

Zooplankton

Sheet 117

PROTOZOA

ORDER: TINTINNIDA

Family: Tintinnidiidae

Genus: Tintinnidium

Family: Codonellidae (1)

Genus: Tintinnopsis

(By S. M. MARSHALL)

1969

Introduction to Plankton Sheets 117-127

Sheets 117-127 are based, as must be any study of the Tintinnida, on the work of KOFOID and CAMPBELL (1929, 1939, 1942). These authors not only described the tintinnids from various expeditions but also reviewed the literature and assigned all published figures to their species.

The taxonomy is founded entirely on the lorica and although this may not be the ideal (FAURÉ-FREMIET, 1924; HOFKER, 1931) it is at present the only practicable method.

More recent workers, studying large populations in one area, have found a great deal of individual variation, and many forms transitional between one species and another (HOFKER, 1931; HALME, 1958; HALME and LUKKARINEN 1960-61; MARGALEF and DURAN, 1953). However, until more is known about reproduction, variation, and the effect of external factors such as temperature and salinity, it seems best to keep separate KOFOID and CAMPBELL's species; this has been done, with notes on the variability where necessary.

Sizes and proportions are as given by the authors or calculated from their figures, but these may cover a wide geographical range. Since ranges in length are often given without corresponding widths, or illustrations, the ratio length/oral

diameter does not always fit for the extreme sizes. As a rule, species are larger in the colder parts of their range and length varies more than width.

Many tintinnids are cosmopolitan and it therefore seemed advisable to include in the area covered, the North Atlantic generally, and the Arctic, as well as the European areas usually covered by the Plankton Sheets. The tropical Atlantic (Sargasso Sea southwards) and the Mediterranean have been excluded.

Two magnifications have been used, one (x 300) for most families and the second (x 150) for those families and sub-families (and one genus) which contain exceptionally long species, namely *Favella*, Rhabdonellidae, Xystonellidae, and Salpingellinae. They are marked with an asterisk in the lists. The fine structure of the lorica wall is usually shown on only part of the drawing.

I am glad to thank Mrs. Heather McBay and Miss Christine OUTHWAITE for copying many of the drawings.

A full bibliography will be found in KOFOID and CAMPBELL (1929). The present reference list contains only more recent work in the relevant area.

Key to numbers used in the tables for distribution

1. Arctic Seas (Spitsbergen, Barents and Kara Seas).
2. Greenland Coasts.
3. Iceland, Faroes, Shetland.
4. Norwegian Coast and Norwegian Sea.
5. Baltic (incl. Gulfs of Finland and Bothnia).
6. Approaches to Baltic (Skagerak, Kattegat, Belt Seas).
7. North Sea.
8. English Channel.
9. St. Georges Channel, Bristol Channel, Irish Sea.
10. Coasts of N. Europe (to Bay of Biscay),
11. Coasts of S. Europe and N.W. Africa.
12. North Atlantic, North.
13. North Atlantic, Central (Canaries, Azores, Gulf Stream).
14. Irminger Sea, Newfoundland Banks, Nova Scotia.
15. West Atlantic (Florida and Labrador Currents, Woods Hole region).

