Zool. Jb. Syst. **114** (1987), 193—239
VEB Gustav Fischer Verlag Jena

Institute of Zoology of the University of Salzburg, Austria

Morphology and Biometry of Some Soil Hypotrichs (Protozoa: Ciliophora)[1])

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With 106 Figures

Abstract

The morphology and the infraciliature of 18 species of hypotrichous ciliates from various soils of the world have been investigated: *Pseudouroleptus procerus* nov. spec., *Kahliella bacilliformis*, *K. simplex*, *Keronopsis wetzeli*, *Paruroleptus notabilis*, *Hemisincirra inquieta*, *H. livida* nov. spec., *Histriculus cavicola* nov. comb., *Lamtostyla edaphoni* nov. spec., *Oxytricha lanceolata*, *O. nauplia* nov. spec., *O. rubripuncta* nov. spec., *Steinia tetracirrata*, *S. citrina* nov. spec., *Tachysoma granulifera* nov. spec., *Urosoma acuminata*, *U. gigantea*, and *Urosomoida agilis*. All species are characterized biometrically. The cysts of *K. bacilliformis*, *H. cavicola*, *U. acuminata*, and *U. gigantea* are described. The cirral pattern of *Paraurostyla buitkampi* is typical for the genus *Pseudouroleptus: Pseudouroleptus buitkampi* (Foissner, 1982) nov. comb. An improved diagnosis of the genus *Lamtostyla* Buitkamp, 1977 is suggested. This oxytrichid genus includes now 4 species: *L. lamottei* (type species), *L. edaphoni* nov. spec., *L. hyalina* (Berger, Foissner, and Adam, 1984) nov. comb. (for *Tachysoma hyalina*), and *L. perisincirra* (Hemberger, 1985) nov. comb. (for *Tachysoma persincirra*). The character pair anteriad displaced transverse cirri and possession of subpellicular granules of the *Steinia inquieta* described by Foissner (1984) requires the establishment of a new species: *Steinia primicirrata* nov. spec. Basing on the original descriptions improved diagnosis of *S. inquieta* (Stokes, 1887) and *S. candens* Kahl, 1932 are suggested.

1. Introduction

Foissner (1981), Foissner and Peer (1985), Foissner et al. (1985), and Foissner (1987) found that $^1/_4$—$^1/_3$ of the known soil ciliate species belong to hypotrichous taxa. In this paper we describe some further species which we have found in some soils of Europe and Asia.

In modern taxonomical research of hypotrichs some important species characters are often neglected. These are the *in vivo* aspect, including the body shape and the presence or absence of subpellicular granules, the infraciliature in ventral and dorsal view, and the biometrical characterization. However, these features are absolutely necessary for a correct determination. It is surely inadequate to show only the ventral aspect of the infraciliature.

[1]) The authors wish to thank Dr. Tadao Matsusaka (Kumamoto University, Japan), Mr. Eugen Lehle (University of Ulm, West Germany), and Mr. Hannes Augustin (University of Salzburg) for providing samples from Japan, Federal Republic of Germany, and Israel respectively. The photographical assistance of Mrs. Karin Bernatzky is greatly acknowledged. The study was supported by the "Fonds zur Förderung der wissenschaftlichen Forschung, Projekt Nr. P 5226".

Table 1. Localities of the populations

Species	Date	Locality	Sea-level (m)
Hemisincirra inquieta	20. 1. 1985	Upper soil layer (0—5 cm) of a spruce forest near Ulm, West Germany.	c. 500
Hemisincirra livida	June 1984	Litter and soil particles of a very shallow soil of a goat pasture between Nauplion and Tripolis, Peloponnesus, Greece.	c. 1,000
Histriculus cavicola			
Austrian population	25. 10. 1985	Upper soil layer (0—5 cm) of an arable land near Salzburg, Austria. "Versuchsfläche D" in FOISSNER et al. (1985).	c. 420
Japanese population		From a soil in Japan. Kindly supplied by Dr. T. MATSUSAKA. Designated in his works as *Histriculus muscorum* (e.g. MATSUSAKA 1979).	
Kahliella bacilliformis	13. 2. 1985	Upper layer (0—5 cm) of a loamy soil of a wheat field near Kibbitz, about 10 km south of Nazaret, Israel. Cultured on Eau de Volviv enriched with squeezed wheat grain.	?
Kahliella simplex	24. 3. 1984	Upper soil layer (0—5 cm) of a pasture near Seekirchen, Austria. "Versuchsfläche E" in FOISSNER et al. (1985).	c. 540
Keronopsis wetzeli	2. 5. 1985	The lower part of a bundle of straw which was in contact with the soil. The bundle was used for the culture of the fungus *Leccinum testaceo-scabrum*. Salzburg, Austria.	c. 420
Lamtostyla edaphoni	2. 5. 1985	See *Keronopsis wetzeli*.	c. 420
Oxytricha lanceolata	29. 10. 1983	Upper soil layer (0—5 cm) of a pasture near Seekirchen, Austria. "Versuchsfläche F" in FOISSNER et al. (1985).	c. 500
Oxytricha nauplia	June 1984	Upper layer (0—5 cm) of a salt soil with rush, about 50 m away from the sea. Nauplia Bay, Peloponnesus, Greece.	c. 1
Oxytricha rubripuncta	14. 2. 1985	Upper soil layer (0—5 cm) of an uncultivated grassland (dominated by *Poa* sp.) in the Golan Hills, Israel.	above 1,500
Paruroleptus notabilis	20. 1. 1985	See *Hemisincirra inquieta*.	c. 500

Table 1 (continued)

Species	Date	Locality	Sea-level (m)
Pseudouroleptus procerus			
Population 1	13. 7. 1984	Upper soil layer (0—5 cm) of a meadow near Salzburg, Austria. "Versuchsfläche A" in FOISSNER et al. (1985).	c. 420
Population 2	25. 10. 1984	See *Kahliella simplex*.	c. 540
Population 3	6. 5. 1985	Arable soil near Vienna, Austria.	c. 200
Steinia tetracirrata	June 1984	See *Oxytricha nauplia*.	c. 1
Steinia citrina	June 1984	See *Hemisincirra livida*.	c. 1,000
Tachysoma granulifera	19. 4. 1985	Arable soil near Vienna, Austria.	c. 200
Urosoma acuminata	14. 2. 1985	See *Oxytricha rubripuncta*.	above 1,500
Urosoma gigantea	29. 10. 1982	Soil of a saline grassland with halophile plants near the Neusiedlersee, Burgenland, Austria.	c. 115
Urosomoida agilis	8. 11. 1981	Xerothermic site without trees in the Tullnerfeld, Lower Austria. "Profil 4" in FOISSNER et al. (1985).	189

2. Material and methods

For the material see Table 1. The culture method and protargol staining technique according to FOISSNER (1982) were used. Furthermore, the silvercarbonate method of FERNANDEZ-GALIANO (1976) was employed.

All countings and measurements were performed at a magnification of 1,000× with different instruments (1 unit = 1 μm and 1.4 μm respectively). The data in the Tables are based on protargol impregnated specimens. All measurements in μm. As proposed by BERGER (1978) and FOISSNER (1982) following sample statistics were calculated: $\bar{x}$, arithmetic mean; M, median; SD, standard deviation; SE, standard error of the arithmetic mean; CV, coefficient of variation in %; Min, minimum value; Max, maximum value; n, sample size. Statistical procedures follow methods as described in SOKAL and ROHLF (1981).

The body shape of the living specimens was drawn from slides without cover glasses. Details were observed on slightly to strongly squeezed individuals using the oil immersion objective (×100; eyepiece, ×10) and bright field technique. The drawings of the impregnated specimens were made with a drawing attachment.

The terminology is according to KAHL (1932), BORROR (1972), and CORLISS and LOM (1985). The right dorsal kinety in dorsal view is always designated as dorsal kinety 1.

1 slide of holotype specimens and 1 slide of paratype specimens of the new species and one slide of each other species described have been deposited in the collection of microscopical slides of the Upper Austrian Museum in Linz.

3. Description of the species

Pseudouroleptus procerus nov. spec. (Figs. 1—6, Table 2)

Diagnosis: *In vivo* about 170—250×30—40 μm (n = 4), vermicular, 2 unshortened dorsal kineties and 1 extremely reduced (1 basal body pair) dorsal kinety. 33 adoral membranelles, 47 left and 48 right marginal cirri on the average.

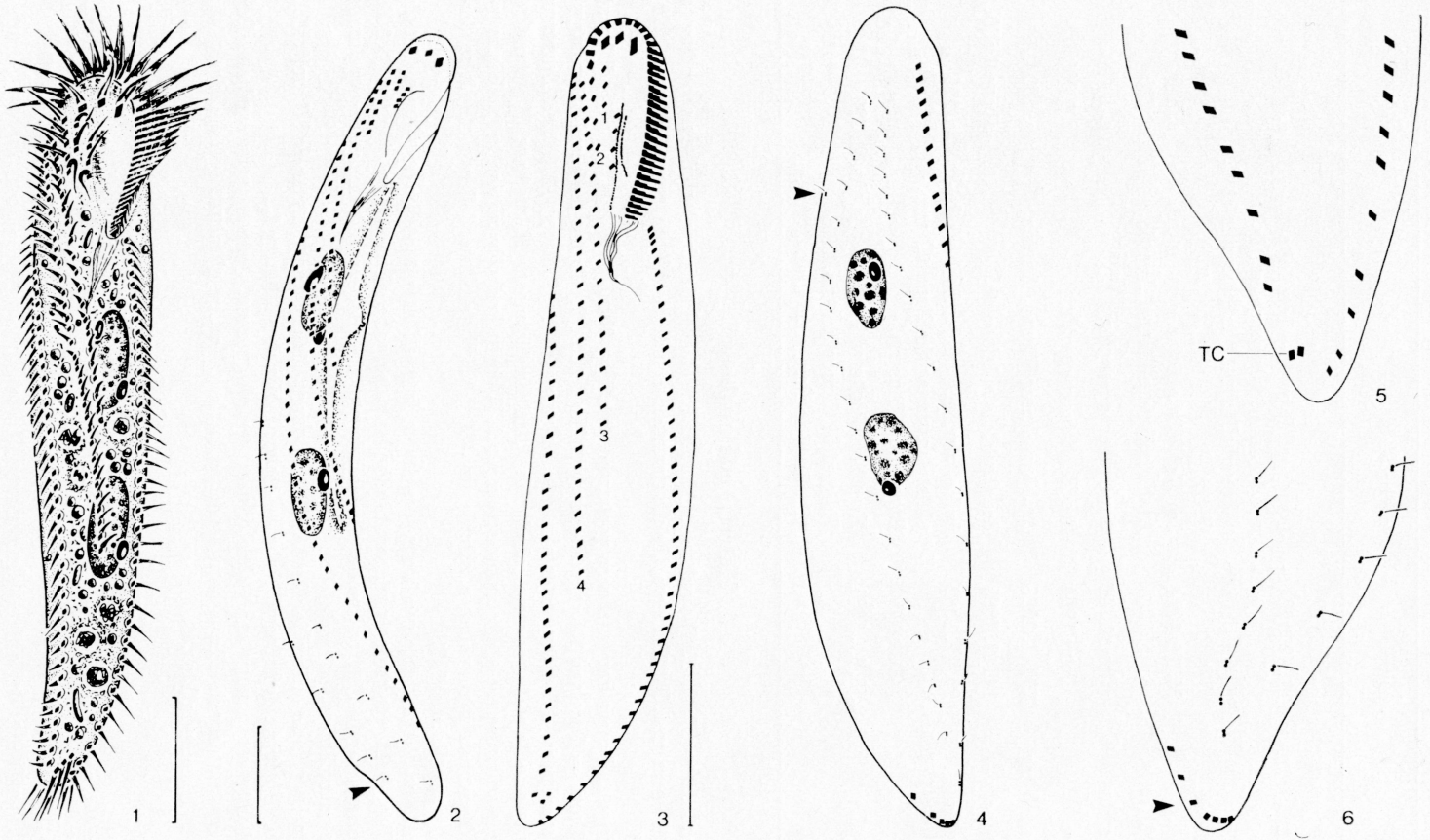


Fig. 1—6. *Pseudouroleptus procerus* from life (Figs. 1, 2) and after protargol impregnation (Fig. 3—6). Population 1 (Fig. 1). Population 2 (Fig. 2). Population 3 (Figs. 3—6). 1: Ventral view. 2: Ventral view of a twisted specimen. Arrow head, notch on the right posterior margin. 3, 4: Infraciliature in ventral and dorsal view. Arrow head, dorsal kinety 1. 5, 6: Infraciliature of the posterior ventral and dorsal surface. Arrow head, caudal cirri. Scale marks = 30 μm. TC, transverse cirri; 1, 2, 3, 4, ventral rows 1—4.

Type location: Moderately frequent in the upper soil layer (0—5 cm) of a meadow near Salzburg, Austria.

Description: Body margins parallel or slightly converging posteriad, very flexible (especially under the cover glass), slightly to distinctly twisted, inconspicuously flattened dorso-ventrally. Both ends rounded, sometimes a small notch on the right margin immediately above the posterior end (Figs. 1, 2). Macronuclear segments *in vivo* c. 21—28×10—14 μm (n = 3), lying slightly left of the median. Contractile vacuole on the left-hand border, distinctly above the middle of the cell, during diastole with channels. Pellicle without subpellicular granules. Cytoplasm colourless, filled with some fatty shining 0.5—2 μm large inclusions, numerous 1—2 μm large, colourless globules, and many colourless cloddy particles, about 1—8 μm in diameter. Feeds on phytoflagellates (*Euglena* sp.), zooflagellates, naked amebas, and ciliates (*Colpoda* sp.).

Adoral zone of membranelles about $^1/_4$ of body length, bases of the largest membranelles *in vivo* c. 5—8 μm wide (n = 3). Buccal area considerably deepened, undulating membranes *in vivo* distinctly bent, pharyngeal fibers conspicuous (Figs. 1—3). Frontal cirri *in vivo* about 12 μm long, left frontal cirrus usually slightly larger than the middle and right one. 4 ventral cirral rows, which begin at the level of the distal end of the adoral zone of membranelles, become longer from left to right (Fig. 3, Table 2). Pellicle along the ventral and marginal rows distinctly crenelated. Ventral and marginal cirri *in vivo* c. 8—10 μm long. Right marginal row extends onto the dorso-lateral surface anteriorly. Between the posterior ends of the marginal rows a small group of cirri (transverse cirri?), *in vivo* about 15 μm long. 1 short cirral row (caudal cirri?) at the posterior dorsal surface. Dorsal cilia about 3 μm long, dorsal kinety 1 usually consists only of 1 basal body pair (Figs. 4—6).

Discussion: *Pseudouroleptus procerus* differs from *P. caudatus* and *P. humicola* mainly in the infraciliature of the ventral and dorsal surface and the number of macronuclear segments respectively (Gellért 1956; Hemberger 1985). It differs from the very similar *P. terrestris* Hemberger, 1985 in the number of dorsal kineties and marginal cirri and the ratio of body width : body length (*P. procerus*, 1 : 4—6; *P. terrestris*, 1 : 3). However, a reliable comparison of the shape is impossible because Hemberger (1985) figured only a single protargol impregnated specimen, which looks distinctly different from our Figures 1 and 3. In fact, if we would have identified our population with Hemberger's species, in future a correct determination would be very arbitrarily because of its great variability.

Paraurostyla buitkampi Foissner, 1982 has the same type of infraciliature. Hence, it is transferred to this genus: *Pseudouroleptus buitkampi* (Foissner, 1982) nov. comb. It differs from the other members of the genus in the wide body shape, 4 macronuclear segments, and a longitudinal posterior cirral row, designated as "transverse cirri" in Foissner (1982). Perhaps this row is homologous with the short cirral row on the posterior dorsal surface of *P. terrestris* and *P. procerus*. However, only morphogenetic studies can clarify the correct designation of these rows.

Kahliella bacilliformis (Gelei, 1954) Corliss, 1960 (Figs. 7—17, Table 3)

Redescription: Size *in vivo* about 115—170×25—40 μm (n = 4). Body cylindrical, flattened only in the oral region. Anterior end slightly tapering, posterior one rounded or truncated (Figs. 7, 8). Macronuclear segments usually 2, *in vivo* c. 20×9 μm, lying slightly left of the median. Sometimes one or both segments bisected. Nucleoli spherical, of very different size (Figs. 7, 8, 10, 12). Contractile vacuole on the left-hand

Table 2. Biometrical characterization of *Pseudouroleptus procerus*

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	139.0	140.0	12.2	3.536	8.8	120.0	165.0	12
Body, width	32.7	32.5	3.7	1.075	11.4	28.0	39.0	12
Adoral membranelles, No.	32.7	33.0	1.7	0.494	5.2	30.0	35.0	12
Adoral zone of membranelles, length	36.3	36.0	1.8	0.512	4.9	34.0	39.0	12
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	12
Posterior Ma, length	16.3	15.0	2.1	0.595	12.6	14.0	20.0	12
Posterior Ma, width	7.6	7.5	0.9	0.255	11.6	6.0	8.5	12
Ma, distance between	15.5	15.0	4.0	1.151	25.7	9.0	24.0	12
Micronulei, No.	2.0	2.0	0	0	0	2.0	2.0	12
Posterior micronucleus, length	3.0	3.0	0.3	0.077	8.8	2.5	3.5	12
Posterior micronucleus, width	2.3	2.3	0.3	0.086	13.1	2.0	2.8	12
Distance 1	15.5	15.0	1.7	0.500	11.2	14.0	20.0	12
Distance 2	24.3	24.5	2.3	0.664	9.5	21.0	27.0	12
Distance 3	67.6	67.5	8.3	2.388	12.2	56.0	84.0	12
Distance 4	90.2	88.0	12.0	3.470	13.3	72.0	115.0	12
Left marginal row, No. cirri	46.1	47.0	6.3	1.828	13.7	31.0	55.0	12
Right marginal row, No. cirri	47.7	48.0	4.3	1.251	9.1	40.0	55.0	12
Ventral row 1, No. cirri[2])	3.2	3.0	0.6	0.167	18.2	2.0	4.0	12
Ventral row 2, No. cirri[2])	5.5	5.5	0.8	0.230	14.5	4.0	7.0	12
Ventral row 3, No. cirri[2])	22.8	24.0	2.5	0.726	11.0	17.0	25.0	12
Ventral row 4, No. cirri[2])	33.3	34.0	4.4	1.275	13.3	21.0	29.0	12
Enlarged frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	12
Buccal cirri, No.	3.8	4.0	0.4	0.112	10.2	3.0	4.0	12
Transverse cirri, No.[3])	2.1	2.0	0.4	0.125	16.6	2.0	3.0	8
Caudal cirri, No.[3])	4.9	4.5	1.1	0.313	22.1	4.0	7.0	12
Dorsal kineties, No.	2.9	3.0	0.3	0.083	9.9	2.0	3.0	12

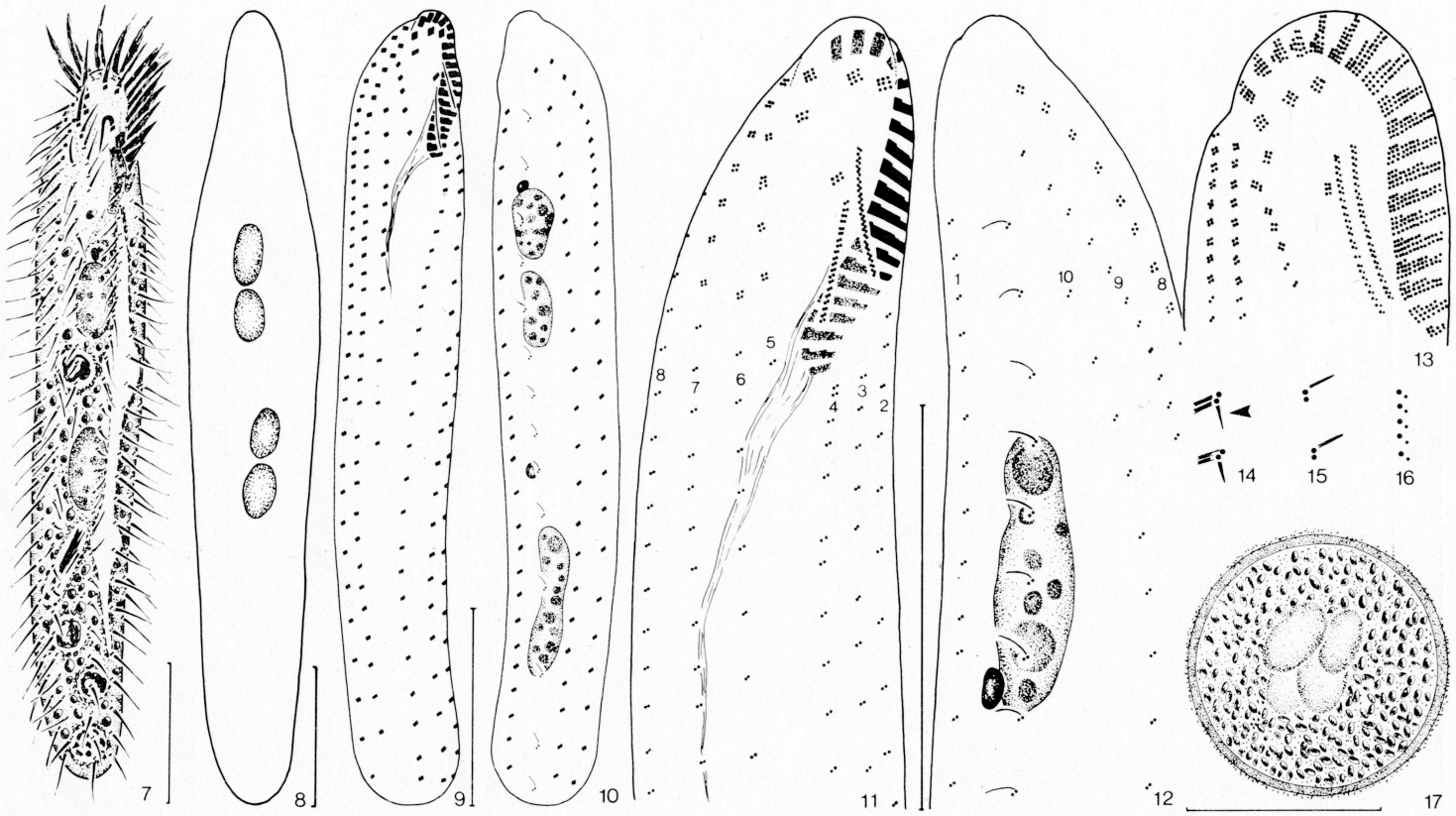
[1]) Legend: Distance 1, 2, 3, 4, distance between the anterior end of the cell and the posterior end of the ventral rows 1—4 (see Fig. 3); Ma, macronuclear segment.

