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Fish leeches of Poland in relation to the Palaearctic piscicolines (*Hirudinea*: *Piscicolidae*: *Piscicolinae*)

ALEKSANDER BIELECKI
Zoological Institute, University of Wrocław, Sienkiewicza 21, 50-335 Wrocław, Poland

ABSTRACT. A standardized description of leech body form is proposed. Descriptions of 10 genera and 20 species are presented, and identification keys are provided. A model is used to investigate interactions between the leech body form and habitat. Phenetic analysis of 20 leech species of 6 genera was based on 19 metric and 113 non-metric characters. Alimentary tract is used for systematic purposes for the first time. A solution of taxonomic problems within *Piscicolinae*, especially at the generic level, is proposed and generic diagnoses are provided for the first time. The following piscicoline genera are jusified: *Pawlowskiella* gen. n., *Italobdella* BIELECKI, 1993, *Piscicola* DE BLAINVILLE, 1818; *Limnotrachelobdella* EPSHTEIN, 1968; *Taimenobdella* EPSHTEIN, 1964; *Cystobranchus* DIESING, 1859; *Codonobdella* GRUBE, 1873; *Baicalobdella* DOGIEL et BOGOLEPOVA, 1957. Most of them are re-interpreted. *Acipenserobdella* EPSHTEIN, 1969 and *Caspiobdella* EPSHTEIN, 1966 require a thorough revision. *Epsteiniabdellini* trib. n. and *Pawlowskiella* gen. n., are distinguished, and 12 new species are described within the *Piscicolinae*; all from Poland, *Piscicola borowieci* (Silesia), *witkowskii* (Baltic Coast), *annae* (Pomeranian Lakeland), *elishebae* (Pomeranian Lakeland), *niewiadomskae* (Masurian Lakeland), *pomorskii* (Baltic Coast), *kusznierzi* (Baltic Coast), *margaritae* (Silesia), *jarai* (Silesia), *wiktori* (Silesia), *Italobdella epshteini* (Masurian Lakeland) and *Pawlowskiella stenosa* (Silesia). Descriptions of the following species are updated supplemented with new characters: *Cystobranchus mammillatus* (MALM, 1863), *Caspiobdella fadejewi* (EPSHTEIN, 1961), *Acipenserobdella volgensis* (ZYKOFF, 1903), *Italobdella ciosi* BIELECKI, 1993, *Piscicola geometra* (LINNAEUS, 1761), *Piscicola pojmanskae* BIELECKI, 1994, *Piscicola fasciata* KOLLAR, 1842, and *Piscicola respirans* TROSCHEL, 1850.

Key words: Poland, taxonomy, *Hirudinea*, *Piscicolinae*, adult, morphology, anatomy, classification, model, system, space of logical possibilities, space of implementation.

CONTENTS

I. INTRODUCTION

Within the last years the systematics of fish leeches (*Piscicolidae* JOHNSTON, 1865) has undergone considerable changes thanks to the studies of V. M. EPSHTEIN, who distinguished many new genera and changed the status of some species. These changes were dictated mainly by the studies on the structure of the reproductive system (EPSHTEIN 1959, 1961a, b, 1962a, b, 1966, 1968a, b, c, 1969, 1973, 1983, 1984, 1985, 1987, 1989, 1992, 1993, EPSHTEIN et al. 1994, BIELECKI and EPSHTEIN 1994, 1995).

The studies on the reproductive system of fish leeches (*Piscicolidae* JOHNSTON, 1865) were initiated by BRUMPT (1900a, b), who presented in detail its basic characters and demonstrated peculiarities of that system in many species. However, that author did not apply these characters to improve the classification system. The same can be said of ZELENSKII (1915), the author of one of the most fundamental papers on leech anatomy; he did not employ his rich material to modify the system of the *Piscicolidae*.

The revision of the system of freshwater, Palaearctic fish leeches (*Piscicolinae*) - presented by EPSHTEIN (1968a, 1969, 1973) - was based not only on the structure of their reproductive system, but also on the structure of coelom and some parts of the alimentary tract. In consequence, he distinguished 8 genera: *Limnotrachelobdella* Epshtein, 1968; *Baicalobdella* DOGIEL, 1957; *Caspiobdella* EPSHTEIN, 1966; *Piscicola* DE BLAINVILLE, 1818; *Cystobranchus* DIESING, 1859 *Taimenobdella* EPSHTEIN, 1964; *Codonobdella* GRUBE, 1872; *Acipenserobdella* EPSHTEIN, 1969. These genera included a total of 15 species, of which only one - *Piscicola geometra* (LINNAEUS, 1761) - had a transpalaearctic distribution.

LUKIN (1978), when commenting on the revision, stressed that though it was still far from complete, the changes in the taxonomic status of the Palaearctic piscicolines proposed by EPSHTEIN (1968a, 1969, 1973) rather well reflected basic eco-geographic groups of species. However, they were not sufficient to explain phylogenetic relationships among the Palaearctic genera, and their relationships with some marine taxa.

In his extensive, three-volume monograph SAWYER (1986) presented his opinion, not accepting diagnoses of many of the genera distinguished by EPSHTEIN (1968a, 1969, 1973).

Recently, a ninth genus *Italobdella* BIELECKI, 1993 has been described from northern Italy, and a tenth genus *Pawlowskiella* gen et sp. n. is erected in this paper.

An important moment in constructing the system of fish leeches (*Piscicolidae* JOHNSTON, 1865) was distinguishing subfamilies: I. *Platybdellinae* EPSHTEIN, 1970; II. *Pontobdellinae* LLEWELLYN, 1966 and III. *Piscicolinae* CABALLERO, 1956 (SAWYER 1986, BURRESON and DYBDAHL 1989) on the basis of the structure of coelom and the associated respiratory organs. In 1983 EPSHTEIN, and later EPSHTEIN et al. (1994), divided the subfamilies into tribes, assuming as a basis variants of the reproductive system. The *Piscicolidae* included a total of 20 tribes with 54 genera. Recently UTEVSKY (1994), after examining the holotype of *Trulliobdella alba* EPSHTEIN 1970 of

the subfamily *Platybdellinae* EPSHTEIN, 1970, distinguished a new genus *Epsteinia*. Since the diagnose of the genus suggests its distinctness from the remaining genera in the subfamily, it is justified to distinguish a tribe *Epsteiniabdellini* **trib. n.**, based on the structure of the reproductive system (no accesory glands on atrium, bursa short, conductive tissue absent, copulatory area located on clitellum).

At present 9 tribes and 20 genera are distinguished in the subfamily *Piscicolinae* CABALLERO 1956, on the basis of the structure of the reproductive system (CABALLERO 1956, SAWYER 1972, 1986, EPSHTEIN 1968a, 1969, 1973, 1987, 1983, 1987, 1989, BURRESON and DYBDAHL 1989, DAVIES 1971, 1972, 1973, 1991, EPSHTEIN et al. 1994, BIELECKI 1993, 1994, 1996).

PAWŁOWSKI (1968) paid attention to the development and directions of studies on leeches (*Hirudinea*) in Poland. In his opinion studies on parasitic leeches and their hosts were advisable. From 1936 to 1990, during over half a century, only three fish parasites of the subfamily *Piscicolinae* were known from Poland: *Piscicola geometra* (LINNAEUS, 1761), *Piscicola fasciata* KOLLAR, 1862 and *Piscicola respirans* TROSCHEL, 1850, and the occurrence of a fourth species *Cystobranchus mammillatus* (MALM, 1863), according to PAWŁOWSKI (1968), required confirmation. The low number of species recorded from Poland and the fact that nobody undertook studies proposed by PAWŁOWSKI (1968) resulted in a complete lack of attempts at a more detailed description and classification of the *Piscicolidae* by Polish leech specialists.

There are only a dozen or so papers dealing with problems of leech parasitism on fishes (SITOWSKI 1937, PAWŁOWSKI and JAŻDŻEWSKA 1970; PAWŁOWSKI 1974; BIELECKI 1977, 1978, 1986, 1988a, b, c, 1990a, b, c, d; BIELECKI and WITKOWSKI 1988; WITKOWSKI and KOWALEWSKI 1989; DANILKIEWICZ 1981; RADKIEWICZ 1991; POJMAŃSKA and CHABROS 1992). The phenomenon is still insufficiently known, since there were no systematic studies and, most of all, fish leeches were hardly ever collected. Till now, three more species have been recorded from Poland: *Caspiobdella fadejewi* (EPSHTEIN, 1961), *Acipenserobdella volgensis* (ZYKOFF, 1903) and *Piscicola pojmanskae* BIELECKI, 1994 (BIELECKI 1990a, 1991, 1994). The occurrence of *C. mammillatus* has also been confirmed; the species was originally recorded from a single, enigmatic locality in the Goczałkowice Reservoir (ZAĆWILICHOWSKA 1965) and during the next 27 years its occurrence was not confirmed (BIELECKI 1992).

Other papers on the three species mentioned above, known from the Polish fauna prior to my own studies: *P. geometra*, *P. fasciata* and *P. respirans*, pertain to their biology in broad sense, but not to their interactions with the hosts (GEDROYĆ 1916, LISKIEWICZ 1925, 1934, DEMEL 1925, 1927, 1933, PAWŁOWSKI 1947a, b, 1950; PAWŁOWSKI and HOFFMAN 1959; SANDNER 1953; WOJTAS 1959, 1960, 1961, JAŻDŻEWSKI 1962; JAŻDŻEWSKA 1962, 1966, MATYSIAK 1967, 1976, MIGAŁA 1971, BIELECKI 1976, 1979, HAJDUK et al. 1978, 1985, AGAPOW 1975, 1982, 1988, BIELECKI et al. 1985).

The evolution of leeches involves reduction of various structures on one hand and acquisition of adaptations to parasitic mode of life on the other. This results in great difficulties in character polarization. The only attempt at cladistic analysis of the group was that by SIDDALL and BURRESON (1995). The attempt at systematization of fish leeches in this paper is purely phenetic, hopefully providing a hypothesis to be

later tested with synapomorphy analysis. Besides, the mathematical model applied to describe the leech body form imposes the use of phenetic methods.

The phenetic method is probably better for classification than for constructing classification systems; it is based on informatics and mathematical methods which allow classification based on the general similarity of objects. It groups taxa that have the most numerous characters in common. Theoretically, it considers a maximum number of characters, with no attention paid to their evolutionary significance. It is assumed that with increasing accumulation of data, significant information becomes pronounced sort of automatically, neutralizing the "background noise" (CAIN 1954, SOKAL and MICHENER 1958, SOKAL and SNEATH 1963, SOKAL 1968, SNEATH and SOKAL 1973, LONC 1989).

Another aim of this paper is to propose a standardization of the description of the body form based on systemic-model solutions and non-metric characters of the members of the subfamily *Piscicolinae*, interactively associated with the fishes of Poland, in relation to fish leeches of the Palaearctic.

II. GENERAL MORPHOLOGY AND ANATOMY OF ADULT FORMS

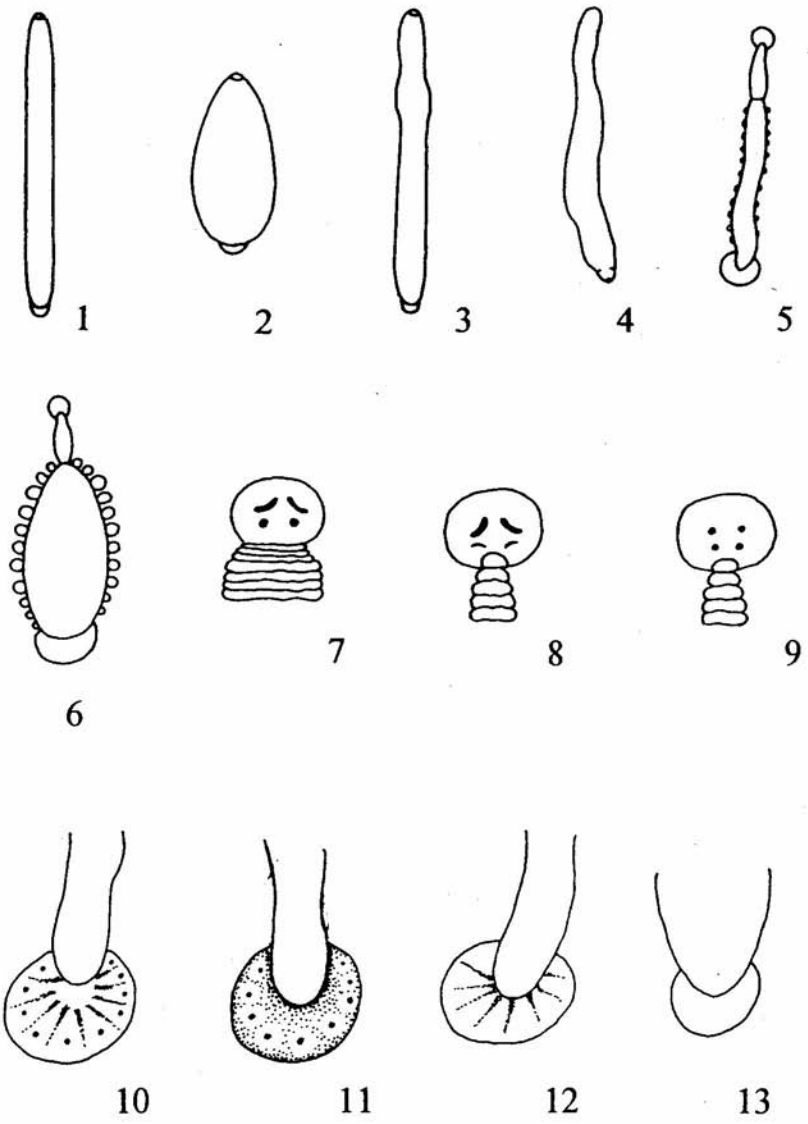
The body length ranges from 8 to 200 mm. The body form is variable - from cylindrical to leaf-like. In some species it is relatively constant, in many it varies within a broad range depending on age, degree of filling of intestine and ability to extend. The body form is a systematic character in various taxa of the class (figs 1-6).

The body is divided into segments (somites). Their number is constant. According to LIVANOV (1940), the leech body (except *Acanthobdellida*) consists of a cephalic region and 33 somites. According to other specialists, leeches have no cephalic region and their body consists of 34 somites (SCRIBAN and AUTRUM 1932, 1934, HOTZ 1938).

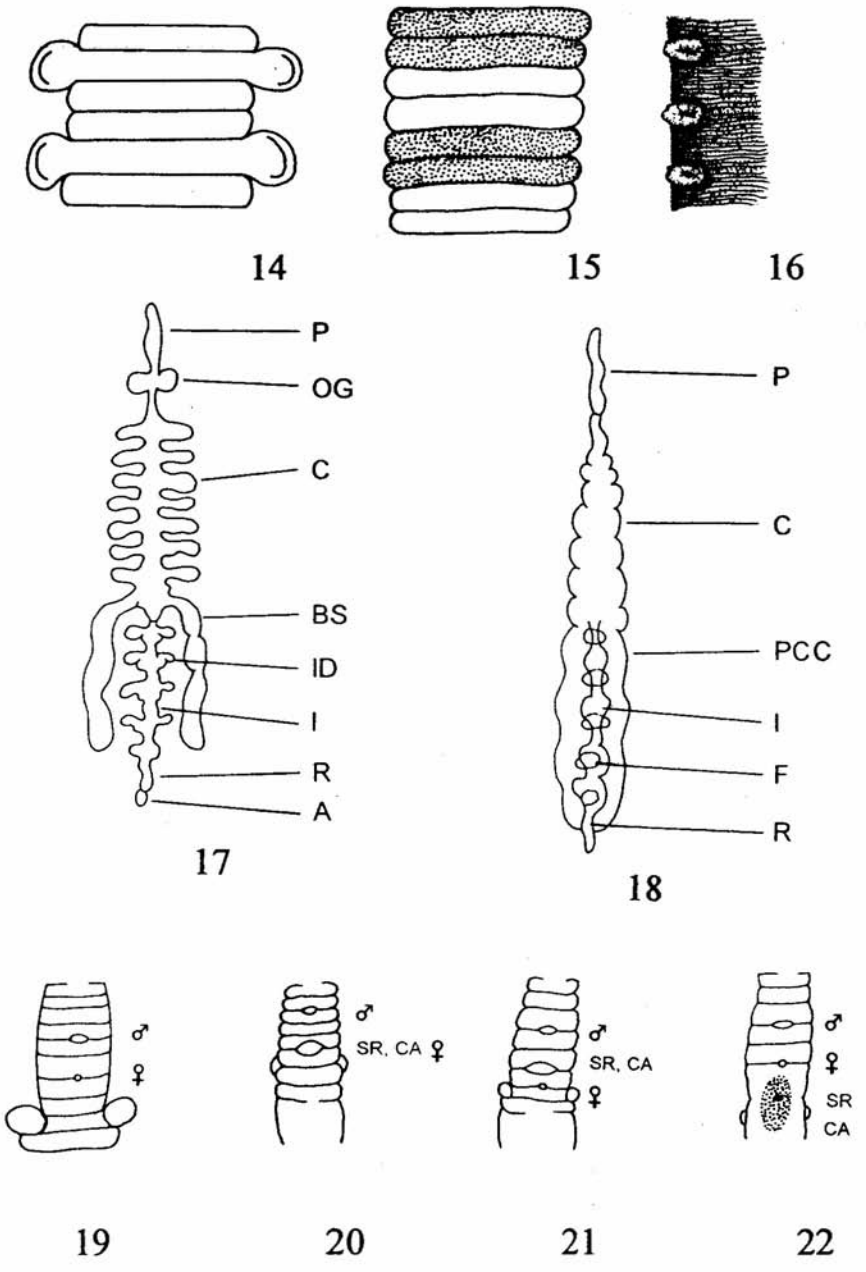
The somites form heteronomic body regions, characteristic of all the leeches: clitellar region, crop region, intestinal region and posterior sucker region. Opinions on the composition of these regions vary. Based on the analysis of segmentation in the piscicolids, it seems reasonable to adopt the following scheme: the region of anterior sucker occupies the cephalic region and 5 somites (I-V); the preclitellar region occupies 3 somites (VI-VIII); the clitellar region - 3 somites (IX-XI); the crop region - 7 somites (XII-XVIII); the intestinal region - 9 somites (XIX-XXVI); the posterior sucker region -7 somites (XXVII-XXXIII).

The body regions are combined to form the following parts: anterior sucker, trachelosome, urosome and posterior sucker (figs 5, 6). The anterior sucker comprises the cephalic widening and somites of a part of the head. Somites of the preclitellar and clitellar region constitute the trachelosome. The crop and intestinal regions form the urosome. Somites of the posterior sucker region form the posterior sucker.

The anterior sucker, when attached to the substratum, is a sucking disc, well delimited from the rest of the body, and its posterior lip is always delimited from the trachelosome. Its size and the degree of eccentricity of its connection with the body



1-13. Body structure. Diagrammatic: 1-6 - body shape, 7-9 - anterior suckers, 10-13 - posterior suckers.



14-22. Body structure. Diagrammatic: 14-16 - somites, 17-18 - alimentary tract: A - anus, BS - blind sacs, C - crop, F - fenestrae, I - intestine, ID - intestinal diverticulum, OG - oesophageal glands (mycetomes), P - proboscis, PCC - posterior crop caecum, R - rectum, 19-22 - position of gonopores, spermatheca opening and copulatory area (modified from EPSHTEIN, 1987).

vary between species (figs 7-9). The posterior sucker is usually larger than the anterior and varies with respect to the same characters (figs 10-13). The sucker structure is an important taxonomic character. In many species the anterior sucker bears eyes, and some have eye-like spots on the posterior sucker (figs 7-11).

The internal segmentation is complicated as a result of secondary annulation: the somites are externally marked by shallow grooves which only touch the body covers, and are further divided into an array of annuli whose number in the mid part of the body (on full, mid-body somites) varies between species. In order to count the somites, segmentally repeated structures are used - lateral respiratory vesicles, elements of colouration, annuli of different length, sensillae of different size and nephridiopores (figs 14-16, 41, 52, 61, 71, 93, 106, 118, 131, 142, 150, 161, 172, 182, 192, 202, 210, 218, 227, 239). In the *Piscicolidae* the number of annuli per somite ranges from 2 to 14. For this reason it is often used as an important taxonomic character.

The dermal-muscular sac (body wall) is built of a thin cuticle, mono-layer epiderm, with numerous glandular cells among the epidermal cells, a layer of mesenchyme and three layers of muscles; circular, transverse and longitudinal. Besides these muscles, there are dorso-ventral muscles. Thick, powerful muscles build greater parts of the suckers. There are also muscles that fulfill particular functions, especially muscles responsible for the functioning of the anterior part of alimentary tract.

The structure of coelom (system of lacunae) varies from completely primitive to a complex system of canals with associated structures: respiratory vesicles and gills.

The central nervous system consists of a paired cerebral ganglion, oesophageal connectives and the ventral nerve cord. The first 4 ganglia of the ventral cord in the *Piscicolidae* are fused to form a suboesophageal ganglionic mass. In the nerve cord of most species there are 21 ganglia. The anal ganglionic mass in leeches is formed of 7 ganglia.

Alimentary tract. It consists of oral cavity, pharynx, oesophagus, crop, posterior crop caecum and intestine (figs 17-18, 42, 53, 62, 72, 82-84, 94-95, 107-111, 119-121, 132-133, 143, 151, 162-163, 173-174, 183-185, 193-194, 203, 211, 219-220, 228, 240). The mouthpore is situated in the centre or at the posterior edge of the anterior sucker. In proboscis-bearing leeches in the pharynx and in a part of oesophagus (proboscis sheath), an eversible, muscular proboscis is formed which serves to pierce the host's body covers and to suck its body fluids, including blood. Its length varies between taxa. The proboscis is most often situated between ganglia 1 and 3 of the ventral cord, thus reaching ganglion of segment IX. On the right and left side of the proboscis there are numerous salivary glands, which open to the pharynx. From IX to XII/XIII segment a thin-walled oesophagus extends, which opens to the crop. In many proboscis-bearing leeches the oesophagus has a pair of diverticles - oesophageal glands "mycetomes" (figs 17, 53, 62, 72, 82, 94, 107-108, 119-120, 132, 143, 151, 162, 173, 183, 193, 203, 211, 219, 228, 240), or they are absent (figs 18, 42).

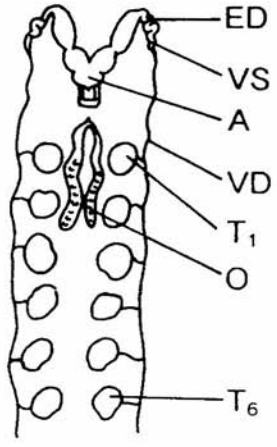
The crop is built of 7, or less often 6 splanchnomeres which are shifted by half length relative to the segments. The crop splanchnomeres usually have lateral diverticles. In the fish leeches (*Piscicolidae*) the last pair of diverticles ("blind sacs") vary in structure - from completely divided (fig. 17) to fused into a common reservoir - posterior crop caecum (figs 18, 42, 53, 62, 72-73, 82, 84, 94, 107, 110, 119, 121, 132, 143, 151, 162, 163, 173, 183-184, 193-194, 203, 211, 219, 228, 240).

Just posterior to the 7th crop splanchnomere (in somite XIX/XX), the intestine branches into a thin-walled, blind posterior crop caecum situated ventrally, and a thick-walled intestine located on the former and dorsally to it. The blind sacs are incompletely fused; 5 fenestrae are preserved at the level of ganglia (figs 73, 84, 110, 121, 132, 163, 184, 194). The intestine is well or poorly developed, with strongly or gently folded walls; it has 4 or 5 pairs of intestine diverticles (figs 42, 53, 62, 72, 83, 94, 107, 111, 119, 133, 143, 151, 162, 173-174, 183, 185, 193, 203, 211, 219-220, 228, 240). Usually the last pair is very poorly visible; posterior to it the intestine forms a coiled tube which extends further, passing into the rectum. The anus is visible, located in the middle of dorsum, anterior to the posterior sucker (figs 72, 94, 107, 111, 119, 133, 143, 151, 162, 173, 174, 183, 185, 219, 220, 240). The structural characters mentioned above are taxonomically useful.

The crop (figs 42, 53, 62, 72, 82, 94, 107, 109, 119, 132, 143, 151, 162, 173, 183, 193, 203, 211, 219, 228, 240) and posterior crop caecum (figs 73, 84, 110, 121, 132, 163, 184, 194) splanchnomeres in most cases are pair-wise divided along the right and left margin into the so called crop and posterior crop caecum diverticles, which in turn may have further - secondary - paired diverticles (figs 94, 95, 107, 109, 110, 119, 121, 132, 151, 162, 163, 173, 203, 211, 219, 228, 240); these can be distinguished on the basis of the depth of constrictions, the diverticles having deeper, and the secondary diverticles shallower constrictions; the latter diverticles are usually shorter and thinner (cf. BIELECKI 1993, 1994).

Reproductive system. It is hermaphroditic - the gonopores are located on clitellum: the male gonopore is located anterior to the female gonopore. Sometimes the female gonopore is invisible, since it is situated in the spermatheca concavity (figs 19, 54, 63). The spermatheca opening may be located between (figs 20, 74, 77, 85, 88) or posterior to the gonopores (figs 22, 96, 112, 122, 134, 144, 152, 164, 175, 186, 195, 204, 212, 221, 229, 241). In some species the spermatheca opening is surrounded by a fold of thickened body covers, that form the copulatory area. The latter may be relatively large (figs 22, 96, 112, 122, 134, 144, 152, 164, 175, 186, 195, 204, 212, 221, 229, 241) or small, and then limited to such covers only within the spermatheca opening (figs 19, 20, 54, 63, 74, 77, 85, 88) or spermatheca opening absent (figs 21, 43).

The male reproductive organs are built of testes divided metamerically into paired parts; paired efferent ducts - seminal canals - depart from them. The canals start as funnels which pass into vasa deferentia which in all the leeches bear seminal vesicles of very different form (as loops, glomeri, ampullae etc.), further passing into vasa deferentia and then into muscular ejaculatory ducts, that open to the atrium. Its paired, terminal parts - horns - merge to form an unpaired common part - bursa copulatrix, whose posterior part enters the body covers and opens to the outside



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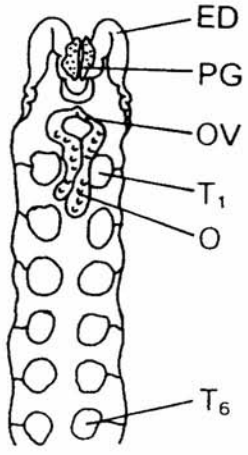

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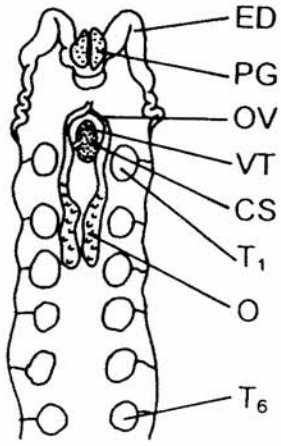

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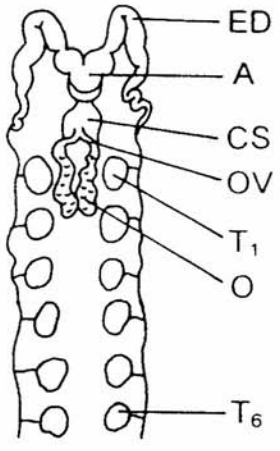

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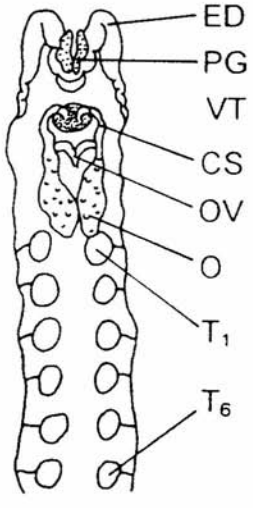

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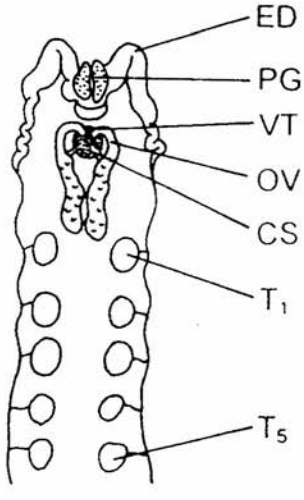

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23-28. Reproductive systems: A - atrium, CS - conducting strans of vector tissue, ED - ejaculatory duct, O - ovisac, OV - oviduct, PG - prostatic glands, T_1, T_6 - testes of the 1st and 5 (6)th pair, SV- seminal vesicles, VD - vas deferens, VT - vector tissue, G - ganglion (modified from EPSHTEIN, 1987).

through the male gonopore. The atrium has many prostate glands in its muscular layer of the wall, below it (figs 23, 26, 44) or above it (figs 24, 25, 27, 28, 55, 56, 64, 75, 86, 97, 113, 123, 135, 145, 153, 165, 176, 187, 196, 205, 213, 222, 230, 242). In many species glands appear on the surface of atrium forming a compact, glandular mass - the so called prostate glands or accessory glands.

The female reproductive organs consist of two ovaries that pass into oviducts which unite into an unpaired vagina; the latter opens through the female gonopore. In many groups of the family there is a conducting apparatus for spermatozoa. From the spermatheca, spermatozoa pass directly through the body covers into the vector tissue, which in some species is located behind the copulatory area as a thick compact mass; in other species besides it there is a paired conducting tissue as conducting strands, leading from the vector tissue to the ovaries (figs 25, 27, 28, 55, 64, 75-77, 86-88, 97, 113, 123, 124, 135, 145, 153, 165-167, 176, 187, 196-197, 205, 213, 222, 230, 242), in others still the vector tissue passes from the posterior part of bursa copulatrix to the ovaries (fig. 26).

