New Distributional Record And Taxonomic Characterization of Some Peritrich Ciliates of Genus Vorticella From A Tropical Mangrove Ecosystem of Southwest Coast of India

P. Chithra[1], R. Sunil Kumar[2], R. Nisanth[3]
[1, 2, 3] Dept of Zoology
[1, 2, 3] Catholicate College, Pathanamthitta

Abstract- *Twenty peritrich ciliates, Vorticella alba,V. annulata, V. bidulphae, V. companula, V. campanulate, V. communis, V. convallaria, V. chlorostigma, V gracilis, V. jaerae, V. kenti, V. lima, V. longitricha, V. lymaearum, V. marina, V. marginata, V. microstoma, V. picta, V. similis, and V. subsinuatawere discovered in the Ayiramthengu mangrove ecosystem of Kerala, south west coast of India. Their morphology and silver line system were described using live observation and silver impregnation. The study also revealed that all the species except V. companulaand Vorticella subsinuatawere found to be new records from India.*

Keywords- Mangrove, Ciliate, Contractile vacuole, Epibionts, Vorticella,

I. INTRODUCTION

Peritrichs are the second most abundant oligohymenophorean group recorded under the phylum Ciliophora. Identification of peritrichs is very difficult because most of them possess a similar morphology, with overlapping characteristics. Misidentification and misinterpretation of characteristics of taxa have accumulated in the taxonomic literature over the years (Kahl, 1933 and Song, 1986).The morphology of ciliates was determined using live observation and Silver impregnation. Silver impregnation is highly species specific, and this plays an essential role in the determination of species (Clamp, 1990, 1997;Foissner, et al. 1992 and Ji and Song, 2004). Species in the genus *Vorticella* are well known as stalked, solitary peritrich ciliates with highly contractile behaviour that have been found worldwide in marine and freshwater biotopes (Jankowski, 1976, Kahl 1935; Precht 1935 and Song 1991).Only a few works were carried out in India and most of them describe the peritrich in genus level. The objective of this paper is to identify and describe the *Vorticella* in species level.

II. MATERIAL AND METHODS

Samples were collected from the Ayiramthengu mangrove situated (lat. $9^0 6^1$ to $9^0 8^1$ N long.$76^0 28^1$ to $76^0 29^1$ E) in Kollam district of Kerala, a part of Kayamkulam estuary, which is the narrow stretch of tropical backwater on the southwest coast of India (Fig. 1). Mangrove prop roots and litters were covered and attached by epibionts films and samples were taken by scraping 1 cm^2 patch of the moist film into sterile 15 ml collecting tubes containing 3% formalin. Living ciliates were observed using bright field microscopy. For proper identification of epibionts, they were isolated and treated using the silver carbonate technique of Fernandez and Castro de (1986). The systematic scheme proposed by Lynn (2008) was followed.

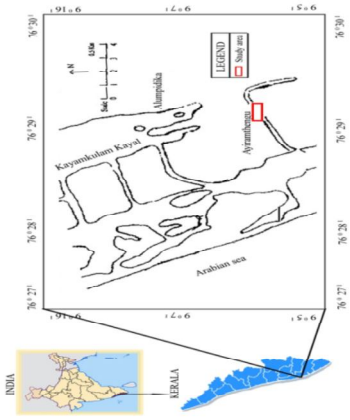

Fig. 1. Map of Ayiramthengu mangrove ecosystem.

III. RESULT

Twenty peritrich ciliates, *Vorticella alba,V. annulata, V. bidulphae, V. companula, V. campanulate, V. communis, V. convallaria, V. chlorostigma, V gracilis, V. jaerae, V. kenti, V. lima, V. longitricha, V. lymaearum, V. marina, V. marginata, V. microstoma, V. picta, V. similis,* and *V. subsinuata* were discovered from the study area (Fig.2-3).

Systematics

The taxonomic position of the genus *Vorticella* is given as follows:
Subkingdom: Protozoa Goldfuss, 1818 emend. Von Siebold, 1845
Phylum: Ciliophora Doflein, 1901
Class:Oligohymenophora
de Puytorac et al., 1974

Subclass: Peritrichia Stein, 1859
Order:Peritrichida Stein, 1859
Suborder: Sessilina Kahl, 1933
Family: Vorticellidae Ehrenberg, 1838
Genus:*Vorticella* Linnaeus, 1767

***Vorticella alba* Fromentel, 1874**
Diagnosis: zooid 55-70 µm long x 21 µm wide, inverted bell-shape and constricted below peristomial lip measures 23 µm. disc convex; Contractile vacuole situated in upper 1/3 of zooid; infundibulum reaches 1/3 body length; macronucleus C- shaped; pellicle smooth and unstriated; stalk 150-250 µm long.

