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NEMATODES PARASITIC IN BIRDS OF CUBA

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Dedicated to the 70th birthday of Professor S. Hrabě

Received December 5, 1968

Abstract: 15 nematode species were identified in post mortem examination of 102 Cuban birds belonging to 10 different orders. One of them, *Microtetrameres longiovatus* sp. n., discovered in the host *Glaucidium siju vittatum*, is new for science. The following 8 species are recorded for the first time from Cuba: *Amidostomum chevreuxi*, *Ornithostrongylus fariai*, *Cyrnea spinosa*, *Oxyspirura ostopapillata*, *Victorocara cucullatus*, *Ascaridia hermaphrodita*, *Contracaecum ovale* and *Capillaria cylindrica*. The species *Strongyloides avium*, *Amidostomum fulicae*, *Ornithostrongylus crami*, *Ganguleterakis dispar*, *Contracaecum rudolphii* and *Aproctella stoddardi* were found in 10 new, definitive hosts. In addition to the original description of the new species *M. longiovatus* n. sp. redescriptions are given for the species *S. avium*, *O. octopapillata*, *V. cucullatus*, *C. cylindrica* and some data on the morphology and measurements of the other mentioned species.

In 1965 (July to December) we continued to collect parasites from Cuban birds*. This paper presents the result of systematic faunistic studies performed in post mortem of 102 birds (28 species and subspecies). The nematodes were discovered in 23 hosts, i.e. in 22.5%.

LIST OF THE NUMBERS OF BIRDS EXAMINED AND THEIR SYSTEMATIC POSITION

(the numerator = number of examined hosts, the denominator = number of infected hosts)

I. Colymbiformes (2/1): *Podiceps dominicus dominicus* (1/1); *Podilymbus podiceps podiceps* (1/–).
II. Anseriformes (3/1): *Anas americana* (1/1); *A. discors* (1/–); *Aix sponsa* (1/–).
III. Falconiformes (19/3): *Cathartes aura aura* (7/–); *Polyborus cheriway audubonii* (1/1); *Falco sparverius sparverius* (1/–); *F. s. sparverioides* (9/2); *Buteogallus anthracinus gundlachii* (1/–).
IV. Gruiformes (3/2): *Grus canadensis nesiotes* (1/–); *Aramus guarauna pictus* (2/2).
V. Ralliformes (33/10): *Fulica americana americana* (20/7); *Gallinula chloropus cerceris* (11/2); *Porphyrula martinica* (2/1).
VI. Columbiformes (18/2): *Columba leucocephala* (2/–); *C. squamosa* (5/–); *C. inornata inornata* (2/–); *Geotrygon montana montana* (1/–); *G. chrysia* (2/–); *Zenaida aurita zenaida* (5/2); *Columbigallina passerina insularis* (1/–).
VII. Psittaciformes (10/2): *Amazona leucocephala leucocephala* (10/2).
VIII. Strigiformes (7/2): *Tyto alba furcata* (1/–); *Glaucidium siju siju* (3/1); *G. siju vittatum* (3/1).

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* I wish to express my gratitude for valuable help in collecting the material to Dr. O. H. Garrido, Mr. Jorge de la Cruz and Mr. Nerly Lorenzo Hernández from Havana, to Dr. J. Groschaft C. Sc. from Prague and to Ing. J. Macko C. Sc. from Košice.

IX. **Caprimulgiformes** (1/–): *Chordeiles minor gundlachii* (1/–).
X. **Apodiformes** (6/–): *Chlorostilbon ricordii ricordii* (4/–); ***Mellisuga helenae*** (2/–).

SYSTEMATIC SURVEY

Fam. Strongyloididae Chitwood et McIntosh, 1934

1. *Strongyloides avium* Cram, 1929 **Fig. 1**

Hosts: *Gallinula chloropus cerceris* Bangs; *Aramus guarauna pictus* (Meyer).
Location: small intestine.
Locality: Plan Fidel – Ciénaga de Zapata (province Las Villas); Paso Real de San Diego (province Pinar del Río).

Incidence in the hosts and weight of parasitaemia: Of the 11 examined *G. chloropus cerceris* this nematode species was found in one host (72 female worms); of the 2 examined *A. guarauna pictus* one was positive (only one female worm).

This nematode species was recorded from birds of the nearctic and neotropic region (U.S.A., Puerto Rico, Cuba); in the latter by Pérez Vigueras (1936) from the host *Gallus gallus* f. *dom.* in the province Havana. We found it in the two mentioned new hosts. The metrical evaluation of our material

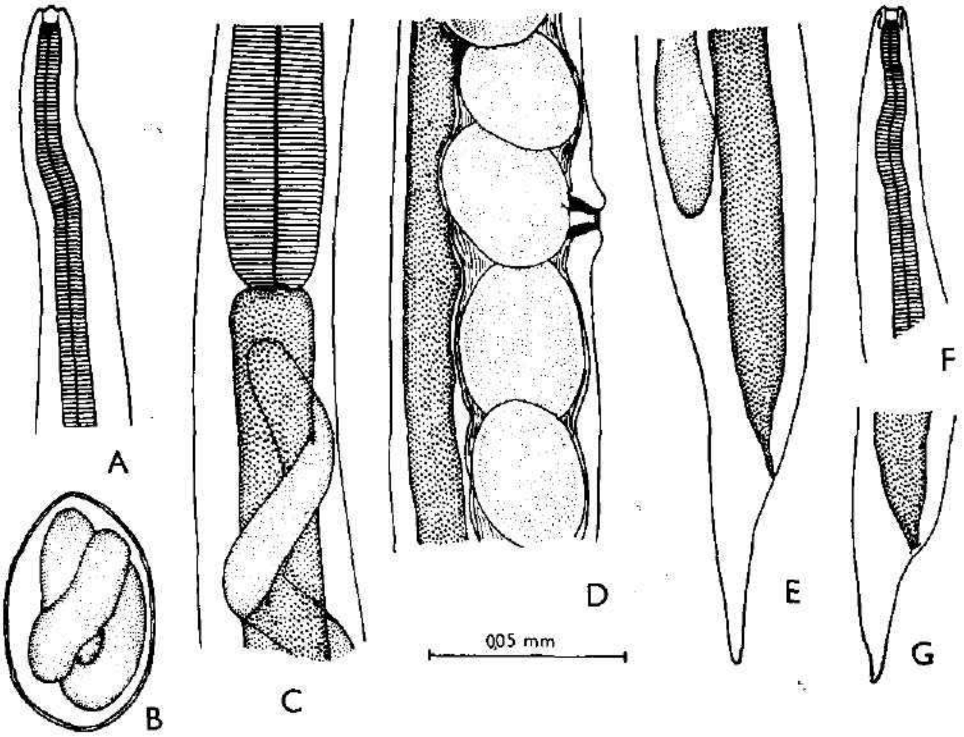

Fig. 1. *Strongyloides avium* Cram, 1929 from the small intestine of the host *Gallinula chloropus cerceris*. A, F — anterior end of body; B — egg; C — oesophagus termination; D — vulva region; E, G — posterior end of body. Orig.

rom the host *G. chloropus cerceris* gives further information on the variability f this species.

Description: small, slender opaque nematodes. Overall length 2.25 to 31 mm, maximum width 0.050—0.058 mm. Cuticle with delicate, trans-erse striation. Mouth terminal with 6 small circumoral elevations. Buccal vity 0.004—0.005 mm deep and 0.003—0.004 mm wide. Oesophagus 0.53 to .66 mm long, maximum width 0.027—0.033 mm. Nerve ganglion at 0.11 0.14 mm from anterior end of body, excretory pore at 0.12—0.16 mm. ulva rounded, slightly elevated at the margin, placed at 1.35—2.13 mm rom anterior end of body. Anterior ovary extended to 0.011—0.104 mm rom oesophagus ending and coiled in three turns round anterior portion of intestine. Posterior ovary extended to 0.058—0.104 mm from posterior end f body. Eggs number 48—59. Measurements of eggs with undeveloped arvae 0.039 to 0.050 mm by 0.027—0.031 mm. Eggs with larvae measure .056 to 0.059 by 0.038—0.040 mm. Anus at 0.031—0.058 mm from poste-ior end of body.

Fam. Trichostrongylidae Leiper, 1912

2. *Amidostomum fulicae* (Rudolphi, 1819)

Hosts: *Fulica americana americana* Gmelin, *Gallinula chloropus cerceris* Bangs.
Location: under the lining of the gizzard.
Localities: Salinas, Plan Fidel — Ciénaga de Zapata (province Las Villas).

ncidence in the hosts and weight of parasitaemia: Of the 20 examined *F. a. mericana*, this species was discovered in 7 of them (4—16 nematodes in one ost); of the 11 examined *G. chloropus cerceris* one was positive (2 worms).

Note: The nematodes *A. fulicae* from the host *F. a. americana* are in norphological agreement with the material from the European host *F. atra* L. Measurements of the male nematodes from both hosts are given in Tab. 1.

Tab. 1. Measurements (in mm) of the male of *Amidostomum chevreuxi* Seurat, 1918 and *A. fulicae* (Rudolphi, 1819) after our material and that of other authors

Species	*A. chevreuxi*		*A. fulicae*	
Host	*Aramus guarauna pictus*	*Himantopus himantopus*	*Fulica americana americana*	*Fulica atra*
Authors	Our data	Seurat (1918)	Our data	Baruš and Lelek (1961)
Body length	12.99	7.9 —8.0	6.02 —7.47	6.28 —7.94
Maximum body width	0.14	0.08	0.16 —0.18	0.12 —0.13
Depth of mouth capsule	0.008	0.007, 0.008	0.011—0.015	0.011—0.012
Width of mouth capsule	0.011	0.010	0.017—0.019	0.020—0.023
Oesophagus length	0.66	0.63—0.84	0.80—0.89	0.66—0.71
erve ganglion	0.23	0.27	0.24 —0.27	—
xcretory pore	—	0.43 —0.49	0.31 —0.34	—
picule length	0.146	0.12	0.191—0.202	0.168—0.178
Maximum spicule width	0.019	—	0.022—0.027	—
ubernaculum length	0.089	0.060	0.081—0.085	0.075—0.078

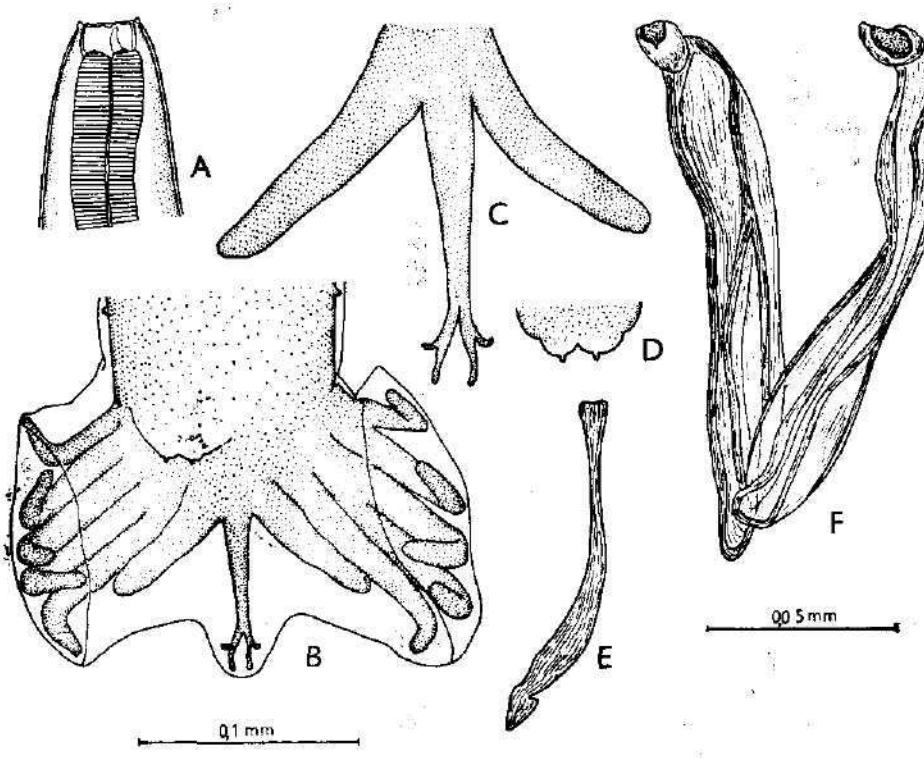

Fig. 2. *Amidostomum chevreuxi* Seurat, 1918 from the gizzard of the host *Aramus guarauna pictus*. A — anterior end of body; B — bursa copulatrix; C — dorsal and externodorsal rib; D — genital cone; E — gubernaculum; F — spicules. Orig.

3. *Amidostomum chevreuxi* Seurat, 1918 **Fig. 2**

Host: *Aramus guarauna pictus* (Meyer)
Location: under the lining of the gizzard.
Locality: Paso Real de San Diego (province Pinar del Río).

Incidence and weight of parasitaemia: Of the 2 examined *A. guarauna pictus* this nematode was discovered in one host (1 male and the fragment of the posterior portion of one female worm).

Note: This species was described by Seurat (1918) from the host *Himantopus* from Algiers. Roudabush (1942) discovered this species in the host *F. americana* in the U.S.A. (Iowa). We found it first in a new host in Cuba. Czaplinski (1962) placed *A. chevreuxi* in synonymy with *A. acutum* (Lundahl, 1848). The nematodes of our material are in complete morphological accord with the original description by Seurat, differing from the redescription of *A. acutum* by Czaplinski (1962) in the shape of the genital cone, in the dorsal rib, the spicules and the vulva. Therefore, we consider *A. chevrouxi* to be a valid taxon. Our measurements of the male worm and the original description of Seurat are given in Tab. 1.

4. *Ornithostrongylus crami* Pérez Vigueras, 1934

Host: *Zenaida aurita zenaida* (Bonaparte).
Location: small intestine.
Locality: La Bajada-Península de Guanabacabibes (province Pinar del Río).

Incidence and weight of parasitaemia: Of the 5 examined *Z. aurita zenaida* this nematode species was found in one host (1 male and 7 females). Pérez Vigueras (1934) described this species from the host *Zenaida macroura macroura* from localities in the provinces Havana and Pinar del Río. Baruš (1966) discovered this species in *Z. aurita zenaida* in the province Oriente.

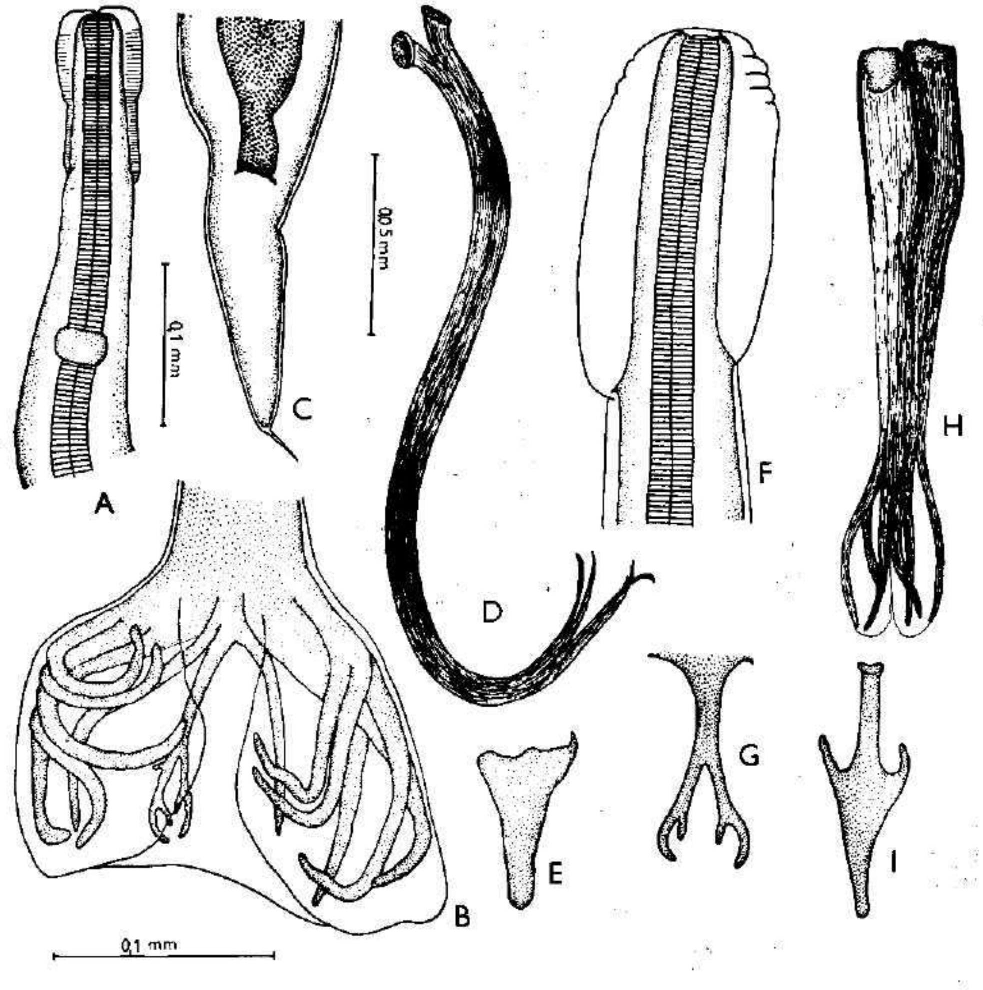

Fig. 3. *Ornithostrongylus fariai* Travassos, 1914 (A, B, C, D, E) and *O. crami* Pérez Vigueras, 1934 (F, G, H, I) from the small intestine of the host *Zenaida aurita zenaida*. A, F — anterior portion of body; B — bursa copulatrix; C — posterior portion of female body; D, H — spicules; E, I — gubernaculum; G — dorsal rib. Orig.

5. *Ornithostrongylus fariai* Travassos, 1914 **Fig. 3**

Host: *Zenaida aurita zenaida* (Bonaparte).
Location: small intestine.
Locality: Playa Larga — Ciénaga de Zapata (province Las Villas).

Incidence and weight of parasitaemia: Of the 5 examined *Z. aurita zenaida* this nematode species was found in one host (1 male and 5 female worms).

Up to the present, this nematode species has been recorded only from hosts of the order Columbiformes (*Leptotila rufaxilla* and *L. ochroptera*) — see Travassos (1937). In Cuba we found it in the new host *Z. aurita zenaida* (Columbiformes). In an earlier paper (Baruš, 1966) we described the finding of one male worm (*Ornithostrongylus* sp.) in the host *Phalacrocorax brasilianus mexicanus* (Pelecaniformes) in the locality Punta Caguanes-Yaguajay (province Las Villas) this belonging also to the species *O. fariai*. There is no morphological difference between our material (male and female worms) and the original description except in the length of the spicules (for measurements of the male worms of *O. fariai* and *O. crami* given by us and in the original description see Tab. 2).

Tab. 2. Measurements (in mm) of the female of *Ornithostrongylus crami* Pérez Vigueras, 1934 and *O. fariai* Travassos, 1914 after our material and that of other authors

Species	*O. Crami*		*O. fariai*		
Host	*Zenaida aurita zenaida*	*Zenaida macroura macroura*	*Zenaida aurita zenaida*	*Phalacrocorax brasilianus mexicanus*	*Leptotila rufaxilla* *L. ochroptera*
Authors	our data	Pérez Vigueras (1934)	our data	Baruš (1966)	Travassos (1914)
Body length	5.61	6—7	6.61	5.90	9—10
Maximum body width	0.10	0.06	0.078	0.099	0.110
Length of cephalic vesicle	0.089	0.80 (?)	0.085	0.096	0.078—0.085
Width of cephalic vecisle	0.054	—	0.042	0.046	—
Oesophagus length	0.35	0.384	0.32	0.30	0.35—0.45
Maximum esophagus width	0.027	0.040	0.031	0.029	—
Nerve ganglion	0.18	0.170	0.15	0.18	—
Spicule length	0.159	0.165—0.175	0.226	0.214	0.285
Gubernaculum length	0.078	0.067	0.058	0.061	0.064—0.071
Gubernaculum width	0.035	0.020	0.027	—	0.021

Fam. Heterakidae Railliet et Henry, 1914

6. *Ganguleterakis dispar* (Schrank, 1790) Fig. 4

Host: *Anas americana* Gmelin.
Location: appendage
Locality: Playa Piloto (province Camagüy).

Incidence and weight of parasitaemia: This nematode species was discovered in the one examined *A. americana* (35 nematodes — 12 male and 23 female worms).

Pérez Vigueras (1936) recorded this species in Cuba from the host *Numida meleagridis* (Galliformes) on localities in the province Havana. These nematodes discovered by us in a new host (*A. americana*) are smaller in size

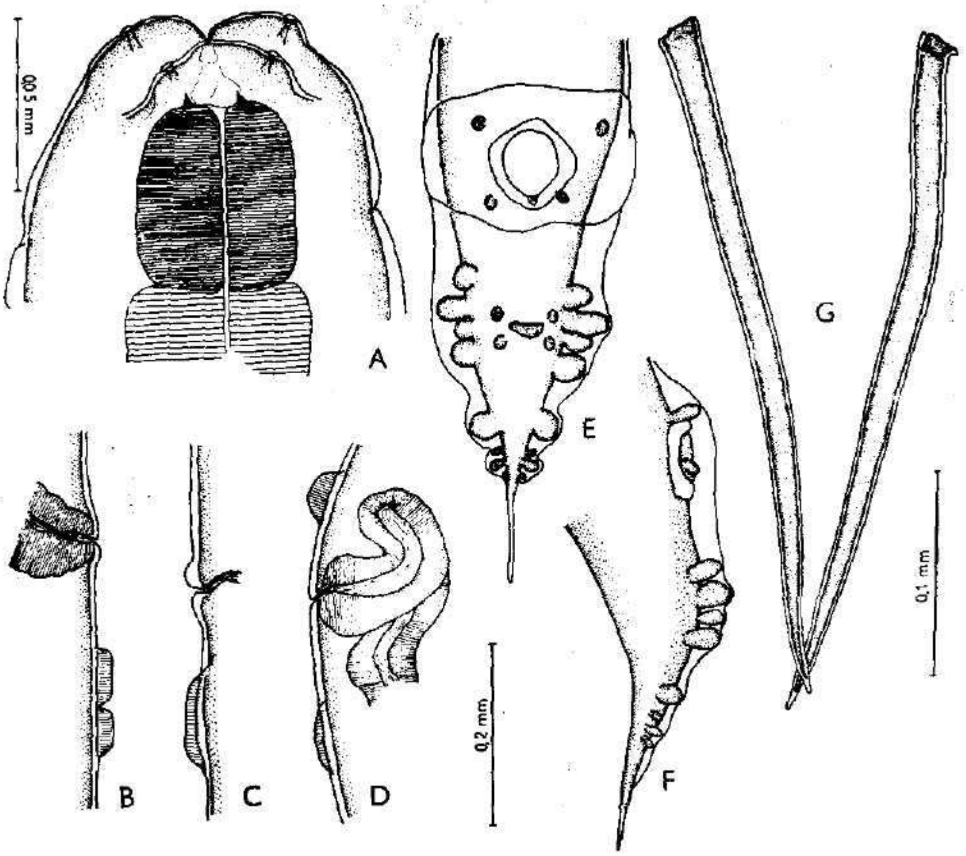

Fig. 4. Ganguleterakis dispar (Schrank, 1790) from the small intestine of **the host** ***Anas americana.*** A — anterior end of body; B, C — vulva region; E, F — posterior end **of male body; G — spicules.** Orig.

(Tab. 3) in comparison with the generally given measurements; in the male worms we noticed only 12 pairs of caudal papillae (generally, 13 pairs); are mentioned in the female worms a great variability was observed in the shape and number of cuticular lumps in the vulva region.

Fam. Spiruridae Oerley, 1885

7. *Cyrnea spinosa* (Gendre, 1922)

Host: *Falco sparverius sparverioides* Vigors.
Location: gizzard.
Locality: La Gloria-Canal Virgil (province Camagüey).

Incidence and weight of parasitaemia: Of the 9 examined *F. sparverius sparverioides* this nematode was found in one host (one male worm). In Cuba (even in the neotropic region) this nematode species was recorded for the first time and in a new host.

Tab. 3. **Measurements** (in mm) **of the male and female nematodes**
Ganguleterakis dispar (Schrank, 1790) in our material from the new host *Anas americana*

	Male	Female
Body length	5.51 −7.65	9.79 −11.74
Maximum body width	0.21 −0.30	0.32 −0.41
Width of anterior body end	0.058−0.066	0.070−0.084
Oesophagus length	0.71 −0.81	0.85 −0.90
Bulbus width	0.13 −0.14	0.15 −0.17
Nerve ganglion	0.20 −0.29	0.23 −0.25
Excretory pore	0.42 −0.46	0.43 −0.47
Cloaca distance	0.23 −0.29	—
Pairs of caudal papillae	12	—
Dia of pseudosuckers	0.097−0.12	—
Spicule length	0.32 −0.40	—
Length of tail extension	0.11 −0.14	—
Distance of vulva from posterior body end	—	3.91 −5.87
Distance of anus	—	0.58 −0.70
Size of eggs	—	0.066−0.070 × 0.042−0.046

C. spinosa differs distinctly from the closely related species *C. mansioni* (Seurat, 1914) recorded from the neotropic region, in the length of the spicules and the shape of the distal termination of the spicules, the spicules of *C. mansioni* being 0.680 mm and 0.315 mm long in Seurat's description; after Gendre the spicules of *C. spinosa* are 1.22—1.37 mm and 0.340—0.410 mm long. The spicule length of the male *C. spinosa* from the host *F. sparverius sparverioides* was 1.20 mm and 0.312 mm (overall length of the male's body 4.62 mm). In the species from the host *Falco tinnunculus* we recorded in an earlier paper (Baruš, 1966) a spicule length of 1.45—1.52 mm and 0.323 to 0.380 mm (overall length of male's body 4.83—7.16 mm).

Fam. Thelaziidae Skrjabin, 1915

8. *Oxyspirura octopapillata* Caballero, 1942 Fig. 5

Host: *Polyborus cheriway audobonii* Cassin.
Location: under the third lid.
Locality: Cayo Potrero (Isla de Pinos).

Incidence and weight of parasitaemia: In the one host examined we discovered one female nematode of this species.

The original description of this species from the same host *(P. cheriway)* was given by Caballero (1942) from Mexico (Tecomatlán, Puebla). In Cuba, we found this species for the first time. The discovered female worm was in complete morphological agreement with the original description except for the smaller size of the body.

Description: (measurements in brackets refer to those given Caballero): Overall length of female 14.77 (18.90) mm, maximal width 0.48 (0.52) mm. Cuticle with distinct transverse striation, cervical alae present. Buccal capsule divided, depth 0.039 (0.041) mm, width 0.035 (0.037) mm. Oesophagus 1.35 (1.36) mm long and 0.058 (0.049) mm wide in the anterior portion, 0.16

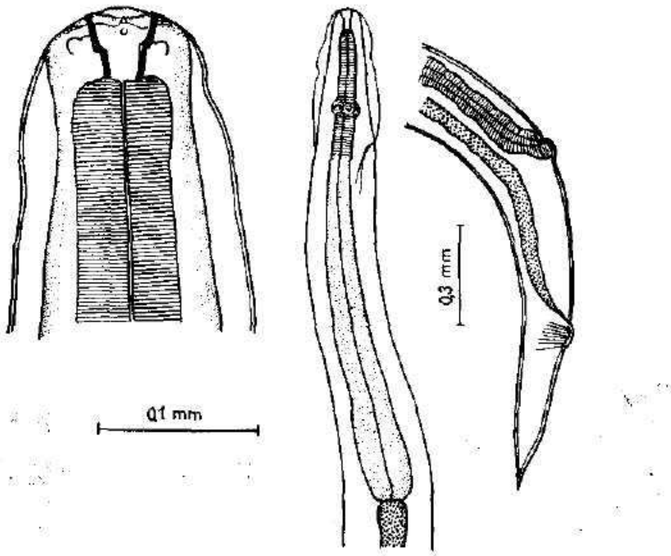

Fig. 5. *Oxyspirura octopapillata* Caballero, 1942 from the eye of the host *Polyborus cheriway audubonii*. A — anterior portion of female body (detail); B — de (general view); C — posterior end of female body. Orig.

(0.072) mm in posterior portion. Nerve ganglion at 0.269 (0.266) mm, excretory pore at 0.370 mm from anterior end of body. Cervical alae 0.37 mm long, maximum width 0.023 mm. Vulva with moderately elevated margins at 0.949 (1.140) mm from posterior end of body, anus at 0.409 (0.440) mm. Eggs measure 0.040—0.046 mm by 0.025—0.027 mm (0.053 to 0.057 by 0.029—0.033 mm).

Fam. Schistorophidae Skrjabin, 1941

9. *Victorocara cucullatus* (Wehr, 1934) Fig. 6

Host: *Porphyrula martinica* (L.).
Location: under the cuticle of the gizzard.
Locality: Cayo Potrero (Isla de Pinos).

Incidence in the host and weight of parasitaemia: Of the 2 *P. martinica* examined this nematode species was found in one host (2 female worms).

Wehr (1934) described this nematode from the host *Rallus elegans* (Ralliformes) in the U.S.A. (Virginia). From Cuba we recorded this species for the first time in the same order of birds. Morphologically our material is in keeping with the original description, but there are considerable differences in the measurements (our specimens were younger worms). We are giving their description from our material.

Description (the data found by Wehr): Overall length of the female 14.95—17.62 (28.0) mm, maximum 0.16—0.19 (0.315) mm. Mouth terminal, surrounded by 2 lateral pseudolabia carrying at their peak a small cuticular extension. A pair of sessile, submedian papillae present at the base of the pseudolabia and from it recedes a pair of cuticular, leafshaped formations with rounded edges (length 0.031 mm). Length of pharynx 0.097 (0.115) mm,

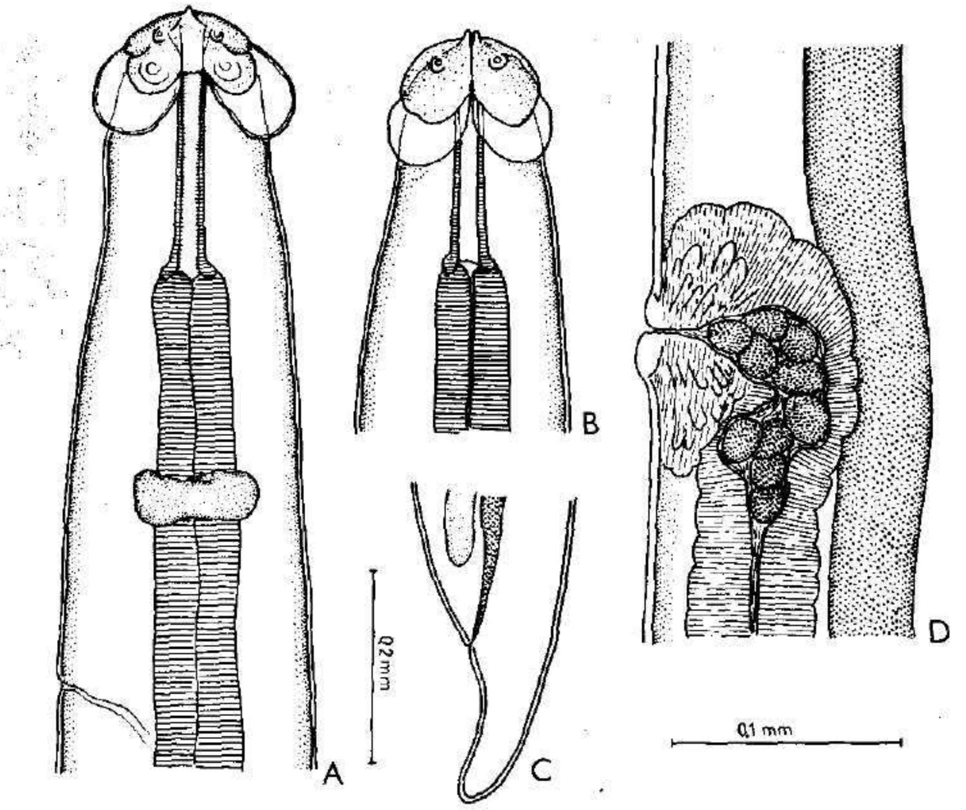

Fig. 6. *Victorocara cucullatus* (Wehr, 1934) from the gizzard of the host *Porphyrula martinica*. A, B — anterior portion of female body; C — posterior portion of body; D — vulva region. Orig.

maximum width 0.016—0.019 mm. Muscular oesophagus 0.97—1.03 (0.81) mm long, glandular oesophagus 1.28—1.31 (1.88) mm. Nerve ganglion at 0.21 (0.22) mm from anterior end of body, excretory pore at 0.30—0.32 mm. Cervical papillae not discovered. Vulva with rounded, moderately elevated margins placed at 8.54—9.43 (14.3) mm from anterior end of body. Posterior end gradually attenuating, termination rounded. Anus at 0.12—0.14 (0.3) mm from posterior end. Eggs 0.039—0.044 by 0.025—0.027 (0.048 to 0.032) mm.

Fam. Tropisuridae Yamaguti, 1961

10. *Microtetrameres (Microtetrameres) longiovatus* sp. n. Fig. 7

Host: *Glaucidium sijú vittatum Ridgway.*
Location: gizzard.
Locality: Cayo Piedras (Isla de Pinos).

Incidence in the host and weight of parasitaemia: Of the 3 examined *G. sijú vittatum* this species was discovered in one host (a total of 3 mal eand 4 female worms).

