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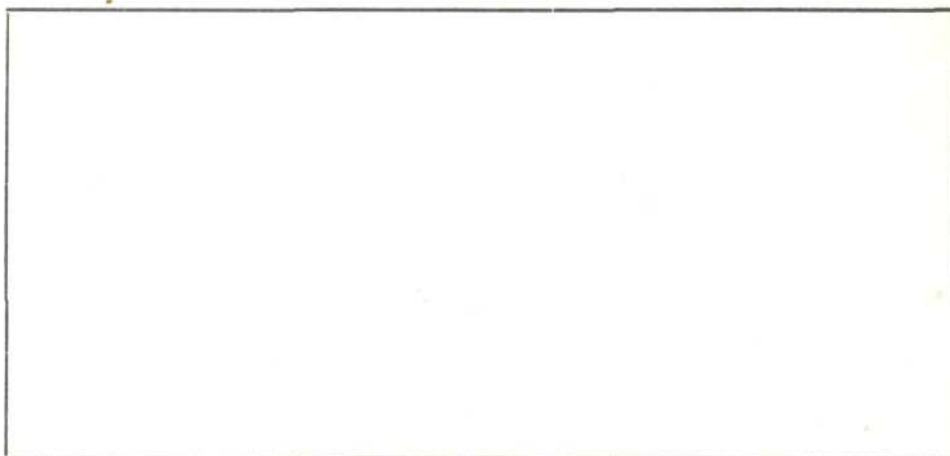
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**PLATYPALPUS STIGMATELLOIDES, A NEW SPECIES FROM CENTRAL EUROPE
(DIPTERA, HYBOTIDAE)**

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Abstract. The species of *Platypalpus* Macquart (Diptera, Hybotidae) collected by Dr L. Matile in Malaise traps near Aosta (Italian Alps) were studied. A new species *P. stigmatelloides* sp. n. (Alps, Carpathians) is described, and a list of 22 species of *Platypalpus* is added. Female of *P. niveisetoides* Chvála is described for the first time.

The present paper is based on a collection of *Platypalpus* species (Diptera, Hybotidae) obtained by Dr L. Matile (Paris) with Malaise traps in the Italian Alps. The specimens were collected in the years 1973 to 1983 in the valleys near Aosta, Italy, at altitudes from 700 to 2000 m above sea level. Altogether 23 species of *Platypalpus* have been found in the studied material; all specimens are preserved in the collection of the Musée national d'Histoire naturelle, Paris. We are very indebted to Dr L. Matile for the privilege of studying this material. Among the specimens collected in the vicinity of Aosta a new species of *Platypalpus* has been found, which is an undescribed species already known to us from other mountain localities in central Europe. It is described here as:

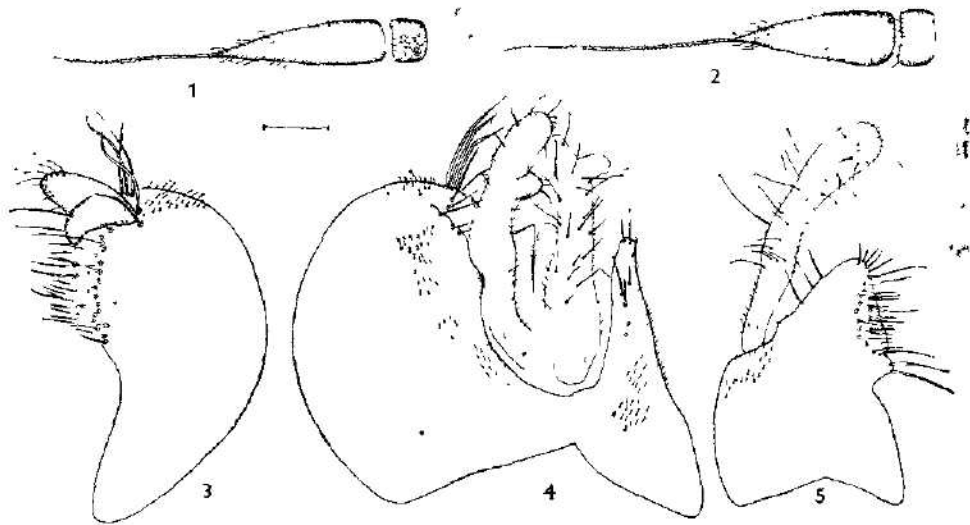
Platypalpus stigmatelloides sp. n.

A medium-sized polished black species, vertical bristles not differentiated, mesonotum polished with sparse minute hairs, and no tibial spur. Closely resembling *P. stigmatellus* (Zetterstedt) but antennae shorter, vertex grey dusted (except for polished ocellar triangle), upper part of mesopleura silvery dusted, and last tarsal segment on all legs contrastingly black.

Male. Head black, polished on frons and on ocellar triangle, otherwise rather densely silvery grey dusted. Frons rather dark reddish black, broad, broader than 2nd antennal segment, and slightly widening above. Face very narrow below antennae, silvery dusted, but clypeus polished black. The dusting on vertex broadly encircling ocellar triangle. Upper occipital hairs sparse and short, yellowish, becoming slightly longer and whitish below neck; vertical bristles not differentiated, anterior pair of ocellar bristles whitish, very small. Antennae (Fig. 1) black, 3rd segment long and narrowly pointed towards tip, at least 3 times as long as deep; arista as long as 3rd segment. Palpi large, apically rounded, yellow in ground-colour and clothed with silvery white pubescence; no long terminal bristles.

Thorax extensively polished black, but prothorax including humeri and pteropleura with a tendency to be brownish in ground-colour. Pronotum between humeri, a small patch above roots of wings and scutellum greyish dusted. Pleura more dusted than in *P. stigmatellus*: whole of prothorax, upper part and sides of mesopleura, upper hind corner of sternopleura, and whole of pteropleura and hypopleura (except for a narrow posterior margin), silvery grey dusted. All thoracic hairs and

bristles pale and weak; acr narrowly biserial, dc uniserial, with only a few similar minute hairs at side. No humeral bristle, a short notopleural, a similarly small postalar bristle, and a pair of slightly longer scutellar bristles with a minute hair on each side.



Figs. 1-5 *Platypalpus stigmatelloides* sp. n., paratypes (Aosta, Italy). 1 - antenna of male, 2 - antenna of female. Male genitalia: 3 - right perianthial lamella, 4 - perianthium with cerci, 5 - left perianthial lamella with left cercus. Scale 0.1 mm.

Wings large, clear, with blackish brown veins; costa thickened at tip of vein R_{8+9} and contrastingly black right up to tip of vein R_{4+5} . Veins R_{4+5} and M parallel, usually slightly curved down apically. Crossveins contiguous, the vein closing anal cell very recurrent. A very small, pale costal bristle. Squamae and halteres yellowish.

Legs rather long and slender, mostly yellow, but posterior four femora towards tip and all tibiae and tarsi slightly light brownish, last tarsal segment on all pairs contrastingly black. Fore femora rather slender, microscopically whitish pubescent beneath, and with a row of very short, inconspicuous pale posteroventral bristles. Mid femora slightly stouter than fore femora, but distinctly longer, the ventral black spines short in anterior row, those in posterior row longer and bristle-like towards base; no posteroventral bristles. Fore tibiae slightly dilated, mid tibia obviously more slender but gently arched, shorter than corresponding femur; apically shining, not stouter towards tip and without a coating of whitish pile; no apical spur, only a very small rim-like projection ventrally at tip. Hind legs long and slender, covered with only short hairs.

Abdomen shining black to blackish brown, dorsum covered with only short, scattered pale hairs. 7th sternum dusted grey, its posterior margin fringed with long yellowish hairs. Genitalia (Figs 3-5) with right lamella large and globular; left lamella small, triangular-shaped, posteriorly with a double row of rather short yellowish bristles. Cerci long and slender dusted grey except for a polished tip of left cercus.

Length: body 2.2-2.6 mm, wing 3.3-3.8 mm.

Female. Resembling male but antennae (Fig. 2) shorter, 3rd segment about twice (or slightly more) as long as deep; arista longer than in male, at least 1.5 times as long as 3rd segment. Palpi with 2 fine pale bristly hairs at tip, otherwise as in male. Abdomen shining except for dusted grey apical two segments and cerci. Length: body 2.2–3.0 mm, wing 3.3–4.0 mm.

Holotype ♂: Italy, Aosta, Vallée de Rhêmes (1900–2000 m) 8. ix. 1978, leg. L. Matile; deposited in the collection of Mus. Hist. nat. Paris.

Paratypes: Italy, Aosta: same data as holotype, 4 ♂ and 1 ♀; Eau rousse, Valsavaranches (1600 m) 4. ix. 1978 6 ♂; Vallée de St Barthelemy Clemenceaud (1600 m) 7. ix. 1978 1 ♂; Etroubles (1600–1650) 13. ix. 1978 1 ♂; Vallée de Gressoney, Biel (1900 m) 11. ix. 1978 1 ♂; Villeneuve Bertolaz (800 m) 11.–15. ix. 1978 1 ♂; Valgrisenche, Chameneon (1280 m) 12. ix. 1974 1 ♀; all leg. L. Matile, in Mus. Hist. nat. Paris. Switzerland: Val Roseg, Engadine (1800 m) 8. viii. 1983 1 ♂, leg. P. Dessart; in the Institut Royal Sci. Nat. Belgique, Brussels; Engiad Bassa, Ramosch R3 (1075 m) 20. viii. 1961 1 ♂ and 1 ♀, leg. L. and F. Keiser; in Museum Basel. Austria: Gastern 30. vii. 1907 1 ♂ and 1 ♀, coll. Villeneuve, *T. stigmatella* Zetterstedt det. Oldenberg; in IRSNB Brussels; Obergurgl, Tirol (1950 m) 21. vii. 1953 1 ♀, 26. vii. 1953 1 ♂, 8. viii. 1953 1 ♂, 17. viii. 1953 1 ♂ and 2 ♀, 18. viii. 1953 1 ♀, same locality (2200 m) 7. viii. 1953 1 ♀; all leg. J. R. Vockeroth, in coll. Ottawa and coll. Chvála; Vent (1850–2000 m) 9.–13. viii. 1967 1 ♀, leg. ?, in I.T.Z. Amsterdam. FRG: Bavarian Alps, Wahnberg (1600 m) 2.x. 1966 1 ♂, leg. M. Chvála, in coll. Chvála. Czechoslovakia: Zapadné Tatry Mts, Žiarská dol. (1150 m) 11. viii. 1982 1 ♀, leg. M. Barták, Vysoké Tatry Mts, Veľká Studená dol. (1450 m), 17. viii. 1982 1 ♀, leg. M. Barták, in coll. Chvála; Studenovodská dol. (Kobíbach) 29. vii. 1907 1 ♀, 7. viii. 1907 1 ♂ and 1 ♀, leg. L. Oldenberg, in IRSNB Brussels.

Derivatio nominis: The specific name *stigmatelloides* indicates a close relationship of the new species to *P. stigmatellus* (Zetterstedt).

Differential diagnosis. *P. stigmatelloides* sp. n. is very closely related to *P. stigmatellus* (Zetterstedt, 1842) with which it has been often confused in central Europe. *P. stigmatellus* has longer antennae in both sexes, 3rd segment is 3–4 times as long as deep in male, and arista is shorter, 2–3 times as long as deep in female, with arista only slightly longer. Moreover, thoracic pleura is more extensively shining black in *P. stigmatellus*, mesopleura polished right up to its upper margin, vertex completely polished including a subshining upper part of occiput, dorsum of abdomen in male (especially the 4th and 5th terga) covered with longer and denser pale pubescence, and tarsi are more uniformly yellowish brown including last segment (last segment is not contrastingly black as in *P. stigmatelloides*). The structure of male genitalia is very similar in both species, though the hairs on upper posterior margin of left lamella are much less distinct in *P. stigmatellus*. Both species are often found together in mountains.

Distribution. Mountains of central Europe (Alps, Carpathians), at altitudes from 800 to 2200 m above sea level, on dates ranging from 21. vii. to 2.x.

The following species of *Platypalpus* were collected by Dr L. Matile together with the above described *P. stigmatelloides* in the vicinity of Aosta, Italy.

P. albomicans (Bezzi, 1892)

Villeneuve Bertolaz (800 m) 5.–15. ix. 1978 3 ♂ 4 ♀.

P. alpinus (Strobl, 1893)

Villeneuve Bertolaz (800 m) 5.–15. ix. 1978 7 ♂ 7 ♀, Piano di Spivencore, Cogne (1550–1600 m) 26. vii. 1983 2 ♂ 3 ♀; Vallée de St Barthelemy, Clemenceaud (1600 m) 7. ix. 1978 1 ♂ 1 ♀; Comba di Vertosan, Breuil (1650 m) 15. ix. 1974 1 ♀; Vallée de Cogne, P. N. G. P. Valnonty (1850 m) 21. ix. 1974 1 ♀; Vallée de Rhêmes (1900–2000 m) 8. ix. 1978 1 ♂.

P. annulipes (Meigen, 1822)

Env. de Villeneuve (700–750 m) 14. vi. 1976 1 ♀.

P. baldensis (Strobl, 1899)

Vallée de Gressoney, Biel (1900 m) 11. ix. 1978 1 ♀.

- P. calcatus* (Meigen, 1822)
Valnontey, Cogne (1620–1720 m) 10. vii. 1975 1 ♀.
- P. calvus* (Fallén, 1816)
Villeneuve Bertolaz (800 m) 4. ix. 1978 1 ♂; Valgrisanche, Chamonecon (1280 m) 12. ix. 1974 1 ♂; Vallée de St Berthelemy, Clemenceaud (1600 m) 7. ix. 1978 1 ♀.
- P. commutatus* (Strobl, 1893)
Etroubles (1600–1650 m) 13. ix. 1978 1 ♀.
- P. coniformis* Chvála, 1971
Vallée de Gressoney (1450 m) 11. ix. 1978 1 ♂; Eaurousse, Valsavaranche (1600 m) 4. ix. 1978 8 ♂ 1 ♀, Etroubles (1600–1650 m) 13. ix. 1978 1 ♂; Vallée de Rhêmes (1900–2000 m) 20. vii. 1975 1 ♀, 8. ix. 1978 1 ♂ 1 ♀.
- P. cruralis* (Collin, 1961)
Valnontey, Cogne (1620–1750 m) 11. vii. 1975 1 ♀; Vallée de Cogne, P. N. G. P. (1650–2000 m) 25. vi. 1973 1 ♀; Vallée de Rhêmes (1880 m) 20. vii. 1975 2 ♀.
- P. kovalevi* Chvála, 1988
Vallée de Gressoney, Biel (1900 m) 11. ix. 1978 2 ♂.
- P. longicornis* (Meigen, 1822)
Villeneuve Bertolaz (800 m) 11. – 15. ix. 1978 2 ♂ 1 ♀, 21. ix. 1974 1 ♂.
- P. longista* (Zetterstedt, 1842)
Env. de Villeneuve (700–750 m) 14. vi. 1976 1 ♀.
- P. luteicornis* (Meigen, 1838)
Valsavaranche 19. vii. 1975 1 ♂; Valnontey (1800 m) 16. vii. 1975 1 ♂; Vallée de Rhêmes (1900–2000 m) 8. ix. 1978 1 ♂.
- P. luteolus* (Collin, 1926)
Villeneuve Bertolaz (800 m) 5. – 10. ix. 1978 1 ♀.
- P. macula* (Zetterstedt, 1842)
Villeneuve Bertolaz (800 m) 5. – 15. ix. 1978 2 ♂; Valgrisanche, Chamonecon (1280 m) 12. ix. 1974 1 ♂; Piano di Sylvenoire (1550 m) 27. vi. 1973 1 ♂, (1600–1700 m) 14. vii. 1975 1 ♂ 1 ♀, (1600–1650 m) 15. vii. 1975 1 ♂, Vallée de Cogne, P. N. G. P. (1700 m) 23. vi. 1973 1 ♀; Vallée de Rhêmes (1900–2000 m) 8. ix. 1978 1 ♀.
- P. maculipes* (Meigen, 1822)
Villeneuve Bertolaz (800 m) 5. – 15. ix. 1978 2 ♀, (850 m) 20. ix. 1974 1 ♀; Valgrisanche, Chamonecon (1280 m) 12. ix. 1974 1 ♀; Piano di Sylvenoire (1550–1600 m) 26. vii. 1983 1 ♂; Eaurousse, Valsavaranche (1600 m) 4. ix. 1978 1 ♀, Vallée de Cogne, P. N. G. P. Valnontey (1650 m) 21. ix. 1974 2 ♂; Valgrisanche (1800 m) 12. ix. 1974 1 ♀.
- P. minutus* (Meigen, 1804)
Env. de Villeneuve (700–750 m) 14. vi. 1976 1 ♂.
- P. navesetoides* Chvála, 1973
Villeneuve Bertolaz (800 m) 5. – 15. ix. 1978 14 ♂ 4 ♀.
This mountain species was known so far only from the holotype male taken at Prenj Planina, Hercegovina (Yugoslavia). Besides the above series of 14 ♂ and 4 ♀ taken by L. Matile in the Italian Alps, we have seen another female taken by Dr J. R. Vockeroth on 14. vii. 1953 in the Austrian Alps at Igls (900 m), Tirol. Since the females are reported here for the first time, a brief description is presented.
- Female. Resembling male in all main differential features. Abdomen shining blackish brown but posterior margin of 7th segment and cerci dusted grey; 8th segment long, ovipositor-like, almost completely dusted grey except for a triangular polished patch at base on both sides.
- P. obscurus* (von Roser, 1840)
Chavonne (650 m) 13. vi. 1976 1 ♀.
- P. pallipes* (Fallén, 1815)
Villeneuve Bertolaz (800 m) 5. – 15. ix. 1978 5 ♂ 6 ♀.
- P. pectoralis* (Fallén, 1815)
Villeneuve Bertolaz (800 m) 4. – 15. ix. 1978 5 ♂ 25 ♀; Piano di Sylvenoire, Cogne (1500 to 1600 m) 26. vii. 1983 2 ♂ 1 ♀.
- P. stigmatellus* (Zetterstedt, 1842)
Villeneuve Bertolaz (800 m) 5. – 15. ix. 1978 2 ♂; Vallée de Gressoney (1450 m) 11. ix. 1978 1 ♂; Eaurousse, Valsavaranche (1600 m) 4. ix. 1978 1 ♂; Vallée de St Barthélemy, Clemenceaud (1600 m) 7. ix. 1978 1 ♂; Valsavaranche, P. N. G. P. (1730 m) 20. ix. 1978 2 ♂.

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**MORPHOLOGY AND LIFE CYCLE OF A NEW GREGARINE ACANTHOGREGARINA
HOSHIDEI N. G. N., N.SP. FROM THE GUT OF LIOGRYLLUS SP.**

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Abstract. A new cephaline gregarine from the gut of a gryllid insect, *Liogryllus* sp. is described. It is placed in a new genus and species, *Acanthogregarina hoshidei* because it combines in it the taxonomic features of the genus *Acanthoepimeritus* Hoshude in possessing a complex epimerite and the genus *Gregarina* in possessing biassociative sporadins. It is placed in the subfamily Actinocephalinae Leger since it has a complex epimerite and cylindrical spores, although the sporadins are biassociative giving greater importance to the former character.

Several gregarines have been reported from insects, particularly from orthopterous and coleopterous insects. A perusal of the literature shows that the common gryllids are less known as hosts of gregarines. So far 18 species belonging to 3 genera (*Gregarina*, *Leidyana* and *Hirmocystis*) are reported from gryllids, of which only 3 species, *Gregarina grylloidesai*, *G. levinei* and *G. guttiventra* Haldar and Sarcar 1980 are reported from India.

The present account deals with a cephaline gregarine infecting the midgut of *Liogryllus* sp. which showed characteristic taxonomic features warranting the creation of a new genus, *Acanthogregarina* (Actinocephalinae: Actinocephalidae). The morphology and life-cycle of the gregarine is described and its taxonomic position is discussed in the following account.

The host insects, *Liogryllus* sp. were collected from different areas in the University Campus at Waltair (Andhra Pradesh, India). They were maintained in small battery jars containing a moist filter paper. Soon after collection some of the insects were decapitated, gut removed and examined under a binocular microscope. Smears were prepared from the infected midgut portion, fixed either in Schaudinn's alcoholic Bouin's fluid and stained either with Heidenhain's Ehrlich's or Delafield haematoxylin. Infected guts were fixed in alcoholic Bouin's fluid, sectioned at 8 μ m thickness and stained with Heidenhain's iron haematoxylin, Azocarmine or Mallory's triple stain. Cysts were collected from the hindgut or from the faecal matter. They were cleaned of the adhering debris and kept in 2.5% Potassium dichromate solution at room temperature (Ca. 28°C) to study gametogenesis and sporogony. Cysts were ruptured at 6 hourly intervals after removing the oocyst with a fine pair of needles and the smears were either air dried, fixed in acetone free methyl alcohol and stained with Giemsa after an initial hydrolysis in 1N HCl at 60°C for 10 minutes or fixed in Schaudinn's or Carnoy's fluid and stained with Heidenhain's iron haematoxylin or according to Feulgen's technique.

Acanthogregarina hoshidei n. gen., n. sp.

Host: *Liogryllus* sp.

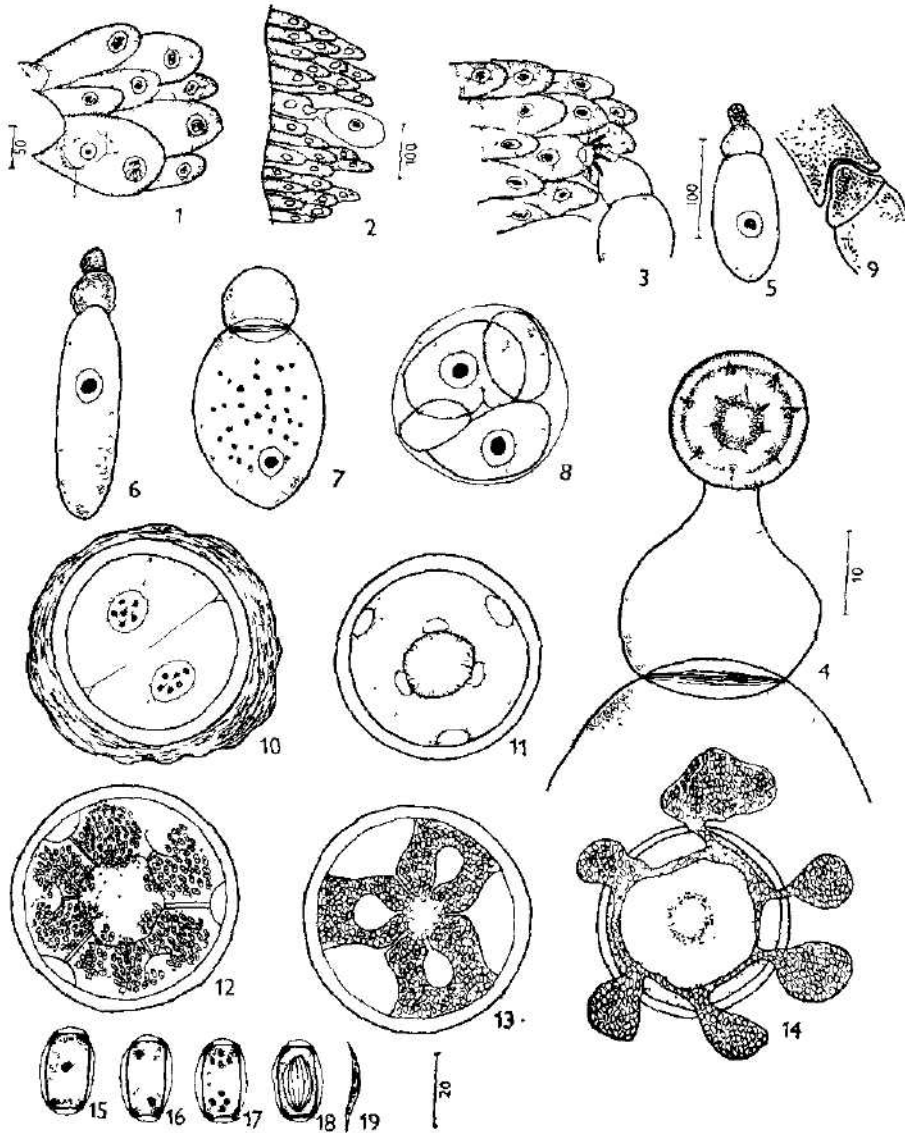
Locality: Andhra University Campus Waltair (Andhra Pradesh)

Site of infection: Midgut

Type slides: Department of Zoology, Andhra University, Waltair and Author's collections.

Sixty to seventy percent of *Liogryllus* sp. were infected with the new species of gregarine. The nymphs appeared in March and the adults were seen from April to

August. Intraepithelial stages and early cephalonts were observed in the gut of nymphs, while the adults harboured sporonts and gametocytes. The incidence of infection increased from April to July. Ninety percent of the cysts were collected in the month of July.



Figs. 1-19. *Acanthogregarina hoshidei* n. gen., n. sp., 1-intraepithelial stage, 2-3 sections of the gut showing attachment, 4 - epimerite of the mature cephalont, 5 - an early cephalont, 6 - sporont with the stalk portion of the epimerite, contracted and rounded, 7 - sporont, 8 - syzygy, 9 - attachment in syzygy, 10 - gametocytes prior to cyst formation, 11 - a binucleate cyst, 12 - cyst showing spore formation, 13 - cyst showing spores aggregated into 6 masses, 14 - cysts after dehiscence, 15-17 sporocysts with 1-8 nuclei, 18 - a sporocyst with sporozoites, 19 - a single sporozoite. Scales in μm .

The earliest stage in the development of the parasite observed was an intra-epithelial stage found in the epithelial cells of the midgut. It was oval in shape measuring $6.5 \times 4.5 \mu\text{m}$ and was found inside a vacuole of the host cell cytoplasm (Fig. 1). The nucleus was vesicular and contained a single deeply stained endosome. No extraendosomal chromatin material was observed. The cytoplasm was finely alveolated and deeply stained.

Young cephalonts were attached to the epithelial cells of the midgut by their epimerites which were deeply embedded in the host cell. They were oval measuring $150 \times 70 \mu\text{m}$. The epimerite was in the form of a globular disc which appeared hyaline and had a small stalk (Fig. 2).

As the parasite grows the deutomerite increased in length and cephalonts varying in size from $150-298 \times 70-120 \mu\text{m}$ were observed. The epimerite at this stage was in the form of a complex disc with 14 small indentations arranged in two concentric whorls of 7 each. The central portion of the epimerite was deeply stained and appeared like a hollow depression (Fig. 4). The protomerite was typically dome-shaped and was connected with the epimerite by a small neck (Figs. 3 & 4). The various body proportions of mature cephalonts were DL:TL = 1:1.26-1.61. PL:TL = 1:3.55-6.7. WP:WD = 1:1.07-2.15. PL:DL = 1:1.5-5.9.*

Sporonts and association stages were found free in the lumen of the midgut. Sporonts were cylindrical measuring $169.0-323.0 \times 45.0-169.0 \mu\text{m}$. When they were detached from the epithelium at the neck region, the stalk portion of the epimerite was contracted and appeared in the form of a small knob-like or globular structure at the anterior tip (Fig. 6) resembling the cephalonts of the genus *Gregarina*. The disc-like portion of the epimerite was presumably left behind in the host cell. The body proportions of sporonts were DL:TL = 1:1.6-3.69. The length width ratio of the deutomerite of the sporadin was always more than that of the cephalont. The protomerite was dome-shaped or subglobular and was widest at its base. The septum between the protomerite and deutomerite in mature cephalonts and sporonts was thick and showed closely set bands of myonemes (Fig. 7). The structure of the nucleus was the same as in that of the cephalonts.

Sporadins were biassociative. Association was caudofrontal. The ratio of L. Pri:L. Sat. was 1:1.3-1.96** The anterior end of the satellite fits into a deep cup-like depression at the posterior end of the primate (Fig. 9).

A freshly formed gametocyst was spherical in shape and transparent and the two associated gametocytes could be seen clearly (Figs 8 & 10). Cysts were passed out at a very early stage of their development. The septum between the gametocytes was intact and a thick mucus ectocyst was formed before they were passed out. The endosome of both the nuclei was broken into 5 or 6 chromatin granules interconnected with achromatic strands. During successive developmental stages the partition between the two gametocytes disappeared and by about 48 hrs. vigorous movements were observed in the gametocytes which indicated the formation of the gametes. Gametes were spherical measuring $4.0 \mu\text{m}$ in diameter, isogamous and without locomotor organelle. This stage was of short duration and lasted for only 30-45 mts. The cysts appeared opaque in subsequent stages. By about 72 hrs 5-6 hyaline zones (patches) were formed on the surface (Fig. 11) and the spores enclosed in thin transparent membranes appeared as dark patches. These hyaline

* TL = Total length; PL = Length of protomerite; DL = Length of the deutomerite; WP = Width of protomerite; WD = Width of deutomerite;

** L Pri. = Length of primate, L sat. = Length of satellite.

patches gradually increased in area and were ultimately pushed to the periphery, when they appeared as small elevations on the surface of the cyst in about 96 hrs (Fig. 13). No typical spore duct formation was observed. Smears prepared at this stage showed uni- or bi-nucleate spores.

Dehiscence appeared rather peculiar. The cysts ruptured only on the 7th day. The rupture took place at the elevated areas. The spores were pushed out slowly together with the membrane in 5 or 6 groups near the periphery (Fig. 14).

The spores were cylindrical with thickened poles and measured $24.0 \times 16.0 \mu\text{m}$ with 1–8 nuclei (Figs. 15–18). They were octozoic and the sporozoites were spindle shaped (Fig. 19).

Discussion and systematic position

The family Actinocephalidae Leger includes two subfamilies, Acanthosporinae and Actinocephalinae (Grasse', 1953). The subfamily Acanthosporinae as it stands includes 14 genera all having complex epimerites and spores with spines. The subfamily Actinocephalinae includes 40 genera, all having solitary sporadins with variously formed epimerites, cysts without spore ducts, spores irregular cylindrical. Kudo (1966), however, considers both the subfamilies as different families.

The present parasite from the gut of *Liogryllus* resembles the genus *Acanthoepimeritus* Hoshide, 1958, *Geniorhynchus* Schneider, 1875 and *Epicavus* Ormieres and Daumal, 1970 in having a complex epimerite with spines, but the epimerite in the present form is unique in having indentations along the periphery (not rigid like the spines of the above mentioned 3 genera) with a central depression. *Epicavus* Ormieres and Daumal also has an epimerite with a cup-like central depression but it is rimmed with a collar and there are no peripheral indentations.

In the family Actinocephalidae the sporadins are always solitary. The presence of biassociative sporadins is a unique character of the family Gregarinidae Labbe where the epimerite is always simple and knob-like. In the present form also the sporadins are biassociative. In both the families (Gregarinidae and Actinocephalidae) the spores are cylindrical or ovo cylindrical. Dehiscence is generally by simple rupture but in some species of the family Gregarinidae 5–6 spore ducts are formed. The present parasite shows the formation of small elevations on the surface of the cyst as in the initial stages of spore duct formation in the family Gregarinidae but typical spore ducts were never formed, instead the spores were released in 5–6 masses by a rupture of the cyst wall at the elevated areas and are enclosed in membranes. This type of dehiscence, hitherto undescribed appears to be unique to this form. The presence of a transverse band of myonemes in the septal region between the protoemerite and deutomerite is also peculiar to this form.

So far 18 species belonging to 3 genera (*Gregarina* Dufour, *Leidyana* Watson and *Hirmocystis* Labbe) are described from gryllids of which 3 species are reported from India. The present form does not resemble any one of them in the structure of the epimerite and in the details of sporogony.

In view of the unique nature of the epimerite nearly resembling *Acanthoepimeritus* Hoshide, the presence of biassociative sporadins (like in the genus *Gregarina* Dufour), peculiar method of dehiscence and cylindrical spores with thickenings at the corners, it is proposed to create a new genus and species, *Acanthogregarina hoshidei* n. gen., n. sp. to accommodate the present form. It is placed in the subfamily Actinocephalinae Leger since it has a complex epimerite and cylindrical spores although the sporadins are biassociative.

Diagnosis

Acanthogregarina n. gen.

Epimerite complex in the form of a disc with a small stalk. Peripheral indentations generally 14 arranged in two whorls of 7 each along the periphery of the disc of the epimerite. Sporadins biassociative. Cysts without spore ducts. Spores released in groups enclosed in membranes. Spores cylindrical with thickened poles.
Type species: *Acanthogregarina hoshidei* n. sp.

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NEMATODES OF FRESHWATER FISHES FROM NORTH VIETNAM. PART 3.
COSMOCERCOIDEA, SEURATOIDEA, ATRACTOIDEA,
HETERAKOIDEA AND ASCARIDOIDEA

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Abstract. Based on the examinations of 22 species of freshwater fishes from North Vietnam (the Red River near Hanoi), collected in 1960–1975, a rather extensive material of parasitic nematodes was obtained. The taxonomic evaluation of members of the superfamilies Cosmocercoidea, Seuratoidea, Atractoidea, Heterakoidea and Ascaridoidea is presented in this paper. These include: *Spironoura babei* S. Kawera, *Pingus sinensis*, *Paragendria* sp. n., *Hakynema vietnamensis* gen. et sp. n., *Meterakis japonica* and *Hysterothylacium fluviale* sp. n. *H. vietnamensis* gen. et sp. n. (only one female available) from the intestine of *Spinibarbus denticulatus* is a member of *Hakynema* gen. n., differing from *Travnema* Pereira, 1938, the only other genus in the family Travnematidae, by the presence of mouth papillae, absence of the buccal capsule and isthmus, different mutual situation of ovaries and by the presence of non-larvated eggs. *Hysterothylacium fluviale* sp. n. (larvae) from the body cavity of *Pangasius pangasius* (type host) and *Arius arius* is characterized mainly by the conspicuously long (4.8–5.8 mm) ventricular appendix exceeding the mid length of the nematode body. Except for *S. babei* and *P. sinensis*, these parasites are reported from Vietnam for the first time, some of them being recorded from new hosts. All the nematodes are briefly described and illustrated and some problems concerning their taxonomy and geographical distribution are discussed.

