ACTA
PROTOZOOLOGICA

Acta Protozoologica (1993) 32: 175 - 182

Idiocolpoda pelobia gen. n., sp. n., a New Colpodid Ciliate (Protozoa, Ciliophora) from an Ephemeral Stream in Hawaii

Wilhelm FOISSNER

Universität Salzburg, Institut für Zoologie, Salzburg, Austria

Summary. *Idiocolpoda pelobia* gen. n., sp. n. was discovered in the mud of a dry river bed in Hawaii. Its morphology and infraciliature were studied in live cells using interference contrast optics and in specimens impregnated with silver carbonate and protargol. The new genus, *Idiocolpoda*, belongs to the family Colpodidae and is unique by having the oral apparatus located entirely at the left side of the body. The new species, *I. pelobia*, measures 25-40 x 15-30 µm and has a deep postoral groove which contains 2 specialized kineties. The two lowermost preoral kineties of the left side are distinctly shortened. The small oral apparatus is situated slightly above mid-body in the right half of the left side of the cell. The flat vestibulum is conspicuously scrotum-shaped and unroofed, exposing the oral polykinetids, which are very similar to those known from small species of the genus *Colpoda*, on the surface of the cell. An improved key to the genera of the family Colpodidae is provided.

Key words. Ciliophora, Colpodea, Colpodidae, ephemeral stream, Hawaii, *Idiocolpoda pelobia* gen. n., sp. n., infraciliature.

INTRODUCTION

55 genera with a total of 170 species are currently assigned to the class Colpodea (Foissner 1993). Most colpodid genera are defined by their oral structures which show a puzzling diversity. Some were thus originally misclassified as gymnostomes (e.g. *Platyophrya*), hypostomes (*Pseudochlamydonella*) or heterotrichs (e.g. *Bursaria*). The new genus described here is unique by having the oral apparatus located entirely at the left side of the body. *Idiocolpoda pelobia* thus looks like the mirror image of a small *Colpoda*.

Address for correspondence: W. Foissner, Universität Salzburg, Institut für Zoologie, Hellbrunnerstrasse 34, A-5020 Salzburg, Austria.

MATERIAL AND METHODS

Idiocolpoda pelobia was discovered on 26. 06. 1992 in a sample of dry mud collected from the bottom of a temporary stream in Hawaii, North Kohala, where Coastal Road 270 crosses the river bed about 100 m above sea-level (W 155° 50' N 20° 04'). This brooklet rises at Kaunu a Kaleloohie in the Kohala Mountains. It has a steep gradient and was dry when the sample was taken. No data are available as to often and at which times it carries water. The stream bed is full of small and large rock pools many of which have a cylindroid shape indicating that there are often strong water currents. The dry mud, which contained the cysts of *Idiocolpoda pelobia,* was collected from two large, rather flat rock pools (lithotelmes) in the centre of the river bed. The mud consisted of soil particles, plant debris and detritus, and was covered by a greenish algal crust.

In the laboratory, the dry mud was saturated with distilled water according to the non-flooded petri dish method (Foissner 1992a). The rewetted mud had pH 7.1 and was highly saline. *Idiocolpoda pelobia*

appeared 4 weeks after rewetting, when the salinity was already weaken because some soil water had been removed and replaced by distilled water during this time. Attempts to establish pure cultures with the usual methods failed. Thus, all results are based on material taken from the raw culture described above.

Cells were carefully studied in vivo using a high-power oil immersion objective and interference contrast (Foissner 1992b). The silver carbonate method, as described in Foissner (1992c), was used to reveal the infraciliature; it yielded excellent preparations. Biometry and drawings were done on protargol impregnated specimens (Foissner 1992d, protocol 1). However, the results with this method were rather mediocre because cells were covered by a thin, protargol-affine layer. Unfortunately, material was too scant to apply the Chatton-Lwoff silver nitrate method; the dry silver nitrate technique did not work, possibly because the material was saline too. Thus, no data can be provided on the silverline system.

Counts and measurements on silvered specimens were performed at a magnification of x 1,000. In vivo measurements were conducted at a magnification of x 250 - 1,000. Although these provide only rough estimates, it is convenient to give such data as specimens usually shrink in preparations or may even contract during fixation. Standard deviation and coefficient of variation were calculated following textbooks on statistics. Drawings of impregnated specimens were made with a camera lucida.

DESCRIPTION

Data shown in Table 1 are not repeated in the description, which follows the pattern used by Foissner (1993) in his monograph on colpodid ciliates.

Idiocolpoda gen. n.

Diagnosis: Small, bacteria feeding Colpodidae having oral apparatus located at left side of body. Vestibulum small, calotte-shaped, left wall projects over right. Right oral polykinetid composed of few, curved kineties.

