

REVISION OF NEMATODES OF THE GENUS CAPILLARIA FROM EUROPEAN FRESHWATER FISHES

F. MORAVEC

Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

Abstract. Studies on the various materials of capillariid nematodes from European freshwater fishes revealed that out of 11 species hitherto described from these hosts in Europe, only 4 species, provisionally assigned to the genus *Capillaria* Zeder, 1800, can be considered valid: *C. brevispicula* (Linstow, 1873), *C. salvelini* Polyansky, 1952, *C. petruschewskii* (Shulman, 1948), and *C. tuberculata* (Linstow, 1914). These are redescribed and illustrated. *C. leucisci* Hesse, 1923 and *C. lewaschoffi* Heinze, 1933 are synonymized with the species *C. brevispicula* (Linstow, 1873), while *C. baicalensis* Ryzhikov et Sudarikov, 1953, *C. coregoni* Shulman—Albova, 1953 and *C. curilica* Zhukov, 1960 are considered to be new synonyms of *C. salvelini* Polyansky, 1952. *C. tomentosa* (Dujardin, 1843) is considered as *species inquirenda*. A key to the species of the genus *Capillaria* parasitizing European freshwater fishes is provided.

From the viewpoint of taxonomy and systematics, nematodes of the family Capillariidae represent one of the most difficult groups of helminths the specific identification of which is often problematic. It results mainly from inadequate knowledge of the morphology of individual species whose descriptions are often poor; many species were described only from females or even from eggs only. Moreover, the situation is complicated by substantial differences in the opinions of various authors as to the taxonomic value of various characters in these nematodes and, consequently, the number of genera in the family Capillariidae.

A total of 11 species of capillariids have so far been described from European freshwater fishes; these were assigned by various authors to the following genera: *Capillaria* Zeder, 1800, *Trichosoma* Rudolphi, 1819, *Trichosomum* Creplin, 1829, *Thominx* Dujardin, 1845, *Hepaticola* Hall, 1916, and *Schulmanella* Ivashkin, 1964. Of these, Skryabin et al. (1957) in their monograph recognized only *Capillaria*, *Thominx* and *Hepaticola*. The genus *Schulmanella* was later synonymized with *Hepaticola* by Ivashkin and Shmytova (1969). On the other hand, Yamaguti (1961) as well as many recent authors have recognized *Capillaria* as the only valid genus. This access to the solution of the problem is, however, too simplified. It is apparent that in future it will be necessary to work out a new classification of nematodes of the family Capillariidae, based on detailed studies on the morphology of separate species. However, until a new delimitation of genera is carried out in this nematode family, I consider it reasonable to deal with the capillariids from fishes only within the genus *Capillaria* Zeder, 1800.

Considering that some species of fish capillariids have veterinary and economic significance, it is important to have their accurate specific identification. The results of the present paper have indicated that the freshwater fishes of Europe are parasitized by four species of these nematode parasites that are here redescribed.

MATERIALS

The specimens examined were from the collections of the following institutions:

1. Institute of Parasitology, Czechoslovak Academy of Sciences, Prague:

C. brevispicula — from *Rutilus rutilus*, *Leuciscus cephalus*, *Phoxinus phoxinus*, *Tinca tinca*, *Cyprinus carpio*, *Gobio gobio* and *Noemacheilus barbatulus* from Czechoslovakia (R. Břehyně, R. Bystřice, R. Klanečnica) (leg. Dr. F. Moravec),

— from *Pachychilon pictum*, *Rutilus rubilio*, *Leuciscus cephalus albus*, *Scardinius erythrophthalmus*, *Alburnus albidus alborella*, *Gobio gobio lepidolaemus*, *Blennius fluviatilis* and *Anguilla anguilla* from Yugoslavia (L. Skadar, R. Orakhovshtitsa, R. Moracha) (leg. Dr. R. Ergens);

C. salvelini — from *Salmo gairdneri* from Yugoslavia (R. Orakhovshtitsa) (leg. Dr. R. Ergens),

— from *Salmo trutta m. fario* from Czechoslovakia (R. Kamenice) (leg. Dr. F. Moravec),

— from *Cottus szanaga*, *Hucho taimen*, *Brachymystax lenok* and *Thymallus arcticus* from Mongolia (R. Onon, R. Tul) (leg. Dr. R. Ergens),

— from *Cottus asper*, *Oncorhynchus kisutch* and *Osmerus mordax* from Canada (streams of Vancouver Isl., L. Huron) (leg. Dr. F. Moravec);

C. petruschewskii — from *Salmo gairdneri* from Italy (Torino) (leg. Dr. I. Dyková).

2. Pacific Biological Station, Nanaimo, B. C., Canada:

C. salvelini — from *Salvelinus namaycush*, *Salmo salar* and *Oncorhynchus kisutch* from Canada (L. Aishihik, Yukon Territory; Deadmans Bay R., Nfld.; streams of Vancouver Isl., B. C. — Coll. No. B 40—75, B 7—74, B 24—77, B 23—77) (leg. Dr. J. R. Arthur, Dr. J. H. C. Pippy and T. E. McDonald),

— from *Lota lota* from the USSR (Lithuania — Kurshyu Marės Bay, Coll. No. B 310—74) (leg. S. I. Getsevichyute).

3. Zoologisches Museum der Humboldt-Universität, Berlin. GDR:

C. tuberculata — syntypes from *Acipenser ruthenus* from the USSR (R. Volga) (Kat. Nr. 5107).

VALID MEMBERS OF *CAPILLARIA* FROM EUROPEAN FRESHWATER FISHES

1. *Capillaria brevispicula* (Linstow, 1873)

(Fig. 1)

Syn: *Trichosoma brevispiculum* Linstow, 1873; *Capillaria leucisci* Hesse, 1923; *C. tuberculata* sensu Lewaschoff, 1929, nec Linstow, 1914; *C. lewaschoffi* Heinze, 1933; *C. rutili* Zakhvatkin et Azheganova, 1940.

The following description is based on specimens from the hosts *Tinca tinca*, *Cyprinus carpio*, *Gobio gobio*, *Pachychilon pictum* and *Leuciscus cephalus albus* (all Cyprinidae) from Czechoslovakia (pond-system of Mácha Lake, R. Bystřice) and Yugoslavia (Lake Skadar).

Description: Middle-sized nematodes. Along almost whole body length extending two lateral bacillary bands provided with scarcely distributed minute papilla-like formations. Head end attenuated, mouth opening surrounded by minute mouth papillae. Stichosome consisting of 35—40 stichocytes arranged in one row; always 1—2 stichocytes lighter in colour alternating with 1—2 darker stichocytes.

Male (7 specimens): — Length of body 3.95—7.18*, maximum width 0.054—0.068. Width of bacillary bands in mid-body 0.024. Length of entire oesophagus 2.99—4.13; this represents 59 to 80 % of whole body length. Length of muscular oesophagus 0.183 — 0.330, distance of nerve ring from anterior extremity 0.084—0.099. Spicule well sclerotized, 0.240—0.330 long and 0.009—0.012 wide; its proximal end distinctly extended and provided with folded, lobular rim; distal end of spicule rounded; spicule surface smooth. Spicular sheath long, without spines. Male tail very short (0.015 to 0.018), rounded, provided with two large, round subventral papillae. Membraneous pseudobursa not present.