This paper is a continuation of the authors' earlier studies (Moravec and Sey 1988a, b) on parasitic nematodes obtained by the second author from 22 fish species during his visit to North Vietnam in 1984. The fishes examined originated from the Red River near Hanoi and were collected in 1960–1975. The present paper deals with members of the superfamilies Cosmocercoidea, Seuratoidea, Atractoidea, Heterakoidea and Ascaridoidea. All specimens have been deposited in the helminthological collection of the Institute of Parasitology, Czechoslovak Academy of Sciences in České Budějovice, Czechoslovakia. All measurements are given in millimetres.

REVIEW OF SPECIES

Fam. Kathlaniidae (Lane, 1914, subfam.)

1. *Spironoura babei* Ha Ky, 1971 (Fig. 1)

Host: *Spinibarbus denticulatus* (fam. Cyprinidae).
Localization: intestine.

Description: Whitish, medium-sized nematodes. Head end narrowed, provided with three rounded lips; each lip with two inner and two outer papillae; inner papillae attached to base of outer papillae by slender stalks. Cuticle forming conspicuous inflation initiating at base of lips and extending somewhat below level of nerve ring; this inflation exceptionally absent in smaller specimens. Cervical alae absent. Deirids simple, small, located between nerve ring and excretory pore. Oesophagus divided

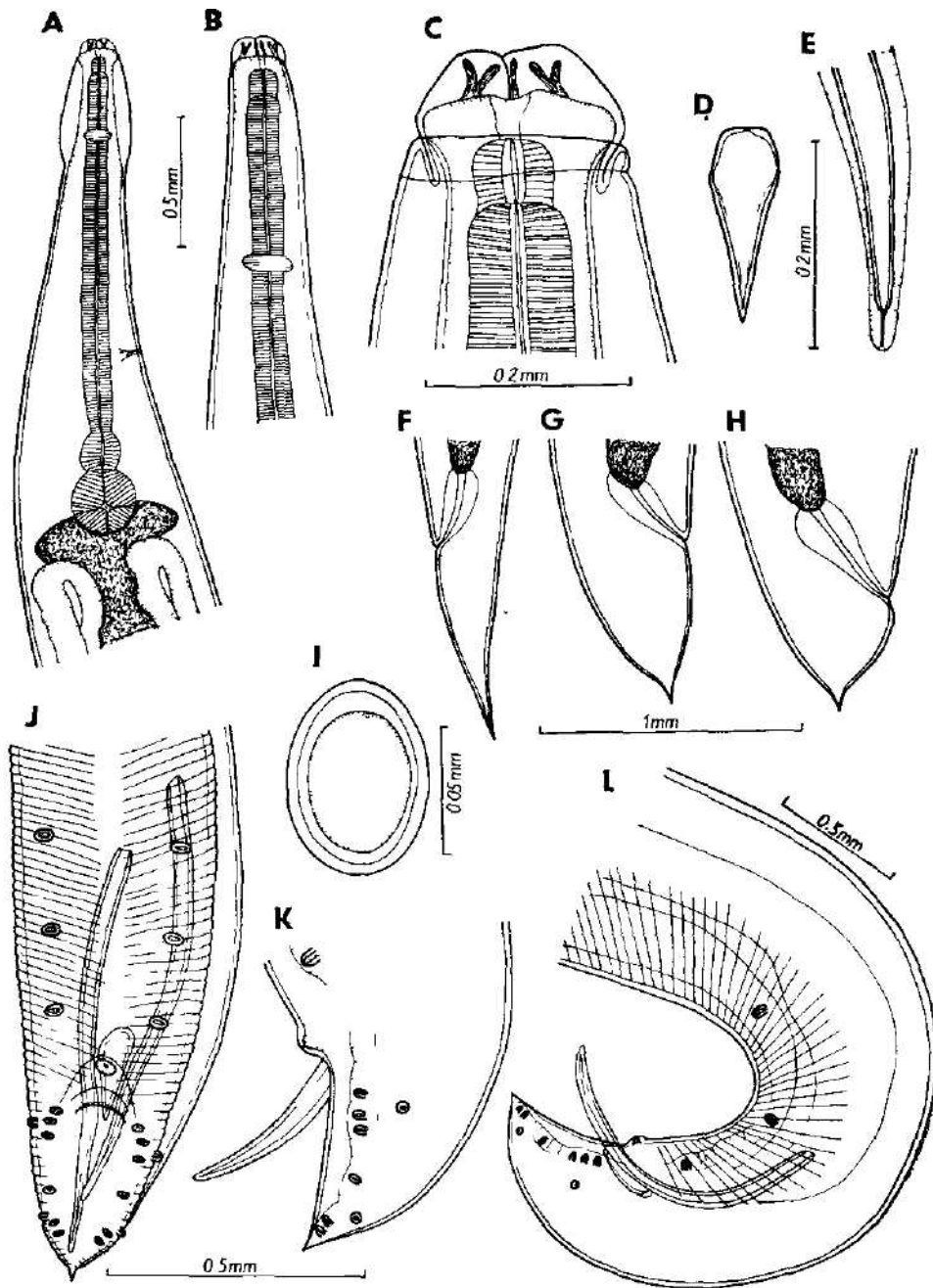


Fig. 1. *Spiroonoura babei* Ha Ky, 1971. A — anterior end of body of typical gravid female, lateral view; B — anterior end of body of female without cephalic inflation of cuticle, lateral view; C — head end of female; D — gubernaculum, lateral view; E — distal tip of spicule; F-H — tail of female; I — egg; J — posterior end of male, ventral view; K — tail of male; L — posterior end of male, lateral view.

into short pharynx, elongate corpus, slightly inflated isthmus and prominent bulb. Excretory pore some distance in front of isthmus.

Male (10 specimens): Length of body 9.18–17.95, maximum width 0.734–0.952. Length of lips 0.068, of cervical cuticular inflation 0.517–0.680, its thickness 0.054–0.095. Length of entire oesophagus 2.41–2.49; pharynx 0.082–0.095, corpus 1.84–1.99, isthmus 0.163–0.190 and bulb 0.326–0.340 long; width of isthmus and bulb 0.136–0.177 and 0.340–0.367, respectively. Nerve ring 0.394–0.517, excretory pore 1.12–1.90 and deirids 0.966–1.40 from anterior extremity. Posterior end of body ventrally bent. Muscular ventral sucker present at distance 2.41–6.28 from posterior end of body; ventral surface of body in region between sucker and cloacal opening provided with many oblique muscle bands. Eleven pairs of caudal papillae present of which 3 subventral pairs being preanal and 8 pairs (6 subventral and 2 lateral) postanal; first three and last two pairs of subventrals close together. In addition to paired papillae, big unpaired papilla present on anterior cloacal lip. Cuticle forming longitudinal folds reminding narrow caudal alae in region of subventral papillae. Length of spicules 1.02–1.33; gubernaculum wedge-shaped, well sclerotized, length 0.218–0.245. Tail conical, 0.299–0.816 long, with distinct sharp cuticular point at tip.

Female (10 specimens): Length of body of gravid females 14.35–19.65, maximum width 0.925–1.280. Length of lips 0.054–0.068, that of cervical cuticular inflation 0.612–0.707, its thickness 0.054–0.095. Length of entire oesophagus 2.57–2.58, length of pharynx 0.082–0.095, of corpus 1.95–2.04, of isthmus 0.177–0.258, of bulb 0.286–0.367; width of isthmus 0.122–0.204, that of bulb 0.229–0.408. Nerve ring 0.517–0.530, excretory pore 1.71–2.01 and deirids 1.40–1.46 from anterior extremity. Anterior end of intestine markedly expanded. Vulva in posterior half of body; vulvar lips small, sometimes somewhat elevated. Vagina directed anteriorly. Uterus amphidelphic, containing numerous eggs. Eggs oval, thin-walled, size 0.066–0.084 × 0.054–0.060, with uncleaved content. Tail conical, 0.503–0.884 long, ending in sharp cuticular point; tail of smaller females relatively more slender and longer than that in more advanced females.

Comments: — Our specimens are more or less in accordance with the original description of *S. babei* given by Ha Ky (1971), who described this species from the nematodes obtained in the same host species (*S. denticulatus*) from North Vietnam. In comparison with the original description, we found a greater number (8) of caudal papillae in the male (in all specimens examined); it is probable that the fourth subventral postanal pair (counting from the cloacal opening) was previously overlooked. For the first time we observed the presence of deirids in this species.

Ha Ky (1971) distinguished *S. babei* from all other species of the genus *Spironoura* on the basis of the presence of "lateral alae". As we found, in the fact these structures are not lateral alae, but the head inflation of the cuticle. This formation was present in almost all specimens examined, being absent from only two smaller-sized specimens (one male and one gravid female). By its morphology, *S. babei* is very similar to *S. barbi* (Baylis et Daubney, 1922), a species described from *Barbus* (= *Tor*) *tor* from India, differing from it, however, mainly by the presence of the head cuticular inflation. However, the significance of this feature as a specific criterion for *Spironoura* members will have to be verified. Nevertheless, for the time being, we consider *S. babei* to be a valid species.

In view of an inadequate description of the type species of the genus *Spironoura*, *S. gracile* Leidy, 1856. Chabaud (1978) and some other authors consider it reasonable

to use the generic name *Falcaustra* Lane, 1915. But we are inclined to the opinion of Skryabin et al. (1964) that *Falcaustra* is a junior synonym of *Spirooura*, 1856.

The larvae of *S. babei* have recently been ascertained as the facultative parasites of the fish digenean *Amurotrema dombrowskayae* in Vietnam (see Sey and Moravec 1986).

2. *Spirooura kaverii* Karve et Naik, 1951 (Fig. 2)

Host: *Lissochilus krempfi* (fam. Cyprinidae).

Localization: intestine.

Description: Medium-sized, whitish nematodes. Head end slightly wider than neck, bearing three lips; each lip with pair of bifurcated papillae characterized of genus. Cervical alae absent. Deirids simple, small, located between nerve ring and excretory pore. Oesophagus divided into short pharynx, elongate corpus, slightly inflated isthmus and prominent bulb. Excretory pore some distance in front of isthmus.

Male (8 specimens): Length of body 8.86–12.61, maximum width 0.503–0.680. Length of lips 0.041–0.068. Length of entire oesophagus 1.81–2.04, that of pharynx 0.082–0.095, of corpus 1.32–1.50, of isthmus 0.150–0.190, of bulb 0.231–0.272; width of isthmus and bulb 0.122–0.150 and 0.245–0.299, respectively. Nerve ring 0.326–0.476, excretory pore 1.27–1.37 and deirids 0.97–1.05 from anterior extremity. Posterior end of body ventrally bent. Muscular ventral sucker present 2.34–3.54 from posterior end; ventral surface of body in region between sucker and cloacal opening provided with numerous oblique muscle bands. Altogether 11 pairs of caudal papillae present of which 3 pairs of subventral papillae preanal and 8 pairs (6 subventral and 2 lateral) postanal; first three and last two pairs of subventral papillae close together. Besides paired papillae, one big unpaired papilla present on anterior cloacal lip. Spicules provided with broad alae; length of spicules 1.55–2.04. Gubernaculum wedge-shaped, fairly sclerotized, length 0.105–0.135. Tail conical, 0.530–0.666 long, with distinct cuticular point at tip.

Female (10 specimens): Length of body of gravid females 10.11–11.87, maximum width 0.653–0.694. Length of lips 0.054. Length of entire oesophagus 1.77–2.04; length of pharynx 0.082–0.095, of corpus 1.36–1.50, of isthmus 0.177–0.190, of bulb 0.258–0.286; width of isthmus and bulb 0.150–0.177 and 0.299–0.326, respectively. Nerve ring 0.408–0.435, excretory pore 1.36–1.43 and deirids 1.22–1.24 from anterior extremity. Anterior end of intestine conspicuously expanded. Vulva postequatorial, 4.08–5.03 from posterior end of body; vulvar lips small, sometimes somewhat elevated. Vagina directed anteriorly. Uterus amphidelphic, containing relatively small number of eggs. Eggs oval, thin-walled, size 0.066–0.078 × 0.048–0.060; content of eggs in uterus uncleaved or at stage of early cleavage. Tail conical, 0.571–0.680 long, ending in sharp cuticular point.

Comments: -- Nematodes of the present material correspond more or less to the description of *S. kaverii*, a species described from specimens from *Barbus* (= *Puntius*) *carnaticus* from India (Karve and Naik 1951). However, contrary to the original description, our specimens are noted for smaller measurements of the spicules (1.6–2.0 mm against 2.0–2.2 mm) and the gubernaculum (0.11–0.14 mm), this being probably associated with the smaller size of body of these Vietnamese nematodes; the shape of the distal tip of spicules is typical of the species *S. kaverii*. The finding of *S. kaverii* in *Lissochilus krempfi* represents a new host record. This species is reported from Vietnam for the first time.

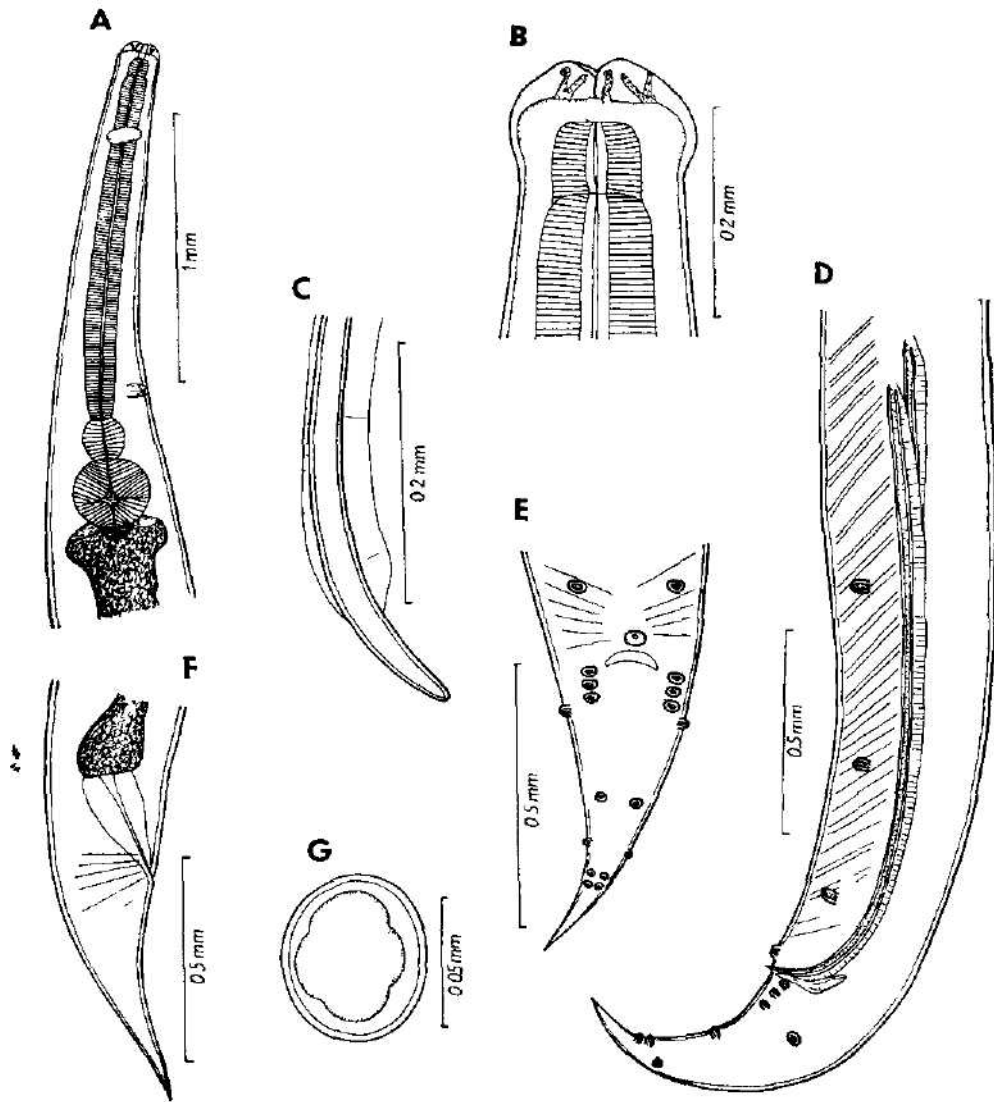


Fig 2 *Spirionoura kaverii* Karve et Naik 1951 A — anterior end of gravid female, B — head end, C — distal tip of spicule, D — posterior end of male body, E — tail of male, F — tail of female G — egg

Fam Quimperidae Baylis, 1930

3. *Pingus sinensis* Hsu, 1933 (Fig 3)

Hosts *Ophicephalus maculatus* (fam Chanidae), *Acanthorhodus fortunensis* (Cyprinidae), and "silurid fish" (misidentification — probably *Ophicephalus* sp.)

Localization intestine (*O. maculatus* and "silurid fish") and stomach (*O. maculatus* and *A. fortunensis*)

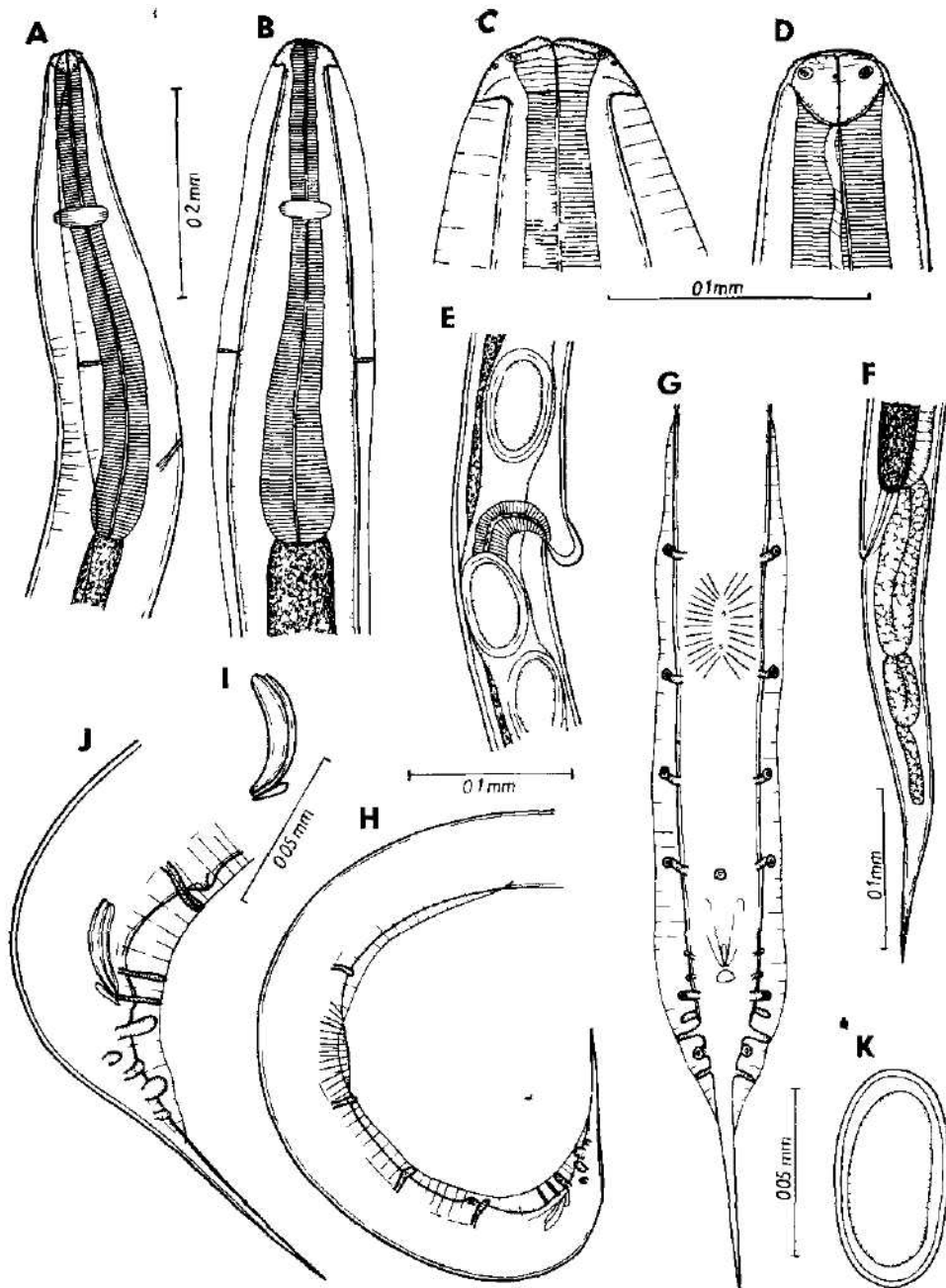


Fig 3 *Pungus sinensis* Hsu, 1933 A, B — anterior end of gravid female, lateral and dorsoventral views, C, D — head end, dorsoventral and lateral views, E — region of vulva, F — tail of gravid female, G, H — posterior end of male, ventral and lateral views, I — spicules and gubernaculum, J — tail of male

Description: Small nematodes with smooth cuticle. Body markedly expanded in oesophageal region. Head end rounded, mouth opening triangular; one pair of small lateral amphids and four submedian doubled mouth papillae with distinctly thickened cuticle present. Head end forming two large lateral lobes; from them, broad lateral alae extending posteriorly along body; alae broadest in oesophagus region. Deirids big, situated approximately in mid-distance between nerve ring and oesophagus end. Distinct buccal cavity absent. Oesophagus long, its posterior end slightly expanded; separation of pharynx indistinct; anterior part of oesophagus up to nerve ring muscular, its posterior part muscular-glandular. Excretory pore at level of posterior end of oesophagus or somewhat more anterior. Tail of both sexes slender, terminating in sharp cuticular point.

Male (6 specimens): Length of body 2.09–4.60, maximum width in oesophageal region 0.068–0.136, width of posterior half of body 0.041–0.068. Maximum width of lateral alae 0.018–0.024. Length of oesophagus 0.360–0.540, its maximum width 0.036–0.048; length of slightly outlined pharynx 0.006–0.009. Nerve ring 0.126–0.168, excretory pore 0.360–0.540, and deirids 0.237–0.324 from anterior extremity. Relatively long, well developed caudal alae extending to some mid-length of tail present. Five pairs of pedunculated preanal papillae present, first four of them being distinctly larger than last preanal pair. Ventral muscular sucker present in space between first and second pairs of preanal papillae; median, unpaired glandular papilla present at level of fourth pair. One pair of small adanal papillae present, these being similar to those of last preanal pair. Postanal papillae: 5 pairs present, first and fourth being subventral, remaining lateral. Two moderately sclerotized, ill-visible spicules (length 0.033–0.039) and gubernaculum (length 0.009–0.012) present. Tail conical, 0.090–0.114 long, its posterior half in shape of slender spike.

Female (8 specimens): Length of body of gravid females 3.48–4.76, maximum width in oesophageal region 0.109–0.122, width of posterior half of body 0.054–0.060. Maximum width of lateral alae 0.027. Length of oesophagus 0.345–0.495, its maximum width 0.045–0.051. Nerve ring 0.150–0.171, excretory pore 0.345–0.405, and deirids 0.285–0.320 from anterior extremity. Vulva situated in posterior half of body, 1.17–1.77 from posterior end; anterior vulvar lip conspicuously elevating in larger females, its length being 0.015–0.033. Vagina short, muscular, directed anteriorly. Uterus amphidelphic, uterine tubes containing small number of eggs arranged in single file. Eggs oval, thin-walled, size 0.060–0.081 × 0.033–0.048. Coils of posterior ovary reaching into tail. Tail slender, conical, length 0.141–0.300, ending in sharp cuticular point.

Comments: — The morphology of specimens of the present material is in a full accordance with the existing descriptions of *P. sinensis* (see Hsü 1933, Akhmerov 1962), but these nematodes are noted for generally smaller body measurements; also Ha Ky (1971) gives smaller measurements for the Vietnamese specimens of *P. sinensis*. These differences may be considered an intraspecific variability.

Originally *P. sinensis* was described by Hsü (1933) from *Ophicephalus argus* from China, later it was a few times recorded from the same host species from China and the Soviet Far East (Wu 1956, 1984, Dogiel and Akhmerov 1959, Akhmerov 1962, Belousov 1965, Chen 1973, Wang et al. 1978). From *O. maculatus* from North Vietnam this species has already been reported by Ha Ky (1971). *Acanthorhodeus fortunensis*, in which one male and one nongravid and one gravid females were found, represents a new host record for this parasite species; it may be considered that, in this case, *A. fortunensis* served as only a facultative host for *P. sinensis*.

4. *Paragendria* sp. (Fig. 4)

Host: *Hemibagrus elongatus* (fam. Bagridae).
Localization: intestine.

Description of nongravid female (1 specimen): *Whitaker, 1978*, *Paragendria* nematode; cuticle largely smooth, with slight transverse striation only in posterior part of body below vulva; length of striae 0.009–0.012. Length of body 9.09, maximum width at level of oesophagus end 0.190; oesophageal region of body not conspicuously broader than posterior part of body. Head end rounded, without lateral lobes, provided with four submedian doubled mouth papillae and pair of lateral amphids. Broad lateral alae, widest in oesophageal region, extending along almost whole body length. Deirids large, situated approximately at mid-distance between nerve ring and end of oesophagus. Small, funnel-shaped buccal cavity without teeth present. Oesophagus long, slender, its posterior end only slightly expanded; part of oesophagus anterior to nerve ring muscular, its posterior part muscular-glandular. Intestine narrow. Nerve ring 0.326, excretory pore 0.775, and deirids 0.598 from anterior extremity; excretory pore approximately at level of end of oesophagus. Vulva situated approximately at border of second and third thirds of body length, 3.29 from posterior extremity; vulvar lips nonelevated. Muscular vagina directed first anteriorly and then pointing backwards. Uterus amphidelphic, eggs not yet present. Coils of posterior ovary reaching into tail. Tail conical, 0.357 long, with minute knob-like process (length 0.003) at tip.

Comments: — Since only one female was found, its specific identification was not possible. According to Chabaud (1978), synonymous with *Paragendria* Baylis,

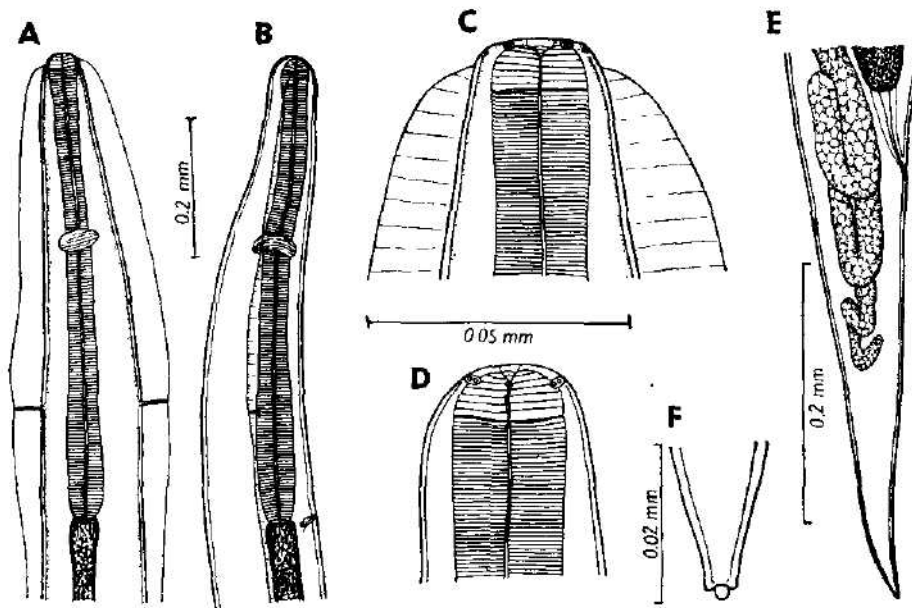


Fig. 4. *Paragendria* sp. — nongravid female. A, B — anterior end of body, dorsoventral and lateral views; C, D — head end, dorsoventral and lateral views; E — tail; F — tip of tail.

1939 are also the genera *Metaquimperia* Karve, 1941 and *Neometaquimperia* Agrawal, 1965. At present the genus *Paragendria* includes several species parasitic in siluriform fishes in India. Members of this genus have not hitherto been reported from Vietnam.

The morphology of the found nematode specimen resembles that of the females of the foregoing genus *Pingus*; however, it distinctly differs from them in the structure of the head end, shape of the vulva and the tip of tail, and also by the general shape and the size of the body.

Fam. Travnematidae Skrjabin, Shikhobalova et Lagodovskaya, 1963

5. *Hakynema vietnamensis* gen. et sp. n. (Fig. 5)

Host: *Spinibarbiichthys denticulatus* (fam. Cyprinidae).

Localization: intestine.

Locality: Red River near Hanoi, Vietnam (date of collection not exactly determined — in 1960 — 1975).

Deposition of specimen: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Helm. Coll. No. N-209 (holotype).

Description of female (1 specimen): Small, whitish fusiform nematode. Length of body 2.29, maximum width 0.340. Cuticle at both ends of body transversely annulated, annules indistinct on rest of body; cuticle of each annule with fine transverse striation. Head end provided with two longitudinal, elongate lateral inflations of cuticle reminding cervical alae, being clearly visible in apical view (see Fig. 5D). Mouth slightly depressed, surrounded by three small flat lips, each of them bearing minute terminal, triangular cuticular tooth. Four large circumoral papillae and one pair of lateral amphids present. Oesophagus composed of oval-shaped, strongly muscular corpus and small bulb; bulb poorly developed, transverse, distinctly narrower than corpus. Isthmus absent. Both corpus and bulb without sclerotized apparatus. Overall length of oesophagus 0.156. Length of corpus 0.135, width 0.087, length of bulb 0.036, width 0.066. Nerve ring encircling base of corpus, being 0.138 from anterior extremity. Intestine straight, relatively narrow. Rectum hyaline tube surrounded by several unicellular rectal glands. Tail conical, 0.183 long, with rounded tip. Excretory pore located well below end of oesophagus, i. e. 0.246 from anterior extremity. Vulva postequatorial, 0.95 from posterior end of body. Muscular vagina directed anteriorly, any lateral diverticule absent. Uterus didelphic, amphidelphic, containing two mature eggs. Anterior ovary reaching anteriorly to level of posterior end of bulb, posterior ovary reflected, not reaching rectum posteriorly. Proximal ends of ovaries strikingly inflated. Oviducts short narrow tubes. Eggs ovoid, thin-walled, size 0.159—0.162 × 0.111. Content of eggs uncleaved.

Genus *Hakynema* gen. n.

Diagnosis: Atractoidea. Mouth opening circular, overlapped by three weakly developed lips provided with terminal cuticular point. Four big submedian mouth papillae and pair of lateral amphids present. Buccal capsule absent. Oesophageal corpus highly developed, oval-shaped, without sclerotized apparatus; isthmus lacking; bulb poorly developed, without sclerotized valvular apparatus. Excretory pore postoesophageal.

Male unknown. Female: Small longitudinal lateral cuticular inflations resembling cervical alae present in region of oesophagus. Tail conical, vulva postequatorial. Eggs ovoid, with uncleaved content. Intestinal parasites of fishes.

Type- and the only species: *H. vietnamensis* sp. n.

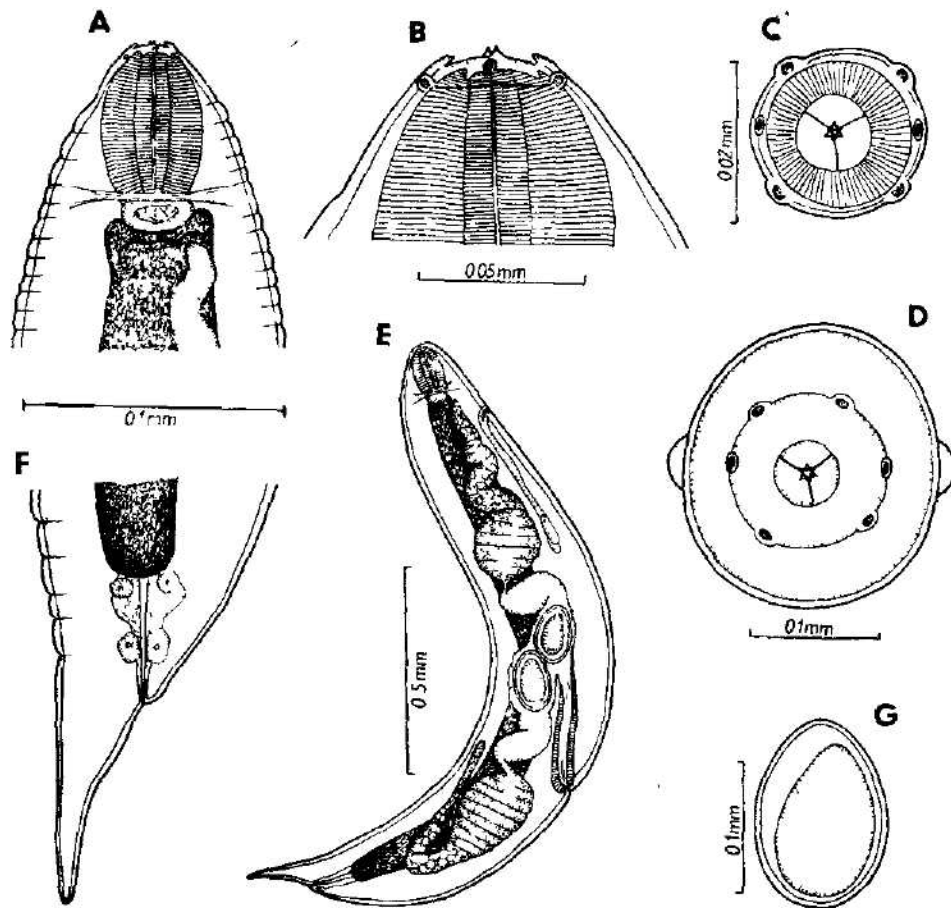


Fig. 5. *Hakynema vietnamensis* gen. et sp. n. — female. A — anterior end of body; B, C — head end, lateral and apical views; D — apical view of anterior end of body with distinct cervical inflations of cuticle; E — general view of body, F — tail.