Type species: *Idiocolpoda pelobia* sp. n.

Derivatio nominis: Composite of "idio" (peculiar, unusual) and "colpoda" (bosom); both Greek. Feminine.

Idiocolpoda pelobia sp. n. (Figs. 1-18, Tab. 1)

Diagnosis: In vivo about 25-40 x 15-30 µm. 12 somatic kineties, 2 of which distinctly shortened preorally on left side. 2 specialized postoral kineties in deep diagonal (postoral) groove. Vestibulum scrotum-shaped and unroofed, exposing oral polykinetids on surface of cell. Left polykinetid composed of 8, right of 4 kineties.

Type location: Temporary stream in Hawaii, North Kohala, W 155° 50', N 20° 04'.

Type specimens: A holotype and a paratype of *I. pelobia* as two slides of protargol impregnated cells have been deposited in the collection of microscope slides of the Oberösterreichische Landesmuseum in Linz, Austria.

Table 1

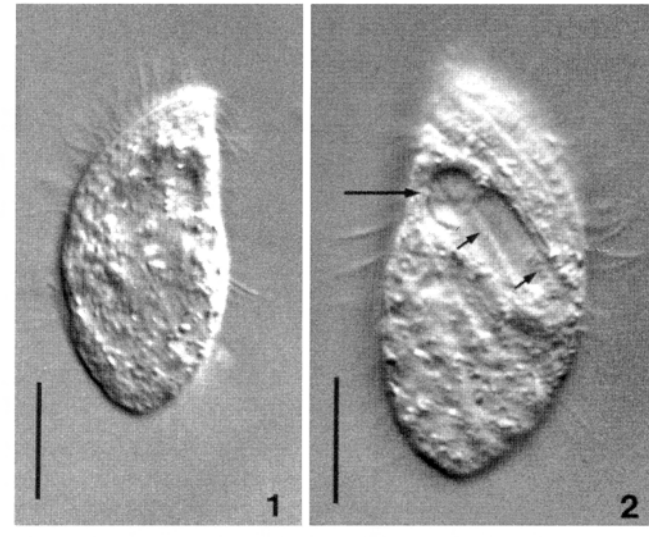
Morphometric characterization of *Idiocolpoda pelobia*[*]

Character	$\bar{x}$	M	SD	$SD_{\bar{x}}$	CV	Min	Max
Body, length	30.8	31.5	3.7	1.0	11.9	23	36
Body, width	16.6	16.5	2.8	0.7	16.8	13	21
Distance anterior end to vestibular opening	7.7	8.0	0.7	0.2	9.4	6	9
Distance anterior end to posterior end of vestibular opening	12.4	13.0	1.2	0.3	9.8	9	14
Distance anterior end to macronucleus	12.6	12.5	2.9	0.8	23.3	5	17
Macronucleus, length	5.4	5.0	0.7	0.2	13.9	4	7
Macronucleus, width	4.8	5.0	0.8	0.2	16.7	4	6
Micronucleus, length	2.7	2.5	0.3	0.03	11.8	2	3
Left oral polykinetid, length	3.4	3.0	0.5	0.1	14.8	3	4
Somatic kineties, number	12.4	12.0	0.6	0.2	5.1	11	13
Postoral kineties, number	2.0	2.0	0.0	0.0	0.0	2	2
Kineties in left oral polykinetid, number	7.6	8.0	0.5	0.1	6.5	7	8
Macronucleus, number	1.0	1.0	0.0	0.0	0.0	1	1
Micronucleus, number	1.0	1.0	0.0	0.0	0.0	1	1

