kofoid & Campbell), Kofoid & Campbell, 1939, p. 134; Silva, 1954, p. 204, pl. 3, fig. 6.

Description: Lorica chalice-shaped; bowl subcylindrical in its anterior half. Aboral portion convex-conical, provided with a short and pointed pedicel. Oral rim smooth. Oral region differentiated, with a small hyaline collar and a suboral shelf; diameter at the level of the shelf being greater than the oral diameter. Reticulated zone covering the surface of the aboral region, with irregular polygons almost reaching the middle of the bowl. Maximum number of reticulations about 18 across one face. Longitudinal anastomosing free lines extending from the reticulated zone to the suboral shelf. Collar with a very tenuous longitudinal striation almost imperceptible.

Dimensions (2 specimens): Total length, 70.5-73.9; oral diameter, 44.7-45.6; diameter in the oral shelf, 53.3- 54.2; length of the caudal appendage, 6.0-7.5.

Occurrence: Only two specimens were observed in the studied region, both in the sample collected on 1/29/82.

Distribution: Southeastern Brazil (Souto, 1970a; Balech, 1971b); Northeastern Brazil (off Ceará State) (Balech, 1971a); Western Atlantic Equatorial waters (Campbell, 1942; Balech, 1971a); South Equatorial Current waters (Brandt, 1906, 1907); Caribbean Sea (Campbell, 1942; Durán, 1957); Gulf of Mexico (Balech, 1967; Lubel, 1974); Gulf Stream waters (Campbell, 1942); Sargasso Sea (Campbell, 1942); Atlantic North Equatorial Current waters (Campbell, 1942); Mediterranean Sea (Travers, 1975); Senegal waters (Silva, 1956a; Durán,1965); Angola waters (Silva, 1954, 1958); Benguela Current waters (Laackmann, 1909); Red Sea (Ostenfeld & Schmidt, 1901; Komarovsky, 1959; Kimor & Golandsky-Baras, 1981); Seychelles Islands waters (Brandt, 1906, 1907); Mozambique Channel (Silva, 1956b, 1960; Travers & Travers, 1965); Malaysia and Western Indonesia· Region (Hada, 1938); Celebes Sea (Taniguchi, 1977); Phillipine Sea (Hada, 1938; Taniguchi, 1977); Marquesas Islands (Kuzmina & Rogachenko, 1980); Great Barrier Reef (Marshall, 1934); California coastal waters (Kofoid & Campbell, 1929); Western Mexican waters (Kofoid & Campbell, 1939; Balech, 1962); Peru-Galapagos waters (Kofoid & Campbell, 1929, 1939; Campbell, 1942); Pacific Equatorial Counter Current region (Kofoid & Campbell, 1929, 1939; Balech, 1962); Easter Island waters (Kofoid & Campbell, 1929).

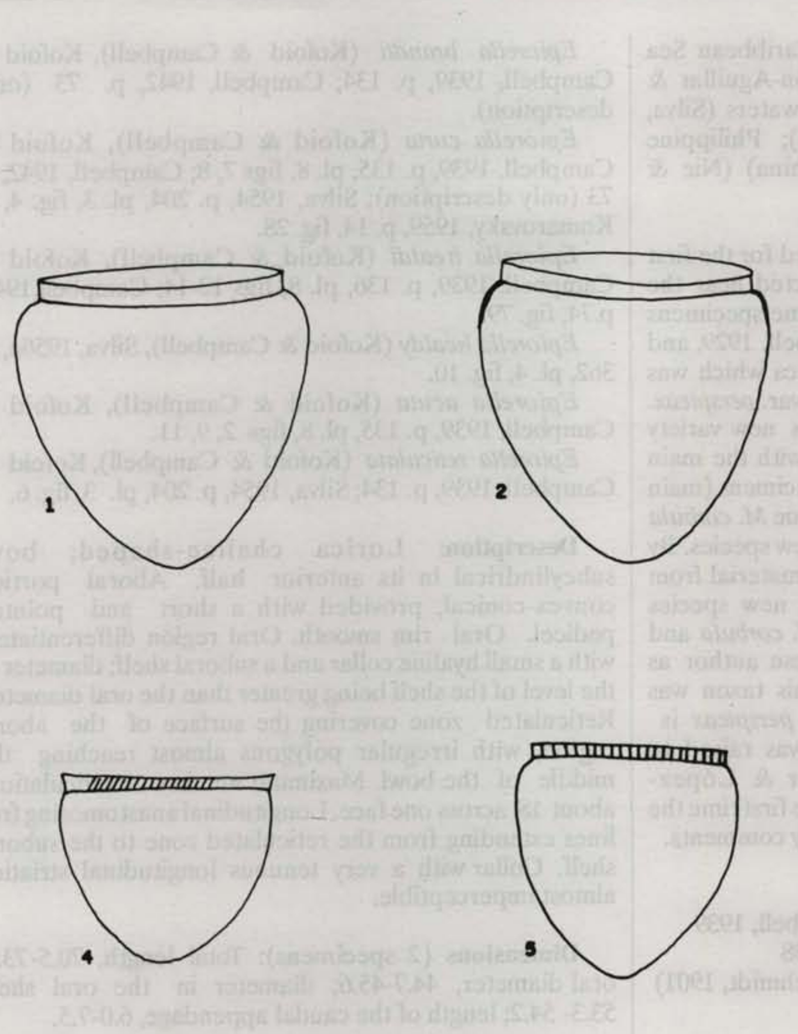

Plate I. *Metacylis mereschkowskyi* (1-6); *Metacylis perspicax* (7-8); *Epilocyloides reticulata* (9).

