Lauterbornia 49: 107-128, D-86424 Dinkelscherben, 2004-05-20

New and rare epizoic peritrichs (Protozoa, Ciliophora) on ostracods (Arthropoda, Crustacea) with description of a new family, Bezedniellidae fam. nov.

Horst Schödel

With 22 figures and 4 tables

Schlagwörter: Peritrichia, Ciliophora, Ostracoda, Crustacea, Epizoen, Bayern, Deutschland, Morphologie, Taxonomie, Nomenklatur, Erstbeschreibung
Keywords: Peritrichia, Ciliophora, Ostracoda, Crustacea, epibionts, Bavaria, Germany, morphology, taxonomy, nomenclature, first description

Three new peritrich ciliates living as epibionts on Ostracoda are described. *Orbopercularia dominiki* n. sp. settles on the legs and the antennae of *Cypria ophthalmica* and *Cyclocypris ovum*, *Orbopyxidiella susannae* n. sp. settles on the outside of these ostracods, and *Bezedniella bambergensis* n. sp. on the inner side of *Cypria ophthalmica*. A detailed description of all three species is given including morphometry, silverline system and ecological information. A new family of peritrich ciliates, Bezedniellidae fam. nov., is established for the genera *Nuchterleinella* and *Bezedniella*. The main feature of the new family is the laterally displaced peristome, lying outside the main axis of the zooids. The rare and inadequately described epizoic peritrichs *Nuchterleinella corneliae* and *Lagenophrys stammeri* are redescribed with morphometric analysis and, in *Nuchterleinella corneliae*, the silverline system.

1 Introduction

Ostracods are far more the subjects of paleontological than of biological or ecological research. For example, recent species of Ostracoda are hardly significant as indicators in biological water analysis, but the fossil species are of high importance as index fossils in micropaleontology. Like most crustaceans, ostracods are carriers of epizoic, sessile peritrichs, and it is not surprising that the first fossil ciliates were found on fossil ostracods from the Lower Triassic of Spitsbergen (Weitschat & Guhl 1994).

The examination of recent ostracods for epizoic peritrichs resulted in discovery of three new species and two other rare and remarkable species, which are described in the following paper.

2 Methods and material

Ostracods were collected with a 50μm-mesh dipnet, killed by slight squeezing with sharply pointed forceps, and dissected with two needles under a stereomicroscope. Microscopical observation was performed with a Leitz-Diaplan compound microscope. Protozoans were observed and measured without fixation, except for *Nuchterleinella corneliae* and *Lagenophrys stammeri*. For preparation of type material, the specimens were fixed with Flemming's fixative and DeFano's fluid, stained with Heidenhain's hematoxylin or borax carmine respectively and embedded in Entellan after dehydration with ethanol and xylene. The silverline pattern was revealed with the "dry" method, as described in Foissner, Blatterer, Berger & Kohmann (1991), using various solutions of silver nitrate (3 %-10 %) and different durations of impregnation (5–15 min.). The ostracods were identified with Meisch (2000).

3 Results

3.1 *Orbopercularia dominiki* n. sp. (Fig.1-5; Tab. 1)

Diagnosis: Species of *Orbopercularia*, length of extended zooids 38–54 μm, mean 48 μm, width of zooids 20–38 μm, mean 27 μm. Colonies with 2–12 zooids, zooids cylindrical to almost egg-shaped. No demarcated peristomial lip. Buccal cavity between macronucleus and contractile vacuole. Peristomial disc small, only about 8 μm in diameter, arched cupulate. Primary stalk up to 65 μm long, irregularly and strongly wrinkled. Silverline system narrowly striated.

Type locality and type host: On crustaceans (type host: *Cypria ophthalmica*, additional host: *Cyclocypris ovum*) of a natural, eutrophic pond in a forest ("Hauptsmoorwald") east of Bamberg, Northern Bavaria, Germany. The exact position of the type locality is on the topographic map Bayern 1:25 000 Bamberg Süd Nr. 6131 marked with the coordinates 4425026 and 5527999.

Type material: One hematoxylin-stained and one silver-impregnated slide with syntypes are deposited in the Zoologische Staatssammlung, Münchhausenstraße 21, D-81247 München, Germany, with the registration numbers ZSM 20030196 and ZSM20030197.

Dedication: *Orbopercularia dominiki* is named after my son Dominik Schödel, Burgebrach.

Description: Colonies consist of up to 12 zooids on branched stalks. Zooids varying little, cylindrical to egg-shaped, slightly widened from scopula to the middle of the body becoming more narrow toward the peristome (Fig. 1). No demarcated peristomial lip. Peristomial disc very small, about 8 μm in diameter, hyaline, arched, and cupulate, only slightly raised over the peristomial edge during food intake (Fig. 2). Cilia 8–11 μm long, in one circuit. Contractile vacuole in oral half of zooid, beside buccal cavity; large ovoid macronucleus in center of zooids. Pellicle with distinct transverse striations. Contraction of zooids occurs without development of two peristomial lips (Fig. 3). Length of primary stalk up to 65 μm. Secondary (lateral) stalks up to 15 μm long, standing closely together, not dichotomously branched (Fig. 1). Stalks irregularly and strongly wrinkled transversely, with fine longitudinal striations inside the stalk, often yellowish or brownish. Morphometry of zooids and stalks: table 1.

Silverline system consisting of narrowly spaced striations (Fig. 4), on average 43 striations from the oral apparatus to the aboral ciliary wreath and 15 from the aboral ciliary wreath to the scopula. Aboral ciliary wreath well visible only in specimens that are transforming into swarmers. Distance between silverlines 0,85 μm on the average. Number of pellicular pores per 100 μm^2: 32–56, mean 48,5. Pellicular pores irregularly scattered (Fig. 5). For detailed morphometry of silverline system, see table 1.

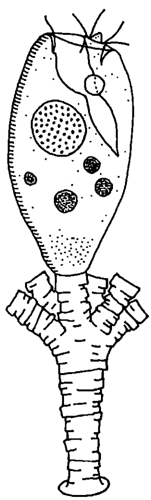

Fig. 1: *Orbopercularia dominiki*. Schematic drawing of a zooid and the form of the colony

