FULL LENGTH ARTICLE

Tintinnids (Protozoa: Ciliata) from the coast of Hurghada Red Sea, Egypt

Mohamed M. Abou Zaid *, Ahmed M. Hellal

Marine Biology and Ichthyology Section, Zoology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt

Available online 18 February 2013

KEYWORDS
Red Sea; Egypt; Plankton; Taxonomy; Protozoa; Ciliata; Tintinnids

Abstract An examination of plankton samples collected from the inshore and offshore waters in the vicinity of Hurghada area in the Egyptian Red Sea coast revealed the presence of a diverse community of planktonic tintinnids (Protozoa). Ninety two tintinnid species belonging to 13 families and 30 different genera are described and illustrated in the present paper. Most of the species recorded in the present work were previously known from tropical waters, some are cosmopolitan, while a few are cold water inhabitants. A comparison between the present data and that previously recorded in the Red Sea and/or adjacent area indicated large differences in records to the favor of the present work (60 new records).

© 2013 National Institute of Oceanography and Fisheries. Production and hosting by Elsevier B.V. All rights reserved.

Introduction

Tintinnids (Protozoa: Ciliata) have been known to marine biologists since the beginnings of plankton study (Haeckel, 1873; Daday, 1887), and records for tintinnid occurrences appear from all the oceans of the world (Pierce and Turner, 1992). Pierce and Turner (1993) reviewed tintinnid distributions, yet few recent studies provide quantitative data on tintinnid diversity in coastal (Cariou et al., 1999; Dolan and Gallegos, 2001; Modigh and Castaldo, 2002) and offshore waters (Dolan and Marrasé, 1995; Thompson et al., 1999; Dolan, 2000; Pitta et al., 2001).

In contrast to other microorganisms, such as the benthic ciliates, for which local and global diversity is similar, i.e. “everything is everywhere” (Fenchel et al., 1997), most tintinnid taxa are not cosmopolitan (Pierce and Turner, 1993) and latitudinal trends in tintinnid species diversity have been described (Dolan and Gallegos, 2001).

A major barrier to defining tintinnid biogeography is poor understanding of tintinnid taxonomy. This taxonomy is based upon morphology of the lorica, or shell. Because tintinnid lori- cae are relatively sturdy, preserve well and are captured in fine-meshed plankton nets. There are many records of tintinnid occurrences scattered throughout the literature. In addition to studies on tintinnids or micro-zooplankton, many such records come from collection in phytoplankton samples.

Unfortunately, from a taxonomic point of view, sizes and shapes of tintinnid lori- cae are highly variable within species. This variability has led to a proliferation of described species, many of which are probably invalid. Recent re-examinations of several tintinnid species and genera have resulted in suggestions to reduce many species to synonyms (Burkovskii, 1973; Bakker and Phaff, 1976; Davis, 1978, 1981; Laval-Peuto,
Considerable research has been carried out on the abundance and species composition of tintinnid protozoans in the world’s oceans (Hedin, 1976; Kimor and Golandsky, 1977; Kimor and Golandsky-Baras, 1981; Capriulo and Carpenter, 1983). Recently, and with the development of staining techniques, which allows comparisons of infra ciliary patterns, a noticeable increase in the frequency for tintinnid taxonomy was noticed (Brownlee, 1977; Sniezek et al., 1991; Snyder and Brownlee, 1991; Choi et al., 1992).

Most previous plankton works done in the Red Sea area were focused on either the large-size portion of the plankton, mainly zooplankton that exceeds 200 \( \mu \) (Delalo, 1966; Halim, 1969; Kimor, 1973; Echehnan and Fishelson, 1990; Almeida Prado-Por, 1990; Abd El-Rahman, 1993; Dowidar, 1994; Khalil and Abd El-Rahman, 1997) or on phytoplankton (Belogorskaya, 1970; Kimor and Golandsky, 1977; Al-Najjar et al., 2003). To the author’s knowledge, no work has been done on the marine planktonic tintinnids of the Red Sea except that of Komarovsky (1959) in the Gulf of Aqaba (Eylath) and most authors neglected even to mention their presence although no plankton sample collected in these waters was devoid of tintinnids. The present paper is an attempt to shed some light on the species of the order Tintinnida (Protozoa: Ciliata) collected from the inshore and offshore waters of Hurghada area at the coast of the Egyptian Red Sea during the period from winter 2009 to spring 2011.

Materials and methods

Samples collection

The study area included the inshore and the off-shore areas around Hurghada city as indicated in Fig. 1. The plankton samples were collected seasonally during the period January 2009 till March 2011 using a 55 \( \mu \) net. Offshore samples were collected from areas around the islands. Samples were examined under a research compound microscope; photos were taken using digital camera (3 mega pixels) mounted on the microscope. Measurements were done using calibrated images of slide micrometer using Image-Pro image analysis software.

Systematic: identification of samples

The identification of samples collected in the present paper follow the literature based entirely on the shape of the loric and its dimensions such as Meunier (1919), kofoid and Campbell (1929), Hada (1938), Komarovsky (1959), Marshall (1969), Balech (1975) and Sharaf (1995). However, for certain species a special publications were used including Fernandes (2004), Agatha and Riedel (2006) and Agatha and TSAI (2008). For confirmation of the identified species several data basis on the World Wide Web was consulted.

Classification criteria applied

Classification criteria applied in the present study depends mainly on the overall structure of the Lorica (Fig. 2) which considered being the primary classification criterion used for the classification of the modern Tintinnids. These criteria included: (A) shape of the Lorica (corolla). (B) Surface ornamentation. (C) Presence or absence of Collar. (D) Shape of the calyx. (E) Presence and number of stems. (F) Type of stems. (G) Collar ornamentation. (H) The thickness of the wall is not used as a classification criterion here because loric wall increase in thickness during life.

A typical ideal tintinnid

The shape of the animal in the swimming state is usually comanulate or conical. below mostly more or less abruptly

![Figure 1](image-url)  
Figure 1  Map indicating the study area and the collecting stations.
narrowing into pedicle, fixed at bottom or lateral wall of the Lorica, frequently on one side with some myofibrils, passing over into lower half of the body (Fig. 2).

Sometimes the body is only attenuated below, in other cases divided into 2–4 short pedicles. At the upper end the body is more or less broad peristomial disc, surrounded by a tubular incrassate peristomial collar, carrying on its top a wreath-or rather, ventrorse spiral of usual 16–24 powerful, long and narrow triangular, obliquely fixed ciliary plates, the membranelles or pectinelles.

The peristomial disk, sunk into the upper end of the body carries the mouth in a more or less deep eccentric “preoral cavity”, where some of the membranelles descend. About in the middle of the disc there is a more or less thick and elevated “piston” which sometimes shows a pumping motion. The membranelles somewhat resemble long and narrow knives with their backs turned outwards, they are more or less deeply fringed into cilia. The peristoma collar appears frequently or mostly lobulated, with rounded lobes, the membranelles being inserted lower down and interstices occupied by more or less elevated plasma bodies running parallel to the insertion lines of the membranelles. In these interstices between the bases of membranelles, on the inner side of the peristome collar there are in certain species peculiar stalked, clavated or tentaculiform organelles called tentaculoids, which seems to be variable in shape and length and therefore perhaps very contractile especially in living animals.

Between the collar and the body there is frequently a more or less marked constriction. Commonly, the body is provided with more or less long and distant longitudinal rows of generally short cilia, also another lateral field of cilia may be found in one side, below the peristome collar (Fig. 2). Most of marine tintinnids have proved to possess two large roundish or ovoid macronuclei, each with smaller, rounded micronucleus.

**Results and discussion**

**Systematic account**

The examination of the collected planktonic samples revealed the presence of 92 species belonging to 30 genera and 13 families. The most dominant family in terms of species number was family Tintinnidae being represented by 19 species belonging to seven genera. The following is a synopsis of the recorded taxa.