Remarks: We are in agreement with Hada (1938) and Durán (1965) that *Epiplocyloides acuta, E. brandti, E. curta* and *E. healdi* do not constitute distinct taxa from *E. reticulata*, i.e., they represent only morphological variants. There are some facts that seem to corroborate this viewpoint: 1) Hada (*op. cit.*) found **loricae** attributable to *E. brandti* and *E. healdi*, but he recognized the difficult to separate the specimens into two groups due to gradual modifications in the lorical contour and extent of the reticulate zone; 2) Silva (1954) observed one lorica (pl. 3, fig. 6) whose general shape evokes *E. brandti;* however, other features observed in the same specimen (extent of the reticulate area, presence of elongated suboral meshes, lack of free lines) are typical of *E. reticulata*; and 3) some authors treat *E. acuta* as a variety of the species under discussion (cf. Hada, 1938; Balech, 1962; Kuzmina & Rogachenko, 1980).

From these considerations, it is clear for us that the diagnostic features taken into account for distinguishing the aforementioned species do not allow the establishment of precise limits among them.

Family Ptychocylididae Kofoid & Campbell, 1929
Genus Favella Jörgensen, 1924
Favella ehrenbergi (Claparède & Lachmann, 1858)
(Plate II, Figs 10-15; III, Figs 16-21; IV, Figs 22-24)

For detailed synonymy see Kofoid & Campbell, 1929 and Balech, 1959. We complete the synonymic lists proposed by these authors, including here the following additional entities:

Tintinnus ehrenbergii Claparède & Lachmann, 1858, p. 203, pl. 8, figs 6, 7.

Cyttarocylis ehrenbergii, Entz, Jr., 1909, pp. 97-225, pl. 10, figs 6, 7.

Cyttarocylis ehrenbergi var. *adriatica* (Imhof), Laackmann, 1913, p. 150, pl. 4, figs 54-57; Brandt, 1907, **partim**, p. 211, 212.

Cyttarocylys [**sic**] *ehrenbergi* var. *adriatica*, Faria & Cunha, 1917, p. 71, pl. 26, fig. 2.

Cyttarocylis annulata Daday, 1887a, p. 582, pl. 21, fig. 6; Entz, Jr., 1909, pp. 101-224, pl. 10, fig. 5.

Cyttarocylis (Coxliella) annulata, Brandt, 1906, p. 20, pl. 28, fig. 6; Brandt, 1907, p. 267 (only description); Rossolimo, 1922, p. 28, fig. 22.

"*Cyttarocylis (Coxliella) annulata* Daday (= *C. ampla* ? Jörg.)", Entz, Jr., 1909, pp. 101-224, pl. 10, fig. 1.

Cyttarocylus [**sic**] *(Coxliella) helicoidea* Faria & Cunha, 1917, p. 72, pl. 26, figs 5, 6.

Tintinnus zonatus Zacharias, 1906, pp. 524-525, fig. 11 (as a synonym of *Coxliella annulata*, **fide** Kofoid & Campbell, 1929, p. 104).

[?] *Tintinnopsis helix* var. *cochleata* (Brandt), Laackmann, 1913, **partim**, p. 147.

[?] *Tintinnopsis helix* (forma *subrotundata*) var. *cochleata*, Laackmann, 1913, **partim**, p. 165, pl. 3, fig. 45-47.

Coxliella annulata, Laackmann, 1913, p. 153, pl. 5, figs. 62, 63; Jörgensen, 1924, p. 74, fig. 84; Kofoid & Campbell, 1929, p. 104, fig. 195; Silva, 1952, p. 620, pl. 3, fig. 1; Krishnamurthy *et al.*, 1979, p. 174, fig. 6.

Coxliella (Protocoxliella) annulata, Margaléf & Durán, 1953, p. 61, fig. 22a.

Coxliella decipiens Jörgensen, 1924, p. 74, fig. 85; Kofoid & Campbell, 1929, p. 97, fig. 203.

Favella adriatica, Jörgensen, 1924, **partim**, p. 27; Rampi, 1939, p. 74, fig. 25.

Favella campanula, Balech, 1959, p. 35, pl. 10, figs 154-157; Sassi & Melo, 1982, p. 147, pl. 5, figs 28-32.

Favella fistulicauda Jörgensen, 1924, p. 31, fig. 34; Kofoid & Campbell, 1929, p. 154, fig. 278; Silva, 1953, p. 111, pl. 3, fig. 3.

Favella sp., Carvalho, 1939, p. 36, fig. 3.

Favella ehrenbergii, Kofoid & Campbell, 1929, p. 152, fig. 280; Laval-Peuto, 1981, p. 249-270, figs 1-34; Laval-Peuto, 1983, p. 503-510, fig. 1-8.

Favella ehrenbergii f. *coxliella*, Kršinić, 1980, p. 43.

Favella ehrenbergi var. a Hada, 1937, p. 186, fig. 32.