***Vorticellaannulata*Gourret and Roeser, 1888**
Diagnosis: zooid 48-56 µm long x 35 µm wide, inverted bell-shape and constricted below peristomial lip measures 35 µm; large contractile vacuole present just below the peristome; infundibulum reaches 1/3 body length; zooids are filled with numerous zoo chlorella; stalk 110-180 µm long.

***Vorticellabidulphae* Stiller, 1939**
Diagnosis: zooid 35-44 µm long x 22 µm wide, triangular in shape with a broad peristomial lip measuring 38- 50 µm across; disc flat or slightly convex; infundibulum reach as the centre of the zooid. Contractile vacuole situated in upper 1/3 of zooid; macronucleus C shaped; pellicle distinctly striated with convex ribbing between the striations; stalk 100-130 µm long.

***Vorticellacompanula* Ehrenberg, 1831**
Diagnosis : zooid 60-155 µm long x 52 µm wide and constricted beneath peristomial lip which measures 65- 130µm ; inverted bell-shaped; Contractile vacuole situated in upper 1/3 of zooid; macronucleus long, J- shaped and situated longitudinally; cytoplasm contains numerous dark,refractile granules; pellicle striated; stalk 180-510 µm long.

***Vorticellacampanulate* Kahl, 1933**
Diagnosis: zooid 45-50 µm long x 53 µm wide constricted beneath peristomial lip which measures 50 µm across; disc flat; infundibulum reaches 1/3 body length; contractile vacuole situated just beneath the peristome; macronucleus C- shaped situated longitudinally in the zooid; pellicle striated; stalk 160-450 µm long.

***Vorticella communis* Fromentel, 1874**
Diagnosis: zooid 26-30 µm long x 24 µm wide, somewhat round and slightly constricted beneath the peristomial lip which measures 25 µm diameter disc flat, contractile vacuole situated in the upper 1/3 of the body; macronucleus C- shaped and lies at the center of the zooid; pellicular striation not visible ; stalk 200-300 µm long.

***Vorticella convallaria* Linnaeus, 1758**
Diagnosis: zooid 53-97 µm long x 34-53 µm wide; inverted bell- shaped and constricted beneath the peristomial lip which measures 53- 70 µm across; disc flat and slightly convex and obliquely elevated; infundibulum reaches 1/3 body length; Contractile vacuole situated in upper 1/3 of zooid; macronucleus long and J-shaped; pellicle distinctly striated; stalk 400-450 µm long.

***Vorticella chlorostigma* Ehrenberg, 1831**
Diagnosis: zooid 58-65 µm long x 23-28µm wide; almost conical in shape; sometimes with a distinct ridge near the telotroch band sharply constricted beneath the peristomial lip which measures 28-33 µm diameter ; disc flat and slightly elevated above peristome; infundibulum reaches 1/4 body length; contractile vacuole situated in upper 1/3 of zooid; macronucleus C- shaped situated longitudinally in the zooid; cytoplasm contains numerous endosymbiotic zoochlorellae; pellicle finely striated; stalk 580-650 µm long.

***Vorticella gracilis* Dujardin, 1841**
Diagnosis: zooid 52-76 µm long x 26-38µm wide; elongated trumpet-shaped shape; slightly constricted beneath the peristomial lip which measures 37-44 µm diameter; disc convex; infundibulum broad and reaches the centre of zooid; Contractile vacuole situated just beneath peristome; pellicle finely striated; stalk 280-320 µm long.

***Vorticella jaerae* Precht, 1935**
Diagnosis: zooid 40-57 µm long x 48-56 µm wide; inverted bell-shaped constricted beneath the peristomial lip which measures 33-42 µm diameter; disc flat; Contractile vacuole situated in upper 1/3 of zooid; irregularly shaped macronucleus; pellicle distinctly striated; stalk 100-140 µm long.

***Vorticella kenti* Kahl,1935**
Diagnosis: zooid 135-160 µm long x 34-43µm wide; elongated trumpet-shaped shape; not constricted beneath the peristomial lip which measures 90-110 µm diameter; disc flat;

Contractile vacuole situated just beneath peristome; pellicle finely striated; stalk 400-480 µm long.

