FOLIA PARASITOLOGICA (PRAHA) 24:193–210, 1977.

CILIATES OF THE GENERA TRICHODINELLA, TRIPARTIELLA AND PARATRICHODINA (PERITRICHA, MOBILINA) INVADING FISH GILLS

J. LOM and D. P. HALDAR*

Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

Abstract. Gills of fishes are regularly inhabited by a numerous group of trichodinid ciliates, characterized by an incomplete turn of the adoral ciliary zone, rather small dimensions and a strict specificity for the gills. Species of two of the genera — *Trichodinella* and *Paratrichodina* — occur on freshwater and marine fishes, the third one, *Tripartiella*, is found on freshwater hosts. Several species — *Paratrichodina incissa, Tripartiella copiosa, T. bulbosa, Trichodinella epizootica, T. subtilis* have been found to be the most common ones, occurring on a wide variety of hosts on the Eurasian continent. Their host specificity, variability and taxonomic relations are discussed. A special attention was paid to the variability of the adoral zone length, in relation to its importance in urceolariid taxonomy. In some species (*Trichodinella subtilis*) the length of the adoral zone is quite constant, while in others (e.g., *T. epizootica*) it may either slightly differ in populations from some hosts, or there are variations within the same population. One new species is described (*Paratrichodina corlissi* sp.n.) from the gills of *Gobio gobio* and *G. kessleri; P. erectispina* sp.n., *Tripartiella kashkovskyi* sp.n., from the gills of North American *Pimephales vigilax* and *Fundulus dispar*, respectively; *Trichodinella lawleri* sp. n. is described from *Lagodon rhomboides* from the Gulf of Mexico coast. The gill-inhabiting trichodinids represent a morphologically and biologically compact assemblage of species, all derived evidently from an original mobiline type with an adoral ciliary zone completing one full turn, of the type of *Trichodina*.

Since the publication of the paper devoted specially to this group by the senior author (1963) urceolariid ciliates of the genera *Trichodinella* and *Tripartiella* were recognized as most common invaders of fish gills in Europe, Asia and North America (e. g., Bogdanova 1963, Haider 1964, Ivanova 1967, Hoffman and Lom 1967, Hoffman 1967, Shtein 1967, 1968, Kazubsky and Migala 1968, Konovalov 1971, Kashkovsky 1974, Golemansky and Grupcheva 1975, Grupcheva 1975a, b.)In the course of the past years numerous new data were obtained on the distribution, host relation, morphology and taxonomy of these and related ciliates, characterized as a group by an adoral ciliary spiral making a turn shorter than 360° and by their presence exclusively on the gills of fishes. This necessitates a critical reappraisal, aimed at a better definition of genera and species, elimination of possible synonymics and evaluation of the variability range. Cursory reports of species mentioned by various authors merely as *Trichodinella* or *Tripartiella* sp. will not be dealt with.

MATERIAL AND METHODS

Methods used have been sufficiently described in a number of papers (e.g., Lom 1963, Wellborn 1967, Lom and Laird 1969). The simple dry silver impregnation technique is a prerequisite for the study of morphology, supplemented by a nuclear stain and as far as possible, by examination of living ciliates (detection of the velum, marginal cilia etc.). The terminology of constituents of the adhesive disc is that used in previous papers of the senior author (1958, 1963); centripetal projection of the denticle is referred to as a thorn, centrifugal as a blade.

*) A participant in the UNESCO postgraduate course, sponsored by the Czechoslovak Academy of Sciences, Prague. Permanent address: Department of Zoology, University of Kalyani, West Bengal, India.

We feel it necessary to stress the way the diameter of the denticulate ring is measured: it is the distance between midpoints of central parts of opposing denticles, not between the outer ends of their blades!! (see Lom 1963). The length of blades and thorns is measured from their tips to the borders of the central part of the denticle (see Lom 1958). Protargol impregnation technique, now being currently used in ciliatology, reveals details of the infundibular ciliature.

Our sincere thanks are due to many colleagues from ČSSR and abroad who aided this study by supplying fish for examination or who sent us slides with material collected by themselves. We are especially thankfull to Dr. V. V. Kashkovsky (Sverdlovsk, USSR), Dr. A. R. Lawler (Ocean Springs, USA) and to Dr. V. Golemansky and G. Grupcheva (Sofia, Bulgaria).

TAXONOMIC PART

The taxonomy of mobiline peritrichs is based upon two main criteria: development of the oral ciliary apparatus and structure of proteinaceous elements of the adhesive disc. The joint outer parts of haplokinety and polykinety spiral around the oral face of the animal (Lom 1964) before they plunge into the infundibulum. This outer spiral, i.e., the adoral ciliary zone, makes an incomplete turn in five genera of the family Trichodinidae (Lom, in press) while in one it oscillates around one turn or more (*Trichodina*- 340° to 540°) and in another it may reach up to 3.5 turns, i.e., 1,260° (*Vauchomia*). This differentiation is reflected also in other features of body structure and in ecology.

Genera with the incomplete turn of the adoral zone include: *Semitrichodina* Kazubski (ciliates living in the mucus of land snails, distinguished by a third kinety paralelling the adoral zone) and genera recorded from fish gills, *Trichodinella* Šrámek—Hušek, *Tripartiella* Lom, *Paratrichodina* Lom and *Dipartiella* Shtein (— as far as the last genus is concerned, see concluding remarks). The giant endoparasitic species *Trichodina oviducti* from genital tractus of skates should be also mentioned here; according to existing reports (Evdokimova et al. 1969, Khan 1972) it seems to be a unique trichodinid with an adoral zone varying from 220° to 380°, i.e., breaking the limits between *Trichodina* and genera with incomplete turn of the adoral zone. This case is reconsidered in another paper (Lom and Haldar 1976).

The ciliates of the *Trichodinella-Tripartiella-Paratrichodina* group share other common features: Presence of more or less conspicuous marginal cilia, small dimensions of the cell, habitat on the fish gills, and structure of the infundibular ciliature. The latter consists of haplokinety and a peniculus-like ciliary belt made out of 6 kineties, both making a half-turn of 180° on the infundibular walls; a short arch-like triple polykinety (homologous to P_3 of other peritrichs, see Lom 1964) is situated at the mouth of the cytostome (see also Lom 1963). This simple structure of infundibular ciliation is also in contrast with *Semitrichodina*, where the infundibular kineties make one and a half turn.

Paratrichodina Lom, 1963

The adoral spiral makes a turn of 150—280°. The denticles (Fig. 1.) have well-developed thorns, and are wedged together only by the central conical parts. If there is an anterior projection near the base of the blade, it does not communicate with a notch in the blade of the preceding denticle. Macronucleus generally horse-shoe shaped, body reminds of a more or less flattened or vaulted hemisphere. On the gills of freshwater and marine fishes; two species endoparasitic in the fish urinary tract.

Type species: *P. incissa* Lom, 1959.

Paratrichodina incissa (Lom, 1959) Lom, 1963

syn. *Trichodinella (Tripartiella) incissa* Lom, 1959
Tripartiella (Paratrichodina) incissa Lom, 1959

First described from the gills of *Noemacheilus barbatulus*. It also regularly occurs on the gills of *Phoxinus laevis, Rutilus rutilus, Scardinius erythrophtalmus, Leuciscus leuciscus* and. *L. idus*. Reported also from *Phoxinus percnurus* and *Thymallus arcticus* (Shtein 1967) and tadpoles of *Rana esculenta*.

Distributed obviously throughout Eurasia.

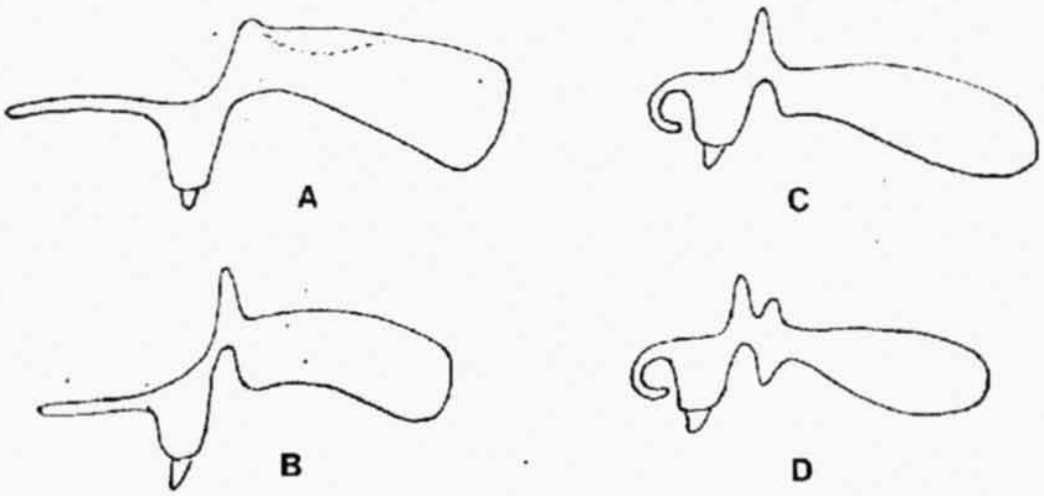


Fig. 1. Diagrammatic representation of denticle shape in A — *Paratrichodina corlissi*, B — *Tripartiella copiosa*, C — *Trichodinella epizootica*, D — *Trichodina subtilis*.

During the years since the publication of the paper by Lom (1963) we have examined diverse populations from various freshwater hosts. A positive evidence was accumulated that the species *P. incissa* as described by Lom (1963) and Ergens and Lom (1970) were in fact two species lumped together. They differ in the structure of their denticles; however, their dimensions fall within the same range (Tables 1 and 2). We have solid reasons to distinguish *P. incissa* sensu stricto and *P. corlissi* (see below).