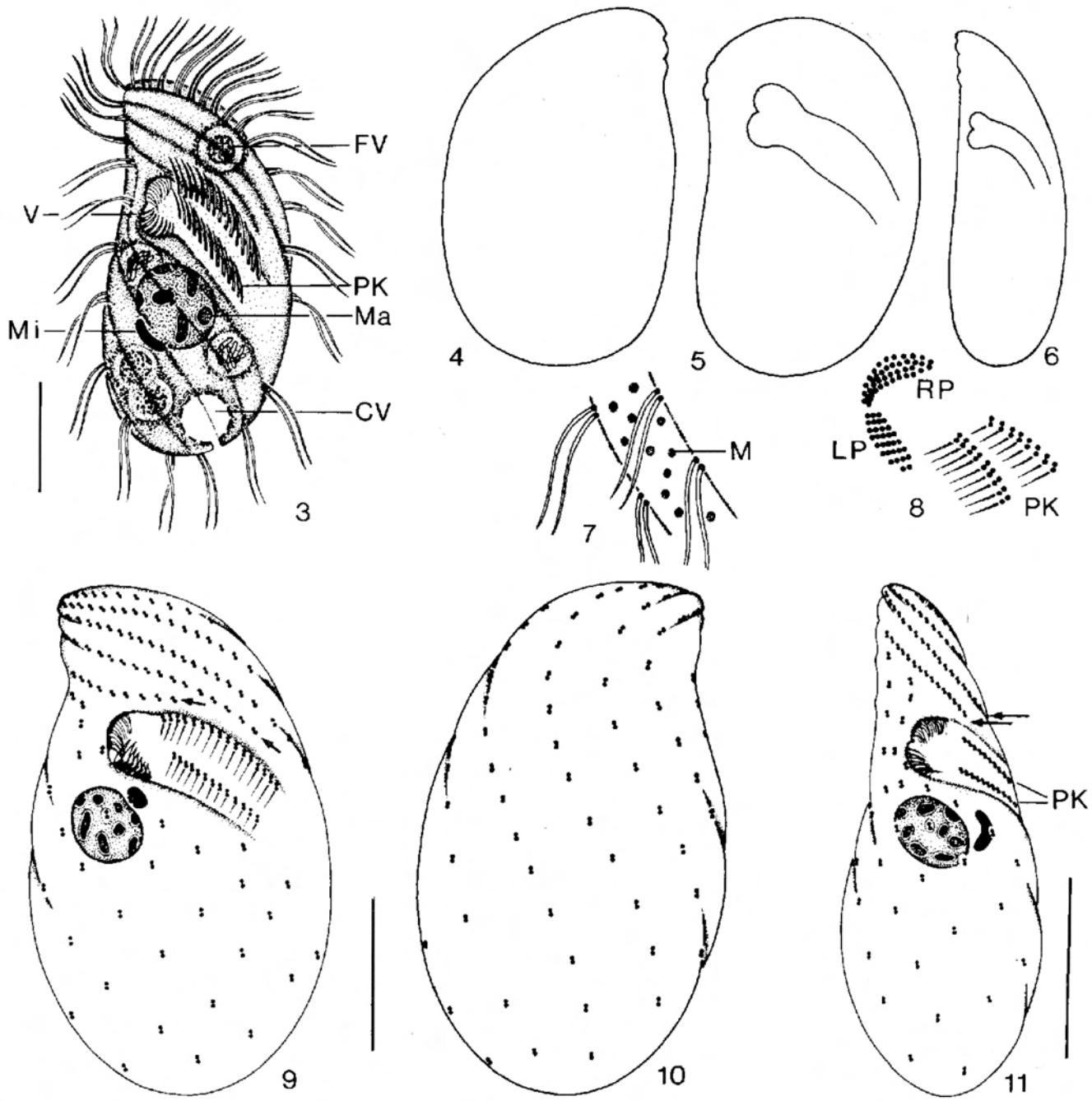
[*] All data based on 14 randomly selected, protargol impregnated and mounted specimens. All measurements in µm. Abbreviations: CV – coefficient of variation in %, M – median, Max – maximum, Min – minimum, SD – standard deviation, $SD_{\bar{x}}$ – standard deviation of the mean, $\bar{x}$ – arithmetic mean.

Derivatio nominis: "pelobia" is Greek and means living in mud.

Description: Colourless and rather hyaline. Size and shape highly variable, slenderly to broadly reniform



