Thomas, R. & Gauthier-Lièvre, L. 1959a. Le genre *Lesquereusia* Schlumberger 1845 (Rhizopodes testacés). *Bull. Soc. Hist. Nat. Afr. Nord*, 50:34-83 + Pl. I, II.

Thomas, R. & Gauthier-Lièvre, L. 1959b. Note sur quelques Euglyphidae d'Afrique. *Bull. Soc. Hist. Nat. Afr. Nord*, 50:204-221.

Thomas, R. & Gauthier-Lièvre, L. 1961. Addenda et corrigenda le genre *Lesquereusia* Schlumberger. *Bull. Soc. Hist. Nat. Afr. Nord*, 52:162-163.

Tolonen, K. 1986. Rhizopod analysis. *In*: Berglund, B. E. (ed.), *Handbook of Holocene Palaeoecology and Palaeohydrology*. John Wiley & Sons N.Y. pp 645-666

Tolonen, K., Warner, B. G. & Vasander, H. 1992. Ecology of Testacea (Protozoa, Rhizopoda) in Mires in Southern Finland. 1. Autecology. *Arch. Protistenkd.*, 142:119-138.

Valkanov, A. 1970. Beitrag zur Kenntnis der Protozoen des Schwarzen Meeres. *Zool. Anz.*, 184:241-290.

Van Oye, P. 1956. Rhizopoda Venezuelas mit besonderer Berücksichtigung ihrer Biogeographie. *Hydrobiologia*, 8:329-360.

Velho, L. F. M. & Lansac-Tôha, F. A. 1996. Testate amoebae (Rhizopodea-Sarcodina) from zooplankton of the High Paraná River floodplain, State of Mato Grosso do Sul, Brazil: II. Family Difflugidae. *Stud. Neotrop. Fauna & Environm.*, 31:179-192.

Vucetich, M. C. 1974. Comentarios criticos sobre *Argynnia* Jung, 1942 (Rhizopoda, Testacea). *Neotropica*, 20:126-128.

Vørs, N. 1993. Marine heterotrophic amoebae, flagellates and heliozoa from Belize (Central America) and Tenerife (Canary Island), with descriptions of new species, *Luffisphaera bulbochaete* n. sp., *L. longihastis* n. sp., *L. turriformis* n. sp. and *Paulinella intermedia* n. sp. *J. Euk. Microbiol.*, 40:272-287.

Wailes, G. H. & Hopkinson, J. 1919. *The British Freshwater Rhizopoda and Heliozoa IV*. Ray Soc. London.

Wailes G. H. & Penard, E. 1911. Rhizopoda, Clare Island Survey, pt.65. *Proc. R. Ir. Acad. Dublin*, 33:1-64 + pl. 1-6.

Wanner, M. 1991. Zur Ökologie von Thekamöben (Protozoa: Rhizopoda) in süddeutschen Wäldern. *Arch. Protistenkd.*, 140:237-288.

Wanner, M. & Funke, W. 1986. Rasterelektronen-mikroskopische Untersuchungen an *Edaphonobiotus campascoides* (Protozoa: Testacea). *Arch. Protistenkd.*, 132:187-190.

Wanner, M., Nähring, J. M. & Fischer, R. 1997. Molecular identification of clones of testate amoebae using single nuclei for PCR amplification. *Europ. J. Protistol.*, 33:192-199.

Zivkovic, A. R. 1975. Nouvelles et rares espèces de Testacea (Rhizopoda) dans la fauna de Danube. *Bull. Mus. Hist. Nat. Belgrad, Ser. B.*, 30:119-123.

FAMILY TRICHOSIDAE Möbius, 1889

by F. L. SCHUSTER

Multinucleate marine amebae with alternation of schizont (asexual) and gamont (sexual) generations, the former with calcite spicules on the surface and the latter without. Page (1983) suggests use of terms "fuzzy" and "smooth" for **schizont** and **gamont** individuals, respectively, until the life-cycle can be better defined. Gamonts rare in cultured material. Spicule morphology and size of amebae useful characters for speciation, though spicule morphology is varied. Organism covered by a complex test or glycocalyx consisting of spicules embedded in mucin layer on top of a fibrillar layer (Sheehan and Banner, 1973). Test contains multiple apertures through which unbranched, probably sensory, dactylopods extend. **Dacytlopods** probably tactile in function. Movement by means of **lobopodia**. Wide distribution in littoral zone, and frequently isolated from marine aquaria. Euryhaline and eurythermal according to Sheehan and Banner (1973). Gametogenesis reported by Schaudinn (1899) and Angell (1976). *Pontifex maximus* is a large marine amoeba described by Schaeffer (1926). Because it resembles in its general characteristics the gamont or smooth form, Griffin and Spoon (1977) and Page (1983) consider it to be *Trichosphaerium*.