**Family: Codonellidae** (Kent, 1882)

**Genus: Tintinnopsis** (Stein, 1867)

1. *Tintinnopsis cylindrica* (Daday, 1887) (Plate I, Fig. 1)

   **Diagnostic characters:** Loricae 75–220 μm long and 34–56 μm wide, orally after preservation with Lugol’s iodine solution; pasteur pipette-shaped, viz., cylindroidal for about two thirds of total length, anterior end transversely truncate, posteriorly tapered, merging into cylindroidal process; process aborally open, usually transversely truncate, straight, variable length (8–11 μm in diameter); hyaline matrix incrusted (various degrees) with particles of non-biogenic origin, diatom (frustules fragments, and green globular organisms); distinct spiraled or annulated structures non-recognizable.

2. *Tintinnopsis campanula* (Ehrenberg, 1840) (Plate I, Fig. 2)

   **Diagnostic characters:** Loricae 75–220 μm long and 34–56 μm wide, orally after preservation with Lugol’s iodine solution; pasteur pipette-shaped, viz., cylindroidal for about two thirds of total length, anterior end transversely truncate, posteriorly tapered, merging into cylindroidal process; process aborally open, usually transversely truncate, straight, variable length (8–11 μm in diameter); hyaline matrix incrusted (various degrees) with particles of non-biogenic origin, diatom (frustules fragments, and green globular organisms); distinct spiraled or annulated structures non-recognizable.

3. *Tintinnopsis gracilis* (Kofoid and Campbell, 1929) (Plate I, Fig. 3)

   **Diagnostic characters:** Finger-like lorica, cylindrical in the upper 2/3; diameter decreases to give conical bluntly pointed

---

Figure 2  Illustrated diagram of a typical tintinnid animal.
aboral end; mouth not flaring with smooth rim; wall coarse, covered by sand and foreign particles; length to oral diameter ratio (L/OD) about 3.3:1. The present form has almost the same diameter from the mouth to the lower 1/3 of the loria; posterior 1/3 of bowl sometimes slightly swollen.

4. *Tintinnopsis davidoffi* (Daday, 1887) (Plate I, Fig. 4)

**Diagnostic characters:** loria length 110 μm (~3–4 oral diameter), bullet-shaped, with aboral spine (45 μm); oral margin ragged; bowl usually cylindrical, sometimes slightly constricted in its middle; aboral region with pointed tip forming an inverted cone of 80–95°, with a long (33–48 μm), somewhat irregularly curved, hyaline spine; wall composed of rather minute foreign particles.

5. *Tintinnopsis radix* (Imhof, 1886) (Plate I, Fig. 5)

**Diagnostic characters:** loria tubular, elongate, slender, sometimes entirely regular; not flaring oral rim; aboral region gradually narrow in the lower 1/4–1/3 toward pedicel; pedicle usually laterally formed aboral opening; spiral structure clearly visible from the mouth down to the aboral cone. More dense agglomerated particles near the mouth and pedicle, but fewer elsewhere; L/OD 6.4–6.7:1.

6. *Tintinnopsis corniger* (Hada, 1964) (Plate I, Fig. 6)

**Diagnostic characters:** loria tubular, not-flaring, covered with sand and foreign particles; aboral horn more than 1/3 of the total length, branched, hyaline with 1–4 brandies; sometimes fine reticulation visible on the horn; L/OD 5.4–6.9:1.
7. *Tintinnopsis lobiancoi* (Daday, 1887) (Plate I, Fig. 7)

**Diagnostic characters:** lorica, 150 μm length (=4.5 times oral diameter), elongate, tubular, usually straight; oral rim ragged; aboral end rounded, somewhat irregularly; wall thin, equal 0.04 μm oral diameter in thickness, roughly agglomerated; no spiral structure.

8. *Tintinnopsis tocanitensis* (Kofoid and Campbell, 1929) (Plate I, Fig. 8)

**Diagnostic characters:** lorica with two sub-equal parts, length 85 μm, cylindrical oral and aboral bulbous; no spiral structure; aboral horn stout; wall thick coarse and covered by sand and foreign particles. This species differs from very closely related species, *Tintinnopsis apertura* in longer and enlargement bulbous and stouter horn.

9. *Tintinnopsis nana* (Lohmann, 1908) (Plate I, Fig. 9)

**Diagnostic characters:** small, short and rare species; lorica tubular, straight with entire oral rim; aboral end rounded; wall thinly agglomerated; L/OD 2:1. Species is considered rare.

10. *Tintinnopsis compressa* (Daday, 1887) (Plate I, Fig. 10)

**Diagnostic characters:** lorica small with wide flaring collar (about twice as wide as bowl) and marked sub-oral constriction leading to a rounded aboral end; bowl wider at the middle; wall coarsely agglomerated; L/OD 4–5:1. This species slightly variable in shape depending on the geographical area, however the examined specimens agree with those previously recorded from the Red Sea.

11. *Tintinnopsis orientalis* (Kofoid and Campbell, 1929) (Plate I, Fig. 11)

**Diagnostic characters:** lorica small, 70–73 μm length, oral diameter 25 μm with flaring oral region and a smooth constriction; bowl rounded with a minute point, widest just below its middle but less wide than the flaring collar; L/OD 1.3–1.4:1.

12. *Tintinnopsis rotundata* (Kofoid and Campbell, 1929) (Plate I, Fig. 12)

**Diagnostic characters:** rare species with cylindrical lorica and hemispherical aboral end; thickly encrusted with particles; L/OD 1.3–2:1

**Genus: Codonella** (Haeckel, 1873)

13. *Codonella amphorella* (Biedermann, 1893) (Plate II, Fig. 1)

**Diagnostic characters:** lorica short, wide, divided by constriction into rounded bowl and upper collar, often with inner ledge corresponding to outer constriction; sometimes mouth bordered with collar rim; collar length equal 1/4–1/5 total length, spiraled annulated, never longer than bowl; aboral end with short pedicel; wall off from bowl.

14. *Codonella galeai* (Haeckel, 1873) (Plate II, Fig. 2)

**Diagnostic characters:** lorica with rotund ovate bowl (=1.57 oral diameters), ovoid, elegant with flaring collar, 85–90 μm length; collar is an inverted segment of a cone (35°), about 1/4 total length, flaring, with hyaline border on oral rim, slightly inner ledge; aboral end broadly rounded, sometimes with minute point; thin-edged oral rim surrounded by a narrow hyaline band; sides are slightly convex in the middle; ovate bowl expands rapidly from the neck, reaches 1.07 oral diameters at its middle, then slowly contracts to the blunt, broad and sub-rotund aboral end.

15. *Codonella nationalis* (Brandt, 1906) (Plate II, Fig. 3)

**Diagnostic characters:** lorica small, 15–23 μm length; oral rim flared; collar about 1/3 total length, cylindrical, slightly flaring with hyaline border; bowl almost globular with distinctly globosely shaped; aboral horn strong.

16. *Codonella daday* (Kofoid and Campbell, 1929) (Plate II, Fig. 4)

**Diagnostic characters:** lorica length about 80–120 μm (=1.95 oral diameter), elongated.; oral rim flared and low; collar 0.4 oral diameters high, flaring 10°; bowl pointed ovate posteriorly, widest at the middle, its posterior 0.5 a wide cone of 90°; collar cylindrical or slightly flaring with hyaline border, about 1/3 total length; bowl almost globular; with distinctly globosely shaped; aboral horn strong.

**Genus: Porococcus** (Cleve, 1902)

17. *Porococcus curtus* (Kofoid and Campbell, 1929) (Plate II, Fig. 5)

**Diagnostic characters:** lorica tall, gobot-shaped, equal 3.2 oral diameter in length; oral margin almost entire; bowl sub-cylindrical, slightly tapering; aboral region abruptly narrowing with a tubular horn (=0.42 of the total length); wall bearing coccoliths fixed thicker on the surface at posterior part than on the anterior one.