[2]) For the designation of the ventral rows see Fig. 3.

[3]) See Figs. 5, 6.

border in the middle of the cell, during diastole with channels. Systole occurs about every 60 s. Pellicle colourless, without subpellicular granules. Cytoplasm densely filled with c. 2 μm large, spherical or elliptical, colourless granules, 2—5 μm large globules, and many food vacuoles containing short and long bacteria, phytoflagellates (*Polytoma* sp.), and wheat-starch from the culture medium. Hence, *K. bacilliformis* appears dark at low magnification. Sometimes a large defecation vacuole at the posterior end of the cell. Movement rapid with rotation around the long axis of the body, resembling a holotrichous ciliate! Cysts spherical, wall smooth, vitreous, about 1.5 μm thick (Fig. 17). Less than 10% of the population encysted under culture conditions. Cyst formation lasts several days as shown by the moving cytoplasm.

Adoral zone of membranelles about $^1/_5$ of body length, formed like a question mark, its proximal third part and the buccal area are covered by the peristomial lip. Bases of the largest membranelles *in vivo* 5—6 μm wide. Cirri *in vivo* about 10 μm long. Undulating membranes straight or slightly bent, usually clearly separated, never overlapping, very probably formed by obliquely arranged basal body pairs. Left basal body



Figs. 7—17. *Kahliella bacilliformis* from life (Figs. 7, 8, 17), after protargol impregnation (Figs. 9 to 12), and after silver carbonat impregnation (Figs. 13 to 16). 7: Specimen with 2 macronuclear segments in ventral view. 8: Specimen with 4 macronuclear segments in lateral view. 9, 10: Infraciliature in ventral and dorsal view. 11, 12: Infraciliature of the anterior ventral and dorsal surface. 13: Infraciliature of the adoral zone of membranelles. 14—16: Part of a somatic cirral row (arrow head, argentophilic fiber), the dorsal kinety, and an undulating membrane. 17: Cyst. Scale marks = 30 μm. 1—10, cirral rows 1—10. The rows 1—4 are situated left, the rows 5—10 right of the median.

Table 3. Biometrical characterization of *Kahliella bacilliformis*

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	124.1	122.0	7.8	2.026	6.3	112.0	145.0	15
Body, width	19.3	19.0	2.0	0.513	10.3	17.0	25.0	15
Adoral membranelles, No.	20.3	20.0	0.9	0.228	4.4	18.0	21.0	15
Adoral zone of membranelles, length	23.7	24.0	1.8	0.475	7.8	21.0	27.0	15
Macronuclear segments, No.	2.7	2.0	0.9	0.232	33.7	2.0	4.0	15
Posterior Ma, lenght	20.0	21.0	6.0	1.540	29.8	11.0	34.0	15
Posterior Ma, width	5.8	6.0	0.7	0.175	11.7	4.0	7.0	15
Ma — pairs, distance between	21.9	22.0	4.3	1.120	19.8	13.0	28.0	15
Micronuclei, No.	2.0	2.0	0	0	0	2.0	2.0	15
Posterior micronucleus, length	2.9	3.0	0.2	0.549	7.4	2.3	3.0	15
Distance 1	22.4	22.0	3.7	0.945	16.3	15.0	29.0	15
Distance 2	15.4	15.0	1.4	0.349	8.8	13.0	18.0	15
Frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	15
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	15
Cirri behind the RFC, No.	1.0	1.0	0	0	0	1.0	1.0	15
CR left of the median, No.	4.1	4.0	0.3	0.067	6.3	4.0	5.0	15
CR right of the median, No.	6.0	6.0	0	0	0	6.0	6.0	15
Cirral row 1, No. cirri	26.1	26.0	3.5	0.907	13.5	20.0	34.0	15
Cirral row 2, No. cirri	23.7	24.0	2.6	0.674	11.0	18.0	28.0	15
Cirral row 3, No. cirri	22.0	22.0	3.3	0.840	14.8	16.0	27.0	15
Cirral row 4, No. cirri	24.3	25.0	2.6	0.679	10.3	20.0	28.0	15
Cirral row 5, No. cirri	4.9	5.0	0.8	0.215	17.1	3.0	6.0	15
Cirral row 6, No. cirri	13.7	14.0	2.1	0.549	15.6	10.0	17.0	15
Cirral row 7, No. cirri	33.1	33.0	4.0	1.032	12.1	25.0	38.0	15
Cirral row 8, No. cirri	35.9	36.0	3.2	0.813	8.8	31.0	41.0	15
Cirral row 9, No. cirri	30.0	30.0	3.2	0.834	10.8	25.0	38.0	15
Cirral row 10, No. cirri	21.3	22.0	2.6	0.679	12.4	18.0	25.0	15
Dorsal kineties, No.	1.0	1.0	0	0	0	1.0	1.0	15
Dorsal kinety, No. basal body pairs	16.9	17.0	2.3	0.597	13.7	14.0	24.0	15
Cyst, diameter[2])	39.2	40.0	2.6	0.543	6.6	34.0	44.0	23

[1]) Legend: CR, cirral rows. For the designation see Figs. 11, 12; Distance 1, 2, distance between the anterior end of the cell and the posterior end of the cirral row 5 and 6 respectively; RFC, right frontal cirrus; Ma, macronuclear segment.

[2]) From life.

frequently less impregnated than the right one (Figs. 9, 11, 13, 16). 3 frontal cirri, each formed by 9 cilia. The buccal cirrus, the cirrus behind the right frontal cirrus, and the cirri 1 and/or 2 of row 5 consist of 6 cilia. The remaining anterior cirri of rows 5—8 are made of 4 cilia. All other cirri are formed only by 2, *in vivo* 10—15 μm long cilia. Row 5 terminates at the level of the cytostome, row 6 shortened anteriorly and posteriorly. Cirral rows 1, 9, and 10 on the dorsal half of the cell. From the posterior basal body a c. 2 μm long argentophilic fiber originates (Figs. 11, 14). Cilia of the dorsal kinety *in vivo* c. 3 μm long (Figs. 9—15).

Discussion: The morphology of our population agrees very well with the original description, especially in possessing only 1 dorsal kinety. Gelei (1954) describes "2 large double-nuclei (4 macronuclei) and 2 micronuclei", whereas our population is dominated by specimens with 2 macro-

Table 4. Biometrical characterization of *Kahliella simplex*

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	114.6	108.0	13.5	3.109	11.8	92.0	140.0	19
Body, width	44.2	43.0	4.4	1.018	10.1	36.0	52.0	19
Adoral membranelles, No.	36.8	36.0	2.7	0.622	7.4	33.0	44.0	19
Adoral zone of membranelles, length	41.6	42.0	4.1	0.943	9.9	36.0	53.0	19
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	19
Posterior Ma, length	18.3	18.0	2.3	0.523	12.5	15.0	22.0	19
Posterior Ma, width	8.1	8.0	1.6	0.358	19.2	7.0	14.0	19
Ma, distance between	16.6	17.0	4.1	0.928	24.4	7.0	22.0	19
Micronuclei, No.	1.5	1.0	0.5	0.118	34.8	1.0	2.0	19
Micronucleus, diameter	3.4	3.5	0.3	0.073	9.5	3.0	4.0	19
Distance 1	30.4	29.0	4.5	1.027	14.7	22.0	39.0	19
Frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	19
Cirral rows, No.[2,3])	11.0	11.0	0	0	0	11.0	11.0	19
Frontal row I, No. cirri[2,4])	2.2	2.0	0.4	0.096	18.9	2.0	3.0	19
Frontal row II, No. cirri[2,4])	4.1	4.0	0.4	0.093	9.9	3.0	5.0	19
Cirral row 1, No. cirri[2])	10.9	11.0	1.4	0.310	12.3	8.0	13.0	19
Cirral row 2, No. cirri	5.5	6.0	2.6	0.609	48.0	2.0	13.0	19
Cirral row 3, No. cirri	9.1	9.0	3.5	0.800	38.5	4.0	18.0	19
Cirral row 4, No. cirri	20.6	21.0	2.6	0.604	12.8	16.0	26.0	19
Cirral row 5, No. cirri	14.7	15.0	2.1	0.490	14.5	11.0	18.0	19
Cirral row 6, No. cirri	17.2	17.0	2.0	0.467	11.9	13.0	21.0	19
Cirral row 7, No. cirri	31.4	32.0	3.8	0.876	12.2	24.0	39.0	19
Cirral row 8, No. cirri	15.6	15.0	4.8	1.106	30.8	10.0	30.0	19
Cirral row 9, No. cirri	7.6	7.0	2.8	0.641	36.9	3.0	14.0	19
Cirral row 10, No. cirri	4.8	5.0	2.1	0.473	42.6	2.0	8.0	19
Cirral row 11, No. cirri	24.9	26.0	2.7	0.623	10.9	19.0	30.0	19
Dorsal kineties, No.[5])	3.0	3.0	0	0	0	3.0	3.0	19
Basal body pairs in front of cirral row 1, No.	8.2	8.0	1.4	0.311	16.5	6.0	11.0	19

[1]) Legend: Distance 1, distance between the anterior end of the cell and the anterior end of the cirral row 6; Ma, macronuclear segment(s).

[2]) For the designation of the cirral rows see Figs. 23, 24.

[3]) The frontal rows I and II and very short fragments on the ventral and dorsal surface are not considered.

[4]) The frontal cirri are not considered.

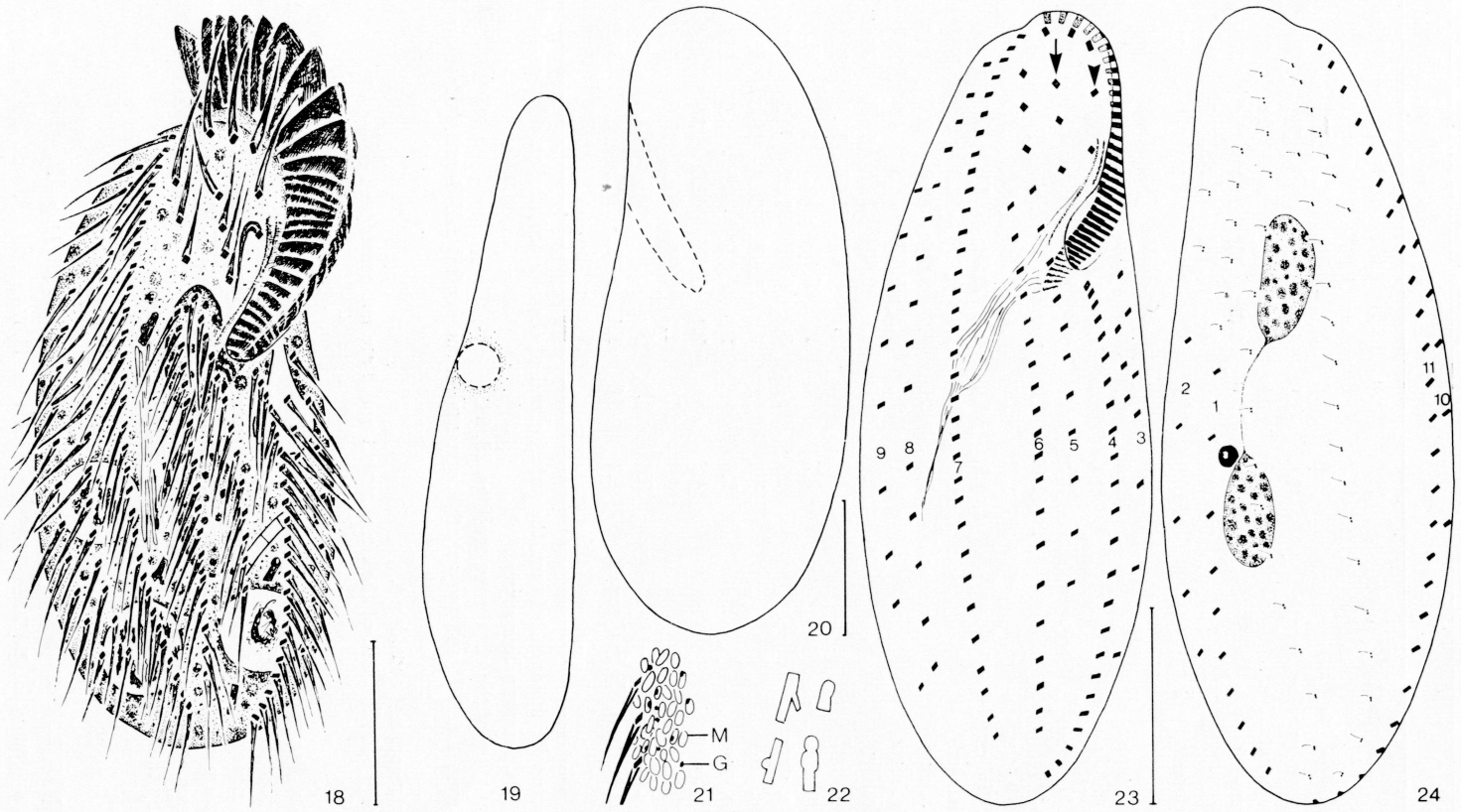
[5]) The basal body pairs in front of the cirral rows 1 and 2 are not considered.

nuclear segments. Fleury and Fryd-Versavel (1984) observed only 2 very variable macronuclear segments. However, the French population is probably not conspecific with the type material an. our population, since it has 3 dorsal kineties and larger somatic cirri which consist of 4 basal bodies

In spite of the variability in the number of macronuclear segments, *K. bacilliformis* can be easily distinguished from other members of the genus (Horváth 1932, 1934; Kahl 1932; Dragesco 1970; Borror 1972) by the vermicular body, the fine somatic cirri, and the single dorsal kinety.

Kahliella simplex (Horváth, 1934) Corliss, 1960 (Figs. 18—24, Table 4)

Redescription: Size *in vivo* about 110—160×50—70 μm (n = 3). Body elliptical but sometimes also with parallel margins, both ends rounded. About 2:1 flattened dorso-ventrally (Figs. 18—20). Macronuclear segments connected by a thin thread,



Figs. 18—24. *Kahliella simplex* from life (Figs. 18—22) and after protargol impregnation (Figs. 23, 24). 18—20: Ventral, lateral, and dorsal view. 21: Part of the pellicle. Close beneath inconspicuous subpellicular granules (G) and ellipsoid structures (mitochondria?; M). 22: Cytoplasmatic crystals. 23, 24: Infraciliature in ventral and dorsal view. Arrow head, frontal row I. Arrow, frontal row II. Scale marks = 30 μm. 1—11, cirral rows 1—11.

lying along the median or slightly left of it. Contractile vacuole on the left-hand border in the middle of the cell, during diastole sometimes with an anterior channel. Subpellicular granules small (< 1 μm), colourless, arranged in loosely organized rows, sometimes difficult to discern and easily confused with the numberless subpellicular mitochondria (1—3 μm) which give this species its conspicuous brownish colour (Fig. 21). Cytoplasm strongly viscid, with numerous yellow shining 2—5 μm large crystals in the posterior part of the cell and voluminous food vacuoles containing bacteria, fungi, and phytoflagellates (*Polytoma* sp.). Movement moderately rapid, usually creeping, sometimes swimming freely with rotation around the long axis of the cell. Cysts have a conspicuous mucous layer and are described in detail by FOISSNER and FOISSNER (1987).

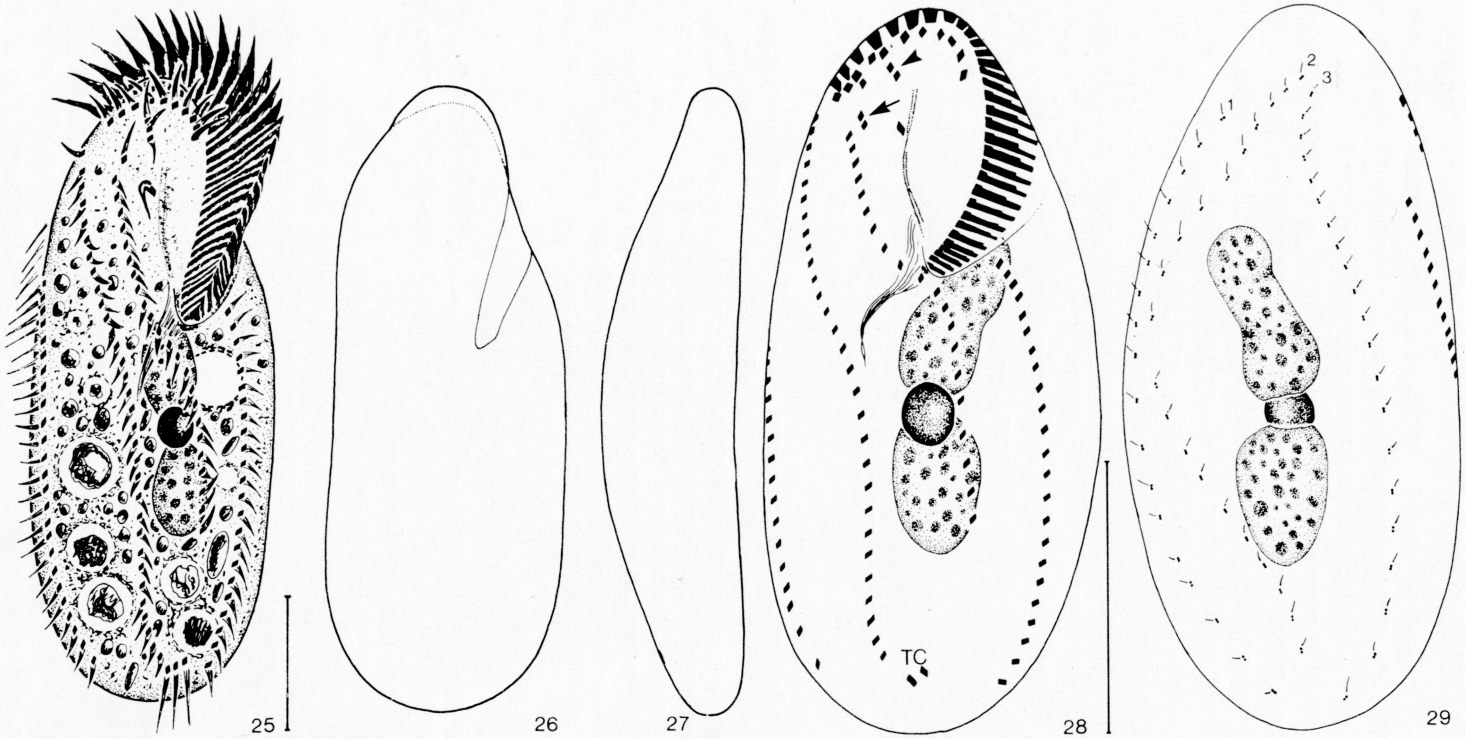
Adoral zone of membranelles c. $^1/_3$ of body length, formed as in *Gonostomum*. Buccal area and the short undulating membranes covered by the peristomial lip. Cirri thin, uniformly about 20 μm long. Cirri in the frontal area only slightly enlarged. Cirral row 6 distinctly shortened anteriorly, row 7 unshortened. Distance between the cirri narrower in rows 4, 6, 7, 11 than in the rows 1—3, 5, and 8—10. Rows 1, 2, 10, 11 situated on the dorso-lateral surface (Figs. 23, 24). Frequently short supernumerous rows occur at different sites. Dorsal cilia *in vivo* c. 3 μm long. Dorsal kinety 3 terminates at the level of the cytostome. Anterior half of cirral row 1 formed by basal body pairs, frequently 1 or 2 basal body pairs in front of the cirral row 2. Dorsal kineties 1, 2, and 3 without caudal cirri (Fig. 24).

Discussion: The body shape, the arrangement of the cirri, and the morphology of the nuclear apparatus seem to be very uniformly within the genus *Kahliella* (exception: *K. bacilliformis*). Thus, the infraciliature can only be used successfully for species discrimination after the biometrical characterization of some populations. Unfortunately, such data are not available (TUFFRAU 1969; DRAGESCO 1970). At present, the number of dorsal kineties is perhaps the best way of separating species. In this respect our population completely matches those of HORVÁTH (1934) and population B of FLEURY and FRYD-VERSAVEL (1982). In contrast, *K. acrobates* is characterized by 4 unshortened kineties and some basal body pairs in front of the left most cirral row (HORVÁTH 1932).

Keronopsis wetzeli WENZEL, 1953 (Figs. 25—29, Table 5)

Redescription: Size *in vivo* c. 140×70 μm (n = 1). Body elliptical, anteriorly conspicuously narrowed, both ends rounded. About 2:1 flattened dorso-ventrally, ventral nearly plain, dorsal convex. Macronuclear segments *in vivo* 18×8 μm (n = 1) with small spherical nucleoli, lying along the median or slightly left of it. 1 large micronucleus constantly located between the macronuclear segments. Contractile vacuole nearly at the level of the cytostome, conspicuously displaced inwards (Figs. 25—27). Pellicle flexible without subpellicular granules. Cytoplasm with numerous spherical, colourless, 1—7 μm large inclusions, many cloddy particles, about 10 μm in diameter, probably digested ciliates (*Colpoda* sp.). Food vacuoles about 12 μm in diameter containing ciliates and green algae.

Adoral zone of membranelles about $^1/_3$ of body length, bases of the largest membranelles *in vivo* c. 7 μm wide, cilia *in vivo* about 15 μm long. Coronal cirri *in vivo* c. 20 μm long, parallel with the distal half of the adoral zone of membranelles. 2 very short frontal rows closely behind the coronal cirri. Undulating membranes nearly parallel, straight to slightly bent (Fig. 28). Both ventral rows sigmoidal. Left row begins



Figs. 25—29. *Keronopsis wetzeli* from life (Figs. 25—27) and after protargol impregnation (Figs. 28, 29). 25, 26: Ventral view. 27: Lateral view. 28, 29: Infraciliature in ventral and dorsal view. Arrow head, left frontal row. Arrow, right frontal row. Scale marks = 30 μm. TC, transverse cirri; 1, 2, 3, dorsal kineties.