Table 1. Biometrical data of *Tripartiella copiosa* and *Paratrichodina incissa*

	Tripartiella copiosa Pooled data from all hosts	*Paratrichodina incissa* Pooled data from all hosts
Diameter of		18—45.5
body	22—48	
adhesive disc	14—45	16—31
denticulate ring	6—37	9—30
macronucleus	10—26	16—24
Number of		
denticles	17—32	19—30
radial pins per denticle	4—6	4—8
Dimensions of denticles		
thorn	0.9—3	1.2—4.3
blade	2.4—4.8	2.3—4.8
center	0.6—2.2	0.6—2.2
Border membrane	1.2—2.6	1.3—3.3
Micronucleus	0.8—2.8 × 1.0—4.8	0.8—1.5 × 2—4.2
Adoral zone	180°—240°	150°—210°

Measurements are given in microns (μm)

Table 2. Biometrical data of *Tripartiella* and *Paratrichodina* species

	Trichodinella lawleri	*Tripartiella obtusa*	*T. bulbosa* Population A*)	Population B**)	*T. kashkovskyi*	*T. bursiformis*	*Paratrichodina erectispina*	*P. corlissi*	*Paratrichodina* sp.
Host	*Lagodon rhomboides*	*Gobio gobio*	1	2	*Fundulus dispar*	*Acantharchus pomotis*	*Pimephales vigilae*	*Gobio kessleri*	*Coregonus nanus*
Localization	Gills	Gills	Gills	Gills	Gills	Gills	Gills	Gills	Gills
Locality	Horn Island Mississippi USA	Pooled data from several localities of Czechoslovakia	Plovdiv Bulgaria	Ural region, USSR	Grand Tower Mississippi, USA	West Virginia, USA	Vicinity of Detroit, USA	Danube Bulgaria	Ural region, USSR
Diameter of									
body	26 (24–30)	30 (23–42)	27–37	26 (13–42)	33	40–42	30 (23–36)	33 (27–39)	34 (29–41)
adhesive disc	14 (12–17)	21 (17–23)	20–24	20 (18–24)	24 (20–27)	32 (29–36)	25 (20–31)	22 (19–25)	24 (23–25)
denticulate ring	7 (6–9)	11 (9–13)	8–9	9 (7–13)	11 (8–12)	14 (12–17)	15 (12–19)	12 (10–15)	15 (15–16)
macronucleus	15–20	19	15–25	—	24–27	24–27	23	27 (24–31)	—
Number of									
denticles	18 (15–19)	24 (21–27)	23–27	26–28	27 (23–29)	29 (26–32)	25 (24–27)	21 (18–24)	23–25
radial pins per denticle	4–6	4 (5)	3–4	4–6	4–5	6 (7)	4–5	6 (5)	6
Dimensions of denticles									
thorn	—	2.1	0.9–1.7	1.6 (1.4–2.4)	2.5–3	2.5–4	2–2.5	2.2–3.3	3 (2–4)
blade	2–3	3.1	3.5–5.2	4.5 (3.6–5.5)	5–6	6.5–8	3–3.5	3.3–3.8	3–4
center	1–2	1.3	0.9–2.1	0.7 (0.6–1.8)	1.5	2	1.2–1.4	1–2	1–2
Border membrane	1–2	2	1.7–2.6	1.2–2.4	2	2–3	2	1.8–2.2	2–3
Micronucleus	—	1.2–2.3	1.7–2.6	—	—	1.5–1.7 × 2.5–3	—	—	—
Adoral zone	180°	180°	—	—	180°		230°–280°	180°–240°	undetected
center of the disc	dark	granulated	black	black	—	—	dark	—	dark

Measurements are given in microns (µm)
*) Data from Golemansky and Grupcheva (1975), **) Data from Kashkovsky (1974)
1 *Ctenopharyngodon idella, Hypophthalmichthys molitrix, Aristichthys mobilis*
2 *C. idella, H. molitrix*

P. incissa as seen on slides impregnated with Klein's technique is characterized by denticles (Plate I, Figs. 1—3) with a large, deep notch in the anterior margin of the blade, near the central part of the denticle; consequently, there is an anteriorly pointed projection at the central part and a narrow isthmus joining the rest of the blade to the central part. The projection does not directly communicate with the preceding blade, unlike *Tripartiella*. Such populations are typically found on the gills of *Noemacheilus barbatulus*, *Rutilus rutilus*, *Leuciscus leuciscus* and other hosts.

Some populations from *Noemacheilus barbatulus* and from *Phoxinus phoxinus* differ a little in that the notch in the blade may be less distinct or even reduced to a narrow incission in some specimens. These differences, however, are by far not pronounced enough to warrant the position of a separate species. Very often this is also dependent on how heavy is the silver deposit on the specimens.

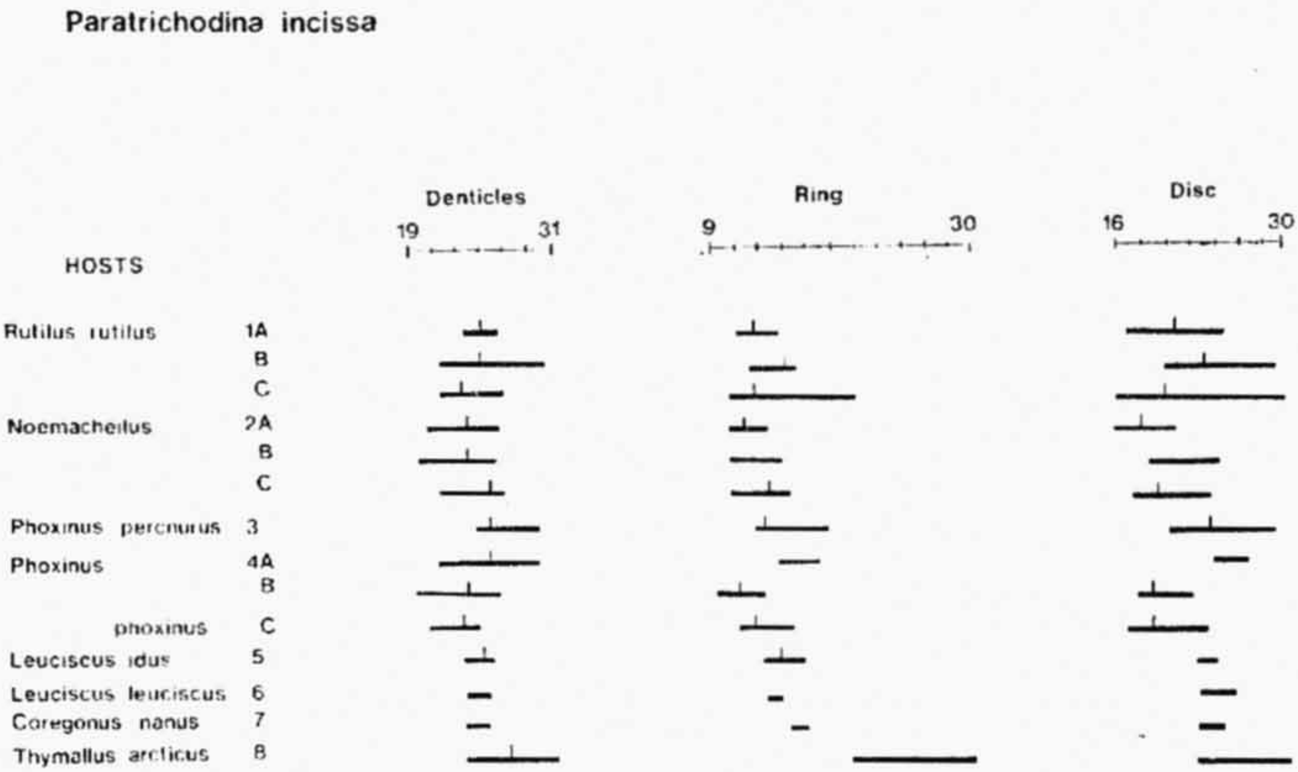


Fig. 2. Variation in different populations of *P. incissa*. Lines indicate the variation ranges on a given population, of the number of denticles and denticulate ring and adhesive discs diameters in microns respectively. Short perpendicular lines indicate mean values, if recorded. Scale divisions indicate two units each. Data on most of the populations concern the author's findings from the territory of Czechoslovakia, some are of different origin or excerpted from other authors: 1 B, 1 C, 1 E collected in Bulgaria; 1 C and 3—Kashkovsky (1974); 2 C—collected in the Ural region by Dr Kashkovsky; 4 A, 4 B—collected in Danube in Bulgaria. 7—morphologically different population (new species? — see p. 198) collected by Dr. Kashkovsky in the Ural region; 8—Shtein (1967).

The length of the adoral ciliary zone may vary to a certain extent in different populations, it is about 200° in *Noemacheilus barbatulus*, 150—190° in *Phoxinus laevis* and 160—190° in *Leuciscus idus*. Other characters are depicted in Lom (1963).

Despite some slight morphological variations in some populations this is a well characterized and homogeneous species. (Fig. 2).

Paratrichodina corlissi sp.n.

syn. *Tripartiella* (*Paratrichodina*) *incissa* (Lom, 1959, pro parte)

Recorded thus far from the gills of *Gobio gobio* (Czechoslovakia) and *Gobio kessleri* (Bulgaria).

The main different feature is the shape of denticles on Klein-impregnated preparations: unlike *P. incissa*, there is no distinct notch in the anterior border of the blade and the blades become distinctly wider towards their truncated distal end. The denticles definitely make the impression of being more massive (Plate I, Figs. 4—6). The adoral zone makes a turn of 180 to 240° (see also Table 2).

Paratrichodina erectispina sp.n.

Found on the gills of *Pimephales vigilax*, collected in the vicinity of Detroit, Michigan, USA, in November 1966.

This species is clearly distinguished from *P. incissa* and *P. corlissi* by a longer course of the adoral zone (230 to 280°) and, chiefly, by the shape of denticles: the thorns are slightly, but distinctly curved (Plate I, Figs. 7—8) the concavity of this arch being directed forwards (i.e., anticlockwise in the aboral view). The thorns are uniformly thin along their length. According to the result of impregnation, the anterior notch in the proximal part of the blade is very small, or it may be very large reducing this part of the blade to a narrow isthmus.

The body is sack-like, its height being shifted sidewise above the adhesive disc, so that the item "diameter of the body" in Table 2, summarizing the biometrical data, signifies rather its transverse diameter or width.

Paratrichodina sp.

Found on the gills of *Coregonus nanus* collected in the Voikar river, USSR, Ural region (see Table 2).

By the courtesy of Dr. V. V. Kashkovsky we had the opportunity to examine a population of this ciliate on Klein-impregnated slide (Plate I, Fig. 9). Since the course of the adoral ciliary zone could not be detected with certainty, we cannot describe it as a new species, though the denticle shape is in favour of our doing so, being different from other species. Straight, thin thorns are slanted backwards; there is a short anterior projection near the base of the blade, which is almost triangular in shape (Fig. 9, Pl. I). In size it coincides with most *P. incissa* populations (Fig. 2, *Coregonus nanus*).

Paratrichodina sp.

Found on the gills of *Notemigonus chrysoleucas*, collected near Carbondale, Illinois, USA.

Only several silver impregnated specimens were observed (diameter of the disc 12 µm, denticulate ring 9 µm; border membrane 2 µm; denticles: thorns 1.5—2 µm, central part 1 µm, blade 2—3 µm). There is a very short anterior projection and a kidney-shaped blade (Plate IV, Fig. 5).

There are more species to the genus: *P. alburni* (Vojtek), *P. globonuclea* Lom and *P. obliqua* Lom (see Lom 1963). The first one is dealt with in another paper (Lom and Haldar 1976, along with the description of a new species). No new data were obtained on the two latter species. Shtein (1975) quotes the last named species under the name *Trichodina inversa;* she identifies this ciliate with Dogiel's (1940) old description done without the aid of Klein's technique and did not pay particular attention to the adoral zone. However, the ciliates studied by us did have a short adoral zone.

Tripartiella Lom, 1959

The adoral spiral makes a turn of 180 to 290°. The delicate central part of the denticle bears a straight thorn, directed in most species backwards. The blades are slanted more or less obliquely backwards; their narrow base by which they join the central part of the denticle extends anteriorly in a projection which may be short and thin or wide and knee-like (Fig. 1). These projections fit well into the corresponding notch in the preceding denticle. Thus the denticles are wedged together both by central conical parts and by the projections.