Holotype (male): Overall length 1.56 mm, maximum width 0.078 mm. An-

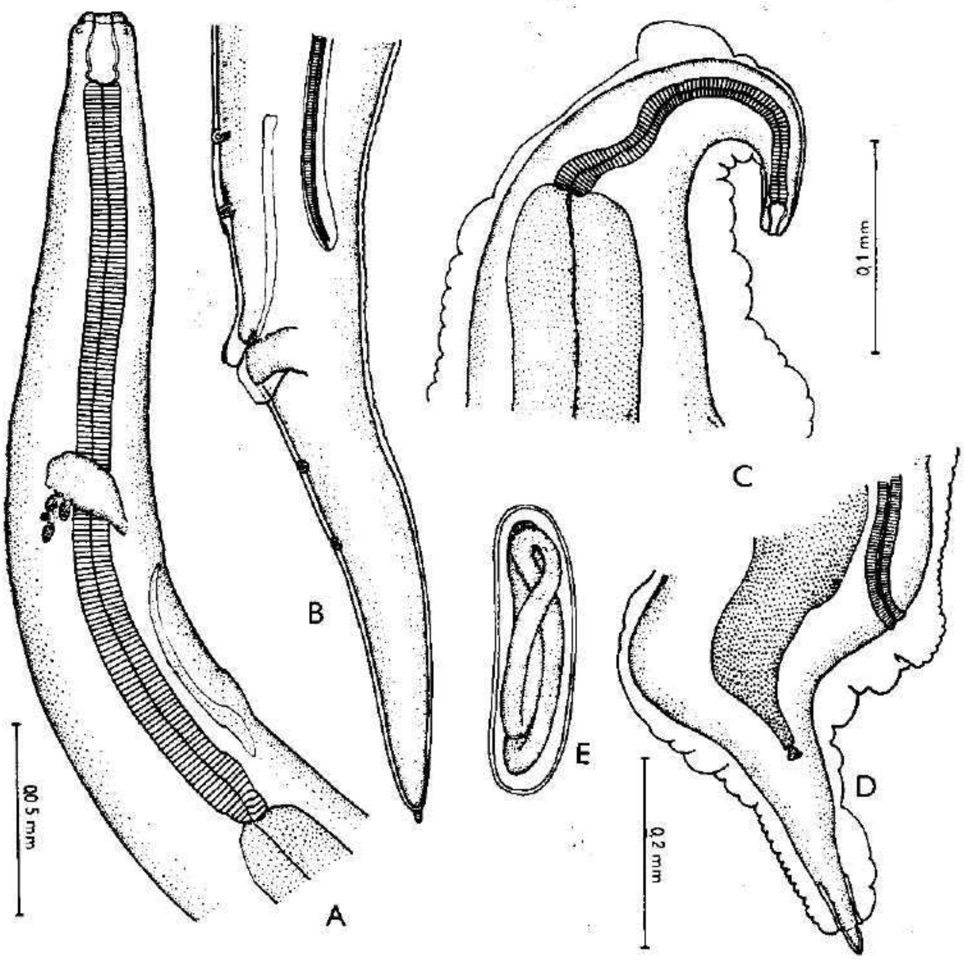

Fig. 7. *Microtetrameres (M.) longiovatus* sp. n. from he gizzard of the host *Glaucidium siju vittatum*. A — anterior portion of male body; B — posterior portion of male body; C — anterior portion of female body; D — posterior portion of female body; E — egg. Orig.

terior portion of body 0.019 mm wide. Mouth capsule 0.019 mm deep, 0.008 mm wide. Muscular oesophagus 0.195 mm long, maximum width 0.014 mm. Glandular oesophagus 0.390 mm long, maximum width 0.031 mm. Nerve ganglion at 0.124 mm from anterior end of body, excretory pore at 0.171 mm. Cervical papillae not found. Gubernaculum absent. Spicules of unequal length and shape. Longer, well pseudochitinized spicule 1.05 mm long, width of its proximal end 0008 mm, distal end bifurcating in two short extensions. Smaller spicule feebly pseudochitinized, indistinct, size 0.066 mm, distal end rounded, proximal end 0.005 mm wide. Cloaca at 0.132 mm from tail end, its margins noticeably elevated. Four pairs of caudal papillae (2 precloacal and 2 postcloacal).

Allotype (female): Body spirally coiled in 2 turns. Anterior end of body 0.019 mm wide. Mouth capsule 0.019 mm deep and 0.008 mm wide. Muscular oesophagus 0.175 mm long, maximum width 0.019 mm. Nerve ganglion at 0.097 mm from anterior end of body. Slender, thin-walled eggs containing a coiled larva measure 0.070—0.078 mm by 0.020—0.023 mm. Anus at 0.226 mm from tail end. Distance anus-vulva 0.187 mm. (Measurements of the paratypes given in Tables. 4 and 5.)

Tab. 4. Measurements (in mm) of the male nematodes *Microtetrameres minima* (Travassos, 1914), *M. asymmetricus* Oschmarin, 1956 and *M. longiovatus* n. sp.

Species	*M. minima*	*M. asymmetricus*	*M. longiovatus*
Host	*Tachyphonus cristatus brunneus* (Passeriformes)	*Lanius cristatus* (Passeriformes)	*Glaucidium sijú vittatum* (Strigiformes)
Authors	Travassos (1914)	Oschmarin (1956)	our data
Body length	1.4	1.4	0.85 —1.56
Maximum body width	—	0.110	0.04 —0.09
Depth of mouth capsule	—	0.014	0.017—0.019
Width of mouth capsule	—	0.006	0.007—0.008
Length of muscular oesophagus	—	0.152	0.15 —0.19
Length of glandular oesophagus	—	0.380	0.33 —0.78
Spicule length (1)	0.99	0.980	1.01 —1.05
Spicule length (2)	0.10	0.082	0.066—0.070
Spicule width (1)	—	0.005	0.008
Spicule width (2)	—	0.004	0.005
Pairs of caudal papillae	(?)	2 + 2	2 + 2
Cloacal distance	—	0.124	0.085—0.132

Discussion: At present the genus *Microtetrameres* (Travassos, 1915) received 37 species and subspecies parasitizing in birds of various orders. These species are divided into two subgenera — *Microtetrameres* Travassos, 1915 and *Gubernacules* Rasheed, 1960. In view of its morphology, the described new species of this genus belongs to the subgenus *Microtetrameres*. The species of this subgenus resembling most closely the species *M. longiovatus* sp. n. are: *M. asymmetricus* Oschmarin, 1956 and *M. minima* (Travassos, 1914). *M. longiovatus* sp. n. differs from the species *M. asymmetricus* in the shape of the mouth capsule and in the proximal end of the long spicule in the males, while the females can be differentiated by the shape and the size of the eggs. Until the present only two species of the genus *Microtetrameres (M. asymmetricus* and *M. longiovatus)* are known to have eggs longer than 0.060 mm (the eggs of *M. asymmetricus* are 0.036—0.039 mm wide, while the eggs of *M. longiovatus* are distinctly narrower measuring only 0.020—0.023 mm). *M. longiovatus* sp. n. differs from *M. minima* in the length of the small spicule (male worm), in the size and shape of the eggs (female worm), in the length of the muscular oesophagus and the distance of the anus from the end of the body.

M. longiovatus sp. n. differs from the other species of the subgenus *Microtetrameres*—*M. cruzi* (Travassos, 1914); *M. accipiter* Schell, 1953; *M. aquila* Schell, 1953, 1953; *M. singhi* Sultana, 1962; *M. cloacitectus* Oschmarin, 1956;

Tab. 5. Measurements (in mm) of female nematodes *Microtetrameres minima* (Travassos, 1914), *M. asymmetricus* Oschmarin, 1956 and *M. longiovatus* sp. n.

Species	*M. minima*	*M. asymmetricus*	*M. longiovatus*
Dia of coiled female	0.78	—	0.89
Maximum width of body	0.64	1.0	0.40 – 0.89
Depth of mouth capsule	0.012	—	0.015 – 0.019
Length of muscular oesophagus	0.074	—	0.16 – 0.17
Maximum width of muscular oesophagus	0.010	—	0.019
Length of glandular oesophagus	0.49	—	0.53
Distance of anus from body end	0.068	—	0.17 – 0.22
Size of eggs	0.045 × 0.024	0.080 – 0.082 × × 0.036 – 0.039	0.070 – 0.078 × × 0.020 – 0.023

M. contorta (Weidman, 1913); *M. corax* Schell, 1953; *M. helix helix* (Cram, 1927); *M. helix asiaticus* Oschmarin, 1956; *M. inermis* (Linstow, 1879); *M. oriolus oriolus* (Petrov et Tschertkova, 1950); *M. oriolus orientalis* Oschmarin, 1956; *M. oriolus rasheedi* (Rasheed, 1960); *M. spiculata* Boyd, 1956; *M. spiralis* (Seurat, 1915); *M. centuri* Baruš, 1966; *M. xiphidiopici* Baruš, 1966 and *M. travassosi* Rasheed, 1960 — in the length of the body and in the length of one or both spicules in the male, the difference in the females being the shape and size of the eggs. From the species *M. bubo* Schell, 1953; *M. canadensis* Mawson, 1956; *M. oschmarini* Sobolev, 1963; *M. paliocephala* Oschmarin, 1956; *M. pusilla* (Travassos 1915); *M. calabocensis* Díaz-Ungría, 1965; *M. saguei* Baruš, 1966 and *M. bucerotidi* Ortlepp, 1964, *M. longiovatus* sp. n. differs in the length of the body, in the length of one or both spicules and in the number of caudal papillae in the males; the females can be distinguished clearly by the shape and the size of the eggs.

The type (male) and the paratype (one female) are deposited in the collection of the Humboldt Museum in Berlin, the allotype (female) and paratype (one male) are in the collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, Prague, the other paratypes (1 male and 2 females) are in the collection of the Biological Institute of the Cuban Academy of Science in Havana.

Fam. Ascarididae Blanchard, 1949

11. *Ascaridia hermaphrodita* (Froelich, 1789) Fig. 8

Host: *Amazona leucocephala leucocephala* L.
Location: small intestine.
Locality: La Bajada-Península de Guanahacabibes (province Pinar del Río).

Incidence in the host and weight of parasitaemia: Of a total of 10 hosts examined this species was discovered in one host (a total of 2 male and 1 female worm).

This nematode species is a frequent parasite of birds of the order Psittaciformes in the neotropical region. Mozgovoj (1953) recorded in his monograph a total of 34 birds as definitive hosts of this nematode. In Cuba this species was found by us for the first time. The nematodes from the host

A. leucocephala are still within the range of variability of this species. Noteworthy is only the number and distribution of the caudal papillae in the male (we observed only a total of 15 pairs, of these 8 precloacal, one adanal and 6 postcloacal pairs) and the length of the spicules (3.02 mm).

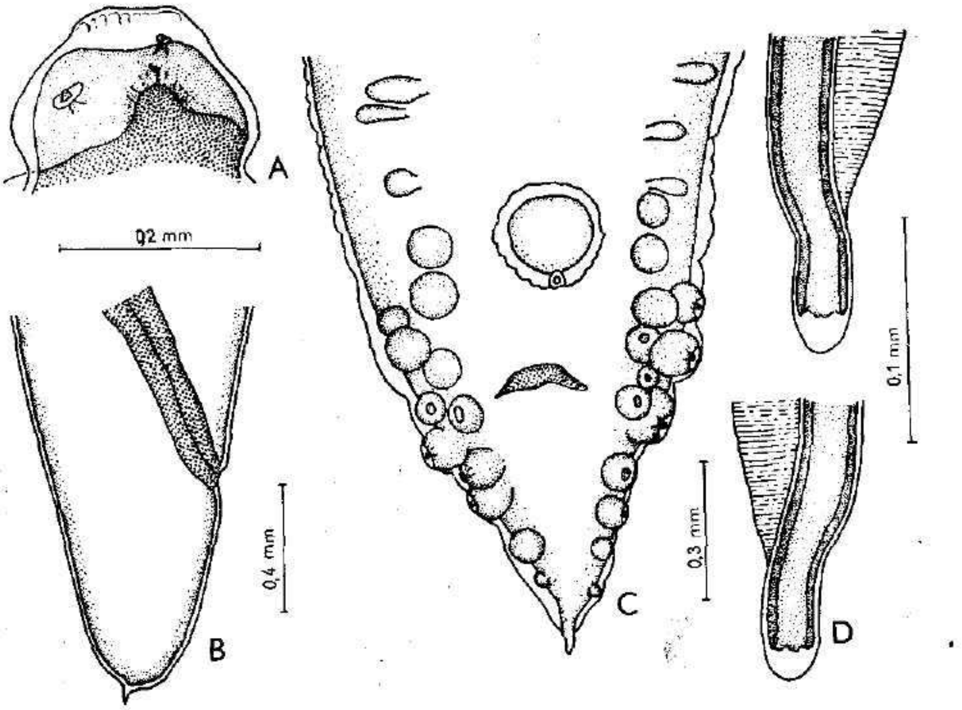

Fig. 8. *Ascaridia hermaphrodita* (Froelich, 1789) from the small intestine of the host *Amazona leucocephala leucocephala*. A — lip; B — posterior part of female body; C — posterior part of male body; D — distal tips of spicules. Orig.

Fam. Stomachidae (Johnston et Mawson, 1945) Hartwich, 1957

12. *Contracaecum ovale* (Linstow, 1907)

Host: *Podiceps dominicus dominicus* L.
Location: small intestine.
Locality: La Gloria-Canal Virgil (province Camagüey).

Incidence in the host and weight of parasitaemia: In the one *P. d. dominicus* examined we found 2 female of this species. In Cuba this nematode was found for the first time and in a new host. The morphology and measurements of this nematode species is still within the range of variability given for this species by Hartwich (1964).

13. *Contracaecum rudolphii* Hartwich, 1964

Host: *Aramus guarauna pictus* (Meyer).
Location: small intestine.
Locality: Paso Real de San Diego (province Pinar del Río).

ncidence in the host and weight of parasitaemia: Of the 2 examined hosts his species was discovered in one of them (1 male and 3 female worms).

In Cuba Pérez Vigueras (1936) first found this species in the host *arus argentatus* and Alegret in 1941 in the host *Phalacrocorax auritus floridanus*. Later Baruš (1966) discovered this nematode in the host *Ph. brasiianus mexicanus*. *A. guarauna pictus* is a new host for this nematode.

Note: In the host *Polyborus cheriway audubonii*, locality Cayo Postrero Isla de Pinos) we discovered in the gizzard 3 juvenile specimens of nematodes of the genus *Contracaecum* Railliet et Henry, 1917. Their exact systematic position could not be established and, therefore, we designated them only *Contracaecum* sp. (larvae).

Fam. Oswaldofilariidae Sonin, 1966

14. *Aproctella stoddardi* Cram, 1931

Host: *Glaucidium sijú* (d'Orbigny) and *Amazona leucocephala leucocephala* L.
Location: abdominal cavity.
Locality: Mandinga-Baracoa (province Oriente) and La Bajada, Peninsula de Guanahacabibes (province Pinar del Río).

Incidence and weight of parasitaemia: Of the 3 examined *G. sijú* this nematode species was found in one bird (1 female worm); of the 10 examined *A. l. leucocephala* this species was found in one bird (1 male worm). This nematode species is very frequent in birds of Cuba (see Sonin and Baruš, 1968).

Fam. Capillariidae Neveu-Lemaire, 1936

15. *Capillaria cylindrica* (Eberth, 1863) Fig. 9

Host: *Falco sparverius sparverioides* Vigors.
Location: small intestine.
Locality: Botanical garden in Havana (province Havana).

Incidence in the host and weight of parasitaemia: Of the 9 hosts examined this nematode species was found in one of them (6 male and 23 female worms).

Discussion: Birds of the order Falconiformes are parasitized by four species of nematodes of the family Capillariidae (see Baruš, 1964, 1966): *Capillaria falconis* (Goeze, 1782) = syn. *C. strigis* (Froelich, 1802); *C. (s. l.) cylindrica* (Eberth, 1863); *Thominx dispar* (Dujardin, 1845) and *Th. contorta* (Creplin, 1839). Of these the least known species is *C. cylindrica* which since Eberth's description has not been recorded by other investigators, being mentioned only in monographs and lists (Travassos, 1915; Yorke and Maplestone, 1926; López-Neyra, 1947; Skrjabin et al., 1957). Eberth's description (ex Freitas and Almeida, 1935) contained only data on its location (oesophagus), its host (*Buteo vulgaris*), on the length of the female (6 mm), the width of the body (0.054 mm), the location of the anus (terminal), the presence of bacillary cords and a vulval bell-shaped extension (pictured). The males of this species are not known and the author did not mention the locality of his finding. The presence of the bell-shaped vulval extension differentiates this species form all other capillarids parasitic in birds of the order Falconiformes, in which this extension is not present. In our collection of nematodes of the genus *Capillaria* Zeder, 1800 from the host *F. sparverius sparverioides* we observed a typical tubular to bell-shaped vulvar extension. The males differ in morphology and measurement distinctly from all nowadays known members of the genus *Capillaria*. Although we found in a comparison of specimens from our material with the original description differences in the situation of the anus and in the location in the definitive host, we consider the discovered nematodes to be representatives of the species *C. cylindrica* (Eberth, 1863) and are adding their detailed redescription. Baruš (1966) found in the host *F. sparverious sparveroides* (locality La Palma, province Pinar del Río) one female worm and designated it *Capillaria* sp. Also this nematode belongs to the species *C. cylindrica*.

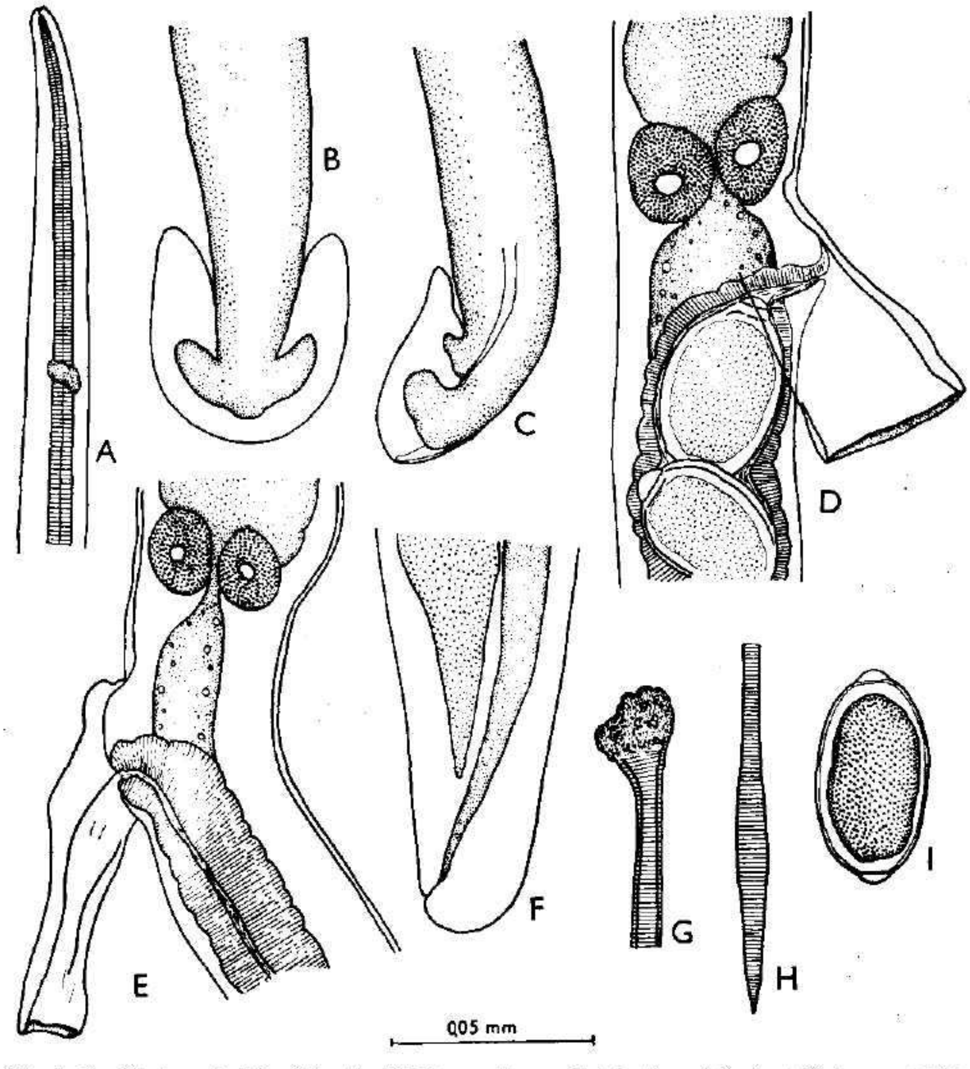

Fig. 9. *Capillaria cylindrica* (Eberth, 1893) from the small intestine of the host *Falco sparverius sparverioides*. A — anterior end of body; B — pseudobursa (dosal view); C — pseudobursa (lateral view); D, E — vulva region; F — posterior end of female body; G — proximal end of spicule; H — distal end of spicule; I — egg. Orig.

Description: Slender, small nematode of whitish colour. Cuticle with delicate, transverse striation. Mouth terminal. Two longitudinal, laterally placed, bacillary cords present. Number of stichocytes 39—42.

Male: Overall length 7.12—8.72 mm, width at the level of the oesophageal end 0.035 to 0.042 mm. Width of anterior portion 0.008—0.011 mm. Length of oesophagus 3.91—4.24 mm (pre-oesophagus length 0.27—0.38 mm). Nerve ganglion at 0.124—0.175 mm, excretory pore at 0.195—0.230 mm from anterior end of body. Ratio of oesophageal portion of body to posterior portion 1 : 0.8—1 : 1. Two wide and long lateral lobes of the pseudobursa are supported at each side by a long postcloacal and one small precloacal papilla. Length of pseudobursa 0.058—0.062 mm, width in dorsoventral position 0.054—0.058 mm. Spicule sheath spineless, transversely folded, 1.17 to 1.75 mm long. Spicule length 0.858 to 0.995 mm, width of proximal end 0.019—0.022 mm, distal end pointed.

Female: Overall length 9.25—10.85 mm, width at oesophagus ending 0.050—0.057 mm. Anterior end of body 0.008—0.011 mm wide. Oesophagus length 4.27—4.98 mm, length of pre-oesophagus 0.351—0.390 mm. Nerve ganglion at 0.143—0.165 mm from anterior end of body. Ratio of anterior oesophageal portion of body to posterior portion 1 : 1.1—1 : 1.3. Vulva at 0.019—0.063 mm from oesophagus end forms the typical tubular to bell-shaped cuticular extension measuring 0.054—0.066 mm in length. Anus subterminal at 0.008—0.011 mm from end of body. Eggs measure 0.046 to 0.050 mm by 0.027—0.031 mm.

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A NEW SPECIES OF THE GENUS HERPETOSTRONGYLUS (NEMATODA) FROM VARANUS INDICUS*

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Received June 10, 1968

Abstract: *Herpetostrongylus indicus* sp. n. from *Varanus indicus* is described. *H. indicus* sp. n. differs from *H. pythonis* Baylis, 1931 in the absence of alae infront of the bursa in the male and from *H. varani* Baylis, 1931 in not having a pair of blunt subventral processes in the tail region of the female. The present worm resembles *H. leiperi* Sharief, 1957 in morphological aspects but differs from the latter in possessing a telamon and gubernaculum in the male.

Introduction

The genus *Herpetostrongylus* was erected by Baylis, 1931 to accommodate two species *H. pythonis* and *H. varani* which he had collected from python and varanus. The third species *H. leiperi* was added by Sharief, 1957, the host being *Varanus indicus*. The present form is also collected from the same host, but there are certain vital structural differences with necessitate the following decription.

Herpetostrongylus indicus sp. n.

Host: *Varanus indicus*
Location: Intestine
Locality: Aurangabad (Maharashtra) India

The worms were found deeply embedded in the intestinal epithelium of the host. Numerous males and females were available for study. The filiform worms were very much coiled. The cuticle is striated. The head end has an inflated cuticle for a distance of 0.10—0.12 mm in the male and 0.11 to 0.13 mm in the female. The mouth is surrounded by very much reduced lips. There are three lips, each provided with a pair of papillae. The mouth opens into a narrow buccal capsule which is 7—10 μm long in the male and 10 to 12 μm in the female.

Three forwardly directed teeth are also present; one of these is dorsal in position while the other two are subventral. The oesophagus is muscular throughout, with the posterior region slightly dilated. It measures 0.30 to

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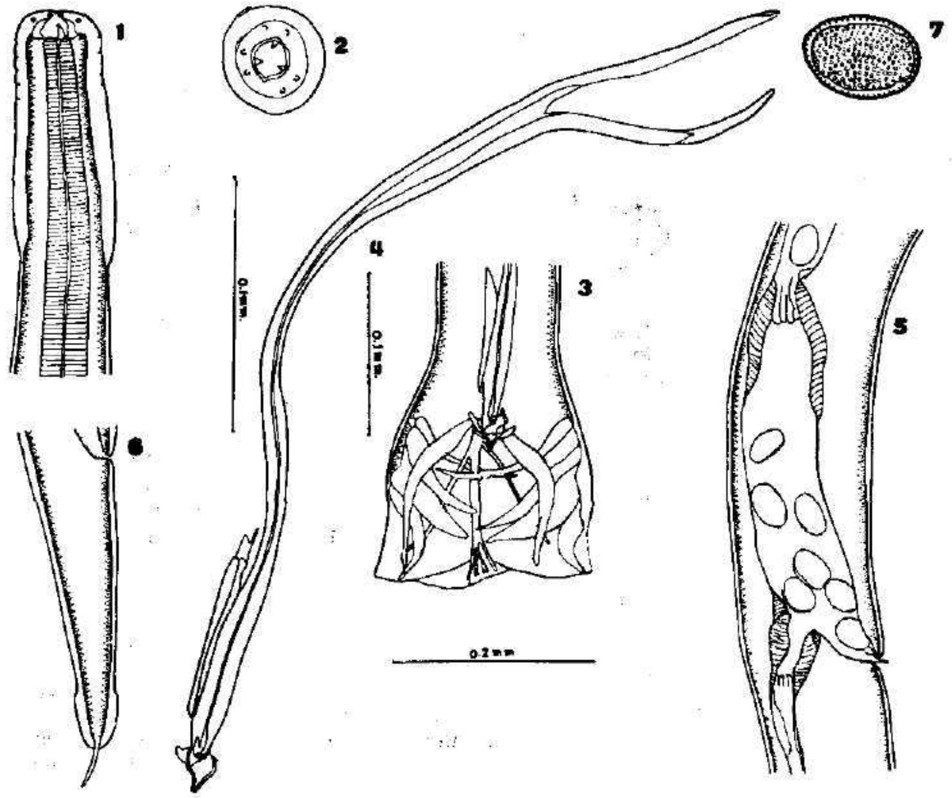
* Part of the thesis submitted to the Marathwada University for the award of Ph. D. Degree, February, 1967.

0.34 mm in the male and 0.35—0.37 mm in the female. The nerve ring is seen at 0.19—0.24 mm from the head end in the male and 0.20—0.23 mm in the female. The excretory pore and the cervical papillae could not be observed.

Male: The male measures 4.78—6.60 mm in length and 0.09—0.13 mm in maximum thickness. The cloaca is present at a distance of 0.11—0.13 mm from the tip of the dorsal lobe of the bursa. The tail is provided with well developed caudal bursa and the arrangement of the rays is the same as described by Sharief. The ventro-ventrals are thin and directed anteriorly and the ventro-laterals are thicker and the two arise from the same stem. The three laterals also arise from the common stalk. The antero-laterals are the thickest while the postero-laterals are the thinnest of the three. The externo-dorsal and the dorsal arise from the same root, the dorsal gives off two branches one on each side, before it is futher bifurcated into two. The spicules are almost equal measuring 0.61—0.65 mm. The right spicule has a slight backwardly directed spur-like projection near its posterior end. An accessory piece is also precent in the form of a telamon, measuring 0.07—0.12 mm in length. In addition to it, a well developed triangular gubernaculum is present.



Herpetostrongylus indicus sp. n.: Male — 1: anterior end, ventral view; 2: end, on view; 3: posterior end, ventral view; 4: spicules. Female — 5: vulva, lateral view; 6: tail end, lateral view; 7: egg. Scale: 0.2 mm applies to Figs. 3 and 5; 0.1 mm applies to Figs. 1, 2, 4, 6 and 7.

Its maximum breadth and length are 0.03—0.04 mm and 0.02—0.03 mm respectively.

Female: The female measures 7.18—7.87 mm in length and 0.11—0.12 mm in maximum thickness. The vulva opens in the posterior half of the body *at 0.83—0.93 mm from the tip of the tail. The divergent uteri possess globular* sphincters at the junction with the vagina. The posterior arm of the uterus is very much reduced; the anterior one is sufficiently long measuring 0.37 mm *in length and 20—30 μm in width. The tail measures 0.10—0.13 mm in length* and the tip is provided with a fairly well developed spike. The eggs are thin shelled, measuring 40—50 μm in length and 20—30 μm in width.

Holotype: *1 male;* allotype: *1 female;* paratypes: Several males and females preserved in 70% Glycerine alcohol, are deposited in the Department of Zoology, Marathwada University, Aurangabad, Maharashtra.

Differential diagnosis: *At present the genus Herpetostrongylus* Baylis, 1931 contains three species: *H. pythonis* Baylis, 1931; *H. varani* Baylis, 1931 and *H. leiperi* Scharief, 1957. The present worm differs from *H. pythonis* in not having alae in front of the bursa. Moreover the spicules of the latter are alate. The present worm differs from *H. varani* in the size of the spicules. The spicules in the present form are 0.61—0.65 mm long, where as in *H. varani* the spicules are 0.30—0.34 mm long. The worm under discussion resembles *H. leiperi* as far as the body measurements are concerned. But if differs from the latter in having right spicule provided with spur-like projection and in possessing the gubernaculum. Thus the author feels that the worm is quite distinct from *H. leiperi*, hence named as *Herpetostrongylus indicus* sp. n.

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The author is grateful to Prof. S. Mehdi Ali under whose guidance the work has been carried out.

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Pädagogische Fakultät, Ústí nad Labem

DIE MORPHOLOGIE DES MAGENS BEI ASELLUS AQUATICUS (LINNÉ) UND JAERA ALBIFRONS LEACH* (ISOPODA, ASELLOTA)

MARIE FLASAROVÁ

Herrn Prof. Dr. S. Hrabě, DrSc. zum 70. Geburtstag gewidmet

Eingegangen am 10. Dezember 1968

Abstrakt: Die Autorin beschreibt die Morphologie des Magens bei *Asellus aquaticus* (Linné) und *Jaera albifrons* Leach. Sie vergleicht beide Arten und ergänzt die Angaben der älteren Autoren.

Über den Bau des Magens der Art *Asellus aquaticus* gibt es — vor allem in der älteren Literatur — zahlreiche Abhandlungen. Sie befassen sich mit der gesamten Morphologie, dem histologischen Bau und der Funktion der einzelnen Magenteile. Von der Art *Jaera albifrons* kenne ich aus der Literatur lediglich eine ungenügende Beschreibung und Abbildung, die von Sye (1887) stammt. Die vorliegende Arbeit enthält die Beschreibung des Magens der *Jaera albifrons*, weiters eine genauere Beschreibung einiger Details des Magenbaues des *Asellus aquaticus*, und schliesslich werden beide Arten miteinander verglichen.

Das Material von *Jaera albifrons* habe ich im Verlaufe meiner Forschungen auf der Insel Hiddensee gesammelt. Ich danke Herrn Prof. Dr. H. Schildmacher — Direktor des Biol. Forschungsanstalts in Kloster, für die Ermöglichung meines Aufenthaltes auf Hiddensee.

HISTORISCHER ÜBERBLICK

Die älteste Beschreibung und Abbildung des Magens der Art *Asellus aquaticus* stammt von Sars (1867), welcher die dorsale, ventrale und laterale Seite mit grosser Genauigkeit eingezeichnet hat. An dem geöffneten Magen bemerkte er auch einige Details. Dohrn (1867) hat die embryonale Entwicklung des *Asellus aquaticus* studiert. In Tafel XV, Abb. 36 sehen wir einen schematisch dargestellten Blick auf die dorsale Magenseite. Er unterscheidet den Cardiacalabschnitt (die vordere Magenkammer) und den Pyloricalabschnitt (die hintere Magenkammer). Im Cardiacalabschnitt sind die Lateralia (die beweglichen Kauhöcker) mit den Zähnen. Auf der ventralen Seite, ihnen gegenüber, liegen die Reibplatten. Rosenstadt (1889) gab eine ausführliche Beschreibung des Magens, jedoch ohne eine einzige Abbildung. Ide (1892) studierte die Objekte sehr genau an Hand von histologischen Schnitten. Schönichen (1898) verfertigte an Hand von histologischen Schnitten einige graphische Rekonstruktionen. Rehorst (1914) studierte das Material ebenfalls an Hand von histologischen Schnitten, rekonstruierte den Pyloricalabschnitt und erklärte das Prinzip des Filtersystems. Siewing (1956) löst die phylogenetischen Beziehungen bei den Malacostraca auf Grund von Forschungen des Magenbaues. In diesem

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* In meinem Material handelt es sich um die Unterart *Jaera albifrons syei* Bocquet.

Zusammenhang äussert er sich auch über den Magen der Art *Asellus aquaticus*. Er geht dabei von der Arbeit Schönichen's aus (1898).

Mit der Morphologie des Magens der Art *Jaera albifrons* befasste sich Sye (1887 — syn. *Jaera marina*). Er zeichnet sehr schematisch den Cardiacalabschnitt, von der Seite gesehen — siehe Tafel III. Auf Abb. 29 ist ein Teil der Speiseröhre, das Laterale (Reibplatte) mit einer Zahnreihe und unter dem Laterale verlaufende Plica lateralis (Chitinleiste mit Haarsaum) zu sehen.

Die Nahrung dieser Arten wurde von mehreren Autoren untersucht. Bei *Asellus aquaticus* — Willer (1917) und Levanidov (1949); bei *Jaera albifrons* — Sye (1887), Forsman (1944) und Gruner (1962). Angaben über die Nahrung beider Arten finden wir auch in den Monographien von Birstein (1951) und Gruner (1965).

MATERIAL UND TECHNIK

Zu dieser Arbeit habe ich in 70% Alkohol konserviertes Material verwendet. Die herauspräparierten Mägen habe ich in einer 5% KOH Lösung von der Muskulatur befreit. Zuletzt habe ich sie in destilliertem Wasser gespült und in Glycerol präpariert.

BESCHREIBUNG DES MAGENS DES ASELLUS AQUATICUS (LINNÉ)

Der Magen hat eine längliche Form, der Cardiacal — und Pyloricalabschnitt sind fast in einer Linie und ziemlich weit voneinander entfernt. Die dorsale und die ventrale Seite des Magens sind auf Abb. 1 und 2 zu sehen.

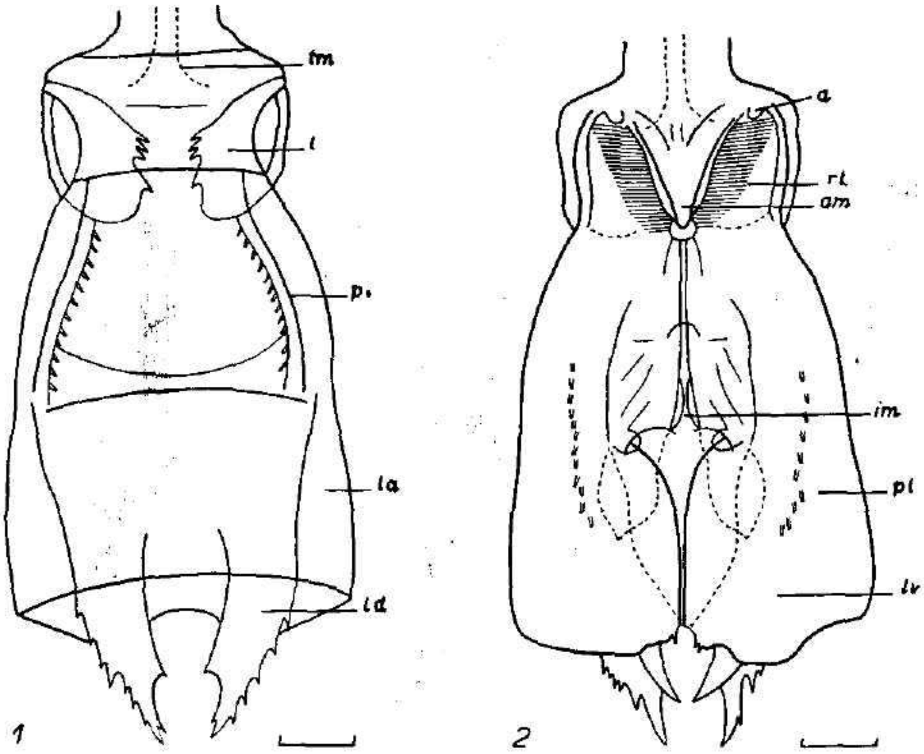


Abb. 1, 2 — *Asellus aquaticus* (L.) ■ 1 — Dorsalseite des Magens ■ 2 — ventralseite des Magens; tm — Tuberculum marginale, l — Laterale, rb — Reibplatte, am — Anteromedianum, ld — Lamella dorsalis, lv — Lamella ventralis, im — Inferomedianum, pl — Plica lateralis, la — Lamella annularis, a — Apophyse. Fundstelle: Unčín bei Teplice v Čechách (Nordböhmen). Masstab = 100 μm.

