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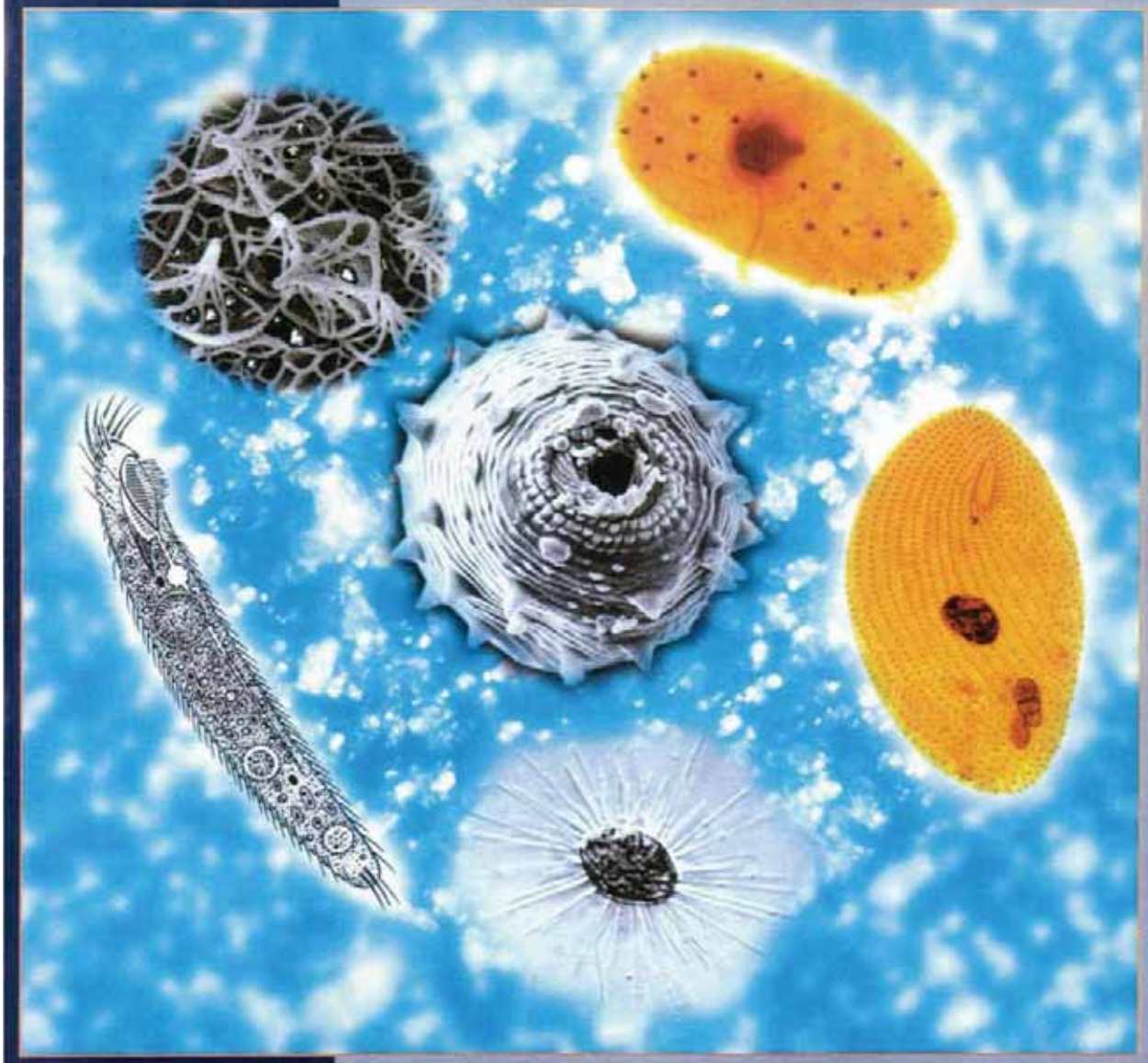

W. Foissner, S. Agatha & H. Berger

Soil Ciliates (Protozoa, Ciliophora) from Namibia (Southwest Africa), with Emphasis on two Contrasting Environments, the Etosha Region and the Namib Desert

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Soil Ciliates (Protozoa, Ciliophora) from Namibia (Southwest Africa), with Emphasis on Two Contrasting Environments, the Etosha Region and the Namib Desert

PART II: Photographs

Wilhelm FOISSNER, Sabine AGATHA and Helmut BERGER

Denisia

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June 2002

Fig. 222. Sampling site (4): Bukaos River bank. 11 new species.

Fig. 223. Sampling site (5): *Aloe dichotoma* forest at Gariganus Guest Farm.

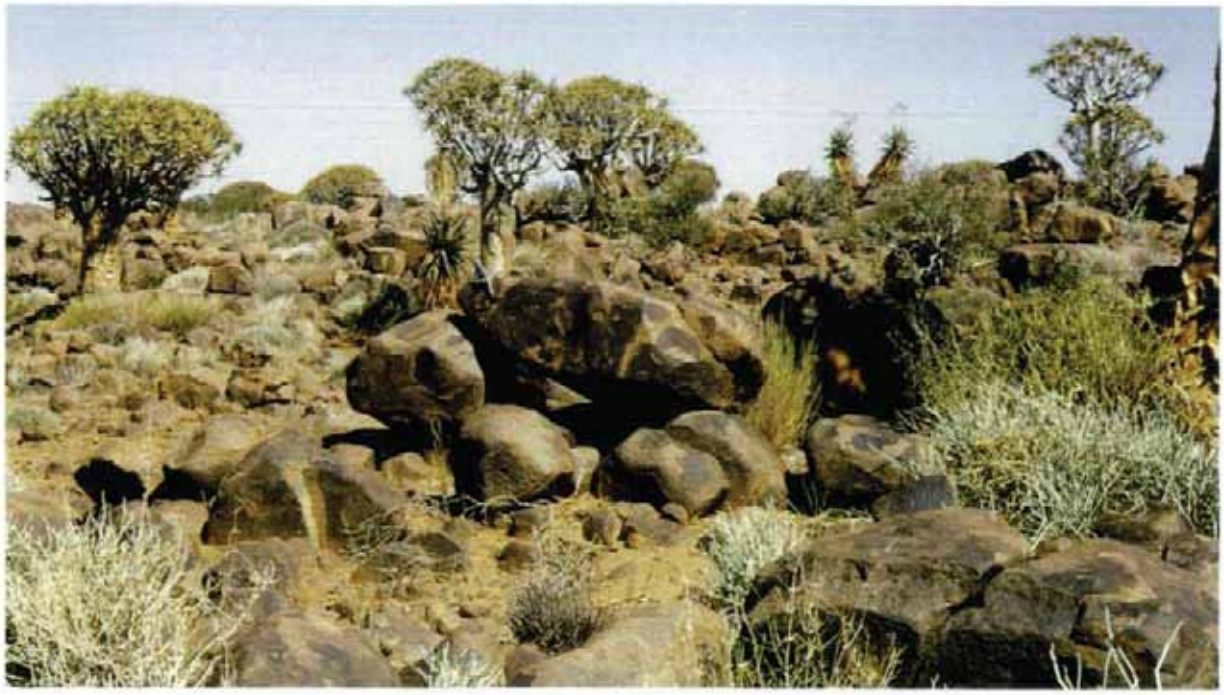


Fig. 224. Sampling site (5): *Aloe dichotoma* forest. 11 new species.

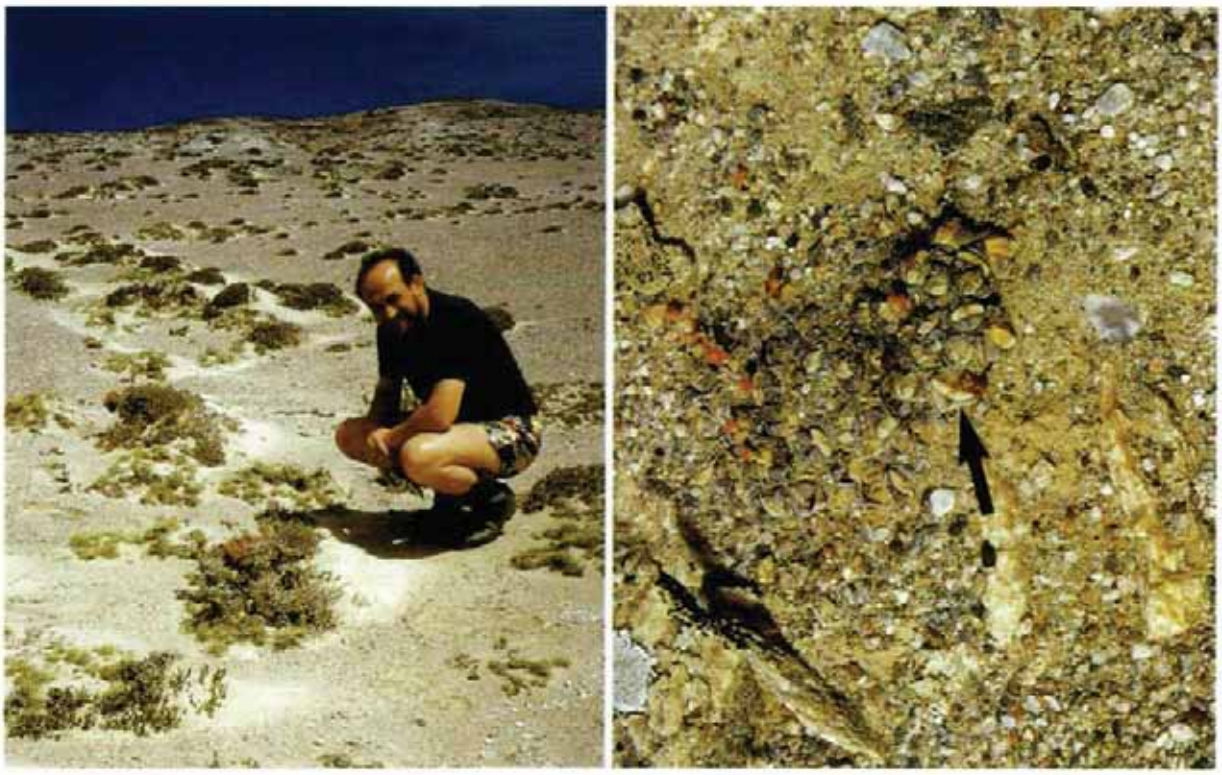


Fig. 225. Sampling site (10): Succulent steppe and W. FOISSNER near the town of Lüderitz.

Fig. 226. Sampling site (11): As figure 225. Arrow marks a "living stone".

Fig. 227. Sampling site (11): Transparent quartz stones have an organism rich crust soil on the side embedded in the ground (arrow). 4 new species.

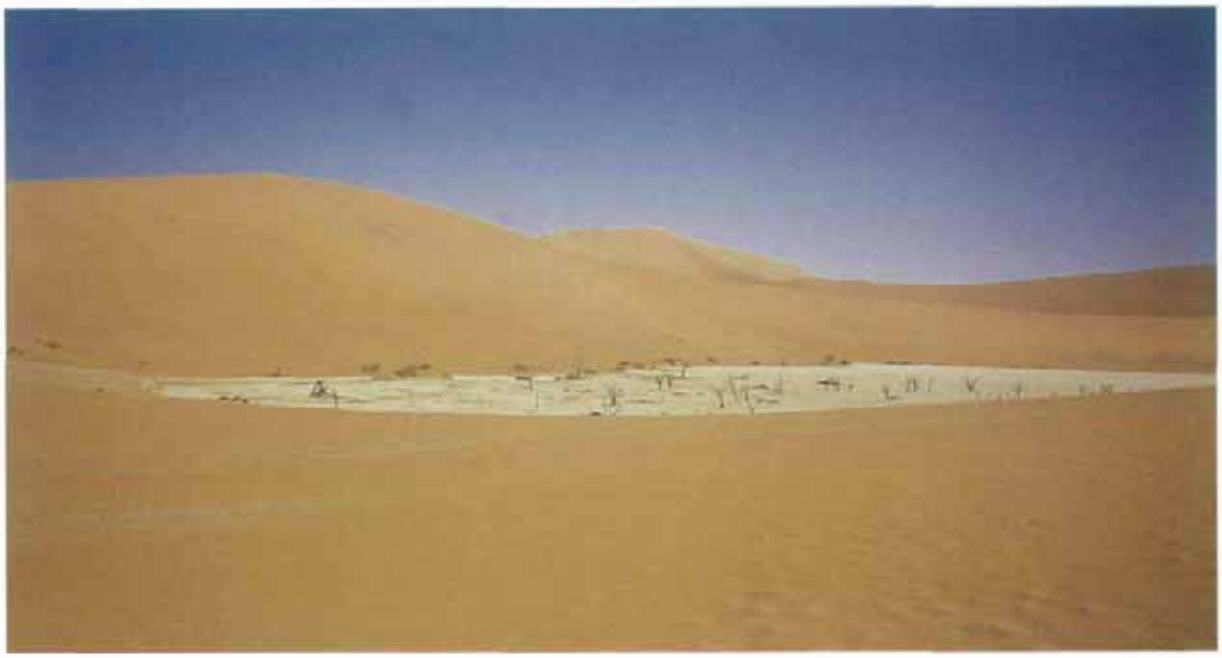


Fig. 228. Sampling site (21): Death Vlei in the Namib Desert.

Fig. 229. Sampling site (23): Southern Namib Desert, centre of Sossus Vlei.

Fig. 230. Sampling site (23): *Nara* shrubs in the Namib Desert.

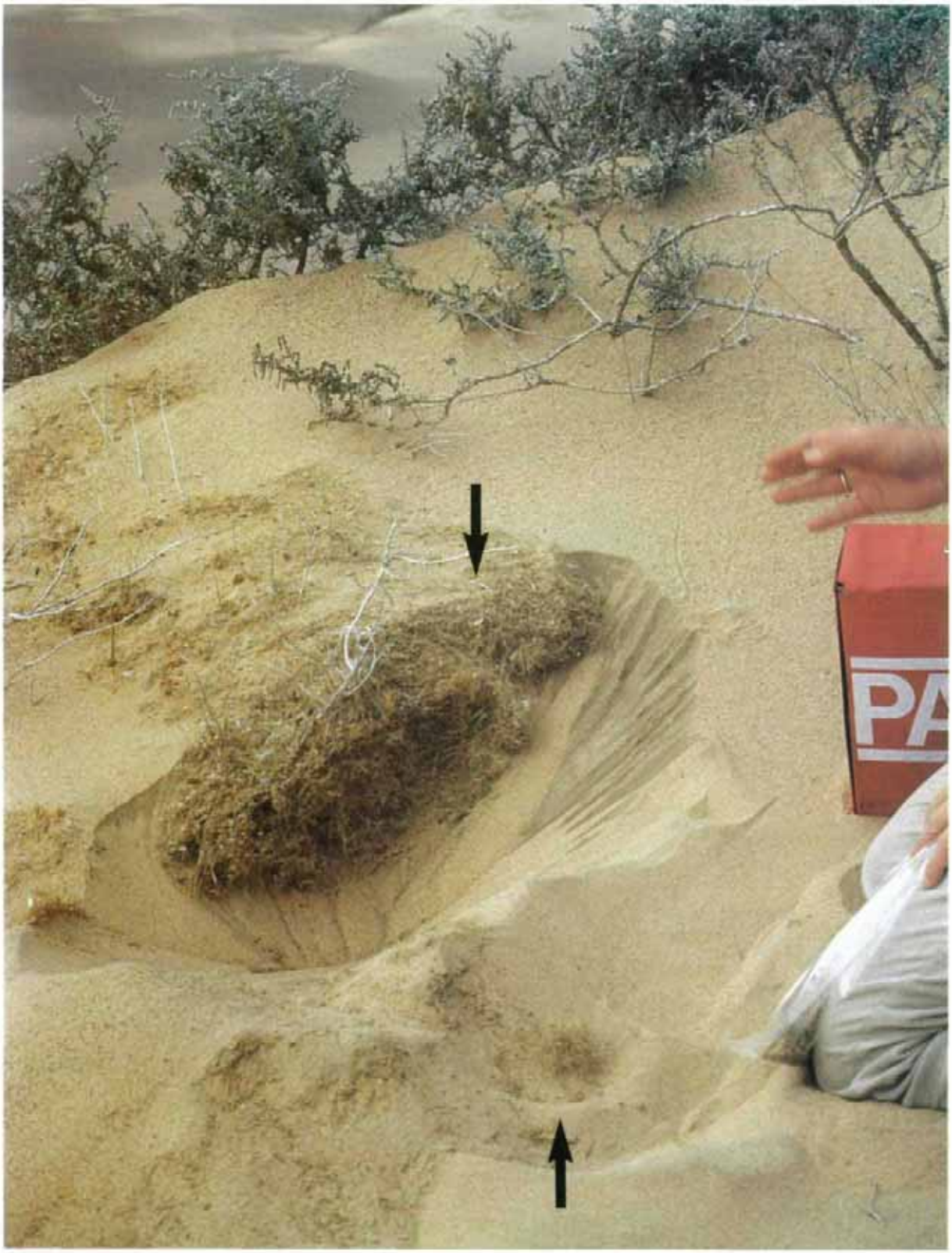


Fig. 231. Sampling site (23): Southern Namib Desert, centre of Sossus Vlei. The sand is full of plant residues, the food of microorganisms (arrows). 5 new species.