Female (13 specimens): — Length of gravid females 7.30—12.04, maximum width 0.068—0.108. Width of bacillary bands in mid-body 0.030—0.033. Length of entire oesophagus 3.94—5.15; this forms 35—59 % of whole body length. Length of muscular oesophagus 0.285—0.321, distance of

* all measurements in mm

nerve ring 0.090—0.096. Vulva usually situated a short distance (0.030—0.066) below end of stichosome, only exceptionally at its level or slightly in front of it; distance of vulva from anterior extremity 3.99—5.26. Vulval lips either not elevating or only anterior lip slightly elevating. Uterus containing numerous eggs arranged in one row near vulva region, more distant eggs in several rows.

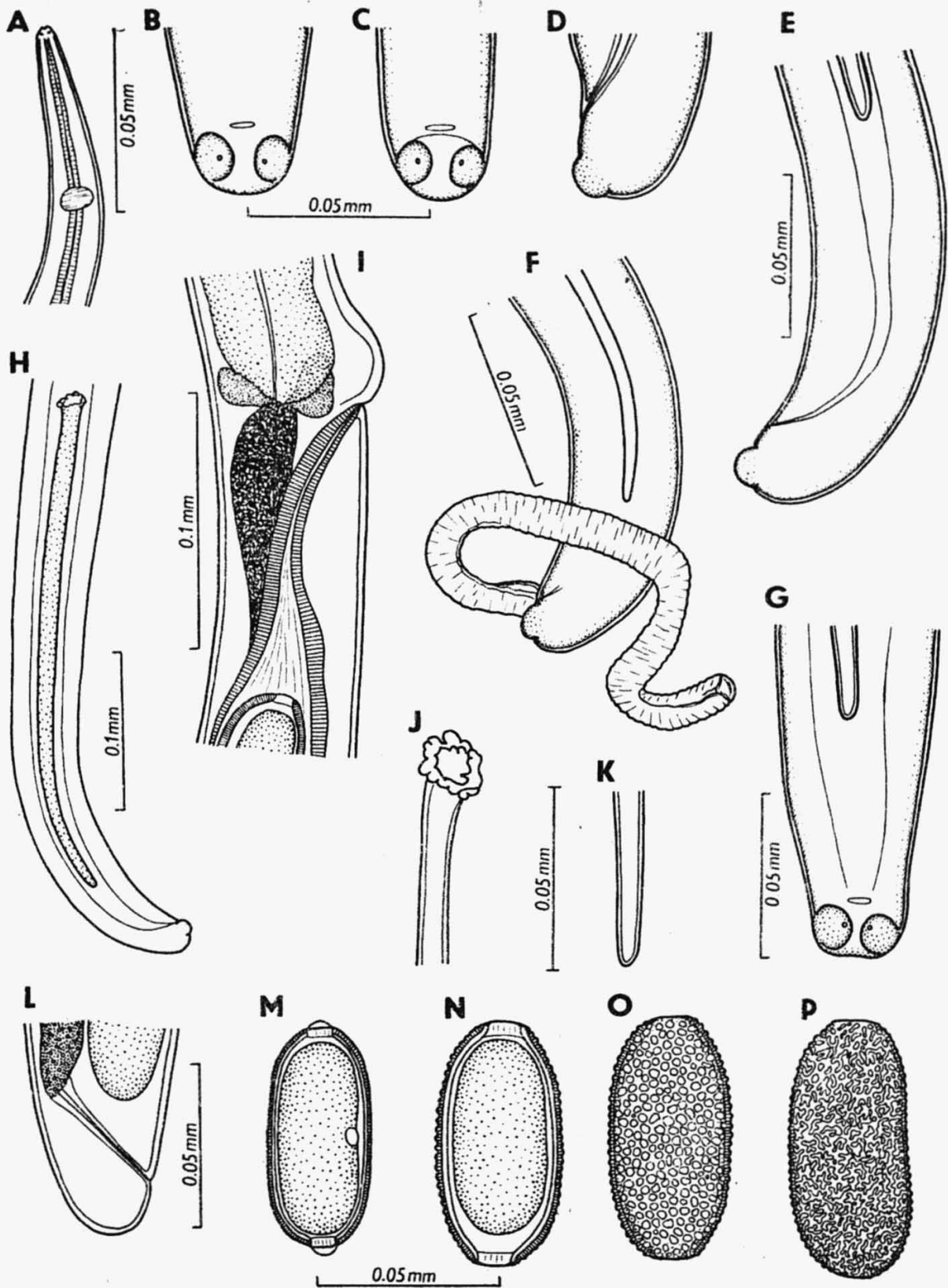


Fig. 1. *Capillaria brevispicula* (Linstow, 1873). A — head end; B—G — tail of male (ventral and lateral views); H — posterior part of male body; I — vulva region of female body; J, K — anterior and posterior tips of spicule; L — female tail; M — not fully developed egg; N—P — fully developed eggs. (A, F — from *G. gobio*, B—E, G—P — from *T. tinca*.)

Mature eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer hyaline, smooth, strongly refractile, outer layer forming distinct irregular, fairly rough sculpture on its surface. Egg content uncleaved. Wall of not fully developed eggs thinner, superficial sculpture less distinct and both polar plugs distinctly protruding (Fig. 1 M). Size of fully developed eggs $0.063-0.078 \times 0.030-0.039$. Posterior end of body rounded, anal opening subterminal; length of tail $0.009-0.015$.

Hosts: Definitive hosts are various cyprinids — *Blicca bjoerkna* (type host), **Rutilus rutilus*, **R. rubilio*, **Pachychilon pictum*, *Leuciscus leuciscus*, **L. cephalus*, **L. cephalus albus*, **Phoxinus phoxinus*, **Scardinius erythrophthalmus*, **Tinca tinca*, *Chondrostoma nasus*, **Alburnus albidus alborella*, *Abramis brama*, *Pelecus cultratus*, **Gobio gobio*, **G. gobio lepidolaemus*, *Barbus barbus*, **Cyprinus carpio*, etc. Frequently also found in fishes of other families — e.g. in **Noemacheilus barbatulus* (Cobitidae), *Lota lota* (Gadidae), *Lepomis gibbosus* (Centrarchidae), **Blennius fluviatilis* (Blenniidae), **Anguilla anguilla* (Anguillidae), which apparently serve as pardefinitive or postcyclic hosts only. (Nematodes from the hosts designated with an asterisk were studied by the present author.)

Location: intestine (mainly its posterior section).

Distribution: This Palaearctic species is widely distributed over Europe, being reported from Great Britain (Hesse 1923), Germany (Linstow 1873, 1909, Heinze 1933), Czechoslovakia (Vojtková 1959, Ergens 1962, Moravec 1971, 1978), Hungary (Edelényi 1967, Molnár 1970), Roumania (Roman 1955), Yugoslavia (Čanković et al. 1968, Moravec and Ergens 1971, Kažič et al. 1977), Albania (Ergens 1960) and European part of the USSR (e.g. Lewaschoff 1929, Izyumova 1960, Bykhovskaya-Pavlovskaya et al. 1962, Ergens et al. 1975). In the USSR it was also recorded from Trans-Caucasia, Central Asia and Siberia (Skryabin et al. 1957, Bykhovskaya-Pavlovskaya et al. 1962).

Comments: In 1873 Linstow described from the intestine of white bream (*Blicca bjoerkna*) a new nematode species *Trichosoma* (= *Capillaria*) *brevispiculum*; later he (Linstow 1909) reported as host also burbot (*Lota lota*). Linstow's specimens were later studied by Heinze (1933) who mentioned also localities — Ratzeburg and Hameln in Germany.

