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Laboratory of Fischery Research of Slovak Agricultural Academy, Bratislava, Czechoslovakia

THE INTERVALS OF EARLY FISH DEVELOPMENT AND THEIR TERMINOLOGY

(A review and proposals)

E. K. BALON

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I. INTRODUCTION

As the complete text of this paper was only mimeographed in the announced volume of lectures of "The International Conference of Ageing and Growth of Fishes" (Smolenice 1968) which was finally cancelled in Czechoslovakia, I feel that at least a part concerned with the early development of fish should be published in this form.

Recently increasing interest has been shown in the treatment of the theory of intervals in the life of the fish, and a great number of authors have attempted to make the terminology more precise. Nevertheless we still find in the literature considerable differences concerning the characteristics of the intervals of development and the terms which designate the individual degrees of development. Even in recent books of Mansueti and Hardy (1967) the illogical terminology is often used (egg stage, yolk-sac larva stage, praejuvenile stage) without respect to any of in last decenium published papers* and mentioned proposals (the complete review see in Balon 1958a, 1959b, 1960b).

However, so far such an abundance of material has been amassed that it is possible to trace a plan of the intervals of development from fertilisation to the death of the organism. In order to avoid errors and to be able to compare studies of development, it may be even proposal to unify the terminology and characteristics of each period of development.

II. REVIEW

Even earlier authors (e. g. Vogt, 1842) pointed out that the early development of the fish consisted of several "epochs". But subdivision of the development was carried out mechanically, generally without any exact characterisation and hardly ever complete. Certain terms were chosen but often they designated different periods of development. The English authors called the small fish with yolk sac after hatching prelarva (fry in the salmon species); after the resorption of the yolk sac they called it a larva. Only Kyle (1926) suggested to name postlarva the young fish after resorption of the yolk.

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* Very simple cases found in Mansueti and Hardy (l. c.) Bibliography are cited incorrectly (see Bragensky, 1960; Krevanovski, 1956).

Hubbs (1943) trying to introduce into the USA this "European" terminology for the stages of development suggested the following terms: Embryo — from fertilisation up to hatching; Larva-from hatching to the transition to the juvenile. But he recommends that the latter stage should be divided into prelarva (larva with yolk sac) and postlarva (larva after resorption of the yolk). This latter term should only be used when the larva looks essentially different from the juvenile fish. Alevin — a term for the larva of those species in which no postlarval stages are observed, i. e. secies in which the larva with yolk sac (prelarva) change immediately into young fish (e. g. Salmonidae); and so on. More later he (Hubbs, 1958) proposed even "prejuvenile" to cover the intermediate interval between larval and juvenile form for special modified pelagic developmental stages by some marine fishes (Holocentridae, Branchiostegidae, Chaetodontidae, Acanthuridae). It corresponds with similar proposals of the "metamorphic stage" by Ahlstrom and Couts (1958) and Gehringer (1959).

Balinsky (1948) divides the early development of the carp species into three periods: 1. the embryonic period, 2. the period of non-feeding larvae and 3. the period of feeding larvae. He further divides these periods into 46 stages. Lagler (1956) takes over in essence Balinsky's division of developmental stages, which Winn and Miller (1954) have adapted for American carp species, and also Hubbs' terminology, though slightly altered: 1. larva (pre- and post larva), 2. young, 3. juvenile and so on. Rass (1946) distinguishes four phases in early development: a — spawn, b — prelarva (larva with yolk sac), c — larva (from resorption of the yolk up to the end of the change which coincides with scales formation), d — young fish (juvenis). He further divides the larval phase into two stages: 1. unformed larva, larva I, protopterygiolarva (characterised by the protopterygium or the embryonic fin fold without rays), 2. formed larva, larva II, pterygiolarva (with rays in the unpaired fins D and A).

Vasnecov was the first to divide the early development of fish into intervals which differ from one another not only in structure but also in their physiology and biology. Such an extension enabled his successors to explain and establish a whole series of laws of development and enabled him later to identify with authentic material actual boundaries for the intervals of development and above all to characterise precisely each interval of development. He called these intervals "etaps" (steps). In 1946, Vasnecov drew attention to the theory of etaps for the first time. He and his collaborators treated this thoroughly in the volume entitled "Morphological pecularities determining the feeding of the bream, the caspian roach and the wild carp in all stages of development" (Vasnecov et alii, 1948).

Kryzhanovskij et alii (1953) was the first to characterise precisely those intervals of development which are larger than the steps. He called them periods. In the development of most fish we can distinguish four periods: embryonic, larval, young fish, and sexually mature fish. The embryonic period is characterised by exclusively endogenous nutrition, i. e. the yolk from the yolk sac is the embryo's only food. This period elapses in many fish during the development in the egg membrane and in certain fish (salmonids) sometimes a very long time after hatching. In many fish the whole embryonic period takes place in the egg membrane. Independant collecting of food i. e. exogenous nutrition characterises the larval period. At the beginning of this period the larvae usually feed themselves with mixed nutrition — endogenous and exogenous. They posses temporary larval organs e. g. unpaired fin fold with no skeleton or muscular system, external gills, etc. But they still lack many of the organs which characterise adult fish (e. g. ventral fins, scales, pyloric caeca, etc.). In the juvenile period the larval organs disappear being replaced by organs which characterise the adult fish — typical gill breathing etc., but many organs may still be missing. We can assert that a group of consecutive steps which is characterised by the same qualitative specification forms a period of development.

First we must explain the meaning of the term "stage". According to Kryzhanovskij et alii (l. c.) this term has been correctly used for a long time in agreement with its etymological meaning, indicating any definite moment of development. It is, however, completely wrong to use it, as often done, to indicate several stages or even periods of development e. g. the "embryo stage", "prelarve stage", "larval stage", etc. It is just like using seconds to indicate month or seasons. In embryonology "stage" is used correctly, but in literature about the development of fish the expression is usually used in the wrong sense (Kryzhanovskij, 1956).

Earlier I adopted Vasnecov's theory of developmental steps and Kryzhanovskij's periods without alternation (Balon, 1956, 1958). But later it became apparent that it was better to divide the development into intervals characterised morphologically, in order to achieve a more practical orientation. Therefore was proposed the notion of "phases" (Balon, 1958a, 1959, 1959a, 1959b). Thus we used four terms to indicate separate intervals of development: period, phase, step and stage. The longest interval of development is the period, which is divided into phases; each phase is divided into several steps; "stage" refers only to just observed moment of development. The reciprocal relationship between period, phase, step and stage can be compared to the relationship existing between measurable units of time as day, hour, minute and second.

The embryonic period was divided into three phases: ovular, embryonic and prelarval (Balon l. c.). By "ovular phase" I meant the interval of development within the egg membrane from fertilisation until the beginning of organogenese; but ovulation referring to the processes of egg maturation and division before fertilisation, I have recently found it necessary to propose "cleavage" rather than "ovular" phase. The interval from organogenesis until hatching (within the egg membrane) is called the "embryonic phase". The interval from heatching until the transition to independant feeding is termed the "prelarval phase". The larval period was divided into two phases: protopterygiolarval and pterygiolarval, with the characterisation introduced by Rass (1946). I have suggested some minor alternations for these intervals which will be discussed later when presenting the newly organized developmental system.

Kryzhanovskij (1956, p. 5) criticizing the wrong use of the word "stage" also pointed out the illogical use of terms such as prelarval stage, postlarval stage and so on. According to him, such classification lacked in elementary logic since each moment of development both preceeded the following one and succeeds the preceeding one. If we speak of "prelarva", we should also call "premorula" the stage of two blastomeres; we should also call the blastula "pregastrula" etc. In the same way if we speak of postlarva we should, according to this classification, call the adult fish "postjuvenile". The organism is in each moment of development formed in one respect and not yet formed in another respect. Therefore if we term what preceeded the young fish "unformed young", we should logically call the young fish "unformed adult" and the blastula "unformed gastrula". In the "phase" terminology (Balon, 1958a, 1959a, 1959b) we limited the use of the term "prelarva" to the embryonic period after hatching; we also divided the larval period into unformed and formed larva. But according to the above mentioned criticism, this was completely wrong. "We have not yet noticed the illogicality which this term has brought into our sytem, but it does a great deal of damage and must be removed" (Kryzhanovskij in litt. 30 May 1959).

At the same time we must mention the wrong use of the expression "postembryonic development". This expression is used to indicate the early development after hatching. But in fact it includes the last phase of the embryonic period, larval period, etc. (Balon, 1958). Following the correct terminology we can at best speak of embryonic development, larval development, etc., always keeping in mind the period boundaries (Balon, 1959a).

Now we can begin the reconstruction of the best corresponding characterisation of the intervals of development and its terminology. In this paper we shall deal with the first two periods, the original lecture takes into account even further juvenile, adult and senile periods.

III. CONCLUSIONS

As I have already mentioned, we shall use the following four terms to indicate the intervals of development of fish: period, phase, step and stage. The period is the longest interval of development; it is divided into phases, and each phase into several steps. The shortest just observed moment of development is called stage.

The whole life of the fish, from fertilisation until the death consists of five periods: embryonic, larval, juvenile, adult and senile (senective).

1. Embryonic period begins with fertilisation, the joining together of sex cells. It is charycterised by the exclusively endogenous nutrition — yolk from the yolk sac. I divided it into the following phases:

1.1. Cleavage phase — interval of development within the egg membrane lasting from fertilisation to the begenning of organogenesis.

1.2. Embryonic phase — interval of development last from organogenesis to hatching.

1.3. Eleuterembryonic phase — (eleuteros gr. = free 'embryo from egg membranes') interval from hatching to the beginning of independant feedeing. This latter phase may be very long as in the salmonid species for example; but in most fish, it is very short becoming even completely omitted if the fish begin to seek their own food immediately after hatching.

The boudary for the beginning of this phase — the release from the egg membranes — is fairly artificial, since embryos of the same species hatch at different times, e. g. earlier in low oxygen concentrations (Dziekonska, 1956). Also different species hatch at different stages of development. Therefore the eleuterembryonic phase seems to be more valid as a division based on practical reasons as a synonym for "prelarva". It is merely a continuation of the embryonic phase.

2. The larval period begins at the moment of transition to exogenous nutrition. It lasts until the termination of the ossification of the main parts of the skeleton and the complete resorption of the embryonic fin fold. It is characterised by a large number of specific larval organs which seem to replace the as yet undeveloped final organs. I divided the larval period into two phases:

2.1. Protopterygiolarval phase — includes the interval between the transition to exogenous feeding and beginning of the differentiation of embryonic fin fold.

2.2 Pterygiolarval phase — last from the beginning of the differentiation of the unpaired fins until the complete disappearance of the fin fold.

We differerientiated the phases solely on the basis of morphological criteria. Therefore it is expedient to name the fish accordingly and as follows *for each interval of development: cleavage egg, embryo, eleuterembryo,* protopterygiolarva, pterygiolarva.

The lowest category of development intervals for fish is the step. The development from the egg to the senile fish takes place sporadically, not gradually. Not only morphological changes but also ecological and physiological changes typify the development. The old organs die, new ones appear; the movement of the fish changes and with this also the places it lives in; there are changes in the feeding habits, in its reaction to environment, etc. During the time between one leap in development and another, no more important changes in the fish organism appear which would be reflected in its biology. And it is precisely this interval between one leap and another which Vasnecov called "etapa" (step here). And practically the steps here are very similar to Brody's (1945) "stanzaz" and leaps to his "thresholds". In different species of fish, the lenght and number of steps in the same periods of life vary. Even if each individual step differs qualitatively from one another they remain closely connected and dependant of one another, since they are progressive intervals in the life of the same organism.

The qualitative leap from one step to another is very short, but the quantitave changes are long and take place between one leap in development and another. In each step the fish needs a certain kind of nutrient. If this is not available, its development is arrested and sometimes the fish even dies (Balon, 1960). The fish has in almost every step precise requirements concerning its environment. It is incotestable that the proposed plan of development of fish is correct from the biological point of view. But I must point out that this classification is not based on interruptions in development but on the termination of one process of development and the beginning of another.

The form of the transition from one step to the next, which some authors have qualified as violent and leapic demands further explanation. Konstantinov (1957) *wrote for example: "The transition from one step to another* is connected with the leapic (rapidly elapsing) changes in the structure and function of all or many organs and systems in the fish and hence also with the changes in the relationship of the fish to its environment". The morphological, ecological and physiological differences between the individual steps of development do not arise suddenly; they evolve gradually, in the lower steps of development. Only the functional changes which result from these take place rapidly. — The mouth and the gas bladder, for example, develop gradually over a fairly long period of time. Then the mouth begins to move, as the fish must take in air, although respiration itself comes about very quickly. Then the gas bladder fills with air equally quickly. Similarly the adaptation to swimming takes a long time, but the transition from the passive state to active swimming is and must be very rapid, since it is connected with the transition to exogenous nutrition and the quest for food which renders this necessary. In any case it is more correct to replace the term "leap" from one step to another by the expression "transition" or "threshold".

One must always characterise each step by several criteria, usually referring to linear growth, age and weight. But only the morphological characteristics of the steps remain invariable; the other criteria alter with each change in the environment, i. e. the lenght of the fish changes in the individual steps, the fish reaches certain steps when young in some cases, when much older in other, and weight also changes as the fish grows bigger. In other words, the measurable criteria are always valid for certain environmental conditions (Shamardina, 1957).

Vasnecov originally indicated the individual steps by letters of the alphabet, and this is still practised by many Russian authors. Kryzhanovskij (1953) introduced a more suitable notation; he denoted each step by the initial of the period to which it belonged and the ordinal number of the step in the period. It seems to be more advantageous to use the phases as the basic category, and therefore I denote the individual steps in each phase by the ordinal as follows: C1, C2, C3, . . . (steps of the cleavage phase); E1, E2, E3, . . . (steps of the embryonic phase); F1, F2, F3, . . . (eleuterembryonic or free-embryo phase); PP1, PP2, . . . (protopterygiolarval phase); P1, P2, . . . (pterygiolarval phase). Such symbols are advantageous becouse they immediately define the number of steps in each individual phase and at the same time make it possible to determine the correct term for the individual in a certain step of development (Tab. 1) e. g. cleavaged egg, embryo, eleuterembryo etc. Vasnecov and his collaborators originally identified only the steps from hatching to the beginning of the juvenile period.

Table 1. Terms and indications of intervals of early life history

Period	Phase	Step	Stage
embryonic	cleavage	C1, C2, C3, . . .	a, b, c, . . .
	embryonic	E1, E2, E3, . . .	a, b, c, . . .
	eleuterembryonic	F1, F2, F3, . . .	a, b, c, . . .
larval	protopterygiolarval	PP1, PP2, . . .	a, b, c, . . .
	pterygiolarval	P1, P2, . . .	a, b, c, . . .

The steps of the embryonic period were defined for the first time by Kryzhanovskij et alii (1953). Other studies have appeared later in which the steps of several fish species have been identified (Disler, 1957; Smirnova, 1957; Balon, 1959, 1959a, 1960a etc.).

If we compare the steps of the eleuterembryonic phase and also the larval periods of the different species, we establish increasingly greater differences regarding the development of individual organs and the point when they begin to function. The individual organs develops differently in almost every species; in one species early, in another later. Indeed, while certain organs develop earlier and others later in one species, in another species the former organs develop later and the latter earlier — they develop at different steps. Also the beginning of activity for the individual organs is different with the above. But as the rapid functional transitions of the vital organs determine the boundaries of the steps, the latter can be different in almost all species.

These minute differences in the cleavage phase intensify more and more as development progresses. Therefore in the individual species, the claims on the environment have different sequences in the same steps, and it seems to be that one must observe each species independantly from this point of view. Konstantinov (1957) for example realised that one can easily find identical steps in *Stizostedion lucioperca*, *S. volgense* and *Perca fluviatilis*. He did not succed, however, in aproximating these steps to the concrete steps of the carp species, even though perch and carp have in common many ganeral laws for their developmental steps. On the other hand, Vasnecov et alii (1957) fond a significant correspondance between the individual steps of the different species. There remains at present much to be discussed on this point, but will become clearer in time, as more work is done on the theory of intervals.

IV SUMMARY

Even recent studies of early development of fishes show illogical terminology and do not respect the theory of intervals. After brief historical reviews and discussions different terms used in the unification and characteristics of each period of development are proposed. To indicate the intervals of development four terms are used: period, phase, step and stage. Periods are the longest intervals and stage is the shortest observed moment of development. The first embryonic period characterised by the exclusively endogenous nutrition is divided into:

1. cleavage phase, 2. embryonic phase and 3. eleuterembryonic phase. The second larval period which start with beginning of transition to exogenous nutrition and last until the ossification of the main parts of the skeleton and resorption of the embryonic fin fold is divided into 1. protopterygiolarval phase and 2. pterygiolarval phase. It is proposed to name the fish in each interval of development as: cleavaged egg, embryo, eleuterembryo, protopterygiolarva and pterygiolarva (juvenis, adultus, and senilis are the subject of another paper). Further, the theory of development through thresholds in steps is given in details.

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Author's present address: Dr. E. Balon, Central Fisheries Research Institute (UNDP - FAO), Chilanga, Zambia.

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INDIVIDUAL VARIATION OF THE AMUR LEOPARD CAT, PRIONAILURUS BENGALENSIS EUPTILURUS (ELLIOT, 1871), FROM KOREA

Luděk J. DOBRORUKA

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Abstract: The individual variation of external characters of 320 skins of *Prionailurus bengalensis euptilurus* (Elliot, 1871) from Korea is described and a brief comparison of external characters of *P. b. euptilurus* and *P. b. chinensis* (Gray, 1837), which is the nearest related subspecies, is given.

In 1968 I had an opportunity to examine 320 skins of the Amur Leopard Cat, which were imported for furrier's purposes from Korea. As far as we know this was the most numerous material examined from that country. In spite of the lack of exact localities it can represent a rather valuable contribution to our knowledge of the external variation in this subspecies. Because the skins were bought directly in Northern Korea by an official of the Firma KARA it is no doubt about their origin.

The type locality of *Prionailurus bengalensis euptilurus* (Elliot, 1871) is the Amur River, 60 km downstream from the mouth of the river Zea (Stroganov, 1962). The distribution area includes the Siberian Far East, Ussuri and Amur basins up to about 51° N, Korea and the extreme NE China up to the Manchurian Lowland. Most of the Chinese Territory is inhabited by a closely related subspecies, viz. *P. b. chinensis* (Gray, 1873).

The description of the individual variation of the subspecies *P. b. euptilurus* from the northern part of its range (Siberian Far East) gave Ognev (1935) and Stroganov (1962). We shall try to add to these excellent accounts of the both well known authors a description of the external variation of *P. b. euptilurus* from Korea.

Ground colour: from capuchine yellow to capuchine orange (colour nomenclature after Ridgway, 1912) with strong grey shade as in the hare in the winter. In about of 2 per cent of examined specimens the colour is darker on the dorsal side forming thus a dark dorsal stripe, about 10—15 mm wide.

Head: with typical four stripes going from the front to the nape.

Throat: with numerous small rusty spots (mars yellow to micado orange), forming four not very distinct transversal colar rings.

Body: the ground colour as described above, on the dorsal side brownish, mostly without spots, to the sides being gradually paler. Only 17 skins (i. e. about 0.5 per cent) with distinct dorsal spots. Most of the examined skins with 4 rows of rather indistinct side spots, of about 10 mm in diameter. In the spots brown and black hairs are mixed. 28 skins (i. e. 8.7 per cent) without any spots on the sides, the ground colour being very similar to the winter colour of an European hare.

Belly: whitish, with the spots of 20—30 mm in diameter, forming 4—6 transversal rows. The hairs in the spots mostly black.

Extremities: with small rusty spots (about mars yellow).

Tail: bushy, with 7—8 indistinct rings. The tip of the tail is dark.

We did not take measurements of all the examined skins; measurements of three largest and three smallest skins are, however, given here: three largest specimens: total length 121 cm (head and body 87 cm, tail 34 cm); 113 cm (87,26); 114 cm (85,29) three smallest specimens: 87 cm (60,27); 82 cm (62,20); 83 cm (62,21)

The length of the dorsal hair is 25—40 mm.

The Amur Leopard Cat is the largest subspecies of *Prionailurus bengalensis*. The tail is comparatively short, measuring only about 1/3 of the head and body length whilst in other subspecies and even in the most related *P. b. chinensis* it measures about 1/2 of the head and body length. These facts demonstrate the effect of the Bergmann's and Allen's Rules in this species.

Not only in cranial and body measurements but also in external characters the Amur Leopard Cat differs very distinctly from other subspecies. The nearest related subspecies is the Chinese Leopard Cat, *Prionailurus bengalensis chinensis* (Gray, 1837). The most detailed description of the variation in the Chinese Leopard Cat was given by Allen (1938) who examined 56 skins from various parts of China. His statements are used for following comparison:

The ground colour in *P. b. chinensis* is more greyish, very often without any tinge of buffy. The spots are more numerous than in *euptirulus*, forming sometimes small rosettes. On the dorsal side there are distinct rows of longer spots. In *P. b. euptilurus* the spots on the body are less numerous or, even, completely absent, never forming any rosettes. On the dorsal side the spots are generally entirely absent. The tail patterns forms a very characteristic distinction: in *P. b. chinensis* there are 10 or more indistinct rings, whilst in *P. b. euptilurus* there are just 7 or 8 rings, not connected in the mid-dorsal line. Contrary to *P. b. euptilurus*, in which the proximal tail-hairs form a dark tip, the tail tip in *P. b. chinensis* is not dark.

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Author's address: Dr. L. J. Dobroruka, Zoological Garden Prague, Prague 7 - Troja 120.

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Institute of Systematic Zoology, Charles University, Prague
Institute of Systematic Zoology, J. E. Purkyně University, Brno

THE STATUS OF EPTESICUS OGNEVI BOBRINSKII, 1918, AND REMARKS ON SOME OTHER SPECIES OF THIS GENUS (MAMMALIA: CHIROPTERA)

VLADIMÍR HANÁK & JIŘÍ GAISLER

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Abstract: The taxonomic characters of *E. ognevi* were analyzed and the species was compared with the allied forms of the genus *Eptesicus*. The results indicate that the form under study should be denoted as *E. bottae ognevi* (Bobrinskii, 1918). *E. sodalis* does not belong to the form group of *E. bottae* but is related with *E. serotinus* with which it is perhaps conspecific. *E. bobrinskii* is an independent species showing relation to the group of forms around *E. nasutus* and *E. walli*.

INTRODUCTION

During a collecting expedition to Soviet Turkmenia, the former author succeeded to obtain, in the Repetek Oasis (70 kms SW of Chardchou, East Turkmenia) on 2nd August, 1964, three specimens of *Eptesicus ognevi*, one of the least known Palearctic bat species. Later on, the evaluation of the material collected in Afghanistan by the latter author has revealed a demand for a detailed analysis of this form as well as of some additional medium-sized and small species of the genus. We have attempted at such an analysis in the present paper which, apart from *E. ognevi* and the group of forms around *E. bottae*, involves also *E. sodalis* and *E. bobrinskii*.

Apart from our own materials collected in Turkmenia (*E. ognevi*), Czechoslovakia, the Balkan Peninsula and Transcaucasia (*E. serotinus*) and Afghanistan (*E. nasutus*), our taxonomic analysis is based also on the materials of the Zoological Museum of the Moscow University, Institute of Zoology of the Academy of Sciences of the USSR in Leningrad, Central Asiatic University in Tashkent, and the British Museum (Natural History) in London. Besides, we had the opportunity of examining specimens in the private collection of Dr. D. L. Harrison (Sevenoaks), from whose papers we have adopted the dimensions of certain other species, insufficiently represented in the collections of the above institutions.

Although we accumulated all available data, it has appeared that the hitherto materials of some of the forms compared are little numerous and do not invariably allow to draw definitive conclusions. Nevertheless, we have arrived at some new aspects on the taxonomy of the forms under study, which we consider worth publishing, particularly as we have had the first opportunity of comparing the materials from the Soviet museums with the British and our own materials collected in Near and Middle East.

At the same time, we would like to express our gratitude to all persons who have made it possible to us to examine the museum collections of the species under study; above all, to Professor Dr. V. G. Heptner and Dr. O. L. Rossolimo (Moscow) Dr. I. M. Gromov and Mr P. P. Strelkov (Leningrad), Dr. R. N. Meklenburcev (Tashkent), Dr. G. B. Corbet and Mr J. E. Hill (London) and Dr. D. L. Harrison (Sevenoaks). We thank Mrs P. Bajtlerova for drawing the illutrations and diagrams.

ON THE SYSTEMATIC POSITION OF EPTESICUS OGNEVI

Historical

E. ognevi was described in 1918 by N. A. Bobrinskij on ground of five specimens collected on 30th June—12th July, 1914, at Sochta-Chinar, Gissarsko bekstvo, in Bokhara (central Tadzhikistan of today). The type specimen, an individual showing HB 58; FA 46.5; CB 17.5 mm, with sex unstated, is missing for all we know. In his paper, Bobrinskij states that he had hesitated to describe a new species on the mere ground that his specimen differs from *E. serotinus* by distinctly smaller dimensions. He decided to describe it only after having ascertained a difference in the colour of its fur which he characterized as follows (Bobrinskij, 1918): "Pellis colore pallido similis est Eptesico serotino isabellino Blyth,*) sed setae bicolores sunt, nam superiore corporis parte ab initio ex fusco albidae, deinde flavi paulumque cani; parte autem inferiore ab initio cani, deinde albi paulumque flavi canescenteque."

In the papers of subsequent authors, this important character was considered of minor importance; the main emphasis was put on the size of the form examined, and this criterion was decisive in estimating the relationship of the form to the Eurasiatic species of the same size. Thus, e.g., Ognev (1928) considers the present form to be a mere subspecies, *E. sodalis ognevi*. However, Ognev's fairly detailed description does not contain the above character nor a comparison with the related forms from the Near East and North Africa that had been described before. Later on, this evaluation was adopted by Bobrinskij (1929) himself as well as by Tate (1942) who states that he had not seen Bobrinskij's paper and that he considers Ognev's evaluation. Hence, it is natural that the form *ognevi* was likewise evaluated by Ellerman & Morrison-Scott (1951) who had at their disposal only the papers by Ognev and Tate. Only Kuzjakin (1950) has granted *E. ognevi* the status of a species, as in his opinion *E. sodalis* is "merely one of the types of variability in *E. serotinus*" (original statement in Russian), differing from the normal individuals of *E. serotinus* merely by having shorter wings. *E. ognevi* is then evaluated as an independent species even in subsequent Russian literature (Bogdanov, 1953; Sokolov & al., 1963; Bobrinskij & al., 1965, etc.). A new aspect of the systematic position of the form under study has lately been forwarded by Harrison (1963a, 1964) who has found that the forms *bottae*, *hingstoni* and *innesi* are closely related and, at the same time, has included the form *E. isabellinus* under *E. serotinus* (Harrison, 1963b). Also, Harrison considers the pale coloured and slightly bigger populations from the *hingstoni* group inhabiting Iraqi Kurdistan and Iran, expressing the opinion that "They may prove to be close to the Persian form *mirza* de Filippi, 1865 or to the Turkestan form *ognevi* Bobrinskii, 1918, which clearly belongs in this species group." Thus, the above conclusions tend to indicate indirectly that the smaller Central Asiatic populations of the genus *Eptesicus*, characterized by pale two-coloured fur, could be evaluated as *E. bottae ognevi*. After all, this has been indirectly pointed out by Tate (1942) who, in a paragraph concerning *E. bottae*, states that it is "more probably either near *sodalis* and *ognevi* . . .".

Results

Body and skull dimensions. Let us mention first the relations between the basic skull dimensions CL and ZB in the form *ognevi* and all the remaining species and subspecies of the genus *Eptesicus* compared (Fig. 1). It appears that the dimensions of the form *ognevi* fall within the variation range of these values for the forms *bottae*, *hingstoni* and *innesi* and differ markedly both from the dimensions of the larger *E. serotinus* and *E. sodalis* and from those of the smaller Asiatic forms. These relations are precised by

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*) Under *E. s. isabellinus*, Bobrinskij arranged pale-coloured Central Asiatic populations denoted at present as *E. s. turcomanus* (Eversmann, 1840).