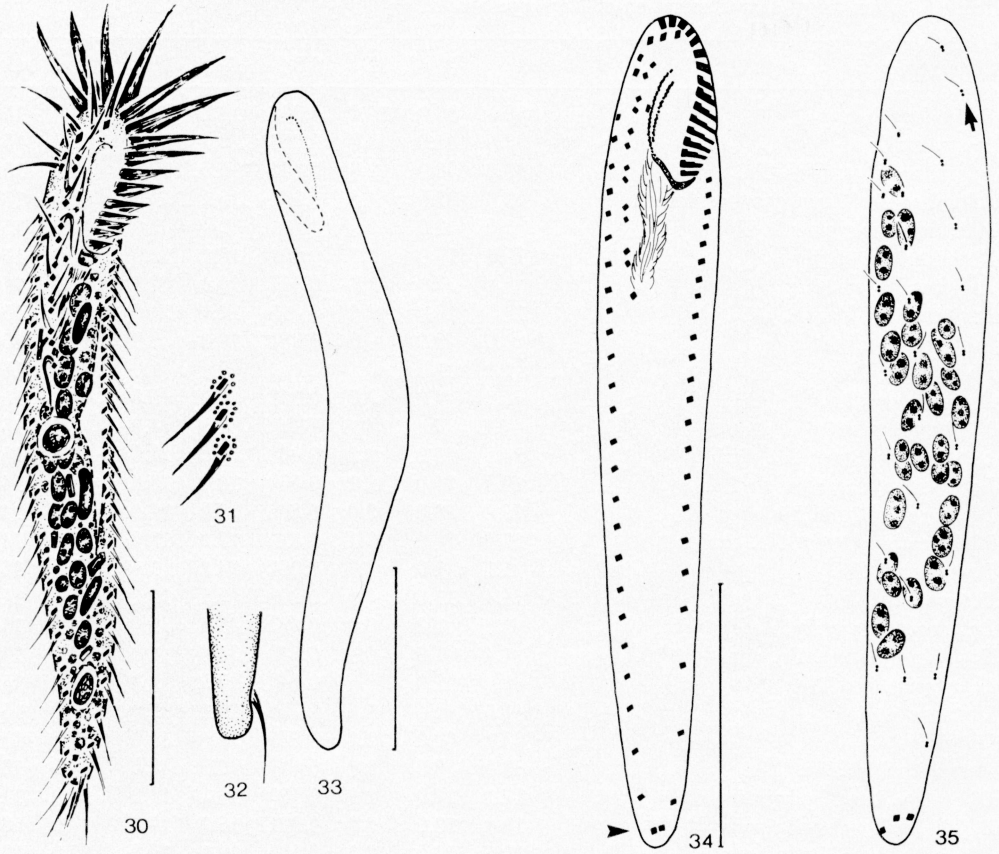
Table 5. Biometrical characterization of *Keronopsis wetzeli*

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	89.5	86.0	16.7	4.306	18.6	69.0	114.0	15
Body, width	39.0	41.0	4.9	1.254	12.4	30.0	45.0	15
Adoral membranelles, No.	29.6	30.0	1.9	0.496	6.5	27.0	34.0	15
Adoral zone of membranelles, length	30.6	31.0	4.6	1.190	15.1	22.0	39.0	15
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	15
Anterior Ma, length	15.6	16.0	2.7	0.691	17.1	12.0	20.0	15
Anterior Ma, width	8.8	9.0	1.3	0.327	14.4	7.0	11.0	15
Posterior Ma, length	16.5	16.0	2.0	0.515	12.1	14.0	22.0	15
Posterior Ma, width	9.0	9.0	0.9	0.231	10.0	8.0	10.0	15
Micronuclei, No.	1.0	1.0	0	0	0	1.0	1.0	15
Micronucleus, length	6.7	6.0	0.5	0.128	7.9	5.5	7.0	15
Micronucleus, width	5.2	5.0	0.8	0.205	15.4	4.0	7.0	15
Left marginal row, No. cirri	24.5	25.0	2.2	0.568	9.0	21.0	29.0	15
Left ventral row, No. cirri	20.9	21.0	2.1	0.569	10.2	18.0	25.0	14
Right ventral row, No. cirri	27.8	28.0	3.0	0.806	10.9	22.0	34.0	14
Right marginal row, No. cirri	25.6	26.0	3.1	0.817	11.9	19.0	32.0	14
Buccal cirri, No.	1.1	1.0	0.3	0.067	24.2	1.0	2.0	15
Coronal cirri, No.	11.4	11.0	0.9	0.279	8.1	10.0	13.0	11
Left frontal row, No. cirri	1.8	2.0	0.8	0.222	43.4	1.0	4.0	13
Right frontal row, No. cirri	1.4	1.0	0.5	0.140	36.6	1.0	2.0	13
Transverse cirri, No.	2.0	2.0	0.5	0.148	27.7	1.0	3.0	14
Distance 1	41.6	42.0	6.7	1.726	16.1	32.0	51.0	15
Distance 2	62.1	60.0	12.1	3.937	19.5	48.0	83.0	15
Dorsal kineties, No.	3.0	3.0	0	0	0	3.0	3.0	13
DK 1, No. basal body pairs	17.1	17.0	2.6	0.780	15.1	13.0	23.0	11
DK 2, No. basal body pairs	19.8	19.0	2.6	0.901	12.9	17.0	24.0	8
DK 3, No. basal body pairs	20.5	20.0	2.5	0.685	12.1	15.0	25.0	13

[1]) Legend: Distance 1, 2, distance between the anterior end of the cell and the anterior end of the micronucleus and the posterior end of the left ventral row respectively; DK, dorsal kinety; Ma, macronuclear segment.

at the level of the buccal cirrus, usually terminates more anteriorly than the right one, which begins almost at the distal end of the adoral zone of membranelles. To the left of the posterior end of the right ventral row a very short, rather oblique cirral row (transverse cirri?), with about 20 μm long cirri, projecting distinctly beyond the posterior border. Marginal cirri *in vivo* c. 14 μm long, rows widely open posteriorly, right row extends onto the dorso-lateral surface anteriorly. Dorsal cilia *in vivo* about 4 μm long. Dorsal kinety 1 slightly shortened anteriorly. Central part of kinety 2 distinctly bent (Fig. 29).

Discussion: In the genus *Keronopsis* Penard, 1922 and its synonym *Paraholosticha* Kahl, 1932 (see Hemberger and Wilbert 1982) several monomicronucleate species have been described (Kahl 1932; Wenzel 1953; Gellért and Tamas 1959; Groliere 1975). We identified our population as *K. wetzeli* according to the drawings of Wenzel (1953) and Groliere (1975). However, the identification is not completely sure, because Wenzel (1953) unfortunately described this species with 2 micronuclei although the drawing shows unequivocally a single large micronucleus between the macronuclear segments. There are also some minor differences in the cirral pattern, but



Figs. 30—35. *Paruroleptus notabilis* from life (Figs. 30—33) and after protargol impregnation (Figs. 34, 35). 30: Ventral view. 31: Subpellicular granules around the bases of the cirri. 32: Posterior end in lateral view. 33: Dorsal view. 34, 35: Infraciliature in ventral and dorsal view. Arrow head, transverse cirri. Arrow, dorsal kinety 4 (see text). Scale marks = 30 μm.

these can be easily explained by the variability and misobservation, because WENZEL (1953) did not have the advantage of silver impregnated material.

Paruroleptus notabilis FOISSNER, 1982 (Figs. 30—35, Table 6)

Discussion and redescription: This population differs distinctly from the type material in body length, number of adoral membranelles, right and left marginal cirri, and macronuclear segments. In spite of this, it may be considered as conspecific because of strong similarities in body shape, ventral cirral pattern, subpellicular granulation, and cytopharyngeal structure. Further investigations on the variability must prove whether our decision is correct or whether the German population should be separated at the species level. Hence, we give a complete redescription.

Size *in vivo* about 80—110×15—25 μm (n = 4). Body vermicular, very flexible, tapered posteriorly, only slightly flattened dorso-ventrally. Macronuclear segments *in vivo* c. 5×3 μm. 2 or 3 (n = 2) kidney-shaped micronuclei, *in vivo* about 7×2 μm.

Table 6. Biometrical characterization of *Paruroleptus notabilis*

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	93.6	94.0	11.2	3.369	11.9	74.0	110.0	11
Body, width	16.5	15.0	3.9	1.163	23.3	13.0	25.0	11
Adoral membranelles, No.	16.7	17.0	0.7	0.195	3.9	16.0	18.0	11
Adoral zone of membranelles, length	21.2	21.0	2.3	0.698	10.9	18.0	27.0	11
Macronuclear segments, No.	30.6	31.0	3.1	0.938	10.2	25.0	35.0	11
Posterior Ma, length	4.9	5.0	1.0	0.313	20.4	3.0	6.0	10
Posterior Ma, width	2.7	2.9	0.4	0.127	14.6	2.0	3.0	10
Distance 1	32.5	32.0	4.3	1.303	13.3	25.0	39.0	11
Enlarged frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	11
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	11
Frontoterminal cirri, No.	2.0	2.0	0	0	0	2.0	2.0	11
Midventral cirri, No.	12.5	13.0	1.9	0.562	14.8	9.0	15.0	11
Left marginal row, No. cirri	24.0	24.0	1.3	0.381	5.3	22.0	27.0	11
Right marginal row, No. cirri	22.5	23.0	2.2	0.652	9.6	18.0	25.0	11
Transverse cirri, No.	1.7	2.0	0.7	0.195	37.4	0	2.0	11
Caudal cirri, No.	2.3	2.0	0.7	0.195	28.5	1.0	3.0	11
Dorsal kineties, No.[2])	4.0	4.0	0	0	0	4.0	4.0	11

[1]) Legend: Distance 1, distance between the anterior end of the cell and the posterior end of the midventral row; Ma, macronuclear segment.

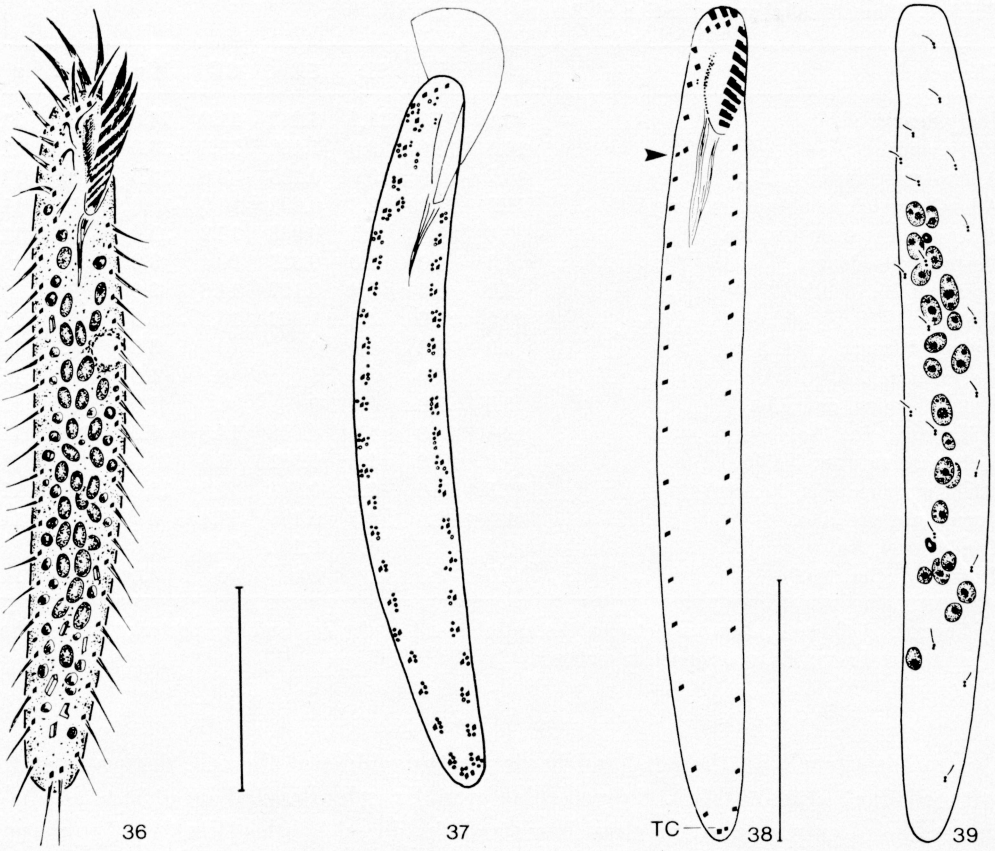
[2]) See text.

Contractile vacuole on the left-hand border in the middle of the cell, during diastole with channels (Figs. 30, 33). Subpellicular granules colourless, about 0.5 µm in diameter, found only around the cirral bases and the dorsal bristles (Fig. 31). Cytoplasm colourless, with a few yellowish crystals and small plates of mice and some food vacuoles containing flagellates and fungal spores. The posterior part is filled with many 1—3 µm large yellowish globules, making the specimens dark at low magnification. Movement winding and fast sliding.

Adoral zone of membranelles $^1/_4$—$^1/_5$ of body length, cilia of distal membranelles about 15 µm long. Buccal area deep, anteriorly distinctly bent to the left, but undulating membranes nearly straight. Pharyngeal fibers conspicuous *in vivo* and after protargol impregnation (Figs. 30, 34). Frontal cirri slightly enlarged, buccal cirrus situated about in the middle of the length of the undulating membranes. Midventral row about $^1/_3$ of body length, begins at the level of the frontoterminal cirri. Marginal cirri consist of 4 *in vivo* c. 10 µm long cilia. Going backward the distances among the cirri become distinctly wider. Transverse cirri *in vivo* about 12 µm long, distinctly projecting beyond the posterior border. The short dorsal kinety 4 is very probably the continuation of the right marginal row, as in other holostichids (see FOISSNER 1982, 1984) (Figs. 32, 34, 35).

Hemisincirra inquieta HEMBERGER, 1985 (Figs. 36—39, Table 7)

Redescription: Size *in vivo* about 80—100×14—15 µm (n = 2). Body very fragile, elongated, cylindrical, margins parallel or slightly converging anteriad and posteriad, both ends rounded. Body shape very stable within the population. Macro-



Figs. 36—39. *Hemisincirra inquieta* from life (Figs. 36, 37) and after protargol impregnation (Figs. 38, 39). 36, 37: Ventral view. Figure 37 shows the subpellicular granules. 38, 39: Infraciliature in ventral and dorsal view. Arrow head, anterior end of the right marginal row. Scale marks = 30 μm. TC, transverse cirri.

nuclear segments spherical to ellipsoid, *in vivo* about $4 \times 2\,\mu$m, lying in the 2nd and 3rd quarter of the body (Figs. 36, 37). Contractile vacuole slightly above the middle of the cell. Pellicle and cytoplasm colourless. Close beneath the pellicle groups of 3—6 bright yellow, small (less than 1 μm) granules around the bases of the cirri and the dorsal bristles (Fig. 37). Hence, the animals have a brownish colour at low maginification. Middle part of the cell filled with 1—4 μm large, colourless globules. In the posterior part some yellowish crystals. No food vacuoles recognizable.

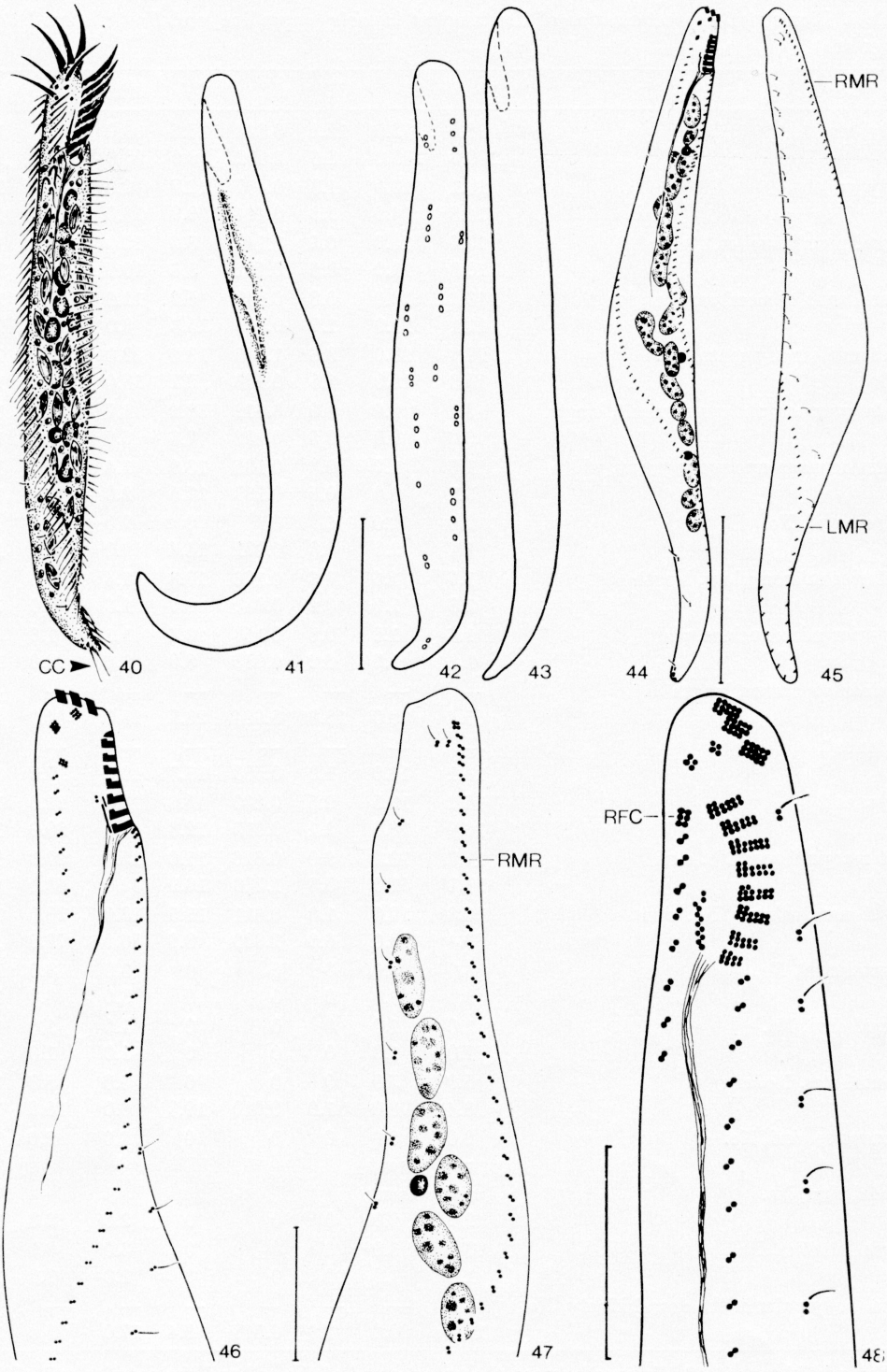
Adoral zone of membranelles about $^1/_6$ of body length, the 3 distal membranelles distinctly separated from the others. Buccal area slightly deepened, undulating membranes moderately bent. Pharyngeal fibers pronounced *in vivo* and after protargol impregnation. Frontal cirri arranged in a rather oblique row. Buccal cirrus near the anterior end of the undulating membranes, inconspicuous, consists of only 2 cilia. Frontal row short, 2nd anteriormost cirrus slightly shifted to the left. 2 basal body pairs immediately left of the anterior part of this row (Fig. 38). Cirri of the frontal and

Table 7. Biometrical characterization of *Hemisincirra inquieta* (upper line) and *Hemisincirra livida* (lower line)

Character[1])	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	78.0	75.0	12.1	3.824	15.5	63.0	100.0	10
	106.9	105.0	8.6	2.592	8.0	98.0	122.0	11
Body, width	10.1	10.5	1.3	0.407	12.7	7.0	11.0	10
	14.8	14.0	1.5	0.444	9.9	13.0	7.0	11
Adoral membranelles, No.	13.0	13.0	0.5	0.149	3.6	12.0	14.0	10
	10.8	11.0	0.6	0.182	5.6	10.0	12.0	11
Adoral zone of membranelles, length	13.2	13.0	0.8	0.249	5.9	12.0	15.0	10
	11.1	11.0	1.7	0.513	15.3	8.0	14.0	11
Macronuclear segments, No.	27.7	29.0	3.6	1.155	13.2	22.0	32.0	10
	15.9	16.0	1.5	0.436	9.1	13.0	18.0	11
Posterior macronucleus segment, length	3.1	2.7	1.0	0.312	32.2	1.7	4.2	10
	6.6	7.0	0.5	0.152	7.6	6.0	7.0	11
Posterior macronucleus segment, width	1.8	1.7	0.3	0.105	18.3	1.4	2.5	10
	3.1	3.0	0.5	0.163	17.5	2.0	4.0	11
Micronuclei, No.	2.0	2.0	0	0	0	2.0	2.0	3
	2.1	2.0	0.3	0.091	14.4	2.0	3.0	11
Posterior micronucleus, length	1.7	1.6	0.3	0.176	18.3	1.4	2.0	3
	1.8	1.7	0.2	0.049	8.9	1.6	2.0	11
Posterior micronucleus, width	1.3	1.2	0.3	0.153	20.4	1.1	1.6	3
	1.8	1.7	0.2	0.049	8.9	1.6	2.0	11
Nuclear apparatus, length	—	—	—	—	—	—	—	0
	65.4	70.0	18.8	5.664	28.7	13.0	84.0	11
Distance 1	—	—	—	—	—	—	—	0
	14.1	14.0	1.9	0.563	13.3	10.0	17.0	11
Distance 2	16.2	16.5	2.5	0.800	15.6	13.0	21.0	10
	16.7	16.0	2.1	0.619	12.3	15.0	20.0	11
Left marginal row, No. cirri	17.7	18.0	2.0	0.616	11.0	15.0	22.0	10
	53.1	51.0	5.8	1.750	10.9	42.0	63.0	11
Right marginal row, No. cirri	16.8	17.0	1.9	0.611	11.5	13.0	20.0	10
	69.4	69.0	6.0	1.800	8.6	56.0	77.0	11
Frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	10
	3.0	3.0	0	0	0	3.0	3.0	11
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	10
	1.0	1.0	0	0	0	1.0	1.0	11
Frontal row, No. cirri	5.0[2])	5.0	0	0	0	5.0	5.0	10
	8.4	8.0	1.0	0.310	12.3	6.0	10.0	11
Transverse cirri, No.	2.0	2.0	0	0	0	2.0	2.0	10
	not present							
Caudal cirri, No.	not present							
	2.0	2.0	0	0	0	2.0	2.0	11
Dorsal kineties, No.	3.0	3.0	0	0	0	3.0	3.0	10
	1.0	1.0	0	0	0	1.0	1.0	11
Basal body pairs in the dorsal kinety, No.	—	—	—	—	—	—	—	0
	19.9	20.0	1.9	0.563	9.4	17.0	23.0	11

[1]) Legend: Distance 1, 2, distance between the anterior end of the cell and the anterior end of the nuclear apparatus (1) and the posterior end of the frontal row (2).