Since that time *C. brevispicula* has frequently been found in various freshwater fishes of Europe and Asia, but its distinction from several other related species on the basis of existing descriptions has remained rather problematic; it is apparent that other species have often been included under the name *C. brevispicula*. It has been revealed by a recent reexamination of specimens from salmonids and cottids of Mongolia, reported erroneously by Moravec and Ergens (1970) as *C. brevispicula*, that these all belonged to the species *C. salvelini* Polyansky, 1952; conspecific with the latter species are probably also the nematodes reported as *C. brevispicula* by Allamuratov (see Daniyarov 1974) from *Salmo trutta oxianus* from the USSR.

Insufficient studies on the morphology of *C. brevispicula* and confusions as to the taxonomic value of individual morphological characters in capillariids caused that in the past these nematodes were described under several synonyms. In 1971 Moravec synonymized with *C. brevispicula* the species *C. rutili* Zakhvatkin et Azheganova, 1940. Moreover, I suggest to synonymize with this species also *C. lewaschoffi* Heinze, 1933, described from *Pelecus cultratus* from the R. Volga in the USSR, and *C. leucisci* Hesse, 1923, reported from *Phoxinus phoxinus* from Scotland; both the species are in main characters identical with *C. brevispicula* and certain differences in the structure of the male tail in *C. leucisci* can evidently be ascribed to the erroneous description of this feature; hosts of both *C. lewaschoffi* and *C. leucisci* are also known as hosts of *C. brevispicula*. Morphologically and metrically very close and possibly identical with *C. brevispicula* are also the species *C. amurensis* Finogenova, 1967, and *C. gobionina* Lomakin, 1971, described from the USSR from the cyprinid *Pseudaspius leptcephalus* of the R. Amur basin and from gobiids *Gobius fluviatilis* and *G. kessleri* of the Caspian Sea, respectively; since, however, I had no specimens of these species available and because these two species occur either in geographically distant area (*C. amurensis*)

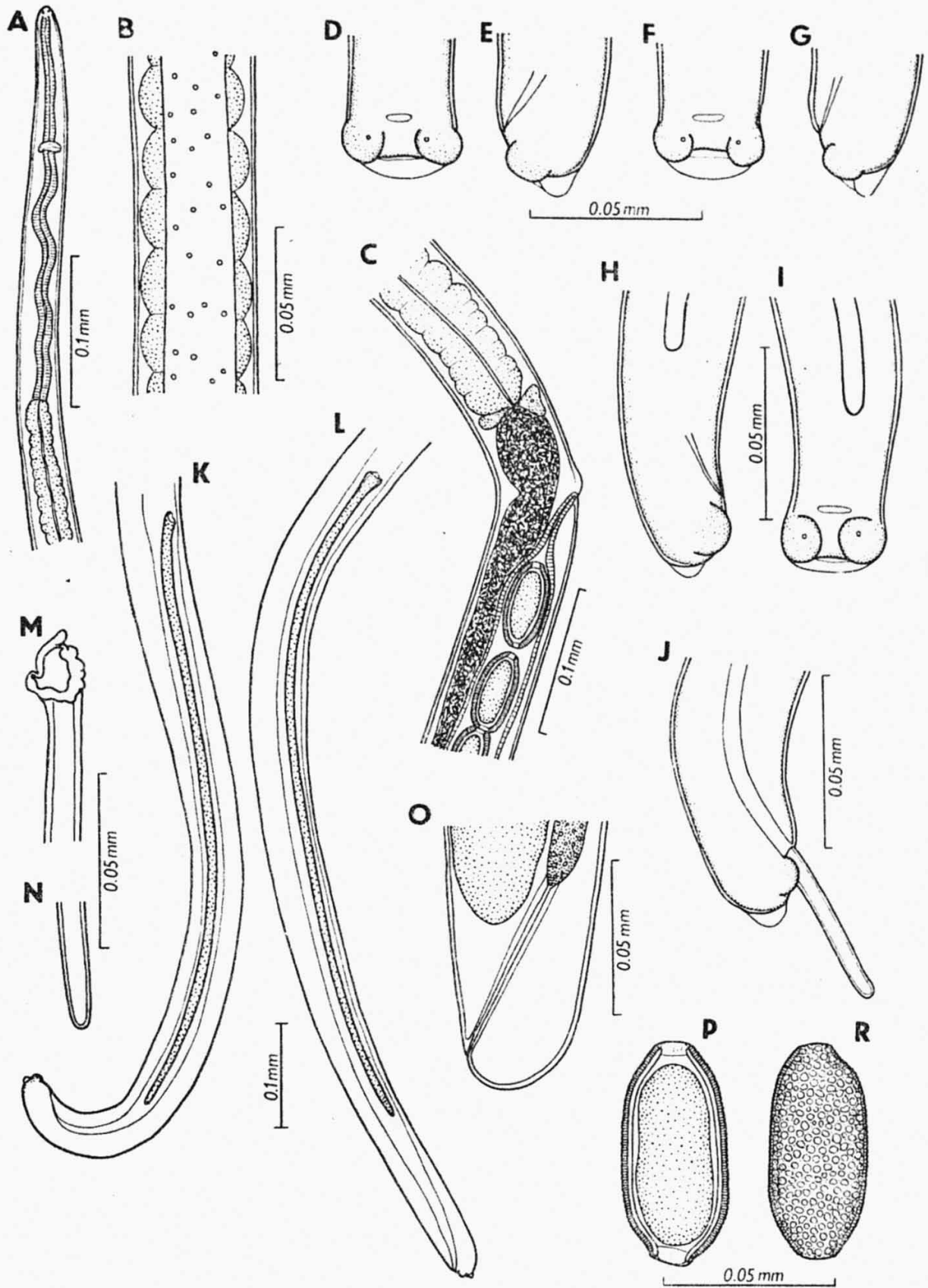


Fig. 2. *Capillaria salvelini* Polyansky, 1952. A — head end; B — bacillary band in stichosome area; C — vulva region of female body; D—J — tail of male (ventral and lateral views); K, L — posterior part of male body; M, N — anterior and posterior tips of spicule; O — female tail; P, R — fully developed egg. (A, D, E, K — from *Th. arcticus*, B, H—J, O, R — from *C. szanaga*, F—G, L — from *S. gairdneri*, C, M—N, P — from *B. lenok*.)

or in the hosts atypical of *C. brevispicula* (*C. gobionina*), I consider them for the time being as valid.

In addition to *C. brevispicula* also *C. tomentosa* is reported to be the parasite of European cyprinids; the latter species was described by Dujardin (1843) from the females found in *Scardinius erythrophthalmus* and *Leuciscus idus* in France (Rennes). Although it is probable that this species is identical with *C. brevispicula*, its inadequate description prevents from synonymizing these species; moreover some characters (e.g. number and structure of bacillary bands) reported for *C. tomentosa* do not correspond to *C. brevispicula*; males of *C. tomentosa* are unknown. Therefore, I consider *C. tomentosa* to be *species inquirenda*. Apparently *C. brevispicula* was mistaken for the latter species in cases of more recent records of *C. tomentosa* from Europe (e.g. Heinze 1933, Roman 1955, Ergens et al. 1975).