Macronucleus generally horse-shoe shaped; body has the shape of a flattened hemisphere or it is sack-like with a deeply vaulted adhesive disc. Exclusively on gills of freshwater fish.

Type species: *T. copiosa* Lom, 1959.

In this paper, we present 7 species of the genus *Tripartiella*. The first one has the anterior projection on the blade in form of a sharp spike (*T. copiosa*). In the second, the projection becomes rather a less sharp bend (*T. obtusa*). Then comes the group of 5 species with denticles characterized by a very delicate central part, and relatively very long blade joining the centre by a more or less pronounced knee-like bend (*T. bulbosa*, *T. bursiformis*, *T. lata*, *T. leucisci* and *T. kashkovskyi*). Most probably some more species of this kind will be discovered soon, which will make their mutual differentiation by the means presently at hand rather dificult, regarding the minuteness of their body and similarity of adhesive disc structure.

Tripartiella copiosa Lom, 1959

It occurs regularly on the gills of *Rutilus rutilus;* common also on the gills of *Alburnus alburnus*, *Leuciscus leuciscus*, *L. cephalus*, *Rhodeus sericeus*, *Blicca bjoerkna*, *Leucaspis delineatus* and *Cobitis taenia*.

This species has been thoroughly discussed by Lom (1963). Kashkovsky (1974) found it on *Rutilus rutilus* in the Ural region (USSR). It is evidently distributed throughout the Eurasian continent, on much more hosts than those known at present. Fig. 1, Plate II. shows typical denticles.

Tripartiella obtusa Ergens and Lom, 1970

Found regularly but exclusively on the gills of *Gobio gobio* from Czechoslovakia. It complies with the species *T. copiosa* by the same range of dimensions of all important structures, but differs in the shape of denticles. The anterior projections of denticles are not in the shape of a narrow, sharp spike, but rather resemble a rounded triangle (Plate II, Figs 2—5) forming together with the blade a „V" pointed anticlockwise. The difference is a very marked one; the denticles of *T. obtusa* also make a much stouter impression. Due to a typographic error, in the book of Ergens and Lom (1970) this species was dated *T. obtusa* Lom, 1967 instead of *T. obtusa* sp. n.; it should read *T. obtusa* Ergens and Lom, 1970.

Tripartiella bulbosa (Davis, 1947) Lom, 1959

syn. *Trichodina bulbosa* Davis, 1947
Trichodina ovaliformis Chen-Chih-leu, 1956
Tripartiella leucisci (Suzuki, 1950) Shtein 1968 (?)

Originally described from *Margariscus margarita* from West Virginia, USA (Davis 1947). Reported by Kuo Tung Pai (1950) from *Macropodus chinensis* and tadpoles of *Bufo bufo gargarizans* from the vicinity of Shanghai and by Chen (1956) from four species of Chinese herbivorous fishes (those three quoted below plus *Mylopharyngodon piceus*). The first identification, by means of silver technique, was done by Ivanova (1966) on ciliates from three species of herbivorous fishes (see below) from Krasnoyarsk region; Kashkovsky (1974) and Golemansky and Grupcheva (1975) reidentified it by means of silver impregnation technique on the Chinese herbivorous fishes, *Ctenopharyngodon idella, Hypophthalmichthys mollithrix* and *Aristichthys nobilis* from Bulgaria.

The species is characterized by its denticles. At variance with *T. bursiformis* and *T. lata*, the denticles have short and stumpy thorns; blades unconstricted at either end, with parallel borders. The anterior projection is reduced to an insignificant tubercle. The overall dimensions and the number of denticles, as compared to *T. bursiformis*, are somewhat smaller (see Davis 1947, Golemansky and Grupcheva 1975, Kashkovsky 1974 vs. Hoffman and Lom 1967).

We have found populations which corresponded rather precisely to *T. bulbosa* as described by Ivanova (1966) and Kashkovsky (1974) on imported *Ctenopharyngodon idella*. Further, we found it on the gills of *Abramis brama* collected in 1967 in the Tisza river, Hungary.

The adoral zone describes an incomplete turn of 140 to 180°.

Tripartiella lata Lom, 1963

Originally described from *Phoxinus laevis* from Czechoslovakia. Konovalov (1971) found it on the gills of *Oncorhynchus nerka* in Kamchatka, Grupcheva (1975) on *Salmo gairdneri* in Bulgaria.

The species was described in detail by Lom (1963). From the closely related *T. bursiformis* and *T. bulbosa* it differs by having tapering, slender and backwards slanted thorns; blades join the central parts by a wide rounded "knee" projecting forwards and fitting into the hollow part of the preceding "knee". We have found it also on the gills of *Pimephales vigilax* from the vicinity of Detroit, Mich., USA in 1966. (Plate II, Figs 6—7). This population is distinguishable from the *T. lata* as described from Czechoslovakia; it is another case of transcontinental distribution of some trichodinid species, exhibiting no apparent host specificity.

Tripartiella leucisci (Suzuki, 1950) emend.

syn. *Cyclochaeta leucisci* Suzuki, 1950

This species, described from the skin (!) and gills of *Leuciscus hukuensis* and tadpoles of *Rana rugosa* from Yamagata, Japan, without the use of impregnation technique, will be difficult to re-identify. Shtein (1968) found on four species of freshwater fishes from the Amur river a ciliate which she claimed to be identical with *T. leucisci;* the number of denticles corresponds to the latter. Denticle shape reminds also of *T. bursiformis*, although the overall dimensions are slightly smaller. Reexamination of her own material has led Shtein (1976—personal communication) to the assumption that *T. leucisci* is probably synonymous with *Tripartiella bulbosa*.

Tripartiella bursiformis (Davis, 1947) Lom, 1959

syn. *Trichodina bursiformis* Davis, 1947

Found on *Ambloplites rupestris* from West Virginia, USA (Davis 1947); *Acantharchus pomotis* from North Carolina, USA (Hoffman and Lom 1967).

The species is characterized (Fig. 8, Plate II) by the shape of denticles. In addition to characters common to *T. bulbosa* and *T. lata*, the denticles are distinguished by centripetally directed, slender thorns; the anterior projection of the blade is knob-like and the adjoining proximal part of the blade is constricted. The overall dimensions are markedly larger than in *T. bulbosa* and *T. lata*. Adoral zone makes a turn of 250—290°.

Tripartiella kashkovskyi sp. n.

Found on the gills of *Fundulus dispar* in the Illinois stretch of the Mississippi river, USA (locality Grand Tower) in 1966.

This species differs from *T. bulbosa* by having longer, slender thorns of denticles (Figs. 9—11, Plate II). From *T. bursiformis* it differs by having a knee-like junction — rather than just a small knob-like projection — between the central part of the denticle and the blade, and further by somewhat smaller overall dimensions and a shorter course of the adoral ciliary zone (i.e., 140—180° rather than 250—290°). From *T. lata* it differs in having the thorns pointed centripetally or slightly forwards instead of being slanted backwards; the "knee" forming the junction of blade and central part is not as wide as in *T. lata* and the overall dimensions and denticle number are greater (see Table 2).

For all these reasons we propose to designate this ciliate as *T. kashkovskyi* sp. n. in honor of the Soviet ichthyoparasitologist Dr. Kashkovsky.

Trichodinella Šrámek—Hušek, 1953

syn. *Brachyspira* Raabe, 1950

The adoral spiral makes a turn of 180—270°. The denticles with a delicate central part, whose anterior right border extends in a projection, fitting well into the notch between the central part and the blade of the preceding denticle. Thus the denticles are wedged together both by central conical parts and by the projections. The thorn instead of being stout and straight as in *Trichodina*, forms a short delicate hook curved along the central part (Fig. 1). The hook owing to its minuteness is not easy to distinguish in live ciliates and is rather difficult to impregnate. Macronucleus generally horse-shoe shaped, body reminds of a more or less flattened or vaulted hemisphere. Exclusively on fish gills; on freshwater, rarely marine hosts.

Type species *T. epizootica* (Raabe, 1950) Šrámek—Hušek, 1953.

Trichodinella epizootica (Raabe, 1950) Šrámek—Hušek, 1953

syn. *Brachyspira epizootica* Raabe, 1950
Trichodinella epizootica f. *percarum* Lom, 1959
Trichodinella maior Reichenbach-Klinke, 1962
Trichodinella percarum (Dogiel, 1940) Chan, 1961
Trichodinella percarum f. *lotae* Chan, 1961
Trichodinella lotae (Chan, 1961) Shtein, 1962
Trichodinella carassii (Dogiel, 1940) Kostenko, 1969 pro parte

It occurs regularly on the gills of *Perca fluviatilis, Acerina cernua, Esox lucius, Lota lota;* common on the gills of *Cyprinus carpio.* It is also found on the gills of *Aspro zingel, Barbus barbus, Blicca bjoerkna, Carassius carassius, C. auratus gibelio, Stizostedion lucioperca, Misgurnus fossilis, Oncorhynchus nerka, Pelecus cultratus, Salmo trutta, Rhodeus sericeus, Scardinius erythrophtalmus* and *Tinca tinca.* The area of distribution covers probably all of Eurasia.

The body has the shape of a vaulted disc, assymetrical due to one-sided localization of the adoral spiral. Velum is not distinctly developed. Detailed data on the general shape of the body, denticles and on the ultrastructure were given by Lom (1959, 1973).

T. epizootica invades gills of many fish species over the Eurasian continent. Accordingly, the morphology of the adhesive disc reveals a certain degree of variability (Plate III) so that at first inspection one is tempted to discern various different populations and attribute them taxonomic significance (see below). Also the spacing of denticles in the denticulate ring bears upon their shape. The denticles are minute and very delicate structures prone to various impregnation artifacts, and may be demonstrated differently, especially according to more or less heavy silver deposit. Considerable variation of denticles in one population has been demonstrated in ciliates from *Lota lota* (Lom 1963).

At close inspection it is evident that the species consists of a number of varying populations, with differences in morphology not always related to their host. At present, there are thus far no grounds for separating populations from various hosts as independent species; differences in structure or size overlap, are variable and inconstant and not sufficient enough for such an action.

Summarized biometrical data of *T. epizootica* from various hosts as well as pooled data from all fish hosts, are presented in Tables 2 and 3, Fig. 3. It is evident that all populations more or less coincide and are grouped around a rather narrow average value. There are rather few exceptions to this; e.g., in some population from the gills of *Aspro zingel* from the Danube river the dimensions have a range placed at the upper limits of the species.