Comments: — The general morphology of this nematode shows affinities with the superfamily Rhigonematoidea (Sanchez, 1947) Kloss, 1960, which includes the parasites of arthropods, especially with the genera *Dudekemia* Artigas, 1930 and *Ichthycephalus* Artigas, 1926 from diplopods. But the character of its oesophagus (absence of a sclerotized valvular apparatus in the corpus, shape of the corpus and the bulb) and other features make it possible to assign it to the superfamily Atractoidea Skrjabin et Shikhobalova, 1951, including the parasites of vertebrates.

In view of the fact that the males of *Hakynema* are not known so far, an assignment of this genus to a family is difficult and it cannot be excluded that in future it will be necessary to create a new independent family to accommodate this genus. From this reason we are listing *Hakynema* gen. n. tentatively in the hitherto monotypic family Travnematidae Skrjabin, Shikhobalova et Lagodovskaya, 1963, even though in some features (e. g. presence of mouth papillae, non-larvated eggs) it does not

correspond exactly to the diagnosis of this family given by Skryabin et al. (1964). The only other genus of this family, *Travnema* Pereira, 1938 (listed in the Pharyngodonidae, superfam. Oxyuroidea by Petter (1976)), with the only species *T. travnema* Pereira, 1938 from Brazilian fishes (see Vicente et al. 1985), strikingly differs from *Hakynema* gen. n. in the absence of mouth papillae, presence of the buccal capsule and the isthmus, mutual situation of ovaries and in the presence of larvated eggs. On the other hand, both the genera are characterized by some common features, e. g. the absence of a sclerotized valvular apparatus inside the oesophageal bulb, presence of cervical alae, postoesophageal situation of the excretory pore and markedly large eggs.

Fam. Heterakidae Railliet et Henry, 1912

6. *Heterakis japonica* (Wilkie, 1930) (Fig. 6)

Syn.: *Spinicauda japonica* Wilkie, 1930; *Africana howardi* Li, 1933.

Host: *Elopichthys bambusa* (fam. Cyprinidae).

Description: Medium-sized nematodes of light brown colour; cuticle thin, with fine longitudinal striation. Numerous minute somatic papillae present. Head end narrowed, bearing three lips. Very small, funnel-shaped buccal cavity with three oesophageal teeth present. Head end provided with four doubled, slightly elevated submedian mouth papillae (2 on dorsal lip and 1 on each of two subventral lips) and one pair of lateral amphids. Oesophagus narrow, with distinctly separated anterior pharynx and posterior, pear-shaped bulb. Excretory pore opening into spacious vesicle; nerve ring situated in front of excretory pore level. Anterior end of intestine expanded. Narrow lateral alae present, starting at level of nerve ring and ending at level of anterior margin of caudal alae in male and extending up to tail in female.

Male (1 specimen): Length of body 5.54, maximum width 0.299. Maximum width of lateral alae 0.027. Overall length of oesophagus 0.952; length of pharynx 0.057; length of corpus 0.707, width 0.048; size of bulb 0.180 × 0.159. Nerve ring and excretory pore 0.340 and 0.517, respectively, from anterior extremity. Two equal, well sclerotized spicules present, being 0.600 long and 0.036 wide at their mid-length; their anterior ends expanded, posterior ends pointed. So called gubernacular mass present, being some 0.8 long. Size of ventral preanal sucker 0.039 × 0.045; group of oblique muscle bands leading to this sucker. Tail conical, 0.315 long, ending in sharp point. Caudal alae well developed. Altogether 19 pairs of caudal papillae present: 3 pairs of large, massive papillae supporting caudal alae of which two anterior pairs being situated at level of ventral sucker and most posterior one at level of cloacal opening; 5 pairs of tiny ventral papillae forming two longitudinal rows in space anterior to cloacal opening; these rows continuing posteriorly by two pairs of larger ventral papillae of which first being adanal and second postanal; remaining postanal papillae being represented by 3 pairs of lateral, 2 pairs of sub-dorsal, and 1 pair of ventral papillae. Besides above mentioned papillae, additional 2 pairs of minute papillae situated on anterior cloacal lip and 1 pair of very small papillae on anterior, inner rim of ventral sucker. In addition to paired papillae, one small, odd ventral papilla present on posterior rim of ventral sucker.

Female (4 specimens): Length of body of gravid females 5.03–5.64, maximum width 0.286–0.313. Maximum width of lateral alae 0.027. Overall length of oesophagus 0.884–0.993; length of pharynx 0.051–0.060; length of corpus 0.571–0.734, width 0.048–0.057; size of bulb 0.204 × 0.218. Nerve ring and excretory pore 0.272–0.326

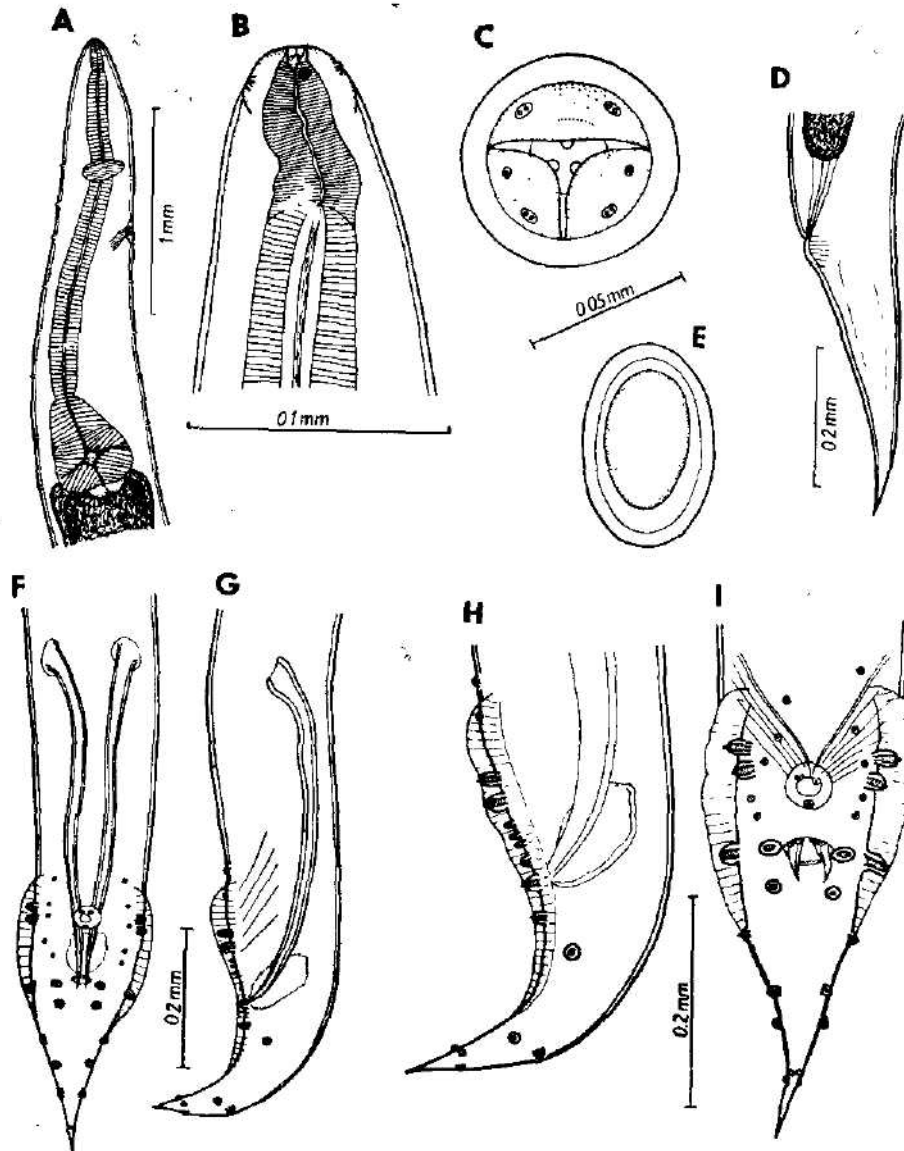


Fig. 6. *Meterakis japonica* (Wilkie, 1930). A — anterior end of gravid female; B, C — head end, lateral and apical views; D — tail of female; E — egg; F, G — posterior end of male, ventral and lateral views; H, I — tail of male, lateral and ventral views.

and 0.354–0.462, respectively, from anterior extremity. Vulva postequatorial, 1.93–2.18 from anterior end of body. Muscular vagina directed posteriorly. Uterus with numerous eggs filling mainly posterior space of body below level of vulva. Posterior ovary not reaching level of rectum. Eggs oval, thick-walled, size 0.069–0.075 × 0.042–0.045; thickness of wall 0.004–0.005; contents of eggs uncleaved. Tail conical, 0.381–0.476 long, ending in sharp cuticular point.

Comments: — These nematodes correspond, more or less, to the existing descriptions of the species *M. japonica* (see Skryabin et al. 1961); small differences are only in the numbers and the size of caudal papillae in the male. According to Koo (1939) and Inglis (1958), there is a considerable intra-specific variability in members of *Meterakis* as to the size, number and distribution of male caudal papillae; moreover, some tiny papillae are observable only with difficulties.

All members of the genus *Meterakis* are the parasites of amphibians and reptiles. The species *M. japonica* is known from various species of frogs (Ranidae and Bufonidae) from Japan, China and N. Borneo (see Baker 1984). The fish *Elopichthys bambusa* is apparently only a facultative host of these nematodes, it probably acquired the infection of *M. japonica* accidentally by swallowing up a frog, the original definitive host of this parasite. This species is reported from Vietnam for the first time.

Fam. Anisakidae (Railliet et Henry, 1912, subfam.)

7. *Hysterothylacium fluviatile* sp. n. — larvae (Fig. 7)

Hosts: *Pangasius pangasius* (fam. Pangasidae) (type host) and *Arius arius* (fam. Ariidae).

Localization: intestine.

Locality: Red River near Hanoi, Vietnam (date of collection not exactly determined — 1960—1975).

Deposition of specimens: Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Holm. Coll. No. N — 210 (holotype and two paratypes).

Description (3 specimens; measurements of holotype in brackets): Whitish nematodes with body tapering to both ends. Cuticle almost smooth, being slightly transversely striated on tail only. Length of body 8.23—10.20 (10.20), maximum width 0.258—0.340 (0.299). Mouth surrounded by three anlagen of lips 0.006 (0.006) long; larval tooth well developed, length 0.009 (0.009). Oesophagus twisted (not straight), its anterior end with distinct inflation. Length of oesophagus (except ventriculus) 0.789—0.831 (0.831), width 0.021—0.039 (0.030). Nerve ring 0.218—0.261 (0.261) and excretory pore 0.231—0.326 (0.326) from anterior extremity; latter well visible. Ventriculus almost round, being 0.060—0.066 (0.066) long and 0.048—0.081 (0.081) wide. Posterior ventricular appendix yellow-coloured, conspicuously long, exceeding mid-length of body; its length 4.76—5.69 (5.69), width 0.082—0.114 (0.095). Intestine wide, light in colour, with distinct cellular structure. Anterior intestinal caecum relatively wide, reaching nearly to excretory pore level; its length 0.360—0.510 (0.503), width 0.048—0.075 (0.075). Length ratio of intestinal caecum and ventricular appendix 1 : 10—13 (1 : 10). Rectum hyaline tube, 0.114—0.120 long. Tail conical, 0.096—0.138 (0.138) long, with tip broadly rounded.

Comments: — Altogether three larvae of this species were found in siluriform fishes, two in *P. pangasius* and one in *A. arius*. These larvae, noted for the markedly long ventricular appendix, have been assigned to the genus *Hysterothylacium* Ward et Magath, 1917 (syn. *Thynnascaris* Dollfus, 1933, in part) only tentatively, because the larval morphology of the related genera *Lappetascaris* Rasheed, 1965 and *Mehdiascaris* Kalyankar, 1969 is not known so far. Members of the two last named genera are the parasites of marine fishes, whereas those of the genus *Hysterothylacium* are parasitic as adults both in marine and freshwater fishes.

It is known that in anisakid nematodes the length ratio of the intestinal caecum and the ventricular appendix is much the same in conspecific larvae and adults. The revision of the relevant literature has shown that in almost all species of *Hystero-*

thylacium this ratio is much lower than 1 : 10, i. e. that the ventricular appendix is relatively much shorter than that in larvae of the present material. A conspicuously long (3.3–4.5 mm) ventricular appendix has only been reported for the larvae designated by Kagei et al. (1970) as *Contracaecum* (= *Hysterothylacium*, in part) Yamaguti-type – V from marine fishes in Japan; however, in them, the length ratio of the intestinal caecum and the ventricular appendix is 1 : 30–33, whereas that in our specimens it is 1 : 10–13; moreover, the Japanese larvae are characterized by the presence of a mucron on the tip of the tail and by a much shorter (0.1–0.25 mm) intestinal caecum. Regarding the striking morphological differences between the Vietnamese larvae and all other *Hysterothylacium* species, we consider it necessary to establish for the Vietnamese larvae a new species, *H. fluviatile* sp. n.

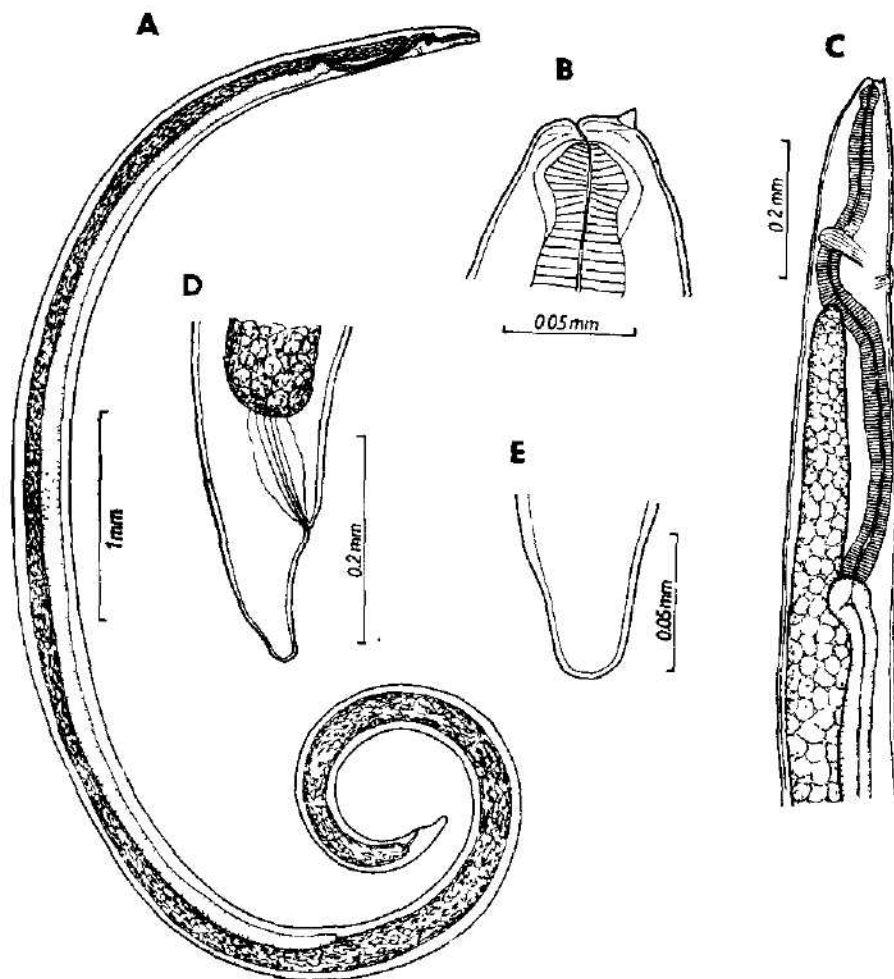


Fig 7. *Hysterothylacium fluviatile* sp. n. — larva. A — general view; B — head end; C — anterior end of body, D — tail, E — tip of tail

It has already been mentioned that the larvae of *H. fluviatile* sp. n. might belong as well to *Lappelascaaris* or *Mehdiascaaris*, adult forms of both these genera differ from *Hysterothylacium* members principally in the structure of lips; however, these are not yet sufficiently developed in larvae. Nevertheless, in the only member of *Lappelascaaris*, *L. lutjani* Rasheed, 1965, the length ratio of the intestinal caecum and the ventricular appendix is at most 1 : 2, while in *Mehdiascaaris* with the only species *M. bombayensis* Kalyankar, 1969 (syn. *M. suraiyae* Kalyankar, 1969) this ratio is 1 : 20–30; the same ratio in *H. fluviatile* sp. n. is 1 : 10–13. Both *L. lutjani* and *M. bombayensis* are the parasites of marine fishes, whereas *H. fluviatile* sp. n. is being described from freshwater fishes.

The establishment of *H. fluviatile* sp. n. as a new species on the basis of larvae is in a full accordance with the International Code of Zoological Nomenclature (Article 17, paragraph 4).

Etymology: The specific name "*fluviatile*" (= freshwater) reflects the fact that these nematodes occur in freshwater fishes.

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PARASITIC PROTOZOA OF THE GENUS SARCOCYSTIS (APHOMPLEXA,
SARCOCYSTIDAE) IN PHEASANTS, HENS AND SOME FREE-LIVING
BIRDS IN CZECHOSLOVAKIA

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Abstract. A total of 90 pheasants (*Phasianus colchicus*) were examined in two localities of South Bohemia region. Out of 63 pheasants examined in the pheasantry of Jindřichův Hradec 21 (33.3%) birds were positive for *Sarcocystis* muscle stages. Out of 27 pheasants examined in the pheasantry of Třeboň 25 (92.6%) birds were positive. The lancet-shaped cystozoites measured $14-16 \times 2-3 \mu\text{m}$. The sarcocysts were nearly 2 mm long, with $3.2 \mu\text{m}$ thick wall. The dogs were proved to be definitive hosts of this species. Meronts were found in capillaries of heart musculature of pheasants on day 8 p. i. and measured $7.1-7.8 \times 5.2-6 \mu\text{m}$. Cystozoites and sarcocysts of two species were found in 3 out of 30 examined hens (*Gallus gallus*). *Sarcocystis horwathi* Ratz, 1909 was revealed in two cases and *Sarcocystis* sp. Wenzel et al., 1982 in one case. Cystozoites of *Sarcocystis* sp. were found in two out of four jays (*Garrulus glandarius*) and were banana-shaped measuring $8-10.5 \times 2.5 \mu\text{m}$. The sarcocysts were very thin and smooth-walled, extremely long and their width was $36-39 \mu\text{m}$. *Sarcocystis* muscle stages were not observed in 7 examined gulls (*Larus ridibundus*) and one robin (*Erithacus rubecula*).

Sarcocystis belongs to the obligatory two-host parasitic Protozoa. The asexual stages of their developmental cycle which completes with formation of muscle cysts (sarcocysts), develops mostly in herbivorous intermediate host. The sexual stages, develops in the intestine of carnivorous final host.

Previously, the birds have been known to be the hosts of monoxenous species of the genus *Eimeria*, *Isospora* and *Caryospora* (Pellérdy 1974). The first summary work dealing with the findings of *Sarcocystis* species known until that time, was published by Kalyakin and Zasukhin (1975). The muscle stages of the genus *Sarcocystis* in birds are mentioned by them in 71 species of 28 families and 14 orders. Numerous authors, e. g. Munday et al. (1979) and Drouin and Mahrt (1979) have extended this specification to further hosts.

Drouin and Mahrt (1979) examined four pheasants (*Phasianus colchicus*) for *Sarcocystis*. However, they did not find any cyst-forming coccidia species. Also Hiepe et al. (1980) obtained no positive results during the examination of pheasants from the region of Berlin. First, well-documented finding of *Sarcocystis* from pheasant together with the attempt of identification of final host, is reported by Wenzel et al. (1982). *Sarcocystis* was detected in three out of 36 examined birds (8.3%). Dog was found as final host of *Sarcocystis* from pheasants. In Czechoslovakia, two types of *Sarcocystis* were described in musculature of pheasants from the pheasantry in Jindřichův Hradec (Černá and Pecka 1984, Černá 1984). The lancet-shaped type (type II) corresponded to the morphology of cystozoites and sarcocysts of *Sarcocystis* sp. which was described by Wenzel et al. (1982). The banana-shaped type (type I) with cystozoites of size $6 \times 2 \mu\text{m}$ was a new type of *Sarcocystis* found in pheasants.

Sarcocystis in hens was first described by Munday et al. (1977). The infection was found in 45% of examined birds. Asthenia developed during the infection and in some cases resulted in death. Dog passed oocysts of *Sarcocystis* type after the in-

fection with muscles which harboured sarcocysts. Golubkov (1978) recorded 0.95% infection of chickens in abattoir in the USSR.

Wenzel et al. (1982) studied *Sarcocystis* in hens more thoroughly. He found two different types of cystozoites and sarcocysts. The first one corresponded to the genus *S. horwathi* Ratz, 1909. The second one was determined as *Sarcocystis* sp. and was found only in breast musculature. Both dog and cat passed oocysts — sporocysts after feeding with infected muscles of hens.

Dylko reported *Sarcocystis* sp. in jay in 1962. He mentioned he had found only muscle cysts which measured $75-506 \times 10-101 \mu\text{m}$, without any further details concerning morphology.

The findings of *Sarcocystis* species obtained from above mentioned birds in Czechoslovakia are included in this work, together with some latest knowledge of morphology and life cycles of these parasites.

MATERIAL AND METHODS

A total of 132 birds were examined for the presence of muscle stages of *Sarcocystis* sp. Following material was obtained from various localities of South Bohemia in Czechoslovakia.

1. pheasants from the pheasantry in Jindřichův Hradec (63) and Třeboň (27)
2. hens obtained from amateur breeders (10) and from the State Veterinary Institute in České Budějovice (20)
3. jays from the region of Třeboň (4)
4. gulls (7) and one robin from the region of Klec

The infection was observed after muscle homogenization (Černá and Pecka 1984) on the one hand and after histological processing of muscles on the other hand. The sections were examined after staining with Harris or Heidenhain's hematoxylin. Three dogs were fed muscles obtained from naturally infected pheasants. One dog was killed on 10 day post infection (DPI). The intestinal tissue of the dog were processed histologically like the muscles of birds. Faeces of other dogs were examined by the flotation method and the material of oocysts — sporocysts were harvested by the method of Černá (1968). Seven pheasants were fed with this material of oocysts — sporocysts. Three pheasants remained as controls. The infected pheasants were killed on 8 DPI, 5 weeks and 3 months p. i. and were examined for the presence of developmental stages of *Sarcocystis*.

The muscle cysts were removed from the muscles by using dissecting needles. The sarcocysts were washed in saline and fixed in 4% buffered paraformaldehyde. Then they were washed in distilled water and critical-point dried in CO_2 , stucked on the discs, coated with gold and examined with a Tesla BS-300 scanning electron microscope.

RESULTS

The muscle stages of *Sarcocystis* species were revealed in 46 pheasants (*Phasianus colchicus*), 3 hens (*Gallus gallus*), and 2 jays (*Garrulus glandarius*). The sarcocysts were not observed in 7 gulls (*Larus ridibundus*) and 1 robin (*Erithacus rubecula*) (Table 1).

Sarcocystis in pheasants and its experimental transmission to dog

A total of 90 pheasants were examined. Out of 63 pheasants examined in the pheasantry of Jindřichův Hradec 21 (33.3%) were positive for *Sarcocystis* muscle stages. Out of 27 pheasants examined in the pheasantry of Třeboň 25 (92.6%) were positive. The lancet-shaped cystozoites measured $14-16 \times 2-3 \mu\text{m}$ (Table 1 Fig. 1), which both poles were narrower with the nucleus extracentrally located. The muscle cysts found in this type were nearly $2000 \times 80 \mu\text{m}$. The cyst wall was $3.2 \mu\text{m}$ thick and formed thin, finger-like protrusions (Pl. I., Fig. 3,5).*

* Plates I—IV will be found at the end of this issue

Table 1. Findings of *Sarcocystis* in bird species examined.

Host	Number of birds examined	Number of infected birds	
		Absolute number	Relative share
<i>Erithacus rubecula</i>	1	0	0.0
<i>Larus ridibundus</i>	7	0	0.0
<i>Gallus gallus</i>	30	3	10.0
<i>Garrulus glandarius</i>	4	2	+
<i>Phasianus colchicus</i>			
Jm. Hr. Hradec	63	21	33.3
Treboň	27	25	92.6

+ not presented owing to small number of birds examined

A dog was fed muscles obtained from infected pheasants. At 6 DPI the dog began to pass sporocysts measuring $13-15 \times 9-11 \mu\text{m}$ (Pl. II., Fig. 2). Oocysts were found in enterocytes in the whole length of the small intestine of a dog which was killed at 10 DPI (Pl. II., Figs. 3,4). The seven pheasants were experimentally infected with oocysts obtained from dogs. Meronts which were $7.1-7.8 \times 5.2-6.0 \mu\text{m}$ were found in capillaries in the heart musculature of pheasants at 8 DPI (Pl. II., Fig. 1). Sarcocysts, which were morphologically homologous with the cystic stages from naturally infected pheasants were observed in muscles of birds 5 weeks p. i. Dogs were re-fed this muscles and they passed oocysts from 6-8 DPI till 50 DPI.

Sarcocysts in hens and its transmission to a dog

Cystozoites and sarcocysts of two different species were found in 3 out of 30 examined hens. Cystozoites of typical banana shape, which measured $10-12 \times 3.5 \mu\text{m}$ with excentrically situated nucleus and well stainable zone of apical complex, were found in two birds (Pl. III., Fig. 1). The cyst wall of this type was formed with conspicuous, finger-like protrusions, which measured $3.4-3.6 \times 0.8 \mu\text{m}$ (Pl. IV., Fig. 1). This type conforms to the description of *Sarcocystis horvathi* Ratz, 1909.

In one hen cystozoites of lancet shape were revealed. They measured $12-14 \times 3 \mu\text{m}$ with excentrically situated nucleus (Pl. III., Fig. 2). The cyst wall was found with finger-like protrusions measuring $1.8-2.3 \times 0.8-0.9 \mu\text{m}$ (Pl. IV., Fig. 2). This type corresponds morphologically to *Sarcocystis* sp. described by Wenzel et al. (1982). The faeces of a dog which fed sarcocysts from hens remained negative for *Sarcocystis* - oocysts.

These both types of *Sarcocystis* from hens were found in breast and femoral muscles.

Sarcocystis in a jay

Both cystozoites on smears and sarcocysts were found in two out of four jays. The banana-shaped cystozoites measured $8-10.5 \times 2.5 \mu\text{m}$ (Pl. IV., Fig. 3). The excentrically situated nucleus measured $2.4-3.5 \times 2-3 \mu\text{m}$. The pink zone of apical complex was well-visible after the staining with Giemsa's stain. The wall of microscopical sarcocysts ($36-39 \mu\text{m}$ in width) was smooth and relatively thin. The sarcocysts were cylindrical and considerably long (Pl. IV., Fig. 3). The longest part of the sarcocyst was $770 \mu\text{m}$.

DISCUSSION AND CONCLUSION

Sarcocystis in pheasants becomes topical especially from the point of view of present breeding in pheasantries, where conditions for *Sarcocystis* from the only source of infection are favourable. Wenzel et al. (1982) found dog to be the definitive host of *Sarcocystis* sp., which fully corresponds to our type from pheasants (see also the type II, Černá and Pecka 1984). In addition to dog, also fox has its share on the life cycles of *Sarcocystis*; e. g. *Sarcocystis cruzi* in cattle, *S. tenella* in sheep, and *S. miesheriana* in pigs (Levine and Tadros 1980).

From the results obtained it appears that *Sarcocystis* infection in pheasants is common in Czechoslovakia. Drouin and Mahrt (1979) and Hiepe et al. (1980) reported only negative results. First records were mentioned by Wenzel et al. (1982). *Sarcocystis* was revealed in 8.3% of examined pheasants. Two types of *Sarcocystis* in the pheasantry of Jindřichův Hradec were described by Černá and Pecka (1984). During further examination we continued to find only the lancet type (type II), described by Wenzel as *Sarcocystis* sp., which was revealed in 33% of examined birds in the pheasantry of Jindřichův Hradec and even in 92.6% of examined birds in the pheasantry of Třeboň. From our examination results that the length of muscle cyst can be even 2 mm, while Wenzel mentioned 100–360 μm . As mentioned above, dog was proved to be definitive host of these species and we revealed his sexual development throughout the whole length of the dog's small intestine. The pheasants were experimentally infected with these oocysts. Meronts measuring $7.1-7.8 \times 5.2-6.0 \mu\text{m}$ were found in capillaries of heart musculature at 8 DPI. We did not succeed in finding out the stages of asexual development in other organs (liver, lung, brain). The muscle cysts, morphologically concurrent with the cysts obtained from the natural infection, were found in pheasants 5 weeks p. i.

By hens, our attention was directed especially at the examination of birds from amateur breedings, where the contact between intermediate host and definite host is more possible. Wenzel et al. (1982) described two types of *Sarcocystis* in hens, *S. horwathi* and *Sarcocystis* sp. Dog and cat are considered to be final hosts of *Sarcocystis* sp., sarcocysts of which they found only in the breast muscles. Our examinations revealed that both mentioned species of *Sarcocystis* occur by hens in Bohemia. Both types were found in breast and femoral muscles. We assume that in birds, similarly as in mammals, the occurrence of individual species of *Sarcocystis* cannot be strictly referred to various muscle parts.

Out of four jays (*Garrulus glandarius*) two were positive for *Sarcocystis* sp. This species belongs to such species harbouring in birds, which possess a very thin sarcocyst wall (1 μm). Sarcocysts are elongated, of microscopic size and contain cystozoites which are $8-10.5 \times 2.5 \mu\text{m}$. Goshawk (*Accipiter gentilis*) could be considered as the final host of these *Sarcocystis* — species because goshawks prey upon jays. Different oocysts — sporocysts of *Sarcocystis* were revealed in goshawk in high percentage of cases (Černá et al. 1978, 1982) and the life cycle involving bird — bird relation in *Sarcocystis* was described by Černá and Kvašňovská (1986).

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NOTES ON THE DISTRIBUTION OF REPTILES AND AMPHIBIANS IN EGYPT

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Abstract. Records of distribution for 36 species of Egyptian reptiles and amphibians are given based on collections made in the vicinities of Cairo, Asyut, Aswan, Abu Simbel, Hurghada and nearby islands, and in the Red Sea hills 50–60 km SW of Hurghada.

INTRODUCTION

Knowledge of the distribution of Egyptian herpetofauna still remains very incomplete. Only a few areas of Egypt, mainly lower Egypt, especially in the vicinity of Cairo, are well mapped with regard to the distribution of reptiles and amphibians. Basic publications dealing with the distribution of Egyptian herpetofauna are those by Anderson (1898) and Flower (1933). The distribution maps of individual species, based on collections obtained by the United States Naval Medical Research Unit No. 3, are available in Marx (1968). This paper also contains identification keys. Keys for squamats only are in Marx (1963). Additions to the distribution of the herpetofauna of eastern lower Egypt are given in Werner (1983). The latter also reviewed the literature dealing with the distribution of Egyptian herpetofauna. This paper presents our records of collections of Egyptian reptiles and amphibians, and comparisons with data of above mentioned authors are given. Occasional notes are added for several species.

MATERIALS AND METHODS

This paper is based on collections and observations made in Egypt by ReháK in July-August 1981 and August-September 1982 in the vicinities of Cairo, Asyut, Aswan, Abu Simbel, Hurghada and nearby islands of Giftun Saghir and Giftun Kebir; and by Osborn in May-June 1984 in the Red Sea Hills area of Gebel Shayib el Banat and the Qattar massive 50–60 km SW of Hurghada (between Lat. 26.55–27.05 N. and Long. 33.13–33.34 E.) and is referred to as the Shayib-Qattar area in the text.

The preserved specimens are in collections of the Department of Zoology, Charles University, Prague.

Several records of endangered and large species (e. g. marine turtles, *Crocodylus*, *Varanus*) are based on observations only or specimens killed by natives, and documented with photographs

Crocodylus niloticus Laurenti, 1768 Nile Crocodile

Specimens collected: 4 sp., north part of Nubian Lake (= Aswan reservoir), August 1981 1982, juveniles killed by fishermen.

At least 40 hatchlings and 3 subadults (up to two meters in length) collected by native fishermen in Nubian Lake were seen in August 1981 and August 1982. Crocodiles are killed for skins or other tourist souvenirs. Two subadults were observed near Aswan High Dam in 1981 and one in 1982.

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Historically, the Nile Crocodile is well documented from Egypt up to the Nile Delta. However, its populations were very reduced in Egypt and Nubia (cf. Flower 1933), and Wermuth and Fuchs (1978) even gave its recent distribution in the Nile southwards from Khartoum which is not correct, of course, because the Nile Crocodile is distributed in Sudan in the Nile as far north of Khartoum as Wadi Halfa (Flower 1933, Reháč — unpublished data). Our data indicate that after the building of the High Dam and origin of the Nubian Lake with large unsettled areas and little influence by human activity, breeding populations of Nile Crocodiles were established here, and the High Dam now seems to be its northern limit.