[2]) The 2 basal body pairs left to the anterior part of the frontal row are not included.



Figs. 40—48. *Hemisincirra livida* from life (Figs. 40—43) and after protargol impregnation (Figs. 44 to 48). 40—43: Different body shapes in ventral and dorsal view. Figure 42 shows the subpellicular

marginal row(s) *in vivo* about 10 μm long, made up of only 4 cilia. Right marginal row begins to the right of the posterior end of the frontal row. Transverse cirri inconspicuous, caudal cirri absent. Dorsal cilia about 3 μm long. Kinety 1 consits of 2 or 3 basal body pairs (Figs. 38, 39).

Discussion: *Hemisincirra inquieta* was also found in an alder stand at the Stubnerkogel, Gastein area, Salzburg ("Taxotop D" in FOISSNER and PEER 1985). The morphology of this alpine population concurs very well with that of the population of Ulm. HEMBERGER (1985) describes only the infraciliature of this species, which agrees compietely with our results. However, the type material — from which the type location is not given — has only 14—17 macronuclear segments. The drawing of *H. kahli* (BUITKAMP, 1977) is also very similar to our population of *H. inquieta*. Especially the number of macronuclear segments and the position of the contractile vacuole correspond better than with the type material of *H. inquieta*. However, the infraciliature is different. In *H. kahli* the right marginal row begins more anteriorly than in *H. inquieta* and there are no basal body pairs immediately left of the anterior part of the frontal row. Furthermore, HEMBERGER (1982) re-studied the type material of *H. kahli* and found it to be much more vermiculare (width : length about 1 : 15) than shown in the drawing of BUITKAMP (1977a). Considering these differences in the body shape and the infraciliature our population agrees more with the type material of *H. inquieta*. Unfortunately, no drawings of the *in vivo* aspects of the type material are available. Thus, a reliable comparison is difficult and further populations must be investigated to decide whether *H. kahli* and *H. inquieta* are real species or extremes of a polytypical species.

Hemisincirra livida nov. spec. (Figs. 40—48, Table 7)

Diagnosis: *In vivo* about 110—155 × 10—25 μm (n = 4), vermicular, often strongly twisted, blue-green to livid subpellicular granules and spindle-shaped food vacuoles. About 16 adoral membranelles. 1 dorsal kinety.

Type location: Moderately frequent in the litter and upper soil layer of a pasture between Nauplion and Tripolis, Peloponnesus, Greece.

Description: Body flexible but not contractile, margins converging anteriad and posteriad, sometimes nearly parallel. Anterior end rounded, posterior one tapered and usually bent to the left in ventral view. Anterior fifth very thin, remaining body not flattened, but constantly tapered posteriorly (Fig. 40—43). Macronuclear segments spherical, ellipsoid, or dumbbell-shaped, with medium sized nucleoli. Contractile vacuole on the left-hand border, distinctly above the middle of the cell, during diastole with 2 channels. Close beneath the pellicle short rows of about 1.5 μm large blue-green to livid granules, giving the whole animal a bluish shimmer at low magnification (Figs. 40—42, 44). Cytoplasm colourless, with numerous 1—3 μm large, colourless globules and many 7—9 × 2—4 μm large, spindle-shaped food vacuoles with a parallel arrangement of bacteria. Movement very slow, worm-like.

Adoral zone of membranelles about $^1/_{10}$ of body length, the 3 distal membranelles distinctly separated from the proximal, nearly perpendicular arranged part. Buccal area very small. Pharyngeal fibers terminate in the middle of the cell (Figs. 44—48). Frontal cirri and anteriormost cirrus of the right marginal row consist of 4 or 6 cilia,

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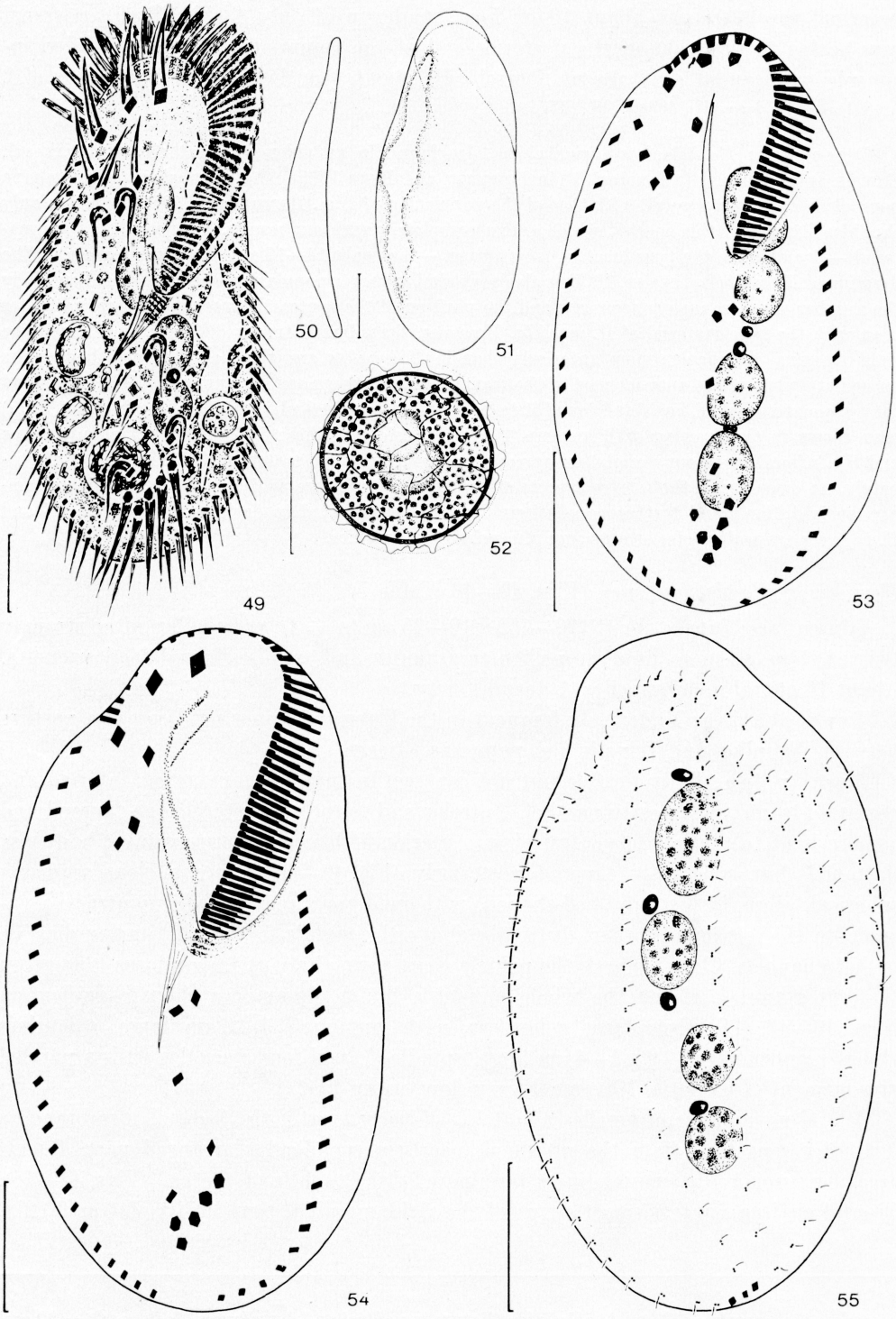
granules. Scale mark = 30 μm. 44, 45: Infraciliature in ventral and dorsal view. Scale mark = 30 μm. 46—48: Infraciliature of the anterior part in ventral and dorsal view. Scale marks = 10 μm. CC, caudal cirri; LMR, left marginal row; RMR, right marginal row; RFC, right frontal cirrus.



Figs. 49—55. *Histriculus cavicola* from life (Figs. 49—52) and after protargol impregnation (Figs. 53 to 55). Austrian population (Figs. 49—52, 54, 55). Japanese population (Fig. 53). 49—51: Ventral, lateral, and dorsal view. 52: Cyst. 53—55: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

all other cirri are made of 2 cilia only! Left frontal cirrus adjacent to the middle of the 3 separated membranelles; right cirrus posterior to the middle one and near the anterior end of the undulating membranes, which are too small to be studied in detail with the light microscope. Left marginal row begins close to the proximal adoral membranelle, the right one at the anterior end of the cell, both making nearly 1 turn to the posterior end of the cell (Figs. 44, 45). Dorsal cilia *in vivo* about 2—3 μm long. Dorsal kinety unshortened (Figs. 45, 47, 48).

Discussion: About 2 months after the discovery of the type material, a second population was found in arable soil near Vienna. This population had exactly the same diagnostic characters: worm-like, helically twisted body, blue-green subpellicular granules, spindle-shaped food vacuoles, and slow movement. These characters separate *H. livida* from other worm-shaped congeneric species like *H. interrupta*, *H. filiformis*, *H. vermiculare* (Foissner 1982; Hemberger 1985). It differs from *H. viridis*, which also possesses spindle-shaped food vacuoles and prominent green subpellicular granules, by its body shape, cirral pattern, and nuclear apparatus (Foissner 1982).

Histriculus cavicola (Kahl, 1935) nov. comb. (Figs. 49—55, Table 8)

The 2 populations studied are very similar. Thus they are not described separately. However, some biometrical differences are shown in Table 8.

Redescription: Size *in vivo* about 140—220×70—100 μm (n = 2). Body stiff, outline ovoid, both ends broadly rounded. About 2.5 : 1 flattened dorso-ventrally, anterior and posterior part very thin (Figs. 49—51). Dorsal furrow pronounced, even in overfeed specimens. Macronuclear segments *in vivo* c. 20×15 μm, lying along the median or slightly left of it. Anterior macronuclear segment usually slightly larger than the posterior segments (Figs. 53, 55, Table 8). Micronuclei *in vivo* about 4 μm in diameter. Contractile vacuole on the left-hand border roughly in the middle of the cell, during diastole with 2 large dilated channels. Pellicle and cytoplasm colourless, subpellicular granules absent. In the cytoplasm some 1—5 μm large, colourless globules and 1—6 μm large yellowish crystals. Food vacuoles with ciliates (*Tetrahymena* sp.) and cysts of naked amebas. Also cannibalistic! Movement rapid, usually sliding, sometimes rotating like a board around the long axis of the cell.

Adoral zone of membranelles about 44% (Austrian population; 40% in the Japanese population) of body length, bases of the largest membranelles *in vivo* about 11 μm wide. Buccal area large, undulating membranes bent. Frontal and ventral cirri *in vivo* about 25 μm long, genus-specifically arranged. Bases of the transverse cirri slightly enlarged, cirri *in vivo* c. 35 μm long, posterior 2 protrude beyond the posterior border. Marginal cirri *in vivo* about 20 μm long. Right marginal row begins almost at the level of the right frontal cirrus. Anteriormost cirrus of this row usually slightly detached and not involved in the primordium of the right marginal row of the proter (Figs. 53, 54). Space between the posterior ends of the marginal rows small, occupied by the 3, only slightly dorsal inserted caudal cirri, *in vivo* hardly distinguishable from the cirri of the marginal rows. Dorsal cilia *in vivo* c. 3 μm long. Kineties 3 and 4 slightly shortened anteriorly (Fig. 55).

Cysts with an irregular toothed surface, teeth about 2.5 μm high. Inner wall c. 1.4 μm thick. Cytoplasm densely filled with small globules (Fig. 52, Table 8).

Table 8. Biometrical characterization of *Histriculus cavicola*[1])

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length[2])	135.3***	133.0	25.2	5.503	18.6	88.0	186.0	21
	102.9	102.0	8.3	2.081	8.1	87.0	121.0	16
Body, width[2])	73.9***	72.0	18.4	4.023	24.9	42.0	112.0	21
	53.7	54.0	6.8	1.711	12.7	43.0	67.0	16
Adoral membranelles, No.[2])	48.1***	45.0	9.3	2.029	19.3	32.0	70.0	21
	33.3	33.0	1.5	0.373	4.5	30.0	36.0	16
Adoral zone of membranelles, length[2])	60.5***	56.0	15.2	3.324	25.2	39.0	96.0	21
	41.6	41.0	2.1	0.515	4.9	39.0	46.0	16
Macronuclear segments, No.	4.1	4.0	0.2	0.048	5.4	4.0	5.0	21
	4.0	4.0	0	0	0	4.0	4.0	16
1st macronuclear segment, length[3])	22.3	23.0	5.4	1.402	24.4	12.0	29.0	15
	14.5	14.0	1.1	0.274	7.5	13.0	17.0	16
1st macronuclear segment, width	16.0	16.0	4.2	1.078	26.1	9.0	23.0	15
	10.7	10.0	1.1	0.262	9.8	8.5	12.5	16
2nd macronuclear segment, length	17.4	19.0	5.0	1.290	28.7	10.0	25.0	15
	12.1	12.0	1.5	0.369	12.2	10.0	15.0	16
2nd macronuclear segment, width	14.3	14.0	3.6	0.943	25.6	9.0	20.0	15
	9.2	9.0	0.7	0.164	7.1	8.0	10.0	16
3rd macronuclear segment, length	18.1	18.0	5.6	1.439	30.8	10.0	28.0	15
	12.9	13.0	2.0	0.493	15.3	10.0	16.0	16
3rd macronuclear segment, width	13.6	14.0	2.8	0.721	20.5	9.0	19.0	15
	8.9	9.0	0.6	0.164	7.3	8.0	10.0	16
4th macronuclear segment, length	20.4	20.0	5.4	1.400	26.6	12.0	28.0	15
	12.1	12.0	1.5	0.364	12.0	10.0	14.0	16
4th macronuclear segment, width	13.2	13.0	2.7	0.707	20.7	8.5	18.0	15
	9.2	9.0	1.0	0.250	10.8	7.0	11.0	16
Macronuclear segment pairs,	7.1	7.0	3.6	0.782	50.1	3.0	17.0	21
distance between	5.8	5.0	3.1	0.776	53.4	2.0	13.0	16
Micronuclei, No.	3.4	3.0	0.7	0.163	21.8	2.0	5.0	21
	4.6	4.0	1.1	0.429	24.8	3.0	6.0	7
Posterior micronucleus, length	2.9	2.8	0.3	0.064	10.1	2.5	4.0	21
	2.0	2.0	0	0	0	2.0	2.0	16
Posterior micronucleus, width	2.7	2.7	0.2	0.032	5.4	2.5	3.0	21
	2.0	2.0	0	0	0	2.0	2.0	16
Left marginal row, No. cirri[2])	21.6 ns	21.0	2.6	0.567	12.1	18.0	28.0	21
	21.3	21.0	1.2	0.301	5.6	19.0	24.0	16
Right marginal row, No. cirri[2])	24.8*	25.0	1.9	0.418	7.7	22.0	29.0	21
	23.3	23.0	1.2	0.296	5.1	22.0	26.0	16
Enlarged frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	21
	3.0	3.0	0	0	0	3.0	3.0	16
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	21
	1.0	1.0	0	0	0	1.0	1.0	16
Ventral cirri, No.	4.0	4.0	0	0	0	4.0	4.0	21
	4.0	4.0	0	0	0	4.0	4.0	16
Postoral ventral cirri, No.[4])	5.0	5.0	0.2	0.048	4.3	5.0	6.0	21
	5.5	5.0	0.8	0.247	15.0	5.0	7.0	11

Table 8 (continued)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Transverse cirri, No.	5.0	5.0	0	0	0	5.0	5.0	21
	5.1	5.0	0.3	0.085	6.6	5.0	6.0	16
Caudal cirri, No.	3.4	3.0	0.6	0.129	17.4	3.0	5.0	21
	3.0	3.0	0	0	0	3.0	3.0	14
Dorsal kineties, No.	6.1	6.0	0.3	0.066	4.9	6.0	7.0	21
	6.0	6.0	0	0	0	6.0	6.0	11
Cyst, diameter[5])	55.3	56.0	4.4	0.884	8.0	48.0	62.0	25
	—	—	—	—	—	—	—	0

[1]) Upper line, Austrian population; lower line, Japanese population.
[2]) The populations were compared with the analysis of variance or the KRUSKAL-WALLIS test (SOKAL and ROHLF 1981). ns, $P > 0.05$; *, $0.05 \geqslant P > 0.01$; **, $0.01 \geqslant P > 0.001$; ***, $P \leqslant 0.001$. Two-tailed.
[3]) This is the anterior macronuclear segment.
[4]) The ventral cirri near the transverse cirri are included.
[5]) From life.

Discussion: The Austrian population is larger than the population from Japan, which has been under culture conditions for many years. But the very similar arrangement of the cirri and the peculiar enlargement of the anterior macronuclear segment justify the assumption of conspecifity.

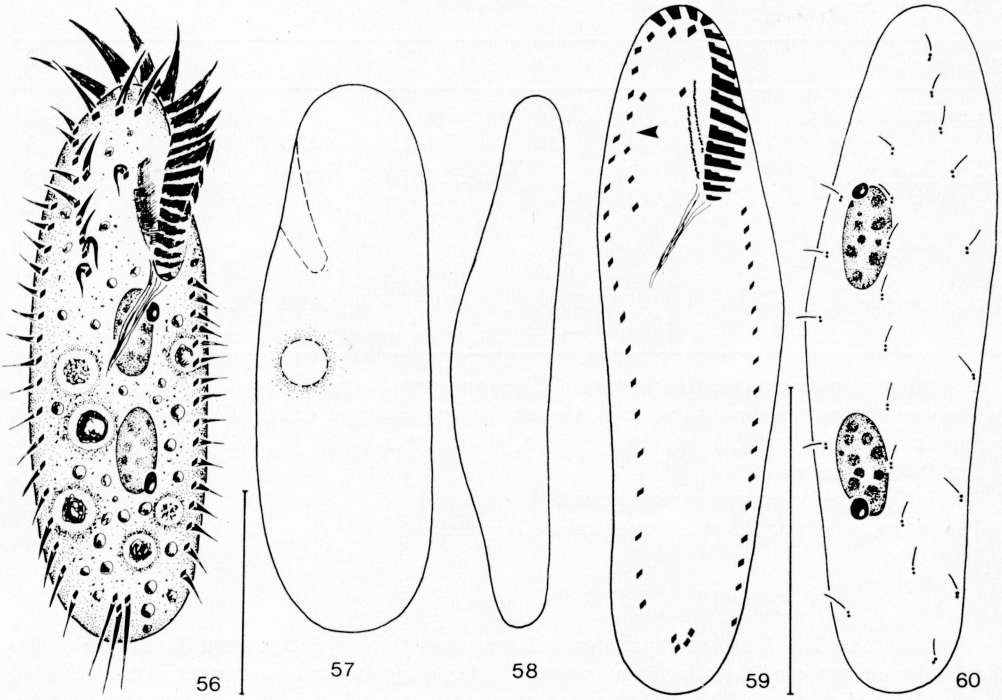
The identification of our population as *Oxytricha cavicola*, which was rather insufficient described by KAHL (1935), is somewhat arbitrary and based on the number of macronuclear segments, the cell size, and the terrestrial habitat. The stiff body and the inconspicuous caudal cirri of the living specimens require the classification in the genus *Histriculus*, which is probably a synonym of *Stylonychia* (KAHL 1932, 1935; WIRNSBERGER et al. 1986). *Histriculus cavicola* can be separated from other quadrinucleate oxytrichids by the habitat [*H. similis* QUENNERSTEDT, 1867 in KAHL (1932); marine], the caudal cirri [*Stylonychia grandis;* very prominent caudal cirri (KAHL 1932)], the number of ventral cirri [*H. lemani;* more than 18 ventral cirri (DRAGESCO 1966a)], and the shape of the undulating membranes [*Steinia quadrinucleata;* conspicuously bent anteriorly (DRAGESCO and NJINE 1971; FOISSNER 1984)]. *Oxytricha magna* GELEI and SZABADOS, 1950 is probably synonymous with *H. cavicola* (BORROR 1972).

Lamtostyla edaphoni nov. spec. (Figs. 56—60, Table 9)

Diagnosis: *In vivo* about 70—85 × 20—30 μm (n = 4), long ellipsoid, c. 7—9 cirri in the frontal row. 1 cirrus left of the frontal row at about the level of the buccal cirrus. About 17 adoral membranelles.

Type location: Scattered in the lower part of a bundle of straw, which was in contact with the soil. Salzburg, Austria.

Description: Margins nearly parallel, anterior part slightly converging, both ends rounded, about 2 : 1 flattened dorso-ventrally (Figs. 56—58). Macronuclear segments ellipsoid with large nucleoli, lying slightly left of the median. Each segment usually with 1 micronucleus, the anterior segment rarely with 2. Contractile vacuole without channels, about in the middle of the cell, conspicuously displaced inwards (Figs. 56, 57, 60). Pellicle without subpellicular granules. Cytoplasm colourless, containing some



Figs. 56—60. *Lamtostyla edaphoni* from life (Figs. 56—58) and after protargol impregnation (Figs. 59, 60). 56—58: Ventral, dorsal, and lateral view. 59, 60: Infraciliature in ventral and dorsal view. Arrow head, discontinuity in the frontal row. Scale marks = 30 μm.

1—3 μm large globules and many 4—10 μm large food vacuoles with bacteria and unidentifiable content. Movement rapid.

Adoral zone of membranelles about 30% of body length, bases of the largest membranelles *in vivo* c. 5 μm wide. Buccal area flat and narrow, undulating membranes nearly parallel, slightly bent. Buccal cirrus positioned near the anterior end of the left undulating membrane (Figs. 56, 59). Frontal cirri slightly enlarged. Frontal row begins near the right frontal cirrus, terminates at about the level of the cytostome, sometimes with a discontinuity in the middle part (Fig. 59). Marginal rows widely open posteriorly, cirri *in vivo* c. 10 μm long. Transverse cirri not enlarged, *in vivo* about 15 μm long, distinctly protruding beyond the posterior border. Dorsal cilia *in vivo* c. 3 μm long (Figs. 59, 60).