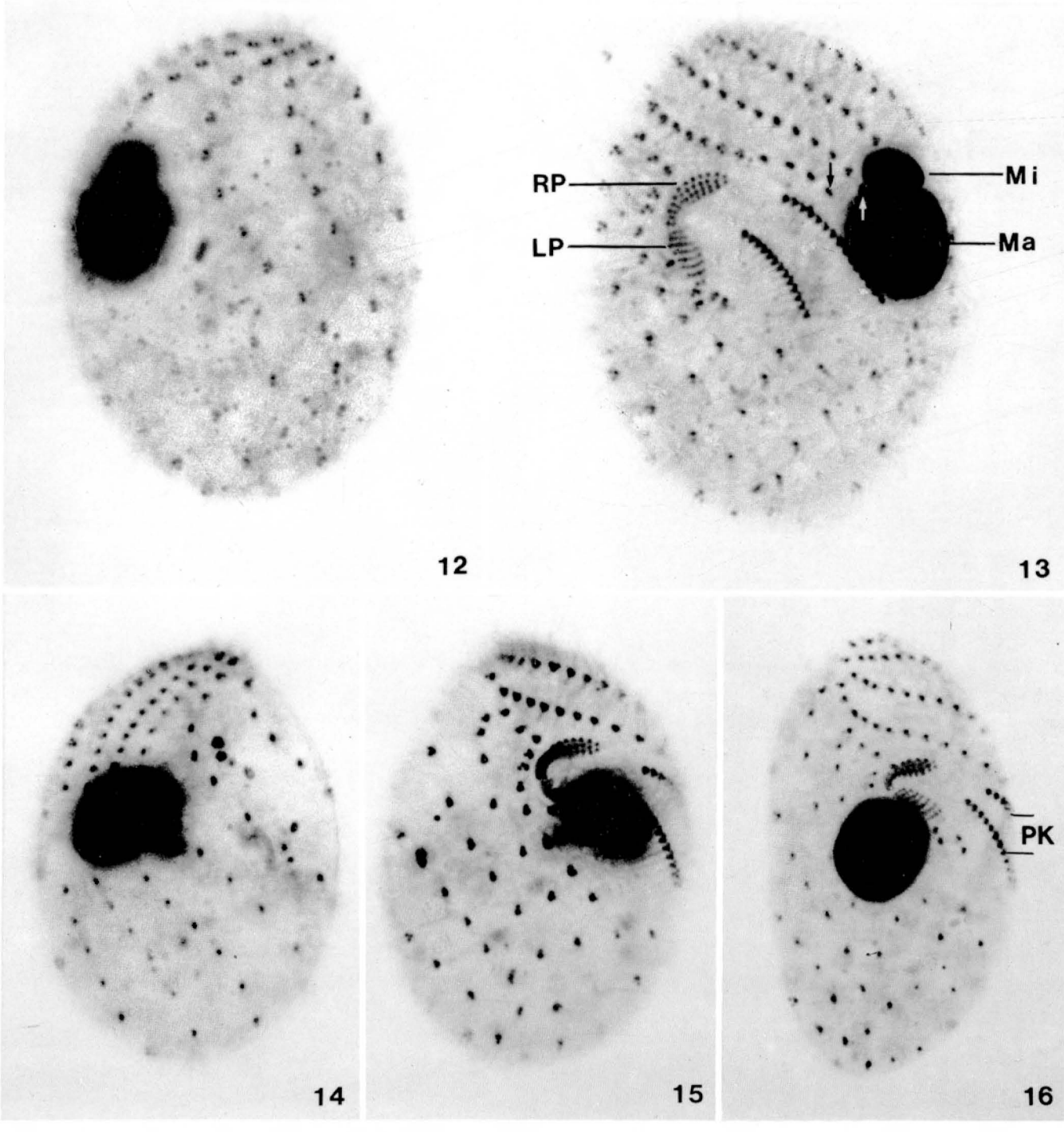
Figs. 1, 2. *Idiocolpoda pelobia*, interference contrast micrographs of live specimens. 1 - right lateral view of typical specimen; 2 - left lateral view of typical specimen showing scrotum-shaped vestibular opening (large arrow) and postoral kineties (small arrows) in deep diagonal groove extending obliquely from vestibulum to dorsal side. Bars - 10 µm



Figs. 3 - 11. *Idiocolpoda pelobia* from life (3-7), after silver carbonate impregnation (8), and protargol staining (9-11). 3 - left lateral view of typical specimen; 4, 5 - right and left lateral view of broad specimens; 6 - left lateral view of slender specimen; 7 - surface view showing loosely arranged cortical granules, very likely mucocysts; 8 - oral infraciliature; 9, 10, 11 - infraciliature of left, right, and ventral side. Arrows mark shortened preoral kineties. CV – contractile vacuole, FV – food vacuole, LP – left oral polykinetid, M – mucocyst, Ma – macronucleus, Mi – micronucleus, PK – postoral kineties in diagonal groove, RP – right oral polykinetid, V – vestibular opening. Bars – 10 µm