***Vorticella lima* Kahl,1933**
Diagnosis: zooid 55 -75 µm long x 28-32 µm wide; usually curved and constricted beneath well-developed peristomial lip which measures 24- 27 µm across; disc convex and elevated above peristome; infundibulum short; Contractile vacuole situated in upper 1/3 of zooid; macronucleus C- shaped situated longitudinally in the zooid; pellicle distinctly striated with concave ribbing between the striations; stalk 145-180 µm long.

***Vorticella longitricha* Gajewskaja, 1933**
Diagnosis: zooid 29-34 µm long x 24-27 µm wide; inverted bell- shaped and no constricted beneath the peristomial lip which measures 30-37 µm across; disc prominently arched above peristome; infundibulum reaches 1/3 body length; Contractile vacuole situated just below peristome ; macronucleus C- shaped situated longitudinally in the zooid; pellicle finely striated; stalk 80-100 µm long.

***Vorticella lymaearum* Viljoen and As, 1983**
Diagnosis: zooid 25-32 µm long x 26-37 µm wide; inverted bell- shaped with a broad peristomial lip which measures 43-47 µm across; peristomial disc convex; macronucleus C-shaped; pellicle striated ; stalk 198-247 µm long.

***Vorticella marina* Greeff, 1870**
Diagnosis: zooid 35-67 µm long x 42-53 µm wide; inverted bell- shaped and sharply constricted below peristomial lip which measures 38-53 µm; disc flat and obliquely elevated above peristome; infundibulum short; contractile vacuole large and situated just below the peristome; macronucleus C-shaped; pellicle distinctly striated; stalk 290-310 µm long.

***Vorticella marginata* Stiller, 1931**
Diagnosis: zooid 65-100µm long x 30-45 µm wide; elongate and slightly constricted beneath the peristomial lip which measures 90- 105 µm across; disc broad, flat and obliquely elevated above peristome; infundibulum short; macronucleus C- shaped; pellicle finely striated; stalk 230-250 µm long.

***Vorticella microstoma* Ehrenberg, 1830**
Diagnosis: zooid 29-88 µm long x 20-46 µm wide; inverted bell- shaped and constricted beneath the peristomial lip which measures 13- 23 µm across; disc convex and infundibulum reaches 1/3 body length; Contractile vacuole empties into ventral wall of infundibulum; cytoplasm contains numerous endosymbiotic zoochlorellae; macronucleus long and C-shaped; pellicle distinctly striated; stalk 360-400µm long.

***Vorticella picta* Ehrenberg, 1831**
Diagnosis: zooid 41-69 µm long x 25-40 µm wide; inverted bell- shaped and slightly constricted beneath peristomial lip which measures 36-56 µm across; disc convex; two contractile vacuoles situated in upper 1/3 of zooid; macronucleus long, J-shaped and situated longitudinally; pellicle finely striated; stalk 520-600 µm long.

***Vorticella similis* Ehrenberg, 1830**
Diagnosis: zooid 56-83 µm long x 36-49 µm wide; elongate and slightly constricted beneath the peristomial lip which measures 41-45 µm across; disc convex ; contractile vacuole large and situated just below the peristome; pellicle finely striated; stalk 120-200 µm long.

***Vorticella subsinuata* Ghosh, 1922**
Diagnosis: zooid 43-55 µm long x 33-42 µm wide; inverted bell- shaped may or may not be constricted below peristomial lip which measures 38-48 µm infundibulum short. Contractile vacuole situated in upper 1/3 of zooid; macronucleus short; pellicle not striated; stalk 45-50µm long.

IV. DISCUSSION

Peritrichs are the most successful symbionts of the class oligohymnophoreacoming under the phylum Ciliophora. This is undoubtedly due in part to their ability to attach to a variety of substances and in genera, sessile peritrichs use the scapula while mobiline forms use their adhesive disc for attachment (Lom, 1994). The scopula may secrete substances to aid attachment to the host surface or may have specialized cilia that enable attachment (Lom and Corlis, 1968). Therefore the occurrence of twenty species of genus *Vorticella* is the first-ever report from the Ayiramthengu mangrove ecosystem of Kerala southwest coast of india and out of the tweny species, except *V. companula* and *V. subsinuata* remaining 18 species are new distributional record from India.Regarding the occurrence of *Vorticella* species earlier Santhakumari and Balakrishnan isolate and describe *V. companula*from wood-boring isopod *Sphaeroma* and Ghosh (1922) described*Vorticella subsinuata* as a new species from two different regions of India.

V. ACKNOWLEDGEMENTS

The authors are thankful to Principal, Catholicate College, Pathanamthitta for the facilities provided.