Fertilization is effected through spermatophore formed in the atrium; in some leeches the spermatophore attaches to various parts of body surface, in others to the clitellum where in many species of fish leeches a concavity - spermatheca - is located. Leeches lay eggs in cocoons which are secreted by glands located on clitellum. The cocoons have a thick cover. Each cocoon contains a single egg. Freshwater species attach their cocoons to aquatic plants and various submerged objects. The larva develops inside the cocoon, and feeds on a liquid protein substance. The piscicolids are parasites of fishes (*Pisces*), cyclostomates (*Cyclostomata*), crustaceans (*Crustacea*). One species is known to parasitise bivalves (*Lamellibranchiata*).

Fish leeches are distributed in continental waters of northern continents. They are the only group of leeches which has invaded the shelf of the Pacific Ocean from the Polar basin to the shores of Antarctis (EPSHTEIN 1987).

III. MATERIAL AND METHODS

III. 1. TRADITIONAL METHODS OF DESCRIBING TAXA

Description is a necessary analytical (idiographic) phase and remains the most important, central aim of systematics: it is the description area that is the source of data (MATILE et al. 1993). In literature there are many theoretical papers whose results are never applied to construct classification systems.

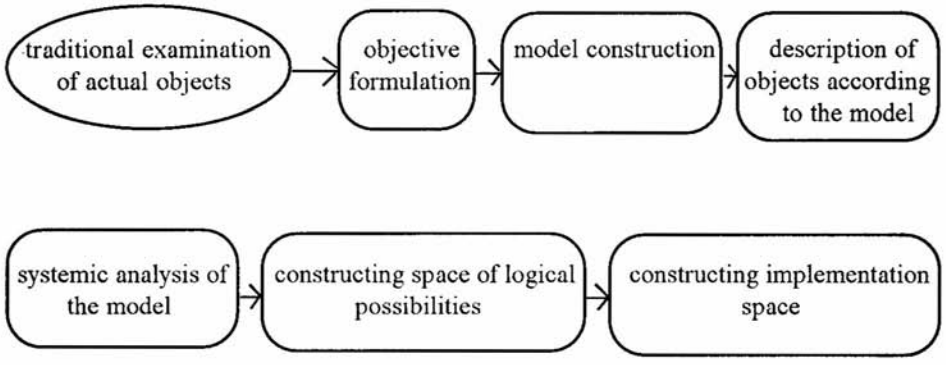
In the class of leeches (*Hirudinea*) descriptions of most groups are insufficient. Morphometry is limited to the information on the length and breadth. Anatomical characters are not examined, and when they are known, their systematic significance is not understood. We (BIELECKI and EPSHTEIN 1994) have thus proposed a standard description based on characteristics of species contained in the papers of other authors and on our own studies. The description contains morphometric data, external morphological data (annulation, eyes, eye-like spots, papillae, respiratory vesicles),

characters of alimentary tract and reproductive system, and also information on the host and localization. Most species of fish leeches (*Piscicolidae*) of the Palaearctic (10 genera) were described according to this standard (EPSHTEIN 1984, 1985, 1987, BIELECKI 1992, 1993, 1994, 1995, 1997 in press). We (BIELECKI and EPSHTEIN 1994, 1995) added to the description a mathematical model of the body form, and the most recent results of studies on the reproductive and alimentary systems.

In the opinion of many researchers (PAWŁOWSKI, WILKIALIS, LUKIN, EPSHTEIN, NIEWIADOMSKA, pers. com.), leeches are difficult to interpret because of their soft bodies; this dictates sophisticated methods of study. When interpreting their morphological structure, I propose a computer morphometric analysis.

III. 2. SYSTEMIC - MODEL METHODS OF SPECIES DESCRIPTION

Systemic studies are always based on the results of traditional research. With accumulation of data, a necessity appears to connect the data and find relationships between them. The process is diagrammatically presented in fig. 29.



29. Scheme of the process of elaboration and application of systemic models, organization of biological species.

Systemic mathematical modelling, as applied to invertebrates, was first used by RAUP (1966, 1967, RAUP et al. 1973) who described in this way spirally coiled shells of fossil and extant molluscs.

In my studies the same method is applied, the object of modelling being the body shape of leeches. This object, i.e. body shape, was selected for the following reasons.

1. It is a significant ectosomatic character;
2. In some taxa within the class of leeches it is of phylogenetic significance;
3. It describes the limits of space within which topographical changes of internal organs take place;
4. The body shape in leeches is easily formalized.

III. 3. Standardized description of the body form, alimentary tract and reproductive systems

III. 3. 1. Construction, description and application of the model

Based on the parameters of the body form model in leeches (figs 30, 31) proposed by Epshtein (1989), I have produced my own, modified and supplemented model (figs 32, 33) of leech body form (Bielecki 1993, 1994, 1997 in press, Bielecki and Epshtein 1994, 1995).

The model presents the leech body on a plane, as two ellipses (suckers) and trapeziums situated between them (anterior body part - trachelosome - two trapeziums; posterior body part - urosome - four trapeziums). Besides, transverse sections through the trachelosome and urosome are considered as two ellipses (figs 30, 32). An abundant material provides evidence that the model permits a sufficiently exact decsription of the body form of various leech species.

The model is constructed according to the following parameters:

(1-4) Parameters describing the form of the anterior sucker: C_1 = horizontal diameter; C^1_1 = vertical diameter; R_1 = length of anterior part of sucker; M_1 = length of posterior part of sucker.

(5-12) Parameters describing the form of the trachelosome: d_1 = width at sucker junction; d_2 = width at outline narrowing; d_3 = width at border with urosome; D_1 = largest width of trachelosome; N_1 = largest height of trachelosome; S_1 = height of first trapezium; S_2 = height of second trapezium; $L_1 = (S_1 + S_2)$ = length of trachelosome.

(13-25) Parameters describing the form of the urosome: width at places of outline distortion (bases of consecutive trapeziums); d_4 = base of first trapezium; d_5 = base of second trapezium; d_6 = base of third trapezium; d_7 = base of fourth trapezium (width at sucker junction); D_2 = largest width of urosome; N_2 = largest height of urosome; $L_2 = (S_3 + S_4 + S_5 + S_6)$ = urosome length (height of consecutive trapeziums); S_3 = height of first trapezium; S_4 = height of scond trapezium; S_5 = height of third trapezium; S_6 = height of fourth trapezium; K_1 = distance from d_3 to D_2; K_2 = distance from D_2 to d_7.

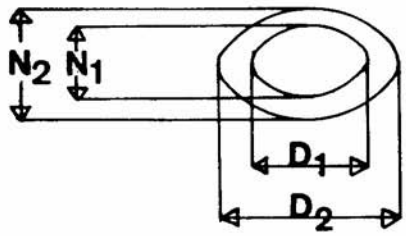
(26-29) Parameters describing the form of posterior sucker: C^1_2 = horizontal diameter; C_2 = vertical diameter; M_2 = length of anterior part of sucker; R_2 = length of posterior part of sucker.

The 19 body proportion indices (invariants) are:

1. Index describing L/D_2 = relative body length.

Indices describing anterior sucker: 2. C^1_1/d_1 = ratio of horizontal diameter of sucker to trachelosome width at sucker junction; 3. C^1_1/D_1 = ratio of horizontal diameter of sucker to greatest width of trachelosome; 4. R_1/M_1 = ratio of dorsal part of sucker to its ventral part; 5. C^1_1/C_1 = ratio of horizontal diameter of sucker to its vertical diameter.

Indices describing trachelosome: 6. L_1/D_1 = ratio of trachelosome length to its greatest width; 7. D_1/N_1 = ratio of greatest trachelosome width to its greatest height; 8. S_1/S_2 = index describing position of greatest width of trachelosome.



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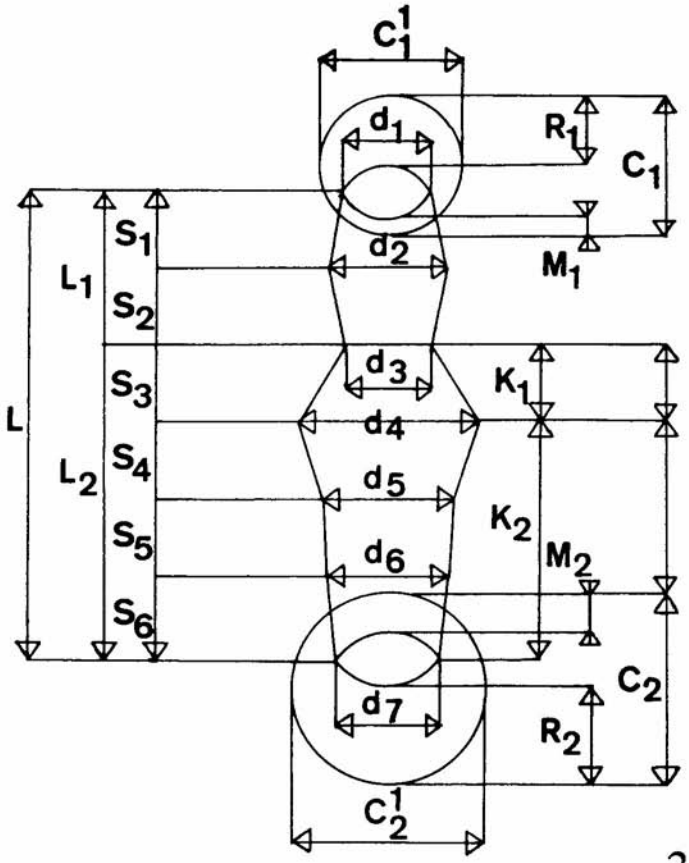

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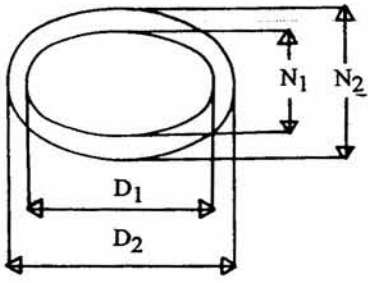
30-31. Model of leech body form (EPSHTEIN, 1984).



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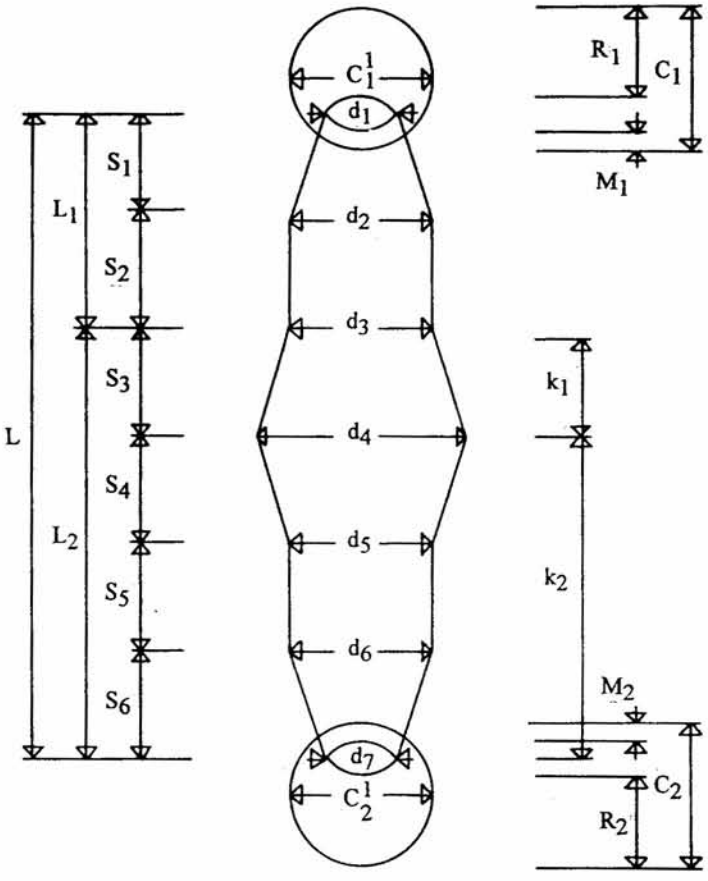

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32-33. Model of leech body form (BIELECKI, 1993).

Tab. 1. Mean values of 19 body proportion indices in 20 species of *Piscicolidae*.

Species	Invariants - 19 body proportion indices (mean)									
	1 L/D_2	2 C^l_1/d_1	3 C^l_1/D_1	4 R_1/M_1	5 C^l_1/C_1	6 L_1/D_1	7 D_1/N_1	8 S_1/S_2	9 L_2/D_2	10 D_2/N_2
Cystobranchus mammillatus	3.0	1.6	0.9	2.0	1.0	1.0	2.3	2.0	2.4	4.0
Acipenserobdella volgensis	4.2	1.6	0.9	4.0	1.0	2.1	1.3	0.9	3.2	1.0
Caspiobdella fadejewi	7.4	1.5	1.2	4.0	1.0	3.0	1.0	0.9	5.5	1.1
Italobdella epshteini	3.4	1.3	0.8	5.0	1.1	1.3	1.7	1.3	2.6	1.0
Italobdella ciosi	4.0	1.6	0.9	5.0	1.0	2.3	1.5	1.0	3.1	1.0
Piscicola geometra	12.7	2.4	1.5	2.7	1.0	3.7	1.1	0.7	10.0	1.2
Piscicola respirans	4.4	1.6	0.9	3.0	0.8	1.5	2.4	1.9	3.4	2.8
Piscicola fasciata	5.0	2.1	1.3	5.0	1.0	3.2	1.7	1.2	3.7	3.0
Piscicola pojmanskae	6.7	1.1	0.7	2.7	0.8	2.1	1.1	2.2	5.3	1.0
Piscicola annae	9.6	2.4	1.4	5.7	1.0	5.3	1.0	0.9	7.3	1.2
Piscicola borowieci	23.0	2.0	1.3	3.0	1.0	6.0	1.2	1.1	17.6	1.0
Piscicola pomorskii	5.6	2.3	1.6	3.3	1.0	3.1	1.7	0.9	4.3	3.1
Piscicola witkowskii	6.5	1.8	1.0	3.0	1.0	2.2	1.1	1.5	5.2	1.2
Piscicola kusznierzi	6.6	2.0	1.5	3.5	1.2	3.2	1.6	1.2	5.0	2.7
Piscicola wiktori	15.0	1.0	0.8	5.0	0.6	6.2	1.7	0.9	11.7	2.5
Piscicola niewiadomskae	6.1	2.2	1.3	4.0	1.1	3.1	1.3	0.9	4.8	1.0
Piscicola elishebae	5.2	2.0	1.2	3.3	1.0	2.5	1.3	1.0	3.9	1.3
Piscicola margaritae	6.5	1.3	0.8	4.0	0.8	2.4	1.4	0.9	5.5	2.5
Piscicola jarai	11.0	1.3	0.8	6.0	1.0	3.1	2.5	1.8	8.5	2.6
Pawlowskiella stenosa	19.6	1.7	1.2	4.0	1.2	6.3	2.0	1.2	14.1	1.4

Tab. 1. Continuation.

Species	Invariants - 19 body proportion indices (mean)									No. of specimens
	11 K_1/K_2	12 C^1_2/d_7	13 C^1_2/D_2	14 R_2/M_2	15 C^1_2/C_2	16 L_2/L_1	17 D_2/D_1	18 N_2/N_1	19 C^1_2/C^1_1	
Cystobranchus mammillatus	0.3	5.2	1.6	1.0	1.0	4.3	1.8	1.0	3.3	7
Acipenserobdella volgensis	1.0	1.2	0.6	2.0	1.0	3.3	2.1	1.9	1.5	29
Caspiobdella fadejewi	1.2	1.3	1.0	1.7	0.9	2.9	1.6	1.4	1.3	148
Italobdella epshteini	1.1	0.9	0.7	1.7	0.9	2.9	1.5	2.6	1.2	4
Italobdella ciosi	1.9	1.5	0.5	1.6	1.0	3.1	2.3	2.5	1.4	11
Piscicola geometra	0.5	2.2	1.8	2.2	1.0	2.7	1.4	1.3	1.7	247
Piscicola respirans	0.9	1.9	1.0	1.6	1.0	3.7	1.7	1.4	1.7	167
Piscicola fasciata	2.7	2.9	2.5	2.5	1.0	2.7	1.6	1.0	2.0	75
Piscicola pojmanskae	1.8	1.4	1.0	2.2	0.9	4.0	1.6	1.6	2.5	38
Piscicola annae	1.2	1.7	1.0	1.3	1.0	3.2	2.3	1.9	1.6	27
Piscicola borowieci	0.3	2.1	2.1	2.0	1.0	3.4	1.2	1.4	1.9	17
Piscicola pomorskii	0.8	1.6	0.8	2.6	0.9	3.5	2.5	1.3	1.2	2
Piscicola witkowskii	2.9	1.3	1.0	1.0	1.0	3.9	1.7	1.6	1.7	8
Piscicola kusznierzi	2.1	1.6	1.1	2.7	1.1	3.1	2.0	1.2	1.5	3
Piscicola wiktori	0.9	1.1	0.9	3.5	0.8	3.8	2.0	1.3	2.3	7
Piscicola niewiadomskae	0.9	1.3	0.8	2.0	1.1	3.5	2.3	2.9	1.4	11
Piscicola elishebae	0.3	1.4	1.1	2.0	1.0	2.8	1.8	1.9	1.8	4
Piscicola margaritae	0.3	1.4	0.7	1.3	0.8	5.3	2.3	1.3	1.9	5
Piscicola jarai	0.3	1.7	1.5	1.3	1.0	3.6	1.3	1.3	2.4	4
Pawlowskiella stenosa	3.3	1.3	1.4	1.7	1.0	2.6	1.2	1.7	1.4	3

Indices describing urosome: 9. L_2/D_2 = ratio of urosome length to its greatest breadth; 10. D_2/N_2 = ratio of greatest urosome width to its greatest height; 11. K_1/K_2 = ratio describing position of greatest width of urosome.

Indices describing posterior sucker: 12. C^1_2/d_7 = ratio of horizontal diameter of sucker to urosome width at sucker junction; 13. C^1_2/D_2 = ratio of horizontal diameter of sucker to greatest body height; 14. R_2/M_2 = ratio of dorsal part of sucker to its ventral part; 15. C^1_2/C_2 = ratio of horizontal diameter of sucker to its vertical diameter.

Indices describing relations between urosome and trachelosome: 16. L_2/L_1 = ratio of urosome length to trachelosome length; 17. D_2/D_1 = ratio of greatest width of urosome to greatest width of trachelosome; 18. N_2/N_1 = ratio of greatest height of urosome to greatest height of trachelosome.

Index describing proportions of suckers: 19. C^1_2/C^1_1 = ratio of horizontal diameter of posterior sucker to horizontal diameter of anterior sucker.

The mean values of the body proportion indices and the number of specimens examined are presented in Table 1.

The ratios of these parameters characterize the total body shape of leeches. Using the programme "Power Point" 2.0 for IBM computer, a model of the measured leeches was constructed (figs 32-33). The model uses 19 body proportion indices (called invariants). Drawings of average specimens of the 20 discussed species were generated with the programme (based on mean measurements) (figs 39-40, 47-48, 59-60, 69-70, 80-81, 91-92, 100-101, 116-117, 129-130, 130-141, 148-149, 159-160, 160-171, 180-181, 190-191, 200-201, 208-209, 216-217, 225-226, 233-234).

III. 3. 2. List and description of non-metric characters

The list includes only the analysed characters of species of the genera: *Cystobranchus*, *Caspiobdella*, *Acipenserobdella*, *Italobdella*, *Pawlowskiella*, *Piscicola*. When describing the genera *Limnotrachelobdella*, *Taimenobdella*, *Codonobdella* and *Baicalobdella* which do not occur in Poland. I based my descriptions on those of Lukin (1976), Epshtein (1987) and on the figures included in their papers, and gave no diagnoses. In the list, abbreviations used in the figures, are given in parentheses.

1. Papille (PA), sensillae, tubercles (tangoreceptores) in great number, on all annuli of the somite
2. Papille numerous, on three annuli of the somite
3. Papille moderately numerous, on two annuli of the somite
4. Papille absent
5. Mid-body somite 4-annulate
6. Mid-body somite 6-annulate, annuli of equal length
7. Mid-body somite 7-annulate, annuli of equal length
8. Mid-body somite 7-annulate, first annulus longer
9. Mid-body somite 14-annulate, annuli equal
10. Mid-body somite 14-annulate, two groups of annuli of unequal length
11. Mid-body somite 14-annulate, three groups of annuli of unequal length
12. Mid-body somite 14-annulate, four groups of annuli of unequal length
13. Gonopores separated by 2 annuli
14. Gonopores separated by 3 annuli
15. Gonopores separated by 4 annuli

16. Gonopores separated by 5 annuli
17. Gonopores separated by 6 annuli
18. Female gonopore on clitellum invisible (located within spermatheca opening in its anterior wall)
19. Copulatory area (CA) on bursa
20. Copulatory area on clitellum
21. Copulatory area very short
22. Copulatory area short, within spermatheca opening
23. Copulatory area long, surrounding spermatheca opening and encroaching on the first somite of urosome
24. Copulatory area circular
25. Copulatory area elliptical, parallel to the body long axis, symmetrical before and behind the first pair of respiratory vesicles
26. Copulatory area elliptical, transverse to the body long axis, symmetrical before and behind the first pair of respiratory vesicles
27. Copulatory area as a reversed triangle
28. Copulatory area anterior to the first pair of respiratory vesicles
29. Spermatheca opening (SR) parallel to the body long axis
30. Spermatheca opening transverse to the body long axis
31. Spermatheca opening anterior to the first pair of respiratory vesicles
32. Spermatheca opening at the level of the first pair of respiratory vesicles
33. Spermatheca opening absent
34. Crop (C) and posterior crop (PCC) caecum splanchnomere diverticles (CD) divided into 3 secondary small diverticles
35. Crop and posterior crop caecum splanchnomeres of 2 equal diverticles, with no secondary diverticles
36. Crop and posterior crop caecum splanchnomeres of 2 equal diverticles divided into 4 secondary small diverticles
37. Crop and posterior crop caecum splanchnomeres of 3 diverticles, with no secondary diverticles
38. Crop and posterior crop caecum splanchnomeres of 3 diverticles, no secondary diverticles, diverticles 1 and 3 of equal width, diverticle 2 wider
39. Crop and posterior crop caecum splanchnomeres of 4 diverticles, first diverticles longer than the remaining ones, divided in 3 secondary small diverticles
40. Crop and posterior crop caecum splanchnomeres of 5 diverticles, first diverticles longer than the remaining ones, divided in 4 secondary small diverticles
41. Crop and posterior crop caecum splanchnomeres of 6 equal diverticles, each divided in 4 secondary small diverticles
42. Intestine (I) well developed, covers almost all posterior crop caecum
43. Intestine poorly developed, larger part of posterior crop caecum not covered
44. Intestine walls strongly folded
45. Intestine walls gently folded
46. Atrium (A) with a characteristic process
47. Atrium of two symmetrical transverse to the body long axis
48. Prostatic glands (PG) on atrium very large, well developed
49. Prostatic glands on atrium very poorly developed
50. Prostatic glands on atrium absent
51. Ejaculatory ducts (ED) between ganglia 3 and 4
52. Ejaculatory ducts reach ganglion 4
53. Ejaculatory ducts between ganglia 4 and 5
54. Ejaculatory ducts at the level of ganglion 5
55. Ejaculatory ducts bent sharply once, parallel to the body long axis
56. Ejaculatory ducts bent sharply once perpendicular to the body long axis
57. Ejaculatory ducts bent 3 times
58. Ejaculatory ducts bent 4 times
59. Ejaculatory ducts bent 5 times

60. Ejaculatory ducts bent more than 5 times (ca. 10 times)
61. Ejaculatory ducts once gently bent, semicircular
62. Ejaculatory ducts circular (make a full circle)
63. Ejaculatory ducts with an ampulla-like widening (epididymis)
64. Vasa deferentia (VD) straight, not coiled
65. Vasa deferentia moderately coiled
66. Vasa deferentia strongly coiled
67. Seminal vesicles (VS) far anterior to testes 1, reaching anterior parts of ovaries
68. Seminal vesicles reaching testes 1
69. Seminal vesicles reaching testes 2
70. Seminal vesicles ampulla-like
71. Seminal vesicles as rods transverse to the body long axis
72. Seminal vesicles as rods situated parallel to the body long axis
73. Seminal vesicles classically U-shaped
74. Seminal vesicles looped several times, up to 4
75. Seminal vesicles multiply looped, up to 10 times and more
76. Seminal vesicles round
77. Seminal vesicles trifid
78. 5 pairs of testes (T) (pair 2 absent)
79. 6 pairs of testes
80. Ovaries (O) short, reaching testes 1
81. Ovaries long reaching testes 2
82. Ovaries between testes
83. Ovaries on testes
84. Ovaries strongly twisted and coiled, polylobate
85. Ovaries strongly twisted
86. Ovaries elongate, cylindrical
87. Ovaries sac-like
88. Ovaries - posterior parts free
89. Ovaries - posterior parts intertwined
90. Oviducts (OV) enter vector tissue
91. Oviducts enter female gonopore anterior to vector tissue
92. Oviducts enter female gonopore posterior to vector tissue
93. Oviducts very close to conducting strands, difficult to separate and thus giving an impression of a single duct
94. Oviducts close to conducting strands, their separation very well visible
95. Oviducts considerably remote from conducting strands
96. Vector tissue (VT) anterior to female gonopore
97. Vector tissue posterior to female gonopore
98. Vector tissue in middle on female gonopore and spermatheca opening
99. Vector tissue elliptical, parallel to the body long axis
100. Vector tissue elliptical, transverse to the body long axis
101. Vector tissue as a fold, transverse to the body long axis
102. Vector tissue triangular
103. Vector tissue circular (discodial)
104. Conducting strands (CS) connected with atrium
105. Conducting strands connected with vector tissue
106. Conducting strands very long
107. Conducting strands long
108. Conducting strands short
109. Conducting strands wide
110. Conducting strands narrow
111. Conducting strands enter anterior part of vector tissue
112. Conducting strands enter mid part of vector tissue
113. Conducting strands enter posterior part of vector tissue

Phenetic analysis was performed with Statistica for Windows, for IBM PC. (Release 5.0, B, Copyright Statsoft. Inc. 1984-1996. This product is licensed to: Tomek, serial number SW 5126704720A50, single user version).

The joining or tree clustering algorithm was chosen to interpret the similarity of body form of the 20 species. When selecting distance measures, city-block (Manhattan) distance was chosen, which minimizes the effect of more distant objects (morphotypes). Of amalgamation or linkage rules, Ward's method was used, since it tends to yield small clusters and with such a low number of species gives a high resolution. The procedure made it possible to divide the species morphotypes in 2 polytypic clusters (fig. 34):

I. cluster including the following species of very similar body form:

I^1. sub-clusters *Piscicola wiktori* n. sp., *Piscicola jarai* n. sp., *Piscicola annae* n. sp., and *Piscicola geometra*. In this cluster *P. jarai* n. sp. and *P. annae* n. sp. are the most similar;

I^2. sub-clusters *Pawlowskiella stenosa* n. sp. and *Piscicola borowieci* n. sp. have the most similar body form.

II. another polytypic cluster comprising the remaining species. The cluster has two large sub-clusters: II^1 and II^2.

II^1 sub-cluster, including *Cystobranchus mammillatus* and *Piscicola respirans*, the most similar in their body form, and *Acipenserobdella volgensis* and *Italobdella ciosi* as well as *Italobdella epshteini* n. sp. of a somewhat different body form.

II^2 sub-cluster comprising 9 species; *Caspiobdella fadejewi*, *Piscicola niewiadomskae* n. sp., *Piscicola elishebae* n. sp., *Piscicola margaritae* n. sp., *Piscicola pojmanskae*, *Piscicola witkowskii* n. sp., *Piscicola fasciata*, n. sp., *Piscicola pomorskii* n. sp., *Piscicola kusznierzi* n. sp. The following species pairs have the most similar body form: *C. fadejewi* and *P. niewiadomskae* n. sp., *P. pojmanskae* and *P. witkowskii* n. sp.; *P. pomorskii* n. sp. and *P. kusznierzi* n. sp.

Other methods (Euclidean distance, squared Euclidean distance, Chebychev distance, power distance) gave very similar results. Results obtained with 1-Pearson r method and percent disagreement depart from them somewhat more.

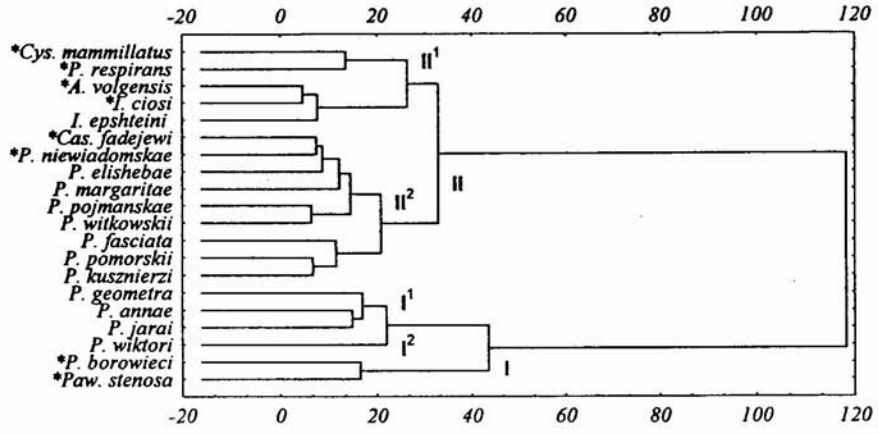
When analyzing the similarity of the 20 species based on 113 non-metric characters, percent disagreement was used as distance measure since it is particularly useful when the data for the dimensions included in the analysis are categorical in nature. Of amalgamation or linkage rules, Ward's method was selected for the reasons stated under "Body form". As a result, 3 (one monotypic and two polytypic) clusters were obtained (fig. 35):

I. monotypic, with only *Cystobranchus mammillatus* rather remote from the remaining species which form another cluster.

II. formed by the genus *Piscicola* with 14 species. The cluster comprising species of the genus *Piscicola* is distinctly divided in 2 sub-clusters:

II^1. sub-cluster, including *P. geometra*, *P. annae* n. sp., *P. niewiadomskae* n. sp., *P. borowieci* n. sp., *P. wiktori* n. sp., *P. witkowskii* n. sp., *P. kusznierzi* n. sp.,

II^2. sub-cluster, including *P. respirans*, *P. fasciata*, *P. pojmanskae*, *P. pomorskii* n. sp., *P. jarai* n. sp., *P. margaritae* n. sp. and *P. elishebae* n. sp.