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
Family TINTINNIDIIDAE KOFOID & CAMPBELL, 1929						Wall soft and viscous, accumulating foreign particles, sometimes with a faint spiral structure. Tube- or sack-shaped, rarely with a collar. Aboral end open or closed.
Genus <i>Tintinnidium</i> KENT, 1882	Plate I					Tube- or sack-formed or irregular, sometimes with a collar. Aboral end open or closed. HOFKER thinks shape of lorica is no guide to identification and that there may be only one species.
<i>T. incertum</i> BRANDT, 1906	1	100-269	27-40	6.1	10	Lorica long, tube-shaped, closed at aboral end.
<i>T. mucicola</i> (CLAPARÈDE & LACHMANN, 1858)	2	100-240	30-63	4.0-6.0	4, 5, 6	Lorica very soft and irregular. Aboral end closed.
Genus <i>Leprotintinnus</i> JÖRGENSEN, 1899						Lorica more or less cylindrical, open at aboral end. Sometimes a spiral structure present.
<i>L. bottnicus</i> (NORDQVIST, 1890)	4	90-320	25-40	4.5-7.5	1, 2, 5, 6, 7, 12	Lorica more or less cylindrical, narrowing considerably to open aboral end.
<i>L. pellucidus</i> (CLEVE, 1899)	3	200-240	35-47	3.9-6.4	1, 2, 4, 6, 10, 11	Lorica more or less cylindrical, open aboral end narrower than oral often after a slight constriction. Spiral structure sometimes visible.
Family CODONELLIDAE KENT, 1882						Form very variable, globose to conical or cylindrical, with or without collar; aboral end rounded, pointed, or with pedicel, almost always closed. Collar with or without nuchal constriction, never spiral or hyaline. Wall composed of minute primary alveoli and much coarser uneven secondary structure, thickly or thinly scattered with particles made of wall substance. Inner and outer laminae ill-developed, spiral structure sometimes present. Differs from other families mainly in structure of wall.
Genus <i>Tintinnopsis</i> STEIN, 1867	Plate I, II					Mainly neritic and temperate. Form very variable as above. Spiral structure often present especially at oral end. Aboral end almost always closed.
<i>T. acuminata</i> DADAY, 1887	8	54-78	18-21	2.9-3.5	3, 4, 5, 6, 7, 8, 9, 10	Tubular, contracting in lower $\frac{1}{4}$ to bluntly pointed aboral end. Few particles.
<i>T. amphora</i> KOFOID & CAMPBELL, 1929	6	130-160	21-32 (53-60)	5-8	6, 11	Fusiform. Oral diameter less than half maximum diameter which is in aboral half.
<i>T. angusta</i> MEUNIER, 1910	9	70	20	3.5	1	Rather fusiform but oral diameter more than half maximum diameter of bowl.



Plate I.



Plate II.

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
<i>T. annulata</i> (CLAPARÈDE & LACHMANN, 1858)	5	270	70	3.8	4	Large but ill-defined species more or less cylindrical anteriorly, inflated in aboral $\frac{3}{4}$ bowl. KOFOID and CAMPBELL suggest it is an aberrant <i>T. subacuta</i> .
<i>T. baltica</i> BRANDT, 1896	49	42-110	30-50 (35-39)	1.2-2.0	5, 6, 7, 11	Small with flaring mouth, slightly inflated bowl and pointed aboral end. HALME and LUKKARINEN include it in their <i>lobiancoi</i> group in which, with <i>T. lata</i> and <i>T. turbo</i> it is one of the smaller forms. HOFKER includes it with <i>T. fimbriata</i> and <i>T. meunieri</i> , both wider in proportion to length. Sometimes with one or more annulations below mouth.
<i>T. beroidea</i> STEIN, 1867	19	34-100	18-36 (18-36)	1.5-3.0	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	Small, cylindrical, with bluntly pointed or rounded aboral end, sometimes slight ring or spiral formation below mouth c.f. <i>T. parvula</i> which some authors include here but which narrows to the mouth. With this is included <i>T. angustior</i> which HADA (1937) separates from <i>T. beroidea</i> and <i>T. acuminata</i> as being more slender and blunter aborally, both variable characters.
<i>T. brandti</i> (NORDQVIST, 1890)	7	65-215	42-50 (66-100)	1.3-4.3	4, 5, 6	Cylindrical, widening aborally to a surface usually flat, occasionally with a small point. HALME and LUKKARINEN find forms transitional between this and <i>T. tubulosa</i> but distinguish them on width of aboral end: $>66\mu = T. brandti$; $<62\mu = T. tubulosa$.
<i>T. bütschli</i> DADAY, 1887	26	80-144	66-92 (39-117)	1.3-1.6	6, 10, 11	Cylindrical with widely flaring mouth and rounded aboral end. See <i>T. campanula</i> .
<i>T. campanula</i> (EHRENBERG, 1840)	25	110-200	78-150	1.5	4, 5, 6, 7, 8, 10, 11, 12, 14	Typically cylindrical with a widely flaring mouth and a stout pedicel. Often indication of annulation below flare. HOFKER says this species is very variable in flare, presence or absence of pedicel, and encrustation with particles. He includes as forms of same sp. <i>T. bütschli</i> , <i>T. cincta</i> , <i>T. cyathus</i> , <i>T. lindeni</i> .
<i>T. cincta</i> (CLAPARÈDE & LACHMANN, 1858)	31	104-147	35-60	2.5-5	4, 5, 6	Cylindrical with slight oral flare bluntly pointed aboral end and ring or spiral structure below mouth. See <i>T. campanula</i> .
<i>T. cochleata</i> (BRANDT, 1906)	15	146-270	44-90	3.0-6	5, 6	Long, cylindrical, with rounded aboral end. Spiral structure extends almost throughout.
<i>T. compressa</i> DADAY, 1887	55a & b	47-90	37-75 (37-65)	1-1.3	11, 15	Small, rounded, with nuchal constriction. SILVA's specimen from the Portuguese coast has marked constriction and flaring collar and is perhaps a different species. (a) the Portuguese, (b) the more usual, form.