Der Cardiacalabschnitt

Lateralia (l) — an den Lateralia sind zwei auffalende Zahnreihen. Diese wurden von allen Autoren vermerkt, welche sich eingehend mit der Morphologie des Magens dieser Art befasst haben. Schönichen (1898, p. 152) führt an, dass es sich um stark entwickelte Borsten handelt und spricht von Übergangsstadien zwischen Zähnen und einfachen Borsten. In der Abbildung der ventralen Magenseite (p. 151, Textfig. 1b) zeichnet er sie jedoch — ähnlich wie andere Autoren — als einfache Dreiecke ein. Die Anordnung der Zähne an dem Laterale ist in Abb. 3 dargestellt. Schönichen (1898) gibt für die obere Reihe 7 und für die untere 12 Zähne an. Ich habe bei verschiedenen Einzeltieren in der oberen Reihe 5—8 Zähne gezählt, in der unteren 12—15. Die Anzahl der Zähne muss auch nicht an den Lateralia eines und desselben Tieres die gleiche sein. Die Zähne sind entweder lang mit Ausläufern an der ventralen Seite, oder kurz und breit mit einem höckerigen unteren Rand (Abb. 4a, b). Zwischen den Zahnreihen sind Gruppen von kurzen, kammförmigen Borsten verstreut (Abb. 4c). Die übrige, den Reibplatten zugekehrte Fläche ist dicht mit langen Borsten bedeckt.

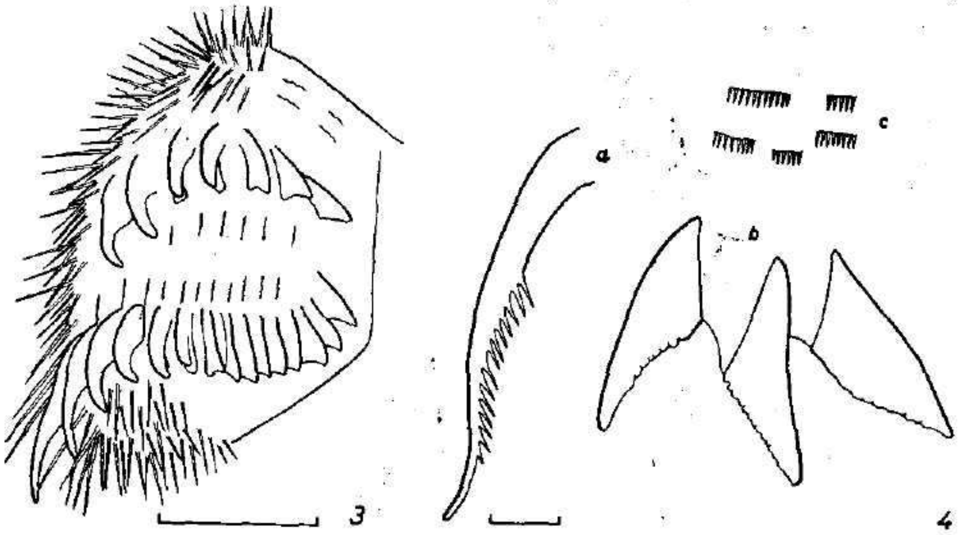


Abb. 3, 4a, b, c — *Asellus aquaticus* (L.) ■ 3 — Laterale, Massstab = 50 µm. ■ 4a, b — Zahntypen an dem Laterale, 4c — kammförmige Borstengruppen zwischen den Zahnreihen. Massstab = 10 µm.

Die cardiacalen Reibplatten (rb) — sind gut entwickelt und in der Form des Buchstaben V angeordnet. Sie setzen sich aus zahlreichen feinen Borsten mit Seitenausläufern zusammen.

Das Anteromedianum (am) — nimmt den Platz zwischen den Reibplatten ein und ist spärlich mit ziemlich langen Borsten besät.

Der Cardiacalabschnitt ist mit Chitinleisten befestigt, die vor allem an der ventralen Seite ausgebildet sind und die Reibplatten besäumen. Auffalend sind zwei starke Apophysen (a), die jedoch nicht — wie bei den Oniscoideen waagrecht liegen, sondern sich hakenförmig zur ventralen Seite drehen.

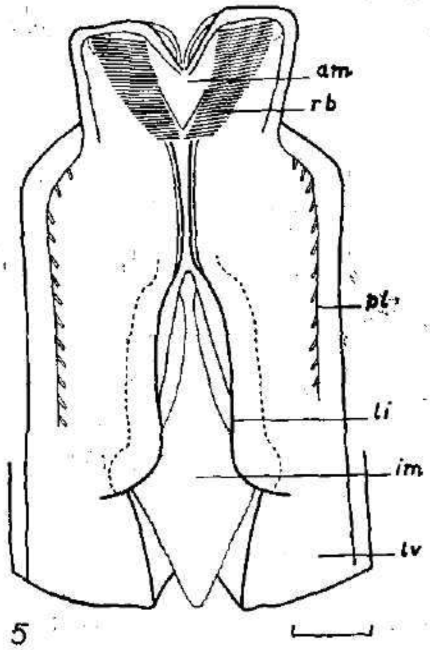
Besonders gut sind sie vom Profil sichtbar. In den Abbildungen der Arbeit von Sars (1867) sind sie nicht eingezeichnet. Die Lateralia sind an den Seiten durch dünne Chitinleiste befestigt.

Der Pyloricalabschnitt

Die Lobi interni der Interolateralia (li) — sind im unteren Teil hervortretend und stark gebogen. Der innere erhöhte Teil fällt zu den umgebenden Magenwänden (Abb. 5).

Das Inferomedianum (im) — ist in der Längsrichtung verzogen (Abb. 6).

Die Lamellae ventrales (lv) — sind sehr kurz, schräg abgehackt und ragen fast nicht über den unteren Teil des trichterförmigen Teils des Inferomedianums vor.



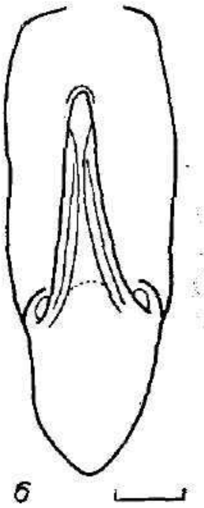


Abb. 5 — *Asellus aquaticus* (L.) — Ventralseite des geöffneten Magens; rb — Reibplatte, am — Anteromedianum, lv — Lamella ventralis, im — Inferomedianum, li — Lobus internus des Inferolaterale, pl — Plica lateralis. Massstab = 100 *µm*.

Abb. 6 — *Asellus aquaticus* (L.) — Inferomedianum. Massstab = 100 µm.

Die zusätzlichen Magenteile

Die Lamella dorsalis (ld) — ist länger als Lamellae ventrales. In der Mitte des unteren Randes ist sie ausgeschnitten und verläuft in zwei zerklüftete Zipfel. Der rechte Zipfel ist in Abb. 7 eingezeichnet.

Die Tubercula marginales (tm) — sind ausgeprägt und dicht mit Borsten besetzt.

Die Lamellae annulares (la) — Ide (1892, p. 133) bemerkt über den Bau dieser Lamellen folgendes: „. . . Les lamelles annulaires présentent à peu près les mêmes particularités que chez les oniscides . . .". Bei den Oniscoideen, die er untersucht hat, fand Ide 2—3 verhältnismässig kurze Lamellen. Die äussere Lamelle ist die längste und bildet den am wenigsten abgeschlossenen Ring. Von diesen Lamellen konnte ich nur die äussere beobachten, die bis in die Mitte der Lamella dorsalis reicht. Die Länge der Lamelle kann jedoch auch durch eine andere als die von Ide benutzte Art der Präparation beeinflusst sein.

Die Plicae laterales (pl) — ziehen sich an den Magenwänden entlang und sind bemerkenswert durch eine Reihe von Borsten, die auch bei geringer Vergrösserung sichtbar werden. Die Borsten sind nicht stark und einfach, wie in der Literatur angeführt ist, sondern bei näherer Untersuchung können wir feststellen, dass es sich um Gruppen von Borsten handelt, die — vor allem in den basalen Teilen — sehr eng miteinander verbunden sind (Abb. 8). Diese Borstengruppen liegen an der dünnen Chitinleiste.

Die gesamte innere Magenoberfläche ist von in Gruppen angeordneten Borsten bedeckt (Abb. 9a, b).

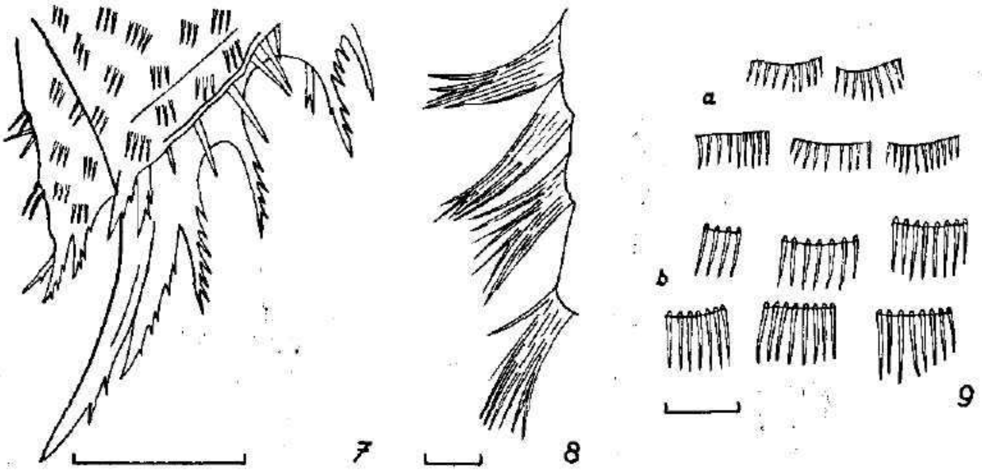


Abb. 7, 8, 9a, b — *Asellus aquaticus* (L.) ■ 7 — zerklüfteter Zipfel der Lamella dorsalis. Massstab = 50 µm. ■ 8 — Borstengruppen an der Plica lateralis, Massstab = 10 µm. ■ 9a, b — Borstengruppen an der Innenseite der Lamella dorsalis. Massstab = 10 µm.

BESCHREIBUNG DES MAGENS DER JAERA ALBIFRONS LEACH

Der Magen ist mehr in die Länge gezogen als bei der vorgenannten Art. Die dorsale und die ventrale Seite sind in Abb. 10 und 11 eingezeichnet.

Der Cardiacalabschnitt

Die Lateralia (l) — haben ebenfalls 2 Zahnreihen. Die Zähne sind ziemlich lang und mit Ausläufern am unteren Rand versehen. Die Zähne sind in geringerer Anzahl vorhanden und die Entfernungen zwischen ihnen sind grösser. Die Anzahl der Zähne ist nicht gleich. In der oberen Reihe habe ich

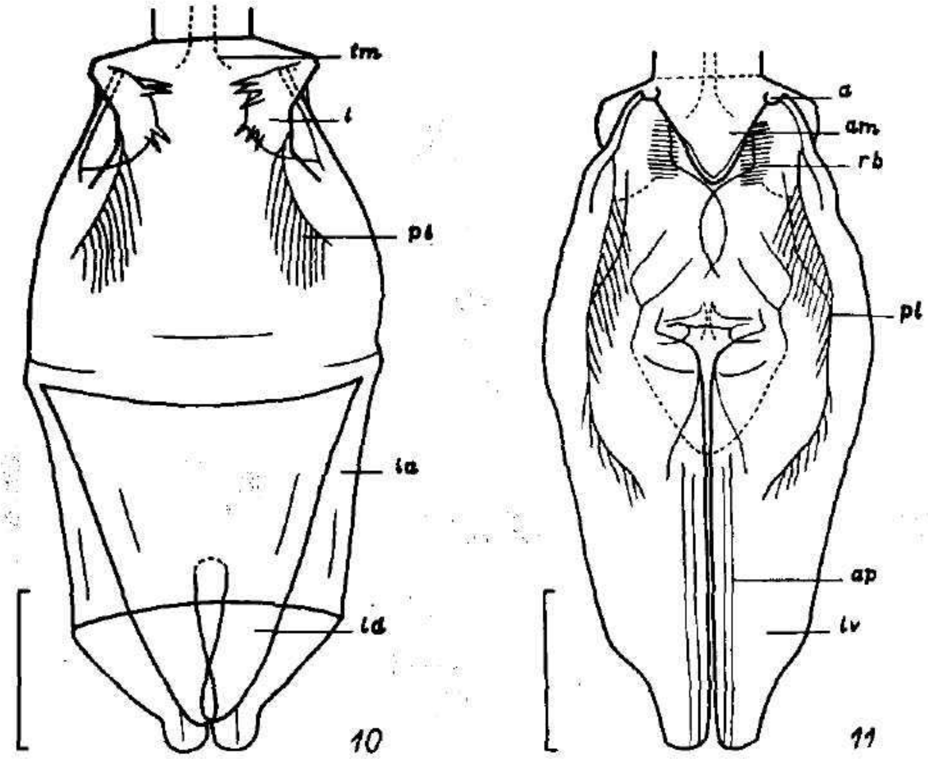


Abb. 10, 11 — *Jaera albifrons* Leach ■ 10 — Dorsalseite des Magens ■ 11 — Ventralseite des Magens; tm — Tuberculum marginale, l — Laterale, rb — Reibplatte, am — Anteromedianum, ld — Lamella dorsalis, lv — Lamella ventralis, pl — Plica lateralis, la — Lamella annularis, a — Apophyse, ap — Apodeme. Fundstelle: Insel Hiddensee — Ostsee. Massstab = 100 μm.

bei den verschiedenen Einzeltieren 3—6, in der unteren Reihe 5—6 Zähne festgestellt. Zwischen den beiden Reihen sind sehr spärliche kurze Borsten im kammförmigen Gruppen angeordnet. Die gesamte Anordnung der Zähne an dem Laterale ist aus Abb. 12 ersichtlich. Die einzelnen Zähne sind in Abb. 13a, b eingezeichnet. Die übrige Fläche der Lateralia ist mit längeren Borsten besetzt.

Die cardiacalen Reibplatten (rb) — haben kleinere Ausmasse (im Verhältnis zur Grösse des Magens) als bei *Asellus aquaticus*. Sie bestehen aus einer verhältnismässig kleinen Anzahl starker Borsten, die ziemlich weit voneinander entfernt sind, sodass ihre Seitenläufer mehr hervorragen (Abb. 14).

Das Anteromedianum (am) — ist dicht mit kurzen Borsten besetzt.

Die Ventralseite des Cardiacalabschnittes ist mit Chitinleisten verstärkt. Die Apophysen (a) sind gut entwickelt und nach der ventralen Seite geneigt. An den äusseren Rändern der Lateralia befinden sich ebenfalls dünne Leisten.

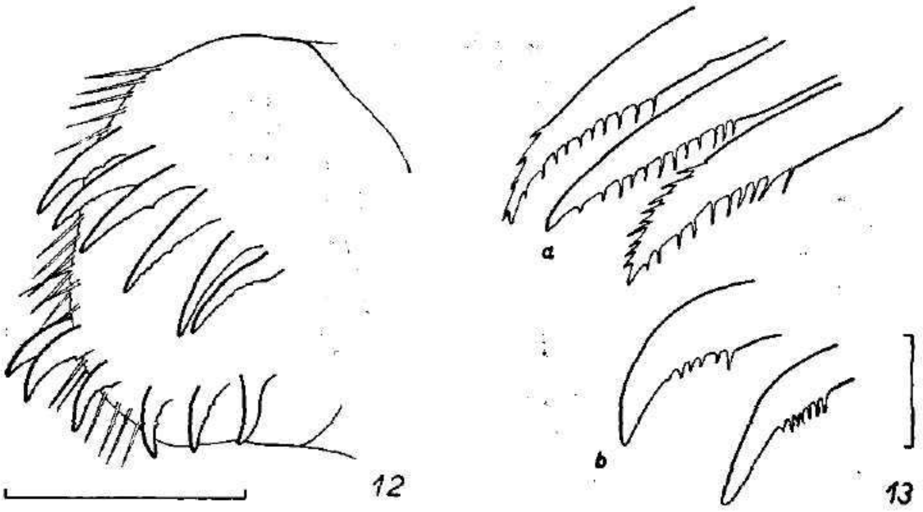


Abb. 12, 13a, b — *Jaera albifrons* Leach ■ 12 — Laterale. Massstab = 50 μm. ■ 13a, b — Zahntypen an dem Laterale. Massstab = 10 μm.

Der Pyloricalabschnitt

Lobi interni der Inferolateralia (li) — sind ähnlich geformt wie bei *Asellus aquaticus* (Abb. 15). Die Inferolateralia sind kurz und breit, entsprechend den Seiten des Inferomedianums.

Inferomedianum (im) — ist breit und dreieckig (Abb. 16).

Die Lamellae ventrales (lv) — sind etwas länger als die Lamella dorsalis. Ihre inneren Ränder sind durch Apodemen (ap) verstärkt.

Die zusätzlichen Magenteile

Die Lamella dorsalis (ld) — ist lang und dreieckig, ihr unterer Teil läuft in zwei lange, abgerundete Zipfel aus.

Die Tubercula marginales (tm) — sind entwickelt, ihre Borsten sind nur bei starker Vergrösserung sichtbar.

Die Lamellae annulares (la) — von ihrem Bau gilt dasselbe, wie unter *Asellus aquaticus* angeführt.

Die Plicae laterales (pl) — sind in ihrer ganzen Länge von dünnen langen Borsten besäumt.

Die innere Magenoberfläche ist mit feinen, in Gruppen angeordneten Borsten bedeckt. An der Lamella dorsalis habe ich keine Borsten festgestellt.

ZUSAMMENFASSUNG

1. Die Autorin hat die Morphologie des Magens der Art *Asellus aquaticus* (Linné) — Asellidae und *Jaera albifrons* Leach — Janiridae studiert.

2. Die Form des Magens ist bei *Jaera albifrons* im grossen ganzen schlanker und länglicher als bei *Asellus aquaticus*.

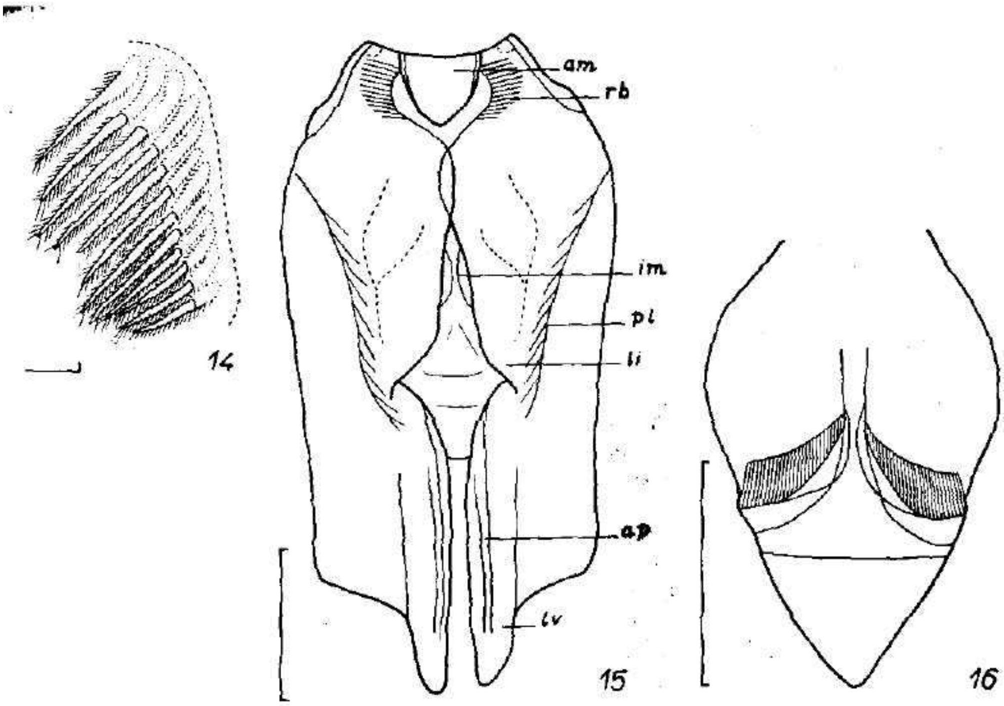


Abb. 14, 15, 16 — *Jaera albifrons* Leach ■ 14 — Reibplatte. Massstab = 10 μm, ■ 15. Ventralseite des geöffneten Magens; rb — Reibplatte, am — Anteromedianum, lv — Lamella ventralis, im — Inferomedianum, li — Lobus *internus* des Inferolaterale, pl — Plica lateralis, ap — Apodeme. Massstab = 100 μm. ■ 16 — Inferomedianum. Massstab = 100 μm.

3. Bei *Asellus aquaticus* und *Jaera albifrons* sind die Mägen in ihren Grundzügen nach dem gleichen Plan gebaut. Zu den charakteristischen Merkmalen, die beide Arten aufweisen, gehören:

a) die Zähne an den Latereralia, die in zwei Reihen angeordnet sind,
b) die in der Form des Buchstaben V angeordneten Reibplatten,
c) ein ähnliches System der Stützleisten im Cardiacalabschnitt,
d) der untere Teil der *Lamella dorsalis ist in zwei Zipfel geteilt,*
e) die Lobi interni der Inferolateralia sind bei den beiden Arten ähnlich gebildet.

4. Die Unterscheidungsmerkmale zwischen den beiden Arten können wir gemäss der einzelnen Magenteile in einige Gruppen einteilen.

Asellus aquaticus (L.)	*Jaera albifrons* Leach
a) Laterale	
Eine grössere Anzahl von Zähnen (in der oberen Reihe 5—8, in der unteren 12—15). Die Zähne sind in ihrer Form unterschiedlich.	Eine kleinere Anzahl von Zähnen (in der oberen Reihe 3—6, in der unteren 5—6). Die Zähne sind in ihrer Form sehr ähnlich.
b) Lamella dorsalis	
Das untere Ende läuft **in zwei** zerklüftete dornenförmige Zipfel aus.	Die Zipfel sind einfach und abgerundet.
c) Plicae laterales	

Gruppen von kurzen, miteinander verbundenen Borsten.	Lange, dünne, einzelne Borsten.
d) Lamellae ventrales	
Kurz.	Lang, an den inneren Rändern mit den Apodemen versehen.
e) Reibplatten	
Gross, aus einer grossen Anzahl von sehr feinen Borsten bestehend.	Klein, aus einer geringen Anzahl verhältnismässig starker Borsten bestehend.
f) Anteromedianum	
Spärlich mit längeren Borsten bedeckt.	Dicht mit kurzen Borsten bedeckt.

5. Beide Arten nähren sich vorwiegend von Pflanzenkost, wie die obengenannten Autoren zitiert haben. *Jaera albifrons* verzehrt auch die toten Artgenossen und die eigene abgeworfene Kutikula. Mit der Art der Nahrung hängt zweifellos auch der subtile Bau des Magens (er ist feiner als bei den Oniscoideen), die schwache Entwicklung des Stutzsystems in dem Cardiacal- und Pyloricalabschnitt und bei *Asellus aquaticus* die sehr fein gebauten Reibplatten zusammen. In der verhältnismässig markanteren Form der einzelnen Borsten der Reibplatten bei *Jaera albifrons* können wir wohl eine Adaptation an eine teilweise Nahrungsannahme des tierischen Ursprungs sehen, welche Chitin enthält.

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A NOTE ON THE OCCURRENCE AND TAXONOMY OF BROWN TROUT — SALMO TRUTTA LINNAEUS, 1758 IN THE DANUBE RIVER

JURAJ HOLČÍK

Received November 29, 1968

Abstract: The author describes the occurrence of 4 trouts in the Danube River in Bratislava and discusses their systematic status. On the base of their colouration (presence of black spots), growth rate and age the author considers these trouts to be particular danubian variety of the non-migratory trout which validation is probably the category of *infraspecies* (sensu Berg).

The occurrence of brown trout in the submountaneous zone (formerly the zone of barb) of the Danube river was not known to the older authors. One single information was found only in the papers of Balon and Havlena (1964), Balon (1966) and Pachinger (1967). Balon introduces brown trout from the Danube near Žitava and Štúrovo (southern Slovakia, Central Europe), while Pachinger described the finding of brown trout from the river bed of Danube below Bratislava.

In 1968 we have received further specimens of this species from the river bed of the Danube river directly in Bratislava. The fish were caught by means of dip net by mr. Veselský, fisherman, in course of spring, summer and autumn months. All trouts are now deposited in fish collection of Slovak National Museum in Bratislava. The sample consists of 3 males and 1 female 180.5—193.6 mm of the fork length, age 1+ and 2+, with traces of the parr colouration (hardly visible darker dispersed crossbands on the body sides). Counts and measurements of these fish are visible from the Table 1, the general appearance is shown in the Fig. 1.

The colouration of all fish is very interesting. No. 1759 and 1753/2 they are scattered with black spots on their backs, banks, head tops, opercles and dorsal fins. Some of spots are bordered by a pale brim. Female, no. 1743/1 is coloured similarly, but she has also few unbordered orange spots along the side line, 9 on the left, 7 on the right side. Generally, the spots in all fish roughly reach the lateral line, but in the area between P and V they descend below it. The last trout, no. 1818 has its sides covered by minute scarce black spots placed between the lateral line and back, and by some (3—5) almost invisible black spots above the base of pectoral fins. This specimen has also some remnants of the red spots in the form of pale blots sometimes with red point in a centre. These remnants follow the lateral line (about 7 on each side). The basic colouration of all fish is greyish or brownish-grey.

The occurrence of these fish and some their characters give us an occasion for some interesting speculations. First of all I cannot agree with the opinion of Pachinger (1968) as for casualty and rareness of trout occurrence in the Danube river. According to mr. Veselský he alone catches about 10 trouts yearly and some of them weight up to 2 kilograms. This statement refute the suspection that these fish are torn down by the stream from the upper part of the Danube river or its tributaries. As known (Balon and Havlena 1964, Balon 1967) the Czechoslovak part of the Danube river belongs to the submountaneous zone inhabited also by such fish like *Cottus gobio*, *Zingel streber*, *Zingel zingel*, *Hucho hucho* etc. Besides this, in course of 1966—1968 there were no floods in the Danube river which would wash-down the trouts from Austria or Morava river.

What is the systematic position of the Danubian trouts? This question which concerns also the trouts of the Black Sea watershed, is still unclear. Berg (1948) calls trouts from the Black Sea *Salmo trutta labrax* Pallas, 1811, and stationary forms inhabited in the rivers, brooks and lakes of this watershed are called as *morpha fario* and *morpha lacustris* — similarly like trouts of the nominate form —*Salmo trutta trutta* Linnaeus, 1758. The criterion of how to distinguish the separate forms is their migratory *(S. trutta trutta, S. trutta labrax)* or non-migratory instinct *(morpha lacustris, morpha fario)* and colouration: migratory forms are covered with black spots only (*S. trutta trutta* from the Baltic Sea has sometimes also the red spots), whilst the brown trout is covered both with black and red spots and lake trout has only black spots (but he losts the migratory instinct). Trewavas (1953) recommends to abandon the international nomenclature for the migratory and non-migratory trout and to call them, each in his vernacular, the sea-trout, estuarine-trout, lake-trout and brook-trout of the species *Salmo trutta*. Bănărescu (1964) does not admit the existence of morphae and distinguishes only subspecies. He calls and differentiates them as follows: *S. trutta labrax* with black spots only and number of scales between the base of D and lateral line is 16—23; *S. trutta fario* possesses black and red spots — the last bordered by a white brim, number of scales is 12—17; and *S. trutta lacustris* with the same number of scales like in *fario* but without any red spots or without the white brim around them. I have found that the distinction of trouts based on the number of scales between the base of D and lateral line is not reliable. It can be shown in the table 2, which compares the trouts from different water-bodies belonging to the drainage of the basins of the rivers Danube, Poprad and Tisa. As it may be shown, the number of scales is always higher than 20. Balon (1966, 1968) rejects the validity of subspecies *labrax* and tries to prove that the trouts caught in the Danube estuary are specimens washed down from the upper Danube. Balon recommends to call them as *S. trutta trutta morpha labrax*, those inhabiting the mountain brooks and rivers as *S. trutta trutta m. fario* whilst the fish living in lakes should be called *S. trutta trutta m. lacustris* and *S. trutta trutta* infrasubspecies *schiffermülleri* (deep-water form from some alpine lakes). Pachinger (1968) designes his trout as the transitional form between the brook and lake trout and called it *S. trutta morpha fario* $\lesseqgtr$ *lacustris*.

According to my opinion, the existence of subspecies *labrax* cannot be

Tab. 1. Counts and measurements of brown trout from the Danube river in Bratislava

No. coll	1743/1	1743/2	1759	1818
Date of capture	20. 5. – 10. 6. 1968		5. – 24. 7. 1968	1. – 11. 10. 1968
Sex	♀	♂	♂	♂
Fork length (mm)	192.0	193.6	185.0	180.5
Total length (mm)	205.0	200.0	196.2	189.9
Age	2+	2+	1+	1+
Rays in D	III 10	IV 9	III 9	IV 10
Rays in A	III 8	III 8	II 9	IV 8
Pored scales in side line	125	119	115	120
Scales between D and 1.1.	21	23	21	25
Branchial spines	17	19	17	18
In % of fork length:				
Head length	24.2	22.1	21.5	24.7
Praeorbital length	6.3	6.3	6.1	7.3
Internasal distance	3.8	4.0	4.0	4.2
Diameter of eye	4.4	3.8	4.3	5.1
Interorbital distance	7.2	7.6	8.1	7.4
Postorbital distance	14.0	12.9	12.4	13.2
Head depth	14.6	14.4	15.1	14.8
Head width	12.4	12.7	13.4	12.7
Praedorsal distance	41.7	40.0	42.1	40.4
Praeventral distance	47.9	47.4	47.5	49.2
Praeanal distance	66.8	67.1	66.4	67.9
Caudal peduncle length	27.4	25.5	29.0	26.1
Caudal peduncle depth	10.4	11.3	10.5	9.5
Body depth	19.1	21.6	21.0	17.7
Body width	9.6	12.8	15.2	11.6
Minimal body depth	9.1	8.8	8.1	8.0
P-V distance	26.3	28.9	28.8	27.7
V-A distance	19.5	20.7	19.6	20.2
Length of D	11.9	11.8	10.1	11.7
Length of A	7.9	8.3	8.8	8.0
Length of C_1	15.6	13.4	15.9	15.1
Length of C_2	16.1	12.8	15.1	15.1
Length of P	16.7	14.8	15.5	14.5
Length of V	12.3	11.1	12.4	11.6
Depth of D	14.0	13.8	14.5	13.4
Depth of A	12.2	11.8	13.3	12.1
Upper jaw length	11.4	10.4	10.4	12.4
Number of pyloric coeca	52	64	37	58

abandoned or refused. It is true, that by means of introduction of trouts from one drainage to another, the trout populations are mixed in some cases and the role of branchial spines as the chief distinguishing character of subspecies is bloted out. But generally it was proved by many authors (Berg, 1948; Mišík, 1959; Holčík and Mišík, 1962; Frank and others 1962; Holčík and others 1965) that subspecies *labrax* exhibits a larger number of gill rakers than the nominate form trutta. Balon (1968) does not admit this difference despite its presence in table introduced by him (Tab. 1, page 2). This difference can be shown also at least in our table (Tab. 2) though it comprises only some trouts from a relatively small and close area. It must be

Tab. 2. Comparison of danubian trouts with trouts from some other water-bodies of Slovakia

Locality	Danube (Bratislava)		Trnávka brook (Trstená)		Poprad river (Mengušovce)		Okna brook (Figliarka)		Morské Oko lake (Vihorlat)	
River basin	Danube				Vistula		Tisa			
	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges
Fork length (mm)	187.8	180.5–193.6	160.3	106.8–200.0	172.2	108.8–113.6	181.8	104.6–240.0	329.2	290.1–405.0
Ramified rays in D	9.5	9–10	9.3	8–11	8.9	7–10	9.5	7–11	9.5	8–11
Ramified rays in A	8.3	8–9	7.5	6–8	7.1	7–8	7.9	7–9	8.2	7–9
Pored scales in l. l.	119.3	115–123	114.5	111–120	120.9	111–124	117.6	112–126	118.2	105–130
Scales between D and linea lateralis	22.5	21–25	22.4	20–23	23.1	21–26	23.6	21–25	22.4	18–29
Gill rakers	17.8	17–19	17.6	16–20	17.4	16–19	17.9	15–21	18.7	17–20
Fish examined	4		8		7		18		11	

Tab. 3. Number of gill rakers in trouts of different size from some Slovakian waters

Locality	Morské Oko lake				Okna brook				Poprad river			
Size group in mm	< 100		> 100		< 100		> 100		< 100		> 100	
	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.	Ranges
Fork length (mm)	55.5	53.0–62.5	329.2	290.0–405.0	87.1	72.6–97.2	181.8	104.6–240.0	54.4	44.5–89.6	172.2	108.8–113.6
Gill-rakers	15.7	14–18	18.7	17–20	17.3	16–18	17.9	15–21	14.22	12–17	17.42	16–19
Fish examined	10		11		8		18		9		7	

noted that the number of gill rakers in trout depends also from its size. This can be seen in the Table 3. The same was stated also by Solewski (1960) concerning trouts from the Vistula drainage. Consequently it follows that only fish of the same size are to be compared to prevent the doubtful results. The trouts caught in the Danube river basin and other rivers inflowing the Black Sea must be called *Salmo trutta labrax* wherever they have more branchial spines regardless of derivation of this form from *Salmo trutta trutta* (Balon, 1968).

Further question arises to what form does our Danubian trout belong. From the mentioned facts it follows that the only reliable criterion is colouration. In consideration of this character we can decide only on two from our trouts could be brown trout (no. 1743/1, 1818) washed down from the upper Danube or its tributaries. Further two trouts exhibit either lake trout — *Salmo trutta labrax* m. *lacustris* washed down from the alpine lakes or smolts of the migratory form *Salmo trutta labrax*. The existence of artificial lakes on the upper Danube, relatively large size of all 4 fish and fast growth at the low age (calculated average lengths are: l_1 — 108 mm (ranges 94—138), l_2 — 157 mm (ranges 138—175 mm)) stands against *lacustris*. The arguments against the migratory form *labrax* are hitherto unknown upstream migrations of adult trouts from the Black Sea and a large distance from the Danube delta (more than 1700 km). Bănărescu (l.c.) quoted *Salmo trutta labrax* only from the lower part of the Danube river about 400 km only from the estuary. It is interesting and important to note the small size of these trouts (25—30 cm only). These facts allow us to consider a third possibility that these fishes exhibit a particular non-migratory variety — *infraspecies* (sensu Berg) — of trout adapted to the life conditions in the great river. This form, which might be called *Salmo trutta labrax* infraspecies *danubicus*, if our findings and speculations were right, is probably the transition between the form *labrax* and *fario*.

