THE IDENTIFICATION OF TINTINNIDS (PROTOZOA: CILIATA: TINTINNIDA) OF THE ST. ANDREW BAY SYSTEM, FLORIDA[1]

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ABSTRACT

A key to the tintinnids of the St. Andrew Bay system, Florida, is presented. The relationships shown in the key are supported by light and scanning-electron photomicrographs. Included in the key are 21 species: eight were previously unreported from Florida estuaries, and two unidentified species of *Metacylis* are described. Each species reported is described, previous location sites are stated, and statistical information on lorical size is included where available.

INTRODUCTION

Prominent among marine zooplankters are cilate protozoans of the order Tintinnida. The vast majority of these ciliates belong to the pelagic marine fauna of both the oceanic and neritic waters of all oceans and are numerically important second trophic level feeders (Zeitzschel, 1967), consuming small diatoms and other constituents of the ultra- and nannoplankton.

Some workers have studied the cellular organization of several species of tintinnids (Campbell, 1926, 1927; Hofker, 1931; Biernacka, 1952, 1965), but most investigations dealing with them are taxonomic surveys or systematic treatments. There are two main reasons for this situation: until recently tintinnids were difficult to study because of the associated problems of maintaining and raising them in the laboratory (Gold, 1968, 1969); and fixation of plankton samples containing tintinnids generally causes abandonment of the lorica or shrinkage of the organism. Intra-ordinal classification is therefore restricted to lorical morphology.

The most recent monographs on tintinnids were published by Kofoid & Campbell (1929, 1939). Other workers have defined the tintinnid fauna from many regions of the world, the major regions including the Mediterranean Sea (Jörgensen, 1924), Great Barrier Reef (Marshall, 1934), western Pacific (Hada, 1932a, b; 1937; 1938), Philippines (Roxas, 1941), and the South Atlantic and eastern Pacific (Balech, 1948, 1962). Numerous other less extensive reports exist.

The literature concerning marine ciliates of the Gulf of Mexico was reviewed by Borror (1962); of the 22 papers listed, only three referred to tintinnids. Smith (1904) identified *Tintinnopsis beroidea* from the

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Louisiana area. Ten genera were identified from the southern Gulf Coast of Florida by Davis (1950), and King (1950) recorded "unknown tintinnids" from the west coast of Florida. The first listing of tintinnids from the Gulf of Mexico was published by Hopkins (1966), who identified 13 species from an estuarine environment, the St. Andrew Bay system, Florida. Balech (1967) published a list of 55 species and included information of the distribution of forms taken on cruises throughout the Gulf of Mexico; all of his stations were in the open waters of the Gulf of Mexico. A publication by Balech in 1968 contained descriptions of some species from the Gulf of Mexico and Caribbean regions.

This investigation was conducted to expand knowledge of the species of the order Tintinnida found in the estuarine environments of the northeast Gulf of Mexico. The representative estuary system chosen was that of St. Andrew Bay, Florida, because of its extent and because some initial research on this order had been conducted there (Hopkins, 1966). From February through August 1967, plankton hauls were made and some hydrographic data taken to assess the constituents of the tintinnid biota. It was hoped that the results of this investigation would furnish enough data to allow construction of a key to the estuarine tintinnids of the northeast Gulf of Mexico. Information in the form of light and scanning-electron photomicrographs was gathered to supplement the descriptions of the organisms.

Methods and Materials

Tintinnids were collected in biweekly plankton samples at St. Andrew Bay, Florida, from February through August 1967. Three sampling stations were used: Station 1—Gulf of Mexico at the southern entrance to the bay system; Station 2—eight miles north at the junction of West Bay and North Bay; Station 3—four miles north of Station 2 in North Bay (see Hopkins, 1966: 17). Samples were collected by oblique hauls through the entire water column with a No. 20 mesh (76μ) plankton net. All samples were preserved in 2 per cent buffered formalin–sea-water solution.

Although temperature and salinity measurements were made for each station, no correlation was found between the presence of individual species or groups of species with either temperature or salinity (Cosper, 1969).

Loricae were studied by a variety of techniques, including examination of permanent mounts in Canada Balsam and semipermanent mounts, prepared as prescribed by Pantin (1964: 21). The best method used to examine loricae involved gradual transference of the loricae to distilled water and examination of the loricae with a compound microscope in preparations with and without a coverslip.

The potential of scanning electron microscopy for studying the morphology of microorganisms has been reviewed by Bartlett (1967). To prepare the loricae for use by the scanning electron microscope, about five specimens of each species were pipetted from buffered 2 per cent formalin–sea-water solution into two successive solutions of distilled water to remove the salt. The loricae were then pipetted directly onto an aluminum stub without the use of an adhesive substance. Subsequent coating of the specimens and the photography itself were performed by the technician.

The distribution lists prepared for each species were not intended to be comprehensive, since previous identifications vary widely with the area studied and with the author. Only those publications with which the author felt reasonable agreement were used as indications of previous site records.

Morphology of the Lorica

Although there is an intimate relationship between the protozoan and its lorica, the organism is only attached aborally by a slender peduncular region equipped with an adhesive disk. If the lorica is open at both ends, then attachment is lateral; if the lorica is closed at the aboral end, attachment is nearer the closed end.

Lorical morphology is divergent in the various families. Loricae closed at one end may resemble a bell, a vase, or a horn. Some may resemble a long hollow cylinder with a tapering end. In some genera the lorica is open at both ends; however, in most genera, the oral end is open, while the aboral end is closed and may be rounded, pointed, or prolonged into a solid or hollow aboral horn (see Campbell [1954] for definitions of morphological terms).

The simplest lorica consists of a fine membrane which is structureless when examined with the light microscope. Loricae considered to be more advanced (Kofoid, 1930) exhibit fine reticulations. The loricae of some genera show a marked tendency to include numerous foreign particles, which give the loricae an agglomerated or arenaceous appearance. The inclusion of this particulate material may be in highly regular and patterned arrangements of coccoliths, as illustrated by the genus *Codonella*; or the inclusions may be sparse to heavy scatterings of fragments of diatom frustules and coccoliths, as in the genus *Tintinnopsis*.

Besides wall construction, other characteristics on which the present systematic arrangement of the order is based include the presence and arrangement of spiral structures, the shape and sculpture of the oral rim, and the presence and structure of ornamentation. Elaboration of the basic lorical structure is seen in the form of aboral horns (Fig. 13), aboral points or knobs (Fig. 1), fins (Fig. 22), indentations (Fig. 23), and oral collars (Fig. 9). The relative proportions of the lorica, such as the ratio

of total length to oral diameter, have proven to be of aid in specific designations. Size is rarely considered to be a taxonomically distinctive characteristic because of the evidence indicating an inverse correlation of lorical size with water temperature (Heald, 1911).

The following systematic treatment is based on Corliss (1962) for supraordinal classification, and Campbell (1954), Tappan & Loeblich (1968), and Loeblich & Tappan (1968) for familial and subfamilial classification.