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
<i>T. coronata</i> KOFOID & CAMPBELL, 1929	37	250	50	5	13	Elongated cylinder with slightly flaring oral end and short pedicel. Distinguished from <i>T. cylindrica</i> by the flaring mouth.
<i>T. cyathus</i> DADAY, 1887	27	100-196	30-87	2-3	4, 5, 7, 8, 11, 12	Cone shaped or cylindrical in lower half with rounded aboral end, gently flaring to mouth. Spiral structure sometimes visible throughout. Differs from <i>T. bütschli</i> in having less oral flare and from <i>T. cincta</i> by its more rounded aboral end. See <i>T. campanula</i> .
<i>T. cylindrica</i> DADAY, 1887	36	120-240	37-45	3-5	4, 5, 14	Almost cylindrical for about $\frac{2}{3}$ bowl then sometimes very slightly inflated before narrowing to a stout pedicel. Differs from <i>T. coronata</i> in relatively greater width and from <i>T. lindeni</i> in lack of spiral structure.
<i>T. ecaudata</i> KOFOID & CAMPBELL, 1929	29	100-150	75-90 (45-50)	1-1.6	4	Slightly convex bowl and flaring brim with rounded or slightly pointed aboral end. Differs from <i>T. bütschli</i> and <i>T. everta</i> in convexity of bowl.
<i>T. everta</i> KOFOID & CAMPBELL, 1929	30	65-150	65-122	1-1.3	5	Like <i>T. cyathus</i> but usually shorter. Blunt to rounded aboral end and spiral structure visible.
<i>T. fennica</i> KOFOID & CAMPBELL, 1929	34	120-150	40-60	2.5-3	5, 6	Almost cylindrical, narrowing in lower $\frac{1}{3}$ - $\frac{2}{3}$ to a short pedicel. Spiral structure, if any, faint. Oral rim irregular. Particles thinly scattered on bowl.
<i>T. fimbriata</i> MEUNIER, 1919	38	68-75	53-55 (53)	1.2-1.4	5, 10, 12	Small rounded bowl with nuchal constriction, slightly flared oral and pointed aboral end. Mouth sometimes surrounded by an irregular fringe. See <i>T. meunieri</i> .
<i>T. incurvata</i> MEUNIER, 1910	41	48-68	22-30 (25)	1.2-2.3	1, 11	Sack-like, with mouth at an angle to main axis. Recorded from Arctic and once off Portuguese coast. Former has annulated oral end, latter has not, and mouth is smaller.
<i>T. karajacensis</i> BRANDT, 1896	18	75-172	35-60	2-3.5	1, 2, 4, 5, 6, 7, 12, 14	Cylindrical with rounded aboral end, sometimes slightly expanded at mouth and lower part of bowl. Spiral structure visible suborally. Less expanded suborally, than <i>T. subacuta</i> , shorter than <i>T. tubulosa</i> . See <i>T. lobiancoi</i> .
<i>T. lata</i> MEUNIER, 1910	17	62-70	38-42	1.5-2	1, 6, 11	Short, bluntly pointed aborally and slightly expanded above this. Differs from <i>T. nucula</i> and <i>T. turbo</i> by the wider mouth. See however <i>T. lobiancoi</i> .
<i>T. levigata</i> KOFOID & CAMPBELL, 1929	40	42-70	18-25	2-3	11	Short cylindrical with a stout pedicel. Much smaller than <i>T. cylindrica</i> or <i>T. fennica</i> .