2. *Capillaria salvelini* Polyansky, 1952

(Figs. 2, 3)

Syn.: *C. baicalensis* Ryzhikov et Sudarikov, 1953; *C. coregoni* Shulman—Albova, 1953; *C. curilica* Zhukov, 1960; *C. brevispicula* sensu Moravec et Ergens, 1970, nec Linstow, 1873; *C. bakeri* sensu Meyer, 1954, nec Mueller et Van Cleave, 1932.

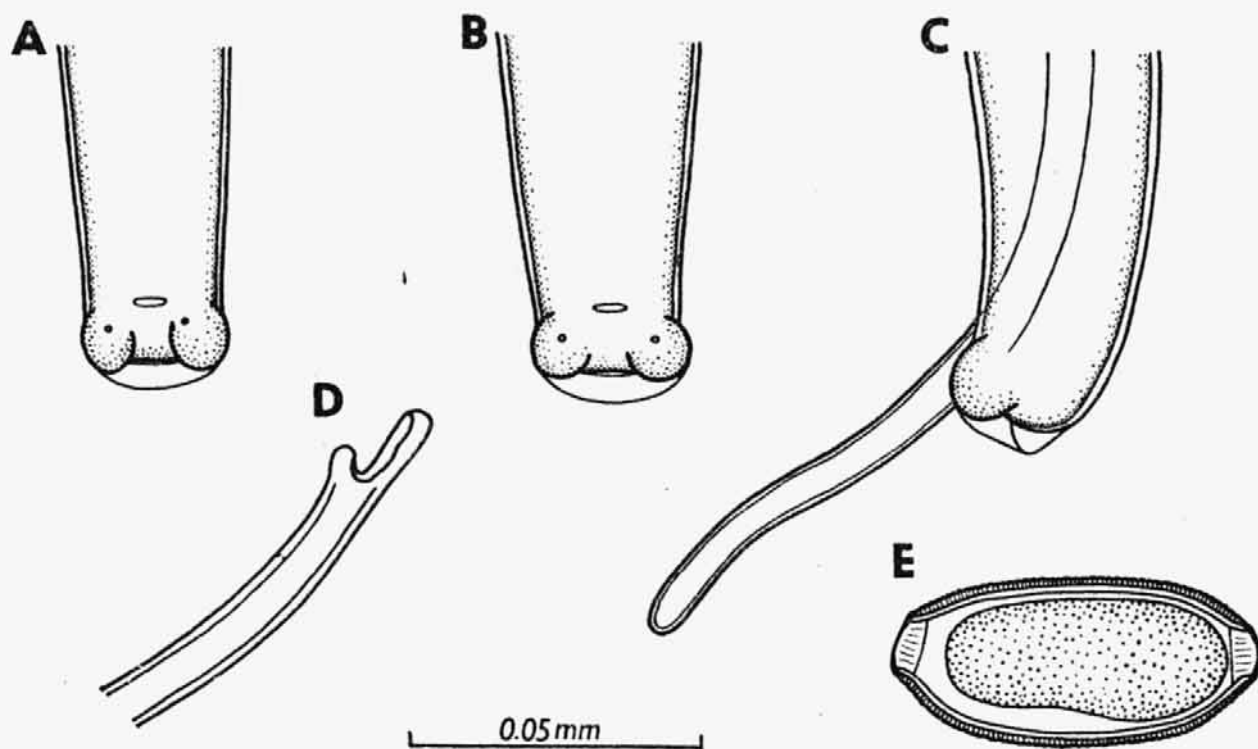


Fig. 3. *Capillaria salvelini* Polyansky, 1952 from North American fishes. A—C — tail of male (ventral and lateral views); D — anterior tip of spicule; E — fully developed egg. (A, D — from *O. kisutch*, B—C, E — from *S. namaycush*.)

The following description is based on specimens from the hosts *Salmo trutta* m. *fario* from Czechoslovakia, *S. gairdneri* from Yugoslavia and *Hucho taimen*, *Brachymystax lenok*, *Thymallus arcticus* and *Cottus szanaga* from Mongolia.

Description: Middle-sized nematodes. Two lateral bacillary bands present, starting a short distance below anterior extremity and extending posteriorly practically along whole body length; surface of bacillary bands with scarcely distributed minute papilla-like formations. Head end attenuated, provided with minute mouth papillae. Stichosome consisting of 26—35 stichocytes arranged in one row, alternation of darker and lighter stichocytes less distinct than in *C. brevispicula*.

Male (6 specimens): — Length of body 6.17—9.11, maximum width 0.060—0.084. Width of bacillary bands in mid-body 0.024 — 0.027. Length of entire oesophagus 3.20—4.53; this represents 48—60 %

of whole body length. Length of muscular oesophagus 0.285–0.330, distance of nerve ring from anterior extremity 0.087–0.099. Spicule smooth, well sclerotized, 0.405–0.636 long and 0.009–0.012 wide at its anterior part; proximal end of spicule extended, with lobular rim, distal end rounded. Spicular sheath long, smooth, without spines. Male tail very short (0.018–0.027), rounded, provided with two large ventrolateral round papillae connected between each other by a rather wide dorsal cuticular membrane, forming thus a kind of pseudobursa.

Female (4 specimens): — Body length of gravid females 7.15–13.46, maximum width 0.054–0.095. Width of bacillary bands in mid-body 0.027–0.033. Length of entire oesophagus 4.31–5.58; this forms 43–71% of whole body length. Length of muscular oesophagus 0.300–0.393, distance of nerve ring 0.095–0.102. Vulva situated a short distance (0.030–0.081) below stichosome end level, 4.35–5.58 from anterior extremity. Vulval lips not elevating or only anterior lip slightly elevating. Eggs arranged in one row at proximal part of uterus, more distant eggs in several rows. Mature eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer hyaline, conspicuously refractile, outer layer with distinct, irregular superficial network sculpture similar to that in *C. brevispicula*, but a little finer. Mature egg content uncleaved; size of fully developed eggs 0.060–0.075 × 0.027–0.030. Posterior end of body rounded, anal pore subterminal; length of tail 0.009–0.015.

Hosts: Definitive hosts are mainly fishes of the families Salmonidae, Thymallidae and Cottidae. In Europe it has been recorded only from salmonids — *Salvelinus alpinus* (type host), **Salmo trutta m. fario*, *S. trutta marmoratus*, **S. gairdneri*, *S. salar*, *Salmothymus obtusirostris oxyrhynchus* and *Coregonus lavaretus pidschian*, while from Palaearctic Asia (USSR, Mongolia) are reported as hosts, in addition to salmonids (*Salvelinus leucomaenis*, *Salmo trutta*, **Brachymystax lenok*, **Hucho taimen*, *Oncorhynchus masou*), also **Thymallus arcticus* (Thymallidae), **Cottus szanaga*, *Batrachocottus baicalensis* (both Cottidae) and even cyprinids *Phoxinus lagowskii*, *Ph. percnurus* and *Hemiculter leucisculus*; however, cyprinids serve apparently as pardefinitive or postcyclic hosts only. In North America (Canada, USA) it has been reported from **Salmo salar*, *Salvelinus alpinus*, *S. fontinalis*, **S. namaycush*, hybrids *S. fontinalis* × *S. namaycush*, *Prosopium cylindraceum*, **Oncorhynchus kisutch*, *Coregonus clupeaformis* (all Salmonidae), *Thymallus arcticus* (Thymallidae) and **Osmerus mordax* (Osmeridae); recently I have found this species also in **Cottus asper* (Cottidae) from the Vancouver Island (Carnation Creek, Sproat River) in Canada. (Nematodes from the hosts designated with an asterisk were studied by the present author.)