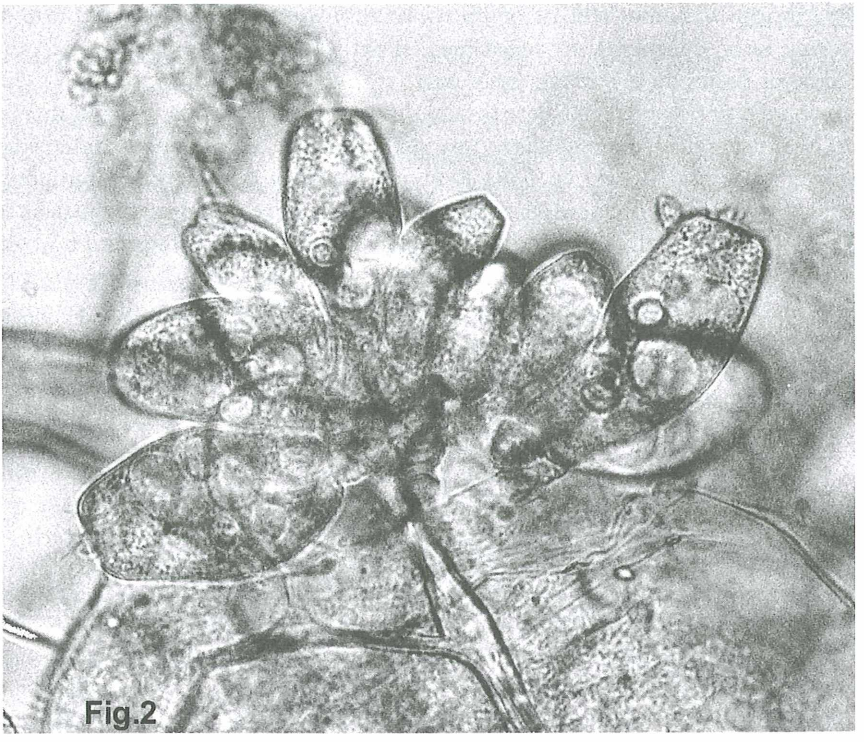
Fig.2

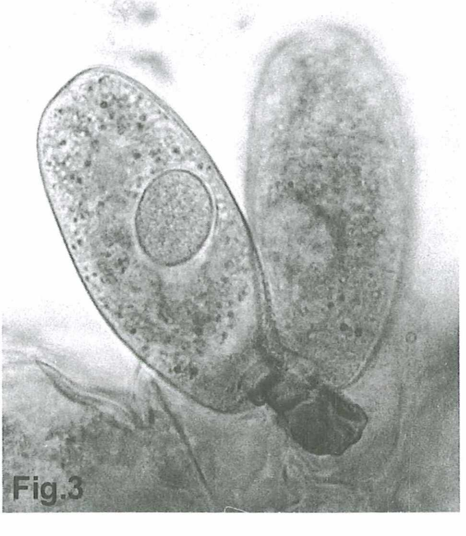
Fig.3

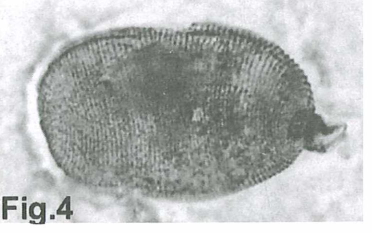
Fig.4

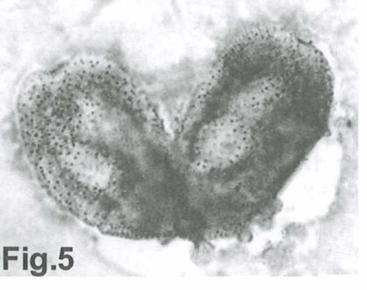
Fig.5

Fig. 2-5: *Orbopercularia dominiki.* 2: Two colonies; left and right zooid with extended small peristomial disc. 3: Methyl green-stained colony with oval macronuclei and wrinkled stalk. 4: Silver-impregnated zooid with closely spaced silverlines. 5: Poorly silver-impregnated zooids with irregularly scattered pellicular pores

Tab. 1: Morphometry of zooids, stalks (in vivo, µm) and the silverline system of *Orbopercularia dominiki.* Abbreviations (after Foissner & Schiffmann 1974): O-W = number of silverlines from oral apparatus to aboral ciliary wreath, W-S = number of silverlines from aboral ciliary wreath to scopula. Ag-lines, measured: distance between silverlines in µm. Ag-lines, calculated: median of zooid length/Median number of total silverlines. P/100 µm² = number of pellicular pores per 100 µm²

	Median ± SD	Minimum	Maximum	n
Zooid, length	48 ± 4,0	38	54	32
Zooid, width	27 ± 4,5	20	38	32
Peristome, width	19 ± 2,6	15	25	19
Stalk, length			65	19
Stalk, width	8	6	9	19
O-W	43 ± 2,2	40	45	4
W-S	15 ± 1,3	13	16	4
Ag-lines, measured	0,65 ± 0,08	0,56	0,85	14
Ag-lines, calculated	0,85 ± 0,05	0,79	0,97	15
Total number of Ag-lines	57 ± 3,3	50	61	15
P/100µm	48,5 ± 7,3	32	56	10

Ecology and occurrence: *Orbopercularia dominiki* lives on the basal segments of legs and antennae of *Cypria ophthalmica* Jurine, 1820. It never settles on the shell. The species was found on approximately 80 % of the hosts examined since 1994. The nameless pond (type locality) is approximately 50 x 40 m in size with a depth of 0,1–0,3 m. The bottom is covered with a layer of anaerobic mud up to 0,3 m thick consisting of the decomposed leaves of alders and oaks.
A chemical analysis at 1997-04-22 showed a conductivity (20 °C) of 318 µS/cm, 10,9 mg oxygen/l, that was 102 % of saturation, at a water temperature of 11,0 °C. During autumn and winter oxygen saturation decreased to 53 %, due to the decomposing leaves. In the pond, several vertebrates and invertebrates could be found: *Triturus alpestris* , *Triturus vulgaris* Linnaeus, *Rana* sp., *Asellus aquaticus* (Linnaeus), *Culex* sp., *Limnephilus flavicornis* (Fabricius), *Stagnicola* sp., *Hesperocorixa sahlbergi* Fieber, *Hydroporus incognitus* Sharp, *Hydroporus palustris* Linnaeus, *Agabus sturmi* Gyllenhal, *Cloeon dipterum* Linnaeus and *Siphlonurus aestivalis* Eaton. The rare epizoic ciliates *Stylocometes digitatus* Stein (Suctoria) and *Usconophrys aperta* (Plate) were frequently present on the gills of highly abundant *Asellus aquaticus.*

Although *Orbopercularia dominiki* was found mainly on *Cypria ophthalmica*, a few occurrences were recorded on *Cyclocypris ovum*; it did not occur on other macrozoobenthic hosts or on aquatic plants. Other ostracods from the same habitat (*Bradleystrandesia reticulata* Zaddach, *Notodromonas monacha*

Mueller, and *Bradleystrandesia fuscata* Jurine) also lacked *Orbopercularia dominiki*. It seems then, that *Orbopercularia dominiki* is an obligatory epibiont of just two species of ostracods.

Additional record: Pond near Haid (see *Lagenophrys stammeri*).

Comparison with related species: *Orbopercularia dominiki* differs from all known species of the genus *Orbopercularia* by the combination of the following characteristics: Length of zooids 38–54 µm, very small cupolate-shaped disc hardly raising over the peristome, strongly wrinkled stalk. The main features that distinguish the species from other congeners with comparable lengths of zooids are described in the following. All species except *Orbopercularia tretzeli* live on water beetles:

Orbopercularia hydropori (Nenninger, 1948) Lust, 1950: Zooids becoming much narrower toward the peristome. Stalk shorter and pedestal-like.