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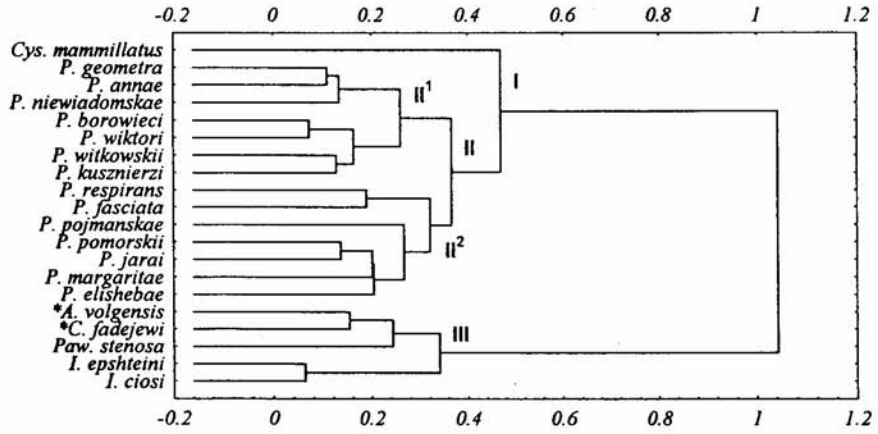


35

34. Tree diagram for 20 species (*Piscicolinae*) based on mean value of 19 body proportion indices (Wards method, Manhattan distances); 35. Tree diagram for 20 species (*Piscicolinae*) based on 113 non-metric characters (Wards method, percent disagreement) (*see text).

III. includes four genera - *Italobdella*, *Pawlowskiella*, *Caspiobdella* and *Acipenserobdella*. The genus *Pawlowskiella* is more similar to *Caspiobdella* and *Acipenserobdella* than to the genus *Italobdella*.

Other methods (percent disagreement and complete linkage furthest neighbor, UPGMA, WPGMA) gave very similar results.

Because leeches are organisms whose genealogy is very difficult to trace, and the mathematical model of the body form imposes the use of phenetic (numerical) method, thus avoiding the eclectic error, this method was consequently used in the interpretation of non-metric characters of the reproductive systems and alimentary tract. An additional reason for the use of phenetic method is a limited material - of 20 genera described in the subfamily *Piscicolinae* only 6 are represented in Poland.

III. 3. 3. Preservation methods, measurements and dissection

Leech preservation is difficult, and for measurements and dissection the leeches should be extended and not twisted. In view of the strong contractability, their shape easily becomes distorted, hence fixation must be preceded by anaesthesia. The most practical aneasthesising liquid is 10% ethyl alcohol. Depending on species, the leeches must be left in alcohol for a few or a dozen or so hours. During anaesthesia in 10% alcohol, some species secrete much mucus. Then, following anaesthesia, the specimens should be washed from mucus in 50% alcohol, and placed in vials with 75% alcohol or formol - 3% aqueous solution of formalin (Pawłowski 1936). Specimens preserved with this method are stretched, moderately extended, do not change their colour, and the annuli are well visible.

Measured values are best expressed in mm, with accuracy of 0.1 mm.

Prior to taking measurements, each specimen should be placed on a Petri dish filled with paraffin, covered with distilled water. The paraffin can be stained with e. g. Sudan III, for better contrast; besides, the stain well differentiates the structures of alimentary and reproductive systems. Then the specimen is stretched and fixed with entomological needles (these should be made of stainless steel, needles of coroding metals can not be used) on both sides (suckers). The measurements are taken under stereomicroscope at 10-20x magnification, starting with width and length of dorsal side of trachelosome and urosome. It is advisable to stick needles beside the specimen, in the places of the largest width of trachelosome D_1 and urosome D_2. More needles are not necessary for trachelosome measurements, since two next widths are determined by well-defined places: junction of trachelosome and anterior sucker d_1 and position of the first pair of respiratory vesicles d_3. The next two needles should be placed at roughly equal distances anterior and posterior to the needle determining the largest width of trachelosome D_1. After width of trachelosome and urosome have been measured, their length is measured [from the width at the place of junction with anterior sucker to the first needle, then from needle to needle, and from the last needle to the junction with posterior sucker d_7]. In order to check the data, the lengths of urosome and trachelosome should be added, and then the whole length of specimen

should be measured from the junction with anterior sucker d_1 to the junction with posterior sucker d_2. Next, the width of anterior C^1_1 and posterior C^1_2 sucker is measured, and the length of the anterior part of anterior sucker R_1 and posterior part of posterior sucker R_2.

Further measurements are taken on the ventral side: length of anterior C_1 and posterior C_2 sucker, and then the length of posterior part of anterior sucker M_1 and length of anterior part of posterior sucker M_2. The last two measurements are the most difficult, since the object should be specially prepared. After immobilizing anterior sucker, the body should be bent by 180° and then posterior part of the sucker can be measured, M_1; the procedure is similar when measuring posterior sucker M_2. After turning the object on one side, its thickness at trachelosome N_1 and urosome N_2 is measured at places of their greatest width.

For such measurements the leech should be placed between two needles in order to immobilize it. If the specimens are numerous, in order to check the accuracy of measurements, suckers can be removed and their posterior parts measured at dorsal side. The same can be done when measuring the greatest thickness of trachelosome and urosome. Measurements are taken thrice, according to requirements of morphometry.

Leeches are dissected under stereomicroscope on the dorsal side. Like for measurements, the leech is placed in a Petri dish filled with paraffin covered with distilled water, fixing it with needles on both ends (stainless needles and of adequate size; larger needles for larger leeches). The body covers are cut with a scalpel, starting with the junction of trachelosome and anterior sucker, slightly to the left or to the right of the dorsal midline so as not to damage the proboscis. Then the cut body covers are spread aside using blunt, bent dissection needles, and fixed with the first two needles. This is the most important moment, then the specimen is immobilized and further dissection can be continued. It should be extremely precise, since the next cut is just above the oesophagus which is joined by diverticles, and the first crop splanchnomere located between ovaries. Below these structures the reproductive system is situated; if the cut in this place is too deep, the most important structures in the diagnose will be impossible to interpret for a beginner. Again the body covers are spread aside and fixed with needles, the procedure being repeated several times, depending on the length of specimen. Behind crop splanchnomere 7 the dissection should be very precise, since from that place to the end of the body intestine is situated, which is very thin-walled and in most cases not filled with any contents. One cut can be performed, but it should uncover the first pair of intestine diverticles, then the body covers are spread again and the procedure repeated several times till the body covers are cut up to the posterior sucker.

Further dissection.

Cleaning alimentary tract and its interpretation. The alimentary tract is always covered with various tissues, muscles, coelomic structures, large groups of lipid cells which should be removed to make the tract better visible. Dissection needles, bent, sharp or blunt, are used for this purpose. Proboscis and oesophagus should be free of

these structures in order to be able to observe between which ganglia the proboscis is situated, and to find if the oesophagus is joined by mycetomes which are located on ejaculatory ducts. Behind the oesophagus there is the first crop splanchnomere. It is situated between the ovaries, literally squeezed in and is usually of different structure from the next six splanchnomeres. It is best to remove crop splanchnomeres singly, levering each and checking if ganglia and testes are not removed. Then their structure is interpreted: the number of diverticles per splanchnomere, their width and length. To dissect and interpret the posterior crop caecum, the rectum should be removed. Before doing this, it should be carefully cleaned and the number of diverticles observed; usually the first three or four pairs are well visible, the fifth, when present, is very small, barely visible, with rounded margins. Then the rectum is lifted with forceps till the very end and freed by shifting towards crop (anterior sucker). Usually it is possible to free it completely. Then interpretation of the structure of posterior crop caecum splanchnomeres can start, similar to the interpretation of crop splanchnomeres. Fenestrae between these splanchnomeres should be also observed and counted, in case of an incomplete fusion of blind sacs.

Cleaning and interpretation of the reproductive system. This is the most difficult dissection, since the area is very small and the reproductive structures very delicate. The thinnest dissection needles with bent, blunt ends and a fine forceps are used. The unnecessary structures are levered with the needles, caught with forceps and delicately removed. We usually start with uncovering ejaculatory ducts and atrium. To do this, the mycetomes should be carefully removed from the ejaculatory ducts, and the osesophagus taken out. After this has been accomplished, it is usually possible to observe at which level loops of the ejaculatory ducts are situated, to orient them in reference to ganglia 3, 4, and 5, and to ascertain if there are prostatic glands on the atrium. Then, after the first crop splanchnomere has been removed, the following structures should be carefully cleaned of remnants of tissues: ovaries, vector tissue and conductive strands, first pair of testes. Separating the ovaries, oviducts and vector tissue is the most difficult. Proximal parts of the oviducts should be found, and a blunt dissection needle inserted between the oviduct and the conductive strand, the needle being then moved towards the ovary (posterior body part). If this is successful, it will be possible to observe with certainty if the oviducts open to the female gonopore anterior to the vector tissue, posterior to it or to the tissue. In most species the ovaries are much longer than the strands of conductive tissue and they are twisted on considerable length. When difficulties in interpretation arise, it is necessary to shift ovaries towards the body sides or turn them by 180°. Then they can be fixed with needles, usually one needle is enough; the structures are paired and it should be remembered that the needles make additional opening in the region of clitellum, which may later make it difficult to interpret the position of the gonopores and spermatheca opening.

IV. TAXONOMIC PART

KEY TO THE PALAEARCTIC FRESHWATER AND BRACKISH-WATER GENERA OF THE SUBFAMILY *PISCICOLINAE*

1. Prostatic glands on atrium, vector tissue and spermatheca absent, eyes and eye-like spots poorly developed or absent ..... 2.
-, Prostatic glands on atrium, vector tissue and spermatheca present, eyes and eye-like spots well developed ..... 3.
2. Posterior sucker very small, its horizontal diameter distinctly smaller than or equal to the largest urosome width. Respiratory vesicles large, spherical, semispherical or conical ..... ***Limnotrachelobdella*** (p. 248).
-, Posterior sucker large or very large, its horizontal diameter distinctly larger than the largest urosome width. Respiratory vesicles fairly small, fine or nearly invisible ..... ***Taimenobdella*** (p. 250).
3. Conducting strands connect ovaries with bursa ..... ***Cystobranchus*** (p. 251).
-, Conducting strands do not connect ovaries with bursa ..... 4.
4. Female gonopore on clitellum invisible, located in spermatheca opening. Oviducts cross vector tissue ..... 5.
-, Female gonopore on clitellum visible, located beyond spermatheca opening. Oviducts do not cross vector tissue and enter female gonopore anterior to it ..... 6.
5. Posterior sucker medium-sized, body covered with fine tubercles. Bursa short. Conducting strands and oviducts run together ..... ***Caspiobdella*** (p. 257).
-, Posterior sucker small, body smooth. Bursa longer. Conducting strands and oviducts separate ..... ***Acipenserobdella*** (p. 265).
6. Spermatheca opening located between gonopores ..... ***Italobdella*** (p. 270).
-, Spermatheca opening located behind gonopores ..... 7.
7. Copulatory area surrounds spermatheca opening ..... 9.
-, Copulatory area surrounds gonopores and spermatheca opening ..... 8.
8. Oviducts enter vector tissue, 6 pairs of testes, oesophageal diverticles present ..... ***Pawlowskiella*** gen. n. (p. 279).
-, Oviducts do not enter vector tissue, they enter female gonopore anterior to vector tissue, 5 pairs of testes, oesophageal diverticles absent ..... ***Codonobdella*** (p. 283).
9. Copulatory area well developed, enters the first somite of urosome. Size medium or large (body length exceeding 15 mm) ..... ***Piscicola*** (p. 284).
-, Copulatory area poorly developed, does not enter the first somite of urosome. Size very small (body lengh smaller than 15 mm) ..... ***Baicalobdella*** (p. 351).

Genus: *Limnotrachelobdella* EPSHTEIN, 1968

Limnotrachelobdella EPSHTEIN 1968c: 138.

Type species: *Trachelobdella sinensis* BLANCHARD, 1896.

DESCRIPTION

Size large (45 mm) or medium (15-30 mm). Body short or elongate, flattened or flat. Urosome distinctly wider than trachelosome. Suckers very small. Anterior sucker eyes poorly developed or absent. Posterior sucker connected somewhat eccentrically, its eye-like spots absent. Respiratory vesicles large, well delimited from the body or less distinctly protrude above its sides, their form and number variable. Number of annuli per mid-body somite variable: from 3 with secondary grooves, to 14. Body surface smooth, tubercles (tangoreceptors) absent. Mouthpore located centrally. Proboscis base at ganglion 3. Oesophageal glands present. Crop and posterior crop caecum with diverticles. Posterior crop caecum splanchnomeres divided or incompletely fused; 5 fenestrae at the level of ganglia are preserved. Both gonopores well visible, separated by varied number of annuli. Spermatheca and copulatory area on clitellum absent. 5 or 6 pairs of testes. Seminal vesicles poorly developed, their form and location vary but they are always located much anterior to testes 1. Vasa deferentia short, slightly coiled. Ejaculatory ducts fine and narrow or thick and well developed, at the level of ganglion 5 or 4, or between ganglia 4 and 5, most often bent once parallel to the body long axis. Prostatic glands on atrium absent. Ovaries short (reaching testes 1) or very long (reaching testes 6, on entire crop length), their distal ends free. Vector tissue and conducting strands absent (EPSHTEIN 1987).

Palaearctic genus - 5 species.

KEY TO THE SPECIES

Note ! The following key is given after LUKIN (1978) and EPSHTEIN (1987), with some modifications.

1. Respiratory vesicles spherical or semispherical, 11 pairs ..... 2.
-, Respiratory vesicles conical, 10 pairs ..... ***taimeni***
2. Somite 3 or 6-annulate, divided by additional grooves (as a result the number of annuli may reach 14) ..... 3.
-, Somite 5-annulate, annuli very distinct ..... ***okae***
3. Respiratory vesicles round, horizontal diameter of posterior sucker larger than half of the largest width of urosome; large leeches, length to 45 mm ..... ***sinensis***
-, Respiratory vesicles semispherical, horizontal diameter of posterior sucker smaller than the half of the largest width of urosome; medium-sized leeches, length to 18 mm ..... ***turkestanica***

Limnotrachelobdella taimeni EPSHTEIN, 1957

Trachelobdella taimeni EPSHTEIN, 1957: 1414-1416, figs 1-2.

Salosa River (Amur River basin). On taimen, *Hucho hucho taimen* (PALLAS). On fins.

Limnotrachelobdella okae (MOORE, 1924)

Trachelobdella okae MOORE, 1924: 345, fig. 427.

Peter Veliki Zaliv (Sukhodol and Ussurijskij Bay); outlet of the Narva River (south of Primorskiy Kraj), Bira River basin, Khivanda River, Nizhnjaja Uda (tributary of the river Amgun in its lower section), liman of Amur River. On great Siberian sturgeon, *Huso dauricus* (GEORGI), chum [dog] salmon, *Oncorhynchus keta* (WALBAUM), pink [humpback] salmon, *Oncorhynchus gorbuscha* (WALBAUM), salmon trout, *Oncorhynchus masu* (BREVOORT), Pacific [eastern] redfin, *Leuciscus* (*Tribolodon*) *brandti* (DYBOWSKI). On gills, fins, body surface.

Limnotrachelobdella sinensis (BLANCHARD, 1896)

Trachelobdella sinensis BLANCHARD, 1896: 316-318, fig. 1.
Trachelobdella selenskyi VASILEV, 1939: 29-32, pl. I, figs 1-2, pl. II, fig. 3, pl. III, figs 6-7.

Lake Khanka, Amur River near Blagoveschensk and Khabarovsk. On carp, *Cyprinus carpio haematopterus* TEMMINCK et SCHLEGEL and goldfish, *Carassius auratus gibelio* (BLOCH). On the inner side of operculum.

Limnotrachelobdella turkestanica (STSCHEGOLEW, 1912)

Trachelobdella turkestanica STSCHEGOLEW 1912: 179-190, figs 1-5.
T. aralensis DOGIEL et BYCKHOWSKY, 1934: 314-318.

Aral Sea, rivers Chu, Ila, Talass; Lake Balkhash; Sirdarja, Zeravshan, Amudarja and its tributaries (Vakhsh, Surkhandarja); reservoirs of Uzboja and Lenkoranskii nature area. On big Amu-dar shovelnose, *Pseudoscaphirhynchus kaufmanni* (BOGDANOV), khramulyas, *Varicorhinus* sp., barbel, *Barbus barbus* (L.), Sevan barbel, *Barbus capito conocephalus* KESSLER, Aral [Caspian] barbel, *Barbus brachycephalus* KESSLER, Ili [Issyk-Kul] marinka, *Schizothorax pseudaksaiensis* HERZENSTEIN, Balkhash marinka, *Schizothorax argentatus* KESSLER, striped [Syrdar] bystranka, *Alburnoides taeniatus* (KESSLER) and carp, *Cyprinus carpio* L. On body surface and fins.

Genus: *Taimenobdella* EPSHTEIN, 1969

Taimenobdella EPSHTEIN, 1969: 286-287.

Type species: *Piscicola amurensis* EPSHTEIN, 1964.

DESCRIPTION

Size very small (up to 8 mm). Body long, cylindrical. Suckers large, deep, connected eccentrically. Division into trachelosome and urosome invisible. Anterior

sucker eyes (2 pairs) well developed. On posterior sucker eye-like spots. Respiratory vesicles barely visible, their number not established. Mid-body somite 7-annulate (annuli of varied length). Mouthpore situated centrally. Structure of alimentary tract unknown. Spermatheca and copulatory area absent. 5 pairs of testes. Seminal vesicles very poorly developed, in the shape of fine loops, located much anterior to testes 1. Vasa deferentia short. Ejaculatory ducts wide and thick, well developed, at the level of ganglion 4, bent once parallel to the body long axis. Prostatic glands on atrium absent. Unpaired, common part of atrium (bursa) in the shape of a muscular trumpet. Ovaries long reaching testes 2 (3), their distal ends free. Vector tissue and conducting strands absent (EPSHTEIN 1964, 1987, LUKIN 1987). One species known: *T. amurensis* (EPSHTEIN 1964).

Taimenobdella amurensis (EPSHTEIN, 1964)

Piscicola amurensis EPSHTEIN, 1964: 1164-1181, figs 3-4.

Khivanda River (Amur River basin). On taimen, *Hucho hucho taimen* (PALLAS). On gills.

Genus: *Cystobranchus* DIESING, 1859

Cystobranchus JOHANSSON, 1896: 30-31, pl. VI, figs 67-68, pl. X, fig. 100.

Type species: *Platybdella mammillata* MALM, 1863.

DIAGNOSIS

Species of the genus *Cystobranchus* are somewhat similar to the genus *Piscicola;* both share female gonopore on clitellum visible and the presence of conducting strands. *Cystobranchus* differs from *Piscicola* in the following characters: copulatory area located on bursa (in *Piscicola* on clitellum), spermatheca, mycetomes, prostatic glands on atrium and vector tissue absent (in *Piscicola* present), conducting strands connect ovaries with atrium (in *Piscicola* with vector tissue).

DESCRIPTION

Medium-sized (up to 35 mm). Body short, flattened or flat, division into urosome and trachelosome well visible. Anterior sucker small or medium-sized, with no eyes or eyes poorly developed. Posterior sucker large or very large, connected centrally or somewhat eccentrically, its eye-like spots absent or present. Two rows of 12 ocelli located segmentally on each side of body, or lateral ocelli absent. Respiratory vesicles (11 pairs) medium-sized, very well visible. Mid-body somite 7-annulate. Body surface smooth, tubercles (tangoreceptors) absent. Gonopores separated by a varied number of annuli. Copulatory area on clitellum absent, or developed as a very short field on bursa. Spermatheca absent. Mouthpore situated centrally or eccentrically, in the posterior part of anterior sucker. Proboscis short, its base between ganglia 2 and 3.

Oesophageal glands absent. Crop splanchnomeres 6. Crop and posterior crop caecum splanchnomeres specific for the genus, different from those in other piscicolids, more like those in the glossiphonids. Posterior crop caecum splanchnomeres incompletely fused; five fenestrae remain at the level of ganglia. Intestine well or poorly developed, with strongly or gently folded walls. 6 pairs of testes. Seminal vesicles poorly marked or undeveloped, situated much anterior to testes 1. Prostatic glands on atrium absent. Ovaries long or very long (reachingtestes 2 or 3) their distal ends free or intertwined. Conducting strands connect atrium with ovaries (LUKIN 1976, EPSHTEIN 1969, 1987, EPSHTEIN et al. 1994, SAWYER 1986, BIELECKI 1992).

Transpalaeartic - Holarctic genus. In Palaearctic one species *C. mammillatus* (MALM, 1863).

KEY TO THE SPECIES

Note ! The following key is given after SAWYER (1986).

1. No eyes nor eye-like spots evident on either sucker ..... ***mammillatus***
-, Anterior sucker with two pairs of eyes ..... 2.
2. No eye-like spots on posterior sucker ..... ***verrilli***
-, 8-10 eye-like spots on posterior sucker ..... 3.
3, Two rows of 12 ocelli located segmentally on each side of body ..... ***meyeri***
-, Lateral ocelli absent ..... ***virginicus***

Cystobranchus mammillatus (MALM, 1863)

(Figs 36-43; Table 1)

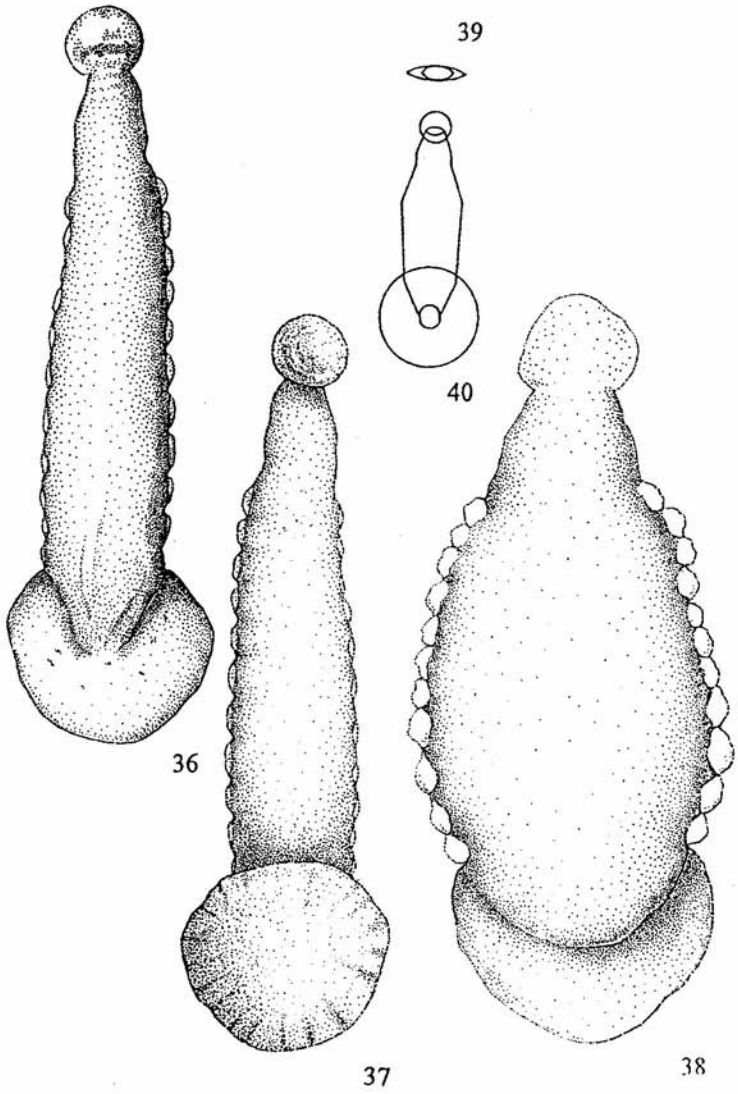
Platybdella mammillata MALM, 1863: 218-220, pl. 4, figs 13a-b;
C. mammillatus: JOHANSSON 1896: 30-31, pl. VI, figs 67-68, pl. X, fig. 100; 1898: 679; BRUMPT 1900b: 706, figs 18-19; ZELENSKII 1915: 229-230; SCHEURING and GASCHOTT 1926: 166-170, figs 1, 2; MARKEVICH 1934: 68; PAWLOWSKI 1936a: 95, figs 66-67; PETRUSHEVSKII, MOSEVICH and SHCHUPAKOV 1948: 80-81, 93; BAUER 1948a: 135, 155; BAUER and GEREZE, 1948: 189; SHCHEGOLEV 1949: 141; KUDRJAVCEVA 1957: 1295; AUTRUM 1958: 11, Abb. 30; SHULMAN 1958: 228; EPSHTEIN 1962: 624, fig. 1546; LUKIN 1962: 116-117, fig. 73; SOOS 1965: 435; EPSHTEIN 1969: 287; MEYER and ROBERTS 1977: 513-517; BIELECKI 1992: 115-122, figs 1, 2, 3.

MATERIAL EXAMINED

Poland, Żydów near Kalisz, Prosna River, 21-V-1985, 1-VI-1986. Leg. A. BIELECKI, 7 specimens, on *Lota l. lota* (L.).

DIAGNOSIS

See diagnosis of the body form of *P. respirans*. Besides, the species is very similar to North American *C. verrilli* MEYER, 1940, *C. meyeri* HAYUNGA et GREY, 1976, *C. virginicus* HOFFMAN, 1964, *C. salmositicus* (MEYER, 1946).



36-40. *Cystobranchus mammillatus*: 36, 38 - dorsal view, 37 - ventral view, 39-40 - body form specimens generated with the Power Point 2.0 programme.

DESCRIPTION

Body shape and size as in figs 36-38 and Table 1. Body length 26.9-27.2 mm. L/D_2 - 3.0, C^1_1/d_1 - 1.6, C^1_1/D_1 - 0.9, R_1/M_1 - 2.0, C^1_1/C_1 -1.0, L_1/D_1 - 1.0, D_1/N_1 - 2.3, S_1/S_2 - 2.0, L_2/D_2 - 2.4, D_2/N_2 - 4.0, K_1/K_2 - 0.3, C^1_2/d_7 - 5.2, C^1_2/D_2 - 1.6, R_2/M_2 - 1.0, C^1_2/C_2 - 1.0, L_2/L_1 - 4.3, D_2/D_1 - 1.8, N_2/N_1 - 1.0, C^1_2/C^1_1 - 3.3.

Body form (figs 39, 40). Body rather short, very much flattened. Division into trachelosome and urosome distinct, especially in older individuals, trachelosome width nearly twice smaller than that of urosome. Posterior sucker large, much wider than the largest body width, centrally connected.

Body coloration (figs 36-38). In live leeches on posterior part of anterior sucker a brownish-grey pigmented streak. On trachelosome 6 transverse pigmented streaks. On urosome the streaks always less distinct. In body wall always a large number of stellate pigment cells. Body wall transparent, when the crop is filled with blood the body becomes pink. Lateral respiratory vesicles white, distinct, occupying 5 or 6 annuli. On posterior sucker no radial streaks and no eye-like spots.

Eyes. Most often no eyes on anterior sucker, or they are very poorly developed (2 pairs). When eyes present, then the first and second pair in the form of poorly marked, indistinct spots, one pair anterior to the pigmented stripe, the other just posterior to it.

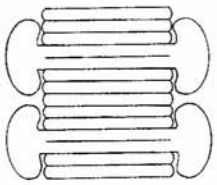
Segmentation (fig. 57). Mid-body somite 7-annulate, all annuli equal. Annuli very well visible. Papillae (sensillae, tangoreceptors) absent.

Alimentary tract (fig. 41). Mouthpore situated eccentrically in the posterior part of anterior sucker. Proboscis short, its base between ganglia 2 and 3. Crop and posterior crop caecum splanchnomeres of the same structure, built of one diverticle, separated by a constriction, divided in 3 secondary diverticles. Structure of splanchnomeres specific, different from that in the remaining piscicolids, more resembling that in the glossiphonids. Intestine poorly developed, not covering completely posterior crop caecum, walls strongly folded; 4 large diverticles, the 5th very small.

Reproductive system (figs 43-44). Gonopores well visible, separated by 2 annuli. Male gonopore larger, female gonopore smaller. Spermatheca and copulatory area on clitellum absent. Copulatory area located on bursa, very short. Male reproductive system. 6 pairs of testes. Seminal vesicles poorly developed, located much anterior to testes 1, close to the place where the ovaries pass into oviducts; they make a circle. Vasa deferentia slightly coiled. Ejaculatory ducts fine and narrow, at the level of ganglion 5, most often they make full circles in the form of loops. Prostatic glands on atrium absent. Female reproductive system. Vector tissue absent. Ovaries elongate, located on testes, built of multiple lobes, long, their distal ends free, touch testes 2. Oviducts considerably removed from conducting strands, they run separately. Conducting strands narrow, long, connect each ovary with atrium.