Artificial Key to the Species of Estuarine Tintinnids of the St. Andrew Bay System, Florida

A. Lorica includes agglomerated particles 1, 2
  1. Lorica without aboral horn ..... a-c
    a. lorica with large oral flare ..... *Tintinnopsis mortenseni* (Figs. 11, 12)
    b. lorica with two regions, column and bowl ..... i, ii
      i. column with spiral structure ..... *T. brandti* (Fig. 1)
      ii. column without spiral structure ..... *T. tubulosa* (Figs. 15, 16)
    c. lorica with one main region, bowl shaped ..... i, ii
      i. lorica with a slight nuchal constriction ..... *T. beroidea* (Fig. 9)
      ii. lorica without nuchal constriction ..... *T. parvula* (Fig. 8)
  2. Lorica with aboral horn ..... a-c
    a. lorica an acute cone, blending into horn *T. cylindrica* (Fig. 5)
    b. lorical column cylindrical, agglomerated particles on horn ..... i-iv
      i. bowl between column and horn ..... *T. tocantinensis* (Fig. 4)
      ii. horn about 0.2 of total lorical length, gradual slope to horn ..... *T. levigata* (Fig. 2)
      iii. horn about 0.2 of total lorical length, acute slope to horn ..... *T. kofoidi* (Fig. 3)
      iv. horn about 0.3 of total lorical length, horn length over 70μ ..... *T. radix* (Figs. 6, 7)
    c. lorical column cylindrical, horn without particles ..... *Stylicauda platensis* (Figs. 13, 14)

AA. Lorica without agglomerated particles ..... B, BB

B. Lorica composed of primary and secondary reticular elements 1, 2
  1. Lorica composed completely of a spiral band ..... *Coxliella longa* (Fig. 10)
  2. Lorica without spiral band ..... *Favella panamensis* (Fig. 19)

BB. Lorica without reticulations C
C. Lorica hyaline 1-3
1. Lorica closed at one end ..... a-c
a. lorica flared orally ..... i, ii
i. lorica truncated aborally ... *Amphorides brandti* (Fig. 22)
ii. lorica pointed aborally ... *Amphorellopsis acuta* (Fig. 21)
b. lorica with a short collar ..... i-iii
i. lorica long, truncated aborally ..... *Metacylis* sp. (Fig. 23)
ii. lorica as wide as long ..... *M. mereschkowskii* (Fig. 25)
iii. lorica rounded aborally ..... *Metacylis* sp. (Fig. 24)
2. Lorica with spiral band in anterior ½ to ⅓ .....
..... *Helicostomella subulata* (Figs. 17, 18)
3. Lorica open at both ends ..... a, b
a. lorica flared orally ..... *Eutintinnus tenuis* (Fig. 20)
b. lorica without oral flare ..... *E. tubulosus* (Fig. 26)

Phylum PROTOZOA Goldfuss
Subphylum CILIOPHORA Doflein
Class *CILIATA* Perty
Subclass SPIROTRICHA Bütschli
Order TINTINNIDA Corliss
Family Codonellidae Kent
Genus *Tintinnopsis* Stein
Tintinnopsis beroidea Stein, 1867
Fig. 9

Description.—Lorica bullet-shaped, about 1.5 oral diameters in length, consisting of an oral rim leading to a slight nuchal constriction, then spreading to about the same diameter as the rim and tapering to a blunt aboral portion; oral rim sometimes ragged; no spiral structures.

Dimensions.—Total length 60μ (52μ-65μ); oral diameter, 39μ (37μ-42μ); widest diameter, 39μ (37μ-42μ); diameter at nuchal constriction, 35μ (32μ-36μ). 7 loricae.

Localities.—This is a cosmopolitan species, which is distributed in the neritic zone of the temperate seas.

Comparison.—Differs from *Tintinnopsis parvula* Jörgensen by possessing a nuchal constriction and a distinct oral collar.

Discussion.—I have followed Kofoid & Campbell (1929) in their acceptance of Jörgensen's (1927: 67-68) emendation of this species. *T. beroidea* has one of the simplest loricae of all the tintinnopsoids and is frequently confused with *T. parvula.* There is a distinct possibility that gradations exist between these two species, making assignment of the intergrades impossible.

My assignment of this species is supported by Wailes (1925: 535), who described *Tintinnopsis beroidea* Stein as "having the aperture slightly everted, the body of equal or nearly equal diameter throughout and the fundus hemispherical or bluntly pointed." He described the length as 55μ-100μ, the diameter being about half the length.

Tintinnopsis brandti (Nordqvist) Levander, 1900
Fig. 1

Description.—Lorica cylindrical with a flattened, spreading base, about 4 oral diameters in length, consisting of a spirally formed cylindrical column with a flattened, bowllike aboral region, tapering sharply to a blunt point; spiral structure emphasized, always rotating counterclockwise from bottom to top; wall encrusted with and including fine- to medium-sized particles.

Dimensions.—Total length, 166μ; standard deviation (S.D.), 10μ; coefficient of variation (C.V.), 0.06. Oral diameter, 63μ; S.D., 4μ; C.V., 0.07. Bowl diameter, 84μ; S.D., 4μ; C.V., 0.05. Column length, 117μ; S.D., 9μ; C.V., 0.07. 30 loricae.

Localities.—Finnish Sea (Levander, 1900); St. Andrew Bay system, Florida (Hopkins, 1966).

Comparison.—Differs from *T. tubulosa* in the possession of spiral structures.

Discussion.—*T. brandti* has recently been characterized by Balech (1968). His figure of *T. brandti* lacks an aboral tip, but the other characters given are in very close agreement with my description.

Tintinnopsis cylindrica Daday, 1887
Fig. 5

Description.—Lorica tubular, elongated, about 7-8 oral diameters in length; bowl cylindrical, narrowing gradually about midway of the lorica to a very stout horn; wall with a weakly developed spiral structure.

Dimensions.—Total length, 308μ; S.D., 21μ; C.V., 0.07. Oral diameter, 40μ; S.D., 2μ; C.V., 0.04. Column length, 180μ; S.D., 13μ; C.V., 0.07. Horn length, 125μ; S.D., 14μ; C.V., 0.11. 30 loricae.

Localities.—Mediterranean, Baltic, and western Pacific (Marshall, 1934).

Comparison.—Differs from *T. radix* and *T. kofoidi* by possessing a thicker aboral horn.

Discussion.—I have had considerable difficulty distinguishing *T. cylindrica* from *T. radix* in the literature. Kofoid & Campbell (1929) offered bibliographic cumulation and one figure for each species; they did not offer

descriptive information. The major authors I have relied on are Roxas (1941), Hada (1937, 1938), and Jörgensen (1924) for *T. radix*; and Marshall (1934) for both species.

Although the diagrams shown in both of Hada's publications resemble *T. cylindrica*, they are identified as *T. radix*. My observations agree with those of Marshall, and her meticulous work lends itself more to credibility than does the abbreviated account issued by Kofoid & Campbell in their *Conspectus*. Marshall (1934: 637) contrasted *T. radix* and *T. cylindrica* as follows: in the latter "the pedicel is wider and usually nearly half as long as the whole lorica; it is very frequently broken off short; the diameter is less and the lorica invariably gets slightly narrower towards the pedicel; it is more thickly encrusted with agglomerated material . . . ." She gave the following dimensions for *T. cylindrica*: total length, 144μ-300μ; diameter at the mouth, 34μ-45μ. These figures agree with my data.

Tintinnopsis kofoidi Hada, 1932
Fig. 3

Description.—Lorica cylindrical, about 5 oral diameters in length, consisting of a long, tubular body narrowing to an aboral horn; oral rim irregular; column cylindrical, tapering sharply aborally; aboral horn short, tubular; aboral tip open, often obliquely; wall thin, irregularly but completely agglomerated with large and small particles and without observable spiral structure.

Dimensions.—The data are for two populations of *T. kofoidi* collected 8 April 1967 at Stations 1 and 2.