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
<i>T. lindeni</i> DADAY, 1887	32	116-192	43-55 (46)	2.7-3.5	11	Cylindrical for most part widening slightly before narrowing to a pedicel. Wall thick, indistinctly separated into two layers. Annulated over most of bowl. Like <i>Coxiella helix</i> in many ways.
<i>T. lobiancoi</i> DADAY, 1887	11a, b	93-409	36-62	2-7	1, 5, 7, 10, 11, 14	Long, cylindrical, occasionally slightly dilated aborally (b) aboral end usually rounded sometimes slightly pointed. (a) is the more usual form. HALME and LUKKARINEN have studied large populations in the Baltic and found transition stages between this and many of the listed spp. They would include here <i>T. baltica</i> , <i>T. karajacensis</i> , <i>T. lata</i> , <i>T. pistillum</i> , <i>T. rotundata</i> , <i>T. strigosa</i> , <i>T. subacuta</i> , <i>T. tubulosa</i> , <i>T. turbo</i> , while admitting that some may be sub-spp. or var. <i>T. baltica</i> , <i>T. lata</i> and <i>T. turbo</i> are usually shorter than the rest. <i>T. strigosa</i> has a more developed pedicel.
<i>T. magna</i> MERKLE, 1909	57	170-204	150-180	1.2	4, 6	Large, wide, conical with rounded aboral end (possibly flattened by pressure).
<i>T. major</i> MEUNIER, 1910	28	130	65	2	1, 4, 5	Cylindrical with rather flaring mouth and pointed aboral end, annulated in upper half. Like <i>T. cyathus</i> except for pointed aboral end and perhaps belongs to <i>T. campanula</i> group.
<i>T. meunieri</i> KOFOID & CAMPBELL, 1929	39	69-76	57-62 (53-60)	1.3-1.5	1, 5, 6, 7	Short, round with nuchal constriction below flaring mouth; short point at aboral end. Oral rim ragged. Differs little from <i>T. fimbriata</i> with which HOFKER unites it.
<i>T. minuta</i> WAILES, 1925	46	25-45	11-15	2-2.5	11	Very small cylinder with rounded aboral end. Very similar to <i>T. nana</i> with which HOFKER suggests it may be united.
<i>T. nana</i> LOHMANN, 1908	45	30-47	12-19	2.5-3.5	5, 7, 11	Very small cylinder with slightly pointed aboral end. Differs from <i>T. minuta</i> only in shape of aboral end and ratio of length to oral diameter, both rather variable characters.
<i>T. nitida</i> BRANDT, 1896	43	67-105	41-70	1.5-2	1, 2, 4, 5	Small, vase-shaped with slightly inflated lower bowl, flaring mouth with flattened rim and bluntly rounded aboral end. Less pointed aborally than <i>T. baltica</i> narrower than <i>T. fimbriata</i> , relatively wider than <i>T. sinuata</i> .
<i>T. nucula</i> (FOL, 1884)	53	48-111	22-62	1.3-3.3	4, 5, 6, 7	Small, oval, of very variable shape according to KOFOID and CAMPBELL's attributions. Sometimes with narrower cylindrical collar set off from bowl or sometimes widening or narrowing to mouth. Thickly encrusted with particles. With this HOFKER includes <i>T. turbo</i> .