Fig. 232. Sampling site (26): Namib desert, base of dune 45. 3 new species.

Fig. 233. Margin of the southern Namib Desert.

Fig. 234. Sampling site (28): Upper region of the Aubschlucht in the Namib Escarpment. The Aubschlucht contains a nice stream with many rock-pools (see following pictures).

Fig. 235. Sampling site (29): Middle region of the Aubschlucht with many rock-pools. 5 new species.

Fig. 236. Sampling site (30): Lower region of the Aubschlucht, at the so-called Riedloch. 7 new species.

Fig. 237, 238. Sampling sites (32, 34): Central Namib Desert, Welwitschia drive. Even in this very meagre region, containing the famous *Welwitschia mirabilis*, 1 new ciliate species was discovered.

Fig. 239. Sampling site (36): Central Namib Desert, "Moon Landscape". 2 new species.

Fig. 240. Sampling site (39): Central Namib Desert at the Atlantic coast. Wide areas are covered by the orange lichen *Teloschistes capensis*. 2 new species.

Fig. 241. Sampling site (41): Rock-pools on the Spitzkoppe. 6 new species.

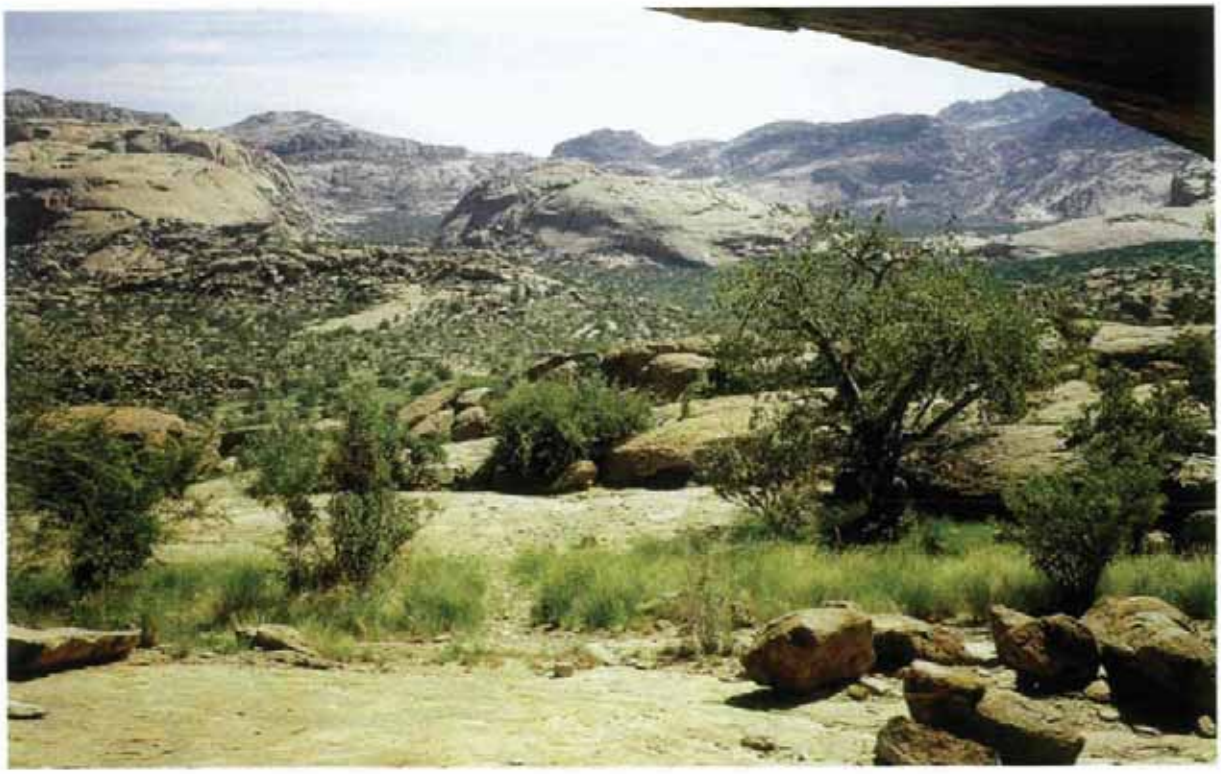


Fig. 242. Sampling site (43): Ameib Guest Farm area. 9 new species.

Fig. 243. Sampling site (52): Dung beetle in Mopane forest. 5 new species.

Fig. 244. Sampling sites (55, 56): Ghost tree forest in the Etosha region. 10 new species.

Fig. 245. Sampling site (57): Etosha Pan with Foissner's tracks. 11 new species.

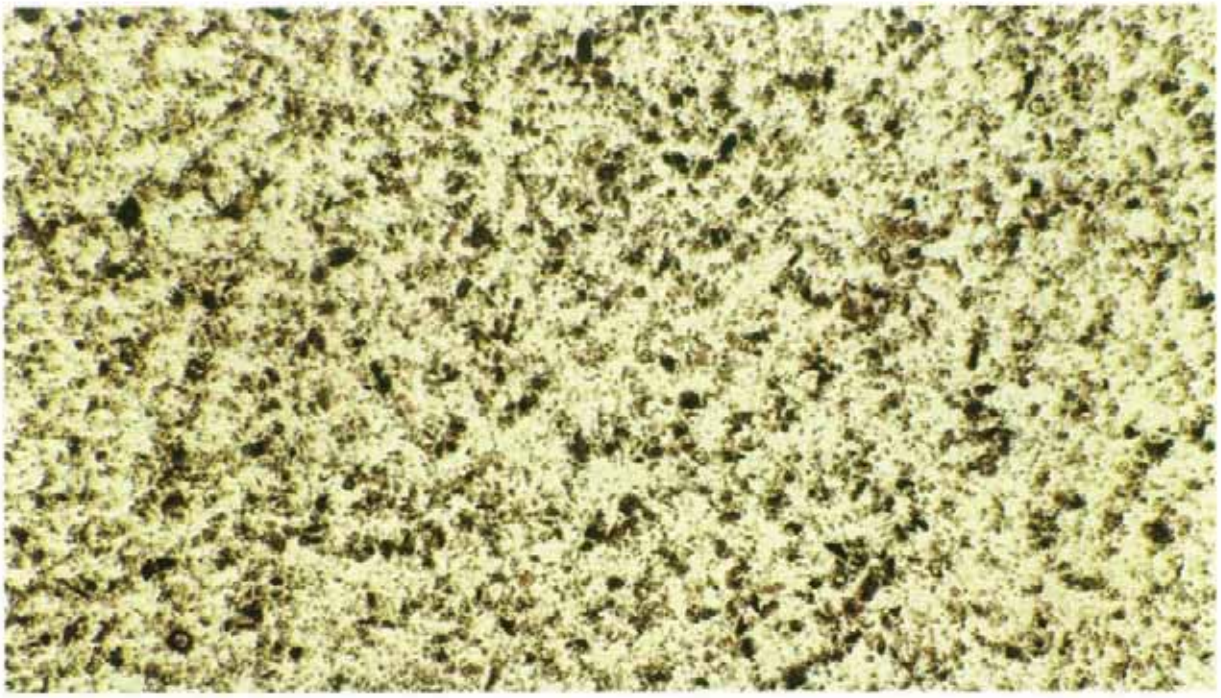


Fig. 246. Sampling site (57): Soil suspension at a magnificiation of X40.

Fig. 247. Sampling site (57): Non-flooded Petri dish culture covered with cyanobacteria after four weeks. 11 new species.

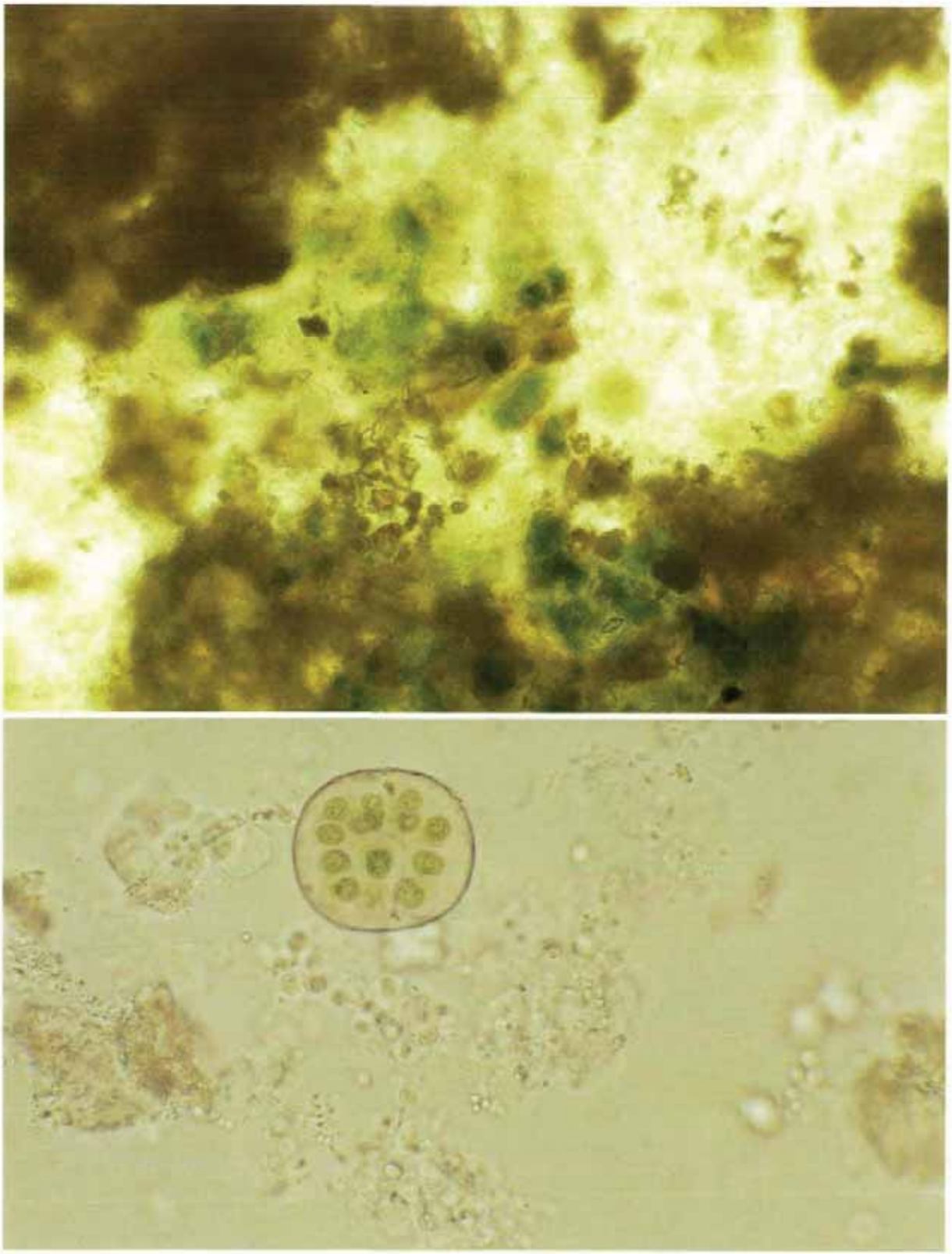


Fig. 248, 249. Sampling site (57): Suspended upper layer of a four weeks old non-flooded Petri dish culture. The soil is mixed with many organic debris (brown) and cyanobacteria (greenish).

Fig. 250, 251. Sampling site (57): The Pan soil is a mixture of clay, lime, and salt, pH 7.6–9.7. The air-dried mixture (Fig. 250) is like a stone, but quickly doubles its volume and becomes a fluffy pancake when rewetted (Fig. 251).

Fig. 252. Sampling site (58): Cyanobacterial crust at Pan margin. 2 new species.

Fig. 253, 254. Sampling site (59): Etosha Pan margin, salt bush and grass girdle. See also following figures. 4 new species.

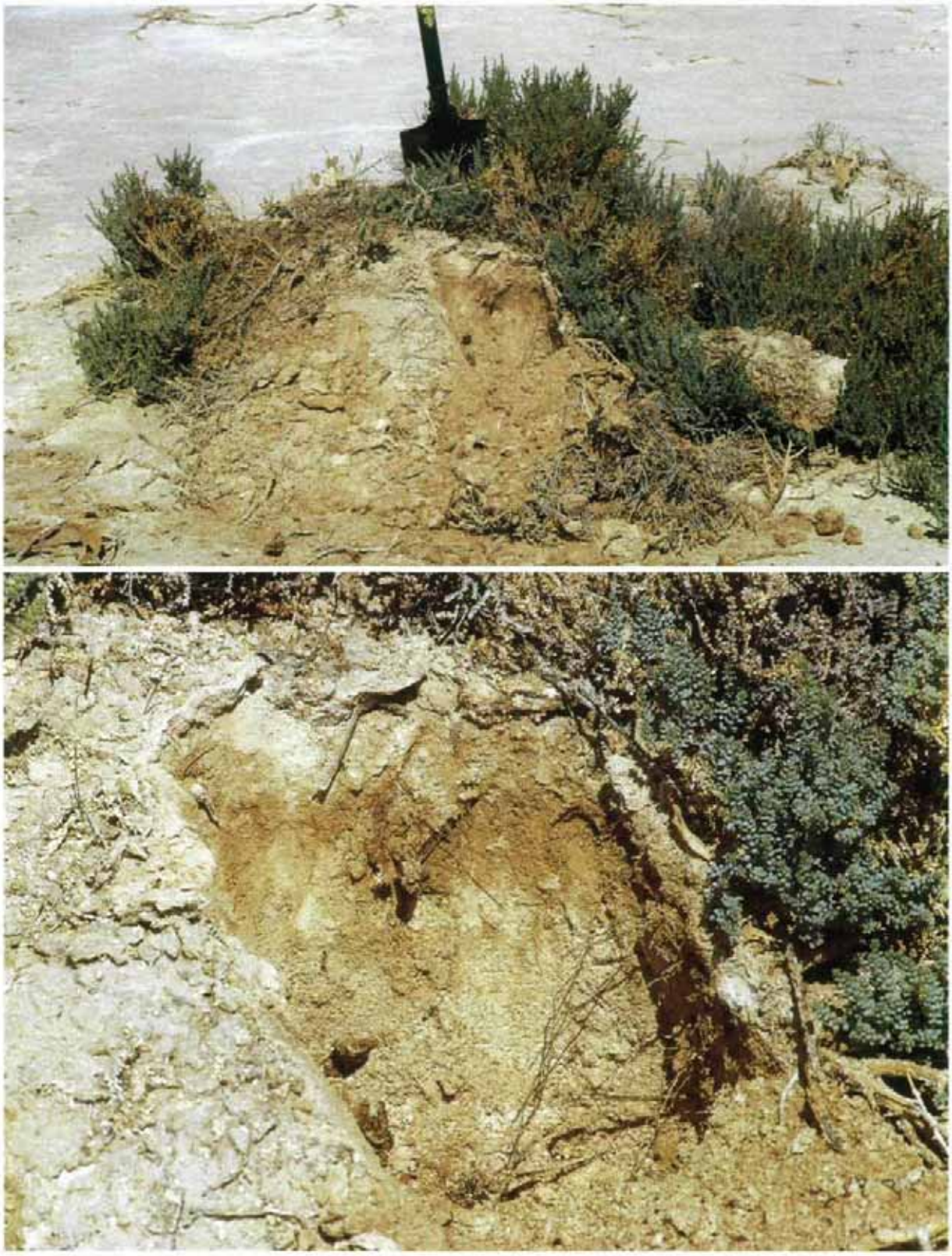


Fig. 255, 256. Sampling site (59): Etosha Pan margin, salt bush girdle. See also previous figures. Sand accumulates around the shrubs. It is mixed with much organic debris (brown spots) and contains steep salinity gradients.