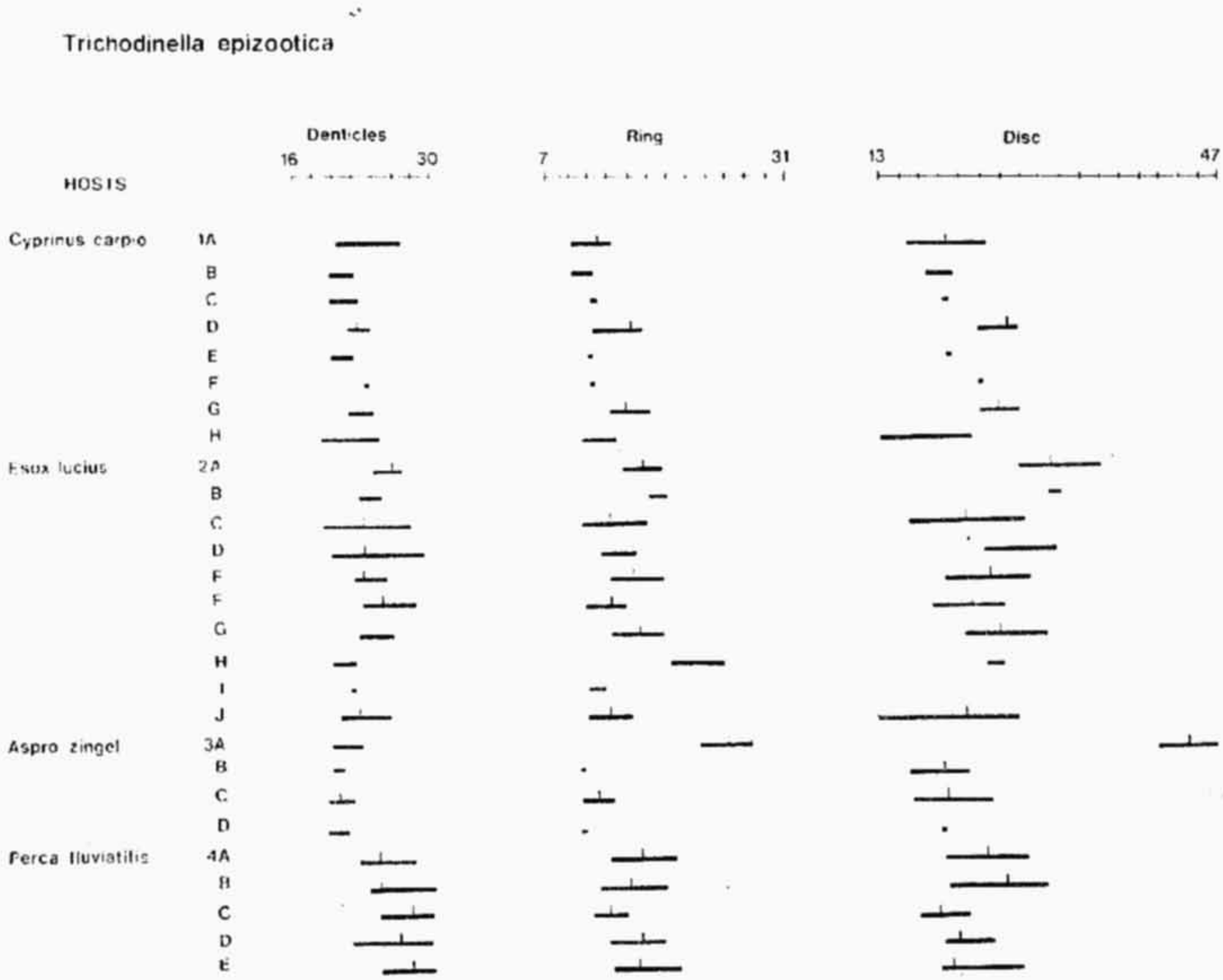


Fig. 3. Variation in different populations of *Trichodinella epizootica*. The same legend as in Fig. 2. 1 G—Raabe (1950); 1 H—Golemansky and Grupcheva (1975); 2 G—Raabe (1950); 2 H—Shtein (1967); 2 I—Chan (1961); 2 J—Kashkovsky (1974).

The adoral zone makes a turn of about 180° in most of the populations; invariably in those of *Perca fluviatilis*, *Acerina cernua*, *Lota lota* and carps. Pike populations collected on the territory of Czechoslovakia had the adoral zone of a constant course of 180°. In one population from perches from the Lake Arakul in the Asian part of the USSR it varied from 180° to 270°. The slide was kindly made available to us by courtesy of Dr Kashkovsky. Dr. G. Shtein from Leningrad has kindly communicated us her

Table 3. Biometrical data of *Trichodinella epizootica* and *T. subtilis*

	T. epizootica Pooled data (literature and authors' records) of populations from						*T. subtilis* Pooled data of populations from		
	All hosts	*Perca fluviatilis*	*Esox lucius*	*Acerina cernua*	*Lota lota*	*Cyprinus carpio*	All hosts	*Cyprinus carpio*	*Carassius carassius*
Diameter of									
body	18–60	23–50	22–48	24–41	27–60	25–38	22–46	24–44	22–46
adhesive disc	13–47	13–30	14–35	17–30	18–30	16–28	14–16	15–28	14–32
denticulate ring	8–30	8–27	10–24	8–18	9–30	8–17	7–20	7–15	7–20
macronucleus	13–37	16–31	18–37	12–16	10–29	—	15–26	15–26	19–26
Number of denticles	16–30	16–28	19–29	21–30	18–28	19–30	16–36	16–25	19–36
radial pins per denticle	4–10	4–6	4–6	4–5	5–10*	4–5	4–6	4–6	4–6
Dimension of denticles									
blade	1.4–5.4	2.2–3.6	3–5.4	3–4.8	1.4–4.8	2.2–3.9	2.0–4.8	2.1–4.8	2–4.8
center	0.6–3.3	0.6–2.2	0.6–3.3	0.6–2.0	1.2–2.6	1.7–2.6	0.6–2.6	0.9–2.6	0.6–3
Border membrane	1.4–3.3	1.8–3.3	1.6–2.4	1.4–2.5	1.8–2.4	2.2–3.3	1.3–3.3	1.3–2.6	1.4–3.3
Micronucleus	0.6–2.9 × ×2.0–7.0	0.6–2.4 × 2–4	0.8–2.2 × 4–7	1.2–2.5 × ×2.4–4.2	1–2.9 × 2–5	—	0.4–1.5 × 2.4–4	1.2 × 2.4–3.6	1.2–1.5 × 3.6–4
Adoral zone	180°–270°	180°	180°–270°	180°	180°	180°	180°	180°	180°

Measurements are given in microns (μm)
*) our own data never included more than 6 radial pins to a denticle!

data on another pike population of *T. epizootica* from the territory of Russian part of the USSR, with adoral zone variation from 180° to 270°. In *Blicca bjoerkna* population from Bulgaria the variation was 180—200°, in *Aspro zingel* population from the Danube it was 210 to 270°.

Factors that vary most in the morphology of the adhesive disc are:
— shape of the denticle blade: spoon-like or board-like, depending upon whether its margins are even and parallel or if they reveal a deep anterior notch. This also gives the final impression of the blades being obliquely or centrifugally set;
— the posterior projection of the blade may be more or less pronounced. It is more pronounced in populations found on *Esox lucius* (Fig. 2, Plate III), *Coregonus peled* (Figs 4, 5, Plate III) and in some populations from carps and *Acerina cernua*.
— the hook (centripetal projection) may be difficult to be revealed properly, thus sometimes changing the appearance of the denticles.
— the distance between the ends of the blades and the margin of the adhesive disc may also vary. This distance may depend on the state of contraction of the adhesive disc.

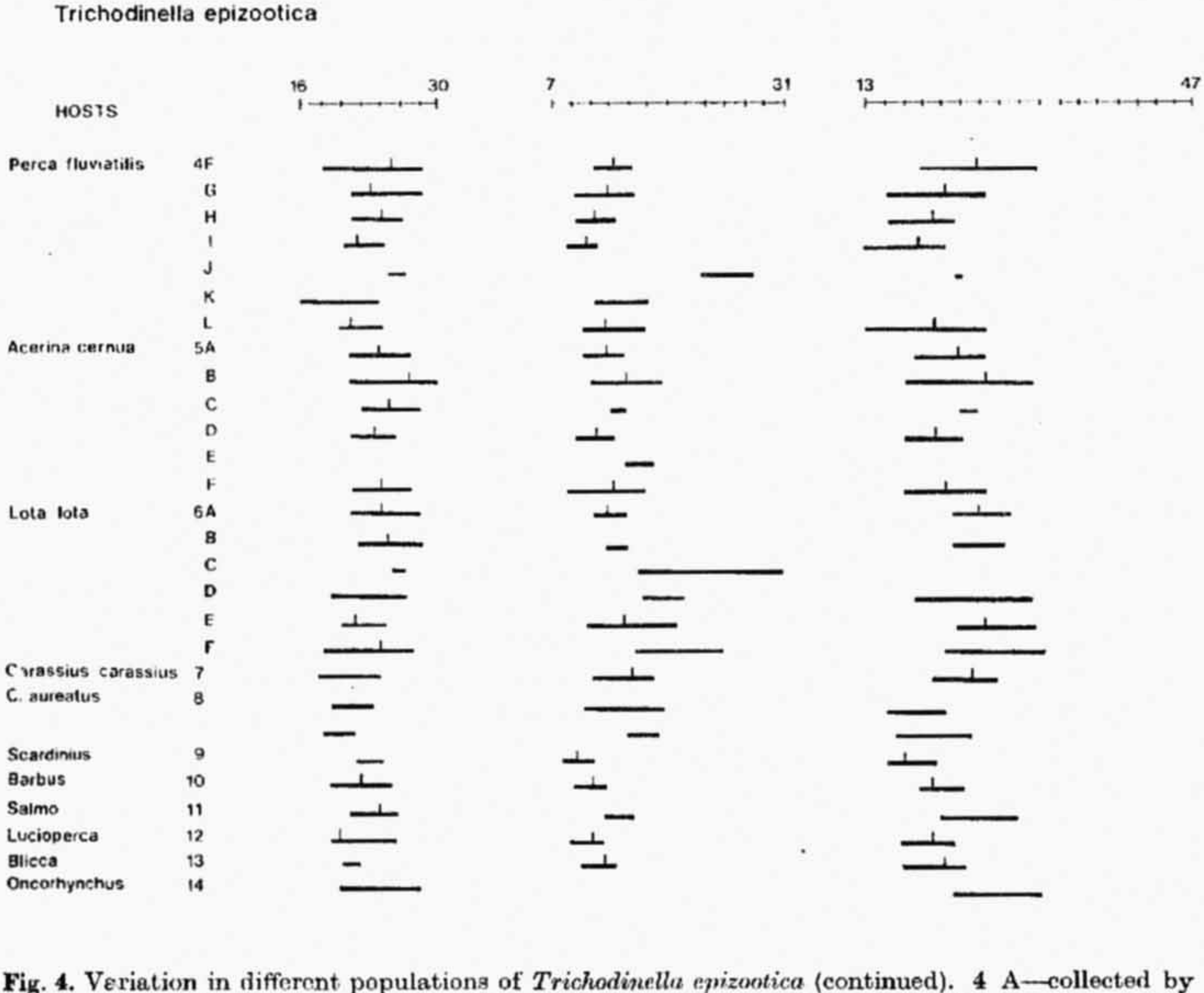


Fig. 4. Variation in different populations of *Trichodinella epizootica* (continued). 4 A—collected by Kashkovsky in the Ural region; 4 J—Shtein (1967); 4 K—Chan (1961); 4 L—Kashkovsky (1974); 5 A—collected by Kashkovsky in the Ural region; 5 E—Chan (1961); 5 F—Kashkovsky (1974); 6 C—Chan (1961); 6 D—Shtein (1968); 6 E—Kashkovsky (1974); 6 F—Kostenko (1969) 7—Raabe (1950); 8—two populations of Shtein (1968); 9 (= *S. erythrophtalmus*)—Raabe (1950) 10—*Barbus barbus*; 11—*Salmo trutta*; 12—*Stizostedion lucioperca;* 13—*Blicca bjœrkna* collected in Bulgaria; 14 (*Oncorhynchus nerka*)—Konovalov (1971).