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
<i>T. parva</i> MERKLE, 1909	44	30-49	20-23 (15-31)	1.2-2.5	5, 6, 10, 11	Small, widest in middle, narrowing slightly to mouth, more sharply to pointed aboral end.
<i>T. parvula</i> JÖRGENSEN, 1912	54	51-70	20-37	1.8-3.4	1, 2, 4, 5, 6, 11	Small, slightly expanded below a cylindrical anterior region, pointed aborally. More pointed aborally than <i>T. nucula</i> and more expanded than <i>T. beroidea</i> with which HOFKER unites it.
<i>T. patula</i> MEUNIER, 1910	23	78	58 (40)	1.6	1	Oval bowl with flaring oral and rounded aboral end. The nuchal constriction separates it from <i>T. butschli</i> and it is relatively longer than <i>T. compressa</i> .
<i>T. pistillum</i> KOFOID & CAMPBELL, 1929	13	144-175	36-50	3.6-4.7	5, 6	Long, cylindrical with expanded aboral end. Spiral structure visible. See <i>T. lobiancoi</i> .
<i>T. plagiotoma</i> DADAY, 1887	52	50-60	46-60	1-1.1	11	More or less open cone bluntly pointed aborally. Much smaller than <i>T. magna</i> .
<i>T. radix</i> IMHOF, 1886	35	182-524	30-53	3.5-11.0	15	Cylindrical or almost so, narrowing gradually to pedicel which has often an opening near tip, possibly an artefact. Variable spiral structure in bowl.
<i>T. rapa</i> MEUNIER, 1910	42	50-65	20-25	2.2-2.7	1, 4, 5, 10	Like <i>T. parvula</i> and only slightly narrower.
<i>T. rara</i> KOFOID & CAMPBELL, 1939	47	48-56	32-37 (45-54)	1.4-1.6	11	Rotund, narrowing to a short upright collar bluntly pointed aborally. Collar barely visible in SILVA's Portuguese specimen to which this record and figure belong.
<i>T. rotundata</i> JÖRGENSEN, 1899	16	45-90	24-47	2.0	5, 11	Cylindrical with hemispherical aboral end. Thickly encrusted with particles. See <i>T. lobiancoi</i> .
<i>T. sacculus</i> BRANDT, 1896	21	60-105	44-58	1.5-2.0	1, 2, 5, 6, 12	Short, cylindrical, with rounded aboral end. Particles smaller and less numerous than on <i>T. rotundata</i> .
<i>T. sinuata</i> BRANDT, 1896	24	104-140	45-60	2.1-2.4	1, 2, 4	Vase-shaped, widest above middle, nuchal constriction and suddenly flaring flattened brim. Bluntly pointed aborally. See <i>T. nitida</i> .
<i>T. spiralis</i> KOFOID & CAMPBELL, 1929	20	82-100	37-45	2.2-3	1	Cylindrical with flaring mouth, bluntly pointed aboral end. 10-12 indistinct spiral turns. Oral rim with adherent spicules.
<i>T. strigosa</i> MEUNIER, 1919	33	55-85	29-40	2.4	5, 7, 10	Cylindrical, narrowing aborally to short wide pedicel. See <i>T. lobiancoi</i> .
<i>T. subacuta</i> JÖRGENSEN, 1899	14	81-227	42-64 (46-56)	3-7	1, 5, 6, 7	Irregular cylinder with slightly expanded aboral end and aboral point. Variable in form but KOFOID and CAMPBELL separate it from <i>T. tubulosa</i> by the aboral point, from <i>T. tubulosoides</i> by the aboral expansion. See however <i>T. lobiancoi</i> .

	Fig.	Length in μ	Oral diam. in μ (Max. width in brackets)	Approx. ratio L/oral diam.	Distribution	Notes on lorica
<i>T. tubulosa</i> LEVANDER, 1900	10a, b	125-450	40-49 (42-57)	3.3-7.5	4, 5, 6, 7, 11	Cylindrical with a slightly expanded and rounded aboral end. See <i>T. lobiancoi</i> . (a) after LEVANDER (b) after MERKLE.
<i>T. tubulosoides</i> MEUNIER, 1910	12	83-200	34-56	2.3-4.5	1, 5, 8	Cylindrical with well marked spiral structure, ending aborally in a wide and not always well marked point. Possibly in the <i>T. lobiancoi</i> group.
<i>T. turbo</i> MEUNIER, 1919	51	54-63	37-38	1.6-1.7	5, 6, 7, 10	Small, rounded with a bluntly pointed aboral end. Widest in middle narrowing to oral end which may have short cylindrical section. Relatively wider than <i>T. nucula</i> and <i>T. parva</i> .
<i>T. undella</i> MEUNIER, 1910	22	75-94	20-38 (42)	2.6	1, 10, 11	Vase shaped, slightly expanded in lower $\frac{2}{3}$ widening slightly to mouth.
<i>T. urnula</i> MEUNIER, 1910	48	54-60	37-43	1.5	1	Small and oval, bluntly rounded aborally, nuchal constriction below a slightly flaring mouth. Smoother oral rim than <i>T. fimbriata</i> .
<i>T. vasculum</i> MEUNIER, 1919	50	73-100	40-51 (64)	1.8	7, 10, 11	Lower half a blunt cone, narrowing above to a more or less cylindrical collar about 0.28 total length. More nuchal constriction than in <i>T. angusta</i> . Less pointed aborally than <i>T. rapa</i> .
<i>T. ventricosoides</i> MEUNIER, 1910	56	64-105	43-75 (59-83)	1.3-1.6	1, 12	Widest in middle narrowing slightly towards mouth, aboral end a blunt triangle. Very similar to <i>Stenosemella ventricosa</i> with which it has often been confused, but it lacks the hyaline collar.