Fig. 257. Sampling site (60): Etosha Pan margin, mixed grass and salt bush girdle. This figure shows why the Pan, which is in the background, was named "Etosha", that is, large, white place. 9 new species.

Fig. 258. Sampling site (62): Etosha Pan margin, thorn-bush girdle. 1 new species.

Fig. 259. Sampling site (63): Etosha Pan, *Mopane* savannah.

Fig. 260. Sampling site (65): Etosha Pan, small pan with many halophytes (see also next figure). 7 new species.

Fig. 261. Sampling site (65): A small salt pan covered with halophytes.

Fig. 262. Non-flooded Petri dish cultures.

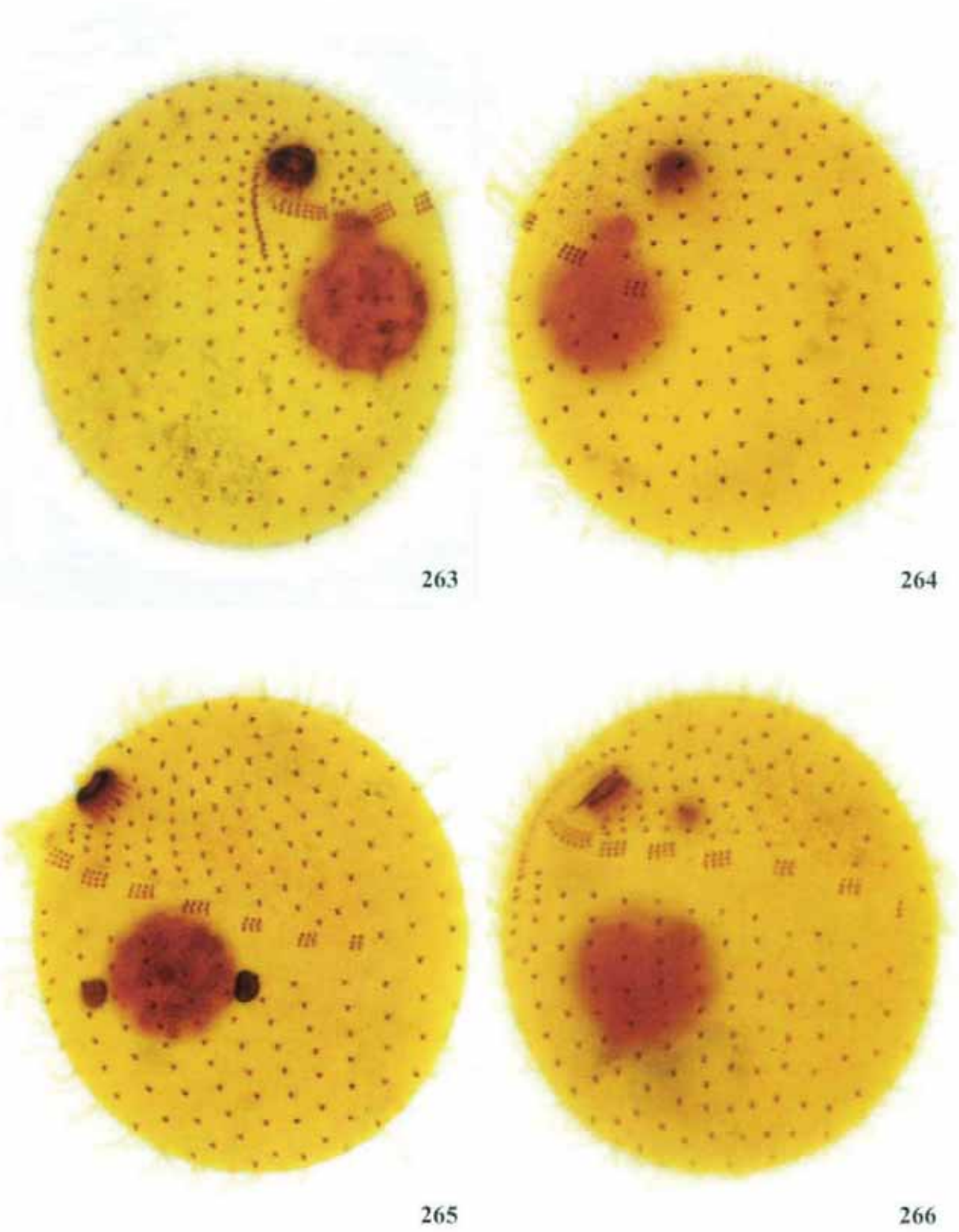


Fig. 263–266. *Nassula longinassa*, infraciliature and nuclear apparatus after silver carbonate impregnation. Note the distinct paroral membrane (263) and the two micronuclei (265). For labels, see black and white micrographs.

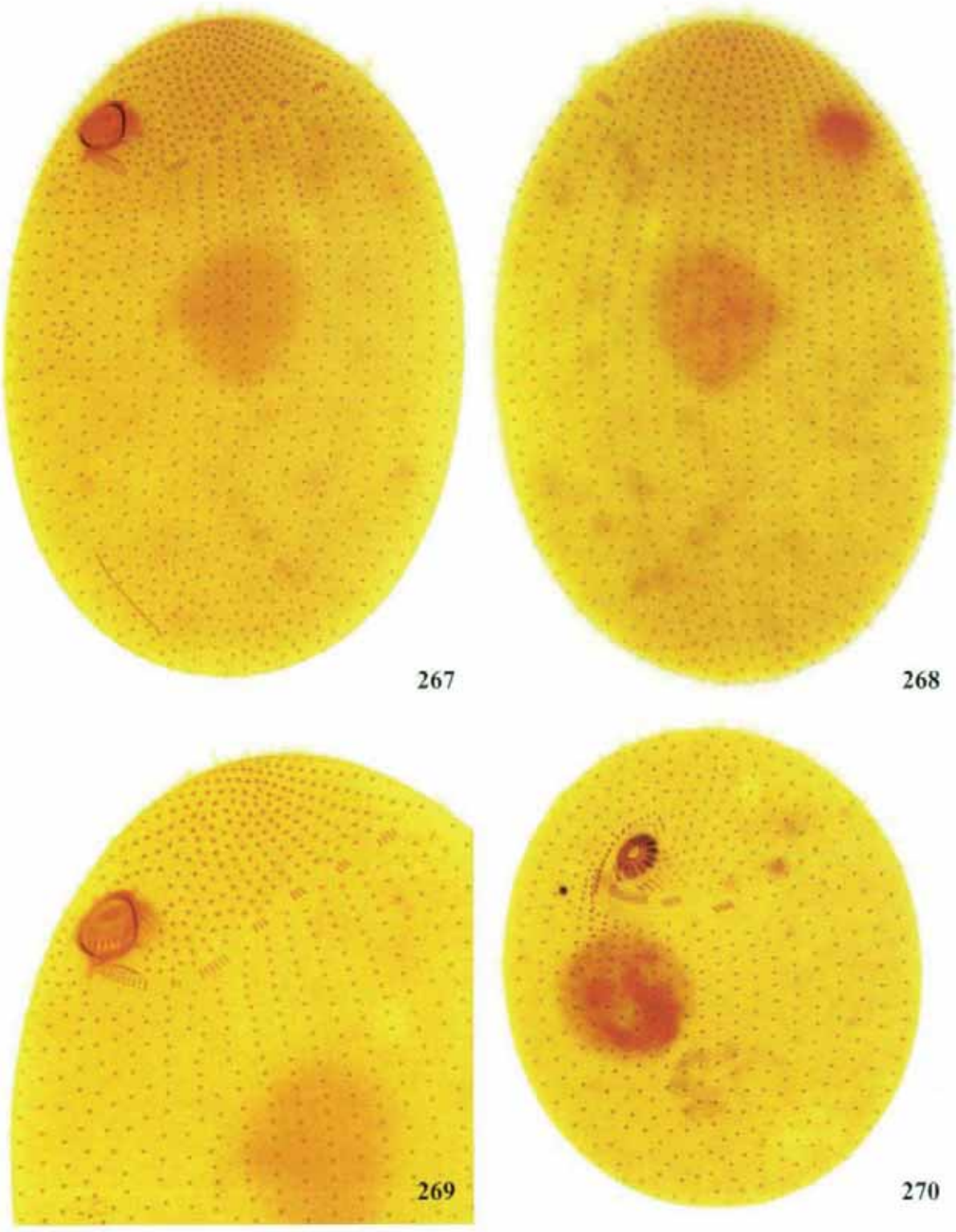


Fig. 267–269. *Nassula granata*, infraciliature after silver carbonate impregnation. The hypostomial organelle band ends at level of oral opening.

Fig. 270. *Naxella rosea* has a distinct paroral and only three hypostomial organelles (silver carbonate impregnation).

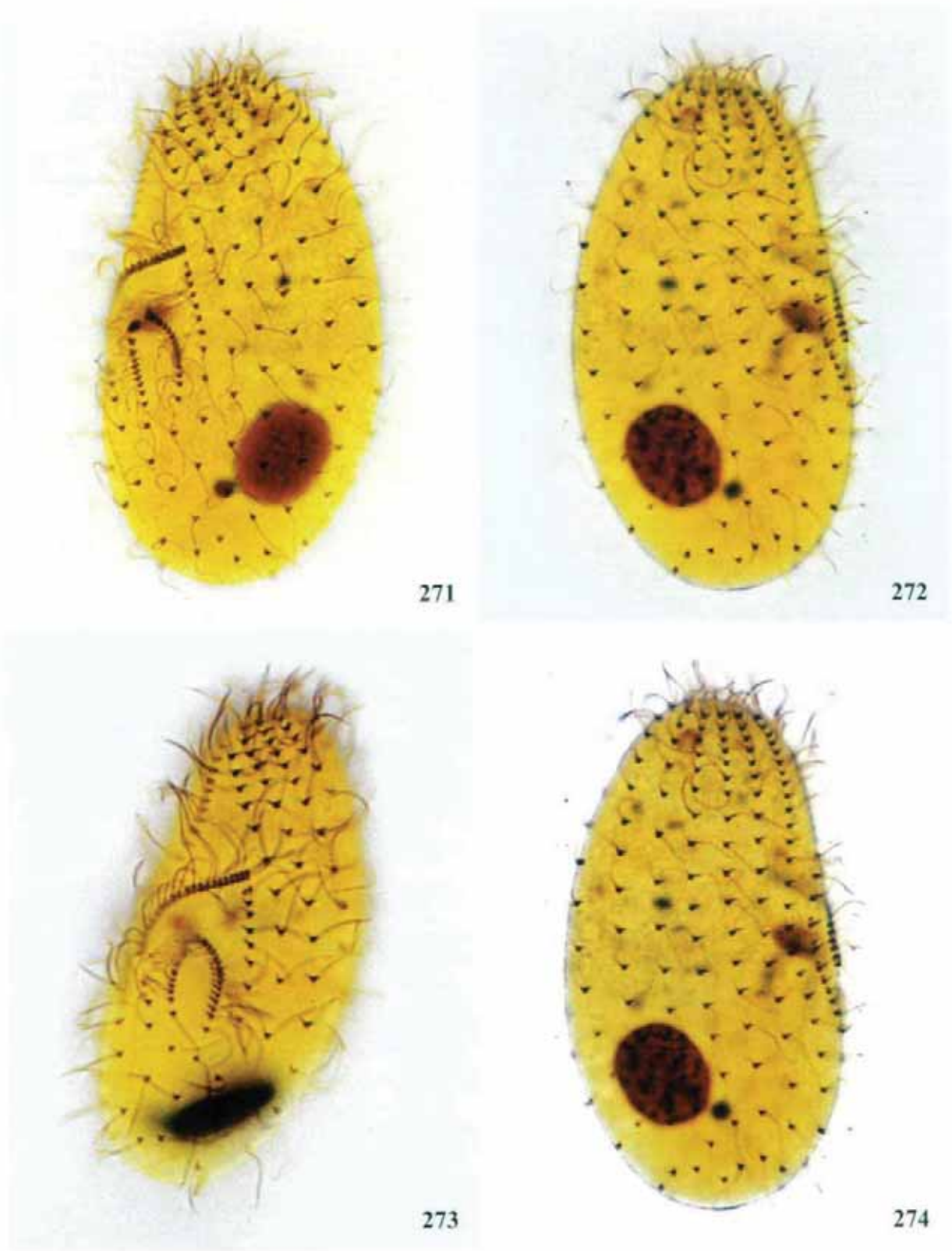


Fig. 271–274. *Colpodidium (Colpodidium) trichocystiferum*, infraciliature and nuclear apparatus after silver carbonate impregnation.