Discussion: *Lamtostyla edaphoni* differs from its congeners in the number and arrangement of the cirri in the frontal area, the number of dorsal kineties, and the nuclear apparatus.

The new species, *Tachysoma hyalina*, and *T. perisincirra* have to be classified in the genus *Lamtostyla* Buitkamp, 1977 [*Lamtostyla hyalina* (Berger, Foissner, and Adam, 1984) nov. comb., *Lamtostyla perisincirra* (Hemberger, 1985) nov. comb.], because they agree with the type species *L. lamottei* in the following characters: dorsal kineties without caudal cirri, small body length, a reduced number of transverse cirri and adjacent ventral cirri, lack of postoral ventral cirri, and possession of a short frontal row which terminates at about the level of the cytostome. Especially *L. peri-*

Table 9. Biometrical characterization of *Lamtostyla edaphoni*

Character[1])	x̄	M	SD	SE	CV	Min.	Max.	n
Body, length	61.1	62.0	6.7	2.131	11.0	49.0	69.0	10
Body, width	15.9	16.0	1.5	0.458	9.1	13.0	18.0	10
Adoral membranelles, No.	16.7	17.0	0.7	0.213	4.1	16.0	18.0	10
Adoral zone of membranelles, length	18.5	18.0	2.2	0.687	11.7	15.0	22.0	10
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	10
Anterior Ma, length	9.9	10.0	1.3	0.400	12.8	8.0	12.0	10
Anterior Ma, width	4.7	4.0	0.5	0.153	10.3	4.0	5.5	10
Posterior Ma, length	9.3	9.5	1.6	0.517	17.6	6.0	11.0	10
Posterior Ma, width	4.8	5.0	0.6	0.201	13.4	4.0	6.0	10
Ma, distance between	8.1	8.0	2.0	0.634	24.9	5.0	12.0	10
Distance 1	17.4	17.0	2.5	0.791	14.4	14.0	22.0	10
Micronuclei, No.	2.2	2.0	0.4	0.133	19.2	1.0	3,0	10
Posterior micronucleus, length	2.0	2.0	0.2	0.050	8.1	1.5	2.0	10
Posterior micronucleus, width	1.8	2.0	0.4	0.112	20.2	1.0	2.0	10
Left marginal row, No. cirri	17.6	18.0	1.8	0.567	10.1	15.0	20.0	10
Right marginal row, No. cirri	18.1	18.0	1.7	0.526	9.2	16.0	22.0	10
Frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	10
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	10
Frontal row, No. cirri	8.0	8.0	0.7	0.211	8.3	7.0	9.0	10
Distance 2	19.2	18.5	2.6	0.827	13.6	15.0	25.0	10
Cirri left of the frontal row, No.[2])	1.0	1.0	0	0	0	1.0	1.0	10
Transverse cirri, No.[3])	4.1	4.0	0.6	0.179	13.8	3.0	5.0	10
Dorsal kineties, No.	3.0	3.0	0	0	0	3.0	3.0	10
DK 1, No. basal body pairs	5.8	6.0	1.0	0.366	18.0	4.0	7.0	8
DK 2, No. basal body pairs	9.9	10.0	1.3	0.441	12.6	8.0	12.0	8
DK 3, No. basal body pairs	8.8	8.5	0.9	0.313	10.1	8.0	10.0	8

[1]) Legend: Distance 1, 2, distance between the anterior end of the cell and the anterior end of the anterior macronuclear segment and the posterior end of the ventral row respectively; DK 1, DK 2, DK 3, dorsal kineties 1, 2, 3; Ma, macronuclear segment(s).

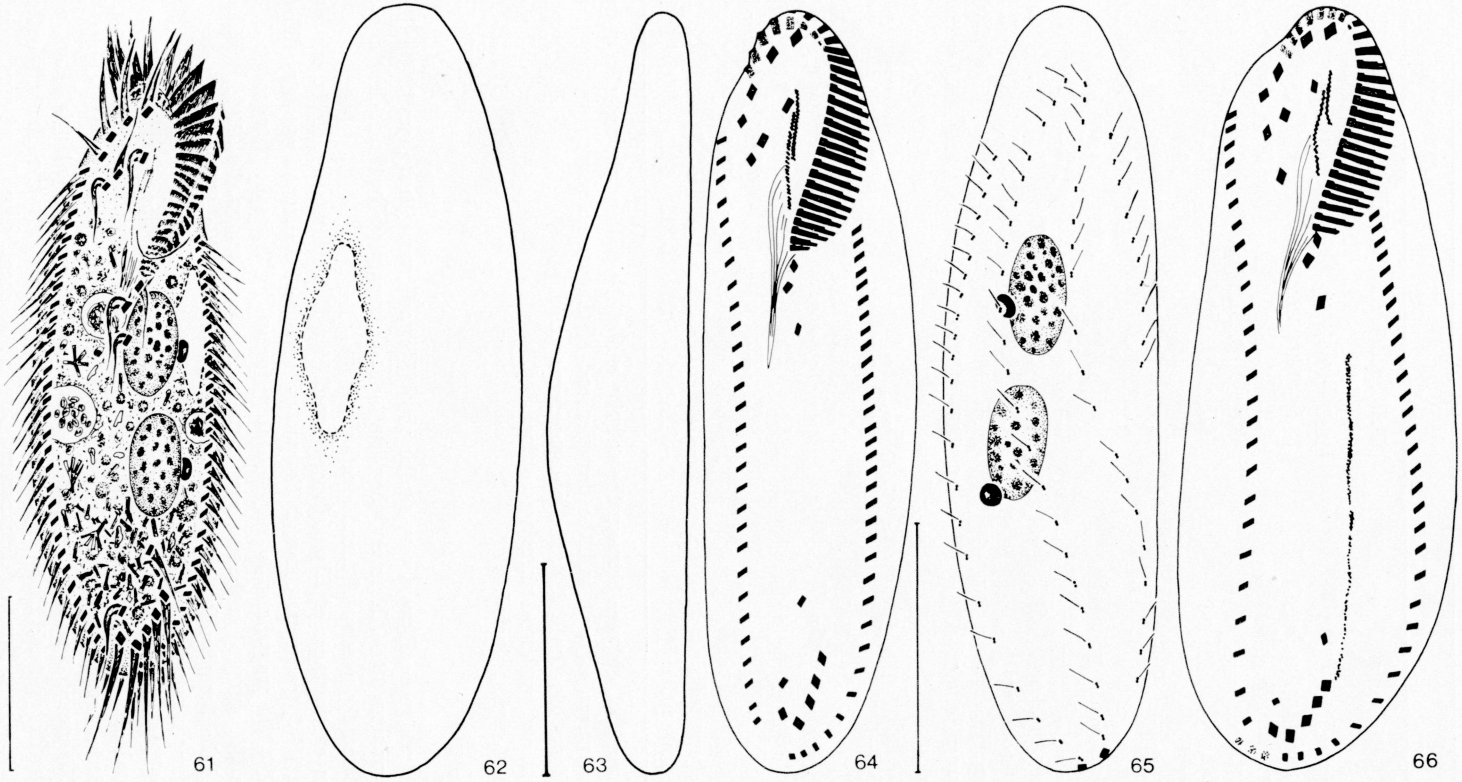
[2]) The frontal cirri and the buccal cirrus are not included.

[3]) Adjacent ventral cirri are included.

sincirra and the type species have a very similar ventral infraciliature (Buitkamp 1977b; Berger et al. 1984; Hemberger 1985). However, they can be easily separated by the nuclear apparatus, the body shape, and the number of dorsal kineties.

Some morphogenetic stages of *L. perisincirra* reveal that 1) the formation of the oral primordium begins at the left transverse cirrus, 2) the posterior cirrus of the frontal row is modified to a primordium, and 3) the frontal row is (very probably) formed by 2 streaks (Berger et al. 1984). Character 1) was also observed in the new species and *L. hyalina* (Berger et al. 1984), character 2) in *L. hyalina*, and the discontinuity in the frontal row of *L. edaphoni* (Fig. 59) supports point 3). Unfortunately, nothing is known about the morphogenesis of the type species.

Buitkamp (1977b) supposed that *Lamtostyla* is in the holostichid lineage, whereas Small and Lynn (1985) classified it in the family Cladotrichidae. However, the general morphology and the known stages of the morphogenesis (see above) indicate a classification within the Oxytrichidae. Buitkamp (1977b) provided no satisfying characterization of the genus *Lamtostyla*. Thus, we propose the following diagnosis: Usually small, wide to long ellipsoid Oxytrichidae without caudal and postoral ventral cirri. Number of transverse cirri and adjacent ventral cirri usually reduced. 1 short frontal row, which originates from 2 streaks. Type species: *Lamtostyla lamottei* Buitkamp,



Figs. 61—66. *Oxytricha lanceolata* from life (Figs. 61—63) and after protargol impregnation (Figs. 64—66). 61—63: Ventral, dorsal, and lateral view. 64, 65: Infraciliature in ventral and dorsal view. The figures show a specimen with a reduced number of cirri beside the adoral zone of membranelles and caudal cirri. 66: Early morphogenetic stage in ventral view. Scale marks = 30 μm.

1977. *Lamtostyla* differs from *Tachysoma* in the ventral cirral pattern. It can be sepparated from *Hemisincirra* by the body shape and the origin of the frontal row (FOISSNER 1982, 1984; HEMBERGER 1982, 1985).

Oxytricha lanceolata SHIBUYA, 1930 (Figs. 61—66, Table 10)

Redescription: Size *in vivo* about 100×40 μm (n = 1). Body very flexible, but of constant shape, ellipsoid, anterior third part narrowed and slightly contractile, both ends rounded. About 2:1 flattened dorso-ventrally (Figs. 61—63). Macronuclear segments *in vivo* about 21×10 μm, lying slightly left of the median. Micronuclei *in vivo* about 3 μm in diameter. Contractile vacuole on the left-hand border, slightly above the middle of the cell, during diastole with 2 inconspicuous channels. Pellicle without subpellicular granules. Cytoplasm colourless, with many 3—8 μm large, colourless globules and 2—7 μm large crystals in the posterior part of the body. Food vacuoles about 10 μm in diameter, with crystalline content. Movement very rapid, sliding hastily to and fro.

Adoral zone of membranelles about 30% of body length, cilia of the distal membranelles c. 13 μm long. Buccal area small, undulating membranes nearly straight. Frontal cirri slightly enlarged, *in vivo* about 16 μm long. Buccal cirrus inserted near the anterior end of the undulating membranes (Figs. 64, 66). All postoral ventral cirri immediately posterior to the proximal part of the adoral zone of membranelles. Transverse cirri enlarged, slightly cup-shaped, *in vivo* about 28 μm long, distinctly projecting beyond the posterior border. Marginal cirri *in vivo* about 13 μm long, left marginal row J-shaped, terminates at the posterior end of the cell, whereas the right one ends at the level of the posterior transverse cirrus (Figs. 64, 66). Caudal cirri inconspicuous. Usually 1 caudal cirrus on dorsal kineties 1—3 each, sometimes 2 on each of these kineties (Figs. 65, 66). Dorsal cilia about 3—4 μm long. Dorsal kinety 1 slightly shortened anteriorly, kinety 4 terminates at the middle of the cell.

The stomatogenesis begins with the formation of a long and narrow oral primordium, which extends from the left transverse cirrus to the posterior postoral ventral cirrus (Fig. 66).

Discussion: The habitat and the general morphology of our population concur very well with the original description which is, however, based on living observations only (SHIBUYA 1930). We do not agree with BORROR (1972) that *O. lanceolata* is a synonym of the limnetic *O. aeruginosa*, since this species is coloured and the transverse cirri are conspicuously displaced anteriad (WRZESNIOWSKI 1870).

Oxytricha nauplia nov. spec. (Figs. 67—70, Table 10)

Diagnosis: *In vivo* about 85—100×40 μm (n = 2), ellipsoid to nearly parallel sided, about 24 adoral membranelles, c. 21 cirri both in the left and right marginal row. 5 dorsal kineties, only row 5 shortened posteriorly. Dorsal cilia *in vivo* c. 2 μm long.

Type location: Upper layer (0—5 cm) of a salt soil with rush, about 50 m away from the sea. Nauplia Bay, Peloponnesus, Greece.

Description: Body very flexible, but of constant shape, anterior part narrowed, posterior end broadly rounded. About 2:1 flattened dorso-ventrally (Figs. 67, 68).

Table 10. Biometrical characterization of *Oxytricha lanceolata* (upper line), *Oxytricha nauplia* (middle line), and *Oxytricha rubripuncta* (lower line)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	87.9	89.5	7.3	2.109	8.3	75.0	100.0	12
	63.3	60.0	8.1	2.552	12.7	56.0	80.0	10
	140.1	140.0	11.8	3.056	8.5	112.0	160.0	15
Body, width	30.8	30.0	3.5	1.016	11.4	27.0	39.0	12
	26.1	26.0	2.6	0.809	9.8	21.0	29.0	10
	45.1	45.0	4.6	1.179	10.1	34.0	52.0	15
Adoral membranelles, No.	26.5	27.0	1.5	0.417	5.5	23.0	28.0	12
	24.5	24.5	1.7	0.522	6.7	22.0	27.0	10
	39.2	40.0	1.9	0.500	4.9	36.0	42.0	15
Adoral zone of membranelles, length	27.5	27.5	1.1	0.314	3.9	25.0	29.0	12
	21.1	22.0	1.5	0.458	6.9	18.0	22.0	10
	43.7	45.0	3.5	0.909	8.1	35.0	49.0	15
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	12
	2.0	2.0	0	0	0	2.0	2.0	10
	2.0	2.0	0	0	0	2.0	2.0	15
Posterior macronuclear segment, length	15.3	14.5	2.3	0.653	14.9	13.0	21.0	12
	11.1	11.0	1.4	0.433	12.3	10.0	14.0	10
	20.1	20.0	2.3	0.597	11.5	15.0	25.0	15
Posterior macronuclear segment, width	7.8	7.0	1.1	0.305	13.6	7.0	10.0	12
	7.8	8.0	0.8	0.249	10.1	6.0	9.0	10
	7.2	7.0	0.6	0.145	7.8	6.0	8.0	15
Macronuclear segments, distance between	3.9	3.0	3.0	0.874	77.3	1.0	12.0	12
	5.4	5.0	2.0	0.636	37.2	3.0	9.0	10
	16.8	18.0	4.5	1.156	26.6	8.0	24.0	15
Micronuclei, No.	2.1	2.0	0.7	0.193	32.1	1.0	3.0	12
	2.7	3.0	0.5	0.153	17.9	2.0	3.0	10
	2.4	2.0	0.6	0.163	26.4	2.0	4.0	15
Posterior micronucleus, length	2.8	2.8	0.2	0.045	5.7	2.5	3.0	12
	1.7	1.6	0.2	0.053	9.8	1.6	2.0	10
	2.8	2.8	0.2	0.045	6.1	2.5	3.0	15
Posterior micronucleus, width	2.7	2.7	0.1	0.042	5.3	2.5	3.0	12
	1.7	1.6	0.2	0.053	9.8	1.6	2.0	10
	2.8	2.8	0.2	0.045	6.1	2.5	3.0	15
Left marginal row, No. cirri	31.4	31.5	2.6	0.763	8.4	27.0	35.0	12
	20.8	20.5	1.7	0.533	8.1	18.0	23.0	10
	29.4	29.0	1.7	0.434	5.7	26.0	32.0	15
Right marginal row, No. cirri	28.4	29.0	2.0	0.583	7.1	25.0	32.0	12
	21.5	22.0	1.8	0.582	8.6	19.0	24.0	10
	28.6	29.0	2.4	0.631	8.5	24.0	32.0	15
Enlarged frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	12
	3.0	3.0	0	0	0	3.0	3.0	10
	2.7	3.0	0.5	0.118	16.8	2.0	3.0	15
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	12
	1.0	1.0	0	0	0	1.0	1.0	10
	1.0	1.0	0	0	0	1.0	1.0	15

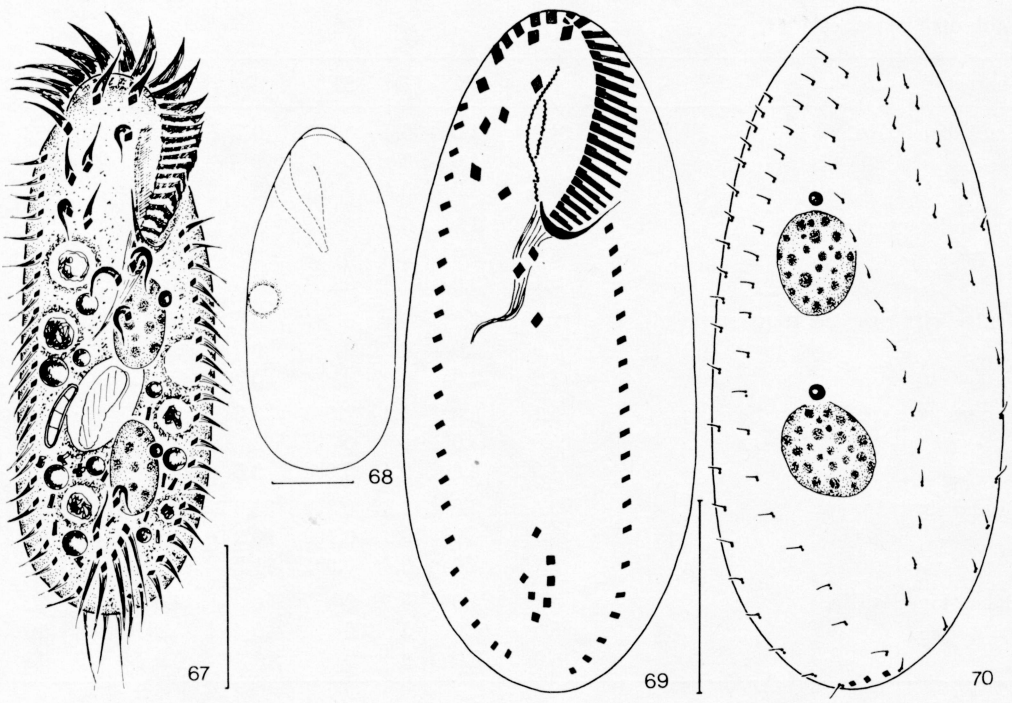
Table 10 (continued)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Ventral cirri, No.	4.0	4.0	0.4	0.123	10.7	3.0	5.0	12
	4.0	4.0	0	0	0	4.0	4.0	10
	3.8	4.0	0.4	0.107	10.9	3.0	4.0	15
Postoral ventral cirri, No.	3.0	3.0	0	0	0	3.0	3.0	12
	3.0	3.0	0	0	0	3.0	3.0	10
	3.1	3.0	0.5	0.133	16.5	3.0	5.0	15
Ventral cirri near the transverse cirri	2.0	2.0	0	0	0	2.0	2.0	12
	2.0	2.0	0	0	0	2.0	2.0	10
	2.0	2.0	0	0	0	2.0	2.0	15
Transverse cirri, No.	5.1	5.0	0.3	0.083	5.7	5.0	6.0	12
	5.0	5.0	0	0	0	5.0	5.0	10
	4.0	4.0	0.4	0.098	9.5	3.0	5.0	15
Caudal cirri, No.	3.6	3.0	1.3	0.379	36.6	2.0	6.0	12
	3.1	3.0	0.3	0.100	10.2	3.0	4.0	10
	3.1	3.0	0.4	0.091	11.2	3.0	4.0	15
Dorsal kineties, No.	4.0	4.0	0	0	0	4.0	4.0	12
	5.0	5.0	0	0	0	5.0	5.0	10
	6.0	6.0	0	0	0	6.0	6.0	15

Macronuclear segments *in vivo* c. $21 \times 10\,\mu$m, with medium-sized nucleoli, lying slightly left of the median. Micronuclei *in vivo* about $3\,\mu$m in diameter. Contractile vacuole on the left-hand border in the middle of the cell. Pellicle without subpellicular granules. Cytoplasm colourless, filled with many 2—5 μm large crystals, shining globules (3 to $10\,\mu$m in diameter), and food vacuoles which contain fungal spores and phytoflagellates (*Anisonema* sp., *Euglena viridis)* (Fig. 67). Movement rapid.

Adoral zone of membranelles c. $^1/_3$ of body length, bases of the largest membranelles *in vivo* about $7\,\mu$m wide. Buccal area flat and very narrow. Undulating membranes bent and largely superimposed (Figs. 67—69). Frontal cirri *in vivo* c. $20\,\mu$m long, bases slightly enlarged. Right frontal cirrus between the distal end of the adoral zone of membranelles and the anterior end of the right marginal row. Buccal cirrus near the anterior end of the undulating membranes. Transverse cirri about $20\,\mu$m long, bases only slightly enlarged, almost forming a longitudinal row (Fig. 69). Marginal cirri *in vivo* c. $20\,\mu$m long, rows distinctly separated posteriorly. Caudal cirri *in vivo* c. $20\,\mu$m long, very motile. Dorsal kineties 1—4 unshortened, row 5 terminates at about the level of the cytostome (Fig. 70).

Discussion: In the body shape, the size, and the arrangement of the frontal-ventral-transverse cirri *O. nauplia* resembles *O. matritensis* Ramirez-Montesinos and Perez-Silva, 1966. In this species, however, no caudal cirri were observed, indicating that it probably belongs to *Tachysoma*. From the other small to medium sized *Oxytricha* species, such as *O. hymenostoma* Stokes, 1887, *O. ludibunda* Stokes, 1891, *O. monspessulana* (Chatton and Séguela, 1940), *O. elliptica* Gelei and Szabados, 1950, *O. minor* Dragesco 1966, and *O. variabilis* Groliere, 1975 it differs either in the body shape, the ventral cirral pattern, the number and arrangement of the dorsal kineties, or in the habitat.



