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NEMATODES OF THE GENERA SPAULINGODON, SKRJABINODON AND PHARYNGODON (OXYURIDAE) PARASITIZING CUBAN LIZARDS

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Received February 22, 1973

Abstract: The nematode species *Spaulingodon californiensis, S. cubensis, S. antillarum* n. sp., *Skrjabinodon* sp. and *Pharyngodon sphaerodactyli* n. sp. were found to parasitize Cuban lizards of the family Gekkonidae, while the species *Skrjabinodon anolis* and *Skrjabinodon cricosaurae* n. sp. were found in the hosts of the families Iguanidae and Xanthusiidae, respectively. All species of nematodes are described and figured on the basis of our material and the new species (*S. antillarum* n. sp., *S. cricosaurae* n. sp. and *P. sphaerodactyli* n. sp.) are differentiated from the known ones. The following species were transferred to the genus *Spaulingodon: S. viracochai* (Freitas, Vicente et Ibanez, 1968) nov. comb., *S. maytapaci* (Vicente et Ibanez, 1968) nov. comb., *S. dimorpha* (Chabaud et Brygoo, 1962) nov. comb. and *S. morgani* (Fitzimons, 1961) nov. comb. The species *S. dossae* (G. Caballero, 1968) nov. comb., *S. ovocaudatus* (G. Caballero, 1968) nov. comb., *S. pigmentatus* (Markov et Bogdanov, 1961) nov. comb. and *S. capacyupanquii* (Freitas, Vicente et Ibanez, 1968) nov. comb. were transferred to the genus *Skrjabinodon*.

The helminth fauna of Cuban lizards has been described in the papers by Baruš and Coy Otero (1969) and Coy Otero (1970). In the paper, we are completing these data by a study of the hosts belonging to the families Gekkonidae and Xanthusiidae, which have not yet been examined for helminth parasites. In the collected material the species of the genera *Spaulingodon*, *Skrjabinodon* and *Pharyngodon* were determined. The genera *Skrjabinodon* and *Spaulingodon* were found in Cuba for the first time. A total of 7 nematode species were identified, of which 3 are new for the science and 3 were found for the first time in new definitive hosts in Cuba. In addition to the taxonomic position of the nematodes obtained, the species composition of the genera *Spaulingodon* and *Skrjabinodon* was dealt with.

MATERIAL

The nematodes described were recovered from 78 hosts dissected, belonging to the families Gekkonidae, Xanthusiidae and Iguaniidae and to six species — *Sphaerodactylus cinereus* (21 — number of examined/1 — number of positive species), *S. intermedius* (2/1), *Hemidactylus brooki* (9/3), *H. turcicus* (3/3), *Tarentola americana* (27/11), *Cricosaura typica* (12/8) and *Anlis alutaceus alutaceus* (4/1).

We are grateful to Dr. O. H. Garrido and Mr. L. de Armas of the Zoological Institute of the Cuban Academy of Sciences in Havana for their kind help in catching the hosts. Dr. Garrido has also determined all definitive hosts mentioned in this paper.

RESULTS

Genus *Spaulingodon* Skrjabin, Schikhobalová et Lagodovskaja, 1960

1. *Spaulingodon californiensis* (Read et Amrein, 1953)

Host: *Hemidactylus turcicus* L. (Gekkonidae)
Location: large intestine.
Locality: Baracoa (province Oriente) and Sagua la Grande (province Las Villas).

This species of nematodes was found in all of the three *H. turcicus* examined. Our material consisted of 10 worms: 1 male and 9 females (6 of them adult).

Description (Figs. 1 and 2). The body is of whitish colour, the cuticle has a distinct transverse striation. The mouth opening is bounded by three bilobed lips with six small papillae. The lateral alae are present in both sexes. The oesophagus possesses a tri-valvulate posterior bulb. There is a needle-like process on the posterior end of body.

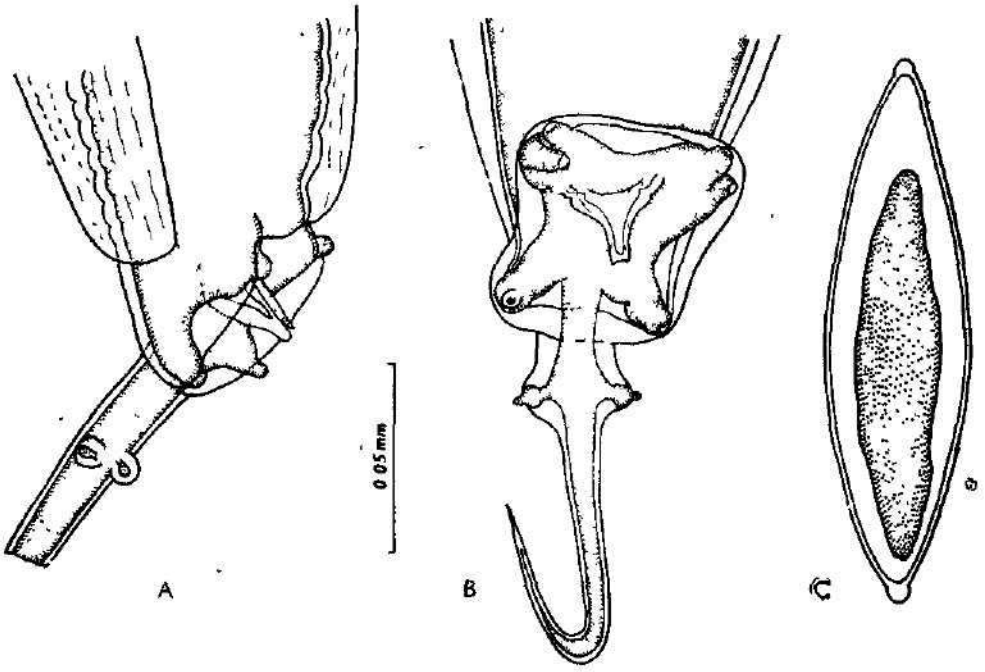

Fig. 1. A — *Spaulingodon californiensis* (Read et Amrein, 1953) from the host *Hemidactylus turcicus*; B, C — *Spaulingodon cubensis* (Read et Amrein, 1953) from the host *Tarentola americana*. A — posterior end of male (lateral view), B — posterior end of male (ventral view), C — egg. Orig.

Male: Length of body 1.53 mm, maximum width 0.20 mm. Length of oesophagus (including bulb) 0.27 mm; bulb 0.056 mm long and 0.063 mm wide. Nerve ganglion and excretory pore 0.12 and 0.32 mm, respectively, from the anterior end of body. Caudal alae present, surrounding only 2 anterior pairs of caudal papillae. Cloaca 0.32 mm from tail end. Prominent cloacal protuberance present. Spicule absent.

Female: Length of body 2.17—3.36 mm, maximum width 0.30—0.34 mm. Length of oesophagus (including bulb) 0.31—0.42 mm; bulb 0.084—0.098 mm

long, 0.091—0.10 mm wide. Nerve ganglion 0,091—0.11 mm from anterior end of body. Excretory pore and vulva 0.23—0.29 and 0 26—0.32 mm, respectively, from anterior extremity. Needle-like caudal process with 8—15 cuticular spines. Anus 0.84—1.05 mm from tail end. Eggs measure 0.119—0.133 × 0.035—0.042 mm. One of their poles distinctly flattened, the other rounded (in some eggs with a small protuberance).

Remarks Our specimens recovered from *H turcicus* are distinctly smaller in comparison with the original description of this species from *Coleonys variegatus* (Gekkonidae) from California (Read and Amrein 1953) The important taxonomic characters of the genus *Spaulingodon* were used for species determination, namely the morphology, size and shape of eggs, length of female tail and number of cuticular spines Considering that the definitive host (*H turcicus*) is of the Mediterranean origin, we have compared our material with the nematodes of the genus *Spaulingodon* found in *H turcicus* in Egypt The nematodes from Egypt markedly differ from those found in Cuba the tail of females is smooth and the shape and size of eggs is different. They belong evidently to another species The finding of *S californicus* in *H turcicus* in Cuba corresponds with the supposition that this species was introduced to Caribbean region most probably via Key West (U S A) or Yucatan

2. *Spaulingodon cubensis* (Read et Amrein, 1953)

Host: *Tarentola americana* Gray, 1831 (Gekkonidae).
Location large intestine
Locality: Trinidad (province Las Villas)
This species was found in 1 of the 27 *T americana* examined Our material consisted of 14 nematodes (7 males and 7 females)

S. cubensis from the typical host *T americana* from Cuba was found and decribed by Read and Amrein (1953). Later on Baruš and Coy Otero (1969) an Coy Otero (1970) recovered and redescribed this species from the same host. It differs from the foregoing species *(S. californiensis)* in the shape of eggs and their larger size; the first pair of caudal papillae of male is forked (Fig. 1).

3. *Spaulingodon antillarum* n. sp.

Hosts: *Hemidactylus brooki* Gray, 1844 and *Sphaerodactylus cinereus* Wagler, 1830 (both Gekkonidae)
Location large intestine
Locality: El Cobre — Santiago de Cuba (province Oriente) for *H brooki*; San Antonio de los Baños (province Havana) for *S cinereus*
This species was found in 3 of the 9 *H. brooki* examined Our material consisted of 41 nematodes: 1 male and 40 females (only 3 of them adult) Four adult females were found in one of the 21 *S cinereus* examined

Description (based on the material from *H. brooki*): The nematodes are of white colour, the cuticle has a distinct transverse striation. The mouth opening is triangular, bounded by three small bilobed lips. The papillae on the inner circle are indistinct, the outer circle bears 4 double papillae and 2 amphids. Three cuticular onchia are present. The lateral alae are present in both sexes The oesophagus possesses a tri-valvulate posterior bulb. Both in males and females there is a needle-like process with cuticular spines at the posterior end of body.

Holotype — male (Fig. 2) Length of body 1.33 mm, maximum width 0.24 mm. Length of oesophagus (including bulb) 0 22 mm; bulb 0 049 mm long, 0.070 mm wide. Nerve ganglion and excretory pore 0.075 and 0 287 mm, respectively, from anterior end of body. Posterior end of body with a needle-

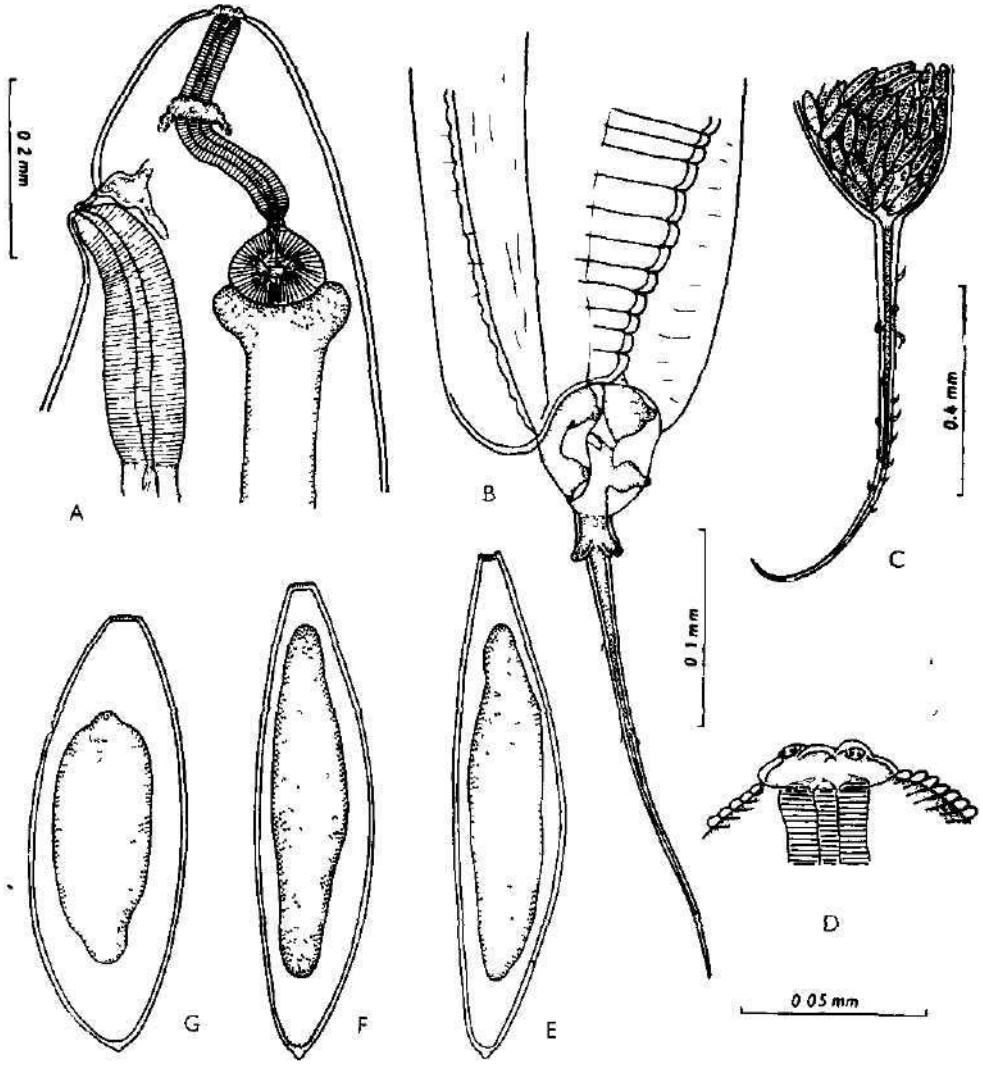

Fig 2 A–F — *Spaulingodon antillarum* n sp from the host *Hemidactylus brooki*, G — *S californiensis* (Read et Amrein, 1953) from the host *H. turcicus* A — anterior end of female (lateral view), B — posterior end of male (latero ventral view); C — posterior end of female (lateral view), D anterior end of female (detail), E, F, G — eggs Orig

like process bearing three cuticular spines. Three pairs of caudal papillae present. one prae-cloacal, one post-cloacal and the third at the beginning of a needle-like process. Caudal alae surround the first two pairs of caudal papillae Cloaca 0.30 mm from tail end Prominent cloacal protuberance present Spicule absent.

Paratype — female (based on the specimens with eggs)· Body 2.72 to 5.70 mm long, maximum width 0.26—0.49 mm. Length of oesophagus (including bulb) 0.34—0 40 mm, length of bulb 0.077—0.098 mm. Nerve

ganglion and excretory pore 0.084—0.105 and 0.24—0.46 mm, respectively, from anterior end of body. Vulva with salient margins, situated 0.27—0.50 mm from anterior end of body. Needle-like process at the posterior end of body, bearing 8—15 cuticular spines. Anus 0.98—1.12 mm from tail end. Eggs with finely spotted surface, measuring 0.132—0.140 × 0 030—0.036 mm. One pole of eggs flattened, the other bears always a distinct small protuberance.

Discussion: The genus *Spaulingodon* was erected by Skrjabin, Schikhobalova and Lagodovskaja (1960) with a type species *S. extenuatus* (Rudolphi, 1819) and other species: *S. cubensis* (Read et Amrein, 1953), *S. californiensis* (Read et Amrein, 1953), *S. auziensis* (Seurat, 1917), *S. giganticus* (Read et Amrein, 1953), *S. laevicauda* (Seurat, 1914), *S. mearnsi* (Edgerly, 1952), *S. oxkutzcabiensis* (Chitwood, 1938), *S tarentolae* (Spaul, 1926) and *S. tectipenis* (Gedoelst, 1919). In addition, other authors referred to this genus further species, namely *S. eremiasi* Markov et Bogdanov, 1961, *S. parasskiffi* Markov et Bogdanov, 1961, *S. saxicolae* Scharpilo, 1961, *S. schikhobalovi* Markov et Bogdanov, 1962, and *S. termezenzis* Markov et Bogdanov, 1962. We are transferring to this genus also *S. viracochai* (Freitas, Vicente et Ibanez, 1968) nov. comb. and *S. maytapaci* (Vicente et Ibanez, 1968), previously included in the genus *Parathelandros*, and *S. morgani* (Fitzimmons, 1961) nov. comb. and *S. dimorpha* (Chabaud et Brygoo, 1962) nov. comb., originally assigned to the genus *Thelandros*.

The species *S. antillarum* n. sp. described in this paper distinctly differs from *S. eremiasi*, *S. parasskiffi*, *S. schikhobalovi*, *S. laevicauda* and *S. auziensis* in the spinous tail of female (the tail of the other species is smooth, without cuticular spines). From the species *S. cubensis*, *S. californiensis*, *S. saxicolae*, *S. termenzenzis*, *S. morgani*, *S. dimorpha*, *S. giganticus*, *S. tarentolae*, *S. tectipenis* and *S. extenuatus* it differs in the shape and size of eggs, from *S. mearnsi* and *S. maytapaci* in the topography and number of caudal papillae of males.

S. antillarum n sp. most closely resembles the species *S. viracochai* from the host *Phyllodactylus gerrhopygus* (Gekkonidae) from Peru and *S. oxkutzcabiensis* from the host *Thecadactylus rapicaudatus* (Gekkonidae) from Yucatan. It differs from *S. viracochai* in the longer tail of females (0.52 to 0.55 mm in *S. viracochai*; 0.98—1.12 mm in *S. antillarum*) and in larger number of cuticular spines on the tail of female (only 2 in *S. viracochai* and 8—15 in *S. antillarum*). *S. antillarum* n. sp. differs further from *S. oxkutzcabiensis* in the following features: size of eggs (0.132—0.140 × 0.030 to 0.036 mm in *S. antillarum*; 0.120—0.130 × 0.033—0.037 mm in *S. oxkutzcabiensis*), length of tail (0.750—0 835 mm in *S. oxkutzcabiensis*) and presence of 3 cuticular spines on the tail of male (in *S. antillarum*).

The specimens of *S. antillarum* n. sp. are deposited in the collections of the Humboldt Museum in Berlin (1 male and 2 females), of the Institute of Parasitology, Czechoslovak Academy of Sciences, Prague (20 females) and Zoological Institute of the Cuban Academy of Sciences, Havana (22 females).

Genus *Skrjabinodon* Inglis, 1968

1. *Skrjabinodon anolis* Chitwood, 1934

Host: *Anolis alutaceus alutaceus* Cope, 1861.
Location: rectum
Locality: Guanahacabibes peninsula (province Pinar del Rio).
A single female was recovered from one of the 4 *S. anolis* examined.

Description (Fig. 3): The mouth opening is triangular, bounded by thre small bilobed lips. The mouth cavity is very small. The cuticle has distinc transverse striation all over the body surface, with the exception of a needle like tail process. The female body is 2.45 mm long, maximum width 0.28 mm The oesophagus with a prominent, tri-valvulate posterior bulb measure 0.40 mm in length. The bulb is 0.077 mm long and 0.10 mm wide. The nerv

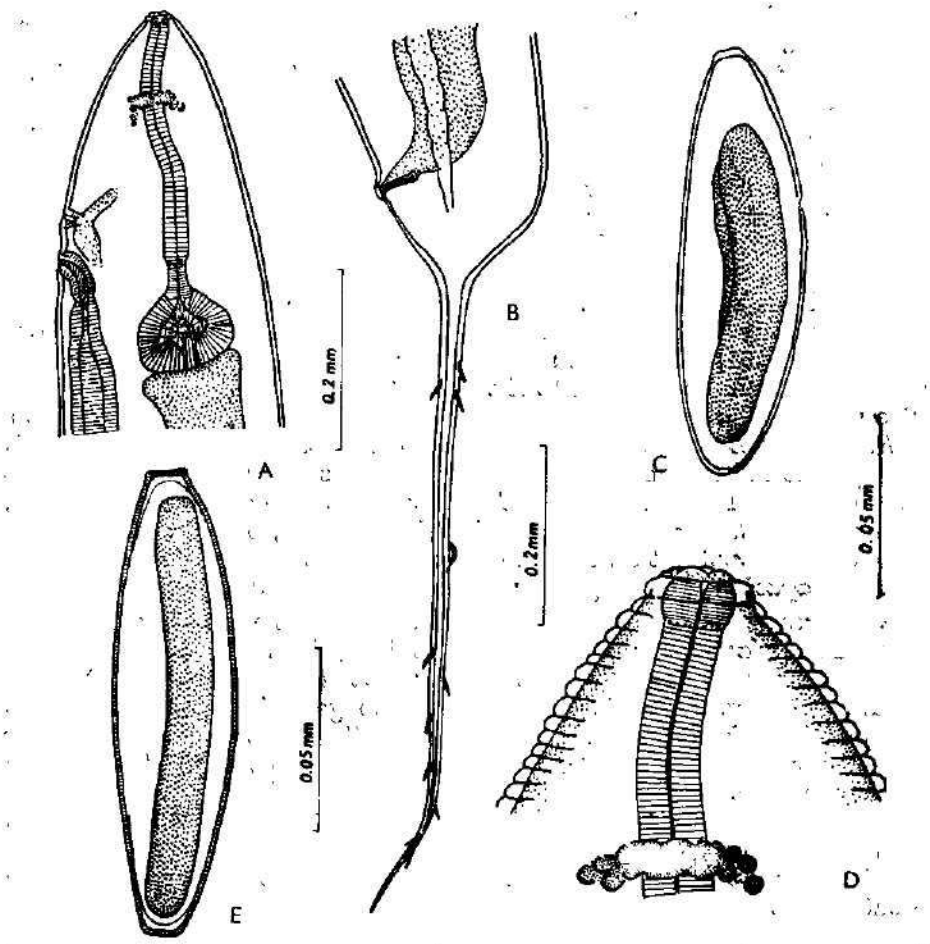

Fig. 3. A—D — *Skrjabinodon anolis* (Chitwood, 1934) from the host *Anolis alutaceus alutaceus* E — *Skrjabinodon cricosaurae* n. sp. from the host *Cricosaura typica*. A — anterior end of femal (lateral view); B — posterior end of female (lateral view); C, E — eggs; D — anterior end o female (detail). Orig.

ganglion lies 0.090 mm from the anterior end of body. The excretory por and vulva is situated 0.26 and 0.30 mm, respectively, from the anterior end of body. The genital apparatus is amphidelphic. The anus is situated at the distance of 0.84 mm from the tail end. The tail bears 11 small cuticular spines The lateral alae are very narrow and double from just behind the head to the

level of the anus. The eggs are smooth, measuring 0.112—0.119 × 0.035 to 0.047 mm, slightly flattened on one pole.

Remarks: The species *S. anolis* was described by Chitwood (1934) from the host *Anolis cristatellus* from Puerto Rico. Our specimens were tentatively assigned to the species *S. anolis* on the basis of the identical system of cephalic papillae (8 large labio-papillae, see Chitwood), the shape and location of lateral alae and other morphological and metrical features. Our material differs from the original description in the location of nerve ganglion (0.17 mm after Chitwood) and in the size of eggs (0.102—0.104 × 0.043—0.051 mm). As soon as further material from Cuban lizards of the genus *Anolis* is available, the final taxonomic position of this species will be specified.

2. *Skrjabinodon cricosaurae* n. sp.

Host: *Cricosaura typica* Gundlach et Peters, 1863 (Xanthusiidae).
Location: rectum.
Typical locality: Cabo Cruz (province Oriente).

Description (Figs. 3 and 4): The body is of white colour, cuticle with distinct transverse striation. The mouth is bounded by three lips, which are bilobed in females and single in males. The amphids are larger than the four large cephalic papillae. The lateral alae on both sexes are very narrow (double on females), extending from about the midlength of the oesophageal region to the level of the anus. The oesophagus has a prominent tri-valvulate bulb.

Holotype — male: Length of body 0.89 mm, maximum width 0.094 mm. Oesophagus (including bulb) 0.175 mm long, bulb 0.035 mm long, 0.035 mm wide. Nerve ganglion and excretory pore 0.10 and 0.31 mm, respectively, from the anterior end of body. At the posterior end of body is a thin, needle-like tail. Cloaca 0.094 mm from tail end. Caudal alae absent. Of the three pairs of papillae one pair prae-cloacal, one post-cloacal and the third lies at the beginning of the tail. Spicule well sclerotized, 0.037 mm long, with sharp distal end.

Paratypes — female (on the basis of specimens containing eggs): Length of body 3.41—4.62 mm, maximum width 0.28—0.38 mm. Length of oesophagus (including bulb) 0.31—0.34 mm. Bulb 0.063—0.084 mm long and 0.077—0.098 mm wide. Nerve ganglion and excretory pore 0.084—0.10 and 0.23—0.35 mm, respectively, from anterior end of body. Vulva with slightly salient margins, 0.25—0.44 mm from anterior end of body. Intestine with spherical enlargement in the anterior part, then straight, ending by a short rectum. Posterior end of body runs into a needle-like tail with 3—7 cuticular spines. Anus situated 0.56—0.91 mm from tail end. Vagina muscular, one uterus runs posteriorly and the other almost immediately runs anteriorly. Eggs with rough surface, measuring 0.124—0.135 × 0.036—0.042 mm. Both poles are flattened (one of them more).

Discussion: The genus *Skrjabinodon* was established by Inglis (1968), with *S. mabuyae* (Sandground, 1936) as a type species and these further species: *S. anolis* (Chitwood, 1934), *S. apapillosus* (Koo, 1938), *S. mabuiensis* (Malan, 1939), *S. megalocerca* (Skrjabin, 1916), *S. oedurae* (Johnston et Mawson, 1947), and *S. scelopori* (Caballero, 1938). Skrjabin et al. (1960) placed previously all the species in the genus *Parathelandros* Baylis, 1930. Recently also the species *S. smythi* Angel et Mawson, 1968, *S. parasmythi* Mawson, 1971 and *S. leristae* Mawson, 1971 were included in the genus *Skrjabinodon*. We are further listing in this genus the species *S. dossae*

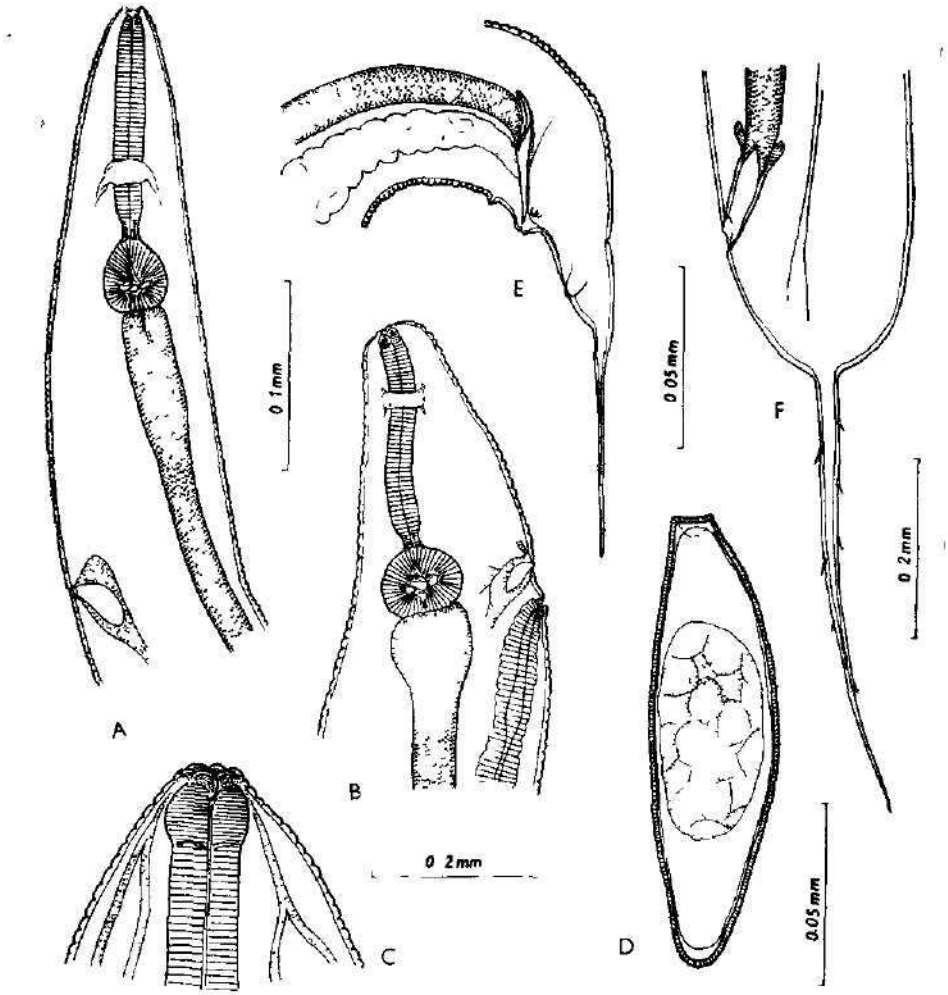

Fig. 4. *Skrjabinodon cricosaurae* n. sp. from the host *Cricosaura typica*. A — anterior end of male (lateral view); B — anterior end of female (lateral view); C — anterior end of female (detail); D — eggs; E — posterior end of male (lateral view); F — posterior end of female (lateral view). Orig.

(G. Caballero, 1968) nov. comb., *S. ovocaudatus* (G. Caballero, 1968) nov. comb., *S. pigmentatus* (Markov et Bogdanov, 1961) nov. comb. and *S. capacyupanquii* (Freitas, Vicente et Ibanez, 1968) nov. comb. referred previously to the genus *Parathelandros*.

According to the presence or absence of spicules the species belonging to the genus *Skrjabinodon* can be divided in two groups. The spicule is absent in the species *S. anolis*, *S. apapillosus*, *S. dossae*, *S. ovocaudatus*, *S. mabuiensis*, *S. megalocerca*, *S. pigmentatus*, *S. leristae* and *S. smythi*. A well sclerotized spicule is present in the species *S. parasmythi* (0.060—0.065 mm long), *S. mabuyae* (0.085—0.090 mm long), *S. scelopori* (0.082 mm long),

S. oedurae (0.11 mm long) and *S. capacyupanquii* (0.12—0.13 mm long). The species *S. cricosaurae* n. sp. described by us belongs to the group possessing the spicule. However, it differs distinctly from the other members of this group in the length of its spicule (0.037 mm). *S. cricosaurae* n. sp. is morphologically most similar to the species *S. scelopori* from the host *Sceloporus torquatus* (Iguanidae) from Mexico. It differs not only in smaller spicule, but also in shorter tail of female (0.48—0.58 mm in *S. cricosaurae*, 0.97 to 1.05 mm in *S. scelopori*), lower number of cuticular spines on the tail (3—7 in *S. cricosaurae*, 10—12 in *S. scelopori*) and in the surface of eggs (rough in *S. cricosaurae*, smooth in *S. scelopori*).

The specimens of *S. cricosaurae* n. sp. are deposited in the collections of the Humboldt Museum in Berlin (1 male and 4 females), of the Institute of Parasitology, Czechoslovak Academy of Sciences, Prague (10 females, 5 of them juvenile) and in the collection of the Zoological Institute of the Cuban Academy of Sciences, Havana (12 females, 9 of them juvenile).

3. *Skrjabinodon* sp.

Host: *Tarentola americana* Gray, 1831 (Gekkonidae).
Location: large intestine.
Locality: Trinidad (province Las Villas).

This species was found in one of the 27 *T. americana* examined (only 2 males). It is related to *S. scelopori* (Caballero, 1938) from which it differs in the shorter tail of males. From *S. cricosaurae* it differs in the longer spicule. More exact taxonomic position will be determined as soon as female specimens are available.