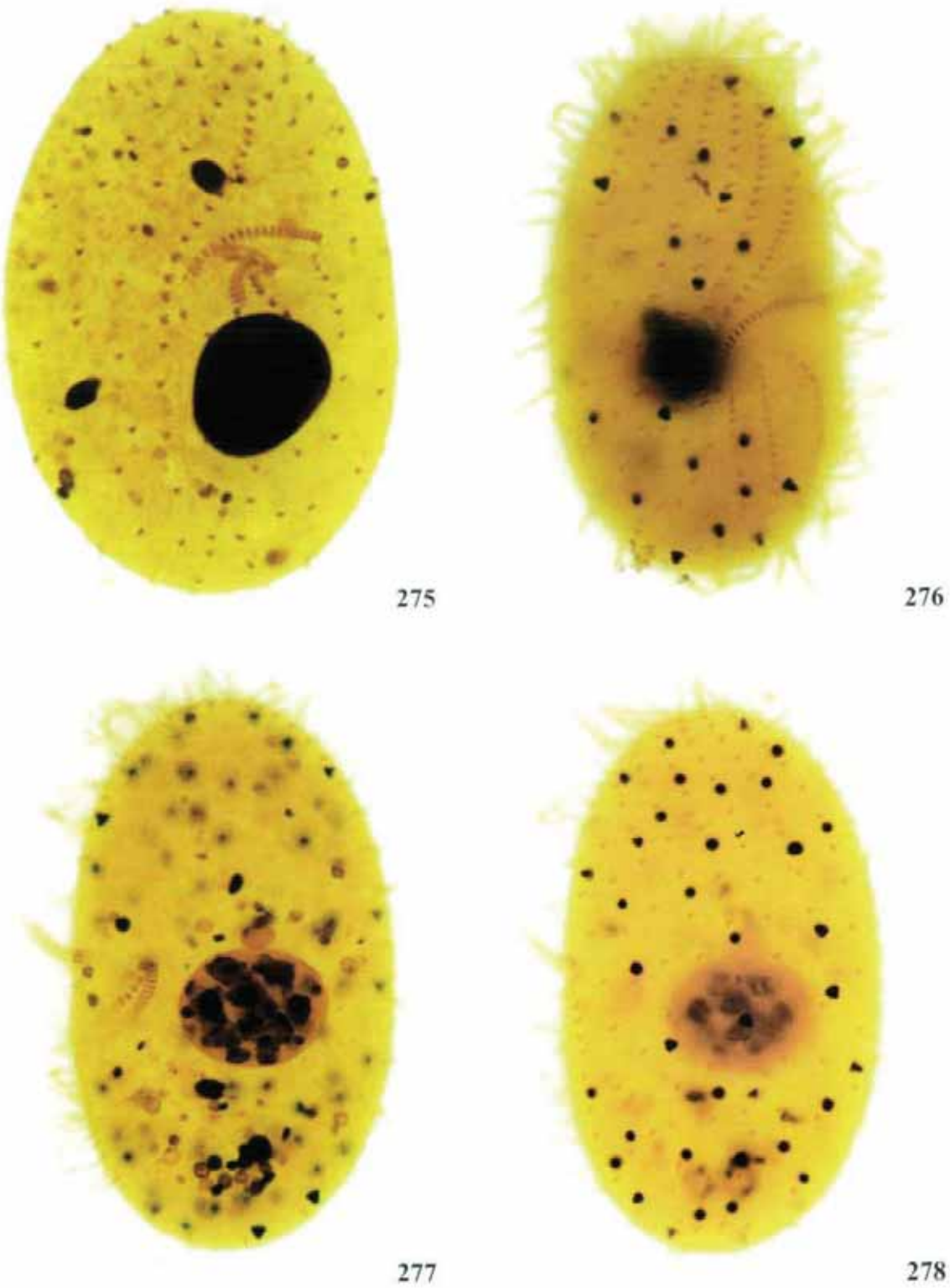


Fig. 275–278. *Colpodidium (Colpodidium) horribile*, infraciliature and nuclear apparatus after silver carbonate impregnation. The peculiar extrusomes appear as large, black dots (276-278). For labels, see black and white micrographs.

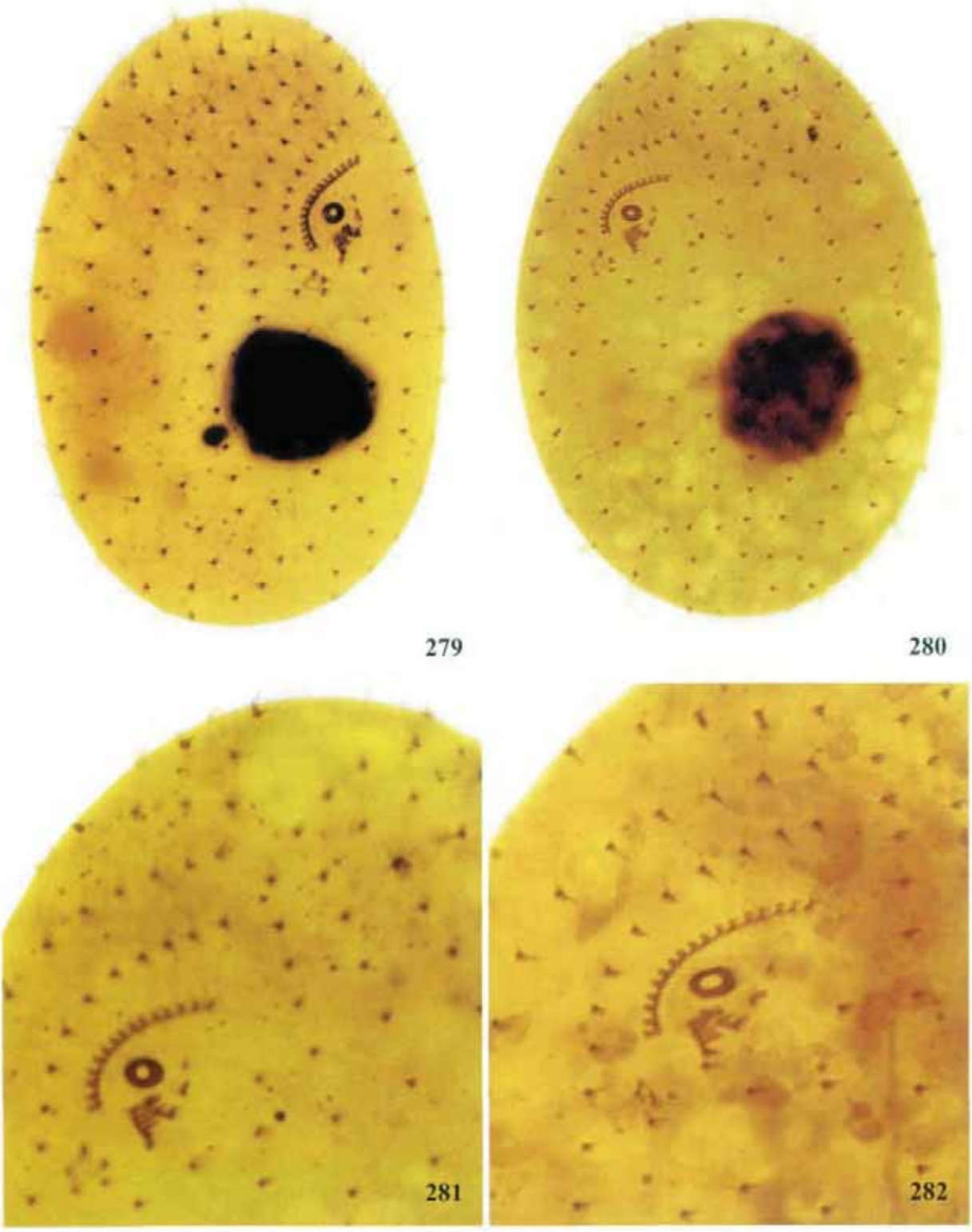


Fig. 279–282. *Apocolpodidium (Apocolpodidium) etoschense*, infraciliature and nuclear apparatus after silver carbonate impregnation.

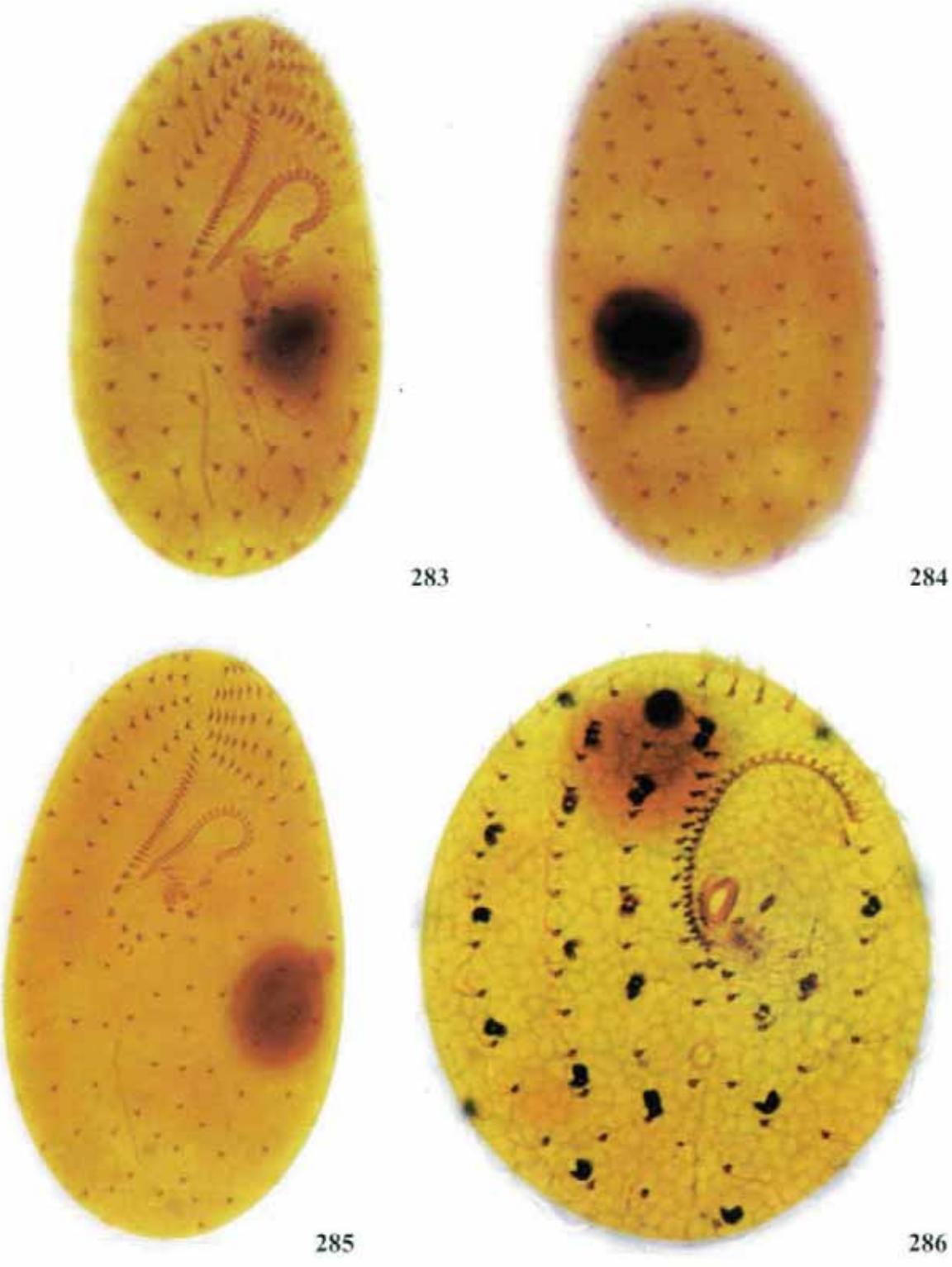


Fig. 283–286. *Pedohymena australiense* (283-285) and *Apocolpodidium (Phagoon) macrostoma* (286), infraciliature and nuclear apparatus after silver carbonate impregnation. Note the huge paroral membrane in *A. (Phagoon) macrostoma*.

Fig. 287–290. *Gastrostyla (Gastrostyla) steinii*, morphostatic (287) and dividing (288-290) specimens after protargol impregnation. Note the four macronuclear nodules and the W-shaped pattern formed by proter anlagen 4-6. See black and white micrographs for detailed labels.

Fig. 291. *Gastrostyla (Gastrostyla) steinii*, ventral view of an early divider after protargol impregnation. See black and white micrographs for detailed labels. Dorsal side is shown in next micrograph.

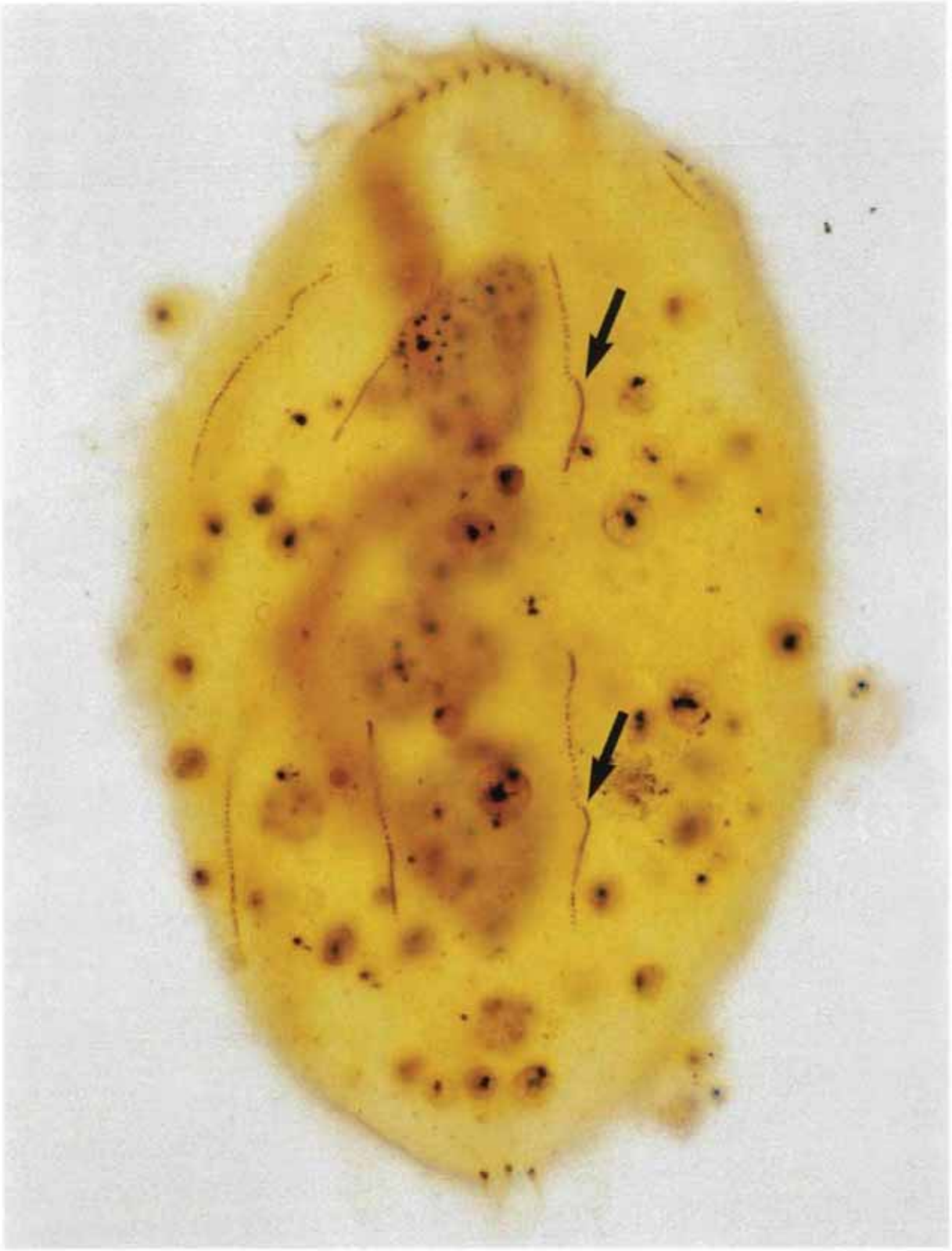


Fig. 292. *Gastrostyla (Gastrostyla) steinii*; dorsal view of the specimen shown in figure 291. Arrows mark beginning fragmentation of dorsal kinety 3, producing kinety 4. Note the three minute caudal cirri at rear end.