Classification of *T. epizootica* has been subject to a certain confusion. Dogiel (1940) gave an inadequate description of *Trichodina domerguei* f. *percarum* from the gills of perches and *Acerina cernua*. Of the important diagnostic characters he presented only diameter of the body and denticulate ring, number of denticles and radial pins which themselves do not suffice for a reliable determination in addition to an oversimplified, sketchy design of the denticulate ring. Thus only the hosts indicate the possible identity of the ciliates; in addition to that, the term "forma *percarum*" has no real taxonomic significance. That is why Lom (1959) identified ciliate populations found on perches and *Acerina cernua* with *Trichodinella epizootica*, described accurately by Raabe (1950) using the Klein's silver impregnation technique. Raabe (1950) recorded *T. epizootica* from *Esox lucius*, *Cyprinus carpio*, *Carassius carassius* and *Scardinius erythrophtalmus;* this is in agreement with the wide host range of this species which we witness today. Lom (1959) separated populations from perches as *T. epizootica* f. *percarum* (Dogiel, 1940) suggesting their possible identity with Dogiel's description, since given a rather limited material at that time it seemed that in ciliates from perches the blades extended more obliquely backwards than on other populations. However, after a larger comparative material has been collected, it became clear that trichodinellas from *Perca* and *Acerina* do not differ enough to stay taxonomically isolated from populations living on other hosts (Lom 1953). Therefore they were identified with *T. epizootica* (Raabe), which was the first valid species duly described.

Chan (1961) described *T. epizootica* from the gills of *Lota lota* as a separate form, *T. epizootica* f. *lotae*. Kostenko (1969) proposed to establish a separate species, *T. percarum* (Dogiel, 1940) for populations from perches, differing from *T. carassii*, which was in her conception a synonymum of *T. epizootica*. Differential features comprised slight quantitative differences in the number of radial pins, course of the adoral zone, body size and denticle number. Kashkovsky (1974), Kashkovsky et al. (1974) adopted Chan's and Kostenko's taxons recognizing in addition to *T. epizootica* the species *T. carassii*, *T. percarum* and *T. lotae*. He interprets the differences between *T. epizootica* and *T. percarum* as follows: *T. epizootica* (as hosts he lists *Esox* and *Acerina*) has more marked anterior spike and posterior notch of the blade than in *T. percarum;* the centripetal projection of the thorn is a backwards curved hook. In *T. percarum*, this projection has the shape of a short, straight, directly centripetal projection. This, however, does not correspond with our innumerous light and electron microscope observations of *T. epizootica* from *Perca*. Kashkovsky (1974) describes (see his Fig. 24) under the name *Trichodinella carassii* a slightly different population from the gills of *Cyprinus carpio*. On analysing the morphology and quantitative data of *Trichodinella* populations from *Lota lota* we were unable to detect any evidence of their substantial difference from *T. epizootica* from other hosts; thus we cannot endorse *T. lotae* as a separate species.

For this reason and because of the absence of distinct and invariably constant differences between populations from separate hosts, we are in favour of maintaining a single species, *T. epizootica* (Raabe), which would include all populations discussed above. We are fully aware of the fact that *T. epizootica* comprises numerous populations which vary to a certain extent in their morphology and extent of the adoral ciliary zone. However, these differences are not well defined, their features overlapping, so that unless some well demonstrable criteria will prove otherwise, we refrain from splitting the species *T. epizootica*.

Duncan (in press) has prepared a description of a new species to be named *Trichodinella carpi* sp.n., from the gills of cultured carp in the Phillippines. It seems also to be identical with *T. epizootica* except perhaps for slightly smaller diameter of denticulate ring (6—10 µm) and denticle number (15—20).

Trichodinella baltica (Stryjecka-Trembaczowska, 1953) Lom, 1959

syn. *Brachyspira baltica* Stryjecka-Trembaczowska, 1953.

We concur with Raabe (1959) that the relation of this species described from the gills of *Gobius niger* from the brackish area of the Baltic sea (and not seen since) to *T. epizootica* has to be clarified, since it may well represent just a slightly different population of the latter. Morphologically, it shows no differences.

Trichodinella minuta] (Chen, 1956) Kostenko, 1969

syn. *Trichodina minuta* Chen, 1956

Found on the gills of herbivorous fishes *Aristichthys nobilis* and *Hypophtalmichthys mollithrix* in China.

Chen's description was very incomplete; he did not give any precise measurements; just the number of denticles (20—25) and radial pins (3—4) which fall within the range of *T. epizootica*. Kostenko (1969) found on the gills of *Hypophtalmichthys mollithrix* imported in the Ukrainian SSR ciliates which she identified as *T. minuta*. Diameter of the body 26—35 μm, adhesive disc 11—21 μm number of denticles 24 (22—24), length of their blade 4.4 μm, width of border membrane 5.5 μm and extent of the adoral zone 270°. Her photomicrograph of the silver impregnated adhesive disc does not clearly show the identity or difference from *T. epizootica*. Thus we are still inclined to consider *T. minuta* as a propable synonymum of *T. epizootica*.

Trichodinella myakkae (Mueller, 1937) Raabe, 1950

syn. *Trichodina myakkae* Mueller, 1937

Originally described from the gills of *Aplites salmoides;* Davis (1947) recorded it from *Ictiobus bubalus*, *Carpioides carpio*, *Salvelinus fontinalis*.

Mueller's and Davis' descriptions make it clear that it is a *Trichodinella;* however, they might not have observed the same ciliate since the dimensions disagree. In absence of impregnated specimens, the species is to be considered a nomen dubium; it may well be *T. epizootica*.

Trichodinella longispira Shtein, 1962

Described from the gills of *Esox reicherti* collected in the Amur river basin.

The diagnostic characters should be, according to Shtein (1962), the extent of the adoral zone making an arch of 315°, in contrast to 180—240° in *T. epizootica*. However, we found that the variation in some *T. epizootica* populations may reach 270° which leaves a narrow gap between the two species. The extent of adoral zone in *T. epizootica* populations on *Esox lucius* in Czechoslovakia was constantly 180°. Only two populations from pikes made an exception — the range was 180—270°. It follows that various populations of *T. epizootica* found on pikes in the Asian part of their distribution area may be slightly different. If *T. longispira* has to be upheld as an separate species, additional proofs for its independence have to be supplied.

Trichodinella subtilis (Lom, 1959) emend.

syn. *Trichodinella* (*Foliella*) *subtilis* Lom, 1959

Trichodinella carassii (Dogiel, 1940) Kostenko, 1969 pro parte

Typical host from which it was first described is *Carassius carassius*. Frequent also on *Cyprinus carpio;* found also on *Tinca tinca*, *Blicca bjoerkna*, *Pelecus cultratus*, *Salmo gairdneri* and *Rhodeus sericeus*. Distribution covers Eurasian continent.

The body has the shape of a hemisphere, with the oral surface wrinkled by 2—3 oblique furrows. The velum which is distinctly developed bears upwards directed marginal cilia. The morphology and dimensions of the adhesive disc vary to a certain extent, however, none of the populations is different enough to warrant the creation of a separate taxonomic unit. Populations found on crucian carps have higher denticle counts as well as greater dimensions of the adhesive disc and denticle ring than other populations (Table 1). On the contrary, populations from *Blicca bjoerkna* and *Salmo gairdneri* are distinguished by very low values (see Lom 1963 and Grupcheva 1975). Summarized data of various populations are presented in Table 3.

In one population from crucian carps from the Ural region, sent to us by the courtesy of Dr V. V. Kashkovsky, the number of denticles showed two peaks; in addition to that, two individuals with unusually high number of denticles (59!) were recorded. These are doubtlessly morphogenetical anomalies (Plate IV, Fig. 1).

The thorns of denticles (Fig. 1) have been reduced to delicate hooks directed backwards. The central part is generally slender; its anterior right border extends anteriorly into two projections, each separated by a deep notch. On the posterior border of the blade protrudes a similar, only slightly shorter projection, fitting into the notch between the anterior projections of the succeeding denticle. The two anterior projections and the posterior projection are the most reliable features for determination. The width of the blade seems to vary in populations from different hosts as well as among the individuals within a population. It is difficult to ascertain what is in such cases due to the extent of variation or to differences in impregnation. It is mostly the anterior part of the blade which fails to impregnate properly; then the blade seems to join the central part at a more oblique angle. The distal end of the blade can be truncated if it is close to the periphery of the disc, otherwise it may be rounded (Plate IV).