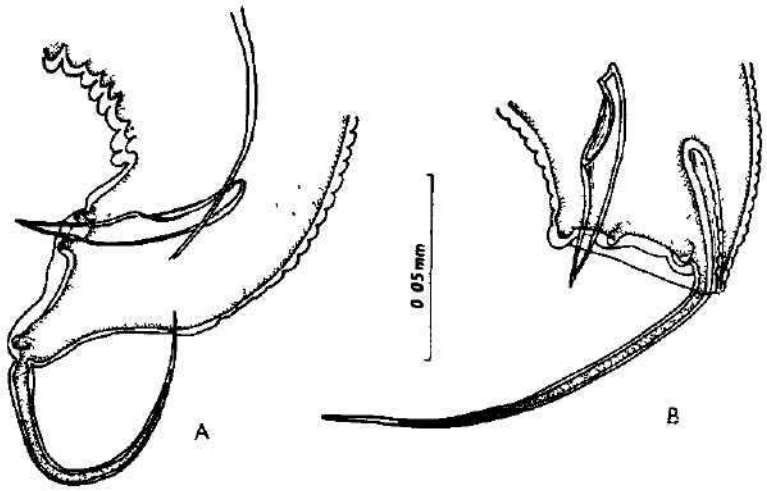

Fig. 5. Skrjabinodon sp. from the host Tarentola americana. A, B – posterior end of male (lateral view). Orig.

Description (Fig 5): Length of male body 0.95—1.22 mm, maximum width 0.11—0.12 mm. Cuticle with fine transverse striation. Mouth with three simple lips. Narrow lateral alae present. Length of oesophagus (including bulb) 0.23—0.24 mm. Bulb 0.063 mm long, 0.063 mm wide. Nerve ganglion and excretory pore 0.098—0.11 and 0.39—0.41 mm, respectively, from anterior end of body. Posterior end of body runs into a needle-like tail.

Cloaca 0.12—0.14 mm from tail end. Spicule well sclerotized, 0.060—0.063 mm long, 0.009 mm wide. Three pairs of caudal papillae, of these one prae-cloacal, one post-cloacal and one at the beginning of tail. Caudal alae absent.

Genus *Pharyngodon* Diesing, 1861

1. *Pharyngodon sphaerodactyli* n. sp.

Typical host: *Sphaerodactylus intermedius* Barbour, 1919 (Gekkonidae).
Location: large intestine.
Typical locality: Playa Allende (province Matanzas).
A total of 4 females were found in one of the two *S. intermedius* examined.

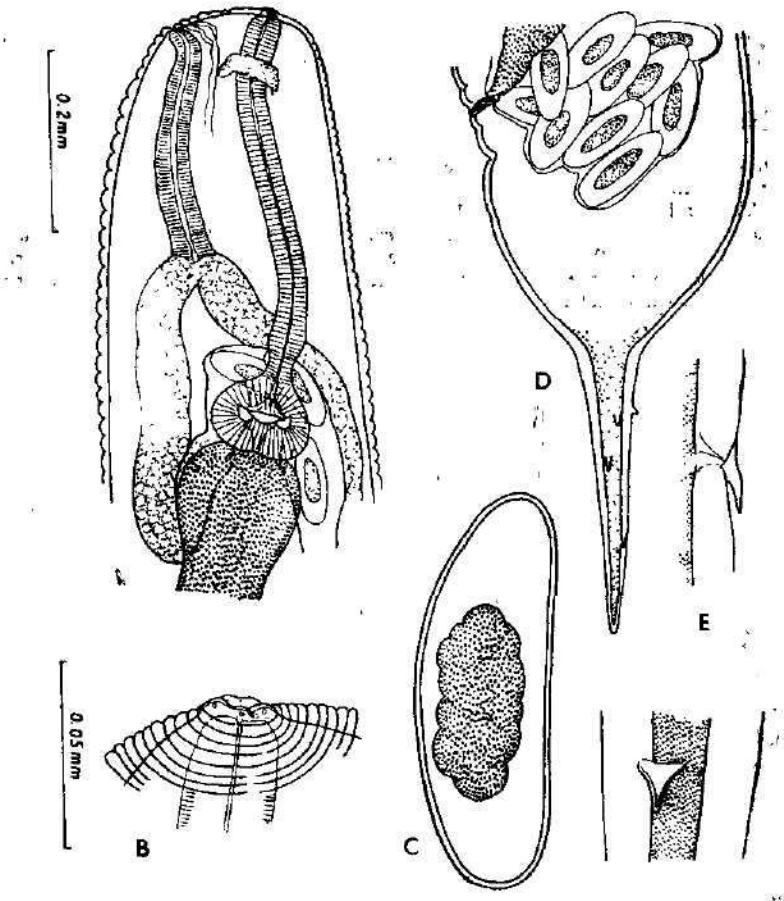

Fig. 6. *Pharyngodon sphaerodactyli* n. sp. from the host *Sphaerodactylus intermedius*. A — anterior end of female (lateral view); B — anterior end of female (detail); C — egg; D — posterior end of female (lateral view); E — spines on female tail (detail). Orig.

Description (Fig. 6): Body of living specimens of white colour, cuticle with marked transverse striation. Mouth with three small, indistinctly bilobed lips, each bearing 2 small papillae. Lateral alae absent. Oesophagus with tri-valvulate bulb.

Holotype (measurements of paratypes are given in brackets): Female body 2.45 (2.10—2.24) mm long, maximum width 0.32 (0.32—0.35) mm. Anterior end of body rounded, mouth cavity indistinct. Oesophagus 0.45 (0.47—0.52) mm long. Bulb 0.098 (0.084—0.091) mm long, 0.098 (0.069 to 0.084) mm wide. Nerve ganglion and vulva 0.077 (0.069—0.084) mm and 0.063 (0.070—0.090) mm, respectively, from anterior end of body. Excretory pore just anterior to vulva. Lower margin of vulva slightly salient. Muscular vagina 0.23 (0.30—0.33) mm long. Posterior end of body slightly tapering and running into a straight tail with 4—5 cuticular spines. Anus 0.60 (0.59 to 0.64) mm from tail end. Eggs thin-shelled, with small pits on their surface. Both poles of eggs rounded, without distinct opercula. Size of eggs 0.096 to 0.112 × 0.035—0.045 mm.

Discussion: The species *P. sphaerodactyli* n. sp. differs from all known species of the genus *Pharyngodon* in the position of vulva, which is close to the head end at the level of nerve ring (0.063—0.090 mm from the anterior end of body). This character differentiates this species, tentatively assigned by us to the genus *Pharyngodon*, from all species of the genera *Thelandros*, *Parathelandros*, *Parapharyngodon*, *Spaulingodon* and *Skrjabinodon*. Other characteristic features of *P. sphaerodactyli* n. sp. are the shape and length of female tail, and the shape and surface structure of eggs. The definitive host is a Cuban endemit.

Type species of *P. sphaerodactyli* n. sp. is deposited in the collection of the Humboldt Museum in Berlin, paratypes in the collections of the Zoological Institute of the Cuban Academy of Sciences, Havana (2 females) and Institute of Parasitology, Czechoslovak Academy of Sciences, Prague (1 female).

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BEMERKUNG ZUR BIONOMIE DER FAMILIE CYPRINODONTIDAE (PISCES) MIT RÜCKSICHT AUF DIE ABHÄNGIGKEIT DER ENTWICKLUNG DER EMBRYONEN DES PRACHTKÄRPFLINGS ROLOFFIA ROLOFFI (AHL, 1938) VON DER WASSERHÄRTE

STANISLAV FRANK

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Abstrakt: Der Prachtkärpfling *Roloffia roloffi* bewohnt die Urwaldgewässer der südlichen Sierra Leone in Westafrika. Der Fisch ist in der Gefangenschaft leicht im Aquarium zu pflegen und zu züchten, und eben aus diesem Grunde wurde er für Laborexperimente ausgewählt. Es wurde festgestellt, dass die Sterblichkeitsrate der Prachtkärpflingsembryonen während der Entwicklungsperiode von der Eibefruchtung bis zum Freischwimmen der Brut stark von der Wasserhärte abhängig ist. Aus unseren Beobachtungen geht hervor, dass der optimale Wasserhärtebereich für die Entwicklung der Eier und Larven bei 14—16 ° dNKH liegt, in welchem Falle die Sterblichkeit höchstens 5 % beträgt. Bei einer Herabsetzung der Wasserhärte unter 10° und bei einer Erhöhung auf über 20° dNKH steigt die Sterblichkeit ersichtlich an. Noch viel negativer beeinflusst die Entwicklung eine, 1° dKH übersteigende Karbonathärte. Torfextraktstoffe verzögern die Entwicklung der Embryonen in der Eihülle bei einer gleichen Wassertemperatur von 26 °C um fast die doppelte Zeit, d. h. von 10 – 12 Tagen auf 18—22 Tage, wobei auch die Mortalität stark ansteigt.

EINLEITUNG

Die grosse Fischfamilie der eierlegenden Zahnkarpfen (*Cyprinodontidae*), die insgesamt über 430 bekannte Arten einschliesst, ist in allen Kontinenten, mit Ausnahme Australiens, weit verbreitet. Die meisten Arten bewohnen vor allem tropische Gewässer, wenn auch einige Vertreter weit in die gemässigte Zone der nördlichen Hemisphäre vorgedrungen sind (Nordamerika, Europa). Die meisten eierlegenden Zahnkarpfen sind kleine Fische, die eine Gesamtlänge von nur etwa 5 bis 10 cm erreichen. Die Paarung ist einfach und nahezu bei allen Arten ähnlich. Unterschiede existieren vor allem in der Wahl des Laichsubstrats. Manche Arten setzen die Eier an Pflanzen ab, andere betten sie in den Grund der Gewässer ein. Man unterscheidet deshalb „Haftlaicher" und „Bodenlaicher". Die Haft- und Bodenlaicher unterscheiden sich jedoch nicht durch die Wahl des Laichsubstrats, sondern auch in ihrer Biologie. Haftlaicher leben in der Regel in Gewässern, die während der Trockenzeit nicht völlig austrocknen. Sie können einen, aber auch mehrere Jahreszyklen als Fisch überleben. Ihre Embryonalentwicklung ist dabei dem Jahreszyklus gar nicht oder nur wenig angepasst.

Im Gegensatz dazu leben die Bodenlaicher in solchen Gewässern, die nur in der Regenzeit Wasser führen. Die Fische können also nur während der

Regenzeit existieren und müssen die Trockenzeit als Embryonen in der Eihülle, eingebettet in den ein wenig feuchten Grund, überdauern. Diesen Lebensbedingungen ist daher auch die Embryonalentwicklung angepasst; sie ist diskontinuierlich, wobei Entwicklungsphasen mit Ruhe- oder Hemmungsphasen (Diapausen) abwechseln.

Jene Arten, die einen oder mehrere Jahreszyklen als Fische überleben, bezeichnet man als „nicht-annuelle" (in der Regel sind sie Pflanzenlaicher), die Arten, die einen gewissen Teil des Jahres nur im Embryonalstadium verleben, als „annuelle" (meistens sind sie Bodenlaicher). Einige Arten können sich den jeweiligen Lebensbedingungen anpassen und entweder Pflanzen- oder Bodenlaicher sein.

Die Eihüllen aller eierlegenden Zahnkarpfen sind dick und hart. Bei den „nicht-annuellen" Arten entwickeln sich die Eier in Wasser mit normalem Sauerstoffgehalt kontinuierlich und ohne jede Verzögerung. Der Embryo schlüpft je nach Wassertemperatur und Fischart nach 2 bis 4 Wochen aus. Die Eier der „annuellen" Zahnkarpfen können dagegen Tage, Wochen, Monate, ja sogar Jahre in ihrer Entwicklung stagnieren (Scheel, 1968, Sterba, 1970 u. a.).

Nach bisherigen Beobachtungen soll die Art *Roloffia roloffi* in der Natur zu den „halb-annuellen" eierlegenden Zahnkarpfen gehören und ihre Eier sollen sich meist kontinuierlich entwickeln und die Brut ohne Verzögerung schlüpfen.

MATERIAL UND METHODIK

Für die folgenden Versuche wurden Vollglasbecken mit Ausmassen von 30 × 22 × 22 cm (Länge × Breite × Höhe) verwendet. Bei der Mehrzahl der Versuche diente als Grundlage Quellwasser mit 120° dGH (104° dNKH und 16° dKH). Dieses sehr harte Naturwasser wurde je nach Bedarf in verschiedenem Verhältnis mit Schneewasser verdünnt. Die Karbonathärte wurde im Bedarfsfalle durch Abkochen des Wassers vor seiner Anwendung herabgesetzt oder völlig beseitigt. In keinem Falle wurde das Wasser mit Hilfe von Ionenaustauschern enthärtet. Die Wasserstoffionen-Konzentration bewegte sich bei allen Experimenten im neutralen Bereich, bei einem pH-Wert zwischen 6,5 und 7,5.

Als Laichsubstrat diente Javamoos *(Vesicularia dubyana)* und Treppenfarn *(Microsorium pteropus)*. Zum Laichen wurden immer je 4 Weibchen und 2 Männchen in einem Vollglasbecken untergebracht. Die Eier wurden täglich, d. h. stets nach Ablauf von 24 Stunden, mittels Glasröhrchens abgefangen. Ihre Entwicklung wurde in Wasser mit konstanter Härte und Temperatur beobachtet. Die Wassertemperatur bewegte sich bei allen Versuchen zwischen 25 und 27 °C. Zuchtbecken und die Becken mit den Eiern wurden permanent und gleichmässig stark durchlüftet. Während der Entwicklung der Eier wurde kein Desinfektionsmittel beigefügt. Alle im folgenden aufgeführten Beobachtungen waren vor allem darauf gerichtet, den Einfluss der Wasserhärte auf die Mortalität des Prachtkärpflings *Roloffia roloffi* festzustellen.

ERGEBNISSE UND DISKUSSION

Entwicklung der Embryonen

Die Zuchtfische der Art *Roloffia roloffi* sind sehr laichwillig und wechseln gern das Laichsubstrat, d. h. einerseits Wasserpflanzen, andererseits den Bodengrund. Die Eier sind relativ klein. Der durchschnittliche Durchmesser von 20 Eiern betrug 0,8 (0,7—1,0) mm. In den Eihüllen entwickelten sich die Embryonen recht schnell. Die gesamte Brut schlüpfte bei einer Wassertemperatur von 25—27 °C schon nach 10 bis 12 Tagen. Die durchschnittliche Gesamtlänge der 20 frisch geschlüpften Jungtiere betrug 4,8 (4,6—5,1) mm. Schon beim Ausschlüpfen waren sowohl in der Schwanzflosse als auch in den Brustflossen verknöcherte Flossenstrahlen gut sichtbar, wenn auch der

Tab. 1. Gesamtverhältnis der sich normal entwickelnden und abgestorbenen Prachtkärpflingsembryonen seit Anfang der Entwicklung in den Eihüllen bis zum Übergang der geschlupften Larven zur Schwimmblasenfüllung und zum Freischwimmen, je nach Wasserhärtegrad (die unbefruchteten Eier wurden in den Zahlen nicht berücksichtigt)

Wasserhärtegrad			Gesamtanzahl der befruchteten Eier	Anzahl der freischwimmenden Exemplare mit gefüllter Schwimmblase	Gesamtanzahl der abgestorbenen Embryonen während der Entwicklung	Sterblichkeit während der gesamten Entwicklung in %
°dGH	°dNKH	°dKH				
2	2	0	53	17	33	63
11	11	0	96	91	5	5
17	17	0	72	70	2	3
24	24	0	38	32	6	16
34	34	0	89	26	63	71
38	38	0	97	19	78	80
46	46	0	112	7	105	94
52	52	0	82	3	79	96
0,5	0,3	0,2	46	3	43	93
2	1	1	42	9	33	78
6	5	1	59	38	21	35
10	9	1	48	43	5	10
16	15	1	106	105	1	1
22	21	1	74	56	18	24
28	27	1	83	52	31	37
36	35	1	114	12	102	89
4	2	2	93	19	74	80
13	11	2	62	41	21	34
18	16	2	76	48	28	37
20	18	2	43	21	22	51
34	32	2	84	6	78	93
18	4	4	82	6	76	93
4	10	4	28	9	19	68
18	14	4	126	34	92	73
22	18	4	97	12	85	87
25	21	4	71	8	63	89

ursprüngliche undifferenzierte Flossensaum noch den ganzen Körper umgab (siehe Abb. 5 und 6) und die anderen Flossen (Rücken-, After- und Bauchflossen) noch nicht ausgebildet waren. Die Brut schwimmt sofort nach dem Schlüpfen waagrecht, in den Blutgefässen sind die Blutkörperchen vom Blut getragen, das Blut fliesst regelmäsig. Der Dottersack ist nur winzig klein. Spätestens nach 24 Stunden nach dem Verzehren des Dottersacks geht die Brut zu exogener Nahrungsaufnahme über. Obwohl die Larven in den ersten Lebensstunden sehr klein sind, fangen sie leicht die Nauplien des Salinenkrebschens (*Artemia salina*) und wachsen bei diesem Lebendfutter sehr schnell.

Abhängigkeit der Mortalität der Embryonen von der Wasserhärte

Wie aus der Tab. 1 und Abb. 9 hervorgeht, ist die Entwicklung der Embryonen der *Roloffia roloffi* direkt vom Wasserhärtegrad abhängig. Die optimale Sulfat-(Nichtkarbonat-)Härte liegt ungefähr zwischen 10 und 20° dNKH. wobei die natürliche Mortalität der Embryonen 1—8 % beträgt. Bei einer

Herabsetzung oder Erhöhung der Sulfathärte steigt die Mortalität der Embryonen im Ei stark an. Demgegenüber wurde ein ziemlich negativer Einfluss der Karbonathärte nachgewiesen. Ein kleiner Karbonatgehalt des Wassers von 0 bis 1° dKH hatte auf die Entwicklung keinen auffallenden Einfluss. Sobald jedoch der Karbonatgehalt 1° dKH überstieg, wuchs die Mortalität stark an, wie die Tabelle und die graphische Darstellung zeigt.

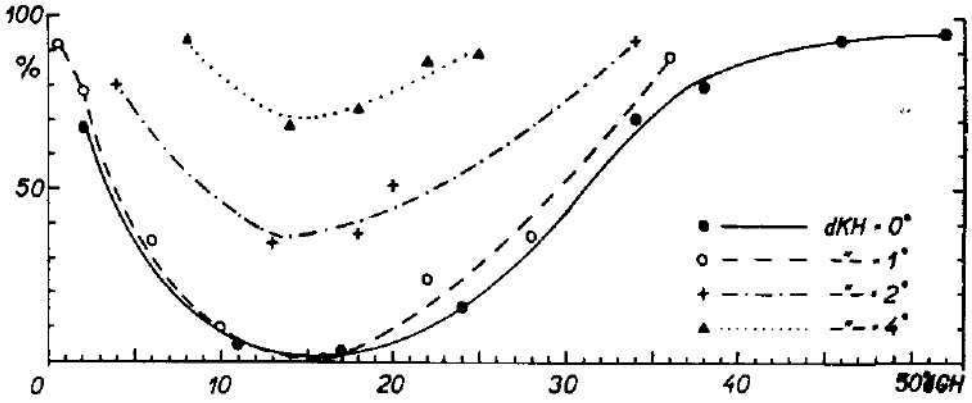

Abb. 9. Perzentuelle Gesamtsterblichkeit der Prachtkärpflingsbrut während der Entwicklung, d. h. der Embryonen von der Befruchtung der Eier bis zum Übergang der Larven zu exogener Nahrung, je nach Wasserhärtegrad.

Die Embryonen des Prachtkärpflings (*Roloffia roloffi*) benötigen demnach zu einer erfolgreichen Entwicklung eine bestimmte Sulfathärte, deren idealer Wert nach der graphischen Darstellung bei 14—16° dNKH liegt, und eine sehr niedrige Karbonathärte (unter 1° dKH).

Die ablaichenden Zuchtfische reagieren sichtbar in keiner Weise auf keine, wenn auch sehr jähe Veränderung der Wasserhärte, wie z. B. bei ihrer Übertragung aus einem harten Wasser mit 52° dNKH in ein Wasser mit nur 2° dNKH und umgekehrt. Dieser Versuch wurde einigemal wiederholt und die Zuchtpaare setzten dabei sogleich das Ablaichen fort. Auch weitere Beobachtungen der Fische nach einigen Stunden, eventuell mehreren Tagen ergaben bei ihnen keine pathologischen Veränderungen, nicht die geringsten Flossen- und Hautverletzungen. Die erwachsenen Prachtkärpflinge sind demnach imstande, einen Unterschied im osmotischen Druck von 50° dNKH sofort und ohne feststellbare physiologische Beschwerden auszugleichen. Auch die Atmung war nicht einmal in den ersten Augenblicken nach dem jähen Wechsel der Wasserhärte weder beschleunigt nocht sonst sichtbar erschwert.

Es ist nicht uninteressant, dass allgemein angenommen wird, dass die eierlegenden Zahnkarpfen der afrikanischen Unterfamilie *Rivulinae*, vorwiegend Bewohner von Urwald- und periodischen Gewässern, ein sehr weiches Wasser benötigen. Die Tatsachen der Versuchsserie mit der Art *Roloffia roloffi* zeigen jedoch, dass die optimale Wasserhärte für die Entwicklung der Embryonen hier viel höher liegt als z. B. bei den Karpfenfischen der gemässigten geographischen Zone, wo z. B. bei der Plötze (*Rutilus rutilus*) das Optimum 6—10° dGH beträgt (Frank, 1973).

Weiters wurde der Einfluss von Torf und wachsendem Torfmoos (*Sphagnum*) auf die Entwicklung der Eier der Art *Roloffia roloffi* untersucht. Nach einem Zusatz von Torfmull (auf 10 l Wasser ein hühnereigrosses Stück, das zerbröckelt wurde) laichten die Zuchtfische sehr intensiv in dieses am Beckenboden liegende Laichsubstrat. Innerhalb einer Woche nahm das Wasser eine klar goldgelbe Farbe an und im Verlauf von 3 Wochen sank die Wasserhärte von den ursprünglichen 16° auf 10° dNKH (bei 0° dKH). Befremdend ist dabei die Tatsache, dass sich die Entwicklungsdauer der Embryonen im Ei auffallend auf fast das Doppelte verlängerte, auch bei einer konstanten Durchschnittstemperatur von 26 °C und einer gleich starken Durchlüftung des Wassers. Sie stiegt von ursprünglich 10—12 Tagen auf 18—22 Tage an. Die Mortalität der Embryonen blieb im Prinzip in direkter Abhängigkeit von der Wasserhärte, der Zusatz von Torfmull verursachte jedoch einen auffallenden aber gleichmässigen Anstieg der Mortalität in allen Wasserhärten von 5 bis 25° dNKH um weitere 60—70 %. Unterhalb und oberhalb der erwähnten Härtegrenze erreichte die Mortalität sogar volle 100 %.

Einen weniger negativen Einfluss auf die Entwicklung hatte der Zusatz eines Büschels von wachsendem Torfmoos (*Sphagnum*), das im warmen und harten Wasser zu vegetieren begann und nach und nach abstarb. Innerhalb von 3 Wochen (d. h. während der Entwicklung der Eier, die sich ebenso wie im Falle des Zusatzes von Torfmull auf das Doppelte verlängerte), sank lediglich die Karbonathärte von 1—3° auf 0° dKH. Die Sulfathärte blieb unverändert. Die Mortalität der Embryonen blieb in einem direkten Verhältnis zur Wasserhärte, der Zusatz von Torfmoos erhöhte sie jedoch um weitere 10—15 % bei allen angewandten Wasserhärten von 2 bis 22° dNKH.

Bei den typischen Bodenlaichern, die gleichzeitig „annuelle" Arten sind, wurde bisher angenommen, dass eine oder mehrere Unterbrechungen der Entwicklung der Embryonen im Ei (Diapausen) vor allem durch Schwankungen im Sauerstoffgehalt des Bodengrundes verursacht sind. Der Sauerstoffgehalt des Grundes zur Zeit des Laichens ist nämlich viel niedriger und die Eier entwickeln sich vorerst gar nicht. Erst wenn der Grund zum Teil oder völlig ausgetrocknet ist, hat der Luftsauerstoff nach Freilegung des Grundes einen besseren Zutritt in den rissigen Boden und in den Schlamm und daher auch zu den Eiern. Die Eier und das Laichsubstrat bleiben jedoch ständig feucht. Die zweite Hemmungsphase tritt dann ein, wenn der Embryo bereits voll entwickelt ist, die Regenzeit jedoch noch nicht begonnen hat. Die Brut schlüpft erst dann, wenn die Eier unter Wasser gesetzt sind. Man setzt deshalb voraus, dass die erste Entwicklungsunterbrechung durch Sauerstoffmangel, die zweite hingegen durch Sauerstoffüberfluss hervorgerufen wird.

Die Beobachtungen des Einflusses der Wasserhärte auf die Entwicklung der Eier rückt einen weiteren Faktor in den Vordergrund, der auf eine ähnliche Art und Weise wie die Schwankungen des Sauerstoffgehalts die Embryonenentwicklung beeinflussen könnte. Zur Regenzeit wird zwar an den Naturlaichstellen der eierlegenden Zahnkarpfen meist eine sehr niedrige Gesamtwasserhärte (im allgemeinen 1—2° dGH) gemessen. An einigen Lokalitäten erreicht sie dagegen bei nur ein paar Arten bis 10° dGH, wie es Radda 1970, Sterba 1970, Busink-Nieuwenhuizen 1971, Foersch 1971a, b, Roloff 1971 und Schrieken 1971 feststellen konnten. Man kann jedoch gleichzeitig vermuten, dass während des Austrocknens periodischer Tümpel

lediglich Wasser (H_2O) verdunstet, die Salze sich jedoch in der verbleibenden kleineren Wassermenge konzentrieren und demnach die Wasserhärte erhöhen. Die Härte nimmt natürlich nicht direkt proportional zur Abnahme der Wassermenge zu, da Pflanzen, Zweige und Wurzeln von Bäumen und Sträuchern dem Wasser Salze entnehmen, oder auch unter gewissen Voraussetzungen in abgestorbenem Zustand schwache Ionenaustauscher werden. Dadurch nimmt vor allem die Karbonathärte des Wassers ab und eben deshalb sind wohl die Eier der Art *Roloffia roloffi* gegen Veränderungen dieser Härte besonders empfindlich. Nach Scheel (1966, 1968) stehen einander die Gattungen *Roloffia*, *Aphyosemion*, *Fundulosoma* und *Nothobranchius* entwicklungsmässig durch die Anzahl und Form der Chromosome sehr nahe. Es lässt sich deshalb voraussetzen, dass auch die Eier weiterer Arten der erwähnten Gattungen während ihrer Entwicklung ganz bestimmte und keinesfalls niedrige Ansprüche an die Sulfathärte des Wassers stellen. Im übrigen dürften z. B. die Vertreter der Gattung *Nothobranchius* wohl nicht in allen Fällen typisch „annuelle" Arten sein, wovon Beobachtungen von der Insel Mafia (Korthaus, 1973) zeugen, wo auch während der Trockenzeit täglich Regenfälle zu verzeichnen sind und die Tümpel nie völlig austrocknen. Dort bleiben also die Eier dieser Fische die ganze Zeit lang im Wasser und entwickeln sich darin.

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Die Tafeln sind am Ende des Heftes zu finden.

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NOTES ON THE MAMMAL FAUNA OF BULGARIA (INSECTIVORA, CHIROPTERA, RODENTIA)

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Abstract: The information is presented on new finds of 27 small mammal species (Insectivora, Chiroptera, Rodentia) in two areas of Southern Bulgaria (Central Rodopi Mts., Black Sea coast). Based on previous literature data brief remarks are given concerning the occurrence of these mammal species in Bulgaria. Special attention has been paid to the bat species collected — in particular to *Myotis nattereri* and *Myotis brandti* that were not previously recorded from Bulgaria.

INTRODUCTION

The Bulgarian small mammal fauna was studied by many authors, by Bulgarians (Beron, Bureš, Josifov, Kovačev, Markov, Paspalev, Pešev, and others) as well as by foreigners (Gaisler, Hanák, Hanzák, Heinrich, Nehring, Niethammer, Wolf, and others). Howerer, the knowledge on the distribution of some mammal species in Bulgaria and on the small mammal fauna of some regions of this country is not so far complete. This is why the publication of the present paper may serve a useful purpose.

The material recorded in the present paper was obtained in July and August 1971 during our stay in two areas of Southern and South-Eastern Bulgaria. We visited several localities in Central Rodopi Mts. (neighbourhood of the town Čepelare, the mount Perelik, neighbourhood of the village Jagodina) and several localities on the southern coast of the Black Sea (Some places at "Arkutino" Swamp and at Maslen-nos peninsula near the town Primorsko, neighbourhood of the village Izgrev near the town Mičurin) — fig. 1.

Small mammals were collected by means of common clap-traps. The number of traps set in one night ranged from 25 to 120; 495 — traps were set during 7 nights in Rodopi Mts. and 295 traps during 5 nights in the coast area. Bats were captured in mist nets stretched in front of cave entrances, over brooks, under bridges e.t.c. A part of bats caught was let out after identification, the main part of the sample obtained was taken for use in taxonomical studies.* In total, 130 specimens of bats and 45 specimens of insectivores and rodents were caught. The material we collected in Bulgaria is deposited in the collections of the Department of Zoology, National Museum, Prague, several specimens of bats *(Myotis daubentoni, Myotis bechsteini, Eptesicus serotinus, Barbastella barbastellus, Plecotus auritus)* are deposited in the collections of the Institute of Zoology, Bulgarian Academy of Sciences, Sofia.

Acknowledgements

We are very obliged to Dr. Petar Beron of the Institute of Zoology, Bulgarian Academy of Sciences, Sofia, for facilities enabling us to collect the mammals in Bulgaria as well as for his

* The informations on the results of taxonomic studies on material collected will be published in another paper.

kind help in preparing the expedition. Many thanks go to the members of the speleological club "Studenec" in Čeperale (Smoljan district) — especially to its chief Mr. Dimitr G. Rajčev, and to the members Kostadin Milčev, Ilja Jončev, Georgi D. Rajčev for their extensive help in our field work.Our thanks are due also to Dr. V. Hanák, CSc., Dr.V . Vohralík and Dr. J. Hanzák, CSc. (Prague) for their valuable comments on the present paper and for the loan of literature. We also thank Dr. J. Žalman (Brandýs n. Labem) for his kind loan of some traps.