Anyway, the taxonomy and ecology of trouts living in the Danube river needs attention and more investigation.

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The plate will be found at the end of this issue.

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ON THE EARLY DEVELOPMENT OF BUNODERA LUCIOPERCAE (MÜLLER, 1776) (TREMATODA: BUNODERIDAE)

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Dedicated to the 70th birthday of Professor S. Hrabě

Received July 15, 1968

Abstract: Two new, first intermediate hosts of the trematode *Bunodera luciopercae* — *Pisidium casertanum* (Poli, 1791) and *P. personatum* Malm, 1855* were discovered in experimental studies. In these intermediate hosts first the spherical sporocyst develops from the miracidium. The sporocysts produce mother rediae; in these develop the daughter rediae which, finally, produce cercariae. The development of *B. luciopercae* is very slow as revealed by these experiments, the complete life cycle lasting two years under natural conditions.

Linstow (1873) was the first to study the development of the trematode *Bunodera luciopercae*, cultivating its eggs and describing briefly the miracidium. However, his statement that the intermediate host of *B. luciopercae* is the snail *Paludina impura* (= *Bithynia tentaculata*), this being also accepted by other investigators (Wright, 1884; Linton, 1892; Yamaguti, 1958) is not in keeping with the actual facts. Linstow's description and drawings of the cercariae discovered in this intermediate host suggest that they are xiphidiocercariae of the virgula group, belonging evidently to the species *Pleurogenoides medians* (Olsson, 1876), the adults of which are frequent parasites of frogs. The actual intermediate hosts were discovered by Wiśniewski (1958), who found naturally infected bivalves *Sphaerium corneum* and *S. rivicola* and studied experimentally the development of *B. luciopercae* from the cercaria to the juvenile stages in fishes.

Since the development of *B. luciopercae* in the first intermediate host has not been studied up to the present, we performed several experiments in the years 1965 and 1966 and succeeded to infect with this trematode species two species of bivalves — *Pisidium casertanum* (Poli, 1791) and *P. personatum* Malm, 1855 and to study the development of *B. luciopercae* in these intermediate hosts up to the daughter redia stage. Our attempts to infect the species *Sphaerium corneum* with this trematode species remained negative.

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* *Pisidium casertanum* and *P. personatum* were identified by Dr. J. G. J. Kuiper of the Institut Néerlandais, Paris, to whom our thanks are due.

MATERIAL AND METHODS

Eggs obtained from the uterus of adult trematodes were placed in water in small petri dishes (dia 55 mm) adding also a small amount of unicellular algae to ensure a better oxydation of the water and to prevent the growth of mould. The eggs were cultivated under room temperature (20—24° C). The emerged miracidia were collected with a fine pipette and transferred to a slide. To prevent rapid movement the miracidia were placed into blood serum diluted with water at a ratio of 1 : 1 and observed in viable state. When the first miracidia started to emerge the eggs with the fluid were poured into small aquaria (5 l) each containing about 300 Pisidia (*P. casertanum* and *P. personatum*) which had been collected from swamps in Šumava, where a natural infestation with *B. luciopercae* was out of question. Simultaneously we examined a control group of about 50 specimens of Pisidia finding in them only solitary developmental stages of trematodes of the genus *Gorgoderina* the adults of which parasitize frogs. The infected Pisidia were bred in 5 l aquaria with a small layer of mud and sand containing numerous plant remnants. We examined the compressed Pisidia under the microscope, at first after a week, later after a fortnight to one month. Developmental stages obtained from these Pisidia and studied mostly in the native stage were discovered in approximately 50% of the examined Pisidia of both species.

THE EGG (Fig. 1)

Colour yellowish brown, shape oval, size 0.068—0.081 × 0.043—0.054 mm, surface smooth, operculum little distinct.

The eggs obtained from the uterus of adult trematodes were at different stages of development; the most advanced eggs contained a relatively large embryo, but not fully developed miracidia. Also in the culture we observed a non-uniform development of the eggs, in some eggs the development was retarded and many eggs had not developed at all.

The younger eggs contain in subequal position a small concentration of propagatory and somatic cells lying at the wall of the egg. These cells can be readily distinguished because their colour is distinctly lighter, they are only feebly granulated and contain a large, relatively expressive cell nucleus. This ball of cells is surrounded throughout by yolk with clearly distinguishable yolk cells.

In the later development the ball of propagatory and somatic cells increases in bulk, the cells are more numerous but less large. After 1—2 days the embryo in some of the eggs occupies most of the space. Thereby, the yolk cells disappear gradually being pressed to the wall of the capsule by the embryo, where they start to break up. Two days later the embryo occupies the whole inside of the capsule. In it two aggregations of still indistinct dark pigment granules are being formed, later constituting the pigment layer of the eyes. At this stage the yolk cells have almost disappeared. On the third day the embryo shows signs of activity; the two pigmented eye spots are well developed although still distincly smaller than those in the mature miracidium and clearly divided from each other. Four days after the onset of the experiment many eggs contained fully formed miracidia with expressive, large, pigmented eye spots; these, having become joined, at this stage resemble a single, large, bilobate spot. The miracidia are very active and the cilia covering the surface of their body are visible. The miracidium occupies the whole capsule cavity. The minute remnants of yolk cells are pressed to the wall of the capsule.

The miracidia emerge after 5—7 days and only a few remnants of yolk cells and some excrements can be found in the egg capsule.

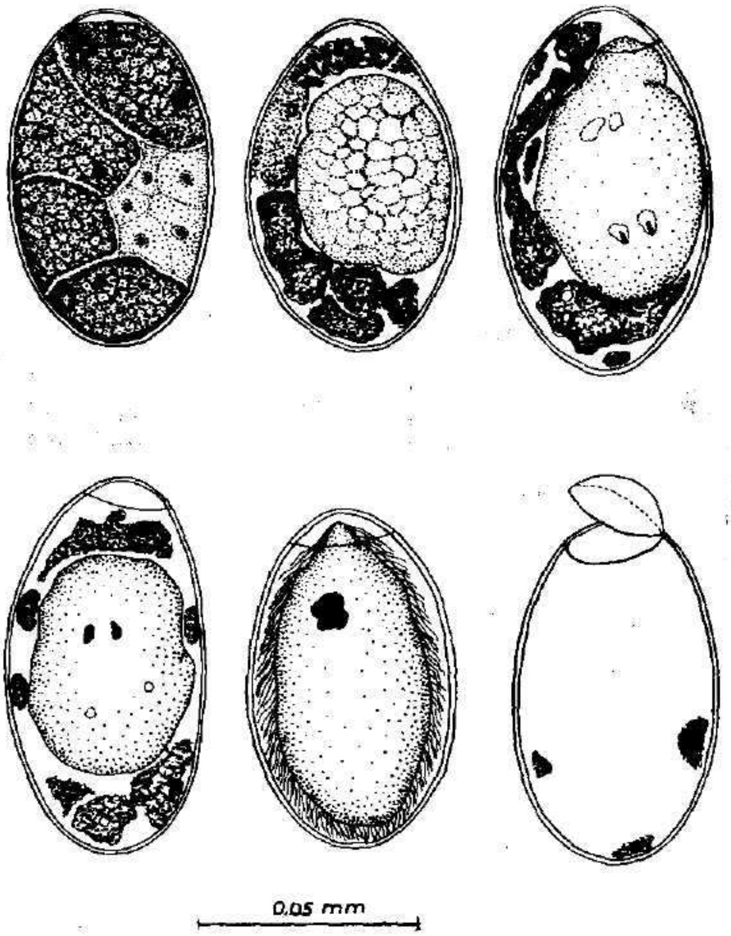

Fig. 1. *Bunodera luciopercae* (Müller, 1776) — development of the miracidium in the egg.

THE MIRACIDIUM (Figs 2, 3)

The very changeable shape of the miracidium ranges from an almost spherical to a very elongate form. Its size depends on its shape, its body length being 0.051—0.072 mm, its maximum width 0.036—0.042 mm. The body is covered with a ciliated epithelium, the cilia being slightly denser and also slightly longer on the anterior half of the miracidial body, measuring 0.007 mm in length, while those on the posterior portion only 0.004 to 0.005 mm. The large, pigmented eye spot measuring 0.007—0.009 mm in diameter is situated at the end of the anterior third of the body and consists of numerous, large, pigment granules. Mostly this eye spot is bilobated originating from the joining of the two original pigment spots. On the anterior end of the body a short, saclike, apical gland (0.014—0.016 mm long) can be distinguished, its posterior margin being level with the anterior margin of the pigmented eye spot. The brain ganglion follows closely behind its

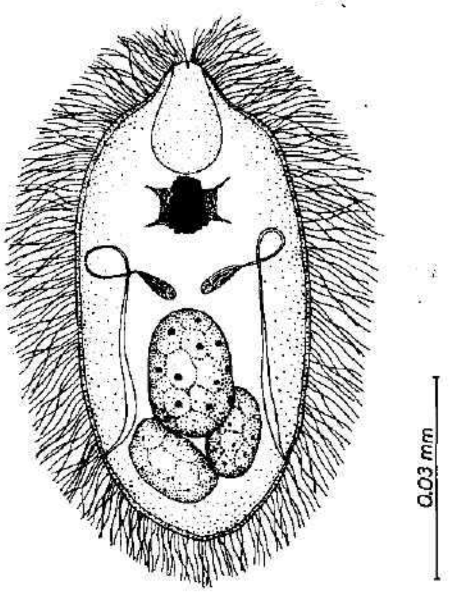

Fig. 2. *Bunodera luciopercae* (Müller, 1776) — miracidium.

posterior margin, being situated directly under the eye spot. The excretory system of the miracidium consists of two large flame cells placed submedially in the middle of the body at 0.036 mm from its anterior end. From them the excretory canals run backwards opening laterally in the posterior portion of the body. The germ balls are clearly visible in the posterior portion of the body.

THE SPOROCYST (Figs 4, 5)

After entering the Pisidium, the miracidium sheds its ciliated epithelium and settles in the gill tissue of its intermediate host, where it proceeds to develop.

In the week following the infestation the young sporocysts are still of the same size as the miracidia. Their shape is irregular, being either spherical or oval, their posterior end bears a distinct, tail-like lobe. The pigmented eye spots become visibly divided. Inside the body of the young sporocyst germ balls are aggregated, these being lighter and less granular than the remaining tissue of the sporocyst. The movements of the sporocyst are very limited and slow.

14 days after the invasion the sporocysts measured 0.063 by 0.066 mm. Their shape was irregularly oval, the tail-like extension of the end of the body was very small, but still visible. The separation of the eye spots was more marked. The young sporocysts grew slowly while still retaining their oval shape. The lobate, tail-like formation disappeared gradually from the end of the body. After 28 days the sporocysts measured 0.075 by 0.048 mm. A month after the invasion the sporocysts started to grow more rapidly, attaining an almost

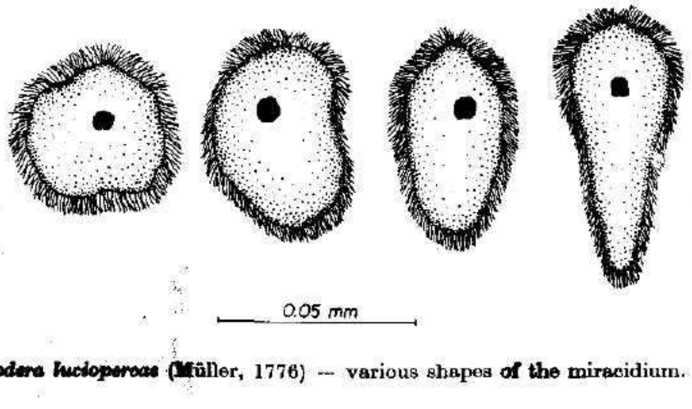

Fig. 3. *Bunodera luciopercae* (Müller, 1776) — various shapes of the miracidium.

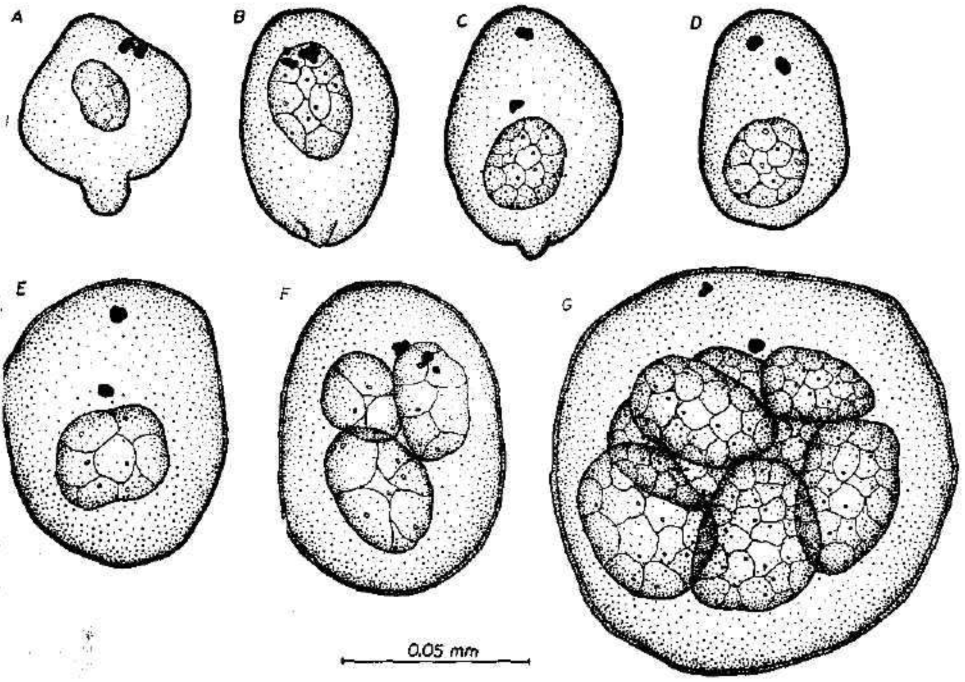

Fig. 4. *Bunodera luciopercae* (Müller, 1776) — development of the sporocyst. A — sporocyst 7 days after infection, B, C, D — sporocysts 14 days after infection, E, F — sporocysts 28 days after infection, G — sporocyst 35 days after infection.

spherical shape and the original germ balls started to divide into numerous germs of a lighter colour than that of the remaining tissue of the sporocyst.

Fully developed sporocysts were present two months after the invasion, being not very active, of almost spherical shape and containing young mother rediae. The mature sporocysts measuring at first 0,174 by 0.237 mm attain a size of up to 0.258—0.312 mm. They are dark and densely granular. Their surface is smooth with one irregular, craterlike pit at the site, where the mother rediae escape. Laterally, there are two pigmented eye spots on the sporocysts. The young mother rediae inside the sporocysts have a distinctly, developed, spherical, muscular pharynx of 0.033 mm in dia. After the emergence of the mother rediae, the sporocysts change into dark, wrinkled, spherical formations and become very granular; their eye spots decompose gradually into separate pigment granules. In spite of this the sporocyst still survive for a certain time (about one month) and shows little activity.

THE MOTHER REDIA (Figs 6, 7)

The first liberated mother rediae were discovered in the Pisidia as late as 67 days after invasion. At this time the gill tissue of the Pisidia contained in addition to the liberated mother rediae also developed sporocysts carrying young, very active mother rediae. The young mother rediae are lighter in colour than the sporocysts and have no pigmented eye spots. The body of the

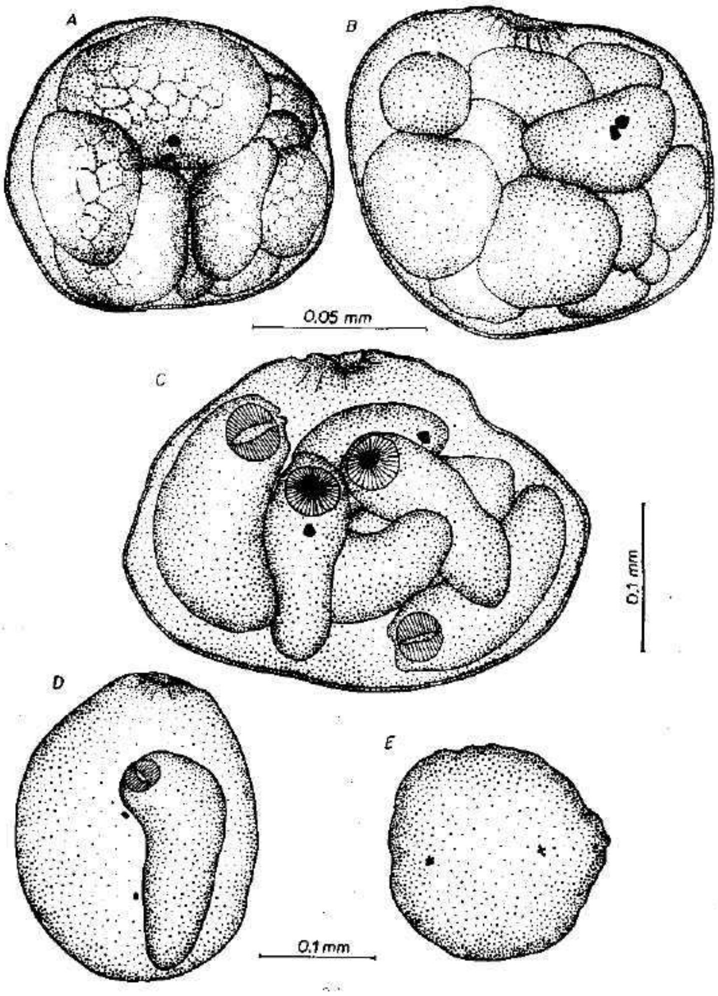

Fig. 5. *Bunodera luciopercae* (Müller, 1776) — development of mother rediae in the sporocyst. A, B, C — sporocysts two months after infection, D — sporocyst with the last redia inside the body, E — surviving, empty sporocyst.

mother rediae is more thickset, with an obtuse anterior end and a retractible mount round the mouth opening. Their body is 0.126—0.135 mm long and 0.075—0.078 mm wide. A large, feebly transversely oval to almost spherical and very muscular pharynx measuring 0.030—0.033 mm in dia is situated at the anterior end. The saclike intestine is not developed. The body cavity is occupied by large, spherical cells, in its posterior third there is a distinct aggregation of lighter germ balls. The excretory system is most indistinct.

The development proceeds very slowly, the mother rediae become larger and more elongate. The cells filling in the space behind the pharynx to about the middle of the body darken and take on the character of gland cells.

116 days after the infection the single ball of germ cells divides into several smaller balls, which dilate and develop into daughter rediae. 167 days after the infection these balls of germ cells form relatively large embryos filling in almost the whole cavity of the mother redia. In some of these embryos the developing anlage of the pharynx becomes visible. 226 days after the infection the mother rediae measure 0.135—0.270 by 0.054—0.135 mm, the pharynx is 0.030—0.033 *mm* in dia. As late as 241 days after the invasion fully developed motile daughter rediae could be observed in the mother rediae. These daughter rediae seem to leave the mother rediae through their body wall.

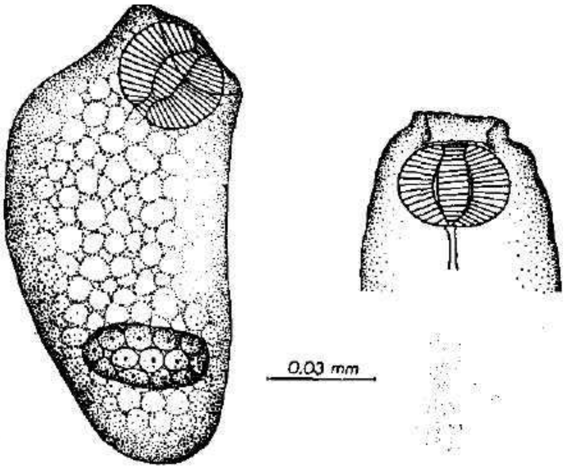

Fig. 6. *Bunodera luciopercae* (Müller, 1776) — young mother redia 67 days after infection.

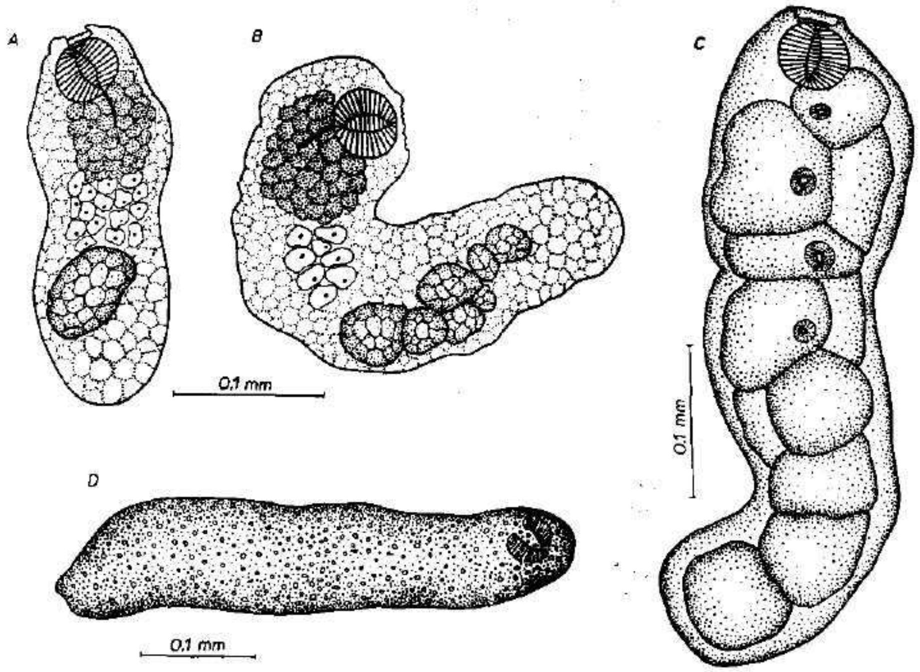

Fig. 7. *Bunodera luciopercae* (Müller, 1776) — mother rediae. A, B, C — development of daughter rediae in the body of mother redia, D — dead mother redia emptied of daughter rediae.

THE DAUGHTER REDIA (Fig. 8)

Young daughter rediae are very similar to the mother rediae. 241 days after the infection with the miracidia they are 0.135—0.195 mm long and 0.054—0.090 mm wide. The spherical pharynx measures 0.030 mm in dia. The general constitution of the body is similar to that of the mother redia, differing only in the numerous balls of germ cells occupying most of the body cavity of the daughter redia. The size of the pharynx is the same as that of the mother redia (0.030 mm in dia), the saclike intestine is also not developed. The excretory system is more distinct consisting of eight flame cells.

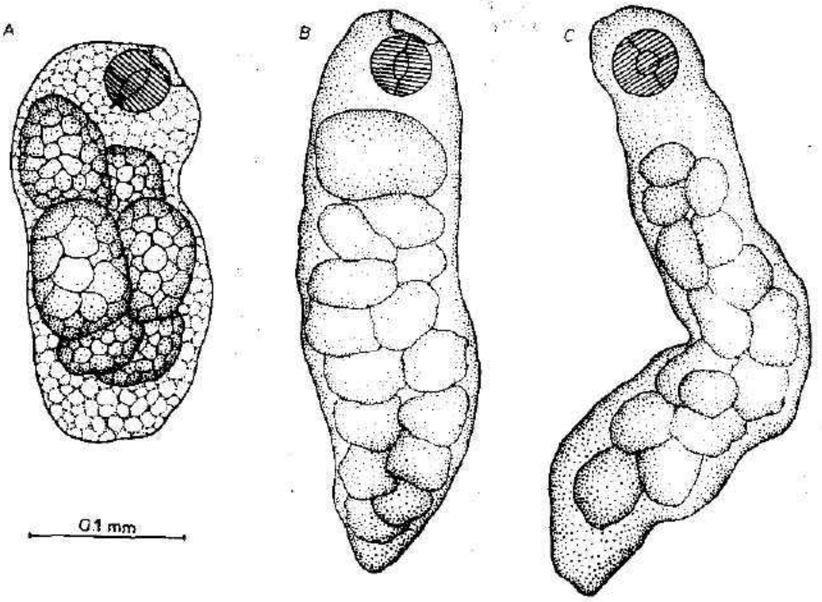

Fig. 8. *Bunodera luciopercae* (Müller, 1776) — daughter rediae. A — young redia 241 days after infection, B — redia 303 days after infection, C — redia 363 days after infection.

The daughter rediae grow very slowly. 303 days after the infection they measure 0.255 by 0.090 mm; the pharynx is 0.030 mm in dia. This daughter redia is of a very similar morphology to that having just left the mother redia being only slightly larger and more elongate and containing more germ balls. The last daughter rediae to be examined were those found 363 days after the infection. These were irregularly elongate, morphologically little different from the foregoing forms. Their body length attained 0.315 mm, the maximum width was 0.060 mm, the pharynx measured 0.027 by 0.030 mm. Contrary to the younger daughter rediae their body was completely occupied by the embryos of the cercariae.

DISCUSSION

Our experiments confirmed that in addition to the species of the genus *Sphaerium* also members of the genus *Pisidium* may be the first intermediate hosts of the trematode *B. luciopercae*, this being similar as in the related North-American species *Bunoderina eucaliae* Miller, 1936, which includes *Pisidium novebracense* into its life history (Hoffman, 1955). The species *Pisidium casertanum* and *P. personatum* experimentally infected by us are probably not the first intermediate hosts of this trematode in nature, because they live in different biotopes than their definitive hosts. Our experiments, however, suggest the not too high specificity of this trematode to its first, intermediate host. Thus, in nature they may develop not only in members of the genus *Sphaerium*, but also in various species of the genus *Pisidium*.

Our experiments performed at room temperature indicate further that the development of *B. luciopercae* is very slow. The eggs obtained at the beginning of February took more than 12 months to develop into the daughter redia stage in the Pisidia (until the beginning of March of the following year). In view of the seasonal occurrence of adults in fishes (Komarova, 1941; Dyk, Lucký, Valenta, 1954; Koval, 1955) the development seems to last approximately for the same length of time under natural conditions. This has been confirmed also by Frolova (1958) who found young and maturing rediae in bivalves in April-May. Since their development in fishes is also slow (see Ljajman, 1940) and they need also second intermediate hosts for their development, including various members of the class *Copepoda*, *Ostracoda* and *Phyllopoda* (Wiśniewski, 1958) the development of *B. luciopercae* seems to last two years in nature. This supports the hypothesis of Malachova (1963) presupposing the development of *B. luciopercae* to last two years.

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Zoological Institute of Charles University in Prague, Laboratory of Ichthyology

THE MYODOME IN THE WHITEFISH, COREGONUS LAVARETUS MARAENA (BLOCH)

OTA OLIVA & VLASTISLAV SKOŘEPA

Received January 11, 1968

Abstract: Both myodomes, the anterior and posterior one, are developed in the whitefish, *Coregonus lavaretus maraena* (Bloch). The anterior myodome is formed only by one muscle, the obliquus superior, and the canal is embedded in ethmoidal cartilage, lateral ethmoid and partially in frontal. The posterior myodome is spacious and opened posteriorly as in the herring, the canal is protected by the parasphenoid, basioccipital, prootic and anteriorly by the alisphenoid.

MATERIAL AND METHOD

Several heads of adult whitefish were used for study. The amputated heads were fixed in 4% solution of formaldehyde, later transfered into 5% trichloacetic acid, after softening the skull the topography of eye muscles was studied.

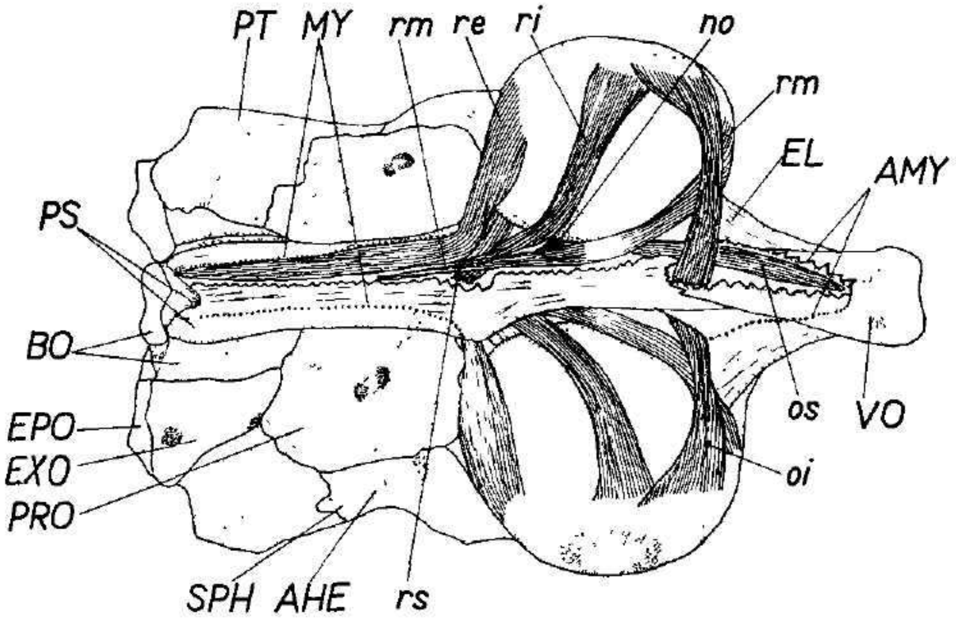
Explanations to abbreviations

AHE — articulation of hyomandibular
AMY — anterior myodome
ASPH — alisphenoid
BO — basioccipital
cao — cartilago ethmoidalis
EL — lateral ethmoid
EXO — exoccipital
EPO — epiotic
FR — frontal
ME — mesethmoid
MY — posterior myodome
no — optic nerve
oi — obliquus inferior muscle
os — obliquus superior muscle
PA — pariotal
PRO — prootic
PS — parasphenoid
SPH — sphenotic
re — rectus externus muscle
ri — rectus inferior muscle
rm — rectus medialis muscle
rs — rectus superior muscle
VO — vomer

RESULTS

The anterior myodome is formed by one oblique muscle only, namely the obliquus superior. This muscle has it course aborally below the frontal and its attachment can be seen on the dorsal part of the eye bulb. Here the muscle is flat, towards its origin it becomes conical in shape. About one half of the total number of muscle fibers originate from lateral ethmoid near the entrance into the anterior myodome and by this way the obliquus superior passes into the most anterior part of the myodome where it is strikingly thickened. The obliquus inferior is flat, flattened lateromedially. It originates from the entrance of the anterior myodome (from the fibrous septum which is growing from lateral ethmoid closely below the frontal) bone, but does not enter into it. Its attachment partially covers the attachment of the rectus inferior. Both obliqui communicate closely.

The whole anterior myodome is embedded in the lateral ethmoid, ethmoidal cartilage, and is partially covered by the frontal. The posterior myodome is opened posteriorly, as in the herring, and is formed by the basioccipital, parasphenoid, prootic and alisphenoid. The longest from the recti muscles is the rectus externus, which reaches up to the posterior end of the myodomic canal. The muscle originates from the basioccipital, it passes towards the eye bulb in the dorsal half of the canal. Both recti mediales originate in about one half of the length of the canal. The rectus externus is flat, toward its attachment to the eye bulb, toward ist origin it becomes more narrower. The rectus medialis muscle originates from the parasphenoid. The basioccipital-prootic suture can be visible closely above its origin seen from the lateral side. The origin is longer and crest-like in shape, here also the muscle is conical, but flat, near its attachment to the oral part of the eye bulb, where the shape of the rectus medialis is band-like and flat. The rectus inferior has its course laterally to the course of the rectus medialis, and almost vertically from the course of the latter, moreover ventrally from the course of the rectus externus and rectus medialis. The attachment of the rectus inferior is covered by the attachment of the obliquus inferior. The rectus inferior is a short muscle, it originates from the fascia connecting recti closely of the entrance into the myodome, that is from the alisphenoid and prootic. The rectus superior muscle originates between the course of recti mediales from the parasphenoid near the entrance into the posterior myodome, from its origin it tends from



Coregonus lavaretus maraena (Bloch). The oblique ventral view of the cranium.

the lateromedial position to the dorsoventral plane, but its origin is above the course of both recti mediales when seen from the lateral face. The attachment on the dorsal surface of the eye bulb is partially covered by the attachment of the obliquus superior muscle. The parasphenoid covers the course of the posterior myodome, this bone is connected with the prootic and the basioccipital by means of an oblique suture.

DISCUSSION

The topography of the eye muscles in the whitefish resembles to that of herring, especially by the identical formation of the anterior myodome by one muscle only, namely the obliquus superior. The posterior myodome is open the same way as in the herring, but there is a difference in the length of both longest recti, rectus externus and rectus medialis; in the herring they pass both through the whole length of the myodomic canal, in the whitefish the rectus medialis is shorter and passes only to the middle of the canal, similarly as in trouts (*Salmo trutta* and *Salmo gairdneri irideus*, see Oliva, 1961). Contrary to the smelt, *Osmerus eperlanus*, where the posterior myodome is closed, it is opened in the whitefish, which is somewhat curious regarding the close relationship of both. The presence of myodome in the whitefish is not mentioned by Bayer (1889), but it is visible from his excellent figures (e.g. Fig. 7).

When summarizing former results (Oliva, 1961; Oliva & Skořepa & Stokłosowa, 1968 in *Clupea* and *Salmo* posterior myodomes are opened, in *Osmerus* is the posterior myodome closed. The anterior myodomes are formed normally by both obliqui in *Salmo* and in *Osmerus*, but only by the obliquus superior in *Clupea* and *Coregonus*.

ACKNOWLEDGEMENTS

The authors wish to thank to Professor Dr Zygmunt Grodziński (Kraków) for recommending the problem for study. Mgr Alina Olko (Kraków) has redrawn the figure from the dissection photograph mady by Dr Stanislav Frank, CSc. (Praha).

SUMMARY

The anterior and posterior myodome were found and described in the whitefish, *Coregonus lavaretus maraena* (Bloch). The anterior myodome is formed, similarly as in the herring, only by the obliquus superior muscle, the posterior myodome by the rectus medialis and rectus externus muscle. Only the rectus externus muscle passes through the myodomic space and reaches the posterior end of the myodome, which is open as in the genus *Salmo* and *Clupea*. On the other hand its close relative, the smelt, *Osmerus eperlanus*, has a closed posterior myodome.