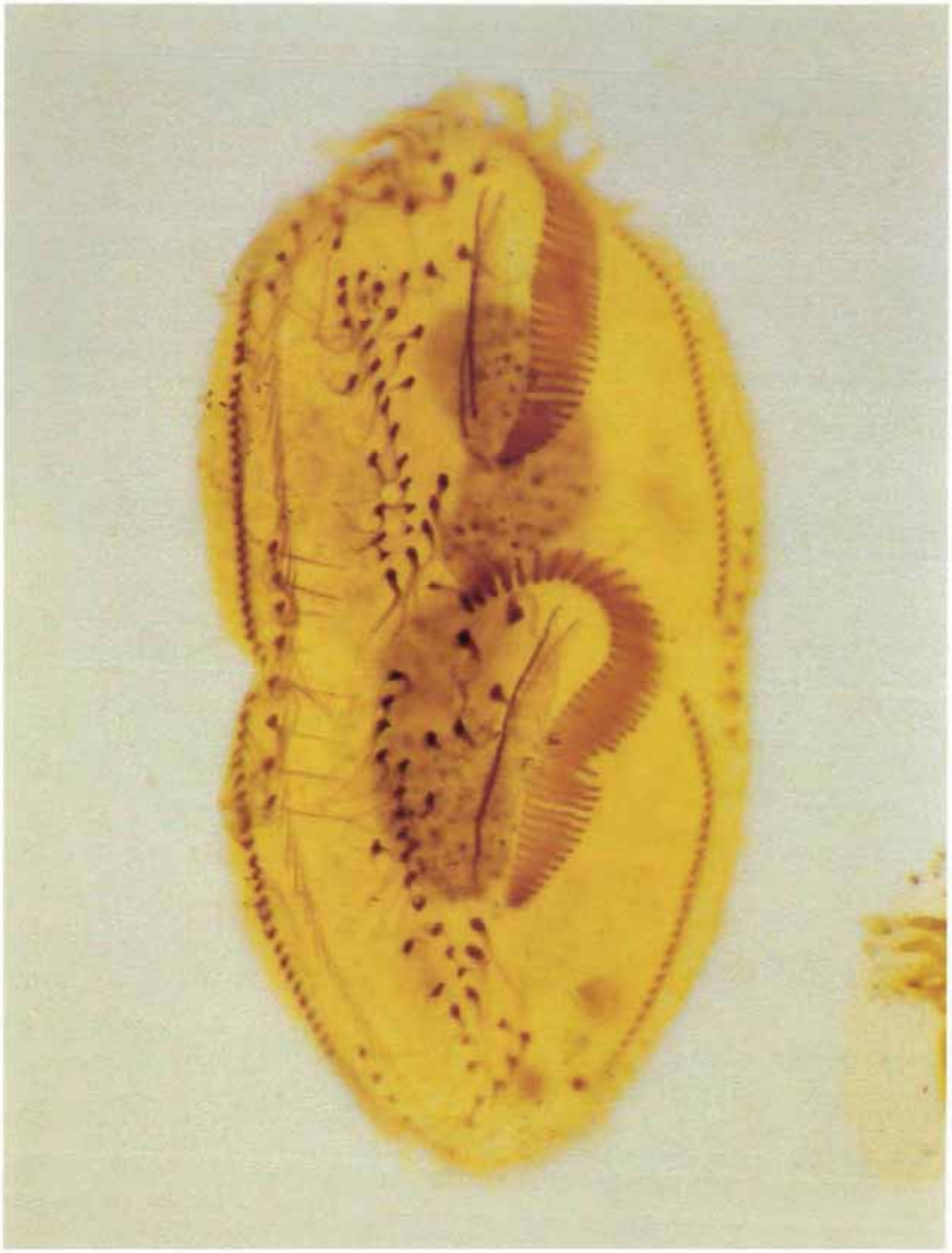


Fig. 293. *Gastrostyla (Gastrostyla) steinii*, ventral view of a late divider after protargol impregnation. The new cirral pattern is already recognizable.

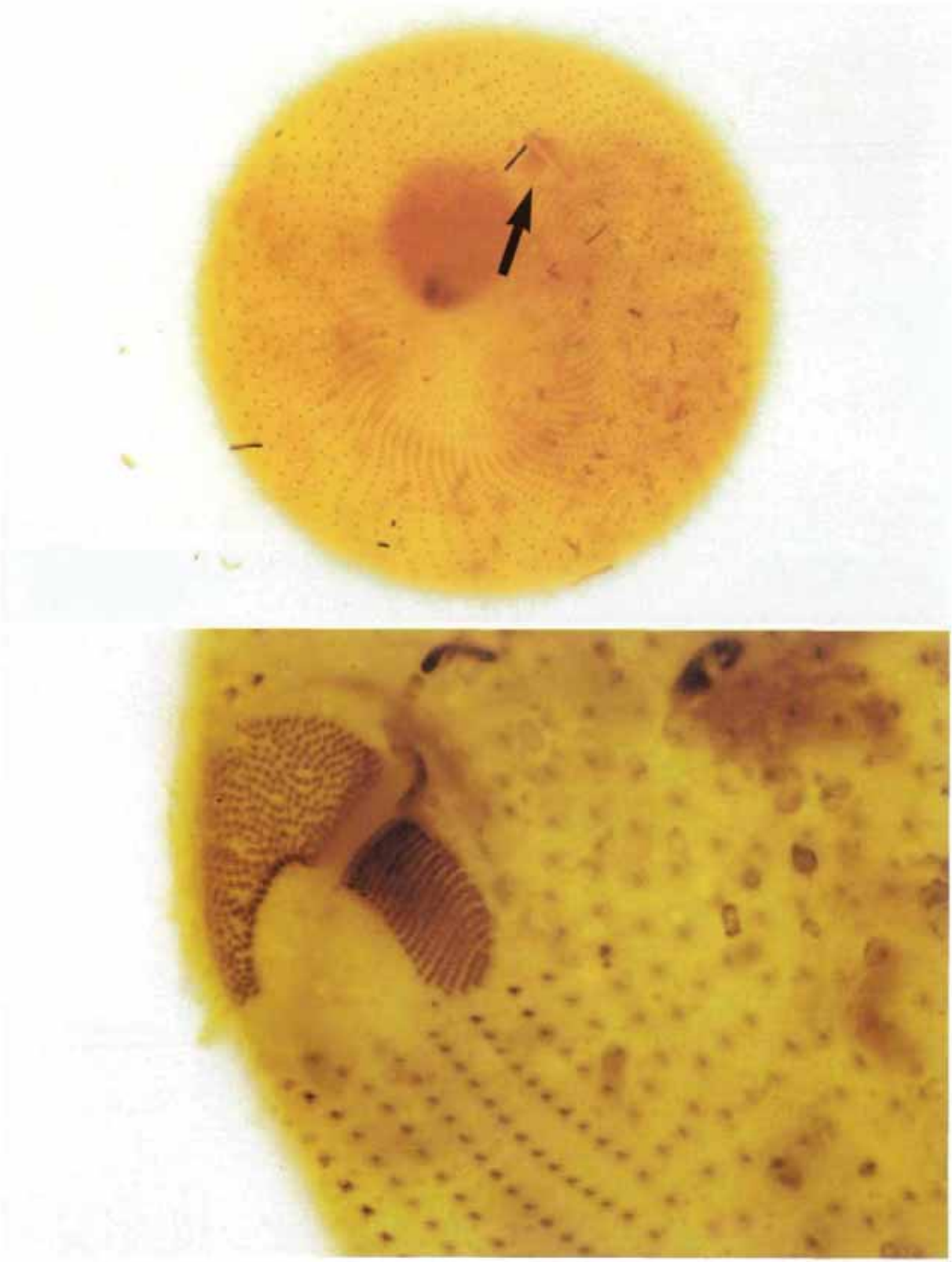
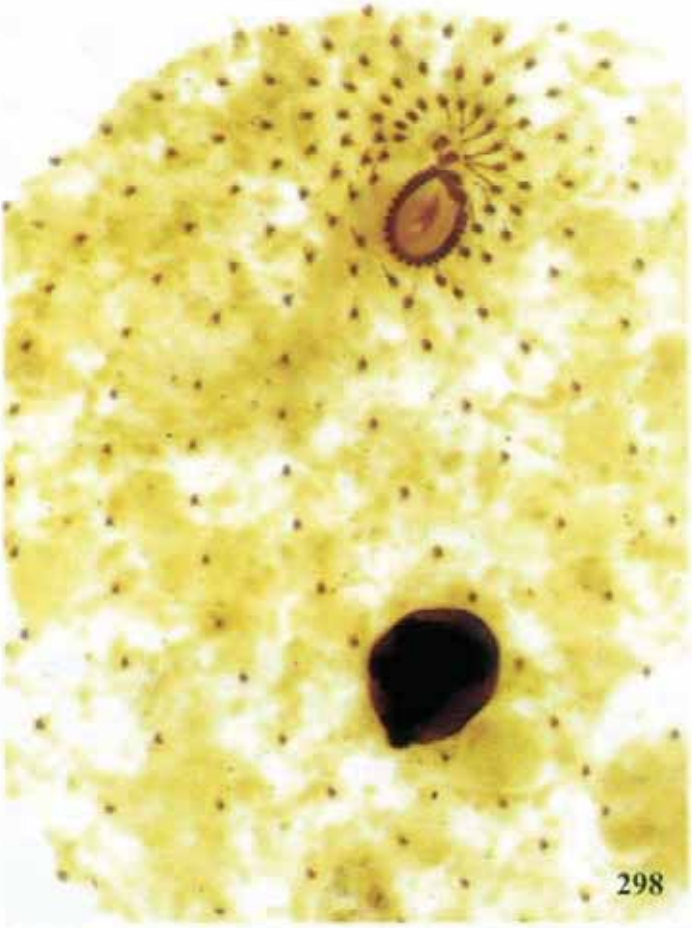


Fig. 294, 295. *Maryna namibiensis namibiensis*, posterior polar views after silver carbonate impregnation. Arrow marks oral apparatus, shown at higher magnification in figure 295.

Fig. 296, 297. *Rostrophrya namibiensis namibiensis*, oral and somatic ciliary pattern and nuclear apparatus after silver carbonate impregnation. For labels, see black and white micrographs.



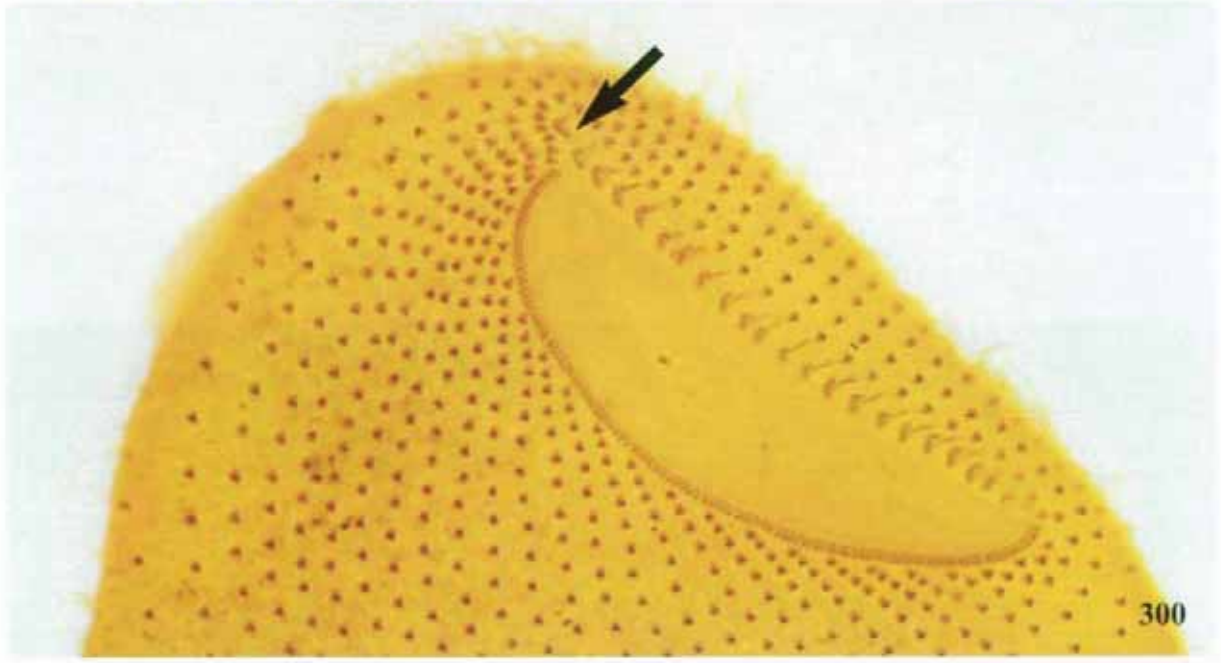


Fig. 298–300. *Etoschophrya oscillatoriophaga* (298) and *Woodruffides terricola* (299, 300), ciliary pattern and nuclear apparatus after silver carbonate impregnation. Arrow in figure 300 marks a single organelle in the minute preoral suture.

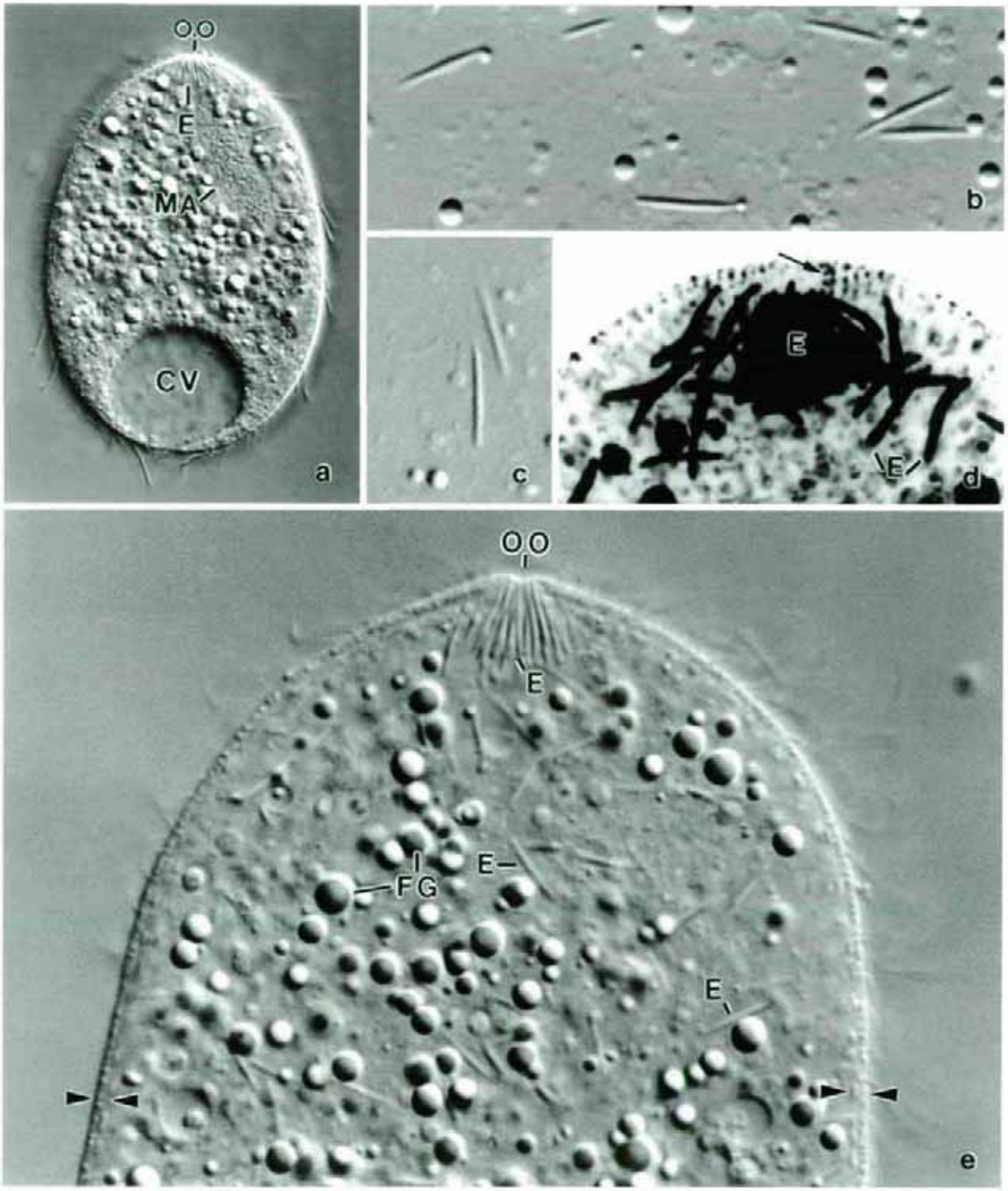


Fig. 301a–e. *Pseudoholophrya terricola*, South African (a–c, e) and Venezuelan (d) specimens from life (a–c, e) and after silver carbonate impregnation (d). **a, e:** Slightly squeezed and flattened specimens showing main cell organelles. The oral opening and the oral bulge are minute and packed with about 5 µm long extrusomes. Note the thick, gelatinous cortex (arrowheads) containing closely spaced rows of minute granules. **b, c:** The 5–6 µm long extrusomes are rod-shaped at first glance, but slightly fusiform or acicular on more detailed inspection. **d:** The minute oral opening is packed with extrusomes and probably surrounded by a dikinetidal circumoral kinety (arrow). CV – contractile vacuole, E – extrusomes, FG – fat globules, MA – macronucleus, OO – oral opening.