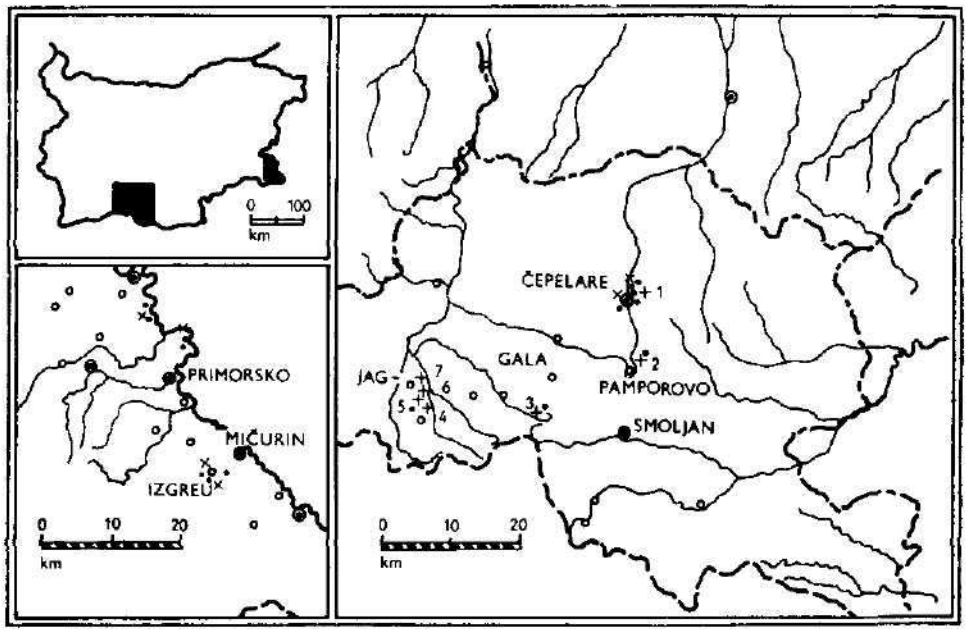

Fig. 1. Sketch-map of the investigated area. Explanations: — — - Bulgarian state border, — . — . — district border, ○ town, ○ village, • places where small ground mammals were collected, + caves where bats were netted, × localities where bats were netted, excluding caves. The numbers on figure indicate the situation of individual caves: 1 — Samurski dupki, 2 — the cave near the village Pamporovo, 3 — Ladenica, 4 — Jagodinska peštěra, 5 — Sančevo dupka, 6 — Dolno Karanska dupka, 7 — Gorno Karanska dupka.

RESULTS

Chiroptera

Systematical review

Rhinolophus ferrumequinum (Schreber, 1774)

CZE material (i. e. material collected in Bulgaria by the authors) "Jagodinska peštěra" Cave near the village Jagodina (Smoljan d.), 1050 m altitude — 3 ♂ ad., 1 ♀ ad., 2 ♀ subad. (2 August, 1971); "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — 1 ♂ ad. (3 August, 1871); "Karaul Taš" (Watch rocks") at Maslen-nos peninsula near the town Primorsko (Burgas — south d.), 10 m altitude — 11 ♀ ad., 3 ♂ juv., 1 ♀ juv. (17. August, 1971).

Previous records from Bulgaria: This species has been frequently recorded from 9 localities already by Kovačev (1906, 1907). Heinrich (1936) reports the species from the the caves in Strandža Mts., Hanák & Josifov (1959) present data on 11 additional finds of *R. ferrumequinum*, mostly also from the caves. Beron (1962) reports the occurence of this species in 62 caves of all main karst areas of Bulgaria.

Remarks: Common species all over the country, probably the most frequent of all Bulgarian horseshoe bat species.

Rhinolophus hipposideros (Bechstein, 1800)

CZE material: "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — recent skeleton (13 August, 1971).

Previous records from Bulgaria: From several caves recorded already by Bureš (1917, 1926), Kvartirnikov (1953), Beron (1958) and others. Beron (1962) presents the data on occurrence of this species in 45 caves.

Remarks: Relatively common species all over the country.

Rhinolophus euryale (Blasius, 1853)

CZE material: "Karaul Taš" (Watch rocks") at Maslen-nos peninsula near the town Primorsko (Burgas — south d.), 10 m altitude — 17 ♀ ad., 1 ♂ subad., 5 ♀ subad., 9 ♂ juv., 13 ♀ juv. (17 August, 1971).

Previous records from Bulgaria: "Temnata dupka" Cave near the village Lakatnik (Sofia d.) — Bureš (1917); "Devataškata peštěra" Cave (Loveč d.) — Kovačev (1925); "Golema Podlisca" Cave (Tarnovo d.) — Bureš (1926); caves at Strandža Mts. — Heinrich (1936); the caves: "Saeva dupka" and "Rušovata peštěra" (Loveč d.), "Golaškata peštěra" Cave (Sofia d.) — Beron (1958); the galleries north of Burgas — Hanák & Josifov (1959); "Zmejovi dupky" Cave (Sliven d.), Primorsko (Maslen-nos peninsula), (Burgas — south d.) — Hanák & Josifov (1959); "Uruška maara" Cave, "Futjovskaja peštěra" Cave (both Loveč d.), "Malkata peštěra" Cave (Vratca d. — Beron (1962).

Remarks: In Bulgarian temperate regions obviously no rare species.

Rhinolophus blasii (Peters, 1866)

CZE material: "Karaul Taš" (Watch rocks") at Maslen-nos peninsula near the town Primorsko (Burgas — south d.), 10 m altitude — 9 ♀ ad., 3 ♀ subad., 3 ♂ juv., 4 ♀ juv. (17 August, 1971).

Previous records from Bulgaria: the caves: "Ražiška peštěra" and "Komina" (Sofia d.), the cave near the village Sredná mera (Ruse d.) — Kvartirnikov (1957); the caves: „Židanka", "Temnata dupka" (Sofia d.), „Zmejovi dupki" (Sliven d.) — Beron (1958); „Suchata peštěra" Cave (Sofia d.), Primorsko (Maslen-nos peninsula), (Burgas — south d.) — Hanák & Josifov (1959); the caves: "Svinskata dupka" (Sofia d.), "Bozkite" (Jambol d.), "Prileparnika" (Vratca d.), "Orlovata peštěra" (Sliven d.), "Levi suhi peč", "Vodni peč", "Desni suhi peč" (Vidin d.), "Mišin kamik" (Michajlovgrad d.) — Beron (1962)

Remarks: *R. blasii* does live probably all over Bulgaria, it does not seem to be so common as the preceeding species, however.

Myotis mystacinus (Kuhl, 1819)

CZE material: "Ladenica" Cave on slope of the mountain "Perelik" near the village Gala (Smoljan d.), 1350 m altitude — 6 ♂ ad., 1 ♀ subad. (31 July, 1971); "Samurski dupki" Cave near the town Čepelare (Smoljan d.), 1240 m altitude — 1 ♂ subad. (7 August, 1971); the cave near the village Pamporovo (Smoljan d.), 1420 m altitude — 1 ♂ subad. (8 August, 1971); the river 1 km north of the town Čepelare (Smoljan d.), 1040 m altitude — 1 ♀ ad. (5 August, 1971); the stream 1 km south of the village Izgrev (Burgas — south d.), approx. 200 m altitude — 2 ♂ subad., 1 ♂ juv. (15 August, 1971).

Previous records from Bulgaria: neighbourhood of the town Plovdiv, September, 1921: 6 specimens (a type series of *Myotis mystacinus bulgaricus*, nom. nud.) — Heinrich 1936); Sofia, the loft of the Museum building, 15 July, 1921: 1 specimen (Petrov leg.), 5 September, 1931: 1 specimen (Konstantinov leg.); the village Tulovo near Kasanlak (Gabrovo d.), 22 May, 1957: 1 specimen — Hanák & Josifov (1959); the village Kubatovo (Sofia d.): 1 specimen (fals. det. *Myotis ikonnikovi* Ognev, 1912) — Kvartirnikov (1957).

Remarks: In Bulgaria, *Myotis mystacinus* seems to be a rare species. Based on our experiences, we suppose it to be relatively frequent in suitable regions of the country (especially in the mountains, near water tanks, e.t.c.). A great individual variation has been observed in collected specimens. E.g. several specimens have some features typical for *Myotis brandti* (protoconulus, secondary conus on P^3, and others) as well as others typical for *Myotis mystacinus* (measurements). This phenomenon is most conspicuous in specimens from Izgrev, which are very small in dimensions and in some external signs they remind of *Myotis ikonnikovi*.

Myotis brandti (Eversmann, 1845)

CZE material: "Ladenica" Cave at slope of the mountain "Perelik" near the village Gala (Smoljan d.), 1350 m altitude — 4 ♂ ad. (31 July, 1971); "Samurski dupki" Cave near the town Čepelare (Smoljan d.), 1240 m altitude — 1 ♂ subad. (7 August, 1971).
No previous records are known from Bulgaria.

Problem: In the year 1958 Topál noticed the occurence of two different forms of *Myotis mystacinus* in Europe, differing mainly in shape and size of penis and baculum. These, as well as other differences (mostly in measurements) are shown by Hanák (1965), who also analysed the known findings of the two forms and found them to be subspecies of *Myotis mystacinus*. After a profound study of extensive material Hanák (1970) and Gauckler & Kraus (1970) came to the conclusion that both forms should be considered two distinct, though morphologicaly similar, species: *Myotis mystacinus* (Kuhl, 1819) and *Myotis brandti* (Eversmann, 1845).

General distribution: Type locality: Sakmara river at the South of the Ural Mts. (*Vespertilio Brandti* Eversmann, E. 1845 — in Bull. Soc. Imp. Nat. Moscow XVIII : 489—516). The occurence of the form *brandti* is recorded from the European part of the U.S.S.R., Soviet Cenral Asia, Yugoslavia, Czechoslovakia (Hanák, 1965), from Hungary (Topál, 1958), Italy (Lanza, 1959), from southern Sweden (Wallin, 1969), Poland (Woloszyn, 1967; Hanák, 1970), Holland and France (Hanák, 1970), and from Germany (Hanák, 1970; Gauckler & Kraus, 1970). The finds of *Myotis brandti* in the Hungarian pleistocene (Topál, 1963) and in holocene materials from the Polish Tatra caves (Woloszyn, 1967; 1970) and the considerable its predominance in these materials indicate that in Europe *Myotis brandti* is more original species than *Myotis mystacinus* (Hanák, 1970).

Remarks: The majority of *Myotis brandti* specimens collected in the Rodopi Mts. seems to be similar to those from Central Europe in most of the studied signs (measurements, shape and size of penis and baculum, teeth). On basis of the relatively mass occurence of this species in the investigated area, we belive that *Myotis brandti* is probably not a very rare species there.

Myotis emarginatus (Geoffroy, 1806)

CZE material: "Ladenica" Cave at the slope of mountain "Perelik" near the village Gala (Smoljan d.), 1350 m altitude — 2 ♂ ad. (31 July, 1971); "Jagodinska peštěra" near the village Jagodina (Smoljan d.), 1050 m altitude — 6 ♂ ad. (2 August, 1971); "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — 3 ♂ ad. (3 August,1971); "Gorno Karanska" Cave near the village Jagodina (Smoljan d.), 1140 m altitude — 1 ♂ ad. (3 August, 1971); "Karaul Taš" ("Watch rocks") at Maslen-nos peninsula near the town Primorsko (Burgas — south d.), 10 m altitude — 1 ♀ subad. (17 August, 1971).
Previous records from Bulgaria: the caves at Strandža Mts. — Heinrich (1936); "Zmejovi dupki" Cave (Sliven d.), 27 May, 1957: nursing colony of about 50 individuals (Hanák leg.) — Hanák & Josifov (1959); Maslen-nos peninsula near Primorsko: nursing colony? — Beron (1958, 1961); "Bozkite" Cave near the village Mramor (Jambol d.), 7 July, 1959: nursing

colony of about 200 ind. (Beron leg.) — Beron (1961, 1962); the caves "Levi suhi peč" and "Vodni peč" near the village Dolni Lom (Vidin d.), 14 July, 1960: nursing colonies (Beron leg.) — Beron (1961, 1962); districts Peštěra and Pazardžik (Southern Bulgaria) — Atanasov & Pešev (1963).

Remarks: In the caves of temperate Bulgarian areas *Myotis emarginatus* ranks obviously among frequent species. Our finds indicate the possibility of its occurence also in regions of relatively higher altitudes.

Myotis nattereri (Kuhl, 1818)

CZE material: "Gorno Karanska" Cave near the village Jagodina (Smoljan d.), 1140 m altitude — 1 ♂ ad. (3 August, 1971).

No previous records are known from Bulgaria.

General distribution: From Western Europe to Japan (type locality: Hanau (Hesen — Central Germany) — as *Vespertilio Nattereri* H. Kuhl, 1818: in Ann. Wetter. Ges. Naturk. 4 (1) : 33). In Europe, *Myotis nattereri* seems to be most frequent in humid, cooler Central European midland regions (Germany, Bohemia). This species is supposed to live permanently also in the South-European areas, of course much more rarely. Only two finds (both of single individuals) were known from Balkan peninsula: one in Rumania (Bielz, 1888 — ex Dumitrescu et al., 1960) and one in Eastern Hercegovina (ex Dulić, Tortić, 1959). Recently, Mirić (1969) reports the finds of 3 specimens (1 ♂, 2 ♀) in neighbourhood of the town Novi Sad (Vojvodina, Yugoslavia).

Remarks: The measurements (HB 40, T 43.5, FA 40, E 18, Tr 10.5) as well as other signs in our specimen do not differ from those in specimens from Central Europa. The character of the area where our specimen was obtained seems to be quite different from the character of areas in Bohemia in which we known *Myotis nattereri* to be a relatively frequent species.

Myotis bechsteini (Kuhl, 1818)

CZE material: „Jagodinskaja peštěra" Cave near the village Jagodina (Smoljan d.), 1050 m altitude — 1 ♂ ad. (2 August, 1971).*)

Previous records from Bulgaria: the valley of the river Kamčija — Heinrich (1936); Evksinograd near Varna, 3 August, 1935: 3 spec. — Bureš leg.; Borovec in Rila Mts. (1350 m altitude), 18 July, 1950: 1 spec. — Bureš leg.; "Gornata propast" Cave near the town Bělogradčik (Vidin d.), 16 February, 1960: 1 male — Beron leg. (Beron, 1961).

Remarks: The occurence of *Myotis bechsteini* is recorded almost from all European contries (in the East as far as from Transcaucasia), however nowhere frequently. It seems to be a relict retreating species occuring mostly in coherent forested mid- and highlands areas.

Myotis myotis (Borkhausen, 1797)

CZE material: "Ladenica" Cave on slope of the mountain Perelik near the village Gala (Smoljan d.), 1350 m altitude — 4 ♂ ad., 1 ♀ ad., 1 ♀ subad. (31 July, 1971); „Jagodinskaja peštěra" Cave near the village Jagodina (Smoljan d.), 1050 m altitude — 1 ♂ ad., 1 ♀ ad. (2 August, 1971); "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — 1 ♂ ad. (3 August, 1971); "Samurski dupki" Cave near the town Čepelare (Smoljan d.), 1240 m altitude — 1 ♀ subad. (7 August, 1971).

Previous records from Bulgaria: *Myotis myotis* ranks among frequent species. Many authors record it from a great number of localities — e.g. Beron (1962) presents data on the occurence of this species in 31 caves in most of Bulgarian Karst areas.

*) In June 1972, 2 ♀ subad. *Myotis bechsteini* were collected at Arkutine Natural Park (Burgas-south d.) by Dr. Z. Bárta (Muzeum of Litvínov, Czechoslovakia). Both the specimens are deposited in the collections of Institute of Systematic Zoology, Charles University, Prague under Coll. No. 54/73 and 55/73.

Myotis blythi (Tomes, 1857)

CZE material: "Ladenica" Cave on slope of the mountain Perelik near the village Gala (Smoljan d.), 1350 m altitude — 3 ♂ ad., 2 ♀ ad., 4 ♀ subad. (31 July, 1971); "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — recent skeleton (2 August, 1971).

Previous records from Bulgaria: A very common species all over the country. As *Myotis oxygnathus* Monticelli, 1885 and *Myotis blythi oxygnathus* recorded from many localities by e.g. Heinrich (1936), Kvartirnikov (1956), Hanák & Josifov (1959), Beron (1958, 1962).

Myotis daubentoni (Kuhl, 1819)

CZE material: the stream 1 km south of the village Izgrev (Burgas d.), approx. 200 m altitude — 1 ♂ subad. (15 August, 1971).

Previous records from Bulgaria: valley of the river Kamčija (Varna d.) — Heinrich (1936); Sofia, loft of the Museum building, 20 May, 1932: 1 spec. (Konstantinov leg.) — Hanák & Josifov (1959); "Orlovata peštĕra" Cave near the town Kotel (Sliven d.): 1 spec. (Gueorguiev leg.) — Beron (1961, 1962); a mine tunnel at Lozen Mts. (20 km south from Sofia), 5 April, 1958: 1 spec. (Beron leg.) — Beron (1961, 1962); "Kalenska peštĕra" Cave near the village Kalen (Vratca d.), 8 September, 1959: 1 spec. (Beron leg.) — Beron (1961, 1962); „Uruška maara" Cave near the village Krušuna (Loveč d.), 24 July, 1959: 1 juv. spec. (Beron leg.) — Beron (1961, 1962).

Remarks: *Myotis daubentoni* appears to occur uncommonly in all lowland areas of Bulgaria, in particular obviously near water tanks, streams, e.t.c.

Eptesicus serotinus (Schreber, 1774)

CZE material: "Ladenica" Cave on the slopes of mountain Perelik near the village Gala (Smoljan d.), 1350 m altitude — 1 ♂ ad. (31 July, 1971); "Jagodinskaja peštĕra" Cave near the village Jagodina (Smoljan d.), 1050 m altitude — 2 ♂ ad. (2 August, 1971); "Sančevo dupka" Cave near the village Jagodina (Smoljan d.), 1020 m altitude — 1 ♂ subad. (3 August, 1971).

Previous records from Bulgaria: the village Sadovo (Plovdiv d.) — Kovačev (1907); the valley of the river Lom near the village Pisanec (Ruse d.), the valley of the Kamčija river (Varna d.), Plovdiv, the Strandža Mts. — Heinrich (1936); the Rila monastery — Wolf (1940); „Levi suhi peč" Cave near the village Dolni Lom (Vidin d.), 2 February, 1961: 1 spec. — Beron (1962); Pazardžik, Šumen — Atanasov & Pešev (1963); Kavarna (1 ♂), Pechtera (1 ♂) — Gaisler (1970).

Remarks: Beron (1962) considers this species to be rare in Bulgaria. On the basis of comparing the results of our Bulgarian netting works with results of similar works in Czechoslovakia, where *Eptesicus serotinus* seems to be a common species, it does not appear to be very rare in the areas studied. As species which does not occur in caves as a rule, it is ascerteinable by commonly used methods only with dificulty.

Barbastella barbastellus (Schreber, 1774)

CZE material: "Ladenica" Cave on the slope of mountain Perelik near the village Gala (Smoljan d.), 1350 m altitude — 1 ♂ ad. (31 July, 1971).

Previous records from Bulgaria: the valley of the Kamčija river (Varna d.) — Heinrich (1936); neighbourhood of the town Velingrad (Pazardžik d.) — Atanasov & Pešev (1963).

Remarks: *Barbastella barbastellus* lives in Europe predominantely in cooler humid forest areas (e.g. Central Europe). It occurs obviously in areas with similar character also in South European regions, but much less frequently as indicated by a small number of the finds of this species in these regions. In Bulgaria it seems to be a very rare species.

Plecotus auritus (Linnaeus, 1758)

CZE material: "Samurski dupki" Cave near the town Čepelare (Smoljan d.), 1240 m altitude — 1 ♂ subad. (30 July, 1971); "Ladenica" Cave on the slope of mountain Perelik near the village Gala (Smoljan d.), 1350 m altitude — 1 ♂ subad. (31 July, 1971). One recent and six subrecent skulls and partial skeletons of this species were found at the second dome of a last cave (aproximately 100 m from the cave entrance).

Previous records from Bulgaria: The species *Plecotus auritus* and *Plecotus austriacus* (Fischer, 1829) were distinguished in principle only recently. In Bulgarian material, in the year 1964 by Beron. Until this year, all Bulgarian *Plecotus* bats were recorded as *Plecitus auritus* (by Kovačev; Bureš; Wolf; Beron, 1958, 1959, 1962; Hanák & Josifov, 1959; Atanasov & Pešev, 1963; and others). According to Beron's (1964) data the majority of *Plecotus* findings reported by mentioned authors should be be considered as findings of *Plecotus austriacus*. Then, *in Bulgaria, only four specimens from two localities were precisely known to be Plecotus auritus:* Borovec in the Rila Mts.: 3 spec. — Bureš leg.; Pamporovo in the Rodopi Mts. (Smoljan d.:) 1 spec. — Beron (1964). As *Plecotus auritus* should be considered probalby also bats recorded from the Rila Mts. by Boetticher (1925) — cf. Beron (1964).

Remarks: According to our opinion the present findings indicate the *Plecotus auritus* being the original, and at present the only, member of the genus *Plecotus* in woody mountain areas of Bulgaria. This suggested fact agrees with the situation in other European regions (Hanák, 1966, 1969). Based on our present findings we suppose *Plecotus auritus* not to be very rare in highland areas of Bulgaria.

Ecological remarks to the finds of bats

The caves in the Rodopi Mts. where the bats were netted could be devided into two types (according to the character of karst area in which they are situated): (1) the caves of "forest karst" (Samurski dupki, Ladenica, the cave near the village Pamporovo), and (2) the caves of "plateau karst" (Jagodinskaja peštěra, Sančevo dupka, Dolno Karanska dupka, Gorno Karanska dupka). The caves of the first type are situates at the deep, narrow and humid valleys covered by coherent — mostly conifer — growth; they often have the mountmilk decoration, the stalagmite decoration is poor. (2) The caves of "plateau karst" have a rich stalagmite decoration as a rule, they are situated in broad, open temperate dells with rare leafy woods changing through bush vegetation into bare broken rocks. We suppose that both these types of karst areas differ considerably in their climatic conditions (then also in microclimatic conditions of individual caves). According to our opinion this is the main reason explaining not only the differences in the cave decoration but also the differences observed in species composition of the fauna of bats seeking for these caves (cf. tab. 1).

None of the caves we visited in the Rodopi Mts. is evidently ihabited by bats permanently during the summer. The bats we netted at the cave entrances, are supposed to use these caves as transient rooststs. Based on our present expeiences, we supposed that the bats in the period when they change their permanent summer and winter roosts probably visit and "inspect" a great number of possible roosts during one night. Thus, the probability of finding them is considerably greater in this period than in any other time. This is an explanation of the fact why there have been obtained specimens of the species otherwise very rare in the studied area, that seem to be practically unobtainable by commonly used methods.

Tab. 1. The composition of samples of the bats netted at entrances of caves in the Rodopi Mts.

Type of locality	cave of "the forest karst"					cave of "the plateau karst"					Total					
Locality / Species	Samurski dupki 30—7—1971 7—8—1971	Ladenica 31—7—1971	cave near Pamporovo 8—8—1971	Total x	Total %	Jagodinska peštéra 2—8—1971	Sančovo dupka 3—8—1971	Gorno Karanska dupka 3—8—1971	Total x	Total %	♂ ad.	♂ sad.	♂ juv.	♀ ad.	♀ sad.	Total
Rhin. ferrumequinum	—	—	—	—	—	6	1	—	7	28	3	1	—	1	2	7
Myotis mystacinus	1	7	1	9	25	—	—	—	—	—	6	1	1	—	1	9
Myotis brandti	1	4	—	5	15	—	—	—	—	—	4	1	—	—	—	5
Myotis emarginatus	—	2	—	2	5	6	3	1	10	40	12	—	—	—	—	12
Myotis nattereri	—	—	—	—	—	—	—	1	1	4	1	—	—	—	—	1
Myotis myotis	1	6	—	7	20	2	1	—	3	12	5	—	—	2	3	10
Myotis blythi	—	9	—	9	25	—	—	—	—	—	3	—	—	2	4	9
Myotis bechsteini	—	—	—	—	—	1	—	—	1	4	1	—	—	—	—	1
Eptesicus serotinus	—	1	—	1	2,5	2	1	—	3	12	3	1	—	—	—	4
Barb. barbastellus	—	1	—	1	2,5	—	—	—	—	—	—	1	—	—	—	1
Plecotus auritus	1	1	—	2	5	—	—	—	—	—	—	2	—	—	—	2
Total	4	31	1	36	100	17	6	2	25	100	38	7	1	5	9	61

Tab. 2. Time of capturing bats in mist nets at the entrances of caves in the Rodopi Mts.

species \ time of capturing	6–7 P. M.	7–8 P. M.	8–9 P. M.	9–10 P. M.	10–11 P. M.	11–12 P. M.	0–1 A. M.	1–2 A. M.	Total	
Rhin. ferrumequinum	0	0	0	1	1	1	3	1	7	
Myotis mystacinus	0	2	0	2	1	3	1	0	9	
Myotis brandti	0	1	0	0	2	1	1	0	5	
Myotis emarginatus	0	0	2	0	2	5	0	1	10	(+2)
Myotis nattereri	0	0	0	0	1	0	0	0	1	
Myotis myotis	0	0	1	1	4	1	2	0	9	(+1)
Myotis blythi	0	0	0	2	1	2	1	3	9	
Myotis bechsteini	0	0	0	0	0	1	0	0	1	
Eptesicus serotinus	0	0	0	0	1	0	3	0	4	
Barb. barbastellus	0	0	0	0	0	1	0	0	1	
Plecotus auritus	0	0	1	1	0	0	0	0	2	
Total X	0	3	4	7	13	15	11	5	58	(+3)
%	0	6	7	13	20	26	19	9	100	

The nettings provided some information on the night flying activity of bats in summer migrations. As demonstrated in tab. 2, the majority of bats obtained was caught around midnight (10 PM — 1 AM).

The fact is interesting that there are practicaly only the adult and subadult, sexually active individuals in the obtained sample (tab. 1). This fact seems to be a characteristic feature of the initial phase of autumn migrations, when the possible roosts are sought by adult animals (in particular by males which use these localities already from the early summer — some males apper to have probably no permanent summer roosts) for mating. In the other phase migrations, whose aim is probably the selection of suitable winter roost, the immature animals form an adequate part of the sample (Horáček, in prep.).

Insectivora and Rodentia

Note: Considering the fact that practically all the collected species of both these orders seem to be common in Bulgaria and their occurence is known from the visited areas, we consider a detailed evaluation of our limited material unnecessary. In this paper, we would like to give only a brief enumeration of our own findings without presenting the literature data on previous records from Bulgaria.

Systematical review

Sorex araneus Linnaeus, 1758

CZE material: subalpine meadow on the slope of the "Perelik" mountain near the village Gala (Smoljan d.), 1720 m altitude — 1 ♀ (1 August, 1971); the meadow at the edge of forest, approx. 2 km to the south of village Pamporovo (Smoljan d.), 1350 m altitude — 1 ♀ (9 August, 1971).

Remarks: Atanasov & Pešev (1963) record this species to be common at suitable localities all over Bulgaria. The Rodopian population of *Sorex araneus* is analysed by Mitev (1970).

Sorex minutus Linnaeus, 1766

CZE material: Čepelare (Smoljan d.), the meadow at the edge of a forest, approx. 2 km north of the town, 1100 m altitude — 1 ♂ (6 August, 1971).

Remarks: In Bulgaria *Sorex minutus* is known to occur in the mountains: Vitoša, Rila and Rodopi (Markov, 1957; Atanasov & Pešev, 1963). Specimens of *Microtus arvalis*, *Pitymys subterraneus* and *Apodemus (flavicollis?)* were obtained at the same place as the specimen mentioned above.

Crocidura leucodon (Hermann, 1780)

CZE material: the peninsula near Arkutino Natural Park (Burgas — south d.), dry meadow approx. 30 m altitude — 1 ♂ (13 August, 1971); the Natural Park Arkutino (Burgas — south d.) bushs at the outskirts of swamp virgin forest, 10 m altitude — 1 ♂, 2 ♀ (19 August, 1971).

Remarks: Relatively frequent occurence of this species recorded from many localities (Markov, 1957). From the South Bulgarian Black Sea coast it is recorded by e.g. Hanák (1964) from the places only several km away from our locality.

Crocidura suaveolens (Pallas, 1811)

CZE material: the peninsula near Arkutino Natural Park (Burgas — south d.), dry meadow approx. 30 m altitude — 1 ♂ (13 August, 1971); dry plateaus with bush vegetation near the village Izgrav (Burgas — south d.), approx. 300 m altitude — 1 ♀ (14 August, 1971), 1 ♀ (15 August, 1971).

Remarks: Probably the most frequent Bulgarian shrew species.

Dryomys nitedula (Pallas, 1779)

CZE material: Čeperale (Smoljan d.), stone wall at the slope of a hill approx. 2 km north of the town, 1150 m altitude — 1 ♂ (6 August, 1971).

Remarks: Relatively common species in all Bulgarian highlands (Markov, 1964).

Mus musculus Linnaeus, 1758

CZE material: Čepelare (Smoljan d.), a little house at the river, 1050 m altitude — 1 ♂ (5 August, 1971), 1 ♀ (10 August, 1971); the peninsula at Arkutino Natural Park (Burgas — south d.), dry meadow, approx. 30 m altitude — 1 ♂ (13 August, 1971); the orchard near the village Izgrev (Burgas — south d.), approx. 300 m altitude — 1 ♀ (14 August, 1971).

Remarks: The specimens from the coast localities have signs distinguishing the subspecies *Mus musculus spicilegus* Petenyi, 1882 (syn. ? *Mus musculus hortulanus* Nordmann, 1840), whose common occurence is known from many areas of Bulgaria (e.g. Heinrich, 1936; Markov, 1962, 1964). Very dark colouring of specimens from the Rodopi Mts. enables us to consider them to be members of the subspecies *Mus musculus domesticus* Rutty, 1772, whose occurence is also recorded from Bulgaria (Atanasov & Pešev, 1963 — as *Mus musculus musculus* Linnaeus, 1758).

Apodemus sylvaticus (Linnaeus, 1758) et *Apodemus flavicollis* (Melchior, 1834)

Note: In view of the fact that exact distinguishing of the specimens of the mentioned species (in particular those of South-European populations) is very difficult (cf. Niethammer, 1969), we present the data on our findings of both these species together.

CZE material: Čepelare (Smoljan d.), the meadow at a brook valley 1 km east of the town, 1050 m altitude — 1 ♂, 1 ♀ (30 July, 1971); the meadow on a slope of Perelik mountain near the village Gala (Smoljan d.), 1700 m altitude — 1 ♂ (1 August, 1971); Čepelare (Smoljan d.), the meadow at a summit of a hill 3 km north-east of the town, 1200 m altitude — 1 ♀ (5 August, 1971); Čepelare (Smoljan d.), the meadow at a forest edge 2 km north-east of the town, 1100 m altitude — 2 ♂, 1 ♀ (6 August, 1971); Čepelare (Smoljan d.), a stone wall on the slope of a hill 2 km north of the town, 1150 m altitude — 3 ♂, 1 ♀ (10 August, 1971); dry plateau with bush vegetation near the village Izgrev (Burgas — south d.), approx. 300 m altitude — 1 ♂ (14 August, 1971); dry meadow with bush vegetation at Maslen-nos peninsula (Burgas — south d.), 20 m

altitude — 1 ♀ (17 August, 1971); the swamp virgin forest Arkutino (Burgas — south d.), 10 m altitude — 2 ♀, 1 ♂ (19 August, 1971).

Remarks: Both species are known to be common in all Bulgaria (Atanasov & Pešev, 1963).

Pitymys subterraneus (de Sélys Long-champs, 1836)

CZE material: the meadow at a slope of the mountain Perelik near the village Gala (Smoljan d.), 1700 m altitude — 1 ♀ (1 August, 1971); Čepelare (Smoljan d.), the meadow at the edge of a forest, 2 km north-east of the town, 1100 altitude — 3 ♀ (6 August, 1971).

Remarks: Atanasov & Pešev (1963) record the occurence of *Pitymys subterraneus* from the mountains of Pirin and Rodopi. The Rodopian population of this species is analysed by Mitev (1971).