Station 1: Total length, 199μ; S.D., 16μ; C.V., 0.08. Oral diameter, 38μ; S.D., 5μ; C.V., 0.14. Aboral diameter (at horn-body junction), 11μ; S.D., 3μ; C.V., 0.31. 30 loricae.

Station 2: Total length, 207μ; S.D., 27μ; C.V., 0.13. Oral diameter, 36μ; S.D., 2μ; C.V., 0.18. 30 loricae.

Localities.—Type-locality, Matsushima Bay (Hada, 1932a); Mutsu Bay and the Sea of Okhotsk (Hada, 1932a); the St. Andrew Bay system (Hopkins, 1966); South Atlantic (Balech, 1948).

Comparison.—Differs from *T. cylindrica* in the presence of an aboral opening and from *T. radix* in the possession of a shorter, stouter horn and in the lack of a spiral structure.

Discussion.—*T. kofoidi* was abundant in plankton samples from mid-February through mid-April 1967, in samples from all three stations. Station 1 always had more individuals of this species than did the other two stations. *T. kofoidi* showed almost the identical distributional pattern exhibited by *T. tubulosa* Levander. Both were early constituents of the zooplankton and their presence is correlated with the earlier phyto-

plankton bloom of that year. Furthermore, both species appear to be abundant in temperatures ranging from around 14°C in mid-February to about 22°C in mid-April.

Tintinnopsis levigata Kofoid & Campbell, 1929
Fig. 2

Description.—Lorica cylindrical, about 3 oral diameters in total length, consisting of a cylindrical fundus sloping to a short, blunt aboral horn; oral rim usually entire; wall with medium to fine agglomerated particles with no visible sign of spiral structures.

Dimensions.—Total length, 113μ (112μ-115μ); oral diameter, 33μ (31μ-34μ); horn length, 20μ (no range). 5 loricae.

Localities.—Type-locality is Strait of Georgia, British Columbia (Wailes, 1925). Also identified from Bodega Bay, California (personal observation).

Comparison.—Differs from *T. radix* in the shorter length of the aboral horn and from *T. kofoidi* by having a more gentle slope from the fundus to the horn.

Discussion.—*Tintinnopsis levigata* Kofoid & Campbell was first reported by Wailes (1925: pl. 2, fig. 4) as *Tintinnopsis davidoffi* var. *laevis* Wailes; the length reported by Wailes was 50μ-70μ, and the diameter was 20μ-30μ. Kofoid & Campbell (1929: 37) gave as references Wailes (1925) and Daday (1887: 552) when they raised this former variety to specific status. Daday had named the tintinnid *Tintinnopsis urniger* var. *laevis* and had assigned the total length of 144μ-153μ with an oral diameter of 45μ-60μ. Although the latter dimensions agree closely with my measurements, Daday's drawing is of a lorica with a slightly spreading oral region, while Wailes's drawing, which was followed by Kofoid & Campbell in their emendation, is of a lorica identical in proportions to the one I have illustrated. Kofoid & Campbell appear to have included Daday's *Tintinnopsis urniger* var. *laevis* because of coincidental nomenclature rather than because of any morphological similarities.

Although the possibility does exist that the Gulf of Mexico species is a variant of *Tintinnopsis kofoidi*, the similarity in form to *Tintinnopsis levigata* prompts me to assign this specific name to this species. The discrepancies in size may be accounted for in temperature-difference considerations. However, I am opposed to assigning new specific names to organisms whose loricae differ in size only. Therefore, I tentatively report *Tintinnopsis levigata* Kofoid & Campbell, 1929, from the waters of the northeast Gulf of Mexico, realizing that future studies may invalidate this particular specific assignment.

Tintinnopsis mortenseni Schmidt, 1901
Figs. 11, 12

Description.—Lorica cylindrical with a wide-spreading brim, 0.8 oral diameters in total length; brim with heavy agglomerations on the periphery, sloping to an annulated throat region which leads to a short, stout cylinder; some indication of a bowl is usual aborally; no aboral horn.

Dimensions.—Total length, 75μ (70μ-78μ); oral diameter, 90μ (85μ-92μ); nuchal diameter, 31μ (no range); bowl diameter, 32μ (no range). 10 loricae.

Localities.—Gulf of Siam (Schmidt, 1901); Great Barrier Reef (Marshall, 1934).

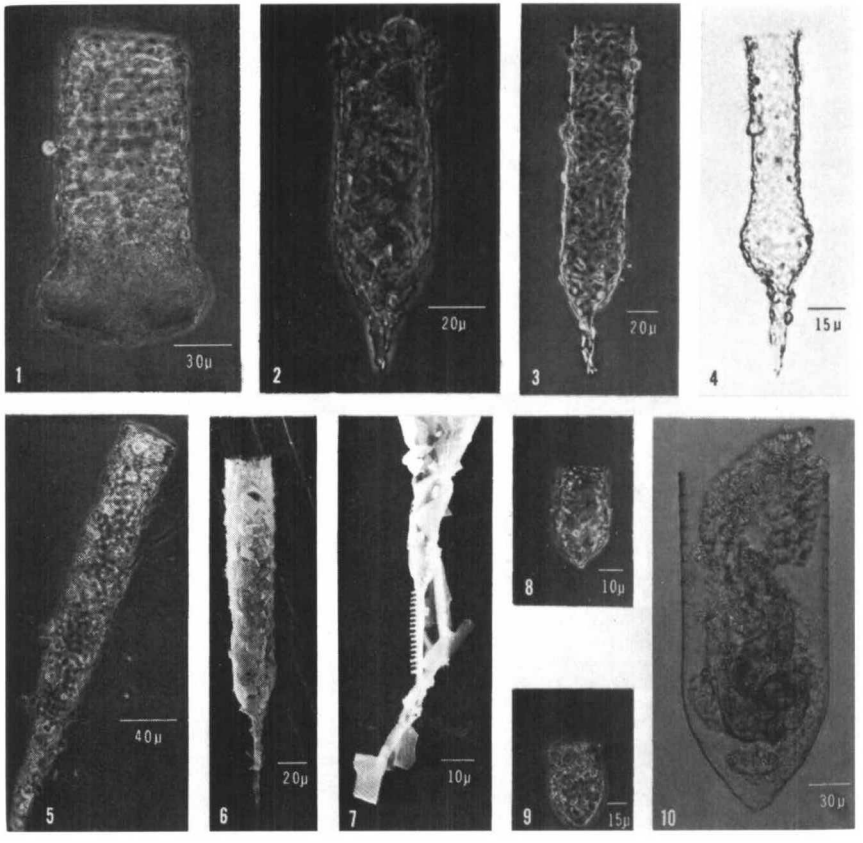
Comparison.—Differs from *Tintinnopsis tubulosa* Levander in the possession of a wide-spreading brim and in the presence of a spiral structure in the throat.

Discussion.—The notable features of this species are the flared oral region, the spiral structures in the region of the throat, and the thickening of the lorica in the peripheral region of the brim. Neither Schmidt (1901), Kofoid & Campbell (1939), nor Roxas (1941) referred to the spiral structure, and all three authors figured this species without an expanded aboral region. Marshall's (1934) drawing is quite similar to my own, and her drawing shows the same clockwise spiraling that is evident in my illustration.

An anomalous form of *T. mortenseni* with a greatly expanded throat and spiral region was collected in a single sample at Station 2 on 5 August 1967. I noted only four or five loricae of this type, although "normal" loricae of *T. mortenseni* composed about 25 per cent of the total tintinnid loricae in the sample. There was a change in the direction of the spiral rotation in column formation on this anomalous form. I see no reason to refer to this form as a variety or a subspecies. The dimensions for the anomalous form are as follows: total length, 125μ; oral diameter, 100μ; bowl diameter, 55μ; maximum column diameter, 38μ.