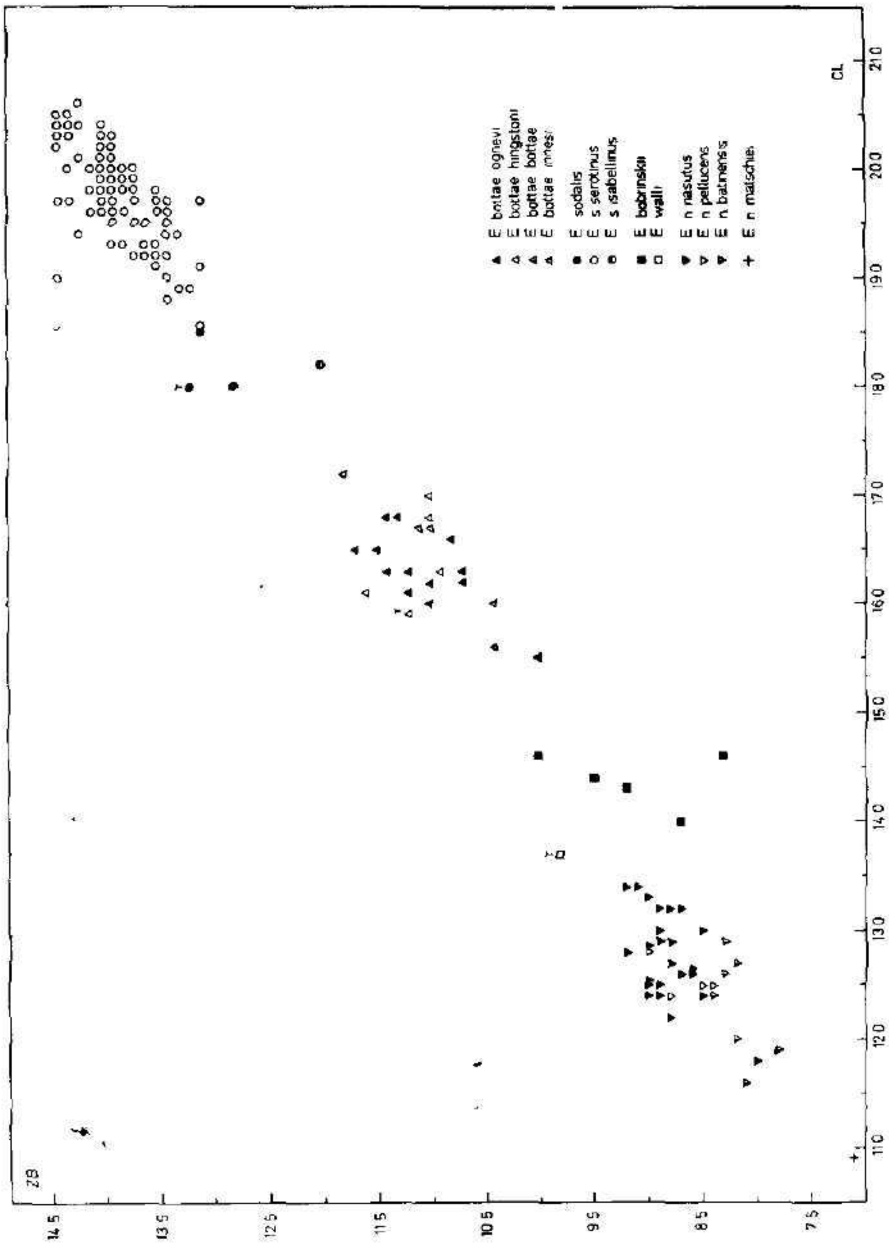

Fig. 1. Scatter diagram on which the zygomatic width (ZB) is plotted against the condylobasal length (CL) in several species and subspecies of the genus *Eptesicus*. Origin of material: *E. s. serotinus*, Central and Eastern Europe and Transcaucasia; *E. s. isabellinus*, Northern Africa; *E. sodalis*, Central and Eastern Europe; the remaining forms, Near East, Soviet Central Asia, Afghanistan (for particulars, cf. the text). Dimensions of *E. bottae ognevi*, *E. s. serotinus*, *E. bobrinskii*, *E. walli*, *E. n. nasutus* and of the holotype of *E. sodalis* have been obtained by own measurements, those of most of the remaining forms have been adopted from Harrison (1964) or as stated in the text. T, holotype.

Tab. 1. The comparison of external measurements of *Eptesicus b. ognevi* and *E. b. hingstoni* (after **Harrison**, 1964)

		HB			T			FA			E			TR	
		n	Min. Max.	x	n	Min. Max.	x	n	Min. Max.	x	n	Min. Max.	x	n	Min. Max.
E. b. ognevi	♀♀	8	45,0—110,0	69,2	8	29,0—50,5	42,9	3	43,0—44,4	43,9	5	15,0—16,8	16,2	5	8,3—9,5 8,7
	♂♂							8	37,4—42,0	41,0					
E. b. hingstoni	♀♀	12	102,0—114,0	108,3	12	43,0—52,0	47,2	5	45,9—50,0	46,8	12	14,0—18,0	15,9		—
	♂♂							5	43,0—46,3	45,1					

additional diagrams showing pairs of skull dimensions in the forms *ognevi*, *bottae*, *hingstoni* and *innesi*. Moreover, these diagrams indicate that the differences between the above forms are minimum except for *bottae*, represented by a single specimen whose dimensions stand distinctly apart in all diagrams. In Fig. 4, *hingstoni* is slightly different from *ognevi* due to lower values of C—M³ in the former. The dimensions of the single specimen of innesi do not altogether exceed the scatter of the values for *ognevi* and *higstoni*.

A slightly different situation is found in comparing the variation ranges and average values of certain other body and skull dimensions in the series of specimens of *ognevi* with those of the geographically closest form *hingstoni*. While the above-mentioned correlation diagrams demonstrate minimum differences, far more appreciable differences are found between the above two forms as far as the average values of certain dimensions are concerned. Disregarding the body dimensions which are hardly comparable as they had been measured by various authors (Tab. 1), one cannot omit distinct diferences in both skull length values and in the length of the maxillary toothrow (Tab. 2). Surprisingly enough, these differences do not appear in the length of the mandible and in that of the mandibular toothrow. Equal values tend to occur, above all, in those dimensions which had been taken from fairly large materials, minimizing the deviation due to different technique of measuring. At all events, the differences observed should be considered real, although the results of testing their significance are not unambiguously positive.

Colour of pelage. The pelage of *E. ognevi* is soft, dense and rather long (about 8 mm in dorsal region and 6 mm on the belly). The pelage on both the dorsal and the ventral side is distinctly two-coloured; the tips of the dorsal hairs are brownish-yellow with a honey tinge; the basal parts of these hairs are much darker, slate grey to blackish-grey. The hairs of the ventral pelage are also paler at their tips which are whitish with a grey tinge; their bases are pale grey. The line of demarcation between the dorsal and ventral surface on the

Tab. 2 The comparison of cranial measurements of *E. b. ognevi* and *E. b. hingstoni* (after Harrison, 1964)

		Eptesicus bottae ognevi			*Eptesicus bottae hingstoni*		
		n	Max. Min.	x	n	Max. Min.	x
GL	♀♀	8	16,3–17,2	16,8	4	17,3–18,0	17,7
	♂♂	5	16,0–17,0	16,4	3	16,7–17,4	17,2
	♀ + ♂	13	16,0–17,2	16,6	12	16,6–18,2	17,4
CL	♀♀	9	16,1–16,8	16,4	4	16,8–17,4	17,1
	♂♂	5	15,8–16,8	16,1	3	16,1–16,8	16,4
	♀ + ♂	15	15,8–16,8	16,3	11	15,9–17,5	16,8
ZB	♀ + ♂	16	10,3–11,5	11,1	8	10,9–11,8	11,2
IC	♀ + ♂	25	3,5– 4,1	3.9	12	3,3– 3,9	3,6
BB	♀ + ♂	3	7,7– 7,8	7,8	12	7,3– 8,0	7,2
MB	♀ + ♂	21	8,3– 9,1	8,8		—	
HS	♀ + ♂	4	6,5 – 7,3	7,2		—	
$C-M^3$	♀ + ♂	9	6,2– 6,5	6,3	12	5,7– 6,3	6,0
$C-M_3$	♀ + ♂	8	6,6– 7,0	6,8	12	6,5– 6,8	6,7
M	♀♀	9	11,9–12,6	12,3	4	11,6–13,0	12,3
	♂♂				3	12,2–12,8	12,5
	♀ + ♂	19	11,8–12,6	12,3	12	11,6–13,4	12,4

side of the neck is rather distinct. The wing membranes and the auricles are distinctly darker than the pelage; they are brownish-grey of much the same shade as in *E. serotinus turcomanus*.

In our earlier paper on the bats of Afghanistan (**Gaisler**, 1970a), we have pointed out that two-coloured pelage is the common character of the forms *bottae*, *hingstoni*, *innesi* and *ognevi*, separating them from all subspecies of *E. serotinus*. Thus, by its colour, the form *ognevi* resembles the sympatric *E. serotinus turcomanus*, except that *turcomanus* shows unicoloured pelage. In general colouration, there are no substantial differences between *ognevi* and *bottae* or *hingstoni*, as stated by **Harrison** (1964 : 140, 142) and as we ourselves could have confirmed by examining the specimens in British collections. The form *innesi* is stated to show slightly longer hairs and indistinct demarcation line between the dorsal and ventral colour on the sides of the neck.

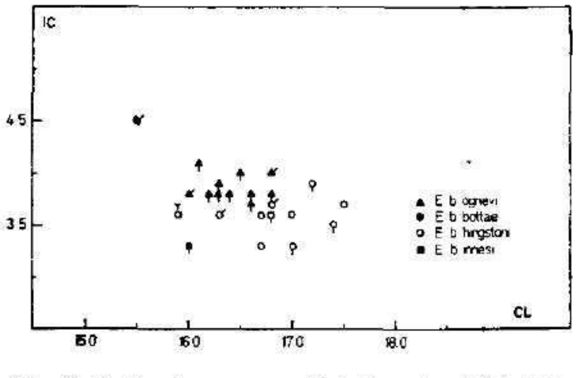

Fig. 2. Scatter diagram on which the interorbital constriction (IC) is plotted against the condylobasal length (CL) in the subspecies of *E. bottae*. Short lines pointing upwards, males; short lines pointing downwards, females; T, holotype.

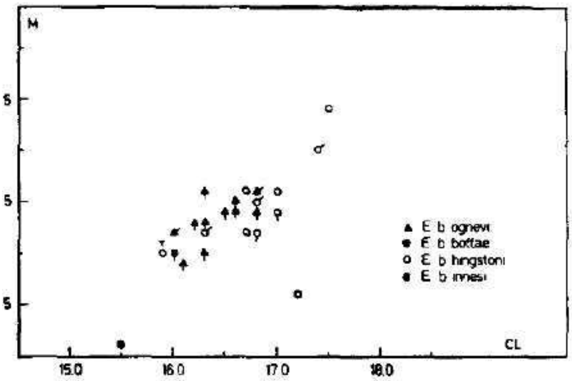

Fig. 3. Scatter diagram on which the mandible (M) is plotted against the condylobasal length (CL) in the subspecies of *E. bottae* Explanations as in Fig. 2.

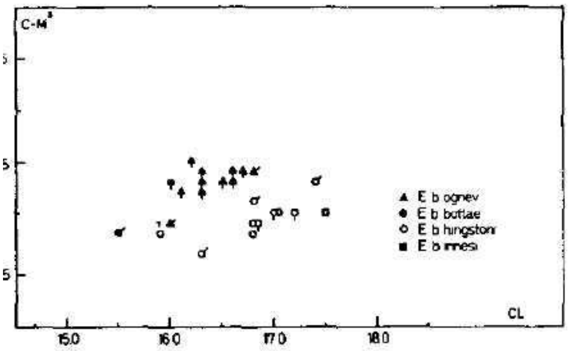

Fig. 4. Scatter diagram on which the maxillary toothrow (C-M^3) is plotted against the condylobasal length (CL) in the subspecies of *E. bottae* Explanations as in Fig. 2.

Shape of skull. The details of the shape of skull in *E. ognevi* are shown in Figs. 5 and 6. Compared with that of *E. serotinus*, the skull of *E. ognevi is distinctly smaller and* not so robust. Connected with this fact is perhaps also the weaker development of certain projections and crests, e.g., the sagittal crista. The descriptions presented by Harrison (1964 : 140 ff.) tend to indicate that there are no appreciable differences in *the shape of the skull* between *E. ognevi* and the subspecies of *E. bottae.*

Dentition. Apart from the correspondingly smaller di*mensions, the dentition of E. ognevi* shows no marked difference from that of *E. serotinus*. The upper jaw shows a conspicuously large I^1 with two peaks and a smaller, two-peaked I^2 whose higher peak slightly exceeds the cingulum of I^1 (Fig. 7). In the structure of the molars, there is a marked *craniocaudal narrowing in* M^3 (Fig. 8) which essentially corresponds to that in *E. serotinus* bur separates *E. ognevi* from *E. nilssoni* and certain other species. The dentition of *E. ognevi* is practically identical with that of *E. bottae innesi* and *E. bottae hingstoni* (cf. Harrison, 1964).

Penis and baculum. The penis of *E. ognevi* is not large, strongly enlarged in its terminal part. In this basic shape, the baculum maintains the type of penial bones of the genera *Eptesicus* and *Myotis* but differs in details from all the allied forms of the genus *Eptesicus* which we could have examined in this respect (Fig. 9). Due to scarcity of our own material, we could not have compared it with any of the forms of the *E. bottae* group, which would have been most important for our purpose. In general, the baculum in *E. ognevi* is very small (0.95 mm in length and 0.70 mm in width) and is situated in the tip of the glans penis (Fig. 10). This small size of the baculum has obviously led Kuzjakin (1950) to his erroneous statement that in this species the baculum is not developed.

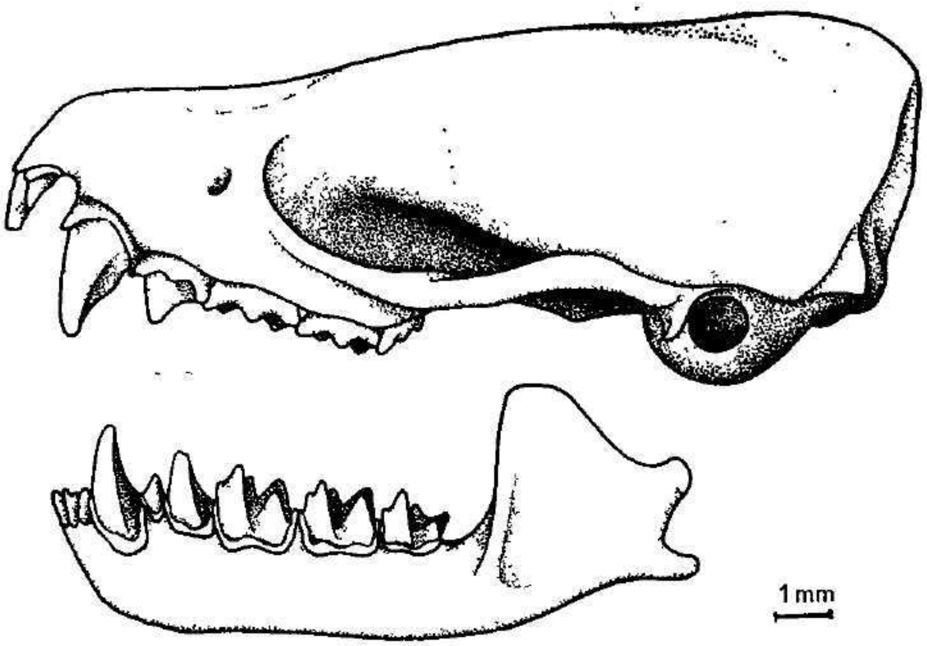

Fig 5. Skull of *E. ognevi* in lateral view. Specimen No. SA-218, ♀ad., locality Repetek **in Turkmenia**, Coll. Inst. Vert. Zool. Charles Univ Praha.

Auricle. In its shape, the auricle of *E. ognevi* is much the same as that in *E. serotinus* but seems to be slightly broader and more tapering towards the tip. The tragus reaches nearly the half of the length of the auricle; it is about equally broad all along its length and obtused and slightly inwardly bent at its tip. The outer margin of the distal part of the auricle is distinctly incrassate and forms a suggestion of a pocket at its base. Kuzjakin's (1950 : 387—389) opinion that the auricle of *E. ognevi* is simplified and approaches the type shown in the genus *Myotis* does not appear to be well-founded.

Additional characters. The calcar in *E. ognevi* is well developed and the epiblema is considerably reduced, similarly as described in *E. b. innesi* (Harrison, 1964).

Distribution. Zoogeographical data are another important base for the evaluation of the systematical relationship. For this reason, we give the present knowledge on the distribution of *E. ognevi* in comparison with that of the subspecies of *E. bottae*. According to Kuzjakin (1950, ex Bobrinskij & al., 1965) and Afanasjev et al., 1953), *E. ognevi* occurs in Turkmenia (Kara-Kala, Kabakly, Ogri-dag, Repetek, Tachta-Bazar, Aktan mountains north of Bokhara), Uzbekistan (Šochta-Činar, Kiik-Dagan, Tamerlan's Canyon), Kazakstan (Aksu-Džebogly, northern coast of the Aral Sea, Mangyšlak), SW Mongolia (Eczin), eastern Transcaucasia (Mingezčaur) and northern Armenia According to Sokolov & al. (1963), it occurs in additional localities in Uzbekistan and Tadzhikistan where also the type series had been collected. Besides the recent data, Vereščagin (1959) enumerates the fossil findings of this species in the Caucasian Pliocene. In Afghanistan, there are two more or less uncertain records in Faizabad and Kabul (Gaisler, 1971). The above data indicate that *E. ognevi* inhabits a large part of Soviet Central Asia and penetrates into Transcaucasia, northern Afghanistan and Mongolia; the eastern limit of its range (Chinese Turkestan ?) is unknown. From among the subspecies of *E. bottae*, *E. ognevi* neighbours only with *E. b. hingstoni* in the western part of its area (Harrison, 1964); it is still uncertain which of the two forms inhabits Iran. The remaining subspecies of *E. bottae* are distributed more to the south.

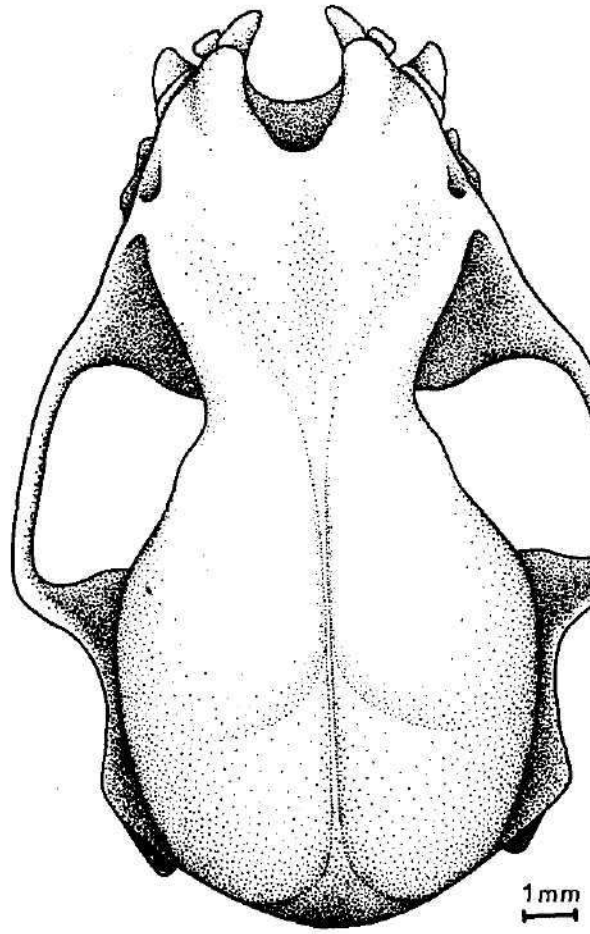

Fig. 6. Skull of *E. ognevi* in dorsal view. Specimen No. SA-218, ♀ad., Repetek in Turkmenia, Coll. Inst. Vert. Zool. Charles Univ. Praha.

Conclusions of the taxonomical analysis

As already mentioned in the Historical, the present literature contains four different evaluations of the systematical position of the form *ognevi*. The results obtained in our analysis can be summarized in the following conclusions.

(1) While *E. ognevi* is very close to *E. serotinus* by its cranial characters and dentition, it is not conspecific with it in any case. The specific difference between the above forms is based, apart from the zoogeographical viewpoints, on marked difference in the colour of their pelage, in size, in the shape of their baculum, etc. Including *E. ognevi* in the little known form *E. sodalis* is also out of consideration with respect to the difference in their colouration (absence of two-coloured pelage in *E. sodalis*) and size, to say nothing of the problematical position of *E. sodalis* (see next chapter).

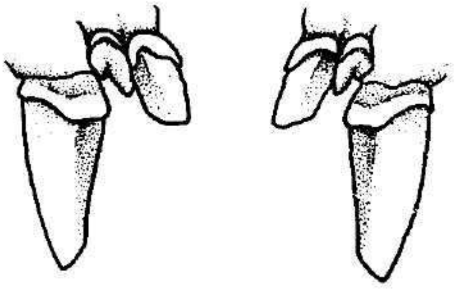

Fig. 7. Incisors and canines of *E. ognevi*. Specimen No. SA-218, ♀ad., Repetek in Turkmenia, Coll. Inst. Vert. Zool., Charles Univ. Praha.

(2) With regard to the fact that *ognevi* shows a number of characters indicating its close relationship to the form group of *E. bottae*, the problem under study is restricted to a consideration whether *ognevi* is an independent allied species or a mere subspecies of *E. bottae*. However, the solution of this problem meets with difficulties arising from insufficient material, above all, of the subspecies *bottae* and *innesi*. Nevertheless, the close relationship between *hingstoni* and *ognevi* is indisputable.

(3) The forms *hingstoni* and *ognevi* agree in their colouration, shape of skull, dentition, and shape of auricle, as well as in a majority of body and skull dimensions. It is a pity that it has been impossible to compare such an important taxonomical character as the size and shape of baculum. With respect to the fact that the areas of both forms border on each other, it cannot be ruled out that they represent a single form. At discordance with this possible evaluation are only the differences in the average values of some of their cranial dimensions (CL, $C-M^3$) which, of course, could have resulted from different ways of measurement.

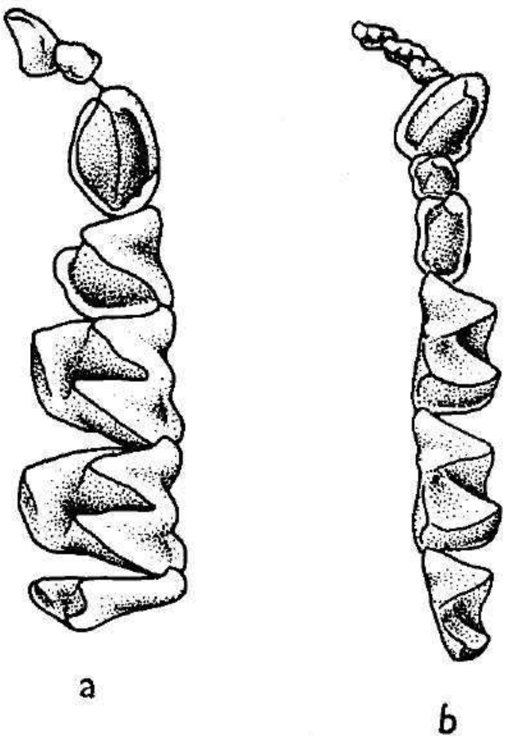

Fig. 8. Upper (a) and lower (b) toothrow of *E. ognevi*. Specimen No. SA-218, ♀ad., Repetek in Turkmenia, Coll. Inst. Vert. Zool. Charles Univ., Praha.

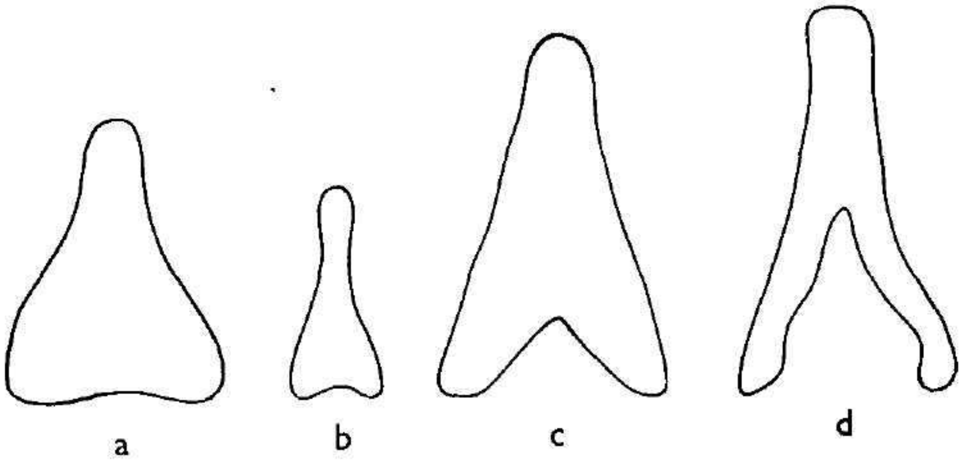

Fig. 9. The baculum of (a) *E. ognevi* (No. SA-216), (b) *E. bobrinskii* (after Harrison, 1963a), (c) *E. serotinus* (No. 664/59, Czechoslovakia), (d) *E. nilssonii* (No. 361/58, Czechoslovakia).

(4) For the time being, it is our opinion that the medium-sized members of the genus *Eptesicus*, showing pale, two-coloured pelage and inhabiting Central Asia, Transcaucasia and Mongolia, should be evaluated as *Eptesicus bottae ognevi* (Bobrinskii, 1918). A definitive solution of the systematical position of *E. bottae* will be possible only after obtaining adequate series of all four subspecies recognized at present; let it be remarked that according to the priority rule, the following is the order of the respective forms: *bottae* (Peters, 1869), *innesi* (Lataste, 1887), *ognevi* (Bobrinskii, 1918), *hingstoni* (Thomas, 1919).

ON THE SYSTEMATIC POSITION OF EPTESICUS SODALIS

The taxonomical value of this form, described on ground of two specimens from Roumania and Switzerland by Barrett-Hamilton in 1910, has not been

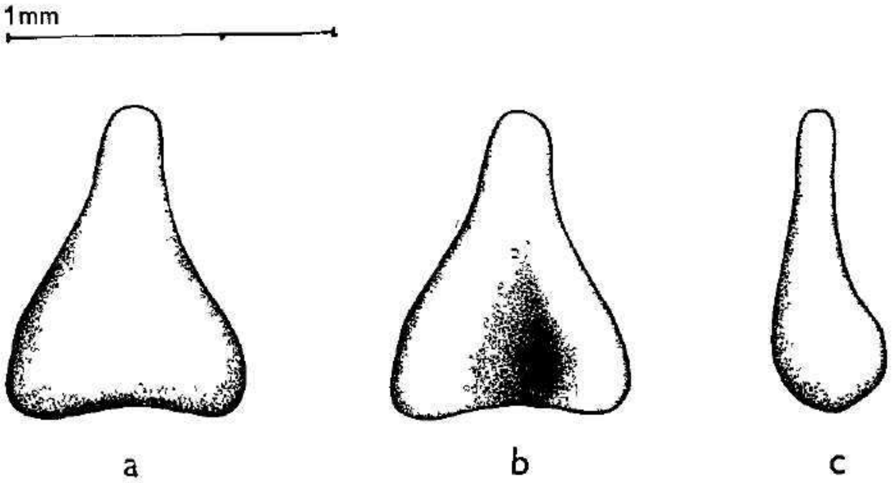

Fig 10. The baculum of *E. ognevi*; a, dorsal view, b, ventral view, c, lateral view

plausibly elucidated up till now. The form ognevi included as a subspecies under *E. sodalis* by certain authors (Ognev, 1918; Ellerman & Morrison-Scott, 1951). On the other hand, Harrison (1964) considers the possibility of including *sodalis* as a subspecies under *E. bottae*. Hence, in evaluating the form *ognevi*, we felt obliged to examine the hitherto data on *E. sodalis* as well. The data on this form are scarce, as it has not been found since the description until quite recently. Lately, Bauer (1968) reported on the discovery of two skulls of additional two specimens in a recent material from Austrian caves; in Bauer's opinion, this is a valid species, very likely inhabiting higher elevated areas of Central and Eastern Europe.

Through the courtesy of Dr. Corbett and Mr Hill of the British Museum (Natural History), we have had the opportunity of examining the type specimen of *E. sodalis*, which is a male collected at Bustenari, Roumania, No. 4 4.6.1. In the shape of this skull, auricles and in the colour of its pelage, this specimen does not differ from the specimens of *E. serotinus* from Europe, thus lacking in two-coloured pelage, an important character of all subspecies of *E. bottae*. The specimen shows the following dimensions (our own measurements*): HB, 63.0; T, 42.0; FA, 46 0; HF, 10 5; E, 18 0; GL, 18.7; CL, 18.1; ZB, 13.4; IC, 4 6; BB, 9.3; MB, 10.0; HS, 8.0; $C-M^3$, 7.3 mm (for explanation of the abbreviations, cf. Gaisler, 1970). Again, this measurement has revealed smaller body and skull dimensions than those stated for Central and Eastern European populations of *E. serotinus;* hence, the present one is not a mere brachypterous form, as supposed by Kuzjakin (1950). As shown in Fig. 1, the values of CB and ZB of the measurable skulls of *E. sodalis* are closer to the respective values of a large series of *E. serotinus* than to those of the subspecies of *E. bottae;* however, they represent a fairly independent series at the lower limit of the values for *E. serotinus*. Only one specimen of the series of *E. serotinus* (No 1503, a male, collected in a gallery at Srbsko near Beroun, Czechoslovakia) shows dimensions quite corresponding to the values of Austrian *E. sodalis*. In this connection it is necessary to point out the rather great differences between the values of three measurable skulls of this species. The lowest values are reported in the specimen from Switzerland (CL, 18.0; ZB, 12.8); the Roumanian specimen is slightly larger (CL, 18.1; ZB, 13.4); and the Austrian one is the largest (CL, 18.5; ZB, 13 1). Thus, the Austrian specimen lies at the very lowest limit of the series of *E. serotinus* from Central and Eastern Europe.