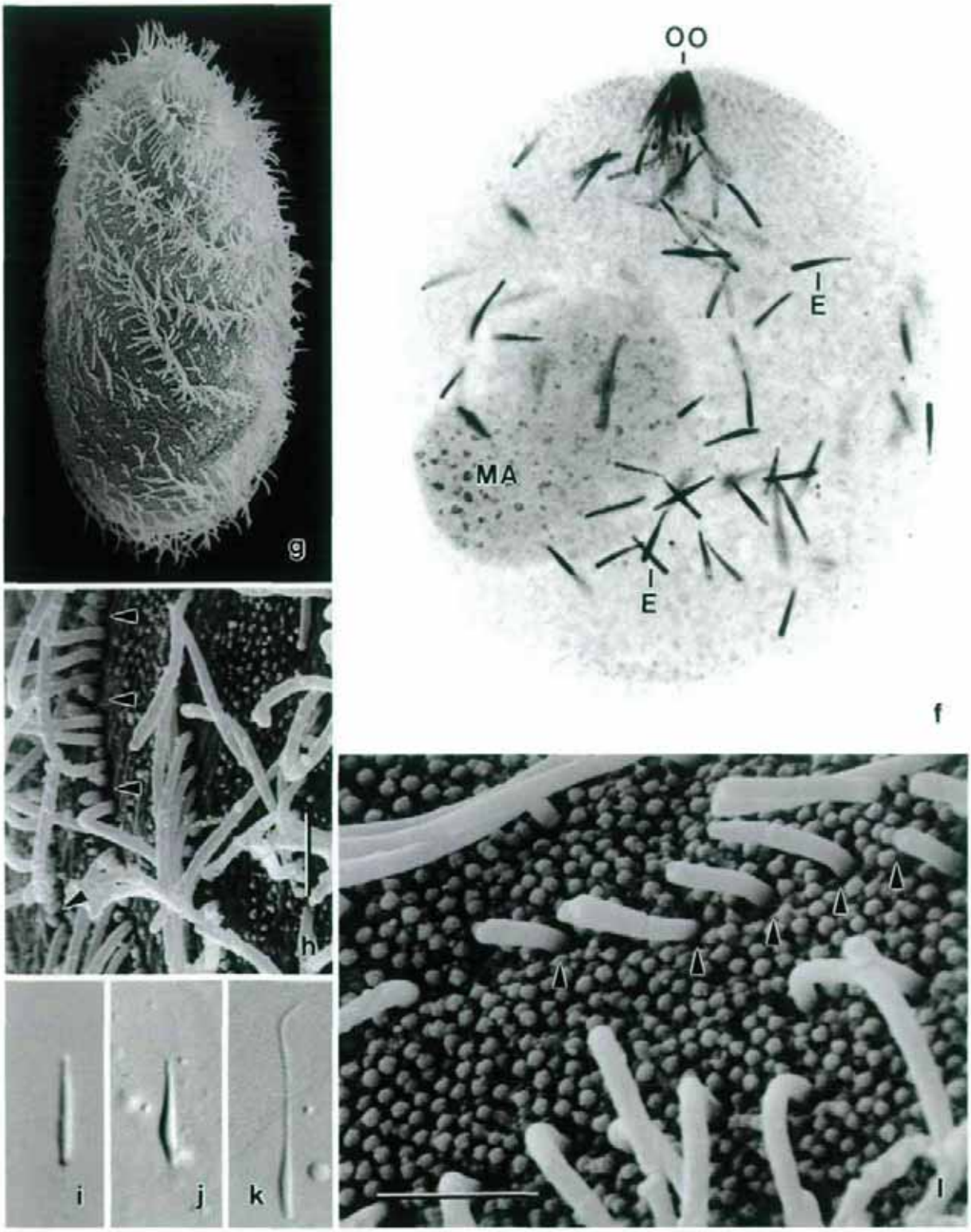


Fig. 301f–l. *Pseudoholophrya terricola*, Maldivean (g–l) and Benin (f) specimens from life (i–k), in the scanning electron microscope (g, h, l), and after silver carbonate impregnation (f). **f:** Slightly acicular extrusomes are packed in the oral bulge and scattered in the cytoplasm. **g:** Overview showing dense ciliature. **h, l:** The dorsal brush consists of minute bristles (arrowheads) interspersed among ordinary cilia. Note the dense cortical granulation. **i–k:** The same extrusome resting, exploding, and exploded. E – extrusomes, MA – macronucleus, OO – oral opening. Scale bars 2 µm.

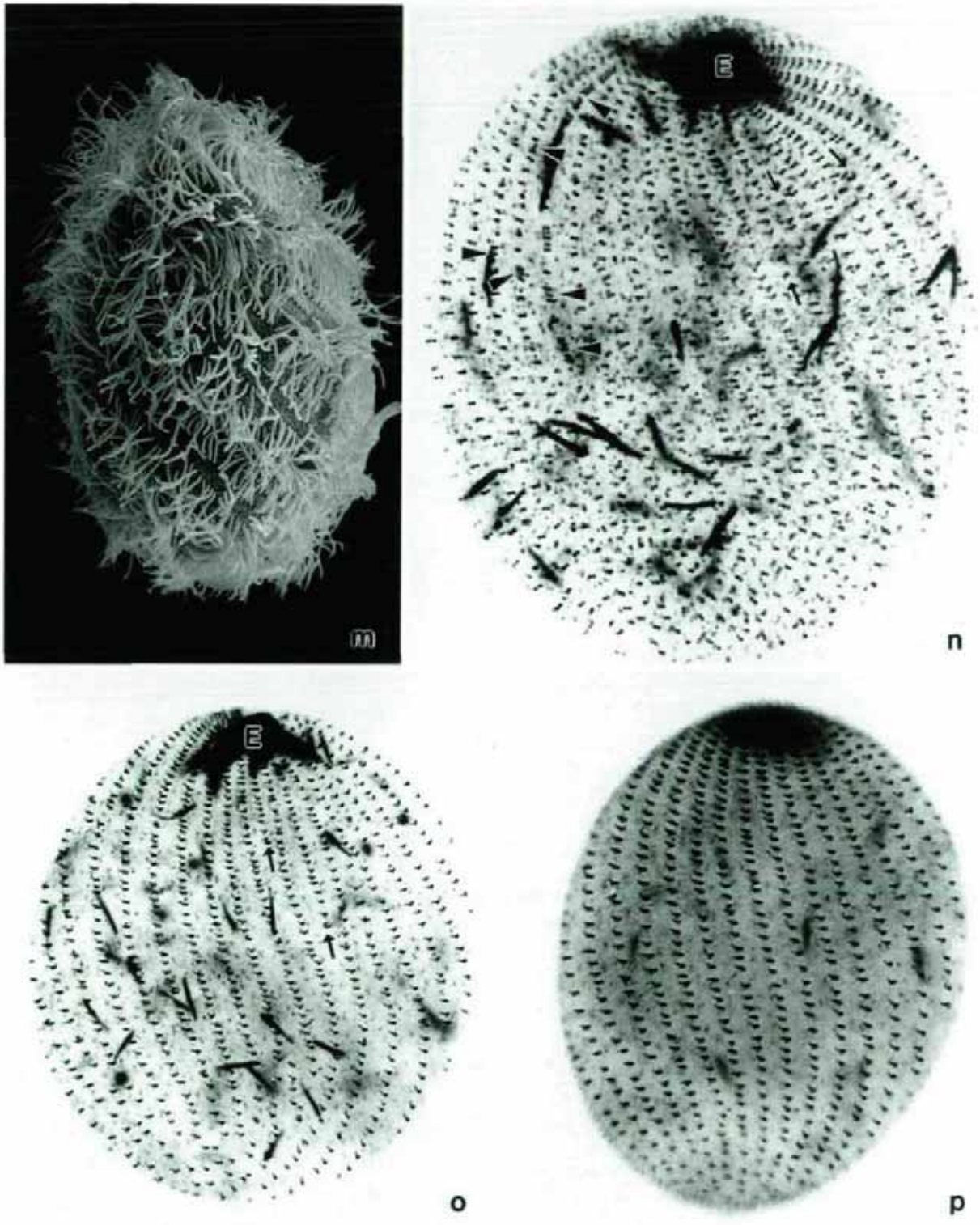


Fig. 301m–p. *Pseudoholophrya terricola*, Maldivean (m) and Benin (n–p) specimens in the SEM (m) and after silver carbonate impregnation (n–p). **m:** Overview showing spiralling ciliary rows. **n–p:** Dorsal (n) and ventral (o, p) views of ciliary pattern. Arrows mark shortened ciliary rows. Small kinetofragments (arrowheads) bearing minute bristles (Fig. 301h, l) are interspersed among ordinary cilia in the anterior half of three kineties. E – extrusomes in oral opening.

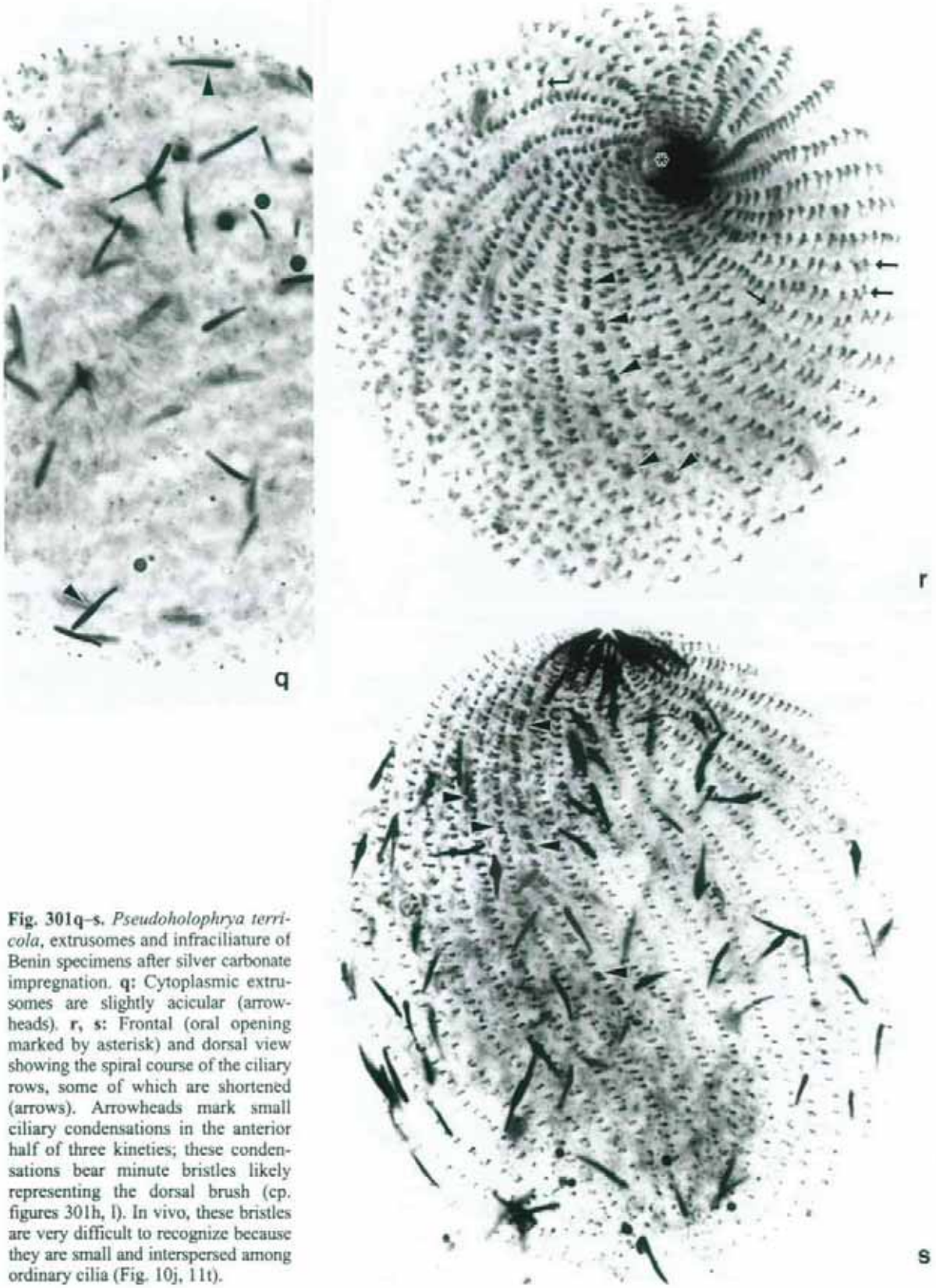


Fig. 301q–s. *Pseudoholophrya terricola*, extrusomes and infraciliature of Benin specimens after silver carbonate impregnation. **q:** Cytoplasmic extrusomes are slightly acicular (arrowheads). **r, s:** Frontal (oral opening marked by asterisk) and dorsal view showing the spiral course of the ciliary rows, some of which are shortened (arrows). Arrowheads mark small ciliary condensations in the anterior half of three kineties; these condensations bear minute bristles likely representing the dorsal brush (cp. figures 301h, l). In vivo, these bristles are very difficult to recognize because they are small and interspersed among ordinary cilia (Fig. 10j, 11t).

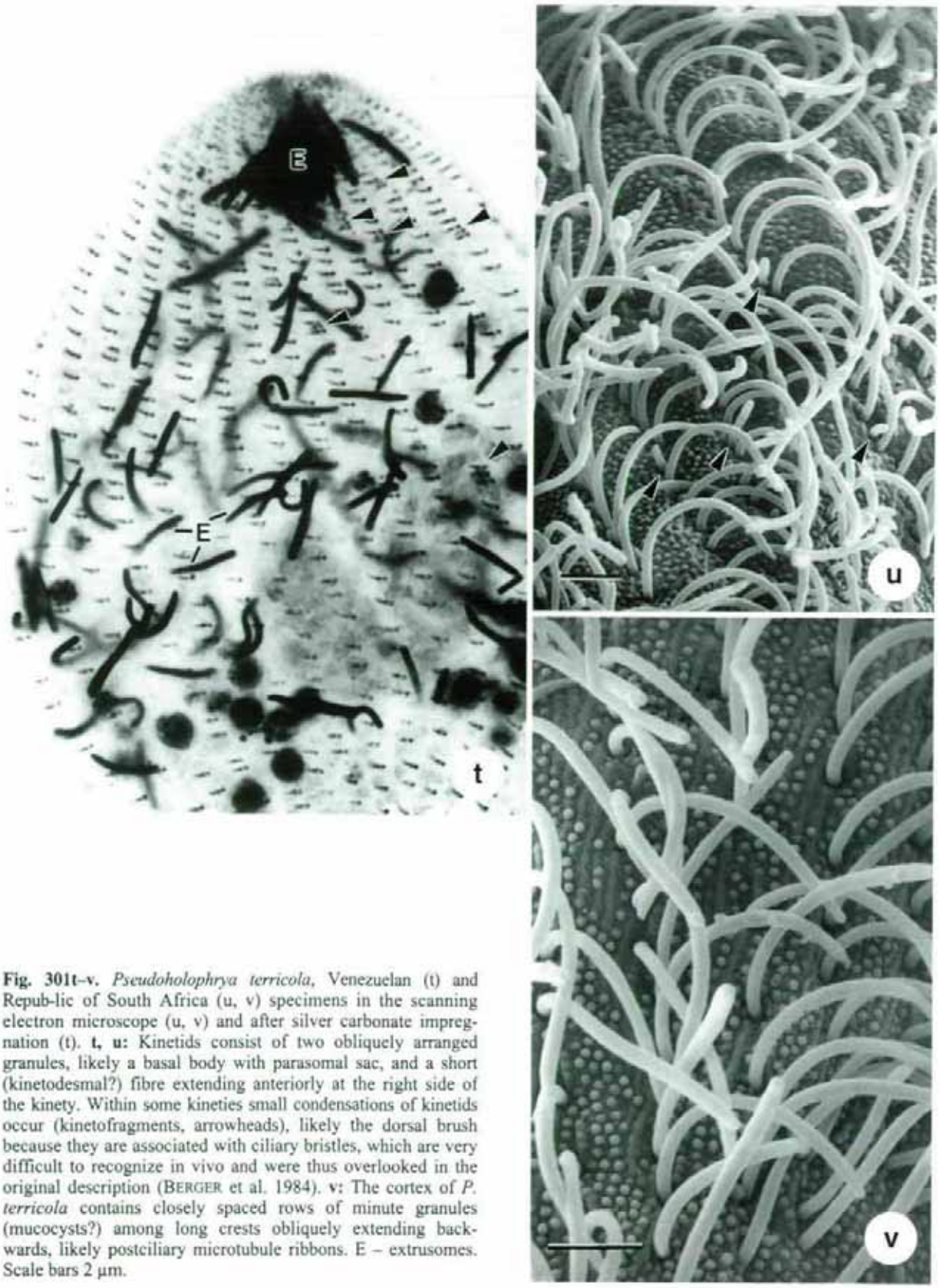


Fig. 301t–v. *Pseudoholophrya terricola*, Venezuelan (t) and Repub-lic of South Africa (u, v) specimens in the scanning electron microscope (u, v) and after silver carbonate impregnation (t). **t, u:** Kinetids consist of two obliquely arranged granules, likely a basal body with parasomal sac, and a short (kinetodesmal?) fibre extending anteriorly at the right side of the kinety. Within some kineties small condensations of kinetids occur (kinetofragments, arrowheads), likely the dorsal brush because they are associated with ciliary bristles, which are very difficult to recognize in vivo and were thus overlooked in the original description (BERGER et al. 1984). **v:** The cortex of *P. terricola* contains closely spaced rows of minute granules (mucocysts?) among long crests obliquely extending backwards, likely postciliary microtubule ribbons. E – extrusomes. Scale bars 2 µm.