Tintinnopsis parvula Jörgensen, 1912
Fig. 8

Description.—Lorica short, stout, about 1.7 oral diameters in length, consisting of a cylindrical oral region expanding within the upper one-half to a rounded aboral region which tapers to a blunt point; oral rim uneven, ragged; no collar present; column cylindrical with an uneven spiral structure sometimes hidden by the medium to fine agglomerated particles; aboral and evenly tapering to a blunt point.



FIGURES 1-10. Tintinnid loricae: 1, *Tintinnopsis brandti*; 2, *T. levigata*; 3, *T. kofoidi*; 4, *T. tocantinensis*; 5, *T. cylindrica*; 6, *T. radix*, scanning electron photomicrograph; 7, *T. radix*, scanning electron photomicrograph of body-tail junction; 8, *T. parvula*; 9, *T. beroidea*; 10, *Coxliella longa*.

Dimensions.—Total length, 39μ (35μ-40μ); oral diameter, 23μ (20μ-24μ). 4 loricae.

Locality.—North Sea (Jörgensen, 1927).

Comparison.—Differs from *Tintinnopsis beroidea* in the absence of a nuchal constriction and oral rim and in the presence of an aboral expansion, spiral structures, and aboral point.

Discussion.—Rossolimo (1922) figured several loricae which suggest an intergradation of *Tintinnopsis parvula* and *Tintinnopsis beroidea.* Although *T. parvula* occurred throughout the year, as did *T. beroidea*, these two

species were found together only once (25 March 1967, Station 1). The suggestion of an intergradation of these two species is not discounted. However, in the specimens examined, there were enough differences in lorical morphology to justify assignment to the two species. If further investigation should show that an intergrade does exist, I suggest reassignment of all notations of *T. parvula* to *T. beroidea*, since the latter was the first named of the two species. At this time I have no evidence supporting the existence of an intergradation; indeed, all loricae examined showed remarkable adherence to the limitations imposed in the descriptions for these two species.

T. parvula was never common in late summer plankton hauls and could easily go unnoticed in general low-power (× 100) examination of the plankton samples. Using the evidence presently available, I report *Tintinnopsis parvula* Jörgensen as a rare constituent of the plankton in the waters of the St. Andrew Bay system, Florida.

Tintinnopsis radix (Imhof, 1886)
Figs. 6, 7

Description.—Lorica elongated, tubular, about 6 oral diameters in length, consisting of a cylindrical bowl tapering in the posterior ⅓ of the total length to a slender aboral horn; some evidence of a weak spiral structure; agglomerations fine to medium and occasionally heavy.

Dimensions.—Total length, 249μ (230μ-258μ); oral diameter, 39μ (37μ-40μ); horn length, 78μ (70μ-85μ). 8 loricae.

Localities.—This is a cosmopolitan temperate- and tropical-water species reported by several authors, including Jörgensen (1924), Marshall (1934), Hada (1937, 1938), Roxas (1941), Hopkins (1966), and Balech (1967).

Comparison.—Differs from *T. kofoidi* by having a longer aboral horn and in the lack of parallel sides; differs from *T. cylindrica* by having a more slender aboral horn.

Discussion.—Hada's (1937, 1938) figures of *T. radix* closely resemble the figures of *T. cylindrica* of Marshall (1934). The difference is in the emphasis of the juncture of the aboral horn and the column proper. There is a rather abrupt demarcation in *T. radix*, while the slope is more gentle in *T. cylindrica*. I suspect that variants of each species would share each of these characters which would make separation into species impossible. I suggest the possibility of the existence of natural populations sharing characters common to both. This could explain the confusing diagrams of Hada (1937, 1938). In any case the organisms found in plankton tows from the St. Andrew Bay system usually exhibit enough morphological differences to make species assignment possible.

The scanning electron photomicrographs were taken of *T. radix* collected on 5 August 1967 at Station 2. The differences noted in lorical morphology between this and the forms collected earlier in the year of this same species are another example of the effects of water temperature and viscosity on lorical shape (Heald, 1911).

Tintinnopsis tocantinensis Kofoid & Campbell, 1929
Fig. 4

Description.—Lorica of three characteristic portions: cylindrical adorally with bulbous midsection and thick aboral horn; lorica about 7 oral diameters in total length; wall thick with heavy agglomerations.

Dimensions.—Total length, 125μ; oral diameter, 18μ; column diameter at bowl, 15μ; bowl diameter, 25μ; horn length, 31μ. 1 lorica.

Localities.—Type-locality is the mouth of the Tocantins River of South America (Brandt, 1906); South Atlantic near Uruguay (Balech, 1948).

Comparison.—Differs from *T. aperta* in having a longer, more rounded bulbous enlargement and a stouter horn.

Comment.—I have included this species on the basis of only one lorica because of its highly characteristic structure.

Tintinnopsis tubulosa Levander, 1900
Figs. 15, 16

Description.—Lorica vase-shaped, usually with hemispherical bowl and cylindrical oral end, about 3 oral diameters in length, consisting of a cylinder spreading sharply into an aboral sphere; bowl about 0.4 of the total length in length, with a diameter averaging 1.30 oral diameters; wall thin and irregular; no spiral structures.

Dimensions.—Total length, 93μ; S.D., 6μ; C.V., 0.06. Oral diameter, 32μ; S.D., 2μ; C.V., 0.05. Bowl diameter, 42μ; S.D., 3μ; C.V., 0.07. Column diameter, 31μ; S.D., 1μ; C.V., 0.04. Bowl length, 35μ; S.D., 2μ; C.V., 0.06. 30 loricae.

Locality.—Off Finland (Levander, 1900).

Comparison.—Differs from *T. brandti* in the absence of spiral structures and from *T. mortenseni* in the absence of an oral rim.

Discussion.—The identification of this species as *Tintinnopsis tubulosa* Levander was kindly confirmed by Dr. Bernt Zeitzschel at Scripps Institution of Oceanography, La Jolla, California.

The tubular construction of the lorica varies aborally to a high degree, even among members of the same population, from a cylinder with a conical bowl to a cylinder lacking any indication of a bowl. These organisms

were especially abundant in plankton hauls in the St. Andrew Bay system from early February through mid-April 1967. The loricae pictured were taken in a plankton haul on 8 April 1967 at Station 2.

The greater depth of field allowed by the scanning electron microscope permitted elucidation of pores in the lorica of this species, especially in the region of the column. These pores seem to be regular (see Fig. 16) in form and distribution and are possibly a character of the lorica appearing at the time of its formation. The function of the pores is unknown.

Family Coxliellidae Kofoid & Campbell
Subfamily Coxliellinae Kofoid & Campbell
Genus *Coxliella* Brandt
Coxliella longa (Laackmann, 1909)
Fig. 10

Description.—Lorica bullet-shaped, about 2 oral diameters in total length, consisting entirely of a single band forming laminae; oral rim finely irregular; cylindrical orally 0.6 of length; convex conical aborally; wall double with fine primary and coarser secondary prismatic or reticular elements; wall with 15 turns of spiral laminae, becoming threefold wider aborally.

Dimensions.—Total length, 214μ (205μ-217μ); oral diameter, 101μ (95μ-105μ). 7 loricae.