Location: intestine (mainly its posterior section).

Distribution: *C. salvelini* is a Holarctic species widespread in Eurasia and North America; although it is a freshwater parasite, in migratory fish hosts it is frequently found in marine environment. In Europe it has been recorded from the USSR (Barents Sea—Murmansk area, White Sea) (Polyansky 1952, 1955, Shulman-Albova 1953), Norway (Kennedy 1977, 1978a), Ireland (Arthur et al. 1976), Great Britain (Campbell 1972–1973, Kennedy 1978b, Arthur et al. 1976), Czechoslovakia (Moravec 1980), Yugoslavia (Čanković et al. 1968, Moravec and Ergens 1971) and Spain (Cordero del Campillo and Alvarez Pellitero 1976, Alvarez Pellitero et al. 1978). In Asia it was reported from the territory of Mongolia and the USSR, viz. from the basins of Lake Baikal, system of the R. Amur, from the rivers of Kamchatka and Kurile Islands and from the Okhotsk Sea (Mamaev et al. 1959, Ryzhikov and Sudarikov 1953, Zhukov 1960, Bykhovskaya-Pavlovskaya et al. 1962, Bogdanova 1963, Roytman 1963, Belous 1965, Moravec and Ergens 1970). In North America *C. salvelini* is widely distributed over the territory of Canada (Labrador, Newfoundland, New Brunswick, Nova Scotia, Quebec, British Columbia, Yukon Territory) and was recorded also from the USA (Maine) (Meyer 1954, Pippy 1969, Threlfall and Hanek 1969, 1970, Hicks and Threlfall 1973, Hanek and Molnar 1974, Arthur et al. 1976, Hare and Burt 1976, Chinniah and Threlfall 1978, Dechtiar and Berst 1978, Margolis and Arthur 1979, Bell and Beverley-Burton 1980).

Comments: In 1952 Polyansky described from the intestine of *Salvelinus alpinus* from the USSR (Murmansk area) a new species — *C. salvelini*. In the following year Shulman-Albova (1953) described from *Coregonus lavaretus pidschian* from the near White Sea another new species — *C. coregoni*. The original descriptions of both these species are very poor, particularly as to the structure of male body and the character of eggs. More important, differences between *C. salvelini* and *C. coregoni*, according to the descriptions, concern only the character of eggs (see also Arthur et al. 1976); these can be explained, however, by the different stage of development of the studied eggs (presence or absence of elevating polar plugs) and by inaccuracies in observations. In other significant characters (e.g. length of spicule and structure of its proximal end)

both the species are practically identical. Both original descriptions mention the presence of an elastic coiled thread around the base of the spicule; it is possible to agree with Arthur et al. (1976) that only a wrinkling of the spicule sheath was erroneously interpreted in these cases. From these reasons I consider both species identical. Although my attempts to obtain the type specimens of *C. salvelini* or *C. coregoni* were not successful (these are apparently no longer extant — see also Arthur et al. 1976), there is no doubt that the nematodes from our material are conspecific with *C. salvelini*. As a synonym of the latter species it is necessary to consider also the species *C. curilica* Zhukov, 1960, described from *Salvelinus leucomaenis* from the Kurile Islands.

Roytman (1963) reported from several fish species of the Far East nematodes *Capillaria lagodowskii* Belous, 1952. The description of this species was not, however, published (it was reported only in the thesis) and, therefore, the specific name is invalid. Belous (1965) later listed this species under the name *C. salvelini* Polyansky, 1952.

Own studies on a number of specimens of *C. salvelini* from the various species of salmonids from Czechoslovakia, Yugoslavia, Mongolia and Canada showed that this species is, in addition to other features, characterized mainly by the structure of the posterior body end of male; from the closely related species *C. brevispicula* it can be reliably distinguished by the presence of the cuticular membrane connecting both caudal papillae (Moravec 1980). A revision of the capillariids from fishes of Mongolia, reported as *C. brevispicula* by Moravec and Ergens (1970), confirmed that these belonged in fact to the species *C. salvelini*. Conspecific are also the nematodes found by Meyer (1954) in *Salvelinus fontinalis* in the USA and erroneously reported as *C. bakeri* (see Bell and Beverley-Burton 1980).

Ryzhikov and Sudarikov (1953) described from a cottid *Batrachocottus baicalensis* from Lake Baical in the USSR a new species *Capillaria baicalensis*. The type specimens were lost (pers. comm. of Prof. M. D. Sonin); however, it is obvious from the original description that this species does not differ in its morphology from *C. salvelini* from our materials. Since *C. salvelini* is a common parasite of fishes of the drainage system of L. Baical and because in addition to salmonids it is often found in cottids (Moravec and Ergens 1970, new data), I consider *C. baicalensis* a synonym of *C. salvelini*.

Similarly as in *C. brevispicula*, also this species may be apparently found not only in the definitive hosts but as well in the facultative postcyclic hosts. It is indicated by the finding of *C. salvelini* in burbot (*Lota lota*) (fam. Gadidae) in the Lithuanian SSR (Kurshyu Marės Bay, 13 November 1974 — leg. S. I. Getsevichyute); apparently these fishes become infected while feeding on salmonids — the definitive hosts. The specimens of *C. salvelini* from burbot (1♂ + 4 gravid ♀♀) are now deposited in the collections of the Pacific Biological Station in Nanaimo, Canada (Coll. No. B 310 to 374) and were reexamined by the present author.

3. *Capillaria petruschewskii* (Shulman, 1948)

(Fig. 4)

Syn.: *Hepaticola petruschewskii* Shulman, 1948; *Capillaria eupomotis* Ghittino, 1961, *C. acerinae* Thieme, 1961.

The following description is based on specimens from *Salmo gairdneri* from Italy (Torino).

Description: Middle-sized nematodes. Two lateral bacillary bands present, starting near anterior extremity and extending posteriorly along whole body length. Anterior part of body somewhat attenuated, head end rounded, provided with minute mouth papillae. Muscular oesophagus somewhat extended at its posterior third. Stichosome composed of three longitudinal rows of stichocytes (one dorsal and two lateral) with conspicuous nuclei; each row consisting of some 40 stichocytes (entire stichosome of about 120 ones).

Male (10 specimens): — Length of body 5.75–8.66, maximum width 0.068–0.095. Maximum width of bacillary bands 0.036. Length of entire oesophagus 1.49–2.08; this represents 19 to 33% of whole

body length. Length of muscular oesophagus 0.228 — 0.354, distance of nerve ring from anterior extremity 0.069—0.099. Spicule well sclerotized, its surface except for proximal and distal ends provided with distinct transverse wrinkly structure. Proximal spicule end somewhat funnel-shaped in ventral view, not in lateral view; distal end rounded. Length of spicule 0.210—0.279, width 0.012