Favella ehrenbergi, Balech, 1959, p. 33, pl. 9, fig. 146-149, pl. 10, fig. 150-153; Durán, 1965, p. 19, pl. 6, figs 66-68; Hada, 1974, p. 92, fig. 41.

Description: Lorica bell-shaped, hyaline, subcylindrical in the anterior portion and convex conical in the posterior one. Oral rim uneven or entire. Oral region provided with a collar, usually composed of one ring. Nevertheless, it is common the occurrence of loricae with supernumerary (spiraled) collar, consisting of several spiral turns (up to eight, in our samples). Aboral horn without fins, elongate, varying in length and form and sometimes provided with few longitudinal ridges. Wall bilamellate. Reticulation regular.

Dimensions (30 specimens): Total length, 155.0-247.6; oral diameter, 79.5-107.1; height of the collar, 4.0-37.2; length of the caudal appendage, 19.0-52.5.

Occurrence: It was the most frequent and abundant species in the studied region. Present on 07/03/81 (1), 07/17/81 (3), 08/06/81 (4), 08/14/81 (2), 08/21/81 (3), 09/02/81 (1), 10/02/81 (16), 10/09/81 (2), 12/23/81 (2), 02/19/82 (2), 02/26/82 (1), 03/17/82 (3), 04/07/82 (521), 04/16/82 (1), 04/22/82 (2), 05/14/82 (1), 05/27/82 (3), 04/07/83 (1), 04/15/83 (1), 06/01/83 (1), 07/20/83 (1), 09/06/83 (6) and 12/13/83 (1).

Distribution: Southern Brazil (Cunha & Fonseca, 1918; Seguin, 1965); Southeastern Brazil (Faria & Cunha, 1917; Carvalho, 1939; Krau, 1958; Seguin, 1965); Northeastern Brazil (Paranaguá & Neumann-Leitão, 1980; Sassi & Melo, 1982); Caribbean Sea (Durán, 1957); Gulf of Mexico (Marrón-Aguilar & López-Ochoterena, 1969; Lubel, 1974); Northeastern United States (Hargraves, 1981; Stoecker et al., 1981; Capriulo & Carpenter, 1983); Norwegian Sea (Jörgensen, 1899); western coast of Sweden (Hedin, 1975); North Sea (Claparède, 1863, fide Jörgensen, 1924; Cleve, 1900; Breemen, 1905; Meunier, 1919); Portugal waters (Jörgensen, 1924; Silva & Pinto, 1949; Silva, 1950, 1953); southwestern coast of Spain (Jörgensen, 1924; Margaléf & Durán, 1953); west of the Strait of Gibraltar (Jörgensen, 1924); Mediterranean Sea (Daday, 1887a; Zacharias, 1906; Entz, Jr., 1908, 1909; Laackmann, 1913; Jörgensen, 1924; Rampi, 1939, 1950; Durán, 1953; Balech, 1959; Travers & Travers, 1971; Travers, 1975; Kršinić, 1977; Rassoulzadegan, 1978, 1979; Kršinić, 1980; Laval- Peuto, 1981, 1983; Koray, 1983; Koray & Özel, 1983; Abboud-Abi Saab, 1985; Lakkis & Novel-Lakkis, 1985; Kršinić, 1987a, b); Black Sea (Rossolimo, 1922; Jörgensen, 1924); Mauritania coast (Durán, 1965); Guinea-Bissau waters (Silva, 1952);