Microtus arvalis Pallas, 1778

CZE material: the meadow on a slope of Perelik mountain near the village Gala (Smoljan d.), 1720 m altitude — 1 ♂, 1♀ (1 August, 1971); Čepelare (Smoljan d.), the meadow at a forest edge 2 km north-east of the town, 1100 m altitude (the type locality of *Microtus arvalis rhodopensis* Heinrich, 1936, ssp. nom. nud.) — 1 ♀ (6 August, 1971); the peninsula near Arkution Natural Park (Burgas — south d.), dry meadow, 30 m altitude — 1 ♂ (13 August, 1971).

Remarks: Common occurence of *Microtus arvalis* is known from many localities in practically all Bulgarian areas.

Microtus nivalis Martins, 1842

CZE material: Čepelare (Smoljan d.), a stone wall on the slope of a hill 2 km north of the town, 1150 m altitude — 2 ♀ (9 August, 1971); 1 ♂, 1♀ (10 August, 1971); Čepelare (Smoljan d.), a stone wall at a summit of a hill 3 km north-east of the town, 1200 m altitude — 1 ♀ (6 August, 1971).

Remarks: Pešev (1969, 1970) studying the distribution and systematic position of Bulgarian *Microtus nivalis*, records this species from the mountains of Vitoša, Rila, Rodopi, Pirin, Slovjanka, Balkan.

Note:

The occurence of some small mammal species was ascertained also by presence of the remains of their skeletons in the Eagle Owl (*Bubo bubo*) pellets found at a rock in Maslen-nos peninsula near the town Primorsko (Burgas — south d.). Results of the analysis of about 10 pellets taken at this place is given below.

Insecta, Coleoptera: *Lucanus cervus* — 1 spec., *Cerambyx cerdo* — 1 spec.
Aves: *Gallinula chloropus* — 1 spec.
Mammalia: *Erinaceus roumanicus* — 1 spec., *Muscardinus avellanarius* or *Dryomys nitedula* (one mandible without teeth only), *Glis glis* — 3 spec., *Microtus arvalis* — 4 spec., *Arvicola terrestris* — 2 spec., *Apodemus (Sylvimus)* sp. *(sylvaticus ?)* 1 spec., *Rattus rattus* — 1 spec.

Remarks: The ascertaining of only the find of *Muscardinus avellanarius* (or *Dryomys nitedula*) seems to be of more interest. According to our knowledge none of these species was found in the mentioned area. *Muscardinus avellanarius* is known to occur only in the neighbourhood of Sofia, in Bulgaria. The occurence of all other species recorded above is known so far from South Bulgarian coast area.

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ON SOME NEMATODES FROM EGYPTIAN FRESHWATER FISHES

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Abstract: The present paper comprises a systematic survey of parasitic nematodes collected from 189 specimens of freshwater fishes in Egypt. The recovered nematodes represented 9 species (*Camallanus longicaudatus*, *Paracamallanus cyathopharynx*, *Procamallanus laeviconchus*, *Rhabdochona congolensis*, *Spinitectus allaeri*, *Cucullanus barbi*, *Dichelyne fossor*, *Citharinicola citharini* and *Capillaria fritschi*), four of them being reported from North Africa or Egypt for the first time. In addition to some new and revised data on the morphology and variability of the individual parasite species, taxonomic problems, the range of hosts and geographical distribution are also discussed. The species *Paracamallanus senegalensis* Vassiliades, 1970 has been synonymized with *P. cyathopharynx* Baylis, 1923 and *Capillaria yamagutii* Tadros et Mahmoud, 1968 with *C. fritschi* Travassos, 1914. A new name, *Cucullanus papernai* nom. nov. is proposed for *C. barbi* Paperna, 1964 which is the homonym to *C. barbi* Baylis, 1923.

Although studies on parasitic worms from Egyptian fishes date back to the last century (Wedl, 1862; Fritsch, 1886; Loos, 1893, 1899), little knowledge is available on the helminth fauna of freshwater fishes from Egypt. Generally attention has been given to digenetic trematodes, while other groups of parasites have been neglected. Data on nematodes from Egyptian fishes have been reported only by Wedl (1862), Fritsch (1886), Baylis (1923a, b), Törnquist (1931) and Tadros, Mahmoud (1968) who found a total of five species. Lately two theses have been worked out on parasites of Egyptian freshwater fishes; the results, however, have not been published as yet. The thesis by El-Naffar (1970) has not been available to the present author. Imam (1971) in his thesis reports on helminth parasites from seven species of Nile fishes; among these six nematode species were recorded. A new fish nematode, *Camallanus longicaudatus*, has been described from Egypt quite recently (Moravec, 1973).

From October 1971 until March 1972, while working at the National Research Centre, Cairo, the author examined helminthologically some Nile fishes which proved to be invaded by a number of helminth parasites. The present paper involves results of the systematic evaluation of nematodes.

MATERIAL

A total of 189 fishes representing 25 species of 12 families were dissected. Most of them were bought in the fish market in Cairo (Giza), this being supplied almost exclusively with fishes from the Nile near Cairo, less often from the adjacent irrigation canals. Only a small number of fish was caught by the author and his colleagues in the River Nile in Cairo and near the village of El-Karatem as well as in some canals and drains in the vicinity of Cairo. Helminthological examinations were carried out in the laboratories of the National Research Centre, Cairo. A list of the fish hosts examined is as follows (the number of specimens dissected is given in brackets):

Fam. Mormyridae: — *Mormyrus caschive* (1), *Mormyrus kannume* (2), *Marcusenius isidori* (5)
Fam. Characidae: — *Hydrocyon forskali* (1), *Alestes nurse* (21)
Fam. Cyprinidae: — *Labeo horie* (4), *Labeo forskali* (1), *Barbus bynni* (7), *Barbus perince* (9), *Barbus werneri* (1)
Fam. Clariidae: — *Clarias lazera* (25), *Clarias anguillaris* (1)
Fam. Bagridae: — *Bagrus bayad* (12), *Bagrus docmac* (1), *Chrysichthys rueppelli* (9)
Fam. Mochocidae: — *Synodontis schall* (4)
Fam. Schilbeidae: — *Schilbe mystus* (4), *Eutropius niloticus* (1)
Fam. Malapteruridae: — *Malapterurus electricus* (1)
Fam. Poeciliidae: — *Gambusia affinis* (25)
Fam. Anguillidae: — *Anguilla anguilla* (8)
Fam. Serranidae: — *Lates niloticus* (7)
Fam. Cichlidae: — *Tilapia zilli* (32), *Tilapia nilotica* (1), *Haplochromis desfontainesi* (6)

SURVEY OF SPECIES

Fam. Camallanidae Railliet et Henry, 1915

1. *Camallanus longicaudatus* Moravec, 1973

Host: *Labeo horie* Heck.
Location: anterior end of intestine.
Incidence: in 1 out of 4 fishes examined; intensity of infection: 3 specimens.

A description of this new nematode species has been given in an earlier paper (Moravec, 1973).

2. *Paracamallanus cyathopharynx* (Baylis, 1923) (Fig. 1)

(Syn.: *P. senegalensis* Vassiliades, 1970)
Host: *Clarias lazera* C. & V.
Location: posterior part of intestine.
Incidence: in 4 out of 25 fishes examined; intensity of infection: 1 to 3 specimens.

Description: Medium sized nematodes, females considerably larger then males. Buccal capsule large, strongly sclerotized, yellowish to orange in colour. Mouth composed of two lateral valves, each strengthened inside by several longitudinal ribs extending maximally to base of tridents. Each valve provided with two big mouth papillae (one dorsolateral, one ventrolateral) and two elongated, oblique, strongly sclerotized plates near its anterior margin. Dorsal and ventral sides of anterior part of buccal capsule armed with large tridents with moderately sclerotized posterior ends. Valves followed by "pharynx", divided into two sections. Anterior section almost as wide as the valvular part of buccal capsule, formed by a wide, thick-walled, strongly sclerotized ring with a spacious cavity inside. Posterior section of "pharynx" represented by thin-walled ring (shaped as a reversed truncated cone), with three big teeth inside. Teeth occupying almost the entire space of the posterior section of "pharynx", their anterior ends protruding up to the cavity of anterior section. Cervical papillae small, situated just below the buccal capsule. Oesophagus composed of two parts — slightly shorter anterior muscular part and posterior glandular part. Nerve ring encircling oesophagus at a short distance below buccal capsule, excretory pore not located.
Male: Length of body 3.37—4.89 mm, maximum width 0.082—0.122 mm. Complete buccal capsule measuring 0.093—0.105 mm (anterior part 0.060 to 0.069 mm, "pharynx" 0.033—0.042 mm) in length; maximum width of anterior part 0.063—0.069 mm, of "pharynx" 0.051 mm. Each valve always

with 9 ribs. Length of tridents 0.051—0.060 mm. Length of muscular oesophagus 0.405—0.450 mm, of glandular oesophagus 0.456—0.600 mm. Nerve ring at 0.135—0.183 mm, cervical papillae at 0.129—0.156 mm from anterior extremity. Posterior end of body conical provided with narrow alae; tail tip with a sharp cuticular spike. Papillae pedunculate, 5 pairs preanal and 5 pairs postanal were found. First and second as well as third and fourth postanal pairs close to each other. Papillae of last pairs indistinct, possibly

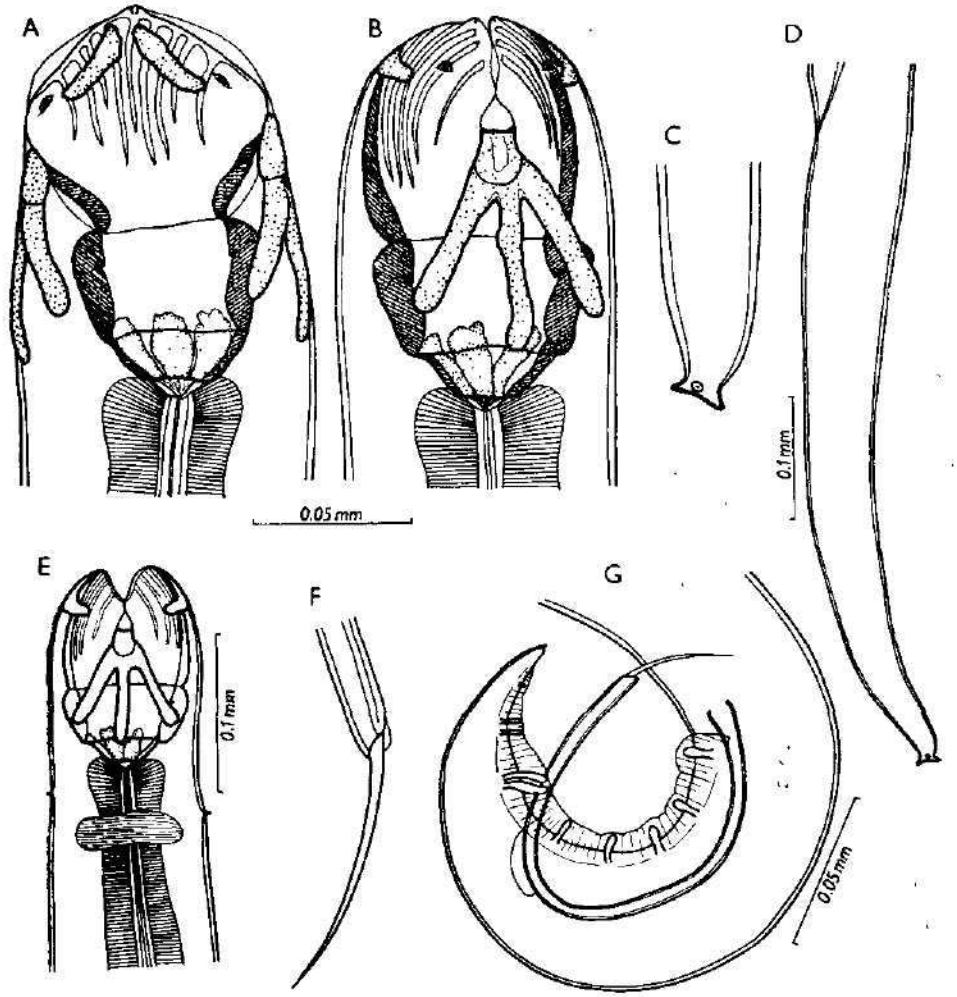

Fig. 1. *Paracamallanus cyathopharynx* (Baylis, 1923). A, B — buccal capsule (lateral and dorsal view); C — tip of female tail; D — female tail; E — head end (dorsal view); F — distal end of spicule; G — posterior end of male (lateral view). Orig.

more postanal pairs present. Spicules unequal. Larger spicule well sclerotized, 0.249—0.261 mm long, with awl-shaped distal process (0.036—0.039 mm long). Small spicule weakly sclerotized, hardly visible, approximately

0.025 mm long; its shape and location suggesting the gubernaculum. Length of tail 0.063—0.066 mm.

Female: Length of body 8.30—13.75 mm, maximum width 0.136—0.190 mm. Length of complete buccal capsule 0.135—0.165 mm (length of anterior part 0.081—0.099 mm, of "pharynx" 0.057—0.069 mm), maximum width of its anterior part 0.090—0.099 mm, of "pharynx" 0.072—0.084 mm. Tridents 0.069—0.081 mm long. Length of muscular oesophagus 0.525 to 0.680 mm, of glandular oesophagus 0.675—0.816 mm. Nerve ring at 0.195 to 0.249 mm, cervical papillae at 0.162—0.189 mm from anterior extremity. Tail conical, 0.315—0.570 mm long, ending in three small, cone-shaped processes (length 0.006—0.009 mm). Vulva with elevated lips, almost equatorial, only in younger females shifted more posteriorly. Diameter of round eggs 0.018—0.024 mm. Uterus of fully mature females filled with moving larvae (length 0.264 mm, width 0.012 mm).

Comments: Originally the species *P. cyathopharynx* was described by Baylis (1923a) from the host *Clarias anguillaris* from Egypt, from where it has recently been reported also by Imam (1971). The same nematode is known to parasitize fishes of the family *Clariidae* in the Sudan (Törnquist, 1931; Khalil, 1969), the Congo (Campana-Rouget, 1961) and in Israel (Paperna, 1964a). The morphology and measurements of the nematodes from the present material agree in general with data in the literature; in addition I found the presence of three large teeth in the "pharanx" (these correspond to the three sectors of the oesophagus) which are less sclerotized than other parts of the buccal capsule.

In 1970, a new species of the genus *Paracamallanus—P. senegalensis* was described from Senegal by Vassiliades who separated it from *P. cyathopharynx* mainly on the basis of the longer size of its tridents. However, as I found in the specimens of the present material and as quoted by Törnquist (1931), the tridents are much longer in *P. cyathopharynx* than figured by Baylis (1923a). These differences can be explained by the fact that the posterior ends of the tridents are considerably less sclerotized than their anterior parts and consequently less distinct. I found the structure of the buccal capsule in *P. cyathopharynx* identical with that described for *P. senegalensis*, and also the measurements of both species are similar. The only difference is in the number of postanal papillae in the male; Vassiliades (1970) described for *P. senegalensis* two additional pairs of transverse papillae situated close to each other just below the cloaca. His drawings indicate, however, that the two transverse cuticular mounds, which are present also in several other members of the family *Camallanidae* (e.g. of the genus *Camallanus*), were taken for the papillae. In view of the close relationship of the hosts of both species and of the fact that both parasite species occur in the same geographical region, I consider the name *Paracamallanus senegalensis* Vassiliades, 1970 to be a synonym of *P. cyathopharynx* (Baylis, 1923).

3. *Procamallanus laeviconchus* (Wedl, 1862) (Fig. 2)

Hosts: *Clarias lazera* C. & V., *Schilbe mystus* (L.).

Location: stomach.

Incidence: in 2 out of 25 *C. lazera* and in 1 out of 4 *S. mystus* examined; intensity of infection: 1 to 2 specimens.

Male: Length of body 5.56 mm, maximum width 0.109 mm. Cuticle very thick with distinct transverse striation. Mouth apperture rounded, its margin provided with fine cuticular membrane. Four oral papillae (two dorsolateral and two ventrolateral) and two lateral amphyds present. Mouth a yellowish, oval, buccal capsule; its bottom formed by two-layered sclerotized ring. Anterior end of buccal capsule provided with 6 forwards elevating, sclerotized projections. Length of buccal capsule 0.063 mm, maximum width 0.042 mm, width at level of basal ring 0.030 mm. Cervical papillae small, claw-shaped,

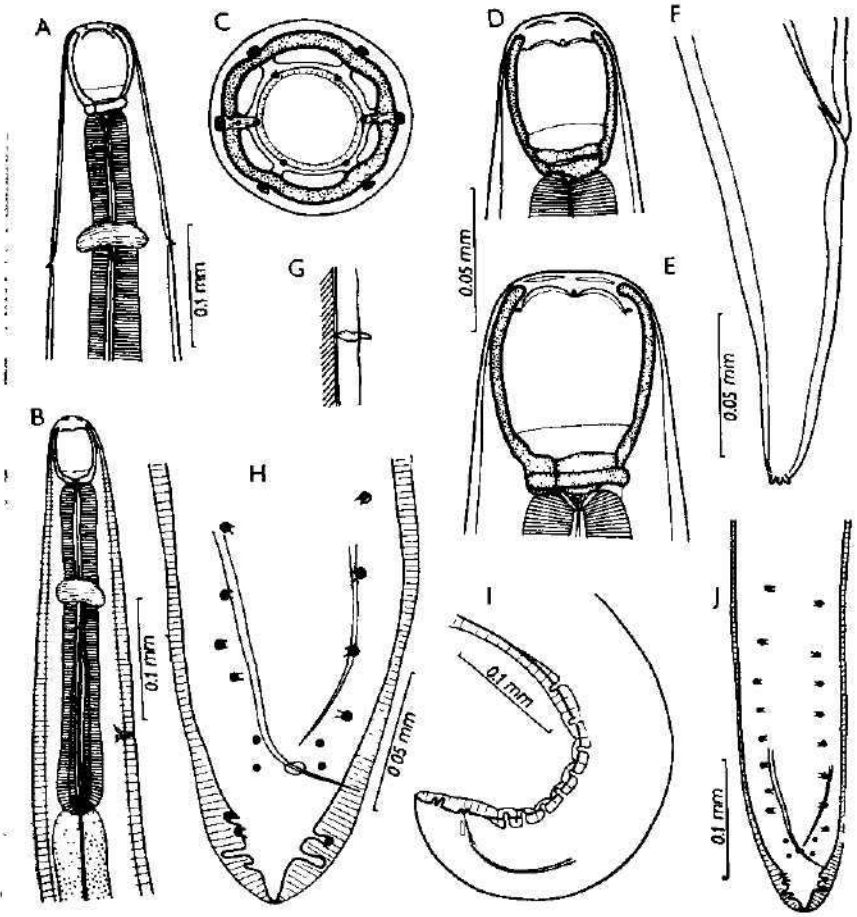

Fig. 2. *Procamallanus laeviconchus* (Wedl. 1862). A, B — anterior end of body (dorsal and lateral view); C — head end ("*en face*" view); D, E — buccal capsule of male and female (lateral view); F — tail of female; G — cervical papilla; H — posterior extremity of male (lateral view); I, J — posterior end of male (lateral and ventral view). Orig.

situated near the nerve ring (at 0.195 mm from anterior extremity). Excretory pore at 0.300 mm, nerve ring at 0.165 mm from anterior extremity. Length of muscular oesophagus 0.312 mm, of glandular oesophagus 0.449 mm;

the latter opening into the intestine through distinct valvae. Posterior end of body conical, with narrow alae. A total of 8 pairs of pedunculate preanal papillae and 2 pairs of small papillae surrounding the cloaca present. Postanal papillae indistinct; 4 postanal papillae on one side of the body and only 2 on the other. Spicules simple, weakly sclerotized; larger spicule 0.135 mm, smaller spicule 0.078 mm. Tail 0.048 mm long.

Female: Length of females containing eggs only 4.12—5.39 mm, maximum width 0.122—0.150 mm. Cuticle thick, with transverse striation. Buccal capsule orange, its length 0.084—0.087 mm, maximum width 0.063 to 0.066 mm, width at level of basal ring 0.036—0.042 mm. Length of muscular oesophagus 0.422—0.435 mm, of glandular oesophagus 0.694—0.775 mm. Cervical papillae at 0.186—0.225 mm, nerve ring at 0.198—0.207 mm, excretory pore at 0.276—0.336 mm from anterior extremity. Vulva posteequatorial (at 1.33—2.49 mm from posterior extremity), its lips considerably elevated. Uterus with round eggs only, 0.021—0.024 mm in diameter. Tail conical, 0.120—0.135 mm long, ending in three minute, finger-shaped processes.

Comments: *P. laeviconchus* is a frequent parasite of African freshwater fishes; it has been reported from Egypt (Wedl, 1862; Baylis, 1923a; Törnquist, 1931; Imam, 1971), the Sudan (Törnquist, 1931; Khalil, 1969), the Congo (Campana-Rouget, 1961) and Ghana (Khalil, 1970). Paperna (1964a) also found this species in Israel. It has been recorded from 23 host species, largely siluroid fishes, less often members of the families *Mormyridae*, *Characidae* and *Tetraodontidae*.

Fam. Rhabdochonidae Skrjabin, 1946

4. *Rhabdochona (Rhabdochona) congolensis* Campana-Rouget, 1961 (Fig. 3)

Hosts: *Hydrocyon forskali* Cuv., *Anguilla anguilla* (L.).
Location: intestine.
Incidence: in one *H. forskali* examined and in 2 out of 8 *A. anguilla*; intensity of infection: 1 to 4 specimens.

Male: Length of body 6.45—8.46 mm, maximum width 0.122—0.204 mm. Cuticle smooth. Prostom funnel-shaped, with small basal teeth; anterior teeth large, 8 in number. Length of prostom 0.033 mm, maximum width 0.018 — 0.024 mm. Vestibule including prostom measuring 0.162—0.177 mm, muscular oesophagus 0.405—0.411 mm, glandular oesophagus 2.24—2.75 mm. Cervical papillae not located. Nerve ring at 0.186—0.231 mm, excretory pore at 0.233—0.309 mm from anterior extremity. Tail conical, 0.183 to 0.255 mm long, with rounded tip. In males of my material either 12 pairs of subventral preanal papillae present, or 11 papillae on one side and 13 on the other. In addition to these subventral papillae two pairs of lateral preanal papillae present between the third and the fourth, and then between the fourth and the fifth subventral pair (counted from cloaca). Six pairs of postanal papillae present, second pair lateral, remaining subventral. Spicules unequal. Larger spicule 0.180—0.186 mm long; smaller spicule simple, without dorsal barb, length 0.048—0.090 mm.

Female: Only females with not fully mature eggs were present, ranging from 16.69 to 21.54 mm in length, with a maximum width of 0.231—0.326 mm.

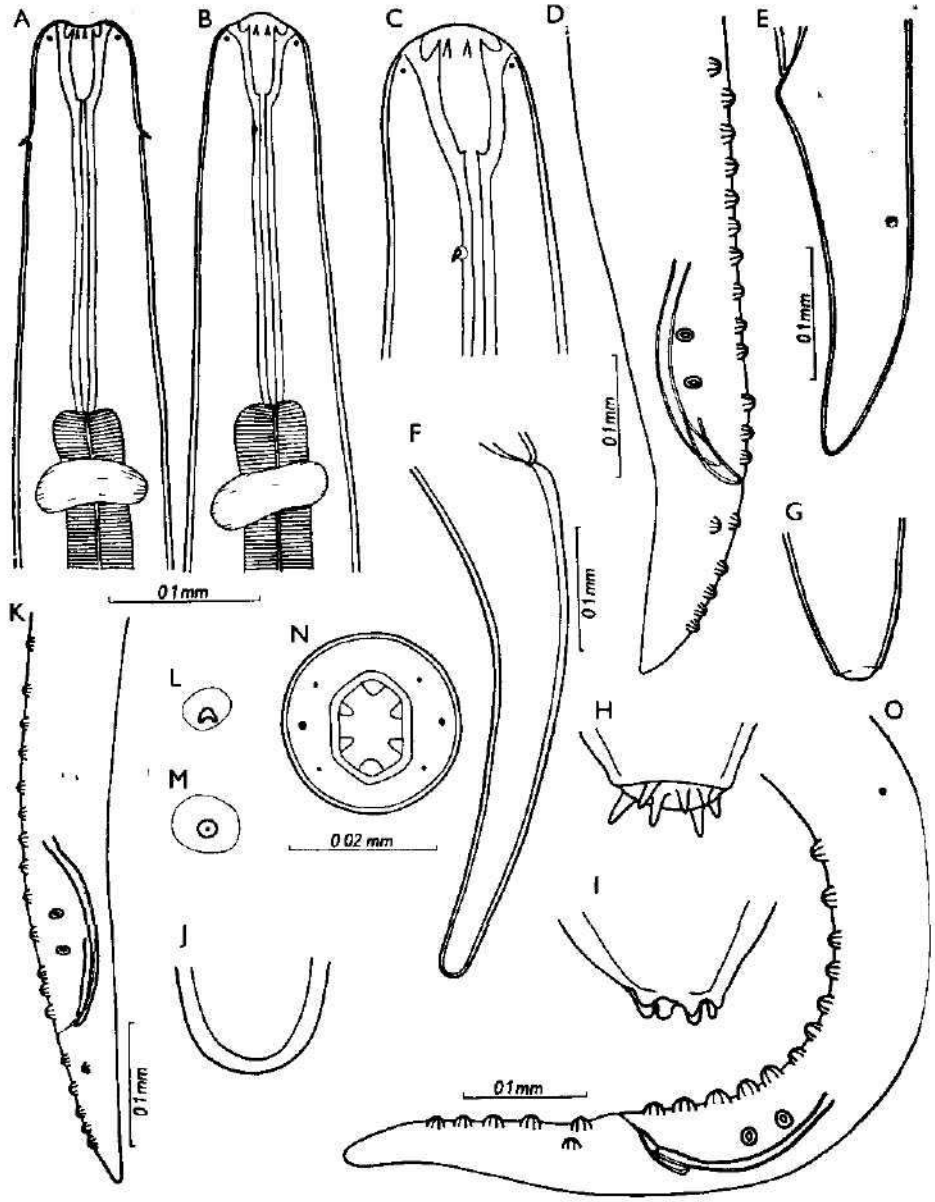

Fig. 3 *Rhabdochona congolensis* Campana-Rouget, 1961. A, B — anterior end of body (dorsal and lateral view) (from the host *H. forskalii*); C — prostom (from *B. bayad*); D — posterior end of male (from *B. bayad*); E — tail of female (from *H. forskalii*); F — tail of female (from *Haplochromis* sp.); G—J — tips of female tail (G — from *H. forskalii*, H — juvenile ♀ from *H. wingati* I — from *H. wingati*, J — from *Haplochromis* sp.); K — posterior end of male (from *H. wingati*) L—M — cervical papilla (A — of fourth-stage larva, B — of adult); N — head end of fourth-stage larva ("*en face*" view); O — posterior end of male (from *A. anguilla*). Orig.

Prostom funnel-shaped, 0.045—0.054 mm long and 0.024—0.030 mm wide, provided with 8 large anterior teeth; basal teeth distinct. Cervical papillae large, simple (not bifurcated), located not far below prostom (at 0.075 to 0.081 mm from anterior extremity). Vestibule including prostom 0.240 to 0.243 mm, muscular oesophagus 0.666 mm, glandular oesophagus 2.49 to 5.98 mm long. Nerve ring at 0.285—0.294 mm, excretory pore at 0.384 to 0.402 mm from anterior extremity. Tail conical, 0.285 mm long, tip rounded or truncated, without any processes. Vulva postequatorial, at 7.75—9.07 mm from posterior end. Eggs in uterus numerous, not fully mature.

Comments: Originally this species was described from the Congo (Campana-Rouget, 1961), later it was reported from fishes of the Albert Nile (Rasheed, 1965) and Cameroon (Moravec, 1972b). Recently I had the opportunity of studying specimens of *R. congolensis* from the collection of the British Museum from the host *Haplochromis* sp. from Lake Victoria, from *Haplochromis* sp. from Lake George in Uganda and from *Haplochromis bloyeti* (a new host) from the River Semliki in the Congo (unpublished). Imam (1971) found it in *Bagrus bayad* in Egypt but misidentified it for the species *R. pellucida* Gustafson, 1949; his material was revised by the present author. *R. pellucida* is a synonym of *R. cascadilla* Wigdor, 1918, parasitic in North American fishes; its morphology is very different (see Moravec, Arai, 1971).

Studies on the specimens of *R. congolensis* from the hosts *Haplochromis* spp., *Anguilla anguilla*, *Hydrocyon forskali* and *Bagrus bayad* revealed that the finger-shaped processes at the tip of the female tail, mentioned by Rasheed (1965) and Moravec (1972a, b), were present only in female fourth-stage larvae and in juvenile females. In females containing eggs these processes occur exceptionally only when small sized female nematodes can mature, apparently limited in size by the type and size of the host. This finding is noteworthy, since similar processes are constantly present in the adults of several species of this genus. It was found also that only 6 anterior teeth were present in the prostom of the fourth-stage larvae and that the cervical papillae were bifurcated (the adults have 8 anterior teeth, the cervical papillae are simple). The species *R. congolensis* is morphologically very close to *R. paski* Baylis, 1928, also a parasite of African fishes; the latter is distinguishable only in larger sizes of the body, longer spicules and in more numerous preanal papillae. Since all these features are rather variable in nematodes of the genus *Rhabdochona* (see Moravec, 1972a), additional studies may prove their conspecificity.

5. *Spinitectus allaeri* Campana-Rouget, 1961 (Fig. 4)

Hosts: *Clarias lazera* C. & V., *Bagrus bayad* (Forsk.), *Bagrus docmac* (Forsk.), *Synodontis schall* Bl. Schn., *Lates niloticus* L.

Location: anterior part of stomach.

Incidence: in one *B. docmac* examined, in 4 out of 12 *B. bayad*, in 6 out of 25 *C. lazera*, in 1 out of 4 *S. schall* and in 1 out of 7 *L. niloticus* examined; intensity of infection: 1 to 30 specimens.