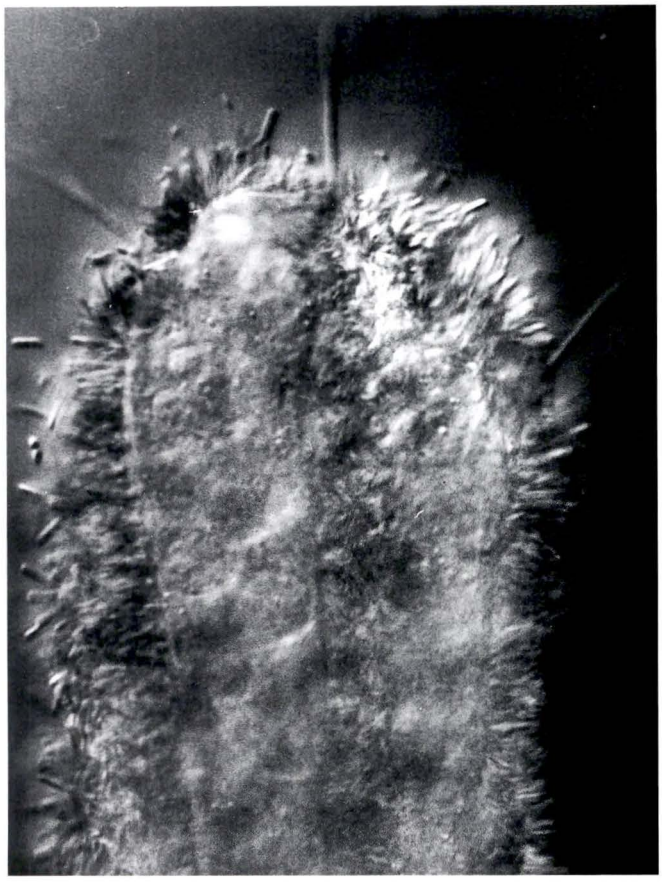

Fig. 1. Schizont stage of *Trichosphaerium sieboldi* with spicules covering the cell surface and dactylopods projecting beyond the spicule layer. X2700.

Genus ***Trichosphaerium*** Schneider, 1878

Trichosphaerium sieboldi Schneider, 1878
Multinucleate marine amoebae occurring as schizonts or gamonts, with characteristics of the the Order. Test of schizont individuals covered with spicules having triangular aspect in cross-section. Nuclear divisions synchronous and occur within the nuclear envelope. Ref. Page (1983), Schaudinn (1899), Schuster (1976).

KEY TO SPECIES

1. Calcareous spicules triangular in cross-section. Large amoebae up to 2 mm in diameter .....***Trichosphaerium sieboldi***
2. Amebae average 36 µm in diameter..... .....***Trichosphaerium micrum***
3. Calcareous spicules flat and blade-shaped..... .....***Trichosphaerium platyxyrum***

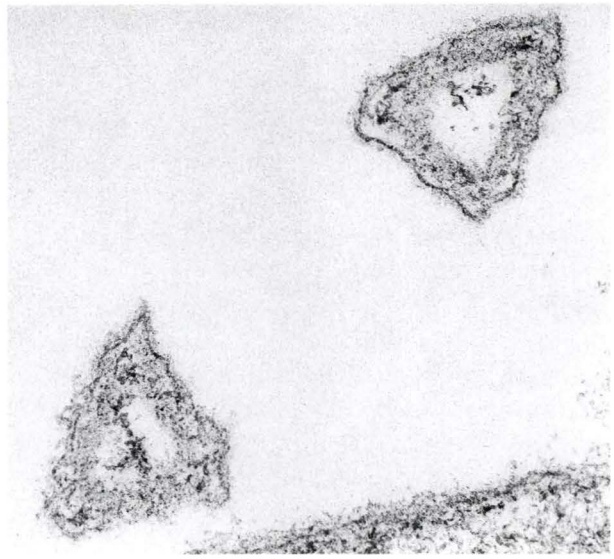

Fig. 2. Transverse section (TEM) through two spicules showing triangular shape and hollow center. X94,000.