The above data tend to furnish fairly convincing evidence that *E. sodalis* has hardly anything in common with *E. bottae* and, hence, with *E. b ognevi*. On the contrary, it has been reaffirmed that of all species coming into consideration, *E. sodalis* is the closest to *E. serotinus* with which it is either conspecific as maintained by Kuzjakin (1950, in Bobrinskij, 1965) or an independent species, sympatric with *E. serotinus* in the European part of the area of the latter (Bauer, 1968). While the insufficient material of *E. sodalis* available makes it impossible to adopt a definite view, our investigations tend to corroborate the opinion that *E. sodalis* is not an independent species; since a subspecies is out of consideration, it would be a nomen nudum. The small differences in the size of the skull between the Austrian specimen and the least specimen of *E. serotinus* from Czechoslovakia indicate a considerable

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*) Bauer (1968) states only slightly different dimensions of the same specimen

variability of *E. serotinus*. It is possible that larger series of *E. serotinus* from various parts of Europe would encompass a gradual transition from specimens of the *sodalis* type to the average ones of *E. serotinus*.

ON THE SYSTEMATIC POSITION OF EPTESICUS BOBRINSKII

Including the form *ognevi* enlarges the complex of subspecies of *E. bottae* whose relationship to smaller Asiatic forms of the genus *Eptesicus* has not been investigated in detail as yet. This pertains, above all, to *Eptesicus bobrinskii* Kuzyakin, 1935, as well as to several subspecies of *Eptesicus nasutus* (Dobson, 1877). Of the two, *E. bobrinskii* is less known. This species differs in a number of characters from *E. bottae ognevi* (smaller size, typical shape of skull with low braincase, shape of baculum, etc.) with which it is sympatric in the Soviet Central Asia and in the Caucasian region (Kuzjakin, 1950; Bobrinskij & al., 1965; Vereščagin, 1959) and, very likely, even more to the south, e.g., in Iran. Like *E. nasutus*, even *E. bobrinskii* does not show two-coloured pelage. Hence, *E. bobrinskii* cannot belong to the *E. bottae* form group. A specific character is adscribed to *E. bobrinskii* both by the Soviet authors (Kuzjakin, 1950; Strelkov in Sokolov & al., 1963, etc.) and by Harrison (1963). Under *E. bobrinskii*, Harrison includes eve

Tab. 3. The comparison of some external and cranial measurements of *E. bobrinskii* (U.S.S.R.), *E. nasutus* (Afghanistan) and *E. nilssonii* (Czechoslovakia)

		E. bobrinskii			*E. n. nasutus*			*E. nilssonii*		
FA	♂♂	7	32,0–37,0	35,2	14	34,5–39,0	37,8	7	37,0–41,5	39,8
	♀♀				12	36,5–42,0	40,1	9	37,0–43,6	40,5
GL	♂♂	6	14,7–15,6	14,9	14	12,0–13,5	13,0	10	14,9–15,6	15,2
	♀♀				11	12,9–13,9	13,4	12	14,8–16,0	15,3
CL	♂♂	6	14,0–15,2	14,5	14	11,8–13,2	12,5	8	14,3–15,3	14,7
	♀♀				12	12,4–13,4	12,9	12	14,5–15,3	15,0
ZB	♂♂	3	9,2–10,0	9,5	13	8,0– 9,0	8,7			
	♀♀				10	8,5– 9,2	8,9	20	9,8–10,6	10,1
IC	♂♂	5	4,0– 4,2	4,1	14	3,1– 3,5	3,2			
	♀♀				12	3,0– 3,3	3,1	21	3,9– 4,4	4,2
MW	♂♂	5	8,0– 8,5	8,3	14	6.7– 7,3	6,9			
	♀♀				12	7,0– 7,4	7,1	21	7,4– 8,2	7,8
HB	♂♂	4	5,7– 6,1	5,9	14	5,5– 5,8	5,6			
	♀♀				12	5,5– 5,9	5,7	19	6,1– 7,2	6,7
$C-M^3$	♂♂	6	5,1– 5,3	5,2	14	4,3– 4,9	4,6			
	♀♀				12	4,6– 5,0	4,8	21	5,3– 5,9	5,6
$C-M_3$	♂♂	7	5,4– 5,9	5,6	14	4,7– 5,2	5,0			
	♀♀				12	4,9– 5,4	5,0	21	5,8– 6,4	6,0
M	♂♂	7	10,2–10,8	10,4	14	8,9– 9,7	9,3	10	10,7–11,5	11,0
	♀♀				12	9,3–10,4	9,7	12	10,8–11,6	11,2

the seven specimens from Guter Su, NW Iran. His opinion is corroborated even by our diagram (Fig. 1) including, apart from the above-mentioned values of the skull dimensions, *E. bobrinskii* differs distinctly not only from the subspecies of *E. bottae* but also from *E. n. nasutus* and *E. n. matschiei*. The latter very likely represents another independent species, as already considered by Harrison (1964).

Since concrete data on body and skull dimensions of *E. bobrinskii* are still scarce in non-Russian literature and could not have been compared with other Asiatic species, we have arranged them in a Table together with the data on the dimensions of related forms (Tab. 3). Again, this Table tends to corroborate the difference between *E. bobrinskii* and *E. nasutus* or *E. nilssoni*, which latter species *E. bobrinskii* resembles by its size. In skull dimensions, *E. bobrinskii* seems to be the closest to *E. walli*, another nearly unknown species (only two specimens being known). After doubt had been thrown on the main character of the form *walli*, i.e., interfemoral membrane with small warty excrescences (Gaisler, 1970), a closer relationship between both forms cannost be entirely ruled out. Since *E. walli* is known to occur in southern Iraq only and, hence, is allopatric with respect to *E. bobrinskii*, one might consider the possibility of including both forms as subspecies to one species; in that case, the name *walli* Thomas, 1919, has the priority. However, certain serious differences, above all, the low values of GL, CL and IO of the holotype of *E. walli*(BMNH 19.3.1.2, Basra, Mesopotamia, ♀, GL 13,9; CL 13,7; ZB 9,8; IC 3,2; BB 6,7; MB 7,5; HS 6,0; $C-M^3$ 5,3; $C-M_3$ 5,8; M 10,4) support the opinion of specific independence of both these forms.

SUMMARY

The taxonomical characters of *E. ognevi* are analysed on grounds of the authors' own material as well as those of the Soviet and British collections. In cranial and dentition characters, this form, distributed in Central Asia, is close to *E. serotinus* but differs from it in such essential characters as the size, colour and shape of the baculum. For the same reasons, it cannot be included under *E. sodalis* either. A detailed analysis of its dimensions, above all, the cranial ones, as well as of the colouration of its pelage and certain other characters indicates a close relationship of the form under study to *E. bottae hingstoni*. Although the definite solution of this problem will require obtaining sufficiently numerous material, above all, of the nominate *E. b. bottae*, the authors consider it right to tentatively evaluate the form under study as a subspecies *Eptesicus bottae ognevi* (Bobrinskii, 1918).

The taxonomical value of *E. sodalis* was examined by direct examination of the type specimen and by comparing the data obtained with the literary data on the other two known specimens. In addition, *E. sodalis* was compared with a large series of *E. serotinus* as well as with forms of the *E. bottae* group. It has appeared that *E. sodalis* has nothing in common with *E. bottae* but is very close to *E. serotinus* with which it is probably conspecific.

Scarce literary data have been collected on another Central Asiatic species, viz., *E. bobrinskii*. A brief analysis of these data has confirmed the hitherto opinion that *E. bobrinskii* is well separated both from the subspecies of the slightly larger *E. bottae* and from those of the slightly smaller *E. nasutus*.

E. bobrinskii could be considered to be more closely related to *E. walli* only; however, a comparison of the dimensions of the two forms tends to indicate that they are not conspecific.

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Authors address: Dr. Vl. Hanák, CSc., Viničná 7, Praha 2; Dr. J. Gaisler, CSc., Kotlářská 2, Brno.

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Slovak Agricultural Academy, Laboratory of the Fishery Research, Bratislava, Czechoslovakia

ON THE TAXONOMIC STATUS OF ACHEILOGNATHINAE FISHES (TELEOSTEI: CYPRINIDAE) FROM NORTH VIETNAM

JURAJ HOLČÍK

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Abstract: The author describes the occurrence of *Rhodeus spinalis* Oshima 1926, *Acanthorhodeus macropterus tonkinensis* Vaillant 1892 and *Acanthorhodeus deignani* Smith 1954, in the Bôi River at Chine, Hoa-Binh Province, North Vietnam. The finding of *Rhodeus spinalis* is the first record in the continental Asia, that of *Acanthorhodeus deignani* the first discovery outside of Laos.

The cyprinoid subfamily Acheilognathinae Bleeker, 1873 represents a well defined group, its centre of distribution being is South-Eastern Asia, mainly China, Korea and Japan. In the area lying southwards from the Chinese-Vietnamese boundaries only one species of this group was known up to 1945. It was *Acanthorhodeus tonkinensis* Vaillant 1892, described from the Noi River in Upper Tonkin. Fifty years later another species of *Acanthorhodeus* was described by Hugh M. Smith (1945), named by him as *A. deignani*. This species was found in the brook Nam Puat, Mekong River basin, Laos. Despite this, only *A. tonkinensis* is reported to inhabit the rivers of Vietnam and adjacent countries in a few works dealing with fresh-water fishes of that territory (Dao and Mai, 1959; Wu 1964).

In 1963 I obtained a small collection of Acheilognathinae fish from Vietnam, presented by Professor Dao Van Tien from Hanoi. Fishes labelled as *Acanthorhodeus tonkinensis* were collected in the Bôi River, Chine District, Hoa-Binh Province, Vietnam Democratic Republic (23°31′ *N*, 117°17′ *E*). Studying this sample I was able to find three species of Acheilognathinae: *Rhodeus spinalis* Oshima, 1926, *Acanthorhodeus macropterus tonkinensis* Vaillant, 1892 and *Acanthorhodeus deignani* Smith, 1945. The first species — *R. spinalis* seems to be the first record from the continental Asia, the third — *A. deignani* is the first discovery outside of Laos and the second record of this species after its description at all. All fishes are now deposited in the ichthyological collection of the Slovak National Museum (SNM-RY) in Bratislava, Czechoslovakia.

Rhodeus spinalis Oshima, 1926

SNM-RY 2171, 9 specimens (5 males, 4 females), 37.0—48.2 mm in standard length (40.98 mm in average).

D III 11—13 (11.7), A III 13—14 (13.7), number of transversal scale rows 35—37 (36.1), number of pored scales in lateral line 5—8 (6.6), number of gill-rakers 8—9 (8.6), pharyngeal teeth uniserial, slightly hooked at tips, completely smooth (Fig. 1). First three simple rays in D and A (the first rays rudimentary) transformed in hard spines which are, however, not so strong and distinct like in the genus *Acanthorhodeus.* No barbels. Scales rhomboidal with 8—19 (15.7) mostly straight radii (grooves) (Fig. 1). The relationship of the caudal and centrolateral radius of the scale to that of the oral is *o : c : cl = 1 : 1.83 : 2.41.*

Colour in alcohol uniformly brown. The black "rhodeine" strip of females is more narrow than that of males. Besides this females possesses a distinct black spot on first rays of dorsal fin near its base (Phot. 1).

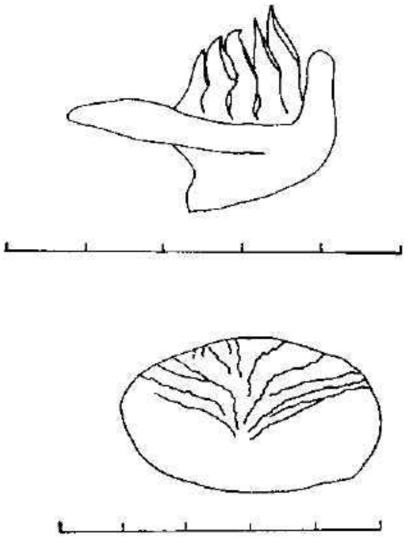

Fig. 1. Form of pharyngeal teeth of *Rhodeus spinalis* (male, 39.3 mm of standard length) and the form of scale (female, 42.8 mm). Scale: 5 mm.

Measurements in per cents of standard length: head length 23.7—25.1 (24.6), snout length 5.7—7.4 (6.7), internasal distance 4.0—5.4 (4.9), diameter of eye 7.8—9.5 (8.8), distance between eyes 9.0—9.9 (9.5), postorbital distance 9.7—11.8 (10.7), head depth 19.9—25.7 (23.1), head width 12.5—13.8 (13.3), predorsal length 51.0—58.3 (55.7), preventral length 44.5—52.4 (47.2), preanal length 59.3—65.4 (62.8), body depth 45.7—49.8 (47.5), caudal peduncle length 16.7—20.6 (19.2), caudal peduncle depth 15.2—17.8 (16.2), minimal body depth 12.3—14.1 (13.3), P-V distance 21.2—25.1 (23.3), V-A distance 15.4—19.2 (17.5), length of D 24.4—29.5 (26.9), length of A 25.2—28.4 (26.9), length of C 22.8—27.9 (26.2), length of P 18.0—20.4 (19.8), length of V 18.4—23.1 (16.7), depth of D 18.4—23.1 (20.6), depth of A 15.6—19.0 (16.8).

This species was firstly described from the Kachek River in Hainan by Oshima (1926), then mentioned also by Nichols and Pope (1927), Lin (1935) and Wu (1964) also only from this island. Our discovery in Vietnam shows, however, that *Rhodeus spinalis* occurs also in the mainland of Asia, probably mainly in the river basins of North Vietnam flowing into the Bay of Tonkin. *Rhodeus spinalis* can be easily recognized and distinguished from all the other members of the genus by the presence of slight spines in D and A and by highest number of branched rays in both fins as well. I was unable to find any difference between spinalis from Hainan and Vietnam.

Acanthorhodeus macropterus tonkinensis Vaillant, 1892

SNM-RY 952, 13 specimens (3 males, 10 females), 41.6—60.0 (49.03) mm in the standard length.

D III 13—16 (14.6), A III 11—14 (12.2), scales in lateral line 33—37 (35.0), pored scales in lateral line 31—35 (33.5), number of scales between base of D and lateral line 5—6 (5.9), number of scales between base of V and lateral line 4—5 (4.9) number of gill-rakers 5—9 (7.9), pharyngeal teeth uniserial, 5—5 in formula, deeply plicated on their inner sides, edges of the grinding surface sometimes even serrate (Fig. 2). First simple rays in D and A transformed into the strong and hard spines. There are a minute but distinct barbels at the end of maxillaries measuring 0.2—1.0 % (0.6 in average) of the standard length. Lateral line in majority of specimens ends 1—2 scales in front of caudal base. In one fish (female 47.8 mm in standard length) lateral line interrupted, showing the following formula (scales without pores in parentheses): 25 (7) 1 (3). On the opposite (right) side the lateral line is normal showing 34 + 1 scales. Scales rhomboidal, large with 16—39 (27.1) dense, zig-zag vawed radii on their caudal part (Fig. 2). The relation of different radius of scale is $o : c : cl = 1 : 1.83 : 2.18$.

Colour in alcohol uniformly brown with pale fins. Very narrow black "rhodeine" strip placed in the centre of another but wide (occupying the width of two scales) and light yellowish band running from the opercle through the centre of body to nearly end of caudal peduncle. This black stripe begins just under the dorsal spines or a litle in front of them. Some fishes have a black spot on D which is mark of juvenility especially in the species *Acanthorhodeus macropterus* (Nikolsky, 1956; Holčík, 1962).

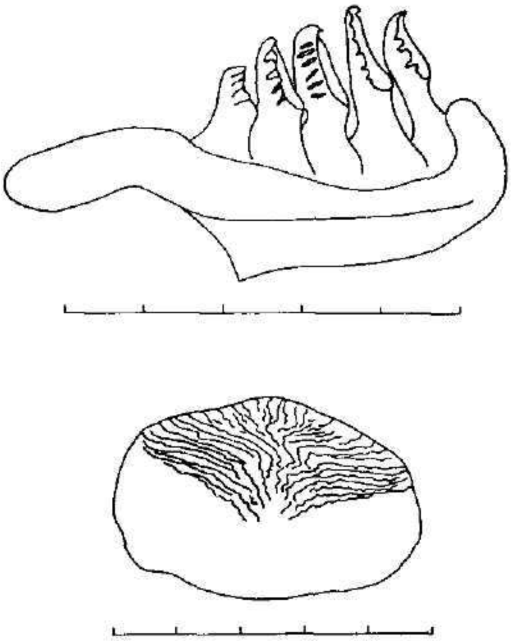

Fig. 2. Form of pharyngeal teeth and scale of *Acanthorhodeus macropterus tonkinensis* (female, 58.9 mm of standard length).

Measurements in per cents of standard length: head length 24.2—27.0 (25.6), snout length 6.1—8.5 (7.2), length of barbel 0.2—1.0 (0.6), internasal distance 3.8—5.3 (4.4), diameter of eye 8.7—10.0 (9.1), distance between eyes 8.3—10.0 (9.0), postorbital distance 10.3—11.9 (11.0), head depth 21.5—25.2 (22.8), head width 11.8—13.7 (13.0), predorsal distance 52.3—59.2 (55. 8), preventral distance 46.2—51.6 (48.4), preanal distance 61.6—66.8 (64.1), body depth 40.5—47.3 (44.4), caudal peduncle length 16.6—22.1 (20.2), caudal peduncle depth 14.3—18.6 (15.8), minimal body depth 12.2—13.6 (12.9), P-V distance 21.8—28.0 (23.7), V-A distance 15.1 to 19.7 (17.5) length of D 28.4—33.6 (31.4), length of A 20.8—25.7 (24.0), length of C 22.0—28.1 (25.9), length of P 16.3—21.2 (18.8), length of V 15.6 to 18.6 (17.6), depth of D 17.4—21.0 (19.0), depth of A 14.1—18.4 (16.3).

Acanthorhodeus macropterus tonkinensis was firstly described as *Acanthorhodeus tonkinensis* by Vaillant (1892) from the Noi River, Upper Tonkin, then from the river Kachek and the vicinity of Nodoa at Hainan (Oshima, 1926; Nichols and Pope, 1927), but later on it was described also from

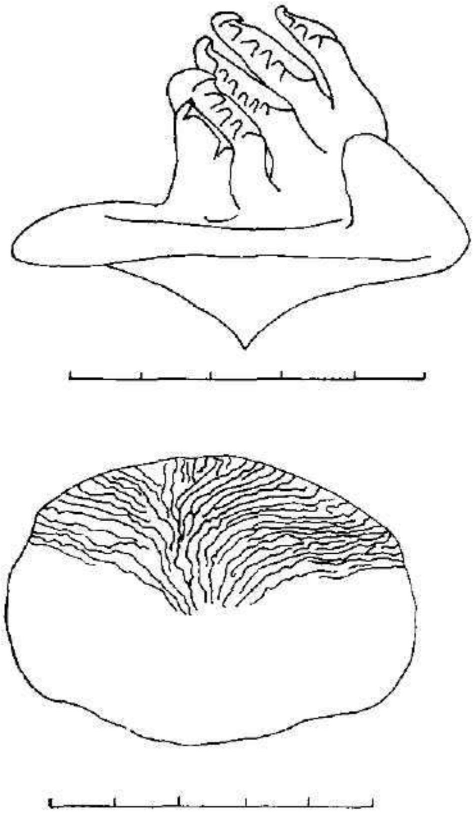

Fig. 3. Form of pharyngeal teeth and scale of *Acanthorhodeus asmusii* from the Amur River (female, 66.8 mm of standard length).

the Li-Kiang, China (Wu, 1939). Nichols (1943) mentiones this species even from Kienning, Fukien Province, which is far from the "normal" area of distribution (the diagnostic features, however, agree well with typical *A. macropterus tonkinensis*).

After a partial revision of the genus *Acanthorhodeus* in which I am still working, some deep changes in the taxonomy inside this genus have to be realised. The dubious existence of some *Acanthorhodeus* species was pointed out already by Holčík (1962), Wu (1964) and by Holčík and Nalbant (1964). As this question will be dealt with elsewhere I can only refer here briefly that the species *A. macropterus* Bleeker, 1871, *A. guichenoti* Bleeker, 1871, *A. taenianalis* Günther, 1873, *A. asmussii* (Dybowski, 1872), *A. dicaeus* Rutter, 1897, *A. longispinnis* Oshima, 1926, *A. jeholicus* Mori, 1934, have to be lumped together because they represent a single species the correct name of which is *Acanthordeus macropterus* Bleeker, 1871. All other names are the junior synonyms only. *A. tonkinensis* Vaillant, 1892 (syn. *A. longispinnis* Oshima, 1926) also belongs to the range of *A. macropterus* but it can be regarded as the subspecies which differs from the nominate form only by a lesser number of branched rays in D (which is 13—16, against 15—18 in the nominate form). All other characters, including the important number of gill-rakers, form of pharyngeal teeth and even the form and structure of scales, are identic or very similar (Fig. 2, 3, 4). A further difference of ssp. *tonkinensis* from the nominate form can be found in the body size. Ssp. *tonkinensis* is the smallest form (up to 70.0 mm of standard length) in comparison with other *macropterus* populations from which those inhabiting the Amur River seem to be the biggest (up to 120 mm of standard length). This can be regarded as the further evidence of the Bergman's rule influence in the cold-blooded animals, as recently proved by Lindsey (1966). *Tonkinensis* can be considered also to be the most southern cline of *A. macropterus*.

It must be noted here, that Wu's (1964) *A. tonkinensis* includes probably also some other *Acanthorhodeus* species (*polylepis* Wu, or *deignani* Smith) because of the lesser number of branched rays in D and the too high number of gill-rakers.

Acanthorhodeus deignani Smith, 1945

SNM-RY 2172, two specimens (females), 50.0—52.1 mm in standard length (Phot. 3).

D III 12, A III 10, scales in lateral line 36, pored scales in lateral line 34 and 35, number of transversal scales: 6 between the base of D and lateral line and 5 between latter and the base of ventrals, number of gill-rakers 11, pharyngeal teeth uniserial, 5—5 in formula, plicated, but also smooth in some cases (Fig. 4), hooked at their tips: Unbranched rays in D and A developed into strong and hard spines. Maxillary barbel well developed, visible also by a naked eye, measuring 3.4—3.8% of standard length. Lateral line channel ceases 1—2 scales before it reaches the base of caudal fin. Scales resemble those of *A. macropterus tonkinensis*, but their radii are thin, amounting only 16—17 (Fig. 3) in number. Relation of scale radii is *o : c : cl = 1 : 1.78 : 1.94*, thus showsing the more oval shape of scale.

Colour in alcohol uniformly brown with pale fins is nearly identical with the colour pattern of the previously mentioned species. The difference is in the form of "rhodeine" strip which is very narrow in comparison with that of *A. m. tonkinensis*.

Measurements in per cents of standard length: head length 24.0, snout length 6.0—7.0, length of barbels 3.4—3.8, internasal distance 4.2—5.2, diameter of eye 7.7—8.6, distance between eyes 7.7—8.8, postorbital distance 9.6—10.4, head depth 20.2—20.7, head width 12.1—12.6, predorsal length 54.3—57.7, preventral distance 45.0—46.0, preanal distance 62.3—63.2, body depth 42.6—43.0, caudal peduncle length 18.8—21.7, caudal peduncle depth 15.7—15.8, minimal body depth 12.5—13.0. P-V distance 21.3—22.0, V-A distance 17.2—18.2, length of D 28.2—28.4, length of A 20.2—20.5, length o C 25.6—27.3, length of P 19.0—21.0, length of V 17.9—18.0, depth of D 20.0, depth of A 16.9—18.0.

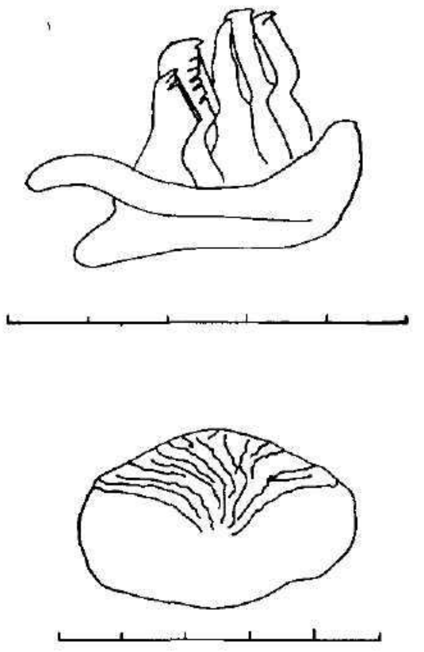

Fig. 4. Form of pharyngeal teeth and scale of *Acanthorhodeus deignani* (female, 52.1 mm of standard length).

Almost all parameters of the investigated specimens from Vietnam agree with those of the typical form described by Smith (1945) from Laos. As this author inroduced only some features in his description, I have used the counts and measurements of the type specimens kindly made for me by Dr. Petru Banarescu from Bucarest during his visit of U.S. National Museum in Washington. A more important difference I have found only in the number of gill-rakers: 6—9 in the types and 11 in both specimens from Vietnam. As the compared material is too small for any serious comparison I cannot give the explanation or speculation concerning this finding. Visually *deignani* resembles *macropterus tonkinensis* with exception of more emphasized transition from head to the back in the first species (Phot. 2, 3). The back of *macropterus tonkinensis* is not so arched as in *deignani*. Despite this resemblance I cannot agree with Smith (1945) that *deignani* "... appears to be closest to Vaillant's imperfectly described species *A. tonkinensis*". Considering the counts one can see more close relationship between *deignani* and *omeiensis* Shih'et'Tchang, 1934, or *polylepsis* Wu, 1964:

Table 1. Comparison of the chief meristic features in all *Acanthorhodeus* species equipped with barbs

Species Feature	*macropterus*	*macropterus tonkinensis*	*deignani*	*omeiensis*	*polylepis*	*barbatus*
Rays in D	15—18	13—16	12	10	12—14	10—11
Rays in A	11—14	11—14	10—11	8	9	10
Lat. line	32—38	33—37	35—36	35—36	38—39	35—39
Gill-rakers	6—10	5— 9	6—11	8	10—11	6

DISCUSSION AND CONCLUSIONS

The occurrence of three *Acheilognathinae* species in North Vietnam and in one locality of the relatively small river Bôi, instead of one traditionaly mentioned species *A. macropterus tonkinensis* suggests three ideas:

1) more species of *Achilognathinae*, both from the continental China as well as from the Hainan island could be found over this territory. The emphasis can be laid on the presumable occurrence of the species *Rhodeus sinensis*, *Rhodeus ocellatus*, *Acanthorhodeus atranalis*, *A. elongatus*, *A. omeiensis* and *Paracheilognathus barbatulus* occurring in the adjacent territory of China, and on *Pseudoperilampus hainanensis* still known only from Hainan.

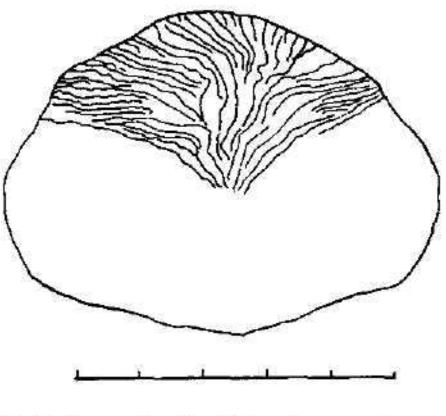

Fig. 5. Form of scale of the type specimen of *Acanthorhodeus guichenoti* from the Yangtze River (Mus. Nat. Hist. Natur. Paris No 5043 — standard length 112.2 mm).

2) *Acanthorhodeus deignani* can be found in the rivers of Hainan and,

3) the Acheilognathinae fauna of the Hainan island shows a closer relation to that of Vietnam than to the bitterlings of China. It is no doubt that *Acanthorhodeus macropterus tonkinensis* and *Rhodeus spinalis* from Vietnam and Hainan are of the same origin. The occurrence of these two species in the rivers of Hainan prove that this island had to be formerly connected with the Upper Tonkin and its rivers had to be a part of river net of the Red River (Songha). It is very interesting, that *A. macropterus tonkinen-*

sis both in Vietnam and Hainan forms very important and dense populations as stated by **Nichols** and **Pope** (1927) and **Dao** and **Mai** (1959).

Acknowledgement

I wish to give my sincere thanks to Professor **Dao** Van Tien, Hanoi, Vietnam, for sending me the material of bitterlings from the Bôi River; to Dr. Petru **Banarescu**, Bucarest, Roumania for sending me the counts and measurements of *A. deignani* and for the valuable advices as well as to colleague Dr. K. **Hensel**, Bratislava, Czechoslovakia, for his consultation concerning the geographic and linguistic problems.