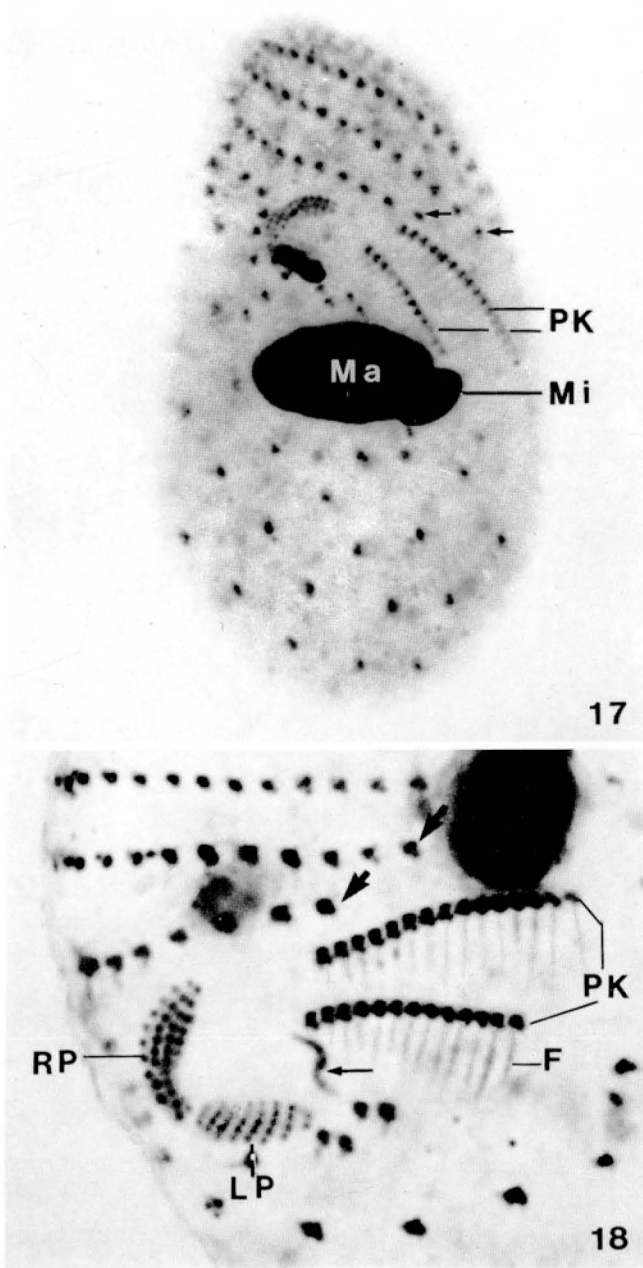
(Figs. 1-6). Dorsal side distinctly convex, ventral side flat or slightly concave, rarely convex. Anterior end sharply tapered to bluntly pointed, keel usually distinctly serrate by preoral kineties. Posterior end broadly rounded. Well-nourished cells almost circular in transverse view, theronts flattened up to 2:1. Ventral and dorsal view broadly to slenderly wedge-shaped, no postoral sack (Fig. 11). Postoral groove very conspicuous, extends diagonally from vestibulum across left side, gradually flattening and disappearing at dorsal side (Figs. 2, 3, 5, 9).

Macronucleus globular, near centre of cell, contains many ellipsoid nucleoli. Micronucleus loosely attached to macronucleus, conspicuous as main axis half as long



Figs. 12 - 16. *Idiocolpoda pelobia* after silver carbonate impregnation. 12, 13 - infraciliature of right and left side. Arrows mark shortened preoral kineties; 14, 15 - infraciliature of right and ventral side; 16 - infraciliature of ventral side. LP – left oral polykinetid, Ma – macronucleus, Mi – micronucleus, PK – postoral kineties, RP – right oral polykinetid. Figures purposely without scale bars since the applied staining technique leads to inavoidable distortions of the cells which would give meaningless measurements

as macronucleus, lenticular to slightly thorn-shaped, highly refractive in vivo but usually weakly stained by protargol (Figs. 13, 17). Contractile vacuole at dorsal posterior end, i.e. slightly left of median if cell is viewed from left side, releases content via single excretory pore. Cortex thin, flexible, in anterior half of cell distinctly furrowed by somatic kineties, contains loosely arranged, bright granules about 0.3 µm in diameter between kineties (Fig. 7); these granules are very likely mucocysts since protargol impregnated cells are coated by a thin (1 µm), homogenous layer which often obscures the infraciliature. Cytoplasm with few to many food



Figs. 17, 18. *Idiocolpoda pelobia* after silver carbonate impregnation. 17 - infraciliature of left side. Arrows mark shortened preoral kineties; 18 - high magnification of oral infraciliature. Large arrows mark shortened preoral kineties. Small arrow marks pharyngeal fibres. F – conspicuous fibres extending posteriad from dikinetids of postoral kineties, LP – left oral polykinetid, Ma – macronucleus, Mi – micronucleus, PK – postoral kineties, RP – right oral polykinetid. Figures purposely without scale bars since the applied staining technique leads to inavoidable distortions of the cells which would give meaningless measurements

vacuoles about 5 µm in diameter and many tiny (1 µm) crystals recognizable only in interference contrast by their silvery shimmer. Feeds on small bacteria.

Movement highly characteristic, viz. slow and trembling, like certain large flagellates with which this species is easily confused. Usually, *I. pelobia* glides shakily on the right side but, like all colpodids, it can also slowly swim in wide spirals by rotation about its long axis.