Description: Small sized nematodes with cuticle bearing rings of minute spines; first six rings conspicuous, raised, the first two close to each other. Annulation starting at the level of anterior end of muscular oesopagus or

close below it. Spines biggest on anterior part of body, considerably smaller and irregular on posterior part. Female tail with either two rings of spines or these may be completely lacking. On lateral view always 12 to 18 spines visible in one ring (anterior rings); on apical view of female (Fig. 4b) 35 spines present in the first ring and 37 spines in the second. Mouth with two small,

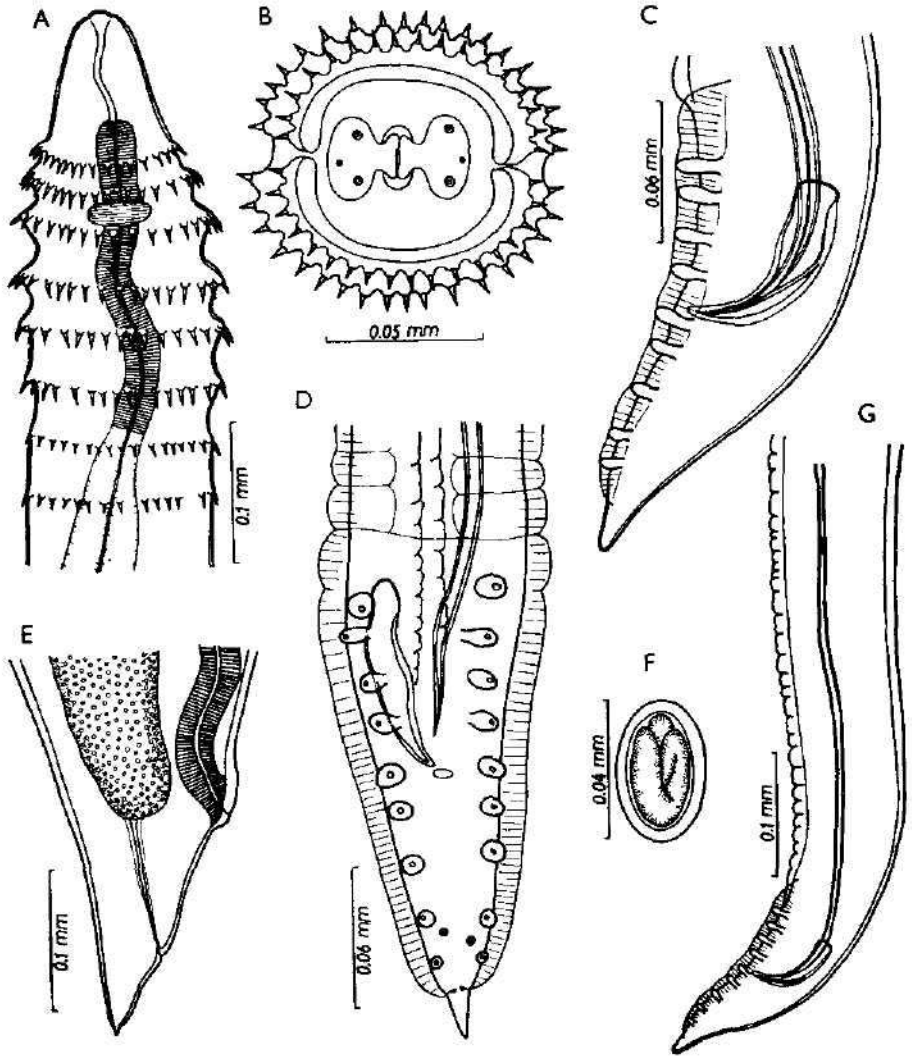

Fig. 4. *Spinitectus allaeri* Campana-Rouget, 1961. A — anterior end of body; B — head end ("*en face*" view); C, D — male tail (lateral and ventral view); E — posterior end of female (lateral view); F — egg; G — posterior end of male (lateral view). Orig.

lobular, lateral lips, each bearing two oral papillae and one amphyd at its base. Vestibule relatively long, anteriorly widened to form a small prostom. Muscular oesophagus slender, somewhat shorter than glandular one.

Male: Length of body 3.33—4.84 mm, maximum width 0.095—0.122 mm. Maximum length of spines 0.006—0.009 mm. Vestibule measuring 0.045 to 0.078 mm, muscular oesophagus 0.168—0.237 mm, glandular oesophagus 0.600—0.702 mm. Nerve ring at 0.099—0.168 mm from anterior extremity. Posterior end of body provided with narrow alae ending in a short distance from tip of tail. Of a total of 9 subventral, pedunculate pairs of papillae, 4 are preanal, 5 postanal; first postanal pair located almost at cloaca level. An additional pair of small, ventral sessile papilae present in space between the fourth and the fifth postanal pedunculate pair. Several longitudinal, cuticular ridges are developed on the ventral precloacal surface. Spicules unequal. Larger spicule slender, 0.405—0.471 mm long, with a sharp tip; smaller spicule wider, 0.069—0.087 mm long. Length of conical tail 0.090 to 0.105 mm.

Female: Length of females containing eggs 4.20—6.58 mm, maximum width (at posterior half) 0.163—0.204 mm. Maximum length of spines 0.009 mm. Vestibule measuring 0.063—0.075 mm, muscular oesophagus 0.177—0.255 mm, glandular oesophagus 0.600—0.840 mm. Nerve ring at 0.123—0.144 mm from anterior extremity. Tail conical, 0.063—0.078 mm long, ending in a sharp cuticular spike. Vulva considerably shifted to posterior end of body (located at a short distance in front of the anus), at 0.159—0.207 mm from posterior extremity. Thick-walled eggs smooth, without filaments, embryonated when laid; size of eggs 0.036—0.039 × × 0.021—0.024 mm.

Comments: This species was described by Campana-Rouget (1961) from the Congo (Lakes Édouard and Albert) from the fish hosts *Malapterurus electricus*, *Eutropius niloticus*, *Bagrus bayad*, *Lates albertianus* and *Mormyrus caschive*; the author also listed *Alestes dentex* (p. 37), although the other species, *Spinitectus polli*, is reported from this host in a survey on page 50 of the same paper. The present material corresponds in general with the original description. However, I found 6 pairs of postanal papillae only in the male instead of 7 pairs as illustrated by Campana-Rouget (1961). It appears that the author took the folds of the posterior ends of alae for the last pair of minute papillae (Fig. 4d). The finding of *Spinitectus allaeri* in Egypt is the first record of representatives of this genus from North Africa, and *Clarias lazera*, *Bagrus docmac* and *Lates niloticus* are new hosts.

Fam. Cucullanidae Barreto, 1916

6. *Cucullanus barbi* Baylis, 1923 (Fig. 5)

Hosts: *Barbus bynni* (Forsk.), *Barbus perince* Rupp.
Location: intestine.
Incidence: in 2 out of 7 *B. bynni* and in 2 out of 9 *B perince* examined; **intensity of infection**: 1 to 6 specimens

Description: Anterior end of body blunt provided with two lateral valves; their margins bearing a row of minute teeth and a membranous ala (collarette). Mouth slit-shaped surrounded by 4 oral papillae (two dorsolateral, two ventrolateral). Oesophagus muscular, extended at anterior end to form a pseudocapsule; posterior end of oesophagus also extended. Excretory pore lying below nerve ring. Cervical papillae small, simple, approximately opposite midportion of oesophagus. Tail conical in both sexes.

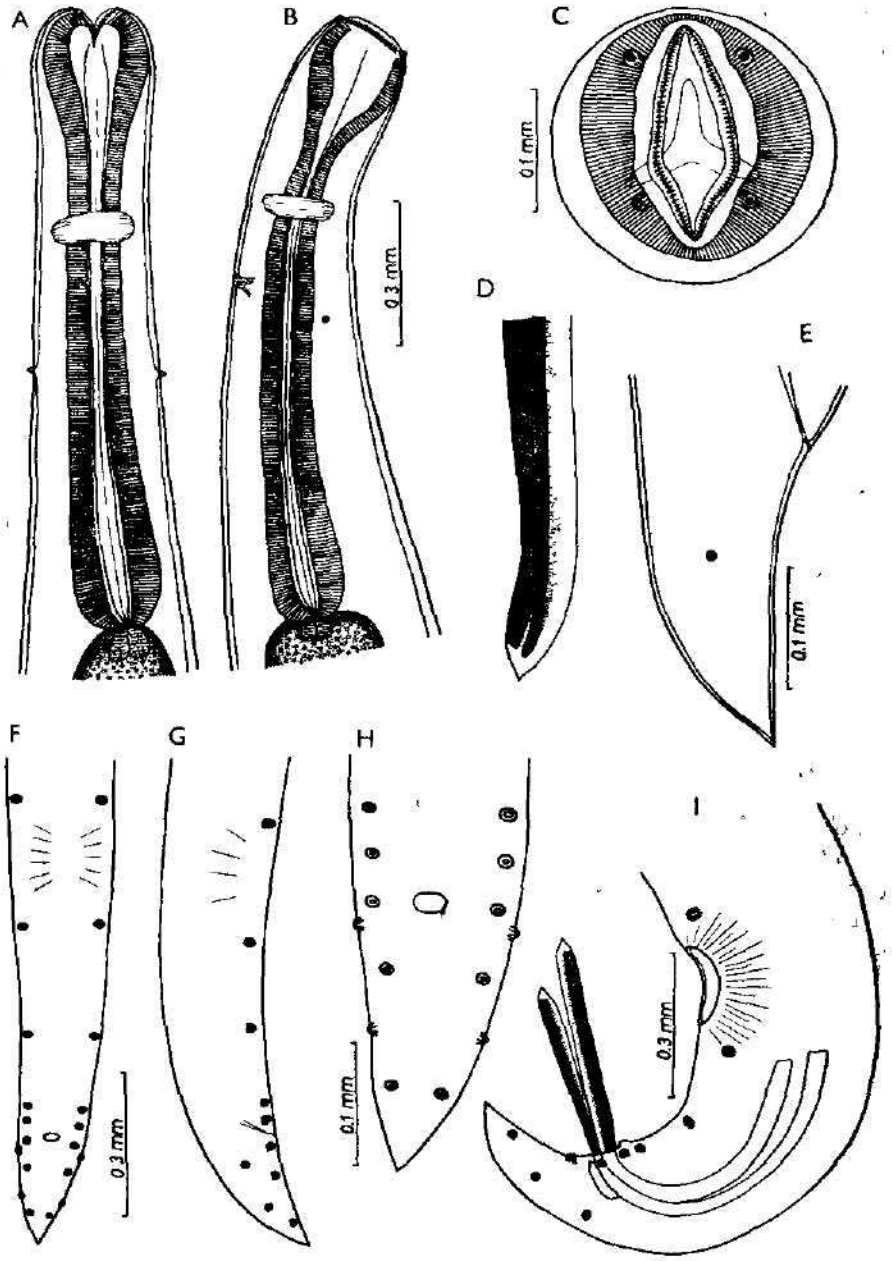

Fig. 5. *Cucullanus barbi* Baylis, 1923. A, B — anterior end of body (dorsal and lateral view); C — head end ("*en face*" view); D — distal end of spicule; E — female tail; F, G — posterior end of male (ventral and lateral view) (from *B. bynni*); H — male tail (ventral view); I — posterior end of male (lateral view) (from *B. perince*). Orig.

Male: Length of body 10.54—12.92 mm, maximum width 0.394—0.476 mm. Entire oesophagus including pseudocapsule 1.43—1.46 mm long; length of pseudocapsule 0.217—0.258 mm, maximum width 0.190—0.217 mm, maximum width of posterior end of oesophagus 0.177 mm. Nerve ring 0.435 to 0.476 mm, excretory pore 0.666—0.748 mm, cervical papillae 0.530 to 0.707 mm from anterior extremity. Tail conical, 0.255—0.354 mm long. Five pairs of subventral preanal papillae present; out of five pairs of postanal papillae the second and the third pair being lateral, the remaining subventral. In older males ventral sucker present in space between the first and the second pair of preanal papillae, being either indistinct or absent in younger males. Spicules equal (0.707—1.183 mm long), winged. Gubernaculum small, weakly sclerotized, length 0.078—0.099 mm.

Female: Length of body 10.61—14.96 mm, maximum width 0.435 to 0.666 mm. Oesophagus including pseudocapsule measuring 1.33—1.67 mm; length of pseudocapsule 0.258—0.299 mm, maximum width 0.177—0.285 mm; maximum width of posterior end of oesophagus 0.177—0.258 mm. Nerve ring at 0.476—0.503 mm, excretory pore at 0.558 mm, cervical papillae at 0.653 — 0.843 mm from anterior extremity. Tail 0.231—0.285 mm long; lateral phasmids inconspicuous, situated near the middle of the tail. Vulva postequatorial (4.22—5.30 mm from posterior extremity), with elavating lips; vagina pointing forwards. Eggs roughly oval-shaped, thick-walled, size 0.072—0.084 × 0.063—0.072 mm.

Comments: These nematodes were described by Baylis (1923c) from the cyprinid fish, *Barbus bynni* from the Sudan, and later (Imam, 1971) were found in the same host in Egypt. The specimens from our material are smaller than those quoted by Baylis (1923c). In nematodes from *B. bynni* this can be interpreted by their incomplete maturity (spicules of males weakly sclerotized, papillae and ventral sucker inconspicuous, females mostly without eggs), while in those from *B. perince* host variability may be responsible. *Barbus perince* is a new host for this helminth.

In 1964, Paperna described from *Barbus* sp. from Israel a new species of the genus *Cucullanus*, naming it *C. barbi*. Since this name is a homonym to *C. barbi* Baylis, 1923, the new designation, *Cucullanus papernai* nom. nov. (= *C. barbi* Paperna, 1964) is now proposed. There is a considerable similarity both in the morphology and dimensions between these nematodes and those of the species *C. barbi* Baylis, 1923, the only substantial difference being in the number of papillae in the male. However, since the number and arrangement of caudal papillae, as given for *C. papernai* nom. nov., is quite unusual within the genus *Cucullanus*, further detailed studies may prove the identity of this species with *C. barbi* Baylis, 1923. Until this problem is satisfactorily solved I consider both species to be independent.

7. *Dichelyne fossor* Jägerskiöld, 1902 (Fig. 6)

Host: *Lates niloticus* L.
Location: intestine.
Incidence: in 2 out of 7 fishes examined; intensity of infection: 1 specimen.

Male (1 young specimen): Length of body 3.39 mm, maximum width 0.272 mm. Cuticle very thick (in anterior part of body up to 0.036 mm, in posterior part 0.018 mm), smooth. Mouth formed by two lateral valves, their margin being provided with a narrow membrane and numerous minute

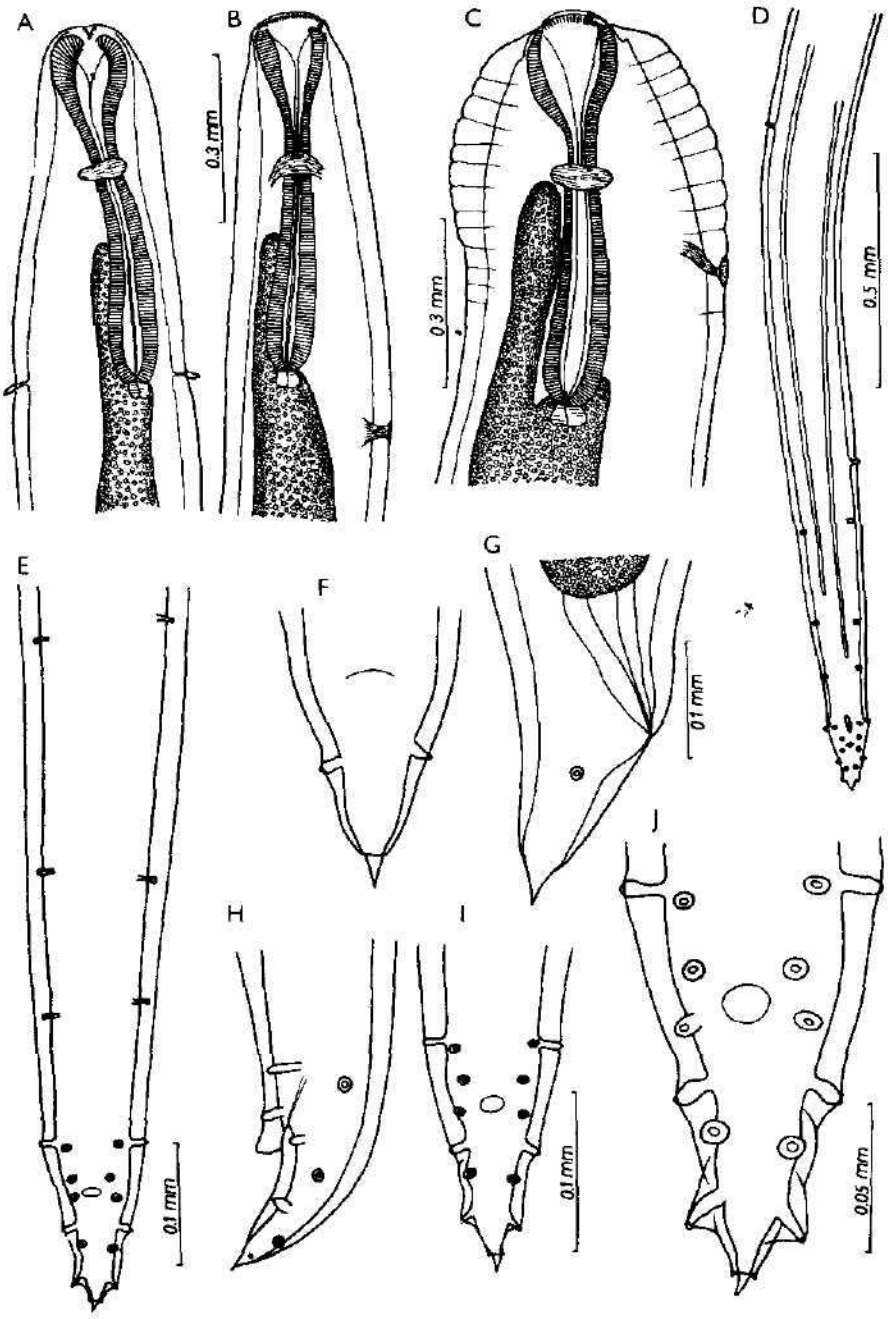

Fig. 6. *Dichelyne fossor* Jägerskiöld, 1902. A, B — anterior end of male (dorsal and lateral view); C — anterior end of female (lateral view); D, E — posterior end of male (ventral view); F, G — tail of female (ventral and lateral view); H—J — tail of male (lateral and ventral view). Orig.

teeth. Each valve with two big oral papillae (dorso- and ventrolateral) and a papilla-like amphyd. Oesophagus 0.558 mm long, extended at its anterior end to form a pseudocapsule (length 0.156 mm, maximum width 0.117 mm). Posterior part of oesophagus wider (maximum width 0.081 mm), but not as wide as the pseudocapsule. Nerve ring encircling oesophagus at a distance of 0.243 mm from anterior extremity. Intestine forming a dorsal, blind process 0.270 mm long. Excretory pore considerably large, located at a short distance below the end of oesophagus, at 0.680 mm from anterior extremity. Cervical papillae fairly big, situated near the end of oesophagus (0.584 mm from anterior extremity). Tail conical, 0.105 mm long. A total of 7 pairs of preanal papillae present, two of them being lateral, the remaining subventral; papillae of the first lateral preanal pair considerably asymmetrical to each other (Fig. 6d). Of the 4 pairs of larger postanal papillae the second and the fourth are lateral, the remaining subventral; an additional, hardly visible pair of minute lateral papillae present not far from the tip of the tail. Spicules still weakly sclerotized, 1.22 mm long. Length of gubernaculum about 0.063 mm.

Female: Length of body 5.66 mm, maximum width 0.544 mm. Cuticle very strong, mainly at the anterior end of body (at anterior end up to 0.081 mm, at posterior part of body only 0.021 mm). Oesophagus including pseudocapsule measuring 0.694 mm; length of pseudocapsule 0.210 mm, maximum width 0.180 mm. Dorsal, blind intestinal process 0.367 mm long, extending up to the nerve ring; the latter at 0.313 mm from anterior extremity. Cervical papillae located near nerve ring, at 0.435 mm from the head end, excretory pore at a distance of 0.544 mm. Tail conical, 0.192 mm long, with two large lateral, papilla-like phasmids in the middle. Vulva approximately equatorial (2.72 mm from posterior extremity). with elevated lips. Eggs still absent. Comments: The nematodes found were young specimens only and accordingly their measurements are smaller than those given in the original description or by Törnquist (1931). Contrary to Törnquist (1931), who described 6 pairs of preanal papillae only (all subventral), I found an additional pair of asymmetrical lateral papillae; moreover, the third preanal pair (counted from cloaca) was also lateral.

The species *D. fossor* has been known from the Sudan only (Jägerskiöld, 1902, 1909; Baylis, 1923c; Khalil, 1969) from fishes *Lates niloticus* and *Bagrus bayad*. So far it has not been reported from Egypt.

Fam. Syphaciidae Skrjabin et Shikhobalova, 1951

8. *Citharinielle citharini* Khalil, 1964 (Fig. 7)

Host: *Synodontis schall* Bl. Schn.
Location: rectum.
Incidence: in 1 out of 4 fishes examined; intensity of infection: 295 specimens.

Description: Small sized nematodes with a very long, slender tail. Cuticle almost smooth, with only slightly outlined longitudinal ribs. Mouth formed by three weakly developed lips, provided with a membranous margin. Four big oral papillae and two smaller amphyds surrounding the mouth. Vestibule very short. Oesophagus cylindrical, uniform in diameter, ending in a globular bulb provided with valvular apparatus. Intestine straight, narrow, its anterior

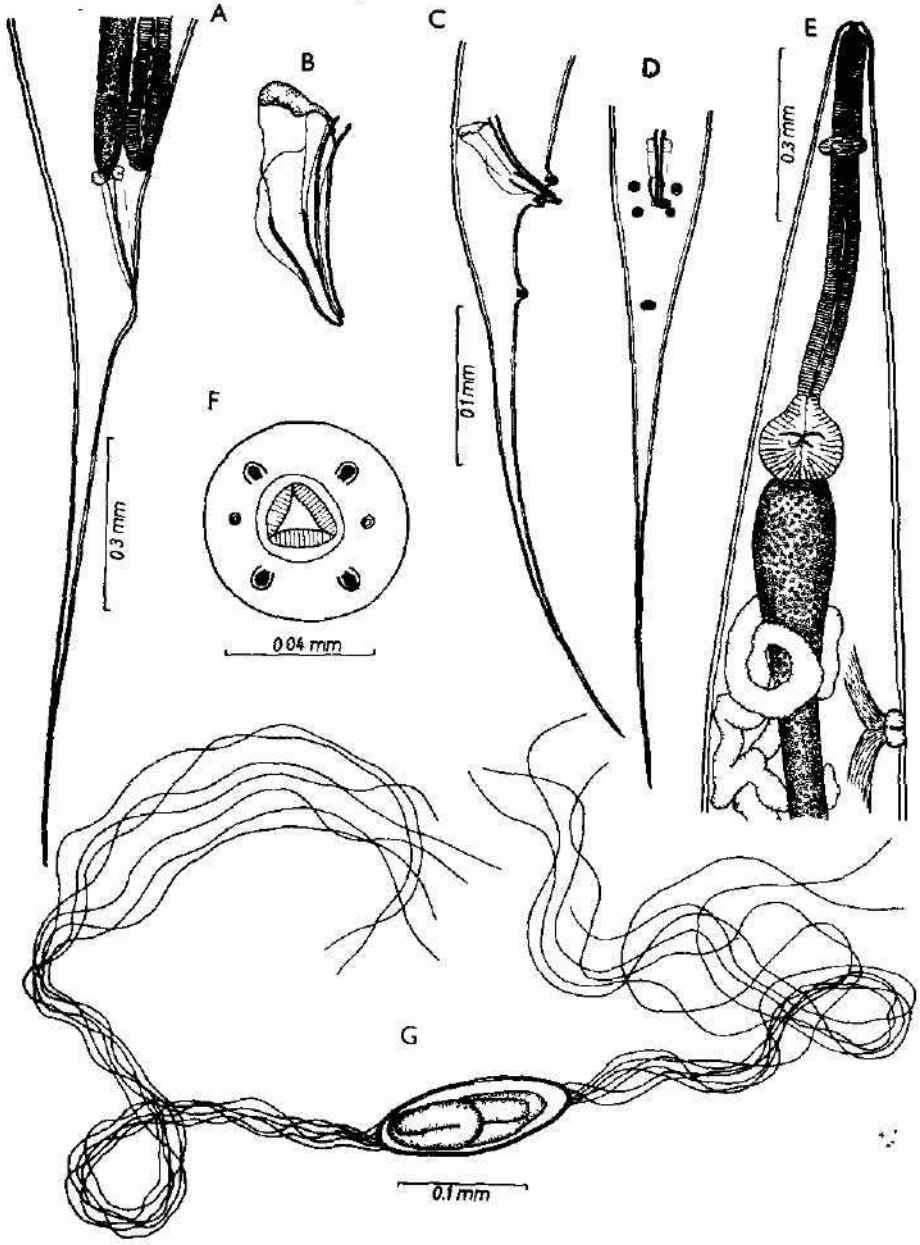

Fig. 7. *Citharinella citharina* Khalil, 1964. A — posterior end of female (lateral view); B copulatory apparatus of male; C, D — tail of male (lateral and ventral view); E — anterior e of female (lateral view); F — head end ("*en face*" view); G — egg. Orig.

end slightly extended. Nerve ring encircling the oesophagus at its first ha excretory pore located relatively far below the bulb.

Male: Length of body 1.47—2.24 mm, maximum width 0.095—0.163 mm. Entire oesophagus measuring 0.375—0.516 mm, width of its anterior part 0.030—0.036 mm, size of bulb 0.075—0.105 × 0.084—0.096 mm. Nerve ring at 0.105—0.165 mm, excretory pore at 0.504—0.669 mm from anterior extremity. Tail conical, attenuating posteriorly to form a long, terminal awl-shaped process (length of entire tail 0.405—0.450 mm). Only one, simple spicule (length 0.078—0.102 mm) and a slightly wider, less sclerotized gubernaculum (length 0.045—0.060 mm) present. The tissue in front of the proximal end of gubernaculum appearing as a certain elongation of gubernaculum, but without clear sclerotization. Only anterior margin of this formation seems to be sclerotized, appearing on lateral view as a dorsal process of the spicule. Cloaca surrounded by two pairs of papillae (1 preanal and 1 postanal). In addition to these an unpaired, conspicuous papilla present at a distance of 0.069 — 0.099 mm below the cloaca; exceptionally this papilla can be paired. The ventral precloacal surface of the older males with distinct oblique bands; these are absent in younger specimens. Indistinct precloacal sucker-like organ slightly outlined in several older males only, largely it is absent.

Female: Length of body of females with eggs 1.81—4.58 mm, maximum width 0.204—0.340 mm. Entire oesophagus measuring 0.615—0.707 mm; width of its anterior part 0.048 mm, size of bulb 0.123—0.138 × 0.129—0.138 mm. Nerve ring at 0.123—0.186 mm, excretory pore at 0.621—1.088 mm from anterior extremity. Tail 0.750—0.843 mm long, with awl-shaped terminal process; posterior anal lip slightly elevated. Two ovaries present, the anterior lying slightly below the bulb, the posterior in front of the vulva. Uterine branches joining into a relatively long vagina, pointing backwards. Vulva opening at a short distance in front of anus (at 0.96—1.06 mm from posterior extremity). Eggs elongate, thin-walled, with a tuft of about 8—10 thread-like filaments at each pole; length of filaments approximately 0.6 mm. Eggs embryonated when laid, size 0.129—0.138 × 0.042—0.045 mm.

Comments: This species has been described by Khalil (1964) from the Nile fish, *Citharinus citharus* from the Sudan and later it was also reported by Imam (1971) from *Synodontis schall* from Egypt and by Petter, Vassiliades and Troncy (1972) from *Citharinus citharus* and *Distichodus brevipennis* from Senegal. Contrary to the original description our specimens from *S. schall* exhibit some differences, mainly in the measurements of the body and individual organs. A marked difference is in the spicular length, this being in our specimens only half the length given originally; the length of the gubernaculum is similar to that in Khalil's description (1964). It is evident that these metrical differences are associated with age or host variability of the species. Furthermore, some less important morphological differences were found in our material, concerning mainly the presence and type of the precloacal sucker-like organ in the male, the structure of the spicule and the gubernaculum and also the character of egg filaments; these may be due either to the different age of nematodes (suckerlike organ) or to difficulties of detailed studies on the structure of some organs (e.g. spicules and gubernaculum owing to their insufficient sclerotization). The presence of polar filaments only on the egg of this parasite has already been mentioned by Imam (1971). Recently Petter, Vassiliades and Troncy (1972) des-

cribed from *Synodontis gambiensis* and *S. sorex* from Senegal and Tchad a new species, *Citharinella khalili* which is probably identical with *C. citharini*.

The same as the hosts, also the parasite shows affinities to the South American forms, mainly to the genus *Laurotravassoxyuris* Pérez Vigueras, 1938 as already pointed out by Khalil (1971).

Fam. Capillariidae Neveu-Lemaire, 1936

9. *Capillaria fritschi* Travassos, 1914 (Fig. 8)

(Syn : *C. yamagutti* Tadros et Mahmoud, 1968)
Hosts: *Bagrus docmac* (Forsk.), *Bagrus bayad* (Forsk.).
Location: anterior part of stomach
Incidence: in one *B. docmac* examined and in 6 out of 12 *B. bayad*, intensity of infection: 1 to 5 specimens.

Male: Length of very young males 3.86—4.42 mm, maximum width 0.041 to 0.054 mm. Anterior part of body slender; mouth terminal, situated on the cone-shaped apical head end. On lateral view two very small oral papillae visible. Two lateral bacillary bands originate near the head end and extend to almost the end of body in young males they are covered with tiny bosses Width of bacillary bands in area of cellular oesophagus 0.009 mm. Entire oesophagus measuring 1.80—1.84 mm, anterior tubular, weakly muscular part 0.201—0.240 mm. Nerve ring at 0.051—0.084 mm from anterior extremity. Glandular part of oesophagus formed by large, elongate cells with huge nuclei; some of these cells with a slightly outlined subdivision into six transverse sections. Spicule still weakly sclerotized, 0.267—0.270 mm in length; spicular sheath smooth, without spines. Posterior end of body somewhat tapering, cloaca subterminal. Tail provided with a relatively wide, rounded cuticular membrane forming a pseudobursa. Cloaca surrounded by two lateral, considerably elevated lobes; internally each of them bearing a large papilla at its base.

Female: Length of body of females with eggs 6.07—9.32 mm, maximum width 0.054—0.081 mm. Bacillary bands well developed, 0.021—0.030 mm wide. In younger females these are embossed with tiny, papilla-like formations which are indistinct in older females. Length of entire oesophagus 2.24 to 3.20 mm, anterior tubular part 0.189—0.330 mm. Nerve ring at 0.072 to 0.090 mm from anterior extremity. Posterior end of body rounded, anus terminal or slightly subterminal Vulva situated just below the end of cellular oesophagus (at 0.003—0.600 mm), its anterior lip sometimes slightly raised. Eggs provided with polar plugs; egg shell consisting of two layers, outer layer with a special sculpture. Size of eggs 0.051—0.066 × 0.027—0.036 mm.