**Family: Codonellopsidae**

18. *Codonellopsis schabi* (Biedermann, 1893) (Plate II, Fig. 6)

**Diagnostic characters:** lorica length 84–104 μm, divided into cylindrical collar and oval bowl, covered by sand and foreign particles; collar more than 1/3 of the total length with little constriction below the slightly flaring mouth, then dilated in the middle; about 12 spiral turns present on the collar, crowded near the mouth and further apart towards the bowl; few fenestrac present at the middle of the collar; bowl wider at the middle, terminates with a blunt aboral end; L/OD 2.3–3.0:1.

19. *Codonellopsis morchella* (Cleve, 1900) (Plate II, Fig. 7)

**Diagnostic characters:** lorica length 65–95 μm; collar somewhat with flaring rim, slightly bulging near its middle, usually lower than the bowl; 4–11 spiral turns present with few elliptical fenestrac; bowl generally ovate, (equal 1.5–1.7 as oral diameters); aboral region convex, conical; aboral end usually round or rarely bluntly pointed; wall of bowl thick, coarsely agglomerated; L/OD 2.2–3.2:1.

20. *Codonellopsis orcinialis* (Hada, 1932) (Plate II, Fig. 8)

**Diagnostic characters:** lorica divided into cylindrical collar and oval bowl, covered by sand and foreign particles; collar with little constriction below slightly flaring mouth, more than 1/3 total length; about 12 spiral turns present on collar, spirals crowded near the mouth and further apart towards bowl; few fenestrac are found at the middle of collar; bowl wide at the middle and terminates with a blunt aboral end; L/OD 2.3–3.0:1 to oral ratio is 2.3–3.0.

21. *Codonellopsis orthoceras* (Haeckel, 1873) (Plate II, Figs. 9 and 10)

**Diagnostic characters:** lorica length 325 μm, with long tubular collar (about 1/2 total length) and ovoid bowl; collar with flaring mouth with slightly concave outline, narrowest at the middle then wider towards the mouth and bowl; about 33 spiral turns are present on collar, more crowded towards the mouth; bowl with neck below the collar and stout pedicel (about 1/7 total length), covered with coccoliths; L/OD 3.8:1.

22. *Codonellopsis ostenfeldi* (Schmidt, 1901) (Plate II, Fig. 11)

**Diagnostic characters:** lorica length 101–195 μm; collar cylindrical, slightly flared at mouth, more or less long, with variable length (1.3–2.3 total length); 10–17 spiral turns and 4–13 fenestrac present, horizontal lines seen between the fene-
strac rows; upper turns below mouth usually without fenestrac; bowl oval and covered with large sand particles; L/OD 2.6–5.0:1.

23. *Codonellopsis erythraensis* (Brandt, 1905) (Plate II, Fig. 12)

Diagnostic characters: lorica length 87 lm, tall top-shaped, (=2.6 oral diameters in length); collar equal 0.6 length of bowl, flaring abruptly below the rim and expanding below the constriction; nine spiral turns widening towards the bowl; bowl acorn-shaped, with abrupt shoulder, wide (1.34 oral diameters) little below collar, orally an inverted convex cone present; aboral end sub-hemispherical; wall exceedingly thick, with primary, secondary and tertiary structure. This species is very closely to *Codonellopsis indicia* in shape.

Family: Cyttarocylididae
Genus: *Cyttarocylis* (Fol, 1881)

24. *Cyttarocylis magna* (Brandt, 1906) (Plate III, Fig. 1)

Diagnostic characters: lorica length 250–320 lm, with very large elongated funnel shaped and slightly flaring, scarcely emergent collar; oral margin thin, averted, with 78 irregular trabecular forming polygons projections; stout, sometimes bifurcate teeth present; bowl conical and more convex aboral-
ly; aboral end with short, blunt, projecting diminutive horn
(2.18–2.36, aver. 2.25 oral diameters). Collar slightly differen-
tiated from bowl by an angular change in contour and inverted
truncate section of the cone.

25. **Cyttarocylis conica** (Brandt, 1906) (Plate III, Fig. 2)

*Diagnostic characters:* lorica length 170–210 μm, hyaline;
oral diameter 122.8 μm; robust brew compost by basket, sepa-
rated by construction, and project to form inverted truncated
cone with parallel sides; pro-life oral boarder denticles, hyaline
discreet;, wall conical, regularly reticulated with about 50 poly-
gons at the sub-oral circumference and 35–40 at meridian;
aboral squarely truncated (=0.2 oral diameter) with minute
point.

26. **Cyttarocylis brandti** (Kofoid and Campbell, 1929) (Plate
III, Fig. 3)

*Diagnostic characters:* lorica length 90–120 μm, aborally
blunt, acorn-shaped, 0.87–0.98 oral diameter in length; oral
margin finely denticulate; collar with slightly convex sides form
short basal segment of an inverted truncated cone (90–100°);
nuchal shelf thin, upturned (50°) forming ridge at the throat;
bowl baggy forming convex conical (about 35° at the upper
end and 130° near the apex); aboral end blunt, barely pointed,
and usually undifferentiated; wall has about 75 small polygons
below the collar and about 40 from throat to tip; polygons pre-
vailing mostly hexagons and few large ones are scattered near the
upper end of bowl; bowl thickest near the shelf and has only
a single layer of more or less sub-uniform secondary prisms. The lumen follows the outer contour save as the nuchal shelf alters it.

**Family: Epiplocyliidae**

**Genus: Epiplocylys** (Jørgensen, 1924)

27. *Epiplocylys acuminata* (Daday, 1887) (Plate III, Fig. 4)

*Diagnostic characters:* loricula goblet-shaped, cylindrical, more wide at the mouth; upright hyaline collar surrounded by slightly flaring lip with narrow groove in between; aboral end with smooth conical outline and short pointed pedicle; coarse reticulation present over most of bowl with free lines running towards the lip; L/OD 1.7:1.

**Genus: Epiplocyloides** (Hada, 1938)

30. *Epiplocyloides reticulata* (Ostenfeld and Schmidt, 1901) (Plate III, Fig. 7)

*Diagnostic characters:* loricula small bell-shaped, cylindrical, more wide at the mouth; upright hyaline collar surrounded by slightly flaring lip with narrow groove in between; aboral end with smooth conical outline and short pointed pedicle; coarse reticulation present over most of bowl with free lines running towards the lip; L/OD 1.3:1.

**Note:** this species is exceedingly variable in the elongation of the loricula, the shape of the aboral region, and the area of reticulation of the surface.

31. *Epiplocyloides ralumensis* (Brandt, 1906) (Plate III, Fig. 8)

*Diagnostic characters:* loricula generally conical; inner oral diameter 41 μm, outer oral diameter 50 μm; aboral region conical, conical (55–75°); aboral horn length 10–11 μm, stout, sharply tapering of 18–20°; reticulation of the surface inconspicuous, if present, covering the posterior half of bowl.

**Family: Metacyliidae**

**Genus: Climacyclus** (Jørgensen, 1924)

32. *Climacyclus scalaria* (Brandt, 1906) (Plate III, Fig. 9)

*Diagnostic characters:* loricula large, hyaline, cylindrical with spiral lamina restricted to anterior half or less; some turns bearing low, bluntly rounded median oral ridge; posterior region tapering; aboral end asymmetrical, irregular equal 3.42–3.94 oral diameter; oral margin entire, very regular, rounded, not everted or incurved; loricula consists of two regions, an anterior sub-cylindrical and posterior one flattened or irregular; spiral bands restricted to the upper part of the loricula with 5–10 turns, the lowest one or two usually flat, the rest produced into rounded ridges. Most of the individuals have thickening wall in one side forming triangular prolongations from one side at the aboral end. Specimens similar to those described by Kofoid and Campbell with side flaps were also seen.