Localities.—Type-locality is off Ralum in the western tropical Pacific (Kofoid & Campbell, 1929); New Pomerania (Brandt, 1907); lagoons of the Palao Islands (Hada, 1938); Manila Bay (Roxas, 1941); off Marokau in the western tropical Pacific (Balech, 1962); Galapagos region and South Pacific island fields (Campbell, 1942).

Comparison and Discussion.—Both Roxas (1941: 123, fig. 53) and Kofoid & Campbell (1929: 101, fig. 196) have included *Cyttarocylis* (?) *ampla* (?) var. *c longa* Brandt (1906: pl. 28, fig. 3) in their respective lists of synonymies concerning *Coxliella longa.* Kofoid & Campbell (1929: 101) first raised this organism from varietal to specific status, naming the organism *Coxliella longa* (Brandt) Laackmann.

The loricae I have described are remarkably similar to the descriptions given by Roxas and by Kofoid & Campbell. There is no material difference in my description and that of Roxas; the organism described by Kofoid & Campbell is somewhat smaller (total length, 130μ-135μ) and does possess a short, stout, curved point. Roxas noted this difference when he stated that the lorica he described shows a thickened aboral plate, and this thickening is reflected in Roxas's drawing of the lorica of *C. longa.* Kofoid & Campbell (1939: 94) described the aboral region as follows: "aboral point short, subcentral, asymmetrical, highly variable, a slender aciculate point, a bluntly rounded, obliquely truncate knob, a scarcely differentiated

acute point, or asymmetrically rounded, even ragged and irregular, without any horn . . . ."

Since the relative proportions of the lorica, the oral-rim characteristics, the wall structure, and laminar development are deemed most characteristic of this genus, and since the aboral development is so slight in the lorica figured by Kofoid & Campbell, I reject Roxas's (1941: 123) designation of this species as *Coxliella longa* Brandt. If enough variation had existed to rule out the organism as *Coxliella longa* (Brandt) Laackmann, then designation of another taxon would appear to have been in order. Rather, Roxas chose to ignore the synonymous nature of the organism named by Brandt and that figured as *Coxliella longa* by Kofoid & Campbell by reverting to older literature in search of a species designation for the lorica he saw because of a minor lorical characteristic.

Coxliella longa (Brandt) Laackmann belongs to the subgenus *Coxliella*. On the basis of wall structure, Jörgensen (1924: 72) divided the genus into two subgenera: *Cochliella* and *Protocochliella*.

Kofoid & Campbell (1929) replaced the taxon *Cochliella* with *Coxliella*, since the generic taxon had not been repeated in the subgenera. The subgenus *Coxliella* includes those tintinnids of the genus *Coxliella* with well-developed inner and outer walls throughout the lorica and with secondary reticular or prismatic structures. *Protocochliella* includes those tintinnids of the genus *Coxliella* with simple lorical walls, imperfectly separated lamellae, and faint and indistinct primary alveoli.

Genus *Stylicauda* Balech

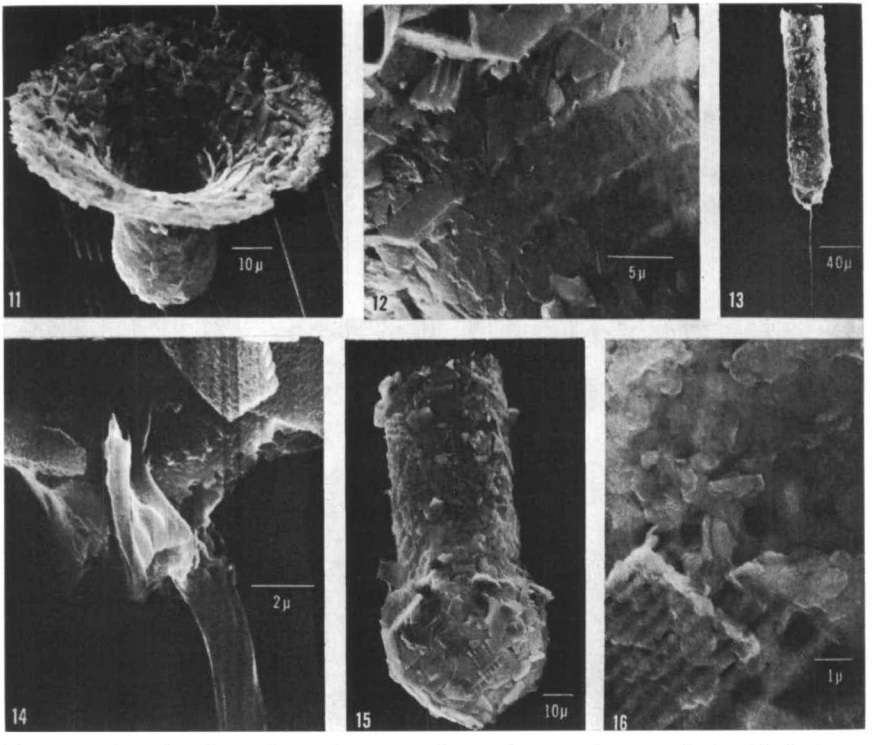
Stylicauda platensis (Cunha & Fonseca, 1917)

Figs. 13, 14

Description.—Lorica divided into two regions, a column and a compact caudal projection; column cylindrical, about 5 oral diameters in length, consisting entirely of irregular spiral laminae; wall of column trilayered, consisting of hyaline inner and outer surfaces enclosing a third layer of particulate matter; inner and outer surfaces joining aborally to form a compact, long prismatic caudal projection or tail.

Dimensions.—Total length, 278μ; S.D., 20μ; C.V., 0.07. Oral diameter, 42μ; S.D., 8μ; C.V., 0.19. Widest diameter, 45μ; S.D., 6μ; C.V., 0.14. Body (column) length, 188μ; S.D., 12μ; C.V., 0.06. Tail length, 88μ; S.D., 12μ; C.V., 0.13. 20 loricae.

Localities.—Type-locality is the South Atlantic, near Mar del Plata (Cunha & Fonseca, 1917); South Atlantic, shores of Buenos Aires, and Rio Negro (Balech, 1951); Palao Island, Saipan, and Yap Island (Hada, 1938); and St. Andrew Bay, Florida (Hopkins, 1966).



FIGURES 11-16. Scanning electron photomicrographs of tintinnid loricae: 11, *Tintinnopsis mortenseni*; 12, same, spiral construction of the throat; 13, *Stylicauda platensis*; 14, same, body-tail junction; 15, *Tintinnopsis tubulosa*; 16, same, pore from the column area.

Comparison.—Differs from all members of the genus *Tintinnopsis* by possessing a column composed completely of spiral laminae and a compact prismatic caudal projection. Differs from other members of the family Coxliellidae by lacking relatively large alveolation in the wall of the lorica and by the character of the agglutinated particulate matter.

Discussion.—*Stylicauda platensis* (Cunha & Fonseca, 1917) was first described from the South Atlantic near Mar del Plata as *Tintinnopsis platensis*. Their description included observations concerning the cylindrical "carapace," the long tail projecting from the base of the carapace, the dispersed silica particles, and the apparent curvature of the tail. The dimensions given were: total length, 250μ; horn length, 60μ; and oral diameter, 45μ.