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THE MYODOME IN CICHLID FISHES (CICHLIDAE)

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Dedicated to the 70th birthday of Professor S. Hrabě

Received September 16, 1968

Abstract: Two myodomes occur in Cichlid fishes. The anterior myodome or eye muscle canal is mostly shallow, formed by ethmoidal cartilage, the surrounding bones are the vomer, the lateral ethmoid and the mesethmoid. The obliquus superior and obliquus inferior muscle enter the anterior myodome. With the exception of *Astronotus ocellatus* and *Cichlasoma biocellatum* the obliqui muscles communicate with the obliqui muscles of the opposite eye. The posterior myodome is open, but the parasphenoid does not posses two wings as in *Clupea*. It is bordered by the basisphenoid, alisphenoid, the prootic and the parasphenoid. The parasphenoid has two facets posteriorly for the upper pharyngeals. The origins of both recti externi muscles are visible behind these facets. The rectus externus muscle and partially the rectus medialis enter the posterior myodome, the rectus superior and the rectus inferior muscle penetrate only into the entrance of the myodome. In all cichlids examined the rectus medialis muscle has a bifurcated attachment. Of total of 13 species representing 8 genera were studied: *Aequidens pulcher, Astronotus ocellatus, Cichlasoma biocellatum, C. festivum, C. meeki, C. nigrofasciatum, C. severum, Herichthys cyanoguttatus, Hemichromis bimaculatus, Pterophyllum scalare, Symphysodon aequifasciata, Tilapia mossambica, T. zilli.*

PROBLEM, MATERIAL AND METHODS

The present communication presumes the presence of myodomes and the size of eye muscles is related either to the mode of life (and the size of eye) of the examined species, or it is influenced by the systematic position. The details about this concept are discussed in previous communications (e.g. Oliva, 1961; Oliva & Skořepa, 1968; Oliva & Skořepa & Stoklosowa, 1968). For our studies were used several heads of adult specimens of each species fixed previously in 4—5% solution of formalin, transferred into 5% trichloracetic acid, after softening the eye muscle topography was studied. All specimens of cichlid are aquarium fish, which we were given for dissections through the courtesy of aquarists.

RESULTS

I. *Aequidens pulcher* Gill (1858)
(= *Aequidens latifrons* Steindachner, 1878)*)

Habitats in South America.

The anterior myodome is shallow, the obliqui eye muscles of both eyes are in contact. The attachment of the obliquus superior covers partially the attachment of the rectus superior on the dorsal surface of the eye bulb.

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*) Nomenclatorically we are following Schultz (1949), who explains in his monograph, that *Acara* Heckel, 1840, with its type restricted by Gill to *Acara crassispinis* Heckel = *Lobotes*

The attachment of the obliquus superior covers the attachment of the rectus inferior to the ventral surface of the eye. The posterior myodome is short, *opened posteriorly, the rectus externus muscle does not* reach up to the basioccipital. Posteriorly behind the facets of the parasphenoid for upper pharyngeals there is a small opening filled with connective tissue, so that we may suppose that the myodome is "closed". The rectus externus muscle penetrates most posteriorly into the myodome, its point of origin being on the basioccipital. The rectus medialis muscle originates on the parasphenoid, but more anteriorly and lies ventrally from the rectus externus muscle. The rectus inferior originates on the prootic, its shape being conical and the whole muscle being short. The rectus superior is also short and originates on the parasphenoid.

2. *Astronotus ocellatus* (Agassiz, 1829)

Habitats in South America.

The anterior myodome is bordered by the vomer, lateral ethmoid and the mesethmoid. The anterior myodome is shallow, the muscles of the opposite eyes are not in contact in the myodomic space.

The obliquus inferior muscle covers the attachment of the rectus inferior muscle, the whole muscle being flat, flattened dorsoventrally. It originates from the lateral ethmoid. The obliquus superior muscle attachment does not cover the attachment of the rectus superior, the point of origin of the obliquus superior muscle is common with the obliquus inferior, the muscle is flat. The posterior myodome is shallow and occupied by *two recti muscles, the rectus* externus and the rectus medialis. The posterior myodome is bordered by the parasphenoid, prootic, alisphenoid, the myodomic canal does not reach to the basioccipital. The rectus externus muscle originates by wide attachment on the lateral surface of the eye bulb, on entering the myodome, this muscle becomes conical in shape, and passes most posteriorly into the myodome. Its point of origin lies on the parasphenoid. The rectus medialis muscle is flat, originating from the parasphenoid; it is attached to the eye bulb on its frontomedial surface. It has two branches, the shorter one originates from the prootic oral from the origin of the rectus externus. The longer branch originates from the prootic oral from the origin of the rectus externus, too. Entering the myodome the position of the rectus medialis between the other recti muscles is the following. Medially runs the rectus medialis, laterally the rectus inferior (which penetrates from below into the rectus externus and rectus medialis), simultaneously aborally from the rectus inferior passes here from above in the same medial level the rectus superior (which originates from the parasphenoid near the entrance of the myodome).

The rectus inferior is flat, it originates from the prootic near the entrance of the myodome, during its course it crosses (as in all cichlids studied) the rectus superior.

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ocellatus Agassiz, is a synonym of *Astronotus* Swainson, 1839, with its type, *Lobotes ocellatus* Agassiz, *the only species mentioned.* Thus, in Regan's revision of the South American cichlid genera, his use of Acara is a synonym of Aequidens (Schultz, lc. p. 170). Our study concerns the popular aquarium cichlid, "blue acara", called *Acara coeruleo-punctata* Kner. var. *latifrons* Steindachner, ***Acara pulchra*** (Gill) or *Aequidens latifrons* (Steindachner) in aquaristical literature.

3. *Cichlasoma biocellatum* Regan 1909

Habitats in Central America.

Two myodomes are developed. Into the anterior myodome enter two obliqui muscles. The obliqui of the opposite eyes are not in direct contact, but their origins lie closely to each other. The obliquus superior covers by its attachment partially the attachment of the rectus superior, the obliquus inferior covers in the similar way the attachment of the rectus inferior. Both obliqui originate from the ethmoidal cartilage. Two longest recti muscle, the rectus externus and rectus medialis pass into the posterior myodome. The rectus externus muscle originates from the parasphenoid near the suture with basioccipital, the conical reaches the end of the myodomic canal. The rectus inferior originates from the prootic, has its course above the course of the rectus medialis, the muscle is flat. The rectus medialis has its point of origin on the parasphenoid bone in first third of length of the myodomic canal. It passes through the ventral half of the canal. The shape of this muscle is conical, the muscle itself possesses two branches, the shorter branch originates from the roof of the entrance of myodome from prootic. The course of the thick optic nerve is covered from ventral side by the rectus medialis muscle. The rectus superior muscle originates from the parasphenoid.

4. *Cichlasoma festivum* Heckel, 1840

Habitats in South America.

Two myodomes occur. In the anterior myodome obliqui muscles of opposite eyes communicate. The obliquus inferior partially covers the attachment of the rectus inferior, near its attachment the first is wide and becomes narrower towards its origin. The obliquus superior muscle is flat, short and covers the attachment of the rectus superior. The rectus externus originates from the basioccipital, passes to the end of the myodomic canal. The rectus medialis muscle has two branches, the shorter branch grows up from the entrance of the myodome from the prootic. The longer branch of this muscle is originating from the parasphenoid in the myodome, but flat outside of it. The rectus inferior muscle has its origin from the prootic, the rectus superior muscle from the parasphenoid.

5. *Cichlasoma meeki* (Brind, 1918)

Habitats in Central America.

Two myodomes occur. In the anterior one the obliqui muscles of opposite eyes communicate. The obliquus inferior muscle partially covers the attachment of the rectus inferior, the obliquus superior muscle in similar way the attachment of the rectus superior.

Into the posterior myodome enter two recti, namely the rectus externus and the rectus medialis. The rectus externus originates from the basioccipital, its shape being conical. The rectus medialis has two branches, the shorter branch originates from the prootic, the longer one from the parasphenoid in the middle of the whole myodomic canal. The muscle is slightly conical in shape and passes in the ventral part of the canal. The rectus inferior has its point of origin on the prootic, close to the parasphenoid, the rectus superior originates on the parasphenoid.

6. *Cichlasoma nigrofasciatum* (Günther, 1869)

Habitats in Central America.

The anterior myodome is very shallow, the obliqui of both opposite eyes communicate. The obliquus superior covers the attachment of the rectus inferior to the eye bulb, the obliquus superior partially covers the attachment of the rectus superior. The rectus externus originates from the basioccipital, passes through the whole space of the posterior myodome. The shape of this muscle is conical. The rectus medialis muscle has two branches, the longer branch enters one third of the myodome, here it originates from the parasphenoid, the shorter branch originates from the roof of the myodome on the prootic. This muscle is comparatively thin and conical in shape. The rectus inferior originates from the prootic, close to the parasphenoid, the rectus superior from the prootic close to the prootic — alisphenoid suture.

7. *Cichlasoma severum* Heckel, 1840

Habitats in South America.

The obliqui muscles of both eyes communicate in the anterior myodome. The obliquus inferior covers the attachment of the rectus inferior. The obliquus superior covers the attachment of the rectus superior; this muscle is flat. The posterior myodome is open chiefly to the rectus externus, which has its point of origin from the parasphenoid near of the basioccipital and parasphenoid suture. The rectus inferior originates from the suture of prootic and alisphenoid, the rectus medialis has its point of origin from the entrance of the myodome from the parasphenoid and its course lies most ventrally from all recti. It has two branches, the shorter one originates from the prootic on the prootic-alisphenoid suture, the second, a longer branch, enters the entrance of the myodome and originates from the parasphenoid. The rectus superior originates from the parasphenoid, medially of it runs the rectus medialis, laterally the rectus inferior, this muscle does not enter the myodome.

8. *Hemichromis bimaculatus* Gill, 1862

Habitats in Africa.

The anterior myodome is shallow, the obliqui muscles of the opposite eyes communicate. The obliquus inferior is flat, it originates from the ethmoidal cartilage, the obliquus superior has the same point of origin. The rectus externus has its point of origin from the basioccipital, here it is conical in shape, but it becomes flat towards its attachment on the eye bulb. The rectus medialis muscle is bifurcated, the shorter branch has its origin from the prootic, the longer one reaches to the middle of the myodomic canal and originates from the parasphenoid. The rectus inferior muscle originates from the prootic, the rectus superior from the parasphenoid.

9. *Herichthys cyanoguttatus* Baird et Girard, 1854

Habitats in Central and SW part of North America.

There are two myodomes. In the anterior myodome the obliqui muscles communicate. The obliquus inferior is flat, the obliquus superior covers the attachment of the rectus superior. In the posterior myodome the rectus externus has its point of origin on the parasphenoid and does not reach the basioccipital. The rectus medialis has its course ventrally of all recti, its origin being near of the entrance of myodome from the parasphenoid. The rectus inferior originates from the prootic, close to the prootic-alisphenoid suture, the rectus superior originates from the parasphenoid.

10. *Pterophyllum scalare* Cuvier et Valenciennes, 1831

Habitats in South America.

In the anterior myodome the obliqui muscles of opposite eyes communicate. The obliquus inferior muscle covers partially the rectus inferior attachment, the short, fakt obliquus superior muscle covers the attachment of the rectus superior. The rectus externus originates from the basioccipital, passes through the whole myodome, its shape inside the myodome being conical, outside flat. The rectus medialis has two branches, the shorter one originates from the prootic near the entrance of the myodome, the longer one from the parasphenoid. The rectus superior is flat and originates from the parasphenoid. It shape becomes conical towards its origin.

11. *Symphysodon aequifasciata* Pellegrin, 1903

Habitats in South America.

The anterior myodome is very short, the obliqui eye muscles of the opposite eyes communicate. The obliquus inferior is very flat, it covers the attachment of the musculus rectus inferior on the bulb. The obliquus superior muscle covers the attachment of the superior rectus. The rectus externus is very wide, flat, in the myodomic canal conical in shape, it has its origin from the basioccipital. The rectus medialis muscle has two branches, shorter one is originating from the prootic, the longer one from the parasphenoid in the middle of the myodomic canal. The rectus inferior muscle originates from the prootic, the rectus superior from the parasphenoid.

12. *Tilapia mossambica* (Peters, 1852)

Habitats in Africa.

In the anterior myodome obliqui muscles of both eyes communicate. The flat obliquus inferior covers the attachment of the rectus inferior. This muscle has its origin in the lateral ethmoid. The obliquus superior muscle originates in the same point, its attachment on the eye bulb covers the rectus superior. Also this muscle is flat in shape. Into the posterior myodome enters the rectus externus muscle. Outside the myodome this muscle is flat, inside conical, it originates from the basioccipital. The rectus inferior muscle originates from the prootic, closely to alisphenoid, near the origin of the rectus medialis at the entrance of myodome. The shape is conical. The rectus medialis muscle originates from parasphenoid closely the entrance of myodome, ventral from the origin of the rectus inferior. The rectus superior muscle originates from parasphenoid. Medially passes the rectus medialis, laterally from it the rectus inferior, the rectus superior does not penetrate into the myodome.

13. *Tilapia zilli* (Gervais, 1848)

Habitats in Africa.

The anterior myodome is shallow, the obliqui muscles of opposite eyes communicate. The obliquus inferior covers the attachment of the rectus

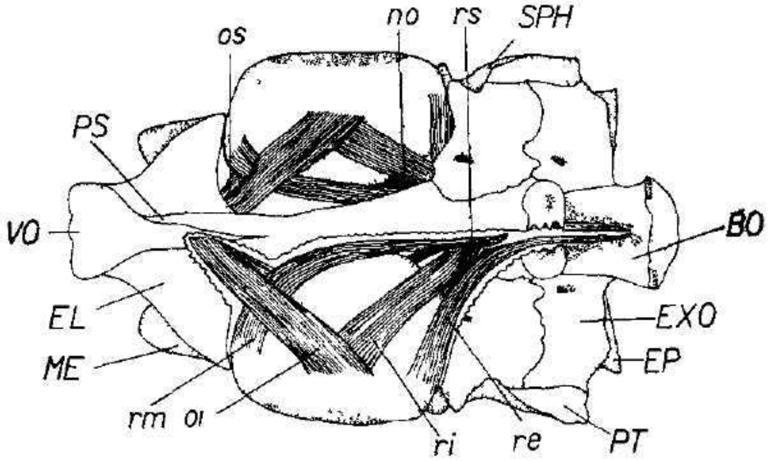


Fig. 14: *Tilapia mossambica* The ventral view of the head The course of myodomes dotted.

inferior. The attachment of the obliquus superior and rectus superior does not cover each other. The rectus externus originates from the basioccipital and it is conical in shape, similarly as the rectus inferior, which originates from the prootic closely the prootic — alisphenoid suture. The rectus medialis enters into the oral part of the myodome, originates from the parasphenoid. The rectus superior originates from the parasphenoid.

DISCUSSION

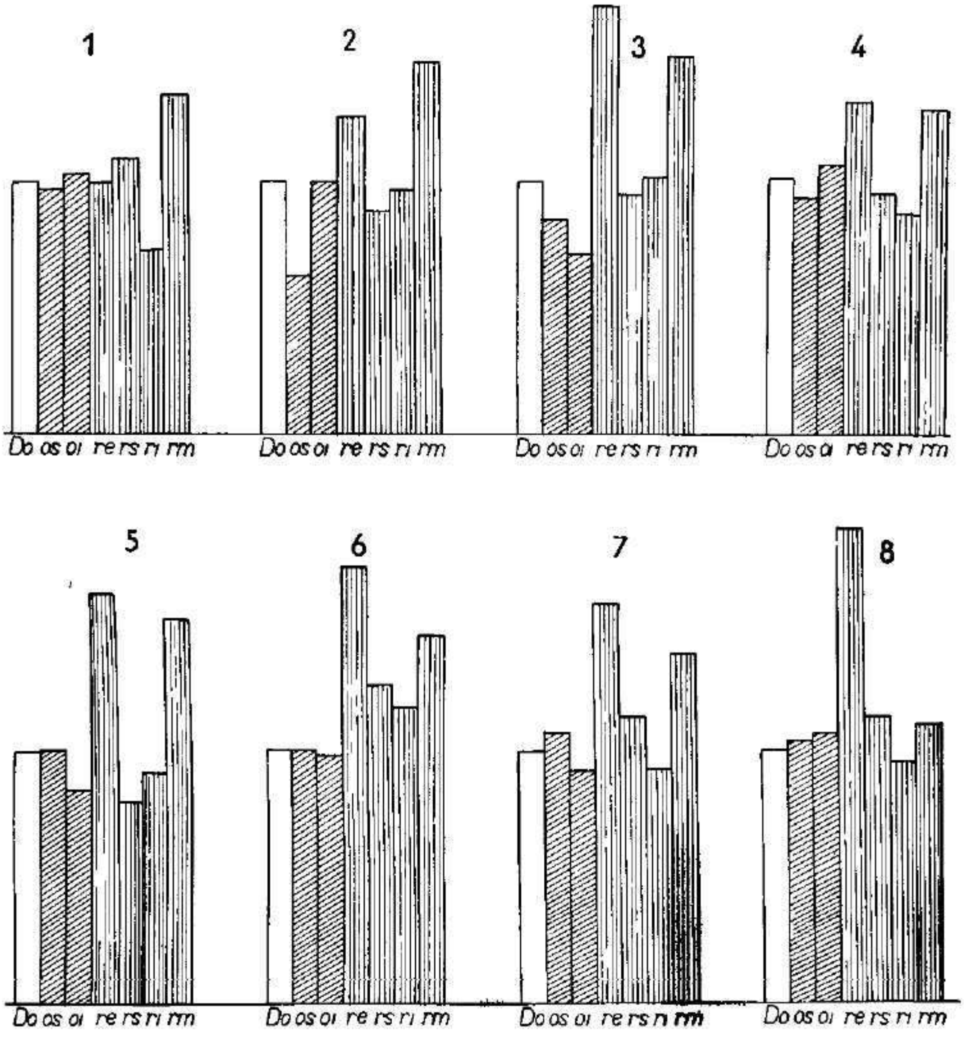
Cichlids are together with carps (Cyprinidae), perches (Percidae), characins (Characidae) one of very important family of fresch water fishes.

They inhabit most part of Southern America, Central America morthly to Mexico and Texas, Afrika, Syria, Madagascar and coastal waters of India, comprising about 450 species in about 40 genera. Most intensive speciation can be observed in Afrika, where about 300 species occur (Gregory, 1933, 1951; Regan, 1906—08). There are reasons to believe the theory of a land-connection between America and Africa in connection to their geographical distribution in Eocene time (Regan, 1906—08), the fact of occurence of many relative genera (between typical fresh water group of fishes such as cichlids) in African and American cichlids (Pellegrin, 1903—04; Gregory, 1951) is cited repeatly among other evidence for a former transatlantic land-bridge. Therefore, it is full of interest to study the topographical anatomy of their eye muscles with regard to geographical distribution and ecology. According to our previous investigations (Oliva, Skořepa, Stokłosowa, 1968) it seems to be evident, cichlids will possess the myodomes, this fact was confirmed now. The opened posterior myodome is a new phenomenon, which was observed here, this resembles to whitefish (*Coregonus lavaretus maraena* — Oliva, Skořepa, 1968) or herring (*Clupea harengus* — Oliva, Skořepa, Stokłosowa, 1968) or trouts (Oliva, 1961). In perch (*Perca fluviatilis*) on the contrary a closed posterior myodome was found (Oliva, Skořepa, Stokłosowa, 1968).

Gregory (1951) 240 shows the myodome perch genus *Roccus*, the myodome is closed, formed by the parasphenoid, basisphenoid, prootic, the myodome does not reach up to the basioccipital.

When we shall assume that large eyes are connected with the presence of myodomes in general, unfortunately, in cichlids examined, in contrary, the shortest recti externi muscles, which are most important for forming of the posterior myodome, posses those species, which have relatively largest eyes *(Pterophyllum)*, *Cichlasoma biocellatum*, e.g., with relatively small eyes, has long recti externi muscles

Computing the diameter of eye in head length (data from Hykeš, 1937 and Pellegrin, 1903—04) the situation is as follows: *Tilapia mossambica* 15—22%, *T. zilli* 20—29%, *Herichthys cyanoguttatus* 22—33%, *Astronotus ocellatus* 23—25%, *Cichlasoma biocellatum* 25%, *C. meeki* 25—30%, *C. severum* 25—33%, *C. nigrofasciatum* 25—36%, *Hemichromis bimaculatus*



25—40%, ***Symphysodon discus*** 27—33%, *Acara pulchra* 28—33%, *Cichlasoma festivum* 29—38%, *Pterophyllum* 33%. Naturally, the size of eye is in relation with size of fish, smaller specimens have much larger eyes.

From the phylogenetical point of view the genus *Crenicichla* Heckel, 1840 and than *Acara* Heckel, 1840 are believed they are most archaic (Pellegrin, 1903 — 04), according to Danilčenko, 1964 the most primitive genus is *Acara* Heckel, 1840, known from Brasilian terciery, then *Aequidens* Eigenmann and Bray, 1894 (pliocene of Brasil), *Cichlasoma* Swainson, 1839 (miocene of West India). Pellegrin (lc.) repeats the idea of Jordan about the „ichthysation process" connected with the reduction of vertebrae number towards the aequator, the number of 24 vertebrae may be typical for tropical Acanthopterygians. In the eocene cichlid genus *Priscacara* Cope, 1877 there was found 23—24 vertebrae according to British Museum specimens (*Priscacara serrata* Cope, 1877 — eocene of Wyoming), *Priscacara clivosa* Cope, 1878, the same locality and stratum. Pellegrin (lc.) supposes from African cichlids *Hemichromis* Peters, 1857 and *Paratilapia* Bleeker, 1868, are still archaic forms, but more advanced.

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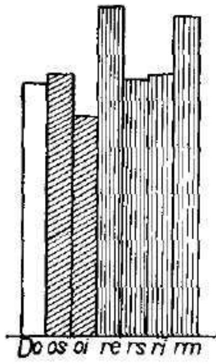

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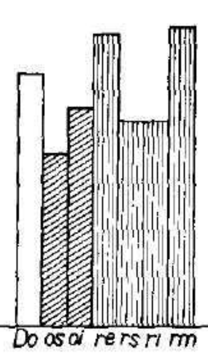

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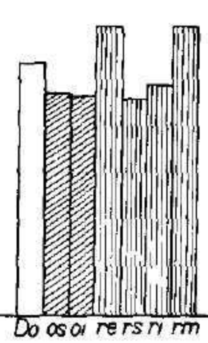

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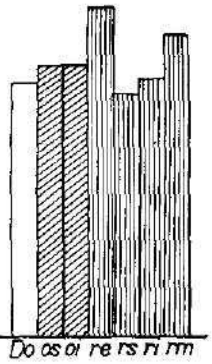

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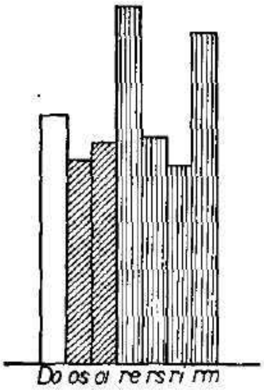

Figs 1—13: Relative length of eye muscles in some cichlids studied. Do — diameter oculi cal- culated as being 100 p. c., the individual length of each muscle is calculated in percents of eye bulb diameter and ilustrated graphically to make comparison possible. 1. *Aequidens pulcher* — 2. *Astronotus ocellatus* — 3. *Cichlasoma biocellatum* — 4. *Cichlasoma festivum* — 5. *Cichlasoma meeki* — 6. *Cichlasoma nigrofasciatum* — 7. *Cichlasoma severum* — 8. *Hemichromis bimaculatus* — 9. *Herichthys cyanoguttatus* — 10. *Pterophyllum scalare* — 11. *Symphysodon aequifasciata* — 12. *Tilapia mossambica* — 13. *Tilapia zilli.*

The main differentation factor stil are the food habits, characterized by special development of teeth, branchial aparatus and digestive system, the differentation goes parallel in American and African species. Unfortunately, many evolutionary features which are so clearly visible in certain anatomical or morphological structures are not distinguishable on the topography of eye muscles. The whole problematics of cichlid evolution is fully explained in the monograph of Pellegrin (1903—04), here may be by cited only some regularities. E.g. branchial spines are of similar structure in *Cichla* Bloch et Schneider, 1801 (America) and *Paratilapia* and *Pelmatochromis* Steindachner, 1894 (Africa), in *Heros* Heckel, 1840 and *Cichla* is the same tendency to enlargement of number of anal spines as in African genera *Lamprologus* Schilthuis, 1891 and *Julidochromis* Boulenger, 1898, the body became longer by enlargement of anterior segments in *Crenicichla* Heckel, 1840 (American genus), or by enlargement of the number of posterior segments. *Ectodus* Boulenger, 1898, *Xenotilapia* Boulenger, 1899 (Africa), the differentiation causes the change of body form from cylindrical *(Crenicichla)* to elevated form (*Symphysodon* Heckel, 1840 or *Pterophyllum* Heckel, 1840) posterior segments. Naturally, there are many intergrades between these examples. The differentiation and speciation is also influenced by the space, Pellegrin (l.c.) took attention to the fact most Acanthopterygian are marine fishes, analogically, in the Lake Tanganyika cichlids are mostly differentiated and resemble the conditions know in marine species. Similar situation is in large water mass of the Amazon stream drainage.

There are obvious relations of cichlids to percids, the location in system between percids (suborder Percoidei) is evident also in mist modern reviews of fish system compiled by Berg (1955) and lately by Greenwood, Rosen, Weitzman and Myers (1966).

From our observations on myodome we must say that the rich speciation and large variability does not show obvious documents regarding eye muscles size and topography, the whole eye muscle apparatus is in general less developed than e.g. in some carps without regard to the well know fact to every aquarist that the cichlids are typical "visual" creatures with very movable eyes.

Acknowledgements

Both authors are indebted to Professor Dr. Zygmunt Grodziński (Cracow) for the encouragement to study this problem in general. Mgr. Alina Olko was very helpful to us in redrawing all figures. Thanks are due to Dr. Stanislawa Stokłosowa (Cracow), Dr. Karol Hensel (Bratislava) Dr. Stanislav Frank (Prague), Professor Dr. Otto Jírovec, Head of the Zoological Institute of Charles University, Prague and the Ministry of Education of Czechoslovakia which enabled the senior author to work in Hoyer Department of Comparative Anatomy in Cracow.

SUMMARY

1. In all 13 species of Cichlids belonging to 7 genera both myodomes, the anterior and posterior occur.

2. The anterior myodome is in general shallow and two obliqui muscles enter it. With exception of *Astronotus ocellatus* and *Cichlasoma biocellatum* the obliqui communicate with the obliqui muscles of the opposite eye.

3. The posterior myodome is open, two recti enter it, the rectus externus and rectus medialis, the rectus superior and the rectus inferior muscles penetrate only to the entrance of the myodome.

4. In all Cichlids species examined the rectus medialis muscle has two branches for attachment.

5. The obliquus superior muscle is shorter than obliquus inferior in *Aequidens pulcher, Astronotus ocellatus, Cichlasoma festivum, Hemichromis bimacullatus, Pterophyllum scalare, Tilapia zilli,* the same length have these two muscles in Tilapia mossambica.

In *Cichlasoma meeki, C. nigrofasciatum, C. severum, Herichthys cyanoguttatus, Symphysodon aequifasciata* occur longer obliquus superior than obliquus inferior.

6. The longest of all recti in all representants is the rectus externus, especially in *Hemichromis bimaculatus*, than in *Cichlasoma biocellatum* and *Cichlasoma nigrofasciatum.* The shortest rectus externus, in contrary, has *Aequidens pulcher, Symphysodon aequifasciata* and *Pterophyllum scalare.*

7. The longest rectus medialis muscle can be found in *Cichlasoma meeki*, further in *Cichlasoma biocellatum* and *Astronotus ocellatus*, the shortest, in *Hemichromis.*

8. The rectus superior muscle is longer in *Aequidens pulcher, Cichlasoma festivum, C. nigrofasciatum. C. severum, Hemichromis bimaculatus, Tilapia zilli,* shortes rectus superior occurs in *Astronotus, Cichlasoma biocellatum, C. meeki, Herichthys, Symphysodon, Tilapia mossambica.* The same length of both muscles was measured in *Pterophyllum scalare.*

Explanation to Abbreviations

AMY — anterior myodome
ASPH — alisphenoid
BO — basioccipital
EL — lateral ethmoid
EXO — exoccipital
EPO — epiotic
FR — frontal
MY — posterior myodome
no — optic nerve
oi — obliquus inferior muscle
os — obliquus superior muscle

Pa — parietal
PRO — prootic
PS — parasphenoid
PT — pterotic
rm — rectus medialis muscle
re — rectus externus muscle
ri — rectus inferior muscle
rs — rectus superior muscle
SO — supraoccipital
SPH — sphenotic
VO — vomer

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Hydrobiological Lab., The Czechoslovak Academy of Sciences, Prague

FORELIA LONGIPALPIS MAGLIO, 1924 — A NEW WATER-MITE (HYDRACHNELLAE) FOR THE FAUNA OF CZECHOSLOVAKIA

PAVEL PUNČOCHÁŘ

Dedicated to the 70th birthday of Professor S. Hrabě

Received September 24, 1968

A female of the species *Forelia longipalpis* Maglio, 1924(which has not yet been taken for the territory of Czechoslovakia) was found in the collections of *Hydrachnellae* from the stagnant waters of the Bohemian-Moravian Highlands. The up-to-date distribution of the species has extended over: Sweden, Germany, Netherlands, Belgium, Austria, Hungary, Italy, Roumania, and Yugoslavia.

Finding place: Pond Homole near the village Kouty (14 km from Ledeč on Sázava) located in the south-western slope of the Melechov Hill, 630 m a.s.l. The stands of vegetation extend far from the shores. The sampling station was placed in the littoral. The brook, which flows through the pond, is 1.3 m wide.

Description of the female

Body length 702 μm, width 232 μm. The skin has markedly irregular incisions, width 6 μm. On the dorsal part of the body (Fig. 1) there are 2 pairs of chitinous plates. For the dimensions of the foremost, larger pair see Tab. 1. The smaller plates are shifted a little to the side and backwards, their width being greater than their length.

The structure of the epimeral plates is identical with those in the other representatives of the genus *Forelia* Haller, 1882.
The genital plates project between the 4th pair of the epimerites. They are elongated on the foremost interior corners; the elongated part contains 1 genital acetabulum (Fig. 1-A). The width of the plates is greater than their length (Tab. 2). The right as well as the left plate bear 15 genital acetabula. The anal opening is on a sclerotized plate.

The first and the second pair of the legs are conspicuous by the structure of their last (5th and 6th) joints, which are thick (see Fig. 2). For the length of individual joints of the legs see Tab. 3. The swimming hairs are on the 5th joint of the 2nd pair (5); on 5th joint of the 3rd pair (6); on 5th joint of the 4th pair (5).

The oral organ bears strongly bent palps. They have the 5th joint much

Tab. 1. Dimensions (in μm) of the larger pair of the dorsal plates

	Length	Width
Right	68	28
Left	64	28

Tab. 2. Dimensions (in μm) of the genital plates

	Left	Right
Length	126	116
Width	137	158

elongated, almost equally long as the 4th. The interior part of the 4th joint of the palps has thin hairs on a small protuberance. The description of the specimen is identical with that of Lundblad (1962) who found a single specimens with this feature among the many females collected. The 2nd joint of the palps is almost straight on the basal part.

The mandibules are double-jointed, the basal part is 124 μm long, the distal claw 48 μm. (See Fig. 2).

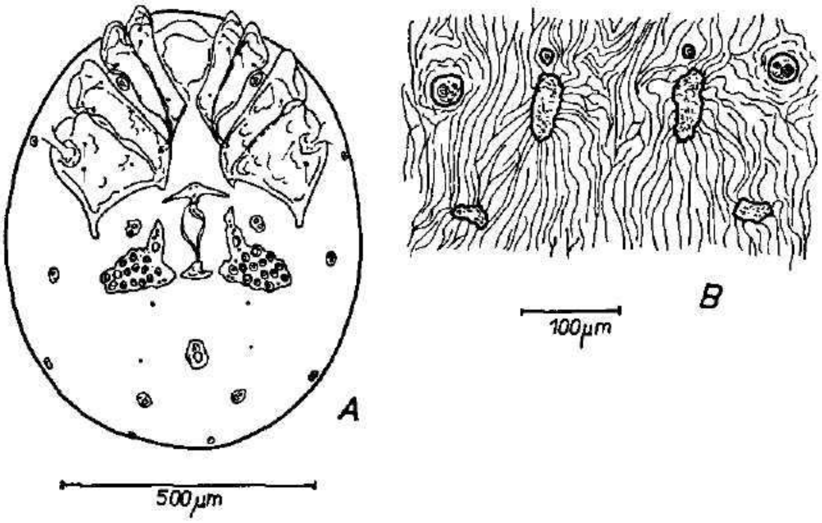

Fig. 1. *Forelia longipalpis* Maglio, 1924. Ventral body surface of a female (A) and part of the dorsal surface of a females body with chitinous plates (B).

Tab. 3. Length (in μm) of individual joints of the legs.

	Joints	1st	2nd	3rd	4th	5th	6th
Pairs							
1st		60	64	80	96	100	128
2nd		80	80	88	108	140	144
3rd		68	100	96	128	196	152
4th		124	124	144	192	208	168

Tab. 4. Dimensions of individual joints of the palps (in μm)

	1st	2nd	3rd	4th	5th
Dorsal length	36	112	56	84	72
Distal dorsoventral height	32	68	56	32	20

Synonyma: *Forelia curvipalpis* Viets, 1930

Lundblad (1962) proves that the distinctive parks of the species *Forelia longipalpis* Maglio, 1924 and *Forelia curvipalpis* Viets, 1930 are variable and that is why it is impossible to distinguish both species.

The findings of the genus *Forelia* Haller, 1882 on the territory of Czechoslovakia

The representatives of the genus *Forelia* Haller, 1882 inhabit stagnant waters or moderately flowing ones. Up to now, approximately 20 species and forms have been described for Europe. Part of these descriptions is old and unconfirmed, several others were placed together as synonyma. At the present time, 8 species and 2 forms are reported for Europe (according to Viets, 1956; Lundblad, 1962; Viets K. and K. O., 1960).

Only 3 species have been found on the territory of Czechoslovakia:

Forelia brevipes (Neuman) 1880

Syn. *Forelia triangularis* (O. F. Müller) 1896.
Finding place: Reservoir Bystřička in Moravia (Láska, 1952a, 1966).

Forelia liliacea (Müller) 1776

Syn. *Acercus liliaceus* Müller, 1776.
Finding place: Pond Pilka at Příbram in Bohemia (Písařovic, 1896). Pond Přelejvač near G. Jeníkov, pond near the farmstead Vrchy, pond Staré Jezero near Chlumec (all in the vicinity of Třeboň in south Bohemia); a small pond near Radostovice overgrown by *Potamogeton* (Bohemian-Moravian Highlands) according to Thon, 1900. The findings of both authors were summed by Láska, 1952b.

Forelia variegator (Koch) 1837

Syn. *Forelia cassidiformis* Haller, 1882.
Finding place: A small reservoir with water passage on the brook Vrbecký (near Ledeč on Sázava, Bohemian-Moravian Highlands), Punčochář, 1966. Brook Valšovský; brook Černý near Bruntál, Láska, 1966. The species was also found in the brook Botič (in the surroundings of Prague); in the brooks Pstružní and Koutecký, and pond Lánský (Bohemian-Moravian Uplands, near Světlá on Sázava).

From the survey it is evident that all findings were made in Bohemia and Moravia. Little attention has been paid to the study of Hydrachnellae of the stagnant waters in Slovakia; that is why none of the common species has been found up to now.