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

Authors' address: RNDr. Juraj Holčík, CSc., Laboratórium rybárstva a hydrobiologie, Drieňová 5, Bratislava, Czechoslovakia.

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Zoological Institute of J. E. Purkyně University in Brno

A NOTE ON THE OLIGOCHAETA OF THE BLACK SEA

SERGEJ HRABĚ

Received April 14, 1970

Abstract: The present paper contains but a list of marine **Tubificidae determined by the** author in the Black Sea and a description of a new species, ***Limnodriloides gurwitschi* sp. n.,** from the shore at Nesebar (Mesembria) and New Nesebar, Bulgaria.

In three papers about Oligochaeta of the Black Sea, published in the Publications de la Faculté des Sciences de l'Université J. E. Purkyně (Hrabě, 1964 1966, 1967), I treated the marine Tubificidae from the collections of Professor Dr. M. Bacescu (Bucaresti) and my own ones. I have found, in the Black Sea, besides some immature indeterminable specimens, the following species on the family Tubificidae:

Peloscolex svirenkoi (Jarošenko), *Peloscolex euxinicus* Hrabě, *Tubificidarum* g. sp., *Rhizodrilus ponticus* Hrabě, *Limnodriloides agnes* Hrabě, *Limnodriloides gurwitschi* sp. n., *Tubifex costatus* Clap.

The first three species occurred in the samples in two collections of Professor Dr. M. Bacescu. *Peloscolex svirenkoi* (Jar.) occurs from the Danube Delta to the Bosporus in depths between 9 and 79 metres. It occurred in 119 out of 144 samples. *Peloscolex euxinicus* Hrabě occurred in only 8 samples. Two mature but insufficiently preserved specimens of Tubificidarum g. sp. were found in only 2 samples.

Rhizodrilus ponticus Hrabě, was collected by me in July, 1928, on the shore near the casino in Constanta in Roumania, and on June 9th, 1966, on the north shore in New Nesebar (loc. A) and June 18th, 1969, on the north shore at the fishermen's pier in Nesebar (Mesembria) (loc. B) in Bulgaria.

Limnodriloides agnes Hrabě. I discovered mature specimens of this species on May 29th and 31th, 1966, in loc. B; on June 18th, 1968, in the same locality; on June 17th, 1968, on the east shore in Nesebar (loc. C) and on June 10th 1966, in loc. A.

Tubifex costatus Clap. I found one immature specimen on June 18th, 1968, in loc. B.

On June 10th, 1968, I collected 12 specimens of a further new species of the genus *Limnodriloides* on the north shore at New Nesebar (loc. A) and the east shore in Nesebar (loc. C).

I dedicate this species to the late Professor Dr Alexander Gurwitsch a famous scientist and an excelent man, in whose laboratory I had the good luck to work some time.

All the above-mentioned species collected in sand between stones on the seashore in a depth of 0 5 to 0.75 metre.

Limnodriloides gurwitschi sp. n.

Body up to 10 mm long, in segment 11 0,35 mm wide, composed of about 50 segments.

Prostomium conical, rounded at apical end.

All setae forked, with the upper prong shorter than the lower one.

$$\text{Setal formula} = \frac{(2)\ 3-5\ \ldots\ |2-3\ |\ 2\ \ |2(3)\ \ldots\ 2}{(2)\ 3-5\ \ldots\ |2-3\ |-\ \ |2(3)\ \ldots\ 2}$$

shows the number of the setae in the mature specimens.

In segment 2 and 3 there are 2—4 forked setae in a bundle and 3—5 in the other anteclitellial segments. In segment 10 2—3 normal setae in the dorsal and ventral bundles; in segment 11, the ventral setae are missing. Posterior the clitellum there are 2(3) setae, in the last segments only 2 per bundle.

Clitellum on segment 11—12.

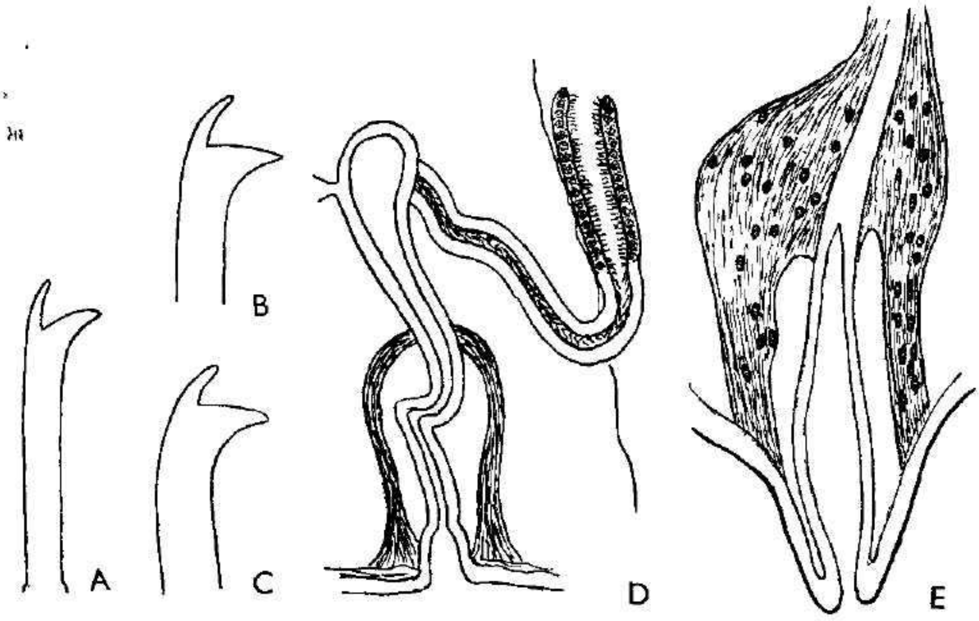

Fig 1 — *Limnodriloides gurwitschi* n. sp Ventral seta of: A — segment 3, distal end; B — segment 25, C — segment 45. D — male duct (half schematically) E — Non quite protruded distal part of male duct

One pair of male pores in place of the missing ventral setae in segment 11. Spermathecal pores and spermathecae absent.

Pharyngeal glands in segment 2—5.

Chloragogen cells invest the digestive tube beginning with segment 6.

Caecal diverticula missing

Coelomocytes of the type of subfam. Rhyacodrilinae absent.

One pair of testes on dissepiment 9/10, one pair of ovaria on dissepiment 10/11.

One pair of cylindrical male funnels on dissepiment 10/11. Holotype (Hr. 1806-3-VI) possesses ripe spermatozoa on the male funnels.

The spermducts 30 μm wide, at most as long as the other parts of the male ducts. They open into long club-shaped atrium. Numerous muscle-fibres fasten both to the distal portion of the atrium and to the body wall. They form a closed, thick-walled, bell-shaped sac.

In it lies freely the remaining part of the male duct. The narrowed portion of the atrial ampulla bends knee-like after entering into the bell-shaped sac and continues into the straight, long enough duct, opening directly on the body surface. This duct does not show any circular fold which may be considered the penis.

The distal end of the male duct protrudes in the form of a conical pseudopenis.

The cavity of the atrial ampulla is covered with cubic epithelium.

The epithelial lining is missing on the external and internal side of the bell-shaped muscular sac.

Compact prostate opens into the apical part of the atrium.

Granules of eosinophile secretion occur in the knee-bent part only in the ripe specimens.

Spermathecae are absent in all the mature and maturing specimens.

Localities. Black Sea, Nesebar (Mesembria) and New Nesebar, Bulgaria, June 10th, 1968 Sand between stones. Collectio Hrabě: Hr. 1806-3 and 6; Holotype, Hr. 1806-3-VI).

The species of the genus *Limnodriloides* can be divided into two groups: one with large, well formed sac-like pseudopenis and another with only narrowed distal portion of the male duct that is protracted during copulation (and sometimes also during fixation — Fig. 1E). To the former group of species belong *Limnodriloides appendiculatus* Pier., *L. prostatus* (Knöllner) and *L. agnes* Hrabě; to the second group, *L. pectinatus* Pier., *L. roseus* Pier., *L. winckelmanni* Mich. and *L. gurwitschi* n. sp.

Limnodriloides gurwitschi sp. n. differs from the other species of this genus and from the other Tubificidae by the muscular sac, surrounding the distal end of the male duct like a continuous layer.

Only in *Branchiura sowerbyi* Bedd., *Aulodrilus kashi* Mehra and *A. stephensoni* Mehra occurs an organ resembling, in some extent, the mentioned sac of *Limnodriloides gurwitschi*. But *B. sowerbyi* possesses only a thinwalled sac (Stephenson, 1930 : 347—350) and in *Aulodrilus kashi* and *stephensoni* the muscle-fibres are not compactly arranged but somewhat loosely connected, so that narrow spaces are left between them.

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A. N. Severtzov Institute of Evolutionary Morphology and Ecology of Animals
Academy of Science of the USSR

SOME NEW ORIBATOID MITES (ACARIFORMES) FROM CENTRAL ASIA

D. A. KRIVOLUCKIJ

Received November 24, 1969

These materials represent some interesting additions to our knowledge aboute oribatoid mites of the Asia desert landscapes. By collecting in new habitats and new localities (sandy, loamy and grey-brown desert soil types) we have to add several species belonging to genera not yet found in Central Asia. These mites were collected by A. A. Rethejum in Uzbekistan and by V. V. Christov in Tadjikistan in 1967—1969.

Since the aim of the present paper is solely the description of the new species, I will desist from the detailed analysis of the several localities as well as from ecological and zoogeographical evaluations.

The holotypes of the new species described hereafter are deposited in the Zoological Institute of Academy of Science of the USSR in Leningrad.

It is ma pleasant duty to express my thanks also in this place to Dr. A. A. Rethejum and Mr. V. V. Christov, the collectors of the material, to Ing. J. Vaněk and Doc. Dr. M. Kunst for the help in preparing this paper.

Fam. Lohmanniidae Berlese, 1916

Asiacarus gen. n.

Genital plate with transversal suture. Praeanal plate absent. Anal and adanal plates not fused. Areae porosae absent. Body cylindrical, slight pygidial and sternal neotrichy.

Aside of the characteristics given in the diagnosis, the new genus resembles *Thamnacarus* Grandjean 1950, differing from it by absence of the praeanal plate. The ventral structures recalls *Papillacarus* Kunst 1959, but *Papillacarus* has a short inequal notogastral hairs and its pygidial neotrichy is more powerful. The genus *Lepidacarus* Csiszar 1961 is distinguished from *Asiacarus* by the vera special spoon- or leap-shaped hairs and more powerful sternal neotrichy.

Type species: *Asiacarus elongatus* sp. n.

Asiacarus elongatus sp. n. (Fig. 1)

Color yellow. Average length — 0.529 mm, breadth — 0.218 mm. Body cylindrical, cuticula with reticulate structure. Sensillus slightly incrassate, end pointed with 15—20 small ciliae. Every hair of prodorsum is long, ciliated. Interlamellar and rostral hairs not longer than others. Rostrum broad, rounded. Legs monodactyle.

The hysterosoma with distinct network consisting of regular hexangular fields which are most distinct on the shoulder. The posterior margin of hysterosoma is rounded. all notogastral hairs are almost equal on length, thin, curved. The dorsal plate rather resembles that of *Thamnacarus deserticola* Grandjean 1934.

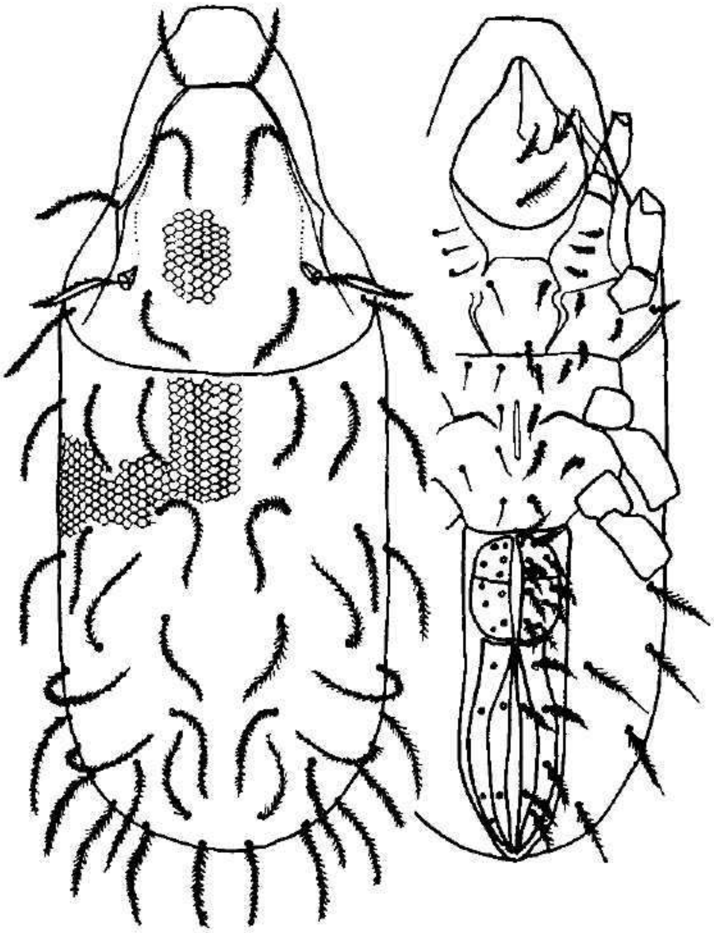

Fig. 1. ***Asiacarus elongatus*** g. n. sp. n., dorsal and ventral.

Coxisternal neotrichy present, coxisternal formula: 4—5—3—3.

Locality: Tadjikistan, Beskentskaja valley, arrival soils.
Type material: Holotype (♂), L — 0.503 mm, B — 0.202 mm; 6 Paratypes (♀).

Fam. Microzetidae Grandjean, 1936

Arenozetes gen. n.

Sensillus filiform, ciliate. Lamellae broad with 2 sharp apices. Interlamellar region with interlamellar apophysis in middle line. The lamellar hairs arising on cuspis, long, ciliate. The interlamellar hairs are very long, arising in interlamellar region.

Fig. 2. *Arenozetes christovi* g. n. sp. n., dorsal and ventral.

Aside of the lamellar structure and by presence of the long straight interlamellar setae the new genus is very original and not resembles any other genus.

Type species: *Arenozetes christovi* sp. n.

Arenozetes christovi sp. n. (Fig. 2)

Color yellow-brown, length 0.258 mm, breadth 0.150 mm. The lamellae form an "H" as a distinct translamella present a little behind the middle of the lamellae, there are two sharp apics on the distal end of lamella. The lamellar hairs are rough, almost parallel, they project with more than half their length beyond the tip of the rostrum. The rostral hairs are curved, thin and directed forwards. Interlamellar hairs stout, rough bristles, which are as long as the sensillus. The sensillus filiform, ciliate.

Hysterosoma is rounded and almost as broad as long; the integument is smooth. The notogastral hairs are well developed, thin. On the shoulders there are two stout bristles on the proximal part of the small pteromorphae. Lags monodactyle.

Locality: Tadjikistan, Beskentskaja valley, arrival soils.
Type material: Holotype (♂).

Fam. Oppiidae Grandjean, 1954

Mystroppia rethejumi sp. n. (Fig. 3)

Color yellow-brown, length 0.301 mm, breadth 0.157 mm. This species has rounded rostrum and well developed lamellae. The lamellae consist of two longitudinal ridges which on short distance lack connection with the more transversely running part of lamella issuing from the bothridium. On a level

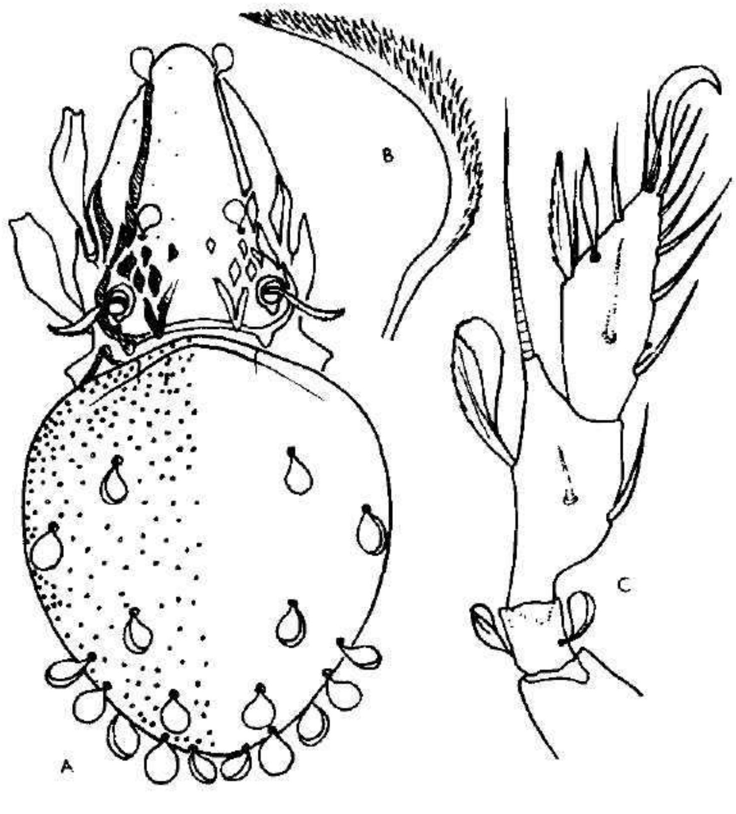

Fig. 3. ***Mystroppia rethejumi*** sp. n., A dorsal, B sensillus, C leg I.

with the interlamellar hairs several tubercules are situated. The sensilli are short; the head is very pointed, lanceolate with 35—40 short hairs on the outher side. The lamellar and interlamellar hairs are spoon-shaped. Propodosoma is weakly granulated.

Hysterosoma fairly rounded, broadest in the middle and slightly pointed posteriorly. Anterior margin rounded in the middle. The cerotogument is weakly granulated. There are 9 pairs of notogastral hairs, all of which are spoon-shaped. The ventral part of the body does not differ visibly from that of *M. sellnicki* Balogh (Balogh, 1959).

This species can at once be distinguished from *M. sellnicki* by the almost smooth propodosoma and by the notogastral hairs inserted on the shorter distence from the posterior margin of the hysterosoma.

Locality: Uzbekistan, sandy soils in Ferganskaja valley.
Type material: Holotype (♀).

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Zoologische Abteilung des Nationalmuseums, Praha

ERSTER FUND DER ART ALLOLOBOPHORA GEORGII MICHAELSEN, 1890 (OLIGOCHAETA: LUMBRICIDAE) IN DER ČSSR

MARIE MIKULOVÁ

Eingegangen am 12. Juni 1970

Abstrakt: In der Regenwürmer-Ausbeute aus dem Fundort bei Mužla, Südslowakei (gesammelt am 15. X. 1968 von Dr. K. Táborský) wurden acht Exemplare der Art *Allolobophora georgii* Michaelsen, 1890 bestimmt. Es ist der erste Beleg des Vorkommens dieser Art aus dem Gebiet der Tschechoslowakei.

Bei der Bearbeitung der Sammlung aus der Exkursion der Zoologischen Abteilung des Nationalmuseums in die südliche Slowakei im Jahre 1968 fand ich im Material aus der Lokalität Mužla bei Štúrovo 8 Exemplare nichtpigmentierter Regenwürmer mit auffallend hervorstehenden eierförmigen Pubertätstuberkeln an dem 31. und 33. Segment. Alle Exemplare hatten eingepaarte Borsten. Die übrigen äusseren Merkmale bewegten sich in folgenden Grenzen: Länge 49—60 mm, der grösste Körperdurchschnitt vor dem Gürtel 2—2,5 mm, Anzahl der Segmente 80—104, Lage des Gürtels an dem 29, 1/n29, 30.—35. Segment. Den Bereich der Länge und Anzahl der Segmente bestimmte ich an 5, die Lage des Gürtels und den Körperdurchschnitt an 7 Exemplaren. Zwei der gefundenen Exemplare waren nämlich defekt und eines juvenil.

Bei zwei der gefundenen Stücke habe ich die Zahl der Samensäcke (vesiculae seminales) und die Zahl und Lage der Samentaschen (receptaculi seminis) festgestellt. 4 Paare der Samensäcke breiten sich vom 9. bis zum 12. Segment aus, 2 Paare der Samentaschen zwischen den Segmenten 10 und 11. Die Samentaschenporen sind an der Oberfläche des Körpers in den Intersegmentalfurchen 9/10, 10/11 in der Borstenlinie cd.

Nach Michaelsen (1900) und Pop (1949) stellte ich fest, dass die gefundenen Stücke zur Art *Allolobophora georgii* Michaelsen, 1890 gehören. Weder Černosvitov (1935), noch Zajonc (1965) führen in ihren Monographien diese Art aus unserem Gebiet an. Mit Rücksicht darauf, dass ich kein Vergleichsmaterial aus anderen Ländern zur Verfügung hatte und aus den in den zitierten Literatur angeführten Beschreibungen ein Unterschied nicht ersichtlich ist, konnte ich leider nicht feststellen, ob es um eine typische Form dieser Art oder um eine Vatietät *transylvanica* Pop, 1938 geht. Michaelsens Beschreibung ist bedeutend kürzer, als jene von Pop, beide stimmen jedoch in den grundsätzlichen systematischen Merkmalen überein. Sie unterscheiden sich in der Beschreibung der Ausmündung der männlichen Poren und in der Beschreibung der Pubertätswälle.

Michaelsen: „Männliche Poren mit kleinen, schwach erhabenen Drüsenhöfen, die nicht auf die benachbarten Segm. übergreifen. Pubertätstuberkel stark erhaben, saugnapfförmig, quer-oval, zwei Paar am 31. und 33. Segm."

Pop: „Männliche kleine Poren ohne Drüsenhöfe. Die Pubertätswälle liegen lateral längs des Gürtels an 1/n30—1/n34. Ventral an dem 31. und 33. Segment bilden sie zwei Paar Tuberkeln."

An meinem Material aus Mužla sind die Drüsenhöfe bei der Mündung der männlichen Poren überhaupt nicht entwickelt. Was die Lage und Form der Pubertätswälle anbelangt, handelt es sich in beiden zitierten Beschreibungen sichtlich um eine subjektiv unterschiedliche Äusserung der gleichen Tatsache (Abb. 1-A, B).

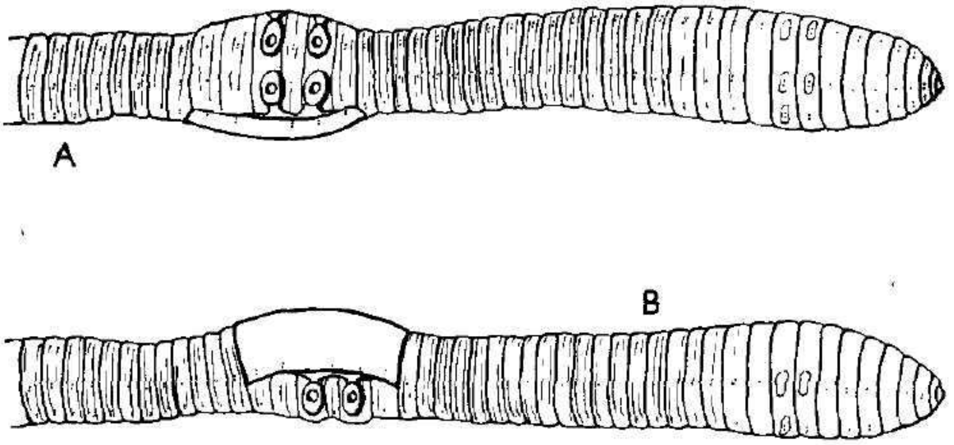

Abb. 1. — *A. georgii*, Vorderteil des Körpers: A — ventral, B — lateral.

Diese feinen Unterschiede in den Beschreibungen gestatten mir nicht zu entscheiden, um welche Varietät es sich handelt, da in der Beschreibung der anatomischen Merkmale beide Autoren völlig übereinstimmen.

Der Fundort der Art *A. georgii* Mužla liegt westlich von Štúrovo in einer Ebene, deren Grundlage Lösboden bildet. Dieses ganze Gebiet hat einen ausgesprochenen Steppencharakter. Die Lokalität selbst liegt etwa 2 km nordwestlich von Mužla. Es ist eine Wiese mit einem durchfliessenden Bach 112 m ü. M.

Das Material der Würmer — insgesamt 120 Stück — wurde durch Heraustreiben aus der Erde mittels einer 2% Formaldehyd-Lösung gewonnen. Es wurden darin folgende Arten gefunden:

Dendrobaena platyura (Fitz.) var. *depressa* (Rosa)	40 Ex.
Allolobophora caliginosa (Sav.)	15 Ex.
Allolobophora georgii Michaelsen	8 Ex.
Lumbricus rubellus Hoffm.	3 Ex.
Octolasium lacteum (Örley)	2 Ex.
Dendrobaena juv.	38 Ex.
Allolobophora juv.	12 Ex.
Lumbricus juv.	2 Ex.

Die Dominanz der Art *A. georgii* in dieser Lokalität ist also 6,7 %.

Die geographische Verbreitung der Art *A. georgii* begrenzt Michaelsen (1900) wie folgt: Syrien, Palästina, Spanien, Irland. Pop (1949) findet ihre Varietät *A. g.* v. *transylvanica* Pop, 1938 in vielen Lokalitäten Rumäniens, Zicsi (1958) findet diese Art an mehreren Orten in Ungarn, Moszyňska (1962) in der Umgebung Warschaus in Polen. Als neue Art für Österreich meldet sie Zicsi (1965).

Der Fund vom 15. X. 1968 in Mužla bei Štúrovo ist der erste Beleg vom Vorkommen dieser Art auch auf dem Gebiet der ČSSR. Das Belegmaterial ist in der Zoologischen Abteilung des Nationalmuseums in Prag unter Inventarnummer 589 Kat. der Wirbellosen III, (Dr. K. Táborský leg.) aufbewahrt.

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Anschrift des Verfassers: Marie Mikulová, Zoologické oddělení, Národní Museum, Václavské náměstí 68, Praha 1-Nové Město, ČSSR.

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Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

STUDIES ON THE DEVELOPMENT OF THE NEMATODE *CYSTIDICOLOIDES TENUISSIMA* (ZEDER, 1800)

František MORAVEC

Received May 28, 1970

Abstract: In studies of the life cycle of the nematode *Cystidicoloides tenuissima* (Zeder, 1800), parasitic in salmonid fishes, we infected mayfly nymphs (*Habrophlebia lauta*, *Habroleptoides modesta* and *Ephemera danica*) with eggs of this nematode species. The development of the larvae, moulting twice in these intermediate hosts, to an invasive third stage was completed within 24—38 days at 13—15° C. The presence of *C. tenuissima* larvae in the body does not prevent the mayfly nymph to complete its metamorphosis. The feeding of larvae-harbouring mayfly nymphs to fishes (*Salmo trutta* m. *fario* and *Thymallus thymallus*) resulted in the establishment of infection and in the finding that adult male nematodes developed in 12 days in the stomach of the definitive host, young females in 20 days.

Although the nematode *Cystidicoloides tenuissima* (Zeder, 1800) is one of the most frequent parasites of salmonid fishes in Europe, Asia and North America, there is little knowledge available on its biology. The only paper dealing with the development of this species (under the synonym *Metabronema salvelini*) is that of Choquette (1955) who found the invasive larvae of *C. tenuissima* in intermediate hosts, the mayfly nymphs *Hexagenia recurvata* and *Polymitarcis* sp., in North America (Canada — Quebec). To establish infection of the definitive host the author fed speckled trout (*Salvelinus fontinalis*) with invaded mayfly nymphs and found that the larvae underwent, two moultings in the definitive host to mature in from 60 to 70 days. However this report lacks detailed data on the individual larval stages in the definitive host. The development of the larvae in the intermediate host has not been studied at all.

Apart from some brief notes on the development of nematodes of the genus *Rhabdochona* (Weller, 1938; Gustafson, 1939, 1942) and *Spinitectus* (Gustafson, 1939), little is known about the life history of other related genera of fish spirurids. Invasive larvae from intermediate hosts have been described only in the genus *Ascarophis* (Uspenskaja, 1953; Uzmann, 1967), *Spinitectus* (Johnson, 1966), *Rhabdochona* (Štejn, 1959) and *Cystidicola* (Baylis, 1931; Bauer and Nikolskaja, 1952).

MATERIAL AND METHODS

Adult females of *C. tenuissima*, obtained from the stomach of *Salmo trutta* m. *fario*, were placed in batches of 10—20 specimens in small petri dishes (⌀ 45 mm) filled with water. The eggs were liberated from the uteri by tearing up the body of the nematode with fine preparation needles.