DISTRIBUTION

C. mammillatus is strongly interactively associated with its host *Lota lota lota* (L.). A comparison of their distribution areas indicates that both the burbot and *C. mammillatus* have a circumpolar distribution. The leech is known at present from



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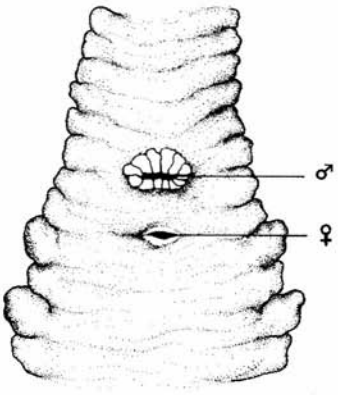

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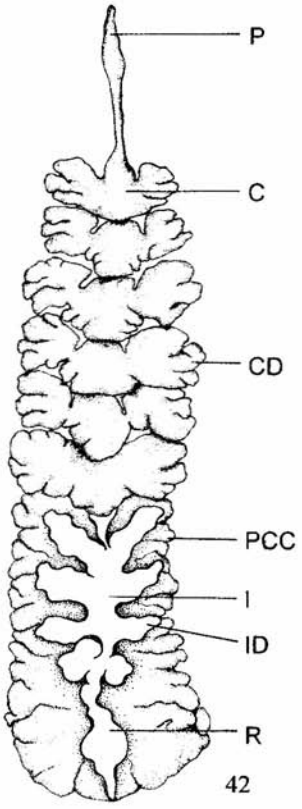

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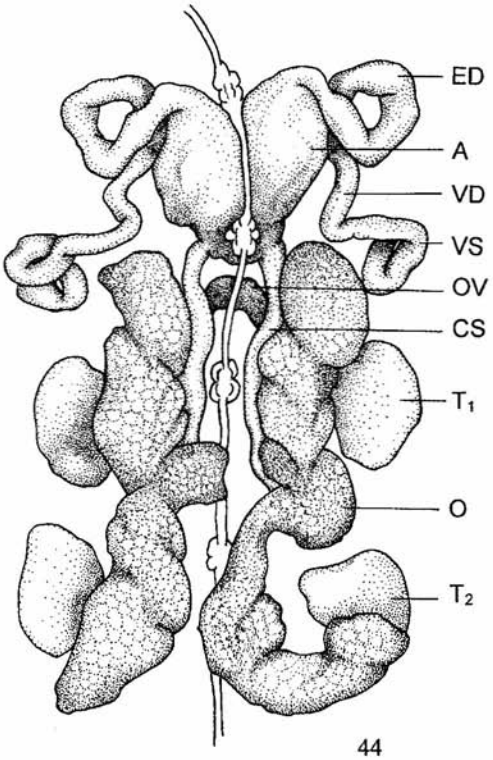

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41-44. *Cystobranchus mammillatus*: 41 - two somites, 42 - alimentary tract: C - crop, CD - caecal diverticulum, I - intestine, ID - intestinal diverticulum, P - proboscis, PCC - posterior crop caecum, R - rectum, 43 - position of gonopores, 44 - reproductive systems: ED - ejaculatory ducts, A - atrium, VD - vas deferens, VS - seminal vesicles, OV - oviducts, CS - conducting strands, T_1-T_2 - testes, O - ovaries.

northern Eurasia and North America. It is common in Sweden (JOHANSSON 1899), Norway (HALVORSEN 1971a, 1971b, 1972) and Poland: Upper Silesia, Goczałkowice Reservoir (ZAĆWILICHOWSKA 1965), Lower Silesia, Prosna River nr. Żydów (BIELECKI 1992). Probably it occurs also in Finland. It was collected from the burbot sold at a market in Germany (München; SCHEURING and GASCHOTT 1926); LUKIN (1976) thinks that the burbot was delivered to the market from the east of Europe. The record of *C. mammillatus* from France (MEYER and ROBERTS 1977) is probably an error and pertains to *C. respirans*. There were no other records from Central Europe. In Russia it is distributed in the waters of the Kola Peninsula, in Karelia (EPSHTEIN 1962; GERD and SOKOLOVA 1965), vicinity of St. Petersburg (MARKEVICH 1934), in the catchment area of the Northern Dvina (KUDRJAVCEVA 1957), Ob (PETRUSHEVSKII et al. 1948), Yenisey (BAUER 1948, EPSHTEIN 1962) and in the Lake Tajmyr (BAUER and GREZE 1948). It has not been found east of the mid and lower Lena River. Besides, it is known from the Lake Baikal basin, outlets of the rivers Selenga, Khilok and Upper Angara. In North America it was found in north-western Canada, in the Mackenzie River near Aklavik (MEYER and ROBERTS 1977). Its host - burbot - in Western Europe reaches the Po River basin, inhabits the Danube river outlet and the south-European territory of Russia, in northern Asia to the Lena and Amur rivers, inclusive. Subspecies of burbot, *L. lota leptura* HUBBS et SCHULTC and *L. l. maculosa* (LE SUEUR) are also present in the north-eastern part of Russia, Canada and USA. Thus the distribution range of the leech is much smaller than that of its host. *C. mammillatus* is most probably more cold-loving, and less tolerant to water oxygenation level than the burbot. The thermal preferences of this leech explain the fact that in Europe its southern distribution range runs more to the north than in Asia; in Siberia it was found in the region of Krasnojarsk and Kizil (LUKIN 1976, EPSHTEIN 1987).

BIOLOGY

A specific parasite of the burbot (*L. l. lota*). On gills, in gill cavity.

Life cycle was described by HALVORSEN (1971a), based on the material from the Glomma River (SE Norway, near Oslo). Attacking the burbot is seasonal, depending both on the host's migrations and water temperature. The leeches are found on the fish from October till June, when the burbot stays in shore waters. The results suggest that the fish is attacked by young leeches, when in early winter it enters shallow waters. During the winter small leeches are attached to the gills, but do not grow or grow very slowly. When the water temperature starts to increase and when the burbot stays in shallow water (rapids), *C. mammillatus* grows rapidly, reaching its maximum size and sexual maturity. It follows from Halvorsen's studies that the parasite reproduces in the spring (in Norwegian conditions June) and the leeches die after laying their cocoons. From July till September, when the fish depart from the shores to deeper waters, they are free from leeches. Cocoons of *C. mammillatus* are most probably laid in shallow water, where at the end of summer they develop and young individuals hatch. When the burbot enters shallow waters again in the early winter (October), it is attacked by the new generation of leeches.

It should be pointed out that the life cycle of *C. mammillatus* in Poland is probably shorter, since in our waters the burbot enters deep water earlier in the summer and returns to shallows earlier in the winter. Because of this, four specimens of *C. mammillatus*, collected from the burbot in the Prosna River, have finished their life cycle probably in May, as indicated by their fully developed seminal receptacles.

Genus: *Caspiobdella* EPSHTEIN, 1966

Caspiobdella EPSHTEIN, 1966: 152.

Type species: *Caspiobdella tuberculata* EPSHTEIN, 1966.

DIAGNOSIS

Species of the genus *Caspiobdella* are most similar to the genus *Acipenserobdella*; they share the following characters: female gonopore on clitellum invisible, vector tissue on female gonopore, conducting strands and oviducts enter vector tissue, copulatory area and spermatheca opening anterior to the first pair of respiratory vesicles, copulatory area limited to spermatheca opening. *Caspiobdella* differs from *Acipenserobdella* in the body covered with fine tubercles (in *Acipenserobdella* absent); mid-body somite 6-annulate with no additional grooves, 7 - or 14-annulate (in *Acipenserobdella* 6 annuli, each with an additional groove); vector tissue as a circular plate (in *Acipenserobdella* a transverse fold); oviducts and conducting strands run very close to each other (in *Acipenserobdella* they run separately).

DESCRIPTION

Size small (to 15 mm) or very small (4.4-6.0 mm). Body long or short, cylindrical or flattened, tubercles (tangoreceptors) present. Ratio of the largest urosome width to the largest trachelosome width varies between species, division into trachelosome and urosome poorly visible or distinct. Anterior sucker small or medium-sized, eyes (2 pairs) very well developed. Posterior sucker medium or large, connected eccentrically, with many eye-like spots or spots absent. Lateral respiratory vesicles (11 pairs) very small, visible. Mid-body somite of 6, 7 or 14 annuli. Somite annulation difficult to interpret. Gonopores separated by various number of annuli. Copulatory area short, limited to spermatheca opening. Spermatheca opening anterior to the first pair of respiratory vesicles. Mouthpore situated centrally. Proboscis of medium length, its base at ganglion 3. Oesophageal glands present. Crop splanchnomeres 7. Crop and posterior crop caecum splanchnomeres of 3 diverticles of equal length. Posterior crop caecum splanchnomeres incompletely fused; 5 fenestrae remain at the level of ganglia. Intestine poorly developed, its walls gently folded. 5 or 6 pairs of testes. Seminal vesicles of classical structure, U-shaped, situated at the level of testes 1. Prostatic glands on atrium present. Ovaries short, reaching testes 1. Oviducts enter vector tissue. Conducting strands connect vector tissue with ovaries. Vector tissue on female gonopore.

In freshwaters two species: *C. fadejewi* (EPSHTEIN, 1961) and *C. hadzi* (Sket, 1985). In brackish and salty waters the remaining two: *C. caspica* (ZELENSKII, 1915) and *C. tuberculata* EPSHTEIN, 1966.

REMARKS

In his description of *Caspiobdella*, EPSHTEIN (1966, 1987 vol. II: 368, fig. 451 E) states that members of this genus have no conducting strands. As I have mentioned in the diagnose, oviducts with conducting strands on their whole length run together and often there is an impression that there is only one duct - interpreted by EPSHTEIN as oviduct.

KEY TO THE SPECIES

1. Posterior sucker large (horizontal diameter 1.5x urosome width), whole body covered with well developed tubercles ..... ***tuberculata***
-, Posterior sucker medium-sized (horizontal diameter equal to largest urosome width), tubercles poorly developed, situated on anterior and posterior parts of body ..... 2.
2. Mid-body somite 7-annulate, eye-like spots on posterior sucker absent ..... ***hadzi***
-, Mid-body somite 14-annulate, eye-like spots on posterior sucker present ..... 3.
3. Body coloration not bright (greenish, grey etc.) in the median line of dorsal side a wide light streak, ventral side poorly coloured ..... ***caspica***
-, Body coloration bright, contrasting, dorsal side light with dark dotted streaks in paramedian lines; ventral side dark grey ..... ***fadejewi***

Caspiobdella tuberculata EPSHTEIN, 1966

Caspiobdella tuberculata EPSHTEIN, 1966: 151-154, fig. 1.

Caspian Sea, exact locality not specified. The leeches (7 specimens) were collected from black-striped pipefish, *Syngnathus nigrolineatus* EICHW.

Caspiobdella hadzi (SKET, 1985)

Piscicola hadzi SKET, 1985: 93, figs 3, 4.

Sources of the Buna River near Mostar, Hercegovina (former Yugoslavia). Outside the host, most probably endemic.

Caspiobdella caspica (SELENSKY, 1915)

Piscicola caspica SELENSKY, 1915: 3,4, 15, 42, 229.

Caspian Sea, at small depths from 3.5 to 6.0 m. Water salinity in the distribution area from 0.20 to 8.64‰. On sturgeon, *Acipenser* sp., starred [stellate] sturgeon,

Acipenser stellatus Pallas, sprats, *Sprattus* sp., roach, *Rutilus rutilus caspicus* (Jakovlev), atherines, *Atherina* sp., bream (eastern Danube), *Abramis brama* (L.), ruffe, *Gymnocephalus* sp., pikeperch, *Stizostedion lucioperca* (L.).

Caspiobdella fadejewi (EPSHTEIN, 1961)

(Figs 45-56; Table 1)

Piscicola fadejewi EPSHTEIN 1961a: 1644-1648, figs 1-2G; LUKIN 1962b: 120-122, figs 77-68; EPSHTEIN 1962; 626, fig. 1540; SOÓS 1965: 445; SKET 1968: 136-163.
Caspiobdella fadejewi: BIELECKI 1988, 1990, 1990a, b, c, d.

MATERIAL EXAMINED

Poland, Dynów-Przemyśl, San River, 1-IV-1989 to 1-IV-1990, leg. A. BIELECKI, 140 specimens from rheophilic *Cyprinidae*. Dębowo, Wroceń, Brzostowo, Mocarze, Rutkowskie, Biebrza River, July and Agust 1989, leg. A. BIELECKI, 8 specimens from *Cyprinidae* and *Esocidae*.

DIAGNOSIS

See diagnosis of body form of *P. niewiadomskae* sp. n.
See diagnosis for non-metric characters of *A. volgensis*.

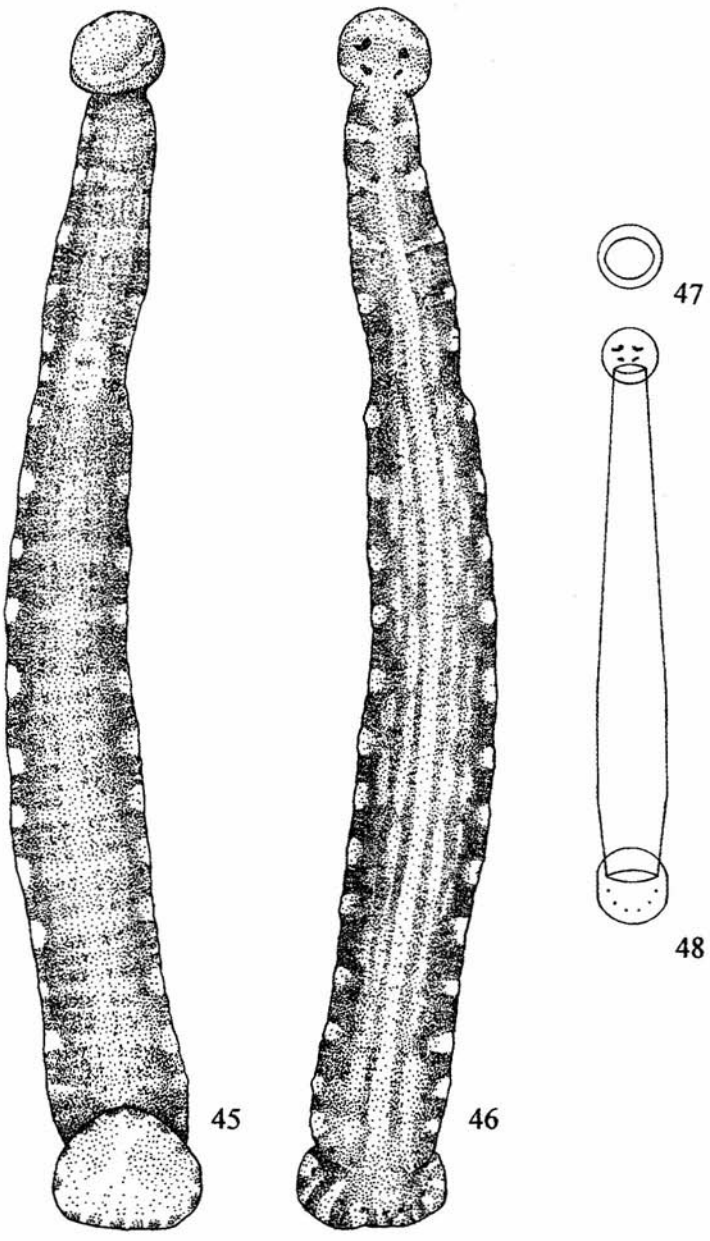
DESCRIPTION

Body shape and size as in figs 45-46, 49 and Table 1. Body length 5.1-7.3 mm. L/D_2 - 6.33, C^1_1/d_1 - 1.2, C^1_1/D_1 - 1.0, R_1/M_1 - 5.0, C^1_1/C_1 - 0.9, L_1/D_1 - 2.3, D_1/N_1 - 1.0, S_1/S_2 - 1.0, L_2/D_2 - 4.8, D_2/N_2 - 1.1, K_1/K_2 - 0.4, C^1_2/d_7 - 1.3, C^1_2/D_2 - 1.0, R_2/M_2 - 1.7, C^1_2/C_2 - 1.0, L_2/L_1 - 3.1, D_2/D_1 - 1.5, N_2/N_1 - 1.3, C^1_2/C^1_1 - 1.5.

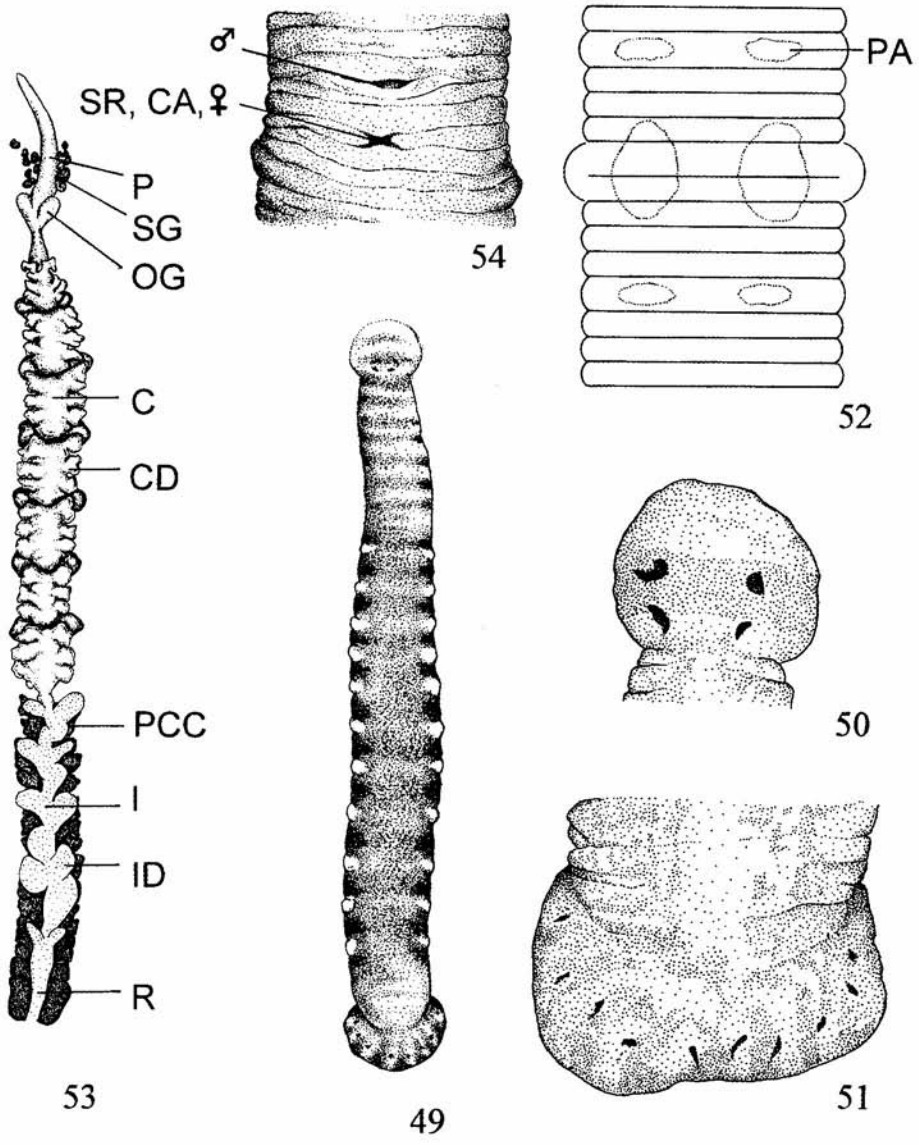
Body form (figs 47-48). Body length most often smaller than 10 mm, reaching 13 mm at the greatest width of 2.5 mm. Body cylindrical or slightly flattened. Division into trachelosome and urosome poorly marked, though in many specimens visible. Suckers medium-sized. Posterior sucker connected eccentrically.

Body coloration (figs 45-46, 49-51). Motley: dorsal side light, light brown or with a yellow hue. On anterior sucker a transverse, rather wide pigmented streak. On posterior sucker 14 radial streaks, of these 7 black on its ventral and 7 brown on its dorsal side. In superficial layers of the body wall there are fine light brown stellate pigment cells, in deeper layers and in the parenchyma - dark brown, large stellate melanophores. On dorsal body side light brown cells concentrate, and dark brown cells are absent. On sides and venter both superficial and deep-situated dark brown cells concentrate. On sides dark, often black segmentally arranged streaks, located anterior to lateral respiratory vesicles (such cells are also situated on the ducts of reproductive system and on the proboscis).

Coloration of dorsal side occurs in two variants. In one, concentrated light melanophores form two streaks along trachelosome and 4 streaks along urosome. As a result, along the middle of the whole dorsal side there runs a light wider streak, two



45-48. *Caspiobdella fadejewi*: 45 - ventral view, 46 - dorsal view, 47-48- body form



49-54. *Caspiobdella fadejewi*: 49 - dorsal view, 50-51 - suckers in dorsal view, 52 - somite: PA - papille, 53 - alimentary tract: SG - salivary glands, OG - oesophaegal glands (mycetomes), 54 - position of gonopores, CA - copulatory area and SR - spermatheca opening

narrower paramedian inner streaks and two paramedian outer streaks, very narrow and poorer marked (fig. 46).

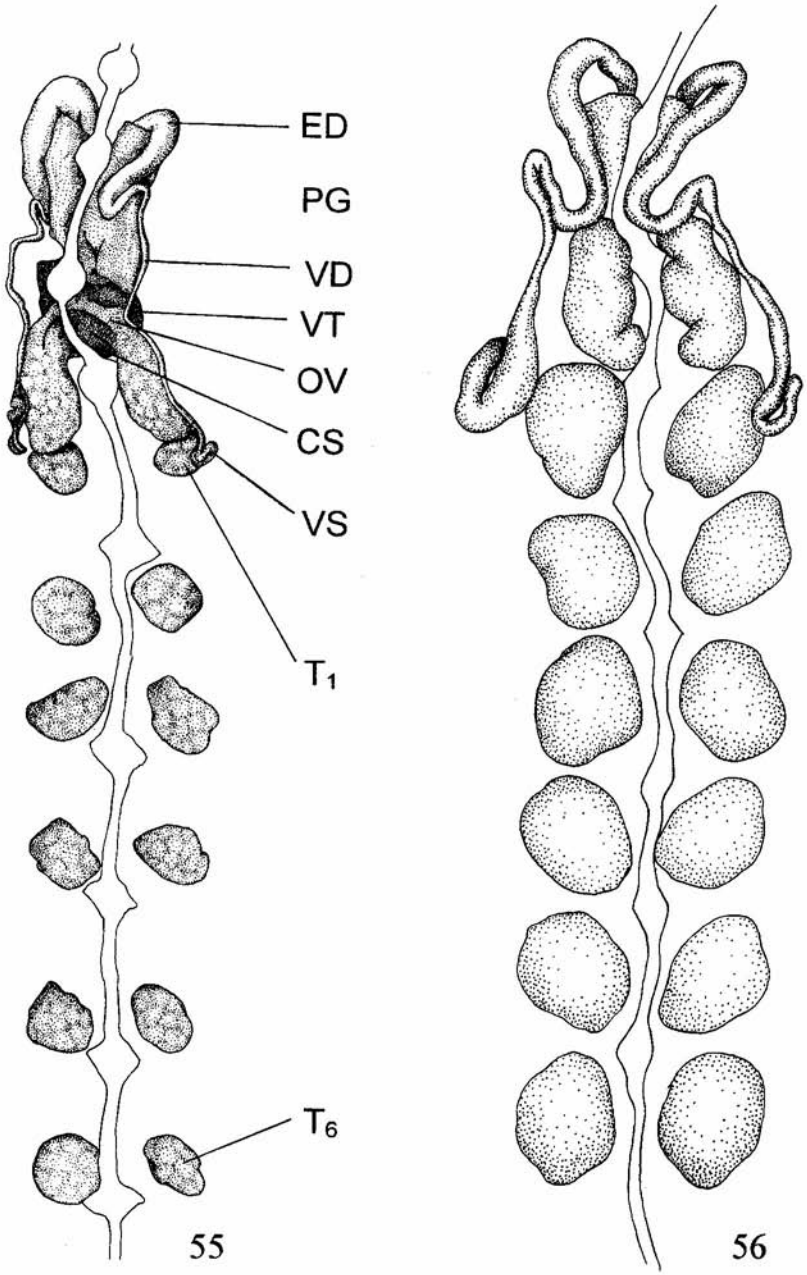
In the second variant, there are no brown and white streaks, but there are transverse, segmental streaks. These streaks are much better visible on trachelosome, since they are wider and lighter. On urosome they are much less distinct, narrow, running at the level of white respiratory vesicles (fig. 49).

Eyes. On anterior sucker 2 pairs of distinct, often large eyes - the first, situated on the pigmented transverse streak, the second slightly anterior to the streak or on its posterior margin. Size of eyes almost equal. On posterior sucker 10 eye-like spots, in its central part situated on the edge of 14 dark radial streaks (figs 50-51).

Segmentation (fig. 52). Mid-body somite 14-annulate; sometimes some grooves are deeper, and some are poorly visible, thus creating an impression of a lower number of longer annuli. When all the annuli (14) are visible, then 2, 6 and 11 are longer than the remaining ones. On longer annuli 2 and 11 smaller tubercles, arranged transversely; on annuli 5, 6, 7 and 8 large papillae, arranged longitudinally relative to the body long axis. Lateral respiratory vesicles small, 11 pairs, fairly well visible, occupy annuli 6 and 7.

Alimentary tract (fig. 53). Mouthpore located centrally. Base of proboscis at ganglion 3. Right and left of the proboscis there are salivary glands. Crop and posterior crop caecum splanchnomeres divided in 3 diverticles; no secondary diverticles. Diverticle ends characteristically hammer-shaped. Intestine poorly developed, its walls gently folded; 5 pairs of diverticles, 4 pairs large, well visible, and the 5th small.

Reproductive system (figs 55-56). Gonopores separated by 3 annuli. Male gonopore larger, female gonopore invisible, located within spermatheca opening, in its anterior part. Since between the male gonopore and the spermatheca opening there are 3 annuli, and the female gonopore is located rather shallow in its concavity, the actual number of annuli between the openings is c. 3.3-3.6. Copulatory area on clitellum short, elliptical, transverse, situated in the spermatheca opening. Spermatheca opening located perpendicular to the body long axis, anterior to the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes (in some specimens 5, pair 1 absent). Seminal vesicles reaching testes 1, classically U-shaped. Vasa deferentia slightly coiled. Apices of ejaculatory ducts beetwen ganglia 4 and 5 or about ganglion 4, once gently bent, parallel to the body long axis. Prostatic glands on atrium moderately developed. Female reproductive system. Vector tissue as a small, circular or discoid plate, located in the openings: female gonopore and spermatheca opening, exactly at the level of ganglion 6. Ovaries short, touch testes 1, sac-like, their distal ends free. They occupy a space between ganglia 6 and 8, removing testes 1 from ganglion 8. Oviducts, with conducting strands of vector tissue, enter the compact, round, discoid plate of vector tissue, running along each other, very close. Most often they give an impression of being one duct. They are very difficult to separate, and thus some authors (e.g. EPSHTEIN 1978; SAWYER 1986) think that species of this genus have no conducting tissue. Conducting strands short, narrow, enter posterior parts of vector tissue.



55-56. *Caspiobdella fadejewi*, reproductive systems.

DISTRIBUTION

LUKIN (1976) includes this species in a group of Palaearctic endemics with limited distribution and in a subgroup of Caspian species, since it occurs in the basins of the Black and Azov Seas (lower Danube, Dnester, Dneper, northern Donec and their tributaries). Besides it occurs in the Volga River. Later the species was abundantly recorded from dam reservoirs: Varvarovski, Bereslavski, Karpovski, Cimljanski, and thus also from the Volga River near Volgograd. Recently recorded in large numbers from the Ribinski and other Volga reservoirs.

In Poland: San River from Dynów to Przemyśl, Biebrza River.

BIOLOGY

It follows from the hitherto studies (EPSHTEIN 1961, LUKIN 1976, BIELECKI 1990a, b, NESSEMAN 1994) that *C. fadejewi* is euryphagous, mostly interactively associated with cyprinid fishes (*Cyprinidae*): chub, *Leuciscus cephalus* (L.), dace, *L. leuciscus* (L.), orfe, *L. idus* (L.), asp (Caspian, Aral) *Aspius aspius* (L.), tench, *Tinca tinca* (L.), barbel, *Barbus barbus* (L.), white [silver] bream *Blicca bjoerkna* (L.), bream, *Abramis brama* (L.), blue bream, *Abramis ballerus* (L.), roach, *Rutilus rutilus* (L.), carp, *Cyprinus carpio* L., gudgeon, *Gobio gobio* (L.), Dnestr long-whiskered gudgeon, *Gobio kessleri* DYBOWSKI, European bitterling, *Rhodeus sericeus amarus* (BLOCH), vimba, *Vimba vimba* (L.), nase, *Chondrostoma nasus* (L.) and also pikeperch, *Stizostedion lucioperca* (L.), perch, *Perca fluviatilis* L, pike, *Esox lucius* L., sterlet, *Acipenser ruthenus* L. It especially often attacks bream and pike (EPSHTEIN 1961, LUKIN 1976). It usually occurs in oral cavity, gill cavity and on gills, sometimes also on head and operculum. Probably in many parts of its distribution area it excludes *P. geometra* (EPSHTEIN 1984, 1987, 1989).

Life cycle was first described in Poland, from the San River (BIELECKI 1990). The leech is a semi-permanent parasite of many fish species (mainly *Cyprinidae*). It shows a great specificity regarding the place of feeding - the gills. The fishings were done in April and May, in July, August and October 1989, in January to March 1990. The observations show that young leeches hatch from their cocoons at the end of March or April and attack various fish species. At that time, they occur mainly on the sides of the fish, in the region of the snout, in the snout or under the operculum. The majority of leeches did not have a well formed reproductive system, and their stomach was filled with blood: the presence of spermatophores suggests that copulation takes place on the gills. At the end of August, the leeches leave the host. They lay cocoons, and die. The cocoons hibernate, and in the early spring (March, April) a new cycle begins. The life cycle of *C. fadejewi* is associated with annual changes of water temperature and with the migration of fishes from the deep lenitic to the shallow lotic parts of the rivers. *C. fadejewi* in the San River was observed on several fish species. Its ecological distribution is more limited than that of its hosts; this suggests that some other factors are significant for habitat preferences of this species.