Dermochelys coriacea (Linnaeus, 1766) — Leatherback

Specimen observed: 1 dead sp. on sea shore 5 km N of Hurghada, August 1981.

According to Marx (1968) the only record of this species from Egypt is a specimen from the Alexandria market mentioned by Flower (1933). Flower examined the carapace in the 1920 year and he pointed out the unclear origin of it. However, the exposition of the Biological Station in Ahaia near Hurghada shows two preserved Red Sea specimens, which indicate that the range of the Leatherback includes the Egyptian Red Sea as it is supported by our record, too.

Eretmochelys imbricata (Linnaeus, 1766) — Hawksbill Turtle

Specimens observed: 1 sp., Giftun Saghir Island near Hurghada, August, 1981; 1 sp., Hurghada 5 km N of, August 1981.

Known from the area (Flower 1933, Marx 1968). Souvenirs made from this turtle are often on sale in Hurghada.

Chelonia mydas (Linnaeus, 1758) — Green Turtle

Specimen observed: 1 dead sp., Giftun Kebir Island near Hurghada, August 1981.

Known from the area (Flower 1933, Marx 1968). Souvenirs made from this turtle are often on sale in Hurghada.

Ptyodactylus hasselquisti (Donndorff, 1798) — Fan-footed Gecko

Specimens collected: 4 sp., Aswan, August 1981; Shayib-Qattar area — 1 sp., Bir Rushweid, 29. 5. 1984; 1 sp., Wadi Kohila, 31. 5. 1984; 1 dead sp., ridge between Wadi Abu Erin and Wadi Abu Teen, N. E. Gebel Shayib at 1,510 m. 13. 5. 1984.

Common in Aswan area. The nearest Nile Valley localities given by Marx (1968) are 600 km north. Flower (1933) mentioned the occurrence of the species in areas of Asyut, Qena and Aswan. Eastern Desert localities according to Marx (1968) are Bir Murra cca 200 km SE Aswan; Wadi Atalla, 150 km SW Hurghada; some localities near the Cairo-Suez Road; and Wadi Quiseb 270 km NNW Hurghada. Our Red Sea records help fill a gap between these localities.

Tarentola annularis (Geoffroy, 1823) — White-spotted Gecko

Specimen collected: 1 sp., Giza, September 1982.

Known from the area (Flower 1933, Marx 1968).

Agama agama spinosa Gray, 1931 — Gray's Agama

Specimens collected: Shayib-Qattar area — 1 sp., Wadi Showak, 1,300 m, 26. 5. 1984; 1 sp., Wadi Showak, 1,230 m, 26. 5. 1984; 1 sp., Wadi Ghoza, 29. 5. 1984; 1 sp., Wadi Qattar, 670 m, 5. 6. 1984; 1 sp., Wadi Naql Tayd, branch of Wadi Qattar, 700 m, 5. 6. 1984.

Known from the area. Marx (1968) gives the locality Gebel Qattar. Goodmann (1986) listed a sight record near Gebel Migif, 24.47 N, 34.42 E.

Agama sinaita Heyden, 1827 — Sinai Agama

Specimens collected: Shayib-Qattar area — 1 sp., Wadi Showak near junction with Wadi Anfei, 28. 5. 1984; 1 sp., Wadi Umm Muneib, 510 m, 1. 6. 1984; 2 sp., Wadi Umm Muneib junction with Wadi Qattar, 1. 6. 1984.

Known from the area. Marx (1968) gives the near southern locality, Wadi Abu Shih. Another older Eastern Desert records are mentioned by Flower (1933).

Uromastyx aegyptius (Forsk., 1775) — Egyptian Dabb-lizard

Specimens collected: 4 sp., Cairo, July 1981.

Known from the area (Flower 1933, Marx 1968, Werner 1983).

Acanthodactylus boskianus asper (Audouin, 1829) — Bosc's Lizard

Specimens collected: Shayib-Qattar area — 1 sp., Wadi Showak, 740 m, 23. 5. 1984; 1 sp., Wadi Showak near junction with Wadi Anfei, 28. 5. 1984; 1 sp., Wadi Greygar, 28. 5. 1984; 1 sp., Wadi Gozah, 28. 5. 1984; 1 sp., Wadi Umm Disi, 540 m, 31. 5. 1984; 1 sp., Wadi Umm Muneib junction with Wadi Qattar, 1. 6. 1984.

Our records between localities Fawakhir Mine 70 km S and Wadi el Nil cca 300 km NW of Hurghada given by Marx (1968) are evidence for a wider distribution of this lizard in the Red Sea area.

Eremias mucronata (Blanford, 1870) — Anseba Lizard

Specimen collected: 1 sp., Wadi Umm Muneib, 510 m, 1. 6. 1984.

Marx (1968) gives no records on distribution of this lizard from Egypt, but records it from Halaib, Sudan, 640 km SE of Hurghada. Our record lies inside the known area of distribution of the species range from Sinai south to Eritrea and Somalilands as it is presented by Marx (1968). However, Flower (1933) pointed out that old Sinai record of the species is doubtful. In this case our record represents great extension of known range of the species to the north, and it is evidence to consider the Anseba Lizard as a member of Egyptian herpetofauna.

Varanus griseus (Daudin, 1803) — Desert Monitor

Specimens collected: 4 sp., Giza, September 1981

Known from the area (Flower 1933, Marx 1968).

Varanus niloticus (Linnaeus, 1766) — Nile Monitor

Specimens observed: 1 sp., east bank of the Nubian Lake, September 1982.

Two Nile Monitors killed by fishermen were seen in Aswan in September 1982, both evidently of Nubian origin. Marx (1968) did not record this lizard from Egypt.

However, the species is known to occur in the Nubian Nile Valley, and even in the Egyptian Nile Valley as north as Giza (Flower 1933).

Chalcides ocellatus (Forskal, 1775) — Ocellated Skink

Specimens collected: 9 sp., Cairo and Giza, August, 1981.

Known from the area (Flower 1933, Marx 1968, Werner 1983).

Mabuia quinquetaeniata (Lichtenstein, 1823) — Bean Skink

Specimens collected: 1 sp., Abu Tig near Asyut, July 1981; 1 sp., Abu Simbel, Nubia, August 1981.

Very dense local populations were observed in vicinity of Abu Simbel. Known from both areas (Flower 1933, Marx 1968).

Scincus scincus (Linnaeus, 1758) — Sandfish

Specimens collected: 4 sp., Giza, September 1982.

Known from the area (Marx 1968, Werner 1983).

Chamaeleo chamaeleon (Linnaeus, 1758) — Common Chamaeleon

Specimens collected: 3 sp., Alexandria, August 1981.

Known from the area (Marx 1968).

Eryx colubrinus (Linnaeus, 1758) — Theban Sand-Boa

Specimens collected: 5 sp., Faiyum, September 1982.

In early September some females observed were highly gravid. Known from the area (Marx 1968).

Eryx jaculus (Linnaeus, 1758) — Javelin Sand-Boa

Specimens collected: 6 sp., Tahreer, August 1982.

Known from the area (Marx 1968). For data on behavior and breeding of the Egyptian Javelin Sand-Boas in captivity see Reháč (1984).

Coluber florulentus Geoffroy, 1827 — Flowered Snake

Specimen collected: 1 sp., Abu Rawash near Giza, July 1981.

Known from the locality (Marx 1968).

Coluber rogersi (Anderson, 1893) — Rogers's Snake

Specimen collected: 1 sp., Shayib-Qattar area — Wadi Showak, 710 m, 27. 5. 1984.

Our record is new for the area. Marx (1968) gave no records in the Red Sea area. The nearest locality is from Cairo-Suez road, about 380 km NW. Flower (1933) gave other records from the desert hills east of Cairo, and he mentioned old Anderson's record (1893) from Shaloof, near Suez.

Dasypeltis scabra (Linnaeus, 1758) — Egg-eating Snake

Specimen examined: 1 sp., collected by natives in Faiyum, September 1982.

Marx (1968) gave no record for this snake. Flower (1933) cited only old record given by Anderson (1898). It seems extremely rare in Egypt.

Lytorhynchus diadema (Duméril et Bibron, 1854) — Diademed Sand-Snake

Specimen collected: 1 sp., Giza, August 1982.

Known from the area (Flower 1933, Marx 1968).

Malpolon moilensis (Reuss, 1834) — Moila Snake

Specimen collected: 1 sp., Giza, July 1981.

Known from the area (Marx 1968).

Psammophis shokari (Forsk., 1775) — Afro-Asian Sand Snake

Specimen collected: 1 sp., Giza, July 1981.

Known from the area (Flower 1933, Marx 1968, Werner 1983).

Psammophis aegyptius Marx, 1958 — Saharan Sand-Snake

Specimens collected: Shayib-Qattar area — 1 sp., Wadi Showak, 710 m, 27. 5. 1984; 1 sp., Wadi Gozah, 810 m, 28. 5. 1984; 1 sp., Wadi Qattar, 590 m, 1. 6. 1984.

Specimen from W. Gozah was collected from a Yassar tree (*Moringa peregrina*), and a young bird was removed from its stomach. The specimen from W. Qattar was from an acacia tree. Marx (1968) recorded single specimen from Red Sea area, Wadi Abu Shih 60 km south of our localities. Our records indicate wider distribution of the Saharan Sand-Snake in Red Sea Hills.

Psammophis sibilans (Linnaeus, 1758) — African Beauty Snake

Specimens collected: 2 sp., Giza, September 1982.

Known from the area (Flower 1933, Marx 1968, Werner 1983).

Spalerosophis diadema cliffordi (Schlegel, 1837) — Clifford's Royal Snake

Specimens collected: 5 sp., Giza and Cairo, August-September 1982.

Known from the area (Flower 1933, Marx 1968).

Telescopus dhara obtusus (Reuss, 1834) — Egyptian Cat-Snake

Specimen collected: 1 sp., Giza, July 1981.

Known from the area (Flower 1933, Marx 1968, Werner 1983).

□ *Naja haje* (Linnaeus, 1758) — Egyptian Cobra

Specimens collected: 2 sp., Faiyum, August 1981.

Known from the area (Flower 1933, Marx 1968).

Walterinnesia aegyptia Lataste, 1887 — Innes's Snake

Specimen examined: 1 sp. from vicinity of Suez collected by natives, September 1982.

Known from the area (Flower 1933, Marx 1968). It seems extremely rare.

Cerastes cerastes (Linnaeus, 1758) — Horned Viper

Specimens collected: 1 sp., Abu Simbel, Nubia, August 1981; 1 sp., Cairo, August 1981.

The species is recorded from Cairo and east of Cairo (Flower 1933, Marx 1968, Werner 1983). From the Nile Valley in Nubia two specimens from west bank of Nile are recorded cca 180 km NE from Abu Simbel. In Sudan records are for Sudan Nubia (Corkill 1935), which indicates a wider distribution of the species in Nubia. A very dense population was observed in vicinity of Abu Simbel in August 1981.

Cerastes vipera (Linnaeus, 1758) — Lesser Cerastes Viper

Specimens collected: 1 sp., Giza, August 1981.

Known from the area (Flower 1933, Marx 1968).

Echis coloratus Günther, 1878 — Burton's Carpet-Viper

Specimens collected: Shayib-Qattar area — 1 sp., Wadi Umm Muneib, 510 m, 1. 6. 1984; 1 sp., Wadi Kohila, 770 m, 30. 5. 1984; 1 sp., Wadi Abu Erin near junction with Wadi Umm Anib, 590 m, 15. 6. 1984.

Marx (1968) records a specimen from a nearby locality, Wadi Fatiri and another one cca 260 km SE (Sukkari mine), which indicate wider distribution of the species in the Red Sea Hills area.

Ptychadena mascareniensis (Duméril et Bibron, 1841) — Mascarene Frog

Specimens collected: 1 sp., Asyut, July 1981.

Marx (1968) gives no record from Upper Egypt, his nearest records are from vicinity of Giza cca 300 km N from Asyut. Flower (1933) gives the nearest records from the areas of Qena and of Edfu in Upper Egypt.

Bufo regularis Rauss, 1834 — Egyptian Square-marked Toad

Specimen collected: 1 sp., Abu Simbel, Nubia, August 1981.

Marx (1968) gives no Nubian record. The southernmost record given by him is from Luxor cca 390 km N from Abu Simbel. Flower (1933) mentioned the wide distribution of the species in Upper Egypt and Nubia along the Nile Valley from Beni Suef to Aswan and Wadi Halfa.

SUMMARY

Records on distribution of 34 species of Reptiles and of 2 species of Amphibians are given on recent distribution of Egyptian herpetofauna. If compared with faunistic records given by Marx (1968) and Werner (1983) the total of 24 species is recorded from areas given also by these authors. For 12 species records from other areas are given, especially for the Red Sea area, Upper Egypt and Nubia. The

records include data on the species very rarely referred in the literature from the Egypt, e. g. *Dermochelys coriacea*, *Eremias mucronata*, *Dasypeltis scabra*, *Walterinnesia aegyptia*; on the endangered forms, e. g. *Crocodylus niloticus*, *Chelonia mydas*, *Eretmochelys imbricata*, *Varanus griseus*, *Varanus niloticus*, *Uromastyx aegyptius*, *Eryx colubrinus*, *Eryx jaculus*; and the data giving the evidence of the wider distribution of several species if compared with literature data, e. g. *Coluber rogersi*, *Psammodphis aegyptius*, *Echis coloratus*.

Data on the distribution of Egyptian herpetofauna are relatively richer in Lower Egypt, and very scanty for Upper Egypt and Nubia. In the latter of interest is the situation in Nubian lake area, where for instance after construction of the High Dam large unsettled areas occur, and a situation-remains convenient for existence of such great forms as Nile Crocodiles.

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**DISTRIBUTIONAL PATTERNS, HOST SPECIFICITY AND DENSITY OF AN EPOICTIC
MIDGE, EPOICOCLADIUS FLAVENS (DIPTERA, CHIRONOMIDAE)
IN CZECHOSLOVAKIA**

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Abstract. Larvae of *Epoicocladus flavens* (Malloch) were found at 268 localities evenly spread in all faunistic districts in Czechoslovakia. Larvae occur currently on larvae of *Ephemera danica* (59.3 % of known host localities) and *E. vulgata* (49.2 %) preferring brooks and small rivers at altitudes of 250–500 m to lakes, ponds and large lowland rivers and biotopes of higher altitudes. *E. flavens* is recorded from *E. lineata* for the first time from a single South Bohemian locality. Chironomid's densities were studied in 5 selected Bohemian localities. Infestation rates on individual mayfly species depends on their density and quantitative presentation; occurrence on larvae of *E. lineata* is probably incidental. There are no substantial seasonal density changes although older larvae of mayflies are infested more frequently (up to 98.2 % specimens infested), especially during winter months.

INTRODUCTION

With the exception of incidental associations between chironomids and mayflies, e.g. findings of *Rheotanytarsus* sp. on *Stenonema smithae* in South Carolina (White et al., 1980), and recently described *Nanocladus* (*Plecopteracoluthus*) *bubrachiatus* on *Traverella* sp. from Honduras (Epler, 1986) larvae of the genus *Epoicocladus* living on mayflies. *E. flavens* is widespread, frequently collected from larvae of the genus *Ephemeroptera* in a large number of European countries (see Fittkau and Reiss in Illies, 1978 and others). Although our knowledge on its development, life cycle and infestation rate is relatively extensive, its distribution and densities within individual areas remain unknown since detailed studies have been conducted only in Sweden (Svensson, 1976, 1978, 1980) and England (Tokeshi, 1986).

E. flavens is considered to be abundant in Czechoslovakia (cf. Landa, 1969; Lellák, 1970, 1980). However, except for some brief mentions, e.g. that by Šulc and Zavřel (1924) on its occurrence on *Ephemera vulgata* in Eastern Bohemia, there are no data concerning its distribution within the country. The present paper is intended to summarize distributional data and to study host-specificity and infestation rates in some selected localities.

MATERIAL AND METHODS

Material of host larvae (4 species of the genus *Ephemera*) was collected during an extensive faunistic research of mayflies carried out in 1950–1965 and 1970–1985. More than 2000 localities evenly spread on the whole Czechoslovakia's territory comprising all types of aquatic biotopes at all altitudinal zones (for details see Landa and Soldán, 1988) were studied.

Only localities with a positive occurrence of larvae of *Epoicocladus flavens* among the material of *Ephemera* larvae are listed below. The data concerning the localities are listed in the following sequence: (i) number of locality, (ii) name (in Czech) of respective aquatic biotope, (iii) name of adjacent town or village, (iv) altitude of locality, (v) coordinates of the uniform entomofaunistic

grid system and (vi) host species of *Ephemera*. Localities are arranged in order of faunistic districts as defined by Landa and Soldán (1985) which mostly correspond to natural main river watersheds. Localities of hosts occurrence (more than 500 localities) are not listed here, for their list see Landa and Soldán (1988); their distribution is presented on the maps showing positive occurrence in the uniform grid system (Figs 1–3). All the material collected is deposited in the collection of Institute of Entomology, Czechoslovak Academy of Sciences, České Budějovice.

The larvae of *E. flavens* frequently leave their hosts during fixation and at least a part of them is usually lost when the material is sorted. Moreover, the larvae of *Ephemera danica* and *E. vulgata* occurring at the same locality were mostly fixed together. Consequently, it is impossible to evaluate their densities on individual hosts in most of samples. In order to study host-specificity and infestation rate five localities were selected (see localities Nos 36, 63, 66, 118, 132). At these localities larvae of *Ephemera* were collected in all seasonal aspects, 4–6 times a year (every sample collected for 1–2 hrs) and fixed and observed individually. Since the numbers of chironomid larvae per host were studied by Svensson (1976) in detail, the level of infestation was simply expressed as a number (percentage) of infested younger and older larvae and average number of chironomids per larva of respective species (infestation quotient by Svensson 1976). "Younger larvae" larvae of *Ephemera* spp. represent those during the first year of their developmental cycle (half-grown), "older larvae" are larvae ready to emerge during the same year. Larvae smaller than 10–12 mm were usually not infested; they were not sampled and analysed.

RESULTS

Distribution of host species

Larvae of *Epoicocladius flavens* were found on three of four species of the genus *Ephemera* living in Czechoslovakia. The most distributed species is *E. danica* (Müll.). *E. danica* is widely distributed European species occurring all over the Europe and representing an arboreal faunistic elements of Mediterranean origin. Throughout Czechoslovakia, its area is quite continuous in both Hercynian and Carpathian systems (Fig. 1). It is a very common species (grade 6 according to Friederichs, 1941) of mass occurrence at most localities. It was found altogether at 401 localities in all faunistic districts. It is distributed mostly at altitudes of 250–500 m but its large ecological range helps to colonize even biotopes above 750–1000 m. Larvae prefers small and mid-sized streams and small rivers often occurring also in very small and shallow brooks and ponds outflows. Larger rivers and ponds or lakes are colonized only occasionally.

Ephemera vulgata L. represents a faunistic element of large distributional area, widespread throughout the whole Westpalearctic region. Its area in Czechoslovakia is quite continuous but it has not been collected yet only in the faunistic district XV. It is a species of moderate occurrence (grades 3–4 according to Friederichs, 1941) so far found at 71 localities (Fig. 2). Larvae prefer especially brooks and smaller rivers at altitudes to 300–500 m very frequently colonizing oligotrophic ponds and lakes as well as large lowland rivers. It occurs also in mountain lakes at higher altitudes.

Ephemera lineata (Eaton) is a Palearctic species and an arboreal faunistic element with probably polycentric area of Mediterranean origin. Its area in Czechoslovakia seems to be disjunct (Fig. 3), restricted to the faunistic district II–VII, IX, XI–XIII, XV and XVII. It was found at 27 localities, occurrence in the district III is probably historical; a species of scarce occurrence (grade 2 according to Friederichs), larvae found solely in large or medium sized rivers and canals with swift current. Fourth Czechoslovakia's species, *Ephemera glaucops* Pictets represents only a potential host for larvae of *E. flavens*. It is a very rare (grade 1 according to Friederichs, 1941) South-central European species and Mediterranean faunistic element, so far known from the faunistic districts XIV and XVII (altogether 6 localities).

Larvae were found solely in large lowland rivers in Czechoslovakia although they live in oligotrophic lakes as well (German Democratic Republic).

As to area changes during the past 20—30 year, only the areas of *E. lineata* and *E. glaucops* were apparently restricted probably because of cumulative pollution of larger lowland rivers. On the contrary, the area of *E. danica* slightly expanded because of the relatively higher vagility of this species. The area of *E. vulgata* did not substantially changed (for details see Landa and Soldán, 1985).

Distribution of *Epoicocladius flavens*

Larvae of *E. flavens* were found at the following localities on the following species ("v" — *E. vulgata*; "dv" — *E. danica* and *E. vulgata*; „dl" — *E. danica* and *E. lineata*; if not stated, the finding refers to *E. danica* as a host species):

I (the upper Elbe basin): 1. Loučná, Týnsko, 200 m a. s. l., coordinates of the uniform grid system 5962; 2. Cidlina, Pamětník, 210, 5858 (v); 3. brook, Nehvizdy, 210, 5854 (v); 4. brook, Nouzov, 215, 5757; 5. Bohumilečský brook, Bukovina, 230, 5861; 6. Doubrava, Žleby, 240, 6159 (v); 7. Podolský brook, Barchov, 245, 5960; 8. brook, Mlékovice, 250, 5956; 9. Brodec, Zdelov, 260, 5862; 10. Loučná, Vysoké Mýto, 287, 6062; 11. Vavřinec, Hřezely, 308, 6056; 12. Struha, Licoměřice, 319, 6059; 13. brook, Lukavice, 320, 6161; 14. brook, Lhota, 325, 5562; Šembera, Doubravčice, 330, 5955; 16. Dlouhá, Solnice, 330, 5473; 17. Černíkovský pond, Černukovice, 341, 5863; 18. Lokotský brook, Solnice, 341, 5763; 19. Novohradka, Doly, 350, 6162; 20. brook, Hranice, 386, 6260; 21. Olešenka, Peklo, 390, 5663; 22. brook, Skuhrov, 395, 5763; 23. Končinský brook, Pazucha, 401, 6164; 24. Chrudimka, Mezišvátí, 410, 6160; 25. Tichá Orlice, Jablonné, 430, 5965; 26. brook, Seč, 443, 6159; 27. Stěňava, Hynčice, 450, 5363; 28. reservoir Seč, Seč, 495, 6159, (v); 29. Tichá Orlice, Lichkov, 527, 5960.

II (the lower Elbe basin): 30. Pšovka, Lhota, 185, 5653; 31. Liběchovka, Tupadly, 190, 5552; 32. Opárenský brook, Opárno, 200, 5450; 33. Liběchovka, Liběchov, 211, 5552; 34. Valtěcký brook, Valtěnice, 230, 5352; 35. Žehrovska, Žabikovy, 231, 5456; 36. Pšovka, Kokořín, 250, 5553, (dv); 37. Mlýnský brook, Jestřebí, 255, 5453; 38. Bobří brook, Borek, 265, 5353, (v); 39. Rásnice, Rásnice, 280, 5057; 40. Ploučnicko, Mimoň, 285, 5354; 41. Bobří brook, Kravaře, 285, 5352; 42. Mohelka, Třtí, 305, 5356; 43. Desná, Tanvald, 310, 5257 (v); 44. Svitavka, Drnovce,

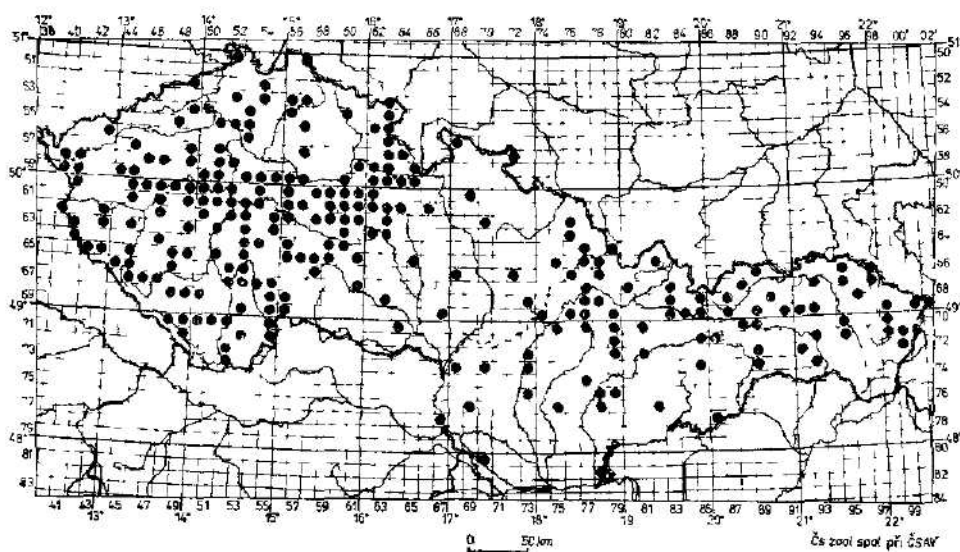


Fig. 1. Dot mapping of the area of *Ephemera danica* in Czechoslovakia; 401 localities grouped according to the uniform grid system.

340, 5254; 45. Lesní brook, Šluknov, 375, 5052; 46. Lužní brook, Bukovice, 410, 5449; 47. Ždírnický brook, Žandov, 530, 5249.

III (the Ohře basin): 48. Hrádecký brook, Raná, 255, 5548; 49. Blšanka, Vroutek, 302, 5846; 50. Lužní brook, Děvín, 430, 5840; 51. Liboc, Mětalov, 500, 5745; 52. Libava, Arnoltov, 531, 5841; 53. Šitbořský brook, Žandov, 545, 5941.

IV (the Berounka basin): 54. Červený brook, Velvary, 190, 5751; 55. Unětický brook, Roztoky, 200, 5853; 56. Rokytky, Počernice, 210, 5953; 57. Švarcava, Černošice, 235, 6051; 58. Kačák, Sv. Jan, 240, 6050; 59. Kačák, Hostim, 245, 6050; 60. Loděnice, Loděnice, 250, 6050; 61. Habrový brook, N. Hut, 250, 6049; 62. brook Davle-Libřice, 250, 6152; 63. Zahoránský brook, Davle-Libřice, 250, 6152; 64. Zlatý brook, Davle-Libřice, 260, 6052; 65. Radotínský brook, Rutický mlýn, 280, 6051; 66. Radotínský brook, Cikanka, 285, 6051, (dv); 67. Zlomeký brook, Žerotín, 285, 5749; 68. brook, Kosoř, 285, 6052; 69. Zbuzský brook, Skryje, 285, 6048; 70. Zlatý brook, Březová, 285, 6052; 71. Zahoránský brook, Zahorany, 300, 6052; 72. Kralovický brook, Hradiště, 300, 6047; 73. Loděnice, Nenačovice, 305, 5950; 74. Radotínský brook, Chotěč, 305, 6051; 75. Chumava, Libomyšl, 305, 6150, (v); 76. Střela, Plasy, 310, 6046; 77. Švarcava, Solepyský, 325, 6051; 78. Chlumčanský brook, Dobruška, 335, 6345; 79. brook, Žerotín, 340, 5740; 80. Karlický brook, Roblín, 345, 6051; 81. Rokytky, Říčany, 350, 5954; 82. brook, Kyšice, 350, 5950; 83. canals, Roblín, 350, 6051; 84. Klíčava, Lány, 355, 5849; 85. brook, Červené Poříčí, 365, 6545; 86. Otročínský brook, Mlýkov, 370, 6243; 87. Lánský brook, Lány, 385, 5849; 88. Bělá, Trnava, 385, 6145; 89. canal, Ruda, 385, 5849; 90. Habrový brook, Nový Jáchymov, 388, 6049; 91. Úpořský brook, Broumy, 390, 6049; 92. Holoubkovský brook, Borek, 390, 6247; 93. brook, Nemanice, 390, 6441; 94. Strupinský brook, Hředle, 400, 6149; 95. Rokytky, Mukařov, 400, 6054; 96. brook, Karlova Ves, 400, 6049; 97. Úhlava, Janovice, 405, 6645, (dv); 98. Padrtský brook, Hrádek, 405, 6247; 99. Poleňka, Slatina, 410, 6545; 100. Zbuzský brook, Zbuz, 410, 6148; 101. Jelenka, Janovice, 420, 6645; 102. Strupinský brook, Žebrak, 420, 6149; 103. canals, Janovice, 425, 6645; 104. Trhanovský brook, Klenčí, 450, 6543, (v); 105. brook, Trhanov, 455, 6542; 106. Šipský brook, Křekovice, 490, 5957; 107. Zubřina, Havlovice, 495, 6543; 108. brook, Ondřejovice, 495, 6645; 109. Kateřinský stream, Kateřina, 514, 6351; 110. canal, Trstěnice, 540, 6042, (v); 111. Senný brook, Drmoul, 582, 6041, (dv); 112. brook, Háje, 75

V (the Vltava basin): 113. Bojovský brook, Měchenice, 210, 6052; 114. Sladovařský brook, Ždáň, 295, 6252; 115. Kocába, Knín, 305, 6251; 116. brook, S. Hut, 345, 6251; 117. Brzina, Dražkov, 350, 6351; 118. Židova strouha, Nuzice, 370, 6752 (dv); 119. Voznický brook, Voznice, 375, 6151; 120. Smutná, Bechyně, 380, 6752, (dv); 121. Plzinský brook, Bechyně, 385, 6652.

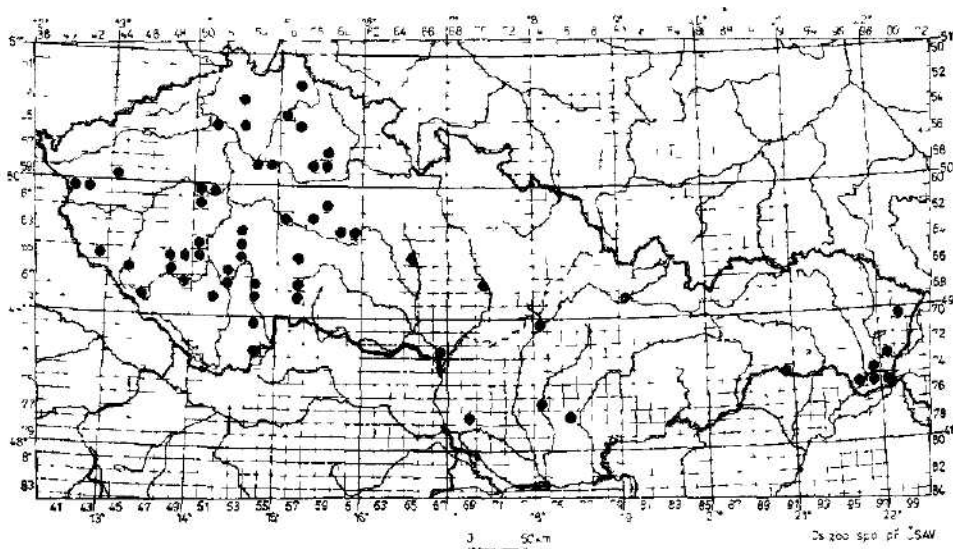


Fig. 2. Dot mapping of the area of *Ephemera vulgata* in Czechoslovakia; 71 localities grouped according to the uniform grid system.

(dv); 122. Bílinský brook, Dražič, 390, 6752; 123. Smutná, Srlín, 394, 6652, (v); 124. Chválovický brook, Bojanovice, 395, 6152; 125. Svinenský brook, Pašínovice, 400, 7153; 126. Malše, Plav, 400, 7052; 127. Liptánský brook, Dobříš, 400, 6150; 128. Sedlecký brook, Sedlec-Prácheň, 405, 6453, (v); 129. Borovanský brook, Dražič, 405, 2652; 130. Kyselý brook, Úsilné, 411, 6953; 131. Bechyňský brook, Záhuží, 416, 6753; 132. Nová řeka, Mláka, 430, 6955, (dl); 133. Hrejkovický brook, Květov, 430, 6551; 134. Košínský brook, Košín, 430, 6553; 135. Zlatá Stoka, Třeboň, 435, 7054, (v); 136. canal, Ženich, 435, 6955; 137. Trnovský brook, Dobříš, 450, 6250; 138. Kosínský brook, Nasavrky, 450, 6543; 139. brook, Rzává, 450, 6553; 140. Tuňš, Suehdol, 455, 7055; 141. Dírenský brook, Dírná, 460, 6754, (dv); 142. Radouňský brook, Radouňka, 475, 6855; 143. brook, Jindřichův Hradec, 480, 6855; 144. brook, Zátoň, 495, 7352; 145. Lhotecký brook, Křemže, 500, 7051; 146. Ženský brook, Studnice, 500, 6755; 147. canal, Studnice, 510, 6755; 148. Koštěmcký brook, Čiměř, 520, 6956; 149. brook, Borotín, 520, 6453; 150. brook Čunek, 525, 6856; 151. Brložský brook, Rojšín, 535, 7051; 152. Stropnice, H. Stropnice, 550, 7254, (v); 153. pond Zvule, Mosty, 640, 6857, (v).

VI (the Otava basin): 154. Lomnice, Mirotec, 405, 6550, (v); 155. Lomnice, Blatná, 440, 6549; 156. brook, Nišovice, 445, 6849; 157. Závěšinský brook, Bezdědovice, 450, 6549, (dv); 158. Peklov, Nikošovice, 456, 6849; 159. Nadymač-pond, Vrbno, 475, 6548, 160. canal of the Krčový pond, 480, 6548; 161. Divišovský brook, Divišov, 485, 6747; 162. canals, Kadov, 505, 6648, (dv); 163. Spůlka, Bohumilce, 565, 6848; 164. Zlatý brook, Záhoří, 680, 7050; 165. Blanice, Blažejovice, 737, 7049.