REFERENCES (Sheets 117-127)

After KOFOID & CAMPBELL, 1929

- BERNSTEIN, T., 1931. "Pelagic protists of the northwest part of the Kara Sea". Trudy arkt. nauchno-issled. Inst., **3**: 1-23. [English Summary].
- BIERNACKA, J., 1948. "Tintinninea in the Gulf of Gdańsk and adjoining waters". Biul. morsk. Inst. ryb.Gdyni, No. 4.
- CAMPBELL, A. S., 1942. "The Oceanic Tintinninea of the plankton gathered during the last cruise of the Carnegie". Pubs Carnegie Instn., No. 537.
- CAMPBELL, A. S., & MOORE, R. C., 1954. "Treatise on invertebrate paleontology. Part D, Protista 3, Protozoa (chiefly Radiolaria and Tintinnina)". Geol. Soc. Amer. & Univ. Kansas Press, Lawrence, Kansas. D1-D195.
- CANDEIAS, A., 1930. "Estudos de plancton na Baía de Sesimbra". Bull. Soc. port. Sci. nat., **11**: (3) 12-14.
- CANDEIAS, A., 1932. "Nota sobre algumas especies de Tintinninea da costa norte de Portugal". Anais Fac. Ciênc. Porto, **17**.
- CORLISS, J. O., 1960. "The problem of homonyms among generic names of ciliated Protozoa, with proposal of several new names". J. Protozool., **7**: 269-278.
- GAARDER, K. RINGDAL, 1946. "Tintinninea from the 'Michael Sars' North Atlantic deep-sea expedition, 1910". Rep. scient. Results Michael Sars N. Atlant. deep Sea Exped., **2**: 1-37.
- HALME, E., 1958 "Planktologische Untersuchungen in der Pojo-Bucht und angrenzenden Gewässers. IV. Zooplankton". Suomal. eläinjal. kasvit. Seur. van. eläin. Julk., **19**: (3) 1-62.
- HALME, E., & LUKKARINEN, T., 1960-61. "Planktologische Untersuchungen in der Pojo-Bucht und angrenzenden Gewässers. V. Die Ziliaten *Tintinnopsis tubulosa* Levander und *T. brandtii* (Nordqv.) Levander". Suomal. eläinjal. kasvit. Seur. van. eläin. Julk., **22**: (2) 1-24.
- HOFKER, J., 1931. "Studien über Tintinninea". Arch. Protistenk., **75**: (3) 315-402.
- KAHL, A., 1932. "Wimpertiere oder Ciliata (Infusoria) 3. Spirotricha". Tierwelt Dtl., **25**: 399-650. (Specific Ref.: 3. Familie. Tintinnidae (Tintinnodea). Nur die Süßwasserformen: 513-518).
- KOFOID, C. A. & CAMPBELL, A. S., 1929. "A conspectus of the marine and freshwater Ciliata belonging to the suborder Tintinninea with descriptions of new species principally from the Agassiz Expedition to the eastern tropical Pacific 1904-1905". Univ. Calif. Pubs Zool., **34**: 1-403.
- KOFOID, C. A. & CAMPBELL, A. S. 1939. "Reports on the scientific results of the expedition to the eastern tropical Pacific in charge of Alexander Agassiz, by the U.S. Fish Commission steamer "Albatross" from October 1904 to March 1905, Lieut.-commander L. M. Garrett, U.S.N. commanding XXXVII. The Ciliata: the Tintinninea". Bull. Mus. comp. Zool. Harv. **84**: 1-473.
- LOEBLICH, A. R., Jr., & TAPPAN, H., 1968. "Annotated index to genera, subgenera and suprageneric taxa of the ciliate order Tintinnida". J. Protozool., **15**: 185-192.
- MARGALEF, R., & DURAN, M., 1953. "Microplankton de Vigo, de Octubre de 1951 a Septiembre de 1952". Publins Inst. Biol. apl. Barcelona, **13**: 5-78.
- RENTZ, G., 1940. "Das Zooplankton der Hidden-See Rügen-schen Boddengewasser und seine Produktionsphasen im Jahresverlauf". Arch. Hydrobiol., **136**: (4) 588-675.
- SCHULTZ, B. & WULFF, A., 1929. "Hydrographie und Oberflächenplankton des westlichen Barentsmerees im Sommer 1927". Ber. dt. wiss. Kommn Meeresforsch. **4**: 238-72.
- SCHWARZ, S., 1961. "Schichtung des Zooplanktons im Küsten und Boddengebiet Rügens". Z. Fisch., N. F., **10**: 361-67.
- SCHWARZ, S., 1964. "Die Tintinninea." Hydrobiologia, **23**: 211-36.
- SILVA, E. DE SOUSA e., 1950. "Les Tintinnidés de la baie de Cascais (Portugal)". Bull. Inst. océanogr. Monaco, (979) 28 pp.
- SILVA, E. DE SOUSA e., 1952. "Estudos de plancton da lagoa de Óbidos. II. Tintinninea". Revta Fac. Ciênc. Univ. Lisb., **2**: 97-116.
- SILVA, E. DE SOUSA e., 1968. "Plancton da lagoa de Óbidos (III). Abundância, variações sazonais e grandes 'blooms'". Notas Estud., Inst. Biol. mar., Lisb., (34) 79 pp.
- SILVA, E. DE SOUSA e., & PINTO, J. S., 1949. "O plancton de baía de S. Martinho do Porto. II Zooplankton". Bolm Soc. port. Ciênc. nat., **2**: (2).
- STRAND, E., 1926. "Miscellanea nomenclatorica zoologica et palaeontologica". Arch. Naturgesch., **92**: (A8) 1-30.
- ZEITZSCHEL, B., 1966. "Die Verbreitung der Tintinnen im Nordatlantik". Veröff. Inst. Meeresforsch. Bremerh., **2**: 293-300.