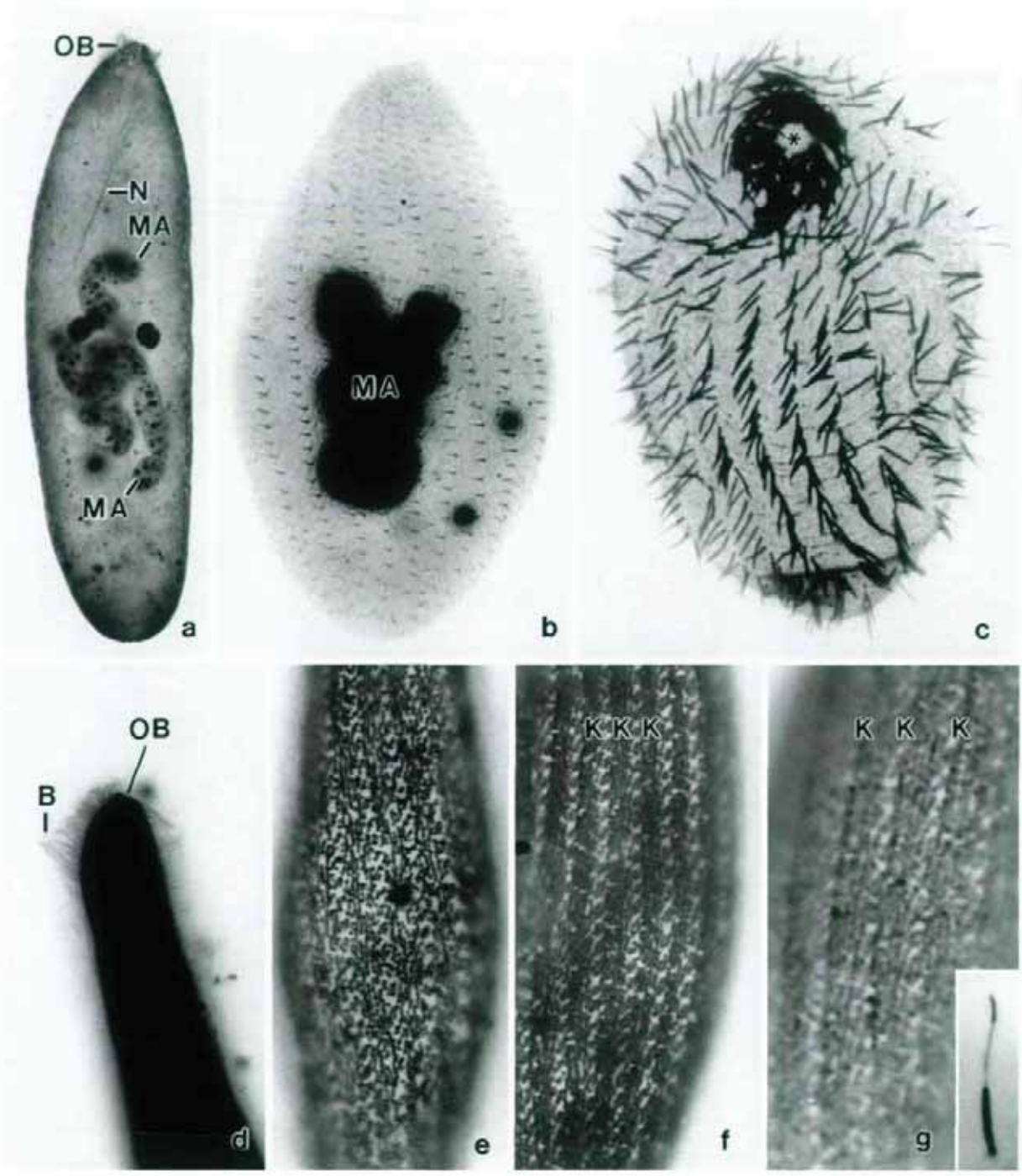


Fig. 302a–g. *Enchelys longitricha* after protargol (a, b–g) and silver carbonate (b, c) impregnation. **a:** General view showing the tortuous, slightly moniliform macronucleus and a bundle of oral basket fibres originating from oralized somatic monokinetids in the anterior portion of the ciliary rows. **b:** Ventral view of a strongly flattened specimen showing the slightly spiral course of the ciliary rows, which consist of basal bodies with a short (kinetodesmal?) fibre attached at right. **c:** The partially extruded toxicysts, which are concentrated around the oral opening (asterisk), form conspicuous rows between the somatic kineties, which are not impregnated. **d:** The dorsal brush (B) has up to 15 µm long bristles in the middle region. **e–g:** The ciliary pattern is hidden by the strongly impregnated cortical granules, which are arranged in oblique, rough rows extending backwards at the right of the kineties. The inset in (g) shows an exploded toxicyst after silver carbonate impregnation. B – dorsal brush, K – somatic kineties, MA – macronucleus, N – nematodesmata, OB – oral bulge.

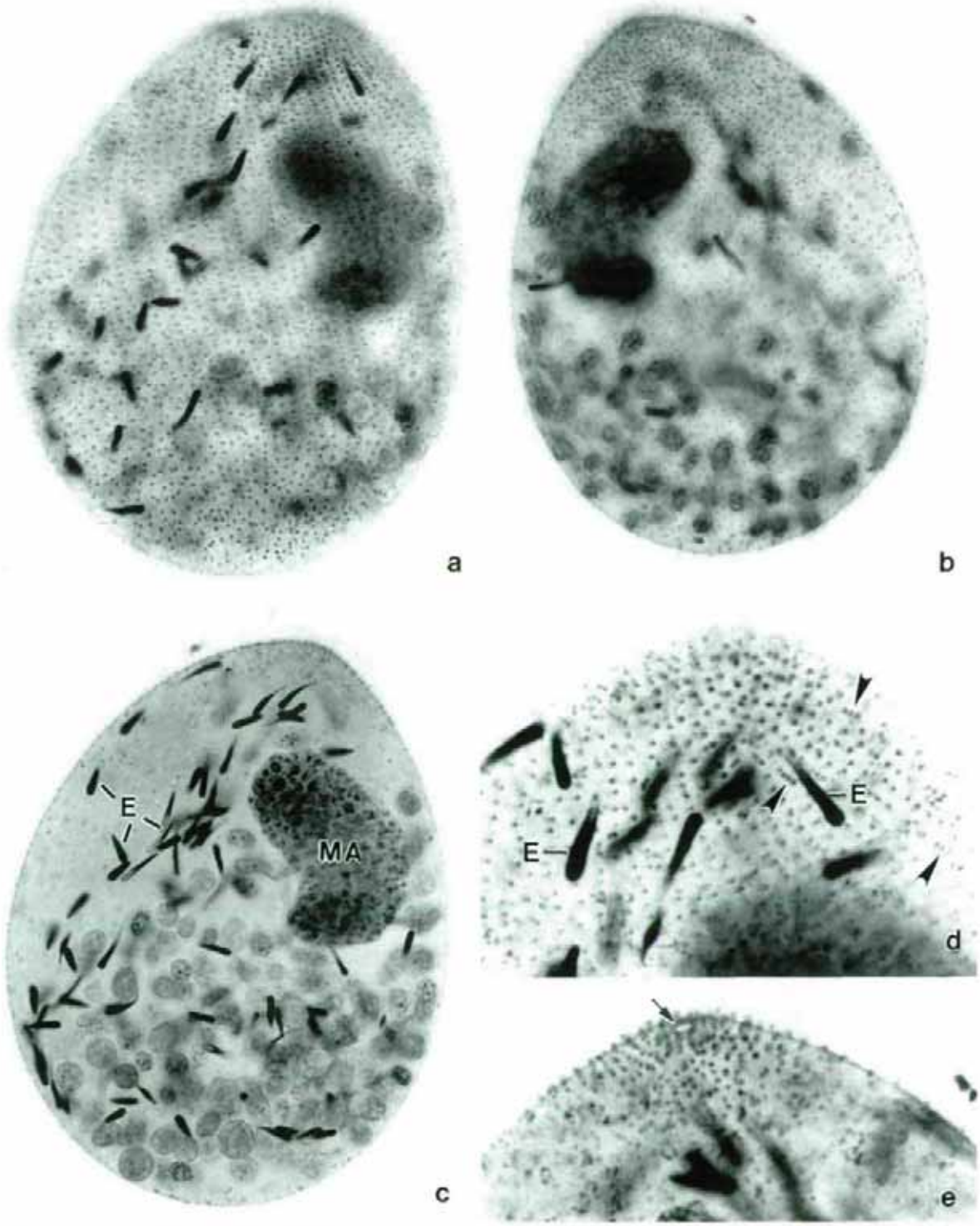


Fig. 303a–e. *Paraenchelys pulchra*, somatic and oral infraciliature and extrusomes after silver carbonate impregnation. All figures show the same, heavily squashed specimen at various focal planes. Arrow in (e) marks the minute oral opening in anterior pole centre. Arrowheads denote minute condensations of the ciliature, representing the dorsal brush. The cytoplasm contains many fat globules, extrusomes (E), and the reniform macronucleus (MA).

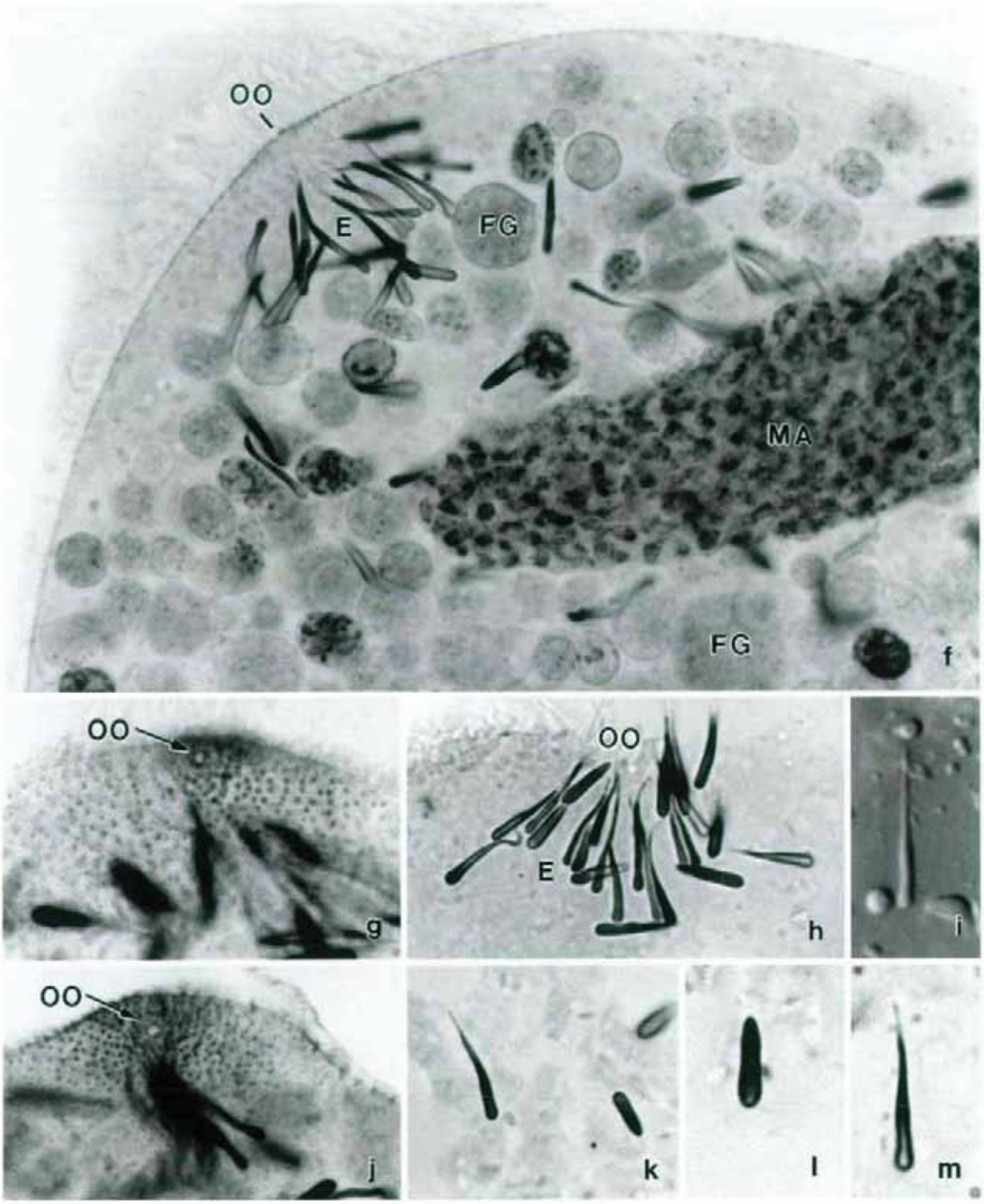


Fig. 303f–m. *Paraenchelys pulchra* from life (i) and after silver carbonate impregnation (f–h, j–m). **f, h, i, k–m:** The neatly-shaped extrusomes around the oral opening are the main feature of *P. pulchra*; those scattered in the cytoplasm are stouter and very likely developmental stages. Note that the filiform, anterior portion of the extrusomes (i) is only partially impregnated or not at all. **g, j:** The minute oral opening is surrounded by a narrow, smooth area (arrows). A circumoral kinety is not recognizable. E – extrusomes, FG – fat globules, MA – macronucleus, OO – oral opening.