Figs. 67—70. *Oxytricha nauplia* from life (Figs. 67, 68) and after protargol impregnation (Figs. 69, 70). 67, 68: Ventral and dorsal view. 69, 70: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

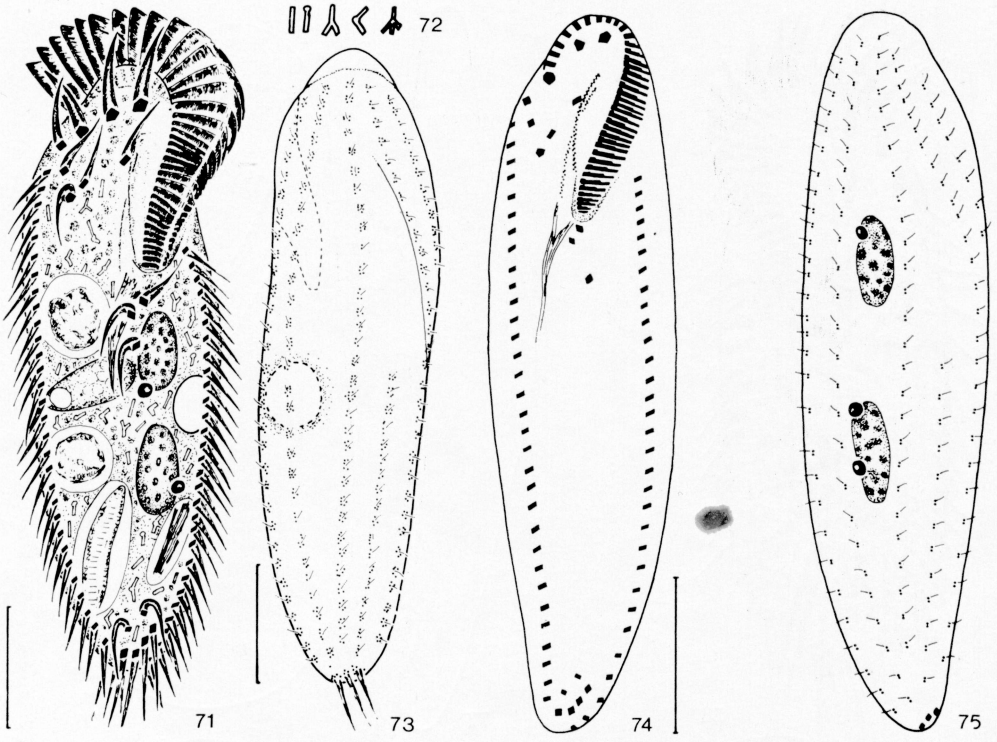
Oxytricha rubripuncta nov. spec. (Figs. 71—75, Table 10)

Diagnosis: *In vivo* about 150×45 μm (n = 1), posteriad slightly narrowed, red subpellicular granules around the bases of the cirri and the dorsal bristles. 40 adoral membranelles on the average. 6 dorsal kineties, kinety 4 conspicuously shortened anteriorly.

Type location: Moderately frequent in the soil of an uncultivated grassland in the Golan Hills, Israel.

Description: Body long oval, both ends rounded, slightly contractile. Macronuclear segments *in vivo* about 21×13 μm, lying slightly left of the median. Micronuclei *in vivo* c. 3 μm in diameter (Figs. 71, 75). Contractile vacuole without channels, about in the middle of the cell on the left-hand border. Subpellicular granules shining red, about 1 μm in diameter, arranged only around the bases of the cirri and dorsal bristles (Figs. 71, 73). Thus, the specimens appear redish even at low magnification. Cytoplasm colourless, densely filled with yellowish crystals (Fig. 72). Food vacuoles contain long bacteria, diatoms (*Hantzschia* sp.), phytoflagellates (*Chlamydomonas* sp.), testate amoebae *(Trinema lineare)*, and ciliates (*Sathrophilus* sp.).

Adoral zone of membranelles about 30% of body length, formed like a question mark. Buccal area flat, undulating membranes slightly bent. Pharyngeal fibers *in vivo* prominent. Frontal cirri *in vivo* about 15 μm long, bases distinctly enlarged. Arrangement of the frontal, ventral, and transverse cirri genus-specific. Transverse cirri only



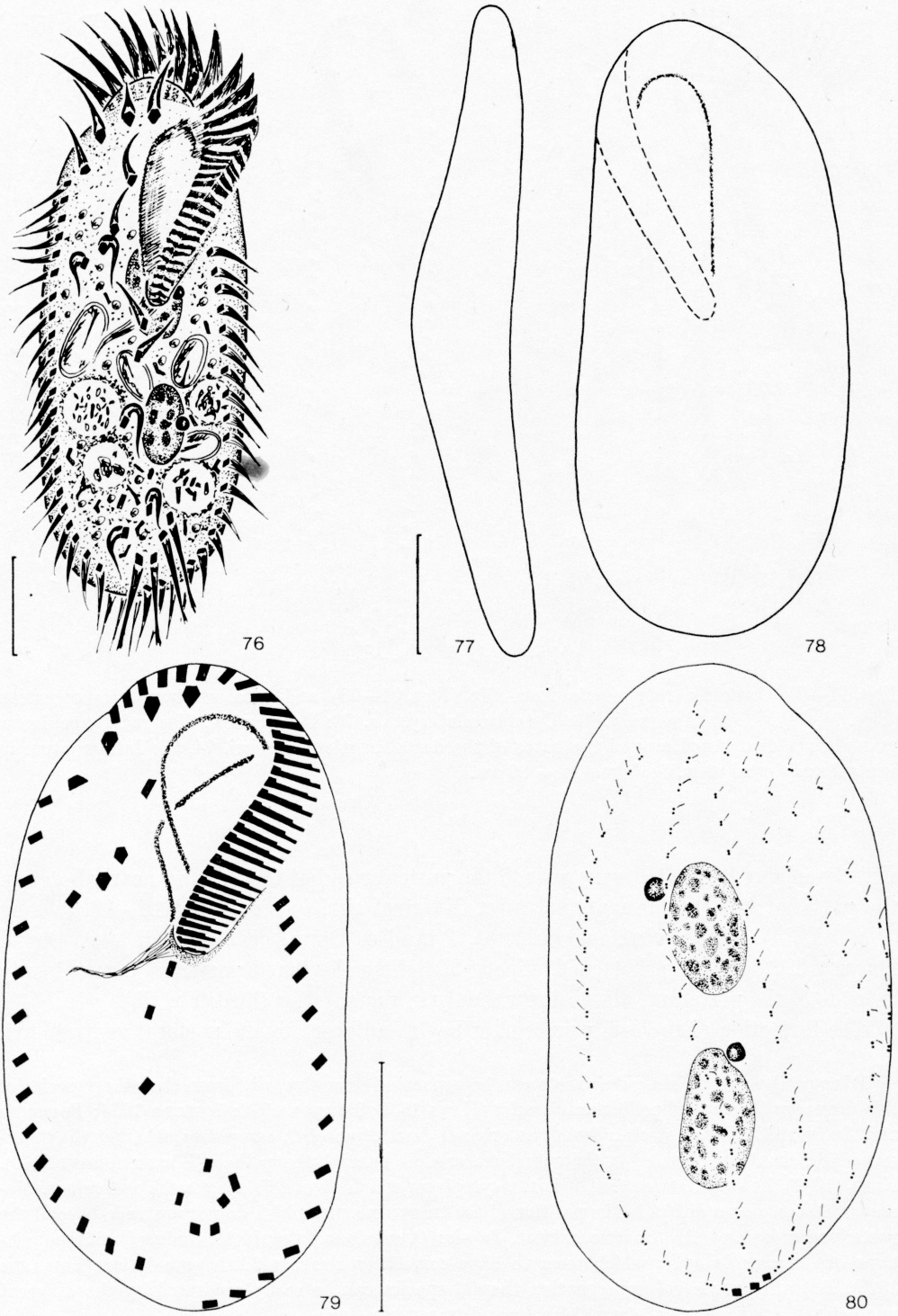
Figs. 71—75. *Oxytricha rubripuncta* from life (Figs. 71—73) and after protargol impregnation (Figs. 74, 75). 71: Ventral view. 72: Cytoplasmic crystals. 73: Dorsal view. The red subpellicular granules are distributed around the bases of the dorsal bristles and cirri. 74, 75: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

slightly enlarged, situated very near to the posterior end of the cell and nearly between the posterior ends of the marginal rows. Marginal cirri *in vivo* about 10—12 μm long (Figs. 71, 74). Caudal cirri on kineties 1, 2, and 4. Dorsal cilia c. 3 μm long. Dorsal kineties 1, 2, and 5 unshortened, kinety 3 slightly shortened posteriorly, row 4 only extends in the posterior half, and row 6 only in the anterior third (Fig. 75).

The formation of the oral primordium begins adjacent to the postoral ventral cirri.

Discussion: *Oxytricha rubripuncta* can be separated unequivocally from the other species of this genus by the red subpellicular granules (Kahl 1932; Borror 1972; Stiller 1974; Foissner and Adam 1983). It is not clear from the original description of *O. aeruginosa*, whether the "rostrothe Körnchen" are situated in the cytoplasm or close beneath the pellicle (Wrzesniowski 1870). Kahl (1932), however, states that it is the cytoplasm which gives this species the red colour. Moreover, *O. aeruginosa* differs in the position of the transverse cirri which do not protrude beyond the posterior border and the limnetic habitat. *In vivo O. rubripuncta* could be confused with populations of *Urosomoida agilis* which seem to have sometimes also a reddish granulation (Foissner 1982). But after protargol impregnation these 2 species can be easily separated by the different number and arrangement of dorsal kineties and transverse cirri.

The classification as a species of the genus *Oxytricha* is based on the phylogenetic system of Wirnsberger et al. (1986).



Figs. 76—80. *Steinia tetracirrata* from life (Figs. 76—78) and after protargol impregnation (Figs. 79, 80). 76—78: Ventral, lateral, and dorsal view. 79, 80: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

Steinia tetracirrata GELLÉRT, 1942 (Figs. 76—80, Table 11)

Discussion: Our population agrees astonishing well with the original description. Since it is published in Hungarian and hence probably difficult to understand we give a complete redescription.

Redescription: Size *in vivo* about 160—170×60—65 μm (n = 2). Margins straight and parallel, right margin sometimes slightly convex, both ends broadly rounded. About 2:1 flattened dorso-ventrally (Figs. 76—78). Body stiff and fragile. Macronuclear segments *in vivo* c. 30×15 μm. Nucleoli large, *in vivo* easily recognizable. Micronuclei *in vivo* about 5 μm in diameter. Pellicle without subpellicular granules. Cytoplasm colourless, contains many 12—17 μm large food vacuoles with crystalline content, bacteria, and phytoflagellates (*Anisonema* sp.). Movement rapid.

Adoral zone of membranelles about 40% of body length, formed like a question mark. Bases of the largest membranelles *in vivo* c. 11 μm wide. Buccal area genus-specific. Undulating membranes consist of 3—4 rows of basal bodies (Figs. 76, 78, 79). Frontal cirri *in vivo* about 25 μm long, bases enlarged. Cirral pattern as shown in Figure 79. Only 4 transverse cirri, *in vivo* about 28 μm long, tips slightly fimbriated. Bases only slightly enlarged; though somewhat displaced anteriad, the cirri protrude distinctly beyond the posterior border. Marginal cirri *in vivo* about 24 μm long, rows do not confluent posteriorly. Left row J-shaped, terminates at the posterior end of the cell (Fig. 79). Dorsal cilia c. 3 μm long. Dorsal kinety 4 only slightly shortened anteriorly (Fig. 80).

Steinia citrina nov. spec. (Figs. 81—84, Table 11)

Diagnosis: *In vivo* about 120—150 μm long. Long ellipsoid, yellowish to orange-yellow subpellicular granules around the bases of the cirri and the dorsal bristles. About 33 adoral membranelles. Transverse cirri inserted near the posterior end. Dorsal kinety 4 begins in the middle of the cell.

Type location: Litter and soil of a goat pasture between Nauplion and Tripolis, Peloponnesus, Greece.

Description: Body flexible, sometimes slightly sigmoidal, left margin slightly convex, right one straight or slight concave, both ends rounded. About 2:1 flattened dorso-ventrally (Figs. 81, 82). Macronuclear segments *in vivo* about 25×14 μm, lying left of the median. Micronuclei *in vivo* c. 7×5 μm. Contractile vacuole on the left-hand border in the middle of the cell, during diastole with inconspicuous channels. Close beneath the pellicle numerous yellowish to orange-yellow subpellicular granules of 0.5—1.5 μm in diameter around the bases of the cirri and the dorsal bristles, which give the cell a yellow shimmer at low magnification (Fig. 82). Cytoplasm colourless, densely filled with food vacuoles which contain diatoms (*Pinnularia* sp.), phytoflagellates (*Anisonema* sp.), fungi, and ciliates (*Cyclidium* sp., *Vorticella* sp., *Pseudocohnilembus* sp.). Movement rapid.

Adoral zone of membranelles about 35% of body length. Buccal area genus-specific. Undulating membranes consist of 2 (perhaps 3) rows of basal bodies. Frontal cirri *in vivo* about 20 μm long, bases slightly enlarged. 3 postoral ventral cirri in close neighbourhood of the proximal end of the adoral zone of membranelles. Transverse cirri

Table 11. Biometrical characterization of *Steinia tetracirrata* (upper line), *Steinia citrina* (middle line), and *Tachysoma granulifera* (lower line)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, length	89.3	90.5	8.1	2.846	9.0	77.0	105.0	8
	99.0	100.0	11.3	3.411	11.4	75.0	112.0	11
	62.6	62.0	7.0	2.120	11.2	55.0	76.0	11
Body, width	46.1	45.5	8.5	2.997	18.4	34.0	59.0	8
	33.5	32.0	4.8	1.436	14.2	27.0	41.0	11
	23.6	22.0	2.3	0.692	9.8	21.0	27.0	11
Adoral membranelles, No.	33.4	34.5	2.7	0.944	8.0	28.0	36.0	8
	33.6	33.0	2.0	0.607	6.0	31.0	37.0	11
	22.9	22.0	1.4	0.415	6.0	21.0	25.0	11
Adoral zone of membranelles, length	36.8	35.5	3.4	1.217	9.3	32.0	42.0	8
	35.0	35.0	2.7	0.820	7.8	31.0	39.0	11
	21.7	22.0	1.4	0.407	6.2	20.0	24.0	11
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	8
	2.0	2.0	0	0	0	2.0	2.0	11
	2.0	2.0	0	0	0	2.0	2.0	11
Posterior macronuclear segment, length	16.6	17.0	1.4	0.498	8.5	14.0	18.0	8
	15.0	15.0	3.2	0.963	21.3	11.0	21.0	11
	12.4	13.0	1.6	0.491	13.2	10.0	14.0	11
Posterior macronuclear segment, width	10.3	10.0	0.5	0.164	4.5	10.0	11.0	8
	7.8	7.0	1.2	0.352	14.9	7.0	10.0	11
	5.4	6.0	1.0	0.310	19.1	4.0	7.0	11
Macronuclear segments, distance between	12.7	14.0	4.4	1.544	34.2	7.0	18.0	8
	—	—	—	—	—	—	—	0
	4.4	4.0	2.5	0.754	57.3	0.0	9.0	11
Micronuclei, No.	2.3	2.0	0.5	0.164	20.6	2.0	3.0	8
	2.2	2.0	0.8	0.226	34.4	1.0	4.0	11
	2.0	2.0	0	0	0	2.0	2.0	11
Posterior micronucleus, length	2.8	2.8	0.1	0.033	3.4	2.8	3.0	8
	3.5	4.0	0.7	0.202	19.2	2.0	4.0	11
	2.8	2.8	0.2	0.062	7.4	2.5	3.0	11
Posterior micronucleus, width	2.8	2.8	0.1	0.033	3.4	2.8	3.0	8
	2.7	2.8	0.4	0.133	16.5	2.0	3.0	11
	1.9	2.0	0.4	0.117	20.5	1.5	2.8	11
Left marginal row, No. cirri	16.4	16.0	2.7	0.944	16.3	13.0	21.0	8
	21.5	22.0	2.1	0.623	9.6	17.0	24.0	11
	14.7	15.0	0.8	0.237	5.3	13.0	16.0	11
Right marginal row, No. cirri	17.0	16.5	3.1	1.102	18.3	14.0	24.0	8
	21.2	21.0	2.2	0.658	10.3	18.0	25.0	11
	16.3	16.0	1.1	0.333	6.8	15.0	18.0	11
Enlarged frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	8
	3.0	3.0	0	0	0	3.0	3.0	11
	3.0	3.0	0	0	0	3.0	3.0	11
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	8
	1.0	1.0	0	0	0	1.0	1.0	11
	1.0	1.0	0	0	0	1.0	1.0	11

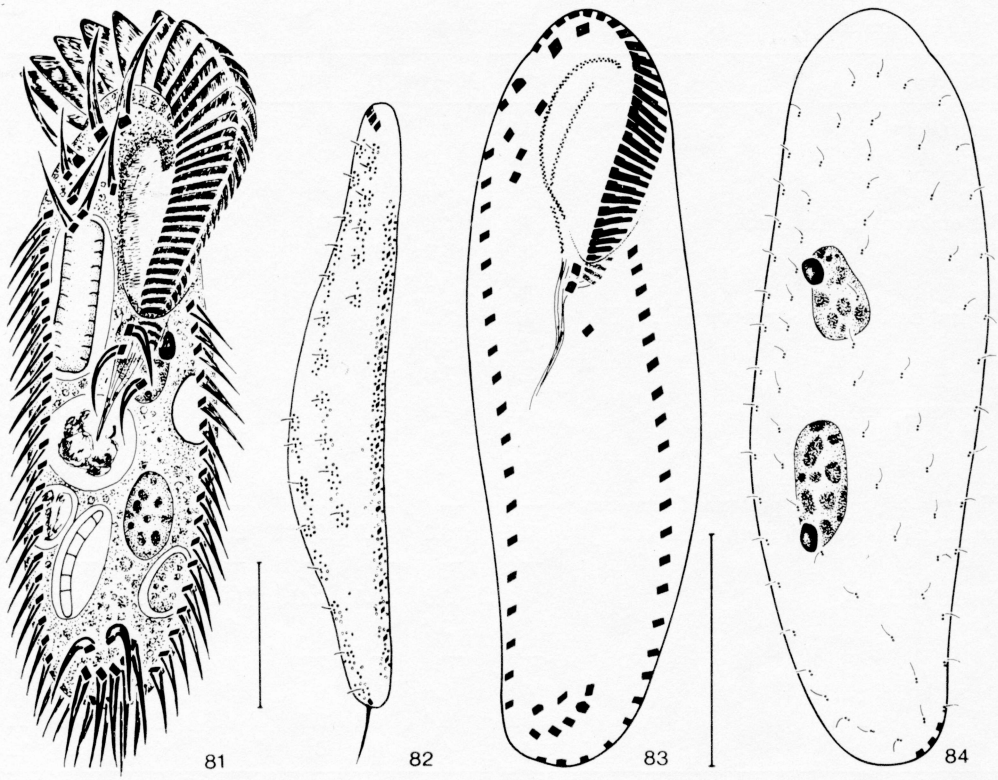
Table 11 (continued)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Ventral cirri, No.	4.0	4.0	0	0	0	4.0	4.0	8
	4.0	4.0	0	0	0	4.0	4.0	11
	4.0	4.0	0	0	0	4.0	4.0	11
Postoral ventral cirri, No.	3.0	3.0	0	0	0	3.0	3.0	8
	3.0	3.0	0	0	0	3.0	3.0	11
	3.0	3.0	0	0	0	3.0	3.0	11
Ventral cirri near the transverse cirri, No.	2.0	2.0	0	0	0	2.0	2.0	8
	2.0	2.0	0	0	0	2.0	2.0	11
	1.0	1.0	0	0	0	1.0	1.0	11
Transverse cirri, No.	4.0	4.0	0	0	0	4.0	4.0	8
	4.9	5.0	0.5	0.163	11.0	4.0	6.0	11
	4.0	4.0	0	0	0	4.0	4.0	11
Distance between the posterior transverse	—	—	—	—	—	—	—	0
cirrus and the posterior end of the cell	3.5	3.0	0.9	0.282	26.3	3.0	6.0	11
	—	—	—	—	—	—	—	0
Caudal cirri, No.	3.3	3.0	0.5	0.164	14.3	3.0	4.0	8
	3.0	3.0	0	0	0	3.0	3.0	11
	—	—	—	—	—	—	—	0
Dorsal kineties, No.	6.0	6.0	0	0	0	6.0	6.0	8
	5.8	6.0	0.4	0.122	6.9	5.0	6.0	11
	4.0	4.0	0	0	0	4.0	4.0	11

distinctly protruding beyond the posterior border, bases only slightly enlarged. Left marginal row J-shaped, terminates at the posterior end of the cell. Right row nearly straight, terminates at the level of the ventral-transverse cirral group. Caudal cirri inserted dorsally, exactly above the gap between the marginal rows. Length of dorsal cilia about 3—4 μm. Dorsal kinety 4 begins in the middle of the cell, rows 5 and 6 shortened posteriorly (Figs. 83, 84).

Discussion: *Steinia citrina* is very probably identical with *S. inquieta* (Stokes, 1887) as described by Kahl (1932), who stated a brownish granulation. However, Stokes (1887) mentioned neither subpellicular granules nor a colouring of the cytoplasm. Foissner (1984) described a *Steinia* population with conspicuously anteriad displaced transverse cirri and yellowish subpellicular granules. Considering the redescription of Kahl (1932) as decisive, Foissner (1984) identified it preliminary as *S. inquieta*. However, the present investigations imply that this pair of characters requires the establishment of a new species: *Steinia primicirrata* nov. spec. (diagnosis see below). Perhaps *S. platystoma* in Dragesco (1970) is conspecific with this new species, at least according to the infraciliature. But unfortunately, there is no indication whether this population possesses a granulation or not.