28. *Epiplocylys blanda* (Jørgensen, 1924) (Plate III, Fig. 5)

*Diagnostic characters:* loricula elongate, twice as oral diameters in length; bowl nearly cylindrical except the reticulated convex conical (85°) aboral region; aboral horn length 30 μm, tapering (15–20°) to a distal point. L/OD 1.9:1.

29. *Epiplocylys undella* (Jørgensen, 1924) (Plate III, Fig. 6)

*Diagnostic characters:* loricula goblet-shaped, 1.7–1.9 oral diameters in length; bowl sub-cylindrical at its upper half, slightly dilated near the portion of its anterior one-third, convex conical (60–90°) in the aboral region; aboral horn length 25–36 μm, forming an inverted tall cone of 10–20° with a pointed tip; coarse reticulation appearing in the narrowing aboral region, having ovate fenestrae in most of its meshes; L/OD 1.7–1.8:1.

33. *Climacyclus scalaroides* (Kofoid and Campbell, 1929) (Plate III, Fig. 10)

*Diagnostic characters:* loricula small, stout, cornucopia-shaped, more transparent and delicate in texture; spiral lamina restricted to anterior half or less; some turns bearing low, bluntly rounded median oral ridge; posterior region tapering; aboral end asymmetrical, irregular equal 3.42–3.94 oral diameter; oral margin entire, very regular, rounded, not everted or incurved; loricula consists of two regions, an anterior sub-cylindrical and posterior one flattened or irregular; spiral bands restricted to the upper part of the loricula with 5–10 turns, the lowest one or two usually flat, the rest produced into rounded ridges. Most of the individuals have thickening wall in one side forming triangular prolongations from one side at the aboral end. Specimens similar to those described by Kofoid and Campbell with side flaps were also seen.

34. *Coxliella fasciata* (Brandt, 1907) (Plate III, Fig. 11)

*Diagnostic characters:* loricula long, rather large, narrow, with tapering conical bowl contracting aborally and feebly differentiated aboral horn with blunt tip (4.5 oral diameter); oral margin thick, flaring; spiral lamina irregularly emarginated, or wavy forming slightly marginal turn; bowl long, 0.65 total length with an inverted, truncate cone (2°), appearing subdivided into two parts; aboral horn inverted forming cone (12°) (0.22 total length); wall large, sub-regular, or sub-uniform, polygonal filled with tiny primary prisms, nine spiral turns present with variable width, 0.3 oral diameters in first two and last turns, 0.5 in third, 0.6 in fourth and seventh, 0.7 in fifth and sixth, and 0.45 in eighth; turns concave or narrowly sigmoid in lateral contour, slope steepest (15–45°) in posterior turns; suture dark, thin, wavy line; very thin, hyaline, uniform inner and outer membranes enclose the single layer of secondary polygons.

35. *Coxliella laciniosa* (Brandt, 1907) (Plate III, Fig. 12)

*Diagnostic characters:* loricula small, short, stout, goblet-shaped and sub-conical anteriorly, contracting abruptly to small, asymmetrical aboral point (= 1.29–1.78 oral diameters); oral margin entire, thin, and erect; loricula contracts evenly in anterior half, gradually increasing posteriorly forming a convex inverted cone changing from 7–65° in anterior 0.7 to 85–96° above aboral horn; aboral end with very short, acute, asymmetrically curved, rod-like point (= 0.25 oral diameter); wall thin (= 0.03–0.07 oral diameter), made of a fine network of secondary sub-polygonal prisms in 1–5 layers between inner and outer thin prismatic membranes, with seven leiotropic spiral turns, increasing in width from 0.06 oral diameters at oral to 0.4 oral diameters towards aboral end; slope of lamina 2–14°, steepest turns being widest, flattest at oral end; suture dark, straight line; no fenestra; lumen enters horn as a canal closed at tip. Individual turns vary in convexity among themselves and in different loriculae, being in some even concave outwardly.

**Genus: Metacylis** (Jørgensen, 1924)

36. *Metacylis jorgensenii* (Kofoid and Campbell, 1929) (Plate III, Fig. 13)

*Diagnostic characters:* loricula short, oval, some time elongate capsular; usually with a wide mouth and short wide collar with a few, low spiral turns or annuli; bowl wide; aboral end rounded, flattened, sometimes with spinule; wall hyaline, bilaminate, simple with indistinet, or with simple prismatic structure.
Diagnostic characters: minute species with stout basket-shaped lorica, equal 1.4 oral diameters in length; collar with four spiral laminae confined to short, contracted neck region; bowl broadly ovoidal; aboral end broadly rounded; oral diameter = 0.83 as greatest diameter of bowl; wall hyaline.

Genus: *Helicostomella* (Jörgensen, 1924)

38. *Helicostomella edentata* (Fauré-Fremiet, 1924) (Plate IV, Fig. 2)

Diagnostic characters: lorica awl-shaped, equal 6.9–7.8 oral diameters in length; oral rim entire; 5–7 sub-oral turns, sub-equal in width or slightly wider orally, with everted anterior edges; bowl cylindrical orally, conical (17°) aborally; aboral horn sub-conical (5°), equal 1.25–2.00 diameter length with blunt tip.

39. *Helicostomella fusiformis* (Jorgensen, 1924) (Plate IV, Fig. 3)

Diagnostic characters: lorica 50–80 μm, small, short, rather plump, with slightly swollen bowl and very short aboral spine (= 2.24 oral diameter); uppermost whorls forming collar and erect oral margin; collar equal 0.22 total length with spiral lamina of four whorls; laminae sub-equal in width; turns slightly concave laterally and separated by fine, dark line, no developed overlap; bowl conical, about 1.1 oral diameter near the middle; lower part narrow down (66°), more conical (90°) nearer the tip; aboral horn narrow conical (15°), pointed distally, about 0.2 oral diameter in length; wall finely alveolar, with tiny secondary Fai’ella like hexagons; wall sub-uniformly
than the outer, sloping (48–55°) to trough base; outer collar separated by shallow trough (distance between two rims = 0.10–0.14 total length); inner collar higher than the outer, sloping (48–55°) to trough base; outer collar abruptly flaring (80–85°); oral margin entire; bowl cup-shaped, sub-conical or globular; wall single-layered, usually hyaline; aboral end rounded, conical, pointing, sometimes with pore; aboral region hemispherical, sometimes convex conical with rounded end; inner oral diameter 30 μm.

**Family: Ascampbelliellidae**

Genus: *Favella* (Jörgensen, 1924)

42. *Favella ehrenbergii* (Claparède and Laachmann, 1858) (Plate IV, Fig. 4)

*Diagnostic characters:* lorica length 230 μm, hyaline, bell-shaped, almost cylindrical having a longer pedicel and flaring oral lip; spiral turns sub-orally sometimes present; pedicel joined with bowl by wings; L/OD 2–3:1; oral diameter 73 μm.

43. *Favella azorica* (Cleve, 1900) (Plate IV, Fig. 6)

*Diagnostic characters:* lorica length 86–94 μm, hyaline, bell-shaped almost cylindrical in the upper half, then it narrows to a blunted pointed aboral end; oral rim smooth and thin; this species may or may not have 1 or 2 annuli at the oral end; L/OD 1.5–1.6:1; oral diameter 57 μm.

44. *Favella serrata* (Möbius, 1887) (Plate IV, Fig. 8)

*Diagnostic characters:* lorica length 320 μm; bell-shaped, conical rather stout with serrate oral rim and conical aboral horn; oral margin bearing 70 min, rounded triangular, subregular, slightly incurved teeth; low, hyaline, suberecct cuff (width lesser than 0.07 oral diameter) below margin; bowl contracts below rim again swells out below rim, then gradually and sub-regularly contracts as a cone (7°); upper part more or less full sides; lower cone slightly convex; aboral horn narrow cone (10°) with 0.86 oral diameter length and pointed tip; wall sub-uniform thickness with thin inner and outer laminae in between radial, single layers of prisms present.