VII (the Sázava basin): 166. Janovický brook, Václavice, 285, 6253; 167. Janovický brook, Vatekovo, 295, 6253; 168. Břežanský brook, Břežany, 320, 6152; 169. brook, Jilové u Prahy, 325, 6152, 170. brook, Mirošovice, 330, 6054; 171. Brejlovský brook, Netvořice, 360, 6153; 172. Blanice, Blanice, 360, 6454; 173. Brodec, Světlá, 380, 5464; 174. Tloskovský brook, 380, 6253; 175. Zdeslavský brook, Trhový Štěpánov, 380, 6255; 176. brook, Talmberk, 385, 6255; 177. canals, Vrchotovy Janovice, 390, 6353; 178. Sázavka, Miřátky, 400, 6258, (dv); 179. Losínský brook, Kácov, 400, 6156; 180. brook, Vyžlovka, 400, 6054; 181. Martinecký brook, Martince, 455, 6456; 182. Bělá, Žižkovo Pole, 465, 6360; 183. Trnávka, Hrádek, 480, 6556; 184. Borovský brook, Macourov, 480, 6360; 185. brook, Skuhrov, 480, 6259; 186. Hejlovka, Hodějovice, 495, 6557; 187. brook Lištěnce, 500, 6353; 188. brook, Přibyslav, 500, 6460; 189. Janovický brook, Jarkovice, 519, 6253; 190. canals of the Kladuný pond, 540, 6558; 191. Trnávka, Obrataň, 550, 6558; 192. Velké Dářko pond, Škrdlovce, 620, 6361, (v).

VIII (the Morava basin): 193. Olšinka, Zdounky, 240, 6770, (v); 194. Haná, Ivanovice, 220, 6668; 195. Brezovský brook, Brezová n. Bradlom, 275, 7370; 196. brook D. Bušnov, 416, 6166; 197. Děvnice, Držková, 445, 6672; 198. Trusovický brook, Těškov, 500, 6270; 199. Rožnovská Běva, Horní Běva, 525, 6575.

IX (the Dyje basin): 200. canal, Markovice, 200, 7064; 201. brook, Obora, 350, 6565, (v); 202. brook Ketkovice, 420, 6863; 203. Býkovka, Bukovice, 435, 6565; 204. O-lava, O-trov, 500, 6561; 205. Bílý brook, Kamence u Poličky, 585, 6263; 206. brook, Blatiny, 705, 6362.

X (the Odra basin): 207. Osoblaha, Osoblaha, 235, 5772; 208. Lučina, Šenov, 246, 6276; 209. Lučina, Vojkovice, 325, 6376; 210. Vidnávká, Žulová, 350, 5865; 211. Morávka, Morávka, 495, 6477.

XI (the lower Váh basin): 212. Šurský brook, Jur pri Bratislave, 145, 7769, (v); 312. Čachtický brook, Čachtice, 185, 7272. 214. Trnávka, Trstín, 210, 7074, (v); 215. Pružinka, Visolaje, 285, 6976; 216. Hôrčanský brook, Hôrka, 285, 7273; 217. Modrovský brook, Modrovka, 203, 7373; 218. Bystrá, Povážská Bystrica, 325, 6877; 219. Vlára, Vlachovice, 335, 6873; 220. Domanžianka, Prečín, 360, 6977.

XII (the upper Váh and Poprad basin) 221. Čierňanka, Svrčomovec, 435, 6578; 222. Vadičovský brook, Lopušné, 450, 6678; 223. Čierňanka, Skalité, 475, 6479; 224. brook Kralovany, 500, 6880, (v); 225. brook, Jablunkov, 500, 6578; 226. Predmieranka, Klokočov, 545, 6577; 227. Zázrivka, Zázrivá, 635, 6780; 228. Kvačianka, Kvačany, 635, 6883; 229. Žarnovica, H. Štubňa, 635, 7179; 230. Rieka Lendak, 705, 6788; 231. Belá, Pribylina, 795, 6885; 232. brook Kastánie, 800, 6578.

XIII (the Nitra basin): 233. brook, Vieska, 165, 7776, (v); 234. Hlavínka, M. Ripňany, 175, 7573; 235. Črešňový brook, H. Slažany, 195, 7575; 236. brook, Nitra, 245, 7674, (v); 237. Dubníčka, Dubníčka, 250, 7674.

XIV (the Hron basin): 238. brook Chlába, 245, 8178; 239. Štampoch, Bohunice, 305, 7678; 240. Klak, Hámre, 305, 7477; 241. Driekyňa, Slovenská Lúča, 390, 7281; 242. Haľčianský brook, Banská Štiavnica, 500, 7579; 243. Kremnický brook, Kremnica, 610, 7279.

XV (the Ipel and Slaná basin): 244. Tisovecká Rimavica, Tisovec, 295, 7385; 245. Madačka, Šula, 350, 7682; 246. Pača, Krásnohorské Podhradie, 335, 7389; 247. Čremošná, Drnava, 445, 7389.

XVI (the Hornád basin): 248. Blatný brook, Zádielské Dvorníky, 190, 7491, (v); 249. Balky, Šarišské Bohdanovce, 300, 7193; 250. Malá Svinka, Svina, 350, 6992; 251. Velký brook, Šarišské Sokolovce, 410, 6993; 252. Velká Biela voda, Píla, 500, 7088; 253. Velká Svinka, Fričovce, 545, 6991.

XVII (the Tisza basin): 254. canals, Somator, 98, 7596, (v); 255. Čierna voda, Strotava 100, 7398, (v); 256. Okna, Jasenov, 130, 7299; 257. Porubský brook, Poruba, 145, 7198; 258. Kusm, Jovsa, 180, 7198; 259. Čertež, Brusnica, 200, 6896; 260. Ondava, Svidník, 230, 6696; 261. Pichoňka, Snina, 245, 6998; 262. Žiarovnica, Hlivišťa, 265, 7199; 263. Kovný brook, Ruský Hrabovec, 265, 71100. 265. Okna, Remetské Hámre, 380, 7199; 266. Velký rybný brook, Lukov, 430, 6793; 267. Kamence, Becherov, 445, 6593; 268. Morské lake, Remetské Hámre, 610, 7099, (v).

Larvae of *Epoicocladus flavens* were found altogether at 268 localities in all 17 faunistic district of Czechoslovakia. It occurs at 35 (49.2% localities of total host occurrence) localities on larvae of *Ephemera vulgata* and at 238 localities (59.3%) on *E. danica*. Infestation of both these species simultaneously was observed at 10 localities only. Although the localities of a chironomid occurrence evenly cover the whole Czechoslovak territory (Fig. 4) its distribution shows certain preference of habitats and/or altitudes.

Larvae prefer host localities of unpolluted brooks approximately up to 5 m across with well aerated but relatively warmer water. There is probably no habitat or microhabitat preference, they occur on mayfly larvae evenly within host habitat range. Larger rivers, although frequently inhabited by *Ephemera* larvae, are usually free of *Epoicocladus*, with the exception of localities Nos. 1, 24, 76, 126, 154 and 155. Eutrophic ponds, although sometimes colonized by *Ephemera* species (mostly *E. vulgata*), are inhabited only exceptionally also by *Epoicocladus* (e.g. locality No. 159). The cases of occurrence in oligotrophic ponds at higher altitudes (Nos. 153, 192), larger reservoirs (No. 28) or submontane lakes (No. 268) are more frequent. On the other hand, some artificial biotopes are inhabited frequently if the conditions resemble those occurring in natural brook and streams. *Epoicocladus* larvae are often found especially in carp ponds in- and outflows or in larger canals (e.g. localities Nos. 3, 83, 89, 110, 160, 190, 236 and others).

As to vertical zonation of localities, lowland localities up to 200 m a.s.l. are relatively rare, except some cases where abiotic factors resemble those in highland and submontane brooks (e.g. Nos. 30, 31, 55, 213, 235). Most localities of *E. flavens* occurrence are situated at altitudes of 250–500 m in highlands. Submontane localities above 400–500 m are represented mostly by smaller rivers with respective abiotic factors (relatively high water temperature), e.g. Nos. 24, 25, 29, 107, 126, 152, 186, 211 and others. Submontane and montane localities are rare as well, the occurrence of *E. flavens* on hosts living at the localities above 700 m is exceptional (Nos. 112, 165, 206, 230–232).

Most localities are concentrated to the Elbe basin, faunistic districts of the South-Bohemian highland and the Berounka highland show the highest number of localities (IV, V); chironomids are frequent also in the district VII (the Sázava river basin). *E. flavens* seems to be sparse in the Odra, Morava and Dyje basins (VIII, X and IX) in Moravia and in Central Slovakia (see Fig. 4). In general, this species can be evaluated as a species of an abundant or of considerable occurrence (grades 5 and 4 of Friederichs, 1941) in Czechoslovakia. No substantial changes were observed while comparing its distribution in 1950–1965 and in 1970–1985, at most localities it occurs during both phases of faunistic research of the Ephemeroptera species.

Host specificity of *Epoicocladus flavens*

Taking into account the distribution of *E. flavens* in Czechoslovakia it seems to be impossible to determine primary host species of this chironomid. It exhibits close

affinities solely to larvae of the genus *Ephemera* and larvae have not been found on other "burrowing" mayflies (*Ephoron*, *Palingenia*) showing a similar larval habits.

There is no clear preference between larvae of *Ephemera danica* and *Ephemera vulgata*. Judging from the number of localities where the larvae of *E. flavens* occurs the infestation of both these species is approximately the same. The relatively high number of localities with infested individual, i.e. 59.3 % in *E. danica* and 49.2 % in *E. vulgata*, supports this conclusion. Moreover, at most localities of common occurrence (e.g. localities Nos. 36, 66, 121, 162) of *E. danica* with *E. vulgata*, both species are usually infested although the infestation rate is mostly different. The differences are probably caused mostly by density factors (see Densities of *E. flavens* at selected localities). However, it seems that ecological requirements of *E. flavens* are similar to those of *E. danica* as to abiotic factors, mainly oxygen content and water temperature. That is why this species is slightly preferred by *E. danica* to *E. vulgata* which lives mostly at lowland localities and often at biotopes with lower oxygenation of water (larger rivers, ponds and lakes). However, higher vagility of *E. danica* (at least in Czechoslovakia and Central Europe) and expansion of its area represent a favourable factor for dispersal of *Epoicocladus flavens*.

On the contrary, the infestation of *Ephemera lineata* is most probably only incidental, since it occurs only at a single locality (No. 132) of 27 localities studied (3.6 %). At the locality in question, which is not typical for *E. lineata* — a canal with aerated water and current speed of 20—50 cm.s⁻¹. The larvae of *E. danica* prevail and are much more infested. Larvae of *E. flavens* were found on only 8 of 85 larvae of *E. lineata*. This is the first record on occurrence of *E. flavens* on this mayfly species (cf. next paragraphs). Larvae of *E. flavens* have not been found on larvae of *Ephemera glaucops*, possible occurrence would be probably only incidental as in *E. lineata*. In Czechoslovakia, there is probably no locality of common occurrence with other *Ephemera* species.

Densities of *Epoicocladus flavens* and their seasonal changes in selected localities

As indicated above, 5 localities (Nos. 36, 63, 66, 118 and 132) were selected to study the chironomid larvae densities on their hosts. Since in all of these localities two of *Ephemera* species occur the changes in host preferences can be studied as well. The data concerning the localities Nos. 36 and 63 are summarized in Tables 1—2.

The locality No. 36 (Pšovka brook, Kokořín, North Bohemia) represents an exception since the abundance of *E. vulgata* is much higher than that of *E. danica*. The infestation rates of *Epoicocladus flavens* on *E. vulgata* are much higher as well reaching nearly 100 % while the infestation of larvae of *E. danica* exhibits a relatively very small percentage. Approximately the same proportions are apparent when evaluating the infestation quotient as defined by Svensson (1976). There is a marked decrease of infestation rates during summer months (June-October) which can be recognized especially in heavily infested *E. vulgata* (Tab. 1). A reverse situation was observed in the locality No. 63 (Zahořanský brook, Davle-Libřice, Central Bohemia) where usual quantitative presentation of individual *Ephemera* species occurred (*E. danica* much more abundant than *E. vulgata*). Infestation rates of chironomids on prevailing *E. danica* larvae are higher, contrary to the situation in the previous locality. The same decrease of infestation rates during summer months is well apparent (Tab. 2).

The locality No. 118 (Židova strouha brook, South Bohemia) was sampled during 1983. As to the quantitative presentation of individual *Ephemera* species the situation is the same as at locality No. 63. The infestation rates are also very similar. The samples containing 118 and 62 larvae of *E. danica* taken on April 8, 1959 and August 24, 1959, respectively, from the collection of the Institute of Entomology were analyzed. The infestation quotients 1.42 (April) and 0.85 (August) are fairly comparable to those obtained at respective seasonal aspects during 1983 (April 25: 1.58; September 1: 0.69). Average infestation (1983) of this locality is 65–75 % for younger larvae and 80–95 % for older larvae of *E. danica* and 35–45 % for younger larvae and 55–75 % for older larvae of *E. vulgata*. Altogether 1168 larvae of *E. danica* and 682 larvae of *E. vulgata* were analysed.

The locality No. 66 (Radotínský brook, Cikánka, Central Bohemia) represents a habitat with approximately equal presentation of larvae of *E. danica* and *E. vulgata* although the former prefer microhabitats near the streamline and the latter sediments in pools and places with slower current speed. During 1977 (5 samples) altogether 952 larvae of *E. danica* and 869 larvae of *E. vulgata* were studied. Infestation rates are approximately the same in both younger and older larvae, slightly higher in *E. danica*, ranging from 69–98 % with quotient 0.52–1.21. Seasonal changes of infestation rates are comparable to those ascertained at localities Nos. 36 and 63, identical in both host species studied. A sample taken on May 9, 1986 (225 larvae of both species) shows nearly identical results as that from April 30, 1977 (infestation rate 92 % and 89 % in older larvae in *E. danica* and 85 % and 87 % in *E. vulgata*, infestation quotient 1.87 and 1.95 in *E. danica* and 1.77 and 1.69 in *E. vulgata*).

The locality No. 132 (Nová řeka canal, Mláka, South Bohemia) represents an exception since larvae of *E. danica* and *E. lineata* live there together. Larvae of

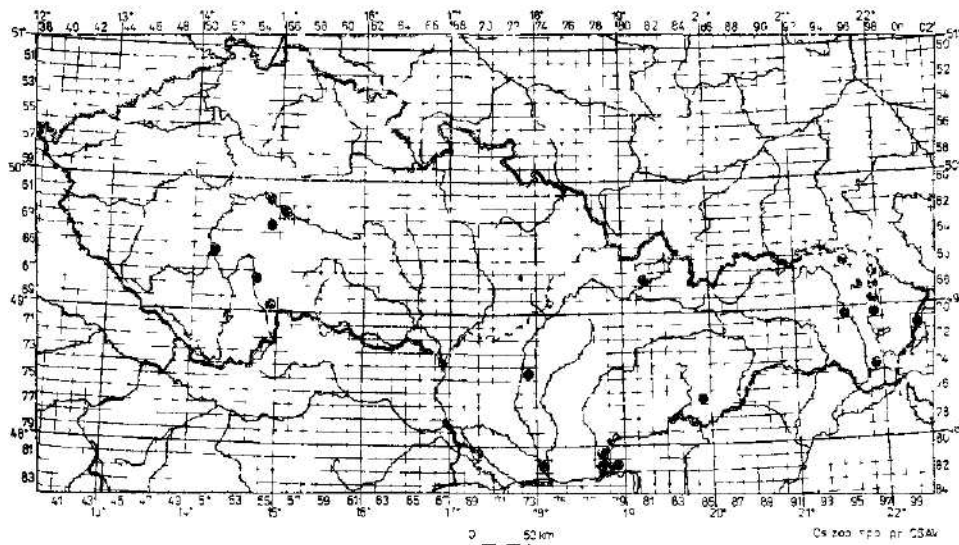


Fig. 3. Dot mapping of the area of *Ephemera lineata* in Czechoslovakia; 28 localities grouped according to the uniform grid system.

E. danica living at places with slow to moderate current speed are common but those of *E. lineata* are very rare occurring at the streamline habitats (cf. Host specificity of *Epoicocladius flavens*). The locality was sampled four times (April, June, August, October in 1974 August, October in 1973), altogether 728 larvae of *E. danica* and 85 larvae of *E. lineata* were collected. The infestation rates and infestation quotients of *E. danica* were very similar to values obtained at the localities Nos. 118 and 63. Larvae of *Epoicocladius flavens* were found on 8 larvae of samples from April and June, each larva harbored a single chironomid larva; in one case, there were 2 chironomids among the gills of the same mayfly larva. Chironomids were not found on 16 *E. lineata* larvae collected in 1979; in 1984 no larvae of *E. lineata* were found at this locality, infestation rates of *E. danica* larvae were normal.

DISCUSSION AND CONCLUSIONS

As documented by its distribution in Czechoslovakia *Epoicocladius flavens* is an abundant species and its distribution is probably correlated with that of its usual host, *Ephemera danica*. However, it has been so far recorded only from several countries, i.e. from France (Arvy and Peters, 1973), Rumania (Codreanu, 1939), Great Britain (Gillies, 1951; Henson 1955, 1957), Sweden (Svensson, 1979, 1980), Germany (Thienemann, 1954) and Czechoslovakia (Šulc and Zavřel, 1924; Landa, 1969; Lellák, 1970, 1980). There is no doubt that it is distributed in most European countries including the European part of the USSR although the northern and southern limits of its area are not known. Svensson (1976) found the larvae on *Ephemera vulgata* in lake Bosarpssjon, 58°58'N in Scandinavia but the extension range of the area is probably larger. I have studied the infested *Ephemera danica* larvae from Hungary, Poland, Bulgaria, Yugoslavia, France and

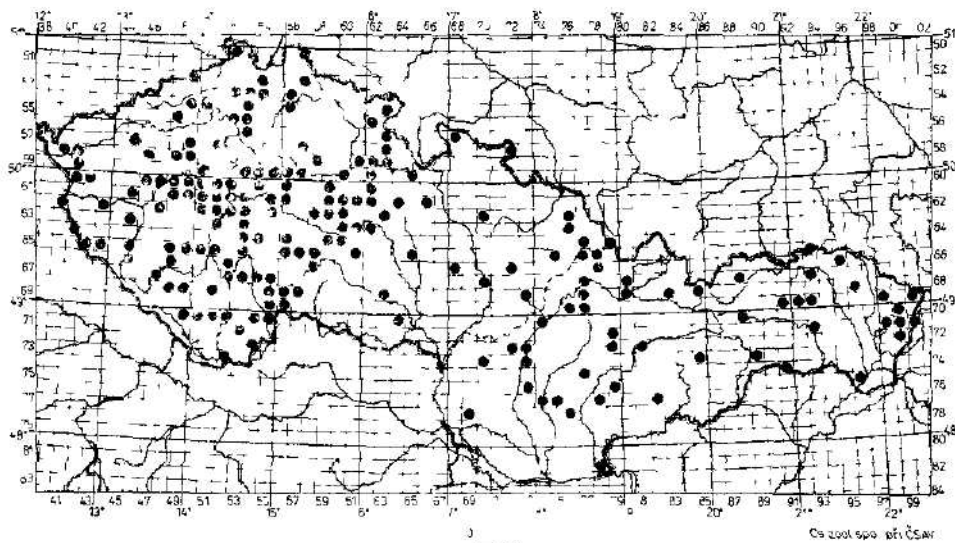


Fig. 4. Dot mapping of the area of *Epoicocladius flavens* in Czechoslovakia; 268 localities grouped according to the uniform grid system.

Tab. 1. Infestation of *Ephemera* spp. larvae at the locality Pšovka, Kokořín (No. 36) and its seasonal changes in 1975

Date of sampling	<i>Ephemera danica</i>				<i>Ephemera vulgata</i>			
	Younger larvae and their infestation (%)	Older larvae and their infestation (%)	and their infestation (%) and infestation quotient		Younger larvae and their infestation (%)	Older larvae, their infestation (%) and infestation quotient		
February	15	36 (36.1)	28 (46.4)	0.95	115 (75.7)	312 (95.5)		1.85
April	20	51 (56.9)	42 (47.6)	0.83	201 (79.1)	514 (98.2)		1.62
May	15	73 (57.7)	34 (17.6)	0.52	189 (91.0)	452 (92.7)		1.19
June	19	65 (69.2)	25 (36.4)	0.78	278 (50.7)	216 (69.4)		1.03
July	29	91 (35.2)	11 (18.2)	0.45	193 (38.9)	85 (71.8)		1.42
August	25	102 (27.5)	18 (27.8)	0.20	342 (46.1)	103 (67.0)		0.63
October	30	86 (33.7)	23 (21.8)	0.38	415 (53.5)	97 (82.5)		0.91
Total		509 (45.2)	181 (30.8)	0.58	1 733 (62.1)	1 779 (82.4)		1.23

Greece as well. All these specimens are morphologically identical with larvae described for *E. flavens* by Šulc and Zavřel (1924) (as *E. ephemerae*) and their relationships to *Epicocladus gynocera* (Edwards) known only in the adult stage from the Alps and Fennoscandinavia is not clear. Svensson (1976, 1978, 1980) and Tokeshi (1986) most probably studied the same species.

Distribution in Czechoslovakia indicates that *E. flavens* is common within its area. It has been found at 268 localities. However, the percentage of localities of *Ephemera* spp. is probably higher than presented (59.3 % and 49.2 % in *E. danica* and *E. vulgata*, respectively) since in some localities only a single non-infested larva or solely adults of *Ephemera* were collected. In Sweden (Stampen) the chironomid

Tab. 2. Infestation of *Ephemera* spp. larvae at the locality Zahoránský brook, Davle Libice (No. 63) and its seasonal changes in 1973

Date of sampling	<i>Ephemera danica</i>				<i>Ephemera vulgata</i>			
	Younger larvae and their infestation (%)	Older larvae and their infestation (%) and infestation quotient			Younger larvae and their infestation (%)	Older larvae, their infestation (%) and infestation quotient		
February	24	309 (57.9)	298 (86.9)	1.89	12 (41.7)	22 (54.6)		0.92
March	31	296 (67.7)	451 (94.2)	1.91	6 (33.3)	37 (56.8)		1.05
April	15	674 (73.6)	627 (93.6)	1.88	24 (29.2)	30 (50.0)		0.84
May	30	230 (64.4)	205 (63.4)	0.79	31 (25.8)	11 (27.3)		0.65
June	25	351 (62.4)	117 (60.7)	0.52	10 (40.4)	16 (25.0)		0.79
August	15	116 (73.3)	158 (76.5)	0.70	5 (20.0)	19 (68.7)		0.37
November	24	197 (80.7)	324 (89.5)	1.07	3 (0.0)	10 (20.0)		0.90
Total		2 173 (68.4)	2 100 (80.7)	1.25	91 (27.2)	145 (43.2)		0.78

larvae were found wherever *E. danica* was present, including stretches where the density of host larvae was even less than 5 ind.m⁻² (Svensson, 1976). It is obvious that the relationships between chironomid and its hosts is much closer than previously thought. Since no free-living larvae were found at the locality in England (Tokeshi, 1986) and host densities directly effect the chironomid's reproductive rates (Svensson, 1980) this association seems to be definitively strictly obligatory (cf. Steffan, 1967). Close correlation between the distributional patterns of hosts and *E. flavens* strongly supports this conclusion, concerning the selective background of the association. A transitory stage of this "phoresy" or "commensalism" can be documented by incidental mayfly-chironomid associations (see e.g. White et al., 1980) or symphoretic but unspecialized chironomid genus *Nanocladius* occurring not only on mayflies (Epler, 1986) but also on the Plecoptera and Megaloptera larvae (Steffan, 1965; Goteit and Mackay, 1980)

There is probably no direct host-specificity among the species of the genus *Ephemera*, since, at least in the case of *E. danica* and *E. vulgata*, the distribution of chironomids within their areas is approximately equal. However, *E. danica* seems to be slightly more infested since its ecological requirements fit better to those of *Epoicocladus*. Chironomids apparently prefer smaller rivers and brooks of lotic erosive biotopes probably because of higher oxygen content and the temperature plays a certain role as well (absence at most of the montane biotopes). The same factors are probably responsible for the absence of *Epoicocladus* on larvae *E. lineata* and especially *E. glaucops* which are specialized on lotic-depositional biotopes of larger rivers, at least in Czechoslovakia. However, infestation of these species is possible especially in the Mediterranean region where their larvae inhabit the same biotopes as *E. danica* in Central Europe.

There is only a single record on occurrence of *Epoicocladus* sp. on other host genus than *Ephemera*. Johannsen (1937) found the larvae on *Litobrancha recurvata* (Palingeniidae; referred as *Spaniotoma* on *Hexagenia recurvata*) but this Nearctic species most probably belongs to a different species of chironomids. Larvae of *Epoicocladus* found on *Ephemera simulans* in Utah, USA, on *Ephemera* sp. in Vietnam and on *E. orientalis* in Korea markedly differs morphologically from those of *Epoicocladus flavens* from Europe representing at least 2 unnamed species (Matěna and Soldán, 1986).

Infestation rates and infestation quotient in selected localities are in full agreement with the values obtained by Svensson (1976, 1980) and Tokeshi (1986) including a decrease of infestation rates during summer months apparently connected with a flight period of the midge. Contrary to populations in England (single generation) and in Sweden (partial second generation) the Czechoslovak population of *E. flavens* seem to have two generations a year since decrease of infestation ratio caused by eggs and first instar chironomid larvae searching for host is relatively long. On the other hand, increased infestation rate of younger nymph during host's flight period probably means that some older chironomid larvae pupate next year and overwinter. Otherwise the population density is nearly constant fitting the semivoltinism of host species (cf. Tokeshi, 1986).

The conclusions that more numerous larvae of prevailing species are more infested agree also with observation by Svensson (1980) who reports that host density is the most important factor for not only a higher average infestation rate but also for a chironomid reproductive success. On the other hand, further studies of these problems are necessary to explain marked differences in average infestation rates in prevailing and the second host species at the same locality. In this respect there

is evidently no host- and habitat-preference but equal infestation rates occur only at localities with approximately the same quantitative presentation of host species. One possible explanation represents a possibility of some differences in olfactory stimuli after which the first instar chironomid larvae are supposed to search for host larvae (Svensson, 1976, 1978).

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**TWO NEW SPECIES OF THE GENUS ILYOCRYPTUS (CLADOCERA, CRUSTACEA) CONFUSED
WITH I. SORDIDUS LIÉVIN**

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Abstract. *Ilyocryptus cuneatus* sp. nov. and *I. spinosus* sp. nov. (Crustacea, Cladocera) from Europe were described. Diagnosis of the species *I. sordidus* based on the Kurz's opinion of the species (Kurz 1878) is given with the key to Palearctic species of the genus *Ilyocryptus*.

INTRODUCTION

The aim of my preliminary work was the study of morphological variability of the species *Ilyocryptus sordidus* in Europe. I have gathered, mostly with helpful assistance of my colleagues, relatively large material from different parts of Europe. The comparison of samples available and literature data (Norman 1863, Kurz 1878, Romijn 1919, Flössner 1972, Fryer 1974, Smirnov 1976) shows that *I. c. f. sordidus* is probably a group of closely related species (Štifter 1984).

METHODS

Part of selected specimens from all samples were stained with the mixture of lignin pink and chlorazol black E in ethylenglycol and alcohol (Brandlová et al. 1972) and mounted in Canada balsam. Some specimens were treated with hot 10% NaOH solution, washed with water and mounted in polyvinylalcohol (Smirnov 1976) stained with lignin pink.

Animals were studied with binocular microscope Biolar. Drawings and measurements were made using the projective screen of the Visopan microscope (Reichert). Morphological terminology was used according to Fryer (1974). If not otherwise mentioned, all comparative scales in the figures represent 0.1 mm. All measurements are in millimeters.

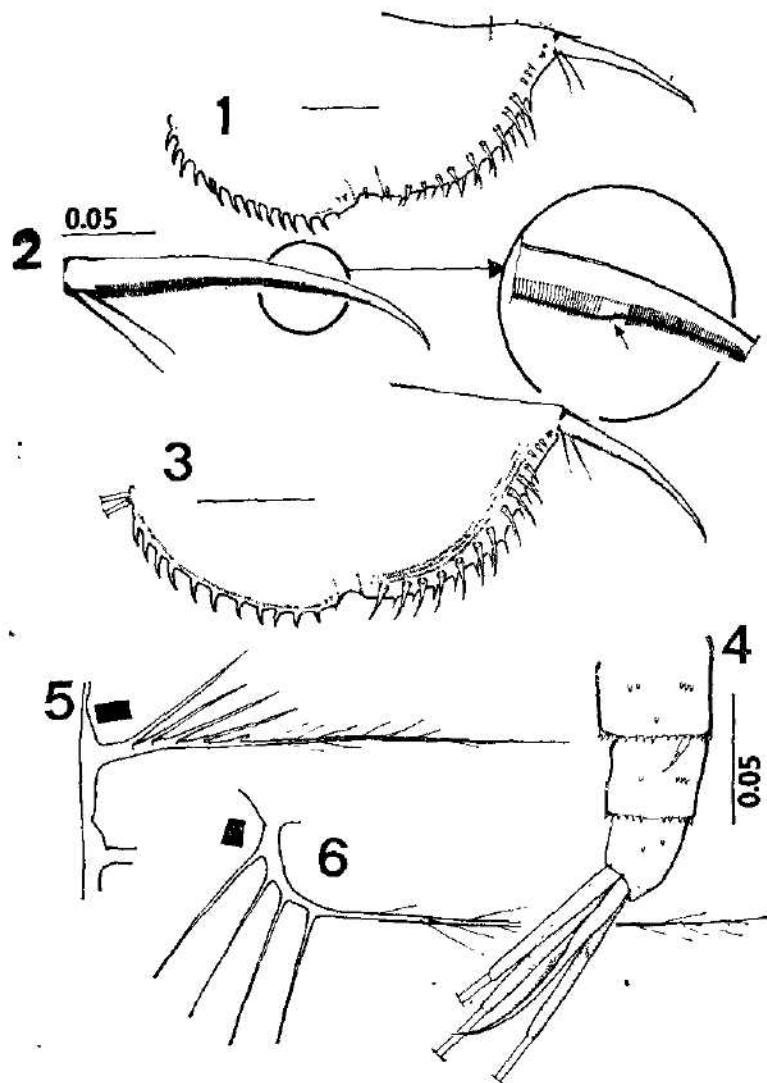
RESULTS

Kurz (1878) described parthenogenetic female and male of *Ilyocryptus sordidus* Liévin, 1848 from Bohemia and all mentioned characters are reliable and well documented in his drawings. Kurz's paper has influenced the opinion what *I. sordidus* was and what it is till now (Matile 1890, Lilljeborg 1900, Romijn 1919, Smirnov 1976), as the Liévin's original description (Liévin 1848) is vague and figures unrealistic. I am not able to collect the material of *I. sordidus* from type area (vicinity of Gdańsk, Poland) so the next text is not the redescription but only delimitation or diagnosis of *I. sordidus* using the literature data and material corresponding to Kurz's description from other parts of Europe.

Ilyocryptus sordidus Liévin, 1848 sensu Kurz 1878

Diagnosis: robust, red coloured form; old carapaces and headshield are retained; thick antennal exopod with one short spine on its second segment; preanal part of postabdomen with row of single spines; moveable lateral denticles on postanal part of postabdomen only; claw without small spine near its tip; Defensive posterior spines of carapace markedly curved with short basal unbranched part.

Differential diagnosis: Table 1 summarizes the morphological differences among parthenogenetic females of *I. sordidus*, *I. cuneatus* sp. nov., *I. spinosus* sp. nov. and *I. silvaeducensis*. Contrary to *I. sordidus* and other species mentioned above, parthenogenetic females of other Palearctic species: *I. agilis*, *I. acutifrons*, *I. vitali* and



Figs. 1-6. *Ilyocryptus sordidus*, parthenogenetic female. 1, 3 - postabdomen, 2 - claw with detail, 4 - three distal segments of antennal exopod, 5, 6 - defensive posterior spine of carapace (5 - ventral aspect); 1-5: Czechoslovakia, Vrbno, 7. 10. 1962; 6: Czechoslovakia, Louti u Rabyně, 15. 6. 1984. If not otherwise mentioned all comparative scales represents 0.1 mm. All measurements are in millimetres.

I. cornutus have different postabdomens, the last species has lateral horns on carapace.

Mature parthenogenetic female: Carapace, seen laterally, subtriangular. Dorsal outline slightly convex. Posterior and ventral margin of carapace forms large and continuous curve. Old carapaces and headshields are retained. Ventral margin of carapace with slightly curved long setae with plumose setulation. Posterior margin of carapace with defensive spines, very short distance between spine's base and the first branching (Figs. 5, 6). Spine on the second segment of antennal exopod shorter or equal to the one-half of the third exopodial segment length (Fig. 4). Postabdomen large, anus in median position between terminal claws and setae natatoriae. Preanal part with single spines, row of moveable lateral denticles never exceeds from postanal part to the preanal one (Figs. 1, 3). Terminal claws in middle suddenly slightly curved with steplike narrowing to distal half (Fig. 2).

Colour: red (hemoglobin). Carapace is always covered with detritus, mineral particles, diatoms.

Sexual female: One layered carapace, ephippium is very similar to the ephippium of *I. cuneatus* sp. nov. (Fig. 14). All other characters are very similar to parthenogenetic female.

Male: Not observed. See the description by Kurz (1878).

Size: Parthenogenetic female 0.62–1.21 mm. Sexual female 0.67–0.69 mm.