In 1938, Hada described a similar organism from the South China Sea;

he suggested that the long tail was an artifact, possibly a spicule from another organism. Balech (1951) published a concise, but comprehensive, summary of this organism, substituting the generic name *Stylicauda* for the reasons I have already mentioned in my comparison. In a series of personal communications with Professor Balech, I learned that either the prismatic caudal projection or the spiral structure of the body of the lorica would suffice as distinct enough to remove this species from the genus *Tintinnopsis*. The caudal projection distinguished this species from all members of the genus *Tintinnopsis*, and its inclusion in the genus *Tintinnopsis* would make that generic designation too broad. The presence of spiral laminae corresponds, with reservations concerning the smaller size of the alveoli in the wall of *Stylicauda*, to characters reserved for members of the family Coxliellidae, the present familial designation of this genus. The genus *Stylicauda* has only one species, *S. platensis*.

The following comment may be of aid to those interested in this classical aspect of ciliate taxonomy. None of the specimens of *S. platensis* I had collected from the St. Andrew Bay system seemed to have spiral structure in the lorica. Each sample had been observed mounted in balsam or in wet-mount condition using a coverslip. The scanning electron photomicrographs showed no evidence of spiral structure. It was only when the specimens were examined in wet-mount condition, in which they were free to rotate, that the spiral structure of the lorica became evident. It is of interest that specimens of this species from Mar del Plata are about the same size as those from Florida, but in those from Florida the spiral structure is concealed by the greater density of agglomerated matter.

Subfamily Metacylidinae Kofoid & Campbell
Genus *Metacylis* Jörgensen
Metacylis sp.
Fig. 23

Description.—Lorica elongated, about 2 oral diameters in total length; collar consisting of 2 spiral turns; bowl elongated, consisting of nearly straight sides gradually narrowing the bowl diameter aborally; aboral region flat to subhemispherical with pronounced indentation centered aborally; wall hyaline.

Dimensions.—Total length, 74μ (72μ-75μ); oral diameter, 36μ (no range). 5 loricae.

Locality.—St. Andrew Bay system, Florida; Station 3, 1 July 1967.

Comparison.—Differs from *M. vitreoides* Kofoid & Campbell by having only two turns in the collar and by having these turns restricted to the collar only.

Metacylis sp.
Fig. 24

Description.—Lorica about 1.4 oral diameters in total length; collar short with slight flare, consisting of two equal-sized rings; constriction at base of collar 1μ-2μ less in diameter than oral diameter, expanding about 6μ to widest diameter of bowl at shoulder, then sloping gradually to almost imperceptible point at aboral end; wall hyaline, of equal thickness throughout lorica.

Dimensions.—Total length, 44μ; oral diameter, 31μ; diameter at constriction, 30μ; widest diameter, 36μ. 4 loricae.

Locality.—St. Andrew Bay system, Florida; Station 1, 1 July 1967.

Comparison.—Differs from *Metacylis* sp. (described above, Fig. 23) in the more rounded aboral region and from *M. angulata* in the lack of thick shoulders.

Metacylis mereschkowskii Kofoid & Campbell, 1929
Fig. 25

Description.—Lorica short and wide, about 0.8 oral diameters in length; collar low with 2 rings; bowl with distinct shoulder below collar, tapering to rounded aboral region; no point; wall structure faint.

Dimensions.—Total length, 46μ (no range); oral diameter, 56μ (no range); widest diameter, 67μ (65μ-67μ). 5 loricae.

Localities.—Black Sea and off the west coast of Europe to Bergen (Kofoid & Campbell, 1929); Mediterranean; near Key West, Florida; North Sea; and East China Sea (Jörgensen, 1924).

Comparison.—Differs from *M. mediterranea* in the possession of an erect instead of a spreading collar and in the absence of rings on the bowl; differs from *M. angulata* Lackey & Balech, 1966, by having less prominent shoulders (1.19 of the oral diameter as compared to 1.50-1.55 for *M. angulata*), faint wall structure, no aboral spine, and more convex sides.

Genus *Helicostomella* Jörgensen
Helicostomella subulata (Ehrenberg, 1834)
Figs. 17 and 18

Description.—Lorica elongate, tubular, about 15 oral diameters in total length; suboral region cylindrical, formed of a spirally wound band of a varying number of turns which fade aborally; oral rim regularly dentate; bowl conical, tapering to a blunt tip; wall thin generally, but thicker in oral and aboral regions; no agglomerated particles.

Dimensions.—Total length, 278μ; S.D., 31μ; C.V., 0.11. Oral diameter,

17μ; S.D., 1μ; C.V., 0.08. Horn length, 52μ; S.D., 14μ; C.V., 0.26. Length of annulated region, 65μ; S.D., 21μ; C.V., 0.33. 30 loricae.

Localities.—Off Naples in the Mediterranean, east coast of Arabia, Red Sea (Jörgensen, 1924); Sea of Okhotsk near the Sea of Japan (Hada, 1932b); Akkeski Bay near the Sea of Japan (Hada, 1938); St. Andrew Bay system, Florida (Hopkins, 1966).

Comparison.—Differs from *H. edentata* in the presence of a dentate oral margin.

Discussion.—The extremely variable size of *H. subulata* indicates a probable temperature relationship with the size of the lorica. I have identified *H. subulata* from the California Current near Bodega Bay, California, in water temperatures of 14°C. The loricae of west coast forms are approximately one-half the total length of the corresponding Gulf Coast species.

The aboral extremities of the loricae exhibit a golden coloration when stained with fast green and viewed at 500 magnifications, using phase-contrast microscopy. This led me to suspect that this area of the lorica was solid. The fact that the lorica did not collapse in this region when subjected to the vacuum apparatus of the scanning electron microscope gives credence to this idea. The annulated region showed the same golden coloration and is also noticeably thicker than the central portion of the lorica.

Peculiar pores were found in the aboral region of the loricae from several collections. The larger (primary) pores lead into smaller, internal (secondary) pores. I detected these pores earlier in light microscope examinations, but did not realize their extent at that time. Neither the origin nor the function of the pores is known.

Jörgensen (1924: 24) described the oral portion of the lorica as "cylindrical and formed by a single, narrow, closely twisted helicoidal band with numerous, superposed turns in contact with each other and coalescent at their lower and upper edges . . . ." That "the upper annuli are usually a little overlapping in an upward direction, and frequently dentate" is illustrated by Figure 17.

Family Ptychocylididae Kofoid & Campbell
Genus *Favella* Jörgensen
Favella panamensis Kofoid & Campbell, 1929
Fig. 19

Description.—Lorica campanulate, cylindrical adorally, contracting to conical aborally and terminating in a closed aboral horn of varying size and shape; its length about 3 oral diameters; oral rim entire but irregular and jagged, with 1 (rarely as many as 8) rings, and lipped below the

initial ring; bowl without nuchal constriction, aboral region with abrupt contraction; aboral horn usually solid, sometimes with a short inner core, sometimes with oblique wings; tip pointed to blunt; wall with fine primary and scattered, coarse, secondary alveolations.

Dimensions.—Total length, 260μ; S.D., 24μ; C.V., 0.09. Oral diameter, 93μ; S.D., 8μ; C.V., 0.08. Body length, 209μ; S.D., 17μ; C.V., 0.08. Horn length, 50μ; S.D., 11μ. C.V., 0.22. 30 loricae.

Localities.—Type-locality is the Bay of Panama (Kofoid & Campbell, 1929); California, Mexican, and Peruvian currents in the Pacific (Kofoid & Campbell, 1929); St. Andrew Bay system (Hopkins, 1966).