The surface displays a fine alveolar structure with an occasional lacuna near the suboral part of the bowl. The cavity of the lorica follows the outer contour except that the horn is solid. The animal has two oval macronuclei.

45. *Favella campanula* (Schmidt, 1901) (Plate IV, Fig. 9)

*Diagnostic characters:* this species similar to *Favella ehrenbergii* but differs in having a slightly flaring oral lip surrounding a collar barely higher than the lip; aboral end convex conical and tapering forming pointed short pedicel; pedicel solid with wings or vertical striae attach with bowl; L/OD 1.5–2.0:1; length 109–164 μm; oral diameter 68–88 μm.

**Family: Rhabdonellidae**

Genus: *Protorhabdonella* (Jörgensen, 1924)

46. *Protorhabdonella simplex* (Cleve, 1900) (Plate IV, Fig. 10)

*Diagnostic characters:* lorica length 47–63 μm, more or less conical, sharply pointed aboral end; about eight vertical ribs are present, ribs not reach the oral; oral rim slightly flaring, marked with spiral line; L/OD 1.4–2.0:1; oral diameter 31–34 μm.

47. *Protorhabdonella curta* (Cleve, 1901) (Plate IV, Fig. 11)

*Diagnostic characters:* lorica length 42 μm, dilutes in the upper 1/3 then narrows to a bluntly pointed aboral end; loria small, hyaline with oral outline; oral rim simple, not flaring; about 16 slightly spiral ribs or lines running from left to right near the mouth then becoming more or less vertical; L/OD 1.6:1; oral diameter 26 μm.

**Genus: Rhabdonella** (Brandt, 1906)

48. *Rhabdonella brandti* (Kofoid and Campbell, 1929) (Plate IV, Fig. 12)

*Diagnostic characters:* lorica length 95–98 μm, short, chalice-shaped with tapering conical bowl and fairly long horn; oral rim thin, erect, upper margin with concave outer edge; suboral trough flattened toward periphery; some suboral flare (28°) present; bowl tapers (10°) for about 0.4 total length, then inverted subconical (33°) for approximately another 0.4; aboral horn narrow, conical (13°), equal oral diameter in length, free tip sharply pointed; wall thickest suborally, then gradually thinner lower down; laminae thin and enclose minute alveoles; 48 long, vertical ribs present; 26–34 min, distinct fenestrae in each inter-costal space.

49. *Rhabdonella amor* (Cleve, 1900), Brandt, 1907 (Plate IV, Fig. 13)

*Diagnostic characters:* lorica length 75–90 μm, conical; outer rim little lower than the inner one (≈1.10–1.22 oral inner diameter); bowl gradually narrowing to acute aboral end; aboral region forming an inverted cone of 40–48°; wall separated at upper 0.1 of the loria, bearing about 20 vertical ribs which sometimes branch; inner oral diameter 37–40 μm.

50. *Rhabdonella poculum* (Ostenfeld and Schmidt, 1901) (Plate V, Fig. 1)

*Diagnostic characters:* lorica length 84–96 μm, wide cone narrows gradually from oral area then more sharply below the middle to a pointed aboral end forming short pedicel; oral rim barely higher than flaring lip; numerous vertical ribs running throughout the length of the loria; L/OD 1.6–2.0:1; oral diameter 47–52 μm.

51. *Rhabdonella spiralis* (Fol, 1881) (Plate V, Fig. 6)

*Diagnostic characters:* lorica length 325 μm long with well marked oral flare; upper 1/3 of the loria almost cylindrical then tapering gradually to a long slender pedicel equal almost 1/3 of the total length; oral rim not higher than lip; numerous spiral ribs running from left to right, numerous, small, circular fenestrae in between there arc; L/OD 4.6:1; oral diameter 70 μm.

52. *Rhabdonella quantula* (Kofoid and Campbell, 1929) (Plate V, Fig. 7)

*Diagnostic characters:* lorica length 133 μm, more tubular, narrows, longer than *R. poculum*, with well marked longer pedicel; aboral end conical with long pedicel (about 1/3 of the total length); straight outline, not concave present on aboral cone; numerous vertical ribs or lines present; L/OD 3.4:1; oral diameter 39 μm.

**Family: Tintinnidae**

Genus: *Amphorella* (Daday, 1887)
53. **Amphorella minor** (Kofoid and Campbell, 1929) (Plate V, Fig. 2)

*Diagnostic characters:* lorica length 75–130 \( \mu \text{m}, \) vase-like; collar widely flaring; low truncated cone; bowl inflated posteriorly; antapex broadly truncated, with four vertical angles extending at least 0.6 of total length.

54. **Amphorella quadrilineata** (Clapare` de and Laackmann, 1858) (Plate V, Fig. 3)

*Diagnostic characters:* this species differs from *A. minor* in having a stouter, much thickened lorica; greatest width in the present form at the middle of bowl; bowl wider above or below the middle; three fins on the aboral region running to the oral area; L/OD 2.6:1; length 122 \( \mu \text{m}; \) oral diameter 47 \( \mu \text{m}.\)

55. **Amphorella brandti** (Jorgensen, 1924) (Plate V, Fig. 4)

*Diagnostic characters:* lorica length 117–127 \( \mu \text{m}, \) vase-shape, narrowest just below the collar, widest in the lower 1/3 and ends with truncate closed aboral end; collar flaring conical and wide; bowl tubular; three longitudinal fins or ridges are running from the aboral lip to the lower third of the lorica; L/OD 2.5–2.9:1; oral diameter 44–47 \( \mu \text{m}.\)

**Genus:** **Amphorellopsis** (Kofoid and Campbell, 1929)

56. **Amphorellopsis acuta** (Schmidt, 1901) (Plate V, Fig. 5)

*Diagnostic characters:* this species differs from *A. brandii* in being smaller size, length 68–94 \( \mu \text{m} \) and has a pointed aboral end; presence of three ridges on the lower half of the lorica; L/OD 2.2–3.0:1; oral diameter 31 \( \mu \text{m}.\)
57. *Dadayiella ganymedes* (Kofoid and Campbell, 1929) (Plate V, Fig. 8)

*Diagnostic characters:* loric length 107–115 μm, hyaline with tubular bowl; oral region slightly flaring with nine primary and secondary ribs extending to the oral edge; bowl with slight constriction below mouth and a slight inflation in the middle, pedicel short ending with knob; L/OD 3.7:1; oral diameter 29–30 μm.

58. *Dadayiella bulbosa* (Brandt, 1906) (Plate V, Fig. 9)

*Diagnostic characters:* loric length 75–105 μm, tall goblet shaped (= 2.9–3.2 oral diameters); oral margin entire, more or less flaring (18–20°); bowl narrowest near the anterior first half of loric, then gradually dilating to the widest part (= diameter of oral aperture); aboral region convex, conical; pedicel tapering (20–25°) to a pointed tip (= 0.07–0.11 of total length); wall provided with seven long striae and seven short ones on the surface of the upper half of the loric; oral diameter 25–30 μm.

59. *Eutintinnus fraknoii* (Daday, 1887) (Plate V, Fig. 10)

*Diagnostic characters:* loric length 195–314 μm, hyaline, transparent, tube form; oral end has well marked flare with brim; L/OD 4.1–6.0:1; aboral end equal 0.4 of oral diameter; oral diameter 47–52 μm. This species has two forms, the side arcs of the first form slightly curved at the lower third then narrows fast to slightly flaring aboral end. The second form longer than the first one and has an almost straight contour line ending with a sudden flare at the aboral end.