Somatic cilia about 7 µm long, paired throughout, closely spaced in anterior portion of kineties, especially on left side of cell. Ciliary rows course distinctly spirally from keel to posterior end. Lowermost preoral kineties of left side shortened, terminate at dorsal side (Figs. 9, 11, 13, 17). Kineties of right and left side abut at acute angles preorally; leftmost 2 kineties of right side abut at lowermost preoral kinety of left side (Figs. 11, 16). One to two sparsely ciliated kineties commence at vestibular opening and at posterior edge of diagonal groove. Two conspicuous postoral kineties extend obliquely from left border of vestibulum across left side of cell in diagonal groove. Dikinetids very closely spaced in postoral kineties, each possessing distinct fibre extending obliquely posteriad for a distance of about 5 µm (Figs. 8, 9, 18).

Oral apparatus sligthly above mid-body in right half of left side, small, but distinctly marked by deep postoral groove. Vestibulum flat, right wall conspicuously scrotum-shaped, left wall passes into postoral groove without distinct border. Vestibular roof absent or very inconspicuous, oral polykinetids thus exposed on surface of cell (Figs. 2, 3, 5, 6, 9, 17). Oral polykinetids small, abut at an angle of about 45°. Left polykinetid at bottom of vestibulum, elliptical, composed of regularly spaced rows of monokinetids. Right polykinetid at right vestibular wall, crescentic, composed of 4 regular rows of basal bodies; no dikinetidal row at its dorsal border (Figs. 8, 18).

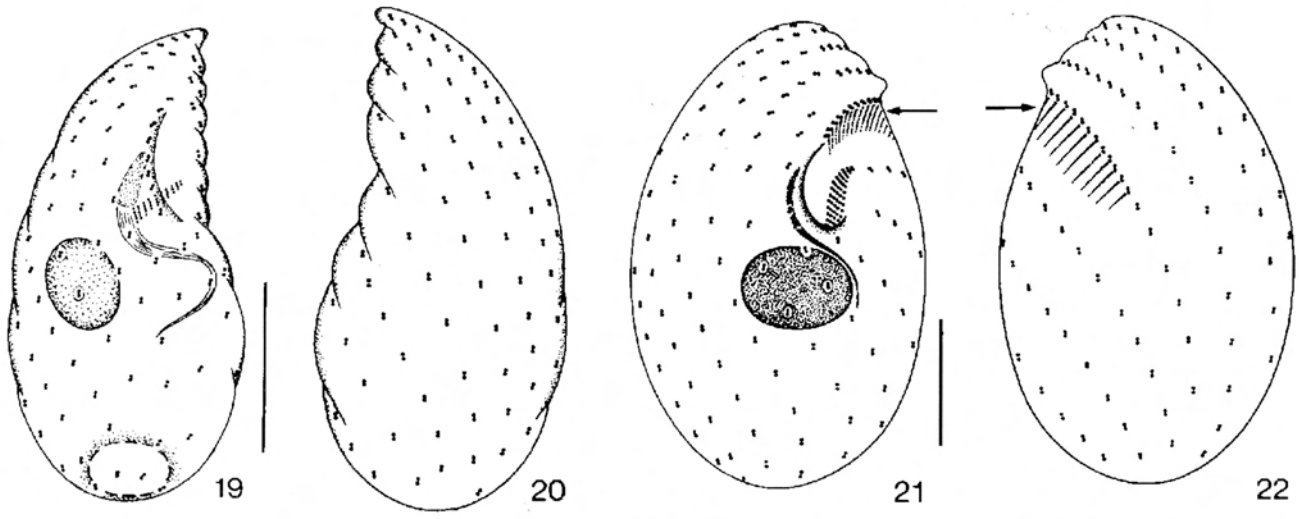
No data available on resting cysts and morphogenesis.

Occurrence: As yet found only at type location, together with 18 other ciliate taxa, some of which are new species too. A complete species list will be published at a later date.

DISCUSSION

Classification and comparison of *Idiocolpoda pelobia* with related taxa

Idiocolpoda pelobia has the typical characteristics of members of the family Colpodidae as defined by Foissner (1993), i.e. the vestibular opening is in the anterior half of the body and the right and left oral polykinetid are approximately equal in length. There are



Figs. 19, 20. *Colpoda edaphoni* (from Foissner 1993), infraciliature of right and left side. Note that vestibular opening is on right ventro-lateral side and not on left side as in *Idiocolpoda pelobia* (Fig. 3). Bar - 10 µm

Figs. 21, 22. *Apocolpoda africana* (from Foissner 1993), infraciliature of right and left side. Arrows mark specialized lowermost preoral kinety which is very similar to the specialized postoral kineties found in *Idiocolpoda pelobia*. The vestibular opening of *A. africana* is, however, on the right side. Bar - 10 µm

thus now seven well-defined genera in the family Colpodidae, four of which are monotypic (Fig. 23). These genera comprise 39 species (Foissner 1993). There is no indication that the family is polyphyletic, i.e. there is no firm character known which would suggest assigning the genera to two or more families.