Material examined: 1. Austria, Tirol, Fiburger See, 30. 5. 1984, Ch. Moritz leg. 2. Austria, Tirol, near Innsbruck, Baggersee Rossau, 8. 5. 1983, Ch. Moritz leg. 3. Czechoslovakia, Blatná, Smyslov Pond, place D – bottom, 24. 6. 1978, J. Chalupský leg. 4. Czechoslovakia, Blatná, Smyslov pond, 7. 8. 1978, J. Chalupský leg. 5. Czechoslovakia, Blatná, Smyslov pond, 8. 7. 1978, J. Chalupský leg. 6. Czechoslovakia, Blatná, Smyslov pond, 16. 9. 1961, V. Kořínek leg. 7. Czechoslovakia, Vrbno, village pond, 7. 10. 1952, J. Lellák leg. 8. Czechoslovakia, Blatná, Smyslov pond, 19. 11. 1981, P. Štifter leg. 9. Czechoslovakia, Loutí u Babyně, village pond, 15. 6. 1984, P. Štifter leg. 10. Czechoslovakia, Lednice, small pond near Nesyt pond, 9. 5. 1964, V. Kořínek leg. 11. Czechoslovakia, Karlovy Vary, Březová reservoir, 20. 9. 1973, P. Štifter leg. 12. Czechoslovakia, Čelákovice – Cisařská Kuchyně, Velká Arazimova pool, 4. 5. 1979, L. Havel leg. 13. Czechoslovakia, Levico, ex coll. Daday, 1902 (Léva – D1211–1902, II – 419) 14. German Democratic Republic, Jena, small pond, 13. 7. 1972, D. Flossner leg. 15. Netherlands, N. O. polder Kavel G, 24. 7. 1942, de Vos leg. 16. Netherlands, Tocht rond IJsselmeer 39, win 5. Spakenburg, 10. 7. 1939, de Vos leg. 17. Netherlands, Amsterdam, Hoge sluis, 9. 1948, Dreucher leg. 18. Netherlands, Tocht rond IJsselmeer 48, 1. 6. 1948, de Vos leg. 19. Netherlands, Tocht rond IJsselmeer 48, Plasbeemduts?, 1. 6. 1948, de Vos leg. 20. Netherlands, N. O., Polder Kavel J 32, 1942, de Vos leg. 21. USSR, carp pond near Leningrad, 10. 7. 1970, V. N. Sergeev leg. 22. USSR, Rybinsk reservoir, Borok, 1968. 23. USSR, Rybinsk reservoir, Suda river, 20. 6. 1979, V. N. Sergeev leg.

Sample No. 13 from Daday collection of Hungarian National Museum (Nat. Hist.) in Budapest, Hungary. Samples No. 15–20 from collection of Zoologisch Museum, Universiteit van Amsterdam, Instituut voor taxonomische Zoologie, Amsterdam, Netherlands.

Ilyocryptus cuneatus sp. nov.

Acantholeberis sordida, Norman, 1863, part., Annals and Magazin Natur. Hist. ser. 3, XI, 61: 411–412, Fig. 7.

Ilyocryptus sordidus, Romijn, 1919, part., Int. Rev. g. Hydrob. u Hydrogr. VIII (5): 529–539, Figs. 17, 18, 23, 24.

Ilyocryptus sordidus, Flossner, 1972, Tierwelt Deutschlands, 60. Teil Krebstiere, Crustacea, Jena: 236–238, Fig. 111.

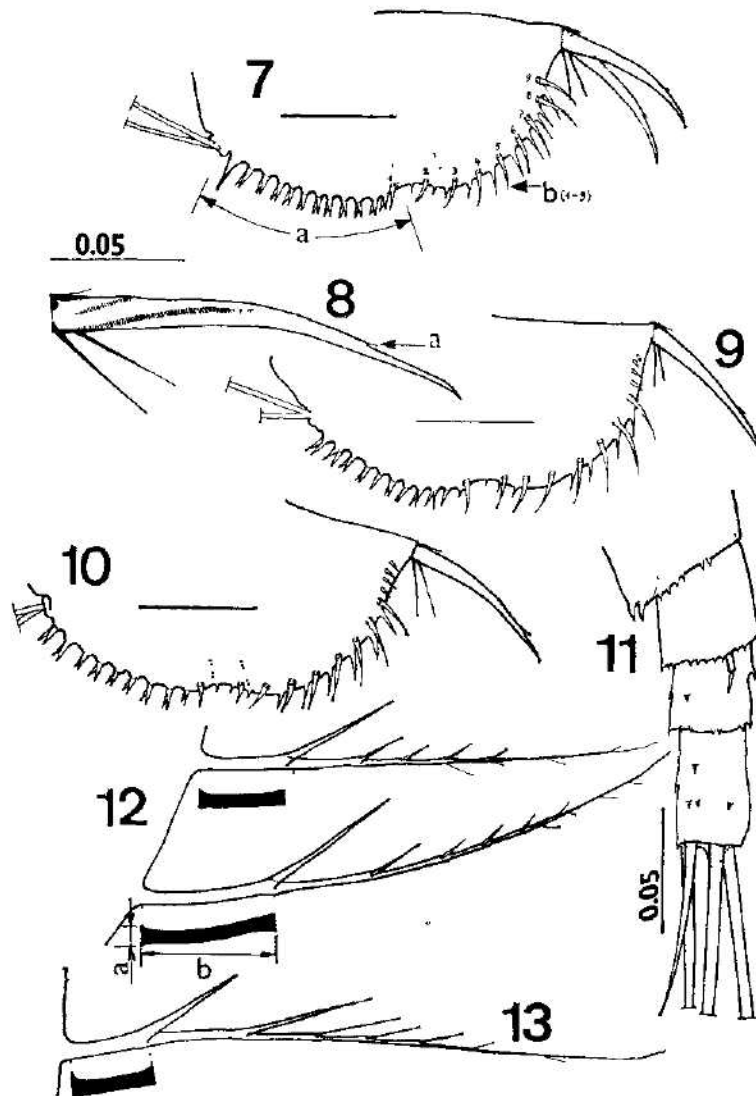
Ilyocryptus sordidus, Frey, 1974, Phil. Trans. R. Soc. London B 269: 243–261, Figs. 134–149.

Ilyocryptus sordidus, Margaritora, 1983, part., Guide per il Riconoscimento delle specie animali delle acque interne Italiane, v. v. 22 Cladoceri (Crustacea, Cladocera), Consiglio nazionale delle Ricerche, Verona, p. 88, Fig. 56 A.

Ilyocryptus silvaeticus, Štifter, 1984, part., Věst. čs. Společ. zool., 48: 132-136, Fig. 9.

Etymology: cuneatus, a, um, (latin) = wedge-shaped

Type locality: Czechoslovakia, West Bohemia, Březová reservoir on the river Teplá, 5 km south of Karlovy Vary (50° 15' N, 12° 44' E), area 0.772 km², max.



Figs. 7-13. *Ilyocryptus cuneatus* sp. nov., parthenogenetic female. 7, 9, 10 - postabdomen: a - preanal part, b - moveable marginal denticles, 8 - claw: a - spine near the distal tip, 11 - segments of antennal exopod, 12, 13 - defensive posterior spine of carapace: a - basal widthness, b - length of unbranched proximal part; 7, 8, 11, 12: Czechoslovakia, Březová reservoir, 20. 9. 1973, paratypes; 9: England, Berner End Tarn; 10, 13: Italy, L. Gutuhanello (Roma), 15. 10. 1974.

depth 20 m, 432 m a. s. l. The specimens were collected when reservoir was drained (20. 9. 1973). Dark muddy bottom were partly covered by pools from which the animals were picked up.

Holotype: A parthenogenetic female 0.63 mm long in alcohol, labelled: "*Ilyocryptus cuneatus* sp. nov., P. Štifter, Holotype, Czechoslovakia, West Bohemia, Březová reservoir, 20. 9. 1973, Štifter leg. Deposited in British Museum (Nat. Hist.), London, United Kingdom, catalogue number: 1988.247
Štifter leg.

Allotype (male) and paratypes (sexual and parthenogenetic female): Stained with lignin pink and mounted in polyvinylalcohol on slides and deposited in British Museum [Nat Hist.], London, United Kingdom, catalogue numbers allotype — 1988.248, paratypes — 1988.249 — 250

Diagnosis: red coloured form; old carapaces and headshields are retained; antennal exopod thick, short with one short spine on its second segment; preanal part of postabdomen with row of mostly doubled spines; moveable lateral denticles exceed on postanal part of postabdomen; claw with one thin spine near its tip; defensive posterior spines of carapace even, basal unbranched part long.

Differential diagnosis. *I. cuneatus* sp. nov. is very similar to the species *I. sordidus* Liévin but there are some significant morphological differences between both: 1. Moveable lateral denticles exceed preanal part of postabdomen in *I. cuneatus* (Figs. 7, 9, 10, 14, 19). 2. Postabdominal claw with thin spine near its tip (Figs. 7—10, 16, 19). 3. Spines on posterior margin of carapace with long unbranched distal part (Figs. 12, 13, 18).

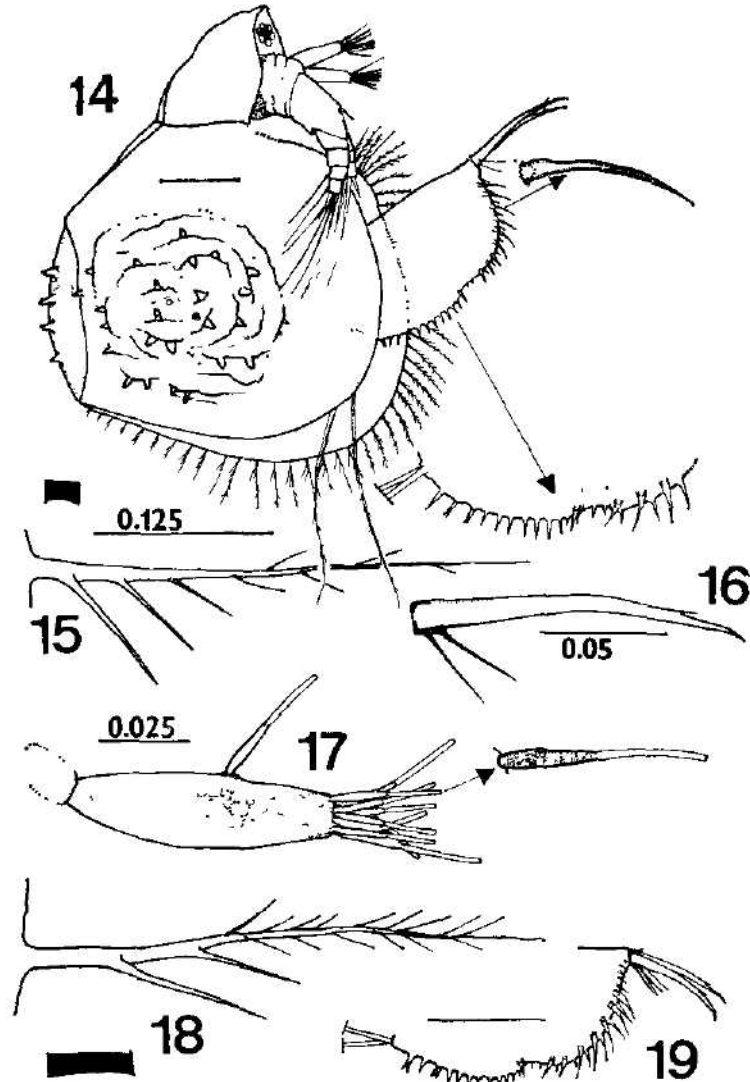
The other closely related species, *I. silvaeducensis* Romijn differs in following characters: 1. preanal part of postabdomen is short, even 2. proximal segment of antennule thin, long. 3. Spine on the second exopodial segment of antenna long. Further comparison of differential characters in Table 1.

Description:

Mature parthenogenetic female: Carapace, seen laterally, subtriangular, wedge-shaped. Dorsal outline slightly convex. Posterior and ventral margin of carapace forming large and continuous curve. Carapace and headshield retained during moulting. Ventral carapace setae even, long, setulated. Spines on posterior margin of the last and previous carapaces long, with 3—4 branches, some spines with one thin spinule near its basis, sporadic setulation distally from the last branching. Defensive spine with long distance between spine's basis and the first branching (Figs. 12, 13). Head triangular, short, frontal margin straight, headshield broad, thick, head pore in the median line between mandibular articulations like nearly rectangular slot. Labrum with slightly convex ventral margin. Antennules two-segmented, the first segment subglobular with one fingerlike projection. The second segment with length/width ratio: 3.4—3.8; 7.8 (USSR). 9 terminal sensory setae on the distal tip of antennule. Antennal setae formula: 0—0—0—3 / 1—1—3 and spine formula: 0—1—0—1/0—0—1. Spine on the second segment of antennal exopod shorter or equal to one half of the third exopod's segment length (Fig. 11). Postabdomen large, ventral margin nearly even, dorsal margin divided by anal opening into two equal parts, preanal part slightly convex with 8—12 mostly doubled spines. Long marginal denticles are shortened distally and last of them is situated ventrally of the first preanal doubled spine near anus (Figs. 7, 9, 10). Postabdominal claws with proximal half nearly straight, distal part markedly curved, with small thin spine on its dorsal margin near tip, two long basal spines situated dorsally and the bristle of thin spines ventrally on the proximal end of claw (Fig. 8).

Colour: red (hemoglobin). Carapace is always covered by layer of detritus and mineral particles.

Sexual female: Ehippial female is smaller than the parthenogenetic one and has only one carapace forming the ehippium with many simple horn-like protrusion (Fig. 14). All other characters very similar to those of parthenogenetic females. The difference is in higher store of single preanal spines within their total number in



Figs. 14–19. *Ilyocryptus cuneatus* sp. nov. 14–16 sexual female, 14 — general view with details, 15 — defensive posterior spine of carapace, 16 — claw. 17–19 male, 17 — antennule, 18 — defensive posterior spine of carapace, 19 — postabdomen; 14–19: Czechoslovakia, Březová reservoir, 20. 9. 1973.

sexual female (Fig. 14). Defensive posterior spines of carapace are direct with short distance between the base and the first branching (Fig. 15).

Mature male: Carapace and head very similar to small parthenogenetic female. Visible difference only in morphology of antennules (trunk limbs were not studied) and postabdomen. Antennule two-segmented, the second segment relatively larger than in female, one soft sensory seta in the middle and terminal sensory setae on the distal tip (Fig. 17). Male has small store of doubled spines on the preanal part of postabdomen as sexual female. Posterior marginal spines are similar to spines of parthenogenetic female but have only 2–3 branching (Fig. 18).

Size: Mature parthenogenetic females 0.58–0.90 mm. Sexual females 0.56–0.79 mm. Mature males 0.46 mm (n = 2).

Range: Probably holarctic species (whole Europe, U. S. A. — Missouri).

Habitat: *I. cuneatus* sp. nov. lives in the upper layer of muddy bottom and was collected together with some other species of the genus *Ilyocryptus*.

Material examined: 1. Czechoslovakia, W. Bohemia, Březová reservoir, 20. 9. 1973, P. Štifter leg. 2. Czechoslovakia, Loutí u Rabyň, small village pond, 15. 6. 1984, P. Štifter leg. 3. Czechoslovakia, Jabkenice, Mlýnský pond, 21. 11. 1981, P. Štifter leg. 4. Czechoslovakia, Dražice nad Jizerou, Horecká pool, 13. 6. 1984, P. Štifter leg. 5. England, Cumbria, Berrier End Tarn, G. Fryer leg. 6. England, Cumbria, Wise End Tarn, G. Fryer leg. 7. GDR, Neuglobsow, Grosser Barchsee (near Potsdam), 12. 6. 1967, D. Flossner leg. 8. GDR, Neuglobsow, 26. 9. 1967, D. Flossner leg. 9. GDR, Neuglobsow, 6. 12. 1967, D. Flossner leg. 10. GDR, Jena, small pond, 13. 7. 1972, D. Flossner leg. 11. GDR, Neuglobsow, Stechlinsee, 10. 7. 1967, D. Flossner leg. 12. Italy, Lago Maggiore, 7. 12. 1961, F. G. Margaritora leg. 13. Italy, Lake Guulanello (Roma), 15. 10. 1974, F. G. Margaritora leg. 14. Italy, Monterotondo, fish pond, (Roma), 28. 1. 1977, F. G. Margaritora leg. 15. Netherlands, Tacht rond IJsselmeer, Haven Elbury lamperdonek, 4. 6. 1948, De Vos leg. 16. Netherlands, Ven Rolderveld (DR), 21. 7. 1977, E. Notenboom leg. 17. Norway, Ostensjovand, slide F 8933, Mp 116, ex coll. Zool. Museum Oslo, G. O. Sars leg. 18. Norway (south), ex coll. Zool. Museum, Oslo, cat. number F 18690, G. O. Sars leg. 19. USA, Missouri, Jasper pond 5, 9. 7. 1985, W. R. Mabee. 20. USSR, Glubokoe lake, 15. 7. 1974, N. M. Korovehinskij leg. 21. USSR, Glubokoe lake, 25. 8. 1980, N. M. Korovehinskij leg. 22. USSR, Rybinsk reservoir, Suda river, 20. 6. 1979, V. N. Sergeev leg.

Ilyocryptus spinosus sp. nov.

Ilyocryptus sordidus, Romijn, 1919, part., Int. Rev. g. Hydrob. u. Hydrogr., 8: 529–539, Figs 21–22.

Ilyocryptus sordidus sordidus, Sturnov, 1976, part., *Macrothricidae i Momidae fauny mira*. In: Fauna SSSR, Rakoobraznye, T. I, Vyp. 3, Izd. Nauka, Leningrad, p. 48, fig. 13 PB — sensu Romijn (1919).

Etymology: spinosus, a, um (latin) = pointed, thorny

Type locality: German Democratic Republic, Kremmener See (near Berlin), 0.75–1.00 m depth. The original Hartwig's label named the locality: Kremmer See. Dr. Gruner and Dr. Flössner (pers. com.) consider this name to be the mistake and must be changed to Kremmener See, near town Kremmen.

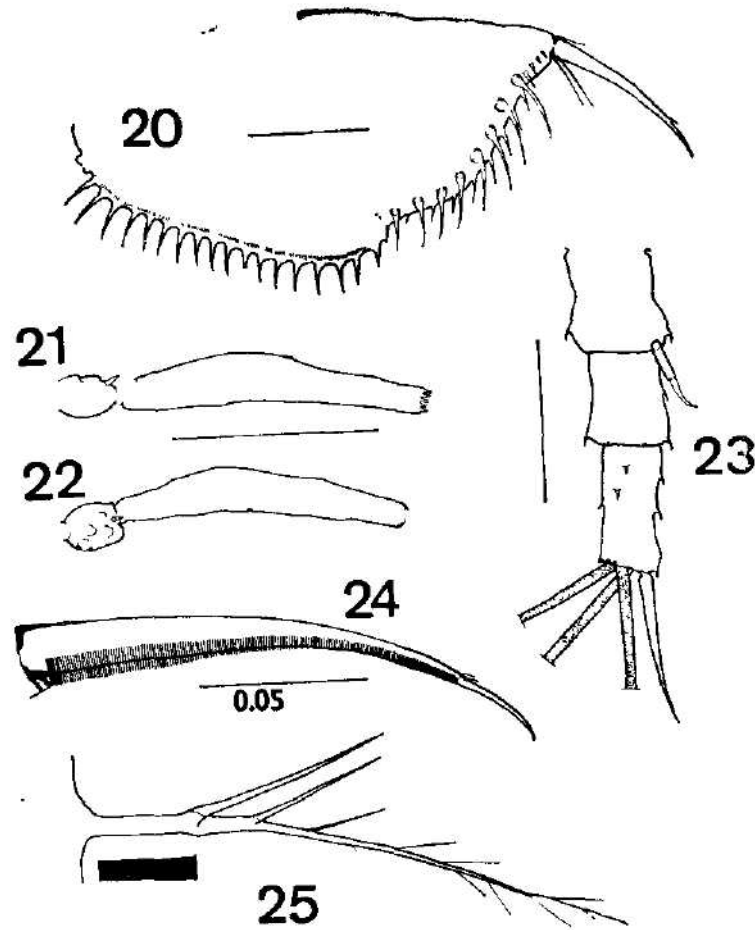
Holotype: A parthenogenetic female 0.86 mm long, stained with lignin pink and chlorazol black E, mounted in Canada balsam on slide labelled: "*Ilyocryptus spinosus* sp. nov. Štifter, Holotype, parthenogenetic female, German Democr. Republic, Kremmener See (near Berlin), 0.75–1.00 m depth, 8. 11. 1897, W. Hartwig leg. Deposited in Zoologisches Museum für Naturkunde der Humboldt-Universität, Berlin, G. D. R., catalogue number: 3973.

Paratypes: 2 parthenogenetic females mounted individually, one female dissected. The slides have been placed in collection of Zoologisches Museum für Naturkunde der Humboldt-Universität Berlin, G. D. R., catalogue numbers: 3974, 3975 (dissected).

Diagnosis: large form, old carapaces and headshields are retained; Antennal exopod with reel-shaped segments, the second segment of antennal exopod with long

spine; preanal part of postabdomen with row of many gracile and long spines; Claw with 1-2 small and thin spine near its tip; Defensive posterior spines of carapace even, the basal unbranched part long.

Differential diagnosis: The combination of the characters on postabdomen's preanal part, thin spine on the distal tip of the claw and the length of the spine on second segment of antennal exopod is typical for the species. *I. spinosus* sp. nov. can be considered similar to the species *I. brevidentatus* Ekman, 1905 in some characters: morphology of labrum, antennal exopod but these two species differ very markedly in armature of postabdomen — character of spines on the preanal part and also in length of moveable lateral denticles (they are very short in *I. brevidentatus*) according to the figures and descriptions of Ekman (1905) and Sars (1909). Further comparison of differential characters in Table 1.



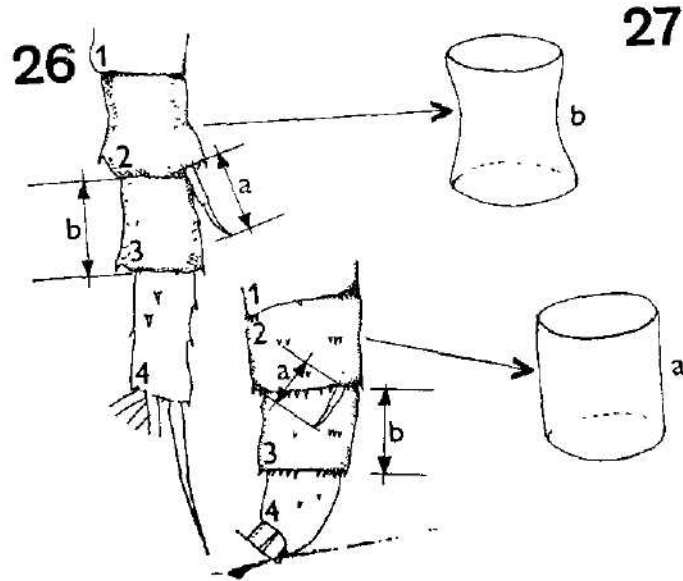
Figs. 20-25 *Ilyocryptus spinosus* sp. nov., parthenogenetic female. 20 — postabdomen, 21 — antennule (lateral aspect), 22 — antennule (anterior aspect), 23 — distal segments of antennal exopod, 24 — claw, 25 — defensive posterior spine of carapace; 20, 21, 23: GDR, Kremmener See, 8. 11. 1897; 22, 24, 25: GDR, Stechlinsee, Neuglobsow, 10. 7. 1967.

Table 1. Some morphological differences among *Ilyocyrtus sordidus*, *I. canebatus* sp. nov., *I. spinosus* sp. nov., *I. silvaceolucensis*.

Parthenogenetic female	<i>I. sordidus</i>	<i>I. canebatus</i> sp. nov.	<i>I. spinosus</i> sp. nov.	<i>I. silvaceolucensis</i>
Antennal exopod				
1) ratio: length of spine on the second segment to the length of third segment (Fig. 26)	smaller than or equal to 0.5	smaller than or equal to 0.5	larger than 0.5	larger than 0.5
2) segments of exopod (Fig. 27)	cylindrical	cylindrical	reel-like	reel-like
Postabdomen				
3) preanal part (Fig. 7a)	arched, with row of single spines on postanal part only	arched, with row of mostly doubled spines on the preanal part near anus	arched, with row of single spines on postanal part only	straight, short, with row of doubled spines on postanal part only
4) moveable marginal denticles (Figs. 7b, 14a)	absent	present	present	present
5) spine(s) near the distal tip of claw (Fig. 8a)	absent	present	present	present
Defensive posterior spines				
6) general view	short, markedly curved	long, direct	long, direct	long, direct
7) ratio: basal widthness of the spine(s) to the length of unbranched proximal part (b) (Fig. 12)	1 : 1 to 1 : 2	1 : 8 to 1 : 10	1 : 6	1 : 3 to 1 : 5

Description:

Mature parthenogenetic female: Carapace similar to other *Ilyocryptus* species, seen laterally, subtriangular, wedge-shaped. The moulting incomplete, old carapaces and headshields are retained. Spines on posterior margin of carapace long with 2-3 branches and distally with sporadic setulation, with long distance between base and



Figs. 26, 27. Scheme. 26 - Antennal exopod: a - length of spine on the second segment, b - length of third segment, 27 - Form of exopodial segment: a - cylindrical, b - reel-like.

the first branching (Fig. 25). Head triangular, short. Headshield broad. Labrum with conspicuous protrusion in the middle of ventral margin. Antennule two-segmented, the first segment with the finger-shaped protrusion and four protuberances second segment long, maximal width in its middle (Figs. 21, 22). Antennal setae formula: 0-0-0-3/1-1-3 and spine formula: 0-1-0-1/0-0-1, spine on the second segment of antennal exopod longer than one half of the third exopod's segment, each segment of endo- and exopod slightly reel-shaped with sporadic denticulation (Fig. 23). Postabdomen large, preanal margin markedly longer than postanal one, with 17-19 long thin, curved spines. Along preanal part near the base, of spines two lateral rows of very fine spinulation (Fig. 20). Postabdominal claws long, slightly curved with two long basal spines and 1-2 small thin spinules on the dorsal margin near tip of claw (Fig. 24).

Colour: only preserved material was studied and colour of specimens is similar to the other preserved material of other species of the genus so we can assume that specimens of *I. spinosus* sp. nov. are also red due to the content of hemoglobin.

Sexual female: unknown.

Male: unknown.

Size: Mature parthenogenetic female 0.67-0.87 mm length.

Range: There are a few informations about distribution of *I. spinosus* sp. nov. Known localities are quite distant (G. D. R., England, U. S. S. R., Czechoslovakia).

This fact shows that the species is probably widely distributed over the northern Europe but more rarely than species *I. sordidus* and *I. cuneatus* sp. nov.

Habitat: The specimens of the species *I. spinosus* sp. nov. were collected together with *I. acutifrons* and *I. sordidus* (U. S. S. R., Rybinsk reservoir, Suda river), *I. cuneatus* sp. nov. (England) and *I. agilis* (G. D. R. — type locality).

Material examined: 1. Czechoslovakia, Central Bohemia, Čelákovice, Procházkova pool, 1. 5. 1957, V. Kořínek leg. (slide with postabdomen only). 2. England, Cumbria, Berner End Tarn, G. Fryer leg. 3. G. D. R., Krenmener See (near Berlin), 8. 11. 1897, W. Hartwig leg. 4. G. D. R., Neuglobsow (near Potsdam), Stechlinsee, 10. 7. 1967, D. Flossner leg. 5. U. S. S. R., Rybinsk reservoir, Suda river, 20. 6. 1979, V. N. Sergeev leg.

Key to the mature parthenogenetic females of Palearctic
Ilyocryptus — modified key of Chirkova (1982)

- 1 (4) Anal opening close to terminal claws
- 2 (3) 5–7 pairs of moveable lateral denticles on the distal part of postabdomen; 17–27 spines on the preanal part of postabdominal margin..... 1. *I. vitalis* Chirkova, 1982
- 3 (2) 14–16 pairs of moveable lateral denticles along the whole dorsal margin of postabdomen 2. *I. acutifrons* Sars, 1862
- 4 (1) Anal opening approximately median
- 5 (6) Carapace with one pair of perspicuous horn like protuberance; 12–18 spines on the preanal margin of postabdomen, their tips are bent backwards (except the first one or two spines 3. *I. cornutus* Mordukhai-Boltovskoi et Chirkova, 1972
- 6 (5) Carapace without horn-like protuberances
- 7 (8) Moulting perfect — old carapaces and head-shields are not retained..... 4. *I. agilis* Kurz, 1878
- 8 (7) Moulting imperfect — old carapaces and head-shields are retained
- 9 (12) Preanal part of postabdomen with row of single spines
- 10 (11) Preanal part of postabdomen with 17–19 thin spines. Segments of antennal endo- and exopod slightly reelshaped; claw with one or two short thin spine near the distal tip 5. *I. spinosus* sp. nov.
- 11 (10) Preanal part with single spines. No short thin spine near the distal tip of claw..... 6. *I. sordidus* Lévén, 1848
- 12 (13) Preanal part of postabdomen large, rounded, with row of 8–12 mostly doubled spines. The second antennular segment short, length/width ratio: 3.4–7.8; spine on the second segment of antennar exopod short 7. *I. cuneatus* sp. nov.
- 13 (12) Preanal part of postabdomen short, straight, with 5–8 doubled spines. The second antennular segment thin, long, length/width ratio: 8–9; Spine on the second segment of antennal exopod long 8. *I. silvaeducensis* Romijn, 1919

Notes to geographical distribution and conclusions

The examined material confirms that all three mentioned species *I. sordidus*, *I. cuneatus* sp. nov. and *I. spinosus* sp. nov. are distributed over Europe (*I. cuneatus* also in the U. S. A.). The largest known area belongs to the species *I. cuneatus* sp. nov. (probably Holarctic), *I. sordidus* was found in Europe north of the Alps only. A few informations about distribution of *I. spinosus* sp. nov. give anticipation that the species is widely distributed over northern part of Europe. More precise studies of larger material and more detailed knowledge of geographical distribution are necessities for better understanding of variability of the species and its evolution within the genus *Ilyocryptus*. Studies of *Ilyocryptus* c. f. *sordidus* (Štifter 1984, present paper) and description of two new species confirm the conclusion of prof. Frey (1985) that in Cladocera: "cosmopolitan species are groups of morphologically similar species."

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**A NEW AENICTOPECHINE BUG FROM TASMANIA (HETEROPTERA,
ENICOCEPHALIDAE)**

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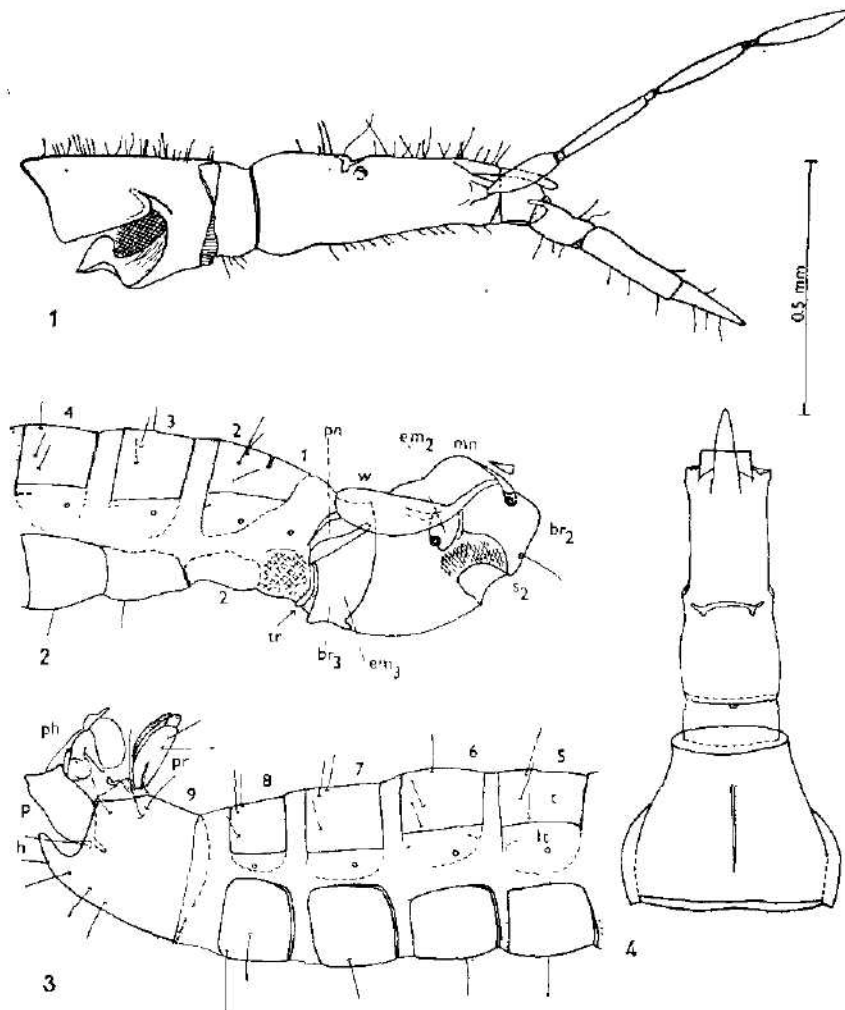
Abstract. *Nymphocoris hilli* sp. n., ♂ (Heteroptera, Enicocephalidae), a second Australian species of the subfamily Aenictopechinae, is described from the summit of Mt. Wellington in Tasmania. The genus *Nymphocoris* Woodward, 1956 has been previously known from New Zealand only, and this is the first case when a species of any of the New Zealand endemic genera of enicocephalids has been found extraliminally. Several structural peculiarities of *Nymphocoris*, unique among the Aenictopechinae, Enicocephalidae or Heteroptera (distribution of pilosity of head, construction of prothoracic collum, position of thoracic spiracles, armature of legs, male terminalia), are described and discussed in detail.