REFERENCES

[1] J . C Clamp Redescription of three species of Lagenophrys (Ciliophora: Peritricha: Lagenophryidae)

and a new North American species of Lagenophrys from hypogean amphipods. Transactions of the American Microscopical Society 109: 1–31.1990

[2] J . C Clamp. Redescription of Ellobiophrya brevipes (Laird, 1959) n. comb. (Ciliophora, Peritrichia) and the fine structure of its pellicle and cinctum. Journal of Eukaryotic Microbiology 44: 374–382. 1997.

[3] F. Doflein Die Protozoen als parasite und Krankeitserreger, nach Biologischen Geschtspunkten dargestellt. Fischer Verlag, Jena, 274. 1901

[4] F. Dujardin. Histoire Naturelle des Zoophytes Infusoires. Paris. 678 . 1841

[5] C.G Ehrenberg Ober die Entwicklung und Lebensdauer der Infusionthiere; nebst ferneren Beitragen zueiner Vergleichung ihrer Organischen Systeme. Abhandlungen der Akademie der Wissenchaften der DDR, year 183 (1):1- 154. 1831.

[6] C.G Ehrenberg . Die Infusionsthierchen als vollkommene Organismen. Ein Blick in das tiefere organische Leben der Natur. Leopold Voss Verlag, Leipzig 1838.

[7] C.G Ehrenberg. Beitrage zur Kenntnis der Organisation der Infusorien und ihrer Geographis-chenVerbreitung, besonders in Siberien. Abhandlungen der Akademie der Wissenchaften der DDR, year 1832: 1-88. 1830.

[8] C. G. Ehrenberg. Ober die Entwicklung und Lebensdauer der Infusionthiere; nebst ferneren Beitragen zueiner Vergleichung ihrer Organischen Systeme. Abhandlungen der Akademie der Wissenchaften der DDR, year 1831: 1-154. 1831.

[9] Fernandez Leborans & M. Castro de Zaldumbide (The morphology of Anophrys arenicola n . sp. (ciliophora, scuticociliatida). Journal of Natural History 20: 713-721. 1986.

[10] W. Foissner, H. Berger & F. Kohmann Taxonomische und o¨kologische Revision der Ciliaten des Saprobiensystems-Band II: Peritrichida, Heterotrichida, Odontostomatida. Bayerisches Landesamt für Umwelt 5 (92): 1–502. 1992.

[11] E. de Fromentel, . Etudes sur les Microzoaires ou Infusoires Proprement Dits, Comprenant de Nouvelles Reserches sur Leur Organisation, Leur Classification, et al Description des Especes Nouvelles ou Peu Connues. 364 pp. G. Masson, Paris.364.1874

[12] NGajewskaja,. Zur Oekologie, Morphologic und Systematik der Infusorien des Baikalsees. Zoologica, Stuttgart 32: 1-298. 1933.

[13] E. Ghosh,. New species of Vorticella from Calcutta. Bulletin of the Carmichael Medical College, Belgachia, Calcutta 3: 8-18.1922

[14] G.A. Goldfuss,Uber die Entwicklungsstufen des Thieres, Nurenberg,18:21. 1818.

[15] F. Gourre&P. Roeser. Les protozoaires de vieux port de Marseille. Archives de Zoologie Experimental et Generale, Paris (Series 2) 4: 443-534. 1886.

[16] RGreeff, Untersuchungen iiber den Bau und die Naturgeschlichte der Vorticellen. Archiv fur Naturgeschichte 37: 353-384. 1870.

[17] A. W Jankowski, . A revision of the order Sessilida (Peritricha) In Material and Public Meeting of Protozoology . Kiev : 168–170.1976

[18] D.Ji, W. Song & A. Warren Pseudovorticella paracratera n. sp., a new marine peritrich ciliate (Ciliophora: Peritrichida) from north China. Hydrobiologia 515:45–97. 2004.

[19] AKahl, . Ciliata libera et ectocommensalia. In: Die Tierwelt der Nord- und Ostsee. (Eds. G. Grimpe and E. Wagler). Lief. 2 (3): 29-146.1933

[20] AKahl,. Urtiere oder Protozoa I: Wimpertiere oder Ciliata (Infusoria). 4. Peritricha und Chonotricha. Die Tierwelt Deutschlands 30: 651–886. 1935.