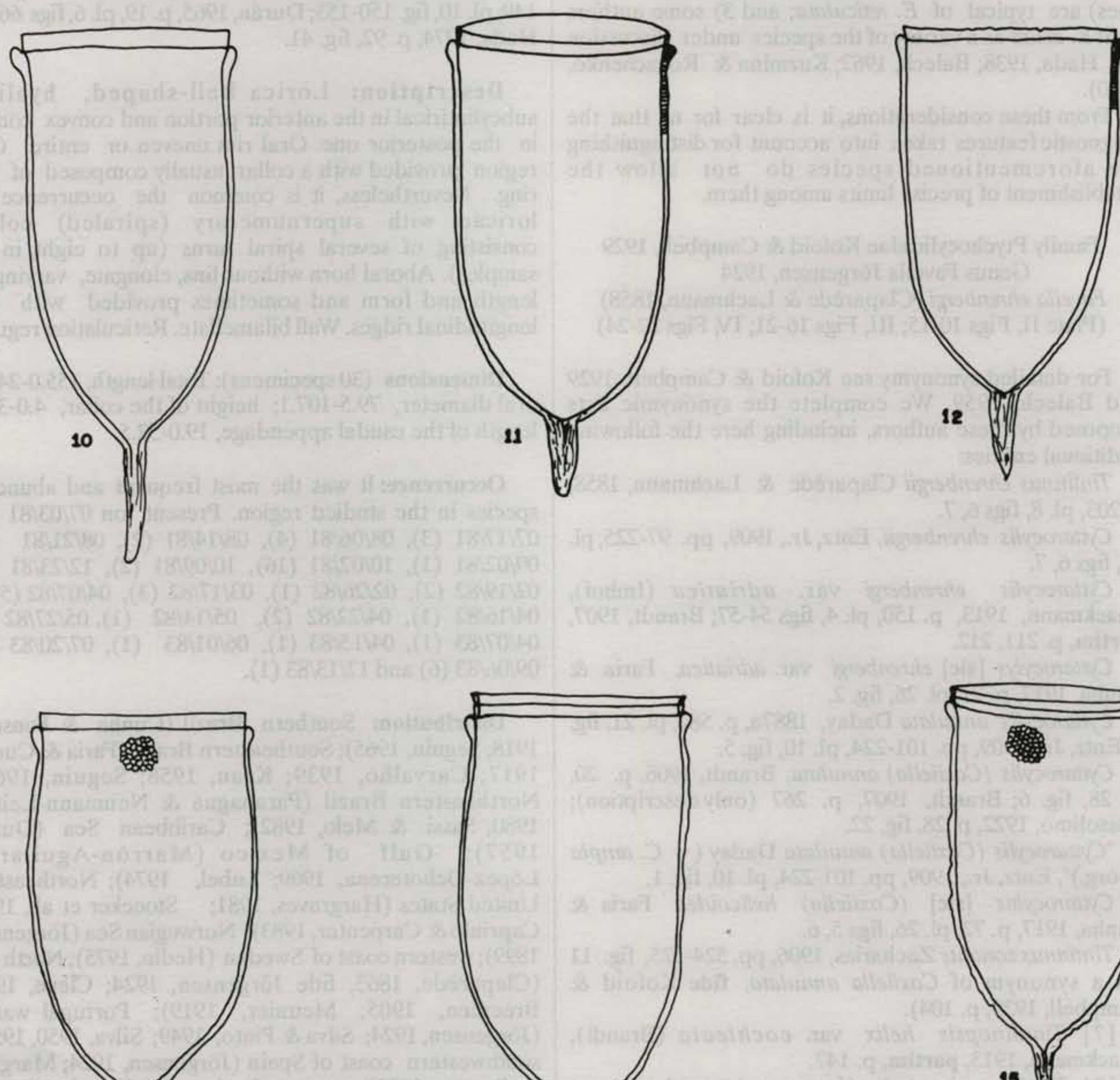

Plate II. *Favella enhrenbergi* (10-15).

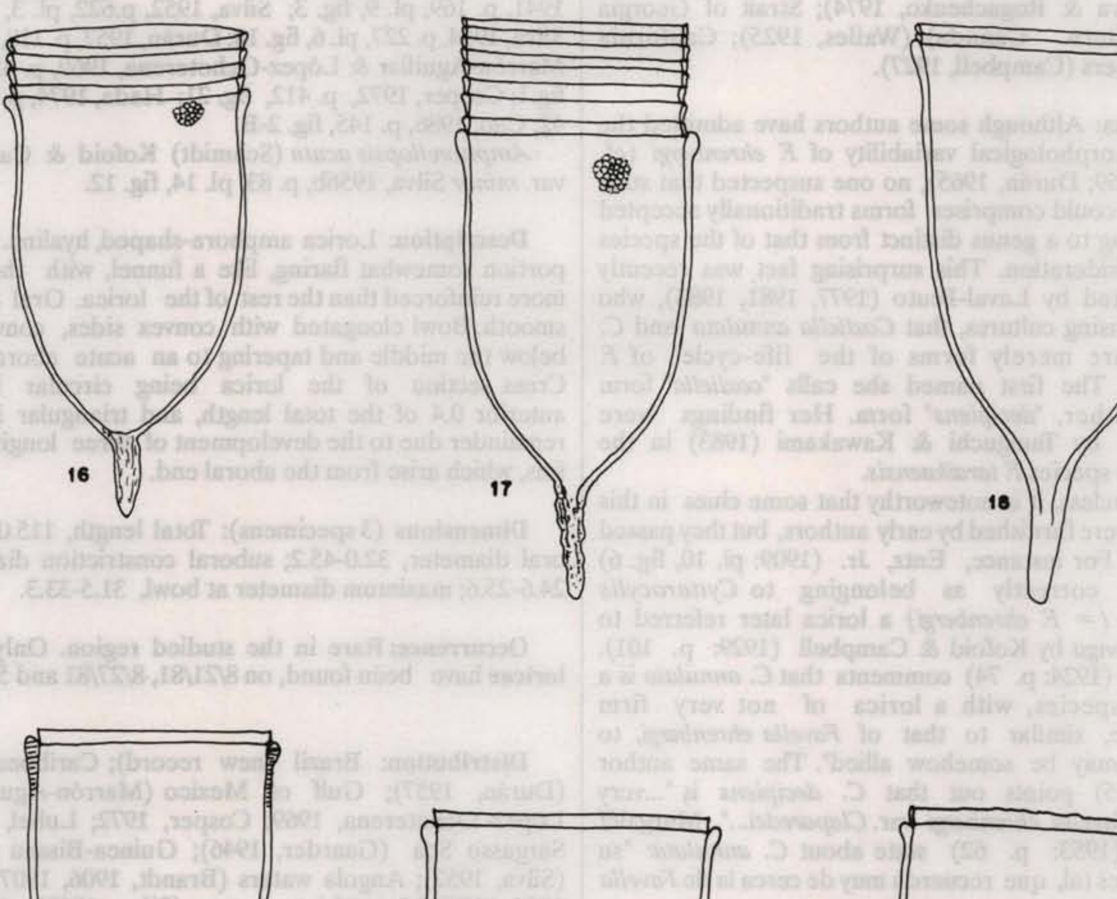

Plate III. *Favella enhrenbergi* **(16-21).**

Angola waters (Silva, 1954); Arabian Sea (Malabar coast, India) (Hada, 1974); Bay of Bengal (Coromandel coast, India) (Krishnamurthy *et al.*, 1978, 1979); Java and Flores Seas (Cleve, 1901); off Shima and Shirahama (Honshu Island, Japan) (Okamura, 1907); Akkeshi Bay (Hokkaido Island, Japan) (Hada, 1937); Japan Sea (Konovalova & Rogachenko, 1974); Strait of Georgia (Southwestern Canada) (Wailes, 1925); California coastal waters (Campbell, 1927).