Orbopercularia hyphydri (Nenninger, 1948) Lust, 1950: With 1 ½ circuit of cilia and peristomial disc more raised. Discus only slightly convex. Short, smooth stalk.

- *Orbopercularia rhanti* (Nenninger, 1948) Lust, 1950: Shallow, very broad peristomial disc. Short, smooth stalk.

Orbopercularia philydri (Nenninger, 1948) Lust, 1950: Peristomial disc shallow, stalk smooth.

- *Orbopercularia serrata* Lust, 1950: Zooids more slender, disc less arched , raising far out of the peristome, stalk otherwise.

Orbopercularia agabi (Fauré-Fremiet, 1906) Lust, 1950: Zooids more slender, peristomial disc longer and flat.

- *Orbopercularia ilybii* (Fauré-Fremiet, 1906) Lust, 1950: Peristomial disc not cupolate-shaped, raises far out of the peristome.

Orbopercularia acilii (Fauré-Fremiet, 1906) Lust, 1950: Zooids more swollen up, peristomial disc much higher, with 1 1/2 circuits of cilia.

Orbopercularia inclinata Lust, 1950: Peristomial disc more raised, neck of the disc bended.

Orbopercularia haliplorum Lust, 1950: 1 1/3–1 1/2 circuits of cilia, base of zooids tapering.

Orbopercularia illustris Lust, 1950: Very large macronucleus. Peristomial disc raises far out of the peristome, disc shallow, zooids tapering to the scopula and peristome.

- *Orbopercularia sitiens* Lust, 1950: Very large disc with 1 1/3–1 1/2 circuits of cilia, zooids tapering to the scopula and peristome, peristomial wall wavy.

- *Orbopercularia liebmanni* Lust, 1950: High disc with 2 circuits of cilia.

Orbopercularia tretzeli Matthes, 1950: Peristomial disc only slightly arched, small colonies, on the lorica of ostracods.

Orbopercularia hebetata Matthes & Guhl, 1974: Very broad and flat peristomial disc.

Orbopercularia discostyla Matthes & Guhl, 1974: Disc is a very broad, navel-bearing plate on a slender stalk, raised far out, middle of zooids more swollen.

Orbopercularia finleyi Matthes & Guhl, 1977: Shallow disc, zooids more slender.

3.2 *Orbopyxidiella susannae* n. sp. (Fig. 6-9; Tab. 2)

Diagnosis: Species of *Orbopyxidiella*, length of zooids 33–45 μm, mean 39 μm, width of zooids 15 – 25 μm, mean 20 μm. Form of zooids varying little; zooids cylindrical with oviform macronucleus in the center of the cell, no peristomial lip, contractile vacuole ventral to the buccal cavity, peristomial disc with one circuit of cilia. Stalk 4–7 μm long. Silverline system consisting of closely spaced striations, on an average 42 lines from the oral apparatus to the aboral ciliary wreath and 15 lines from the aboral ciliary wreath to the scopula. Distance between silverlines approximately 0,7 μm.

Type locality and type host: Same as *Orbopercularia dominiki*

Type material: One hematoxylin- and one borax carmine-stained slide with syntypes are deposited in the Zoologische Staatssammlung, Münchhausenstr. 21, D-81247 München, Germany, with the registration numbers ZSM 20030194 and ZSM 20030195.

Dedication: *Orbopyxidiella susannae* is named in honour of my wife, Susanne Schödel, Burgebrach.

Description: Living as solitary zooids. If there are two zooids on one stalk, one of the specimens is always forming a swarmer. Zooids with characteristic shape, narrow at the scopula, becoming wider toward the oral third, only slightly tapering toward the peristome (Fig. 6.). Form of zooids rather constant. Peristomial disc small, only slightly arched, not umbilicate, only raised a small distance over the peristome, one circuit of cilia. Length of cilia 9–11 μm. Contractile vacuole lies ventral to the vestibulum; large, spherical or oviform macronucleus in the center of zooids or slightly away from the center. Buccal cavity between macronucleus and contractile vacuole. Cytoplasm dense on account of the presence of many small food vacuoles. Cells with distinct transverse striations. Contracted zooids with rounded peristome, without lips; contracting zooids with a nodding movement toward the substratum. Most specimens are fastened obliquely to the host's shell, so that the dorsal side is facing the shell (Fig. 7)

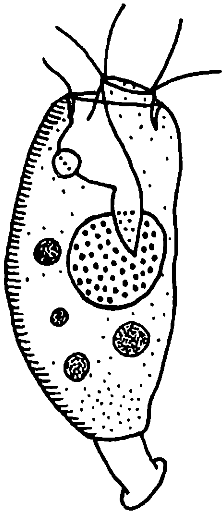

Fig. 6: *Orbopyxidiella susannae*. Schematic drawing of a zooid

Zooids on nearly smooth stalks that are up to 7 μm long. Stalk adherent by a small plate. Silverline system consisting of closely spaced striations (Fig. 8), distance between silverlines 0,7 μm on an average (Tab. 2). Swarmers form an aboral ciliary wreath in the posterior third of zooids.

In March 2002 microconjugants could be observed on a large number of specimens. The microconjugants are cigar-shaped, 25–27 μm long and 7–9 μm wide (Fig. 9).

Tab. 2: Morphometry of zooids, stalks (in vivo, µm) and the silverline system of *Orbopyxidiella susannae*. Abbreviations see tab.1

	Median ± SD	Minimum	Maximum	n
Zooid, length	39 ±3,3	33	45	20
Zooid, width	20 ± 2,6	16	25	20
Peristome, width	16 ± 3,2	11	24	20
Stalk, length			7	14
Stalk, width	4,5	3,5	5	14
O-W	42 ± 6,6	32	50	10
W-S	15 ± 2,2	12	20	10
Ag-lines, measured	0,6	0,4	0,7	10
Ag-lines, calculated	0,7			
Total number of Ag-lines	57 ± 5,8	47	63	10
P/100µm	31 ± 3,7	26	37	8

Ecology and occurrence: *Orbopyxidiella susannae* lives on the outside of the shell of *Cypria ophthalmica* and prefers the region near its rim. The inside of shells, body, and appendages are not colonized. The species was found regularly since 1994 on approximately 50 % of ostracods examined. *Lagenophrys discoidea* Kellicott, 1887 also occurred on the shells and *Nuchterleinella corneliae* Matthes, 1990 and *Orbopercularia dominiki* on the appendages. For ecological characterisation of the type locality, see *Orbopercularia dominiki*.