Comments: In 1886 Fritsch described a female nematode from the fish *Malapterurus electricus* from Egypt, designating it *Trichosoma papillosum*; later Travassos (1914), assigning it to the genus *Capillaria*, considered this nematode to be an independent species and, consequently, proposed the specific name *C. fritschi*. In 1961 three males of the genus *Capillaria* were reported by Campana-Rouget from the same host from the Congo; although the author assumed that the worms belonged to the species *C. fritschi*, in view of the inadequate description of the later she designated them *Capillaria* sp. In 1968 Tadros and Mahmound, considering *C. fritschi* to be a *species inquirenda*, described a new species, *Capillaria yamagutti* from the fish *Bagrus bayad* from Egypt; this species was separated from *C. fritschi* only by

smaller size of the female and by the absence of the papilla-like projections on the cuticle. The same species was reported from the same host from Egypt by Imam (1971) Our specimens, from the same host and the same locality as those of Tadros and Mahmoud (1968), however, indicate that there are no substantial differences between *C. fritschi* and the nematodes from fishes of the genus *Bagrus*, both having the cuticle embossed by small,

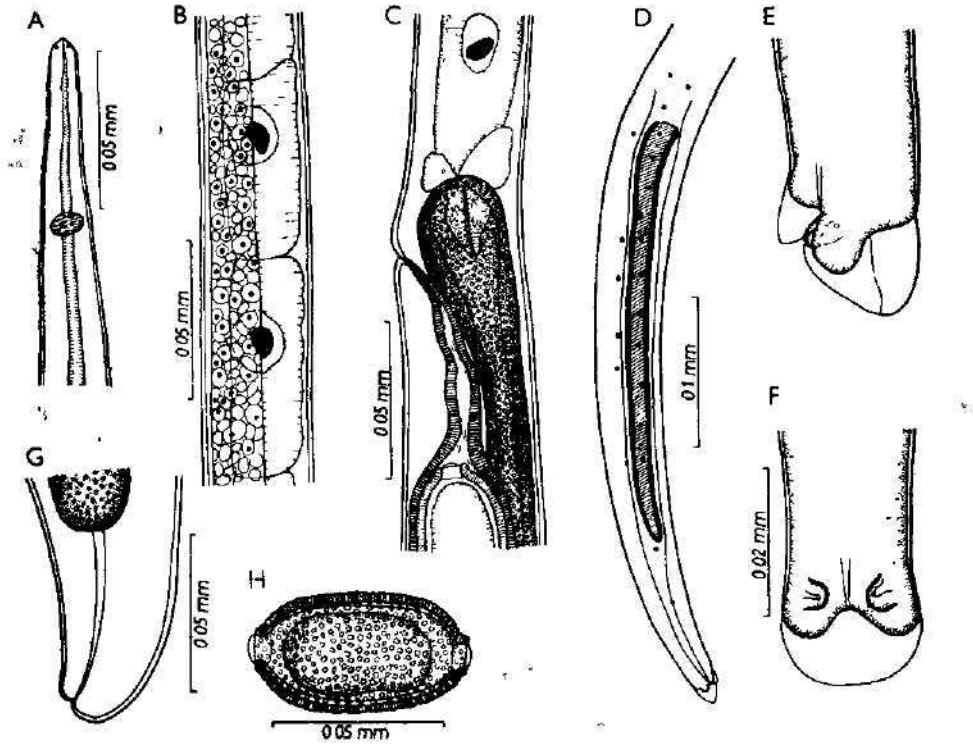

Fig. 8. *Capillaria fritschi* Travassos, 1914 A – anterior end of female; B – oesophagus region of body with marked bacillary band; C – vulva region in female; D – posterior end of male; E, F – posterior extremity of male (lateral and ventral view); G – posterior end of female (lateral view), H – egg Orig

papilla-like projections. Recent investigations (Kutzer, Otte, 1966, Moravec, Ergens, 1970; Moravec, 1970) have shown that metrical and morphological variability is considerable in some fish nematodes of the genus *Capillaria*; furthermore these parasites exhibit a low degree of host specificity so that members of one species can parasitize in a number of fish hosts, often belonging to phylogenetically very distant families. However, both the hosts of *C. fritschi* and *C. yamagutii* are representatives of siluroid fishes. Accordingly, I consider the name *Capillaria yamagutii* Tadros et Mahmoud, 1968 a synonym of the species *Capillaria fritschi* Travassos, 1914, to which also the nematodes *Capillaria* sp. found by Campana-Rouget (1961) in the Congo, should be assigned.

* * *

In addition to nematodes reported in this paper the species *Spirocamallanus spiralis* (Baylis, 1923) has been recorded from fishes of Egypt (Baylis, 1923a, b); consequently 10 nematode species are known at present from Egyptian freshwater fishes. It is evident that this number is not final, because the existing data have a character of only accidental findings. A number of fish parasites known from the Sudan and other neighbouring countries can be expected to be found also in Egypt. As well as almost all their fish hosts, the nematodes recorded so far from the freshwater fishes of Egypt seem to be exclusively representatives of the Ethiopian fauna.

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THE INCIDENCE OF COCCIDIOSES IN TETRAONID BIRDS (TETRAONIDAE) FROM CZECHOSLOVAK HUNTING AREAS

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Received December 14, 1972

Abstract. During 1955—1971 we examined 233 specimens of *Lyrurus tetrix* from various localities of 24 districts, and 114 *Tetrao urogallus* from localities of 33 districts in Czechoslovakia. These examinations were performed during the period when the birds were in heat (April, May). Coprological inspection disclosed the presence of coccidia of the species *Eimeria lyruri* Galli-Valerio, 1927 and *E. nadsoni* Jakimov et Gusev, 1936 in both tetraonid species from various hunting areas of the Czech Socialist Republic and the Slovak Socialist Republic. *E. lyruri* was the dominant species in both birds. In both species the biometry of the oocysts was assessed and the speed of sporulation estimated. Negative results were confirmed in transmission of infection to the pheasant chick.

In Czechoslovakia, no information has been available as yet on the incidence and distribution of coccidiosis in our Tetraonidae. In other European countries, this subject has been dealt with in numerous articles; in Norway by Willumsen (1916), Sörum (1950), Lund (1946, 1954); in Sweden by Hülphers (1930, 1931), Hülphers et al. (1943); in Finland by Lampio (1947) and Raitis (1962); in Germany by Haase (1939), Wetzel and Rieck (1962); in the European parts of the U.S.S.R. by Oliger (1957); in Yugoslavia by Brglez et al. (1970); in Rumania by Almasan et al. (1968); in Austria by Velthuysen (1957). In the U.S.A., coccidioses of the Tetraonidae were studied by Herman (1963). The description of, and biometric data on *Eimeria lyruri* and *E. nadsoni* were done by Galli-Valerio (1927, 1932) and Pellérdy (1963).

MATERIAL AND METHODS

All the material was obtained in April and May, i.e., the period of heat, when hunting is permitted. Material of *Lyrurus tetrix* was collected from 1955—1971. The examined material consisted of 233 specimens of *L. tetrix* from 24 districts of Czechoslovakia. Material of *Tetrao urogallus* was being collected in 1966—1971. The authors examined parasitologically a total of 114 specimens of *Tetrao urogallus* from 22 districts of Czechoslovakia. Most of the material was obtained from the staff of the forest blocks or from taxidermists (either skinned birds of the guts). Coprological tests were performed with faecal samples (3 g) from the caeca and small intestine with either Faust's or Breza's method. The incidence of infection was estimated from the average number of oocysts in the viewing field of the microscope (+ = 1—25 oocysts; ++ = 25—50; +++ = 50—100; ++++ = 100 and more). The duration of sporulation of the oocysts of *E. lyruri* and *E. nadsoni* was assessed in a 2.5% solution of $K_2Cr_2O_7$ with 1% chloramin at different temperatures. In order to confirm the possibility of transmission of infection to the pheasant chick, experimental oral infection of the chicks was performed with 20,000 sporulated

oocysts per bird in a single dose. The number of oocysts was assessed in 1 ml of culture by means of the flotation method suggested by Breza (1959), counting the oocysts in McMaster's counting chamber.

RESULTS

1. *Eimeria lyruri* Galli-Valerio, 1927

Host: *Lyrurus tetrix, Tetrao urogallus.*
Location: central portion of the small intestine.
Intensity of infection: *L. tetrix* weak (+) to very high (++++); *T. urogallus* weak (+) to medium high (+++).
Incidence of infection: *L. tetrix* — in 84 birds, i. e. 36.0%; *T. urogallus* — in 23 birds, i.e 20.1%.
Findings in districts: *L. tetrix* — Bruntál, Český Krumlov, Dolní Kubín, Domažlice, Cheb, Jindřichův Hradec, Jihlava, Klatovy, Karlovy Vary, Liptovský Mikuláš, Poprad, Prachatice, Rakovník, Rokycany, Sokolov, Tachov, Ústí n Orlicí.
T. urogallus — Bruntál, Bánská Bystrica, Čadca, Dolní Kubín, Frýdek-Místek, Klatovy, Lučenec, Liptovský Mikuláš, Poprad, Rožňava, Spišská Nová Ves

Oocysts of longitudinally oval shape, length 26—34 μm, width 15—19 μm (average values 30 × 17 μm), colourless. Oocyst wall smooth, contoured, slightly greenish, with an indistinct micropyle at one pole. This was absent from most oocysts. The unsporulated sporont situated in the centre of the oocyst or at one of its poles. Sporocysts oval, 11 × 3.8 μm. In sporulated oocysts small remnant corpuscles.

At 20° C, sporulation of the oocysts was completed in 48 hrs. In the refrigerator at 10° C, 7 to 13% oocysts kept in the maturing solution $K_2Cr_2O_7$ sporulated in 5 days.
Rate of sporulation at 20° C:

Time	12 hrs	24 hrs	36 hrs	48 hrs	72 hrs	96 hrs
Sporulated			16—19	93—99	95—99	100%
Unsporulated	94—96	88—93	84—81%			

2. *Eimeria nadsoni* Jakimov et Gusev, 1936

Host: *Lyrurus tetrix, Tetrao urogallus.*
Location: central portion of the small intestine.
Intensity of infection: *L. tetrix* — weak (+);
T. urogallus — an occasional oocyst.
Incidence of infection: *L. tetrix* — in 25 birds, i. e. 10,7%;
T. urogallus — in one bird, i. e. 0,86%.
Findings in districts: *L. tetrix* — Bruntál, Český Krumlov, Domažlice, Cheb, Jihlava, Karlovy Vary, Liptovský Mikuláš, Prachatice.
T. urogallus — Dolní Kubín.

Nearly spherical, opaque oocysts without a micropyle, size 19 to 22 μm × 11 to 15 μm (average values 20.5 × 13 μm). Oocyst wall smooth without micropyle, thickness 1.2 to 1.5 μm. Sporont situated in the centre of the oocyst, occupying almost the entire oocyst.

Sporocyst oval, measurements 7.6 × 3.8 μm. Remnant corpuscles in the sporocysts, but not in sporulated oocysts. Polar corpuscles absent, sometimes developing in an occasional oocyst.

At 20° C, the oocysts sporulated from 72 to 96 hrs. When kept in $K_2Cr_2O_7$ at 10° C for 5—7 days in the refrigerator, sporulation became arrested in all oocysts.

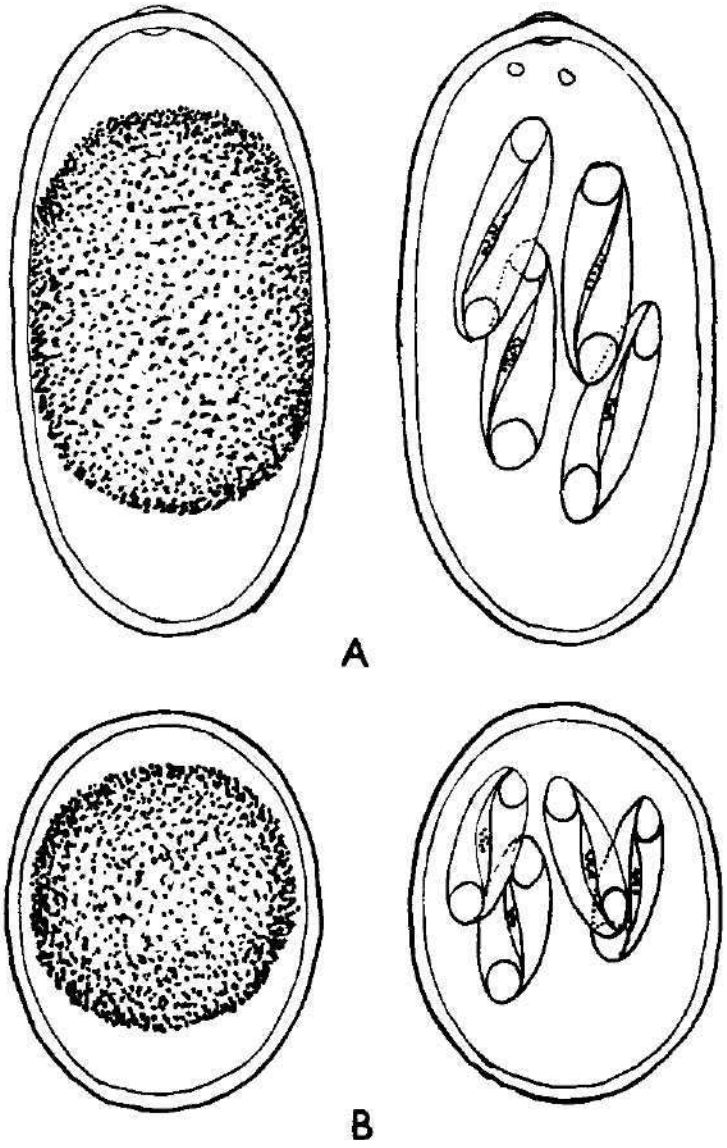

Fig. 1. Oocysts found in tetraonidae birds. A. *Eimeria lyruri* Galli-Valerio, 1927, B. *Eimeria nadsoni* Jakimov et Gusev, 1936

Rate of sporulation at 20° C:

Time	24 hrs	48 hrs	72 hrs	96 hrs	120 hrs
Sporulated			5–25	72–88	88–96%
Unsporulated	100	99	95–75		%

EXPERIMENTAL INFECTION

In order to assess the possibility of transmitting infection to other bird species, a biological experiment was performed with the two coccidian species occuring in Tetraonidae. In our experiment, 20 pheasant chicks aged 3 weeks were infected with a single dose of 20,000 sporulated oocysts per bird. The faeces of the experimental birds were inspected 7 days prior to the infection and, after the experimental infection they were inspected daily for a fortnight (Breza's method — quantitative evaluation of the oocysts according to McMaster's method). The results of this experiment were negative. Nor were there ascertained any development stages of coccidia in intestinal wall smears stained by Giemsa either.

Evaluation of the incidence and distribution of coccidiose in *Lyrurus tetrix* from hunting areas in Czechoslovakia

Coccidiosis is the most frequent protozoan infection of *L. tetrix* in Czechoslovakia. We identified it in 38.1% of the examined birds. Haemoproteosis was found only in two specimens from our material (0.8%) from the Jindřichův Hradec district. The low indicence suggests that these blood parasites are of little importance for Tetraonidae in Czechoslovakia. In the localities of Czechoslovakia, coccidiosis is caused by two coccidian species, *Eimeria lyruri* and *E. nadsoni*. The finding of the two coccidian species is the first finding in tetraonid birds from Czechoslovakia. The former species, *E. lyruri*, is the most common parasite of *Lyrurus tetrix*. It was identified in 36% of these birds, from 17 districts of Czechoslovakia. The coccidian *E. lyruri* infests practically all biotopes in the various zoogeographical zones of Czechoslovakia inhabited by *L. tetrix*. The highest incidence of infection of tetraonid birds with coccidian species was recorded in Bohemia, in the Karlovy Vary district (72.7%); the lowest incidence in the Sokolov district (16.6%). In Slovakia, the incidence of this coccidian was sparser, 11.1% in the Liptovský Mikuláš district, 35% in the Poprad district. Oocysts of *E. nadsoni* were present in localities of 8 districts, mainly in the Czech Socialist Republic. The intensity of infection ranged mostly from weak to medium high. The highest rate of infestation was recorded from the Karlovy Vary district (36.6%), the lowest from the Prachatice district (14.8%). Concomitant infection with both coccidian species, i.e. with *E. lyruri* and *E. nadsoni*, was found in 10.2% of *L. tetrix* examined. In 2.5% of these birds, coccidiosis was concomitant with infection with *Capillaria caudinflata* and with *Ascaridia compar*. Apart from a high incidence of coccidian infection in various zoogeographical zones and under different climatic conditions, an important fact is the intensity of infection —

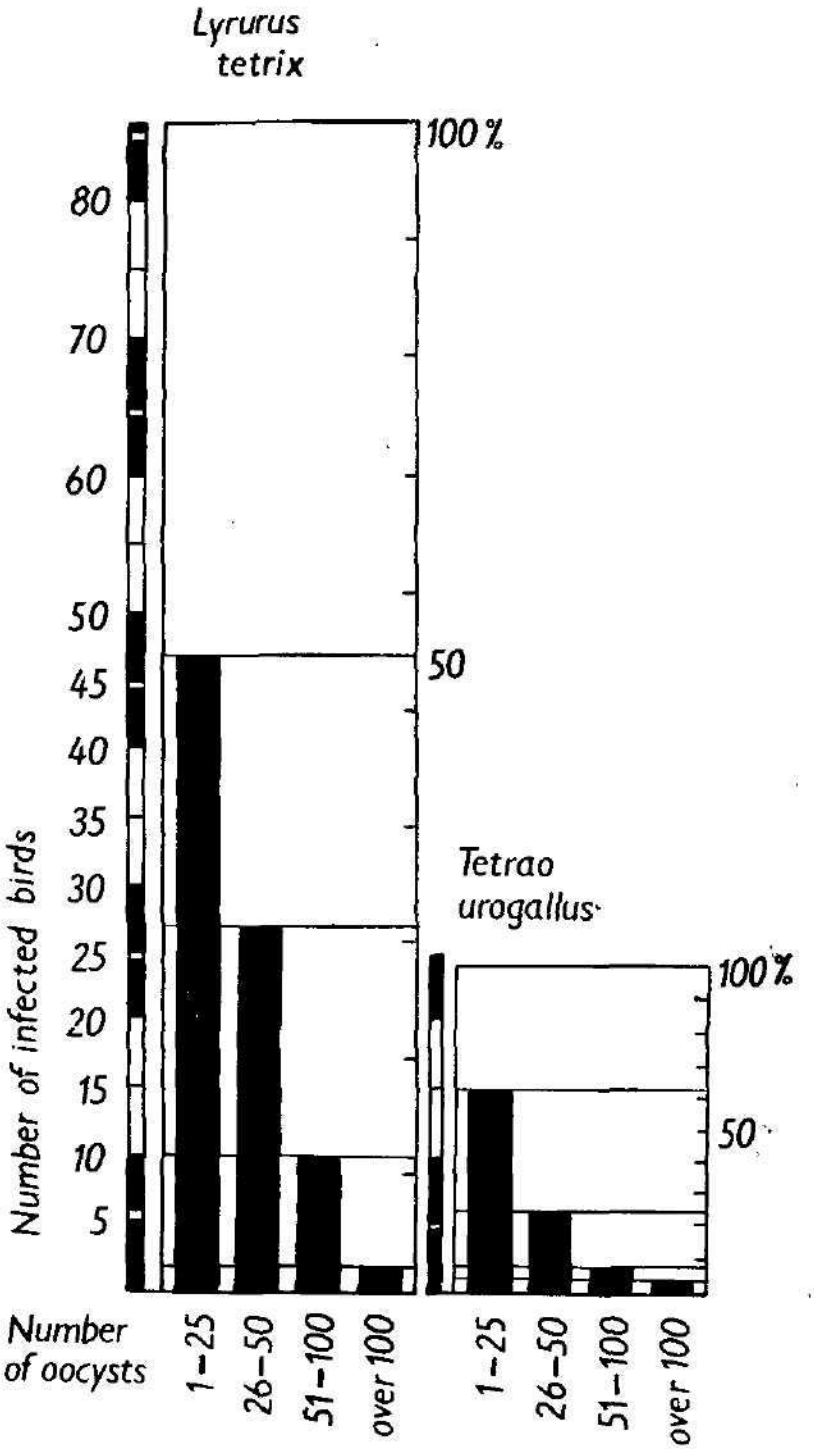

Fig. 2. The correlation between intensity and extensity of infection in both species of examined birds.

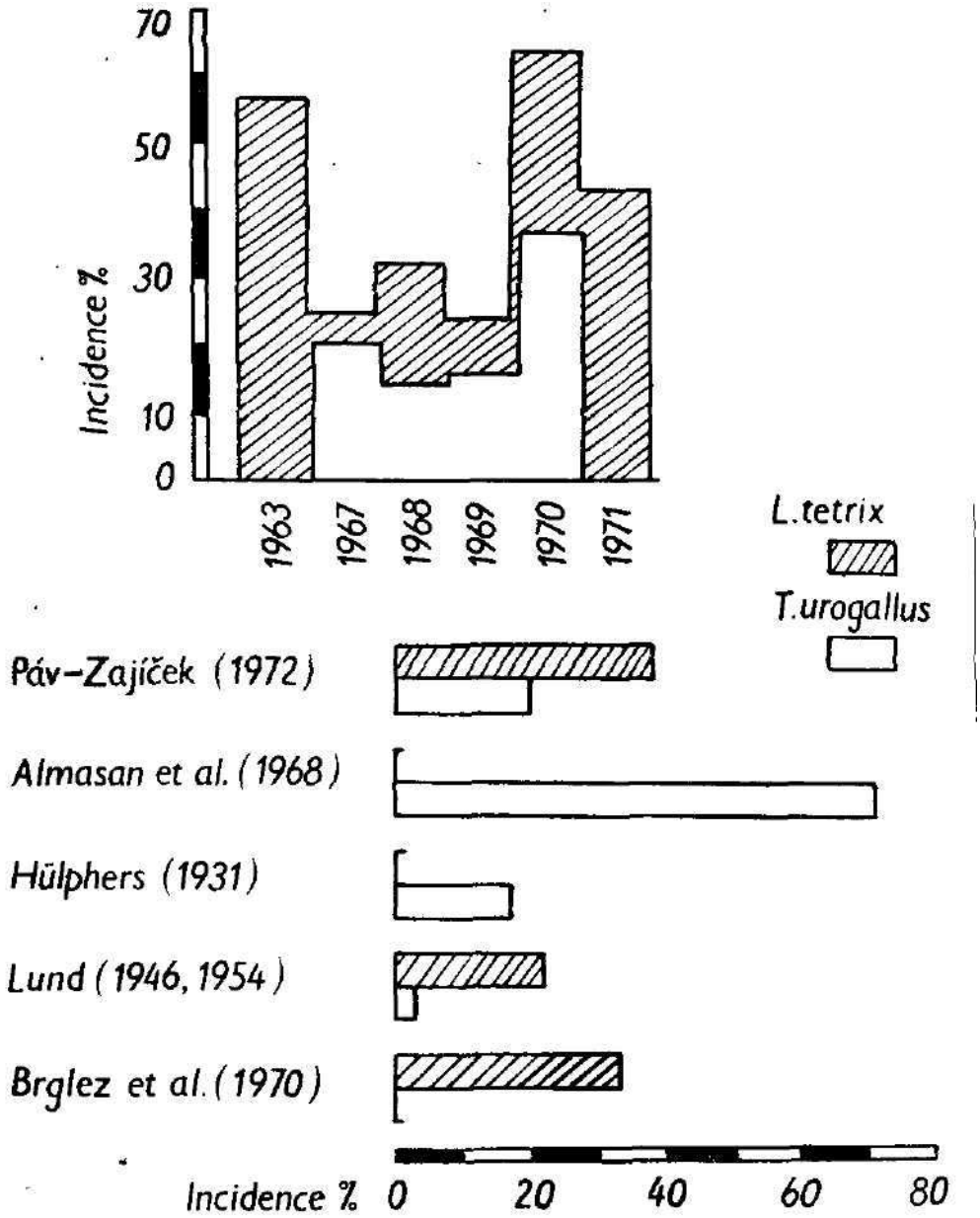

Fig. 3. Incidence of infection in both species of birds during the period examination and the comparison with the results of foreign authors.

medium high coccidian infection was found in 31.4% of *L. tetrix*. The intensity of infection of *L. tetrix* and *T. urogallus* is shown in Fig. 2.

Table 1. Survey of coccidia incidence in examined birds of familly Tetraonidae

Year	*Lyrurus tetrix*			*Tetrao urogallus*		
	Exam.	%	District	Exam.	%	District
1955	3	33.3	1	—	—	—
1956	2	—	1	—	—	—
1962	3	—	2	—	—	—
1963	18	55.5	8	—	—	—
1964	2	—	2	—	—	—
1965	4	25 0	3	—	—	—
1966	4	25 0	3	13	23.0	7
1967	49	24 5	12	29	20 6	10
1968	25	32 0	9	27	14.8	11
1969	54	24.0	14	25	16 0	8
1970	63	63.4	15	19	36.8	12
1971	6	42 8	1	1	—	1

Explanations Exam = total number of examined birds, % = incidence of coccidia, District = number of examined districts.

Evaluation of the incidence and distribution of coccidiosis in *Tetrao urogallus* from hunting areas of Czechoslovakia

Coccidiosis is the most frequent protozoan infection of *T. urogallus* from Czechoslovakia We identified it in 20 1% of the examined birds. Also this bird species is infected with two coccidian species. The dominant species is *Eimeria lyruri* The presence of oocysts was a common finding in *T. urogallus* and infection of these birds was recorded from 12 districts of Czechoslovakia. Infection with the second coccidian species — *E. nadsoni* — was recorded from one capercaillie only (0 8%) from the district Dolní Kubín. The considerable variation in the incidence of coccidian infection was influenced apparently by climatic conditions It ranged from 14% (in 1968) to 36.8% (in 1970) In the Czech Lands, in the districts Bruntál and Klatovy, 50% of birds were infected. In Slovakia, the highest incidence of infection occurred in the district Rožňava (20%), Liptovský Mikuláš (28.5%) and Martin (25%), the lowest incidence was recorded from the district Poprad (8.3%). It is quite evident that coccidioses endanger the general state of health of our tetraonid birds Mixed infection of both coccidian species was found in 1.7% of the examined birds, concomitant coccidian infection with *Capillaria caudinflata* and *Ascaridia compar* in 4 3%

DISCUSSION

Parasitological examination of *Lyrurus tetrix* and *Tetrao urogallus* perforf med during the period of heat (April, May) disclosed the marked incidence o- coccidian infection. The average incidence of infection of *L. tetrix* was 38% with variations in the individual years ranging from 24% in the year 1967, 1968 to 63.4% in 1970. Our results are consistent with those obtained by Lund (1954) from hunting areas in Norway According to this author, the incidence of infection with coccidians ranged from 33% in April to 44% in May. In 93% of *L. tetrix* he observed large numbers of oocysts in the caeca; in 47% in the ileum, in 23% in the duodenum; in these parts of the gut, however, the number of oocysts was generally lower Hulphers (1943) found 45% of *L. tetrix* from various hunting areas of Sweden infected with coccidians, Brglez et al. (1970) 33% in Yugoslavia. Oliger (1957) listed coccidians to the group of obligatory parasites of tetraonid birds, because the intensity of infection and their incidence is very high in Eurasian tetraonids.

The intensity of infection with coccidians was considerably lower in *T urogallus* than in *L. tetrix*, amounting to 20% only In the individual years, the rate of infection ranged from 14 4% in 1968 to 36.8% in 1970 A higher incidence was recorded only by Almasan et al (1968), i e., in 76% of capercaillies from the Northern Carpathian Mts., while Hulphers recorded 17% from Sweden, and Lund (1946) 3% only from Norway

Coccidiosis is distributed throughout all zoogeographical zones of Czechoslovakia and its ubiquitous in practically all biotopes inhabited by tetraonids Having regard to the fact that these biotopes and particularly those situated at higher altitudes, are still snow-bound at the period of heat and that infection of the birds must have been acquired in the autumn of the previous year, the intensity and incidence of infection is extremely high with these birds. Our results, as well as those of Oliger (1957) and Velthuysen (1957) are that coccidiosis constitutes one of the important epizootological factors endangering mainly the rearing of chicks in biotopes of low altidudes where conditions for the development of this protozan infection are most satisfactory during the period of heat.

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ZUR TAXONOMIE DER TULLBERGINAE (APTERYGOTA: COLLEMBOLA)

JOSEF RUSEK

Eingegangen am 6. Februar 1973

Abstrakt: In dieser Arbeit sind zwei neue Gattungen und drei neue Arten beschrieben; *Karlstejnia annae* gen. n. sp. n., *Doutnacia xerophila* gen. n. sp. n. und *Mesaphorura tenuisensillata* sp. n.

In den letzten Jahren wurde den Arten der Gattung *Mesaphorura* Börner, 1901 eine erhöhte Aufmerksamkeit gewidmet. Es wurde ein grösseres Material aus ganz Europa untersucht und es zeigte sich, dass die einzige europäische Art dieser Gattung — *Mesaphorura krausbaueri* Börner, 1901 in Wirklichkeit ein Artkomplex mit mehreren Arten vorstellt (Rusek, 1971; im Druck). Beim Bestimmen einiger grösseren Bodenproben wurden zwischen den *Mesaphorura*-Arten zwei neue Gattungen gefunden, die in dieser Arbeit (zusammen mit der neuen *Mesaphorura tenuisensillata* sp. n.) beschrieben werden. „Makroskopisch" (bei kleinerer Vergrössung) sind sie habituell den *Mesaphorura*-Vertretern sehr ähnlich und wurden bisher auch mit dieser Gattung verwechselt.

Beschreibung der neuen Taxone

Karlstejnia gen. n.

Diagnose: Körper schlank, *Mesaphorura*-artig, 450 µm lang, weiss. Antenne IV dorsal mit 4 deutlich verdickten Sensillen a—d; „Sensille" (e) sehr dünn, borstenartig. Antennalorgan III besteht aus zwei grossen Sinneskolben, zwei kleinen Sinnesstäbchen dazwischen und einer Schutzpapille. Postantennalorgan in ovaler Vertiefung, mit 6 grossen, charakteristischen Höckern (Abb. 2A). Meso- und Metanotum ohne Borsten m_2, m_3 und p_2. Abdomentergit IV mit Medialborste x. Tergit I—V mit Sensillen (p_3 und am Tergit V noch p_5), weitere Sensillen an Pleuriten. Pseudocellen undeutlich begrenzt. Zwei kleine Analdornen vorhanden. Bisexual.

Typische Art: *Karlstejnia annae* gen. n. sp. n.

Verwandtschaftsbeziehungen: Am nächsten ist die neue Gattung mit *Mesaphorura* Börner, 1901 verwandt. Sie haben gemeinsam: die Zahl der Analdornen, die Gestalt des Antennalorganes III und der Pseudocellen. *Karlstejnia* gen. n. hat dagegen ganz anderen Postantennalorgan, andere

Beborstung der Anallappen, borstenartige „Sensille" (e) am Antennalsegment IV und ist bisexuel.

Derivatio nominis: Nach der Burg Karlštejn, die etwa 5 km östlich vom Locus typicus entfernt ist, benannt.

Karlstejnia annae sp. n.

Beschreibung: Körper schlank, *Mesaphorura*-artig, 450 µm lang und 80 µm breit. Farbe weiss. Granulierung regelmässig fein, am Abdomentergit VI am gröbsten. Macrochaeten von den Microchaeten deutlich differenziert (Abb. 1, 2E). Die Beborstung (Abb. 1A, B, 2E) entspricht der Formel:

	I	II	III	I	II	III	IV	V
a	—	10	10	10	10	10	10	10
m	8	6[1])	6[1])	2	2	2	5[2])	—
p	—	8	8	10[3])	10[3])	10[3])	10[3])	6[4])

Anallappen ohne l_2 und l_3 Borsten; l_1, l_5, l_6, l_{8-10} in einem Bogen inseriert (Abb. 2G). (Bei *Mesaphorura* l_6 beim Lappenrand und l_8 zwischen l_7 und l_9).

Pseudocellen undeutlich mit rosettenartigen Rand begrenzt, 10 µm im Durchmesser. Pseudocellenzahl 11/022/11111. Am Meso- und Metanotum sind sie zwischen p_3 und p_4 und zwischen m_5 und p_5.