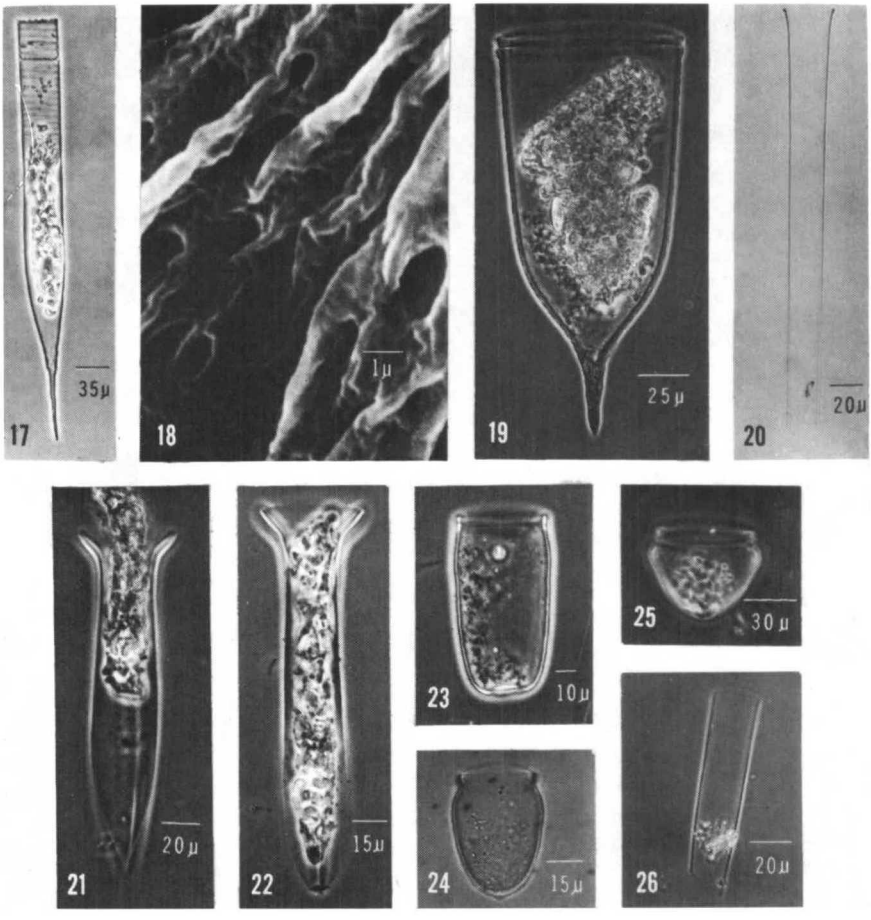
Comparison and Discussion.—*Favella* is a relatively new genus erected by Jörgensen (1924) to distinguish those members of the family Cyttarocylidae whose lorical walls are well developed and which consist of "distinctly separated lamellae, and usually a single . . . or . . . two or more intermediate layers of 'prismatic elements' the lateral walls of which appear on the optical (longitudinal) section of the lorica as short cross-lines, connecting the outer and inner lamellae." (Jörgensen, 1924: 25).

Kofoid & Campbell (1929: 147) in their emendation of Jörgensen's (1924) characterization of the genus *Favella* were more comprehensive: "Favellinae with lorica generally campanulate or subconical; oral rim entire or with small skirt, or with denticles, with or without suboral constriction and ridge; never with a collar separated by a band from the bowl proper, but sometimes with one or more annuli; bowl campanulate to conical, contracting aborally; aboral horn present, generally thick-walled; wall bilamellate, usually with coarse, intermediate prismatic secondary alveoli and a very fine, primary structure, never with regular polygonal structure. Marine."

Kofoid & Campbell were concerned in their characterization with the structure of the oral region of the loricae of the favellinids. In each species cited in the *Conspectus*, where descriptions were given, the form and sculpture of the oral region were discussed.

In my review of the literature concerning this genus, I have been impressed by the wide intraspecific variation of the aboral horn; however, the oral-margin characters are constant on the intraspecific level. My observations of the loricae from the northeast Gulf of Mexico reflect the worth of using oral-rim characters as an index of the first magnitude for taxonomic treatments within this genus.

It is because of the oral-rim characteristics that *F. panamensis* is not confused with *F. ehrenbergii* Kofoid & Campbell, 1929. Although Kofoid & Campbell (1929:152, fig. 280) listed 35 citations in the list of synonymies for *F. ehrenbergii*, no composite list of specifications is noted to characterize



FIGURES 17-26. Tintinnid loricae: 17, *Helicostomella subulata*; 18, same, scanning electron photomicrograph showing primary and secondary pores in tail; 19, *Favella panamensis*; 20, *Eutintinnus tenuis*; 21, *Amphorellopsis acuta*; 22, *Amphorides brandti*; 23, unidentified species of *Metacylis*; 24, another unidentified species of *Metacylis*; 25, *Metacylis mereschkowskii*; 26, *Eutintinnus tubulosus*.

this species. Brandt (1906: pl. 41, fig. 4) drew the original sketch which appears in the Kofoid & Campbell *Conspectus* as *F. ehrenbergii*. The synonymy includes the works of other authors whose drawings of the *F. ehrenbergii* form named by Kofoid & Campbell are very different; for example, Jörgensen (1924:29, figs. 32*a* and 32*b*; 1927:12, figs. 18 and 19) sketched variants of a form he called *F. ehrenbergii* (Clap. et Lachm.) with

6 rings above the "usual" oral margin. (For an even more similar variant of *F. ehrenbergii* Kofoid & Campbell, see Hada, 1937:186, fig. 32.)

Favella campanula Kofoid & Campbell, 1929, was characterized by Hada (1938:121, fig. 38) from Yap Island. *F. campanula* differs from *F. panamensis* by possessing a "wall almost hyaline with hardly visible reticulation."

The species most similar to *F. panamensis* is *Favella philippinensis* Roxas, 1941. In his comparison of his newly named species with *F. panamensis*, Roxas (1941: 124, pl. 15, fig. 53) stated that *F. philippinensis* is similar to *F. panamensis* "in many respects, except in the fine serration of the oral rim." Hada equated serrate with denticulate in the text of the description. This condition would differ from my own observations of the jagged oral margin in *F. panamensis*.

Gold (1969) cultured *Favella campanula* and found striking changes in the morphology of the lorica after three weeks of laboratory culture. Changes in length were first noted, then changes in the length of the aboral horn were observed; in some specimens the horn was reduced to a thickening on the aboral surface of the bowl. The most stable characteristic was the oral diameter.

Family Tintinnidae Claparède & Lachmann
Subfamily Tintinninae Claparède & Lachmann
Genus *Amphorides* Strand
Amphorides brandti (Jörgensen, 1924)
Fig. 22

Description.—Lorica elongated, about 4 oral diameters in total length; collar flaring, trumpet-shaped, its basal diameter about ⅛ of the oral diameter; column with 3 ridges, stretching the last ⅔ of the lorical length and giving the lorica a triangular appearance in aboral cross section; wall hyaline, thickened in the region of the collar and becoming thin aborally; aboral end flattened.

Dimensions.—Total length, 169μ; S.D., 10μ; C.V., 0.05. Oral diameter, 44μ; S.D., 2μ; C.V., 0.04. Nuchal diameter, 25μ; S.D., 3μ; C.V., 0.07. Widest diameter, 28μ; S.D., 2μ; C.V., 0.08. Column length, 154μ; S.D., 10μ; C.V., 0.06. 30 loricae.

Localities.—Type-locality is near Surtoroe, Norway (Claparède & Lachmann, 1858); Indian Ocean off the Strait of Sunda, west coast of Borneo, Palao Islands (Hada, 1938); Mutsu Bay in Japan, Atlantic, Barrier Reef Station (Marshall, 1934).

Comparison.—Differs from *A. amphora* by having a more slender column.