Additional records: Kreuzschuher Bach (Aurach, Regnitz, Main) west of Bamberg, Bavaria, Germany. Exact position on the topographic map 1:25 000 Nr. 6130 (Burgebrach) is marked with the coordinates 4414052 and 5525549. The Kreuzschuher Bach is a small ditch in an agricultural landscape. It flows through several ponds and is moderately polluted. Ostracods live here in a thin layer of organic mud. Additional fauna: *Gammarus roeseli* Gervais, *Polycelis sp.*, *Radix peregra* Mueller, *Platambus maculatus* Linnaeus, *Anacaena globulus* Paykull, *Laccobius bipunctatus* (Fabricius). Pond near Haid (see *Lagenophrys stammeri*).

Orbopyxidiella susannae was found only on ostracods in all habitats; other potential hosts and aquatic plants were not colonized by this species. It seems therefore, that *Orbopyxidiella susannae* is an obligate symphoriont of ostracods, with a preference for *Cypria ophthalmica*. Only a few specimens were found on *Cyclocypris ovum*, none on *Bradleystrandesia fuscata*, *Brandleystrandesia reticulata* and *Notodromonas monacha*.

Comparison with related species: Only four species have been described in the genus *Orbopyxidiella* (Guhl, 1979): *Orbopyxidiella helophori* (Matthes & Guhl, 1975) Guhl, 1979 is significantly longer than *Orbopyxidiella susannae* with a length of zooids of 88–100 μm and is a host-specific epibiont of Hydrophilidae. *Orbopyxidiella matthesi* (Guhl, 1972) Guhl, 1979 lives on oligochaetes. This species is 21–30 μm long and thus smaller than *Orbopyxidiella susannae*. It also differs from this new species by having a thickened peristome wall, differently shaped zooids, and a tall discus. *Orbopyxidiella stammeri* (Lust, 1950) Guhl, 1979 and *Orbopyxidiella minuta* (Lust, 1950) Guhl, 1979 are both epizoic on Hydrophilidae and are also significantly smaller than *Orbopyxidiella susannae* with differently-shaped zooids. Matthes, (1950) described *Opercularia tretzeli*, an epibiont on the shells of ostracods. This species has a spherical macronucleus and thus belongs to the genus *Orbopercularia*. Therefore, the correct name is *Orbopercularia tretzeli* (Matthes, 1950) nov. comb. Many specimens of *Orbopercularia tretzeli* are solitary, and only a few build colonies with two zooids, so the species can be confused easily with *Orbopyxidiella*. The zooids of *Orbopercularia tretzeli* are wider in the middle, the contractile vacuole lies near the cen

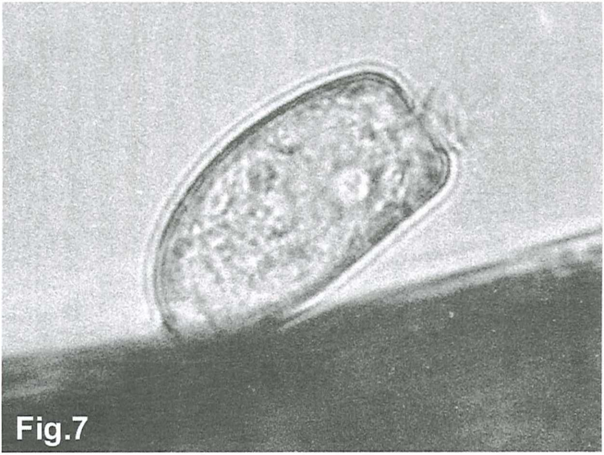

Fig.7

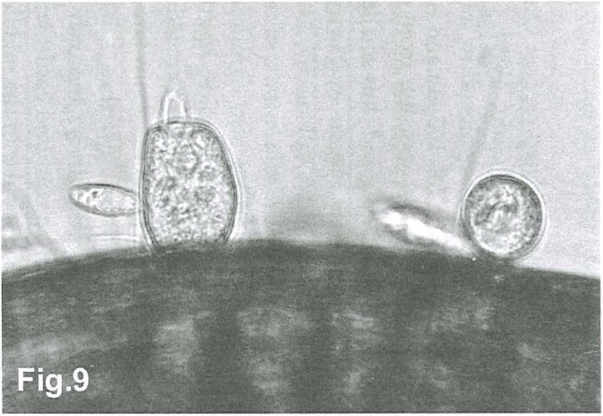

Fig.9

Fig.8

Fig. 7-9: *Orbopyxidiella susannae*. 7: Extended zooid showing typically oblique position relative to the ostracod shell. 8: Silver-impregnated zooid a swarmer-forming. 9: Two individuals with laterally fixed microconjugants

ter of the cells and the zooids are significantly longer (43–67 μm) than those of *Orbopyxidiella susannae*. According to Matthes (personal communication), the two species are not identical. *Orbopyxidiella susannae* differs from *Orbopercularia dominiki* in length of zooids, characteristics of the stalk, having solitary zooids, shape of disc, and location on the host.

Most species of *Orbopercularia* on water beetles (Lust, 1950, Matthes & Guhl, 1974, 1975) differ from *Orbopyxidiella susannae* by being highly specific to their hosts, in length and shape of zooids and stalks, position of macronucleus and contractile vacuole, and occurrence as colonies.

Pyxidiella cothurnoides Kent, 1880, also found on ostracods has a long macronucleus and therefore cannot be confused with *Orbopyxidiella susannae*.

3.3 Description of a new family of Peritrichia: Bezedniellidae fam. nov.

Diagnosis: Colonial or solitary peritrichs with noncontractile stalk. Peristome laterally displaced, sometimes peristome produced into a curved, cylindrical "trunk" The aperture of the peristome lies outside the main axis of zooids. During contraction of the disc the peristomial lips remain open. Macronucleus spherical or ovoid. All known species live on ostracods.
Type Genus: *Bezedniella* Stloukal & Matis, 1994
The new family Bezedniellidae includes the following genera and species:
Genus *Nuchterleinella* Matthes, 1990 with the type species *Nuchterleinella corneliae*.
Diagnosis: Solitary Bezedniellidae, stalk short.
Genus *Bezedniella* Stloukal & Matis ,1994: Type species *Bezedniella prima*.
Diagnosis: Colonial Bezedniellidae, stalk long and branched.

Discussion: The characteristically shaped peristomes of *Nuchterleinella corneliae*, *Bezedniella prima*, and *Bezedniella bambergensis* distinguish these species from all other known Peritrichia so fundamentally that a new family seems appropriate. In all other peritrichs, the scopula is situated opposite to the peristome, but this symmetry is shifted in the family Bezedniellidae. Here, the main axis of the zooid does not connect scopula and peristome as in other peritrichs. The trunk-like, prolonged and curved peristome in the species *Nuchterleinella corneliae* and *Bezedniella prima*, and the dorsally swollen zooid in *Bezedniella bambergensis* upset this symmetry. The family Bezedniellidae belongs to the order Sessilida and appears to be related to the family Operculariidae.

