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## The Hemimastigophora, remarkable heterotrophic flagellates possibly related to euglenoid protists

Die Hemimastigophora, eine außergewöhnliche Gruppe heterotropher Flagellaten, die vielleicht mit den Euglenophyten verwandt ist

W. FOISSNER and I. FOISSNER, Universität Salzburg, Institute für Zoologie und Pflanzenphysiologie, Hellbrunnerstrasse 34, A-5020 Salzburg, Austria

The phylum Hemimastigophora was established in 1988 by Foissner W et al (Europ J Protistol 23, 361) for a unique flagellate, *Hemimastix amphikineta*, discovered in Gondwanian soils. Later, two new species and a new genus were found in freshwaters and soils from Europe and North America (Foissner I, Foissner W: J Protozool, in press). The Hemimastigophora have a unique combination of characters: 2 longitudinal rows of cilia-like flagella are associated with 2 microtubular systems and a membranous sac (Fig. 2); the flagella rows are interposed between 2 large, plicated and microtubule-bearing cortical plates having a diagonal (rotational) symmetry (Fig. 1); the nucleolus persists throughout nuclear division; the mitochondrial cristae are saccular to tubular; complex extrusomes; lack of a permanent cytostome-cytopharyngeal complex, pharyngeal rods, striated fibres, mastigonemes, and paraflagellar rods. Three of the five species known show distinct euglenoid movement (Fig. 3) which, like the special diagonal symmetry of the cortical plates, argues for a common ancestor with the euglenoid-kinetoplastid flagellates (Fig. 1). It is unlikely that such complex synapomorphies evolved twice. However, other characters, especially the lack of euglenoid mitochondrial cristae and the distinct flagella rows with their complex "infraciliature" indicate a long-lasting, separate evolution of the Hemimastigophora. We thus suggest to keep separate these puzzling organisms from the euglenophytes at phylum or class level. The Hemimastigophora give an idea how the complex infraciliature of the ciliates may have evolved (Fig. 2).

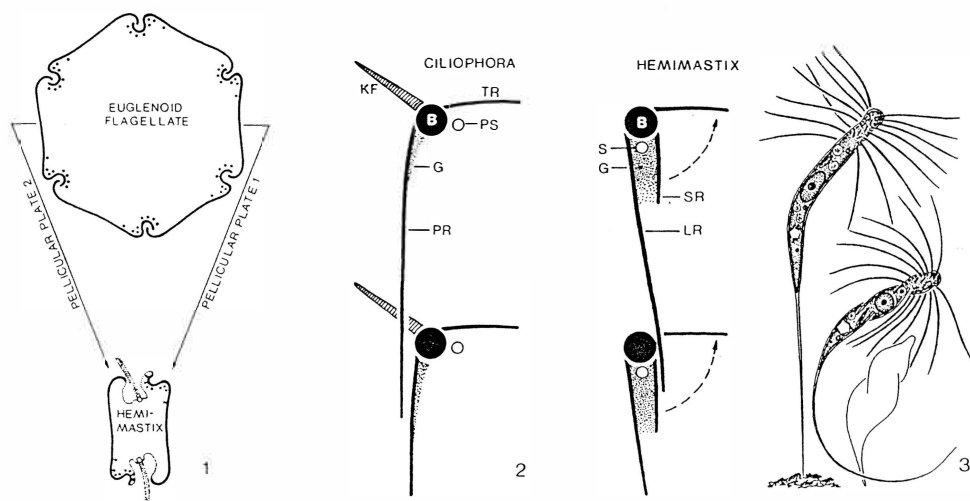


Fig. 1. A *Hemimastix*-like organism can be modeled by taking 2 opposite cortical plates and their associated microtubules (black dots) of an euglenoid flagellate and inserting 2 flagella rows between them. - Fig. 2. Comparison of structures associated with somatic monokinetids in the Ciliophora and in *Hemimastix amphikineta*. A simple rotation by 90° of the short microtubular ribbon (dotted arrow) of *H. amphikineta* produces a nearly (note, however, absence of kinetodesmal fibre) ciliophoran kinetid. - Fig. 3. Extended and contracting *Spironema terricola*. This species shows euglenoid movement. B = basal body, G = granular substance, KF = kinetodesmal fibre, LR = long microtubular ribbon, S = membranous sac, PR = postciliary microtubule ribbon, PS = parasomal sac, SR = short microtubular ribbon, TR = transverse microtubular ribbon.