60. *Eutintinnus lasus-andae* (Entz, 1885) (Plate V, Fig. 11)

*Diagnostic characters:* this species is similar to *E. exigua*, but it is longer and has more marked flare ending with brim; no flare at aboral end; two arc forms present; present specimens lie under slender form; L/OD 0.6:1; aboral equal 0.6 of oral diameter; loric length 256–283 μm; oral diameter 42–47 μm.

61. *Eutintinnus apertus* (Kofoid and Campbell, 1929) (Plate V, Fig. 12)

*Diagnostic characters:* loric length 90–112 μm, straight in the upper 0.77–0.80 length, then abruptly narrowing (30–33°) to an aboral aperture; oral margin more or less flaring with slight brim; aboral region sometimes inclined forming tubular part (= 0.5–0.6 of oral diameter); oral diameter 30–38 μm; aboral diameter 15–22 μm.

62. *Eutintinnus elongatus* (Jörgensen, 1924) (Plate V, Fig. 13)

*Diagnostic characters:* loric length 168–208 μm, elongate, slender (= 6.0–7.4 of oral diameters); oral margin gradually flaring (45°) with a faint brim; anterior part of shaft tapering (8°), then almost cylindrical in the aboral region; oral diameter 28 μm; aboral diameter 12 μm.

*Genus: Leprotintinnus* (Jörgensen, 1899)

63. *Leprotintinnus pellucidum* (Cleave, 1889) (Plate VI, Fig. 1)

*Diagnostic characters:* loric length 156–288 (av. 223) μm, elongate (= 4.8 oral diameter); oral rim usually smooth; shaft slightly conical (1.5–3.0 μm) and little constricted above the posterior end; aboral end rough, flaring (43–97°) with an aboral aperture equal 0.7–1.0 of oral diameter; wall thin with or without spiral turns and foreign particles scattered on its surface, sometimes more dense near sub-oral border; oral diameter 33–42 (av. 38) μm; aboral diameter 25–35 μm.

64. *Leprotintinnus nordqvistii* (Brandt, 1906) (Plate VI, Fig. 2)

*Diagnostic characters:* loric length 150–352 (av. 245) μm, consisting of tubular shaft and an inverted funnel-shaped aboral flare (= 4.3–10.5 of oral diameter); shaft more or less tapering (15°), expanding posteriorly forming distinct aboral conical flare (50–110°); oral rim irregular, usually slightly flaring (800–850°); aboral aperture large (= 1.2–2.3 oral diameter); aboral margin very ragged; wall showing a faint spiral structure, made of rather sparse particles aggregated more thickly on the surface of the aboral flare than on that of the shaft; oral diameter 30–38 μm; aboral diameter 40–80 μm.

65. *Leprotintinnus simplex* (Schmidt, 1901) (Plate VI, Fig. 3)

*Diagnostic characters:* loric length 205 μm, tubular (= 5.8 oral diameter), gradually tapering (2°) to the aboral end and without flare or a constriction; sides more or less curved; wall thin with sparse foreign particles laid spirally on the surface; oral diameter 33 μm; aboral diameter equal 0.86 oral diameter.

*Family: Undelliidae*

66. *Amplectella* (Kofoid and Campbell, 1929)

67. *Amplectella tricollaria* (Laackmann, 1910); Balech, 1975 (Plate VI, Fig. 4)

*Diagnostic characters:* loric length 80 μm, moderately tall, stout, with two rings (= 1.3 oral diameter) at 0.3 and 0.48 of total length from the rim; wall between rings steeply concave; oral margin more or less conical; diameter of lower end equals 1.57 oral diameter; aboral end unmodified; wall thickness 0.08 oral diameter in the cylinder and a trifle less aborally; thin laminar present enclosed hyaline material.

68. *Amplectella fastigata* (Jörgensen, 1924) (Plate VI, Fig. 7)

*Diagnostic characters:* loric length 69–82 μm (= 1.94 oral diameter), short, stout, ovate, with thick wall; loric consists of three sections with round junction between them, upper 0.29 of total length conical (80°), middle 0.49 tapers (23°) and aboral region rounds off; oral margin rounded and thin; aboral end unmodified; wall thickness almost 0.19 oral diameter in upper section and reduced to third as much lower down; inner collar funnel-shaped (20°), equal 0.3 oral diameter in length; laminar rather thin.

69. *Proplectella perpusilla* (Kofoid and Campbell, 1929) (Plate VI, Fig. 8)

*Diagnostic characters:* loric length 41–50 μm, short, ovate, with wide-open aperture (= 1.59 oral diameter); oral margin sharp; bowl sub-cylindrical at upper tenth, then expands rather suddenly (38°) to a diameter equal 1.35 oral diameters near 0.47 total length from the rim; lower bowl contracts (30°–79
to 130° aborally); aboral end rounded over; wall thickness equal 0.12 oral diameter at mid bowl; inner collar diffused; thin laminae present enclosed hyaline material.

Genus: Undella Daday, 1887

70. Undella hyalina (Daday, 1887) (Plate VI, Fig. 6)

Diagnostic characters: lorica length, 153 μm, generally large, with feebly angled and pointed aboral region; oral margin simple cuff formed by the upright inner lamina; bowl sub-cylindrical with developed cuff; aboral region contracts indefinitely (39° in the upper two-thirds and 125° in the lower part) to the blunted aboral end; wall sub-uniform, thickness nearly 0.07 oral diameter; laminae thin, enclosing dense material.

71. Undella claparedei (Daday, 1887) (Plate VI, Fig. 9)

Diagnostic characters: lorica length 41–61 (av. 54) μm, egg-shaped with narrower broadly truncated end (=1.65 oral diameter); oral margin with angle of 25–30°; oral aperture large (=0.54–0.70 total length); oral region everted internally forming concave cone of 30–35°; inner collar thickening forming oral margin with nuchal diameter equal 0.78–0.93 oral diameter; bowl stout ovoidal with greatest diameter at middle (=1.13–1.48 oral diameter); aboral end hemispherical, prismatic; wall thickness equal 0.17–0.20 oral diameter at throat, then gradually thinning at aboral end; oral diameter 27–37 μm; nuchal diameter, 25–37 (av. 27.8) μm.

72. Undella turgida (Kofoid and Campbell, 1929) (Plate VI, Fig. 10)

Diagnostic characters: lorica length, 41–45 μm, short very broadly with convex-conical bowl and thick wall; upward-directed inner lamina forming thin oral rim; slight shoulder present at the outer edge; bowl convex, strongly globose, swells, equal lorica length at the ledge; aboral end barely pointed; wall thickest suborally (=0.06 oral diameter); laminae fairly thick enclosing homogeneous material.

73. Undella globosa (Brandt, 1906) (Plate VI, Fig. 11)

Diagnostic characters: lorica length 37–51 μm (=2.8 oral diameter), generally globose, sub-cylindrical, expanding posteriorly to slightly inflated; aboral region fairly rounded, not expanded behind; bowl equal 1.1–1.3 of oral diameter; oral diameter 25–30 μm.

74. Undella pentagona (Jörgensen) Balech, 1975 (Plate VI, Fig. 12)

Diagnostic characters: lorica length 47–60 μm (=2.1–2.3 oral diameter), pentagonal in side view, extended, cylindrical; collar 7–12 μm; bowl straight after the collar; aboral area truncated 30–35° of the wall, pointed at the end; oral diameter 29–34 μm.

75. Undella subacuta (Cleve, 1901) (Plate VI, Fig. 13)

Diagnostic characters: lorica length 42 μm (=1.19 oral diameter), relatively small, globose; oral margin contracting forming thin lip (=0.05–0.08 of total length); bowl globose, expanded below collar forming slightly shoulder (wide =1.1–1.3 of oral diameter); wall slightly everted with thickness equal 0.5 of oral diameter; aboral end rounded fairly bluntly pointed.