Remarks: Although some authors have admitted the extreme morphological variability of *F. ehrenbergi* (cf. Balech, 1959; Durán, 1965), no one suspected that such variability could comprises forms traditionally accepted as belonging to a genus distinct from that of the species under consideration. This surprising fact was recently demonstrated by Laval-Peuto (1977, 1981, 1983), who observed, using cultures, that *Coxliella annulata* and *C. decipiens* are merely forms of the life-cycle of *F. ehrenbergi*. The first named she calls *"coxliella"* form and the other, *"decipiens"* form. Her findings were confirmed by Taniguchi & Kawakami (1983) in the congeneric species *F. taraikaensis*.

Nevertheless, it is noteworthy that some clues in this direction were furnished by early authors, but they passed unnoticed. For instance, Entz, Jr. (1909: pl. 10, fig. 6) identified correctly as belonging to *Cyttarocylis ehrenbergii (= F. ehrenbergi)* a lorica later referred to *Coxliella longa* by Kofoid & Campbell (1929: p. 101). Jörgensen (1924: p. 74) comments that *C. annulata* is a "... large species, with a lorica of not very firm consistence, similar to that of *Favella ehrenbergi*, to which it may be somehow allied". The same author (1924: p. 75) points out that *C. decipiens* is "...very similar to *Favella ehrenbergi* var. *Claparedei*...". Margaléf & Durán (1953: p. 62) state about *C. annulata:* "su estructura es tal, que recuerda muy de cerca la de *Favella ehrenbergi*".

Beside these evidences, one should consider that the presence of *C. annulata* and *C. decipiens* is almost always associated to that of *F. ehrenbergi* (and/or its synonyms) in the same sample (cf. Laackmann, 1913; Faria & Cunha, 1917; Jörgensen, 1924; Margaléf & Durán, 1953; Silva, 1953; Balech, 1959; Laval-Peuto, 1981).

We did not observe *"coxliella"* and *"decipiens"* **loricae** in our samples probably due to the rarity of such phenotypes in nature (cf. Laval-Peuto, *op. cit.*).

Considering the highly polymorphic nature of *F. ehrenbergi*, we believe that further studies will demonstrate that *F. adriatica, F. brevis, F. campanula* and probably *C. ampla* are also its synonyms.

On the other hand, the allocation by Kofoid & Campbell (1929) of Laackmann's (1913) *Tintinnopsis helix* (f. *subrotundata*) var. *cochleata* in the synonymy of *C. annulata* (and consequently of *F. ehrenbergi)* is very questionable. The general outline of the **loricae** represented by Laackmann (pl. 3, figs 45-47) lead us to think so. Further, the oral diameter estimated from these figures (34-44 μm) is quite lower than that established for the *"coxliella"* form of *F. ehrenbergi*.

Family Tintinnidae Claparède & Lachmann, 1858
Genus Amphorellopsis Kofoid & Campbell, 1929
Amphorellopsis acuta (Schmidt, 1901)
(Plate IV, fig. 25)

Amphorella acuta Schmidt, 1901, p. 184, fig. 2a-c.
Tintinnus acutus, Brandt, 1906, p. 33, pl. 70, figs 6,7; 1907, p. 435.
Amphorellopsis acuta (Schmidt), Kofoid & Campbell, 1929, p. 315, fig. 598; Hada, 1938, p. 169, fig. 85; Kofoid & Campbell, 1939, p. 334 (only description); Osorio- Tafall, 1941, p. 169, pl. 9, fig. 3; Silva, 1952, p.622, pl. 3, fig. 10; Silva, 1954, p. 227, pl. 6, fig. 18; Durán, 1957, p. 118, fig. 19; Marrón-Aguillar & López-Ochoterena, 1969, p. 45, pl. 1, fig.1; Cosper, 1972, p. 412, fig. 21; Hada, 1974, p. 93, fig. 42; Cao, 1986, p. 145, fig. 2-B.
Amphorellopsis acuta (Schmidt) Kofoid & Campbell var. *minor* Silva, 1956b, p. 83, pl. 14, fig. 12.

Description: Lorica amphora-shaped, hyaline. Upper portion somewhat flaring, like a funnel, with the wall more reinforced than the rest of the lorica. Oral margin smooth. Bowl elongated with convex sides, converging below the middle and tapering to an acute aboral end. Cross section of the lorica being circular in the anterior 0.4 of the total length, and triangular in the remainder due to the development of three longitudinal fins, which arise from the aboral end.

Dimensions (3 specimens): Total length, 115.0-143.7; oral diameter, 32.0-45.2; suboral constriction diameter, 24.6-25.6; maximum diameter at bowl, 31.5-33.3.

Occurrence: Rare in the studied region. Only three **loricae** have been found, on 8/21/81, 8/27/81 and 5/20/82.