SUMMARY

The finding of *Forelia longipalpis* Maglio, 1924 (syn. *Forelia curvipalpis* Viets, 1930) is new for the fauna of Czechoslovakia. Thus the number of

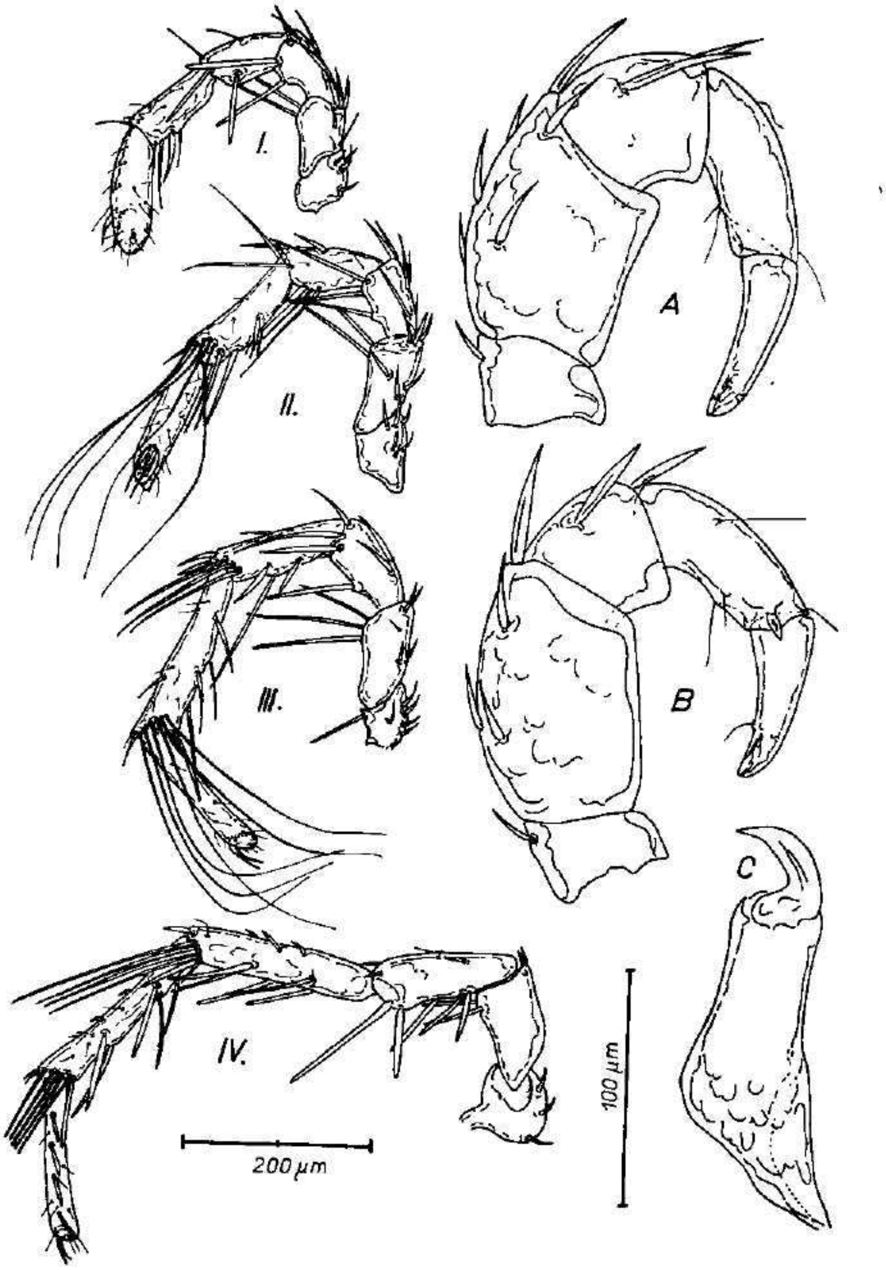

Fig. 2. Female of ***Forelia longipalpis*** Maglio, 1924. I.—IV. — 1st to 4th pair of legs. A — right palp, B — left palp, C — mandibule.

species of the genus *Forelia* Haller, 1882, found up to the present time in Bohemia and Moravia has occupied the fourth place.

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Lehrstuhl für Zoologie der Universität Olomouc

ZUR KENNTNIS DER GATTUNG HYPOCAMPTUS CHAPPUIS, 1929 (COPEPODA: HARPACTICOIDA)

OTAKAR ŠTĚRBA

Meinem sehr geehrten Lehrer, Herrn Univ. Prof. Dr. S. Hrabě, DrSc., zum 70. Geburtstag
gewidmet

Eingegangen am 8. Mai 1968

Abstrakt: Im Rila-Gebirge (Bulgarien) waren drei neue Formen der Gattung *Hypocamptus* gefunden und zwar: *H. hraběi* sp. n., *H.* sp. n.? *(paradoxus ?)*, *H. brehmi* subsp. n.?. Die definitive Beurteilung der letzten zwei Taxone hängt von der Redescription von *H. brehmi* (van Douwe) und *H. paradoxus* (Kreis) ab, weil diese Arten unzureichend beschrieben sind.

Zu der Gattung *Hypocamptus* Chappuis 1929 *(Copepoda, Harpacticoida)* gehörten bisher nur zwei Arten, *Hypocamptus brehmi* (van Douwe 1922) und *Hypocamptus paradoxus* (Kreis 1926). Die erste war aus den Gebirgen von Bayern, die zweite aus der Schweiz beschrieben; um so interessanter ist der Fund von drei Taxonen der Gattung aus zwei Gebirgslokalitäten im Rila-Gebirge (Bulgarien), wo ich im Sommer 1966 kleine Krebstiere erforschte. Dieser Fund bestätigt unter anderem die Annahme, dass es sich um eine ausgeprägte Gebirgsgruppe handelt, die überwiegend an Moosgewässer gebunden ist, ähnlich wie die Mehrzahl der Arten der Gattung *Maraenobiotus* oder *Arcticocamptus*.

Keiner von den gefundenen Taxonen entsprach genau den Beschreibungen der beiden bisher bekannten Arten, jedoch nur in einem Fall bin ich im Stande die Bestimmung einer neuen Art vorzulegen, in den übrigen zwei Fällen ist es notwendig die Redescription und die genauere Beschreibung von *Hypocamptus brehmi* und *Hypocamptus paradoxus* abzuwarten.

Hypocamptus hraběi sp. n.

Fundstelle: Ein Gebirgstümpel mit einer Quelle, dicht beim Gebirgssee „Elenino ozero", Rila-Gebirge, Bulgarien, 7. 8. 1966, 9 ♀, 6 ♂. (Begleitfauna: *Arcticocamptus arndti* (Kiefer) 3 ♀ *Maraenobiotus insignipes* (Lilljeborg) 6 ♂, 14 ♀ (f. *aischghoi*), *Hypocamptus* sp. n.? *(paradoxus)?* 8 ♂, *Epactophanes richardi* Mrázek 4 ♀, *Cyclopoida*).

Weibchen (Holotypus): Die Körperlänge ohne Furkalborste beträgt 0,58 mm. AI achtgliedrig, AII dreigliedrig, AxpAII eingliedrig mit 4 Borsten, der Mdb-Palpus rudimentar mit drei Borsten. Exp1 und Exp2 zweigliedrig, Exp3 und Exp4 dreigliedrig, Enp—4 zweigliedrig. Bewehrung P1—P5:

Exp	Enp
P1: 01/121	10/030
P2: 01/022	00/121
P3: 01/00/122	10/221
P4: 01/10/122	10/221
P5: 6	6

Die Hinterränder der Körpersegmente glatt. Das erste Abdominalglied lateral und dorsal mit Dörnchen am Hinterrand, weitere Dörnchen lateral im oberen Drittel des Gliedes und in der Mitte der Dorsalseite. Das zweite und dritte Glied mit Dörnchen lateral und dorsal und in dem Randdrittel der Ventralseite. Das vierte Segment mit Dörnchen lateral, ventral und dorsal mit einer Unterbrechung über der Mitte der Furkaläste; weitere Dörnchen etwa in der Hälfte des Segmentes lateral und in den Randdritteln der Dorsal- und Ventralseite. Das Analoperculum abgerundet, terminal mit vielen kurzen Dörnchen (Härchen), weitere Reihe feiner in der Mitte der Fläche der Analoperculum. Die Furkaläste unregelmässig „kugelförmig“, sehr speziphisch geformt (siehe Abb. 9). Von der Furkalendborsten die äussere rudimentar, auch die mittlere Borste relativ schwach entwickelt. Die distale Lateralborste am Ende des Furkalrandes inseriert, die proximale etwa in seiner halben Länge und dicht neben ihr noch eine schwache und kurze Borste. Die Dorsalborste befindet sich bis im letzten Drittel der Furkaläste. Um die Insertion der Furkalborsten kleine Dörnchen, eine zusammenhängende Dörnchenreihe ventral am Distalende der Furkaläste. Im Eiersack waren nur zwei Eier (die übrigen Weibchen waren ohne den Eiersack).

Männchen: Die Körperlänge ohne Furkalborste 0,38 mm. AI stark angetrieben, AII, Mdb und die Anzahl der Fussglieder wie beim Weibchen, mit der Ausnahme Enp3, der dreigliedrig ist. Bewehrung P1—P5:

Exp	Enp
P1: 01/121	10/030
P2: 01/022	00/120
P3: 01/00/122	10/’’1‘‘0/020
P4: 01/10/122	00/020
P5: 4	2

Das vorletzte Abdominalglied verhältnissmässig kurz, P6 nur mit 1 Dorn. Das erste Abdominalglied lateral und spärlich dorsal mit Dörnchen, das zweite, dritte und vierte Segment lateral, dorsal und ventral mit einer Dörnchenreihe, ventral sind die Dörnchen weniger dicht. Das letzte Abdominalsegment lateral, dorsal und ventral mit Dörnchen, weiter gibt es die lateralen Dörnchen im oberen Teil, in dem äussersten Drittel der Dorsalseite und zwei kurze Reihen beiderseits der medialen Linie der Ventralseite. Das Analoperculum flach abgerundet, mit etwa 16 Dörnchen. Die Furkaläste üblicher Form, gleich lang wie breit, die Furkalborsten normal, die Dorsal- sowie auch die Lateralborsten distal verschieben; dicht neben der proximale Lateralborste noch eine kurze und schwache Borste. Am Distalende der Furkaläste ventral eine Querreihe der Dörnchen.

Die Variabilität: Die Körperlänge bewegte sich bei den festgestellten Weibchen von 0,55 bis 0,60 mm, bei den Männchen von 0,35 bis 0,40 mm. Bei den zwei Weibchen war an der Innenseite des 2. Gliedes Enp4 nur eine Borste (10/121), einigermassen variabel war auch die Dichte der Dörnchenreihe in den Mittelteilen der Abdominalglieder sowohl ventral, wie auch dorsal bei beiden Geschlechtern. Bei einem Männchen war die Bewehrung eines Exp3: *01/00/122*, des zweiten Exopodites desselben Beinpaares: *01/00/022*, bei weiteren zwei Männchen war das Börstchen an der Innenseite des dritten Gliedes eines Exp3 normal, am zweiten Exopodit rudimentar.

Diskussion: Es handelt sich um eine gut differenzierte Art, deren morphologische Hauptkennzeichen die Form der Furkaläste und die Bewehrung der Beine, besonders P3 beider Geschlechter, sind.

Hypocamptus sp. n.? (*paradoxus* Kreis?)

Die Fundstelle und die Begleitfauna siehe *Hypocamptus hrabĕi* sp. n.

Männchen: Die Körperlänge bewegte sich von 0,40 bis 0,43 mm. AI stark angetrieben, AII zweigliedrig, das erste Glied Exp AII mit 1, das zweite mit 3 Borsten; die Scheidewand zwischen beiden Gliedern Exp AII schlecht sichtbar. Der Mdb-Palpus eingliedrig, rudimentar, durch drei Borsten bewehrt. Expl-4 und Enpl, 2, zweigliedrig, Enp3 dreigliedrig, Enp4 eingliedrig Bewehrung P1—P5:

Exp	Enp
P1: 01/121	00/030
P2: 01/022	00/111
P3: 01/022	00/"1"0/020
P4: 01/022	020
P5: 4	2

Das vorletzte Abdominalglied auffalend kurz, P6 mit 1 Dorn. Die Bedornung der Abdoninalsegmente mit üblichen Dörnchenreihen: I: Lateral, dorsal. II—III: Lateral, ventral, dorsal. IV: Lateral, spärlich ventral, spärlich dorsal. V: Lateral, ventral, spärlich dorsal; weitere spärliche Dörnchenreihe im oberen Teil der Ventralseite. Das Analoperculum flach abgerundet, mit 17—23 feinen, aber verhältnismässig langen Dörnchen. Die Furkaläste 2,7mal so lang wie breit. Alle 3 Furkalendborsten gut entwickelt, die Dorsal- wie auch die Lateralborsten stark distal verschieben; dicht neben der proximale Lateralborste noch eine schwache Borste. Bei der Borsteninsertion kleine Dörnchen, eine Querreihe von Dörnchen beim Distalende der Ventralseite der Furkaläste.

Die Unterschiede von *Hypocamptus paradoxus* (Kreis): 1. Das erste Glied Exp4 an der Aussenseite mit einem starken Dorn versehen (!), das zweite Glied trägt 3 Dornen und 1 Borste, also um eine Borste und einen Dorn mehr. Am Enp4 ist umgekehrt um eine kurzen Dorn weniger.

2. Am Distalende des Innenrandes des 2. Gliedes Exp3 um eine dünne Borste mehr.

3. ExpAII zweigliedrig, insgesamt mit 4 Borsten.

4. Weitere Unterschiede können in dem Mdb-Palpus sein und in der Bedornung der Furkaläste durch kleine Dörnchen, es ist jedoch möglich, dass diese Unterschiede nur scheinbar sind und aus der ungenügenden Beschreibung von Kreis folgen (dieses kann auch des ExpAII betreffen).

Diskussion: Die beschriebenen Männchen aus Bulgarien sind taxonomisch ohne Zweifel der Art *Hypocamptus paradoxus* (Kreis) ähnlich, gleichzeitig aber weisen ausgeprägte Unterschiede aus, von welchen der wichtigste die Bedornung des Exp4 ist.

Da in beiden Fällen nur die Männchen gefunden worden sind und weil die

Beschreibung von Kreis in manchen Punkten unvollständig scheint, lasse ich die Frage des taxonomischen Wertes der bulgarischen Individuen auf weiteres offen.

Die Reduktion der Gliedzahl der Beinen (Exp3, P4) ist das wichtigste gemeinsame Kennzeichen der beiden diskutierten Formen. Falls es auch bei den Weibchen vorkommen wird, könnten wir diese Taxone als eine selbständige Untergattung betrachten.

Hypocamptus brehmi (van Douwe) subsp. n.?

Fundstelle: Das Moos in Quellen unter dem Gebirgsee „Elenino ozero“, Rila-Gebirge, Bulgarien, 9. 8. 1966, 14 ♀, 4 ♂.

Begleitfauna: *Bryocamptus (Rheocamptus) spinulosus* s. lat. 12 ♀, 6 ♂, *Arcticocamptus cuspidatus* (Schmeil) 3 ♀, *Echinocamptus (Limocamptus) echinatus* (Mrázek) 4 ♀, 1 ♂, *Maraenobiotus vejdovskýi* Mrázek 4 ♀, *Attheyella wierzejskyi* (Mrázek) 2♀3♂, *Moria poppei* (Mrázek) 1 ♀.

An der höher angeführten Lokalität wurden u. a. auch die Vertreter der Gattung *Hypocamptus* festgestellt, die mit aller Wahrscheinlichkeit zur Art *Hypocamptus brehmi* (van Douwe) gehören. Weil die Beschreibung der Art *Hypocamptus brehmi* unvollständig ist, bringe ich die Abbildungen aller morphologisch bedeutenden Weibchen- und Männchen-Kennzeichen. Im Vergleich mit der Beschreibung von van Douwe (1922) kennen wir bei den bulgarischen Individuen schon jetzt folgende Unterschiede feststellen:

Weibchen:

1. Der Mdb-Palpus ist mit 3 und nicht nur mit 2 Borsten bewehrt.
2. Das erste Glied Enp2 trägt an der Innenseite eine Borste.
3. Am Enp5 sind nur 6 und nicht 7 Borsten vorhanden.
4. Form der Furkaläste.

Männchen:

1. Der Mdb-Palpus hat 3 Borste.
2. An der Innenseite trägt das 3. Glied Exp3 um einen Dorn mehr, an der Innenseite des ersten Gliedes Enp3 befindet sich ein Dorn.
3. Enp5 mit 5 und nicht nur mit 4 Borsten.

Diese Unterschiede sind zwar bedeutend, aber zur definitiven Beurteilung der Taxonomischen Lage der bulgarischen Populationen ist die Redescription der Nominatform abzuwarten.

Die Körperlänge von gesammelten Weibchen war 0,70—0,80 mm, der Mänchen 0,50—0,55 mm.

ZUSAMMENFASSUNG

Zur Harpacticidengattung *Hypocamptus* Chappuis gehörten bisher nur zwei Arten aus den mitteleuropäischen Gebirgen und deshalb ist der Fund dreier wahrscheinlich neuen Taxonen dieser Gattung aus zwei bulgarischen Lokalitäten im Rila-Gebirge sehr interessant. Keiner von den gefundenen Taxonen entsprach den Beschreibungen der beiden bisher bekannten Arten, aber nur in einem Fall konnte der Autor eine neue Art bestimmen, in den übrigen zwei Fällen ist es notwendig die Redescription von *Hypocamptus brehmi* und *Hypocamptus paradoxus* durchzuführen, weil diese Arten unzureichend beschrieben sind.

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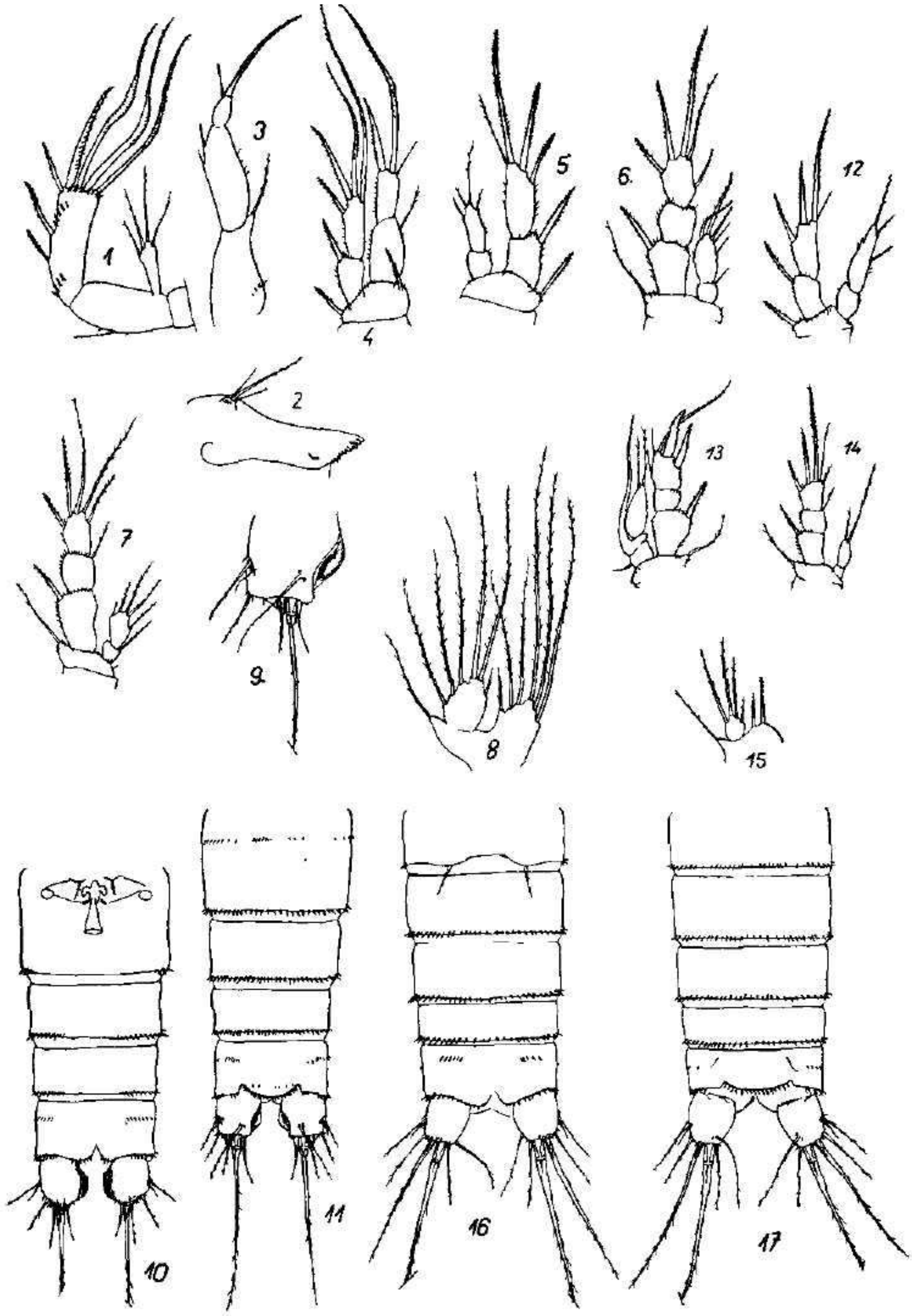

Abb. 1–17: *Hypocamptus hraběi* sp. n.: 1 – AII ♀, ♂. 2 – Mdb ♀, ♂. 3 – Mxp ♀, ♂. 4 – Pl ♀, ♂. 5 – P2 ♀. 6 – P3 ♀. 7 – P4 ♀. 8 – P5 ♀. 9 – Furka ♀. 10 – Abdomen ♀ ventral. 11 – Abdomen ♀ dorsal. 12 – P2 ♂. 13 – P3 ♂. 14 – P4 ♂. 15 – P5 ♂. 16 – Abdomen ♂ ventral. 17 – Abdomen ♂ dorsal.

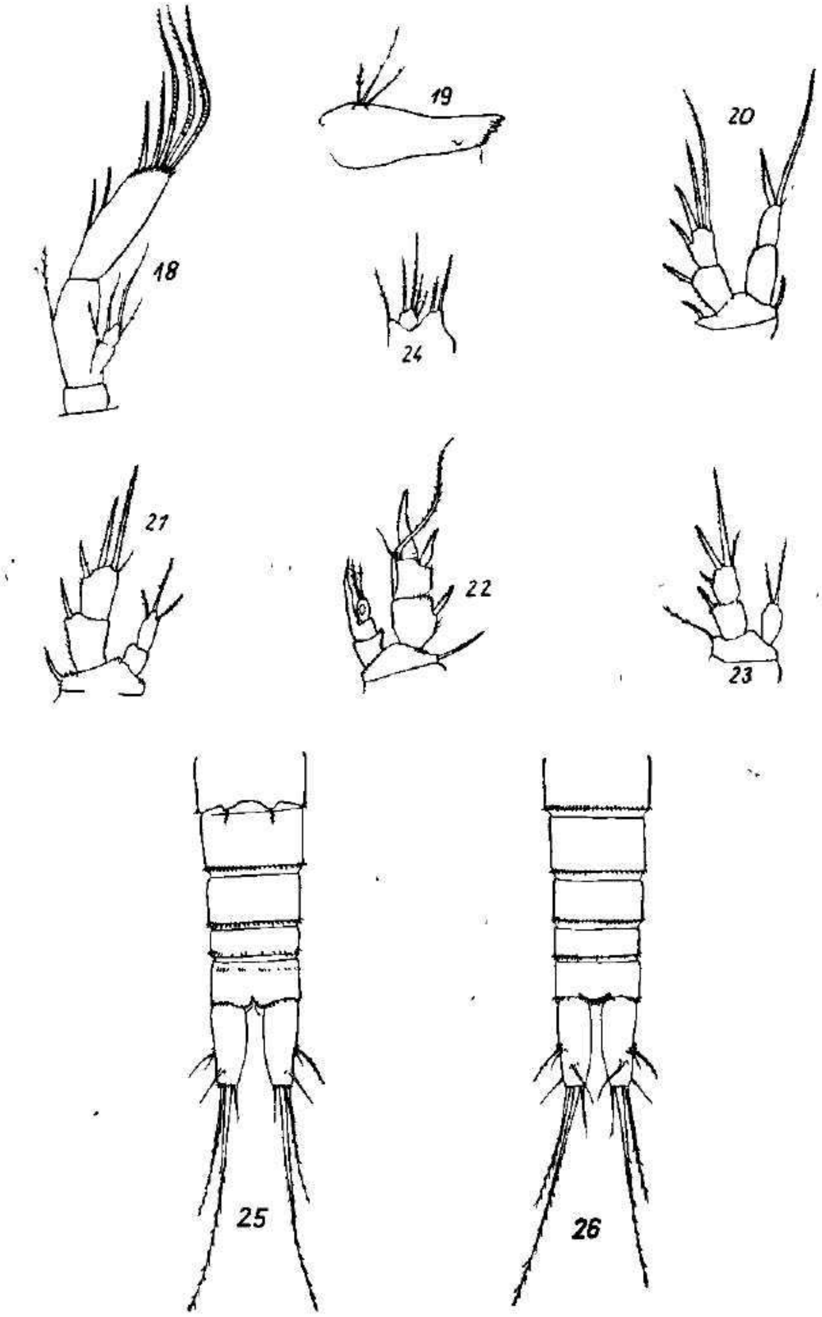

Abb. 18–26: ***Hypocamptus* sp. n.?** *(paradoxus?)*, ♂: 18 – **AII.** 19 – **Mdb.** 20 – **P1**, 21 – **P2**, 22 – P3, 23 – **P4**, 24 – **P5**. 25 – Abdomen ventral. 26 – Abdomen dorsal.

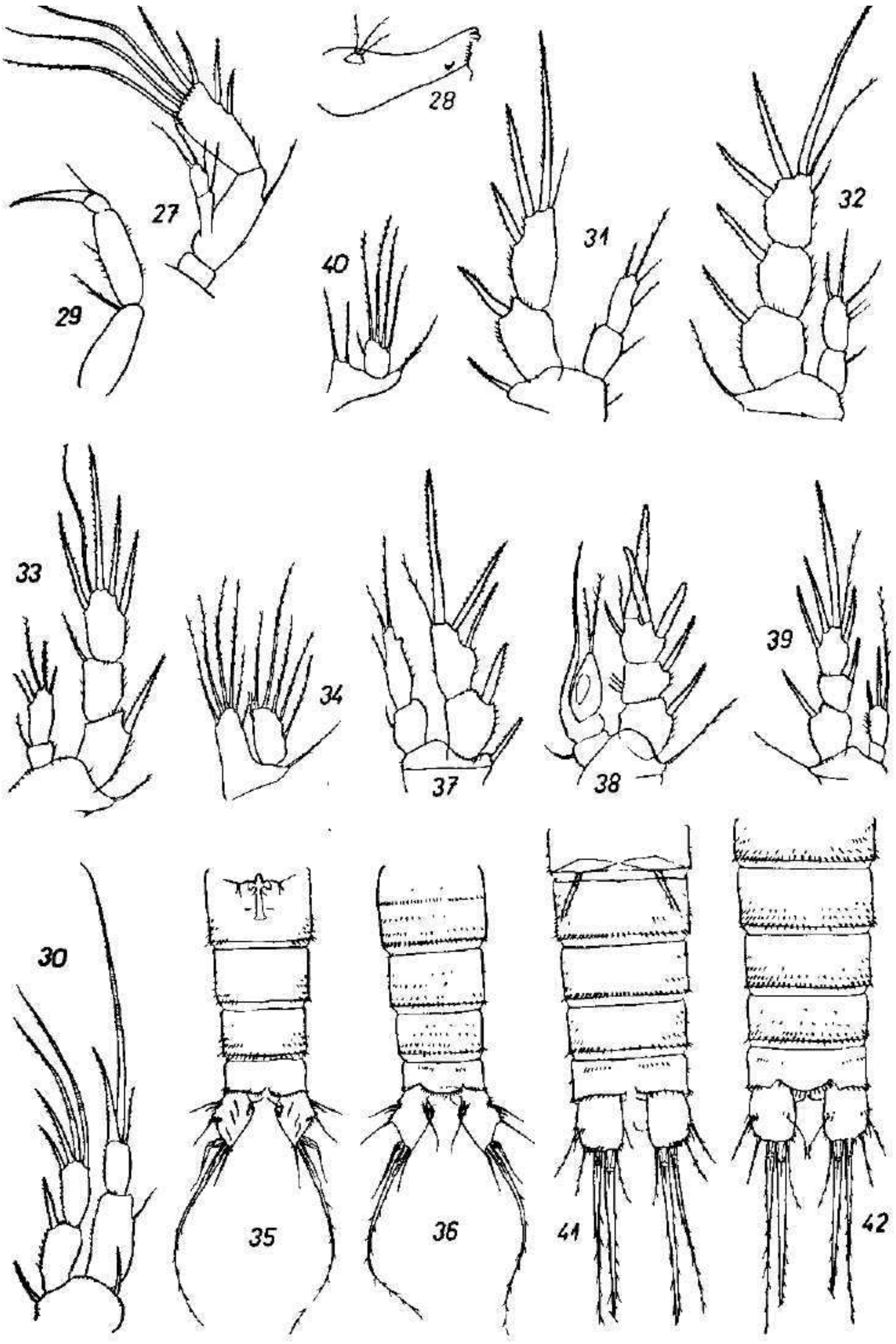

Abb. 27–42: *Hypocamptus brehmi* subsp. nov.? 27 – AII, ♀, ♂. 28 – Mdb ♀, ♂. 29 – Mxp ♀, ♂. 30 – P1 ♀, ♂. 31 – P2 ♀. 32 – P3 ♀. 33 – P4 ♀. 34 – P5 ♀. 35 – Abdomen ♀ ventral. 36 – Abdomen ♀ dorsal. 37 – P2 ♂. 38 – P3 ♂. 39 – P4 ♂. 40 – P5 ♂. 41 – Abdomen ♂ ventral. 42 – Abdomen ♂ dorsal.

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STUDIES ON THE CEPHALIC SENSORY CANALS OF NANDUS NANDUS (HAM.) (PISCES)

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Abstract: The importance of sensory canals is evident as they are intimately connected with certain dermal bones of the skull and help in ascertaining their position. The work of Pollard (1892), Collinge (1895), Allis (1904), Herrick (1901) and Friedrich-Freksa (1930) diverted the attention of Zoologists towards these important structures of fishes, while further details were investigated by Kapoor (1960—61), Khandelwal and Rastogi (1965) and Khandelwal and Sharma (1965). The present paper is aimed to study the cephalic sensory canals of *Nandus nandus*. The posterior prolongation of supraorbital canal of both the sides opens out side by a single median dorsal opening, a characteristic of its own. The supraorbital canal too, contrary to other fishes also gives birth to a anteriorly directed branch in the frontal bone. Other features of the sensory canals resemble the typical teleostean plan.

INTRODUCTION

For the identification and comparision of individual bones and for establishing the homologies, the course of sensory canals play an important role. These canals form a complex pattern in the head and show much variations throughout the Gnathostomes (Goodrich, 1930). But it is pity, that the course of sensory canals in Indian fishes with the exception of e.g. *Notopterus chitala* (Omarkhan, 1949), *Ophicephalus punctatus*, *Heteropneustes fossilis* and *Wallago attu* (Kapoor, 1959, 1960, 1961), *Mystus seenghala* (Khandelwal and Rastogi, 1965), *Silonia silondia* (Khandelwal and Sharma, 1965), have not been studied so far. The present paper attempts to explain the course of sensory canals in the head of *Nandus nandus* a commonly available percoid fish in the fresh water resources of Uttar Pradesh (India).

MATERIAL AND METHODS

Adult specimens of *Nandus nandus* were procured from the local fish market. The course of the sensory canals in the head has been studied in the dried skull and disarticulated skull bones, by inserting a stiff animal hair through them and by injecting Indian black ink into the pores. The course of the canal was also studied by dissecting the head under sterioscopic binocular microscope, after decalcifying the material in a mixture of 100 ml. of 80% alcohol and 4 ml. of nitric acid. Cleared alizarin preparations were also made to study of the various bones associated with the sensory canals.

ABBREVIATIONS

AN. — Angular, ALSP. Alisphenoid, CR. — Crest, DETH. — Dermoethmoid, DN. — Dentry, EPIOT. — Epiotic, ETH. — Ethmoid, EXOC. — Exoccipital, FR. — Frontal, HYM. — Hyomandibular, I_1 to I_8 — Openings of the infraorbital canal, IO. — Infraorbital canal, INO. — Infraorbital bone, IOP. — Interopercular bone, LC. — Lacrymal bone, LET. — Lateral Ethmoid, MC. — Mandibular canal, M1 to M5 — Opening of the mandibular canal, MTP. — Metapterygoid, MX. — Maxilla, NA. — Nasal, OP. — Opercular bone, P1 to P7. — Opening of the preopercular canal, PA. — Parietal, PAS. — Parasphenoid, PC. — Preopercular canal, PF. — Prefrontal, PMX. — Premaxilla, PR. — Preopercular bone, PRO. — Preorbital bone, PL. — Palatine, POO. — Postorbital, PT. — Posttemporal bone, PTE. — Pterotic bone, QU. — Quadrate bone, S1 to S5 — Opening of the supraorbital canal, SO. — Supraoccipital bone, SOOC. — Crest of the supraoccipital bone, SOC. — Supraorbital canal, SOP. — Subopercular bone, SO1. — First branch of supraorbital canal, SO2. — Second branch of supraorbital canal, SPH. — Sphenotic, ST. — Supratemporal bone, TC. — Temporal canal, T1 to T2 — Opening of the temporal canal, X. — Junction of the dermal sensory canal between the mandibular and preopercular canal.