Genus: *Acipenserobdella* EPSHTEIN, 1969

Acipenserobdella EPSHTEIN, 1969: 286.
Acipenserobdella: BIELECKI 1991: 269-271, fig. a, b.

Type species: *Piscicola volgensis* ZYKOFF, 1903.

DIAGNOSIS

See diagnosis of *Caspiobdella*.

DESCRIPTION

Size medium, up to 30 mm. Body short, with no papillae. Division into trachelosome and urosome very well visible, trachelosome flattened and urosome cylindrical. Anterior sucker small or medium-sized, posterior sucker also small and connected somewhat eccentrically. Respiratory vesicles (11 pairs) white, rather small but well visible. Eyes on anterior sucker and eye-like spots on posterior sucker developed. Mid-body somite - number of annuli variable. Mouthpore located centrally. Proboscis large occupies 3.5 somite. Oesophageal glands present. Crop and posterior crop caecum splanchnomeres of 2 diverticles. Posterior crop caecum splanchnomeres incompletely fused; 5 fenestrae remain at the level of ganglia. Intestine poorly developed. Gonopores separated by 3 annuli. Female gonopore invisible. Spermatheca opening large. Copulatory area on clitellum short, located within spermatheca opening. Spermatheca opening and copulatory area anterior to the first pair of respiratory vesicles perpendicular to the body long axis. 6 pairs of testes. Seminal vesicles multiply bent, situated at the level of testes 1. Ejaculatory ducts small, with one bend. Prostatic glands on atrium well developed. Vector tissue as a narrow plate or fold transverse to long body axis, on female gonopores. Ovaries open to female gonopore through vector tissue. Conducting strands as very short, narrow strands of fibres, also enter vector tissue. Conducting strands and oviducts run separately.

Only one species is known: *A. volgensis* (ZYKOFF, 1903).

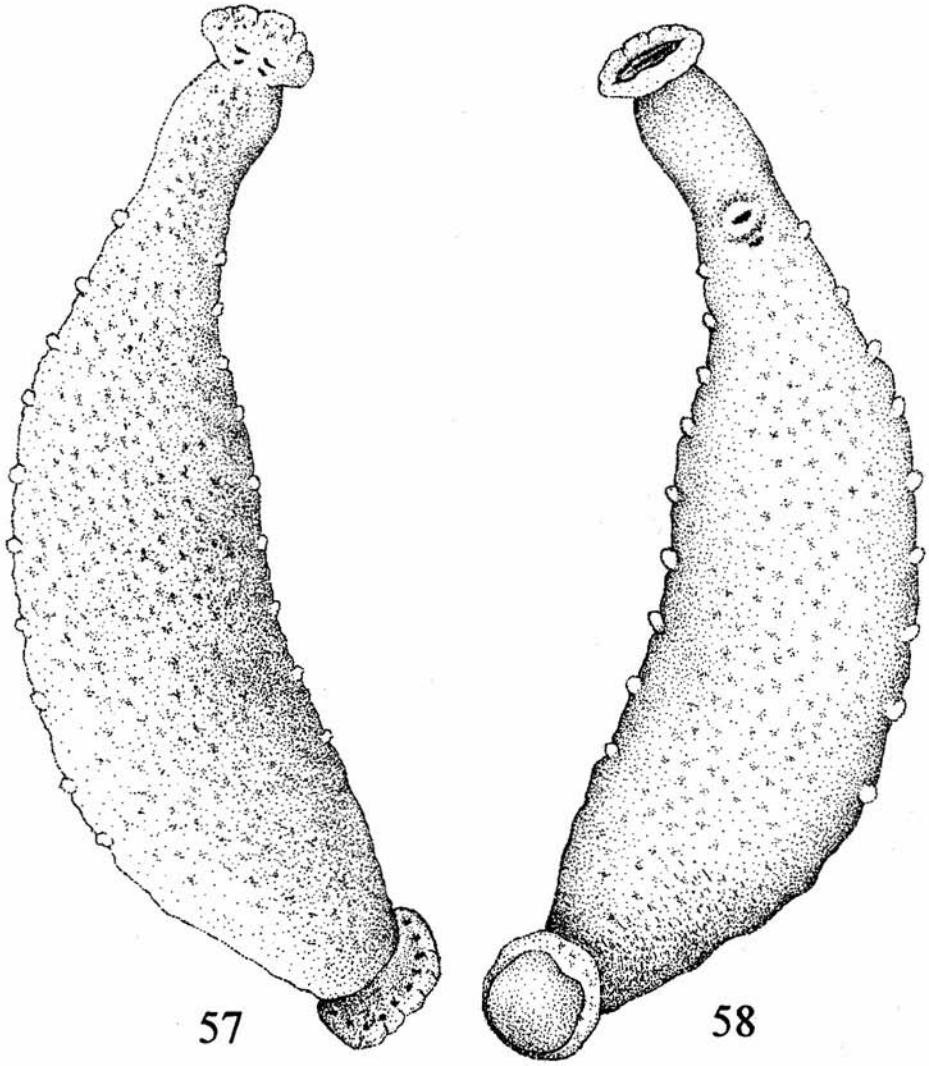
Acipenserobdella volgensis (ZYKOFF, 1903)

(Figs 57-64; Table 1)

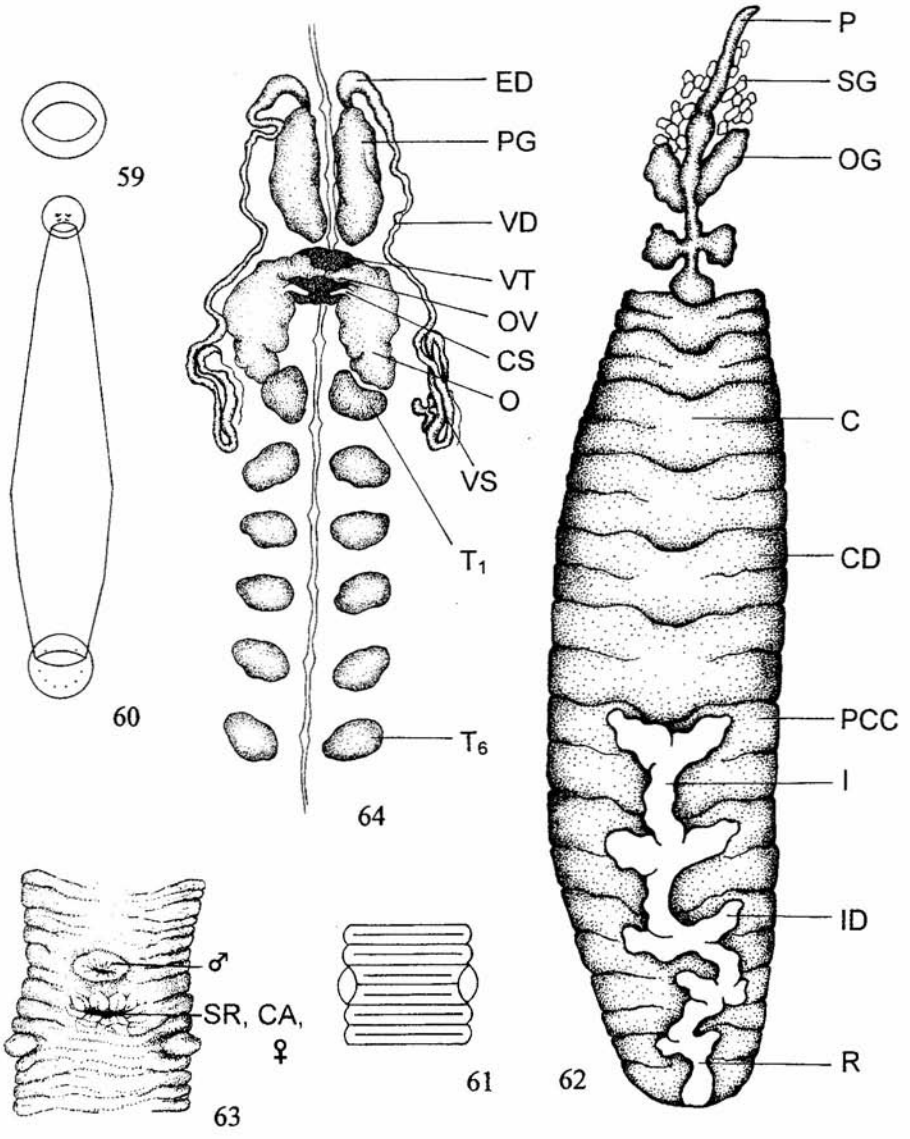
Piscicola volgensis ZYKOFF, 1903: 71-74, figs 29-30; EPSHTEIN 1962: 625, fig. 1549.
Acipenserobdella volgensis: E PSHTEIN 1969: 286-287; BIELECKI 1991: 269-271, fig. a, b.

MATERIAL EXAMINED

Poland, Jeżyczki near Darłowo, Grabowa River, 21-27-VIII-1990, 8 specimens, leg. A. BIELECKI, from *Salmo trutta trutta* L. Darłowo, 7-XI-1991, 21 specimens, leg. A. BIELECKI, from *Salmo trutta trutta* L.



57-58. *Acipenserobdella volgensis*: 57 - dorsal view, 58 - ventral view.



59-64. *Acipenserobdella volgensis*: 59-60 - body form, 61 - somite, 62 - alimentary tract, 63-64 - reproductive systems.

DIAGNOSIS

Considering morphotypes of all the analysed species, and also other genera (fig. 34), in its body form *A. volgensis* is most similar to *I. ciosi*. Both have the following characters in common: urosome cylindrical, trachelosome slightly flattened, elliptical, anterior and posterior suckers round, anterior sucker connected strongly eccentrically. *A. volgensis* differs from *I. ciosi* in the following characters: division into trachelosome and urosome not very distinct (in *I. ciosi* very well visible), greatest body width further from posterior sucker (in *I. ciosi* much closer), difference between the sucker size larger (in *I. ciosi* much smaller).

With respect to non-metric characters *A. volgensis* is most similar to *C. fadejewi* (fig. 35). Both share the following characters: gonopores separated by 3 annuli, female gonopore invisible, copulatory area short and spermatheca opening as a well marked ellipse transverse to the body long axis, anterior to the first pair of respiratory vesicles, intestine poorly developed, prostatic glands vell developed, ejaculatory ducts once bent towards anterior part of trachelosome, vasa deferentia slightly coiled, 6 pairs of testes, seminal vesicles reaching testes 1, ovaries sac-like, short, reaching testes 1, their posterior ends free, oviducts enter vector tissue, conducting strands short, narrow, enter posterior part of vector tissue.

A. volgensis differs from *C. fadejewi* in the following characters: papillae (sensillae, tangoreceptors) absent (in *C. fadejewi* present), mid-body somite 6-annulate (in *C. fadejewi* 14-annulate), crop and posterior crop caecum splanchnomeres of 2 diverticles (in *C. fadejewi* 3 diverticles), intestine strongly folded (in *C. fadejewi* gently folded), ejaculatory ducts between ganglia 4 and 3 (in *C. fadejewi* at the level of ganglion 5), seminal vesicles in the form of multiple bends and loops (in *C. fadejewi* classicaly U-shaped), oviducts close to conducting strands, their division noticeable (in *C. fadejewi* on whole length very close to conducting strands, run together).

DESCRIPTION

Body shape and size as in figs 57-58 and Table 1. Body length 10.1-14.7 mm. L/D_2 - 4.16, C^1_1/d_1 - 1.6, C^1_1/D_1 - 0.9, R_1/M_1 - 4.0, C^1_1/C_1 -1.0, L_1/D_1 - 2.1, D_1/N_1 - 1.3, S_1/S_2 - 0.9, L_2/D_2 - 3.2, D_2/N_2 - 1.4, K_1/K_2 - 1.0, C^1_2/d_2 - 1.2, C^1_2/D_2 - 0.6, R_2/M_2 - 2.0, C^1_2/C_2 - 1.0, L_2/L_1 - 3.3, D_2/D_1 - 2.1, N_2/N_1 - 1.9, C^1_2/C^1_1 - 1.5.

Body form (figs 59-60). Division into trachelosome and urosome very well visible. Trachelosome slightly flattened, urosome cylindrical. Suckers connected eccentrically. Posterior sucker much smaller than the greatest body width.

Body coloration (figs 57-58). Coloration grey or brownish with a violet tint. On anterior sucker a triangular, grey-brown spot. On preclitellar body part 3 narrow light transverse streaks and one wide streak. On urosome segmental streaks absent or very narrow, barely distinct, so that the urosome is more or less evenly spattered with grey or brown melanophores in shape of dots. Ventral side lighter. Posterior sucker cup-like, on it very narrow, radial streaks or streaks invisible. The coloration depends on superficial light brown melanophores and deeper situated dark brown melanophores. Dark brown melanophores occur not only in the mesenchyme, but also on efferent ducts of the male reproductive system (seminal receptacles, ejaculatory canals). On ventral side few pigment cells.

Eyes. On anterior sucker 2 pairs of larger eyes - both situated in the posterior part, first perpendicular to the axial plane; the second slightly oblique to that plane, and somewhat smaller. On posterior sucker 10 large and distinct eye-like spots, in its central part situated on the edge of dark radial streaks (fig. 57).

Segmentation (fig. 61). Number of annuli per somite difficult to interpret, well visible only in some individuals. Mid-body somite of 6 annuli of equal length. Each annulus divided by shallow grooves in 2 parts, so that the number of parts per somite is 12. Since the grooves between six annuli are much deeper and wider, it should be adopted that a full somite of urosome consists of 6 annuli.

Alimentary tract (fig. 62). Proboscis long, its base located between ganglia 3 and 4. Oesophageal glands large, covering almost all ejaculatory ducts. Outline of most of the tract visible through the body covers. Crop and posterior crop ceacum splanchnomers of 2 equal diverticles, no secondary diverticles. First crop splanchnomere smaller and departing in its structure from the remaining six. Intestine poorly developed, with strongly folded walls, with 5 diverticles: 3 larger directed laterally, 4th smaller somewhat displaced towards median plane, 5th very small, poorly visible.

Reproductive system (figs 63-64). Gonopores separated by 3 annuli. Male gonopore very large, female gonopore invisible, located within spermatheca opening in its anterior part (because between male gonopore and spermatheca opening there are 3 annuli, and the female gonopore lies rather shallow in its concavity, the actual number of annuli between the gonopores is over 3 but below 4). Copulatory area on clitellum short, elliptical, limited to raised covers of spermatheca opening, anterior to the first pair of respiratory vesicles. Spermatheca opening large, situated perpendicular to the body long axis. Male reproductive system. 6 pairs of testes. Seminal vesicles at the level of testes 1, in the form of multiple bends (above 4) and loops. Vasa deferentia slightly coiled. Ejaculatory ducts between ganglia 3 and 4, or somewhat protruding beyond ganglion 4, bent gently once parallel to the body long axis, sometimes forming additional bends. Prostate glands on atrium well developed as large lobes. Female reproductive system. Ovaries short, with their posterior ends touching testes 1 (they "lean" on testes), sac-like, their posterior ends free, not intertwined. Anterior ends of ovaries (just before passing into oviducts) enter vector tissue. Vector tissue as a fold or rectangular plate, located exactly on the female gonopore and spermatheca opening, transverse to the long body axis. Conducting strands connect each ovary with posterior part of vector tissue as short, narrow ducts. Conducting strands and oviducts ente vector tissue run at a distance from each other and are easy to distinguish. Thus the space between the converging oviducts and testes 1 (ganglia 6 and 7) is free.

DISTRIBUTION

Upper and mid sections of the Volga River, catchment areas of the Chusovaja Rivers, rivers: Angara and Selenga. In Poland the only locality at the Grabowa River, Darłowo (N Baltic Coast.).

BIOLOGY

On bastard sturgeon, *Acipenser nudiventris* Loretzky, sterlet, *Acipenser ruthenus* L., sturgeon, *Acipenser* sp. One record from gudgeon, *Gobio gobio* (L.). The specimens I examined were collected from the fins and gill cavity of sea trout *Salmo trutta trutta* L.The leech is specific, most probably to the *Acipenseridae*. On body surface and gills.

Genus: *Italobdella* BIELECKI, 1993

Italobdella BIELECKI, 1993: 67-78, figs 1-20

Type species: *Italobdella ciosi* BIELECKI, 1993.

DIAGNOSIS

Species of the genus *Italobdella* are most similar to the genus *Pawlowskiella* gen. n. Both share spermatheca opening located anterior to the first pair of respiratory vesicles, female and male gonopore on clitellum visible. *Italobdella* differs from *Pawlowskiella* in mid-body somite 4-annulate (in *Pawlowskiella* 14-annulate), spermatheca opening located between gonopores (in *Pawlowskiella* posterior to the female gonopore), ovaries enter female gonopore posterior to the vector tissue (in *Pawlowskiella* they enter through vector tissue); vector tissue as a narrow plate transverse to long body axis, anterior to the oviduct outlet (in *Pawlowskiella* as a circular plate situated on female gonopore).

DESCRIPTION

Size very small (5.9 mm) or medium (21.1 mm). Body short. Division into trachelosome and urosome very well visible, trachelosome flattened and urosome cylindrical. Body smooth, with no papillae. Anterior sucker small or medium-sized, posterior also small and connected somewhat eccentrically. Respiratory vesicles (11 pairs) white, rather small but well visible. Eyes on anterior sucker and eye-like spots on posterior sucker developed. Mid-body somite 4-annulate with secondary shallower grooves, up to 12. Oesophagus with glands, crop and posterior crop caecum splanchnomeres of 2 equal diverticles. Posterior crop caecum splanchnomeres incompletely fused; 5 fenestrae remain at the level of ganglia. Intestine poorly or well developed. Spermatheca opening visible as a round white field with an opening in the middle (2 annuli posterior to male gonopore). Copulatory area on clitellum small, surrounding spermatheca opening. Prostatic glands on atrium poorly or well developed. Ejaculatory ducts small, betwen ganglia 4 and 5, or rather slightly protrude beyond ganglion 5, bent once, with characteristic bulbs, epidydymis present or absent. Seminal vesicles situated at the level of testes 1. Vector tissue as a narrow, rectangular plate transverse to body long axis, anterior to oviduct outlet. Oviducts open to female gonopore posterior to vector tissue.

Distribution: Palaearctic genus - 2 species. Europe (N Italy, NW Poland)

KEY TO THE SPECIES

1. Medium-sized, body length up to 21.1 mm, on anterior sucker large white "spectacles", coloration of dorsal side of trachelosome and urosome distinct - a characteristic pattern formed by brown, black, yellow and white melanophores whose arrangement results in white transverse segmental spots (figs 65-68, p. 271) ..... ***ciosi***

-, Very small, body length up to 5.9 mm, on anterior sucker a pigmented, frill-like band, coloration of dorsal side of trachelosome and urosome indistinct - no characteristic pattern, only black melanophores present as very fine dots, slightly concentrated in latero-median lines (figs 78-79, p. 276) ..... ***epshteini*** sp. n.

Italobdella ciosi Bielecki, 1993

(Figs 65-77; Table 1)

Material examined

Italy, Adda River near Milano (Rivolta), December 3rd, 1989; 7 specimens, from *Salmo trutta fario* L., 2 from *Barbus barbus* (L.), and 3 from *Perca fluviatilis* L., leg. S. Cios.

Diagnosis

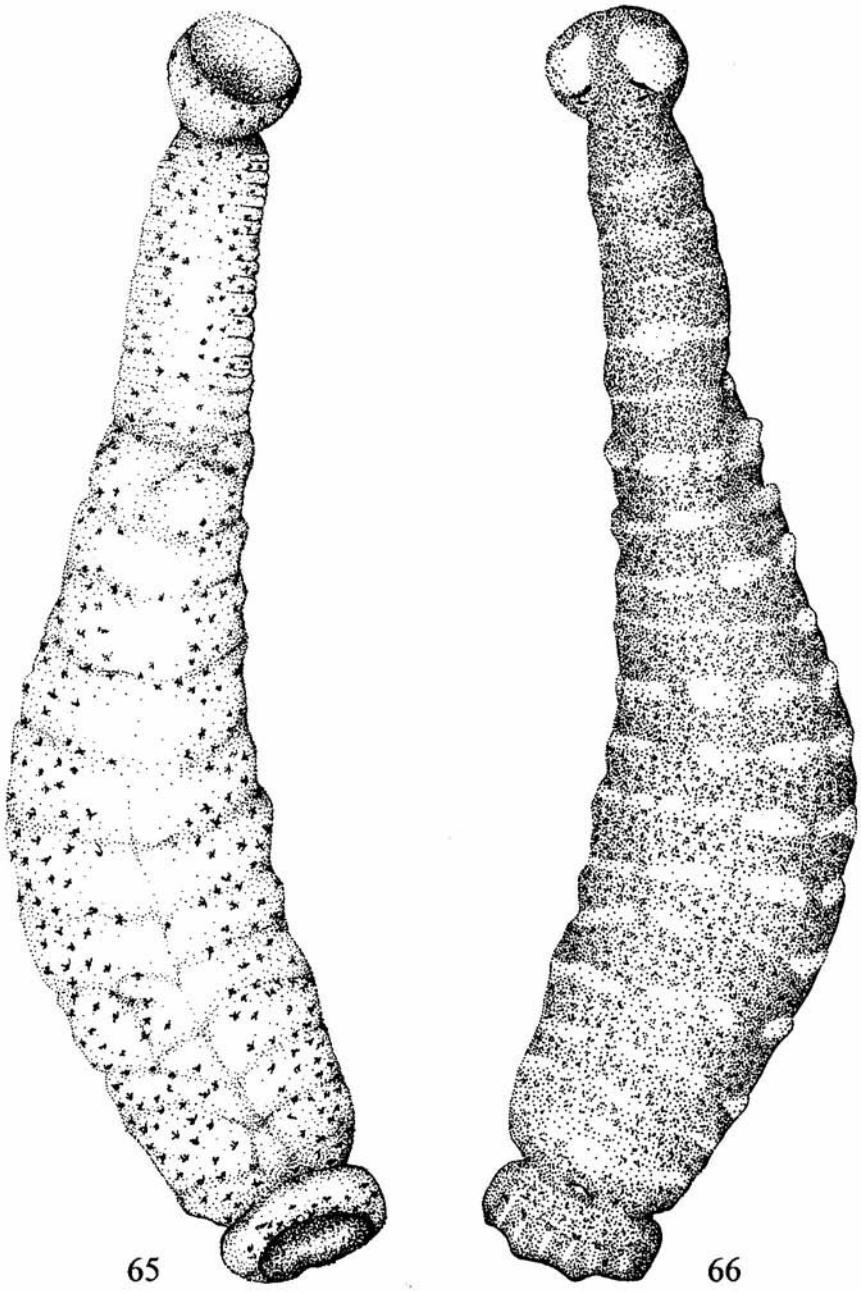
See diagnosis of *I. epshteini* sp. n.

Description

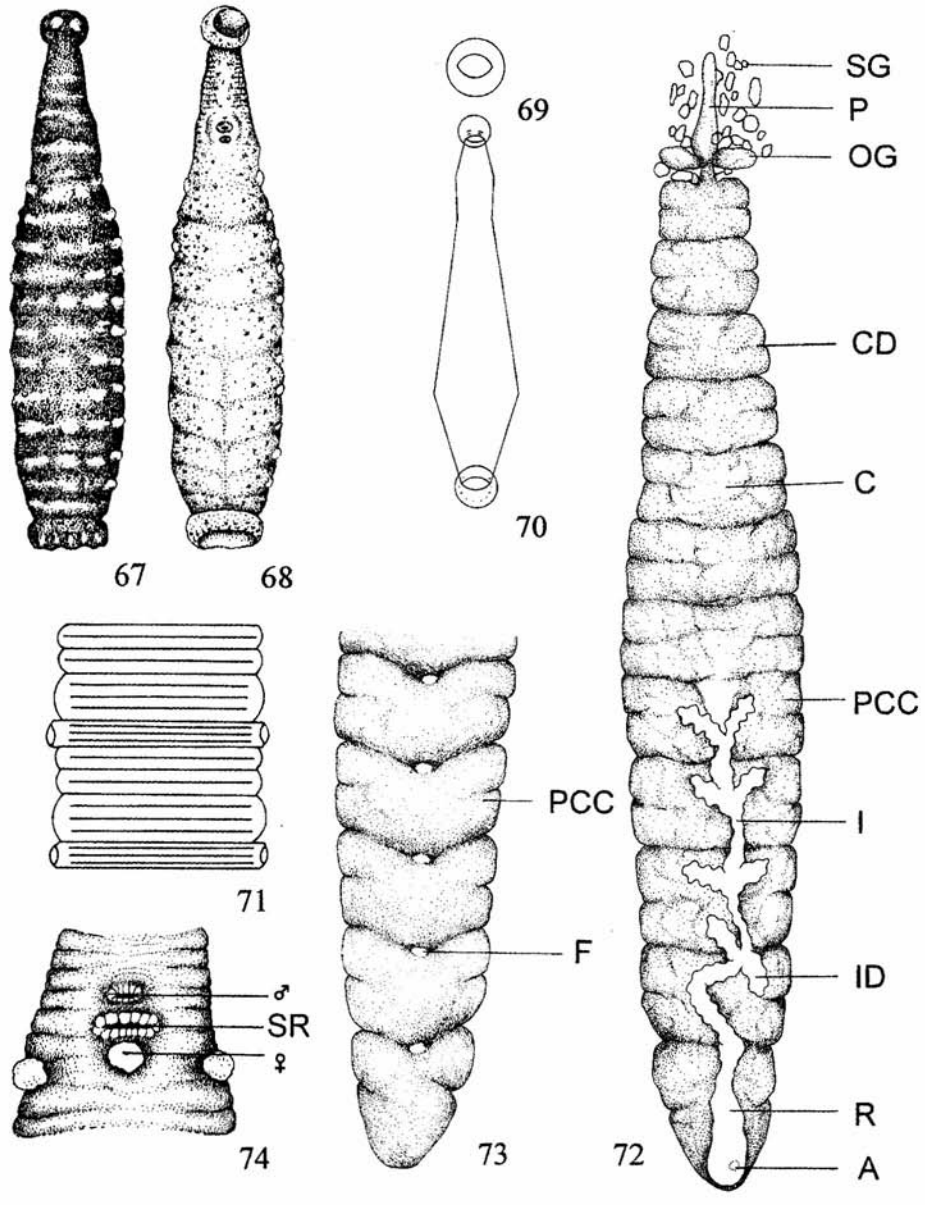
Body shape and size as in figs 65-68 and Table 1. Body length from 14.8 to 21.1 mm. L/D_2 - 4.0, C^1_1/d_1 - 1.6, C^1_1/D_1 - 0.9, R_1/M_1 - 5.0, C^1_1/C_1 -1.0, L_1/D_1 - 2.3, D_1/N_1 - 1.5, S_1/S_2 - 1.0, L_2/D_2 - 3.1, D_2/N_2 - 1.0, K_1/K_2 - 1.9, C^1_2/d_7 - 1.5, C^1_2/D_2 - 0.5, R_2/M_2 - 1.6, C^1_2/C_2 - 1.0, L_2/L_1 - 3.1, D_2/D_1 - 2.3, N_2/N_1 - 2.5, C^1_2/C^1_1 - 1.4.

Body form (figs 69-70). Division into trachelosome and urosome very well visible even in preserved and poorly fed specimens. Body short, flattened, or only trachelosome flattened and urosome cylindrical in well fed specimens. Anterior sucker small or medium-sized, posterior also small and connected somewhat eccentrically. Respiratory vesicles (11 pairs) white, rather small but well visible. Body smooth, with no papillae.

Body coloration (figs 65-68). Results from various arrangements of four kinds of melanophores: brown, black, white and yellow Their arrangement makes the body brightly coloured and very characteristic. The dorsal side is much darker, since brown melanophores are arranged much denser, and though their processes are shorter, the bodies are bigger (thicker). The reverse is true of the ventral side: the processes are shorter and the bodies smaller. The trachelosome is the darkest, the brown melanophores just named lose completely their processes, and only their bodies are left as irregular spots. The urosome, because of the alimentary tract shining through, is lighter. Its



65-66. *Italobdella ciosi*: 65 - dorsal view, 66 - ventral view.



67-74. *Italobdella ciosi*: 67 - dorsal view, 68 - ventral view, 69-70 - body form, 71 - somite, 72 -73 - alimentary tract, 74 - position of gonopores.