Most colpodids have the oral apparatus located more or less distinctly at the right side of the body, so that at least the right vestibular wall or the paroral membrane extends on the right side of the cell (Fig. 23). The only known exceptions are a few members of the family Marynidae which have the oral apparatus shifted to the rear end of the body and to the left side of the preoral suture (Foissner 1993). *Idiocolpoda pelobia* is the first member of the family Colpodidae which has the oral apparatus located entirely on the left body surface. This causes a highly characteristic appearance of the live cells, which look like mirror-imaged, small Colpodas. In fact, I first classified *I. pelobia* as "*Colpoda aspera* (?)". It was only its curious trembling movement on the wrong (right) side that induced me to look at it in more detail.

Idiocolpoda pelobia lacks the right vestibular wall and the oral polykinetids are thus exposed on the surface of the cell. Such specializations are unknown in other members of the Colpodidae but occur in some species of the related family Hausmanniellidae. However, this similarity is very likely a convergence because the right oral polykinetid of *I. pelobia* is much more similar to those known from small *Colpoda* species (e.g., *C. aspera, C. steinii, C. maupasi*) than to those known from hausmanniellid colpodids.

Other remarkable characteristics of *I. pelobia* are the distinct diagonal (postoral, somatic) groove and the two specialized kineties extending within. Such specializations occur in most of the larger *Colpoda* species but are absent in the smaller members of the genus (Figs. 19, 20). There is, however, one small species, viz. *Apocolpoda africana* Foissner, 1993, which has similar characteristics (Figs. 21, 22). It is thus reasonable that *I. pelobia* and *A. africana*, which are known from the tropics only, are rather closely related.

The two specialized postoral kineties of *I. pelobia* are very likely displaced portions of the two lowermost preoral kineties which are shortened by about the number of dikinetids found in the postoral kineties. No other member of the order has shortened preoral kineties.

Idiocolpoda pelobia is easily recognizable, even in vivo, by the location of the oral apparatus and the scrotum-shaped vestibular opening. There is no other species known which has these characteristics [see Foissner (1993) for a detailed account of the whole class].

Key to the genera of the family Colpodidae (Fig. 23)

The following key is an adapted and refined version of that published by Foissner (1993), which includes a detailed discussion of all genera.