From the data above it follows that *S. inquieta* (Stokes, 1887) must be considered as a species without subpellicular granulation. Then it differs from *S. candens* Kahl, 1932 only in the body size. According to Stokes (1887) *S. inquieta* has a body length of about 95 μm. Hence, "*Oxytricha candens*" in Pätsch (1974), which is c. 90 μm long, and *S. candens* var. *depressa* Gellért, 1942 (100—120 μm long) are presumably conspecific with *S. inquieta*. To the contrary, the *S. candens* of Kahl (1932) is conspicuously larger (150—200 μm), which is confirmed by the redescriptions of Grolière (1975) and Foissner (1982). As a result of this discussion we propose the following diagnosis:



Figs. 81—84. *Steinia citrina* from life (Figs. 81, 82) and after protargol impregnation (Figs. 83, 84). 81: Ventral view. 82: Lateral view. The yellow to orange-yellow subpellicular granules are located around the bases of the dorsal bristles and cirri. 83, 84: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

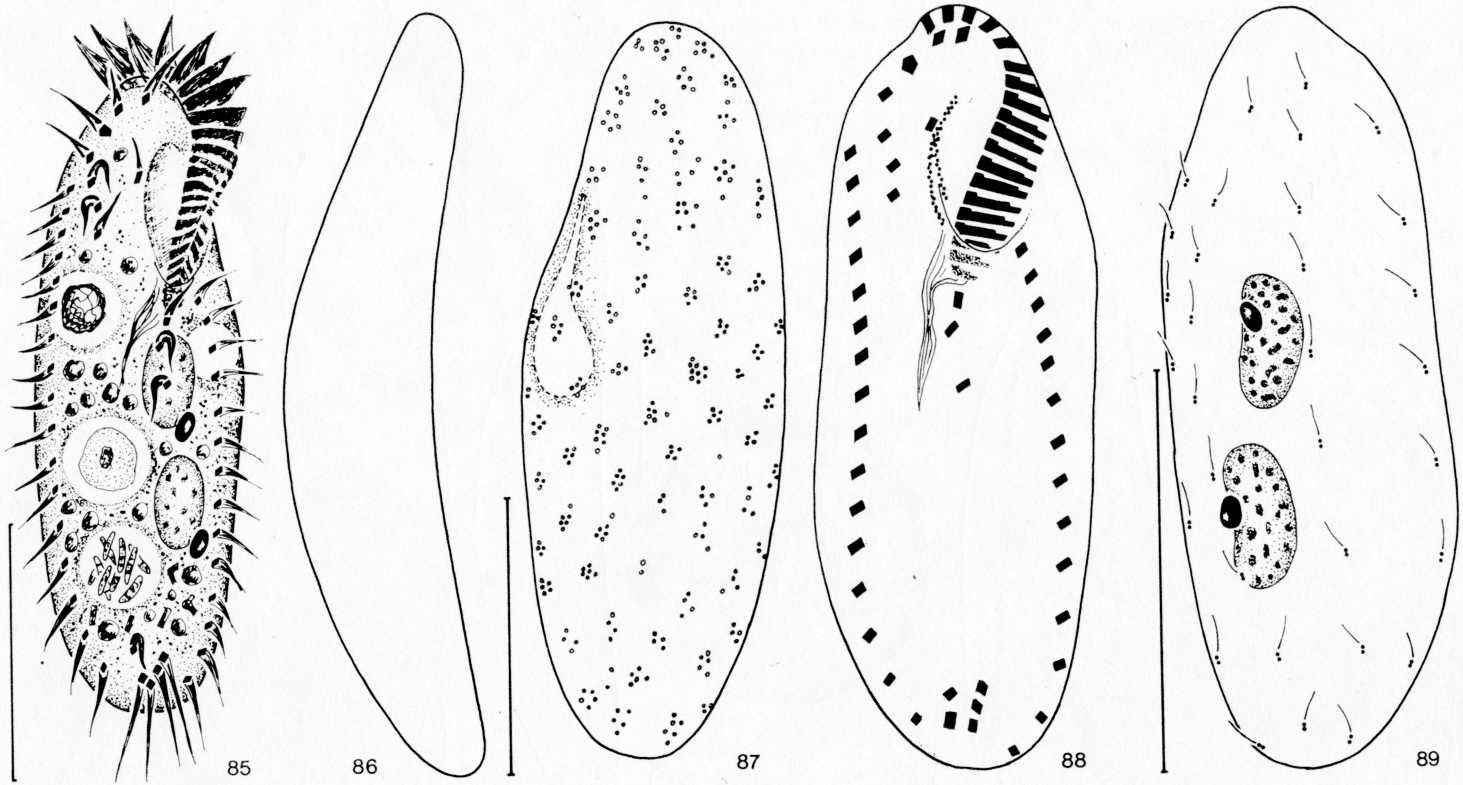
Steinia primicirrata nov. spec. Diagnosis: *In vivo* about 90—130×35—50 μm, ellipsoid, yellow shining subpellicular granules around the bases of the cirri and dorsal bristles. Transverse cirri considerably displaced anteriad. About 30 adoral membranelles. Only dorsal kinety 6 conspicuously shortened. Type location: Upper soil (0—2 cm) of a bottom land in the Tullnerfeld, Lower Austria. Description in Foissner (1984) as *S. inquieta*.

Steinia inquieta (Stokes, 1887). Diagnosis according to Stokes (1887): *In vivo* about 95 μm long, elongate to obovate, about 3 times as long as broad. Subpellicular granules absent. Type location: Standing pond-water with *Lemna* sp. (North America). Description in Stokes (1887).

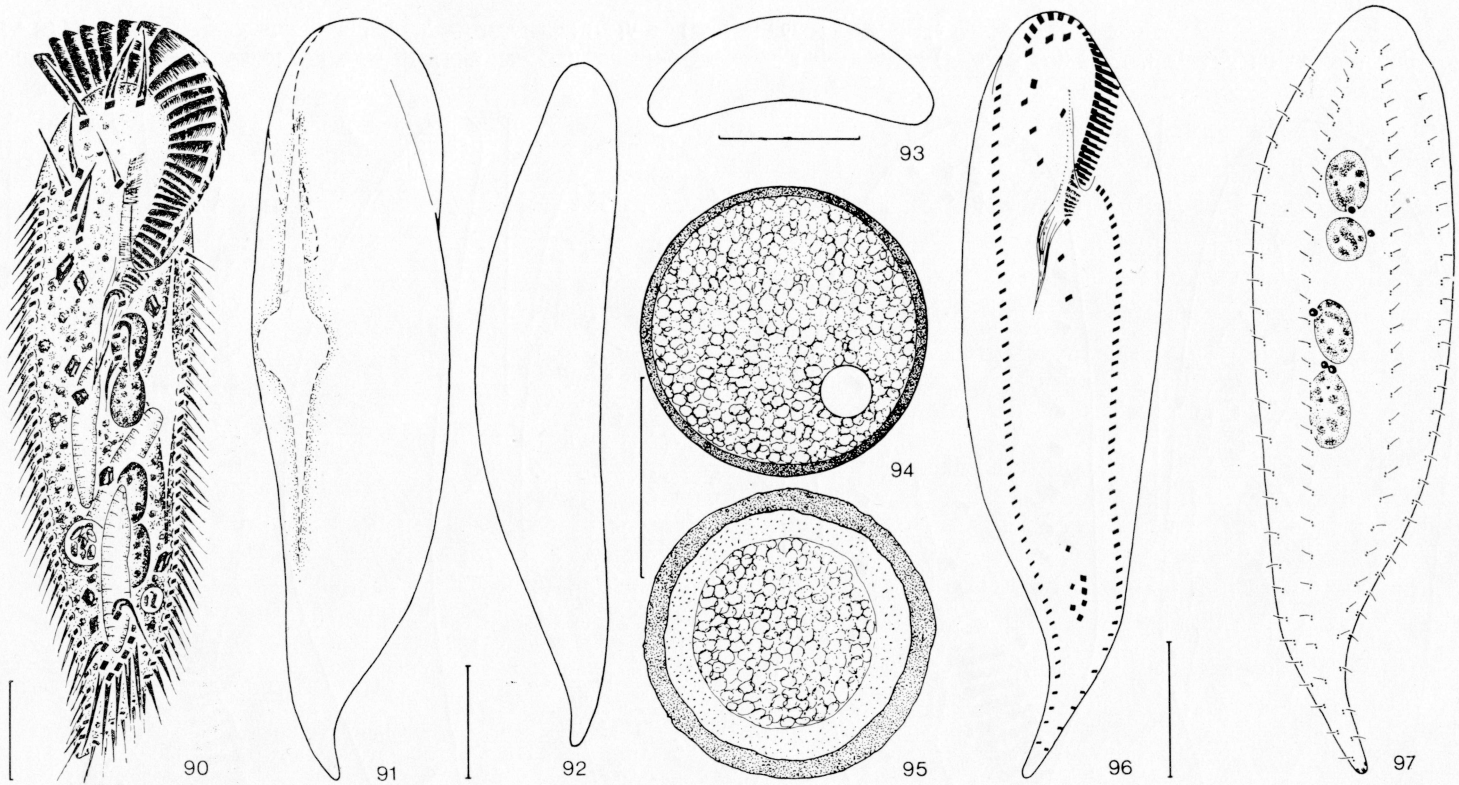
Steinia candens Kahl, 1932. Diagnosis according to Kahl (1932): *In vivo* about 150—200 ×60—80 μm, ellipsoid to ovoid. Transverse cirri protrude distinctly beyond the posterior border. Subpellicular granules absent. Type location: Moss on a shady wall in Volksdorf, Hamburg, West Germany. Description in Kahl (1932), redescriptions in Groliere (1975) and Foissner (1982).

Tachysoma granulifera nov. spec. (Figs. 85—89, Table 11)

Diagnosis: *In vivo* about 70—83×25—33 μm (n = 4), ellipsoid, yellowish to orange-yellow, c. 0.5 μm large subpellicular granules, 4 transverse cirri, 4 dorsal kineties, and about 23 adoral membranelles.



Figs. 85—89. *Tachysoma granulifera* from life (Figs. 85—87) and after protargol impregnation (Figs. 88, 89). 85—87: Ventral, lateral, and dorsal view. Figure 87 shows the subpellicular granules. 88, 89: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.



Figs. 90—97. *Urosoma acuminata* from life (Figs. 90—95) and after protargol impregnation (Figs. 96, 97). 90—92: Ventral, dorsal, and lateral view. 93: Cross-section about in the middle of the cell. 94, 95: Cysts. 96, 97: Infraciliature in ventral and dorsal view. Scale marks = 30 μm.

Type location: Moderately frequent in arable soil near Vienna, Austria.

Description: Margins distinctly convex, left one narrowed anteriorly, both ends rounded. About 2:1 flattened dorso-ventrally (Figs. 85—87). Macronuclear segments with small nucleoli, *in vivo* about $10 \times 7\,\mu m$, lying slightly left of the median. Micronuclei *in vivo* c. $3 \times 2\,\mu m$. Contractile vacuole on the left-hand border, distinctly above the middle of the cell, during diastole with an anterior channel (Figs. 85, 87, 89). Subpellicular granules yellow to orange-yellow, irregularly distributed in loosely arranged groups. In small perhaps precystic specimens they are distinctly orange. Cytoplasm colourless, with some small crystals, many $2—5\,\mu m$ large homogeneous globules, and food vacuoles which contain naked amebas and their cysts, large ($7 \times 2\,\mu m$) fungal spores, green algae and zooflagellates. Movement rapid (Figs. 85, 87).

Adoral zone of membranelles about 35% of body length, bases of the largest membranelles *in vivo* c. $6\,\mu m$ wide, cilia of distal membranelles *in vivo* about $15\,\mu m$ long. Buccal area small, deep, and rather distinctly bent anteriorly. Undulating membranes bent, superimposed anteriorly (Figs. 81, 84). Bases of the frontal cirri only slightly enlarged. Ventral cirri arranged in a line. 3 postoral ventral cirri near the cytostome, 1 ventral cirrus adjacent to the slightly enlarged, *in vivo* c. $22\,\mu m$ long transverse cirri. They protrude distinctly beyond the posterior border. Marginal cirri *in vivo* about $15\,\mu m$ long, going backward the bases become smaller and the distances between them become wider. Marginal rows distinctly separated posteriorly. Dorsal cilia *in vivo* c. $4\,\mu m$ long. Dorsal kinety 1 slightly shortened anteriorly (Figs. 85, 88, 89).

Discussion: The possession of a real *Oxytricha* cirral pattern, the absence of caudal cirri, and the size require the classification in the genus *Tachysoma* (Kahl 1932; Borror 1972; Small and Lynn 1985). From the other members of this genus *T. granulifera* can be easily distinguished by the conspicuous subpellicular granules (Kahl 1932; Borror 1972; Stiller 1974). *In vivo* it can be easily confused with *Steinia citrina* and *S. primicirrata*, because the colour and arrangement of the subpellicular granules are similar. In addition, *T. granulifera* possesses a *Steinia*-like peristomial lip.

Urosoma acuminata (Stokes, 1887) Kahl, 1932 (Figs. 90—97, Table 12)

Discussion: The body shape and the arrangement of the cirri and dorsal kineties fit the redescription of Foissner (1982) well. However, our population is larger ($\bar{x} = 155\,\mu m$; Foissner 1982, $\bar{x} = 113\,\mu m$), has 50% more adoral membranelles ($\bar{x} = 36$; $\bar{x} = 24$), and more cirri in the left ($\bar{x} = 40$; $\bar{x} = 32$) and right marginal row ($\bar{x} = 43$; $\bar{x} = 35$). In spite of the conspicuous interpopulation variability of important characters, a separation at the species level should be avoided since too little is known about the geographic variability of this genus.

Some additional observations: After protargol impregnation many tiny argentophilic globules especially around the bases of the cirri. Feeds on phytoflagellates and diatoms (*Hantzschia* sp.). Cyst formation takes a long time in cultures. Initially the outer layer is smooth and about $2\,\mu m$ thick. The cyst is densely filled with $1—3\,\mu m$ large clod-shaped inclusions. Sometimes the contractile vacuole is still recognizable. The movement of the cytoplasm can be clearly seen (Fig. 94). A second type of cysts occurred rather frequently in older cultures. It has a thick (about $3\,\mu m$) rough wall and a rather clear zone which contains sometimes fast moving particles, probably some sort of parasites (Fig. 95). There were many transitions between these 2 types.

Table 12. Biometrical characterization of *Urosoma acuminata* (upper line) and *Urosoma gigantea* (lower line)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Body, lenght	154.5	155.0	14.2	3.941	9.2	125.0	180.0	13
	157.7	160.0	12.3	2.464	7.8	140.0	182.0	25
Body, width	43.8	43.0	3.3	0.914	7.5	38.0	49.0	13
	47.2	48.0	3.7	0.739	7.8	42.0	58.0	25
Adoral membranelles, No.	36.0	36.0	1.4	0.392	3.9	34.0	38.0	13
	46.8	47.0	2.7	0.536	5.7	42.0	58.0	25
Adoral zone of membranelles, length	41.7	42.0	1.8	0.496	4.3	38.0	45.0	13
	58.0	57.0	3.7	0.747	6.4	52.0	67.0	25
Parorale membrane, length	20.0	20.0	1.1	0.447	5.5	18.0	21.0	6
	23.6	24.0	1.9	0.383	8.1	20.0	27.0	25
Endorale membrane, length	15.2	15.0	1.0	0.401	6.5	14.0	17.0	6
	20.4	20.0	1.6	0.326	8.0	17.0	25.0	25
Macronuclear segments, No.	3.9	4.0	0.4	0.065	9.7	2.0	4.0	34
	2.0	2.0	0	0	0	2.0	2.0	25
Posterior macronuclear segment, length	11.5	10.0	3.3	0.903	28.2	9.0	21.0	13
	21.3	21.0	2.7	0.537	12.6	18.0	28.0	25
Posterior macronuclear segment, width	8.5	9.0	0.8	0.216	9.1	7.0	10.0	13
	9.2	9.0	1.1	0.226	12.2	7.0	11.0	25
Macronuclear segments, distance between[1])	10.9	11.0	3.6	1.003	33.1	4.0	17.0	13
	30.5	28.0	7.1	1.423	23.3	21.0	56.0	25
Micronuclei, No.	5.0	5.0	1.4	0.376	27.1	3.0	8.0	13
	3.4	3.0	1.1	0.215	32.0	2.0	7.0	25
Posterior micronucleus, diameter	1.6	1.6	0.2	0.041	9.2	1.4	2.0	13
	2.6	2.6	0.1	0.026	5.0	2.4	2.8	25
Left marginal row, No. cirri	40.4	41.0	1.4	0.385	3.4	38.0	43.0	13
	34.6	35.0	2.2	0.432	6.3	30.0	38.0	25
Right marginal row, No. cirri	43.2	44.0	2.4	0.635	5.4	37.0	46.0	13
	42.9	43.0	2.2	0.434	5.1	38.0	46.0	25
Frontal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	13
	3.0	3.0	0	0	0	3.0	3.0	25
Buccal cirri, No.	1.0	1.0	0	0	0	1.0	1.0	13
	1.0	1.0	0	0	0	1.0	1.0	25
Ventral cirri, No.	3.8	4.0	0.4	0.104	9.8	3.0	4.0	13
	4.0	4.0	0	0	0	4.0	4.0	25
Postoral ventral cirri, No.	2.8	3.0	0.4	0.104	13.2	2.0	3.0	13
	2.8	3.0	0.5	0.095	16.6	1.0	3.0	25
Ventral cirri near the transverse cirri, No.	1.9	2.0	0.3	0.077	14.4	1.0	2.0	13
	1.9	2.0	0.3	0.055	14.4	1.0	2.0	25
Transverse cirri, No.	4.9	5.0	0.3	0.077	5.6	4.0	5.0	13
	5.0	5.0	0	0	0	5.0	5.0	25
Caudal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	13
	3.0	3.0	0.2	0.040	6.6	3.0	4.0	25

Table 12 (continued)

Character	$\bar{x}$	M	SD	SE	CV	Min.	Max.	n
Dorsal kineties, No.	4.0	4.0	0	0	0	4.0	4.0	13
	4.0	4.0	0	0	0	4.0	4.0	25
Cyst, diameter 1[2])	43.0	43.0	2.5	0.615	5.9	40.0	50.0	17
	64.7	69.5	6.9	1.861	10.8	52.0	70.0	14
Cyst, diameter 2[2])	—	—	—	—	—	—	—	0
	89.5	85.5	8.7	2.329	9.7	76.0	105.0	14
Cyst, diameter 3[2])	—	—	—	—	—	—	—	0
	131.5	130.0	10.1	2.702	7.7	111.0	150.0	14

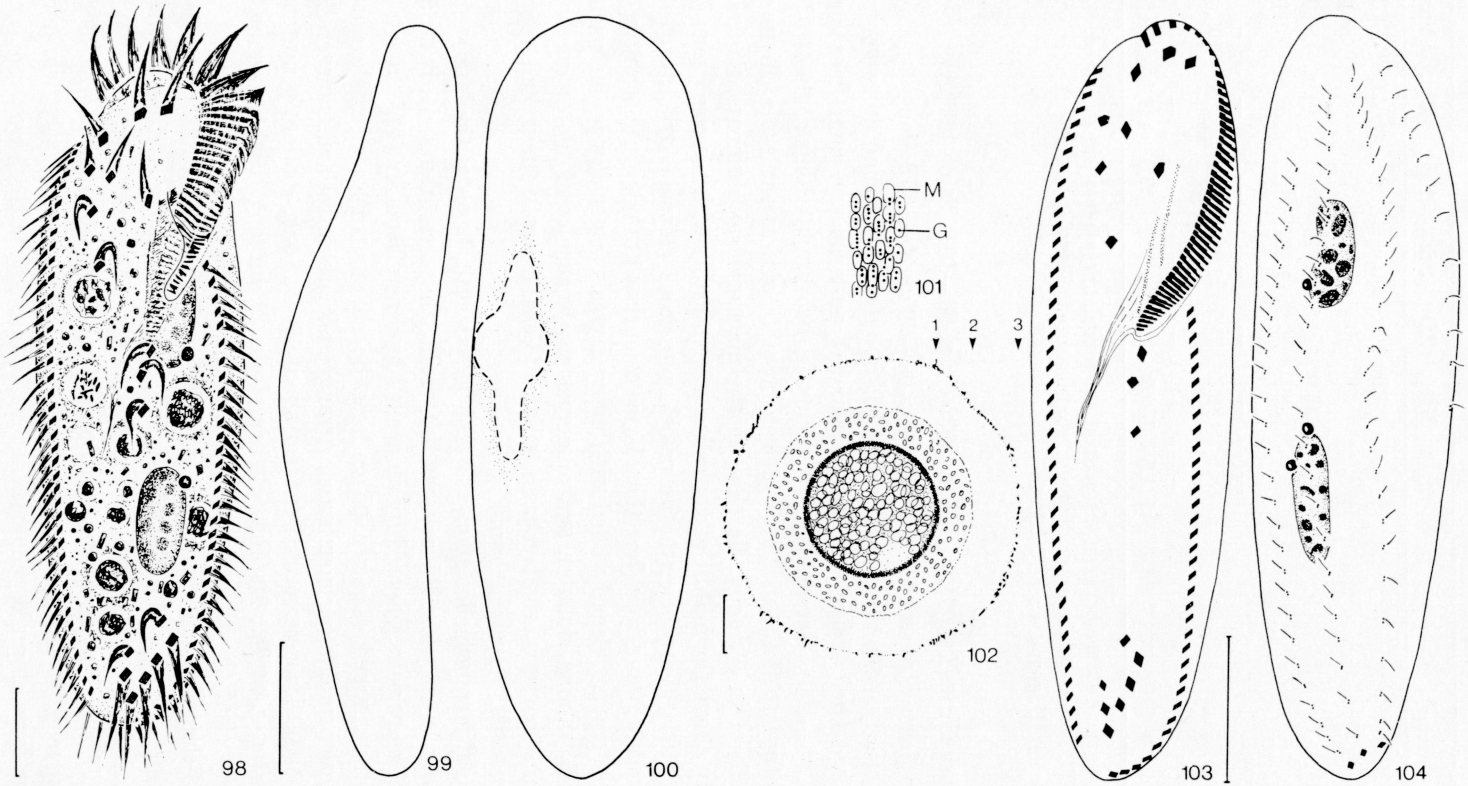
[1]) In *U. acuminata* the distance between the pairs of macronuclear segments was measured.
[2]) From life. In *U. acuminata* the outer diameter was measured (Figs. 94, 95). For the designation of the diameters in *U. gigantea* see Fig. 102.