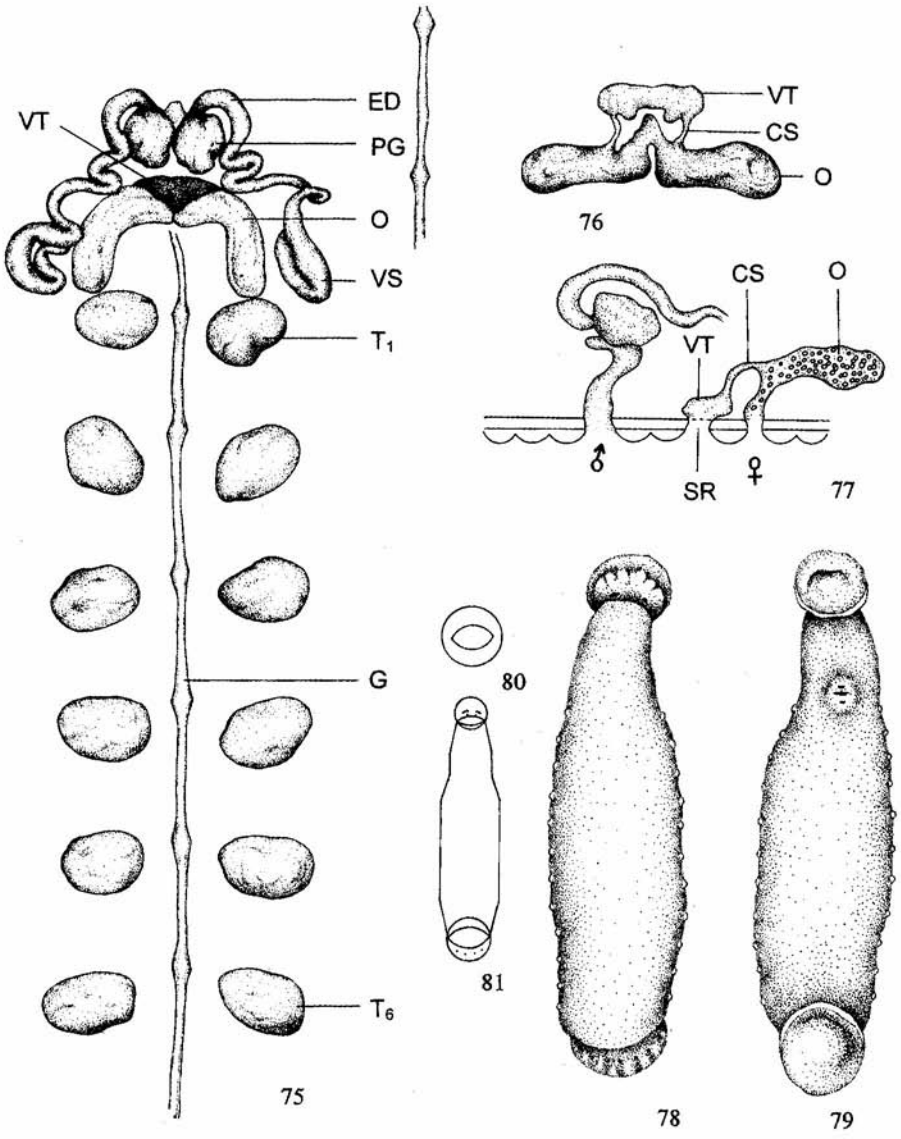
dark colour is caused by densely arranged melanophores, more often brown than black. White melanophores on the trachelosome form 4 or 5 spots in the median plane, the 4th or 5th spot being the largest and occupying 1.5 - 2 annuli. It passes to the ventral side, forming a white band around the trachelosome. Left and right of the white median spots, at the same level there are also white paramedian spots (4 or 5), and on the sides of body also 4 or 5 white spots. On the urosome white spots have a similar arrangement. In the median plane there are 14 such spots, the last, 14th, being situated on the dorsal side of the posterior sucker. Left and right of the median spots there are two rows of smaller white paramedian spots, 13 on each side. On each side of urosome, like on the trachelosome, there are 13 white spots. In some specimens the white spots may fuse, and then transverse bands are formed on the dorsal side; the spots may also disappear completely. On the anterior sucker big white spots form characteristic "spectacles", around which there are brown and black melanophores. The posterior sucker has very narrow white and wide brown-black radial streaks. There are 14 streaks of each kind. Yellow melanophores form small aggregations on the white streaks. They are the most numerous on the white streaks of the anterior sucker and on the 14 white streaks of the posterior sucker.

Eyes. On anterior sucker 2 pairs of eyes - the first larger, situated in the lower part of the white spots, obliquely relative to the axial plane; the second pair, situated perpendicular to that plane, is smaller. On posterior sucker 10 eye-like spots, in its central part situated on the edge of dark radial streaks (figs 66-67).

Segmentation (fig. 71). Mid-body somite 4-annulate, annuli further divided by grooves. The first annulus the widest, divided in four parts, the second (vesicular) also in four, the third in two, and the fourth in two parts. The somite comprises a total of 12 parts.

Alimentary tract (figs 72-73). Mouthpore located eccentrically in the posterior part of anterior sucker. Proboscis base at ganglion 3. Right and left of the proboscis there are salivary glands. Crop and posterior crop caecum splanchnomeres of 2 diverticles, no secondary diverticles. Intestine very narrow, with folded walls and 5 diverticles, of which the first 3 well developed; the 4th not much smaller, the 5th very small. Anus well visible, open, situated on the white field in the middle of dorsum, two annuli anterior to the posterior sucker.

Reproductive system (figs 74-77). Gonopores separated by 3 annuli. Male gonopore very large, female gonopore slightly larger. Copulatory area small (short), limited to the raised body covers surrounding spermatheca opening and within the spermatheca opening. Male reproductive system. 6 pairs of testes. Seminal vesicles at the level of testes 1. Ejaculatory ducts in form of thick loops, which do not reach ganglion 5. Atrium has a characteristic process in its middle upper part, its paired parts arranged longitudinally relative to the body long axis, narrow, elongate. Prostate glands on atrium present, well developed. Female reproductive system. Ovaries flattened, of a semilunate shape, with their posterior ends touching testes 1. Anterior ends of ovaries (just before passing into oviducts) cover vector tissue. Thus the space between the converging oviducts and testes 1 is free. Ovaries more remote from the median line, their posterior ends not intertwined, strongly removed from the median



75-77. *Italobdella ciosi*: reproductive systems. 78-81. *Italobdella epshteini* sp. n.: 78 - dorsal view, 79 - ventral view, 80-81 - body form.

plane, they "lean" on testes 1. Conducting strands in the form of short, narrow strands of fibres connecting each ovary with the posterior part of vector tissue.

DISTRIBUTION

N Italy, Adda River (Rivolta) near Milano.

BIOLOGY

It was collected from ventral fins of the brown trout, *Salmo trutta fario* L. 48 cm long, barbel, *Barbus barbus* (L.) and perch, *Perca fluviatilis* L., (BIELECKI and CIOS in press).

Italobdella epshteini sp. n.

(Figs 78-88; Table 1)

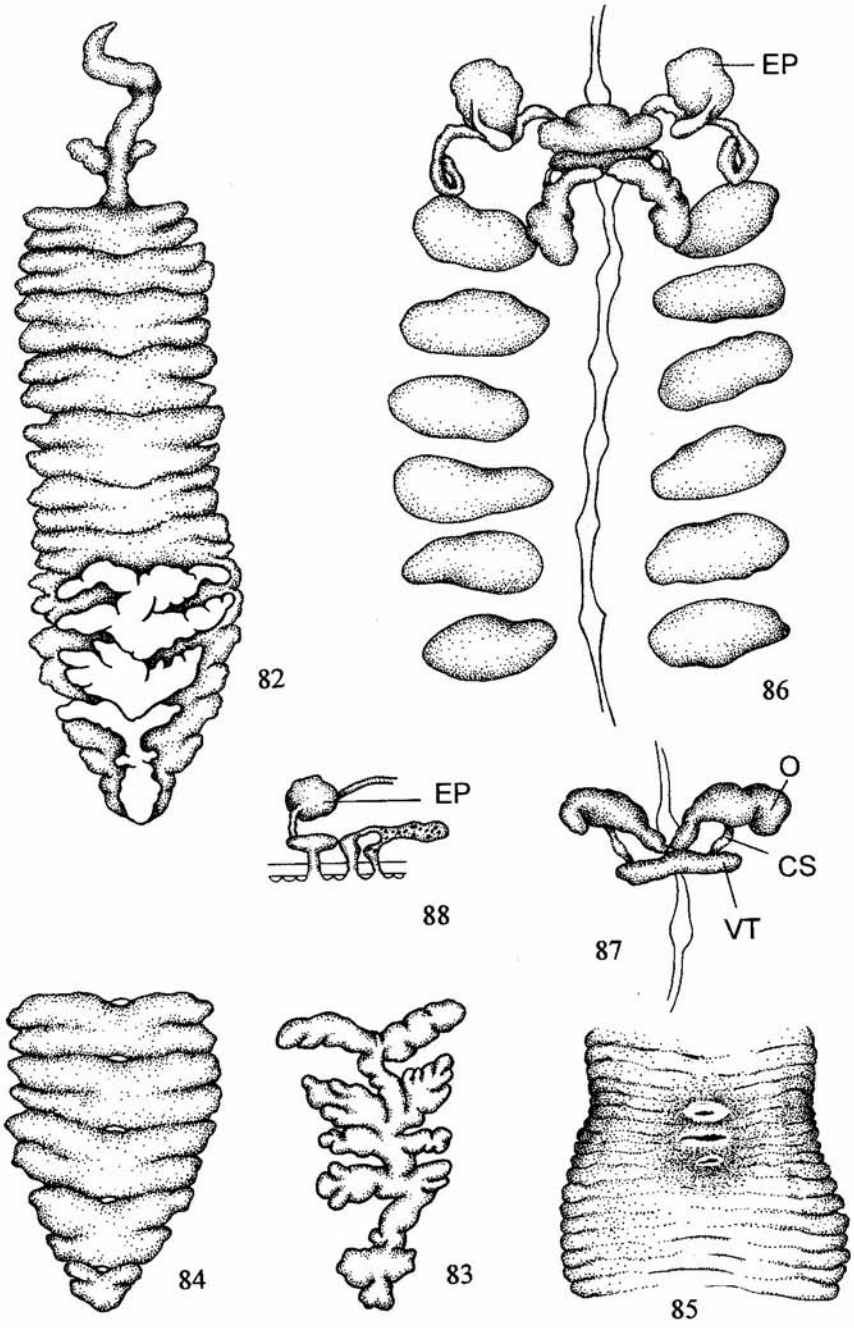
TYPE MATERIAL

Holotype: Poland, Zegrzyński Reservoir, December 13rd, 1993, leg. A. BIELECKI, 3 paratypes: same data. Holotype deposited at the Museum of Natural History, Wrocław University. Paratypes in author's collection.

DIAGNOSIS

In its body form *I. epshteini* sp. n. is not very close to any species, which testifies to the peculiarity of its morphotype: of all the analysed species, also of other genera, its morphotype is similar to that of *I. ciosi* and *A. volgensis* (fig. 34). It can be compared only with *I. ciosi* with which it shares the following characters: division into trachelosome and urosome very well visible, urosome cylindrical, trachelosome flattened and elliptical, anterior and posterior suckers round. *I. epshteini* differs from *I. ciosi* in the following characters: posterior suckers connected almost centrally (in *I. ciosi* eccentrically), division into trachelosome and urosome poorer marked (in *I. ciosi* much more distinct), posterior sucker only slightly smaller than the largest urosome width (in *I. ciosi* much smaller).

With respect to non-metric characters *I. epshteini* is most similar to *I. ciosi* (fig. 35). Both have the following characters in common: papillae (sensillae, tangoreceptors) absent, mid-body somite 4-annulate, gonopores separated by 3 annuli, copulatory area and spermatheca opening as a well marked ellipse transverse to the body long axis anterior to the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 2 diverticles, intestine strongly folded, vasa deferentia slightly coiled; ejaculatory ducts between ganglia 4 and 5, once bent towards anterior part of trachelosome, 6 pairs of testes, seminal vesicles reaching testes 1, classically U-shaped, ovaries sac-like, short, reaching testes 1, their posterior ends free, conducting strands short, narrow, enter posterior part of vector tissue. *I. epshteini* differs from *I. ciosi* in the following characters: intestine well developed (in *I. ciosi* poorly developed), atrium short, wide, its symmetrical parts situated perpendicular to the long body axis, with no characteristic process (in *I. ciosi* narrow, elongate, its



82-88. *Italobdella epshteini* sp. n.: 82-84 - alimentary tract, 86-88 - reproductive systems: EP- epididymis.

symmetrical parts arranged parallelly, with a characteristic process), prostatic glands very poorly developed (in *I. ciosi* well developed), ejaculatory ducts with epididymis (in *I. ciosi* absent).

ETYMOLOGY

The species is dedicated to Professor Wieniamin Mironowich EPSHTEIN, an outstanding specialist of fish leeches.

DESCRIPTION

Body shape and size as in figs 78-79 and Table 1. Body length 6.0-6.4 mm L/D_2 - 3.44, C^1_1/d_1 - 1.3, C^1_1/D_1 - 0.8, R_1/M_1 - 5.0, C^1_1/C_1 -1.1, L_1/D_1 - 1.3, D_1/N_1 - 1.7, S_1/S_2 - 1.3, L_2/D_2 - 2.6, D_2/N_2 - 1.0, K_1/K_2 - 1.1, C^1_2/d_7 - 0.9, C^1_2/D_2 - 0.7, R_2/M_2 - 1.7, C^1_2/C_2 - 0.9, L_2/L_1 - 2.9, D_2/D_1 - 1.5, N_2/N_1 - 2.6, C^1_2/C^1_1 - 1.2.

Size: very small, larger of 2 specimens (holotype) 5.9 mm long, largest width 1.8 mm; smaller (paratype) 5.7 mm long, largest width being 1.6 mm.

Body form (figs 80-81). Body smooth and short. Division into trachelosome and urosome very well visible. Trachelosome flattened, urosome cylindrical. Anterior sucker small or medium-sized, posterior sucker also small and connected slightly eccentrically. Respiratory vesicles (11 pairs) white, rather small but well visible.

Body coloration (figs 78-79). Anterior sucker mostly light, with no melanophores. Only a pigmented, frill-like band, coloration of dorsal side of trachelosome and urosome indistinct, with no characteristic pattern, only black melanophores present as very fine dots with no processes, slightly concentrated in latero-median lines.

Eyes. On anterior sucker 2 pairs of eyes - the first larger, oblique relative to the axial plane; the second pair, situated perpendicular to that plane, is smaller. On posterior sucker 10 eye-like spots, in its central part situated on the edge of dark radial streaks (fig. 78).

Segmentation (fig. 71 see *I. ciosi*). Mid-body somite 4-annulate (fig. 12). On annuli further dividing grooves. First annulus the widest and divided in four parts, the 2nd (vesicular) also in four, the 3rd in two, and the 4th in two parts. The somite comprises a total of 12 parts. Body smooth with no papillae.

Alimentary tract (figs 82-84). Mouthpore located somewhat eccentrically in posterior part of anterior sucker. Proboscis situated between ganglia 1 and 3. On left and right side of proboscis salivary glands. Crop and posterior crop caecum splanchnomeres of 2 equal diverticles. Intestine wide, very strongly developed, with folded walls, with 5 paired diverticles, of which first 3 are well developed, 4th not much smaller, 5th very small and poorly visible. Anus well visible, open, located on a white field in the centre of dorsum, two annuli anterior to posterior sucker.

Reproductive system (figs 85-88). Gonopores separated by 3 annuli. Male gonopore very large, female gonopore slightly larger, located 2 annuli posterior to spermatheca opening. Copulatory area short, limited to covers surrounding spermatheca opening and within spermatheca opening. Spermatheca opening located between gonopores, more precisely one annulus behind male gonopore. Male reproductive system. 6 pairs of testes. Seminal vesicles at the level of testes 1. Prostate glands on

atrium poorly developed. Ejaculatory ducts as thin, single, poorly expressed loops, which nearly reach ganglion 5, on them characteristic bulb-like widenings of epididymis. Ejaculatory ducts as thick loops, which do not reach ganglion 5. Atrium with paired parts narrow, elongated transversely to long body axis. Seminal vesicles reaching testes 1, classically U-shaped. Female reproductive system. Ovaries flattened, of a semilunate shape, their posterior ends touching testes 1. Anterior ends of ovaries (just before passing into oviducts) cover vector tissue. Thus the space between the converging oviducts and testes 1 is free. Ovaries located paramedially, their posterior ends not intertwined, between testes 1, not touching them. Vector tissue as rectangular narrow flat plate, transverse to long body axis. Conducting strands in the form of short, narrow strands of fibres connecting each ovary with the posterior part of vector tissue.

DISTRIBUTION
NE Poland, Zegrzyński Reservoir.

BIOLOGY
At present it is difficult to tell which fish species are preferred by *I. epshteini*, but since the material comes from a dam reservoir on the Vistula River, its potential hosts are probably cyprinids (*Cyprinidae*) and possibly other fishes.

Genus: *Pawlowskiella* gen. n.

Type species: *Pawlowskiella stenosa* sp. n.

DIAGNOSIS
See diagnosis of body form of *Piscicola borowieci* sp. n.
See diagnosis of non-metric characters of *Italobdella*.

ETYMOLOGY
The new genus is dedicated to Prof. Leszek Kazimierz PAWŁOWSKI, one of the most prominent specialists in freshwater leeches of the Palaearctic.

DESCRIPTION
Size medium (up to 35 mm). Body elongate, covered with papillae. Division into trachelosome and urosome poorly visible. Trachelosome and urosome slightly flattened. Anterior sucker medium-sized, posterior sucker small, both connected somewhat eccentrically. Respiratory vesicles (11 pairs) white, rather small but well visible. Eyes on anterior sucker and eye-like spots on posterior sucker present. Mid-body somite 14-annulate, annuli unequal. Copulatory area characteristic, short, including female gonopore and spermatheca opening. Copulatory area and spermatheca opening anterior to the first pair of respiratory vesicles. Spermatheca opening visible 1 annulus posterior to female gonopore. Gonopores separated by 2 annuli. Mouthpore

located centrally. Proboscis large, occupies 3.5 somite. Oesophageal glands present. Crop and posterior crop caecum splanchnomeres of 3 diverticles, first diverticle longer; each divided in 2 secondary diverticles. Posterior crop caecum splanchnomeres incompletely fused; 5 fenestrae remain at the level of ganglia. Intestine poorly developed. 6 pairs of testes. Seminal vesicles characteristically trifid, situated at the level of testes 1. Ejaculatory ducts, with one strong bend, reach half distance between ganglia 4 and 5. Prostatic glands on atrium well developed, very distinct, large. Vector tissue as a circular or somewhat elliptical plate located on female gonopore. Oviducts open to female gonopore through vector tissue. Ovaries reach testes 1. Conducting strands as very short, narrow strands of fibres, also entering vector tissue. Conducting strands and oviducts run separately. Monotypic.

Pawlowskiella stenosa sp. n.

(Figs 89-97; Table 1)

TYPE MATERIAL

Holotype: Poland, Wrzosy near Wołów, fish ponds, 28-X-1989; from *Cyprinus carpio* L., 2 paratypes: from *Stizostedion lucioperca* L., leg. A. BIELECKI. Holotype deposited at the Museum of Natural History, Wroclaw University. Paratypes in author's collection.

DIAGNOSIS

See generic diagnose.

ETYMOLOGY

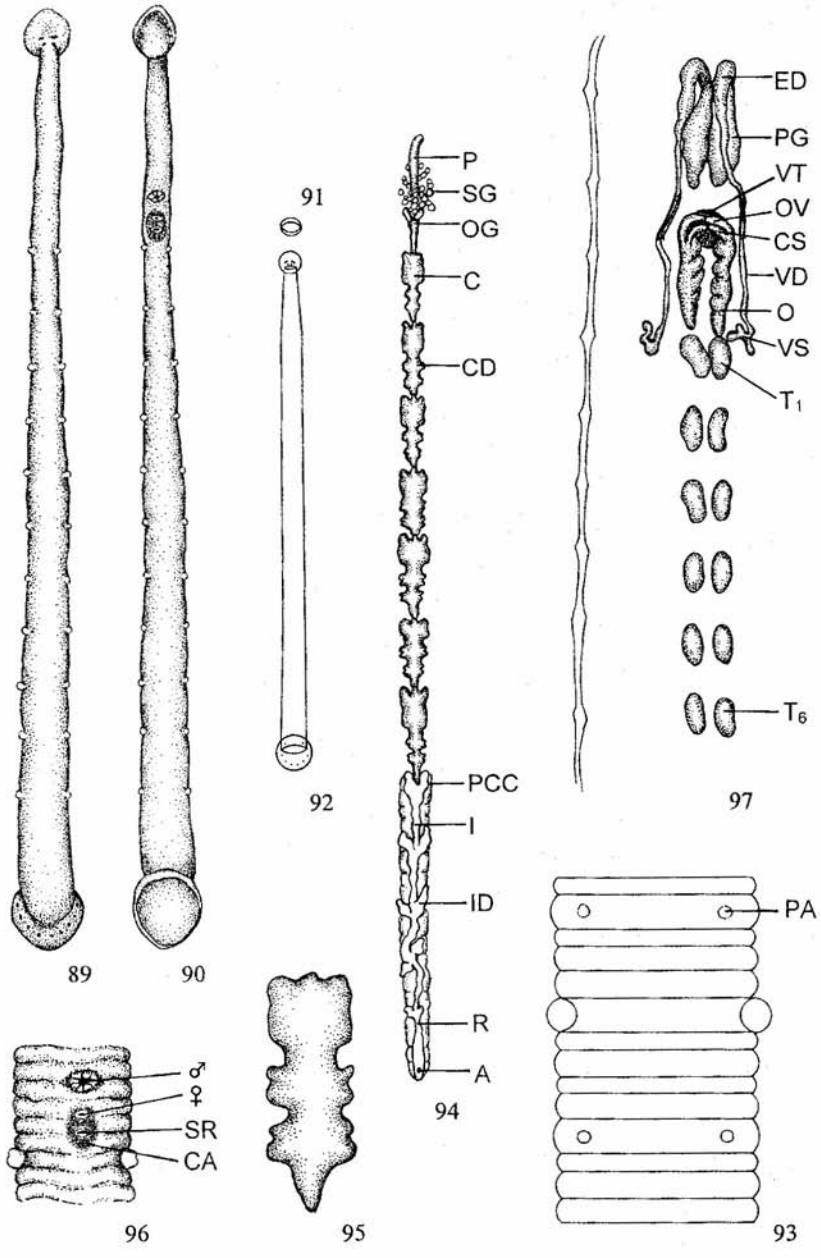
The name refers to the narrow body.

DESCRIPTION

Body shape and size as in figs 89-90 and Table 1. Body length 13.5-13.9 mm. L/D_2 - 19.57, C^1_1/d_1 - 1.7, C^1_1/D_1 - 1.2, R_1/M_1 - 4.0, C^1_1/C_1 -1.2, L_1/D_1 - 6.3, D_1/N_1 - 2.0, S_1/S_2 - 1.2, L_2/D_2 - 14.1, D_2/N_2 - 1.4, K_1/K_2 - 3.3, C^1_2/d_1 - 1.3, C^1_2/D_2 - 1.4, R_2/M_2 - 1.7, C^1_2/C_2 - 1.0, L_2/L_1 - 2.6, D_2/D_1 - 1.2, N_2/N_1 - 1.7, C^1_2/C^1_1 - 1.4.

Body form (figs 91-92). Body strongly elongate, cylindrical, somewhat flattened, gradually widening from anterior to posterior sucker. Anterior sucker medium-sized, posterior sucker small, eccentrically connected, cup-like. Division into trachelosome and urosome invisible.

Body coloration (figs 89-90). Coloration of live leeches unknown. Preserved leeches grey with violet tint. No distinct pattern, on trachelosome and urosome no stellate melanophores. Brown melanophores as fine dots more concentrated on body sides, hence middle of dorsal side as if lighter. Anterior sucker light, of brown melanophores conectrated in its central part. Posterior sucker darker, with evenly distributed brown melanophores, radial streaks absent.



89-97. *Pawlowskiella stenosa* gen et sp. n.: 89-90 - dorsal and ventral view, 91-92 - body form, 93 - somite, 94-95 - alimentary tract, 96-97 - reproductive systems.

Eyes. On anterior sucker 2 pairs of eyes - the first larger, situated in the lower part of the white spots, obliquely relative to the axial plane; the second pair, situated perpendicular to that plane, is smaller. On posterior sucker 10 eye-like spots, very distinct (fig. 89).

Segmentation (fig. 93). Mid-body somite 14-annulate, annuli very distinct and very well visible, unequal, of 3 groups of different length: 2, 6 and 11 the longest; 4, 5, 8, 10, 13 and 14 somewhat shorter; 1, 3, 7, 9 and 12 short. Papillae (sensillae, tangoreceptors) present on annuli 2 and 11. Lateral respiratory vesicles very fine, 11 pairs.

Alimentary tract (figs 94-95). Mouthpore situated centrally. Proboscis base between ganglia 3 and 4. On right and left side of proboscis numerous salivary glands. Crop and posterior crop caecum splanchnomeres of 3 diverticles, the first longer and slightly wider than the remaining two, second and third of equal length and width, each divided in 2 equal secondary diverticles, all grooves rather shallow. Intestine poorly developed, its walls strongly folded.

Reproductive system (figs 96-97). Gonopores separated by 2 annuli. Male and female gonopore well visible. Spermatheca opening visible 1 annulus posterior to female gonopore. Copulatory area on clitellum short, elliptical, limited to covers surrounding spermatheca opening and female gonopore, located in a well-marked concavity, anterior to the first pair respiratory vesicles. Spermatheca opening large, situated transverse to the body long axis anterior to the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes. Seminal vesicles characteristic - trifid, at the level of testes 1. Vasa deferentia straight. Ejaculatory ducts between ganglia 5 and 4, or slightly protruding beyond ganglion 5, sharply bent once parallel to the body long axis, sometimes forming additional bends. Prostatic glands on atrium well developed, as large lobes covering whole atrium. Female reproductive system. Ovaries short, cylindrical, their posterior ends free, not intertwined, reaching testes 1. Their inner, paramedian walls folded. Oviducts pass through vector tissue, just anterior to conducting strands. Vector tissue as a small circular plate, located exactly on openings: female gonopore and spermatheca opening, transverse to the body long axis. Conducting strands connect each ovary with mid part of vector tissue as short, narrow ducts. Conducting strands enter vector tissue. Oviducts much remote from conducting strands, run at a distance from each other and thus it is very easy to observe that these are different ducts. Oviducts open to female gonopore through vector tissue.

DISTRIBUTION

SW Poland, Wrzosy near WOŁÓW, one locality, fish ponds.

BIOLOGY

3 specimens collected in October 1989. The leeches were sitting on the ventral fin of the carp, *Cyprinus carpio* L., and pikeperch, *Stizostedion lucioperca* L.

Genus: *Codonobdella* GRUBE, 1873

Codonobdella GRUBE, 1873: 67-68; DOGIEL and BOGOLEPOVA 1957: 447-448, fig. 13; EPSHTEIN 1961b: 1008-1011, figs 1, 2, 1962: 625, fig. 1548; SOÓS 1965: 438.

Type species: *Codonobdella truncata* GRUBE, 1873.

DESCRIPTION

Size very small (2.7-3.4 mm) or medium (to 27 mm). Body elongate, cylindrical or slightly flattened, on its surface numerous fine papillae. Division into trachelosome and urosome not very well visible. Anterior sucker large or small. Posterior sucker very small, or fine, with numerous eye-like spots or spots absent, connected centrally or eccentrically. Lateral respiratory vesicles (11 pairs) fine, very poorly visible. Eyes undergo reduction (from 2 pairs to 0). Number of annuli per mid body somite variable from 3, with rudiments of further divisions, to 14. Mid-body somite rather 14-annulate. Mouthpore situated centrally. Spermatheca and copulatory area present. Gonopores separated by 2 or 3 annuli. Proboscis large, its base situated between ganglia 3 and 4. Oesophageal glands absent. Crop and posterior crop caecum splanchnomeres have diverticles. Posterior crop caecum splanchnomeres incompletely fused; 5 fenestrae remain at the level of ganglia. Intestine well or poorly developed, with strongly or gently folded walls. 5 pairs of testes (pair 1 absent). Seminal vesicles as few bends, situated at the level of ganglia 6-8 (half length of ovaries). Vasa deferentia rather straight. Ejaculatory ducts with one bend, their apices situated between ganglia 3 and 4 or reaching ganglion 5. Prostatic glands on atrium well developed. Vector tissue as a narrow plate or fold, semilunate, transverse to long body axis, posterior to female gonopore (ends of semilune directed towards urosome). Ovaries long, sac-like, reaching testes 2 (more precisely the place where testes 2 should be situated, since testes 1 are reduced). Oviducts open to female gonopore through vector tissue. Conducting strands as very short, wide strands of fibres, enter mid part of vector tissue .

Note ! The description follows that of LUKIN (1976) and EPSHTEIN (1987).

KEY TO THE SPECIES

1. Medium-sized, body length to 27 mm, body surface covered with numerous fine papillae, division into trachelosome and urosome indistinct, on body sides segmentally arranged, transverse, dark brown or black streaks, ejaculatory ducts long, considerably protruding beyond ganglion 4 ..... ***truncata***
-, Very small, body length 2.7 - 3.4 mm, body surface smooth, with no papillae, division into trachelosome and urosome distinct, coloration uniform, no dark streaks, ejaculatory ducts short, at the level of ganglion 5 ..... ***zelenskiji***

Codonobdella truncata GRUBE, 1873

Codonobdella truncata GRUBE, 1873: 67-68.

On large gammarids and big-headed sculpin, *Batrachocottus* sp. in the Lake Baikal. Found at depths 10-1000 m.

Codonobdella zelenskiji (FINOGENOVA et SNIMSCHIKOVA, 1991)

Dagarobdella zelenskiji FINOGENOVA and SNIMSCHIKOVA, 1991: 134.

Found in the Lake Baikal at depths 25-100 m, not attached to the host, in silt.

Genus: *Piscicola* DE BLAINVILLE in LAMARCK, 1818

Piscicola DE BLAINVILLE in LAMARCK, 1818: 294; LINDENFELD and PIERUSZYŃSKI 1890: 399-473.

Type species: *Hirudo geometra* LINNAEUS, 1761.

DIAGNOSIS

See diagnosis of *Cystobranchus*.