Woodward (1956) revised the fauna of Enicocephalidae of New Zealand, and described on that occasion three endemic genera of the relic subfamily Aenictopechinae. The attribute "relic" has in this case most of the usually accepted meanings: poor in species, of restricted and fragmented distribution, and possessing extremely plesiomorphic features. The subfamily is probably paraphyletic, and re-assessment of the morphology and relationships of New Zealand genera is in my opinion essential for our understanding of the phylogeny and classification of all the "lower Heteroptera". For this reason an extensive, unpublished, and not yet completed study of these genera has been undertaken (the finer points of the morphology of non-New Zealandese aenictopechines are much better known, see e.g. Štys, 1980). The present paper is the first result of this study; its by-product, to be precise, since it concerns a new aenictopechine species discovered in Tasmania, the first extralimital species of any of the genera so far thought to be endemic to New Zealand.

The species described here belongs to the genus *Nymphocoris* Woodward, 1956, of which only the variable and probably polytypic micropterous species *N. maoricus* Woodward, 1956 occurring on both North and South Islands of N. Z. has been known so far. The background knowledge of the latter species enabled me to appreciate some peculiar character of the newly described species which are here discussed, and are mostly genus-specific rather than species-specific; some of them are unique among the Aenictopechinae or even the other Enicocephalidae, and probably do not occur in the Euheteroptera.

The isolated description of the new species has been prompted by the necessity to mention it in a treatment of Heteroptera in a newly prepared edition of the manual "The Insects of Australia". Though the Australian fauna of enicocephalids is rich in (mostly undescribed) species, it largely consists only of species of the subfamily Enicocephalinae. The species described in the present paper is only the second aenictopechine bug of the Australian fauna. The below list of the Eastern Hemisphere species of the Aenictopechinae illustrates the disintegrated distribution of this subfamily which is probably real rather than apparent:

Aenictopechys necopinatus Breddin, 1905 — Java; *Australostolus monteithi* Štys, 1980 — Australia (S. A., N. S. W.); *Boreostolus sikhotalinensis* Wygodzinsky & Štys, 1970, — Soviet Far East; *Lomigostus jeanneli* Villiers, 1958 — Madagascar; *Maoristolus parvulus* Woodward, 1956 and *M. tonnoiri* (Bergroth, 1927) — New Zealand; *Nymphocoris hilli* sp. n. — Tasmania, and *N. maoricus* Woodward, 1956 — New Zealand. (Classification of *Aenictocoris powelli* Woodward, 1956 from New Zealand in the Aenictopecheinae is, in my opinion, open to doubt.)



Figs 1-4. *Nymphocoris hilli* sp. n., ♂ paratype. 1 — Head with appendages and pronotum. 2 — Pterothorax and proximal part of abdomen. 3 — Distal part of abdomen. All in lateral view (legs and mesotrochantum dissected), and as a whole showing the whole insect (arthrodial membranes inflated due to maceration). Acetabula cross-hatched; metacetabulum (and hence also the region of abdominal sternum 1) not clearly seen because of non-dissected remnants of coxa. 4 — Head and pronotum, dorsal view; pilosity omitted. All figures to the same scale.

Lettering: br₂ — mesothoracic precoxal bridge; br₃ — metathoracic precoxal bridge; em₂ — mesepimeron; em₃ — metepimeron; h — hypandrial extension of pygophore; lt — abdominal laterotergite; mn — mesonotum; p — paramere; ph — phallus; pn — metapostnotum; pr — proctiger; s₂ — mesosternum; t — abdominal mediotergite; tr — metatrochantine.

Nymphocoris hilli sp.n.

(Figs 1-4, 6-31)

Etymology: named in honour of Dr. L. Hill, collector of the species.

Material examined: Holotype, ♂, Tasmania, Mt. Wellington (summit, 1250 m), borderate of tussocks of *Poa* grass, mainly, 25 x, 1979, L. Hill leg. Paratype, ♂, same data (dissected, terminalia and right legs kept separately). Both specimens preserved in alcohol, holotype deposited in the collection of Division of Entomology, CSIRO, Canberra, paratype in the Department of Zoology, Charles University, Praha (coll. P. Štys).

Description and measurements are based on the paratype in order to preserve the holotype intact.

Measurements (all in mm; L — length, W — width) Head, anterior lobe 0.30, W across antenniferous tubercles 0.17, W in front of eyes 0.16, transocular W 0.185, interocular W 0.16; posterior lobe: L 0.21, max. W 0.20, neck, L 0.095. Antenna, L segment I 0.14, II 0.24, internode II, III 0.03, III 0.18, internode III/IV 0.02, IV 0.20. Labium, L segment I 0.06, II 0.095 (ventrally), III 0.21 (thickness in lateral view 0.06), IV (0.14). Pronotum: total L 0.36, L collum 0.05, L middle lobe 0.29, L posterior lobe 0.02, max. W 0.37, max. W incl. dorsally visible parts of propleuron 0.44. Fore leg: femur, L 0.45, max. W 0.22; tibia, max. L 0.32, max. W 0.15; tarsus, L 0.13, max. W 0.07, longer claw, L 0.12. Middle leg: femur, L 0.32, max. W 0.12; tibia, max. L 0.24, max. W 0.08 (longest spine, L 0.03); tarsus, L 0.12, max. W 0.05; longer claw, L 0.09. Hind leg: femur, L 0.44, max. W 0.16; tibia, max. L 0.41, max. W 0.095 (longest spine, L 0.085); tarsus, L 0.15, max. W 0.05; longer claw, L 0.11. Pygophore, ventral L 0.24.

Total length (paratype, somewhat macerated) 2.83 mm.

General shape, pilosity, cuticle as described by Woodward (1956) for *N. maoricus*. Coxae and thoracic sterna with spinously wart-like microsculpture, outline of these areas hispid when seen in profile (the spinous microtrichia could easily be mistaken for setigerous tubercles, the latter, however, absent). Laterotergal areas of abdominal terga with numerous serrate microtrichial combs and so distinguished from smooth mediotergal areas. Pilosity short and oblique, but with many long erect setae as illustrated or described.

Coloration. Pale yellowish brown with a greyish tinge (holotype; the paratype pale orange due to maceration), unicolorous.

Head, antennae and labium as illustrated (Figs 1,4). Eyes formed by a single, elongate ommatidium. Shallow postocular constriction provided with strong, transverse, laterally complex apodeme, directed towards eyes, and dorsally associated with primary chaetotaxy (Fig. 24). Postocular lobe ventrally bare, but "neck" ventrally pilose (see Discussion). Second labial segment with a proximodorsal extension, third 3.66 times as long as thick.

Pronotum (Fig. 4) dorsally subdivided into a well delimited collum, large middle lobe with a not completely percurrent, linearly impressed median, and an extremely short posterior lobe. Propleuron as illustrated (Fig. 1; for construction of collum see Discussion).

Forewings (Figs 2,6) very short, reaching the apex of metanotum, proximally stalked, distally turning mesad, apically rounded, not forming any commissure, contacting each other by their rounded apices. Mesoscutellum not definitely delimited. Mesopleuron (Fig. 2) sharply subdivided into precoxal bridge (= mesepisternum & sternum) and small mesepimeron; mesosternal part of the bridge with a pair of long setae.

Both pairs of thoracic spiracles (Fig. 2) situated on mesopleuron (see Discussion). The anterior (mesothoracic) spiracle on a sclerite below the base of forewing; the latter sclerite homologous to mesothoracic prealar bridge and preceded by a triangular sclerite of unknown homology situated in prothoracic-mesothoracic

arthrodial membrane. The posterior (metathoracic) spiracle on posterior margin of mesepimeron. All spiracles large, circular, crater-shaped, similar in shape and size.

Metapleuron as illustrated (Fig. 2); metepimeron well delimited.

Sternal thoracic region not studied; no indication of metathoracic or basiabdominal scent apparatus observed. All acetabula with large trochantines.

¶Trochanteral and femoral sense organs (Figs 12, 13, 16-18). Each leg with (a) posterior trochanteral organ formed by irregularly shaped campaniform sensilla scattered discally on posterior surface of trochanter (5 on fore leg, 6 on middle and hind legs - one of the latter might have been mistaken for a socket of a broken-off seta), (b) anterior trochanteral organ of irregularly shaped campaniform sensilla situated on anterior trochanteral surface near dorsal trochantero-femoral junction (5-6-6 sensilla respectively), (c) condylar trochanteral organ situated on the anterodorsal surface of trochanter near its articulation with coxa, and formed by small, circular campaniform (?) sensilla provided on fore leg with minute pegs (5-3-3 sensilla respectively), and (d) anterior femoral organ (posterior one not developed) situated on the anterodorsal facies of femur near its trochanteral edge, and formed by small circular campaniform (?) sensilla, their row on fore leg being interrupted by a seta (3-4-3 sensilla respectively). Number

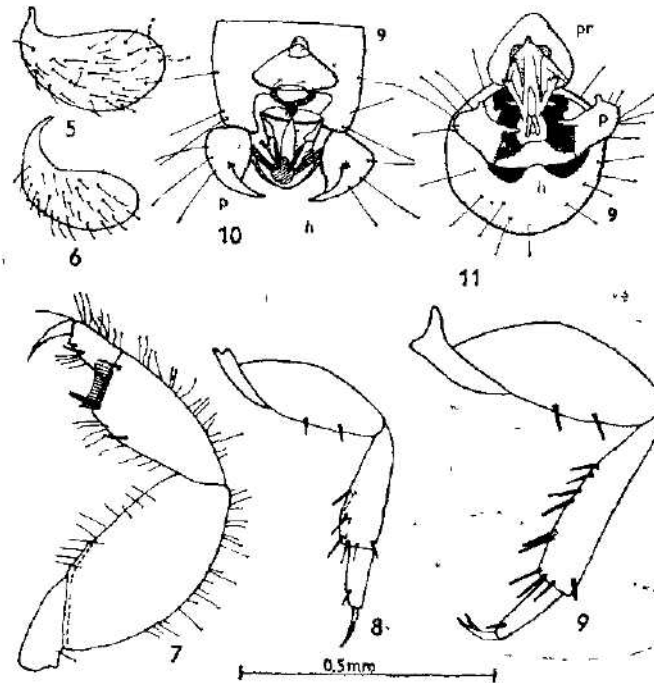


Fig. 5. *Nymphocoris maorvus* Woodward, ♂. Figs 6-11 *Nymphocoris hulli* sp. n., ♂ paratype. 5, 6 - Left forewing: most exposed view. 7 - Right fore leg: anterior view. 8, 9 - Right middle (8) and hind (9) leg: posterior view, trichoid setae not illustrated. 10, 11 - Terminalia in situ: dorsal (10) and posterior (11) view; phallus situated between the parameres, supporting ring of segment 10 shown in Fig. 10. All figures to the same scale.

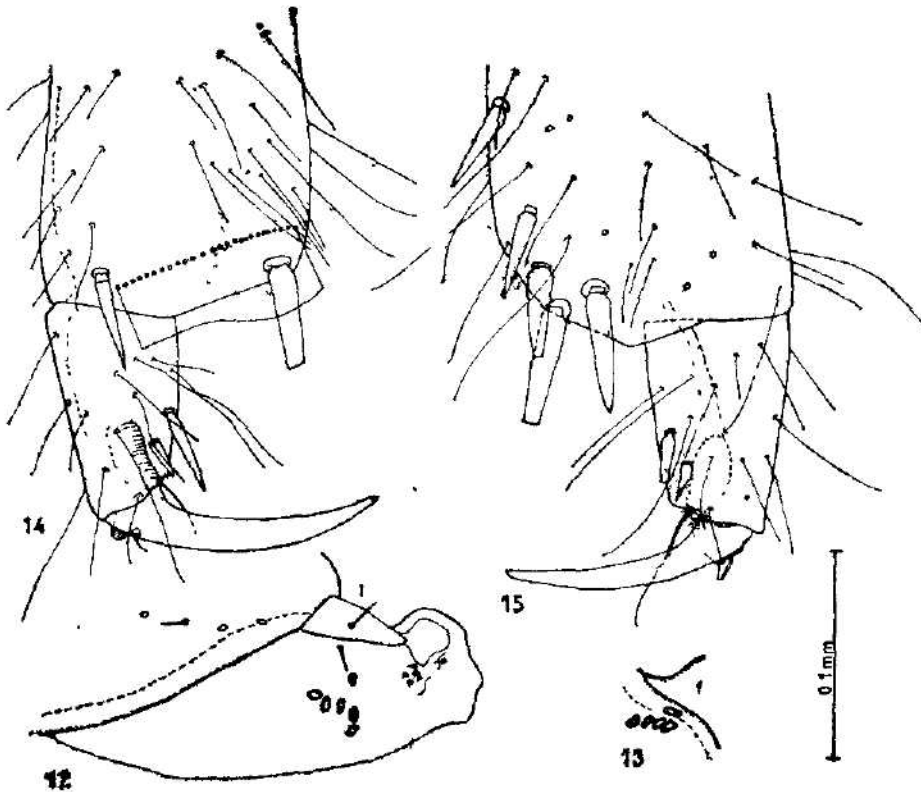
Lettering: h - hypandrial extension of pygophore; p - paramere; pr - prostigter.

and position of sensilla identical on middle and hind legs except that the anterior femoral sensillum on hind leg is missing.

Fore leg (Figs 7, 12–15). Trochanter with an isolated dorsal sclerite. Femur strikingly thick, without spines. Tibia as illustrated (Figs 7, 14, 15), with 7 spines: one proximal pre-apical and one distal pre-apical (both on posteroventral facies), three subapical to apical (on posteroventral facies), one apical (anteroventral), and one apical (antero-subdorsal) situated at the dorsal end of an anterior comb of 26 setae. Ventral apex of tibia not produced. Tarsus one-segmented, with 1 + 1 proximoventral thin spines, and 1 + 1 subapical, ventral, shorter and thicker spines.

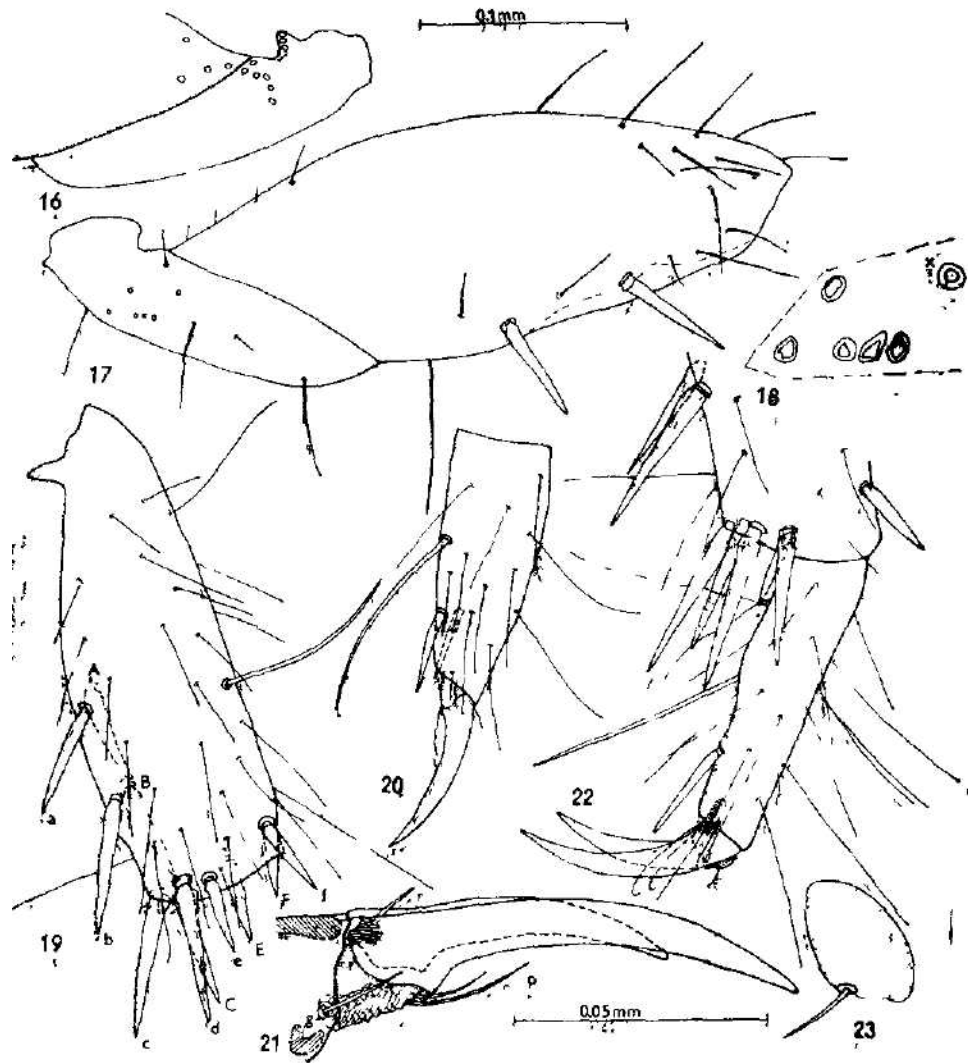
Claws moderately curved, the anterior one slightly longer than the posterior one, but anterior parempodial seta distinctly shorter than the posterior parempodial seta. Arolium bladder-like, occupying all the space between the unguitactor plate and claws, proximodorsally produced in a tubercle which bears a single, short aroliar seta.

Middle leg (Figs 8, 16–21). (Chaetotaxy of posterior facies as illustrated, that of anterior facies of femora and tibiae denser.) Femur incrassate, ventral surface



Figs 12–15. *Nymphocoris hilli* sp. n., ♂ paratype; right fore leg (cleared). 12 – Trochanteral and basifemoral sense organs, anterior face. 13 – Posterior trochanteral organ. 14, 15 – Apex of leg in anterior (14) and posterior (15) view, armature of only the anterior (resp. posterior) facies illustrated (the same for protarsus). All figures to the same scale.

Lettering: f – femur; i – isolated trochanteral sclerite



Figs 16-23 *Nymphocoris hilli* sp. n., ♂ paratype; right middle (16-21) and right hind (22, 23) leg, cleared. 16 - Trochanteral and basifemoral sense organs of middle leg, anterior facies. 17 - Trochanter and femur of middle leg; posterior view. 18 - Posterior trochanteral organ of middle leg. 19 - Middle tibia; posterior view. 20 - Middle tarsus and pretarsus; posterior view; long and thick tarsal seta single, tarsal spine paired; shorter anterior claw not illustrated. 21 - Middle pretarsus, posterior view. 22 - Apex of hind leg, posterior view, both long tarsal seta and tarsal spine single. 23 - Arolium of hind pretarsus. Armature of anterior facies of tibia and tarsus dashed in Figs 19, 20, 22. Figs 16, 17, 19, 20, 22, and 18, 21, 23 to the same scale respectively.

Lettering: a, b, c, d, e, f - posterior spines of middle tibia; A, B, C, E, F - anterior spines of middle tibia; g - claw guard seta, pr - parempodial seta, r - aroliar seta; x - campaniform sensilla or socket of a broken-off seta?

bearing on posterior edge 2 long and thick spines forming a longitudinal series with long trichoid setae; outline of ventral margin simple. Tibia flattened and thick, with 11 strong spines distributed as follows (Fig. 19): ventral pre-apical: 2 posterior (a, b) and 2 anterior (A, B); apical: 4 posterior (c,d,e,f) and 3 anterior (C,E,F). Spines a,b,c and A,B,C forming two longitudinal series. No apicitibial combs. Tarsus one-segmented (no trace of a small basal segment), tapering distad, apex re-inforced by dorsal and ventral thickenings of the cuticle; ventral surface with 1 single, strikingly long mesal seta (no trace of a long proximoventral seta usually occurring on first tarsal segment), and with 1 + 1 subapical spines, markedly different from "normal" trichoid setae; small 1 + 1 "claw guard setae" situated apicilaterally near the bases of claws.

Claws almost straight, only apically bent, the anterior one shorter and associated with also shorter anterior parempodial seta (note the difference from fore tarsus!), Arolium large, with a dorsally directed aroliar seta, rising out of a sclerotized structure.

Hind leg (Figs 9, 22, 23). (Chaetotaxy not illustrated in detail, except for spines, and trichoid hairs of the tarsus). Femora thicker, but tibiae thinner than on middle legs. Femur with 2 ventral spines on posterior facies; spines forming a longitudinal series with long trichoid hairs; ventral outline of femur simple. Tibia slightly concavely bent, altogether with 12 spines distributed as follows: ventral preapical series: 3 anterior and 3 posterior; apical ring: 1 ventral, 2 posterior, 2 anterior, 1 posterodorsal (slightly subapical). Tarsus thinner than on middle leg, also one-segmented, with a single ventral, mesal, long and rather thick trichoid seta, and only a single (unpaired!) subapical ventral spine; claw guard setae in the same position as on middle leg.

Pretarsus essentially as on middle leg, but claws more curved, and the difference between shorter anterior claw and longer posterior one less pronounced (the same is true for shorter anterior and longer posterior parempodial setae); arolium larger, its seta not arising from any differentiated structure.

Pregenital abdomen (segments 1-8; Figs 2,3) only slightly sclerotized, segments of a non-inflated abdomen moderately telescoped, all plates pilose. Mediotergites 1 & 2 fused, delimited by an incomplete transverse impression. Mediotergites 3-8 simple, each with a transverse subdistal row of 3+3 erect setae. Laterotergites continuous with mediotergites, differentiated from them by the presence of serrate microtrichial combs; boundaries of laterotergites not sharply demarcated. No trace of scent gland opening or of its scar on mediotergite 4. Sternum 1 and laterotergite 1 absent. Sterna 2-8 simple, 2-4 not separated by arthrodial membranes, 3-7 with 1+1 long erect setae each, 8 with 2+2 setae. Segment 8 unmodified.

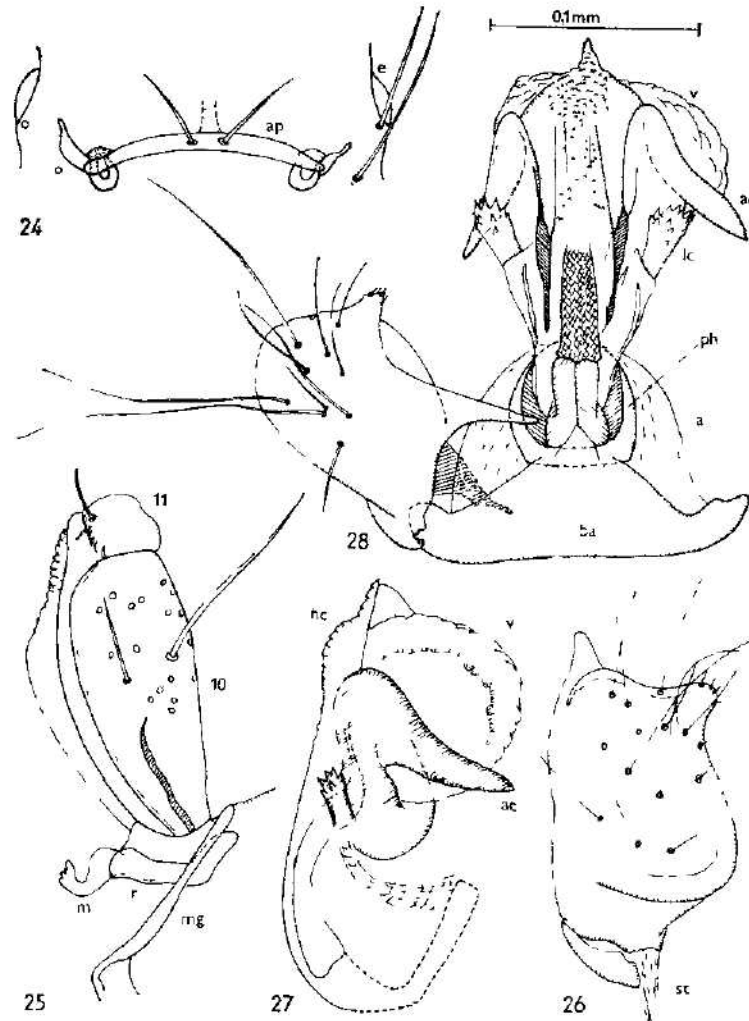
Abdominal spiracles 1-8 present, isomorphic; spiracle 1 in the area where laterotergite 1 would normally be expected (not shifted dorsocephalad!), 2-8 laterally on laterotergites (Figs 2,3).

Terminalia (Figs 3, 10, 11, 25-31) symmetrical. Studied in situ unless otherwise stated; also orientation described as in situ (for natural position see Fig. 3).

Pygophore (Figs 3, 10, 11) subcylindrical, its dorsal bridge very broad and broadly excised posteriorly, the resulting pygophoral lobes with a minute but strongly sclerotized apodeme at the mesal angle (Fig. 11); ventral part produced into a simply convex hypandrial extension slightly rising dorsocaudad (Fig. 3); many long erect setae arranged in a ring.

Proctiger (Figs 3, 10, 11, 25, 29) strikingly large and conspicuous. Segment 10

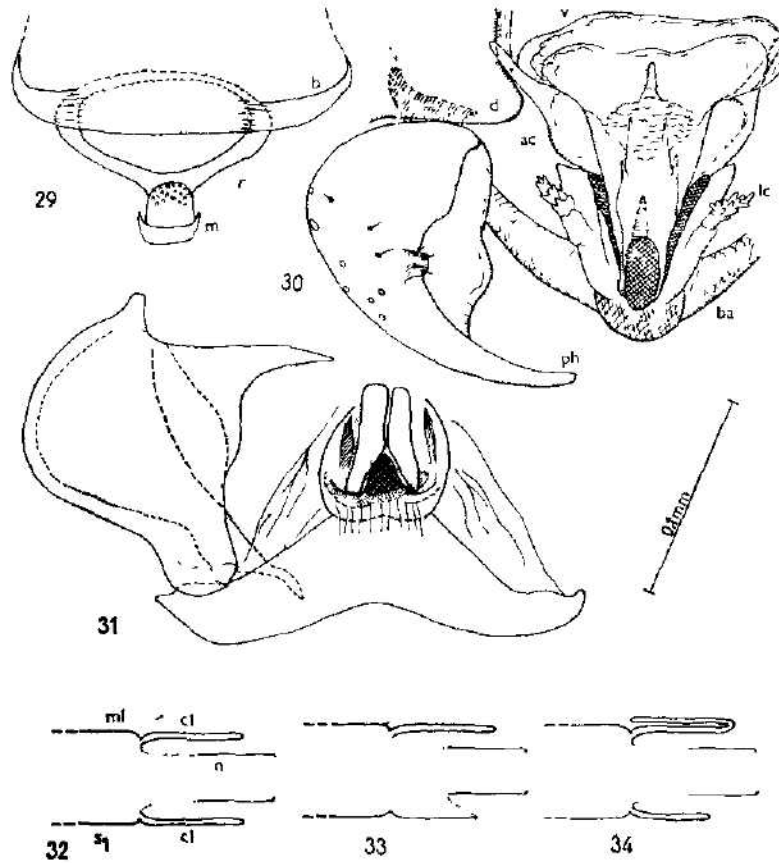
long, large, vertically erect, subrectangular in lateral view, triangular in posterior view, well sclerotized, trough-shaped. its posterior (morphologically ventral) part membranous, lateral margins bordered by desclerotized hyaline fringes; pilosity long and conspicuous; with a pair of longitudinal basilateral apodemes. Segment 11 short, membranous, with 1+1 setae only.



Figs 24–28. *Nymphocorishalla* sp. n., ♂ paratype. 24 – Eyes, interocular apodeme and associated primary setae. 25–28 – Terminalia (cleared): 25 – Proctiger and associated structures in situ; lateral view. 26 – Right paramere in situ; lateral view. 27 – Phallus in situ, lateral view (proximal part situated within pygophore and covered by parameres, and hence its structure not clearly seen). 28 – Phallus and left paramere in situ; posterior view. All figures to the same scale.

Lettering: a – aula; a – anteromesal process of conjunctiva; ap – interocular apodeme, ba – basal apparatus; e – eye; fr – hyaline fringe of segment 10; hc – hyaline plate of conjunctiva; lc – latero posterior process of conjunctiva; m – medial projection of supporting ring; mg – margin of exension of pygophoral bridge; ph – phallotheca; r – supporting ring; st – basal ligament (or stalk ?) of paramere; v – vesica.

Proximal part of segment 10 topographically associated with a subhorizontal supporting ring (homology unknown) situated under the base of segment 10 within the excision of the pygophoral bridge, and formed by a strongly sclerotized ring (through which the rectum might pass) produced caudad into a still more sclerotized, denticulate median projection (shape as in Figs 25, 29) which is possibly



Figs 29–31 *Nymphocoris halli* sp. n., ♂ paratype; terminalia (cleared). 29 – Supporting ring of segment 10; dorsal view. 30 – Phallus and left paramere in situ, dorsal view. 31 – Left paramere (setae omitted) and proximal part of phallus; posterior view – approximately as in Fig. 28, but illustration more realistic since drawn from a detached organ. All figures to the same scale.

Figs 32–34. Diagrams represent schematic sagittal sections through posterior part of head ("neck") and anterior part of pronotum (apodemes not shown). 32 – Modal situation in both Eneocephalidae and Euheteroptera. 33 – Interpretation of the situation in *Nymphocoris halli*. 34 – As 33, another (rejected) alternative. Continuous line – sclerotized cuticle; dotted line – membrane.

Lettering: b – base of segment 10, cl – collum of prothorax; d – dorsomesal process of pygophore; ml – middle lobe of pronotum; n – cephalic neck; s₁ – prosternum. Other symbols as in Figs 24–28.

Table 1. Salient diagnostic characters of *Nymphocoris* species

	<i>N. hilli</i> sp. n., ♂	<i>N. maoricus</i> Woodward, ♂
Antennae	shorter and thicker	longer and thinner (great variation!)
Labium	shorter and thicker; segment 3 shorter than antennal segment 2, ratio of its length: max. thickness 3.7	longer and thinner; segment 3 longer than antennal segment 2, ratio of its length: max thickness about 4.3
All femora and tibiae	thicker	thinner
Middle femur	2 ventral spines (proximal, distal), ventral outline simple	1 ventral spine (proximal); ventral outline microdenticulate
Hind femur	2 ventral spines (proximal, distal)	1 ventral spine (distal)
Fore tibia	altogether 7 spines (1 apical anteroventral)	altogether 8 spines (2 apical anteroventral)
Middle tarsus	1+1 spines (on both anterior and posterior facies)	1 single spine (on posterior facies)
Distribution	Tasmania	New Zealand

connected through a ligamentose plate (not shown in my illustrations*) with the basal apparatus of phallus.

Parameres (Figs 26, 28, 30, 31) very large, mobile, pilosity and shape as illustrated, with 2 mesal processes: distal process long, narrow, bare, pointed; proximodorsal process short, tubercle-shaped, with 4 minute trichoid sensilla. The base of paramere directly articulating with dorsolateral apex of arm of the basal apparatus of phallus, and emitting (at a point anteroventrad to this articulation) also a long mesal apodeme (shown in Figs 28, 31) and thus embracing lateral arm of the basal apparatus also from anteroventral side. Ental part of paramere deeply excavate. The base of paramere also with a ligament (or a fine stalk?); its association not ascertained.

Phallus (Figs 27, 28, 30, 31) situated between parameres, dorsad of hypandrial extension (Figs 10, 11), caudad of segment 10 and the "supporting ring", essentially external, with posterior and dorsal facies fully exposed. At least the distal parts of phallus seem partly inflatable, and the phallus, which seems to be subdivided into modal heteropteran parts, has been studied only in fully inflated state (anterior facies not studied, and many details not clear — see partly contradictory illustrations of some structures drawn in different views).

Basal apparatus (= articulatory app.) compact, undivided, triangular, with long, produced lateral arms associated with bases of parameres; base distant from posteroventral margin of pygophore and free of it. Phallosome enclosed in and connected with basal apparatus by a membranous aula; phallosome subsphaerical, with lateral and dorsal (posterior) pairs of sclerites; the latter contacting each other and only basally divergent, and there embracing an anteriorly (internally)

*) Existence of this connection was pointed out to me by late Prof. R. H. Cobben whose observations on *Nymphocoris* species will be later incorporated in a joint paper.

situated, heavily sclerotized apex of basal apparatus produced into a pair of indistinctly delimited arms embracing the base of phallosome (see Fig. 31 of a dissected phallus; this whole structure may be a part of phallosome rather than of basal apparatus).

Conjunctiva with an unpaired posterodorsal sclerite proximally associated with the dorsal pair of phallosomal sclerites; the former sclerite (internal ? external ?) forming a part of a vaulted membranous dorsomedial wall of conjunctiva which bears some minute denticles, is distinct from more lateral (simpler and not vaulted) parts, and extends distad into a thin hyaline plate terminated by a spinous projection (see Fig. 27) - both are covered by minute denticles to microserrate comb-like ridges. The proximal part of conjunctiva with 2 pairs of processes: shorter, lateroposterior processes 2-segmented, proximal segment membranous, distal one strongly sclerotized, and with many short and broad denticles as illustrated; anteromesal processes strongly sclerotized, proximally narrow, distally widening into a paramere-like, bird-head-shaped extension with an anterolaterally directed, pointed and tapering apex. Vesica apparently inflatable, situated anteriorly of the hyaline plate of conjunctiva, formed by a membranous funnel-like structure, with an extensive, gaping, crater-like terminal opening; details difficult to interpret.

Seminal duct, ejaculatory reservoir (if present) and ejaculatory duct not observed. The exact mutual associations of vesica, conjunctiva and phallosome remain obscure to me.