[21] A Kahl,. Ciliata libera et ectocommensalia. In: G. Grimpe & E. Wagler Eds., Die Tierwelt der Nordund Ostsee, Lief. 23 (Teil, II, c3): Leipzig 147-183.1933

[22] C . Linnaeus, Systemae Naturae. 12th edition. Salvii, Holmiae. 1767.

[23] C . Linnaeus. (Systemae Naturae. 10th edition. Salvii, Holmiae 1758.

[24] J. Lom, Sous−classe des Peritrichia Stein, 1859. In P. de Puytorac (Ed.), Traité de zoologie, infusoires ciliés 2: 681–737 .1994.

[25] J. Lom, &J.O Corliss. Observations on the ultrastructure of two species of the peritrich ciliate genus Scyphidia and on their mode of attachment of their host. Microscopy Society of America.87: 493-509. 1968.

[26] D.H Lynn, The Ciliated Protozoa. Characterization, Classification, and Guide to the literature, 3rd edition, 1-605. 2008.

[27] H. Precht, . Epizoen der Kieler Bucht. Nova Acta Leopoldina 3: 405-474.1935

[28] P.de . Puytorac, , A. Batisse, J. Bohatier, J.O. Corliss, G. Deroux, P. Didier, J. Dragesco, G. Fryd-Versavel, J. Grain, C. A. Groliere, R. Hovasse, F. Iftode, M. Laval, M. Roque, A. Savoie & M. Thffrau . Proposition d'une classification du phylum Ciliophora Doflein, 1901. C. R. Acad. Sci Paris 278: 2799-2802.1974.

[29] VSantha Kumari, & N.N. Balakrishnan . Some ciliates from the marine wood- boring isopod Sphaeroma.Indian journal of fisheries. 32(2): 215-223.1985.

[30] C. T. E. Siebold. Lehrbuch der vergleichenden Anatomie der Wirbellossen Thiere. InLehrbuch der Vergleichenden Anatomie (eds Siebold C. T. E. V., Stannius H.). Berlin, Germany: von Veit.1845.

[31] W . Song,. Descriptions of seven new species of peritrichs on Penaeus orientalis (Peritricha: Zoothamnidae,

Epistylididae). Acta zootaxonomica sinica 11: 225-235.1986

[32] W. Song, Contribution to the commensal ciliates on Penaeus orientalis. I. (Ciliophora, Peritrichida). The Journal of Ocean University of China , 21: 119–128. 1991.

[33] F Stein. von. Der Organismus der Infusionsthiere nach eigenen Forschungen in syste matischer Reihenfolge bearheitet. I: 206.1859

[34] JStiller,. Die Peritrichen Infusorien von Tihany und Umgebung. Arbeiten des Ungarischen Biologischen Forschungs Institutes 4: 171-205. 1931.

[35] J Stiller, Die Peritrichenfauna der Nordsee Bei Helgoland. Archiv fur Protistenkunde 92: 413-452. 1939.

[36] S. Viljoen, & As, J. G. van A taxonomic study of sessile peritrichians with notes on their substrate preferences. Journal of the Limnological Society of South Africa 9(1): 33-42.1983.