DESCRIPTION

Size medium (up to 30 mm), large (up to 56 mm) or very large (up to 75 mm). Relative body length, degree of flattening, ratio of the largest urosome width to the largest trachelosome width and the degree of separation of these sections variable. Anterior sucker small or large. Posterior sucker large (its horizontal diameter considerably exceeds the greatest width of trachelosome) or medium-sized (the respective parameters almost equal), eccentrically connected. 11 pairs of small lateral respiratory vesicles. Two pairs of well-developed eyes. On posterior sucker numerous eye-like spots. Mid-body somite 4, 7 or 14 - annulate. Annuli equal or unequal. No tubercles on body surface, or they are only poorly developed on few mid-body somites; only in some species very well developed. Mouthpore centrally located. Proboscis of medium length, between ganglia 1 and 3. Oesophageal gland present. Crop built of 7 splanchnomeres. Crop splanchnomeres usually have diverticles, which may be divided in secondary diverticles. Posterior crop caecum splanchnomeres, incompletely fused; 5 fenestrae remain at the level of ganglia. Posterior crop caecum splanchnomeres of the same structure as crop splanchnomeres: the first 4 well developed, the 5th less so. Intestine well or poorly developed, with strongly or gently folded walls. Gonopores separated by variable number of annuli, from 2 to 6. Copulatory area long, occupying entire ventral side of the posterior part of clitellum and extending to the first urosomite (encroaching on the first somite of urosome,

symmetrical on both sides of the first pair of respiratory vesicles, on trachelosome and urosome). Its shape varies from circular, through elliptical to triangular. Spermatheca opening transverse or parallel to the body long axis, Spermatheca opening anterior to or at the level of the first pair of respiratory vesicles. 6 or less often 5 pairs of testes. Seminal vesicles variously located: much anterior to testes 1, at testes 1 or 2. Their shape varies from straight rods or ampullae to single and multiple loops. Vasa deferentia straight, slightly or strongly coiled. Ejaculatory ducts variously located relative to ganglia: from half distance between 3 and 4, to 5. They can be sharply or gently bent once, parallel or transverse to the body long axis, or multiply bent. Prostatic glands on atrium very large, well developed or very poorly developed, much less often vestigial. Ovaries short, reaching testes 1, or long, reaching testes 2, located between testes or on them, of varied shape - coiled in many planes, sac-like, cylindrical. Their posterior ends free or intertwined. Oviducts merge into female gonopore anterior to vector tissue, much remote from conducting strands, they run separately. Vector tissue as a plate located posterior to oviduct outlet, of varied shape: ellipse parallel or transverse to the body long axis, circle or triangle. Conducting strands very long, long or short, narrow or wide, may connect ovary with anterior, mid or posterior part of vector tissue.

The genus has a transpalaearctic, Holarctic distribution.

REMARKS

Contrary to SAWYER'S (1986, vol. II: 674) diagnose, in members of this genus the ovaries never enter the vector tissue, and the vector tissue never reaches male gonopore; see also "Discussion".

KEY TO THE SPECIES

1. Body cylindrical or nearly so, ratio of urosome greatest width D_2 to its greatest height N_2, $D_2/N_2 \geq 1$ to 1.5 ..... 2.
-, Body flattened, ratio of urosome greatest width D_2 to its greatest height N_2, $D_2/N_2 \geq$ 1.8 to 3.3 ..... 8.
2. Horizontal diameter of posterior sucker C^1_2 much larger than the greatest urosome width D_2, $C^1_2/D_2 \geq 1.5$ to 2.2 ..... 3.
-, Horizontal diameter of posterior sucker C^1_2 equal to or smaller than the greatest urosome width D_2, $C^1_2/D_2 \leq 1$ ..... 4.
3. Relative body length L/D_2 from 20 to 23, coloration uniform, brown melanophores round and with no processes, posterior sucker with no radial streaks and with no concavity, resembling a horse hoof, annulation excellently visible, crop and posterior crop caecum splanchnomeres of 6 diverticles, seminal vesicles reaching testes 1, ejaculatory ducts between ganglia 4 and 5, gently bent, ovaries short, reaching testes 1 (figs 98-99, 102-105, 107-110, 113, p. 288) ..... ***borowieci*** sp. n.
-, Relative body length L/D_2 from 10 to 13, coloration not uniform, brown and black melanophores stellate, most often form segmental cross-like pattern, on posterior

sucker radial streaks and a concavity, annulation poorly visible, crop and posterior crop caecum splanchnomeres of 5 diverticles, seminal vesicles reaching testes 2, ejaculatory ducts reach ganglion 4, ovaries long, reaching testes 2, their ends between testes 1, always intertwined (figs 114-115, 119-121, 123-124, p. 293) ..... ***geometra***

4. Gonopores separated by 2 annuli ..... 5.
-, Gonopores separated by more than 2 annuli ..... 6.
5. Anterior sucker C^1_1 equal to the greatest width of trachelosome D_1, $C^1_1/D_1 = 1$, crop and posterior crop caecum splanchnomeres of 4 diverticles, secondarily divided, ejaculatory ducts at the level of ganglion 5, bent more than 4 times, seminal vesicles multiply bent, over 10 times, ovaries short, reaching testes 1, their ends not intertwined, small leeches, up to 12.7 mm long (figs 130, 132, 135, p. 299) ..... ***witkowskii*** sp. n.
-, Anterior sucker C^1_1 larger than the greatest width of trachelosome D_1, $C^1_1/D_1 > 1$, crop and posterior crop caecum splanchnomeres of 3 diverticles, further undivided, ejaculatory ducts between ganglia 4 and 5, seminal vesicles classically U-shaped, ovaries long, reaching testes 2, their ends intertwined, large leeches, up to 56 mm long (figs 141, 143, 145, p. 303) ..... ***annae*** sp. n.
6. Mid-body somite 14-annulate, 6 pairs of testes, crop and posterior crop caecum splanchnomeres of 4 and 5 diverticles ..... 7.
-, Mid-body somite of 4 annuli, further divided in 12 additional annuli, 5 pairs of testes, crop and posterior crop caecum splanchnomeres of 2 diverticles (figs, 150, 153, 151, p. 307) ..... ***elishebae*** sp. n.
7. Anterior sucker very small, C^1_1 horizontal diameter smaller than the greatest width of trachelosome D_1, elliptical $C^1_1/C_1 < 1$, horizontal diameter of posterior sucker C^1_2 equal to body height D_2, $C^1_2/D_2 = 1$, division into trachelosome and urosome very poorly marked $D_2/D_1 < 2$, brown and black melanophores form wide segmental transverse streaks, intermittent with narrow white streaks, gonopores separated by 6 annuli, copulatory area circular, crop and posterior crop caecum splanchnomeres of 5 diverticles, seminal vesicles classically U-shaped (figs 154-158, 159-160, 162, 164-165, p. 310) ..... ***pojmanskae***
-, Anterior sucker of medium size C^1_1 horizontal diameter larger than the greatest trachelosome width D_1, round $C^1_1/C_1 = 1$, horizontal diameter of posterior sucker C^1_2 smaller than body height D_2, $C^1_2/D_2 < 1$, division into trachelosome and urosome very well marked, $D_2/D_1 > 2$, brown and black melanophores evenly distributed, gonopores separated by 4 annuli, copulatory area elliptical, crop and posterior crop caecum splanchnomeres of 4 diverticles, seminal vesicles as longitudinal rods (figs 168-169, 170-171, 173, 175-176, p. 317) .. ***niewiadomskae*** sp. n.
8. Mid-body somite 7-annulate ..... 9.
-, Mid-body somite 14-annulate ..... 10.
9. Horizontal diameter of posterior sucker C^1_2 much larger than the greatest body width D_2, C^1_2/D_2 from 2.4 to 3.0, copulatory area circular, spermatheca opening at the level of the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 2 diverticles of equal width, ejaculatory ducts between ganglia

3 and 4, vector tissue circular, a specific parasite of catfish (figs 177-179, 181, 183-184, 186-187, p. 321) ..... ***fasciata***

-, Horizontal diameter of posterior sucker C^1_2 equal to body height D_2, $C^1_2/D_2 = 1$, copulatory area triangular, spermatheca opening anterior to the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 3 diverticles of unequal width, ejaculatory ducts reach ganglion 4, vector tissue elliptical, parasite of trout, grayling and rheophilous cyprinids (figs 188-189, 191, 193-194, 195-196 p. 325) ..... ***respirans***

10. Horizontal diameter of anterior sucker C^1_1 larger than the greatest width of trachelosome D_1, $C^1_1/D_1 > 1$ ..... 11.

-, Horizontal diameter of anterior sucker C^1_1 smaller than the greatest width of trachelosome D_1, $C^1_1/D_1 < 1$ ..... 12.

11. Horizontal diameter of anterior and posterior suckers almost equal, C^1_2/C^1_1 from 1.1 to 1.3, division into trachelosome and urosome distinct, D_2/D_1 from 2.4 to 2.6, horizontal diameter of posterior sucker C^1_2 distinctly smaller than the greatest body width D_2, $C^1_2/D_2 < 1$, black melanophores large with very long processes and brown pigment cells smaller, with no processes, not forming segmental crosses, on posterior sucker no radial streaks or streaks poorly marked, papillae absent, copulatory area circular, ejaculatory ducts reach ganglion 4, 5 times bent, ovaries long, reaching testes 2, vector tissue elliptical, seminal vesicles multiply bent (figs 198-199, 201, 204-205 p. 331) ..... ***pomorskii*** sp. n.

-, Horizontal diameter of anterior and posterior suckers unequal, C^1_2/C^1_1 from 1.4 to 1.5, division into trachelosome and urosome poorer marked, D_2/D_1 from 1.9 to 2.1, horizontal diameter of posterior sucker C^1_2 larger than the greatest body width D_2, $C^1_2/D_2 > 1$, dark grey melanophores with no processes form a pattern of segmental crosses, on posterior sucker radial, dark, wide and narrow white streaks, papillae very numerous, copulatory area elliptical, ejaculatory ducts reach ganglion 4, once bent, ovaries short, reaching testes 1, vector tissue triangular, seminal vesicles as straight transverse rods (figs 206-207, 209, 213, p. 336) ..... ***kusznierzi*** sp. n.

12. Body strongly shortened, its relative length $L/D_2 < 6.5$, along midline of dorsum a light streak, in posterior part of trachelosome its margins diffuse, mid-body somite annuli equal, ejaculatory ducts reach ganglion 4, multiply bent, ovaries long, reaching testes 2, seminal vesicles multiply bent, vector tissue elliptical perpendicular to the body long axis, conducting strands short (figs 214-215, 218, 222, p. 340)..... ***margaritae*** sp. n.

-, Body strongly elongate, its relative length $L/D_2 > 12$, light streak absent, coloration uniform, mid-body somite annuli unequal, ejaculatory ducts reach ganglion 5 or beetwen 4 and 5, once bent, ovaries short, reaching testes 1, seminal vesicles classically U-shaped or ampulla-like, vector tissue elliptical parallel to the body long axis, conducting strands long ..... 13.

13. Anterior and posterior suckesr round, their horizontal and vertical diameter equal, C^1_1/C_1 and $C^1_2/C_2 = 1$, division into trachelosome and urosome poorly marked, D_2/D_1 from 1.1 to 1.4, horizontal diameter of posterior sucker C^1_2, distinctly larger than the greatest body width D_2, $C^1_2/D_2 > 1$, ejaculatory ducts reach ganglion 5,

wide, seminal vesicles classically U-shaped, at the level of testes 1, ovaries wide, sac-like (figs 223-224, 225-226, 230, p. 344) ..... ***jarai*** sp. n.
-, Anterior and posterior suckers spade-shaped, their horizontal smaller than vertical, C^1_1/C_1 and $C^1_2/C_2 < 1$, division into trachelosome and urosome distinct, (D_2/D_1) from 1.8 to 2.1, horizontal diameter of posterior sucker C^1_2, distinctly smaller than the greatest body width D_2, $C^1_2/D_2 < 1$, ejaculatory ducts reach beetwen ganglion 4 and 5, narrow, seminal vesicles ampulla-like, located far anterior to testes 1, ovaries narrow and cylindrical (figs 231-232, 233-234, 235-238, 242, p. 347) ..... ***wiktori*** sp. n.

Piscicola borowieci sp. n.

(Figs 98-113; Table 1)

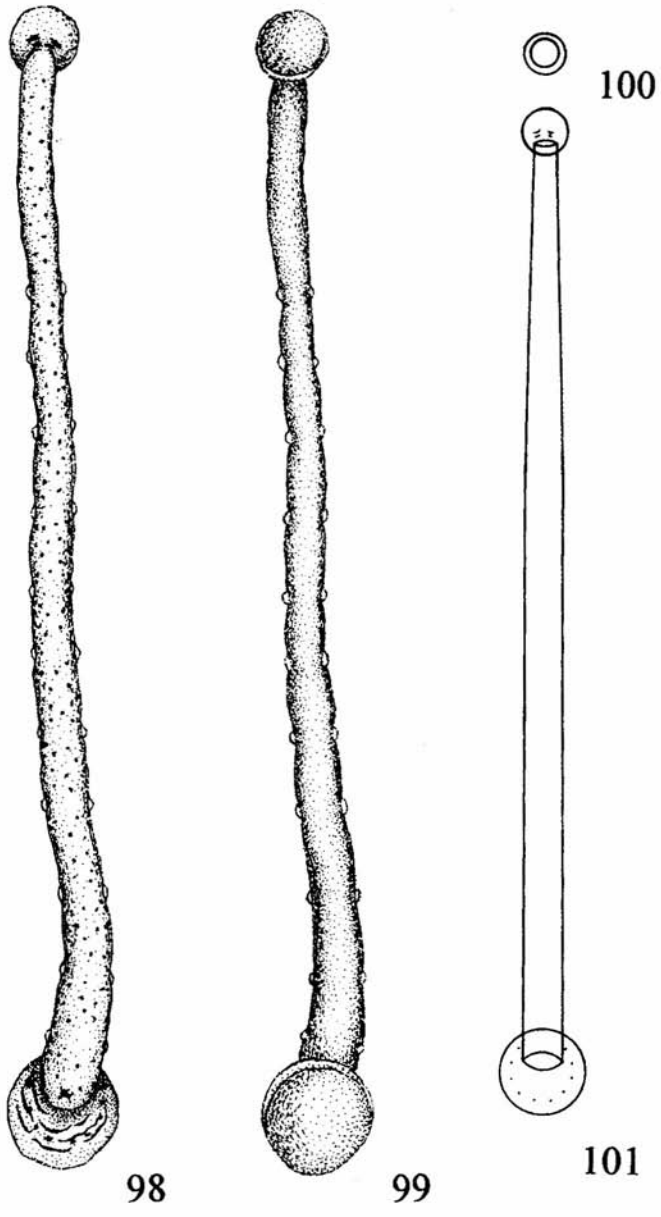
TYPE MATERIAL

Holotype: Poland, Przemków near Legnica 13-II-1987, *Cyprinus carpio* L., from fish ponds; 16 paratypes: 4 from *Cyprinus carpio* L., 2 from *Tinca tinca* (L.), 2 from *Esox lucius* L., 2 from *Stizostedion lucioperca* (L.), leg. A. BIELECKI. 6 from *Ctenopharyngodon idella* Val., Wrzosy near Wołów, 15-XII-1988, from fish ponds, leg. A. BIELECKI. Holotype deposited at the Museum of Natural History, Wrocław Uniwersity; paratypes in author's collection.

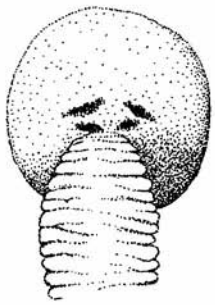
DIAGNOSIS

Considering morphotypes of all the analysed species, also of different genera, in its body form *P. borowieci* sp. n. is most similar to *Pawlowskiella stenosa* gen. et sp. n. (fig. 34). Considering only morphotypes of members of *Piscicola*, it is close to *P. wiktori* sp. n. (fig. 243). It differs from the latter species in cylindrical cross-section of trachelosome and urosome (in *P. wiktori* cross-section elliptical), posterior sucker wider than the largest urosome width (in *P. wiktori* the ratio is equal to one), round suckers (in *P. wiktori* spade-shaped).

In its non-metric characters *P. borowieci* sp. n. is most similar to *P. wiktori* (fig. 35). Both share the following characters: papillae (sensillae, tangoreceptors) absent, mid-body somite 14-annulate, copulatory area as a long, well marked ellipse parallel to the body long axis, spermatheca opening at the level of the first pair of respiratory vesicles, intestine poorly developed with strongly folded walls, prostatic glands very large, well developed, ejaculatory ducts between ganglia 4 and 5, half-loop towards anterior part of trachelosome, 6 pairs of testes, vasa deferentia straight, not coiled, ovaries cylindrical, short, reaching testes 1, their posterior ends between testes, free, not intertwined, vector tissue as a long, well marked ellipse parallel to the body long axis, conducting strands short, narrow, enter mid part of vector tissue. It differs from *P. wiktori* in the following characters: gonopores separated by 5 annuli (in *P. wiktori* 4 annuli), crop and posterior crop caecum splanchnomeres of 6 equal diverticles, each divided in 4 secondary diverticles (in *P. wiktori* splanchnomeres of 4 unequal diverticles, first diverticle long, with 3 secondary diverticles), ejaculatory ducts once



98-101. *Piscicola borowieci* sp. n.: 98-99 - dorsal and ventral view, 100-101 - body form.



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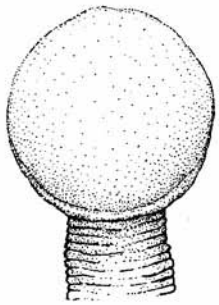

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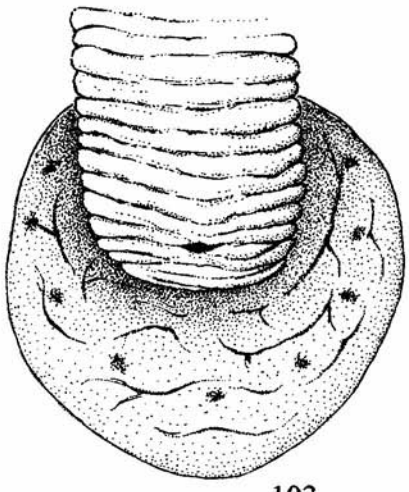

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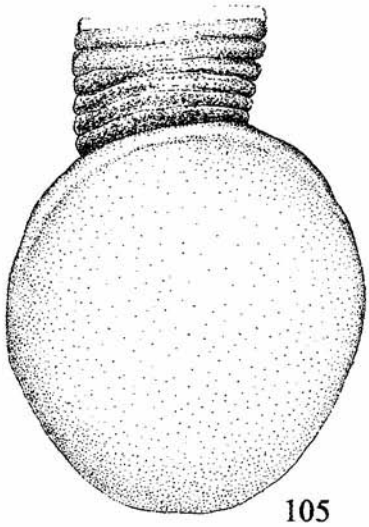

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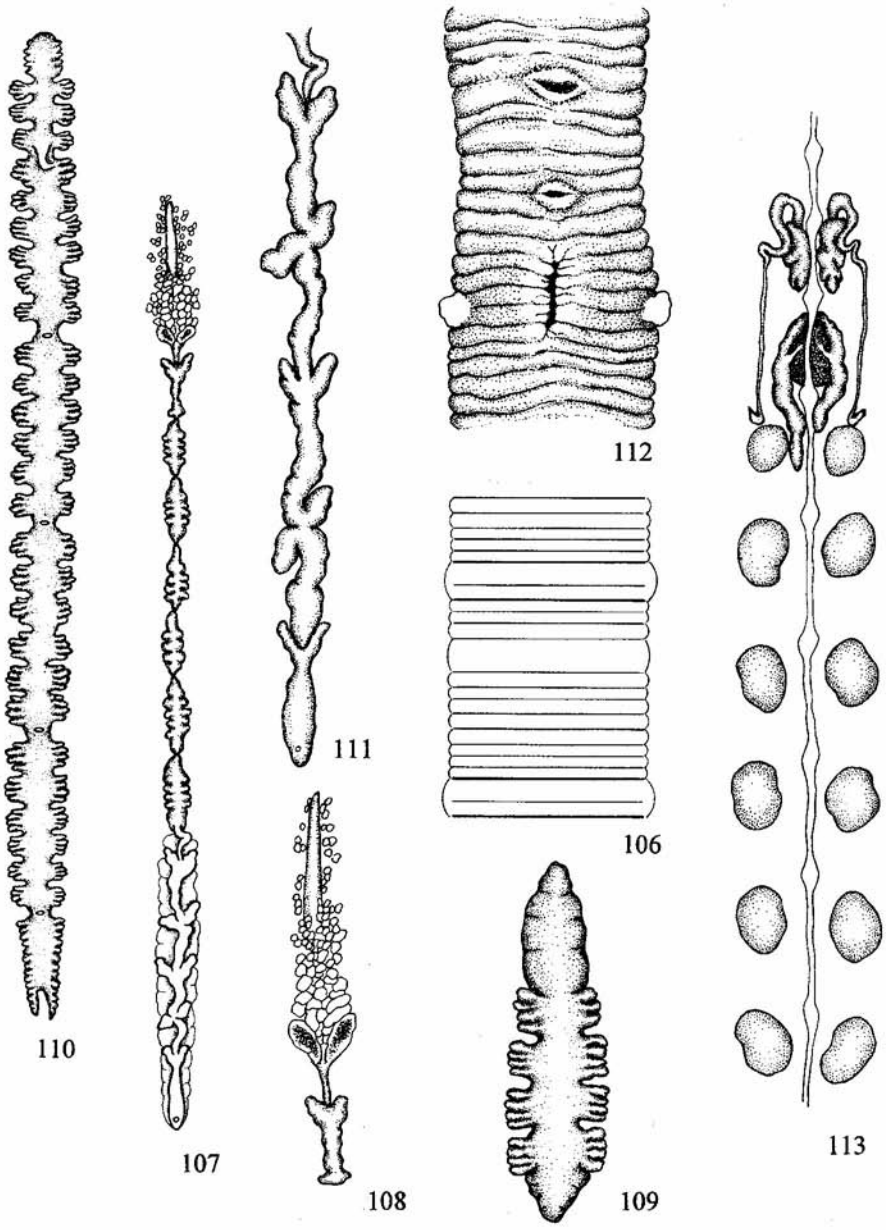
102-105. *Piscicola borowieci* sp. n.: suckers, dorsal and ventral view.



106-113. *Piscicola borowieci* sp. n.: 106 - somite, 107-111 - alimentary tract, 112-113 - reproductive systems.

gently bent (in *P. wiktori* bent sharply once), seminal vesicles reaching testes 1 (in *P. wiktori* much anterior to testes 1), seminal vesicles classically U-shaped (in *P. wiktori* bulb-like).

ETYMOLOGY

Dedicated to Prof. dr hab. Lech BOROWIEC, my colleague and an outstanding entomologist.

DESCRIPTION

Body shape and size as in figs 98-99, 102-105 and Table 1. Body length 12.7-19.3 mm. L/D_2 - 22.71, C^1_1/d_1 - 2.0, C^1_1/D_1 - 1.3, R_1/M_1 - 3.0, C^1_1/C_1 -1.0, L_1/D_1 - 6.0, D_1/N_1 - 1.2, S_1/S_2 - 1.1, L_2/D_2 - 17.6, D_2/N_2 - 1.0, K_1/K_2 - 0.3, C^1_2/d_7 - 2.1, C^1_2/D_2 - 2.1, R_2/M_2 - 2.0, C^1_2/C_2 - 1.0, L_2/L_1 - 3.4, D_2/D_1 - 1.2, N_2/N_1 - 1.4, C^1_2/C^1_1 - 1.9.

Body form (figs 100-101). No division into trachelosome and urosome. Body elongate, cylindrical. Anterior and posterior suckers round, posterior sucker with no concavity (its structure resembling a horse hoof), both medium-sized, connected strongly eccentrically. On posterior sucker characteristic longitudinal grooves and concavities.

Body coloration (figs 98-99, 102-105). Uniform pattern formed of brown melanophores which are round, oval with no processes. Ventral side lighter. Anterior and posterior sucker uniformly coloured, with very fine, brown melanophores. On posterior sucker no radial streaks.

Eyes. On anterior sucker 2 pairs of eyes - first located centrally, obliquely relative to saggital plane, second not much smaller, similarly arranged. On posterior sucker 10 eye-like spots located in its central part (figs 98, 102-103).

Segmentation (fig. 106). Annuli very distinct, mid-body somite of 14 annuli in 4 groups of different length: annulus 11 the longest; 6 somewhat shorter; 1, 2, 7, 10, 12 and 14 short; 3, 4, 5, 8, 9 and 13 the shortest (fig. 5). Papillae (sensillae, tangoreceptors) absent. Respiratory vesicles (11 pairs) small but well visible.

Alimentary tract (figs 107-111). Mouthpore located centrally. Proboscis base at the level of ganglion 3. Crop splanchnomeres of 6 equal diverticles: each divided in four barely discernible secondary diverticles, and 4 small and narrow diverticles (unique character of this species). In the first and sixth diverticles of crop splanchnomeres division into 4 secondary diverticles less distinct. Intestine poorly developed, not covering completely posterior crop caecum, walls folded; 4 large diverticles, the 5th small.

Reproductive system (figs 112-113). Gonopores separated by 5 annuli. Male gonopore large, female gonopore small, very clearly visible. Copulatory area elliptical, parallel to the body long axis. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes. Vasa deferentia simple, not coiled. Ejaculatory ducts as gentle, roundish bends, not reaching ganglion 4, most often they occupy 3/4 distance between ganglia 4 and 5. On atrium prostatic glands well developed in the form of lobes. Seminal vesicles fine at the level of testes 1, with a single bend in the body long axis. Female reproductive system. Ovaries elongate, cylindrical, short, reach testes 1,

their distal ends free, not intertwined. Vector tissue as a fairly long, well marked ellipse parallel to the body long axis. Conducting strands as short, narrow strands of fibres connecting each ovary with the mid part of vector tissue.

DISTRIBUTION

NC Poland.

BIOLOGICAL DATA

The leeches were found on fins and body of carp, *Cyprinus carpio* L., tench, *Tinca tinca* (L.), pike, *Esox lucius* L., pikeperch, *Stizostedion lucioperca* (L.) and grass carp, *Ctenopharyngodon idella* VAL., from fish ponds.

Piscicola geometra (LINNAEUS, 1761)

(Figs 114-124; Table 1)

Hirudo piscium RÖSEL, 1755: 200.
Hirudo geometra LINNAEUS, 1761: 2083.
Hirudo galearia BRAUN, 1805: 35, pl. III, figs 1-3.
Piscicola piscium: LAMARCK 1818: 294; LINDENFELD and PIERUSZYŃSKI 1890: 430.
Ichthyobdella geometra: MOQUIN-TANDON 1827, pl. VII, fig. 1; BLAINVILLE 1828: 558.
Ichthyobdella percae TEMPLETON, 1836: 236, fig. 28a, b, c.
Ichthyobdella piscium: EGIDY 1844: 107, pl. IV, fig. 73.
Piscicola percae: JOHNSTON 1846: 441.
Piscicola piscium: MOQUIN-TANDON 1846: 294-296; APÁTHY 1888a: 154, pl. VIII, fig. 8, 1888b: 785-786.
Piscicola geometra: BLANCHARD 1894: 18-19; JOHANSSON 1896: 23-29, pl. III, 1898: 677-678; BRUMPT 1900b: 689-692, fig. 1-5; JOHANSSON 1909d: 70, figs 115-117; HARDING 1910: 140-142, fig. 2, pl. XIII, fig. 4, 5, 6; ZELENSKII 1915: 1-256; SHMIDT 1925: 319-428, pl. 16-21; LUKIN 1929: 41-44; JANZEN 1932: 327-341; LUKIN 1936a: 130-143, 1936b: 144-161; PAWŁOWSKI 1936: 88-91, figs 55-60; SHMIDT 1941a: 357-489, figs 1-143; Dyk 1941: 1-4, fig. 1, 2; BENNIKE 1943: 81, fig. 18; PETRUSHEVSKII and BAUER 1948b: 217-231; SHCHEGOLEV 1949: 140, figs 76 (3), 77 (9); JUNG 1955a: 118; DOGIEL and BAUER 1955: 40-42, fig. 8; MANN 1955a: 115, fig. 3, 1956: 615-626, pl. 2, fig. 3; AUTRUM 1958: 10, Abb. 3b, 5, 27, 29; SHULMAN 1958: 228; LUKIN 1962b: 122-126, figs 3, 32. 46 78A, B, 79; EPSHTEIN 1962: 626, fig. 1539; SOÓS 1965: 445; TEREKHOV 1966b: 1721-1723, 1967a: 846-849, 1967b: 1-19; BIELECKI 1976: 328-330.