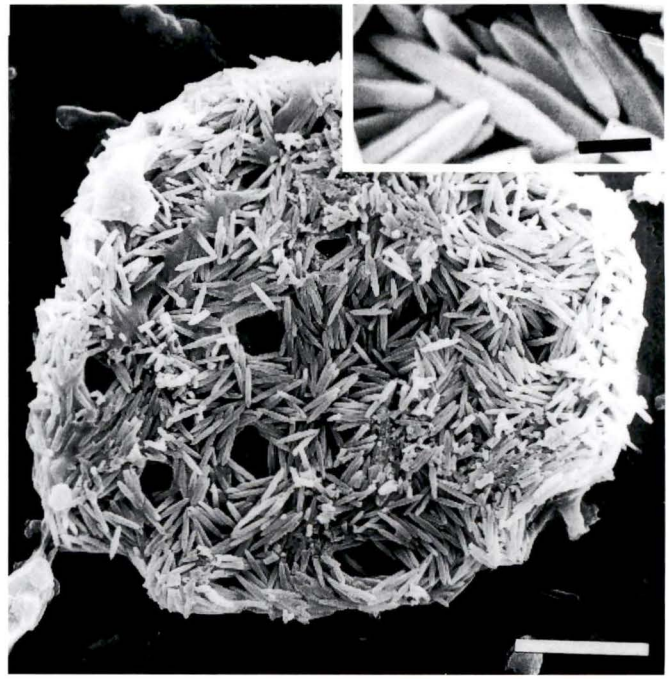

Fig. 3. SEM micrograph of entire schizont of *Trichospherium* with dense layer of spicules. Apertures can be seen in the test. Scale=10 µm. Inset: spicules at higher magnification. Scale=1 µm.

Trichosphaerium micrum Angell, 1975. Size range of amebae 22-50 µm with average at 36 µm. Nuclei range from 2-24 in number per amoeba. Spicules on test are elongate (1-3 µm) and hollow, with blunt ends. Gamonts not observed in cultured material. Ref. Angell (1975).

Trichosphaerium platyxyrum Angell, 1976. Schizont amoebae with size range of 47-93 µm, average 67 µm, with 23-53 nuclei per amoeba, with average of 38. Spicules of schizont are thin and blade-shaped, with squared ends (3-10 µm in length). Multinucleate gamonts lack spicules on test surface. Nuclei number 9-56 with average of 23. Size range of gamonts 37-110 µm (average is 63 µm) but some individuals measure over 1 mm in size. Nuclear division asynchronous in gamont. Early stages of gametogenesis observed. Ref. Angell (1976).

LITERATURE CITED

Angell, R. W. 1975. Structure of *Trichosphaerium micrum* sp. n. *J. Protozool.*, 22:18-22.

Angell, R. W. 1976. Observations on *Trichosphaerium platyxyrum* sp. n. *J. Protozool.*, 23:357-364.

Griffin, J. L., Spoon, D. M. 1977. Ecological interactions of *Trichosphaerium* sp., a multinucleate marine rhizopod. *Int. Congr. Protozool., 5th*, abstract 202.

Page, F. C. 1983. *Marine Gymnamoebae*. Institute of Terrestrial Ecology. Culture Centre of Algae and Protozoa, Cambridge.

Schaeffer, A. A. 1926. Taxonomy of the Amebas. *Carnegie Inst. Wash. Publ.* 345:1-116.

Schaudinn, F. 1899. Untersuchungen über den Generationswechsel von *Trichosphaerium sieboldi* Schn. *Abh. Konigl. Preuss. Akad. Wiss.*, Berlin, 1-93.

Schuster, F. L. 1975. Fine structure of the schizont stage of the testate marine ameba, *Trichosphaerium* sp. *J. Protozool.*, 23:86-93.

Sheehan, R. & Banner, F. T. 1973. *Trichosphaerium*—An extraordinary testate rhizopod from coastal waters. *Estuarine Coastal Mar. Sci.*, 1:245-260.

CLASS XENOPHYOPHOREA Schulze, 1904

ANDREW J. GOODAY and OLE S. TENDAL

INTRODUCTION

Xenophyophores are marine rhizopod plasmodial protozoans which construct an agglutinated test. They range from a few millimeters to 25 cm in size, making them among the largest known protists. Initially described more than a century ago as either sponges or foraminifera, xenophyophores were first recognized as a distinct taxon within the Rhizopoda by Schulze (1907a). The monograph of Tendal (1972) provides the starting point for our modern understanding of the taxonomy, distribution, and biology of the group. Recent reviews by Tendal (1989), Levin (1991, 1994), and Levin and Gooday (1992) have dealt with various aspects of xenophyophore biology, ecology, and taxonomy.

Xenophyophores are one of the few higher taxa to be restricted to the deep sea. They occur at depths between about 500 m and >8000 m (Tendal, 1972; Tendal et al., 1982) and are particularly abundant in regions which experience a high nutrient flux, for example, under upwelling areas and on sloped topography associated with deep sea trenches, submarine canyons, the flanks of seamounts, and continental slopes (Levin and Gooday, 1992). A report by Schepotieff (1912) on xenophyophores from 1-20 m depth in tropical localities is considered unreliable. Tendal (1972) chose to accept it but has since found evidence that the records may represent mistakes, mislabellings, or even fraud. Being confined to the deep sea, xenophyophores are difficult and expensive to collect. The early material was captured in trawls and other towed gears and, as a result, is often fragmented (Tendal, 1972). During the last decade, numerous intact specimens have been recovered in box cores or using submersibles (Levin and Thomas, 1988; Gooday, 1991). *In situ* photographs obtained from submersibles or remote camera systems have provided valuable ecological information (Tendal and Gooday, 1981; Levin and Thomas, 1988; Gooday et al., 1993).