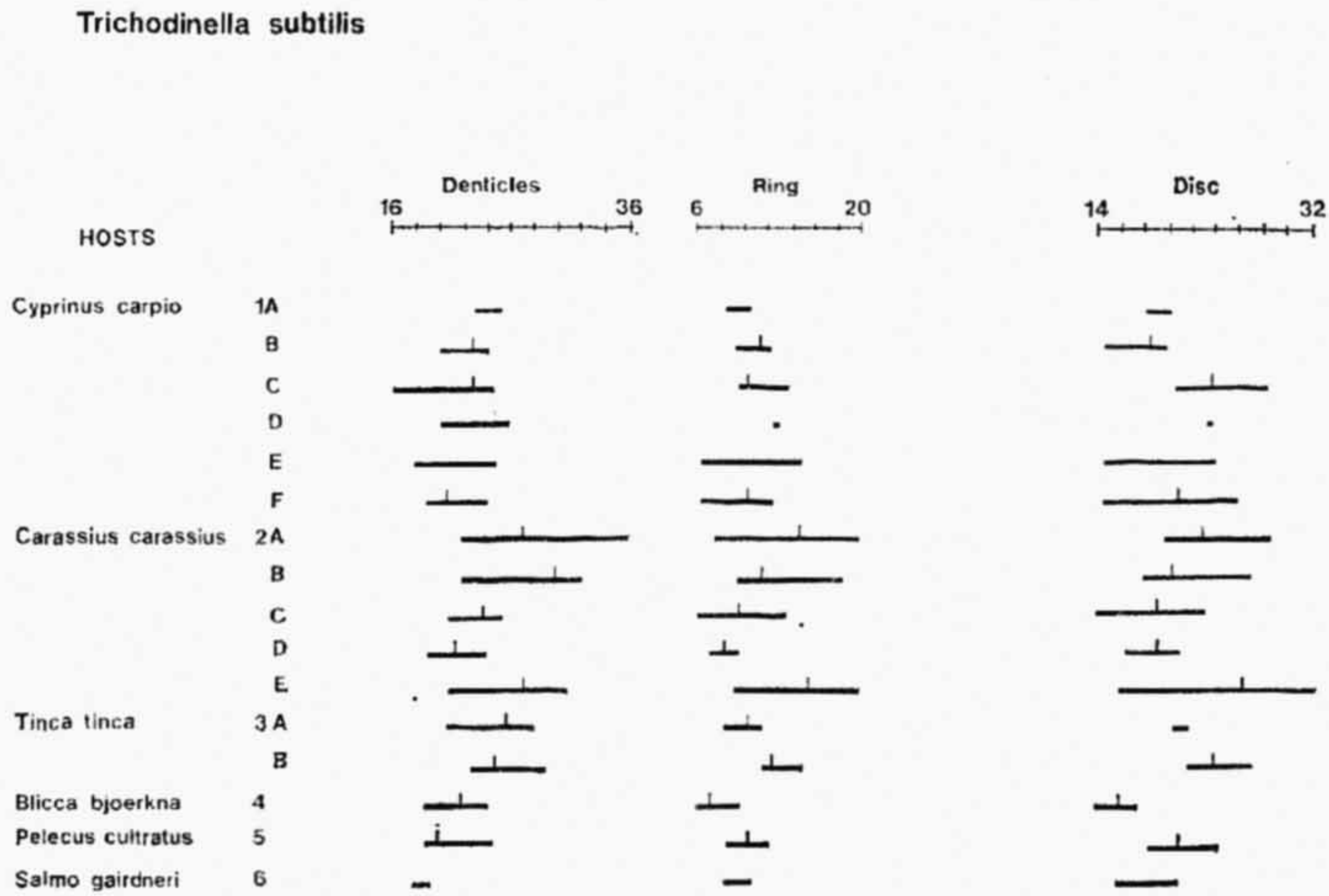


Fig. 5. Variation in different populations of *Trichodinella subtilis*. The same legend as in Fig. 2. 1 B—collected in Bulgaria; 1 F—Kashkovsky (1974); 2 B—collected by Dr Kashkovsky in the Ural region; 2 D—Kashkovsky (1974); G—Grupchova (1975 b).

In all populations where the extent of the adoral zone could be exactly followed, it was almost invariably about 180°, without marked variations.

Dogiel (1940) described from the gills of crucian carps a ciliate, of which he gave two sketchy illustrations. One seems to lack inner thorns of denticles, but the shape of denticles is drawn in a most uncertain way. The other depicts denticles with thorns assignable perhaps to the genus *Tripartiella*. That is why one of us (J. L.) in 1959 listed the *T. carassii* as a probable *Tripartiella* species: *Trichodinella* (*Tripartiella*) *carassii* (Dogiel, 1940), taking in consideration also its small dimensions and localization on the gills — Dogiel made no mention of the adoral zone. Dogiel's description, referring probably to two different and at present undeterminable species, cannot be recognized as valid and *T. carassii* is therefore a nomen dubium.

Some of the recent authors continue to use the name *Trichodinella carassii* for ciliates undoubtedly belonging to the species *T. subtilis* (see Kashkovsky et al., 1974, Fig. 6); however, there are no grounds for such an action.

Trichodinella symmetrica (Davis, 1947) Lom, 1959

This species, originally described by Davis (1947) as a *Trichodina* and supposed (Lom 1959) to be a *Trichodinella*, must be regarded as an unidentifiable nomen nudum. It is a mixture of a *Tripartiella* and a *Trichodinella* species, the proof of which are Figs. 50 vs. 51 and 138 vs. 139 in Davis (1947).

Trichodinella lawleri sp. n.*)

Found on the gills of *Lagodon rhomboides*, a marine fish collected at Horn Island, Mississippi coast of the Gulf of Mexico.

Above the circular base of the adhesive disc, the body is rather elevated (1.5 diameter of the disc). The species (numerical data are presented in Table 2) is characterized by the shape of denticles; their only apparent junction is by means of anterior projections of the proximal part of the blades. Margins of the blades are approximately parallel (Plate IV, Fig. 4). The wedging of the relatively broad central parts is not clearly visible on the impregnated specimens. Due to the very minute dimensions of denticles, the details of their shape could not be observed with accuracy. However, it is quite clear that the denticles differ from all previously known species. Micronucleus was not detected on our Robinow-stained preparations. The extent of the adoral zone does not surpass 180°.

CONCLUDING REMARKS

Gill-invading urceolariid ciliates with an incomplete turn of the adoral zone are among the most common protozoans living on the surface of fishes. They may be heavily pathogenic if present in large numbers (Lom 1972). Therefore reliable data are needed on their biology, host specifity and seasonal fluctuations for adequate evaluation of their role in the aquatic ecosystem and for a possible proposal of control measures. A prerequisite for this is the knowledge of their morphology and taxonomy, which is still far from being satisfactory, partly also due to technical problems connected with small dimensions of the elements of the adhesive disc.

However, from what we know, several important facts emerge. The whole group is well characterized by an incomplete turn of the adoral zone, not surpassing 290°, by overall small dimensions (smallest among mobiline peritrichs) and by living exclusively on the gills of fishes (with two exceptions in the genus *Paratrichodina*). Thus they represent a morphologically and biologically compact assemblage of species, all derived evidently from an original mobiline type with an adoral zone completing 360° or slightly more (Lom, in press).

In most species, the adoral zone is subject to some variation in length. In some, it was found to be quite constant - e.g., in *Trichodinella subtilis*. However, in no case does the variation approach significantly the lower limit of the adoral zone in the genus *Trichodina*, i.e., it never reaches 330°.

Most species have a low host specifity; only *Tripartiella obtusa* and *Paratrichodina corlissi* may be claimed specific for the fish genus *Gobio*. The most distributed one, *Trichodinella epizootica*, is at the same time the most variable species; additional research has to confirm if it is an assemblage of variable populations or ecoforms or if there would

*) The species is named in honour of Dr. A. Lawler, Parasitologist at the Ocean Springs Biological Institute, who has kindly supplied this material.

be reliable grounds for separating it into more units. Unfortunately, no observations on structure and size changes following experimental transfer between various hosts have been done thus far.

The genera *Tripartiella* and *Trichodinella* are closely related to each other by having denticles wedged together by a double system of central conical parts and anterior projections of the blades; moreover, they occur exclusively on the gills. They seem to be evolutionarily more advanced from the supposedly ancestral, *Trichodina*-like type than the genus *Paratrichodina*. It comprises species with denticles more related to the genus *Trichodina* than in the two former ones. The genus *Dipartiella* Shtein, 1961 (= *Dogielina* Raabe, 1959 nom. praeoccup.)which was described as lacking thorns completely and having very reduced central parts (see Raabe 1959, Shtein 1961) is still rather enigmatic. It may in fact well be just populations of *Tripartiella obliqua* (= *T. inversa* Dogiel sensu Shtein 1975) in which the denticles have not been properly impregnated. In this we concur with Shtein (1976, personal communication). Therefore we did not include *Dipartiella* in the present paper.

ЦИЛИАТЫ РОДОВ *TRICHODINELLA*, *TRIPARTIELLA* И *PARATRICHODINA* (PERITRICHA, MOBILINA), ЗАРАЖАЮЩИХ ЖАБРЫ РЫБ

Й. Лом и Д. П. Галдар

Резюме. На жабрах рыб обыкновенно встречаются многочисленные группы цилиат триходин, характеризованные несовершенным поворотом адоральной цилиарной зоны, небольшими размерами и строгой специфичностью для жабр. Виды двух родов — *Trichodinella* и *Paratrichodina* — встречаются на пресноводных и морских рыбах, третий, *Tripartiella*, на пресноводных хозяевах. Было обнаружено, что разные виды — *Paratrichodina incissa*, *Tripartiella copiosa*, *T. bulbosa*, *Trichodinella epizootica*, *T. subtilis* — самые обыкновенные, встречающиеся на различных хозяевах евразийского континента. Обсуждается хозяино-специфичность, вариабильность и таксономические отношения. Особое внимание уделяется вариабильности длины адоральной зоны что касается ее значения в таксономии урцеоларийд. У некоторых видов (*Trichodinella subtilis*) длина адоральной зоны совсем неизменчива, тогда как у других видов (напр. *T. epizootica*) она может или немного отличаться в популяциях некоторых хозяев или встречаются также вариации в пределах одной популяции. Описаны четыре новых вида: *Paratrichodina corlissi* sp. n. с жабр *Gobio gobio* и *G. kessleri*; *P. erectispina* sp. n., с жабр североамериканских *Pimephales vigilax* и *Tripartiella kashkovskyi* sp. n. с жабр *Fundulus dispar*; *Trichodinella lawleri* sp. n. от *Lagodon rhomboides* из побережья Мексиканского залива. Обитающие жабры триходины являются компактной группой видов по их морфологии и биологии. Очевидно они происходят от оригинальных перитрих-мобилин с адоральной цилиарной зоной совершающей один поворот — типа *Trichodina*.

REFERENCES

BOGDANOVA E. A., Fish trichodiniasis and the control measures. Izd. Rybnoe Khozyaystvo, Moskva, 35 pp. 1963. (In Russian).

CHAN SYN MAN, On the taxonomy of the genus *Trichodina*. Parazitologicheskiy Sbornik 20: 360—375, 1961. (In Russian).

CHEN-CHIH-LEU, The protozoan parasites from four species of Chinese pond fishes: *Ctenopharyngodon idellus*, *Mylopharyngodon piceus*, *Aristichthys nobilis* and *Hypophthalmichthys molithrix* I. The protozoan parasites of *Ctenopharyngodon idellus*. Acta hydrobiol. Sin. No. 1: 19—42, 1956.

DAVIS H. S., Studies of the protozoan parasites of freshwater fishes. U. S. Dept. Inter. Fish Bull. Wash. 51: 1—29, 1947.

DOGIEL, V. A., On the classification of the genus *Trichodina*. Tr. Len. Obsh. Yestestvoispitateley 68: 8—31, 1940. (In Russian)

DUNCAN B. L., Urceolariid ciliates of cultured Phillippine fishes. (In press).

ERGENS R., LOM J., Původci parasitárních nemocí ryb. Academia Praha, 383 pp., 1970.

EVDOKIMOVA E. B., KUZNECOVA I. G., SHTEIN G. A., Parasitic ciliates of the family Urceolariidae (Peritricha, Mobilia) of some fishes of southwest Atlantic. Zool. Zh. 48: 1451—1455, 1969. (In Russian).

GOLEMANSKY V., GRUPCHEVA G., Recherches sur les parasites unicellulaires des poissons herbivores annuels en Bulgarie. Acta zool. bulg. 2: 3—14, 1975.

GRUPCHEVA G., Parasitic ciliates (Peritricha, Urceolariidae) of some fishes from the Burgas lake. Acta zool. Bulg. 1: 77—83, 1975a. (In Bulgarian).

—, Unicellular parasites of rainbow trout (*Salmo gairdneri* Richardson) in some fisheries in Bulgaria. Acta zool. Bulg. 2: 70—81, 1975b. (In Bulgarian).