Distribution: Brazil (new record); Caribbean Sea (Durán, 1957); Gulf of Mexico (Marrón-Aguillar & López- Ochoterena, 1969; Cosper, 1972; Lubel, 1974); Sargasso Sea (Gaarder, 1946); Guinea-Bissau waters (Silva, 1952); Angola waters (Brandt, 1906, 1907; Silva, 1954, 1958); Mozambique waters (Silva, 1960); Arabian Sea (Malabar coast, India) (Hada, 1974); Bay of Bengal (Coromandel coast, India) (Naidu *et al.*, 1977); Malaysia and western Indonesia region (Hada, 1938); Phillipine Sea (Hada, 1938); off Baja California (Balech, 1962); Southern California coastal waters (Heinbokel, 1978); Panama waters (Kofoid & Campbell, 1939); Eastern Tropical Pacific (19°57'30" N, 129°44' W; 31°08'30" N, 143°39' W and 28°15' S, 96°54' W) (Balech, 1962); Argentina waters (Cao, 1986).

Remarks: We do not accept the variety **minor** of Silva (1956**b**) since the dimensions and morphological features of her specimens fall within the variability range observed for this species.

Dadayiella ganymedes (Entz, Sr., 1884)
(Plate IV, Fig. 26)

(For complete synonymy and world distribution of this species, see Sassi & Melo, 1986).

Description: Lorica tubulose, with sides slightly diverging towards oral region and converging aborally. Oral rim tenuous, which makes its perception difficult. Upper quarter of the lorica provided with six longitudinal lines; the greatest among them reaching beyond the oral margin. Caudal appendage narrow and elongated.

Dimensions (1 specimen): Total length, 106.6; oral diameter, 33.5; maximum transversal diameter, 27.5; length of the caudal appendage, 21.5; medium diameter of the caudal appendage, 3.5.

Ocurrence: Only one specimen was observed in the studied period on 7/17/81.

Remarks: This is a well known marine species, assigned for tropical and temperate waters around the world. It presents a reasonable degree of polymorphism, with variations in total length, general contour of the lorica, number of longitudinal lines and shape of the caudal appendage (Hada, 1938).

Eutintinnus tubulosus (Ostenfeld, 1899)
(Plate IV, Figs 27-31).

Tintinnus tubulosus Ostenfeld, 1899, p. 439, fig. 2f; Kofoid & Campbell, 1929, p. 340, fig. 651; Hada, 1937, p. 211, fig. 53.

Eutintinnus tubulosus (Ostenfeld), Kofoid & Campbell, 1939, p. 374, pl. 32, fig. 8; Durán, 1951, p. 106, fig. 1a (**non** fig. 1b = *E. lususundae*); Silva, 1954, p. 231, pl. 7, fig. 12; Balech, 1959, p. 58, pl. 21, figs 316-318; Balech, 1962, p. 110, pl. 14, figs 184, 185; Marrón-Aguillar & López-Ochoterena, 1969, p. 47, pl. 1, fig. 6; Balech, 1971**b**, p. 181 (only description); Cosper, 1972, p. 413, fig. 26.

Tintinnus lusus undae Entz, Daday, 1887**a**, p. 527, pl. 18, fig. 3, 14; 1887**b**, p. 159-208, pl. 1, fig. 1.

Tintinnus lusus-undae var. a *tubulosa* (Ostenfeld), Brandt, 1906, p. 32, pl. 65, fig. 14.

Tintinnus lusus-undae var. *tubulosus* (Ostenfeld), Jörgensen, 1924, p. 10, fig. 2.

Tintinnus lusus-undae var. *tubulosa* (Ostenfeld), Jörgensen, 1927, p. 9, fig. 9.

Tintinnus exigua Hada, 1932, p. 570, fig. 24.

Eutintinnus elegans Balech, 1942, p. 248, fig. 6.

Eutintinnus australis Balech, 1944, p. 443.

Description: Lorica hyaline, tubular, as a truncated cone, and with sides almost straight. Wall without visible structures and rarely with foreign bodies adhered. Oral end very slightly expanded outward. Aboral extremity without expansion.

Dimensions (6 specimens): Total length, 154.0-160.5; oral diameter, 37.8-44.1; aboral diameter, 34.5-41.1.

Occurrence: Only eleven specimens were found in the subsamples examined. They were observed on 2/5/82 (1), 4/20/83 (4), 8/11/83 (1) and 12/13/83 (5).

Distribution: Brazil (new record); Western Atlantic Equatorial waters (Balech, 1971*a*); Gulf of Mexico (Balech, 1967; Lubel, 1974); North Atlantic waters (Ostenfeld, 1899); western coast of Sweden (Hedin, 1975); northwestern coast of Spain (Margaléf & Durán, 1953); Mediterranean Sea (Vitiello, 1964; Travers & Travers, 1971; Travers, 1975; Kršinić, 1980, 1982, 1987**a,b**); off Namibia (Kruger, 1980); Mozambique waters (Silva, 1960); Mutsu Bay (Honshu Island, Japan) (Hada, 1932); Philippine Sea (Taniguchi, 1977); South Equatorial Pacific Current (Balech, 1962); Pacific Southern Gyrals (Balech, 1962); Peru Current (Balech, 1962; Uribe & Castillo, 1982); Chilean waters (Uribe & Castillo, 1982); Drake Passage (Balech, 1971**b**); Patagonia waters (Southern Argentina) (Balech, 1942, 1944, 1971**b**; Souto, 1972); off Plata River mouth (Northeastern Argentina) (Balech, 1971**b**).