After mixing the eggs with fine detritus and crushed dry leaves, 20 – 30 mayfly larvae were added to each dish; the dishes were covered with fine nylon cloth, the top secured with a rubber band, and submerged in water in large vessels (40 × 32 cm) under a continuous flow of water (13 – 15° C). After 24 hrs, the mayfly larvae were transferred into larger petri dishes containing detritus and plant remnants but no eggs of *C. tenuissima;* these were covered and submerged in water. At first, the mayfly nymphs were examined every 24 hrs, later every 2 – 3 days. Fishes from localities not infested with *C. tenuissima* were used for infection experiments. These fishes kept in large vessels (250 l) at 18° C were fed with mayfly nymphs harbouring numerous invasive larvae of *C. tenuissima* by forcing them directly into their stomach with a large pipette. Then the fishes were fed with minced meat. The larvae of *C. tenuissima*, obtained from both mayfly nymphs and fishes, were fixed in 2 – 4 % formalin and studied without clearing.

RESULTS

Experimental infection of intermediate hosts

In our experiments, three species of mayfly nymphs were found to be the intermediate hosts of *C. tenuissima* – *Habrophlebia lauta* McLachl., *Habroleptoides modesta* (Hag.) and *Ephemera danica* Müll. The incidence was 50 – 100 %, the intensity of infection 1 – 22 larvae per nymph. No differences were observed in the incidence or intensity of infection of the individual intermediate host species when using the same concentration of eggs. All attempts to infect nymphs of the species *Heptagenia* sp., *Ecdyonurus* sp., *Caenis* sp., *Cloëon* sp. and *Baëtis* sp. (*Ephemeroptera*) remained unsuccessful.

Advanced eggs of *C. tenuissima* containing fully formed first-stage larvae are ingested by the mayfly nymphs together with detritus. In the gut of this intermediate host, the larvae emerge from their egg capsules and penetrate the gut wall on their way to the body cavity to continue their development there. They are mostly located in the abdominal cavity of the intermediate host, mainly on the surface of the gut and later also in the thorax. During the development in the intermediate host, the larvae moult twice (between the 5th – 18th day and 23rd to 26th day after infection) to attain the third, invasive stage. Contrary to what happens in the development of most spirurids, the larvae of *C. tenuissima* do not encyst in the arthropod host after attaining the invasive stage but remain free, coiled, in the body cavity of the abdomen or in the thoracic muscles of the intermediate host, less often (mainly in heavier infection) also in the legs or the head. However, the development of larvae does not cease after attaining the third larval stage; the larvae continue to grow and an additional development of the sexual glands takes place. Even though the third larval moulting has not been observed in the intermediate host, it may be concluded, judging from the body size and the advanced sexual glands of some larvae found in naturally infected mayfly nymphs, that the larvae can develop up to the fourth stage in the intermediate host. The development of *C. tenuissima* to the invasive third larval stage in the body cavity of mayfly nymphs lasts 24 – 38 days at 13 – 15° C.

Massive invasions often resulted in the death of the mayfly nymphs, mostly during the period of intensive growth of *C. tenuissima* larvae, i.e. mainly in the third and fourth week from the outset of the experiment. It was found that as many as 22 larvae of *C. tenuissima* can develop to the invasive stage in one mayfly nymph.

The presence of a smaller number of *C. tenuissima* larvae in the body does not prevent the nayfly nymph to complete its metamorphosis, as observed in the species *Habrophlebia lauta*, when advanced nymphs of this species, experimentally infected with *C. tenuissima* larvae, were kept alive up to the subimaginal or imaginal stage. The maximum number of larvae found in the imago of *H. lauta* was 15, these being located in the abdomen and thoracic muscles. This finding is of considerable importance, since the brown trout (*S. trutta* m. *fario*) — the main definitive host of *C. tenuissima* in Czechoslovakia — feeds mostly on winged insects during spring and summer, catching them from the water surface, so that during these seasons the adult mayfly is a more important source of infection with *C. tenuissima* larvae than its nymph.

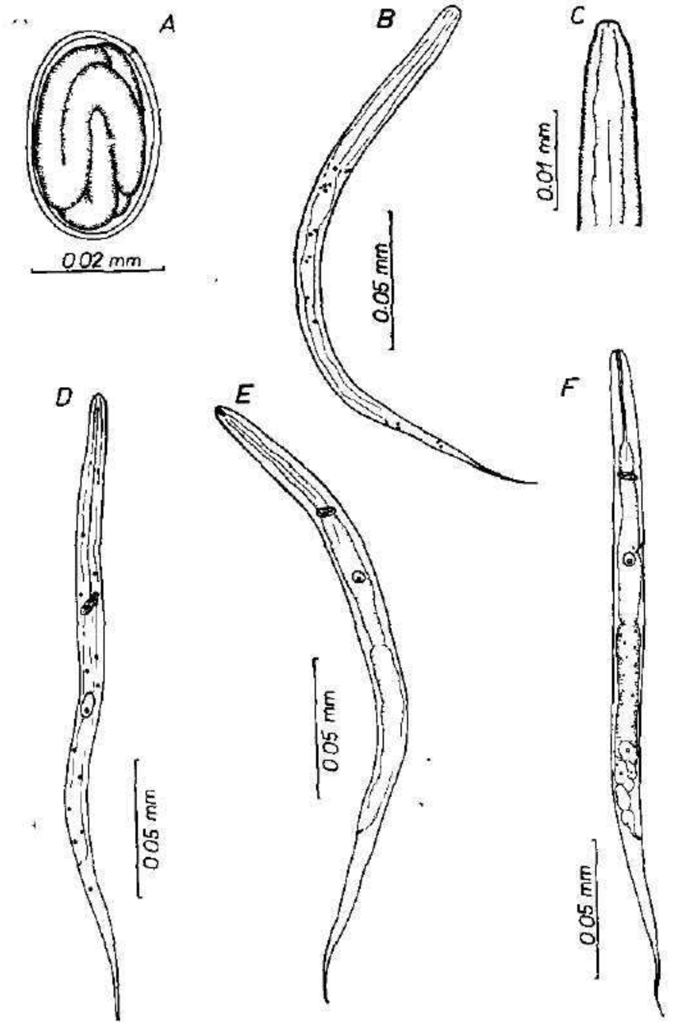


Fig. 1. ***Cystidicoloides tenuissima*** (Zeder, 1800) — egg and first-stage larva from the intermediate host. A — egg, B — larva 24 hrs p. i., C — head end of larva 24 hrs p. i., D — larva 2 days p. i., E, F — larvae 4 days p. i.

Experimental infection of fishes

To trace the development of *C. tenuissima* in the definitive host, a total of 9 fishes has been used in feeding experiments — 4 *Salmo trutta* m. *fario* and 5 *Thymallus thymallus*, coming from a locality where the species *C. tenuissima* has not been recorded. We examined also a control group consisting of 2 specimens of *S. trutta* m. *fario* and 2 of *Th. thymallus* from the same locality. Out of five experimentally infected *Th. thymallus* four turned out positive after examination; of four *S. trutta* m. *fario* three were positive. The positive fishes were examined on the 1st, 3rd, 9th, 12th and 20th day after infection.

The complete development of *C. tenuissima*, until egg production, could not be observed because of a shortage of suitable fishes for experimentation. However, it is obvious from our experiments that adult male nematodes appear as early as on day 12 after infection in the stomach of the definitive host and that the last moulting of the female larva occurs on the 12th to 20th day p.i. Evidently, eggs are laid much later — after a month or even more. In spite of the fact that only the last (fourth) larval moult was recorded in the definitive host (12—20 days p.i.), it may be warrantably assumed that also the third larval moulting can take place in the definitive host soon after infection with invasive larvae. This assumption is supported by the fact that the smallest larvae of *C. tenuissima* (length 3.04 to 3.63 mm), obtained on the 1st and 3rd day p.i., had a conspicuously thick cuticule.

The egg and larval development

a) Egg (Fig. 1a)

The egg of *C. tenuissima* is light, oval-shaped, size 0.036 — 0.048 × × 0.024—0.030 mm. The hyaline wall of the egg is 0.033 mm thick, with a smooth surface. Near one pole the surface of the egg is provided with a feebly visible, small subapical protuberance. The eggs when laid contain fully formed first-stage larvae. As verified experimentally, younger eggs with not fully developed larvae are unable of infecting the intermediate host; when released into water, their development ceases and the eggs gradually die.

b) First-stage larva (Fig. 1b—f, 2)

After ingestion of the advanced egg by the mayfly nymph, the first-stage larva hatches from the egg shells in the gut of this intermediate host and passes through the gut wall into the body cavity. The first-stage larva, recovered from the body cavity of the intermediate host 24 hrs after possible infection, is light, slender, its length is 0.291 mm, maximum width 0.012 mm. The cuticle is very fine, almost smooth. The internal organisation of the larval body is indistinct, the anal pore is difficult to see. By contrast, 2—3 day-old larvae exhibit, in addition to a slight body increase, some morphological changes. Although the digestive tract is still little distinct, the oesophageal part of the body can be distinguished; the oesophageal walls are becoming pseudochitinized at the anterior end, this being the first anlage of the later vestibule; also the nerve ring, the excretory pore and anal pore are becoming visible. While 4 day-old larvae still resemble younger larvae in the shape of their body, their vestibule is already distinctly pseudochitinized, the oesophagus well visible and numerous unicellular rectal glands surround the rectum.

More advanced larvae were obtained as late as 14 days p.i.; in one case, however, one larva (0.820 mm long) just undergoing the first larval moult was found as early as 5 days p.i. 14 day-old larvae measured 0.450 mm; they were plumper in shape and their internal organisation was more distinct. The oral opening is surrounded by four minute lips, the digestive tract begins with a thin, long, *pseudochitinized vestibule, the oesophagus* is short, with several expressive cellular nuclei at its end. The intestine is inconspicuous consisting of large cells. The tail is conical, very sharp. The genital primordium, formed by four cells, lies in the posterior part of the body. During the following development the first-stage larvae undergo little morphological changes except an intensive growth of the body and a gradual rounding of the tail.

The majority of larvae, found 17–18 days p.i., had started their first larval moult; the length of these moulting larvae was 0.82–1.35 mm. In the moulting larvae morphological changes mostly concern the vestibule, where a funnel-shaped prostom forms at its anterior end; its walls are much thinner than those of the remaining part of the vestibule. At this stage, the oesophagus divides gradually into an anterior muscular and a posterior glandular part. The growth of the first-stage larvae is shown in Table 1.

c) Second-stage larva (Fig. 3a, b, c, e, f)

The larvae remain in the sheath of the cuticle of the first stage for several days; immediately after shedding this cuticle the larvae start their second moulting which occurs on day 23–25 p.i. The *length of the transitive stage* larvae is 1.63–3.39 mm during this moult. However, all larvae do not develop contemporarily and hence, individual moulting

Table 1. Growth of first-stage larvae in intermediate hosts

	1 day p.i.	2 days p.i.	3 days p.i.	4 days p.i.	5 days p.i.	14 days p.i.	18 days p.i.
Body length	0.291	0.300–0.315	0.282–0.324	0.300–0.303	0.825	0.450	0.690–1.356
Body with	0.012	0.012	0.012–0.015	0.014–0.015	0.051	0.030	0.045
Length of vestib.				0.036	0.045	0.030	0.042–0.093
Length of *oesoph.*				0.105–0.126	0.285	0.096	0.240–0.357
Distance of n. ring from anter. end			0.079	0.058–0.066	0.105	0.090	0.090–0.117
Distance of exer. p. from anter. end			0.113	0.090	0.135	0.099	0.108–0.171
Length of tail		0.075–0.099	0.067	0.078–0.081	0.090	0.063	0.069–0.078

larvae, 3.4 mm long, were found as late as 52 days p.i. In the course of this moult the same type of vestibule as that of adult nematodes originates in these larvae together with two slightly protruding lateral lips. Three large, unicellular rectal glands are distributed round the colourless rectum.

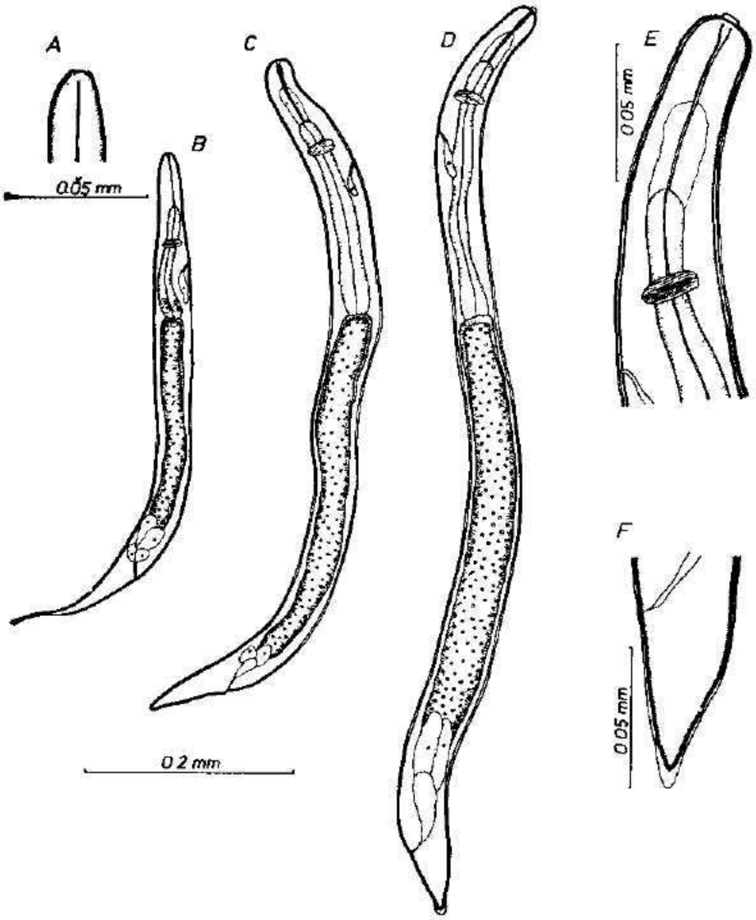


Fig. 2. *Cystidicoloides tenuissima* (Zeder, 1800) — **first-stage larva from the intermediate host.** A, B — larva 14 days p. i., C — larva 18 days p. i., **D, E, F — larva during the first moult** (18 days p.i.).

d) Third-stage (invasive) larva (Fig. 3d, 4)

When the second moult is over, the third-stage larvae remain free in the body cavity (not in cysts). The first third-stage larvae, already without the cuticular sheath of the second moulting, were found in mayfly nymphs 24 days p.i. Third-stage larvae, obtained in experiments 23—38 days p.i., were 2.76—4.08 mm long, slender, with a transversely striated cuticle. The mouth is surrounded by two minute lips; four subterminal head papillae are visible on the anterior end of the body. The vestibule is of the same type as that of the adult. The oesophagus is long, distinctly divided into a shorter,

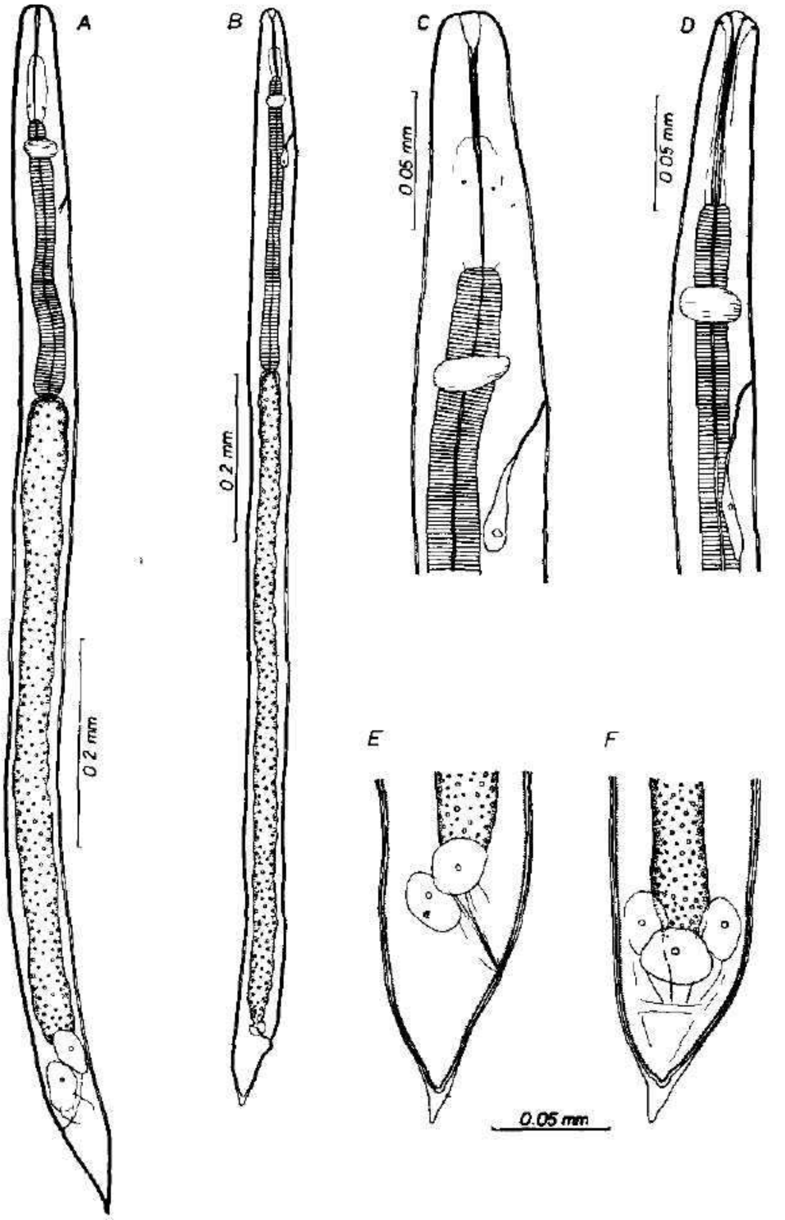


Fig. 3. *Cystidicoloides tenuissima* (Zeder, 1800) — larvae from intermediate hosts. A — less developed larva during the first moult (18 days p. i.), B, C — more advanced larva during the first moult (second-stage larva) 18 days p. i., D — head end of third-stage larva (24 days p.i.), E, F — posterior end of larval body during the second moult (laterally and dorsally) 24 days p.i.

anterior muscular section and a longer, posterior glandular section, opening through a valvular apparatus into the intestine. The nerve ring encircles the oesophagus at the anterior end of its muscular section, the excretory pore is situated shortly behind the nerve ring. The rectum is a thin-walled hyaline tube surrounded by three large, unicellular rectal glands (two lateral and one dorsal). The tail is relatively short, rounded, with a terminal papilla-like protuberance, this being absent in some male larvae. The tail of the male larvae is somewhat longer than that of the female larvae. The anlage of the sexual glands is very elongated.

Having attained the third stage the development of larvae does not cease. This is obvious from the fact that the length of *C. tenuissima* larvae, found in

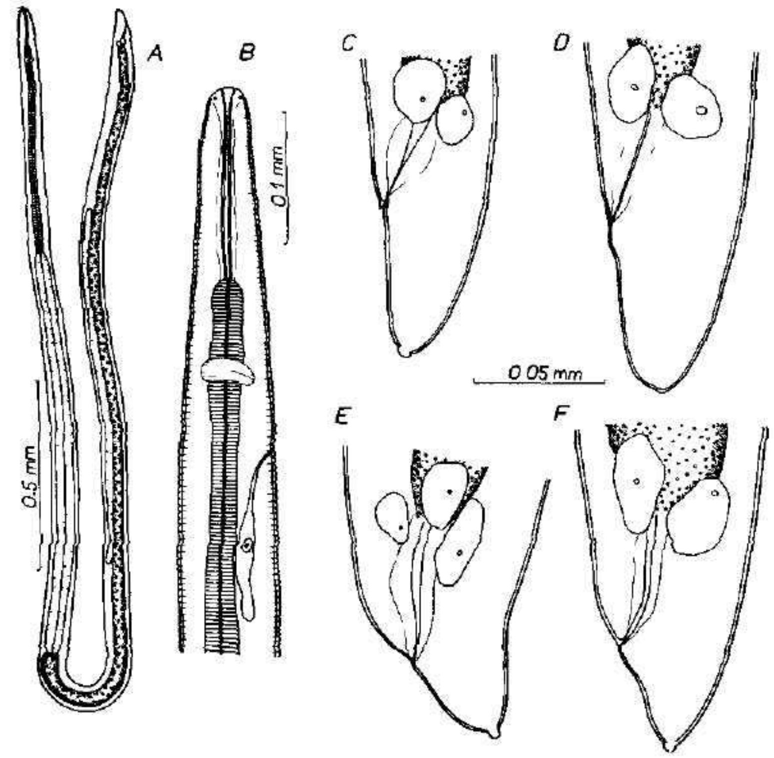


Fig. 4. ***Cystidicoloides tenuissima*** **(Zeder, 1800)** — invasive **larva** from naturally infected intermediate hosts. A — total view, B — head end, C, D — tail of male larva, E, F — tail of female larva.

naturally infected mayfly nymphs (*Habroleptoides modesta* and *Ephemera* sp.), was 4.08—7.94 mm while that of larvae obtained in experiments was only 2.76—4.08 mm. Furthermore, the larvae from naturally infected intermediate hosts differ from those from experimental infection in having much advanced genital tubes. Therefore, it is possible that an additional (third) larval moult, usually taking place in the definitive host, may occur in the body of the intermediate host (probably if the larvae remain there for a long time).

These third-stage larvae (and probably also presumptive fourth-stage larvae) from mayflies are infective to the definitive host, reaching its digestive tract after having been swallowed together with their intermediate host. In the body of the final host the invasive larvae adhere to the wall of the stomach

Table 2. Measurements of second- and third-stage larvae from intermediate hosts

	Larvae of second (transitory) stage		Third-stage larvae	
	23 days p. i.	*24 days* p. i.	*24 days* p. i.	*38 days* p. i.
Body length	1.632–3.114	2.947–3.391	3.440	2 760–4.080
Body width	0.057–0.093	0.051–0.057	0.066	0.057–0.068
Length of vestib.	0.108–0.111	0.102–0.117	0.114	0.105
Length of musc. oesophagus	0.135–0.495	0.486–0 603	0.570	0.486–0.600
Length of gland. oesophagus	0.336–0.924	0.702–0.843	0.900	0.882–1.060
Distance of n. ring from anter. end	0.126–0.159	0.150–0.162	0.159	0.156–0.162
Distance of excr. p. from anter. end	0.189–0.225	0.189–0.201	0.210	0.207
Length of tail	0.066–0.087	0.051–0.075	0.069	0.057–0.060

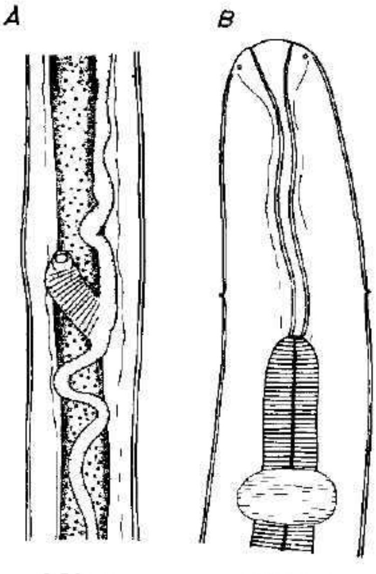
and continue to develop. Although the third larval moulting has not been observed in the definitive host, the smallest larvae, obtained on the 1st and 3rd day *p.i.* (length of body 3.04–3.63 mm) from definitive hosts, exhibited a conspicuously thick cuticle, suggesting that the larvae were prepared for the moult.

e) Fourth-stage larva (Fig. 5)

It is very difficult to distinguish morphologically between the fourth- and third-stage larvae because both larval types are very similar. In addition to differences in size the sexual glands and genital organs of the fourth-stage larvae are more advanced than those of the third-stage larvae. Since the

Table 3. *Comparison of measurements of the invasive larvae of C. tenuissima* with data given by Choquette (1955)

	After Choquette (1955)	Own material	
	natural infection	natural infection	exper. infection
	Hexagenia recurvata *Polymitarcis* sp.	*Habroleptoides modesta* *Ephemera* sp.	*Habroleptoides modesta* *Habrophlebia lauta* *Ephemera danica*
Body length	3.320–7.000	4.080–7.940	*2.760–4.080*
Length of vestib.	0.067–0.128	0.123–0.147	0.105–0.114
Length of musc. oesophagus	0.300–0.748	0.684–1.095	0.486–0.600
Length of gland. oesophagus	0.841–1.840	1 089–2.322	0.882–1.060
Distance of n. ring from anter. end	0.108–0.176	0.174–0.210	0.156–0.162
Distance of excr. p. from anter. end	0.137–0.224	0.233–0.279	0.207–0.210
Length of tail	0.040–0.083	0.051–0.081	0.057–0.069



third larval moulting has not been observed in our experiments, it may be only assumed that this moult occurs in the definitive host soon after infection or even in the intermediate host.

Differences between third- and fourth-stage larvae are less distinct in the male larvae. In the female fourth-stage larvae the genital organs develop rapidly, the vulva, muscular vagina, uterus and ovaries become differentiated (see Fig. 5). The uterus is a thin-walled tube, posteriorly almost extending to the end of the body, anteriorly to the oesophagus. For the first time did we found small, little distinct cervical papillae in the fourth-stage larvae, situated slightly in front of the posterior end of the vestibule.

Fig. 5. *Cystidicoloides tenuissima* (Zeder, 1800) — fourth-stage larva from the definitive host. A — vulva region of female larva 3 days p.i., B — head end of female larva 3 days p.i. (dorsoventral view).

In the intermediate host the last (fourth) larval moult of the male larvae occurred 12 days p.i., that of the female larvae 12—20 days p.i. In male larvae just undergoing moulting (length 4.96—6.06 mm) the caudal papillae and the not fully pseudochitinized spicules are visible under the cuticle from the previous moult. The moulting female larvae measure 6.66—9.10 mm; at this time, some of the uteri already contain several immature eggs.

f) Adults (Fig. 6)

Adult male nematodes were obtained from the definitive hosts on the 12th day p.i., young adult females on the 20th day p.i. Although some eggs were found in the uteri of several females recovered from experimental infection, oviposition seems to commence at a later period — after 2—4 weeks or even later. The morphology of the adult nematodes from experimental infection agrees fully with the description of this species as given by **Moravec** (1967).

DISCUSSION

Our experimental results illustrate the following development of *C. tenuissima*. Adult nematodes are found in the stomach of salmonids and some other fishes. The eggs, containing fully formed first-stage larvae, released to an aquatic environment along with the host's faeces, are ingested by mayfly nymphs. In the gut of these intermediate hosts the first-stage larvae hatch from the egg shells and penetrate through the intestinal wall into the body cavity of the intermediate host, where the larvae moult twice to attain the invasive third larval stage. The invasive larvae do not encyst in the intermediate host but remain free in the body cavity. This development is completed within 24—38 days at 13—15° C. However, the development of the larvae does not cease; these continue to grow in the intermediate host and, after a prolonged period, can moult probably once more to attain the fourth

Table 4. Growth of male larvae and males in the definitive host

	Third- and fourth-stage larvae 1 day p.i.	 3 days p.i.	Moulting ♂♂ 12 days p.i.	 12 days p.i.	♂♂ 30 days p.i
Body length	3.441–4.210	3.046–3.634	4.964–6.062	6.011	5 850–6.365
Body width	0.075–0.090	0.072–0.093	0.088–0.122	0.095	0.095–0.136
Length of vestib	0.096–0.111	0.102–0.114	0.105–0.150	0.141	0.096–0.108
Length of musc. oesophagus	0.438–0 669	0.585–0.630	0.669–0.768	0.900	0.675–0.816
Length of gland. oesophagus	0.911–1.387	1.120–1.350	1.210–1.360	1.564	1 483–1.877
Distance of n. ring from anter. end	0.144–0.180	0.150	0.144–0.156	0.180	0.150–0.204
Distance of excr. p. from anter. end	0.171–0.219	0.195	0.186–0.210	0.219	0.174–0.249
Distance of cerv. p. from anter. end	0.081	0.090			0.105
Length of tail	0.075	0.063–0.069	0.099–0.122	0.111	0.144
Short spicule			0.099	0.120	0.120
Long spicule			0.357	0.303	0.324–0 369

Table 5. Growth of female larvae and females in the definitive host

	1 day p.i.	3 days p.i.	9 days p.i.	12 days p.i.	20 days p.i.
Length of body	6.936	6.690	4.080–7.160	6.419–9.107	6.800–9.887
Width of body	0.117	0.136	0.095–0.163	0.095–0.136	0.122–0.163
Length of vestibule	0.135	0.126	0.126–0.141	0.126–0.135	0.144–0.150
Length of musc. oesophagus	1.245	0.978	0.750–1.029	0.952–1.156	0.939–1.260
Length of gland. oesophagus	2.052	1.770	1.196–2.162	1.632–2.353	1.483–2.216
Distance of n. ring from anter. end	0.210	0.159	0.165–0.213	0.195–0.222	0.195–0.225
Distance of excr. p. from anter. end			0.210–0.291	0.240–0.255	0.249–0.270
Distance of cerv. p. from anter. end			0.117		0.105–0.126
Length of tail	0.060	0.063	0.042–0.045	0.024–0.039	0.054–0.090
Distance of vulva from poster. end	2.448	1 182	2.720–2.840	2.516	2.647–3.644

larval stage. The fish (definitive host) is infected by feeding on mayflies (both adults and nymphs), harbouring invasive larvae of *C. tenuissima* (third- and presumably also fourth-stage larvae). If the definitive host had become infected with third-stage larvae, two more moultings occur in this stomach, but if presumptive fourth-stage larvae had caused the infection, only one, the last moulting, would take place in the definitive host. The first adult males appear 12 days after infection, the females 20 days after infection. Egg production, however, starts much later, probably one month after infection or even later.