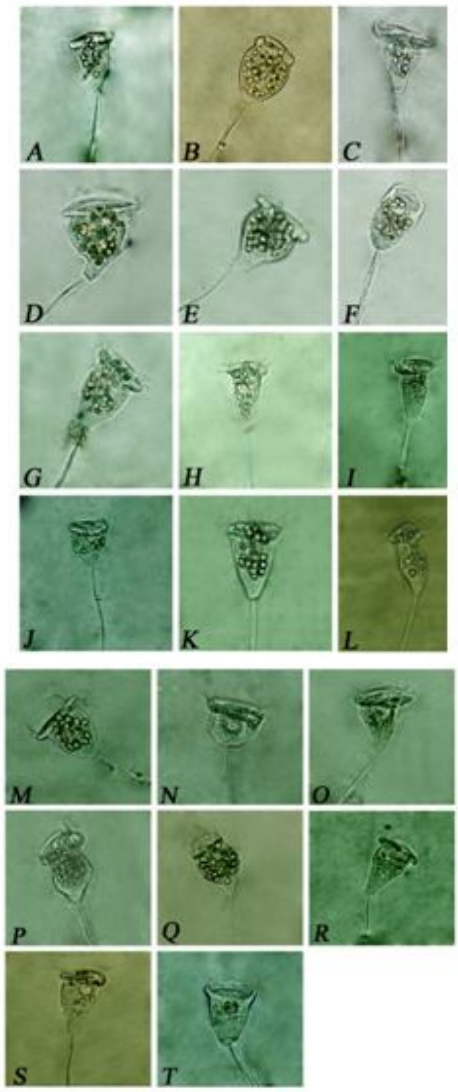

Fig. 2.A-T. Living morphology of species identified. A: Vorticella alba (Fromentel, 1874). B: Vorticellaannulata. (Gourret and Roeser, 1888).C: Vorticellabidulphae. (Stiller, 1939). D: Vorticellacompanula. (Ehrenberg, 1831). E: Vorticellacampanulate. (Kahl, 1933).F: Vorticella communis.(Fromentel, 1874). G:Vorticella convallaria.(Linnaeus, 1758).H:Vorticella chlorostigma.(Ehrenberg, 1831). I:Vorticella gracilis.(Dujardin, 1841). J:Vorticella jaerae. (Precht, 1935). K: Vorticella kenti. (Kahl, 1935). L: Vorticella lima.(Kahl, 1933). M:Vorticella longitricha. (Gajewskaja, 1933). N:Vorticella lymaearum. (Viljoen and As, 1983). O: Vorticella marina. (Greeff, 1870). P:Vorticella marginata . (Stiller, 1931). Q:Vorticella microstoma. (Ehrenberg, 1830). R:Vorticella picta. (Ehrenberg, 1831). S: Vorticella similis. (Ehrenberg, 1830). T: Vorticella subsinuata. (Ghosh, 1922).

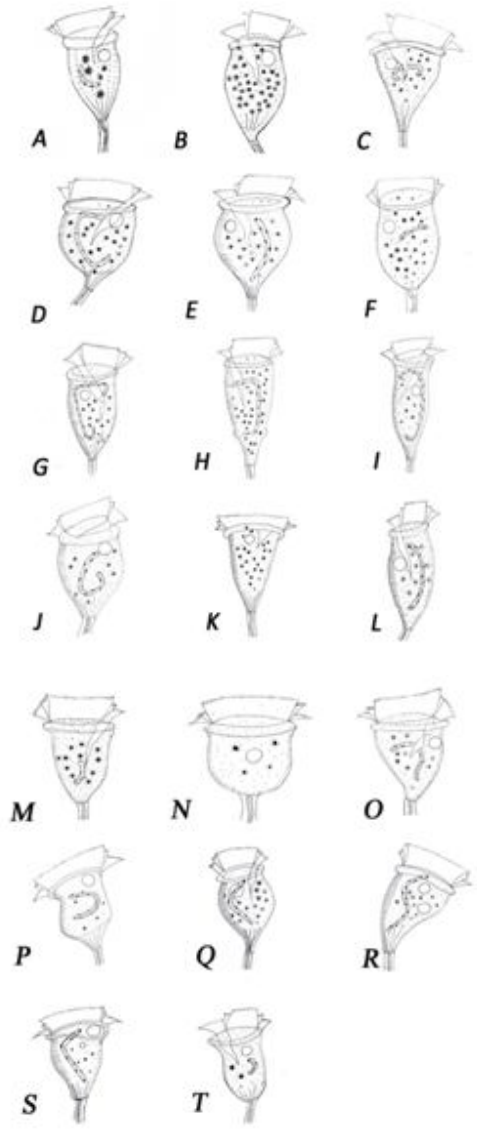

Fig. 3.A-T. Photomicrographs of species identified. A: Vorticella alba (Fromentel, 1874). B: Vorticellaannulata.

(Gourret and Roeser, 1888).C: Vorticellabidulphae. (Stiller, 1939). D: Vorticellacompanula. (Ehrenberg, 1831). E: Vorticellacampanulate. (Kahl, 1933).F: Vorticella communis.(Fromentel, 1874). G:Vorticella convallaria.(Linnaeus, 1758).H:Vorticella chlorostigma.(Ehrenberg, 1831). I:Vorticella gracilis.(Dujardin, 1841). J:Vorticella jaerae. (Precht, 1935). K: Vorticella kenti. (Kahl, 1935). L: Vorticella lima.(Kahl, 1933). M:Vorticella longitricha. (Gajewskaja, 1933). N:Vorticella lymaearum. (Viljoen and As, 1983). O: Vorticella marina. (Greeff, 1870). P:Vorticella marginata . (Stiller, 1931). Q:Vorticella microstoma. (Ehrenberg, 1830). R:Vorticella picta. (Ehrenberg, 1831). S: Vorticella similis. (Ehrenberg, 1830). T: Vorticella subsinuata. (Ghosh, 1922).