Family: Xystonellidae

Genus: Xystonella (Brandt, 1907)

76. Xystonella treforiti (Daday, 1887) (Plate VII, Fig. 1)

Diagnostic characters: lorica length 325–424 μm, elongate, chalice-shaped; outer oral margin flaring (33–45°), minutely dentate; bowl sub-cylindrical or conical (5°), sometimes very slightly bulging below middle, convex conical at aboral region (30–40°); pedicle tapering (6–9°), with knob and pointed tip apical lance (=0.25 total length); knob conical, skirted with acute edge; wall reticulation regularly hexagonal, most coarse near bowl middle; outer oral diameter 75 μm.

77. Xystonella longicauda (Brandt, 1906) (Plate VII, Fig. 2)

Diagnostic characters: lorica length, 242–350 μm, narrow, glassy, elongate, with lancet-shaped expansion (dense brown) at the end of the lance (=8.2 oral diameter); oral rim thin, low erect, not visible in side view; sub-oral trough forming elevated outer rim (=1.27 oral diameter), with free separated edge from the cuff; bowl with long flares (25°) anteriorly, swell at lower end of flare; lower bowl tapers (14°) forming narrow (=0.15 oral diameter) tube with length nearly 0.28 of total length (specific character); wall thickness equal 0.14 oral diameter just below trough, then gradually thins less than 0.02 lower down; laminae thin enclosed subequal, rectangular, radial secondary prisms and minute alveoles; surface bearing small hexagons meshwork.

78. Xystonella lanceolata (Brandt, 1906) (Plate VII, Fig. 3)

Diagnostic characters: lorica length 215–234 μm, rather short, conical, with thick conical horn of moderate length; oral rim low, hidden by sub-oral trough sides of outer edge; trough concave, equal 1.28 oral diameter; bowl flares (34°), taper below flare (10°) at nearly 0.42 total length, then became conical (32°); lance sub-uniformly thick (=nearly 0.22 oral diameter), with acutely angular free tip, equal 0.35 total length; wall thickness about 0.07 oral diameter suburally, and rapidly thin to less than three-tenths at lower bowl; laminae thin enclosed rectangular, subequal, radial secondary prisms; surface mesh small, rounded and hexagons.

79. Xystonella cf. egyptiaca (new species) (Plate VII, Fig. 4 and 5)

Diagnostic characters: this species is much closer to Xystonella treforiti (Daday, 1887) where the lorica elongate chalice-shaped, 4.55–5.45 outer oral diameters in length; outer oral margin flaring (33–45°), minutely dentate, 1.20–1.25 inner oral diameters; bowl sub-cylindrical or conical (5°), sometimes very slightly bulging below its middle, convex conical in the aboral region (30–40°); pedicle tapering (6–9°), provided with a knob and an apical lance, about 0.1–0.15 of the total length without a lance; knob conical, skirted with an acute edge; lance 0.07–0.10 of the total length, pointed at its tip; reticulation of the wall regularly hexagonal, most coarse near the middle of the bowl. In addition to the previous the middle section is provided with 8–9 spiral lamina starts about 1.1 of the oral diameter in length, ends before the slope of the Lorica towards the aboral end. Spiral laminae have leiotropic regular turns. Lamina narrower in 1 or 2 sub-oral turns, widest in posterior 1 or 2, and uniformly graduated between, disappearing with abrupt cessation of spiral ridge; width 0.13–0.50 oral diameter. Suture often irregularly serrate. Length excluding frill 181–258 μm; outer oral diameter 75 μm.

Genus: Parundella (Jörgensen, 1924)

80. Parundella aculeata (Joergensen, 1924) (Plate VII, Fig. 10)

Diagnostic characters: lorica length, 143 μm tall, elongated, with fairly short, contracted aboral region and lance; oral margin thin, sharp-edged; bowl sub-cylindrical at anterior 0.51 of total length, lower part inverted conical (45°) (=0.29 total length); lance narrow, needle-like (8°), equal 0.2 total length, with sharp free tip; wall uniformly hyaline; laminae hyaline enclosing homogeneous material; cavity enters the lance but does not continue its whole length.
81. *Parundella inflata* (Kofoid and Campbell, 1929) (Plate VII, Fig. 11)

*Diagnostic characters:* lorica length 92–125 μm, rather short, elongated with contracted aboral conical part and long spine-like lance (= 3.96 oral diameter); oral margin thin, sharp, without flare; bowl long, sub-medianly inflated to 1.14 oral diameter near 0.33 of total length froming rim, then contracts convexly (30°) near 0.62 of total length; lower part tapers (15°) for 0.15 total length, suddenly contracts (70°) below rim; lance narrow conical (9°), with sharply pointed free tip forming hol- low spine-like (= 0.18 total length); wall hyaline, thickens equal to 0.14 oral diameter at anterior one-fifth.

*Family: Dictyocystidae*

*Genus: Dictyocysta* (Ehrenberg, 1854)

82. *Dictyocysta elegans* (Ehrenberg, 1854) (Plate VII, Fig. 6)

*Diagnostic characters:* lorica length 70–77 μm, moderately large, with double row of open windows; oral margin undulating with thin vertical list and eight flattened arches; collar cylindrical, equal 0.5 total length, eight inverted pentagonal windows present at upper half and 10 small, squarish to pen-
tagonal ones at lower half; beams and mullions heavy and rounded; bowl acorn cup like-shaped with three rows of closed fenestrae and scattered smaller ones; first row near shoulder region includes 10 sub-equal, rounded fenestrae; second, equatorial row, includes larger, more or less circular ones; third, post-equatorial row, of six large, circular ones; inter-fenestral areas reticulated; primary alveolates occur at the upper framework and between bowl reticulations; traces of shoulder present little below lower limit of collar; aboral end rounded, equal to 1.46 oral diameter in length.

83. Dictyocysta reticulata (Kofoid and Campbell, 1929) (Plate VII, Fig. 7)

Diagnostic characters: this species almost similar to Dictyocysta elegans Ehrenberg, 1854 but differs in bowl reticulation arranged in two rows of fenestrae; the first present below the middle of bowl and formed of six large oval fenestrae; second row below the first and consists of few small fenestrae. L/OD 1.5:1; lorida length 60 μm; oral diameter 39 μm.

84. Dictyocysta mitra (Haeckel, 1873) (Plate VII, Fig. 8)

Diagnostic characters: lorida length 60–80 μm, plump, scant division between collar and bowl present, large window-like meshwork; oral rim arched with 7 (8) broad frames; collar equal 0.33 total length; collar region generally bi-conical (33° in the upper and 35° in the lower half); diameter equal 0.88
oral diameter at junction between upper and lower parts; bowl expanded from throat (=1.13 oral diameter) at 0.54 total length, lower bowl rounds off below the maximum diameter; aboral end rounded, blunt to rotund; wall extremely thin; whole surface fenestrated with squarish windows; fenestrae arranged in less uniform 5–7 in vertical rows and 10–12 in horizontal rows; fenestrae of second row smaller than first one and more irregular; at aboral end a nest of tiny ones, and other odd minute scattered between larger ones; all fenestrae enclosed by thickened beams with fine molding around each window; all windows closed by transparent panes.

Family: Petalotrichidae
Genus: Petalotricha (Kent, 1881)
85. Petalotricha major (Jörgensen, 1924) (Plate VII, Fig. 9)
Diagnostic characters: loria length 115 μm, hyaline with globose bowl and flaring collar separated from the bowl by marked nuchal constriction; collar divided into two parts, a slightly flaring sub-oral cone and an outer lip; at junction of two collar pans row of small fenestrae present; bowl widest at the middle with spherical contour; small rounded fenestrae present on the upper 1/2 of bowl; L/OD 1:1; oral diameter 115 μm.