OBSERVATIONS (Figs. 1, 2)

Supraorbital canal (SOC) runs throughout the length of nasal (NA) and frontal (FR) bones. The canal begins with a pore (S1) situated at the

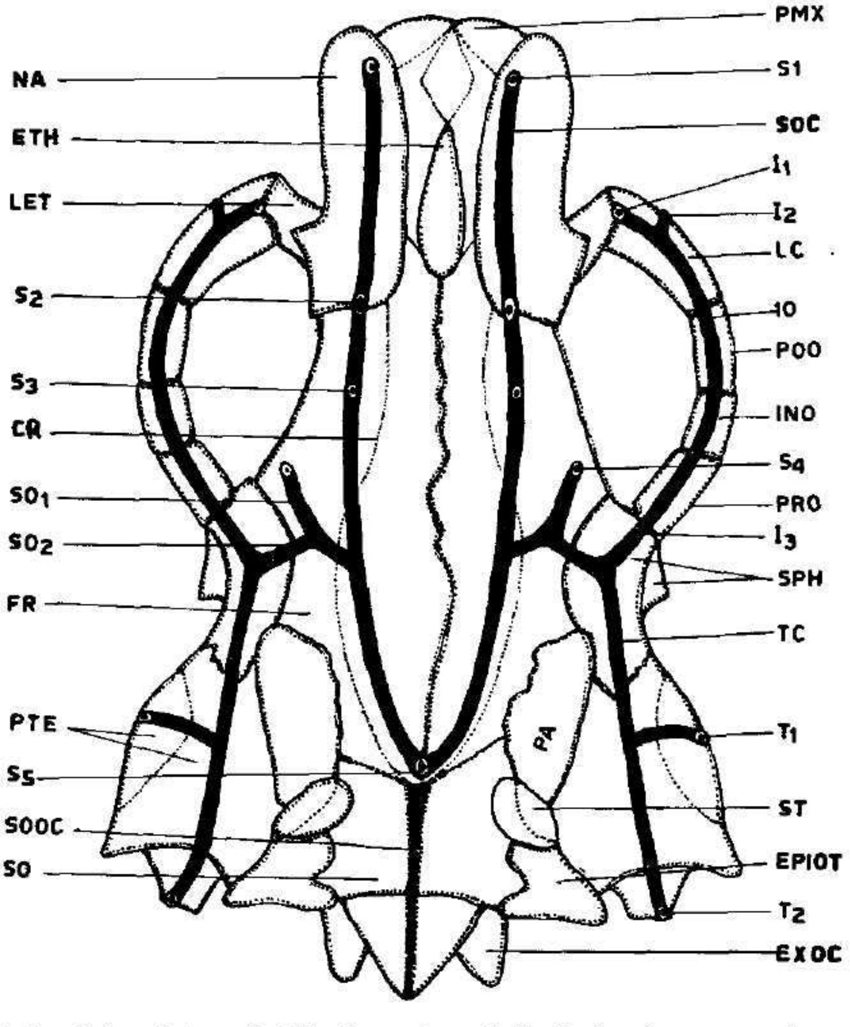

Fig. 1: Dorsal view of the skull of *Nandus nandus* with distribution of sensory canals.

anterior end of the elongated tubular nasal bone. This pore leads to the supraorbital canal, which runs inwardly and backwardly without any other opening. Onwards it enters the frontal bone. The junction of nasal and frontal bone, is characterised by the presence of a dorsally situated big pore (S2). The anterior end of the frontal also bears a pore (S3). The supraorbital canal now runs backwardly for a short distance and sends down a branch which bifurcates. The first branch (SO1) heads towards the orbit and open through a pore (S4). The second branch (SO2) runs towards the posterior side and joins the infraorbital canal in the sphenotic bone. The main supraorbital canals of both the sides run up to the postero-dorsal end of the frontal where they combinely open through a common pore (S5).

Infraorbital canal (IO) traverses the lacrymal (LC), preorbital (PRO), infraorbital (INO), post orbital (POO) and sphenotic (SPH) bones. It begins from a pore (I1) lying at the anterodorsal end of the lacrymal and runs dowarwardly and backwardly. It gives off a small branch which opens outside through a second pore (I2). Now the canal traverses throught the preorbital, infraorbital and postorbital bones. In the bones of the orbital ring this canal neither gives any branch nor open to the out side by any pore. As the canal passes into the sphenotic bone it opens out side through a pore (I3). In the end the infraorbital canal meet with the supraorbital canal in the middle of the sphenotic. The main branch of the infraorbital canal runs backwardly up to the posterior extremity of the sphenotic where it finally joins the temporal canal.

Temporal canal (TC) is enclosed inside the pterotic (PTE) and post temporal (PT) bones. From the junction of the infra and the branch (SO2) of supraorbital canal, the former runs backward for a short distance through the sphenotic (SPH) and finally passes in the pterotic bone as temporal canal. This canal now gives off a small branch towards the outer side in the middle of the pterotic and open out side through a small pore (T1) which meet with the preopercular canal. The temporal canal run backwardly, along the dorsal side of the pterotic bone, continues into the post temporal bone and open out side by a pore (T2), at its posterior extremity. From here the canal passes into the lateral line canal of the trunk.

Mandibular canal (MC) runs throught the dentary (DN) and angular (AN) bones. It begins from the pore (M1) placed ventrally near the tip of the ramus of the lower jaw and runs backwardly throughout the length of dentary. In dentary the canal open out side on the ventral surface through three more pores (M2 to M4). Near the junction of dentary and angular the canal takes a deeper course. The canal then continues through the angular and open out side at its posterior by a pore (M5). As soon as the canal leaves the angular bone it joins the preopercular canal (PC) by the canal present in the dermis marked by (X).

Preopercular canal (PC) is encased within the preopercular (PR) bone. It begins from the anterior end of the preopercular bone through a pore (P1) and traverses through the entire length along the ridge present on the outer surface of the bone. Throughout its course, the canal opens out side through five more pores (P2 to P6) born on small postero-ventrally directed tubes. The Preopercular canal terminates at the upper end of the preopercular in the form of a pore (P7). As the canal comes out from the preopercular bone, it meets the temporal canal.

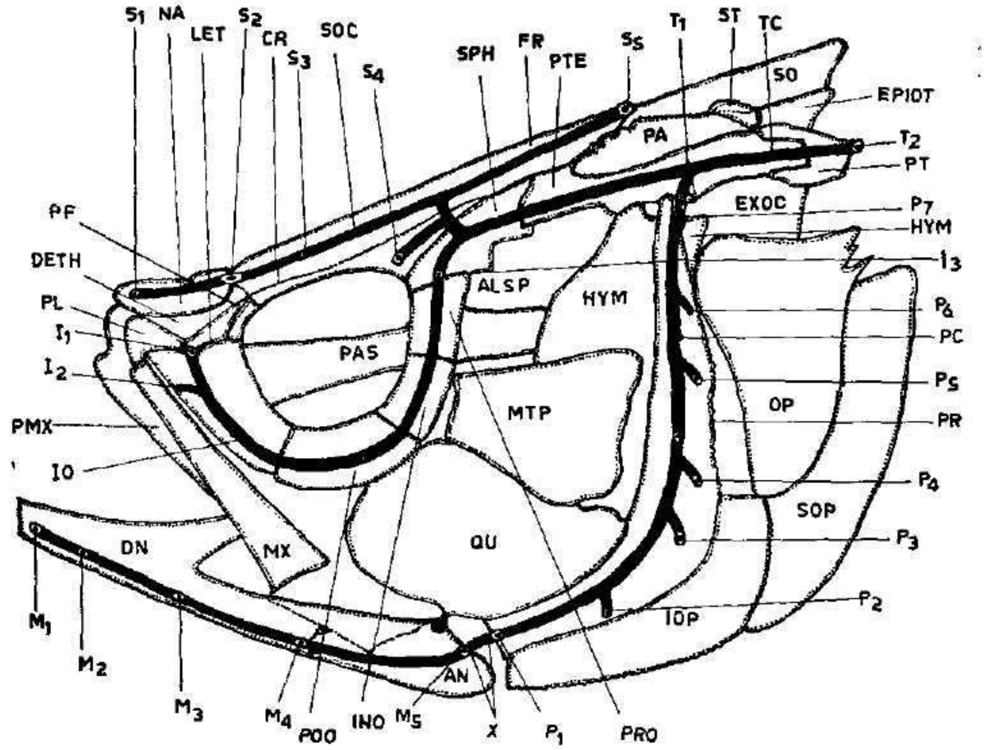

Fig. 2: Lateral view of the skull of *Nandus nandus* with distribution of sensory canal.

DISCUSSION

The acoustico lateral system has been of peculiar interest and is found present in all the craniates, modified in one form or the other. Its original form has been retained only in the aquatic forms, chiefly in fishes. Goodrich (1930) has pointed out that the sensory canal system is not subjected to much variations in the region of the trunk, but in the head region it has been noted to be much variable.

The course of sensory canals in the head of *Nandus nandus* shows the typical teleostean pattern but detailed study reveals a few variations. Pollard (1892) in *Chaetostomus*, Collinge (1895) in *Amiurus*, Kapoor (1960, 61) in *Heteropneustes fossilis* and *Wallago attu* and Khandelwal and Rastogi (1965) in *Mystus seenghala* have reported a small canal (with opening) arising from the main canal in the nasal bone, but in *Nandus nandus* the supraorbital canal does not give any branch in the nasal bone. Collinge (1895) reported that in *Clarias batrachus* the supraorbital canal at its anterior end passes into the premaxilla and terminates here. Kapoor (1960) has also shown its presence in siluroid fishes, but the authors could not find such termination of supraorbital canal in premaxilla.

Pollard (1892) in *Chaetostomus* described a commissure connecting the supraorbital canal of the two sides in the frontal region. Collinge (1895) in *Clarias* has also shown the rudimentary condition of this commissure. Yih (1948) has pointed out a vestigial commissure in *Monopterus*. But in *Nandus nandus* however, no such commissure could be found, there are two pores on each side, one situated at the junction of frontal and nasal and other in the anterior of the frontal bone. A short diverticulum has been reported by Moore and Burris (1956) in *Aphrododerus sayanus*. Friedrich-Freksa (1930) and Kapoor (1960) have stated that a pore tube commissure exists in the *Plotosus* and *Ophicephalus* respectively.

The supraorbital canal opens at its middle to a backwardly directed branch in *Nandus nandus* like other fishes, before it joins the infraorbital canal. This backward prolongation of the canal can be compared with the pit line of *Amia calva* (Allis, 1889). Lekander (1949) has pointed out that the way of the formation of pit line in *Salmo* and lateral line in *Leuciscus* is identical. Pollard (1892) in *Clarias*, Jarvik (1947) in *Polypterus* and Kapoor (1960, 61) in *Heteropneustes* and *Wallago* also described such backward prolongation of the canal. But Khandelwal and Sharma (1965) in *Silonia silondia* have denied the presence of such backward prolongation of the supraorbital.

Unlike other fishes, in *Nandus nandus* the backward prolongation of the supraorbital canal of both sides opens by a common pore (S5) situated on the mid-dorsal line. Moreover, the supraorbital canal, where it joins the infraorbital, continues in a forwardly directed branch within the frontal bone and opens by a pore just behind the orbit. Khandelwal and Sharma (1965) have also observed such branch in the frontal region of *Silonia silondia*. This also seems to be an unique feature in *Nandus nandus*.

The infraorbital canal in *Nandus nandus* traverses through the sphenotic, preorbital, infraorbital, postorbital and lacrymal bones. The same course of this canal has been observed in *Amiurus nebulosus* (Allis, 1904) *Wallago* and *Heteropneustes* (Kapoor, 1960, 61) *Mystus seenghala* (Khandelwal and Rastogi, 1965) and *Silonia silondia* (Khandelwal and Sharma, 1965). The authors observations are also supported by the findings of Allis (1904) showing that this canal runs through the sphenotic bone; but Kapoor (1960) has reported the gutter in *Wallago*, covered by the skin only in which the infraorbital canal is present.

The preopercular canal in *Nandus nandus* trace the same course as in other teleosts. However, Pollard (1892) and Collinge (1895) have pointed out that a small ventral portion of the preopercular canal enters to the interopercular. The authors findings support the view of Kapoor (1961) that the enclosure of the preopercular canal in the interoperculum is purely secondary and is formed by the fusion of a latero-sensory ossicle of bone belonging to the preoperculum with the interopercular bone. The preopercular canal in *Nandus nandus* opens into a temporal canal in the pterotic bone, thus confirming Lekander's (1949) statement saying that "as a rule the preopercular canal opens into the temporal canal", this statement is based on very few observations and needs further confirmation. Kapoor (1960) has found that the preopercular is free from the temporal canal in the young specimen of *Wallago attu* but in adult he has reported the two canals join in the pterotic region through the tubular ring or ossicle of bone, the "Supraopercular". It supports the findings of Herrick (1901) in *Amiurus melas*, Collinge's (1895) in *Salmon*, Devillers (1947) in *Leuciscus* and

Lekander (1949) in *Anguilla*. But Pollard (1892) has not reported any such bony ossicle in *Anchanapis bisculatus* but writes "last portion of the canal lies in the dermis outside the operculae dilator muscle". Wright (1884) has recorded the presence of supratemporal cross commissural canal in *Amiurus catus* but this commissure is missing in *Nandus nandus*.

The temporal canal runs backwardly from the junction of the infraorbital and supraorbital canals through sphenotic, pterotic and post temporal bones. However, the authors could not find the temporal canal traversing the supra temporal bone as it has been described by Khandelwal and Sharma (1965) in *Silonia silondia*. No previous author has reported that the supratemporal bone lies in the course of temporal canal in any siluroid. Kapoor (1960) has reported a supratemporal cross commissural canal as a short diverticulum on either side of the head in *Ophicephalus punctatus* but this cross commissural canal is absent in *Nandus nandus*.

The available data of the mandibular canal in the teleosts confirm the author's observations in *Nandus nandus*, except a few differences. Pollard (1892) denies the presence of mandibular canal in the young specimen of *Callichthys* and *Chetostomus* but the author have observed a fully developed mandibular canal in continuation with the preopercular canal in *Nandus nandus*. Kapoor (1960) has reported that the mandibular canals of either side are continuous with one another at their anterior extremities in *Ophicephalus*. No such continuation of the mandibular canals of the two sides could be observed in *Nandus nandus*. Khandelwal and Sharma (1965) also denied the presence of such connection in siluroid fishes.

SUMMARY

The course of cephalic sensory canals in *Nandus nandus* have been studied. The supraorbital, infraorbital and temporal canals join each other behind the orbit. The posterior prolongation of the supraorbital canal of both sides opens outside by a single median dorsal opening. This is aunique feature of this fish. Moreover, the supraorbital in the region of frontal also gives out an anteriorly directed branch in the frontal bone. The mandibular canal is continous with the preopercular canal and latter with the temporal canal after passing through the dermis between the angular and preopercular and pterotic bones. The mandibular canal of the two sides is separate.

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ERPOBDELLA OCTOCULATA L. (HIRUDINEA), THE RESERVOIR HOST OF MICROSOMACANTHUS PARVULA (KOWALEWSKI, 1904) IN CZECHOSLOVAKIA

D. ZAJÍČEK and Z. VALENTA

Received May 24, 1968

Abstract: During examinations of various fresh-water leeches (1958—1960) we found cysticercoids of the cestodes *Microsomacanthus parvula* (Kowalewski, 1904) Spassky et Spasskaja, 1954 in *Erpobdella octoculata* L. lying freely in the lumen of the intestine. As we found cysticercoids only in the intestine and not in any other organs of the body or in the mezenchyma, the leeches *Erpobdella octoculata* L. should be considered reservoir hosts and the crustaceans intermediate hosts. Although the results of the feeding experiments of cysticersoids from dead crustaceans to leeches could not be confirmed we believe this to be a case of "reservoir habitationism". The species of cysticercoids was identified in a feeding experiment to a duckling and a chick.

Until the present, no complete information has been available on the life cycle of the cestode *Microsomacanthus parvula* (Kowalewski, 1904) Spassky et Spasskaja, 1954, although this cestode was recorded from various duck species in Poland (Kowalewski, 1905; Czapliński, 1956), Sweden (Fuhrmann, 1913), France (Joyeux, 1922), the U.S.S.R. (Skrjabin et Matevosjan, 1945; Shevcov and Zaskind, 1960; Spasskaja, 1966) and in Czechoslovakia (Sommer, 1931; Páv and Zajíček, 1960; Ryšavý, 1962; Zajíček and Páv, 1963). The invasive stage of this cestode, the cysticercoid, was first described by Joyeux (1922) in France; later, the incidence of this cestode was also recorded from England by Soliman (1955).

In our studies of intermediate and complementary hosts of duck parasites, conducted in the years 1958—1960, we found cysticercoids of this cestode species in the leech species *Erpobdella octoculata* L. During our investigation we examined a total of 542 leeches and found in 28 of them (5.1%) 3—6 cysticercoids each lying freely within or without a membranous cyst in the lumen of the intestine. The leeches were collected on the following localities: Lodenice pond, district Kladno, Tchořovický pond near Lnáře, district Strakonice, Prostřední pond (Novosmrkovický), Podkostelní pond (Putimský) and pond Škaredý, district Písek.

The recovered, membranous cysts contained an excentrically located cysticercoid attaining a size up to 0.54 by 0.44 mm. The cysticercoids found in the lumen of the intestine even without the membranous covering were ovoid and measured 0.216 by 0.168 to 0.18 mm. The outer wall of the cysticercoid was bent at the surface and covered by a supplementary membrane. The inner covering of the scolex, occupying the complete space, attained a length

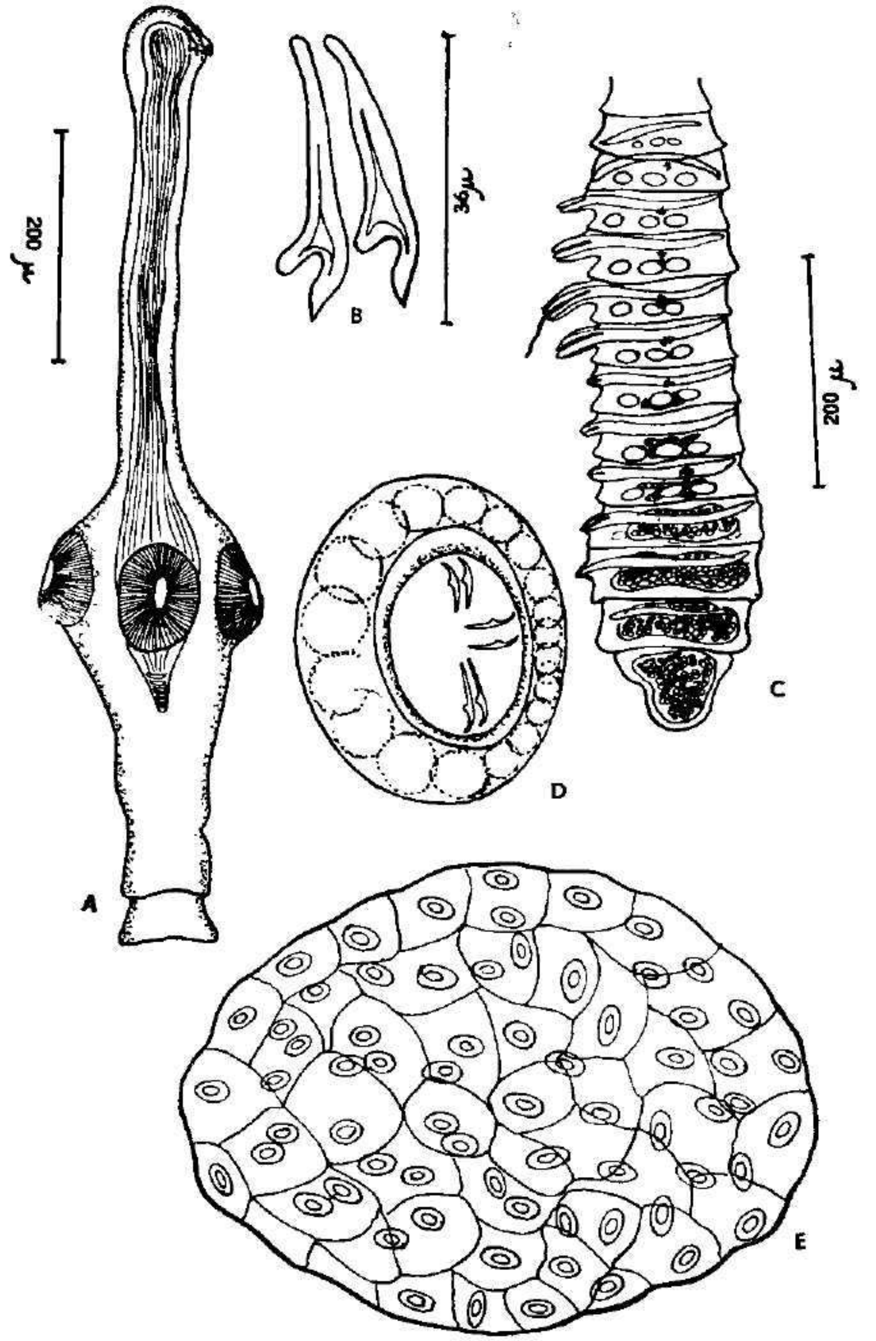

Fig. 1. *Microsomacanthus parvula* (Kowalewski, 1904) Spassky et Spasskaja, 1954. A — Scolex, B — hooks, C — strobila, D — egg, E — Eggs in membranous cluster after leaving the segment.

of 0.144 to 0.156 mm and a width of 0.12 to 0.132 mm. The four distinctly visible suckers on the scolex measured 0.05 by 0.035 mm and were oval in shape. The rostellum varying in position, was armed with 10 hooks of the diorchoid type, measuring 0.036 mm in length. The cysticercoids extracted from the body of the leeches were colourless, bearing no indication of tail remnants. The origin of the membranous cysts could not be identified.

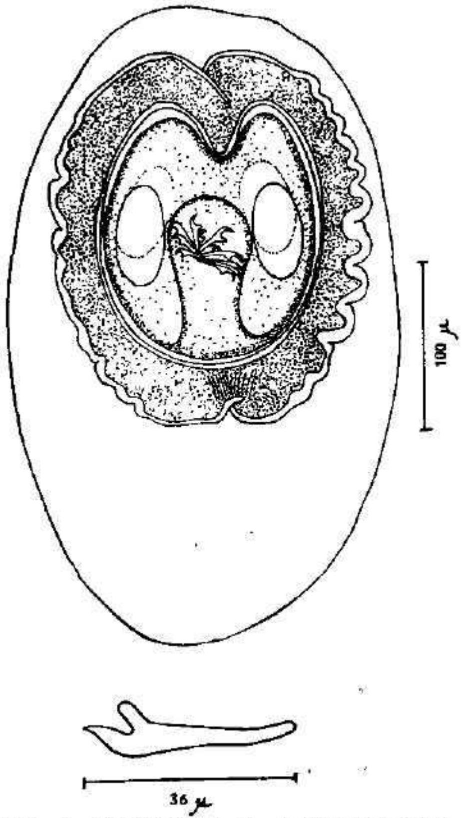

Fig. 2. Cysticercoid of *Microsomacanthus parvula* extracted from the intestinum of *Erpobdella octoculata* L.

The cysticercoids first recovered by Joyeux (1922) in the environments of Paris measured 0.25 mm in length and 0.2 mm in width. The outer wall covered with an additional membrane was of a typical cysticercoidal shape with a deep groove on the one pole and a tail on the opposite pole. The scolex measuring 0.16 by 0.14 mm armed with four suckers (0.045 by 0.035 mm) and the rostellum armed with one row of 10 hooks (size 0.038 – 0.039 mm) occupied the whole cavity. The author found these cysticercoids in two out of the 12 examined leeches of the species *Erpobdella octoculata* L. These were situated in the mezenchyma and became visible after a slight pressure on their body. In the first case he found 30 cysticercoids, in the second case their numbers were not given.

Soliman (1955) found numerous cysticercoids in the mezenchyma of the leeches *Erpobdella octoculata* L., resembling the cestode species *Microsomacanthus parvula* (Kowalewski, 1904) in the number, shape and size of the hooks. The leeches were collected in a mill pond near Reading in eastern England. Neither the sizes of the cysticercoids nor the number of cysticercoids found in the leeches was given by the author. In a later investigation Soliman paid attention to the duodenal portion of the intestine in 18 autopsied ducks reared on this biotope, but found no adult cestode.

Basing on the hypothesis of Joyeux (1922) that this species of leeches constitutes the intermediate host and in regard to the way in which the eggs are liberated from the last disintegrating segments in clusters containing up to 106 eggs, we fed a cluster each to a total of 25 uninfected leeches. In examinations following after the 5th, 8th, 10th, 12th, 14th, 21st and 28th day after infection neither developing stages of the cestode nor developed cysticercoids were found. It was not possible to reproduce the life cycle with crustaceans as intermediate hosts and, in the following years, we obtained neither infective material from leeches collected on the same sites, nor mature proglottids of cestodes in autopsied ducks which could be used for experiments.

In view of these negative results and also of the fact that we found cysticercoids only in the lumen of the intestine and not in any other organs of the body or in the mezenchyma, the leeches *Erpobdella octoculata* L. should be considered to be the reservoir hosts. Joyeux (1922) seemed to have thought the leeches to be intermediate hosts because he found a tail on the posterior pole of the cysticercoid, but he omitted to describe other developmental stages. Also we observed the remnant of the tail in findings of the cysticercoids *Microsomacanthus compressa*, *M. paracompressa* or *Diorchis nyrocae*, extracted from the stomach and hepatopancreas of the snails *Lymnaea peregra peregra* L., *L. peregra ovata* L., *L. auricularia* L., *L. palustris* L. in various localities of southern Bohemia (Zajíček, 1962). The same observations were made by Ryšavý (1962) who demonstrated them in snails of the mentioned species which were fed with experimentally infected dead crustaceans containing cycticercoids in an attempt to reproduce the life cycles of some cestode species. The location of the cysticercoids in the mezenchyma may be easily mistaken for a location in the intestine of the leech, which is very rugate with a number of blind sacs extending to the margin of the body in which the cysticercoids may be deposited. A further reason for considering the leeches to be reservoir hosts was the weight of parasitaemia. We found a maximum of 6 cysticercoids, although in view of the number of eggs in the cluster the incidence should have been much higher.

Although the results of the feeding experiments of cysticercoids from dead crustaceans to leeches could not be confirmed we believe this to be a case of "reservoir habitationism" as described by Ryšavý (1962, 1964) in cysticercoids from cestodes and by Ryšavý, Baruš (1965) from nematodes. Therefore, this state is in agreement with the criteria of the reservoir host laid down by Skrjabin and Shulc (1940) and with the criteria described by Ryšavý (1962), according to which the cysticercoid is deposited without damage in the digestive tract. Biologically this phenomenon is of great importance because the leeches are an important link in the hibernation of the cysticercoids and in the distribution to the definitive host. In favour of the phenomenon of reservoir habitationism in cysticercoids *Microsomacanthus parvula* is also the fact that the leeches *Erpobdella octoculata* are not haemophagous and feed not only on plants but also on small animals and on various remnants of animal origin.

The species of the cysticercoids was identified in a feeding experiment with 10 infected leeches fed to a 4-week-old duckling (*Anas platyrhyncha dom.* L.) and 5 infected leeches fed to a 5-week-old chick (*Gallus gallus* L.). Starting from the 5th day of our experiment, the faeces were examined regularly with coprological methods. The first eggs in a typical cluster were found on the 7th day. The maximum number of egg clusters (19) were found in the duckling faeces on the 16th day of the experiment and on the same day also in the chick faeces. The most suitable flotation mixture for coprological examination was found to be a saturated solution of $NaCl$ and $Na_2S_2O_3$ āā. (ana partes). The duckling and the chick were killed and autopsied on the 18th day of the experiment. In the caudal portion of the duodenum and between the duodenum and the jejunum we found 30 sexually mature cestodes of the species *Microsomacanthus parvula* (Kowalewski, 1904) Spassky et Spasskaja, 1954 and in the chick 5 cestodes of the same species. There was no morphological or metrical difference between the specimens from either animal. The measurements of the found cestodes and their comparison with the data of other authors are given in Tab. 1. Joyeux (1922) found sexually mature cestodes in two duckling fed with infected leeches and confirmed the sexual maturity of the cestodes as late as on the 12th day. The experimental transmission of cestodes to the chick confirms that this species is a species specific not only to *Anatidae*.

Tab. 1. *Microsomacanthus parvula* (Kowalewski, 1904) Spassky et Spasskaya, 1954

Measures in mm	Kowalewski, 1904	Joyeux, 1922	Skrjabin, Matevosjan, 1945	Spasskaja, 1966	Our findings
Overall length	1.7	1.0–2.0	2.0	**2.0**	**2.0**
Maximum width	0.25	0.25–0.3	0.5	**0.3**	**0.3**
Scolex length	0.16–0.2	**0.2**	0.15–0.16	0.15–0.16	0.17–0.22
width	0.13–0.15	**0.15**	—	—	0.12–0.14
Rostellum	0.25–0.3	**0.25**	0.16 × 0.14	—	0.21 × 0.08
Number of hooks	10	**10**	10	**10**	10
Size of hooks	0.038–0.039	0.038–0.04	0.03–0.04	0.03–0.04	0.03–0.04
Oval suckers	0.08	0.09 × 0.07	0.09 × 0.07	0.09 × 0.07	0.09 × 0.07
Neck	not present	not present or contracted	—	—	0.06
Number of segments	35–40	38–43 (51)	—	—	37–40
Cirrus pouch	4/5th of segm.	4/5th–3/4th of segment	0.16 × 0.02	0.16 × 0.02	4/5th of segment
Eggs	—	—	0.02 × 0.015	0.02	0.048 × 0.032
Hooks of oncosphere	—	—	0.012	0.012	0.009

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GLAND CELLS OF THE CERCARIA OF PLAGIORCHIS LARICOLA (SKRJABIN, 1924) (TREMATODA)

Zdeňka Žďárská

Received November 12, 1968

Abstract: The cercaria of *Plagiorchis laricola*, belonging to the group of nonvirgulate xiphidiocercariae, contains four types of gland cells. Three of them, ventral, dorsal and proper cystogenic gland cells are concerned with the formation of the cyst of metacercaria. The fourth type are the penetration gland cells which remain partly preserved for a certain time even in the metacercaria. The ventral and dorsal gland cells discharge their contents before the cercaria leaves the sporocyst and their secretions are spread over the whole surface of the body. The thickest layer of the secretions is in the caudal pocket. After penetration into the second intermediate host the tegument of cercaria forms the outer layer of the cyst wall and the contents of the proper cystogenic gland cells become scattered beneath this layer forming thus the inner layer of the cyst wall. As revealed by the histochemical tests, both ventral and dorsal gland cells contain acid mucosubstances. The ventral gland cells contain mucosubstances with sulphogroups digestible with β-glucuronidase, the dorsal gland cells mucosubstances digestible with testicular hyaluronidase. Both mucosubstances are neuraminidase resistent. The proper cystogenic gland cells contain neutral mucosubstances and proteins with SH-groups, tyrosine and arginine. The layers of the cyst wall consisting of the secretions of the mentioned gland cells are of the same histochemical composition. The penetration gland cells contain mostly proteins with SS- and SH-groups, tyrosine, arginine and tryptophan and a small amount of neutral mucosubstances.

INTRODUCTION

In virgulate and nonvirgulate xiphidiocercariae mainly ventral gland cells have been studied till now by **Kruidenier** and **Mehra** (1957) and **Ortigoza** and **Hall** (1963). **Belton** and **Harris** (1967) investigated the integument of virgulate xiphidiocercaria of *Acanthatrium oregonense* using the electron microscopy. **Pike** and **Erasmus** (1967) studied the cyst wall of the virgulate xiphidiocercaria *Cercaria tarda* Khan, 1961, irrespective of which gland cell secretion it originated.

The first exact histological description of the nonvirgulate xiphidiocercaria *Cercaria helvetica* V is given in the paper by **Dubois** (1929). The author discerns four types of gland cells, namely "cellules ventrales" (our "ventral gland cells" according to similar gland cells in the echinostome cercaria, see **Žďárská**, 1968), "cellules claires" (our "dorsal gland cells'), "cellules cystogènes" (our "proper cystogenic gland cells") and "cellules glandulaires de pénétration" (our "penetration gland cells"). However, **Dubois** did not follow further these cells and the formation of the cyst. In xiphidiocercariae the process of encystation, i.e. the emptying of the gland cells, participation of their secretions in the formation of the integument of the cercaria and the cyst wall of the metacercaria have not been studied till now. We tried, therefore, to elucidate, using histochemical reactions, the process of encystation in the nonvirgulate xiphidiocercaria of *Plagiorchis laricola* and to compare it with the mode of encystation and the histochemical reactions of the individual types of the cystogenic gland cells of the echinostome cercaria of *Echinoparyphium aconiatum* studied earlier (**Žďárská**, 1968).

MATERIAL AND METHODS

For histological and histochemical studies we used the sporocysts with the cercariae of *Plagiorchis laricola* Skrjabin, 1924 which develop in the hepatopancreas of *Limnaea stagnalis* L. and the free-swimming cercariae and metacercariae encysted for various periods in the larvae, pupae and imagoes of the mosquito *Aëdes aegypti* L. The material was fixed at laboratory temperature in Baker's neutral formaldehyde (Pearse, 1960); for the detection of tryptophan the sections were fixed for 16 hours at 4° C in the same liquid, pH of which was adjusted with 0.1 N NaOH to 6.5 (Lojda, 1965). For staining of the sections we used haematoxylin-eosin, modified van Gieson's method (Holuša, 1967), Goldner's and Masson's trichrome, Weigert's phosphowolfram-haematoxylin, the regressive procedure after Giemsa and Gomori's method for the demonstration of reticular fibers.

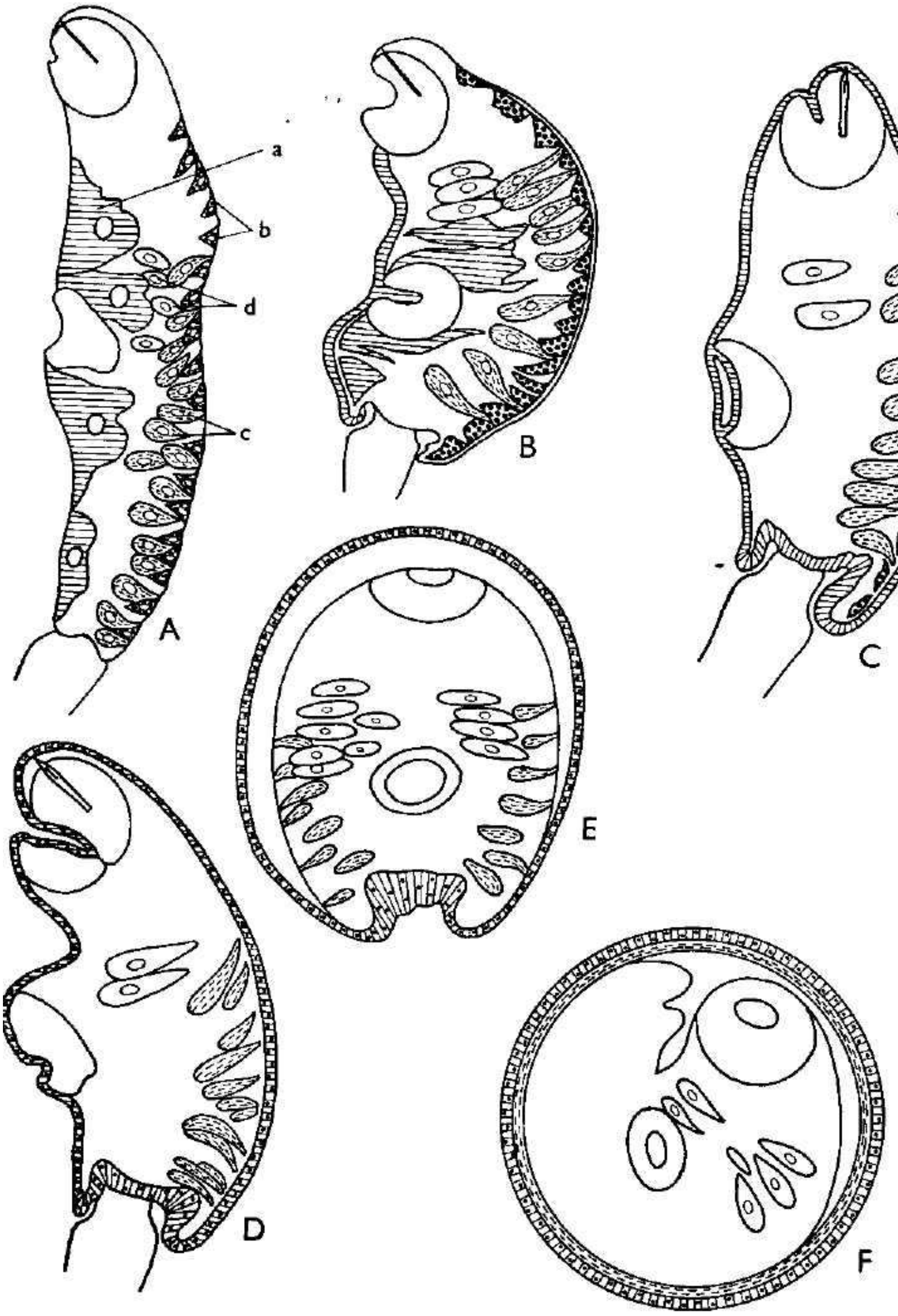
The mucosubstances, proteins and lipids were detected by histochemical tests. For mucosubstances we used Best's carmine in combination with saliva test, PAS method in combination with acetylation, desacetylation and saliva test. Neutral and acid mucosubstances were determined with the AB-PAS method (Mowry, 1963) and acid mucosubstances with alcian blue (AB) pH 2.6 (Scott, Quintarelli and Dellovo, 1964; Quintarelli, Scott and Dellovo, 1964) combined with methylation after Fisher and Lillie (1954) and demethylation after Spicer and Lillie (1959). For further differentiation we used Pearse's methylene blue extinction method (Pearse, 1960), critical electrolyte concentration (CEC) method in modification after Quintarelli and Dellovo (1965) with alcian blue pH 2.6 and $MgCl_2$ and the alcian blue method combined with testicular hyaluronidase (Koch-Light) and neuraminidase ex Vibrio cholerae Koch-Light). pretreatment according to Quintarelli and Dellovo (1966) with β-glucuronidase ex marine molluscs (Koch-Light) pretreatment.