Urosoma gigantea (HORVÁTH, 1933) KAHL, 1935 (Figs. 98—104, Table 12)

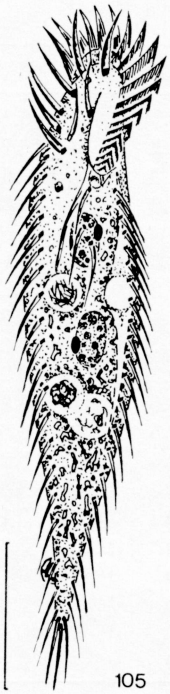
Redescription: Size *in vivo* c. 170—210×65—90 μm (n = 3). Body long ovoid, narrowed posteriorly, sometimes nearly parallel. About 2: 1 flattened dorso-ventrally, dorsal distinctly arched. Usually both ends rounded, posterior end sometimes slightly tapering (Figs. 98—100). Macronuclear segments *in vivo* bright shining, about 32×14 μm, lying slightly left of the median. Nucleoli large, *in vivo* recognizable. Micronuclei *in vivo* about 3 μm in diameter, lie close to the macronuclear segments. Contractile vacuole slightly above the middle of the cell, during diastole with inconspicuous channels (Figs. 100, 104). Close beneath the pellicle numerous ellipsoid structures (about 2 μm; mitochondria?) and tiny (less than 1 μm) colourless granules in loose rows (Fig. 101). Cytoplasm greyish, densely filled with many crystals (especially in the posterior part of the cell), shining globules, and numerous food vacuoles of 10—20 μm in diameter, containing bacteria, zooflagellates, ciliates (*Vorticella* sp.), fungi, and compact unidentified material. Movement rapid.

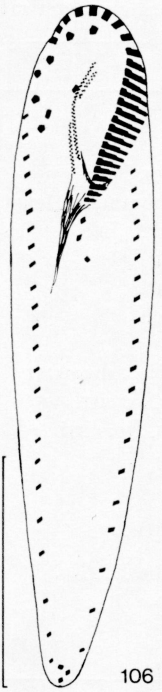
Adoral zone of membranelles about 37% of body length, bases of the largest membranelles *in vico* c. 8 μm wide. Buccal area flat, undulating membranes nearly straight, consist of basal body pairs, covered by an arched hyaline plasma lip (Fig. 98). Frontal cirri only slightly enlarged, *in vivo* c. 25 μm long. Buccal cirrus inserted at the anterior end of the anterior undulating membrane. Arrangement of ventral and transverse cirri constant (Fig. 103). Transverse cirri *in vivo* about 30 μm long, distinctly protruding beyond the posterior border. Marginal cirri *in vivo* c. 21 μm long. Right marginal row begins at the level of the right frontal cirrus, terminates slightly subterminal. Left marginal row J-shaped. Caudal cirri thin, strongly motile inserted at the posterior end of the dorsal kineties 1, 2, and 3. Dorsal cilia *in vivo* about 3 μm long. Kinety 1 slightly shortened anteriorly, kinety 4 terminates in the middle of the cell (Figs. 103, 104).

In culture, *U. gigantea* encysted after conjugation. Cyst yellowish, consist of 1) an outer hyaline mucous layer with adhering bacteria, 2) an inner relatively firm mucous layer with 2 μm large ellipsoid yellow inclusions, 3) a c. 3.5 μm thick cyst wall, and 4) the cytoplasm with 4—8 μm large globules (Fig. 102, Table 12).



Figs. 98—104. *Urosoma gigantea* from life (Figs. 98—102) and after protargol impregnation (Figs. 103, 104). 98—100: Ventral, lateral, and dorsal view. 101: Part of the pellicle with ellipsoid structures (mitochondria?; M) and tiny subpellicular granules (G). 102: Cyst. 103, 104: Infraciliature in ventral and dorsal view. Scale marks = 30 μm. 1, 2, 3, diameters of the cyst. See Table 12.





Figs. 105, 106. *Urosomoida agilis*. 105: Ventral view from life. 106: Infraciliature in ventral view after protargol impregnation. Scale marks = 30 μm.

Discussion: The assumption of conspecifity of our population and the type material is based on following characters: the body shape, the very good agreement in the cirral pattern, the arrangement of the undulating membranes, the transverse cirri which protrude distinctly beyond the posterior border, the possession of short rows of subpellicular granules, and the habitat. The only conspicuous difference exists in the number of dorsal kineties (type material 5, our population 4).

KAHL (1935) mentions a resemblance with *U. macrostyla*. However, in this species the transverse cirri do not protrude beyond the posterior end which is conspicuously notched (WRZESNIOWSKI 1870). In addition, there are great differences in many biometrical characters (compare with FOISSNER 1982).

Urosomoida agilis (ENGELMANN, 1862) HEMBERGER, 1985 (Figs. 105, 106, Table 13)

Discussion and additional observations: As a complement to the redescription of FOISSNER (1982) we give an additional biometrical characterization and some further observations of a conspicuously tapered population.

Size *in vivo* about 80—140×30—33 μm. Bases of the largest adoral membranelles *in vivo* c. 5—7 μm wide, cilia of the distal membranelles about 15 μm long. Length of the marginal cirri c. 10 μm. Caudal cirri about 15 μm long, very thin and motile. Transverse cirri *in vivo* inconspicuous, dorsal cilia c. 3 μm long. Macronuclear segments *in vivo* about 10—14×7 μm, micronuclei c. 4×2 μm. Food vacuoles about 7 μm in diameter. Cytoproct near the posterior end of the cell, through which vacuoles with about 3—4 μm large crystals may be discharged (Fig. 105).

Table 13. Biometrical characterization of *Urosomoida agilis*

Character[1])	x̄	M	SD	SE	CV	Min.	Max.	n
Body, length	86.1	86.0	5.3	1.378	6.2	78.0	96.0	15
Body, width	25.3	25.0	4.2	1.094	16.7	17.0	32.0	15
Adoral membranelles, No.	25.7	26.0	1.9	0.504	7.6	23.0	30.0	15
Adoral zone of membranelles, length	24.5	25.0	1.9	0.496	7.8	22.0	28.0	15
Macronuclear segments, No.	2.0	2.0	0	0	0	2.0	2.0	15
Posterior Ma, length	12.3	12.0	2.3	0.583	18.3	8.0	17.0	15
Posterior Ma, width	6.1	6.0	0.8	0.206	13.2	4.0	7.0	15
Ma, distance between	9.7	10.0	2.6	0.667	26.7	5.0	14.0	15
Micronuclei, No.	2.0	2.0	0	0	0	2.0	2.0	3
Posterior micronucleus, diameter	2.8	3.0	0.3	0.167	10.2	2.5	3.0	3
Left marginal row, No. cirri	23.7	23.0	3.5	0.913	14.9	20.0	31.0	15
Right marginal row, No. cirri	22.7	23.0	2.5	0.636	10.8	17.0	27.0	15
Frontal cirri, No.	2.9	3.0	0.3	0.067	8.8	2.0	3.0	15
Buccal cirri, No.	0.9	1.0	0.3	0.067	8.8	0	1.0	15
Ventral cirri, No.	3.9	4.0	0.4	0.091	9.1	3.0	4.0	15
Postoral ventral cirri, No.	3.1	3.0	0.3	0.067	8.8	3.0	4.0	15
Ventral cirri near the TC, No.	1.0	1.0	0	0	0	1.0	1.0	15
Transverse cirri, No.	2.0	2.0	0	0	0	2.0	2.0	15
Caudal cirri, No.	3.0	3.0	0	0	0	3.0	3.0	15
Dorsal kineties, No.	4.0	4.0	0	0	0	4.0	4.0	15

[1]) Legend: Ma, macronuclear segment(s); TC, transverse cirri.

Since 1982 we have studied many populations of this species and found them all to possess yellowish subpellicular granules around the cirral bases and the dorsal bristles. ENGELMANN (1862) also noted a "schwach röthlichbraune" colour in this species.

Zusammenfassung

Morphologie und Biometrie einiger Boden-Hypotrichen (Protozoa: Ciliophora)

Es wurden die Morphologie und die Infraciliatur von folgenden 18 hypotrichen Ciliaten-Arten aus verschiedenen Böden Asiens und Europas untersucht: *Pseudouroleptus procerus* nov. spec., *Kahliella bacilliformis*, *K. simplex*, *Keronopsis wetzeli*, *Paruroleptus notabilis*, *Hemisincirra inquieta*, *H. livida* nov. spec., *Histriculus cavicola* nov. comb., *Lamtostyla edaphoni* nov. spec., *Oxytricha lanceolata*, *O. nauplia* nov. spec., *O. rubripuncta* nov. spec., *Steinia tetracirrata*, *S. citrina* nov. spec., *Tachysoma granulifera* nov. spec., *Urosoma acuminata*, *U. gigantea* und *Urosomoida agilis*. Alle Arten werden biometrisch charakterisiert. Von *K. bacilliformis*, *H. cavicola*, *U. acuminata* und *U. gigantea* werden die Cysten beschrieben. Die Infraciliatur von *Paraurostyla buitkampi* ist typisch für die Gattung *Pseudouroleptus: Pseudouroleptus buitkampi* (FOISSNER, 1982) nov. comb. Für die Gattung *Lamtostyla* BUITKAMP, 1977 wird eine verbesserte Diagnose vorgeschlagen. Dieses oxytrichide Genus enthält nun 4 Arten: *L. lamottei* (Typusart), *L. edaphoni* nov. spec., *L. hyalina* (BERGER, FOISSNER und ADAM, 1984) nov. comb. (für *Tachysoma hyalina*) und *L. perisincirra* (HEMBERGER, 1985) nov. comb. (für *Tachysoma perisincirra*). Die subpelliculären Granula und die auffallend weit nach vorne verlagerten Transversalcirren von *Steinia inquieta* in FOISSNER (1984) erfordern die Errichtung einer neuen Species: *Steinia primicirrata* nov. spec. Für *S. inquieta* (STOKES, 1887) und *S. candens* KAHL, 1932 werden auf den Originalbeschreibungen basierende Diagnosen vorgeschlagen.

Literature

Berger, H., Foissner, W., and Adam, H.: Taxonomie, Biometrie und Morphogenese einiger terricoler Ciliaten (Protozoa: Ciliphora). Zool. Jb. Syst. **111** (1984), 339—367.

Berger, J.: Quantification of ciliophoran species description: an appeal to reasons. Trans. Amer. Micros. Soc. **97** (1978), 121—126.

Borror, A. C.: Revision of the order Hypotrichida (Ciliophora, Protozoa). J. Protozool. **19** (1972), 1—23.

Buitkamp, U.: Über die Ciliatenfauna zweier mitteleuropäischer Bodenstandorte (Protozoa; Ciliata). Decheniana **130** (1977a), 114—126.

— Die Ciliatenfauna der Savanne von Lamto (Elfenbeinküste). Acta Protozool. **16** (1977b), 249—276.

Chatton, E., et Séguela, J.: La continuité génetique des formations ciliaires chez les ciliés hypotriches. La cinétome et l'argyrome au cours de la division. Bull. Biol. France et Belgique **74** (1940), 349—442.

Corliss, J. O.: The problem of homonyms among generic names of ciliated protozoa, with proposal of several new names. J. Protozool. **7** (1960), 269—278.

— and Lom, J.: An annotated glossary of protozoological terms. In: Lee, J. J., Hutner, S. H., and Bovee, E. C., eds.: An illustrated guide to the protozoa. Lawrence 1985.

Dragesco, J.: Ciliés libres de Thonon et ses environs. Protistologica **2** (1966a), 59—95.

— Observations sur quelques ciliés libres. Arch. Protistenk. **109** (1966b), 155—206.

— Ciliés libres du Cameroun. Ann. Fac. Sci. Yaoundé, Yaoundé 1970.

— and Njine, T.: Compléments à la connaissance des ciliés libres du Cameroun. Ann. Fac. Sci. Cameroun **7—8** (1971), 97—140.

Engelmann, T. W.: Zur Naturgeschichte der Infusionsthiere. Z. wiss. Zool. **11** (1862), 347—393.

Fernandez-Galiano, D.: Silver impregnation of ciliated protozoa: procedure yielding good results with the pyridinated silver carbonate method. Trans. Amer. Micros. Soc. **95** (1976), 557—560.

Fleury, A., et Fryd-Versavel, G.: Aspects de la morphogenèse chez *Kahliella* (Cilié hypotriche). Protistologica **18** (1982), 135—145.

— Unité et diversité chez les hypotriches (Protozoaires ciliés). I. Approche morphogénetique par l'étude de quelques formes peu differenciées. Protistologica **20** (1984), 525—546.

Foissner, I., and Foissner, W.: Electronmicroscopical observations on the resting cyst of *Kahliella simplex* (Horvath, 1934) Corliss, 1960 (Ciliophora, Hypotrichida). Zool. Anz. **215** (1987), in press.

Foissner, W.: Die Gemeinschaftsstruktur der Ciliatenzönose in alpinen Böden (Hohe Tauern, Österreich) und Grundlagen für eine Synökologie der terricolen Ciliaten (Protozoa, Ciliophora). Veröff. Österr. MaB — Hochgebirgsprogramm **4** (1981), 7—52.

— Ökologie und Taxonomie der Hypotrichida (Protozoa: Ciliophora) einiger österreichischer Böden. Arch. Protistenk. **126** (1982), 19—143.

— Infraciliatur, Silberliniensystem und Biometrie einiger neuer und wenig bekannter terrestrischer, limnischer und mariner Ciliaten (Protozoa: Ciliophora) aus den Klassen Kinetofragminophora, Colpodea und Polyhymenophora. Stapfia (Linz) **12** (1984), 1—165.

— Soil protozoa: fundamental problems, ecological significance, adaptation, indicators of environmental quality, guide to the literature. In: Corliss, J. O., and Patterson, D. J., eds.: Progress in Protistology **2** (1987), in press.

— und Adam, H.: Morphologie und Morphogenese des Bodenciliaten *Oxytricha granulifera* sp. n. (Ciliophora, Oxytrichidae). Zool. Scr. **12** (1983), 1—11.

— Franz, H., und Adam, H.: Untersuchungen über das Bodenleben in ökologisch und konventionell bewirtschafteten Acker- und Gründlandböden im Raum Salzburg. Verh. Ges. Ökol. (Graz) **13** (1985), in press.

— und Peer, T.: Protozoologische Untersuchungen an Almböden im Gasteiner Tal (Zentralalpen, Österreich). I. Charakteristik der Taxotope, Faunistik und Autökologie der Testacea und Ciliophora. Veröff. Österr. MaB-Programms **9** (1985), 27—50.

— — und Adam, H.: Pedologische und protozoologische Untersuchung einiger Böden des Tullnerfeldes (Niederösterreich). Mitt. Österr. Bodenk. Ges. **30** (1985), 77—117.

Gelei, J.: Über die Lebensgemeinschaft einiger temporärer Tümpel auf einer Bergwiese im Börzsönygebirge (Oberungarn). III. Ciliaten. Acta Biol. Acad. Sci. Hung. **5** (1954), 259—343.

— und Szabados, M.: Massenproduktion in einer städtischen Regenwasserpfütze. Ann. Biol. Univ. Szegediensis **1** (1950), 249—294.

Gellért, J.: Életegyüttes a fakéreg zöldporos bevonatában. Acta Sci. Math. Nat. Univ. Kolozsvár **8** (1942), 1—36.

— Ciliaten des sich unter dem Moosrasen auf Felsen gebildeten Humus. Acta Biol. Acad. Sci. Hung. **6** (1956), 337—359.

— und Tamás, G.: Ökologische Untersuchungen der Kieselalgen und Ciliaten der Detritus-Driften an dem Südufer der Halbinsel Tihany. Ann. Biol. Hung. Acad. Sci. Tihany **26** (1959), 223—235.

Groliere, C.-A.: Descriptions de quelques ciliés hypotriches des tourbières a sphaignes et des étendues d'eau acides. Protistologica **11** (1975), 481—498.

Hemberger, H.: Revision der Ordnung Hypotrichida Stein (Ciliophora, Protozoa) an Hand von Protargolpräparaten und Morphogenesedarstellungen. Diss. Math.-Naturwiss. Fak. Univ. Bonn, Bonn 1982.

— Neue Gattungen und Arten hypotricher Ciliaten. Arch. Protistenk. **130** (1985), 397—417.

— and Wilbert, N.: Revision der Familie Keronidae Dujardin, 1840 (Ciliophora, Hypotrichida) mit einer Beschreibung der Morphogenese von *Kerona polyporum* Ehrenberg, 1835. Arch. Protistenk. **125** (1982), 261—270.

Horváth, J.: Ein neues hypotriches Infusor, *Kahlia acrobates* nov. gen., nov. sp. Arch. Protistenk. **77** (1932), 424—433.

— Beiträge zur hypotrichen Fauna der Umgebung von Szeged. I. Arch. Protistenk. **80** (1933), 281—302.

— *Kahlia simplex* nov. sp. alkata, élettani megvilágitásban. Acta Lit. Sci. R. Univ. Szeged **3** (1934), 60—76.

Kahl, A.: Urtiere oder Protozoa. I. Wimpertiere oder Ciliata (Infusoria), 3. Spirotricha. In: Dahl, F., ed.: Die Tierwelt Deutschlands. Jena 1932.

— Urtiere oder Protozoa. I. Wimpertiere oder Ciliata (Infusorie), 4. Peritricha und Chonotricha. In: Dahl, F., ed.: Die Tierwelt Deutschlands. Jena 1935.

Matsusaka, T.: Effect of cycloheximide on the encystment and ultrastructure of the ciliate, *Histriculus*. J. Protozool. **26** (1979), 619—625.

Pätsch, B.: Die Aufwuchsciliaten des Naturlehrparks Haus Wildenrath. Monographische Bearbeitung der Morphologie und Ökologie. Arb. Inst. Landwirtsch. Zool. Bienenk. Bonn **1** (1974), 1—82.

Penard, E.: Etudes sur les Infusoires d'eau douce. Geneve 1922.

Quennerstedt, A.: Bidrag till sveriges Infusorie-fauna. II. Acta Univ. Lund **4** (1867), 1—47.

Ramirez-Montesinos, P., and Perez-Silva, J.: *Oxytricha matritensis*, sp. nov. (Ciliados hipotricos). Microbiol. Esp. **19** (1966), 193—199.

Shibuya, M.: Ciliates found in soils from some parts of Japan. J. Imp. Agr. Exp. Stat. Tokyo **1** (1930), 200—214.

Small, E. B., and Lynn, D. H.: Phylum Ciliophora Doflein, 1901. In: Lee, J. J., Hutner, S. H., and Bovee, E. C., eds.: An illustrated guide to the protozoa. Lawrence 1985.

Sokal, R. R., and Rohlf, F. J.: Biometry. 2nd ed. San Francisco 1981.

Stiller, J.: Járólábacskás csillósak — Hypotrichida. Fauna Hung. **115** (1974), 1—187.

Stokes, A. C.: Some new hypotrichous infusoria from American fresh waters. Ann. Mag. Nat. Hist. (5. Ser.) **20** (1887), 104—114.

— Notes of new infusoria from the fresh waters of the United States. J. Roy. Microsc. Soc. 2. Ser. **1891** (1891), 697—704.

Tuffrau, M.: L'origine du primordium buccal chez les ciliés hypotriches. Protistologica **5** (1969), 227—237.

Wenzel, F : Die Ciliaten der Moosrasen trockener Standorte. Arch. Protistenk. **99** (1953), 70—141.

Wirnsberger, E., Foissner, W., and Adam, H.: Biometric and morphogenetic comparison of the sibling species *Stylonychia mytilus* and *S. lemnae*, including a phylogenetic system for the oxytrichids (Ciliophora, Hypotrichida). Arch. Protistenk. **132** (1986), 167—185.

Wrzesniowski, A.: Beobachtungen über Infusorien aus der Umgebung von Warschau. Z. wiss. Zool. **20** (1870), 467—511.

Received: February 6, 1986

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Zool. Jb. Syst. **114** (1987), 240
VEB Gustav Fischer Verlag Jena

Buchbesprechung

KNORRE, D. v., G. GRÜN, R. GÜNTHER und K. SCHMIDT (Hrsg.): Die Vogelwelt Thüringens (Avifauna der Deutschen Demokratischen Republik, Bd. 3). 339 Seiten, 24 Diagramme, 8 Tabellen, 23 Verbreitungskarten, 4 Karten, 53 Fotos. VEB Gustav Fischer Verlag, Jena 1986. Preis: Gebunden 35,— M, Ausland 48,— DM.

Im Rahmen der auf 5 Bände geplanten Avifauna der DDR liegt nach dem bereits 1977 erschienenen 1. Band über die Vogelwelt Mecklenburgs (nunmehr bereits in 3. Auflage) und dem 2. 1983 herausgegebenen über die Brandenburgs nun der 3. Band über die Vogelwelt Thüringens vor. Nach der 1979 über das Gesamtvorhaben und den Inhalt des 1. Bandes (Zool. Jb. Syst. **106**, 167) und 1984 über den des 2. (ibid. **111**, 142) erfolgten Besprechung sei hier zunächst auf die Beibehaltung des bewährten Aufbaus sowie der Gliederung (nach Verbreitung, Häufigkeit, Lebensraum, Bestandsentwicklung, Wanderungen usw.) bei den einzelnen Arten auch für die Ornis der Bezirke Erfurt, Gera und Suhl hingewiesen. Die Vogelwelt des seit dem 18. Jahrhundert durch die klassischen Vogelkundler BECHSTEIN, CHRISTIAN LUDWIG BREHM, v. BERLEPSCH, LIEBE und HILDEBRANDT berühmt gewordenen Gebietes wird nun unter spezieller Mitarbeit von 35 Feldornithologen sowie 5 Fachautoren unter der Führung von G. GRÜN, R. GÜNTHER und K. SCHMIDT, insbesondere aber von D. v. KNORRE, nach dem bis Ende August 1981 erreichten Stand mustergültig dargestellt, wobei freilich leider der nordöstlichste Teil unberücksichtigt bleibt, da zu Bezirk Halle gehörig.

Im einzelnen konnte dabei auch auf den 23 Verbreitungskarten nicht auf die natürliche Landschaftsgliederung Bezug genommen werden, für die von den Botanikern HIEKEL und SCHLÜTER außer einer (bunten) Karte der Flächennutzung und Naturraumgliederung eine ausgezeichnete Charakterisierung gegeben wird. Danach umrahmen 4 mehr oder weniger naturnahe Waldlandschaftstypen (auf Gebirgsböden, Buntsandstein, Muschelkalk und Zechstein) das zentrale Ackerhügel- und Bergstufenland, während Flußlandschaften und Gewässer nur eine untergeordnete Rolle spielen. Eine künftig mehr ökologisch auf Umwelt, Naturschutz und Landeskultur gerichtete Ornithologie findet in den insgesamt 11 ausgeschiedenen Typen eine angemessene Grundlage. 10 Bilder berühmter Thüringer Ornithologen, 20 Fotos typischer Landschaften sowie über 20 markanter Brutvögel bereichern die gründliche Bearbeitung des umfangreichen Datenmaterials, das allein 18 2spaltige Seiten Literatur umfaßt.

H. J. MÜLLER (Jena)