Genus: Salpingella (Jorgensen, 1924)
86. Salpingella decurtata (Jörgensen, 1924) (Plate VIII, Fig. 1)
Diagnostic characters: loria length 230–250 μm, small, slender (=15.4 oral diameter); collar inflated, convex bowl-like; bowl swollen slightly below the middle; four fins present (=0.2 of oral diameter long); aboral cylinder present.

87. Salpingella acuminata (Jorgensen, 1924) (Plate VIII, Fig. 2)
Diagnostic characters: loria length 320–430 μm, very slender, elongate, delicate (=9.0–13.3 of oral diameter); collar low, very widely flaring funnel of 98–110°, with recurved margen;
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Codonellidae</td>
<td><em>Tintinnopsis cylindrica</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis campanula</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis gracilis</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis radix</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis nana</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis rotundata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis corniger</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis lobiancoi</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis orientalis</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis tocametensis</em></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis davidoffi</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tintinnopsis compressa</em></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Codonella amphorella</em></td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Codonella galea</em></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Codonella nationalis</em></td>
<td></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Codonella daday</em></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Poroecus curtus</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Codonellopsidae</td>
<td><em>Codonellopsis schabi</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Codonellopsis orthoceras</em></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Codonellopsis ostenfeldi</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Codonellopsis erythetaera</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Codonellopsis orcinialis</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Codonellopsis morchella</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Cyttarocylididae</td>
<td><em>Cyttarocylis magna</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Cyttarocylis conica</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Cyttarocylis brandti</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Epiplocylididae</td>
<td><em>Epiplocylis acuminata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Epiplocylis blanda</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Epiplocylis undella</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Epiplocyloides reticulata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Epiplocyloides taliensis</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Metacylididae</td>
<td><em>Climacocylis scalaria</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Climacocylis scalaroides</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Coxliella fasciata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Coxliella laciniosa</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Metacylis jorgensenii</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Metacylis corbula</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Helicostomella edentata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Helicostomella fusiformis</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Helicostomella subulata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Ascambelliellidae</td>
<td><em>Aiscamellenella retusa</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Ptychocylididae</td>
<td><em>Favella ehrenbergii</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Favella campanula</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Favella serrata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Favella azorica</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Rhabdonellidae</td>
<td><em>Protorhabdonella simplex</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Protorhabdonella curta</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Rhabdonella amor</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Rhabdonella brandti</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Rhabdonella poculum</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Rhabdonella spiralis</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Rhabdonella quantula</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Tintinnidae</td>
<td><em>Amphorella minor</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Amphorella quadrilineata</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Amphorella brandti</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Amphorellopsis acuta</em></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Dadayiella ganymedes</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Dadayiella bulbusa</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Eutintinnus fraknoii</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><em>Eutintinnus lusus-andae</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
shaft narrow, tapering; 7–9 low aboral fins present (=0.36–0.44 of total length); oral diameter 36–37 μm.

**88. Salpingacantha ampla** (Kofoid and Campbell, 1929) (Plate VIII, Fig s. 4 and 7)

*Diagnostic characters:* lorida length 306–350 μm, stout, (= 10.7–13.2 oral diameter); oral brim with 7–8 incurved teeth; collar convex funnel of 50/C176, with 4–6 longitudinal plications; bowl with five fins (=0.4 of total length); short aboral cylinder present.

**89. Salpingella attenuata** (Kofoid and Campbell, 1929) (Plate VIII, Fig. 5)

*Diagnostic characters:* lorida length 272–283 μm, long, slender resembling long test-tube; flaring collar funnel-shaped, with rim; bowl long, tubular, narrower at lower quarter; aboral end truncate and open; six fins present aborally; L/OD 8.3–8.8:1; oral diameter 31–34 μm.

**Genus: Steenstrupiella** (Kofoid and Campbell, 1929)

**90. Steenstrupiella gracilis** (Jorgensen, 1924): Kofoid and Campbell, 1929 (Plate VIII, Fig. 3)

*Diagnostic characters:* lorida length, 47–54 μm, rather slender, with upright collar and sharply angular aboral end (=2–2.2 of oral diameter); oral margin thin sharp-edged and entire; collar inverted, truncated cone (42°) with length equal 0.16 of total length, and lower end diameter equal 0.8 of oral diameter; bowl conical, (7°) contracts within the aboral fifth forming angular aboral end (56°); wall very thin and hyaline.

**91. Steenstrupiella steenstrupii** (Kofoid and Campbell, 1929) (Plate VIII, Fig. 6)

*Diagnostic characters:* this species is closely related to *S. gracilis* except for more elongated lorida (length 186 μm); lorida slightly swelling at middle part, then gradually narrow toward the aboral end; aboral end either truncate or rounded; oral diameter 33–35 μm.

Table 1 continued

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Undellidae</td>
<td><em>Amplectella tricollaria</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Amplectella collaria</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Proplectella fastigata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Proplectella perpusilla</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Undella clapareei</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Undella turgida</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Undella hyalina</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Undella globosa</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Undella subacuta</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undellidae</td>
<td><em>Undella pentagona</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xystonellidae</td>
<td><em>Parundella inflata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Parundella aculeata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Xystonella treforti</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Xystonella longicauda</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Xystonella lanceolata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Xystonella egypriaca</em>.</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictyocystidae</td>
<td><em>Dictyocysta reticulata</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Dictyocysta elegans</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Dictyocysta mitra</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petalotrichidae</td>
<td><em>Petalotricha major</em></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>92</td>
<td>32</td>
<td>9</td>
<td>26</td>
<td>12</td>
<td>25</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

---

M.M. Abou Zaid, A.M. Hellal
Biogeography of Red Sea tintinnids

The data of the present study revealed that the total number of recorded species were 92 species belonging to 30 genera under 13 families (Table 1). Family Tintinnidae has the largest number of species being, 20 species belonging to eight genera, followed by family Codonellidae and represented by 17 species belonging to three genera. Families Undelliidae and Metacyliidae came in the third and fourth orders and included 9 and 10 species respectively. In contrast, families Ascampbelliellidae, Coxliellidae, Cyttarocylicidae, Epiplocyliidae, Petalotrichidae, Ptychocylidae, Rhabdonellidae, Undellidae, and Tintinnidae have the lowest number of species each represented by one species. On the other hand, the remaining seven families each represented by low number of species ranging from three species belonging to one genus under family Cyttarocylicidae to seven species belonging to two genera under family Rhabdonellidae (Table 1). Generally, families Tintinnidae, Codonellidae and Rhabdonellidae were the more diverse families than other families recorded in the present study. They comprised 21.7%, 18.5% and 9.8% of the total recorded species. The same findings were observed by Komarovsky (1959) and Khalil and Abd El-Rahman (1997) from Gulf of Aqaba, (Sharaf, 1995) from Arabian Sea, (Modigh et al., 2003) from Indian Ocean and Mediterranean Sea.

Comparing the tintinnid fauna in the present study from the Red Sea with that of the adjacent areas indicated that the Red Sea is richer and more diverse than other areas. Meanwhile, the differences recorded in the number of Tintinnids from the Red Sea seem to be resulted from differences in the collecting efforts and seasonality. For example the relatively lower number of species recorded within the Red Sea by Modigh et al. (2003) may contribute to the diversity of the Tintinnids in the area. The same findings were observed by Komarovsky (1959) from Arabian Sea, (Modigh et al., 2003) most probably resulted from the period during which the expedition moved through the Red Sea. In addition, the maritime activities in the Red Sea during the recent decades may contribute to the diversity of the Tintinnids in the area. This was clear in finding a number of both Mediterranean Sea (15–16 species) and Indian Ocean (25 species) within the Hurghada fauna. Similar results were also obtained by Modigh et al. (2003).

References