Amino acids were detected with the following methods: arginine with Sakaguchi's method modified by Baker (1967), tyrosine with Morel-Sisley's diazotization method (Pearse, 1960) and tryptophan with dimethylaminobenzaldehyde (DMAB) method according to Adams (1957). SH-groups were determined with p-nitrobromacetophenone (pNBAPh) method (Gersteyn, 1958) and with 2,2′-dihydroxy-6,6′-dinaphthyldisulfide (DDD) method (Barrnett and Seligman, 1952) controlled by N-ethylmaleimide blockade. The SH- and SS-groups were detected with the DDD method in combination with thioglycollic acid (Barrnett and Seligman, 1954). The SS-groups were detected with performic acid and alcian blue (PFA-AB) method after Pearse (1960) controlled by alcian blue pH 0.2 and with another Pearse's method with peracetic acid and paraldehydefuchsin (PAA-PF) controlled by paraldehydefuchsin staining. For the group test of tyrosine, histidine and tryptophan we used the coupled tetrazonium reaction modified by Müller and Chytil (1962).

RESULTS

I. Histology and histochemistry of the gland cells and tegument of cercaria and the cyst wall of metacercaria

1. Ventral glands cells (Figs. 1Aa, 2, 3) are the largest of the gland cells in the body of cercaria and occupy the ventral side of the body. Two pairs of these cells are situated in front of the ventral sucker and two behind it. In the vertical sections, both longitudinal and transverse, they have triangular shape. As it can be seen on the tangential sections below the body wall of cercaria they form a great number of protrusions projecting into the intercellular spaces among other cells. Therefore their approximate measures can be hardly determined in the tangential sections. They measure about 15 × 15 µm. In the vertical transverse section these cells measure 9 µm on the base near the body wall and are 21 µm high. They contain a large nucleus (5—6 µm) with a nucleolus measuring 2 µm. Homogeneous basophil cytoplasm stains light green in Goldner's trichrome and reduces silver in Gomori's method. In histochemical reactions it shows an affinity to Sudan black B even after chlorofom-methanol extraction. In the reactions for pro-


a
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A
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F

teins (Tab. 2) it gives positive results only for COOH-groups. In histochemical tests for mucosubstances (Tab. 1) it stains with Best's carmine to the medium degree even after the saliva test. PAS reaction is very poor, while AB reaction is very intensive; methylene blue extinction takes place at pH 1.7 and the affinity to alcian blue disappears only at 18% concentration of $MgCl_2$. It does not stain with alcian blue after demethylation and after β-glucuronidase pretreatment, but it stains after hyaluronidase and neuraminidase pretreatment. These methods reveal the presence of the sulphated acid mucosubstances in the ventral gland cells. The same histochemical reactions gave the layer of tegument formed by the secretion of these cells, as well as the outer layer of the cyst (Figs. 1, 2, 3, 4, 5, 8).

2. Dorsal gland cells (Figs. 1Ab, 2, 4) are situated closely below the dorsal body wall of the cercaria extending from the pharynx to the posterior end of the body. These are the smallest of the gland cells (6 × 6 μm) and contain a nucleus measuring 2 μm. In the vertical longitudinal sections they have a shape of triangle whose base lies at the body wall. In the tangential section, close to the body wall, they have a great number of protrusions, similarly as the ventral gland cells. From the common histological methods Gomori's method is the most suitable for their detection. In histochemical tests used for the detection of mucosubstances they give positive reaction with alcian blue (Tab. 1). No staining occurs after demethylation and after hyaluromidase pretreatment. The affinity to alcian blue disappears at 2% concentration of $MgCl_2$. Methylene blue extinction takes place already at pH 6.3. These mucosubstances are neuraminidase and β-glucuronidase resistant. The results show that the mentioned gland cells contain acid mucosubstances digestible with testicular hyaluromidase. These substances cannot be identified in the integument of the cercaria and in the outer layer of the cyst wall. This is probably due to the fact that the dorsal gland cells produce only a small amount of secretion which is discharged into the layer formed by the secretion of the ventral gland cells and both secretions are mixed together.

3. Proper cystogenic gland cells (Figs. 1Ac, 6) occupy the dorsal side of the cercarial body extending from the pharynx to the posterior end. In the vertical longitudinal sections they are club-shaped, orientated in dorsoventral direction, their attenuated end is directed to the dorsal body wall of the cercaria. They measure 15 × 5 μm and contain a large nucleus (3 μm) with a nucleolus (1 μm) and some granules of chromatin. The cytoplasm containing rod-shaped granules stains red with Goldner's trichrome and the granules reduce silver in Gomori's method. In histochemical methods positive reactions were obtained for proteins and mucosubstances. Proteins (Tab. 2) contain mainly tyrosine (Fig. 6), a small amount of arginine and

Fig. 1. Formation of the tegument and the cyst wall of the cercaria of *Plagiorchis laricola* (Skrjabin, 1924): A — cercaria with fully developed ventral gland cells; B — cercaria starting to release the contents of the ventral gland cells to the ventral side of the body; C — cercaria after emptying the ventral gland cells the contents of which is spread on the whole surface of the cercarial body; D — cercaria after release of the secretions of the ventral and dorsal gland cells; the secretions are mixed and form a single layer on the surface of the body; E — beginning of encystation — the tegument of the cercaria formed from the secretions of ventral and dorsal gland cells begin to separate at the anterior end of cercaria; F — fully formed cyst of metacercaria, the inner layer of which consists of the secretion of the proper cystogenic gland cells; a — ventral gland cells, b — dorsal gland cells, c — proper cystogenic gland cells, d — penetration gland cells.

Tab. 1. Results of histochemical reactions for identification of mucosubstances

Reactions	Gland cells				Tegument	Layers of cyst wall	
	ventral	dorsal	proper cystogenic	penetration		external	internal
Best's carmine	+++	−	−	−	+++	++	−
Saliva test + Best's carmine	+++	−	−	−	+++	++	−
PAS	+/−	−	+++++	+	+/−	+/−	+++++
Schiff	−	−	−	−	−	−	−
Saliva test + PAS	+/−	−	+++++	+	+/−	+/−	+++++
Acetylation 58° C, 48 h + PAS	−	−	−	−	−	−	−
Desacetylation + PAS	+/−	−	+++++	+	+/−	+/−	+++++
AB − PAS	blue	blue	red	rose	blue	blue	red
AB pH 2.6	+++++	+++++	−	−	+++++	+++++	−
+ methylation	−	−	−	−	−	−	−
+ demethylation	−	−	−	−	−	−	−
CEC (AB pH 2.6 + $MgCl_2$)	14%	2%	−	−	14%	14%	−
Methylene blue extinction at pH	1.7	6.8	5.1	5.1	1.7	1.7	−
Hyaluronidase + AB	+++++	+	−	−	+++	+++	−
β-glucuronidase	−	++++	−	−	+++	+++	−
neuraminidase	+++++	+++++	−	−	+++++	+++++	−
Aldehyde-fuchsin	+++++	++	−	−	+++++	+++++	−
Thionine	red	light violet	−	−	red	red	−

SH-groups. For the detection of mucosubstances (Tab. 1) only PAS method gives positive results even after saliva test. The proper cystogenic gland cells, therefore, contain besides proteins also neutral mucosubstances. PAS-positive was also the inner layer of the cyst wall of the metacercaria originating from the contents of these glands.

4. **Penetration gland cells** (Figs. 1Ad, 3, 5, 8) are situated in the anterior part of the body (**Žďárská**, 1966) and measure 18 × 6 µm. The nucleus has 3—4 µm in diameter and contains a nucleolus measuring 1—2 µm. Homogeneous cytoplasm stains violet-blue with Goldner's trichrome, orange in the regressive procedure after Giemsa and yellow-brown in the Gomori's method. Of the histochemical reactions for the detection of mucosubstances (Tab. 1) only PAS reaction gives positive results even after saliva test. The reactions for proteins (Tab. 2) are most intensive for SS- (Figs. 3, 5, 8) and SH-groups and tryptophan and less intensive for arginine and tyrosine.

Tab. 2. Results of histochemical reactions for identification of proteins

Reaction	Gland cells				Tegument	Layers of cyst wall	
	ventral	dorsal	proper cystogenic	penetration		external	internal
Sakaguchi	–	–	+	+	–	–	+
Morel-Sisley	–	–	+++++	++	–	–	+++++
DMAB	–	–	–	+++++	–	–	–
DNFB	–	–	++	++++	–	–	++
DDD	–	–	++	++/+++	–	–	++
N-ethylmaleimid + DDD	–	–	–	–	–	–	–
Thioglycollic acid + DDD	–	–	++	+++++	–	–	++
PFA–AB	+++++	+++++	–	++/+++	+++++	+++++	–
AB pH 0.2	+++++	+++++	–	–	+++++	+++++	–
Peracetic acid + aldehyde-fuchsin	+++++	++	–	+++++	+++++	+++++	+/–
Aldehyde-fuchsin	+++++	++	–	–	+++++	+++++	–
Coupled tetrazonium reaction		–	+	+	–	–	+

II. The formation of the tegument of the cercaria and the cyst wall of the metacercaria

The ventral, dorsal and proper cystogenic gland cells are present already in the early developmental stages of the cercaria, in which the suckers begin to develop. The ventral and dorsal gland cells are provided with protrusions (Figs.

2, 3) which are short at the beginning and elongate during the development of the cercaria. The proper cystogenic gland cells have at the beginning a relatively large nucleus with a narrow hem of cytoplasm increasing during the development. They are nearly round, but with the increasing amount of secretion they become club-shaped. At the stage when the body and tail of the cercaria are completely formed, the ventral gland cells start to discharge their secretion (Fig. 1B) which spreads on the whole surface of the cercarial body (Figs. 1C, 4, 5). The thickest layer of this secretion is in the caudal pocket. After the ventral gland cells have discharged their secretion the dorsal gland cells release their contents into the layer formed by the secretion of the ventral gland cells. Since the dorsal gland cells are small, there is also little secretion which is likely to mix with that of the ventral gland cells. There is no exact border between both secretions so that the secretion of the dorsal gland cells cannot be identified either in the tegument or in the layer of the cyst wall. Both types of the gland cells, ventral and dorsal ones, discharge their secretions before the cercaria (Figs. 1C, D; 2, 3, 4, 5) leaves the sporocyst. After the release of the secretion from the dorsal gland cells the tegument of cercaria does not change till the time of encystment. The cercariae which leave the snails look for the mosquito larvae and encyst in their body after the tail has been cast ff. At the beginning of encystment they release at first the tegument formed from the secretion of the ventral and dorsal gland cells, starting from the anterior end of the cercaria (Fig. 1E) to the caudal pocket. After the tegument has been released also from the caudal pocket, the proper cystogenic gland cells start to discharge their secretion below the layer formed from the released tegument and thus give rise to a two-layered cyst wall (Figs. 1F, 7, 8). The outer cyst wall is formed from the tegument of the cercaria which originated already in the first intermediate host and is composed of the secretions of the ventral and dorsal gland cells. *The inner layer of the cyst is formed from the secretion of the proper cystogenic* gland cells, released only after penetration into the second intermediate host.

DISCUSSION

We have compared our observations on the tegument of the nonvirgulate xiphidiocercaria of *Plagiorchis laricola* with those of Belton and Harris (1967) performed with the aid of electron microscope in the virgulate xiphidiocercaria of *Acanthatrium oregonense.* These authors found that the tegument of the cercarial body differs from the tegument of the tail. They distinguish three layers in both teguments. On the surface there is a thin unit membrane, in the middle a cytoplasmic layer which is separated from the musculature by an inner basement layer. The middle layer of the tail tegument differs from that of the body tegument. According to Belton and Harris (1967) this layer contains three types of vesicles only in the body tegument. It can be assumed, therefore, that the vesicles are composed of the mixed secretions released into this layer from the ventral and dorsal gland cells. Since the middle layer is bordered by the outer unit membrane, the released secretions cannot pass through it and therefore do not form drops on the surface of cercaria, but are spread round its body.

Kruidenier and Mehra (1957) used histochemical methods for the study of mucosubstances in the secretion of the ventral gland cells and the tegument of the cercaria formed by it. Their results concerning both virgulate and non-virgulate xiphidiocercariae correspond with our findings. These authors found that the secretion is PAS-negative and shows a strong metachromasia still at pH 1. Also Ortigoza and Hall (1963) investigated the composition of the ventral gland cells, tegument and penetration gland cells of virgulate xiphidiocercariae. In the ventral gland cells, however, they found PAS-positive mucosubstances showing metachromasia at pH 1.7. Some reactions for proteins were slightly positive. They also found that the contents of the ventral gland cells and the tegument of cercaria have a great affinity to Sudan black B even after chloroform-methanol extraction. It seems, therefore, that it is not the question of lipids. However, Ortigoza asserts that lipids are present there.

The composition of the cyst of a xiphidiocercaria was first described in the paper by Pike and Erasmus (1967) who studied the cyst wall of the virgulate xiphidiocercaria *Cercaria tarda* Khan. Their results of histochemical tests cannot be compared with our findings because, according to the authors' information, a layer of the cyst wall was lacking and their histochemical tests were not the same as the ours.

CONCLUSION

When studying the development of the three types of cystogenic gland cells of the xiphidiocercaria of *Plagiorchis laricola* we have found that the tegument of the cercaria is formed by the secretions of two types of holocrine gland cells. The secretion is discharged on the surface of the cercarial body, but not on the surface of the tail. During further development in the second intermediate host the tegument forms the outer layer of the cyst wall. That shows that the tegument and the cyst wall of the xiphidiocercaria of *P. laricola* is formed in the same manner and from the same gland cells as in the echinostome cercaria of *Echinoparyphium aconiatum* (Žďárská, 1968). However, there is a difference in the size of the gland cells. In the cerceria of *P. laricola*, there are few ventral gland cells, large and lobular, while those in the cercaria of *E. aconiatum* are small, club-shaped and numerous. The dorsal and proper cystogenic gland cells in both cercariae are of the same shape. In xiphidiocercaria of *P. laricola* the layers formed from the secretions of the ventral and dorsal gland cells are not separated. Both secretions are mixed together and form therefore only one layer and not two, as it is the case in the echinostome cercaria of *E. aconiatum*. However, the procedure of emptying is the same in all types of gland cells. In both cercariae the ventral and dorsal gland cells discharge their secretions before leaving the preceding parthenogenetic stage (i.e., *E. aconiatum* before leaving the redia and *P. laricola* before leaving the sporocyst). The emptying of the proper cystogenic gland cells occurs in both cases only in the second intermediate host.

If we compare the histochemical reactions of individual types of cystogenic gland cells of the xiphidiocercaria of *P. laricola* with the cystogenic gland cells of the echinostome cercaria of *E. aconiatum* studied earlier (Žďárská, 1968), we can conclude that the mucosubstances are present in all three types of the gland cells and, therefore, in both layers of the cyst wall of the metacercaria of *P. laricola*, as well as of *E. aconiatum*. The mucosubstances in the individual types of the gland cells are different. While in the cercaria of *P. laricola* the ventral gland cells contain only the mucosubstances with sulphogroups, in the cercaria of *E. aconiatum* they contain the mucosubstances with carboxy- and sulphogroups.

The proper cystogenic gland cells of the cercaria of *P. laricola* contain neutral mucosubstances, while those of *E. aconiatum* contain acid mucosubstances with carboxyl groups. In the dorsal gland cells of both cercariae there are the mucosubstances with sulphogroups.

In histochemical reactions for proteins the secretion of the ventral gland cells of the cercaria of *E. aconiatum* differs from that of *P. laricola*, all reactions being negative in *P. laricola*. In the dorsal gland cells of the cercariae of both *E. aconiatum* and *P. laricola* we did not manage to detect proteins. As to the protein contents in the proper cystogenic gland cells, both species contain tyrosin and SH-groups, but arginine is present only in *P. laricola* and SS-groups only in *E. aconiatum*.

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The plates will be found at the end of this issue.

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IN MEMORIAM Dr. ALFONS JUNGER

Am 15. Juni 1968 ist der pädagogisch wirkende Zoologe PhDr. Alfons Junger verschieden, nachdem er als Mittelschullehrer in Bohumín, Mährisch Ostrau und zuletzt in Prag viele Jahre lang tätig war. Nach dem zweiten Weltkrieg gehörte er zum Lehrkörper der Pädagogischen Hochschule in Prag, wo er als Zoologe und erfahrener Biologielehrer völlig zur Geltung kam. Als genauer Kenner des Lehrzwecks und der Ziele des Schulunterrichts bemühte er sich stets um die Durchsetzung eines modernen Lehrprozesses an den Mittelschulen. Es wurden von ihm besonders die Bedeutung des Experiments, der praktischen Übungen, der Interessenzirkel und der Exkursionen im Biologieunterricht hervorgehoben, also alles das, was er selbst seit Jahren vielmals erprobt und überprüft hatte, vorüber er sich selbst überzeugt hatte, dass es eine dauernde Wirkung in den Schülern hinterlässt, ihre Urteilsfähigkeit übt und eine empfindliche Verständlichkeit für die harmonische Natur als vollkommene Umwelt des Menschen bildet. Er bekämpfte jeden veralteten Vorgang im Biologieunterricht, so z. B. die Darstellung der Biologie als blosse Zusammenstellung von Fakten über die morphologische Klassifizierung von Tieren und Pflanzen — für ihn war die Biologie eine Wissenschaft vom wirklichen Leben, d. h. vor allem von den Lebensvorgängen, Lebensfunktionen, von der Reaktion der lebenden Materie in ihrer ganzen Vielgestaltigkeit und Veränderlichkeit der Lebewesen.

Alfons Junger war am 15. August 1895 in Třeboň (Südböhmen) geboren und bestand sein Abitur dortselbst im Jahre 1914. Dann absolvierte er Naturwissenschaften an der Philosophischen Fakultät in Prag, wo er besonders Zoologie unter der Leitung von Professor A. Mrázek studierte.

Damals war Professor Mrázek besonders an der Fauna Südböhmens interessiert, eines Landesteils der zoologisch noch wenig bearbeitet war. A. Junger gehörte nicht nur zu den regelmässigen Begleitern seines Hochschullehrers während der Exkursionen in Südböhmen, sondern sammelte und bestimmte für ihn auch verschiedenes zoologisches Material und untersuchte auf Veranlassung seines Lehrers die Wassermilbenfauna (Hydracarina), was auch den Inhalt seiner späteren Dissertationsarbeit bildete. Während der Jahre 1919 und 1920 arbeitete er noch ein Jahr lang als Assistent am Zoologischen Institut der Karls-Universität, bevor er eine Stellung an der Mittelschule annahm. Sein neuer Beruf hat ihn zwar fast gänzlich von weiterer ausschliesslich zoologischer Originalarbeit abgehalten, hat ihn aber gleichzeitig zur selbständigen Verfolgung didaktischer Probleme veranlasst, wo gerade der Zoologieunterricht die Hauptfrage bildete. Seine Beauftragung an der Pädagogischen Hochschule erlaubte ihm die volle Entfaltung seiner pädagogischen Erfahrungen in mehreren Lehrbüchern der Zoologie und Biologie für Mittelschulen, in etlichen methodischen Anleitungen und in fachlichen oder referativen Aufsätzen in der Zeitschrift „Přírodní vědy ve škole“ (Die Naturwissenschaften in der Schule). Neue Fortschritte der Zoologie wurden von ihm bis zu seinem Lebensende aufmerksam beachtet.

Die zoologische Wissenschaft der Tschechoslowakei hat durch das Ableben Dr. A. Junger's ein wichtiges Verbindugsglied mit dem Biologieunterricht an den Mittelschulen verloren.

Walter Černý

RECENSE — REVIEWS

B. Rensch (1968): Biophilosophie auf erkenntnistheoretischer Grundlage. (Panpsychistischer Identismus). Gustav Fischer Verlag, Stuttgart. — 292 str., 6 obr., cena DM 36,—.

B. Rensch patří k těm zoologům, kteří podstatně přispěli k recentní neo-darwinistické revoluci v biologii a kteří hluboce ovlivnili naše evoluční myšlení. Jeho početné práce týkající se morfologie, taxonomie a evoluce savců, ptáků, měkýšů a hmyzu, i obecné problematiky evoluce, morfogenese, psychofylogenese a filosofické interpretace evoluce a zvláště jeho knihy (1929: Das Prinzip der geographischer Rassenkreise und das Problem der Artbildung; 1934: Kurze Anweisung für zoologisch-systematische Studien; 1959: Evolution above the Species Level) jsou známy všem zoologům zabývajícím se zmíněnou problematikou.

B. Rensch si silně uvědomuje nejen zvyšující se isolovanost pracovníků jednotlivých dílčích biologických disciplin a přeryv vzniknuvší mezi přírodovědeckými a humanitními vědami, ale i neadekvátnost dosavadních filosofických zobecnění výsledků moderní biologie. Ve své nové knize snaží se formulovat nejzákladnější biologické zákonitosti, integrovat je s výsledky ostatních přírodovědeckých disciplin a interpretovat je ve zcela obecné filosofické rovině umožňující podat obraz a výklad světa na úrovni adekvátní moderním znalostem. Do svých úvah zahrnuje B. Rensch důsledně i veškeré aspekty nervové činnosti a všechny projevy psychické, na které biologové často neprávem zapomínají, a formuluje i novou teorii poznání — gnoseologie by podle Rensche měla být vždy jádrem vědecké filosofie.

Krátký přehled členění knihy nejlépe umožní udělat si o ní představu. Po krátkém úvodu (5 str.) následuje kapitola Metody biologického bádání a tvoření teorií (23 str.) diskutující mimo jiné problematiku tvoření pojmů, vztah indukce a dedukce, hypothesy, teorie a zákona, atp. V kapitole Charakteristika života (32 str.) autor zobecňuje moderní poznatky o základních chemicko-morfologických strukturách a o nejdůležitějších projevech aktivity života včetně ontogenetického a fylogenetického vývoje. V oddíle Kausální analysa průběhu života (29 str.) jsou z tohoto hlediska probrány nejdůležitější procesy a projevy v životě individua. Další, z ryze biologického hlediska snad nejzajímavější kapitola, nazvaná Fylogenetický vývoj života (36 str.) zobecňuje poznatky o faktorech a způsobech speciace i transspecifické evoluce, o vzniku života a problému entropie v biologických systémech; ve zvláštním oddíle shrnuje autor nejdůležitější známé zákonitosti evoluce, logicky utříděné podle toho, zda se týkají infraspecifické evoluce, transspecifické cladogenese nebo anagenese. V nejdelším oddíle knihy (119 str.), který je jejím myšlenkovým jádrem, nazvaném Problémy teorie poznání, jsou diskutovány různé gnoseologické teorie, otázky týkající se psychofysického substrátu, fenomenální skutečnosti, analysy vjemů a představ, svobody vůle, psychontogenese a psychofylogenese, pojmu „hmota" a nejobecnějších přírodních zákonitostí, a v jejím závěru formuluje autor svůj světový názor, který charakterisuje jako panpsychistický, identistický a polynomistický. Ve dvou posledních — více méně esejistických — kapitolách (24 str.) dotýká se B. Rensch ethických důsledků světového názoru a jeho vztahu k nábožensko-filosofickým otázkám. Kniha je ukončena bohatým seznamem literatury (14 str.) a autorským a věcným rejstříkem.

Renschovo dílo je možno charakterisovat jako „natur-filosofické", ale právě proto, že autor přistupuje k filosofickému zobecnění na základě dlouholeté konkrétní vědecké práce a hluboké znalosti a plného porozumění biologickým zákonitostem, je toto jeho kredo pravděpodobně jak ve filosofické, tak v biologické literatuře ojedinělé. Musí se s ním seznámit nejen filosofové, ale i každý z biologů mající zájem o integrující pohled na skutečnost a o obecné důsledky poznání biologických zákonitostí.

Pavel Štys

Berndt Heydemann (1967): Die Biologische Grenze Land-Meer im Bereich der Salzwiesen. *Franz Steiner Verlag GmbH, Wiesbaden; 200 stran, 63 obrázků, 12 fotografických tabulí.* — Cena DM 46,—.

Habilitační spis doc. Heydemanna zahrnuje výsledky skoro desetileté práce výzkumu skupiny pracovníků zoologického ústavu university v Kielu vedené autorem. Je to v podstatě biocenologická studie fauny členovců slaných luk (Salzwiese), biotopu, ležícího na rozhraní moře a země.

Práce je členěna do 6 kapitol, z nichž prvé 4 mají úvodní charakter a zahrnují rozbor problematiky, metodiku a přehled míst, kde byl výzkum prováděn. Pátá kapitola je charakteristikou sledovaného biotopu a rozebírá abiotické faktory i složení vegetace. Poslední kapitola, tvořící hlavní část práce, se zabývá faunou slaných luk a je rozdělena do pěti logických celků.

Prvý je přehledem a srovnáním fauny tohoto biotopu na různých, především evropských pobřežích. Najdeme tu i srovnání s vnitrozemskými slanisky. Nejlépe jsou zpracovány řády Coleoptera a Araneae. Další část se zabývá sukcesí druhů přecházejících ze slaných luk na straně jedné a z vnitrozemí na straně druhé na nově získaná území, oddělená od moře hrázemi a zbavená tak vlivu přílivu a odlivu. Sleduje expansi druhů vzduchem, vodou i zemí v závislosti na čase.

Třetí část je věnována ekologické vázanosti na biologickou hranici země—moře. Rozebírá vázanost na vegetaci, obsah solí v půdě i vodě, vlhkost a zalití vodou. V další části je studována resistence organismů proti extrémním podmínkám studovaného biotopu, jmenovitě proti pobytu na vodní hladině a proti přelití vodou v závislosti na teplotě, obsahu solí, kyslíku, pohybu vody, kvalitě substrátu, rytmice přílivu a odlivu, přísunu potravy a z endogenních faktorů na vývojovém stadiu, pohlaví, sezonní adaptaci a ekologickém původu individuí. Poslední část se zabývá přizpůsobením životu na hranici země—voda, které se může projevit ve struktuře těla, ve fysiologických přizpůsobeních nebo v roční periodicitě. Závěr a seznam literatury uzavírají tuto pozoruhodnou práci.

Práce doc. Heydemanna představuje moderní zpracování biocenologického thematu, které se nespokojuje jen pouhou inventarisací fauny. Snaží se na příkladu typických druhů odhalovat i zákonitosti vztahů mezi organismy a extrémním prostředím, které biologická hranice země—moře představuje. Šíří problematiky i zpracováním může být vzorem pro studia podobného charakteru.

Karel Hůrka

Žďárská Z.: Gland cells of the cercaria of Plagiorchis laricola (Skrjabin, 1924) (Trematod


2


3


4


5

Žďárská Z.: Gland cells of the cercaria of Plagiorchis laricola (Skrjabin, 1924) (Trematoda)

6

7

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Fig. 2. Transverse (above) and tangential (below) sections through the body of the cercaria of *P. laricola*. The transverse section shows 1 pair of ventral gland cells with protrusions extending from the base of the cells in the lateral direction. Cell nuclei are unstained. Protrusions of ventral gland cells are well visible in the tangential section. In both sections the dorsal gland cells below the body surface have a faint coloration. Stained by PAA-aldehyde fuchsin method.

Fig. 3. Longitudinal section through the body of the cercaria of *P. laricola*. On the ventral side are two branched ventral gland cells in front of the ventral sucker and only the protrusions of ventral gland cells situated behind the ventral sucker are visible near the lower border of the section. Besides these cells there are also penetration gland cells, the nuclei of which are unstained. In the photomicrograph these cells merge in the ventral gland cells. Stained by PAA-aldehyde fuchsin method.

Fig. 4. Transverse section through the body of the cercaria of *P. laricola* within sporocyst at the level of the ventral sucker. The released secretion of ventral gland cells forms a coherent layer on the surface of the body. Right below the body wall are fully developed dorsal gland cells which are deeply coloured. Stained by PAA-aldehyde fuchsin method.

Fig. 5. Longitudinal section through the body of the cercaria of *P. laricola* within sporocyst after the release of the secretions of ventral and dorsal gland cells on the surface of the body. Inside the body there are penetration gland cells and their ducts intensely stained. Stained by PAA-aldehyde fuchsin method (× 250).

Fig. 6. Free-swimming cercaria of *P. laricola*. In the middle of the photomicrograph below the dorsal body wall in the tangential section and above right in the longitudinal section there are the proper cystogenic gland cells which are intensely stained by Morel-Sisley's diazotisation method for the detection of tyrosine. Tegument of the cercaria originating from the secretions of ventral and dorsal gland cells appears as an unstained border.

Fig. 7. Section through the cyst wall of the metacercaria of *P. laricola* after 24 h encystation in the larva of the mosquito *Aëdes aegypti*. After staining by the same method as in Fig. 6 the outer layer of the cyst wall, originating from the tegument of cercaria, is not stained and the inner layer is positive to the same extent as the contents of the proper cystogenic gland cells (see Fig. 6).

Fig. 8. The same metacercaria as in Fig. 7 (cut in its largest diameter) after staining by PAA-aldehyde fuchsin method, which stains acid mucosubstances and also SS-groups. Outer layer of the cyst wall, containing acid mucosubstances, is intensely coloured, similarly as the tegument of cercaria (see Figs. 4, 5). Inner layer of the cyst wall lying close to the outer layer only on the left side of the photomicrograph, does not stain at all. Penetration gland cells in the body of metacercaria which contain SS-groups are also intensely stained (similarly as in Figs. 3, 5). The nuclei of these cells are unstained (× 250).

J. Holčík: A note on the occurrence and taxonomy of Brown Trout — Salmo trutta Linnaeus, 1758 in the Danube river.

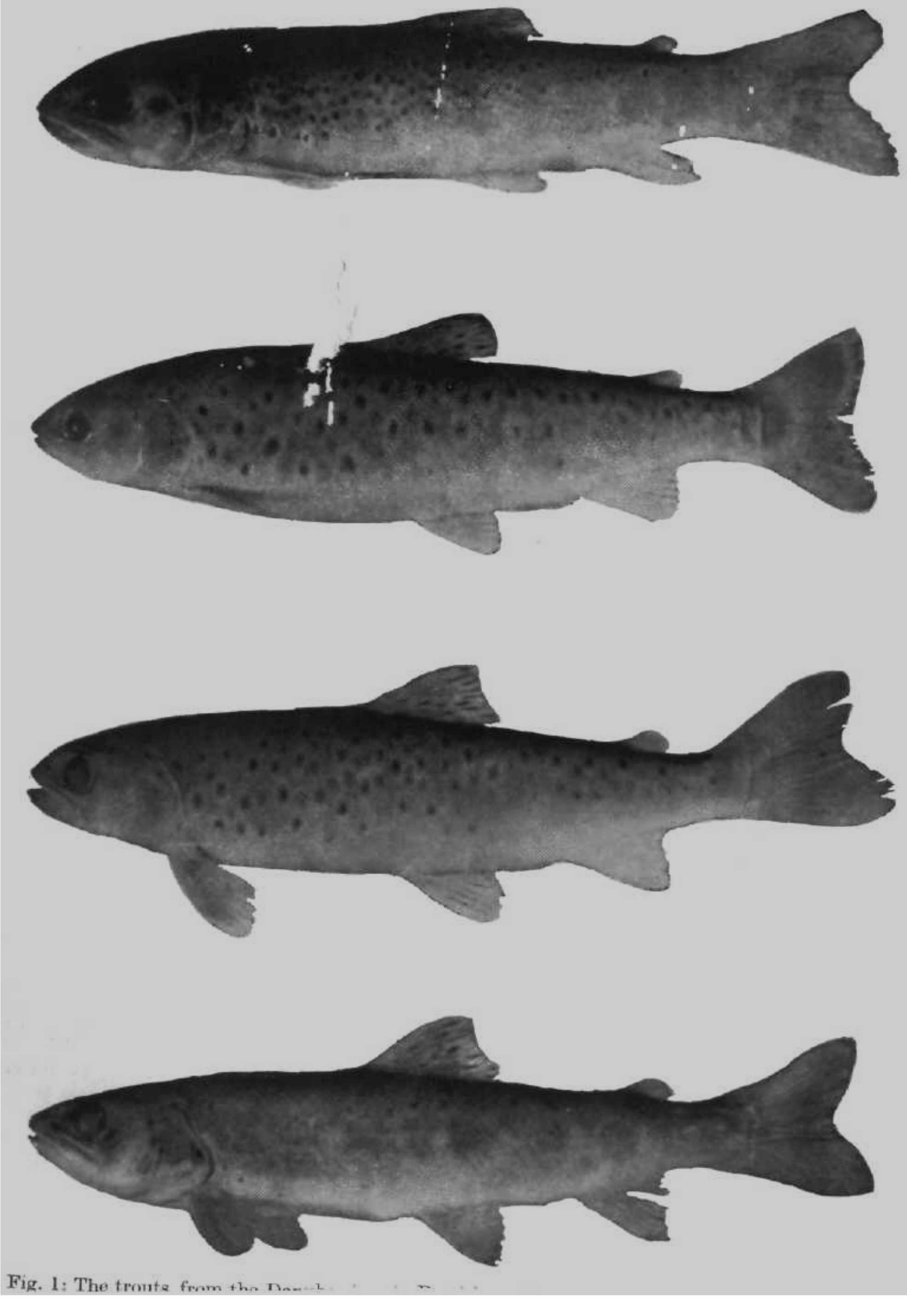

Fig. 1: The trouts from the

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ročník XXXIII

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