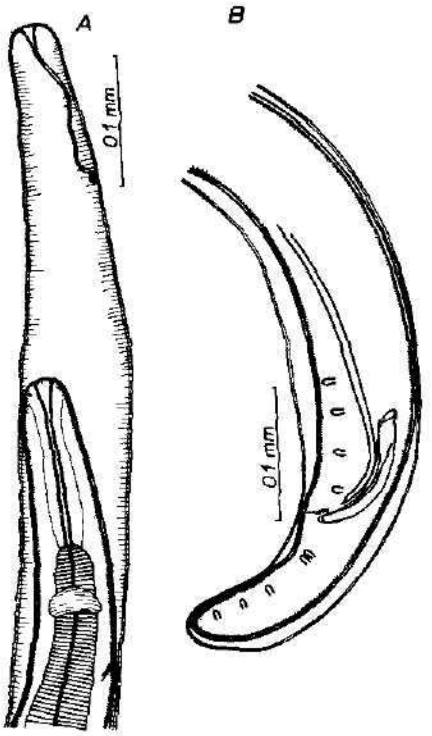


Fig. 6. *Cystidicoloides tenuissima* (Zeder, 1800) — larva just undergoing the last moult. A — head end of male larva (12 days p.i.), B — posterior end of male larva (12 days p.i.).

These experimental data are, on the whole, in agreement with the observations by Choquette (1955) concerning the naturally infected intermediate hosts of *C. tenuissima* in Canada. The comparison of the measurements of invasive larvae, both from experiments and nature from Czechoslovakia, with those of invasive larvae from Canada given by Choquette (1955) shows the metrical identity of the larvae in both cases. Choquette (1955) maintains that the sexes of the third-stage larva can be differentiated by the presence of a knob-like appendage on the tail of the female, whereas the male's tail lacks this appendage. However, our material shows that although this appendage may be almost absent in some male larvae, it may be well developed in others. On the contrary, in some female larvae this appendage is little distinct. However, besides the characters of the developing genital organs, these being often difficult to observe, the future sex of the invasive larvae can be determined by the length and the shape of the larval tail (see Fig. 4).

It is also interesting that the larvae of *C. tenuissima*, after having attained the invasive third larval stage, do not stop their development in the intermediate host; on the contrary they may even double their length and also considerable progress of the anlage of their genital apparatus can be observed. Although the third larval moulting has not been observed in the intermediate host up till now, these advanced larvae may probably represent the fourth larval stage. This presumption is also supported by the observations of Gustafson (1942) in the related genus *Rhabdochona*. Also the larvae from *Gammarus* sp., found by Baylis (1931) and belonging evidently to the related species *Cystidicola farionis*, are considered by this author to be fourth-stage larvae. Very advanced larvae from intermediate hosts are also known from other fish spirurids, for instance the genus *Ascarophis* (see Uzmann, 1967).

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Author's address: **F. Moravec, Institute of Parasitology, *Czechoslovak Academy of Sciences* Flemingovo nám. 2, Praha 6, Czechoslovakia.**

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Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

STUDIES ON PARASITIC WORMS FROM CUBAN FISHES

FRANTIŠEK MORAVEC & VLASTIMIL BARUŠ

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Abstract: The present paper comprises a systematic survey of parasitic worms collected from 129 specimens of fishes (both freshwater and marine) in Cuba. Trematodes were represented by 13 species of which 5 were adults (*Crassicutis cichlasomae, Opistholebes adcotylophorus, Sclerodistomum diodontis, Lecithochirium floridense* and *Asymphylodora* sp.) and 8 juvenile forms or metacercariae (*Pycnadena* sp., *Stephanostomum* sp., *Perezitrema viguerasi* ?, *Clinostomum* sp., *Parascotyle* sp., *Neascus* sp. 1, *Neascus* sp. 2 and Digenea gen. sp.). From the class Cestoidea, only two immature forms were recorded — Proteocephalidae gen. sp. and Pseudophyllidea gen. sp. Also Acanthocephala were represented by juvenile forms only, determined as *Paulisentis* sp., *Rhadinorhynchus* sp. and *Polymorphus mutabilis*. Nematodes were found to belong to 8 species — four adult stages (*Rhabdochona* sp., *Spinitectus agonostomi* sp. n., *Spectatus cichlasomae* sp. n. and *Capillaria* sp.) and four larval stages (*Spiroxys* sp., *Contracaecum* sp., *Eustrongylides* sp. and Nematoda gen. sp.). Besides some new data on the morphology and the metric variability of species in question also their geographical distribution and the range of hosts are discussed.

The helminth fauna of Cuban fishes is still very little known. Some investigations were made only by Pérez Vigueras who, in the years 1935—1958, published a series of 14 papers, comprising mostly descriptions of new trematode species from marine fishes. The parasites of freshwater fishes are mentioned only in three of his papers. In 1936 he described a new cestode species *Proteocephalus manjuariphilus* from the host *Lepisosteus tristoechus* (fam. Lepisosteidae) and, in the years 1944 and 1955 (c), he recorded the finding of the larval stages of the trematode *Posthodiplostomum minimum* in the fish *Lepomis gibbosus* (fam. Centrarchidae). Recently Baruš and Moravec (1967a) reported on the helminth fauna of the gar (*L. tristoechus*).

In 1967 and 1968, during our work at the Biological Institute, Cuban Academy of Sciences, Havana, we could examine some of the most common species of Cuban freshwater fishes and a small number of marine fishes. Our findings of the parasitic worms substantially extend the knowledge of the helminth fauna of these hosts.

MATERIALS

A total of 129 fishes representing 13 families and 19 species were examined. Freshwater fishes were caught at the localities of the provinces: Habana, Pinar del Río, Las Villas and Oriente,

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marine fishes in the litoral near Havana and on the peninsula Zapata. A list of the hosts examined is as follows (the number of hosts examined is given in brackets).
Fam. Anguillidae — *Anguilla rostrata* (5)
Fam. Bothidae — *Bothus lunatus* (1)
Fam. Centrarchidae — *Lepomis pallidus* (13), *Micropterus salmoides* (9)
Fam. Centropomidae — *Centropomus* sp. (1)
Fam. Cichlidae — *Cichlasoma tetracantha* (31), *Cichlasoma* sp. (3)
Fam. Diodontidae — *Diodon holacanthus* (1)
Fam. Cyprinidae — *Cyprinus carpio* (5)
Fam. Eleotridae — *Eleotris guabina* (4), *Dormitator maculatus* (2)
Fam. Elopidae — *Megalops atlantica* (7)
Fam. Gerridae — *Diapterus plumieri* (1)
Fam. Mugilidae — *Agonostomus monticola* (7)
Fam. Poeciliidae — *Gambusia punctata* (15), *Limia vittata* (10), *Cubanichthys cubensis* (3), *Girardinus metallicus* (9)
Fam. Tetraodontidae — *Tetraodon lineatus* (2)

SYSTEMATIC SURVEY

Trematoda

Fam. Lepocreadiidae Nicoll, 1935

1. *Crassicutis cichlasomae* Manter, 1936 (Fig. 1a)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: intestine.

Locality: Rio Mosquito — new dam (province Pinar del Río), Laquito — Marianao and the canal near Guanímar (province Habana), Laguna del Tesoro — Zapata (province Las Villas). This species was found in 6 from a total of 31 hosts examined (intensity of infection 1—12 specimens).

Description: Body oval, with very strong, smooth cuticle. Body length of adult specimens 1.088—3.100 mm, maximum width 0.694—1.700 mm. Subterminal oral sucker measuring 0.150—0.285 × 0.150—0.285 mm, acetabulum situated slightly preequatorially, 0.135—0.353 × 0.150—0.353 mm. Size of muscular pharynx 0.060—0.082 × 0.075—0.190 mm, oesophagus very short. Caeca slender, ending near posterior end of body. Excretory vesicle opening approximately at the level of caeca endings. Testes slightly lobed, left testis usually more elongated and larger. Size of left testis 0.237—0.585 × × 0.114—0.299 mm, of right testis 0.069—0.177 × 0.099—0.204 mm. Seminal vesicle small, situated dorsally from acetabulum. Ovary small (0.069—0.177 × 0.099—0.204 mm), globular, situated in space between left testis and acetabulum. Uterus upward, genital pore medial, just anterior to acetabulum. Eggs oval, size 0.063—0.069 × 0.096—0.114 mm. Vitelline follicles extending mainly laterally and dorsally from caeca and connecting in space behind testes.

This species has been known from *Cichlasoma mayorum* from the peninsula Yucatan (Manter, 1936) and *Cichlasoma* sp. from Costa Rica (Bravo-Hollis, Arroyo, 1962). *Cichlasoma tetracantha* is a new host.

Fam. Allocreadiidae Stossich, 1903

2. *Pycnadena* sp. juv. (Fig. 3a)

Host: *Tetraodon lineatus* (Palma).
Location: intestine.
Locality: Litoral Playa Larga — Zapata (province Las Villas).
In 1 of 2 hosts examined only one specimen was found.

Description. Length of pear-shaped body 0.544 mm, maximum width 0.367 mm. Oral sucker 0.163 × 0.150 mm, acetabulum 0.286 × 0.245 mm. Oesophagus absent, pharynx large (0.122 × 0.109 mm), caeca reaching nearly to posterior end of body. Length of cirrus pouch 0.136 mm. Slightly diagonal, oval testes measuring 0.066—0.069 × 0.051—0.054 mm. Small, globular ovary in front of testes. Vitelline follicles not observed.

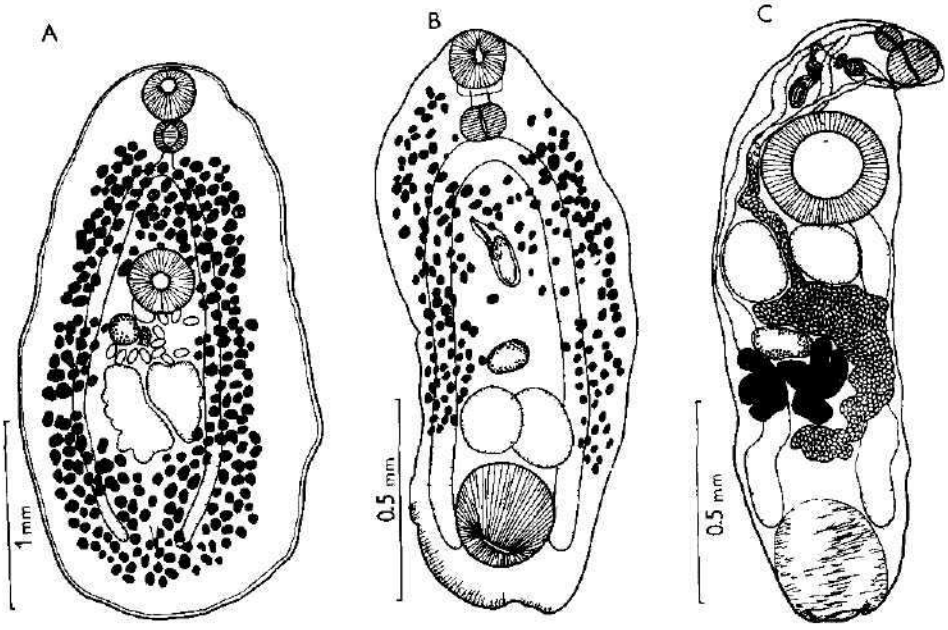

Fig. 1. A — *Crassicutis cichlasomae* Manter, 1936, B — *Opistholebes adcotylophorus* Manter, 1947, C — *Lecithochirium floridense* (Manter, 1934).

Fam. Opistholebetidae Fukui, 1929

3. *Opistholebes adcotylophorus* Manter, 1947 (Fig. 1b)

Host: *Diodon holacanthus* Linnaeus.
Location: intestine.
Locality. Litoral Santa Fé (province Habana).

Description: Length of body 1.74—2.04 mm, maximum width 0.789 to 0.911 mm. Oral sucker 0.190 × 0.190 mm, acetabulum, surrounded by a glandular disk, 0.354—0.394 × 0.354 mm Prepharynx short, pharynx strongly muscular (0.150—0.163 × 0.122 mm), oesophagus absent, caeca reaching nearly to posterior edge of acetabulum Two oval testes (0.231 to 0.272 × 0.190—0.204 mm) symmetrically in front of acetabulum, smaller ovary (0.150 × 0.082—0.095 mm) pretesticular, submedial genital pore situated submedially behind intestinal bifurcation. Vitelline follicles in space from anterior edge of pharynx to posterior edge of testes. Eggs absent.

O. adcotylophorus has been known only from Florida (Manter, 1947) from the same host. Our specimens are of a somewhat more elongated shape of body than is obvious from the original description.

Fam. Sclerodistomatidae Dollfus, 1932

4. *Sclerodistomum diodontis* Yamaguti, 1942 (Fig. 2)

Host: *Diodon holacanthus* Linnaeus.
Location: intestine.
Locality: Litoral Santa Fe (province Habana).
In the only host examined five specimens were found.

Description: Length of body 6.25—8.59 mm, maximum width 1.985 to 2.584 mm. Oral sucker 0.653—0.885 × 0.639—0.748 mm, acetabulum situated approximately in middle of body length, size 1 197—1.523 × 1.129 to 1.387 mm. Pharynx rounded (0.313—0.476 × 0.272—0.381 mm), caeca slender, reaching to posterior end of body. Testes oval (0.340—0.639 × × 0.299—0.544 mm), diagonal or almost symmetrical, posterior to acetabulum or at its level. Large seminal vesicle present, provided with very developed prostatic part; genital pore immediately behind intestinal bifurcation. Oval ovary (0.258—0 558 × 0.163—0.367 mm) submedially behind testes. Uterus with many upward and downward branches in space between caeca. Eggs measuring 0.033—0.042 × 0.027—0.030 mm. Vitellaria consist

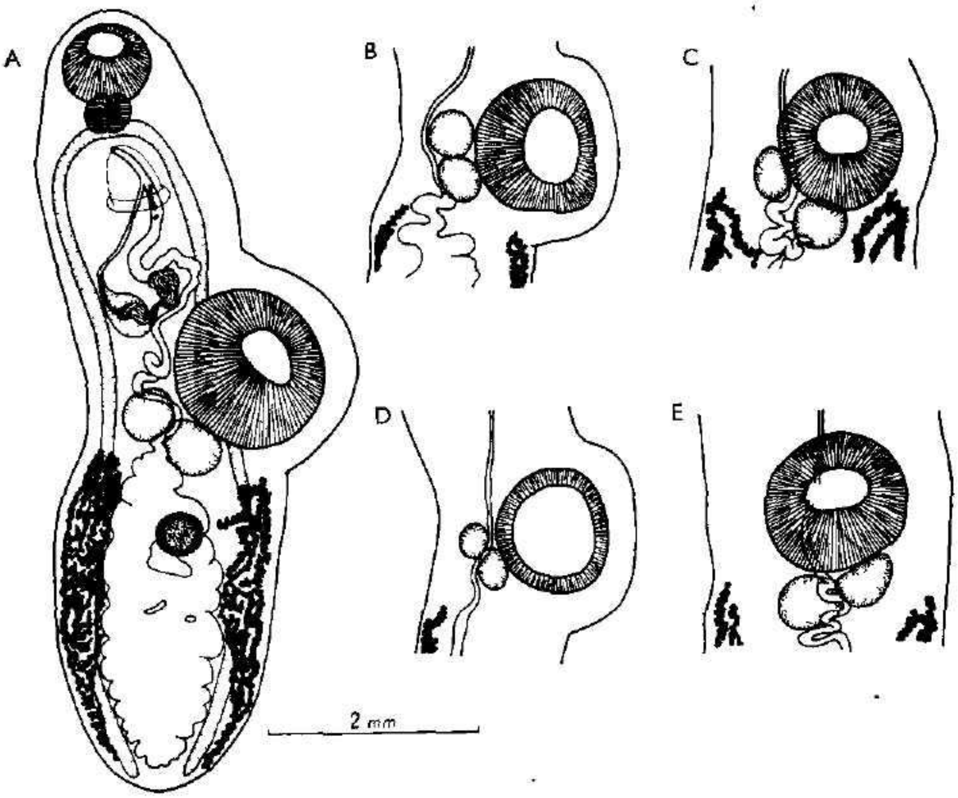

Fig. 2. *Sclerodistomum diodontis* Yamaguti, 1942.

of many tubular lobes situated dorsally and laterally to caeca in space from testes almost to posterior end of body.

The species *S. diodontis* was described from *Diodon holacanthus* from Japan (Yamaguti, 1942), later it was found in the same host from the Mexican Pacific (Bravo-Hollis, 1954).
In 1963 Pritchard, on the basis of the only specimen, described a new species, *Sclerodistomum bravoae*, from the host *Diodon hystrix* (probably identical with *D. holacanthus* — see Gosline and Brock, 1960) from the Hawaiian Islands, differentiating it from *S. diodontis* essentially by the symmetrical position of testes only. To this new species Pritchard (1963) also attributed the specimens recorded by Bravo-Hollis (1954) as *S. diodontis* from the coast of Mexico. As we observed in specimens from our material, the position of testes is rather variable (see Fig. 2) so that this feature has no taxonomical value. Since there are no metrical differences as well between *S. bravoae* and *S. diodontis*, we consider the name *S. bravoae* Pritchard, 1963 a synonym of *S. diodontis* Yamaguti, 1942.

Fam. Lecithochiriidae Skrjabin et Guschanskaja, 1954

5. *Lecithochirium floridense* (Manter, 1934) (Fig. 1c)

Host: *Megalops atlantica* Valenciennes.
Location: stomach.
Locality: Rio Guajaybon (province Habana).
Out of 7 hosts examined these trematodes were found in 2 (intensity of infection 1 and 2 specimens).

Description: Length of body 1.006—2.040 mm, maximum width 0.367 to 0.612 mm. Oral sucker measuring 0.081—0.150 × 0.095—0.177 mm, acetabulum 0.122—0.408 × 0.150—0.435 mm; sucker ratio 1 : 1.5—2.4. Pharynx oval, 0.036—0.068 × 0.045—0.082 mm, oesophagus very short. Caeca extend almost over the whole body length. Oval testes lateral, left testis measuring 0.109—0.218 × 0.177—0.229 mm, right testis 0.109—0.231 × 0.163 to 0.272 mm. Large seminal vesicle opens into an elongated hermaphroditic bursa, provided with a fairly large prostatic vesicle; genital pore just posterior to acetabulum. Rounded ovary measuring 0.095—0.136 × 0.177—0.190 mm, situated below the left testis. Uterus forming an upward and a downward branches, opening into the hermaphroditic duct of the hermaphroditic bursa. Eggs measuring 0.018—0.024 × 0.012 mm. Compact, lobed vitellaria posterior to ovary. Tail appendix representing approximately 1/5 of body length.

Specimens from the present material differ from the original description in somewhat larger eggs and slightly more lobed vitellaria.
The species *L. floridense* has been known from many species of the marine fishes of Florida (Manter, 1934, 1947). In Cuba it has already been found by Peréz Vigueras (1958) in the fish *Trisotropis venenosus apua*. *Megalops atlantica* is a new host for this parasite.

Fam. Monorchidae Odhner, 1911

6. *Asymphylodora* sp. (Fig. 3b)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: intestine.
Locality: canal near Guanimar (province Habana).
Out of a total of 31 hosts examined only one specimen was found in 1 of them.

Description: Length of body 1.605 mm, maximum width 0.598 mm. Cuticle covered with fine spines. Oral sucker measuring 0.204 × 0.231 mm, acetabulum 0.150 × 0.190 mm. Prepharynx short, pharynx globular (0.122 × × 0.122 mm), oesophagus very short. Caeca very difficult to see, but they seem to reach the posterior edge of vitellaria. Ovary and testis considerably damaged and their shape and size indistinct. Cirrus pouch (length 0.435 mm) opening laterally in front of acetabulum. Uterus occupying almost entirely the space posterior to acetabulum. Operculated eggs elongated, measuring 0.021—0.024 × 0.009—0.012 mm. Lateral vitelline follicles extending from the level of posterior edge of pharynx approximately over 3/5 of body length.

Since the only specimen recorvered is considerably damaged and a precise determination of the morphological characters of some of its organs is impossible, we designate it as *Asymphylodora* sp

Fam. Acanthocolpidae Lühe, 1909

7. *Stephanostomum* sp. — metacercaria (Fig. 3c, e)

Host: *Tetraodon lineatus* (Palma).
Location: liver.
Locality: Litoral Playa Larga — Zapata (province Las Villas).
In 1 out of 2 hosts examined one cyst was found.

Description: Globular cyst large, pellucid, measuring 1.387 × 1.401 mm, wall thickness 0.054 mm. Liberated body of metacercaria pear-shaped, with very strong cuticle. Anterior half of body densely covered with small spines, the size of which is gradually making smaller in the backward direction. Length of body 1.36 mm, maximum width 1.020 mm. Two small pigmented eye spots present at the level of anterior edge of pharynx. Oral sucker, measuring 0.272 × 0.150 mm, provided with two rows of big, almost equal spines (length 0.078—0.090 mm), each row consisting of 19 or 20 spines. Prepharynx short, globular pharynx measuring 0.190 × 0.190 mm. Oesophagus indistinct, wide caeca reaching nearly to end of body. Acetabulum measuring 0.408 × 0.286 mm situated at the boundary of the first and the second third of body length. Testes measuring 0.136 × 0.082 mm, ovary 0.060 × × 0.051 mm. Posterior part of body filled in with excretory vesicle.

The number, distribution and size of spines of the oral sucker od the metacercaria found resemble the species *S. anisotremi* Manter, 1940 and *S. longisomum* Manter, 1940.

Fam. Acanthostomidae Poche, 1926

8. *Perezitrema viquerasi* Baruš et Moravec, 1967? — metacercariae (Fig. 3g)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: encysted in body cavity.
Locality: Laguna del Tesoro — Zapata (province Las Villas).
From a total of 31 hosts examined nine cysts were found in 1 of them.

Description· Elongate, transparent, thin-walled cysts measuring 0.653 to 0.748 × 0.286—0.408 mm. Liberated metacercaria of oval shape, length of body 0.680—0.707 mm, maximum width 0.272—0.286 mm. Anterior part of body covered with very fine spines. Oral sucker large, elongated, measuring 0.204—0.258 × 0.136—0.163 mm, oval acetabulum 0.099 × 0.075 mm. Pharynx or oesophagus not distinct; globular pharynx measuring 0.075 × × 0.060—0.069 mm, caeca extending to posterior end of body. Slightly diagonal or symmetrical testes measuring 0.030—0,033 × 0.024—0.027 mm situated at the posterior part of body. Oval ovary (0.033 × 0.027 mm) anterior to acetabulum. Seminal vesicle dorsally from acetabulum.

According to their morphology the metacercariae found in *C. tetracantha* correspond, on the whole, to the species *P. viguerasi* Baruš et Moravec, 1967, differing slightly in the location of sexual glands and the distribution of cuticular spines. Adults of *P. viguerasi* are frequent parasites of the gar (*Lepisosteus trichoechus*) at this locality.

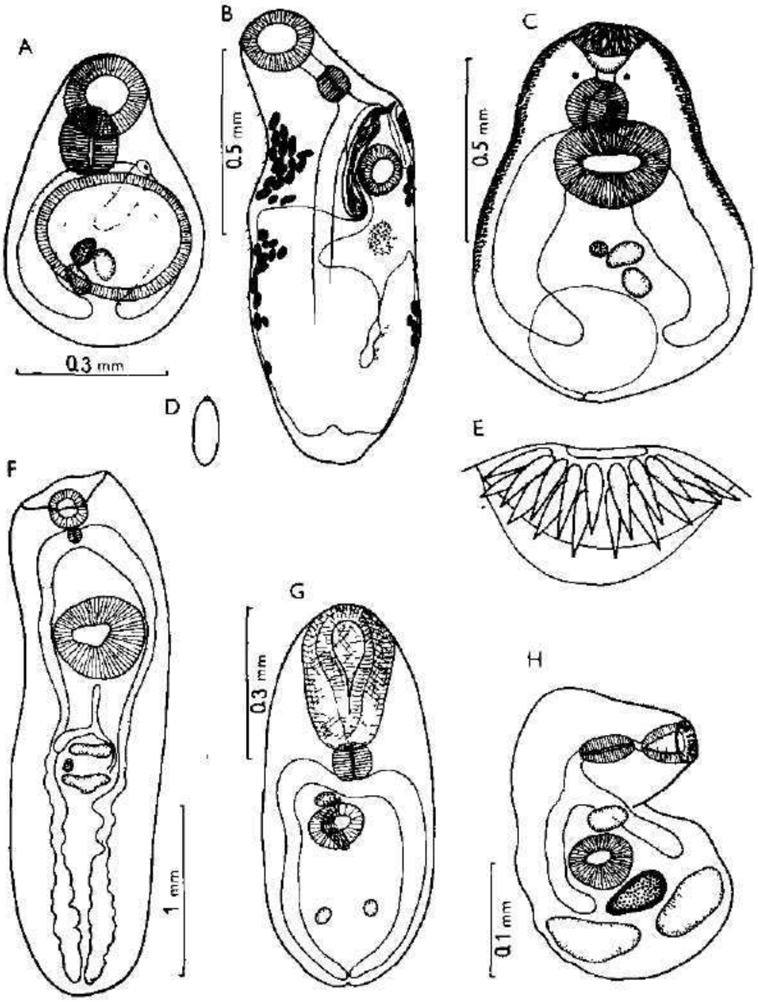

Fig. 3. A — *Pycnadena* sp. juv., B — *Asymphylodora* sp., C, E — *Stephanostomum* sp. — **metacercaria**, D — egg of *Asymphylodora* sp., F — *Clinostomum* sp. — metacercaria, G — ***Perezitrema*** *viguerasi* Baruš et Moravec, 1967? — metacercaria, H — *Parascotyle* sp. — metacercaria.

Fam. Clinostomidae Lühe, 1901

9. *Clinostomum* sp. — metacercariae (Fig. 3f)

Host: ***Cichlasoma tetracantha*** (Cuvier et Valenciennes).
Location: encysted in body cavity.
Locality: Rio Mosquito — old dam (province Pinar del Río).

Out of 31 hosts examined these metacercariae were found **only in 1 of them (55 cysts).**

Description: Cysts measuring 1.265—2.108 × 1.088—1.496 mm. Length of liberated metacercariae 2.625—3.142 mm, maximum width 0.816 to 0.898 mm. Oral sucker, surrounded by colar-like fold when retracted, measuring 0.190—0.218 × 0.163—0.177 mm, acetabulum 0.530—0.571 × 0.435 to 0.503 mm. Pharynx small, dia 0.068 mm. Caeca long, undilated, reaching to the end of body. Testes tandem (0.217—0.299 × 0.109—0.136 mm), at about middle of body. Small ovary (0.072—0.096 × 0.048—0.072 mm) situated submedially in space between testes. Immature uterus anterior to sexual glands.

The metacercariae found resemble those of the species *C. marginatum*, as described by Van Cleave and Mueller (1934). Since, however, more species of the genus *Clinostomum* occur in Cuba (see Yamaguti, 1958), we designate them only as *Clinostomum* sp.

Fam. Heterophyidae Odhner, 1914

10. *Parascotyle* sp. — metacercariae (Fig. 3h)

Host: *Gambusia punctata* Poey, *Girardinus metallicus* Poey, *Cichlasoma* sp.
Location: encysted in body cavity.
Locality: Laguna del Tesoro — Zapata (province Las Villas).

Out of 15 *G. punctata* found in 2 (intensity of infection 1 and 2 cysts), of 9 *G. metallicus* in 1 (intensity of infection 2 cysts), and of 3 *Cichlasoma* sp. in 1 (2 cysts)

Description: Globular, transparent cysts measuring 0,313—0.372 × × 0.272—0.286 mm, wall thickness 0.046 mm. Body of liberated metacercaria 0.276—0.282 mm long, maximum width 0.150 mm. Funnel-shaped oral sucker measuring 0.039 × 0.030 mm, provided with a row of about 25 spines. Acetabulum, measuring 0.048 × 0.039—0.042 mm, situated postequatorially. Short prepharynx, oval pharynx (0.042 × 0.021 mm) and oesophagus present. Caeca extending somewhat over the posterior edge of acetabulum. Testes (0.060—0.066 × 0.030 mm) situated symmetrically at the end of body, ovary (0.051 × 0.036 mm) medially just anterior to testes. Oval gonotyl anterior to acetabulum.