Remarks: Most of the criteria used to distinguish the species of *Eutintinnus* are very subjective. Therefore, the actual status of this and other allied species (*E. pacificus* (Kofoid & Campbell), *E. pinguis* (Kofoid & Campbell) and other trumpet-shaped species as *E. lususundae* (Entz, Sr.)) should be revised using material from different sites as there is no significant morphological and metric differences within their limits of separation, according to the data of the literature.

Beside the intraspecific variability, some of the differences found among them may be also attributed to the position in which the specimens are seen under the microscope or to deformations of the lorica due to coverslide pressure. Our Figure 29 reinforces such comment since it presents a clear intoward aboral inflexion of the lorica, which is not observed in another position (Fig. 28) of the same specimen.

Discussion

The coastal reefs of Ponta do Seixas present a very poor fauna of hyaline Tintinnina as only seven species were found in this ecosystem during a period of two complete years. Only *Metacylis mereschkowskyi* and *Favella ehrenbergi* were the most frequent and abundant species found in the studied area.

Except *F. ehrenbergi*, *Epiplocyloides reticulata* and *Dadayiella ganymedes*, all species constitute new records from Brazil. *Metacylis perspicax* also represents the seventh world citation.

The low diversity and the low density of these protozoans may be associated with food availability, turbulence of the local water mass, and grazing pressure by predators.

According to Sassi (1987), the phytoplankton from Ponta do Seixas reefs is dominated by small diatoms and phytoflagellates. We believe these organisms may not be important as alimentary items for most of the hyaline Tintinnina found in the region. We also think these protozoans are opportunistic, showing intensive growth when a more appropriate food is available. The greater success of *M. mereschkowskyi* and *F. ehrenbergi* upon the other species by colonizing the region most vigourously during some months may be a reflection of this aspect.

Sassi *(op. cit.)* has shown that this region is oligotrophic, although mesotrophic features arise during the rainfall season (March to August) when a moderate phytoplanktonic pulse occurs due to the enrichment of the local water mass by continental runoff. Accordingly, the maximum densities of *F. ehrenbergi* and *M. mereschkowskyi* were observed during these months in 1981/1982. At that time, the samples examinations revealed several specimens belonging to these species with several small phytoplanktonic phagocytated cells. The absence of any intensive growth of these species during 1983 seems to reinforce their opportunism, as well as the hypothesis of appropriated food items for growth, as pointed out above.