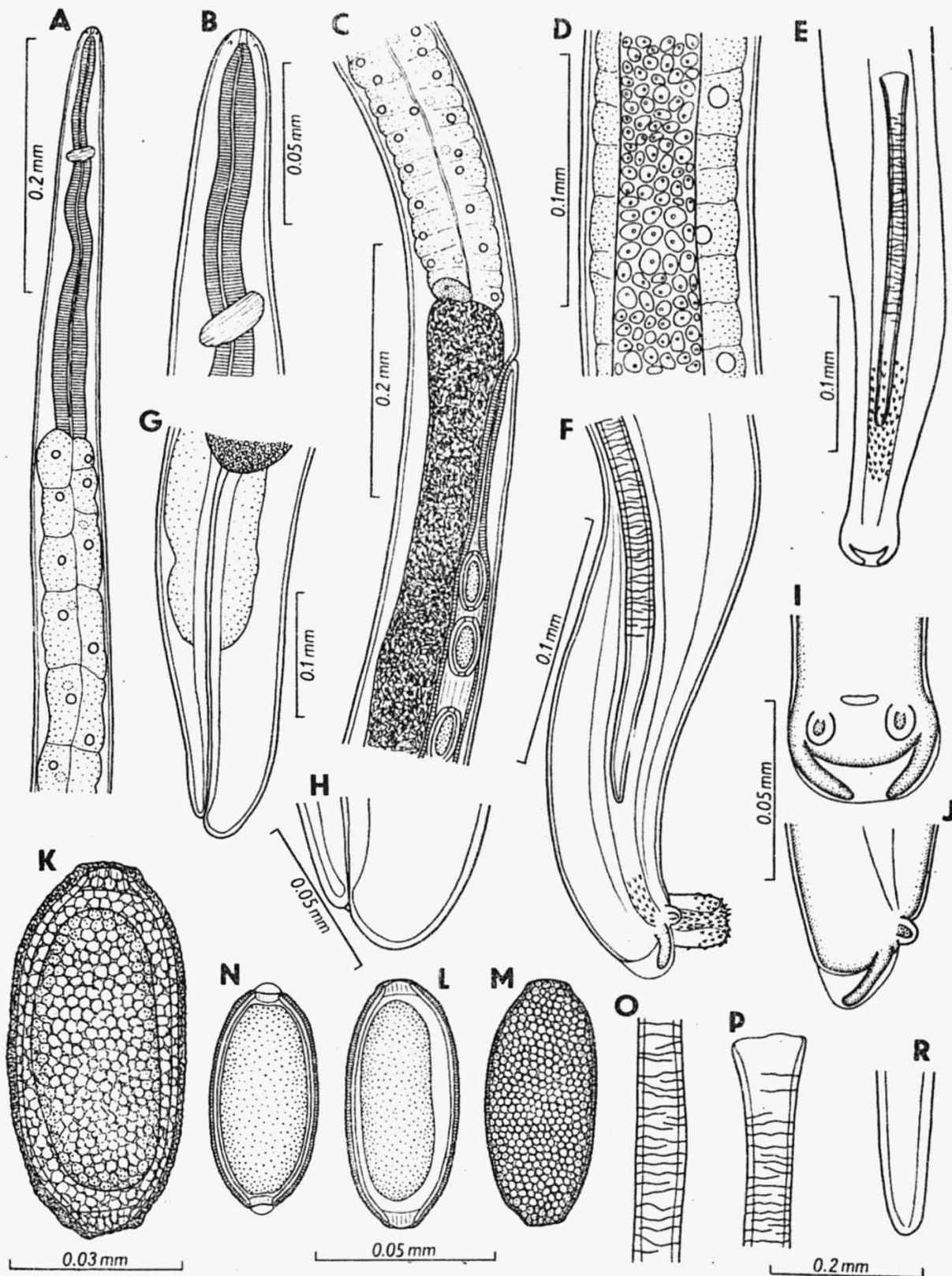


Fig. 4. *Capillaria petruschewskii* (Shulman, 1948). A — anterior part of body; B — head end; C — vulva region of female body; D — bacillary band in stichosome area; E, F — posterior part of male body; G — posterior end of female body; H — tail of female; I, J — tail of male (ventral and lateral views); K—M — fully developed egg; N — not fully developed egg; O — middle part of spicule; P, R — anterior and posterior tips of spicule. (A—R — from *S. gairdneri*.)

to 0.015 in its mid-length. Spicular sheath densely covered with minute flat spines; spicular sheath often funnel-shaped when evaginated from body. Tail very short, rounded, provided with a cuticular membrane forming pseudobursa. Length of tail including membrane 0.018–0.027, of membrane only 0.009. Pseudobursa strengthened with two lateral, dorsally bent rays. Pair of large, round subventral papillae present closely below anal opening.

Female (5 specimens): — Body length of gravid females 10.14 — 14.76, maximum width 0.122 — 0.149. Width of bacillary bands in mid-body 0.054–0.063. Length of entire oesophagus 1.99–2.58; this forms 15–20 % of whole body length. Length of muscular oesophagus 0.282–0.321, distance of nerve ring from anterior extremity 0.084–0.108. Vulva situated at short distance (0.060 — 0.120) below stichosome end level, 2.04–2.39 from anterior extremity. Vulval lips not elevating. Eggs mostly arranged in two rows at proximal part of uterus, rarely in one only, in more posterior parts of uterus in several rows. Fully developed eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer smooth, hyaline, conspicuously refractile, outer layer darker in colour, with a dense, fine superficial network sculpture; egg content uncleaved. In younger eggs outer layer only very thin, with almost smooth surface; polar plugs of these eggs distinctly protruding (Fig. 4N). Length of mature eggs 0.066–0.069, width 0.030–0.036; thickness of egg wall 0.002 to 0.003, polar plugs 0.005–0.006 high. Posterior end of body rounded, tail very short (0.012 to 0.015). Length of rectum 0.210–0.231.

Hosts: This species exhibits only a low degree of host specificity and it was recorded from fishes of the various families. In the literature, the following fish species have been reported as hosts: Salmonidae — *Salmo trutta* m. *fario* and *S. gairdneri*; Thymallidae — *Thymallus thymallus*; Cyprinidae — *Phoxinus phoxinus*, *Leuciscus cephalus*, *L. cephalus cabeda*, *L. idus*, *L. souffia muticellus*, *Alburnoides bipunctatus*, *Abramis brama*, *A. sapa*, *Blicca bjoerkna transcaucasica*, *Scardinius erythrophthalmus*, *Tinca tinca*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Gobio gobio*, *Barbus tauricus cyclolepis* and *Rhodeus sericeus*; Cobitidae — *Cobitis taenia* and *Noemacheilus barbatulus*; Ictaluridae — *Ictalurus nebulosus*; Centrarchidae — *Lepomis gibbosus*; Percidae — *Perca fluviatilis*, *Gymnocephalus cernua* and *Stizostedion lucioperca*. In some of these hosts only the nematode eggs located in the liver were found.

Location: liver tissue.

Distribution: This species is spread in the rivers and lakes belonging to the Black, Caspian, Adriatic, Aegean, Baltic and North Seas basins (e. g. river systems of the Danube, Maritsa, Po, Kura, West Dvina, Neman, Elbe). In Europe it is reported from the USSR (Shulman 1948, Skryabin et al. 1957, Getsevichyute 1958, Bykhovskaya-Pavlovskaya et al. 1962, Ergens et al. 1975, Chernova and Kotov 1978), Bulgaria (Kakacheva-Avramova 1965), Greece (Pneumaticos 1977), Roumania (Roman 1955), Hungary (Molnar 1968, 1970, Ergens et al. 1975), Austria (Kutzer and Otte 1966), Czechoslovakia (Lucký 1955, Vojtek 1959), Italy (Ghittino 1961) and GDR (Thieme 1961). It was also recorded from the R. Kura system in Trans-Caucasia in the USSR (Chiaberashvili 1967).