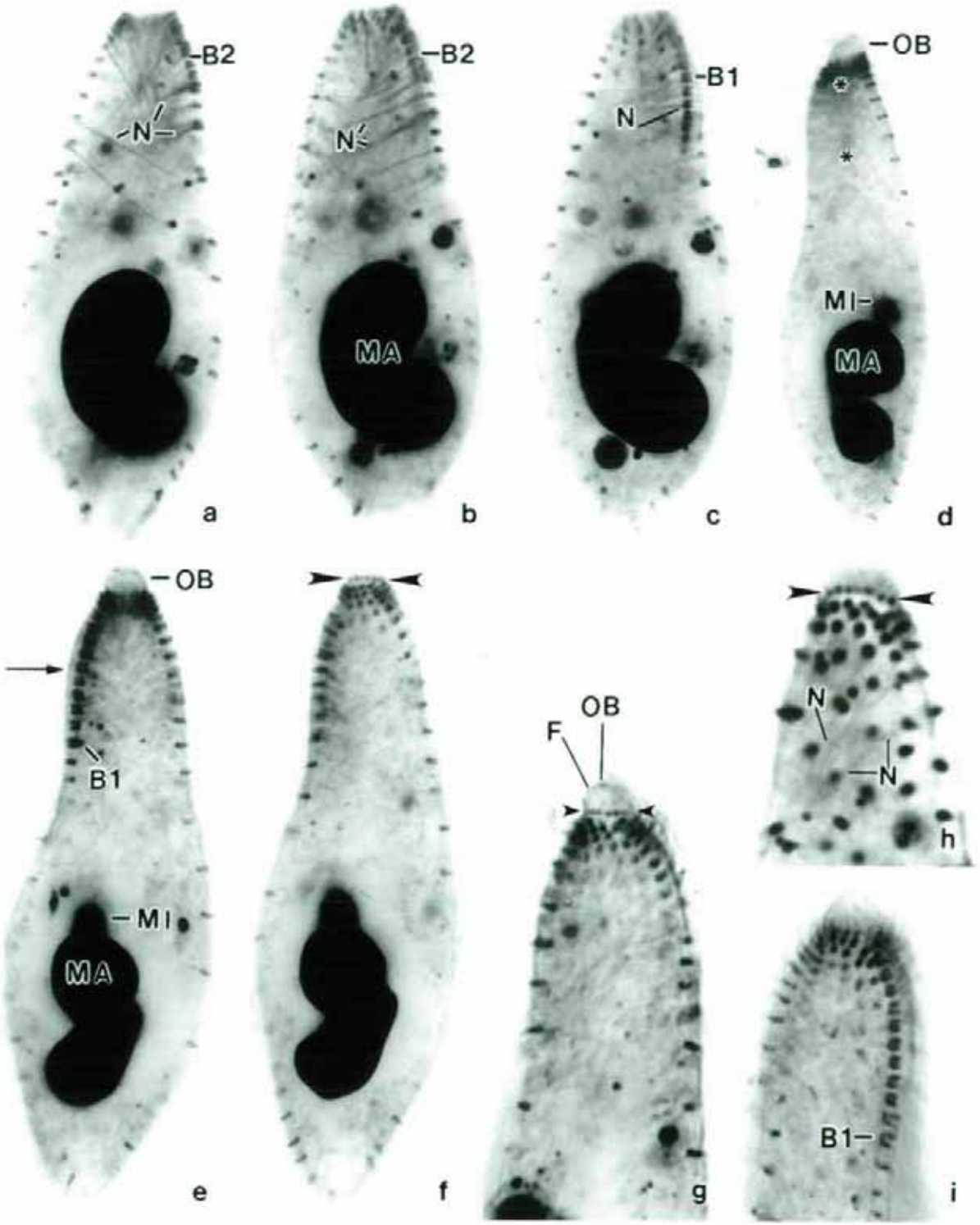


Fig. 304a–i. *Obliquostoma enchelyodontides*, infraciliature after protargol impregnation. **a–c:** Same specimen at three focal planes to show the nematodesmata originating from oralized somatic monokinetids and brush dikinetids. **d:** Holotype specimen showing the oblique oral bulge. Asterisks mark site of dorsal brush. **e–i:** Arrowheads mark row of minute granules associated with the bulge fibres (F). Arrow denotes ridge between dorsal brush rows. B1, 2 – brush rows, F – fibres, MA – macronucleus, MI – micronucleus, N – nematodesmata, OB – oral bulge.

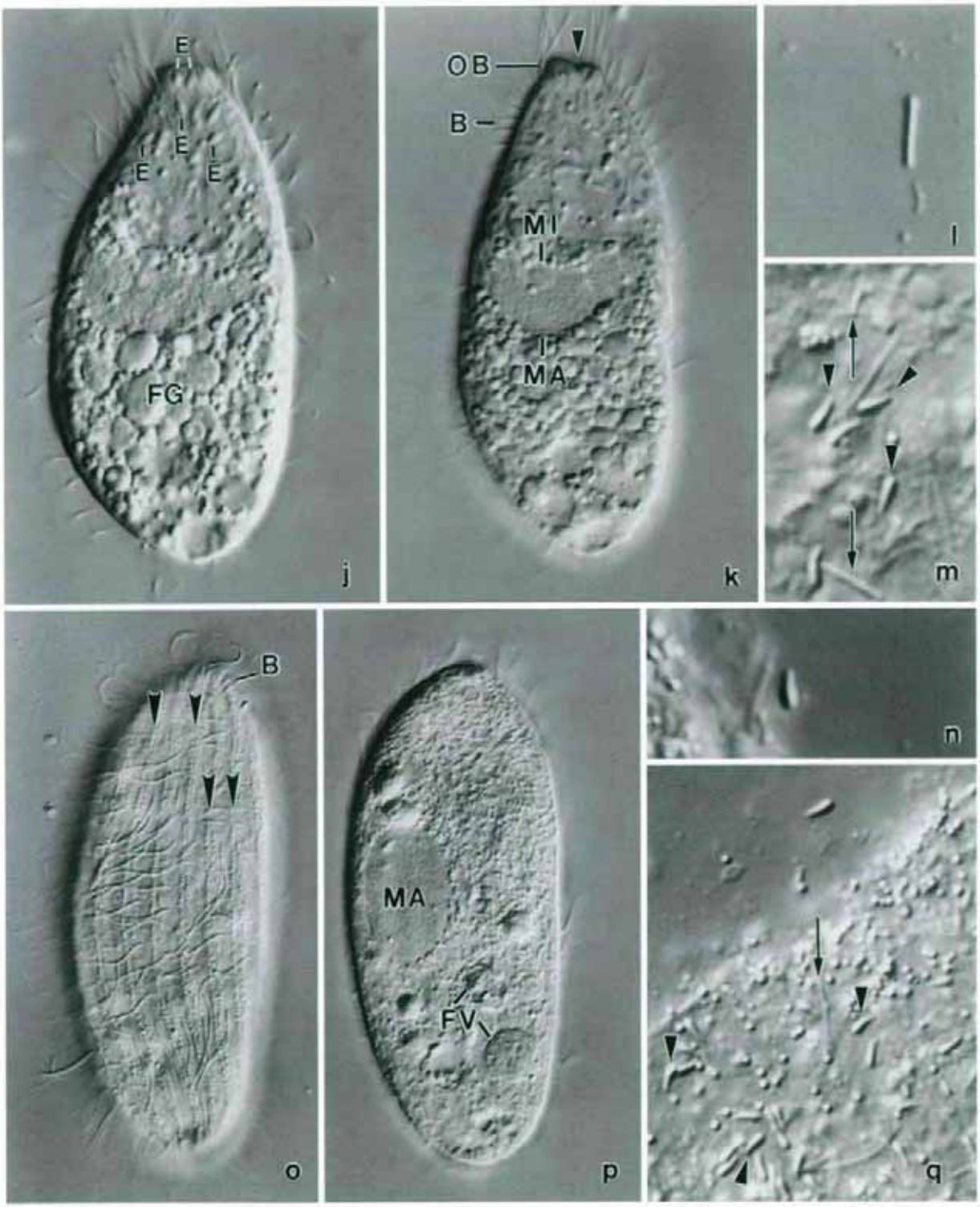


Fig. 304j, k. *Obliquostoma namibiense*, total views of slightly flattened (by cover glass) specimens showing the oblique oral bulge, the reniform macronucleus, and the amphoriform extrusomes.
Fig. 304 l–q. *Diplites telmatobius*, in vivo interference contrast micrographs of site (49) specimens. **l:** Body extrusome, length 4 µm. **m, q:** Oral (arrowheads) and somatic (arrows) extrusomes. **n:** Oral extrusome, length 1.5–2 µm. **o, p:** Surface view and optical section of a slightly flattened (by cover glass) specimen showing the cortical granule rows (arrowheads), the dorsal brush, and various cytoplasmic inclusions. B – dorsal brush, E – extrusomes, FG – fat globules, FV – food vacuoles, MA – macronucleus, MI – micronucleus, OB – oral bulge.

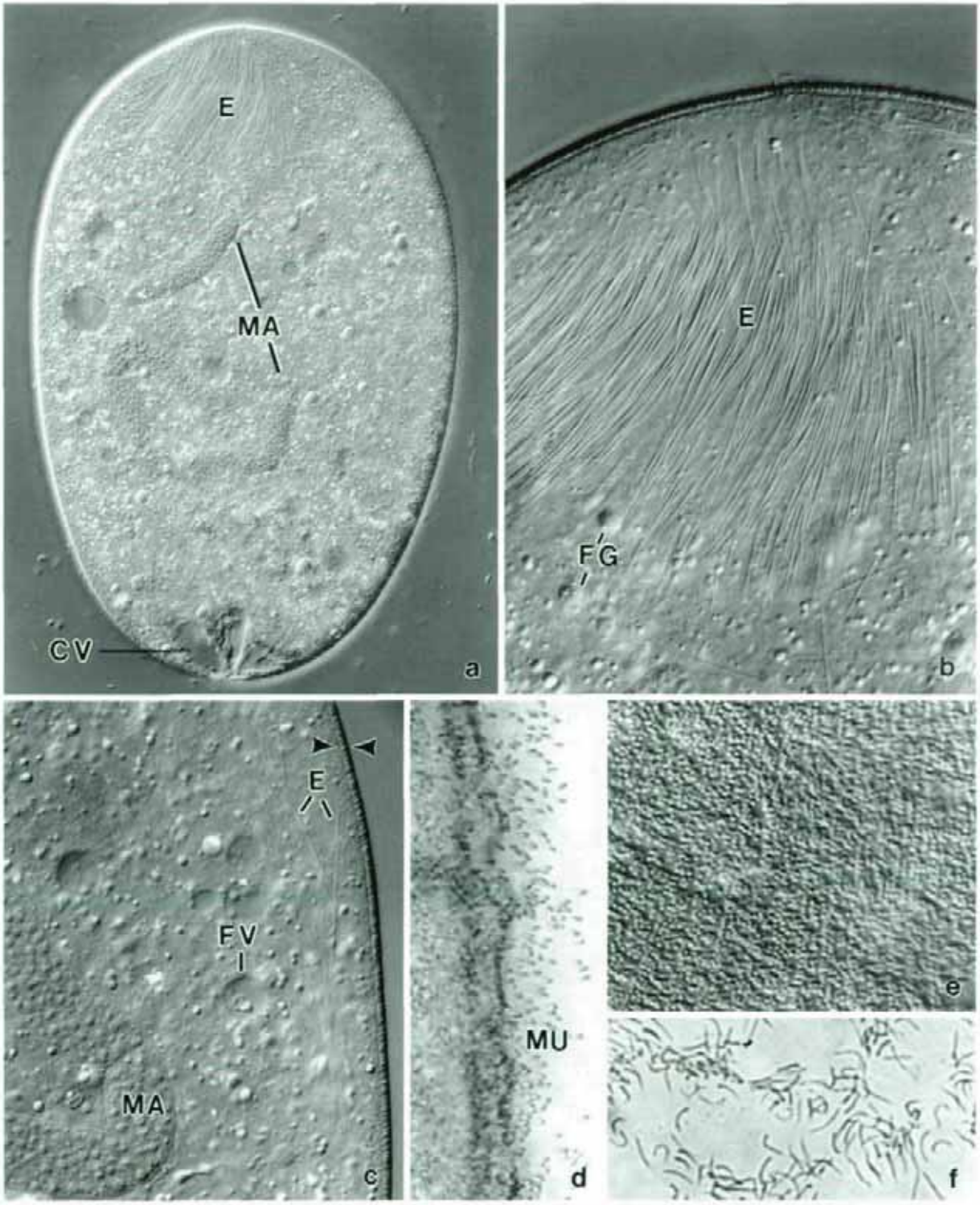
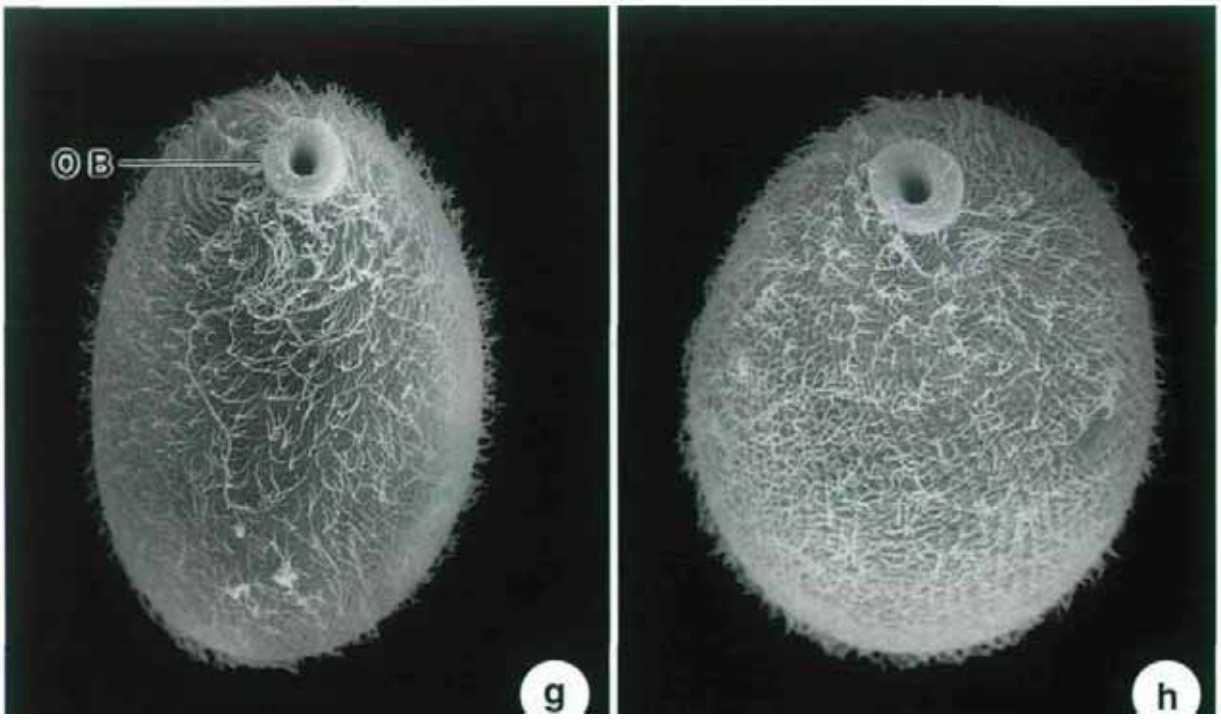


Fig. 305a–f. *Enchelydium blattereri* from life (a–c, e) and after methyl green-pyronin staining (d, f). **a, b:** Slightly squeezed specimen showing main cell organelles, especially the long extrusomes in the oral bulge. **c, e:** Optical section and surface view showing cortex (marked by opposed arrowheads) studded with mucocysts. **d, f:** The mucocysts are extruded when the dye is added (d) and swell to about 5 µm long filaments (f). CV – contractile vacuole, E – extrusomes, FG – fat globules, FV – food vacuoles, MA – macronucleus, MU – mucocysts.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