3.4 ***Bezedniella bambergensis*** n. sp. (Fig. 10-13, Tab. 3)

Diagnosis: *Bezedniella* with colonies of up to ten zooids. Length of zooids 50–68 μm, mean 58 μm, width of zooids 38 – 48 μm, mean 43 μm. Zooids dorsally swollen, therefore peristome laterally displaced. Width of peristome about 1/3 the width of zooids. No peristomial lip. Peristomial disc small and cupulate. Buccal cavity reaches middle of zooid. Contractile vacuole ventral. Macronucleus large, ellipsoid. Zooids widened near the stalk, embracing the stalk. Primary stalk curved near its fixation to the substrate, length up to 135 μm, width up to 22,5 μm. Silverlines very closely spaced near the peristome (distance 0,2–0,5 μm), more widely spaced in the middle of zooid (1,0–1,3 μm).

Type locality and type host: Type locality as *Orbopercularia dominiki*. Type host: *Cypria ophthalmica*.

Type material: One hematoxylin-stained and one silver-impregnated slide with syntype-material are deposited in the Zoologische Staatssammlung, Münchhausenstr. 21, D-81247 München, Germany, with the registration numbers ZSM 20030192 and ZSM 20030193.

Etymology: Named after the town of Bamberg, Bavaria, which is in the vicinity of the type locality.

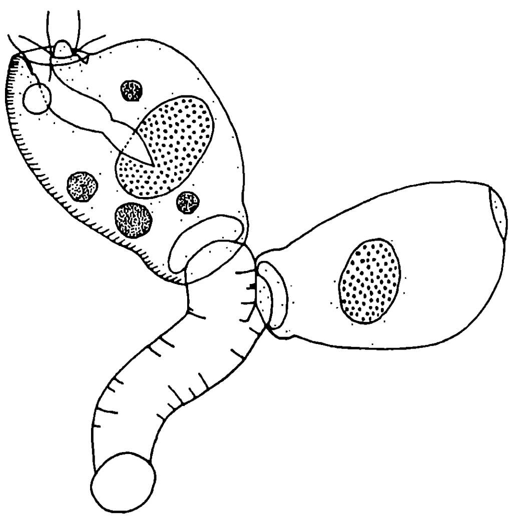

Fig. 10: *Bezedniella bambergensis*. Schematic drawing of a colony with an extended and a contracted zooid. The refractive structure around the scopula was drawn as an optical section

Description: Colonies with up to ten zooids. Zooids dorsally swollen, ventral surface of zooids only slightly arched, giving zooids disproportionate shape (Fig. 10). Peristome laterally displaced, without lip. Width of peristome 15-20 μm, approximately 1/3 of width of zooids. During contraction, only the disc is retracted into the zooid; the peristome is not closed. Peristomial disc cupulate, hardly emerging from peristome. Buccal cavity narrow, contractile vacuole ventrally located beside the buccal cavity near the peristome. Macronucleus ellipsoid or bean-shaped, in the center or aboral half of zooid, sometimes also in the dorsal swelling, lying transverse or oblique to the longitudinal axis of zooid. Zooids widened at insertion of stalk, embracing upper part of stalk. In this basal extension lies a stalk-embracing, refractive and argentophilic structure (Fig. 10, 12) that is distinctly separated from stalk and cytoplasm. Stalks very broad, primary stalk up to 135 μm long and up to 22,5 μm wide, lateral stalks up to 34 μm long and 12 μm broad. Stalks transversely wrinkled and with fine longitudinal striations inside. Main stalk distinctly curved above its fixation to the substrate. No fixation plate.

In some colonies, there were zooids with a cylindrical shape that were smaller than typical zooids, without dorsal swelling, and with a closed peristome (Fig. 11). In the upper third of these zooids, movement of the cilia on the retracted disc could be observed. Three of these zooids were measured: length 31,5–40,5–45 μm, width: 27,0–29,3–33,8 μm. Perhaps these are forms analogues to the specimens of *Nuchterleinella corneliae*, that lack a peristome. Formation of swarmers was never observed. Likewise, no aboral ciliary wreath was discerned in silver-impregnated zooids.

Distance between silverlines uneven, crowded near the oral apparatus (distance 0,2–0,5 μm), more distant in the middle (1,0–1,3 μm). There was a total of 50–63 silverlines. Aboral ciliary wreath not discernable. The silverlines near the scopula were difficult to recognize because of the strong argentophily

Tab. 3: Morphometry of zooids, stalk (in vivo, µm) and silverline system of *Bezedniella bambergensis*. Abbreviations see tab.1

	Median ± SD	Minimum	Maximum	n
Zooid, Length	58 ± 5,9	50	68	16
Zooid, Width	43 ± 2,84	38	48	16
Main Stalk, Length			135	16
Lateral Stalk, Length			34	20
Main Stalk, Width	19.5	17	22,5	8
Lateral Stalk, Width			12	20
Ag-Lines,total number	55 ± 5	50	63	9
Ag-lines, measured	0,96 ± 0,16	0,82	1,27	6
Ag-lines, calculated	0,95 ± 0,08	0,86	1,08	9
P/100 µm2	36,4 ± 4,1	29	42	10