Differential diagnosis. The salient diagnostic characters of the males of both *Nymphocoris* species are summarized in Table 1. Excepts for details in armature of legs they are formulated rather in general comparative terms, since a morphometric study of the very variable populations of *N. maoricus* from New Zealand and of terminalia of this species (which show species-specific differences) has not yet been completed. Surprisingly, the complex armature of spines on middle and hind tibiae is identical in both species, only the ventral spines of hind tibiae are more clustered and shifted more ventrad in *N. maoricus*.

DISCUSSION

(a) Pilosity of posterior lobe of head and neck

In all the enicocephalids the ventral (as well as dorsal) part of the posterior lobe of head is pilose, while the "neck" of the head (i.e. its most proximal, constricted and sharply delimited polished part, fully or partly telescoped within the pronotum) is glabrous like in all the other Heteroptera. The reverse situation in *Nymphocoris* (posterior lobe of head ventrally bare, ventral part of "neck" pilose - Fig. 1) is unique, and suggests that the "neck" cannot be retracted into the pronotum. This situation is possibly correlated with the unique formation of the prothoracic collum as discussed below.

(b) Prothoracic collum (Figs 32-34)

The anteriormost collar-like part of the prothorax, the collum, is developed in both Enicocephalidae and the Euheteroptera as a double-walled cuticular extension, ring-like, best delimited on the pronotum, but also developed laterally and ventrally, and often well delimited from the prosternum (Fig. 32).

The dorsal part of collum in *Nymphocoris hilli* is apparently normally developed, but the collum is twisted laterally (Fig. 1), and its lateroventral and ventral parts

probably are single-walled, overturned and extending cephalad over the most proximal part of the cephalic neck (Fig. 33). Such situation is unusual, but I do not know whether it is unique to *Nymphocoris* or whether it has been overlooked elsewhere. Another possible interpretation (Fig. 34) would be that the most anterior part of the dorsum of collum is overturned back and its ventral part is normally double-walled; however, I reject this alternative on the basis of observation of a cleared specimen. No histological sections have been executed.

(c) Position of thoracic spiracles

The described position of thoracic spiracles in *Nymphocoris hilli* is unusual, if not unique. The embryonically mesothoracic and metathoracic spiracles usually move cephalad in the Heteroptera, and take an intersegmental position.

The anterior spiracles are usually circular in outline, and they are situated in the prothoracic-mesothoracic arthrodistal membrane; in *Nymphocoris* they are situated on mesothoracic pre-alar bridge. A position close to the latter was observed in the Stemmocryptidae (cf. Štys, 1983), but the anterior spiracles are nevertheless clearly intersegmental in the latter dipsocoromorphan family.

The posterior (metathoracic) pair of spiracles usually moves between the mesothorax and metathorax. It is situated in the intersegmental membrane in more primitive taxa, but in the more advanced ones the respective membrane is sclerotized, and the originally metathoracic spiracle is associated with the mesopleuron (e.g. in Nepomorpha: cf. Parsons, 1970). However, the metathoracic spiracle is fully mesopleural in position in *Nymphocoris* as clearly seen in a macerated specimen with a strongly inflated mesothoracic-metathoracic arthrodistal membrane; this spiracle in *Nymphocoris* retains its plesiomorphic rounded shape while it is mostly crevice-shaped in the more advanced terrestrial bugs.

(d) Pronotum

Woodward (1956) stated that the pronotum of *Nymphocoris mauricus* is "bilobed". In reality and in contrast to usual characterizations of the subfamily Aenictopecheinae, the pronotum of *Nymphocoris* and all the other genera of the subfamily is tripartite, but the posterior lobe of pronotum is extremely short (Fig. 4) and hardly or not at all distinguished in the lateral outline of pronotum.

(e) Legs

Only several points will be emphasized. *Nymphocoris* is the only genus of Enicocephalidae in which (a) middle and hind femora bear spines, (b) fore, middle and hind tibiae possess pre-apical spines (my earlier statement (Štys, 1983) on the absence of non-terminal spines in the whole family was erroneous), (c) armature of spines is present besides fore tarsi also on middle and hind tarsi, and (d) tarsal spine may be single (hind tarsus of *N. hilli*, middle and hind tarsus of *N. mauricus*), and not paired as usual. Moreover, *Nymphocoris* is the only genus of Aenictopecheinae with all the tarsi one-segmented (non-segmented); Woodward's (1956) observation on the presence of an extremely short, basal segment on middle and hind tarsus in *N. mauricus* was erroneous. All these characters are apomorphic, and they sharply separate *Nymphocoris* from the rest of the subfamily.

The excessive armature of spines in *Nymphocoris* apparently is an adaptation to the edaphic mode of life; all its legs, including the fore ones, actually are fossorial. Dense concentration of spines on the dorsal process of tibiae and on tarsi of fore raptorial legs and on the apices of middle and hind tibiae in "normal" enicocephalids

can be considered a preadaptation for burrowing; the spreading of already existing structures (spines) along all tibiae and onto the middle and hind femora and tarsi as well, together with incrassation of all femora and tibiae could have converted raptorial and walking legs of normal enicocephalids into efficient fossorial organs. The conversion of a trichoid seta into a thick spine probably is a one-step event as evidenced by comparison of middle and hind femora in *Nymphocoris maoricus* and *N. hilli* (see Table 1). Thin trichoid setae form a longitudinal series including spines in both the species, but in the latter, in this respect more apomorphic taxon, some of the trichoid setae are replaced by thick spines.

The subjects of pedal proprioceptors (briefly mentioned by Štys, 1986a) and various kinds of asymmetry of the pretarsus (see a.g. Štys, 1986a, b) in the Enicocephalidae will have to be reviewed in a separate publication.

(f) Terminalia

Also the structure of terminalia sets *Nymphocoris* apart from the other Aenictopecheinae. Its strikingly long and conspicuously protruding proctiger is unique among all the Enicocephalidae; its supporting, intersegmentally situated ring is an organ of unknown homology and function, without parallel in any heteropteron. (Previewing my study of *Nymphocoris maoricus* the enlarged proctiger as well as presence of the supporting ring are male characters only (apparently autapomorphies of the genus); the female proctiger is small as in other enicocephalids, and it lacks the supporting ring. On the other hand, the ovipositor of *Nymphocoris* is the most plesiomorphic among the Enicocephalidae, retaining all the usual heteropteran components; also the valvifers of the 8th segment are individualized and developed as a pair of free sclerites, which is a unique situation in all enicocephalids so far examined.)

While a presence of a well-developed, externally situated phallus in *Nymphocoris* conforms to the modal situation in the Aenictopecheinae, its partial inflatability and subdivision into regions comparable to those characteristic of Eutheteroptera is different from the other aenictopecheines and, again, probably is plesiomorphic. Also no other enicocephalids possess paired phallic appendages.

(g) Position in classification

The characters mentioned sub (a), (e) and (f), viz. reverse distribution of pilosity on the posterior lobe of head and cephalic neck, armature of legs, and construction of both male and female terminalia sharply differentiate the genus *Nymphocoris* not only from the rest of the Aenictopecheinae but from the other Enicocephalidae as well.

The phylogenetic significance of this wide phenetic gap and of the classification of this genus will be assessed only when my studies of other odd genera occurring on continental islands of the South-Western Pacific and Southern Indian Ocean will have been completed.

Addendum

Concerning terminalia (descriptive part; Discussion, f). The situation of phallus in *Nymphocoris* possibly only seems "external" owing to its inflation in the cleared specimen and partial inflation in all the other originally alcohol-preserved material. If the phallus in resting position is situated within the cavity of the pygophore, the condition in *Nymphocoris* still more resembles that found in Eutheteroptera.

Concerning higher classification (introductory part; Discussion, g). I have recently (Štys, 1989: *Práce slov. entomol. spol.*, Bratislava, 9, in press) reclassified the Enicocephalomorpha. Two distinct families, the Aenictopecheidae and Enicocephalidae s. restr., are accepted, and the former includes the subfamilies Nymphocorinae (for *Nymphocoris*), Maoristolinae (for *Maoristolus*), Aenictopecheinae s. restr. (*Aenictopechys*, *Lomagostus*, *Australostolus*, *Boreostolus*, American genera) and Murphyanellinae (two genera described as incertae sedis by Wygodzinsky & Štys, 1982: *Acta entomol. bohemoslov.*, 79: 12–142 from Singapore). This information should not be understood as an attempt to establish the respective new family-group taxa in the present paper.

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I am greatly indebted to Dr. L. Hill (Australian National Park and Wildlife Services, Canberra) for study the two specimens of *Nymphocoris hilli* collected by him in Tasmania. The kind assistance of Ms Clare Butcher (CSIR, Auckland) and Dr. R. T. Schuh (Department of Entomology, AMNH, New York) enabled me to examine an extensive material of recently collected New Zealand enicocephalids originally on loan to Dr. P. Wygodzinsky (AMNH). The actual work on *Nymphocoris hilli* was carried out while I was working in the Department of Entomology, Agricultural University, Wageningen (The Netherlands), and my thanks are due to late Prof. R. H. Cobben for arranging my stay, providing all the facilities, and discussing with me various morphological problems involved. Dr. K. Schmidt (Simon's Rock College, Great Barrington, USA) has kindly provided information on pilosity of head of American genera of enicocephalids. My thanks for technical assistance to Miss I. Bozděchová.

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REVIEWS

Ride, W. D. L., Younés, T.: *Biological Nomenclature Today*. IRL Press, Oxford (UK), 1986. 70 pp., 5 S (approxim.)

"Biological nomenclature is fundamentally important to international scientific communication. By adopting its standards for self-regulation in nomenclature, all biological scientists, whether they be bacteriologists, botanists, virologists or zoologists, can arrive at and use the same name for the same taxon." These wise words in introduction open the thin book from which it is possible to get excellent information on the modern state of nomenclature in botany, zoology, bacteriology, plant virology and mycology. It is based on papers presented at ICSEB III (International Congress of Systematic and Evolutionary Biology) held in Brighton (UK) in July, 1985.

The chapter on zoological nomenclature has been written by W. D. L. Ride, President of the International Commission on Zoological Nomenclature and Chairman of the Editorial Committee of the 3rd Edition of the International Zoological Nomenclature. It is a very useful reading composed from paragraphs on "Aim and Key Elements of the Zoological Code", "History of Zoological Nomenclature", "Updating and Improving the Code", "Pressures for Change", "Improvements Sought in Support of Changing Taxonomic Procedures and Theory" and "Improvements Sought by Non-Taxonomists Users of Names".

Let us see in more detail what are these pressures for change and improvements. As to the operational improvements they are: 1. Improvers are seeking automatic solutions to issues such as those resulting from the discovery that stability of a name will be upset because its type has been misinterpreted in the past. 2. Most zoologists find unnecessarily burdensome the scholastic adherence in the Code to the extent that the names must conform to the requirements of Latin grammar of which few zoologists today, or in the future, can be expected to have any understanding. 3. There are an interesting number of users of names of organisms in more than one kingdom (such as ecologists, protistologists etc.) and they seek harmonization between the Codes. (To this point see below.) 4. Regarding today's changing technology of printing and publications the operational issues of zoological nomenclature — whether the description of species is valid or not, are growing for change.

Otherwise, the Linnaean binominal system has proved to be sufficiently robust to survive several major revolutions in taxonomic theory. The most serious of these was even of evolutionary biology. Nevertheless proposals have been made, from time to time, to replace the binominal system by accretionary systems of naming. These are mostly numerical but some have been unimominal. Apart from the fact that the replacement of existing names would be a huge task, and numerical identifiers are non-memorable, such systems suffer from the disadvantage that a direct relationship between the name and the highly controversial information that is designed to convey would produce names that are unstable by comparison with the names of the Linnaean hierarchy allocated through the type principle and independent of taxonomy. Also the present revolution in taxonomic methodology, produced by the extensive development of cladistic taxonomy, might be expected to produce pressures for change.

On the other hand, it need not be neglected that in recent years, ecology and conservation have produced a multitude of new users who are not taxonomists and, in fact, many users are legislators far removed from science and who are intolerant of obscure scientific arguments that create instability in names that they have to relay.

Very interesting is the comparison made by C. Jeffrey, a Principal Scientific Officer at the Royal Botanic Gardens, in his chapter "Some Differences between the Botanical and Zoological Codes". (International Code of the Botanical Nomenclature appeared in 1983, Third Edition of International Code of the Zoological Nomenclature in 1985.)

What are these differences? In short: 1. The Codes assert their mutual independence — a name that may be properly used for a taxon under one Code may be a later homonym under the other; (thus *Pieris brassicae* — a butterfly, can with perfect nomenclature propriety pollinate *Pieris ovalifolia* — an ericaceous shrub). 2. Different criteria for valid publication or availability are specified by the two Codes: (for example, Latin diagnoses are generally required as a condition of valid publication in botany, but are not needed in zoology). 3. The name of species may not be a tautonym in botany, but tautonyms are permitted in zoology at the species rank (f.e. *Bubo bubo*). 4. The coordinate status of names at family-group and species-group levels in zoology is to be contrasted with a restricted autonym rule in botany. 5. The concept of illegitimacy in botany, restricting the application of the priority criterion is not found in zoology. 6. Different starting point dates and works are operative in botany (1753, 1801, 1820, 1840, 1866, 1892, 1900) and zoology (1758). 7. Recent non-fossil names have priority over fossil names in botany. 8. Later homonyms are to be rejected under both Codes, but the application of the homonymy

criterion differs profoundly between the Codes. (In botany, the different combinations formed by the same specific epithet with different generic names are considered to be different species names, while in zoology, the different binomia formed by the allocation of the same specific name to different generic names are considered only as different combinations, not as different specific names.) 9. In botany, the earliest name given to the perfect state in pleiomorphic fungi has priority for the holomorph; no such rule exists in zoology for pleiomorphic animals. 10. The two Codes differ in their concepts of the way in which the type method acts as a link between names and taxa. The Zoological Code regards the nominal taxon as the concept, objectively defined by its type and denoted by an available name, one or more of which may be referred to any taxonomic taxon, whereas the Botanical Code regards the type as the objective criterion common to all applications of a given name. 11. The rule of orthography and gender names, and for orthographic correction, differ in the Codes. (For example, the standard endings for the names of higher taxa differ.) 12. Different provisions exist in botany and zoology for the conservation and rejection or suppression of names and works. 13. Rules for the nomenclature of hybrids form part of the Botanical Code, whereas the nomenclature of hybrids is excluded from the Zoological Code.

C. Jeffers closed his chapter as follows: "it should be clear from the above review that the differences between the Botanical and Zoological Codes are far from insignificant, and that any change in either towards a unified Code would result in so many name changes in one and other of the disciplines that unification would be less convenient for biologists than continuation of the admittedly imperfect status quo."

In "Aspects of Zoological Nomenclature" R. V. Melville, Secretary of the International Commission on Zoological Nomenclature from 1968 - 1985, discussed the principle of coordination and the nominal taxon of Jeffers' point mentioned above.

(With the exception of introductory and Jeffers' resum ing sentences, words and lines presented above have been taken directly from the text of the book for sure and correct interpretation of facts, without parenthesis.)

In summary, essential information and excerpts from zoological chapters presented above seem to show clearly that this thin and cheap booklet under review is very usefull and highly recommendable for all zoologists; but not only for them.

J. Chalupský

J. Weiser, Z. Mráček: *Parazitické hlístice hmyzu. (Parasitic nematodes of insects)*. Publ. House Academia, Praha 1988, 256 pp., 75 Figs., 38 Tables. Price 50. — Kčs.

The nematodes represent a helminth group known before all as causative agents of important diseases of man, animals and plants. In the last years, their antagonistic relations to insect pests are studied more and more. The achieved results show that these parasitic organisms can become perspective means for biological control. Their use for the regulation of insect pests numbers without application of toxic substances, contaminating the environment, is a question of near future. This publication, written by two prominent Czechoslovak specialists, will contribute just to this aim, to the application of entomopathogenous nematodes in the control of various insect pests in agriculture, forestry and medicine.

The short introduction is followed by a text giving basic information about the phylum Nematoda and its classification after Maggenti (1981) in which the class Adenophorea with 2 subclasses (Enoplia, Chromadoria), 12 orders and 87 families, and the class Secernentea with 3 subclasses (Rhabditia, Spiruria, Diplogasteria), 8 orders and 96 families are recognized. Members of 27 families are facultative or obligatory parasites of insects or show phoretic relations to this group. The next chapter deals with external morphology and anatomy of nematodes, the following one is devoted to physiology (growth, feeding, digestion, respiration, excretion, osmoregulation, locomotion). Various types of life cycles and the course of infection are discussed in further text on examples of individual species representing the most important families. The authors devote their attention also to problems of nematode specificity, characteristic of the infection, role of bacteria and defense reactions of insects against nematodes. Special chapters concern the ecology of entomophilic nematodes (role of biotic and abiotic factors, influence of pesticides, biotope preference, zoogeographic distribution, migration), their cultivation and methods of their investigations in the field and laboratory. For the practice important are data on the use of various nematodes against pests in agriculture, orchard cultures, forestry, and disease vectors. The most comprehensive chapter deals with the classification of insect nematodes including the families Mermithidae, Tetradonematidae, Rhabditidae, Steinernematidae, Heterorhabditidae, Syrphonematidae, Carabonematidae, Panagrolaimidae, Oxyuridae, Thelastomatidae, Diplogasteridae, Aphelenchoididae, Nectylenchidae, Sphaerulariidae, Allantonematidae and Fergusobiidae. The most important characteristics are given for the families, their genera and individual species, together with recommended literature. The book closes with a 18-page list of references and a subject index.

The publication is well arranged, the matter is lucidly presented, numerous illustrations — both drawing and photos — and tables complement suitably the text. This is a valuable book for all who are interested in the investigations of insect nematodes. No doubt it will serve as an indispensable source of information on the present state and perspectives of this new field of science. The authors are to be warmly congratulated.

V. Černý

**VĚSTNÍK
ČESKOSLOVENSKÉ
SPOLEČNOSTI ZOOLOGICKÉ**

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V Praze 1988

ACADEMIA

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V taxonomických pracích dodržujte zásady, ustanovení a doporučení mezinárodních pravidel zoologické nomenklatury.

V rukopisu nepředpisujte zásadně žádné typy písma, označte pouze tužkou po straně části, které mají být vysazeny petitem.

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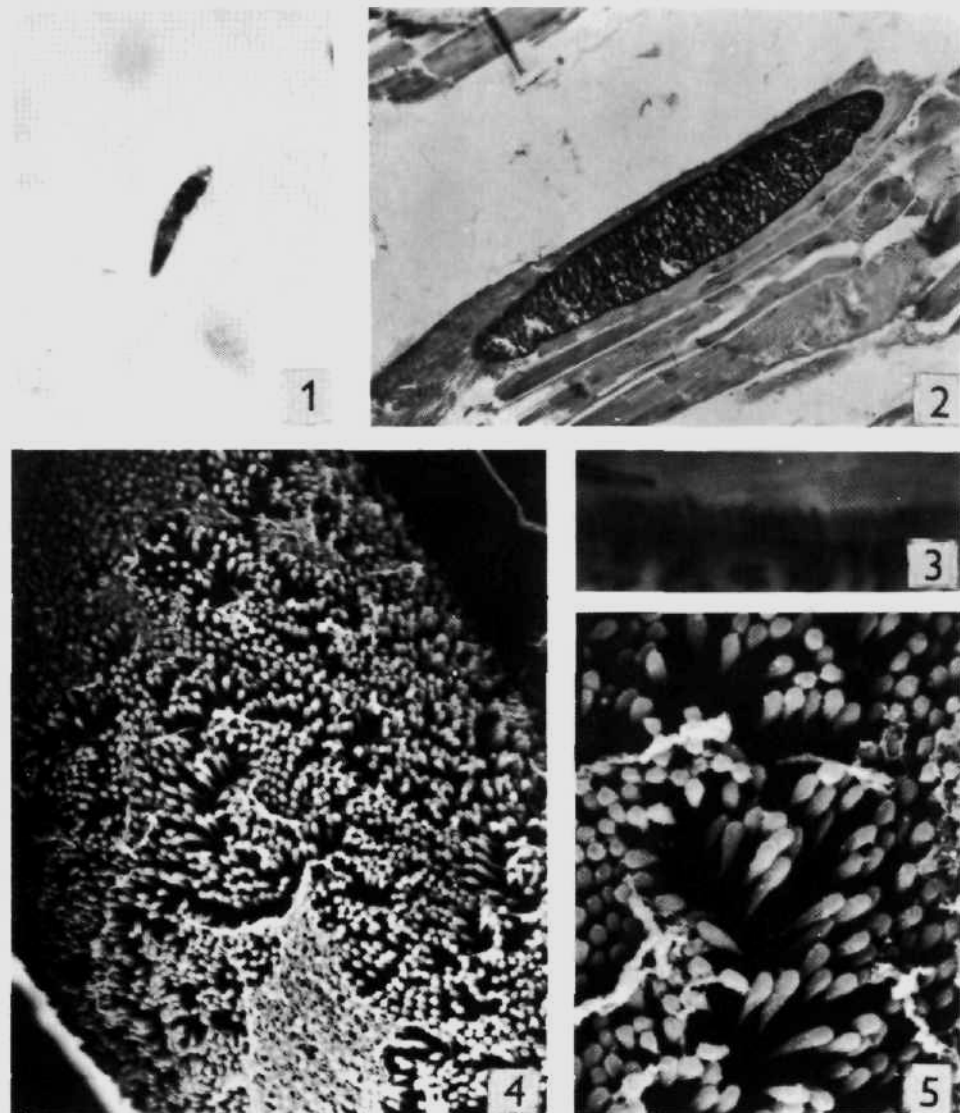


Plate I. *Sarcocystis* sp. from pheasant. Fig. 1. Cystozoite, Giemsa ($\times 1200$). Fig. 2. Muscle cyst, Harris'hematoxylin ($\times 120$). Figs 3-5. The wall of muscle cyst with well-visible finger-like protrusions. 3. The light microscope, Harris'hematoxylin ($\times 1250$). 4,5. The scanning electron microscope 4. $\times 1400$, 5. $\times 3440$

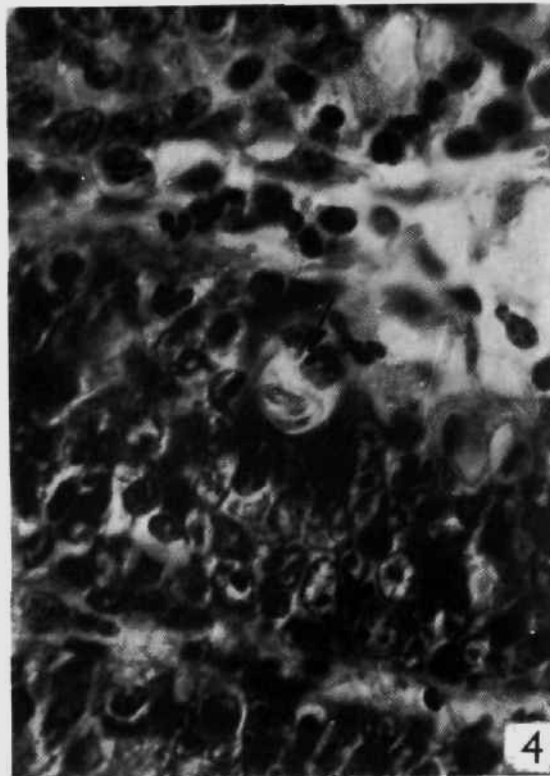
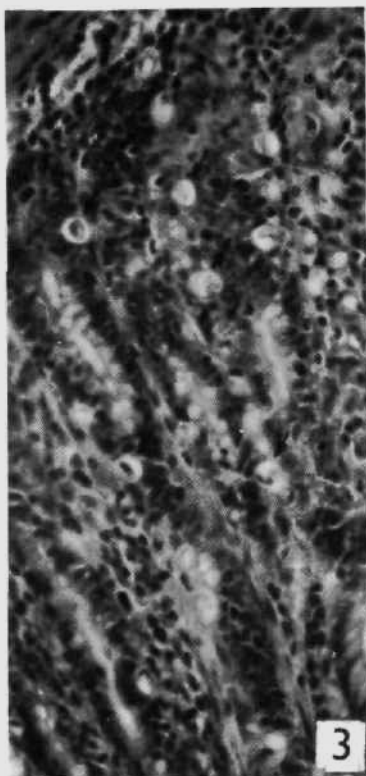
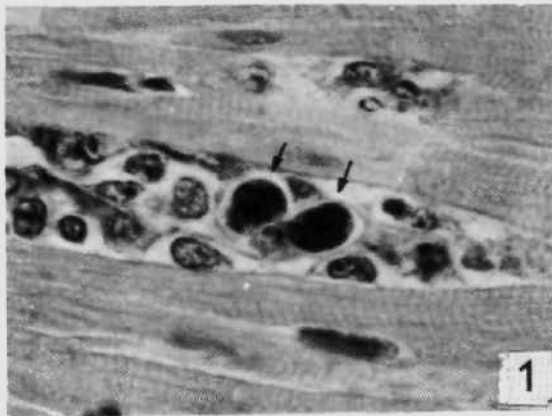


Plate II. Stages of the life cycle of *Sarcocystis* sp. from pheasant. Fig. 1. Two meronts in the capillary of the heart muscles at 8 DPI., Heidenhain's hematoxylin ($\times 1350$). Fig. 2. Oocysts from faeces of experimentally infected dog. ($\times 1390$). Figs. 3, 4. Histological sections through the small intestine of the dog with oocysts at 10 DPI, Harris hematoxylin. 3. The whole view on oocysts in the small intestine. Arrows denote some of them ($\times 280$). 4. Detail of a sporocyst with well-visible sporozoites ($\times 710$).

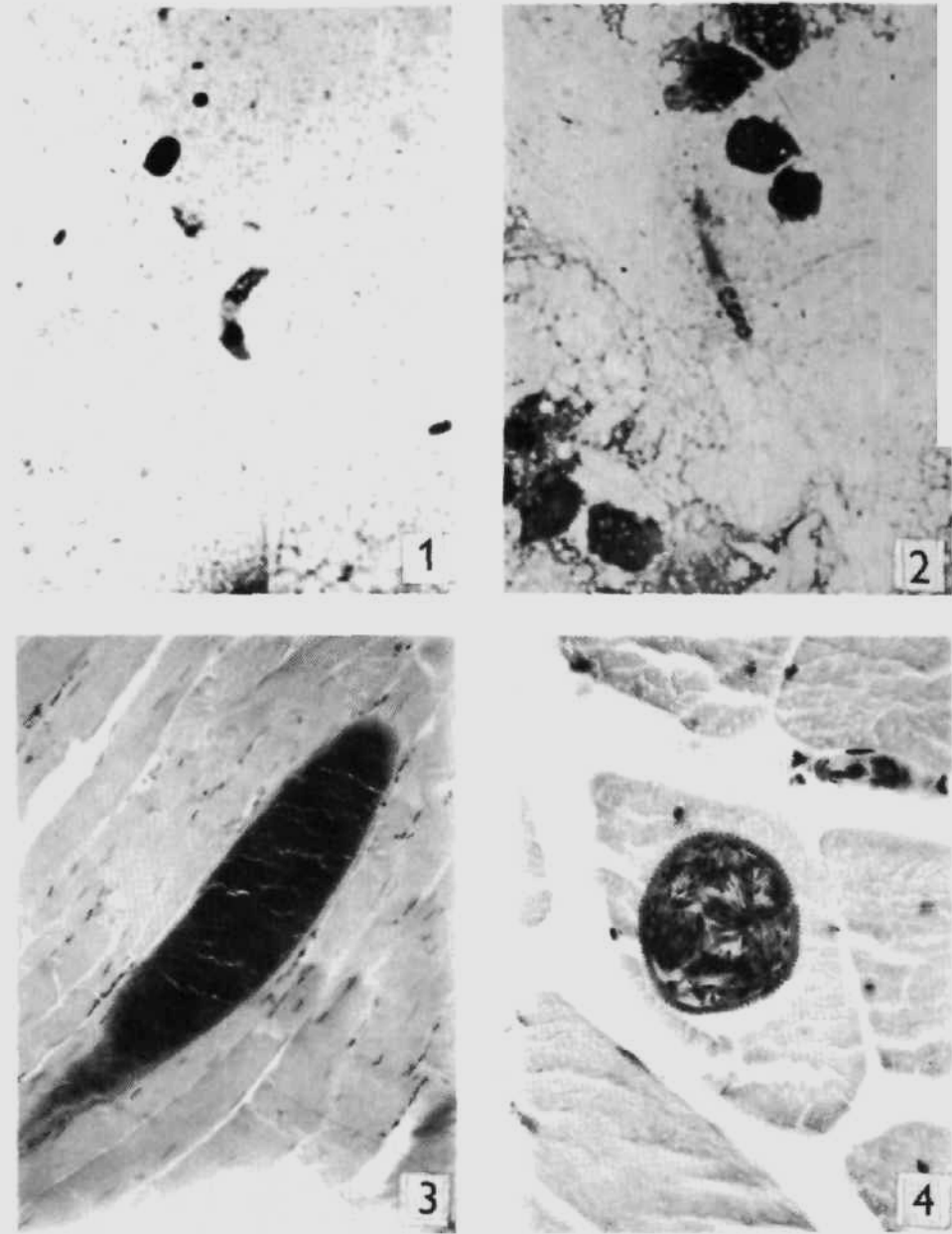


Plate III. Fig. 1. Cystozoite of *Sarcocystis horwathi*, Giemsa ($\times 1140$). Fig. 2. Cystozoite of *Sarcocystis* sp. from hen, Giemsa ($\times 1690$). Fig. 3. Muscle cyst of *Sarcocystis horwathi*, Heidenhain's hematoxylin ($\times 180$). Fig. 4. Muscle cyst of *Sarcocystis* sp. from hen Heidenhain's hematoxylin ($\times 500$).

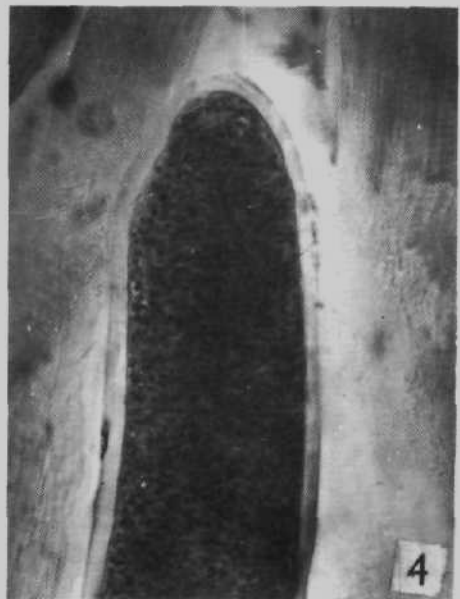
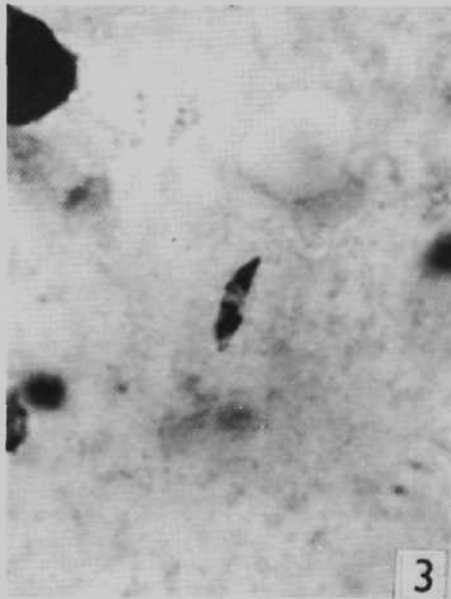
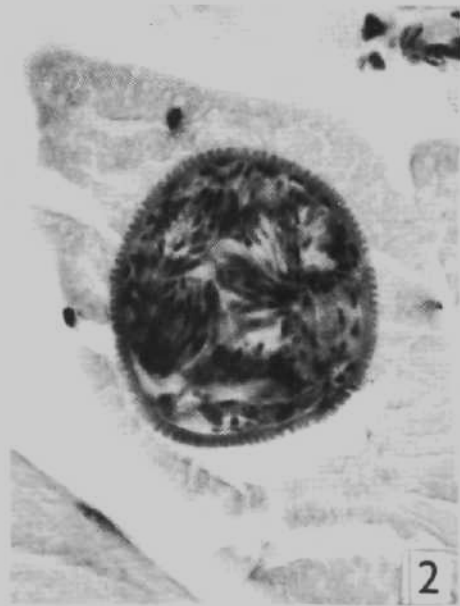
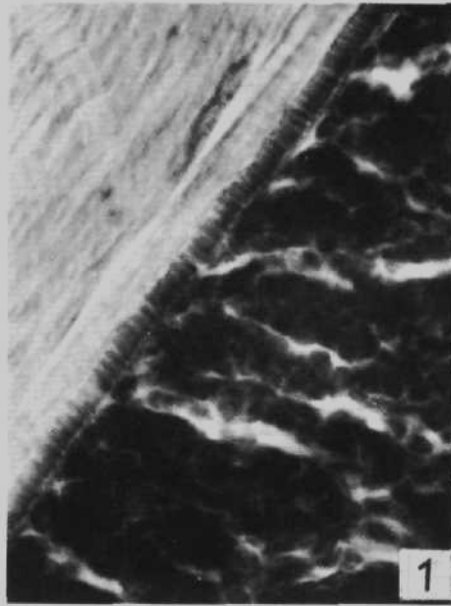


Plate IV. Figs. 1, 2. Detail of sarcocysts from infected hens, Heidenhain's hematoxylin. 1. *Sarcocystis horwarhi* ($\times 1000$). 2. *Sarcocystis* sp. ($\times 850$). Figs. 3, 4. *Sarcocystis* sp. from jay. 3. Cystozoite, Giemsa ($\times 1510$). 4. Part of the sarcocyst in skeletal muscles, Harris' hematoxylin ($\times 650$).