SOURCES OF ILLUSTRATIONS

The illustrations are copied from a number of publications, which I am glad to acknowledge in the following list.

- BRANDT, K., 1906. "Die Tintinnodeen der Plankton-Expedition. Tafeln 1-70". Ergebn. Atlant. Ozean Plankton-exped. Humboldt-Stift., **3**: L.a.
I: 1, 2, 3, 4, 6, 7, 8, 11b, 13, 14, 15, 17, 18, 21, 24, 25.

- II: 29, 31, 34, 35, 36, 39, 42, 49, 51, 53, 54. III: 1, 2, 3, 4, 5, 6, 8, 9, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21. IV: 5a and b, 6, 7, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 34. V: 1, 2, 5, 9, 12, 14, 15, 22, 24. VI: 1, 5, 6, 11, 16, 17, 18, 19, 21, 23, 24, 26. VII: 3, 6, 8, 11, 12, 15, 17, 18, 20, 21, 23, 25, 26, 28, 29, 31, 32, 33, 35, 36. VIII: 1, 5, 6, 8, 9, 10, 14, 17, 18, 19. IX: 1, 3, 4, 5,

- 6, 9, 11, 12, 13, 14, 17, 18, 19, 21, 24, 29. X: 2, 5, 6, 8, 9, 11, 14, 16, 17. XI: 4, 5, 6, 7, 9, 12, 15, 16, 19, 20. XII: 2, 4, 7, 8, 15, 16, 17, 19, 25, 28, 29.
- CAMPBELL, A. S., 1942. "The Oceanic Tintinnoina of the Plankton gathered during the last cruise of the Carnegie". *Scient. Results Cruise VII Carnegie, Biol.* **2**: 1-134. III: 12. VII: 30. IX: 15, 16. XI: 3.
- CLAPARÈDE, E., and LACHMANN, J., 1858. "Études sur les infusoires et les rhizopodes". *Mém. Inst. natn. Génév.*, **5**: (3) 1-260. XI: 3.
- DADAY, E. v., 1887. "Monographie der Familie der Tintinnodeen". *Mitt. zool. Stn Neapel*, **7**: 473-591. II: 27.
- ENTZ, G. Jr., 1909. "Studien über Organisation und Biologie der Tintinniden". *Arch. Protistenk.*, **15**: 93-226. IV: 27.
- GAARDER, K. RINGDAL, 1946. "Tintinnoina from the 'Michael Sars' North Atlantic deep-sea Expedition 1910". *Rep. scient. Results Michael Sars N. Atlant. deep Sea Exped.*, **2**: 1-37. II: 56. IV: 9. IX: 26. X: 1. XI: 8.
- JÖRGENSEN, E., 1924. "Mediterranean Tintinnidae". *Rep. Dan. oceanogr. Exped. Mediterr.*, **2**: 1-110. II: 26, 32, 55a. IV: 19, 20. V: 3. VI: 9, 10, 13. VII: 1, 10, 13, 14, 19, 22, 24. IX: 22, 28, X: 4. XI: 14, 17. XII: 6, 11, 20.
- KOFOID, C. A., and CAMPBELL, A. S., 1929. "A conspectus of the marine and fresh-water Ciliata belonging to the suborder Tintinnoina, with descriptions of new species principally from the Agassiz Expedition to the eastern tropical Pacific 1904-1905". *Univ. Calif. Publs Zool.*, **34**: 1-403. I: 5, 9, 10a, 16, 20, 23. II: 33, 37, 48. III: 7, 10. IV: 18. V: 4, 7, 8, 10, 11, 13, 16, 18, 20, 21, 23. VI: 3, 7, 12, 15, 22, 25. VII: 2, 4, 7, 27, 34. VIII: 2, 3, 4, 7, 11, 12, 13, 15, 16, 20, 21, 22, 23, 24. IX: 2, 7, 8, 10, 20, 23, 25, 27, 30. X: 3, 7, 12, 13, 15. XI: 1, 2, 13, 18. XII: 1, 3, 9, 10, 12, 13, 14, 21, 23, 27.