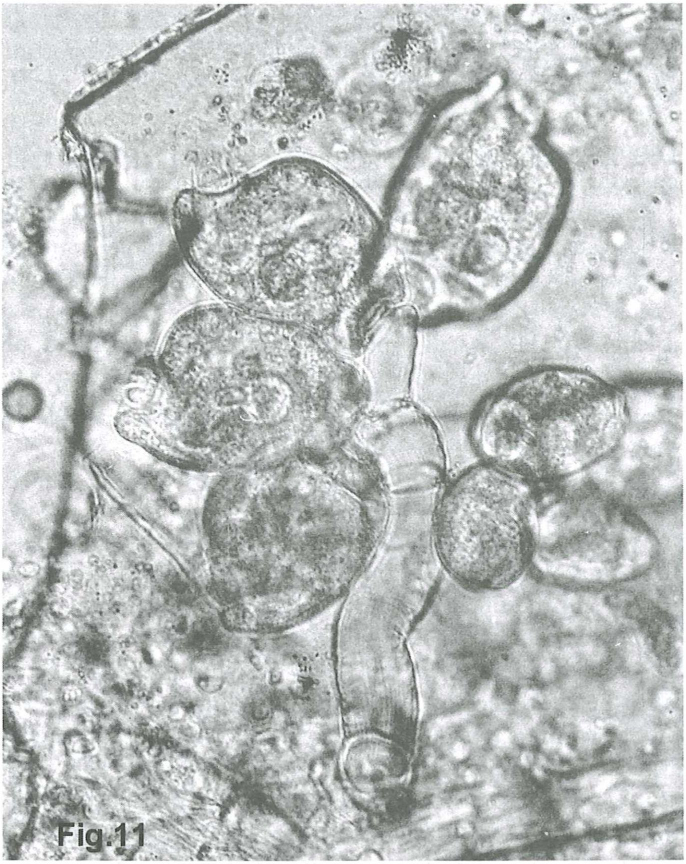

Fig.11

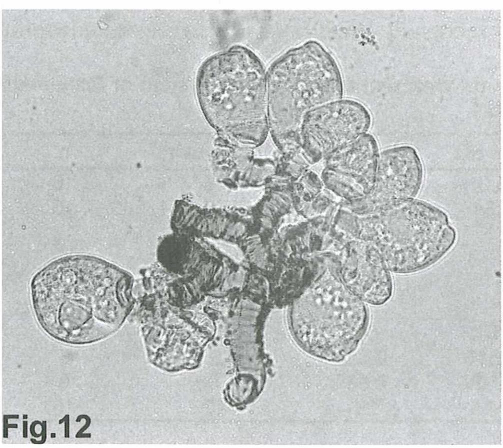

Fig.12

Fig.13

Fig. 11-13: *Bezedniella bambergensis*. 11: A colony on the inner side of the shell of *Cypria ophthalmica*. On the left branch are four large, expanded zooids; on the right branch four small zooids without peristomes, only three of them well-focused. 12: A colony detached from the shell of *Cypria* and squeezed by the cover-glass. Zooid on the left side with refractive structure visible near the scopula. 13: Silver-impregnated zooids, pellicular pores annular, base of zooid argentophilic

of the basal refractive structure (Fig. 13). Number of pellicular pores per 100 μm^2: 29–42; pellicular pores arranged in regular rows on the silverlines.

Ecology and occurence: *Bezedniella bambergensis* lives in the same habitat as *Orbopercularia dominiki* and *Orbopyxidiella susannae*, within the pond "Hauptsmoorwald". It sits exclusively on the inner side of the shell of *Cypria ophthalmica*; it could not be found on the other observed species of ostracods. *Bezedniella bambergensis* is a very rare species on *Cypria ophthalmica*; only about 5 % of the specimens were colonized.

Comparison with related species: The species is placed into the genus *Bezedniella* because of the laterally displaced peristome, the formation of colonies and the ovoid macronucleus. *Bezedniella bambergensis* differs from the sole congener, *Bezedniella prima*, by the following characteristics: peristome not extended like a trunk; disc cupulate; base of zooid widened, with refractive structure; main stalk and lateral stalks not striated differently, thicker than in *Bezedniella prima*.

3.5 *Nuchterleinella corneliae* Matthes, 1990 (Fig. 14-18)

Described as *Nüchterleinella corneliae*. According to article 32.5.2 of the International Code of Zoological Nomenclature (1999) the name of the genus must be changed to *Nuchterleinella* (Aescht 2001). The first record was on *Cypria ophthalmica* from a marshy spring in Northern Bavaria (Matthes 1990). The type locality was not specified. The ciliate lives on the furca and penis of ostracods, not on the shell. It was found on *Cypria ophthalmica* and *Cyclocypris ovum* in Thornhill Pond, Cardiff, U.K. (Griffiths & Evans 1994). *Nuchterleinella corneliae* was frequent on *Cypria ophthalmica* in the same habitats where *Orbopyxidiella susannae* was found by me. The species cannot be confused with other species because of the typical shape of the zooids and the curved, cylindrical, trunk-like peristome (Fig. 14). Matthes (1990) placed *Nuchterleinella* in the family Epistylididae, because he describes a peristome wall. According to my observations, on many specimens the ventral side of peristome is jolted by the curving of the peristome and seems to be thickened, but there is no peristomial lip comparable with those in typical epistylidids. The peristome is clearly *Opercularia*-like because of the stalked disc.

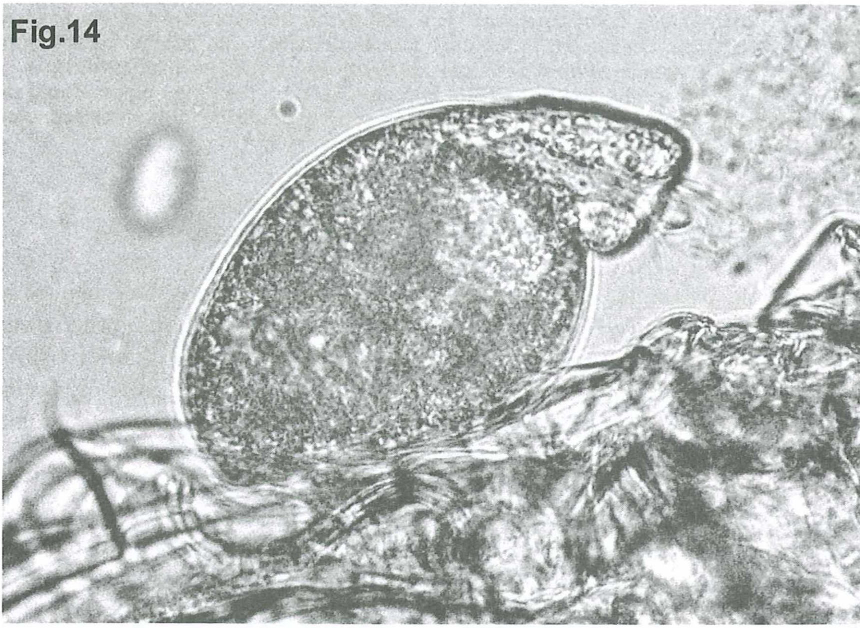
Fig.14

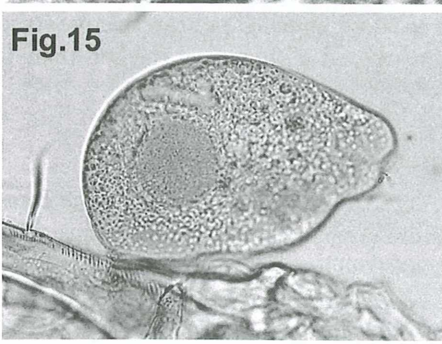
Fig.15

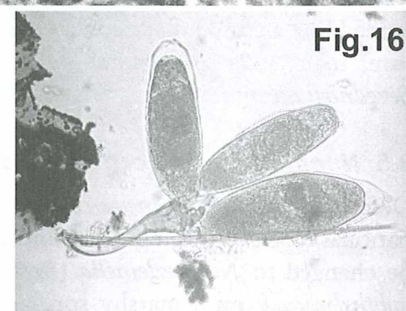
Fig.16


Fig.17

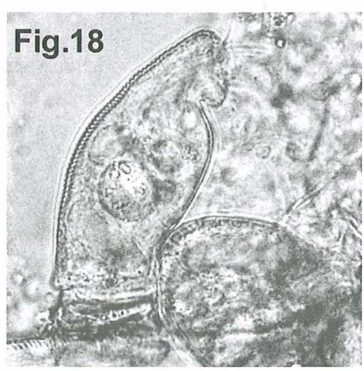
Fig.18

Fig. 14-15, 17-18: *Nuchterleinella corneliae*. 14: A single zooid with extended peristomial disc. 15: Methyl green-stained; spherical macronucleus, no detached membrane. 17: Poorly silver-impregnated, therefore only the annular arranged pellicular pores are visible. 18: Elongated, slender zooid
Fig. 16: *Orbopercularia turgida*. A colony after staining with methyl green with detached membrane

Matthes (1990) proposes that a membrane that detaches from the pellicle after staining with methyl green is a characteristic of the genus. Several attempts to reproduce this effect failed in my populations. Figure 15 shows a specimen with a methyl green-stained macronucleus without any evidence of a detached membrane. Otherwise, this effect sometimes succeeds with other peritrichs. Figure 16 shows a small colony of *Orbopercularia turgida* Lust, 1950 on a rostrum bristle of *Sigara falleni* with detached membrane after methyl green-application. In this species, a membrane was detached not only by using methyl green, but also after dying under the coverglass in the course of long microscopical observation. Therefore, the detaching of a membrane from the pellicle seems to be more an artifact of preparation than a taxonomically usable feature.