Discussion.—Kofoid & Campbell (1939: 330) listed *A. brandti* of Kofoid

& Campbell (1929) as synonymous with *A. amphora* (Claparède & Lachmann) Daday, 1887. Campbell (1942) synonymized *A. brandti* with *A. amphora.* I do not accept this interpretation, since the reclassification makes the concept of this species too broad. *A. amphora* has a much thicker column than *A. brandti.* Hada (1938) stated that the lorica of *A. brandti* was 3.1-3.7 oral diameters in length. These dimensions compare favorably with the dimensions I have stated, but they do not agree with Kofoid & Campbell's (1939) dimensions of 2.47 for the ratio of oral diameter to total length for *A. amphora.*

Genus *Amphorellopsis* Kofoid & Campbell
Amphorellopsis acuta (Schmidt) Kofoid & Campbell, 1929
Fig. 21

Description.—Lorica a truncated spindle with a flaring anterior collar, about 3 oral diameters in total length; oral margin thinning to a sharp edge; bowl circular in cross section orally and triangular posteriorly; aboral end a pyramid of about 40°; fins form 3 vertical equidistant angles; wall hyaline, thicker in the region of the throat.

Dimensions.—Total length, 149μ (144μ-152μ); oral diameter, 44μ (no range); widest diameter, 30μ (no range); diameter at constriction, 25μ (no range). 3 loricae.

Localities.—Palao Islands, off Singapore and Batavia (Hada, 1938); Gulf of Siam (Schmidt, 1901); west Panamic Area (Kofoid & Campbell, 1939).

Comparison.—Differs from all other species of *Amphorellopsis* by possessing three fins.

Subfamily Salpingellinae Kofoid & Campbell
Genus *Eutintinnus* Kofoid & Campbell
Eutintinnus tenuis (Kofoid & Campbell, 1929)
Fig. 20

Description.—Lorica long and narrow, about 8 oral diameters in total length; orally a funnel-shaped cone, subcylindrical posteriorly; without aboral differentiation; funnel a short flare, merging imperceptibly into shaft; shaft tapering without local swellings to truncated aboral end.

Dimensions.—Total length, 283μ; S.D., 24μ; C.V., 0.08. Oral diameter, 35μ; S.D., 3μ; C.V. 0.09. Aboral diameter, 21μ; S.D., 2μ; C. V., 0.10. 30 loricae.

Localities.—Type-locality is off Ralum in the western Pacific (Kofoid & Campbell, 1929); California, Mexican, and Peruvian currents, and South

Equatorial and Equatorial countercurrents, Panamic Area (Kofoid & Campbell, 1939); just northwest of Hawaii (Balech, 1962).

Comparison.—Differs from *Eutintinnus fraknoi* in the absence of an aboral flare.

Discussion.—In 1929, Kofoid & Campbell gave specific status to *Tintinnus tenue*, separating it from *Tintinnus lusus-undae* because of the more slender shaft and more gradual anterior flare of *T. tenue*. When the new generic name was adopted, the specific name of the organism became *Eutintinnus tenuis* (Kofoid & Campbell). The designation was accepted by Balech (1962).

Eutintinnus tubulosus (Ostenfeld, 1901)
Fig. 26

Description.—Lorica a short, truncated, inverted cone, about 4 oral diameters in total length; oral rim projecting slightly horizontally; aboral end without rim; wall hyaline and very thin except for the slight thickening at the oral margin.

Dimensions.—Total length, 92μ; oral diameter, 22μ; aboral diameter, 16μ. 10 loricae. No ranges given due to encrustations.

Localities.—Mexican and Peruvian currents, Galapagos Eddy (Kofoid & Campbell, 1939).

Comparison.—Differs from *E. tenuis* in length and in the horizontal projection of the oral rim.

Discussion.—The lorica of *E. tubulosus* was usually associated with various algae which attached to the central portion of the lorica. In several specimens the encrustations covered the entire lorica with the exception of the oral region. These particles can be removed so that the intact lorica is left. No entire loricae of this species were found.

I am grateful to Dr. Bernt Zeitzschel of the Scripps Institution of Oceanography for confirming my identification of this species.

Discussion and Conclusion

To correlate the work of Hopkins (1966) and Balech (1957) with my own work on the tintinnids of the northeast Gulf of Mexico, I am listing species of tintinnids found by both Balech and Hopkins, by Balech and this investigation, and by all three investigations. The tintinnids are listed in alphabetical order.

Balech and Hopkins found the following tintinnids in common: *Amphoridea amphora* (= *Amphorides amphora*, see Tappan and Loeblich, 1968), *Eutintinnus medius, E. pinquis, Favella panamensis, Stylicauda platensis, Tintinnopsis buetschlii*, and *T. radix*. Therefore, of the 55 species reported

from the open Gulf of Mexico by Balech and the 13 species found in the estuary by Hopkins, only seven species were found by both of them.

Balech reported the following seven species which are also reported in this investigation: *Amphorides amphora* (possibly *Amphorides brandti*), *Eutintinnus tenuis, E. tubulosus, Favella panamensis, Stylicauda platensis, Tintinnopsis tocantinensis*, and *T. radix*.

Hopkins reported the following seven species which are also reported in this investigation: *Amphorides amphora* (possibly *A. brandti*), *Favella panamensis, Helicostomella subulata, Stylicauda platensis, Tintinnopsis brandti, T. kofoidi*, and *T. radix*.

Only four species of tintinnids may be found in common in the three reports: *Amphorides brandti, Favella panamensis, Stylicauda platensis*, and *Tintinnopsis radix*. There is no evidence that the species listed above as collected by Balech were found in exclusively neritic or oceanic areas. For example, one would expect the typically neritic genus *Tintinnopsis* to be found closer to the land mass, but Balech's information discloses that he found *T. radix* in both inshore and oceanic plankton hauls.

It is now recognized that the four species of tintinnids found in all three reports have wider seasonal and temperature distributions than intially realized. *Favella panamensis* and *Stylicauda platensis* were particularly persistent in my own samples; from this evidence I would suggest either species for experimental organisms, due to the eurythermal and euryhaline tendencies they exhibit.

Scanning electron photomicrography of fully formed loricae is useful in elucidating fine structures, as pores and annulations, which could go unnoticed in conventional light photomicrography. Continued use of the SEM technique in conjunction with rearing tintinnids in the laboratory will possibly give further insight into the method of lorical formation. Further, since it is known that some of the debris residual from the tintinnid diet is incorporated into schizont loricae, identification of the silicious and calcareous portions of the lorica would expand knowledge of the tintinnid feeding habits.

Finally, it is suggested that nets of less than 76μ be used in future collecting procedures. Unless the pores of a 76μ net became partially clogged during a haul, many of the smaller tintinnids could go undetected.

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SUMARIO

IDENTIFICACIÓN DE TINTÍNIDOS (PROTOZOA: CILIATA: TINTINNIDA) DEL SISTEMA DE LA BAHÍA DE ST. ANDREW, FLORIDA

Se presenta una clave para la identificación de los tintínidos del sistema de la Bahía de St. Andrew, Florida. Las relaciones presentadas en la clave están basadas en fotomicrografías producidas en microscopios compuesto y electrónico (scanning). Hay 21 especies incluídas en la clave. Ocho no habían sido previamente reportadas en estuarios de la Florida y dos son especies de *Metacylis* no identificadas. Cada especie reportada es descrita, se dan las localidades previas y se incluye la información estadística sobre el tamaño de la lorica, cuando se conoce.

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