HAIDER G., Monographie der Familie Urceolariidae (Ciliata, Peritricha, Mobilia) mit besonderer Berücksichtigung der im süddeutschen Raum vorkommenden Arten. Parasitologische Schriftenreihe, Heft 17, Jena 1964, 251 pp., 1964.

HOFFMAN G. L., Parasites of North American freshwater fishes. Univ. of California Press, Berkeley and Los Angeles. 486 pp., 1967.

—, LOM J., Observations on *Tripartiella bursiformis*, *Trichodinella nigra* and a pathogenic trichodinid, *Trichodina fultoni*. Bull. Wildl. Dis. Assoc. 3: 156—159, 1967.

IVANOVA N. S., Urceolariidae Stein (1876) of White Amur fish and grass carps in water reservoirs of Moscow region and Krasnodar district. Tr. Vsesoyuz. n -i. Inst. prud. ryb. Khozyay. 14: 57—61, 1966. (In Russian).

—, Problems of infection of some pond fishes by ciliates of the family Urceolariidae. Tr. Vsesoyuz. n -i. Inst. prud. ryb. Khozyay. 15: 287—293, 1967. (In Russian).

KASHKOVSKY V. V., Urceolarids (Ciliata, Peritricha) of fishes from Ural. Parazitologiya 8: 368—378, 1974. (In Russian).

—, RAZMASHKIN D. A., SKRIPCHENKO E. G., Diseases and parasites of fishes in Siberian and Ural fish farms. Sredne Uralskoe Knizh. Izd., 160 pp. 1974. (In Russian).

KAZUBSKI S. L., MIGALA K., Urceolariidae from breeding carp *Cyprinus carpio* L. in Zabiniec and remarks on the seasonal variability in trichodinids. Acta protozool. 6: 137—160, 1968.

KHAN R. A., Taxonomy, prevalence and experimental transmission of a protozoan parasite, *Trichodina oviducti* Polyanski (Ciliata, Peritricha) of the thorny skate, *Raja radiata* Donovan. J. Parasitol. 58: 680—685, 1972.

KONOVALOV S. M., Differentiation of the local stocks of nerka, *Oncorhynchus nerka* (Walbaum). Nauka, Leningrad, 228 pp., 1971. (In Russian).

KOSTENKO S. N., On the synonymy of some representatives of the genus *Trichodinella* Šrámek—Hušek 1953 (Peritricha, Mobilia) Zb. Prac. zool. Muzeyu. Inst. Zool. AN USSR 33: 23—30, 1969. (In Ukrainian).

KUO-TUNG PAI, The fibrillar system of *Trichodina pediculus* Ehrb. and *T. bulbosa* Davis. Sinensia (N. S.) 1: 99—111, 1950.

LOM J., A contribution to the systematics and morphology of endoparasitic trichodinids from amphibians, with a proposal of uniform specific characteritisc. J. Protozool. 5: 251—263, 1958.

—, On the systematics of the genus *Trichodinella* Šrámek—Hušek (*Brachyspira* Raabe). Acta Parasitol. polon. 7: 573—590, 1959.

—, The ciliates of the family Urceolariidae inhabiting gills of fishes (Trichodinella group). Věst. Čs. Spol. zool. 27: 7—19, 1963.

—, The morphology and morphogenesis of the buccal ciliary organelles in some peritrichous ciliates. Arch. Protistenk. 107: 131—162, 1964.

—, Les ciliés Péritriches. In: Traité de Zoologie. vol. Ciliés, Masson & Cie, Paris, (In press).

—, The adhesive disc of *Trichodinella epizootica* ultrastructure and injury to the host tissue. Folia parasit. (Praha) 20: 193—202, 1973.

—, HALDAR D. P., Observations on trichodinids endocommensal in fishes. Trans. Amer. micr. Soc. 95: 527-541, 1976.

—, LAIRD M., Parasitic protozoa from marine and euryhaline fish of Newfoundland and New Brunswick. I. Peritrichous ciliates. Can. J. Zool. 47: 1367—1380, 1969.

RAABE Zd., Uwagi o Urceolariidae (Ciliata-Peritricha) skrzel ryb. Ann. Univ. M. Curie-Sklodowska, Ser. DD. 5: 292—310, 1950.

—, Urceolariidae of gills of Gobiidae and Cottidae from Baltic Sea. Acta parasitol. pol. 7: 441—452, 1959.

SHTEIN G. A., On the systematics of Urceolariidae (Infusoria, Peritricha). Zool. Zh. 40: 1137—1142, 1961. (In Russian).

—, Suborder Mobilia Kahl, 1935. In: Bykhovsky B. E., (ed.). Key to the parasites of freshwater fishes of the USSR pp. 151—188, Publ. House Acad. Sci. USSR, 1962. (In Russian).

—, Parasitic ciliates (Peritricha, Urceolariidae) of some fishes of the Kamchatka. Acta protozool. 4: 291—305, 1967. (In Russian).

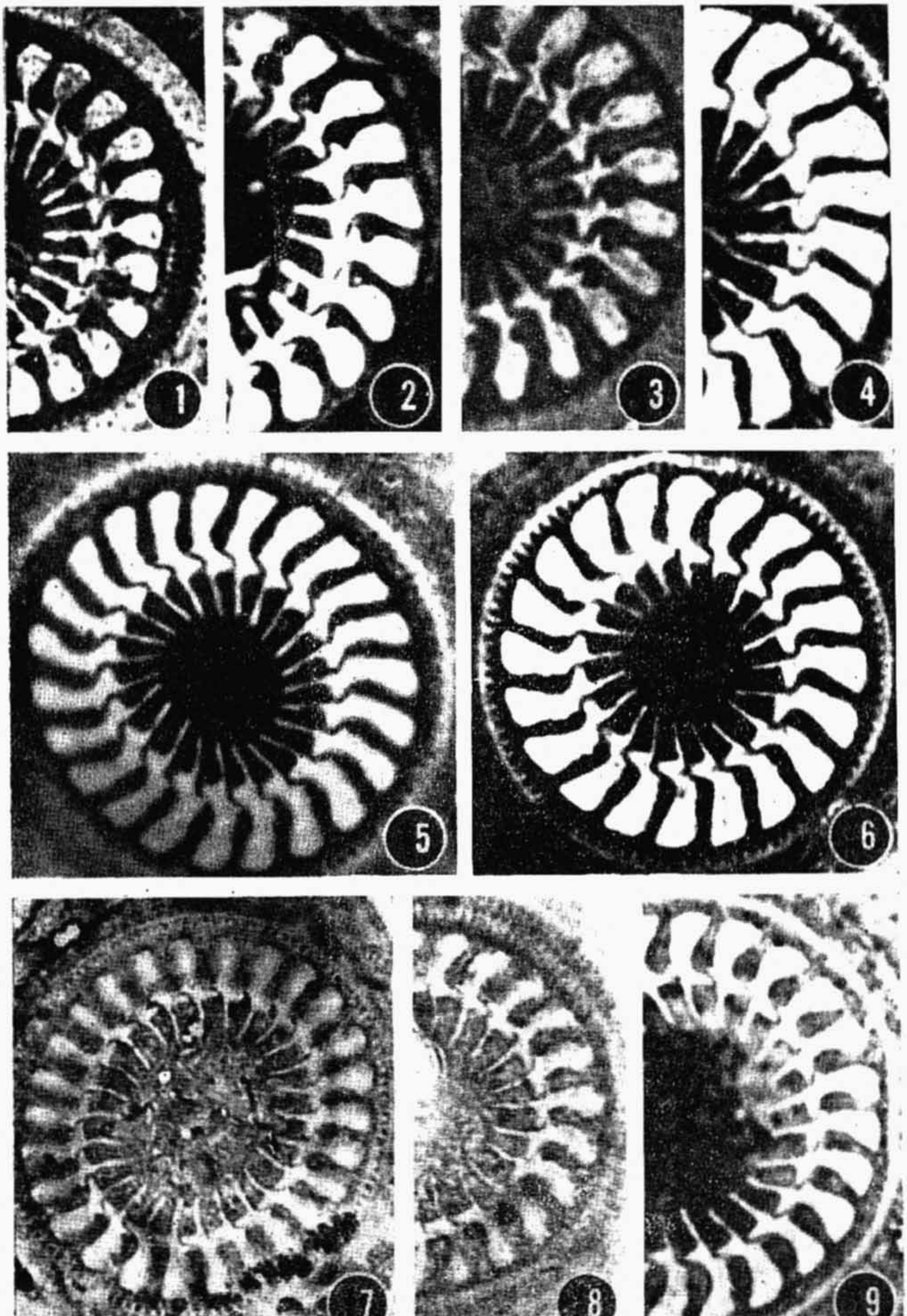
—, Parasitic ciliates (Peritricha, Urceolariidae) of fishes of the Amur basin. Acta protozool. 5: 229—243, 1968. (In Russian).

—, The order Peritricha F. Stein, 1859. In: Greeze V. N., Delyamure S. L., Nikolaeva V. M., eds. Key to the parasites of vertebrates of the Black and Azov Seas, Nauk. Dumka, Kiev pp. 53—71, 1975. (In Russian).

WELLBORN T. L., *Trichodina* (Ciliata: Urceolariidae) of freshwater fishes of the southeastern United States. J. Protozool. 14: 399—412, 1967.

Received 18 October 1976.

J. L., Parasitologický ústav ČSAV, Flemingovo n. 2, 166 32 Praha 6, ČSSR



Figs 1—3: *Paratrichodina incissa;* parts of the adhesive discs impregnated with Klein's method 1 — specimen from *Leuciscus leuciscus,* 2 — from *Noemacheilus barbatulus,* 3 — from *Scardinius erythrophtalmus.* **Figs 4—6:** *P. corlissi* sp.n.; 4 and 6 specimens from *Gobio kessleri,* 5 from *Gobio gobio* **Figs 7—8:** *P. erectispina* sp. n. from *Pimephales vigilax.* **Fig. 9:** *Paratrichodina* sp. from *Coregonus nanus.*