Fam. Diplostomatidae (Poirier, 1886)

11. *Neascus* sp. 1 — metacercariae (Fig. 4a)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes), *Cichlasoma* sp., *Lepomis pallidus* Mittchel, *Micropterus salmoides* (Lecépède), *Limia vittata* (Guichenot), *Gambusia punctata* Poey.
Location: freely in intestine of *M. salmoides* and encysted in body cavity of other hosts.
Locality: Sabanilla and Río Guajaybon, Laquito — Marianao (province Habana), Río Mosquito — new dam (province Pinar del Río), Laguna del Tesoro — Zapata (province Las Villas), dam Cacoyuguin (province Oriente).

Out of 31 *C. tetracantha* examined cysts found in 4 (1—3 cysts), of 3 *Cichlasoma* sp. in 1 (2 cysts), of 13 *L. pallidus* in 1 (1 cist), of 9 *M. salmoides* in 1 (3 specimens), of 10 *L. vittata* in 3 (1—2 cysts) and of 15 *G. punctata* in 4 (2—10 cysts).

Description: Thin, transparent, oval or egg-shaped cysts measuring 0.993—1.968 × 0.639—1.360 mm. Liberated metacercariae measuring 0.598 to 1.170 mm. Anterior part of body 0.394—0.898 mm long and 0.258 to 0.694 mm wide, posterior part 0.204—0.313 mm long and 0.218—0.381 mm wide. Oral sucker measuring 0.042—0.066 × 0.039—0.054 mm, acetabulum 0.057—0.099 × 0.057—0.096 mm. Oval pharynx measuring 0.033—0.048 × × 0.024—0.030 mm. Holdfast situated at the end of anterior part of body, mesuring 0.099—0.174 × 0.090—0.186 mm. Second part of body provided with immature sexual glands.

12. *Neascus* sp. 2 — metacercariae (Fig. 4b)

Host: *Gambusia punctata* Poey.
Location: encysted in body cavity.
Locality: *Laguna del Tesoro — Zapata (province Las Villas).*
Out of a total of 15 hosts examined cysts were found in 2 (1 and 2 cysts)

Description: Very thin, elongated, transparent cysts, somewhat pear-shaped, the larvae inside by far not filling the entire space of the cyst. Size of cysts 1.006—1.088 × 0.558—0.653 mm. Free larvae elongated, length of body 0.639—0.707 mm, maximum width 0.109 mm. Posterior part of body 0.136 mm long. Oral sucker (0.024—0.030 × 0.021—0.027 mm) little distinct, pharynx measuring 0.009—0.015 × 0.009—0.012 mm, short oesophagus present. Acetabulum (0.060—0.075 × 0.054—0.063 mm) protruding from body surface, as well as holdfast (0.090 × 0.060—0.087 mm). Large testes (0.060 × × 0.051 mm) situated at posterior part of body, smaller ovary (0.048 × 0.021 mm) anterior to testes.

According to the shape of body and the arrangement of sexual glands these larvae probably belong to the genus *Uvulifer* Yamaguti, 1934.

13. Digenea gen. sp. — metacercariae (Fig. 4c)

Host: *Gambusia punctata* Poey.
Location: body cavity.
Locality: dam Cacoyugum (province Oriente).
Out of a total of 15 hosts examined these cysts were found in 2 (4 and 5 cysts).

Description: Thin-walled, oval cysts measuring 0.587 × 0.476—0.503 mm. Free metacercariae 0.721—0.993 mm long, maximum width 0.272—0.299 mm. Overall cuticle covered with fine spines, at the level of anterior edge of pharynx two pigment eye spots present. Subterminal oral sucker measuring 0.135—0.150 × 0.123—0.126 mm, acetabulum, situated slightly postequatorially, 0.108—0.117 × 0.084—0.105 mm. Short prepharynx, globular pharynx (dia 0.084—0.090 mm) and short oesophagus present. Caeca extending slightly below acetabulum. Testes situated symmetrically near posterior end of body (size 0.075—0.081 × 0.042—0.045 mm), ovary (0.084 to 0.090 × 0.045—0.060 mm) medial, anterior to testes.

Cestoidea

14. Proteocephalidae gen. sp. — cysticercoids (Fig. 4d)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes), *Cubanichthys cubensis* (Eigenmann).
Location: body cavity
Locality: Laguna del Tesoro — Zapata (province Las Villas).
From 31 *C. tetracantha* examined found in 5 (intensity of infection 5—111 cysticercoids) and from 3 *C. cubensis* examined in 1 (5 cysticercoids).

Description: Oval to egg-shaped cysticercoids measuring 0.219—0.544 × × 0.183—0.503 mm. Outer cover lighter than scolex, its thickness irregular, reaching 0.015—0.075 mm. Scolex, measuring 0.159—0.330 × 0.144 to 0.315 mm, provided with four equal oval suckers (0.057—0.129 × 0.033 to 0.108 mm). Moreover, in some cysticercoids a weakly developed terminal organ is visible, measuring 0.039—0.069 × 0.030—0.066 mm.

The cysticersoids found probably belong to the genus *Ophiotaenia* La Ru 1911 or *Proteocephalus* Weinland, 1858.

15. Pseudophyllidea gen. sp. juv.

Host: *Agonostomus monticola* (Bancroft), *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: intestine.
Locality: Río Mosquito — old and new dam (province Pinar del Río).

From 7 *A. monticola* examined found in 1 (2 specimens) and from 31 *C. tetracantha* in 2 (1 a 2 specimens).

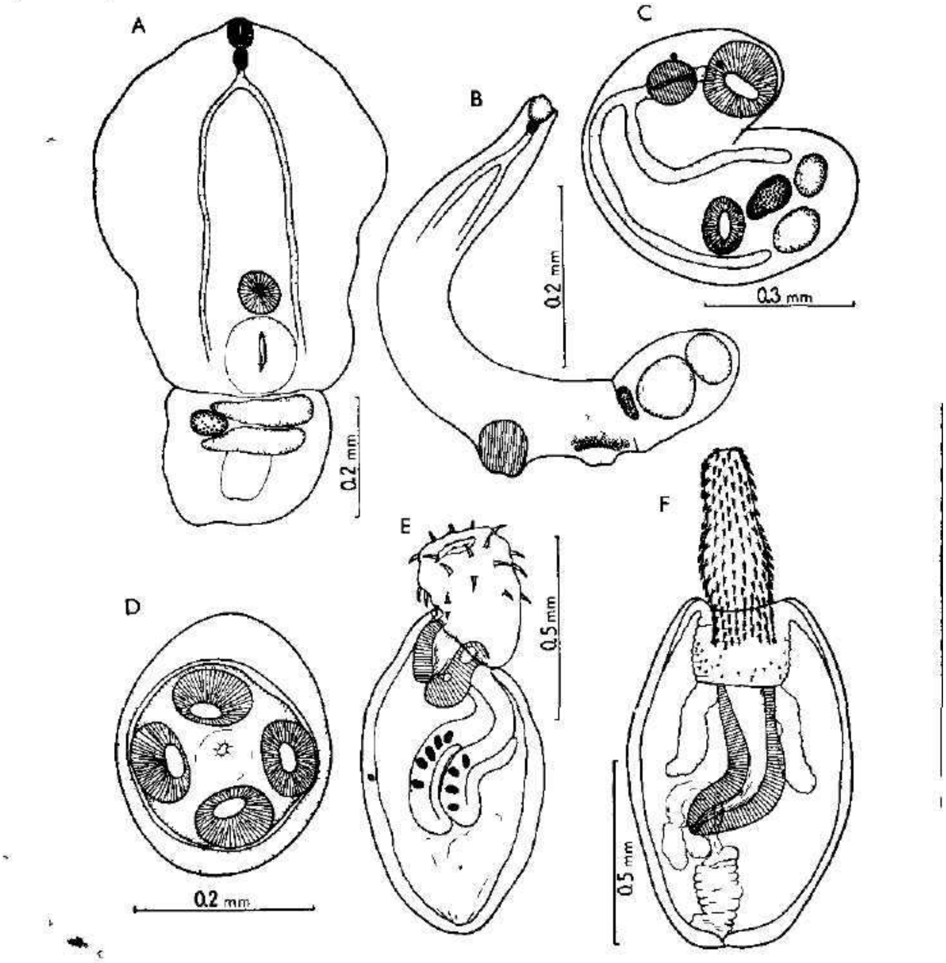

Fig. 4. A — *Neascus* sp. 1, B — *Neascus* sp. 2, C — Digenea gen. sp. — metacercaria, D — Pro teocephalidae gen. sp. — cysticercoid, E — *Paulisentis* sp. — acanthella, F — *Polymorphu mutabilis* (Rudolphi, 1819) — acanthella.

The scolex of these juvenile forms are provided with two bothria (on dorsal and one ventral), every scolex being followed by 3 to 4 short, immatur segments. The length of scolex is 0.707—0.830 mm, width 0.313—0.340 mm the entire body is 1.63—2.04 mm long.

Acanthocephala

Fam. Neoechinorhynchidae Van Cleave, 1919

16. *Paulisentis* sp. — acanthella (Fig. 4e)

Host: *Agonostomus monticola* (Bancroft).
Location: intestine.
Locality: Río Guajaybon (province Habana).
From 7 hosts examined in 1 of them only one acanthella was found.

Description: Length of body 1.428 mm, maximum width 0.666 mm. Proboscis short (length 0.326 mm, width 0.340 mm), with 30 hooks arranged in 6 spiral rows of 5 hooks each. Hooks of the first circle 0.081 mm long, of the last circle 0.054 mm. Lemnisci very long, one provided with 4, the other with 5 large nuclei.

Fam. Rhadinorhynchidae Travassos, 1923

17. *Rhadinorhynchus* sp. juv.

Host: *Bothus lunatus* (L.).
Location: intestine.
Locality: Litoral Santa Fé (province Habana).

Description: The better-preserved specimen 4.162 mm long, maximum width 0.530 mm. Proboscis somewhat cudgel-shaped, 0.612 mm long and 0.340 mm wide. Hooks arranged in 18—19 longitudinal rows of 35—36 hooks each. Anterior five transverse rows consist of distinctly larger hooks than the following rows. Hooks of anterior rows 0.069 mm long, of posterior rows 0.042 mm. Anterior part of the trunk covered with smaller hooks (length 0.036 mm) arranged in rows.

In the number and the arrangement of hooks the specimens found are close to species *Rh. terebra* (Rudolphi, 1819) and *Rh. ornatus* Van Cleave, 1918.

Fam. Polymorphidae Meyer, 1931

18. *Polymorphus mutabilis* (Rudolphi, 1819). (Fig. 4f)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: body cavity.
Locality: Laguna del Tesoro — Zapata (province Las Villas).
From 31 hosts examined the acanthellae were found in 2 (1 and 2 specimens).

Description: Length of body 1.496—1.850 mm, maximum width 0.707 to 0.816 mm. Proboscis 0.666—0.721 mm long, maximum width 0.245 0.286 mm at its middle. Hooks arranged in 15 to 16 longitudinal rows of 18 hooks each; length of hooks 0.048—0.051 mm. Anterior (retracted) part of body covered with fine spines.

According to **Meyer** (1932), **Hartwich** (1956) and **Petročenko** (1958) adults of this species are the parasites of piscivorous birds of the orders Pelecaniformes (*Phalacrocorax*), Ciconiiformes (*Ardea, Butorides, Nyctanassa, Nycticorax*) and also Ralliformes (*Fulica*) of South and Central America. In the same locality (Laguna del Tesoro) an acanthella of this species has already been found by **Groschaft** and **Baruš** (1970) in *Crocodylus rhombifer*.

Nematoda

Fam. Rhabdochonidae Skrjabin, 1946

19. *Rhabdochona* sp. (Fig. 5)

Host: *Gambusia punctata* Poey.
Location: intestine.
Locality: Río Guajaybon (province **Habana**).

From a total of 15 hosts examined only in 1 of them one specimen (♀) was found.

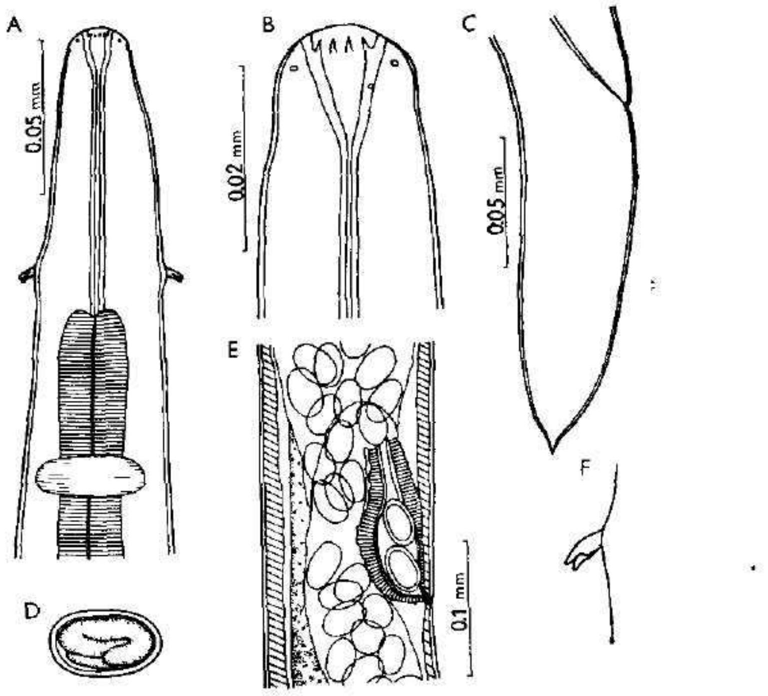

Fig. 5. *Rhabdochona* sp. A — aterior part of body (dorsoventral view), B — prostom, C — tail, D — egg, E — vulva region, F — cervical papilla.

Description: Length of body 8.43 mm, maximum width 0.122 mm. Prostom relatively wide (length 0.015 mm, width 0.012 mm), anteriorly provided with fairly big, forwardly directed teeth, the exact number of which could not be determined. Teeth at the base of prostom absent. Vestibule (including prostom) measuring 0.105 mm, muscular oesophagus 0.952 mm, glandular oesophagus 1.904 mm. Nerve ring surrounding muscular oesophagus at a distance of 0.144 mm from anterior extremity, excretory pore at 0.231 mm. Conspicuous, bifurcate cervical papillae situated at a distance of 0.090 mm from anterior extremity. Tail relatively long (0.165 mm), ending in a sharp cuticular point. Anterior ovary reaching to the posterior end of glandular oesophagus, posterior ovary slightly over the anterior end of rectum. Vulva postequatorial, 4.08 mm from posterior extremity. Eggs oval, size 0.033 to 0.036 × 0.021 – 0.024 mm, without filaments; advanced eggs with larvae formed.

Since, at the present time, it is practically impossible to determine a species of the genus *Rhabdochona* on the basis of female nematodes only, we designate the nematode found as *Rhabdochona* sp. Metrically the specimen considerably resembles the species *Rh. kidderi* Pearso, 1936, described from Mexico (peninsula Yucatan), and the species *Rh. laurentiana* Lyster, 1940, known from Canada.

20. *Spinitectus agonostomi* sp. n. (Fig. 6)

Host: *Agonostomus monticola* (Bancroft) — Mugilidae.
Location: intestine.
Locality: Río Guajaybon (province Habana) (23. 1. 1968).
Out of 7 hosts examined in 1 of them one specimen was found (♂).

Description (male — holotype): Length of body 4.243 mm, maximum width 0.108 mm. Cuticle of anterior part of body bearing rings of spines, each with dorsal, ventral and two lateral interruptions. The total number of these rings is about 30, last 3 to 4 rings being, however, inconspicuous. Single spines, each projecting out from a cuticular thickness, measure 0.006—0.009 mm in anterior rings. From one side of the worm there are always 15 to 18 spines visible, suggesting that each ring consists of about 30 to 36 spines. Mouth represented by two indistinct lateral lips. Vestibule relatively long (0.096 mm), funnel-shaped anteriorly. Muscular oesophagus narrow, beginning slightly in front of the first ring of cuticular spines. Length of muscular oesophagus 0.240 mm, of wider glandular oesophagus 0.585 mm. Nerve ring surrounding muscular oesophagus approximately at the level of the third ring of spines, i.e. at a distance of 0.165 mm from anterior extremity. Neither excretory pore nor cervical papillae observed. Posterior end of body spirally coiled and provided with subventral alae. There are 4 pairs of pedunculate preanal papillae and 6 pairs of postanal papillae, the last pair being probably sessile, other pairs pedunculate. In front of tail alae the cuticle is ventrally covered with cuticular ridges. Longer spicule measuring 1.320 mm, with a conical distal tip, smaller spicule 0.075 mm. Ratio of spicule lengths 1 : 17.6. Length of tail 0.156 mm.

The **holotype** is deposited in the collection of the Institute of Parasitology, Czechoslovak Academy of Sciences, Prague.

As far as can be determined from the literature available, the genus *Spinitectus* Fourment, 1883 comprises 36 species at the present time (see Skrjabin, Sobolev, Ivaškin, 1967; Sahay, Prasad, 1965; Sobolev, Belogurov, 1968; Schmidt, Kuntz, 1969; Overstreet, 1970). From all these species *S. agonostomi* sp. n. differs distinctly in the spicule ratio, this being 1 : 17.6 in this species, while in all other species this ratio is smaller than 1 : 10 (1 : 10 only in *S. guntheri* Baylis, 1929). In the length of the longer spicule *S. agonostomi* sp. n. resembles only the species *S. palawanensis* Schmidt et Kuntz, 1969 in which, however, the small spicule is much longer so that the spicule ratio is 1 : 5. In addition the vestibule in *S. agonostomi* sp. n. is very long (0.096 mm), whereas in *S. palawanensis* the oesophagus begins near behind the mouth opening so that the vestibule is almost absent.

Fam. Spiruridae Oerley, 1885

21. *Spiroxys* sp. — larvae (Fig. 8a)

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes), *Cichlasoma* sp.
Location: Laguna del Tesoro — Zapata (province Las Villas).

Out of 31 *C. tetracantha* examined the larvae found in 5 (intensity of infection 1–2 larvae) and in all 3 *Cichlasoma* sp. examined (intensity of infection 1–11 larvae).

Invasive larvae of the genus *Spiroxys* Schneider, 1886 have already been recorded at the same locality by Groschaft and Baruš (1970) in *Crocodylus rhombifer*. Larvae from the present material from the hosts *C. tetracantha* and *Cichlasoma* sp. seem to be fully identical, both metrically and morphologically, with those described by these authors. It is probable that the larvae in question belong to the species *S. contortus* (Rudolphi, 1819) which is a frequent parasite of turtles *Pseudemys decussata* (see Baruš and Moravec, 1967b). The life cycle of this species has been studied by Hedrick (1939).

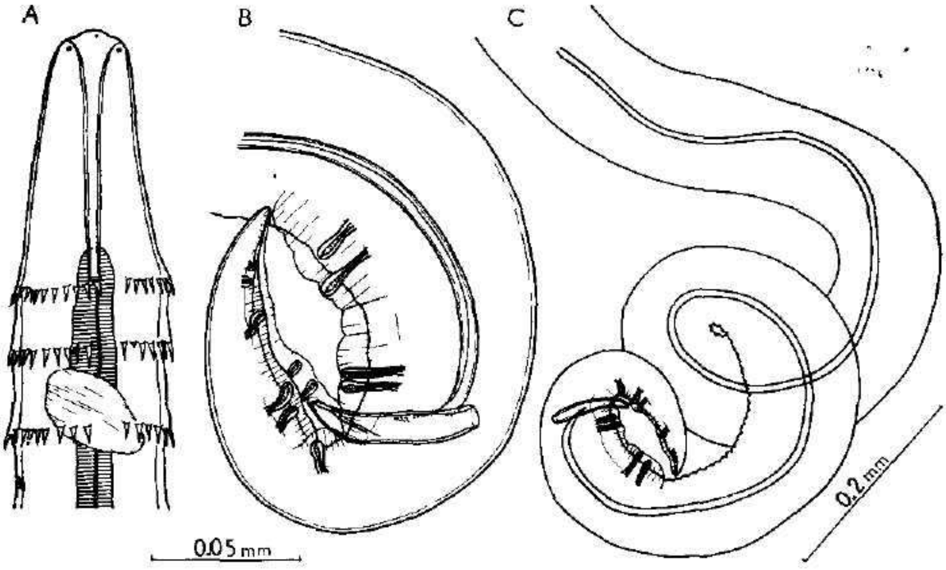

Fig. 6. *Spinitectus agonostomi* sp. n. A — anterior **part** of body (lateral view), B, C — posterior end of body (lateral view).

Fam. Stomachidae (Johnston et Mawson, 1945)

22. *Contracaecum* sp. — larvae

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: encysted in body cavity.
Locality: Laguna Dique, Laguito-Marianao (province **Habana**), Laguna del Tesoro — **Zapata** (province Las Villas).

Out of 31 hosts examined the larvae were found in 5 (intensity of infection 1–5 larvae).

Morphologically identical larvae of the genus *Contracaecum* Railliet et Henry, 1912 have been recorded in Cuba by Baruš and Moravec (1967a, -b) from the hosts *Pseudemys decussata* (Chelonia) and *Lepisosteus tristoechus* (Pisces) and by Baruš and Coy Otero (1966) from *Tretanorhinus variabilis variabilis* (Serpentes). These authors consider this type of larvae, regarding their morphology, to belong to adult forms parasitic in birds of the orders Ardeiformes and Pelecaniformes (probably to *C. caballeroi*, *C. microcephalum*, *C. rudolphii*, *C. pelagicum* and *C. plagiaticum*). The measurements of the larvae from *C. tetracantha* are compared with those from some other hosts in Table 1.

Table 1. Comparison of measurements of *Contracaecum* sp. larvae from various hosts

	Tretanorhinus variabilis	*Lepisosteus tristoechus*	*Cichlasoma tetracantha*
	After Baruš, Coy Otero (1966)	After Baruš, Moravec (1967a)	New data
Length of body	15.11 – 23.75	12.53 – 21.10	9.82 – 21.80
Width of body	0.590 – 0.750	0.510 – 0.850	0.360 – 0.660
Length of oesoph	1.530 – 1.890	1.610 – 2.290	1.530 – 2.240
Length of ventric.	0.089 – 0.106	0.106 – 0.142	0.080 – 0.093
Width of ventric.	0.071 – 0.106	0.071 – 0.100	0.060 – 0.093
Length of ventric appendix	0.223 – 0.329	0.315 – 0.445	0.290 – 0.470
Length of intest. process	1.340 – 1.890	1.400 – 1.770	0.940 – 1.560
Length of tail	0.089 – 0.161	0.074 – 0.157	0.117 – 0.124

Fam. Kathlaniidae Travassos, 1918

23. *Spectatus cichlasomae* sp. n. (Fig. 7)

Host: ***Cichlasoma tetracantha*** (Cuvier et Valenciennes) — Cichlidae.

Location: intestine.

Locality: Sabanilla near the village Cuatro Camino (province Habana) (4. 7. 1967).

Of a total of 31 hosts examined only in 1 of them the only specimen was found (♀).

Description (female — holotype): Dark nematode of middle size. Length of body 8.24 mm, maximum width 0.422 mm. Cuticle very thick, with dense transverse striation. Cone-shaped cervival papillae present at a distance of 0.111 mm from anterior extremity, excretory pore not observed. Mouth formed by six almost equal lips, mouth papillae indistinct. Small, funnel-shaped mouth cavity immediately followed by very long oesophagus. Oesophagus (overall length 1.265 mm) composed of a very long, almost cylindrical portion, this being weakly muscular only, and of a short strongly muscular posterior portion, forming an indistinct bulb at its end. Whole oesophagus internally lined with a thick cuticular layer. Nerve ring situated at a distance of 0.159 mm from anterior extremity. Intestine straight, dark. Colourless rectum very long (0.449 mm). Tail 0.120 mm long, with rounded end. Vulva preequatorial (3.36 mm from anterior extremity), provided with a cuticular cup, protruding out from body surface (measuring 0.045 × 0.030 mm). Sexual organs little distinct. Uterus containing small number of thick-walled, elongate eggs, with uncleaved content when laid. Size of eggs 0.120—0.123 × 0.045—0.048 mm, wall thickness 0.006—0.009 mm.

The holotype is deposited in the collection of the Institute of Parasitology, Czechoslo
Academy of Sciences, Prague.

At present the genus *Spectatus* Travassos, 1923 involves the only spec
S. spectatus Travassos, 1923, described from Brazilian fishes (Travass
1923; Travassos, Artigas, Pereira, 1928). The species *S. cichlasomae* sp.
differs conspicuously from *S. spectatus* in having a cup-shaped vaginal form
tion in females, in the position of the vulva (in *S. spectatus* the vulva is situ
ted postequatorially, whereas in *S. cichlasomae* sp. n. preequatorially), in t
length of the female's tail and its ending, in the situation of the nerve ri
and in the length of the rectum.

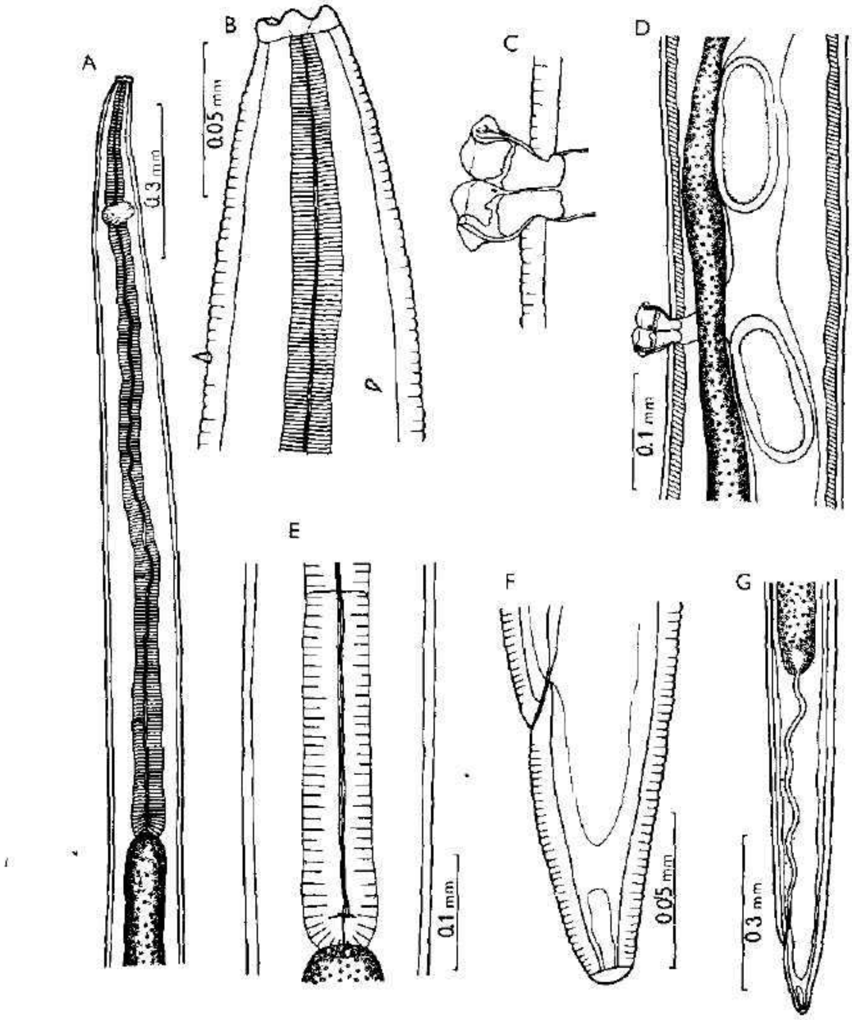

Fig. 7. *Spectatus cichlasomae* sp. n. A — **anterior part** of body, B — anterior extremity **(dorsal view)**, C — vulva, D — vulva region, **E — posterior end of oesophagus, F** — **tail, G — posterior end** of body.

Fam. Capillariidae Neveu-Lemaire, 1936

24. *Capillaria* sp.

Host: *Tetraodon lineatus* (Palma).
Location: intestine.
Locality: Litoral Playa Larga — Zapata (province Las Villas).

Out of 2 hosts examined in 1 of them two fragments of female nematodes were found.

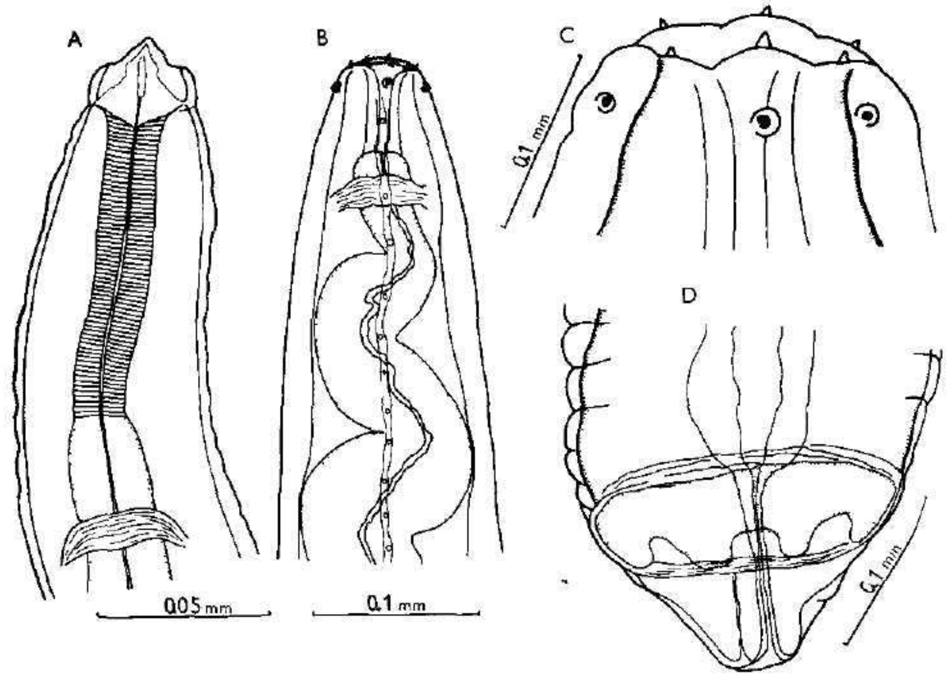

Fig. 8. *Spiroxys* sp. larva — anterior extremity (lateral view), B — *Eustrongylides* sp. larva — anterior part of body, C — *Eustrongylides* sp. larva — mouth, D — *Eustrongylides* sp. larva — posterior extremity.