Comments: In 1948 Shulman described from the liver of *Cobitis taenia* and *Lepomis gibbosus* of the Danube Delta a new nematode species — *Hepaticola petruschewskii*; he also mentioned his earlier findings of the eggs of the same nematode in the liver tissue of *Gymnocephalus cernua* and *Cobitis taenia* in the R. West Dvina. The original specific description is poor. Later this species was somewhat better described from various fishes of Italy as *Capillaria eupomotis* Ghittino, 1961 and from GDR as *C. aceri-nae* Thieme, 1961; both these species have been synonymized with *C. petruschewskii* by Kutzer and Otte (1966) and Moravec (1971), respectively.

Descriptions of this species given by Ghittino (1961), Thieme (1961) and Kutzer and Otte (1966) confirmed that *C. petruschewskii* is characterized by the presence of the sclerotized spicule and spinose spicular sheath; the latter authors have also described the pseudobursa, but they failed to observe the postcloacal papillae in male, as well as bacillary bands. In the original description Shulman (1948) writes that the glandular part of the oesophagus consists of a row of cells arranged one after another. In the following descriptions of *C. petruschewskii*, only little attention was paid to the structure of stichosome; nevertheless, it is obvious from the drawings provided by Ghittino (1961) and Kutzer and Otte (1966) that the glandular cells are arranged in more than one longitudinal row; this is confirmed by own observations. In this character *C. petruschewskii* apparently differs from all other members of *Capillaria*; a similar structure of the glandular part of oesophagus is known in the genus *Cystoopsis*.

4. *Capillaria tuberculata* (Linstow, 1914)

(Fig. 5)

Syn.: *Trichosoma tuberculatum* Linstow, 1914.

The following description is based on the type specimens (syntypes — Kat. Nr. 5107) from the Berlin Museum.

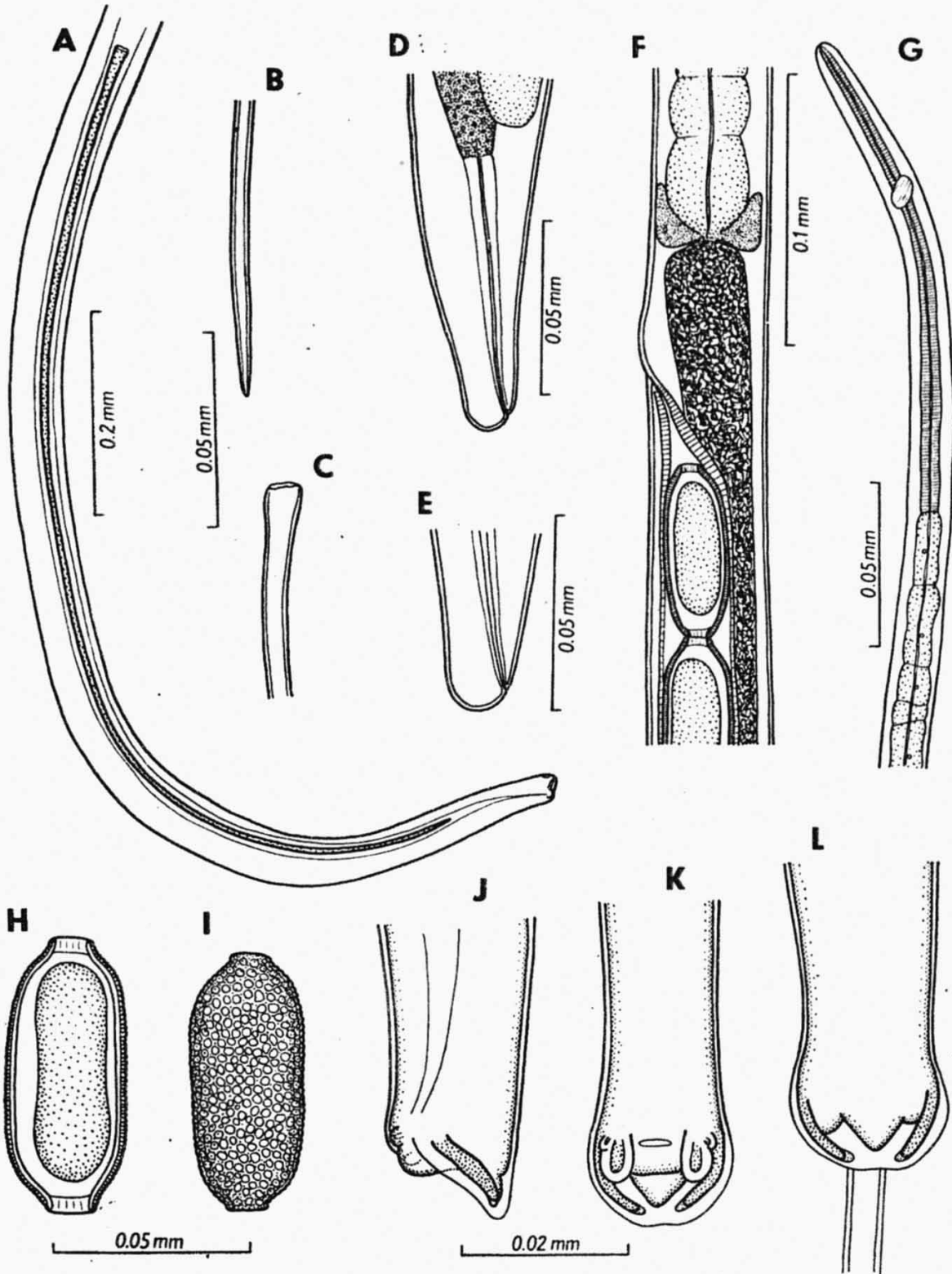


Fig. 5. *Capillaria tuberculata* (Linstow, 1914). A — posterior part of male body; B, C — anterior and posterior tips of spicule; D, E — posterior end of female body; F — vulva region of female body; G — head end; H, I — fully developed egg; J—L — tail of male (lateral, ventral and dorsal views). (A—L — syntypes from *A. ruthenus*.)

Description: Small nematodes. Two little distinct lateral bacillary bands covered with tiny papilla-like formations present. Stichosome consisting of a single row of relatively short stichocytes. Nerve ring encircling muscular oesophagus at boundary of its first and second thirds. Two distinct wing-shaped cells present at junction of stichosome and intestine.

Male (1 complete specimen and 2 posterior end fragments of 2 others): — Length of body 3.84, maximum width 0.039–0.042. Length of entire oesophagus 1.77; this forms 46% of whole body length. Muscular oesophagus 0.243 long, distance of nerve ring from anterior extremity 0.084. Spicule with smooth surface, conspicuously long (0.657–0.786) and slender (width about 0.005); its proximal end slightly extended, distal end almost conical. Spicular sheath withdrawn inside body and, accordingly, indistinct. Tail blunt, provided with rather long cuticular membrane supported by two lateral rays; this bursa-like formation contains a flat, dorsal conical caudal process, not reaching posteriorly level of ray ends. Two large round subventral papillae present at both sides of cloacal opening, each of which bearing at its base an additional small, little distinct papilla. Length of proper tail 0.006.

Female (1 complete female containing eggs and 1 fragment of another): — Body length 8.95, maximum width 0.054–0.081. Length of entire oesophagus 3.40; this forms 37% of whole body length. Length of muscular oesophagus 0.315, distance of nerve ring 0.090. Vulva located at short distance (0.039–0.057) below stichosome end level, 3.44 from anterior extremity; vulval lips not elevating or anterior lip slightly elevating. In proximal part of uterus eggs arranged in one row. Fully developed eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer hyaline, markedly refractile, outer layer thin, with fine network sculpture on its surface. Egg content uncleaved. Size of fully mature eggs 0.066–0.072 × 0.030–0.033; maximum thickness of egg wall 0.003.