Length of zooids according to Matthes: 57–112 μm, median 77 μm, n = 10.
Width of zooids (Matthes 1990): 36–83 μm, median 56 μm, n = 10.
My own measurements of 14 fixed, silver impregnated zooids:
Length of zooids: 61–122 μm, median $\pm$ SD: 83 $\pm$ 16,6 μm.
Width of zooids: 34–65 μm, median $\pm$ SD: 46 $\pm$ 8,9 μm.

Nuchterleinella cornelia is solitary. If there are two zooids on one stalk, one of the zooids reduces the adoral cilia and transforms into a zooid lacking a peristome.

The silverline system (Fig. 17) conspicuously shows that, as in *Bezedniella bambergensis*, no aboral ciliary wreath is visible. Here the trochalband of swarmers usually develops. Matthes presumes that formation of swarmers is connected with the occurrence of zooids lacking peristomes. Once I observed a single zooid of *Nuchterleinella corneliae* that was elongated like a zooid without a peristome but had active, swirling adoral cilia (Fig. 18; Length: 80 μm, Width: 35 μm). Perhaps this could be a recently fixed swarmer before its transformation into a swollen trophont.

Total number of silverlines in six measured specimens: 50–65, median 59. Calculated distance between silverlines 1,4 μm. Silverline system with striations widely spaced. Pellicular pores in regular lines on the silverlines (Fig. 17).

3.6 *Lagenophrys stammeri* Lust, 1950 (Fig. 19-22, Tab. 4)

Originally found on *Cypria ophthalmica* from Jurassic springs near Hersbruck, Northern Bavaria (Lust 1950). Type locality not specified. No further records since Lust's description. The following observations were made on a population from a small pond near Haid, Northern Bavaria.

Host and location: On shells of *Cypria ophthalmica* from a small pond in a forest near Haid. Coordinates on topographic map Bayern 1:25 000 No 6231, Adelsdorf: 4423682 and 5511882. The pond is about 20 x 20 m and heavily shaded by alders and oaks. The only macroinvertebrates are Culicidae larvae, suggesting that the pond dries up in summer.

Voucher material: One hematoxylin-stained and one borax carmine-stained microslide are deposited in the Zoologische Staatssammlung, Münchhausenstr. 21, D-81247 München, Germany with the registration numbers ZSM 20030198 and ZSM 20030199.

Description: Lorica almost circular in dorsal view, usually slightly longer than wide. Margin forms a 4,5 μm-broad, yellowish ring (Fig. 19). Aperture with two lips, lips transparent and without conspicuous structures, only the posterior lip with very slightly thickened edge. Zooids attached to the aperture; macronucleus oval to bean-shaped, consistently on right side beside the aperture. Lust found the macronucleus in the posterior part of the cells. One micronucleus, 4,5 μm in diameter, beside the middle of the concave side of the macronucleus. Swarmers have an elongate, curved macronucleus (Fig. 20). Lateral view similar to the description of Lust (Fig. 20, 21).

Discussion: The observed specimens of *Lagenophrys stammeri* differ from Lust's population in the position of the macronucleus and were slightly larger. *Lagenophrys stammeri* may be confused with *Lagenophrys discoidea* Kellicott, 1887, which also lives on the shells of ostracods. Confusion with other species of this genus can be avoided because of the decided host-specificity of the European species of *Lagenophrys*.

Fig. 19-22: *Lagenophrys stammeri*. 19: Stained with borax carmine after been detached from the shell of *Cypris*. Macronucleus on the right side, above aperture of lorica. 20: Detached individual, stained with borax carmine. Zooid on the right side with short macronucleus fixed to the aperture, swarmer on the left side with elongate and curved macronucleus. 21: Lateral view, aperture opened. 22: Lateral view, aperture closed (same individual as in Fig. 20)

Fig.19

Fig.20

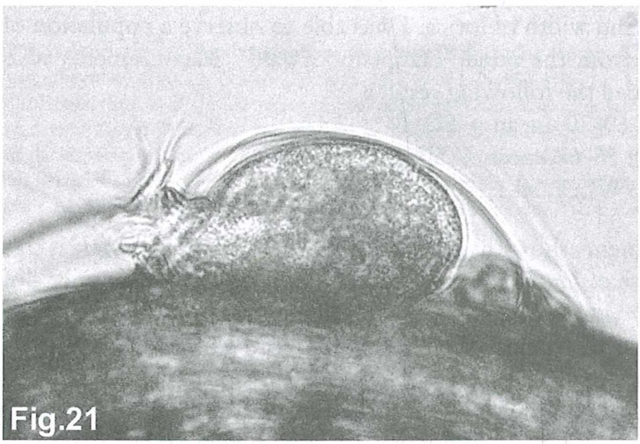

Fig.21

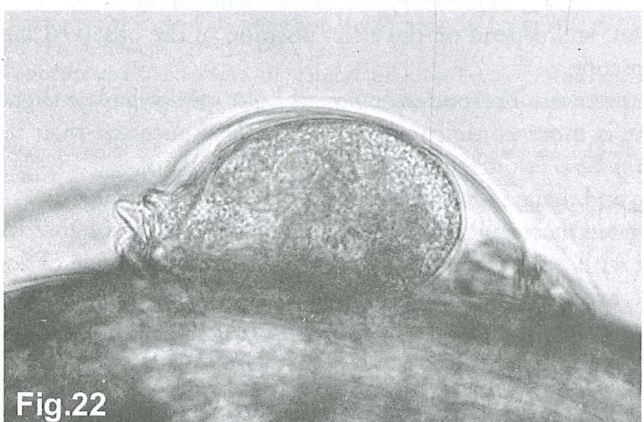

Fig.22

Tab. 4: Measurement0s (µm) and proportions of *Lagenophrys stammeri*, fixed specimens

	Mean ± SD	Maximum	Minimum	n
Length of lorica (LL)	94,6 ± 3,91	103,5	88	21
Width of lorica (WL)	91,9 ± 3,13	96,8	87,8	17
Height of lorica (HL)	42,8	45	40,5	2
Width of lorica aperture (WLA)	23,1 ± 1,64	24,8	20,3	12
Length of macronucleus (LMN)	33,3 ± 3,5	38,3	27	12
Width of macronucleus (WMN)	13,4 ± 1,77	15,8	11,3	11
Length of macronucleus of swarmers	90	90	90	2
Width of macronucleus of swarmers	5	5	5	2
LL/WL	1,03 ± 0,04	1,12	0,98	16
WLA/WL	0,25 ± 0,02	0,28	0,21	12
LMN/WMN (zooids)	2,58 ± 0,47	3,1	1,93	10
LMN/WMN (swarmers)	18	18	18	2

Differences between *Lagenophrys stammeri* and *Lagenophrys discoidea*:
- Length and width of lorica: I was able to observe a population of *Lagenophrys discoidea* from the pond "Hauptsmoorwald" Measurements of 20 fixed specimen yielded the following results:
LL (μm): 60–70, mean ± SD: 64 ± 2,47
WL (μm): 56–67, mean ± SD: 60 ± 2,77
Ratio LL/WL: 1,04–1,17, mean ± SD: 1,08 ± 0,04.