Description: Body thread-like, length of larger fragment 11.94 mm, maximum width 0.081 mm. Length of not entire oesophageal part of body 2.44 mm, maximum width of oesophageus 0.054 mm. Two narrow lateral bacillary bands extending along the whole body, their maximum width being 0.021 mm. Vulva at the level of the junction of oesophagus and intestine (9.49 mm from posterior extremity), lips of the vulva not protruding. Eggs resembling those of the species *C. brevispicula*, measuring 0.057 to 0.060 × 0.027 — 0.030 mm. Posterior end of body rounded, anal opening almost terminal.

Fam. Dioctophymidae Railliet, 1915

25. *Eustrongylides* sp. — larvae (Fig. 8b, c, d)

Host: *Gambusia punctata* Poey.
Location: body cavity.
Locality: Laguito-Marianao (province Habana).

These larvae were found in 1 out of 15 hosts examined (fragments of 4 larvae).

Description: Body with relatively thick cuticle, transversely striated; two lateral rows of small papillae extending along the whole body length. Mouth without distinct lips, surrounded by 12 papillae, arranged in two circles, 6 papillae each. Papillae of internal circle cone-shaped, outer papillae rounded. The largest fragment of anterior part of body 65 mm long and 0.79 mm wide. Vestibule thick-walled, 0.146—0.185 mm deep and 0.057 to 0.080 mm wide. Oesophagus 9.36 mm long, maximum width 0.49 mm. Nerve ring situated at a distance of 0.25—0.27 mm from anterior extremity, excretory pore at 0.45 mm. Posterior end of body 0.21—0.36 mm wide, anus terminal.

Larvae of the genus *Eustrongylides* Jagerskiold, 1909 are very frequent in North American freshwater fishes (see Hoffman, 1967), being considered by some authors to belong to the species *E. ignotus* Jagerskiöld, 1909. The nematodes of the present material are both metrically and morphologically very close to the species *E. ignotus* (? = syn. *E wenrichi* Canavan, 1929).

26. Nematoda gen. sp. — larvae

Host: *Cichlasoma tetracantha* (Cuvier et Valenciennes).
Location: encysted in body cavity.
Locality: Laguna del Tesoro — Zapata (province Las Villas).

Of a total of 31 hosts examined dark cysts, containing inside always 1—32 minute, slender larvae, were found in 3 of them (intensity of infection 1—52 larvae). As the internal organization of these larvae was indistinct, their nearer determination was not possible. The length of the larvae is 0.685—0.707 mm, their maximum width 0.027 mm. The tail is relatively very long (0.114—0.120 mm), with a slightly extended tip.

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Authors' address: V. Baruš and F. Moravec, Institute of Parasitology, Czechoslovak Academy of Sciences, Flemingovo nám. 2, Praha 6, ČSSR.

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
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Institute of Parasitology, Czechoslovak Academy of Sciences, Prague

SNAILS AS THE SECOND INTERMEDIATE HOSTS OF THE TREMATODE PLAGIORCHIS MURIS TANABE, 1922 (TREMATODA: PLAGIORCHIDAE)

DALIBOR ZAJÍČEK

Received July 15, 1970

Abstract: The trematode species *Plagiorchis (Multiglandularis) muris* Tanabe, 1922 obtained from two pigeons experimentally fed with metacercariae found in the snails *Lymna stagnalis* L., *L. auricularia* L. and *L. peregra ovata* L. The same species of trematodes was rear also by McMullen in experimental feeding of pigeons with infected insect larvae.

According to the present knowledge on the life-cycle of the trematod of the family Plagiorchidae Lühe, 1901, the adult specimens or larvae insect serve as the second intermediate hosts of their infective stages (Skrj bin, 1958; Odening, 1959; Podjapolskaja, 1959; Žďárská, 1966).

MATERIAL AND METHODS

During examination of 15,967 snails of 16 species collected in the years 1957—1967 in the lak of South Bohemia, metacercariae recovered from the snails *Lymnaea stagnalis* L., *L. auricularis* and *L. peregra ovata* L. were fed to the pigeons to obtain trematodes of the family Plagiorchid Luhe, 1901. Adult specimens were measured and studied both alive and after staining in Blažm carmine.

Metacercaria of *Plagiorchis* (*M.*) *muris* Tanabe, 1922

Host: *Lymnaea stagnalis* L., *L. auricularia* L., *L. peregra ovata* L.
Location: Hepatopancreas, freely in body cavity
Locality: lake Kočkov, Horní Luskovec (Písek), Tchořovický (Lnáře), Malý Tisý (Lomni n. Luž.), Lenešický (Louny)
Intensity of infection: 6—28 metacercariae in 1 snail
Range of infection: 0.75%; in individual biotopes up to 12.6%.

Metacercariae are spherical, colourless, measuring 0.18—0.2 mm. Th cyst wall is simple, 0.01—0.012 mm thick. Oral and ventral suckers ar of the same size measuring 0.05 mm in diameter. Besides the suckers a wel developed and highly refractile excretory bladder is distinctly visible.

Metacercaria was fed experimentally to 2 pigeons. The first bird weighin 300 g received 120 metacercariae recovered from hepatopancreas of the snai *L. auricularia* and *L. stagnalis* originating from the lake Horní Luskove After 6 days single eggs were found in the faeces. At autopsy 12 trematode *Plagiorchis* (*M.*) *muris* Tanabe, 1922 were found 10 days after infection.

The second pigeon, weighing 325 g, received 148 snails *L. auricularia* an 31 *L. stagnalis* without shells. The trematode eggs were found in the faece on the 6th day after infection. After 11 days the number of eggs increased ten times, the intensity of infection being the same till the 16th day when the pigeon was killed and autopsied. From the 11th day the pigeon showed symptoms of weakness, loss of appetite, increased thirst, its feathers were ruffled and the faeces were coloured with gall colours. The killed bird weighed 220 g. At autopsy a heavy catarrhal up to crupose inflammation of the mucous membrane of the middle parts of jejunum was observed. In this region, *measuring 7 cm, a great number of trematodes were found.* Helmithological examination of the whole intestinal tract revealed 284 specimens of *Plagio-*

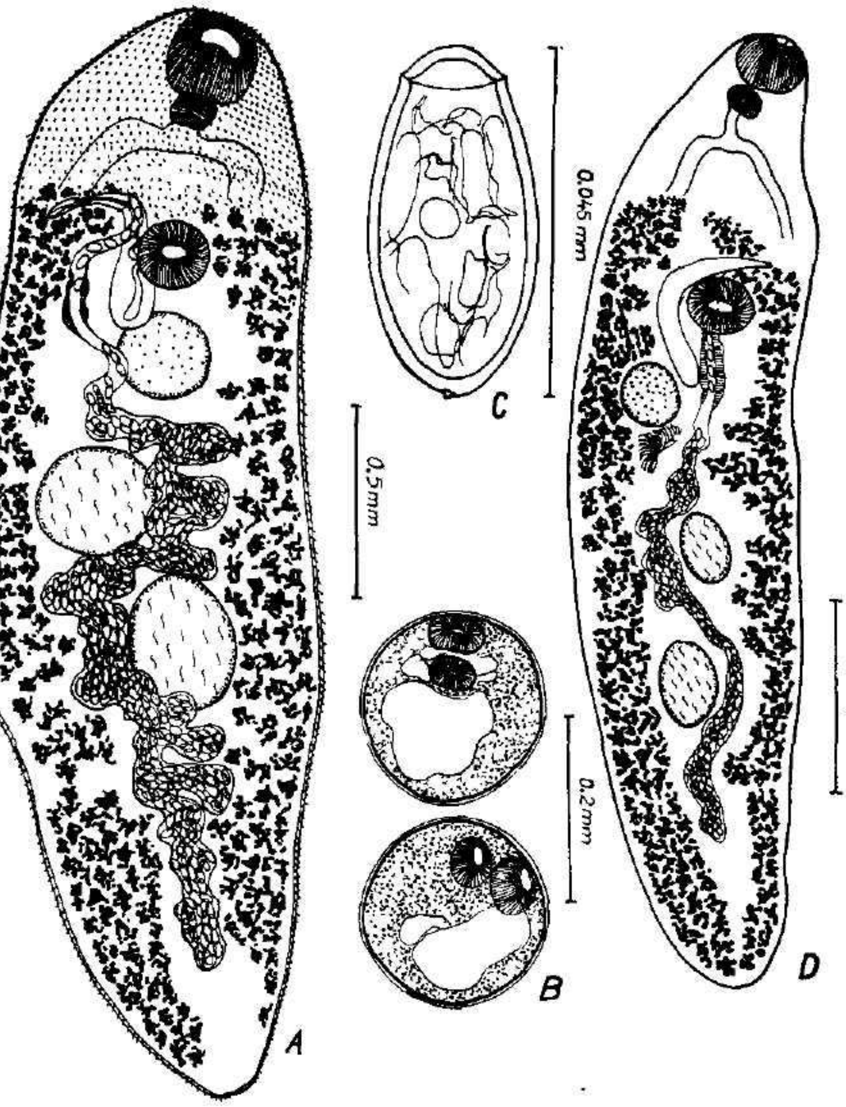

Fig. 1. — *Plagiorchis* (*M.*) *muris* Tanabe, 1922: A — dorsal view of living fluke; B — metacercarial; C — egg; D — stained fluke, ventral view.

rchis (*M.*) *muris* Tanabe, 1922, 162 specimens of *Echinoparyphium cinct* (Rudolphi, 1802), 4 specimens of *Hypoderaeum conoideum* (Bloch, 17 Dietz, 1909, 9 specimens of *Echinostoma revolutum* (Fröhlich, 1802) Die 1909 and 2 specimens of *Microsomacanthus compressa* (Linton, 1892) Lop Neyra, 1942.

The recovered adult trematodes were placed in the genus *Plagiorc* (*Multiglandularis*) *muris* Tanabe, 1922.

Description: Body elongated, oval, covered with small spines arranged intersecting rows. Pharynx adjacent to the oral sucker, which is situat 0.36—0.525 mm from the ventral sucker. Genital pore and uterus op 0.06 mm in front of the ventral sucker. This is surrounded by a sphinc about midway between the first uterus loop and the genital pore. Ute contains a large number of dark yellow-brown eggs and extends nearly up the caudal portion of the body. Ovary situated at a distance of 0.06—0.09 caudally from the ventral sucker, 0.15—0.24 mm more caudally the f testis and 0.075—0.15 mm from it the second one. Ovary and testes are in a line. Vitelline follicles reach over the ventral sucker cranially, but do unite neither in front of it, nor in the caudal portion of body. Under vitelline follicles the intestinal branches extent nearly to the end of bo

Measurements of the trematodes and their organs are shown in Table

Table 1. Survey of dimensions of found trematodes. (Measurements in mm)

	McMullen, 1937	Chalupský, 1954	Own findings	
			native	stained
Body length	2.67	2.0 —2.67	2.7 —3.0	2.5 —2.7
Body width	0.52	0.6 —0.8	0.9 —1.02	0.56 —0.645
Oral sucker	0.213	0.17 —0.22	0.2 —0.24	0.15 —0.21
Pharynx	0.107	0.1 × 0.104	0.09 × 0.135	0.075 × 0.095
Ventral sucker	0.144	0.17 × 0.12	0.18 × 0.195	0.15 × 0.18
Cirrus pouch L.	—	0.23 —0.27	0.61 × 0.135	0.6 × 0.06
W.	—	0.07 —0.09		
Ovary	0.196	0.16 —0.2	0.24 × 0.255	0.18 × 0.165
Testicle I.	0.231	0.25 —0.36	0.3 × 0.345	0.21 × 0.15
Testicle II.	0.252	0.18 —0.29	0.39 × 0.3	0.22 × 0.18
Eggs Length	0.038	0.038—0.04	0.041—0.047	
Width	0.019	0.022—0.024	0.026—0.03	

Location: cranial to middle portion of jejunum
Host: *Columba livia dom.* L. (experimentally)

DISCUSSION

The life-cycle of *Plagiorchis* (*M.*) *muris* Tanabe, 1922 was described Tanabe (cit. Dollfus, 1925) who infected the larvae and nymphs of *Chi nomus* sp. and *Calibaetes* sp. with the cercariae. Metacercariae were of smal size, measuring 0.117—0.14 mm. McMullen (1937) repeated this part life-cycle and found metacercariae measuring 0.2 mm in diameter in larvae and nymphs of *Chironomus* sp. He succeeded in obtaining adult tre todes by experimental infection of rat, mouse and pigeon.

In Czechoslovakia, this species of trematodes was found by Erhardová (1956) in *Microtus oeconomus mehelyi* and by Tenora (1962) in *Microtus agrestis*. Chalupský (1954) reported a finding of *Plagiorchis* (*P.*) *blatnensis* in *Microtus arvalis* from the localities near Blatná, where our snails originated from too. Rosický (1959), referring to the opinion of Erhardová (1958), considers *P. blatnensis* to be a synonym of *P. muris*. This is also in accord with the finding of *P. blatnensis* in *Ondatra zibetica* L. (Tenora, 1956). Styczynska-Jurewicz (1961) considers *P. blatnensis* Chalupský, 1954 to be a synonym of *Pl. elegans* Rudolphi, 1820. The author has described the life-cycle of this species, which has been reared experimentally in mice. However, the comparison of the metacercariae and adult specimens described by this author and by McMullen with our findings supports the opinion of Rosický (1959) and we assume therefore that *P. blatnensis* can be considered to be a synonym of *P.* (*M.*) *muris* Tanabe, 1922.

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Author's address: Dr. D. Zajíček, CSc., **Institute of Parasitology, Czechoslovak Academy** of Sciences, Praha 6, A. Fleminga 2, ČSSR.

RECENSE – REVIEWS

Mayr E. (1970): Populations, Species and Evolution. An Abridgement of Animal Species and Evolution. xv + 453 pp., 51 figs, 29 tbls. The Belknap Press of Harvard University Press, Cambridge, Massachusetts. Price $ 10.00.

The subtitle says that this book is an abbreviated edition of Mayr's 1963 "*Animal Species and Evolution*" (its German translation of 1967 was reviewed by L. Sigmund, 1968: *Acta Soc. zool. Bohemoslov.*, 32 : 395), but it is certainly more than just that. Mayr's original book was a remarkably well written summary of what was known about the animal species, particularly from the evolutionary and genetical points of view, but because it was a first attempt at the synthesis of this ramified subject and because many conclusions were completely new, it had to have many features of a voluminous research paper, for instance numerous citations of literature, extensive inclusion of published evidence and its detailed discussion, long argumentative sections, etc. This, and also the extent of the book, made its use rather difficult for a non specialist, and therefore its shortened version, which is easier to read and which is also more suitable for teaching purposes, has been published. It is concise (453 pages against 797) and written in the textbook style: many less important citations have been eliminated, evidence has been limited to the most telling cases, conclusions are more categorically stated (though the open questions are treated as such), and the Glossary has been extended by one third, including now more then three hundred entries. The general plan of the book has been retained, even the titles of all 20 chapters are the same, but all of them have been not only shortened but also revised, and their subdivision is often different from that applied in 1963.

In spite of the abridgement Mayr was able to include a number of new data and evidence and to incorporate the essence of important recent publications concerning the animal species (144 references to works published in the 1963–70 period). Some chapters have been almost completely rewritten, namely those dealing with species concepts, factors reducing the genetic variation of populations, storage and protection of genetic variation, the unity of the genotype, multiplication of species, and the genetics of speciation (here the discussion of the chromosomal aspects of speciation is even more extensive than in 1963).

Mayr's 1963 "*Animal Species and Evolution*" summarized and deepened our knowledge of the subject and stimulated research in this field, but also provoked much argument. Some chapters of the present book are therefore written with more insight than it was possible at that time. "*Populations, Species and Evolution*" is not only an abridgement, but also a necessary complement to "*Animal Species and Evolution*" — the present book being both an introduction to and development of the subject more fully documented in the former one. The beginner as well as the specialist in this field will benefit from reading it. Because of the lucidity of style, high scientific and intellectual standards, and the overall importance of the subject it should be read by virtually any biologist.

P. Štys

Vladimír Novák a kol. (1969): Historický vývoj organismů. Fylogenese mikroorganismů, rostlin a živočichů. Academia, Nakladatelství Československé akademie věd, Praha, stran 835, obr. 441, cena váz. 78,— Kčs.

V nakladatelství ČSAV vyšla konečně dlouho očekávaná kniha, v níž se kolektiv odborníků pod vedením Dr. V. Nováka pokusil podat přehled současných názorů na vznik života na zemi, na vývoj organismů počínaje virusy a bakteriemi a konče primáty a seznámit čtenáře i s některými obecnými otázkami fylogenetickými. Dílo podobného rozsahu i pojetí je ve světové literatuře ojedinělé a již z tohoto důvodu je nutno ocenit píli, jaké vyžadovalo snesení velkého množství dat zde shromážděných.

Kniha je rozdělena do 18 kapitol. V úvodní části jsou krátce a někde velmi zjednodušeným způsobem vyloženy obecné otázky vývoje organismů. Živočichům je věnováno celkem 460 stran textu Jednotlivé kapitoly počínají krátkými charakteristikami systematických skupin a kromě vlastní části o fylogenesi nalezneme zde i některé obecnější partie věnované např. vývoji orgánových soustav, vzniku sexuality apod. Závěr knihy tvoří seznam použité i rozšiřující literatury a rejstřík. Slovní výklad je doplněn nebo podepřen řadou vyobrazení různé didaktické i technické úrovně. Kniha je vytištěna na pěkném papíře, bohužel grafická úprava vyobrazení není šťastná. Zařazení pérovek na „spadávání" nemá ve většině případů žádné funkční nebo estetické zdůvodnění a nepůsobí pěkně Malá péče byla věnována i poměrnému zmenšování obrázků (srv. např. obr. VII. 17–19 a I. 7).

Díla podobného rozsahu, zpracovaná týmem odborníků trpí často nedostatkem koordinace jednotlivých částí, špatnou proporcionalitou rozsahu i podání. Recensovaná kniha nečiní po této stránce žádnou výjimku.

Převážná většina kapitol je založena na poznatcích klasické morfologie, méně jsou již využita *novější* data z funkční morfologie, fysiologie a biochemie.

Nerovnoměrně jsou zařazovány údaje paleontologické, místy značně statické (hmyz).

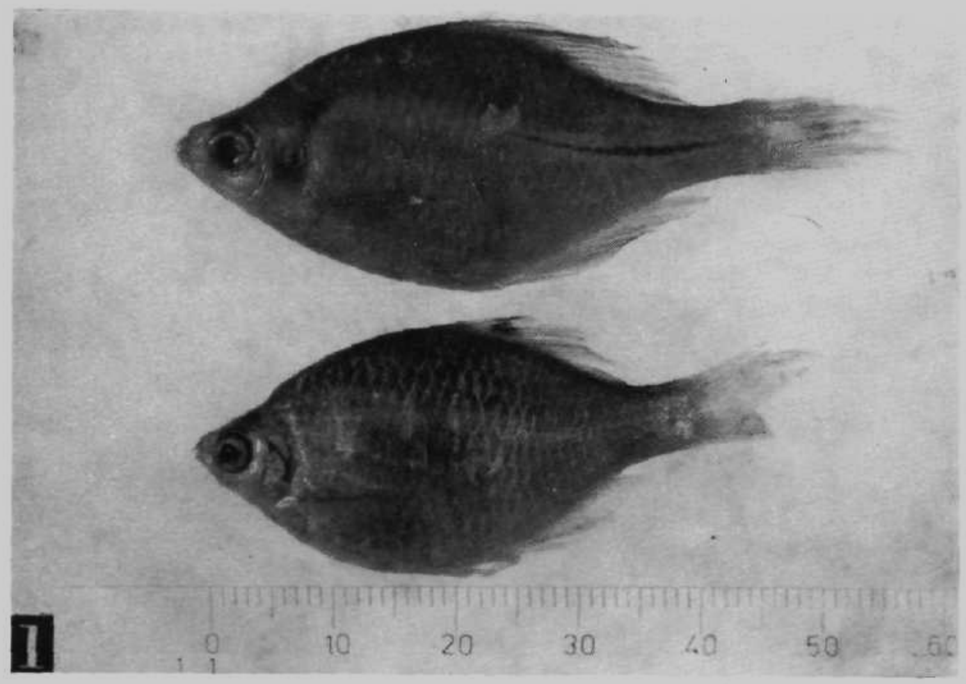
Ve všech kapitolách mělo být pamatováno na grafické znázornění vývojových vztahů mezi probíranými skupinami. U bezobratlých např. tato důležitá pomůcka výkladu chybí.

V seznamech literatury postrádám základní díla autorů takové váhy, jakými jsou např. Simpson, Rensch, Remane, Berrill.

Tyto poznámky ovšem nejsou motivovány dojmem, že by kniha měla být rozšířena. Naopak by bylo omezení rozsahu a poněkud čtivější podání pro širší použití knihy velmi užitečné. Nevím totiž, zda se i dobře fundovaný biolog začte s chutí do kapitol o skupinách organismů jemu *vzdálenějších a při tom se domnívám, že autoři díla měli na mysli i tento integrující cíl, důležitý* v době vyhraněné a někdy i přehnané odborné specialisace.

Přes tyto některé kritické připomínky se domnívám, že recensované dílo je obohacením naší původní odborné literatury a že se stane vyhledávaným přírůstkem knihoven biologických pracovišť nejrůznějšího zaměření. Její prostudování bude i pro naše zoology pobídkou k obecnějšímu hodnocení výsledků vlastní práce.

M. Kunst



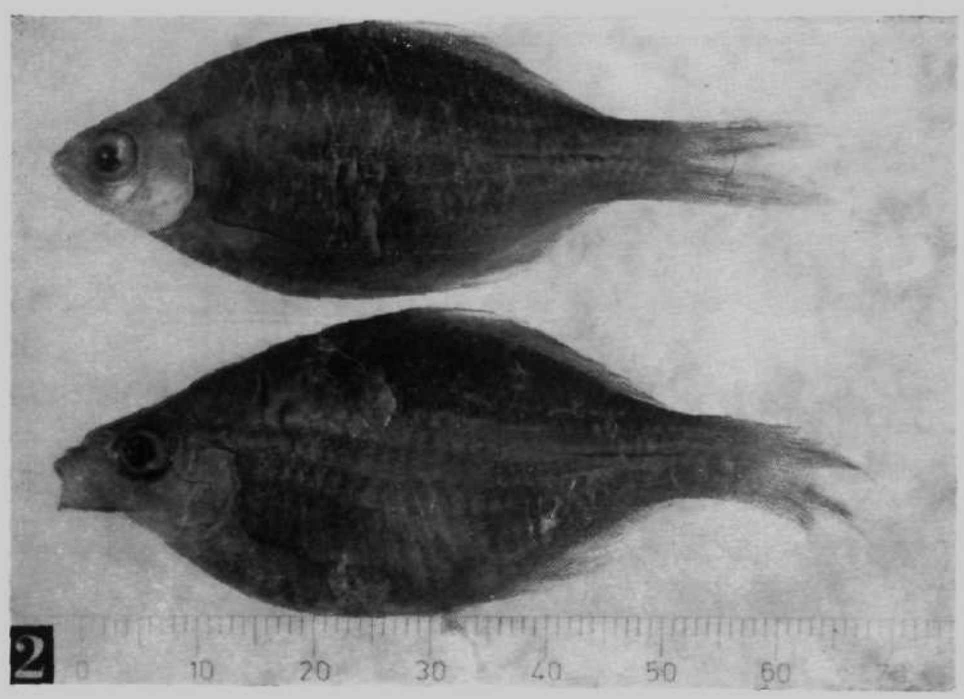


Photo 1. Male (top) and female (bottom) of *Rhodeus spinalis*. Note the differences in colour pattern in female. Scale: centimetres.

Photo 2: Male (top) and female (bottom) of *Acanthorhodeus macropterus tonkinensis*. Note nearly straight back course behind the head.

3

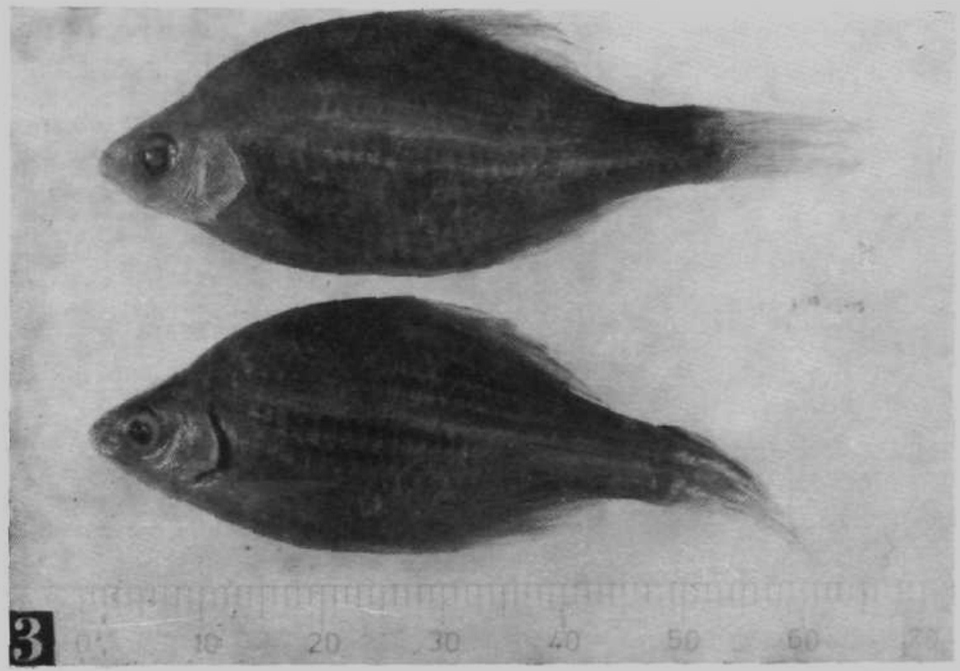


Photo 3. Females of *Acanthorhodeus deignani*. Note nearly invisible black "rhodeine" strip in the centre of caudal peduncle and the arched back behind the head.

Balon E. K. 1971

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Věst. Čs. spol. zool. **35** : 1–8

Dobroruka L. J. 1971

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Věst. Čs. spol. zool. **35** : 9–10

Hanák V., J. Gaisler 1971

The status of Eptesicus ognevi Bobrinskii, 1918, and remarks of some others species of this genus (Mammalia: Chiroptera).

Věst. Čs. spol. zool. **35** : 11–24

Holčík J. 1971

On the taxonomic status of Acheilognathinae fishes (Cyprinidae: Teleostei) from North Vietnam.

Věst. Čs. spol. zool. **35** : 25–31

Hrabě S. 1971

A note on the Oligochaeta of the Black Sea.

Věst. Čs. spol. zool. **35** : 32–34

Krivoluckij D. A.

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Věst. Čs. spol. zool. **35** : 35–39

Mikulová M. 1971

Erster Fund der Art Allolobophora georgii Michaelsen, 1890 (Oligochaeta: Lumbricidae) in der ČSSR.

Věst. Čs. spol. zool. **35** : 40–42

Moravec F. 1971

Studies on the development of the nematode Cystidicoloides tenuissima (Zeder, 1800).

Věst. Čs. spol. zool. **35** : 43–55

Moravec F., V. Baruš 1971

Studies on parasitic worms from Cuban fishes.

Věst. Čs. spol. zool. **35** : 56–74

Zajíček D. 1971

Snails as the second intermediate hosts of the trematodes Plagiorchis muris Tanabe, 1922 (Trematoda: Plagiorchidae).

Věst. Čs. spol. zool. **35** : 75–78

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
ročník XXXV

Vydává Čs. společnost zoologická v Academii, nakladatelství ČSAV, Vodičkova 40
Praha 1 - Nové Město, dod. pú. 1.

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Rozšiřuje Poštovní novinová služba. *Objednávky a předplatné PNS* — ústřední expedice tisku administrace odborného tisku Jindřišská 14, Praha 1. Lze také objednat u každé pošty nebo doručovatele.

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