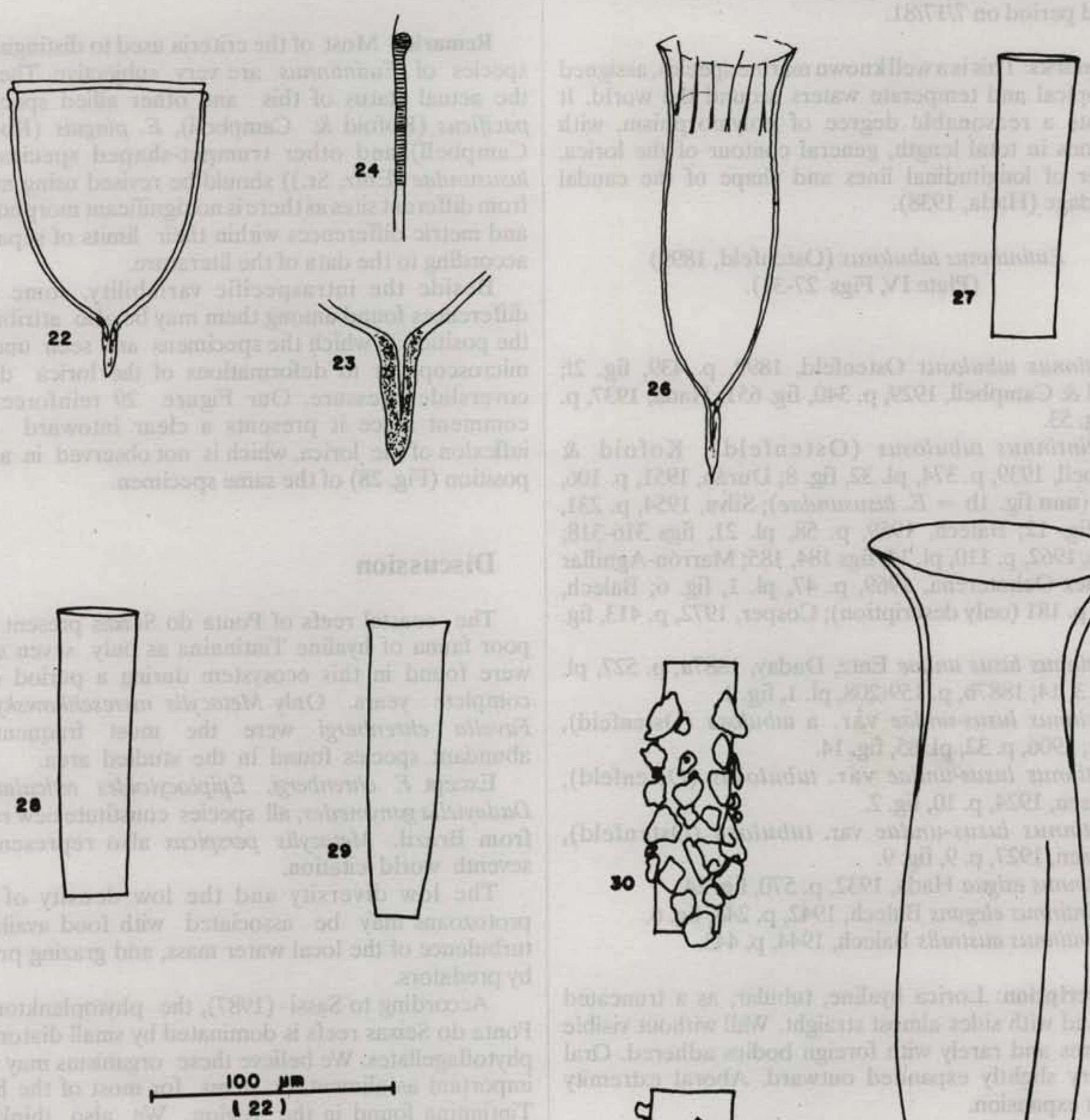

Plate IV. *Favella ehrenbergi* (22-24); *Amphorellopsis acuta* (25); *Dadayiella ganymedes* (26); *Eutintinnus tubulosus* (27-31).

The importance of predators to regulate the diversity and density of the hyaline Tintinnina in the studied region is most difficult to avail, as no data exist for greater zooplankton. Nevertheless, considering the coral are primarily zooplanktophagous, we think the predation of these benthic animals upon the microzooplankton organisms (including Tintinnina) could not be neglected.

It is also relevant to mention the importance of the turbulence. Sassi (*op. cit.*) mentioned the dynamics of the studied region under the hydrographic viewpoint. The surf (resulting from the wave impact upon the reef barrier and near the beach), the drift coastal current (of S-N direction) as well as the wind action may select species adapted to turbulent waters and, at the same time, may limit the growth of those adapted to more stable areas. Regarding this approach we think that the greater frequency of *F. ehrenbergi* and *M. mereschkowskyi* in the studied region should indicate a higher preference of these species for most turbulent zones than the other hyaline species found there. Nevertheless, in conditions of high turbulence one would expect to find more agglutinated Tintinnina, as pointed out by Capriulo *et al.* (1982). The increasing of turbulence would lessen the energy costs used to escape from predators and to maintain their position in the euphotic zone. As agglutinated Tintinnina have a heavier and most rigid lorica due to adhered particles, they could be more favoured than the hyaline Tintinnina (whose lorica is more delicate and could be easily damaged by the turbulence actions) in such highly turbulent environments, becoming most diversified and abundant in coastal zones. By the way, Souto (1970**b**) has observed agglutinated Tintinnina, as *Tintinnopsis*, *Stylicauda* and *Stenosemella* predomin[illegible] shallow coastal waters, and the hyaline Tintinnina [illegible]dominantly in offshore samples. Cao (1986) has also observed the abundance of agglutinated Tintinnina *(Leprotintinnus, Tintinnopsis, Tintinnidium, Stylicauda* and *Codonellopsis)* in estuarine biotopes and of hyaline Tintinnina *(Helicostomella, Favella, Metacylis, Amphorellopsis, Eutintinnus* and *Salpingella)* in sites most influenced by oceanic waters.

The presence of hyaline or agglutinated **loricae** among Tintinnina may be a survival strategy. As pointed out by Capriulo *et al.* (1982), hyaline lorica becomes less visible and is more difficult to be captured by visual predators. Although devoid of adhered particles, these ciliates are still negative buoyant and have substantial sinking rates, which permit them to escape from slower swimming predators, while remaining inconspicuous to the larger visual feeders. The agglutinated lorica is heavier and present faster sinking rates which also increase the possibility of escaping from predators, although this could increase the energetic cost for their swimming and maintainance in the euphotic zone.

Although in agreement with Capriulo *et al.* *(op. cit.)* in the above mentioned considerations we must remember Gold (1979), who has observed non-agglutinated **loricae** in experimental culture studies, formed by species with normally agglutinated **loricae** in the absence of particles. Also Bernatzsky (1981) (**fide** Laval-Peuto & Brownlee, 1986) has observed that in freshwater Tintinnina the agglutination depends on the environment and season. Accordingly, we also found some **loricae** of *Eutintinnus tubulosus* (normally a hyaline Tintinnina) with foreign particles adhered (Figs 30-31).

Regarding the systematic viewpoint, we also stress the necessity for further studies using the soft body (cytological data), as the traditional lorical classification is very arbitrary. Large number of the nearly 1,200 species of known Tintinnina, probably were injustifiably created, as most of them could represent only intraspecific variations of polymorphic species. As pointed out by Durán (1965), although great efforts have been carried out by several authors, a lamentable imprecision in the species diagnosis of these ciliates still remains. Indeed, the magnific morphological changes in the lorica of *F. ehrenbergi* to *"coxliella"* and *"decipiens"* forms, as demonstrated by Laval-Peuto (1981) in "**in vivo**" studies, show how much is still inconsistent the systematics of these important microzooplankters.

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