Measurements show that the lorica of *Lagenophrys stammeri* is significant larger than those of *Lagenophrys discoidea*. The ratio LL/WL is only slightly larger in *Lagenophrys discoidea* than in *Lagenophrys stammeri*, but the difference is distinct in the microscopic view.
- Shape and height of lorica: The differences of the two species as described by Lust – *Lagenophrys stammeri* in the front part steeply ascending, the back part gradually declining, *Lagenophrys discoidea* highly arched – are not recognizable throughout, and depend on the exact position of the observed specimen under the microscope.
- Lorica apertures: The posterior lips of both species have a slightly thickened edge, that is more conspicuous in *Lagenophrys discoidea* than it is in *Lagenophrys stammeri*. For diagnosis of species hardly useful.
- Position and shape of macronucleus: *Lagenophrys discoidea* always with curved and elongated macronucleus in the middle or back part of zooids, *Lagenophrys stammeri* with a short, reniform macronucleus in right side of zooid or in the back part. Swarmers of *Lagenophrys stammeri* with a long macronucleus.

The most significant characteristics for distinguishing the two species are the length and width of the lorica and the shape of the macronucleus.

Lagenophrys stammeri matches *Lagenophrys matthesi* Schödel 1983 in the transparent lips and the shape and position of the macronucleus. Both species differ in the length, width and height of the lorica, that is *Lagenophrys matthesi* is distinctly smaller (LL: 65-82 μm, WL: 60-78 m, HL: 30-40 μm). Further distinctive features are the different shape of the lips in dorsal view and the different invertebrate hosts. *Lagenophrys matthesi* lives on the maxillipeds of species of *Gammarus*.

Acknowledgements

I wish to thank Prof. Dr. W. Foissner, University of Salzburg, Austria, for helpful comments, suggestions, and help with translation and Dr. J. C. Clamp, North Carolina State University, U.S.A., for English correction of the manuscript.

References

Aescht, E. (2001): Catalogue of the Generic Names of Ciliates (Protozoa, Ciliophora).- Denisia 1: 1-350, Linz

Clamp, J. C. (1987): Redescription of Paralagenophrys singularis (Kellicott) n. comb. (Ciliophora: Peritricha: Lagenophryidae).- Journal of Protozoology 34: 249-253, New York

Clamp, J. C. (1990): 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. Columbus, Ohio

Foissner, W. (1979): Peritriche Ciliaten (Protozoa: Ciliophora) aus alpinen Kleingewässern.- Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere 106: 529-558, Jena

Foissner, W., H. Blatterer, H. Berger & F. Kohmann (1991): Taxonomische und ökologische Revision der Ciliaten des Saprobiensystems Band 1: Cyrtophorida, Hypotrichia, Colpodea.- Informationsberichte des Bayerischen Landesamtes für Wasserwirtschaft 1/91, 478 pp., München

Foissner, W. & H. Schiffmann (1974): Vergleichende Untersuchungen an argyrophilen Strukturen von vierzehn peritrichen Ciliaten.- Protistologica 10: 489-508, Paris

Griffiths, H. I. & J. G. Evans (1994): Infestation of the freshwater Ostracod Cypria ophthalmica (Jurine) by the Peritrich Nüchterleinella corneliae Matthes.- Archiv für Protistenkunde 144: 315-317, Jena

Guhl, W. (1979): Beitrag zur Systematik, Biologie und Morphologie der Epistylidae (Ciliata, Peritricha).-Archiv für Protistenkunde 121: 417 – 483, Jena

Kahl, A. (1935): Peritricha und Chonotricha.- In: Dahl, F.(ed.):Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise 30: 651-805, (G. Fischer) Jena

Lust, S. (1950a): Symphorionte Peritriche auf Käfern und Wanzen.- Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere 79: 353-436, Jena

Lust, S. (1950b): Zwei auf Ostracoden lebende Lagenophrys-Arten (Ciliata, Peritricha).- Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere 79: 350-352, Jena

Matthes, D. (1950): Beitrag zur Peritrichenfauna der Umgebung Erlangens.- Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere 79: 437-448, Jena

Matthes, D. (1990): Nüchterleinella corneliae n. g., n. sp. – ein Peritrich auf Cypria ophthalmica (Ostracoda).- Archiv für Protistenkunde 138: 139-141, Jena

Matthes, D. & W. Guhl (1974): Neue opereculariforme Epistyliden mit symphorionter Lebensweise.-Archiv für Protistenkunde 116: 366-380, Jena

Matthes, D. & W. Guhl (1975): Systematik, Anpassungen und Raumparasitismus auf Hydrophiliden lebender operculariformer Epistyliden.- Archiv für Protistenkunde 117: 110-186, Jena

Meisch, C. (2000): Crustacea: Ostracoda.- In: Schwoerbel, J. & P. Zwick (eds) Süßwasserfauna von Mitteleuropa. Begründet von A. Brauer 8,3: 522 pp., (Spektrum) Heidelberg

Nenninger, U. (1948): Die Peritrichen der Umgebung von Erlangen mit besonderer Berücksichtigung ihrer Wirtsspezifität.- Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere 77: 169-266, Jena

Stiller, J. (1971): Szajkoszorus Csillósok-Peritricha.- Fauna Hungariae 105: 1-245, Budapest

Schödel, H. (1983): Drei neue Peritriche von Gammariden.- Archiv für Protistenkunde 127: 115-126, Jena

Stloukal, E. & D. Matis (1994): A New Morphological Type of Peritrich Ciliates and a Description of Bezedniella prima n. g., n. sp. (Peritricha, Ciliophora).- Acta zoologica Universitatis Comenianae 38: 79-82, Bratislava

Weitschat, E. & W. Guhl (1994): Erster Nachweis fossiler Ciliaten.- Paläontologische Zeitschrift 68: 17-31, Stuttgart.

Author's address: Dr. Horst Schödel, Zum Weidig 6, D-96138 Burgebrach, Germany, horst.schoedel@planet-interkom.de

Received: 2003-07-26