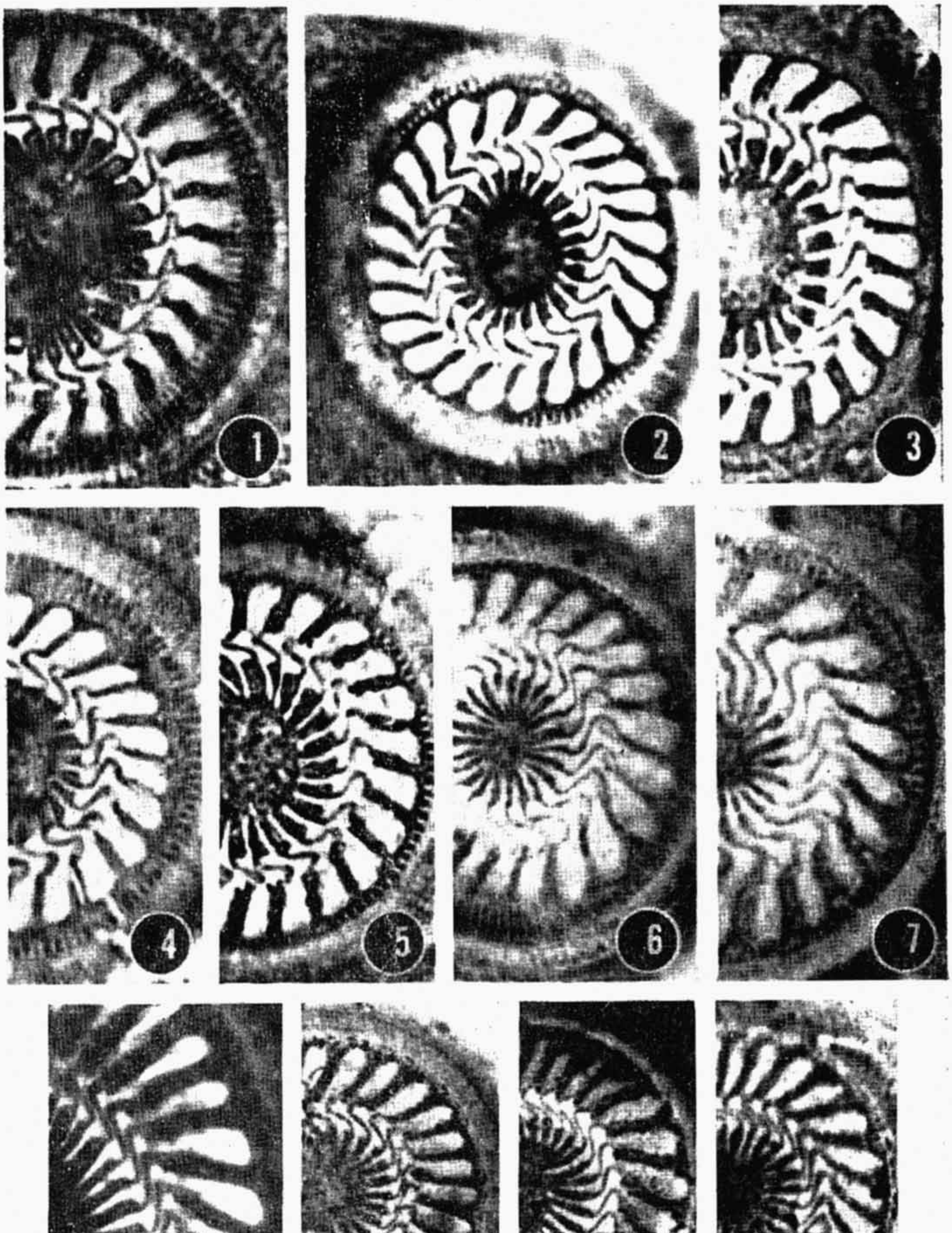
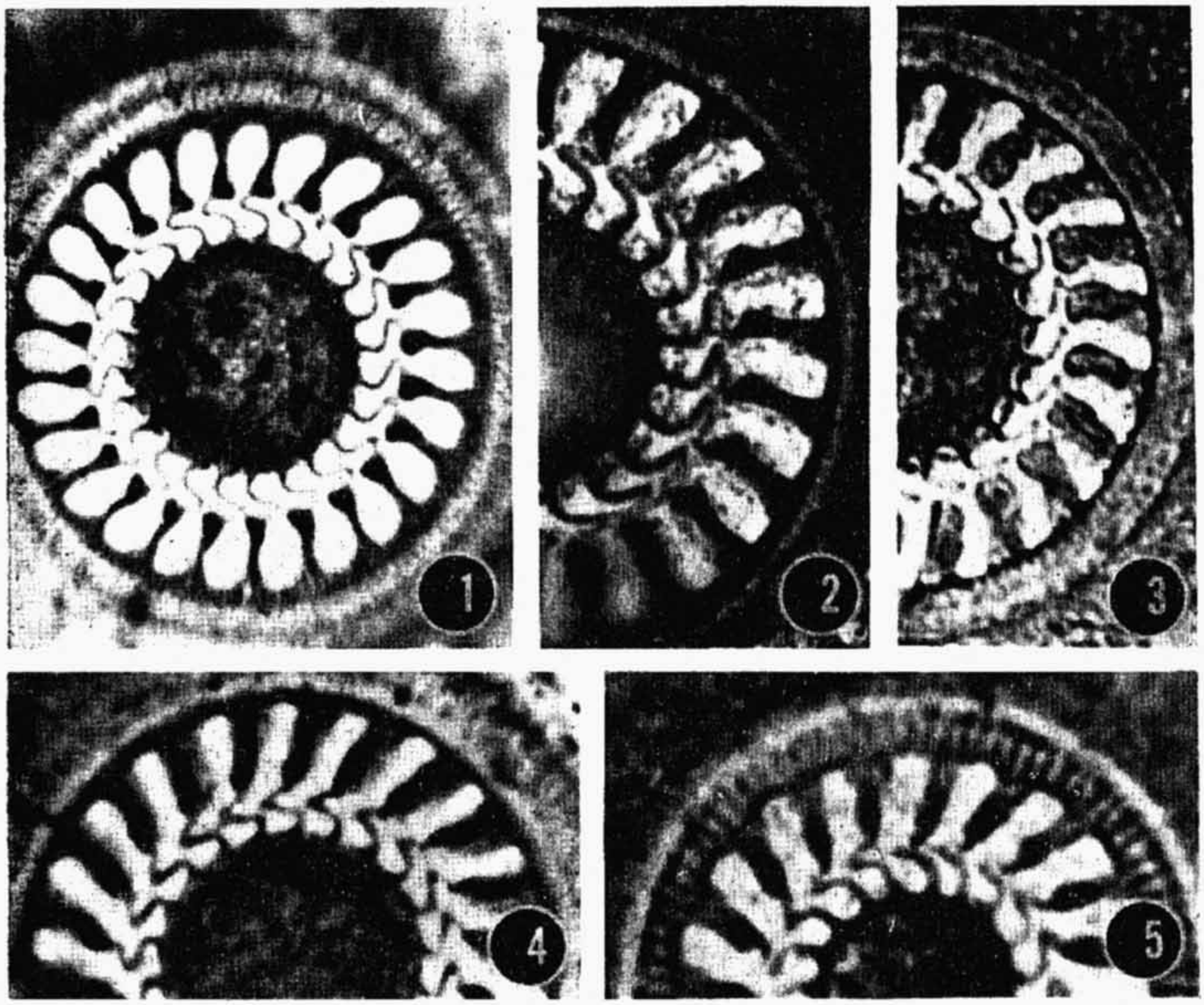
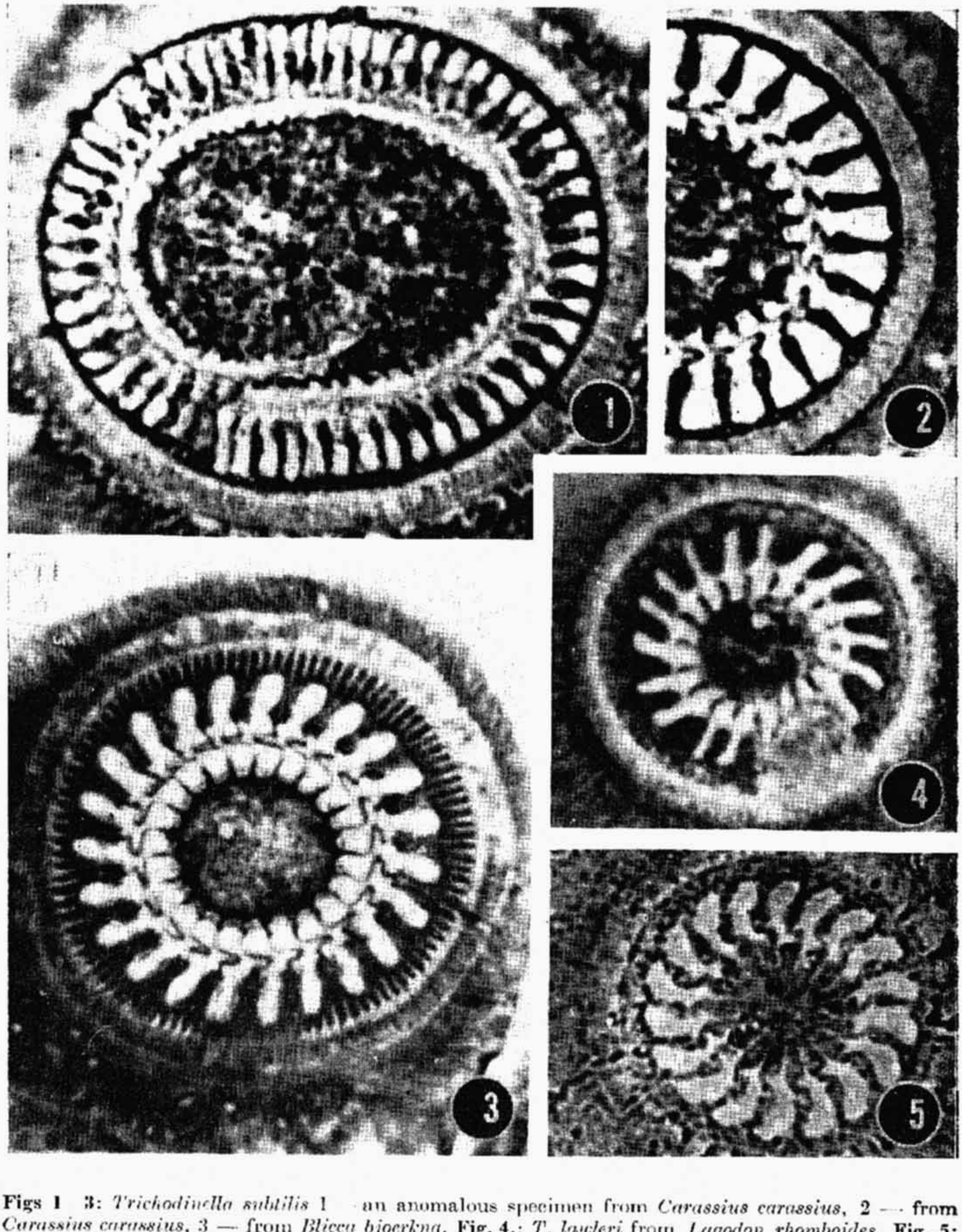


Fig. 1: *Tripartiella copiosa* from *Rutilus rutilus*. **Figs. 2—5:** *T. obtusa* from *Gobio gobio*. **Figs 6 7:** *T. lata* from *Pimephales vigilax*. **Fig. 8:** *T. bursiformis* from *Acantharchus pomotis*. **Figs 9—11:** *T. kashkovskyi* from *Fundulus dispar*.



Trichodinella epizootica **Fig. 1.**: from *Lota lota*. **Fig. 2.**: from *Esox lucius*. **Fig. 3.**: from *Acerina cernua*. **Figs 4–5**: from *Coregonus peled*.



Figs 1–3: *Trichodinella subtilis* 1 — an anomalous specimen from *Carassius carassius*, 2 — from *Carassius carassius*, 3 — from *Blicca bjoerkna*. **Fig. 4.:** *T. lawleri* from *Lagodon rhomboides*. **Fig. 5:** *Paratrichodina* sp. from *Notemigonus chrysoleucas*.