Antennen kürzer als Kopfdiagonale, im Verhältnis zu dieser wie 14 : 16. Antennensegmente I : II : III : IV wie 25 : 30 : 38 : 50. Antennensegment IV (Abb. 2F) dorsal mit 4 deutlich verdickten Sensillen a —d und einem Sinnesstäbchen f. Sensille d kürzer als a, b und c. Die „Sensille" (e) ist borstenartig. Antennalorgan III besteht aus zwei dicken, geneigten Sinneskolben, zwei kleinen Sinnesstäbchen dazwischen und aus einer deutlichen Schutzfalte (Abb. 2F). Auf der Ventralseite des Antennensegmentes III ist ein dicker, ovalliger Sinneskolben (Abb. 2F) vorhanden.

Postantennalorgan (Abb. 2A) befindet sich in einer breit ovaler Vertiefung und besteht aus 6 Höckern. Die mittlere Höcker sind ± symetrisch in der Mitte inseriert, die äusseren und inneren sind dagegen assymetrisch. Labrum mit 4, 2, 5 Borsten (Abb. 1A). Zwei (1 + 1) Praelabralborsten vorhanden (Abb. 1A).

Am Kopfe nur 3 + 3 Macrochaeten vorhanden (sd_2, l_2 und l_5) (Abb. 1A).

Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Lateralsensille s am Meso- und Metanotum schlank und etwa gleich lang wie die Macrochaeten (Abb. 1A, B). Sensille s' klein. Klauen ohne Zähne, 12 µm lang. Empodialanhang klein (etwa 10 % der Klauenventralkante), ohne Innenlamelle (Abb. 2B).

Am Hinterrande des Abdomentergits V befindet sich vor den Pseudocellen 1 + 1 verdickte, spindelartige Sensilla s (Abb. 2C, E) die 13 µm lang ist und etwa 55 % der Macrochaetenlänge (p_2) erreicht. Am Abdomentergit VI sind am Vorderrande sichelförmige Wülste und am Ende auf niedrigen Papillen zwei Analdornen vorhanden (Abb. 2E). Länge der Analdornen 6 µm; sie sind deutlich kürzer als Klaue III. Ventraltubus mit 5 + 5 Borsten,

[1]) m_2 und m_3 nicht vorhanden, [2]) x, m_4 und m_5 vorhanden, [3]) p_3 sensillenartig verdickt, [4]) p_3 und p_5 sensillenartig verdickt.

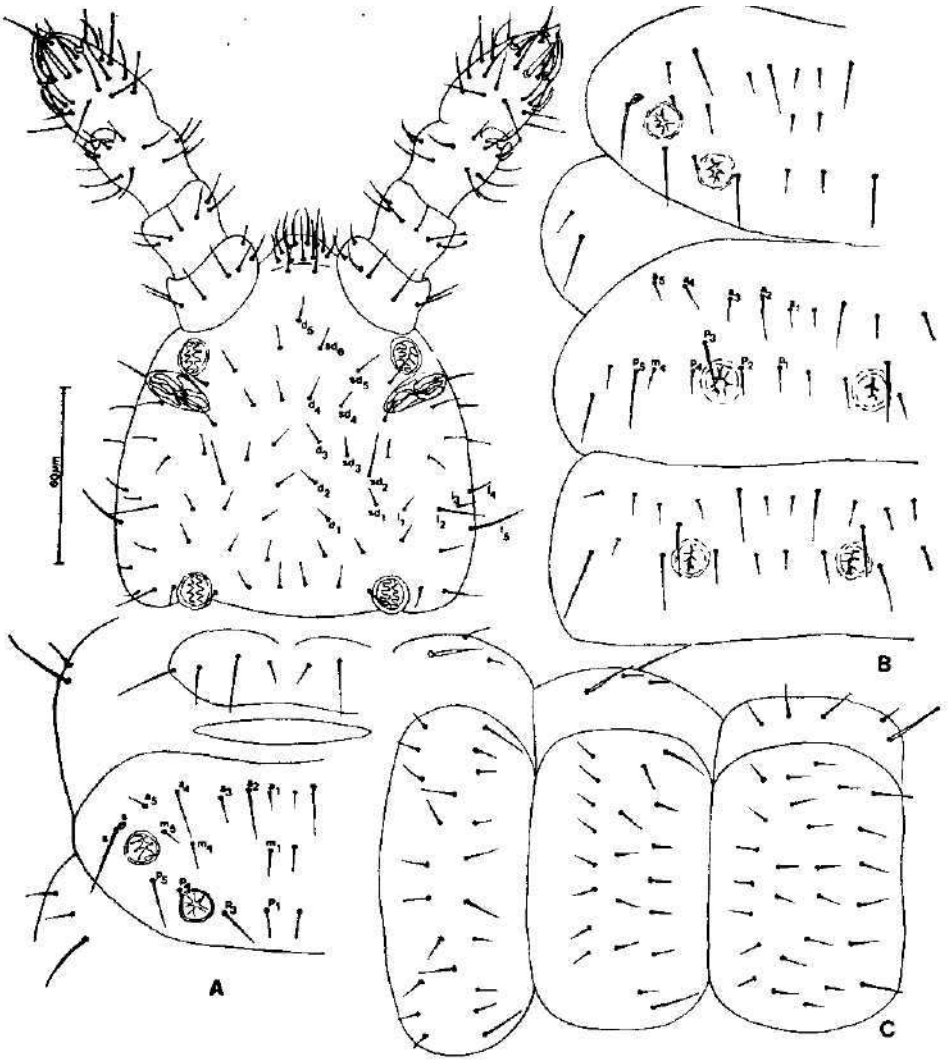

Abb. 1. *Karlstejnia annae* **gen. n. sp. n. A — Beborstung des Kopfes, Pro- und Mesonotums, B — Beborstung des Metanotums und der Abdomentergite I—II, C — Beborstung der Sternite und Pleurite II—IV. (Vergrösserung: 60 µm — A—C).**

weitere 1 + 1 Borsten daneben. Sternalbeborstung siehe Abb. 1C. Ohne Furkarudiment. Männliche Genitalpapille mit 6 + 6 Borsten (Abb. 2D).

Locus typicus: 10. II. 1971, 2 Ex. in Bodenproben aus einer Grassteppe — Asoz. *Festucetum valesiacae*, Subas. *Carex humilis—Festuca sulcata* Klika, 1932 — am S-Hang des Hügels Doutnáč (Naturschutzgebiet) im Böhmischen Karst (SW von Praha), Tschechoslowakei.

Holotypus No. 10. II. 1971/A-110 und Paratypus befinden sich in der Sammlung des Verfassers.

Synökologie: Im Untersuchungsgebiet (Steppenlokalitäten am S-Abhang des Hügels Doutnáč) wurde diese neue Art nur im Boden der Steppen-

assoziation *Festucetum valesiacae*, Subasoz. *Carex humilis—Festuca sulcata* Klika, 1932 festgestellt. Sie lebt hier in der Apterygotenassoziation *Cryptopygus bipunctatus—Onychiurus armatus—Sphaeridia* sp.*—Isotomodes productus—Metaphorura bipartita—Doutnacia xerophila—Isotoma notabilis—Eosentomon transitorium—Sminthurinus aureus* und *Lepidocyrtus lanuginosus*.

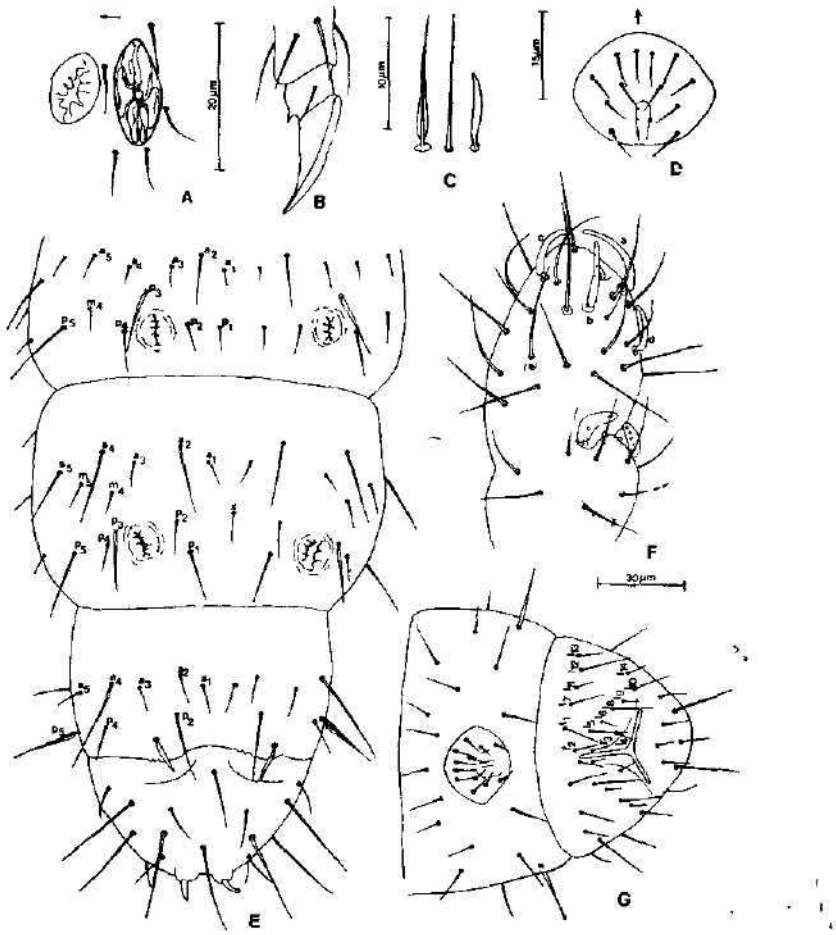

Abb. 2. *Karlstejnia annae* gen. n sp. n. A – Postantennalorgan und Pseudocelle, B – Klaue III, C – p_5, p_2 und p_3 vom Abdomentergit V, D – Männliche Genitalplatte, E – Beborstung der Tergite III–VI, F Dorsalseite des Antennensegmentes IV und III, G – Beborstung der Anallappen und des Sternites V. (Vergrosserung: 10 µm – B; 15 µm – C, D, F; 20 µm – A; 30 µm – E, G).

Derivatio nominis: Diese neue Art wird meiner Mutter Anna zum Geburtstage gewidmet.

Doutnacia gen. n.

Diagnose: Körper schlank, *Mesaphorura*-artig, 460 µm lang, weiss. Antenne IV dorsal mit 4 deutlich verdickten Sensillen a–d; Sensille e ist

nicht vorhanden [= Borste (e)] (Abb. 4E). Sensille b sehr dick. Antennalorgan III besteht aus einem dorsalen, grossen, geneigten Sinneskolben (ventraler fehlt), zwei kleinen Sinnesstäbchen und einer niedrigen Schutzpapille (Abb. 4E). Die ventrale Sensille am Antennensegment III ist nicht geneigt. Postantennalorgan in einer länglich ovalen Vertiefung mit 37 einfachen, in seiner Mitte inserierten, deutlich voneinander getrennten Höckern (Abb. 4D). Pseudocellen mit rosettenartigen Rand und 8—10 Öffnungslappen (Abb. 4C). Am Mesonotum fehlen nur die m_2 und p_2 und am Metanotum noch die a_2 Borsten. Klauen einfach, wie bei *Mesaphorura*. Zwei Analdornen vorhanden. Bisexuel.

Typische Art: *Doutnacia xerophila* gen. n. sp. n.

Verwandtschaftsbeziehungen: Das Antennalorgan III, in dem sich nur eine Sinneskolbe befindet, stellt die neue Gattung in eine Verwandtschaft mit den Gattungen *Clavaphorura* Salmon, 1943, *Austraphorura* Bagnall, 1947 und *Scaphaphorura* Petersen, 1965, die auch nur eine Sinneskolbe in Antennalorgan III haben. *Austraphorura* trägt aber 4 Analdornen und einen weiteren medialen dornartigen Auswuchs unterhalb der Dornen. *Clavaphorura* hat im Antennalorgan III 4 Sinnesstäbchen und trägt am Ende geknöpfte Tibiotarsalhaare. Am nächsten ist mit *Doutnacia* gen. n. die Gattung *Scaphaphorura* Petersen, 1965 verwandt. *Scaphaphorura* hat aber einen ganz anderen Bau des Postantennalorgans und der Klauen (die kleinen Höcker im Postantennalorgan stehen in 5—6 Längsreihen, die Klauen sind dorsal breit gerundet, tragen Basalzähne und sind schlank).

Derivatio nominis: Nach dem Hügel Doutnáč im Böhmischen Karst auf dessen S-Abhang der Locus typicus liegt, benannt.

Doutnacia xerophila sp. n.

Beschreibung: Körper schlank, *Mesaphorura*-artig, 460 µm lang und 90 µm breit. Farbe weiss. Granulierung regelmässig fein, am Abdomentergit VI am gröbsten. Macrochaeten von den Microchaeten deutlich differenziert. Beborstung (Abb. 3) entspricht der Formel:

	I	II	III	I	II	III	IV	V
a	—	10	8[3]	8[4]	10	10	10	8[7]
m	8	8[1]	8	2[5]	2[6]	2	—	—
p	—	8[2]	8	10	10	10	10	6

Die Anallappen (Abb. 4B) ohne l_2 und l'_2 Borsten; l_3, l_5, l_{8-10} in einer Linie inseriert.

Pseudocellen mit rosettenartigen Rand, 10 µm im Durchmesser. Pseudocellenoberfläche in 8—10 „Öffnungslappen" geteilt (Abb. 4C). Pseudocellenzahl: 11/011/11111, auf allen Tergiten gut entwickelt (Abb. 3). Am Meso- und Metanotum befinden sich die Pseudocellen zwischen den Borsten m_5 und p_5.

[1]) m_2 nicht vorhanden, [2]) p_2 nicht vorhanden, [3]) a_3 nicht vorhanden, [4]) a_3 nicht vorhanden, [5]) m_3 vorhanden, [6]) m_4 vorhanden, [7]) a_3 nicht vorhanden.

Antennen kürzer als Kopfdiagonale, im Verhältnis zu dieser wie 60 : 90. Antennensegmente I : II : III : IV wie 10 · 13 : 17 : 24. Antennensegment IV dorsal (Abb. 4E) mit vier Sensillen a—d, Sensille e ist in eine Borste (e) umgewandelt. Sensille b ist sehr dick, c dünn und am langsten, d etwas länger und dicker als a. Ein Sinnesstäbchen f vorhanden. Antennalorgan III besteht (Abb. 4E) aus einer (dorsalen) dicken, geneigten Sinneskolbe, zwei

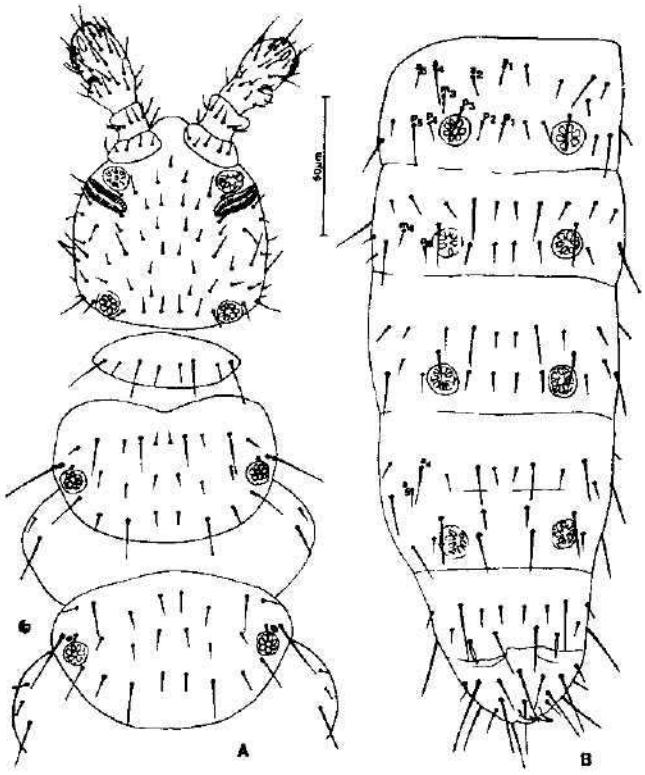

Abb. 3. *Doutnacia xerophila* gen. n. sp. n. A — Beborstung der Kopfdorsalseite und des Pro-, Meso- und Metanotums, B — Beborstung der Abdomentergite I—VI. (Vergrosserung: 50 µm — A, B).

kleinen Sinnesstabchen und einer Schutzpapille. Die zweite (laterale) Sinneskolbe fehlt. Die grosse Sinneskolbe auf der Ventralseite des Antennensegmentes III ist nicht geneigt (Abb. 4E).

Postantennalorgan (Abb. 4D) befindet sich in einer sehr seichten, länglich ovalen Vertiefung und besteht aus 37 einfachen, in zwei Parallelreihen stehenden Höckern. Die Höcker sind langlich oval, in der Mitte etwas verengt und hier durch einen kreisformigen Stiel inseriert. Alle Höcker sind deutlich durch breite Zwischenräume voneinander getrennt.

Am Kopf nur drei Macrochaeten sd_2, l_2 und l_5 vorhanden (Abb. 3A). Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Die laterale Sensille s am Meso- und Metanotum ist

deutlich länger als die Macrochaeten; s' klein. Klauen ohne Zähne, wie bei *Mesaphorura* gebaut, 10 µm lang. Empodialanhang klein (etwa 15 % der Klauenventralkante), ohne Innenlamelle.

Am Hinterrande des Abdomentergites V befindet sich vor den Pseudocellen 1 + 1 verdickte, spindelartige Sensille s (Abb. 3B), die 8 µm lang ist und etwa 50 % der Macrochaetenlänge (p_2) erreicht. Am Abdomentergit VI

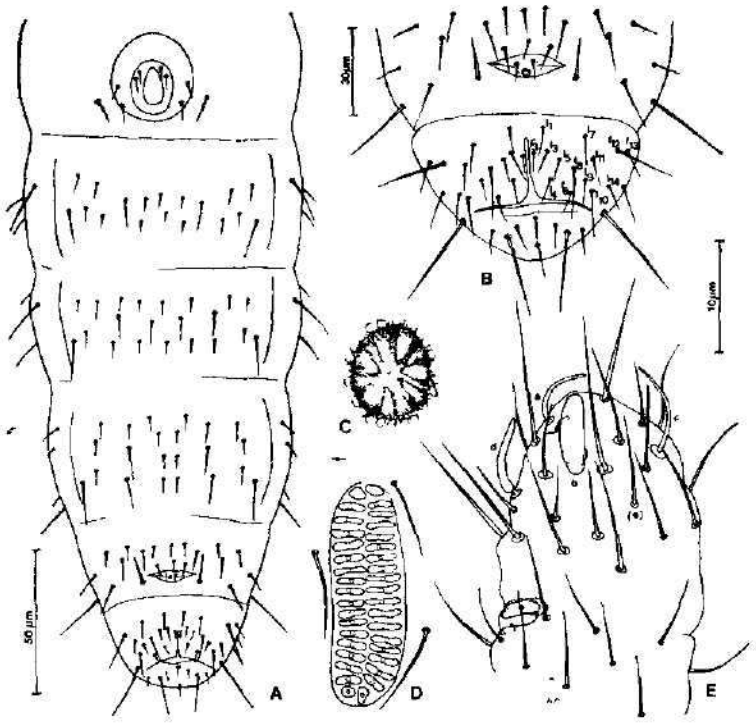

Abb. 4 *Doutnacia xerophila* gen n. sp n. A — Beborstung der Abdomensternite I—VI, B — Beborstung der Anallappen und des Sternites V, C — Pseudocelle vom Kopfvorderrand, D — Postantennalorgan, E — Dorsalseite der Antennensegmente IV und III (Vergrosserung: 10 µm — C, D, E; 30 µm — B, 50 µm — A).

sind am Vorderrande sichelformige Wulste und am Ende auf niedrigen Papillen zwei Analdornen vorhanden (Abb. 3B) Analdornen 8 µm lang, kürzer als Klaue III. Ventraltubus mit 5 + 5 Borsten und weitere 1 + 1 Borsten daneben. Sternalbeborstung siehe Abb. 4A. Ohne Furkarudiment. Weibliche Genitalplatte mit 1 + 1 Microchaeten, lateral daneben mi 1 + 1 dickeren Borsten (Abb. 4B). Mannliche Genitalplatte mit 13 Borsten.

Locus typicus: 10. II. 1971, 8 Ex , 29. IV. 1970, 6 Ex , 20. VII. 1970, 5 Ex , 20. IX. 1970, 3 Ex , 5. IV. 1971, 4 Ex. in Bodenproben aus einer Grassteppe — Asoz. *Festucetum valesiacae*, Subas. *Carex humilis — Festuca sulcata* Klika, 1932 — am S Abhang des Hugels Doutnáč (Naturschutzgebiet) im Bohmischen Karst (SW von Praha), Tschechoslowakei

Weitere Fundorte. Tschechoslowakei — 29 IV. 1970, 1 Ex , 29 IX 1970, 1 Ex., 10. II 1971, 2 Ex., 5 IV. 1971 2 Ex. in Bodenproben aus einer Grassteppe — Asoz *Festuca valesiaca — Erysimum crepidifolium* Klika, 1932 — am S-Abhang des Hugels Doutnáč (Naturschutzgebiet) im Bohmischen Karst (SW von Praha).

20. VII. 1970, 1 Ex., 29. IX. 1970, 1 Ex., 10. II. 1971, 3 Ex. in Bodenproben aus der Waldsteppenenklave, Asoz. *Lathyro (versicoloris)—Quercetum pubescentis* (Klika, 1938) em. Jakucs, 1960 am S-Abhang des Hügels Doutnáč (Naturschutzgebiet) im Böhmischen Karst (SW von Praha).

Italien: — Herbst 1965, 38 Ex. in Streu- und Bodenproben aus *Quercetum ilicis* (macchia mediterranea) in Terracosta bei Torino di Sangro in Abruzzo in Mittelitalien, leg. G. Marcuzzi.

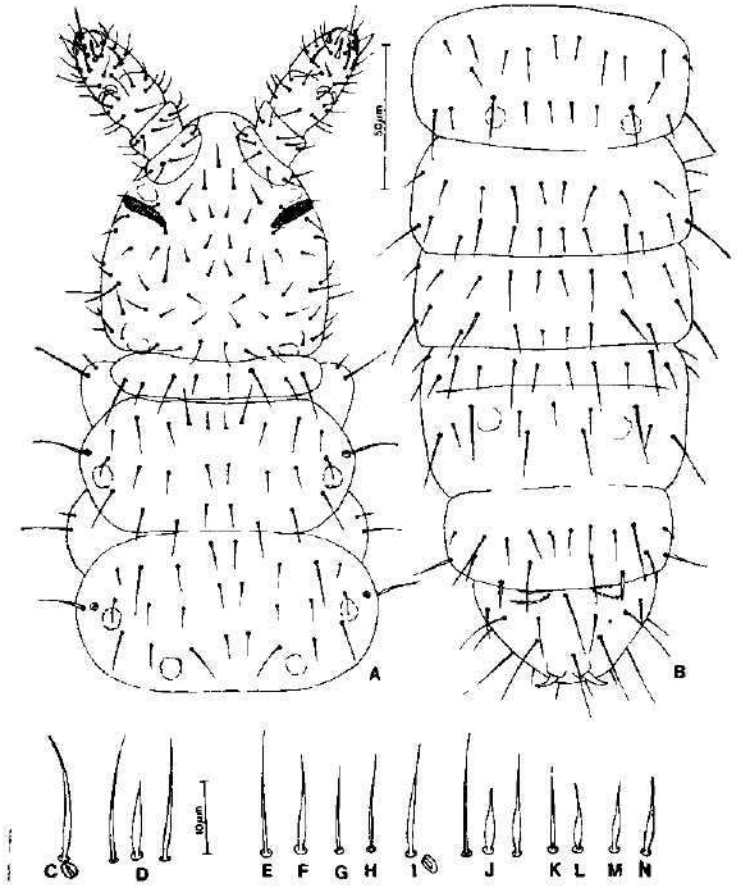

Abb. 5 A—H. *Mesaphorura tenuisensillata* sp. n. A — Beborstung der Kopfdorsalseite und des Pro-, Meso- und Metanotums, B — Beborstung der Abdomentergite I—VI, C — Sensillen s und s' vom Mesonotum, D — Borste p_2 und Sensillen p_3 und p_5 vom Abdomentergit V, E — Sensille p_3 vom Abdomentergit IV, F — Sensille p_3 vom Abdomentergit III, G — Sensille vom Pleurit II, H — Sensille vom Pleurit III.
Abb. 5 I—N. *Mesaphorura sensibilis* Rusek. I — Sensillen s und s' vom Mesonotum, J — Borste p_2 und Sensillen p_3 und p_5 vom Abdomentergit V, K — Sensille p_3 vom Abdomentergit IV, L — Sensille p_3 vom Abdomentergit III, M — Sensille vom Pleurit II, N — Sensille vom Pleurit III. (Vergrösserung: 10 µm C—N; 50 µm — A, B.)

Jugoslavien: 1967, 2 Ex. in Bodenproben unter Pinus nigra im Sandgebiet Deliblatski pesak in NO Jugoslawien, leg. M. Bogojević.

Holotypus No. 10. II. 1971/A-110 und die Paratypen befinden sich in der Sammlung des Verfassers.

Synökologie: Die neue Art kommt in xerothermen Steppen- und Waldsteppenböden vor.

Verwandtschaftsbeziehungen: Diese neue Art ist am nächsten mit *Mesaphorura sensibilis* Rusek, 1974 verwandt. Sie unterscheidet sich von dieser durch die schlankere Sensillen am Antennensegment IV, auf den Abdomentergiten und auf den Pleuriten. Bei *Mesaphorura sensibilis* sind die p_3 Sensillen am Abdomentergit II—V, p_5 am Abdomentergit V und die vordere Sensille am Abdomenpleurit II—III stark verdick und relativ kurz. Bei *Mesaphorura tenuisensillata* ist nur die Sensille p_3 am Abdomentergit III und V stark verdickt, die verbleibenden Sensillen sind fast unverdickt, schlank und relativ lang. Auch die Borsten sind bei der neuen Art länger (z. B. am Abdomentergit V überragt p_2 die Spitze von der Sensille p_3 — bei *Mesaphorura sensibilis* ist sie kürzer).

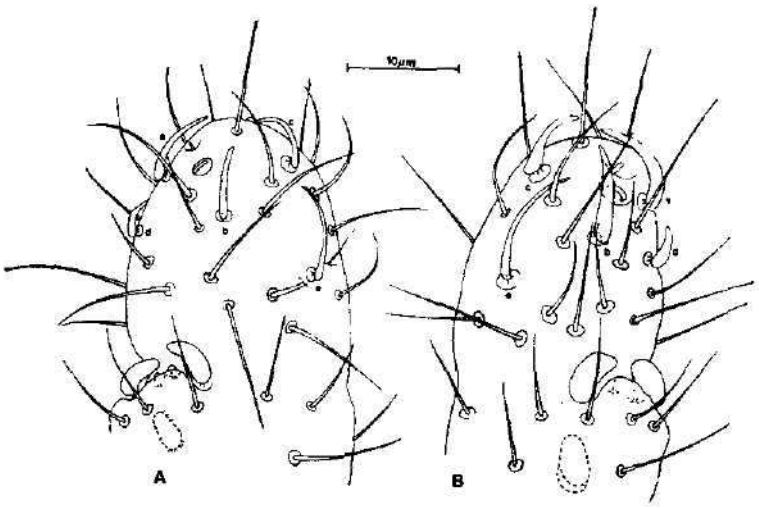

Abb. 6 A. *Mesaphorura tenuisensillata* sp. n. — Dorsalseite des Antennensegmentes IV und III. **Abb. 6 B.** *Mesaphorura sensibilis* Rusek — Dorsalseite des Antennensegmentes IV und III. (Vergrösserung: 10 µm — A, B).

Beschreibung: Körper typisch für die Gattung *Mesaphorura*, 440 µm lang und 100 µm breit. Farbe weiss. Granulierung am Kopf und am ganzen Körper gleich gross, nur am Abdomentergit VI etwas gröber. Macrochaeten von den Microchaeten deutlich differenziert. Beborstung (Abb. 5A, B) entspricht der Formel:

	I	II	III	I	II	III	IV	V
a	—	10	8[3]	10	10	10	10	10
m	8	8[1]	8	2[4]	2	2	4[6]	—
p	—	8[2]	8	10	10	10[5]	11[7]	8[8]

[1] m_2 nicht vorhanden, [2] p_2 nicht vorhanden, [3] a_2 nicht vorhanden, [4] m_4 vorhanden, [5] p_3 deutlich verdickte, schlanke Sensilla, [6] m_4 und m_5 vorhanden, [7] Medialborste x vorhanden, p_2 fast unverdickte Sensilla, [8] p_3 spindelartige und p_5 schlanke Sensilla.

Die Anallappen mit l_2' und l_3'.

Pseudocellenzahl 11/012/10011. Pseudocellen mit rosettenartigen Rand, 9 µm im Durchmesser. Am Mesonotum liegen sie zwischen den Borsten m_5 und p_5, am Metanotum zwischen p_3 und p_4 und zwischen p_5 und m_5 (Abbildung 5A).

Antennen kürzer als Kopfdiagonale (58 µm : 85 µm). Länge der Antennensegmente: I = 10 µm, II = 12 µm, III = 17 µm, IV = 19 µm. Am Antennensegment IV befinden sich dorsal 5 Sensillen a—e und zwei Sinnesstäbchen f und g (Abb. 6A). Alle Sensillen an der Basis mit ferseartigem Ausläufer, mässig verdickt, d kurz, e am längsten. Apikalsensilla klein. Antennalorgan III (Abb. 6A) besteht aus zwei äusseren, dicken, gegeneinander geneigten Sinneskolben und zwei kleinen Sinnesstäbchen dazwischen. Eine deutliche Schutzfalte vorhanden (Abb. 6A). Auf der Ventralseite des Antennensegmentes III in einer Vertiefung eine grosse, dicke Sinneskolbe vorhanden (Abb. 6A).

Postantennalorgan in einer seichten, ovalen Vertiefung, mit 40 dicht nebeneinander stehenden, nierenförmigen Höckern (typisch für die Gattung *Mesaphorura*).

Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Lateralsensilla s (Abb. 5C) ist etwas kürzer als die Macrochaeten, an seiner Basis deutlich verdickt, Sinnesstäbchen s' in kreisförmiger Vertiefung, dünn (Abb. 5C). Klauen 11 µm lang, ohne Zähne. Empodialanhang klein, etwa 25 % der Klauenventralkante erreichend, ohne Innenlamelle.

Am Abdomentergit V ist die Borste p_2 19 µm, Sensilla p_3 11 µm und Sensilla p_5 17 µm lang (Abb. 5D). Am Abdomentergit VI sind am Vorderrande sichelförmige Wülste und am Ende auf deutlichen Papillen zwei Analdornen vorhanden (Abb. 5B). Sie sind 9 µm lang, deutlich kürzer als Klaue III. Ventraltubus mit 5 + 5 Borsten und 1 + 1 weiteren daneben. Ohne Furkarudiment. Nur Weibchen vorhanden.

Locus typicus: 29. IV. 1970, 6 Ex. in Bodenproben aus der Waldsteppenenklave, Asoz. *Lathyro (versicoloris)—Quercetum pubescentis* (Klika, 1938) em. Jakucs, 1960, am S-Abhang des Hügels Doutnáč im Böhmischen Karst (SW von Praha).