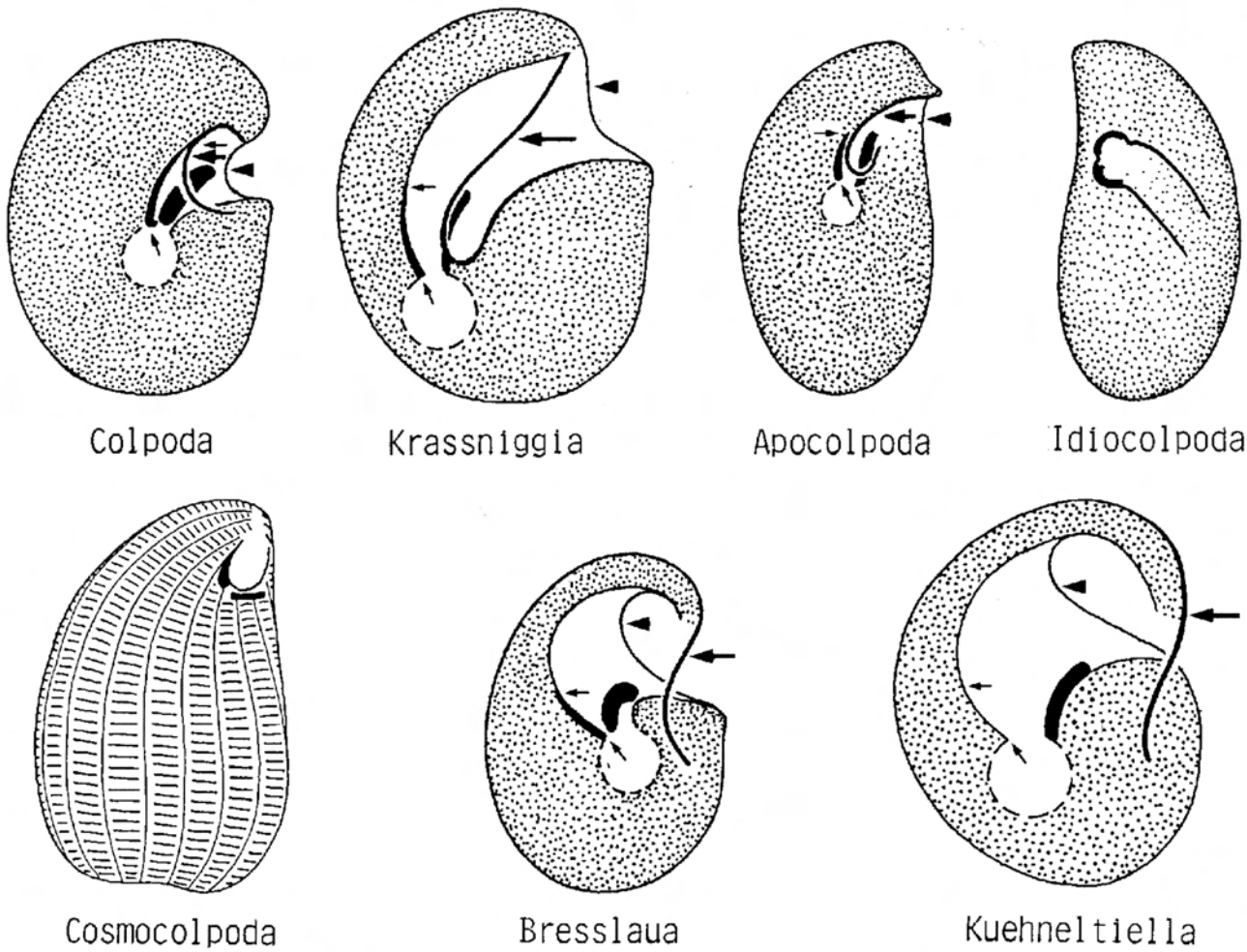


Fig. 23. Genus distinction in the family Colpodidae by the location of the oral apparatus (at left or right side of cell), the structure of the cortex (conspicuous ridges in *Cosmocolpoda*), the shape of the vestibulum (funnel-shaped in *Colpoda*, *Apocolpoda*, *Idiocolpoda* and *Cosmocolpoda*, cave-like in others), the shape of the right (large arrows) and left (arrowheads) vestibular wall, and the right oral ciliary field (small arrows), which consists of a single row of dikinetids in *Kuehneltiella* (from Foissner 1993; supplemented). Vestibulum and descending food vacuole unstippled, oral polykinetids shaded black, ends of right oral polykinetid marked by small arrows

1 Vestibulum large, occupies front half of cell which thus has conspicuous, bright patch anteriorly. Rapacious carnivores 5
– Vestibulum inconspicuous, i.e. usually small compared to size of cell. No bright patch anteriorly. Microphages usually feeding on bacteria..... 2
2 Right wall of vestibulum and oral opening on right or right ventro-lateral side of cell 3
– Right wall of vestibulum and oral opening on left side of cell ..... *Idiocolpoda*
3 Surface smooth or with tooth-like processes 4
– Surface ornamented ladder-like by conspicuous cortical crests..... *Cosmocolpoda*
4 Anterior cell half helmet-like due to distinct preoral ridge, the proximal edge of which forms the right vestibular wall and is aligned with a membranoid structure produced by the lowermost left lateral somatic kinety.....*Apocolpoda*
– Anterior cell half not helmet-like (usually rounded or acute) and without preoral ridge ..... *Colpoda*
5 Right wall of vestibulum overhangs semicircularly notched left vestibular wall; cell thus possesses conspicuous, bright, circular patch anteriorly 6
– Right wall of vestibulum extends utricle-like posteriad on right side of cell, i.e. does not overhang left vestibular wall..... *Krassniggia*
6 Right oral polykinetid composed of many short, disordered kineties (use silver carbonate impregnation) ..... *Bresslaua*
– Right oral polykinetid inconspicuous, composed of single row of dikinetids (use silver carbonate impregnation)..... *Kuehneltiella*

REFERENCES

Foissner W. (1992a) Estimating the species richness of soil protozoa using the "non-flooded petri dish method". In: Protocols in Protozoology (Eds. J. J. Lee, A. T. Soldo). Society of Protozoologists, Allen Press, Lawrence, Kansas, B-10.1 to B - 10.2.

Foissner W. (1992b) Observing living ciliates. In: Protocols in Protozoology (Eds. J. J. Lee, A. T. Soldo). Society of Protozoologists, Allen Press, Lawrence, Kansas, C-10.1 to C - 10.2.

Foissner W. (1992c) The silver carbonate methods. In: Protocols in Protozoology (Eds. J. J. Lee, A. T. Soldo). Society of Protozoologists, Allen Press, Lawrence, Kansas, C-7.1 to C-7.4.

Foissner W. (1992d) Protargol methods. In: Protocols in Protozoology (Eds. J. J. Lee, A. T. Soldo). Society of Protozoologists, Allen Press, Lawrence, Kansas , C- 6.1 to C-6.8.

Foissner W. (1993) Colpodea (Ciliophora). G. Fischer, Stuttgart, Jena, New York.

Received on 21st January, 1993