- KOFOID, C. A., and CAMPBELL, A. S., 1939. "Reports on the scientific results of the expedition to the eastern tropical Pacific, in charge of Alexander Agassiz by the U.S. Fish Commission steamer "Albatross" from October 1904 to March 1905. Lieut. Commander L. M. Garrett U.S.N. commanding XXXVII". *Bull. Mus. comp. Zool. Harv.*, **84**: 1-473. VI: 2. VII: 9. X: 10. XII: 22.
- LAACKMANN, H., 1908. "Ungeschlechtliche und geschlechtliche Fortpflanzung der Tintinnen". *Wiss. Meeresunters. Abt Kiel.*, **10**: 13-34. II: 30. IV: 3.
- LAACKMANN, H., 1909. "Die Tintinnodeen der deutschen Südpolar Expedition 1901-1903". *Dt. Südpol. Exped.*, **11**: 340-496. V: 6. VI: 4. X: 18.
- LOHMANN, H., 1911. "Über das Nannoplankton und die Zentrifugierung kleinster Wasserproben zur Gewinnung desselben in lebenden Zustände". *Int. Revue ges. Hydrobiol. Hydrogr.*, **4**: 1-38. XII: 18.
- MARSHALL, S. M., 1934. "The Silicoflagellata and Tintinnoina". *Scient. Rep. Gt Barrier Reef Exped.*, **4**: 623-664. XI: 11.
- MERKLE, H., 1909. "Untersuchungen an Tintinnodeen der Ost- und Nordsee". *Wiss. Meeresunters. Abt Kiel*, **11**: 139-186. I: 10b, 19. II: 44, 48, 57. XII: 26.
- MEUNIER, A., 1910. "Microplankton des mers de Barent et de Kara". *Campagne Arct. Duc d'Orleans 1907*. 355 pp. I: 12, 22. II: 28. V: 17. VI: 20. VII: 5.
- MEUNIER, A., 1919. "Microplankton de la mer Flamande. 4. Les Tintinnides, etc". *Mém. Mus. r. Hist. nat. Belg.* **8**: 1-59. I: 11a. II: 38, 45, 50. IV: 1, 4, 8. V: 19, 25. VI: 14.
- OSTENFELD, C. H., and SCHMIDT, J., 1901. "Plankton fra det Røde Hav og Adenbugten". *Vidensk. Meddr dansk naturh. Foren.*, 1901, 141-182 pp. VII: 16.
- SILVA, E. DE SOUSA e, 1950. "Les Tintinnidés de la baie de Cascais (Portugal)". *Bull. Inst. océanogr. Monaco*, (979) 28 pp. II: 40, 52, 55b. IV: 17. VI: 8. XII: 24.
- SILVA, E. DE SOUSA e, 1952. "Estudos de plancton da lagoa de Óbidos II Tintinnoina". *Revta Fac. Ciênc. Univ. Lisb.*, **2**: 97-116. II: 41, 46, 47. XII: 5.
- WAILES, G. H., 1925. "Tintinnidae from the Strait of Georgia, B. C". *Contr. Can. Biol. Fish.*, **2**: 531-539. II: 43. IV: 35.