Weiterer Fundort: 29. IV. 1970, 2 Ex. in Bodenproben von einer Steppe (Asoz. *Festucetum valesiacae*, Subasoz. *Carex humilis—Festuca sulcata* Klika, 1932) am S-Abhang des Hügels Doutnáč im Böhmischen Karst.

Holotypus No. 29. IV. 1970/A-117 und die Paratypen befinden sich in der Sammlung des Verfassers.

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SOME NEW FINDINGS OF NEMATODES OF THE FAMILIES OXYURIDAE AND HELIGMOSOMIDAE (NEMATODA) IN CZECHOSLOVAKIA AND POLAND*)

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Abstract: The findings of *Boreostrongylus minutus* (Dujardin, 1845) in Czechoslovakia and *Heligmosomum mixtum* Schulz, 1954 and *Heligmosomoides polygyrus* (Dujardin, 1845) in Poland are reported. *Syphacia obvelata* (Rud., 1802), *Syphacia montana* Yamaguti, 1943, *Syphacia frederici* Roman, 1945, *Syphacia stroma* (von Linstow, 1884) and *Syphacia muris* (Yamaguti, 1935) were found in Czechoslovakia, *S. obvelata* and *S. montana* in Poland. All species, with the exception of *Syphacia obvelata* and *Heligmosomoides polygyrus*, are new for the fauna of these countries. New synonyms of some species were given where nesessary.

A large number of nematodes of the families Oxyuridae**) and Heligmosomidae have been collected at the territory of Czechoslovakia (a) and Poland (b) during the recent years and many papers dealing with this subject have been published to date, e.g. a) — Erhardová and Ryšavý (1955), Erhardová (1958), Tenora (1962, 1963, 1964), Prokopič (1971); b) — Soltys (1949), Furmaga (1957), Kisielewska (1970) etc. Several papers dealing with the systematic and taxonomic position of the above-mentioned nematode families recovered from small rodents have been published recently (Merkusheva, 1964; Durette-Desset, 1968, 1971; Odgen, 1971; Quentin, 1971; Tenora and Mészáros, 1971). The value of some morphological and metrical characters has been discussed from new points of view, using either original material or specimens recovered from hosts and localities given in the original descriptions. We have examined our material with regard to these papers and our study brings some new data on the specimens from Czechoslovakia and Poland.

MATERIAL

This report is based on specimens of parasitic nematodes collected by a scientific expedition to Poland (locality Pieniny) in 1964, headed by Academician Josef Kratochvíl. We also used material collected by Durette-Desset and Tenora in Czechoslovakia (locality Lednice) in 1971. Moreover, we revised the species of the genus *Syphacia* recorded by Tenora (1962, 1963, 1964) and Tenora and Tománek (1963).

*) The specimens were studied in December 1972 during F. Tenora's stay at Muséum National d'Histoire Naturelle, Laboratoire de Zoologie (Vers), headed by Prof. A. G. Chabaud.

**) Oxyuridae Cobbold, 1864; syn.: Syphaciidae Skrjabin et Schikhobalova, 1951 (see Quentin, 1973 in press).

Table I. The main metrical data (in mm) of the species *Boreostrongylus minutus* (Duj., 1845) and *Boreostrongylus dalrymplei* (Dikmans, 1935)

1	*Strongylus minutus* Dujardin, 1845	*Longistriata volgensis* Schulz, 1926	*Longistriata dalrymplei* Dikmans, 1935	*Longistriata dalrymplei* Dikmans, 1935
2	2.25	2.5	3.7 – 4	1.1 – 1.39
3	0.051 – 0.070	0.08	0.04 – 0.05	0.051 – 0.06
4	0.265	0.392	0.34 – 0.36	0.25 – 0.35
5	–	0.030	0.025 – 0.030	0.075 – 0.084
6	2.4	–	4 – 4.7	1.68 – 2.04
7	–	–	0.07 – 0.08	0.06 – 0.063
8	0.11*)	–	0.04 – 0.06	0.033 – 0.036
9	–	–	0.09 – 0.012	–
10	0.09 – 0.075	–	0.055 – 0.065 × 0.035 – 0.04	0.065 – 0.072 × 0.033 – 0.036
11	Dujardin, 1845	Schulz, 1926	Dikmans, 1935	Spasskij et col., 1951
12	France	USSR	USA	USSR

1	*Longistriata dalrymplei* Dikmans, 1935	*Boreostrongylus minutus* (Dujardin, 1845)	*Boreostrongylus minutus* (Dujardin, 1845)
2	1.5 – 2	2.1	1.95 – 2
3	0.07 – 0.082	0.07	0.055 – 0.07
4	0.25 – 0.28	0.34	0.2 – 0.285
5	0.028 – 0.036	0.040	0.026 – 0.040
6	2.5 – 3	2.5	1.7 – 2.5
7	0.1 – 0.11	0.05	0.05 – 0.069
8	0.032 – 0.036	0.035	0.035
9	0.102 – 0.115	0.09	0.099 – 0.1
10	–	0.065 – 0.069 × 0.030 – 0.032	0.06 – 0.07 × 0.030 – 0.041
11	Erhardová, 1956	Present authors	Present authors
12	Czechoslovakia	France	Czechoslovakia

1. Name of species, 2. length of male body, 3. width of male body, 4. length of spicules, 5. length of gubernaculum, 6. length of female body, 7. width of female body, 8. distance of anus from body end, 9. distance of vulva from body end, 10. size of eggs, 11. author, 12. locality.
*) Measurement mentioned by Dujardin, 1845 is not correct, according to his original figures which have not been published yet; correct size is 0.04.

SYSTEMATICS

Heligmosomidae Cram, 1927

1. *Boreostrongylus minutus* (Dujardin, 1845) Durette-Desset, 1971

Host and locality: *Pitymys subterraneus* – Lednice (Czechoslovakia).
Location: small intestine.

This species was first described in France from *Arvicola amphibius* = *Arvicola terrestris*. It was recovered from the same host also in the U.S.S.R. and described under the name *Longistriata wolgaensis* Schulz, 1926. *P. subterraneus* was found to serve as a host of this species first in France (Durette-

Desset, 1968). Due to the fact that our finding is the first for Czechoslovakia, we are giving the main metrical data in comparison with the data available in literature (see Table 1).

The most related species is *B. dalrympley* (Dikmans, 1935) which was described in the U.S.A. as a parasite of *Ondatra zibethica* and *Microtus pensylvanicus*. Later on it was reported hypothetically as a parasite of *O. zibethica* in the U.S.S.R. (Spasskiy, Romanova, Naidenova, 1951: *Longistriata* (?) *dalrymplei* Dikmans, 1935). In Czechoslovakia the species *L. dalrymplei* Dikmans, 1935 = *Boreostrongylus dalrymplei* (Dikmans, 1935) was mentioned by Erhardová (1956) as a parasite of *Microtus agrestis*. As to the finding of Spasskiy et al. (1951), their material should be reexamined by new morphological and taxonomic methods. As regards the paper by Erhardová (1956), the description and figures suggest that the species *B. minutus* and not *B. dalrymplei* was dealt with.

B. minutus parasitizes rodents of the family Microtidae living in moist localities (water basins and their surroundings, moist meadows, inundated areas).

2. *Heligmosomum mixtum* Schulz, 1954

Host and locality: *Clethrionomys glareolus* — Pieniny (Poland).
Location: small intestine.

The specimens recovered correspond with the species characteristics described in the papers by Durette-Desset (1968) and Tenora and Mészáros (1971).

3. *Heligmosomoides polygyrus* (Dujardin, 1845)

Syn. nov.: *Heligmosomum skrjabini* (Schulz, 1926) Skrjabin et Schikhobalova, 1952 nec *Heligmosomum polygyrum* (Duj., 1845) sensu Travassos, 1937; Skrjabin, Schikhobalova, Schulz, 1954.

Host and locality: *Apodemus flavicollis* — Pieniny (Poland).
Location: small intestine.

The specimens recovered correspond with the characteristics described in the revising papers by Durette-Desset (1968, 1971).

Oxyuridae Cobbold, 1864

1. *Syphacia obvelata* (Rud., 1802)

Host and localities: *Mus musculus* — Pieniny (Poland), Lednice, Jeseníky, Hodonín, Č. Budějovice, Jindřichov ve Slezku (Czechoslovakia).
Location: caecum.

The specimens recovered correspond with the characteristics described in the revising paper by Quentin (1971).

2. *Syphacia montana* Yamaguti, 1943

Syn. nov.: *Syphacia obvelata* (Rud., 1802) sensu Tenora, 1962 pro parte.

Host and localities: *Pitymys subterraneus* — Pieniny (Poland), Lednice, Opava, Jeseníky, Hodonín; *Microtus nivalis* — the High Tatra Mts. (Czechoslovakia).
Location: caecum.

Odgen (1971) considered this species a synonym of *S. obvelata* (Rud., 1802). The specimens recovered correspond with the characteristics described by Quentin (1971).

3. *Syphacia frederici* Roman, 1945

Syn. nov.: *Syphacia obvelata* (Rud., 1802) sensu Tenora, 1962, 1963 pro parte.

Hosts and localities: *Apodemus sylvaticus* — Hodonín; *Apodemus agrarius* — Opava, Jindřichov ve Slezku; *Apodemus flavicollis* — Hodonín, Opava, Domica, Žiar (Czechoslovakia).

Location: caecum.

The specimens recovered correspond with the characteristics mentioned by Quentin (1971).

4. *Syphacia stroma* (von Linstow, 1884)

Syn nov.: *Syphacia obvelata* (Rud., 1802) sensu Schulz, 1924 pro parte; *Syphacia obvelata* (Rud., 1802) sensu Tenora, 1962, 1963 pro parte.

Hosts and localities: *Apodemus sylvaticus* — Hodonín; *Apodemus microps* — Hodonín; *Apodemus flavicollis* — Lednice, Hodonín, Opava, Orava, Domica, Žiar, L. Mikuláš (Czechoslovakia).

Location: small intestine.

This species is a parasite of the small intestine of rodents belonging to the genus *Apodemus* in Europe. It was often found not only in *A. sylvaticus*, but also in *A. flavicollis* (see Merkusheva, 1964). It was often mistaken for *Syphacia obvelata* (Rud., 1802) — see e.g. Schulz (1924), Tenora (1962) etc. The specimens recovered correspond with the characteristics described by Quentin (1971).

5. *Syphacia muris* (Yamaguti, 1935)

Hosts and localities: *Rattus rattus* — Beřkovice, Bořislav, Praha; *Rattus norvegicus* — Opava (Czechoslovakia).

Location: caecum.

The specimens were determines erroneously by Tenora and Tománek (1963) and by Tenora (1964) as *Syphacia obvelata* (Rud., 1802). They correspond with the characteristics of *S. muris* described by Quentin (1971).

CONCLUSION

Our results contribute to the knowledge of helminth fauna of small terrestrial rodents in Czechoslovakia and Poland, with a species regard to the nematodes of the families Heligmosomidae Cram, 1927 and Oxyuridae Cobbold, 1864 (resp. Syphaciidae Skrjabin et Schikhobalova, 1951). New synonyms of some species are mentioned where necessary. The results obtained are not only of faunistic but also of systematic and taxonomic character and they may be applied also in ecology

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DIE EINTAGSFLIEGEN (EPHEMEROPTERA) IN FORELLENBÄCHEN DER BESKIDEN. III. DER EINFLUSS DES VERSCHIEDENEN FISCHBESTANDES

Miloš ZELINKA

Eingegangen am 25. Februar 1973

Abstrakt: In den Versuchsbächen der Beskiden haben wir *den Einfluss des* erhöhten Fischbestandes (um fast 100 % bei Forellen) und im Gegenteil des reduzierten (ohne Forellen) auf Zoobenthos verfolgt. In der Arbeit ist es dokumentiert, dass diese Veränderungen an der Abundanz der Eintagsfliegenlarven praktisch kaum bemerktbar sind.

EINLEITUNG

In den Versuchsbächen der Beskiden (die Charakteristik siehe Zelinka, 1969) haben wir binnen zwei Jahren die Höhe des Fischbestandes geändert. Gleichzeitig haben wir den Einfluss dieser Veränderungen auf Zoobenthos verfolgt. Die Durchführung und Erhaltung dieser Veränderungen haben über zwei Meter hohe Stufen (Wehre) im Unterlauf des Baches Brodská ermöglicht. Ausserdem war (Institut für Wirbeltierforschung in Brno) der Fischbestandt viermal jährlich kontrolliert und reguliert. Im Abschnitt A (500 m lang) des Baches Brodská wurden ursprüngliche natürliche Verhältnisse erhalten, Abschnitt B (300 m) war übersetzt und C (300 m) fast ohne Fischbesatz. Die Zahl der Fische siehe Tab. 1. In der Ganzen Trasse des Baches ist kein Zufluss, das Gefälle, die Tiefe und der Bodencharakter sind praktisch gleichbleibend.

Tab. 1. Durchschnittzahl der Fische auf 1 m² des Baches Brodská seit Mai 1967 bis Mai 1969 (Durchschnittgrösse der Fische auf den Abschnitten gleich)

Fischart	Abschnitt A natürlich	B übersetzt	C ohne Forellen
Salmo trutta m. *fario*	0,147	0,273	nur periodisch 0,010
Cottus poecillopus	0,480	0,646	0,350

Tab. 2. Abundanz und Biomasse der Eintagsfliegenlarven in dem natürlichen Abschnitt des Baches Brodská. Jahresdurchschnitte auf 1 m²

Taxon	Jahr	Stromlinie 1966/67	Stromlinie 1967/68	Stromlinie 1968/69	Ufer 1966/67	Ufer 1967/68	Ufer 1968/69
Baetis rhodani		253	108	129	17	20	3
Rhithrogena semicolorata		109	109	118	—	—	—
Ecdyonurus sp. div.		89	88	66	115	116	33
Habroleptoides modesta		55	30	55	38	52	30
Torleya maior		36	136	96	23	97	72
Habrophlebia lauta		3	26	22	52	135	88
Baetis alpinus		43	90	49	—	—	—
Baetis pumilus		42	37	23	—	—	—
Epeorus assimilis		29	11	3	—	—	—
Heptagenia lateralis		—	—	—	13	32	10
Ephemera danica		—	—	—	4	9	13
Caenis sp. div.		—	—	—	3	6	20
Centroptilum sp. div.		—	—	—	6	12	13
übrige Arten		18	16	20	10	11	3
	S	677	651	581	281	496	285
	ø		636			352	
Biomasse g/m²		2,533	2,696	2,105	2,474	3,879	1,661
	ø		2,445			2,671	

METHODIK

Die benutzte Arbeitsmethodik siehe Zelinka (1969). Die Proben wurden monatlich abgenommen und zwar in der Stromlinie und eng am Ufer. Die Untersuchung des Abschnittes A dauerte 3 Jahre (Mai 1966 — Mai 1969), B und C 2 Jahre (Mai 1967 — Mai 1969).

DIE ERGEBNISSE

In der Tabelle 2 sind die Angaben über die Abundanz der einzelnen Arten und über die Biomasse in dem Abschnitt A = natürlich angeführt. Wir können feststellen, dass die Unterschiede der Abundanz und der Biomasse der Eintagsfliegenlarven im Jahresdurchschnitt im Strom relativ klein sind.

Tab. 3. Bach Brodská, die Abundanz der Eintagsfliegenlarven. Jahresdurchschnitte auf 1m².

Abschnitt	Jahr	Stromlinie 1967/68	Stromlinie 1968/69	Stromlinie ø	Ufer 1967/68	Ufer 1968/69	Ufer ø
A — natürlich		651	581	616	490	285	387
B — übersetzt		809	862	835	494	226	360
C — ohne Forellen		442	742	592	482	223	353

Tab. 4. Bach Brodská, die Biomasse der Eintagsfliegenlarven. Jahresdurchschnitte g/m²

Abschnitt	Jahr	Stromlinie 1967/68	Stromlinie 1968/69	Stromlinie ø	Ufer 1967/68	Ufer 1968/69	Ufer ø
A — natürlich		2,696	2,105	2,401	3,879	1,661	2,770
B — übersetzt		2,994	2,535	2,765	3,321	1,408	2,365
C — ohne Forellen		2,180	2,545	2,363	3,415	1,676	2,546

Bei einigen Arten hat sich aber die Abundanz geändert: auffallend war der Rückgang bei *Baetis rhodani* in dem Zeitabschnitt 1967/68 und im Gegenteil die gleichzeitige Zunahme der Larven der Art *Torleya maior*. Kleinere Schwankungen von Jahr zu Jahr beobachten wir auch bei manchen weiteren Arten *(Habrophlebia lauta, Baetis alpinus, Epeorus assimilis)*. Bei anderen war aber die Abundanz fast gleichbleibend *(Rhithrogena semicolorata, Ecdyonurus, Habroleptoides modesta)*. Die Ursache dieser Schwankungen sind vermutlich schlechte oder im Gegenteil günstige Lebensbedingungen in den kritischen Perioden der Entwicklung einzelner Arten.

Tab. 5. Durchschnittliches Stückengewicht (mg) der Eintagsfliegenlarven in den einzelnen Abschnitten des Baches Brodská

Abschnitt	Stromlinie	Ufer
A — natürlich	3,898	7,158
B — übersetzt	3,311	6,569
C — ohne Forellen	3,992	7,213

In ruhigem Wasser am Ufer haben wir aber in der Periode Mai 1967—Mai 1968 eine evidente Zunahme der Gesamtabundanz und der Gesamtbiomasse der Eintagsfliegenlarven festgestellt. Den Anteil an dieser Zunahme haben die Arten *Habrophlebia lauta, Torleya maior* und *Heptagenia lateralis* gehabt. Weil es sich um Arten mit relativ schwachen Möglichkeiten der Widerstandfähigkeit gegen Stromwirkung handelt, sind wir der Meinung, dass der Hauptgrund der Zunahme der Abundanz ausgeglichene Durchflüsse ohne grössere Wasserfluten sind. Nächsten Jahres sank wieder die Abundanz dieser Arten.

Aus der Verhältnissen in dem natürlichen Abschnitt des Baches gehen wir bei der Bewertung des Einflusses der Abänderung des Fischbestandes aus. Die Ergebnisse der zweijährigen Untersuchung (Tab. 3 und 4) zeigen, dass der fast ±100 % Unterschied in der Menge der Forellen und ±30 % in der Menge der Groppen keine nachweisbaren Unterschiede in der Biomasse der Eintagsfliegenlarven hervorgebracht hat. Die Abundanz der Larven war

Tab. 6. Bach Brodská, die Schwankungen der Abundanz einzelner Ephemeropterenarten in der Stromlinie. Durchschnittswerte auf 1 m²
(Bei den Ufern keine nachweisbare Unterschiede)

Abschnitt	A	B		C	
	natürl.	übersetzt		ohne Forellen	
Jahr	1967/69	1967/69	%	1967/69	%
Taxon	ø	ø	A = 100 %	ø	A = 100 %
Baetis rhodani	119	188	158	151	127
Baetis alpinus	70	115	164	29	41
Baetis pumilus	30	41	137	31	103
Rhithrogena semicolorata	114	135	118	115	101
Ecdyonurus sp. div.	77	82	106	73	95
Habroleptoides modesta	43	63	146	58	135
Torleya maior	116	130	112	64	55
Habrophlebia lauta	24	33	137	47	196
Epeorus assimilis	7	20	286	12	171
übrige Arten	16	28	175	12	75
S	616	835	135	592	96

dagegen in der Stromlinie des übersetzten Abschnittes B um 35 % höher. Zugleich verminderte sich aber das durchschnittliche Stückengewicht (Tab. 5). Daraus können wir schliessen, dass die grösseren Larven mehr als die kleineren den Fischen als Nahrung dienen. In schwacher Konkurrenz können sich dann mehrere kleine Larven erhalten. Dagegen in dem Abschnitt fast ohne Fischbesatz — C, war das durchschnittliche Stückengewicht immer maximal. Zur Bestätigung dieser Annahme ist jedoch weitere Forschung nötig.

Die Eintagsfliegenlarven gehören zu den Hauptkomponenten der Nahrung der Forelle in unseren Bächen und zu den wichtigen Komponenten der Nahrung der Groppe (siehe z. B. Tuša, 1968; Sedlák, 1969; Zelinka, 1971; Blahák. 1972). Die häufigste Beute der Forellen sind die Larven der Arten, welche mehr in der Aufwuchsen leben und welche am häufigsten im Drift vertreten sind. In Forellenbächen der Beskiden sind das die Larven der Gattung *Baetis*. Andere Arten werden von den Forellen hauptsächlich nur beim Schlüpfen als Subimagines zur Nahrung gewonnen. Die Groppe sucht die Nahrung unter den Steinen praktisch ohne Auswahl und darum entspricht das Verhältnis der einzelnen Arten der Eintagsfliegenlarven in der Nahrung den Verhältnissen im Bach (Orság und Zelinka, 1973).

In dem übersetzten Abschnitte des Baches Brodská sollten also durch die Fischmast am meisten die Larven der Gattung *Baetis* beeinflusst werden, andere Arten nur gleichmässig. Den wirklich festgestellten Zustand zeigt die Tabelle 6. In dem übersetzten Abschnitte waren alle Arten häufiger vertreten als in dem natürlichen und das gilt auch für die Larven der Gattung *Baetis*. Soweit wir von Jahr zu Jahr die Schwankungen in der Abundanz mancher Arten feststellen (siehe oben), dann finden wir fast dieselbe Schwankungen in allen drei Abschnitten des Baches und darum sind diese Abänderungen durch andere Einflüsse als die Fischmast verursacht.

ZUSAMMENFASSUNG

In dem Forellenbach Brodská haben wir drei Jahre die Abundanz und die Biomasse der Eintagsfliegenlarven verfolgt. In der Stromlinie haben wir in diesem Zeitabschnitt keine nachweisbaren Unterschiede in der Totalabundanz und Biomasse festgestellt. In ruhigem Wasser am Ufer stieg dagegen in der Periode 1967/68 die Abundanz und Biomasse auf 174, resp. 156 % an. Den Anteil an dieser Zunahme hatten durchwegs Arten mit relativ schwachen Möglichkeiten der Wiederstandfähigkeit gegen Stromwirkung. Darum sind wir den Meinung, dass der Hauptgrund die ausgeglichenen Durchflüsse in diesem Zeitabschnitt waren. Die Abundanz einiger Arten hat sich aber von Jahr zu Jahr etwas geändert. Auffalend war besonders der Rückgang bei *Baetis rhodani* im Jahre 1967/68 und die gleichzeitige Zunahme der Larven der Art *Torleya maior*.

Binnen zwei Jahren haben wir die Abundanz und Biomasse der Eintagsfliegenlarven auch in den Abschnitten mit modifizierten Fischbestand verfolgt. Aus den Ergebnissen können wir resultieren, dass die Steigerung der Zahl der Forellen im Durchschnitt um 86 % und der Groppen um 35 % (im vergleich mit dem natürlichen Zustand) keine nachweisbare Veränderungen in der Biomasse der Eintagsfliegenlarven hervorgebracht hat. Die Abundanz war aber um 35 % höher, bei gleichzeitiger Verminderung des Stückgewichtes. In dem Abschnitt fast ohne Forellen und niedriger Zahl der Groppen im Durchschnitt um 27 % haben wir keine Veränderungen in Eintagsfliegenbesiedelung im Vergleich mit dem Zustand in dem natürlichen Abschnitt festgestellt.

Das Wachstum der Forellen in einzelnen Abschnitten werden wir an anderer Stelle auswerten. Vorläufig können wir sagen, dass keine Unterschiede zu erwarten sind. Was den autochtonen Teil der Nahrung betrifft, ist hier kein limitierender Faktor gegen die Möglichkeit der künstlicher Vermehrung des Forellenbestandes mindestens auf die Zahlen, die in der Tabelle 1 für Abschnitt B angeführt sind, das bedeutet um fast 100 % mehr, als es dem natürlichen Zustande entspricht.

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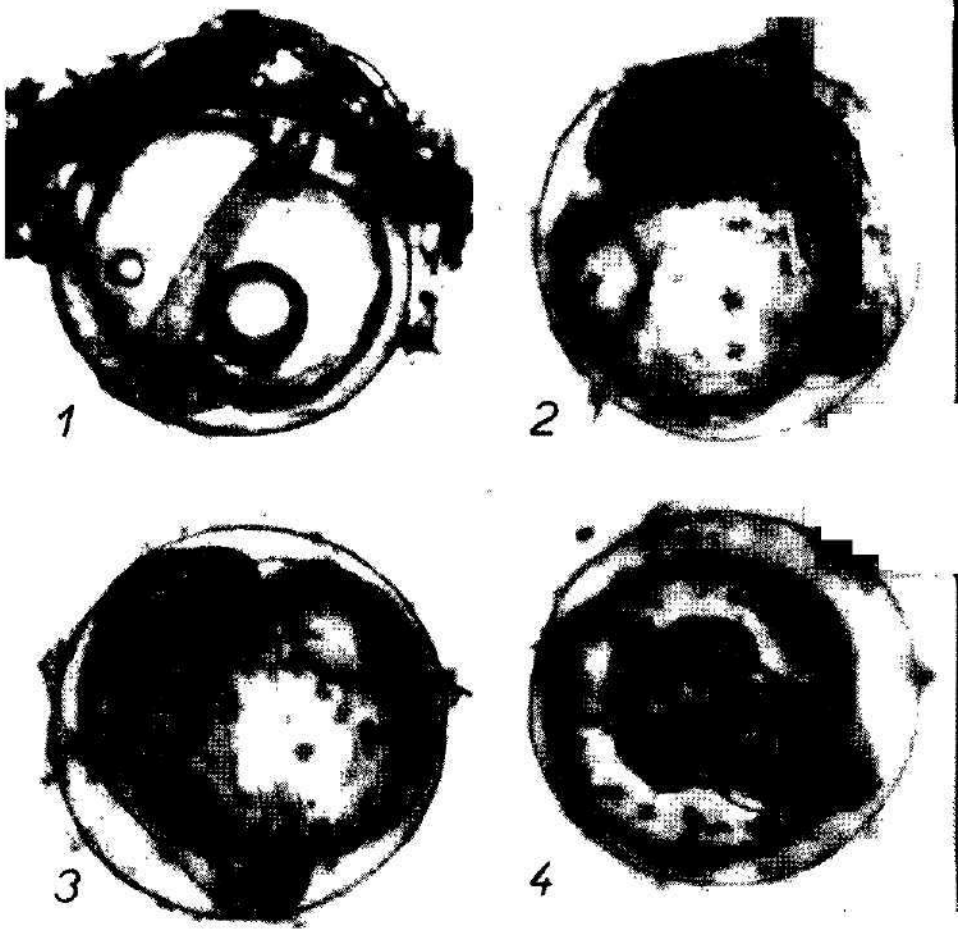

Abb. 1. Der Embryo des Prachtkärpflings *Roloffia roloffi* umwächst im Alter von 48 Stunden den Dottersack. Sein Kopf ist rechts oben, unter ihm sieht man das langsam pulsende Herz. Im Dottersack ist ein grosser und mehrere kleine Öltropfen. (Der Durchmesser des Eies beträgt 0,93 mm).

Abb. 2, 3, 4: Im Alter von 8 Tagen bewegt sich der Embryo bereits hier und da in seiner Eihülle. Er hat schwarz gefärbte Augen, den ganzen Körper und den Dottersack bedecken viele grosse Pigmentzellen. Die Blutkapillaren verlaufen an der ganzen Dottersackoberfläche und der Blutlauf ist kontinuierlich. (Die Durchmesser der Eier betragen 0,87, 0,72 und 0,84 mm).

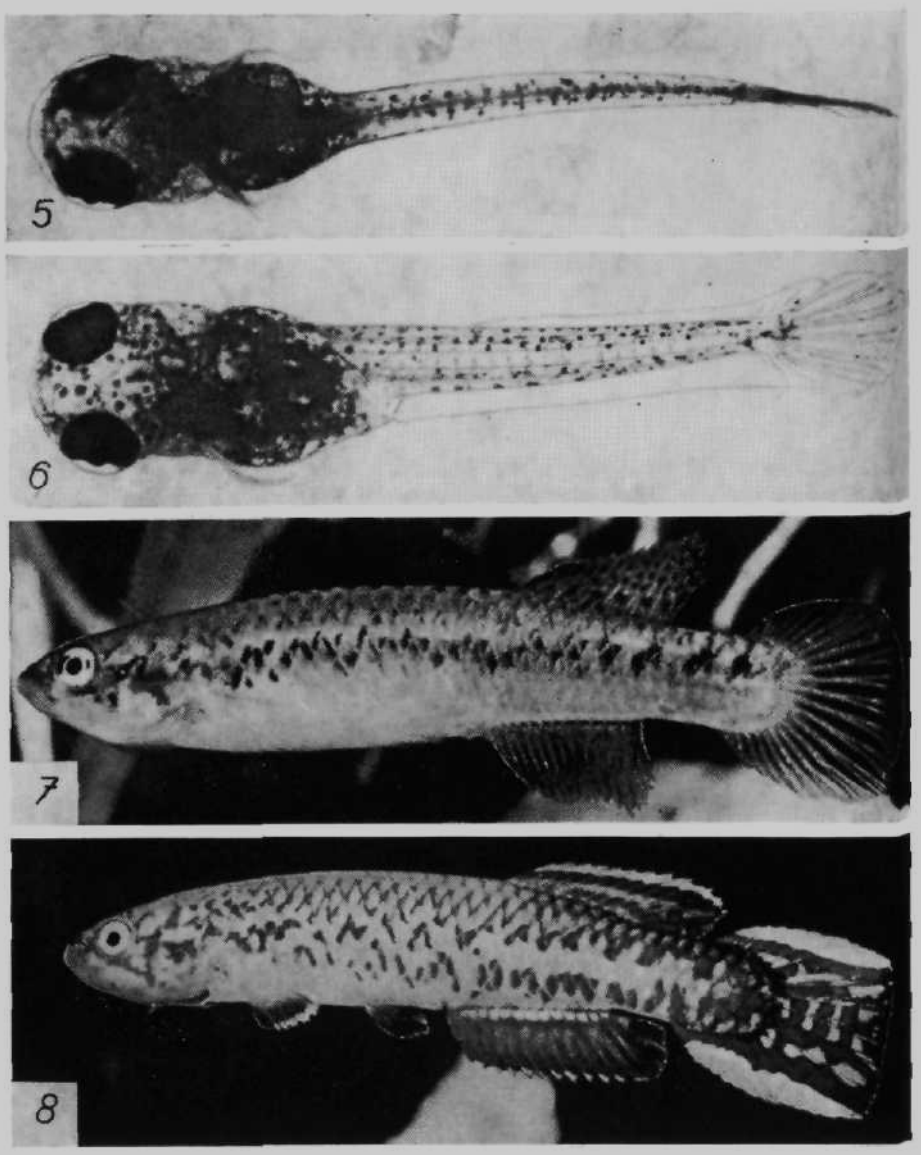

Abb. 5, 6: Jungtier des Prachtkärpflings kurz nach dem Ausschlüpfen im Alter von 11 Tagen (Gesamtlänge von 4,9 mm.)
Abb. 7, 8: Zuchtpaar des Prachtkärpflings *Roloffia roloffi*, oben ein Weibchen (7), unten ein Männchen (8). Der obere und untere Saum der Schwanzflosse des Männchens ist leuchtend gelb. (Die Gesamtlänge des Weibchens beträgt 54 mm, die des Männchens 57 mm).

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ

ročník XXXVIII

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