Hosts: This freshwater parasite occurs only in fishes of the family Acipenseridae; according to Skryabina (1974) the main host is sterlet, *Acipenser ruthenus* (type host), but it was recorded as well in other sturgeon species — *Acipenser nudiventris*, *A. güldenstädti*, *A. stellatus* and *Huso huso*. It attacks largely young fishes in which it may cause inflammation of intestines (Dubinin 1952).

Location: intestine.

Distribution: *C. tuberculata* is distributed over the Caspian and Black Seas basins (Skryabina 1974). By the migratory species of hosts it is frequently brought from the rivers (Volga, Danube) into the marine environment. So far it has been recorded from the USSR only.

Comments: This species was described by Linstow (1914) as *Trichosoma tuberculatum* from the specimens from *Acipenser ruthenus* of the River Volga near Saratov; later Heinze (1933) reexamined the type specimens and added some new data on their morphology. He also correctly pointed out that the nematodes described by Lewaschoff (1929) as *C. tuberculata* from *Pelecus cultratus* of the R. Volga belonged to the other species, which he named *C. lewaschoffi* (= *C. brevispicula* — see p. 312). Although there were several records of *C. tuberculata* in the following years, new descriptions contributed little to the knowledge of its morphology; a more detailed description and drawings were provided only by Lomakin (in Skryabina 1974).

Study of the type specimens revealed that this species is characterized by some specific features which were given inaccurately or erroneously in the previous descriptions, or were not mentioned at all. It concerns particularly the structure and measurements of eggs and the length of the spicule, which is conspicuously long and slender. Apparently, Linstow (1914) gave the spicule length erroneously, because the distal end of spicule is absent from the specimen illustrated by that author. A marked character of *C. tuberculata* is also the structure of the posterior end of body in male; while neither Linstow (1914) nor Heinze (1933) paid attention to this feature, Lomakin (in Skryabina 1974) found the presence of a dorsal conical caudal process supporting the pseudobursa. However, reexamination of the type specimens revealed that, in addition to the caudal process, the pseudobursa contains as well two narrow lateral rays. In its morphology, particularly in the structure of the male pseudobursa, this species resembles *C. freemani* Moravec, Margolis et McDonald, 1980 — a species recently described from skates. Considering the usual correlation of characters, the spicular sheath of *C. tuberculata* is possibly not smooth but spinose, like in *C. freemani*; the evaginated spicular sheath has never been observed in *C. tuberculata*.

KEY TO MEMBERS OF *CAPILLARIA* PARASITIC IN FRESHWATER FISHES OF EUROPE:

1. Glandular part of oesophagus composed of stichocytes arranged in one longitudinal row; length of oesophagus representing 35—80 % of whole body length. Spicule smooth, 0.23—0.79 mm long; spicular sheath smooth or spinose. Pseudobursa, if present, not supported by lateral rays; if lateral rays present, then pseudobursa containing also dorsal caudal process. Intestinal parasites 2
- Glandular part of oesophagus composed of stichocytes arranged in three longitudinal rows; length of oesophagus representing 15—33 % of whole body length. Spicule superficially wrinkled, 0.24—0.28 mm long; spicular sheath spinose. Pseudobursa supported by two lateral rays only, no caudal process. Parasites of liver tissue *C. petruschewskii*
2. Male tail provided with two large, round subventral papillae; caudal cuticular membrane absent. Length of spicule 0.23—0.33 mm. Parasitic mainly in cyprinids *C. brevispicula*
- Male tail provided with two large, round subventral papillae connected between each other by dorsal cuticular membrane. Length of spicule 0.30—0.63 mm. Parasitic mainly in salmonids and cottids *C. salvelini*
- Male tail provided with rather long cuticular membrane supported by two lateral rays and flat conical dorsal caudal process. Two large, round subventral papillae present near cloaca, each of which bearing additional small papilla at its base. Length of spicule 0.52—0.79 mm. Parasitic exclusively in sturgeons *C. tuberculata*

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РЕВИЗИЯ НЕМАТОД РОДА *CAPILLARIA* ОТ ЕВРОПЕЙСКИХ ПРЕСНОВОДНЫХ РЫБ

Ф. Моравец

Резюме. При изучении разных материалов нематод рода *Capillaria* от европейских пресноводных рыб обнаружено, что из 11 видов описанных от приведенных хозяев в этой области только 4 вида, предварительно отнесенные к роду *Capillaria* Zeder, 1800, можно считать валидными: *C. brevispicula* (Linstow, 1873), *C. salvelini* Polyansky, 1952, *C. petruschewskii* (Shulman, 1948) и *C. tuberculata* (Linstow, 1914). Дано переописание и рисунки этих видов. *C. leucisci* Hesse, 1923 и *C. lewaschoffi* Heinze, 1933 считаются синонимами *C. brevispicula* (Linstow, 1873), тогда как *C. baicalensis* Ryzhikov et Sudarikov, 1953, *C. coregoni* Shulman-Albova, 1953, и *C. curilica* Zhukov, 1960 новые синонимы *C. salvelini* Polyansky, 1952. *C. tomentosa* (Dujardin, 1843) рассматривается как species inquirenda. Приведена определительная таблица видов рода *Capillaria*, паразитирующих у пресноводных рыб Европы.

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F. M., Parazitologický ústav ČSAV,
Flemingovo n. 2, 166 23 Praha 6,
ČSSR

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L. Margolis, J. R. Arthur: Synopsis of the Parasites of Fishes of Canada.

Bulletin of the Fisheries Research Board of Canada 199, Department of Fisheries and Oceans, Ottawa 1979, 269 pp. Price \$ 15.55.

This book appeared as the 199th publication of the series Bulletins. It offers a survey of all hitherto published information on the parasites of freshwater and marine fishes of Canada, covering the period from the beginning of investigation of fish parasites in Canada about hundred years ago up to the end of 1977. The authors consolidated all available data on the parasite fauna of fish in Canada, hitherto scattered in various scientific literature and "Report" series, and created thus a basis for further studies of this topic. The most important part of this compilation are two lists, Parasite-Host and Host-Parasite. A total of 830 species of fish parasites (Protozoa, Turbellaria, Monogenea, Trematoda, Cestoidea, Nematoda, Acanthocephala, Hirudinea, Mollusca, Branchiura, Copepoda and Isopoda) have been reported from Canadian waters and additionally there are many records of parasites not identified to species level. In the Parasite-Host list the species of parasites are arranged according to

their systematic position and for each species are given data on its habitat, location in the host, species of hosts, distribution in Canadian waters, and the literary source. The Host-Parasite list is organized according to taxonomy of the hosts with notes on known distribution of the parasite. The book is concluded with a list of cited references, a supplementary list of references and an index to parasites and hosts. As it is stressed by the authors, the aim of the synopsis is not a taxonomic revision, although, where necessary, notes on the taxonomy and nomenclature of some parasite species are included; several new name combinations and a new synonym are proposed.

This synopsis of the parasites of fishes of Canada was prepared very carefully and precisely and will certainly be helpful in further studies on the fish parasites in Canada and North America. It will be also an important source of information for ichthyoparasitological investigations in other geographical regions.

Dr. F. Moravec, C.Sc.