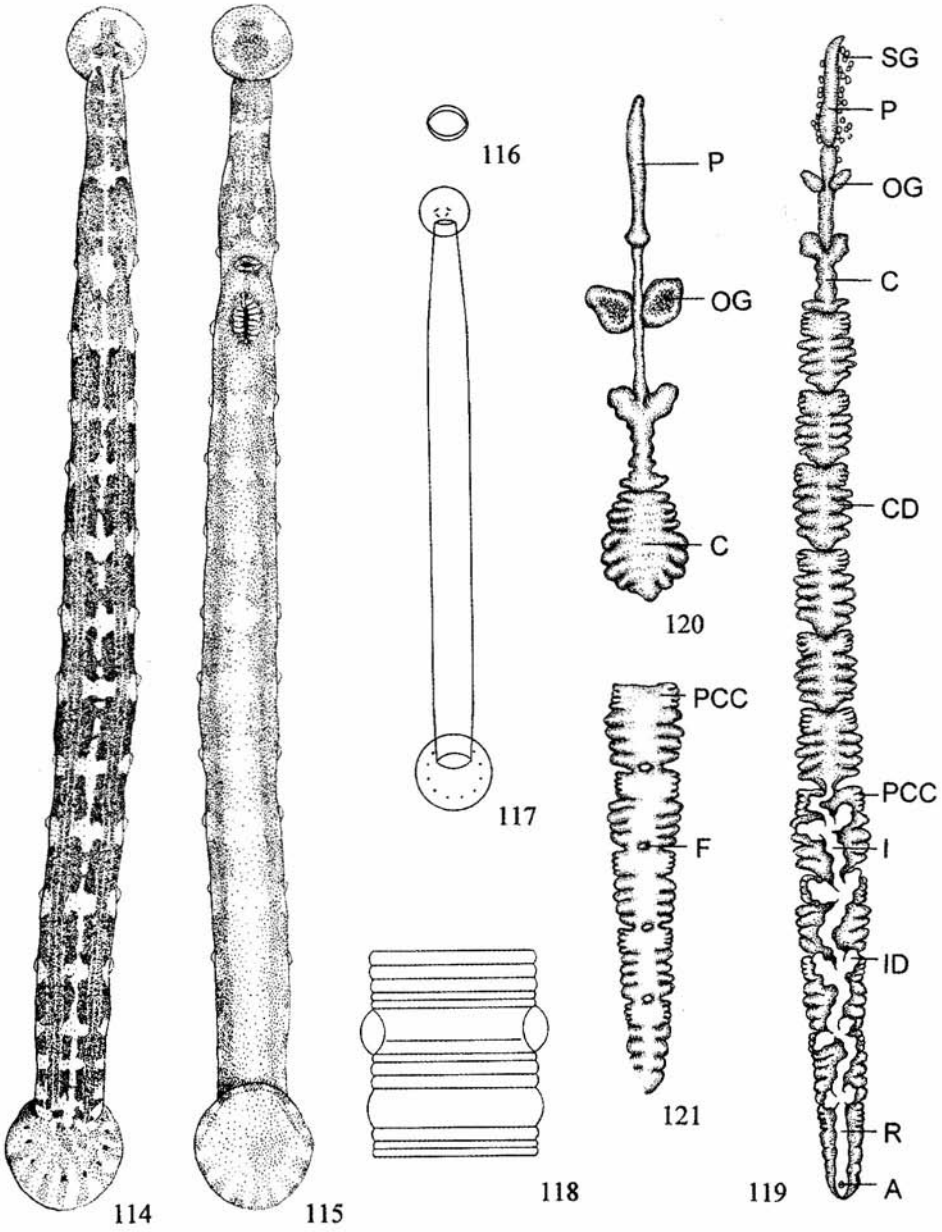
Terra typica: Holarctic.

MATERIAL EXAMINED

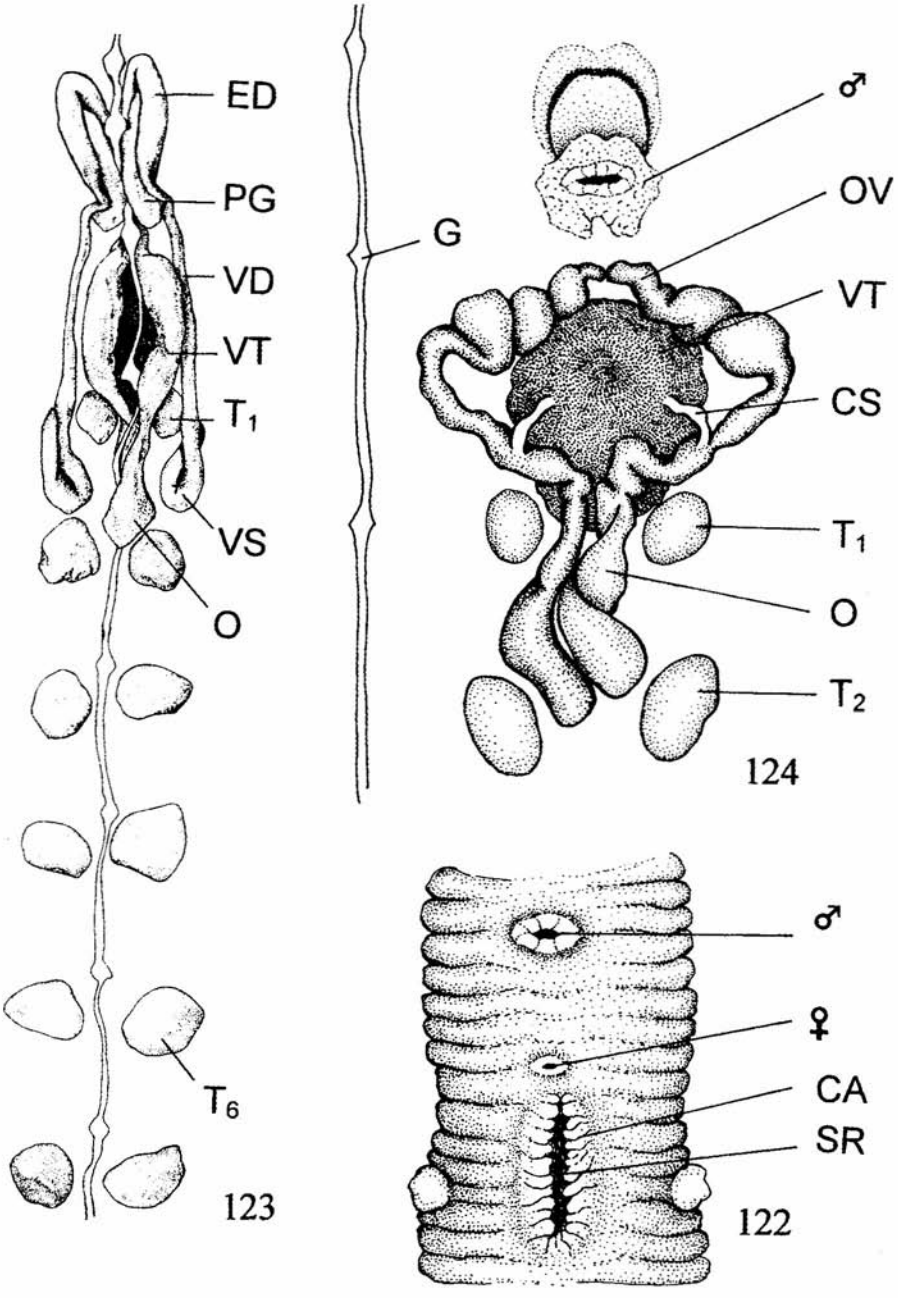
Poland, Szczodre near Wrocław, fish ponds, 247 specimens from *Cyprinus carpio* L., 14-XII-1987. Deposit of material - in author's collection.

DIAGNOSIS

See diagnosis of *P. annae* sp. n.



114-121. *Piscicola geometra*: 114-115 - dorsal and ventral view, 116-117 - body form, 118 - somite, 119-121 - alimentary tract.



122-124. *Piscicola geometra*, reproductive systems.

DESCRIPTION

Body shape and size as in figs 114-115 and Table I. Body length 15.7-30.7 mm. L/D_2 - 7.0, C^1_1/d_1 - 2.4, C^1_1/D_1 - 1.4, R_1/M_1 - 5.7, C^1_1/C_1 -1.0, L_1/D_1 - 5.3, D_1/N_1 - 1.0, S_1/S_2 - 0.9, L_2/D_2 - 7.3, D_2/N_2 - 1.6, K_1/K_2 - 1.2, C^1_2/d_7 - 1.7, C^1_2/D_2 - 1.1, R_2/M_2 - 1.3, C^1_2/C_2 - 1.0, L_2/L_1 - 3.2, D_2/D_1 - 1.2, N_2/N_1 - 1.9, C^1_2/C^1_1 - 2.5.

Body form (figs 116-117). Body cylindrical and elongate, division into trachelosome and urosome not marked. Anterior and posterior suckers circular, not very deep, poorly muscled, connected strongly eccentrically.

Body coloration (figs 114-115). Grey or brownish-olive with a characteristic pattern. In the median line of dorsal side often a light streak, crossed by transverse light streaks; sometimes only the transverse streaks are well visible; they occupy annuli 7-11 or 7-12. This pattern may be divided into segmentally repeated cross-shaped spots or into 3 longitudinal rows of round spots: 1 median and 2 lateral. Rarely dorsal side uniformly coloured. Ventral side lighter. The segmental pattern is less pronounced when the ventral side is uniformly coloured. The number of segmentally repeated streaks or spots is 19 or 20, depending on how distinct is the last streak, adjacent to the posterior sucker. On trachelosome 6 streaks. Sometimes there is an impression of another, very narrow streak, just posterior to the anterior sucker. On urosome 12 or 14 streaks. The coloration depends on the combination of numerous, superficially situated, fine light brown, stellate pigment cells, and deep situated black-brown large star-shaped pigment cells. Yellow pigment cells are of little significance in the general coloration. The large black-brown pigment cells are distributed below the layer of longitudinal muscles in the mesenchyme, on proboscis, male efferent ducts (seminal vesicles, terminal sections of ejaculatory ducts). Depending on physiological condition, they are either round with few processes, or form a network of thin processes. The deeply situated cells form two longitudinal lateral rows of segmentally distributed spots connected by narrow "bridges" within rows, the rows being unconnected.

Eyes. On anterior sucker 2 pairs of eyes of equal size, first pair centrally located, on posterior sucker up to 12, rarely 14 eye-like spots. Radial streaks narrow, but well visible (fig. 114).

Segmentation (fig. 118). Annuli poorly visible, mid-body somite of 14 annuli in 4 groups of different length: annulus 11 the longest; 6 somewhat shorter; 1, 2, 3, 7, 9, 10 and 12 short; 4, 5, 8, 13 and 14 the shortest. Papillae (sensillae, tangoreceptors) absent.

Alimentary tract (figs 119-121). Proboscis base at the level of ganglion 3. Crop splanchnomeres of 5 unequal diverticles: the first larger and broader, divided in four barely discernible secondary diverticles, and four small and narrow diverticles. Intestine poorly developed, not covering completely the posterior crop caecum, walls folded; 4 large diverticles, the 5th small.

Reproductive system (figs 122-124). Gonopores separated by 5 annuli. Male gonopore larger, female gonopore smaller, both well visible. Copulatory area as a narrow, well marked ellipse, parallel to the body long axis. Spermatheca opening

distinct in the centre of the area. Male reproductive system. 6 pairs of testes. Seminal vesicles as simple loops with a single bend, situated longitudinally relative to trachelosome at the level of half distance between testes 1 and 2 or at the level of testes 2. Vasa deferentia straight, not coiled. Ejaculatory ducts narrow, elongated half-loop towards anterior part of trachelosome, reach ganglion 4. On atrium prostatic glands well developed as large lobes. Female reproductive system. Ovaries elongate, cylindrical, long, their distal ends touch testes 2. Oviducts open to female gonopore anterior to vector tissue. Vector tissue as an elliptical large plate, parallel to the body long axis. Conducting strands as short, narrow strands of fibres connecting each ovary with anterior part of vector tissue.

DISTRIBUTION

A transpalaearctic species, distributed in whole Palaearctic (Eurasia) and partly in Nearctic, where it was no doubt introduced with its host - carp. It is also found in brackish parts of the Caspian, Azov and Baltic Seas.

BIOLOGY

On many fish species of various orders and classes, rather a low host-specificity; it was recorded from 30 marine and freshwater fish species in Europe, including *Agnatha - Lampetra planeri* (BLOCH) (DOMBROWSKI 1953, IVASIK 1953, JUNG 1955b, KAMIENIEV 1957, RESHETNIKOVA 1957, SHEVCHENKO 1967, JAŻDŻEWSKA 1966, PAWŁOWSKI 1968). Most often on body surface and fins, less often in oral and gill cavities. It is tolerant with respect to many environmental factors, hence it inhabits a variety of habitats. Its best habitats are cool ponds, lakes and rivers with abundant submerged vegetation and numerous fishes (TEREKHOV 1968c). It has higher oxygen requirements than most freshwater species (MANN 1955, 1956, 1961) and its habitat preferences are associated with good oxygenation or low temperature (MATYSIAK 1967, 1976). Thus it is impossible to find it in a stagnant water of fish ponds where other fish leeches - *H. marginata* - prosper. *P. geometra* does not tolerate well temperatures exceeding 28 °C (TEREKHOV 1967b), but can inhabit warm springs where water has a temperature of 18-20 °C throughout the year (DANIYAROV 1975). When possible, it also attacks amphibians (JUNG 1955b) and feeds on fish eggs (RICHARDSON 1948).

P. geometra shows a positive geotactism and negative phototactism, and consequently assumes its resting position close to the bottom among submerged plants or on stones close to the shore (HERTER 1929; BENNIKE 1943). Hungry individuals are especially susceptible to water turbulence or a moving shadow of a swimming fish (fig. 14). This kind of stimulation (swimming fish) sometimes induces swimming but more often only extensive "examining" and worm-like movements. The immediate consequence of a contact with fish is attack with the sucker. Recognition of an adequate host is effected chemotactically, following contact (HERTER 1929e). The leech attaches with its anerior sucker and moves along the fish till it finds a proper place to feed. Such places may be everywhere on the body, including gill lamellae (BAŻAL et al. 1969).

During feeding the leech attaches to the host with both suckers and inserts its proboscis into capillary vessels. The process may last for an hour in large individuals (film: Westheide 1978, 1981a, b). A result is a possibility of infection.

Contrary to *H. marginata*, fed *P. geometra* may stay on the fish for a time, dangling on its posterior sucker. It make take consecutive meals, but usually a satisfied leech leaves its host within 7 days after feeding (Herter 1929). Young individuals feed every few days, larger specimens feed every 8-14 or more days (Malecha 1979). Satisfied adults may survive without food for 3-4 months at 10-15 °C and 6 months at 6 °C (Elliott and Mann 1979).

Life cycle of *P. geometra* was summarized by Bauer (1961), Terekhov (1966a, 1967b, 1968a, b, c), Halvorsen (1972), and Malecha (1979). The reproductive period is fairly long, from the end of February till September or October. Since two generations hatch during the year, the life cycle is relatively short, not longer than 7 - 9 months. The winter generation starts laying cocoons at the end of February and soon the peak of cocoon-laying is reached. The parental population disappears between April and June, and is replaced by individuals of summer generation, which hatch in May. Individuals of the summer generation spend 15-20 days in cocoon, require 1-2 months to reach sexual maturity, and 3-4 months till active reproduction. Copulation takes place through the exchange of spermatophores in the specialized ventral region - copulatory area (film: Westheide 1981a, b). The summer generation, which is generally not attached to fish hosts, starts reproduction in June and terminates it in September.

Cocoons are continuosly laid throughout a period which depends on water temperature. At 25, 20 and 10 °C the leech lays cocoons during 11, 13 and 19 weeks, respectively. At such temperatures the mean number of cocoons per individual amounts to 54, 54 and 45, respectively.

The next, winter, generation hatches in September and attaches to fish, where it stays during most of the winter, accumulating reserves in fat cells. From September till January the winter generation does not reproduce. The reproductive inactivity during the winter is controlled by inhibiting hormones from the suboesophageal region of cephalic ganglion. Inhibitor secretion is affected by such factors as light and temperature. The reproductive activity is switched off in the autumn by 12-hour light period at 15 °C. Individuals of the winter generation are larger (up to 70 mg) than those of the summer generation (up to 20 mg), because of the inhibited reproduction during winter months.

Cocoons are attached to submerged plants or a solid substratum e.g. stones or mollusc shells (Dyk 1963, Terekhov 1968b, Bennike 1943, Eliot and Mann 1979, Malecha 1979a). Egg development depends on temperature and lasts 14, 24 and 80 days at 25, 15 and 5 °C, respectively (Schmidt 1921, Trerekhov 1968b, Malecha 1979a, Malecha and Vinckier 1983). Newly hatched leeches may survive c. 3 weeks without feeding.

P. geometra and related species are often a plague of fish hatcheries and ponds (Plehn 1924, Wales and Wolf 1955, Safonov 1956, Bauer 1961, Dyk 1963, Goregljad 1965, Migała 1971, Bohl 1973, Van Duijn 1973, Roberts and Shepherd 1974, Bielecki 1976, Dykova and Lom 1978). Energy requirement of fish hosts is

2.24 cal/mg (wet mass) per leech per week (MACE and DAVIS 1972). Effective measures against adult leeches include use of various esters and phosphoric acids. Prophylactics against cocoons and adults consists in pond liming. Cocoons are very resistant to chemical means. Likewise, marine fishes are sometimes killed or attacked by piscicolids in epidemic proportions (BADHAM 1916; SAWYER and HAMMOND 1973).

Piscicola witkowskii sp. n.

(Figs 125-135; Table 1)

TYPE MATERIAL

Holotype: Poland, Darłowo near Jeżyczki, Grabowa River, 21, 27-VIII-1990, from *Salmo trutta trutta* L., leg. A. WITKOWSKI and J. KUSZNIERZ, 7 paratypes: same data. Holotype - Museum of Natural History, Wrocław University; paratypes - author's collection.

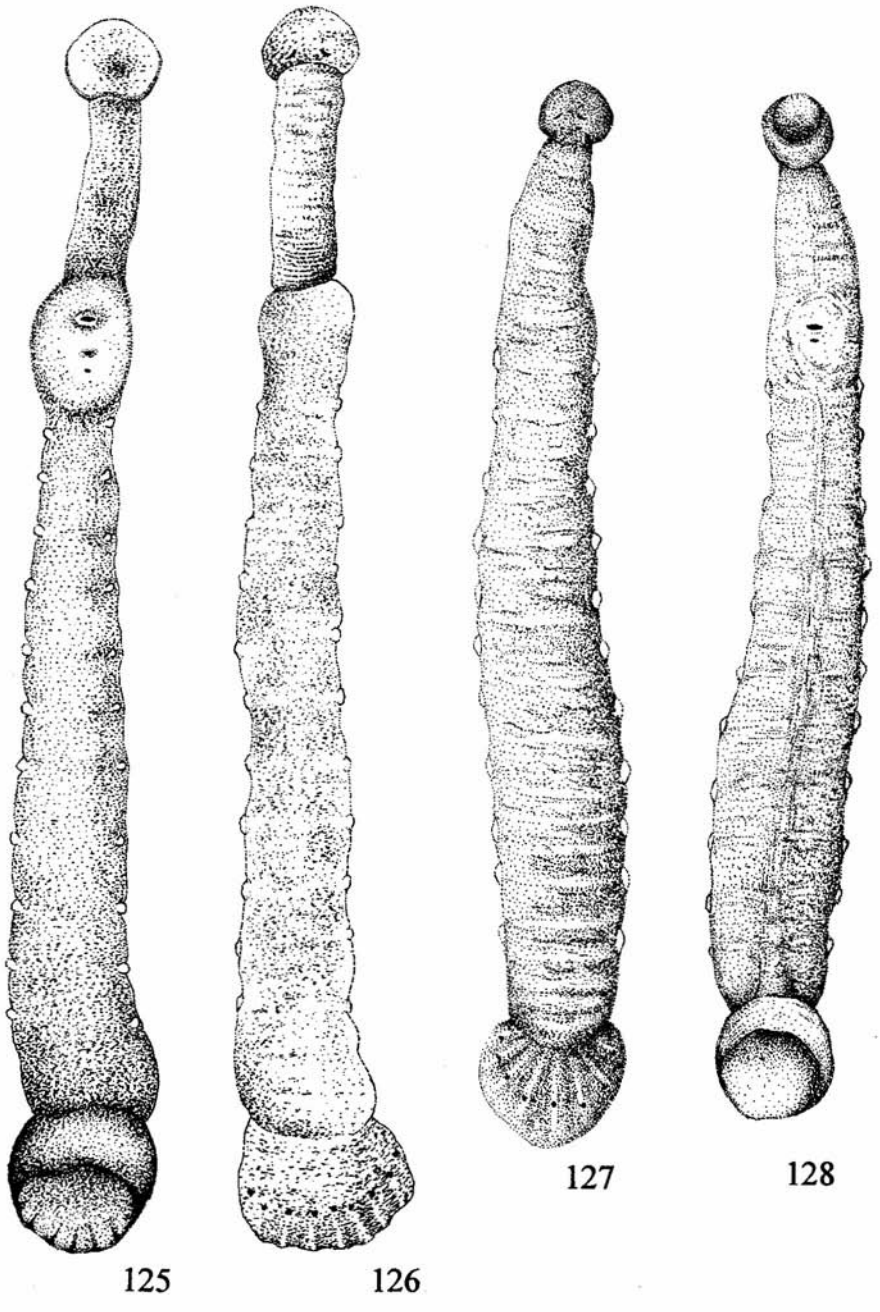
DIAGNOSIS

Considering morphotypes of all analysed species, also of other genera, in its body form *P.witkowskii* sp. n. is most similar to *P. pojmanskae* (fig. 34). Considering only morphotypes of members of the genus *Piscicola*, it is also most similar to *P. pojmanskae* in the cylindrical body cross-section and lack of division into trachelosome and urosome (fig. 243).

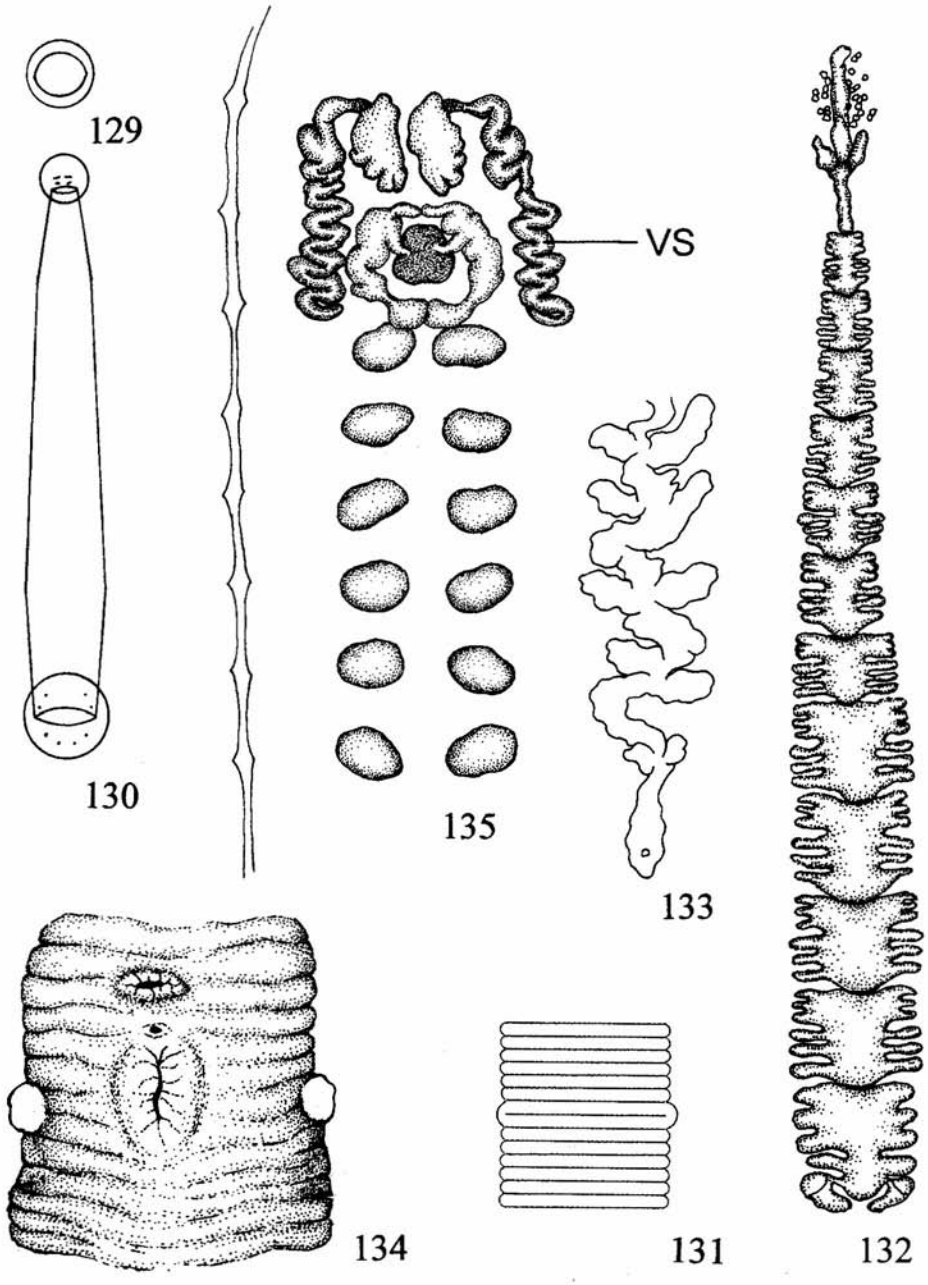
It differs from *P. pojmanskae* in larger anterior and posterior suckers (in *P. pojmanskae* suckers smaller) and round posterior sucker (in *P. pojmanskae* sucker longer than wide).

In its non-metric characters *P. witkowskii* sp. n. is most similar to *P. kusznierzi* sp. n. (fig. 35). Both share the following characters: copulatory area as a long, well marked ellipse parallel to the body long axis, spermatheca opening at the level of the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 4 unequal diverticles, diverticle 1 longer, further divided in 3 secondary diverticles. Intestine poorly developed, with strongly folded walls, prostatic glands very large, well developed, ejaculatory ducts reaching ganglion 5, 6 pairs of testes, seminal vesicles reaching testes 1, ovaries cylindrical, short, reaching testes 1, their posterior ends between testes, free, not intertwined, conducting strands short, enter mid part of vector tissue.

The new species differs from *P. kusznierzi* in the following characters: papillae (sensillae, tangoreceptors) absent (in *P. kusznierzi* very numerous, on all somite annuli) mid-body somite of 14 equal annuli (in *P. kusznierzi* 14 unequal annuli) gonopores separated by 2 annuli (in *P. kusznierzi* 4 annuli), ejaculatory ducts 4 times bent (in *P. kusznierzi* once sharply bent), vasa deferentia slightly coiled (in *P. kusznierzi* very strongly coiled), seminal vesicles as transverse rods (in *P. kusznierzi* bent over 10 times), vector tissue close to well marked ellipse parallel to the body long axis (in *P. kusznierzi* vector tissue triangular), conducting strands narrow (in *P. kusznierzi* wide).



125-128. *Piscicola witkowskii* sp. n.: 126-127 - dorsal view, 125, 128 - ventral view.



129-135. *Piscicola witkowskii* sp. n.: 129-130 - body form, 131 - somite, 132-133 - alimentary tract, 134-135 - reproductive systems.

ETYMOLOGY

Dedicated to Prof. dr hab. Andrzej WITKOWSKI, who deserves special thanks.

DESCRIPTION

Body shape and size as in figs 125-128 and Table 1. Body length 6.7-12.7 mm. L/D_2 - 6,5, C^1_1/d_1 - 1.8, C^1_1/D_1 - 1.0, R_1/M_1 - 3.0, C^1_1/C_1 -1.0, L_1/D_1 - 2.2, D_1/N_1 - 1.1, S_1/S_2 - 1.5, L_2/D_2 - 5.2, D_2/N_2 - 1.2, K_1/K_2 - 2. 9, C^1_2/d_7 - 1.3, C^1_2/D_2 - 1.0, R_2/M_2 - 1.0, C^1_2/C_2 - 1.0, L_2/L_1 - 3.9, D_2/D_1 - 1.7, N_2/N_1 - 1.6, C^1_2/C^1_1 - 1.7.

Body form (figs 129-130). Division into trachelosome and urosome not or only poorly marked. Body in cross section cylindrical, gradually widening towards posterior sucker. Anterior and posterior sucker round, posterior deep, cup-like.

Body coloration (figs 125-128). Uniformly brown, ventral side lighter, copulatory area completely white. Brown colour results from densely arranged brown melanophores in the form of fine dots. On anterior and posterior parts of urosome somites, and often also on vesicular annuli, irregular, dark transverse streaks. The streaks result from the presence of darker pigment cells (black or dark brown). Black melanophores have a shape of shorter or longer dashes. No characteristic stellate melanophores. Anterior sucker uniformly coloured, more intensely brown than trachelosome and urosome. On posterior sucker 14 very wide, dark brown streaks and 14 very narrow white streaks.

Eyes. On anterior sucker 2 identical pairs, in the form of very small black dots. On posterior sucker about 10 eye-like spots, located between radial streaks (figs 126-127).

Segmentation (fig. 131). Mid-body somite of 14 equal annuli. Respiratory vesicles small, white (11 pairs) but well visible.

Alimentary tract (figs 132-133). Mouthpore situated centrally. Proboscis base at ganglion 3. Oesophageal glands small and narrow. Crop built of 7 splanchnomeres, each of 4 unequal diverticles, first somewhat longer than the remaining three which are of equal length, further divided into 3 secondary diverticles. Intestine poorly developed, with strongly folded walls, almost completely covering posterior crop caecum, it has 5 pairs of diverticles: 4 pairs large and well developed, the 5th small.

Reproductive system (figs 134-135). Gonopores separated by 2 annuli. Male gonopore larger, female gonopore smaller, both well visible. Copulatory area as a well marked ellipse, parallel to the body long axis, occupies 1/4 of first somite of urosome. Spermatheca opening distinct in the centre of the area, female gonopore 2 annuli behind it. Male reproductive system. 6 pairs of testes. Seminal vesicles, with posterior ends almost reaching testes 1, have ca. 10 bends situated transversely to the body long axis. Vasa deferentia very short, thus it is difficult to say if they are straight or coiled, but they seem to be slightly coiled. Ejaculatory ducts characteristic, thick, multiply bent (5 or 6 times), their apices reach ganglion 5. Besides the first pair which is located rather parallel to anterior part of trachelosome, the bends are transverse. On atrium prostatic glands well developed as large lobes. It should be stressed that all the components except for testes and prostatic glands are difficult to distinguish, since they have almost equal diameter. Female reproductive system. Ovaries cylindrical,

elongate, short, touch testes 1, their distal ends have characteristic constrictions, not intertwined. Vector tissue as an elliptical small plate, parallel to the long body axis. Conducting strands as short, narrow strands of fibres connecting each ovary with the mid part of vector tissue. Oviducts enter female gonopore just anterior to vector tissue. The latter has a shape of elliptical plate parallel to the body long axis, posterior to oviduct outlet.

DISTRIBUTION

NW Poland, Baltic Coast.

BIOLOGY

The leeches were found on fins and body of the sea trout, *Salmo trutta trutta* L., 62 cm.

Piscicola annae sp. n.

(Figs 136-145; Table 1)

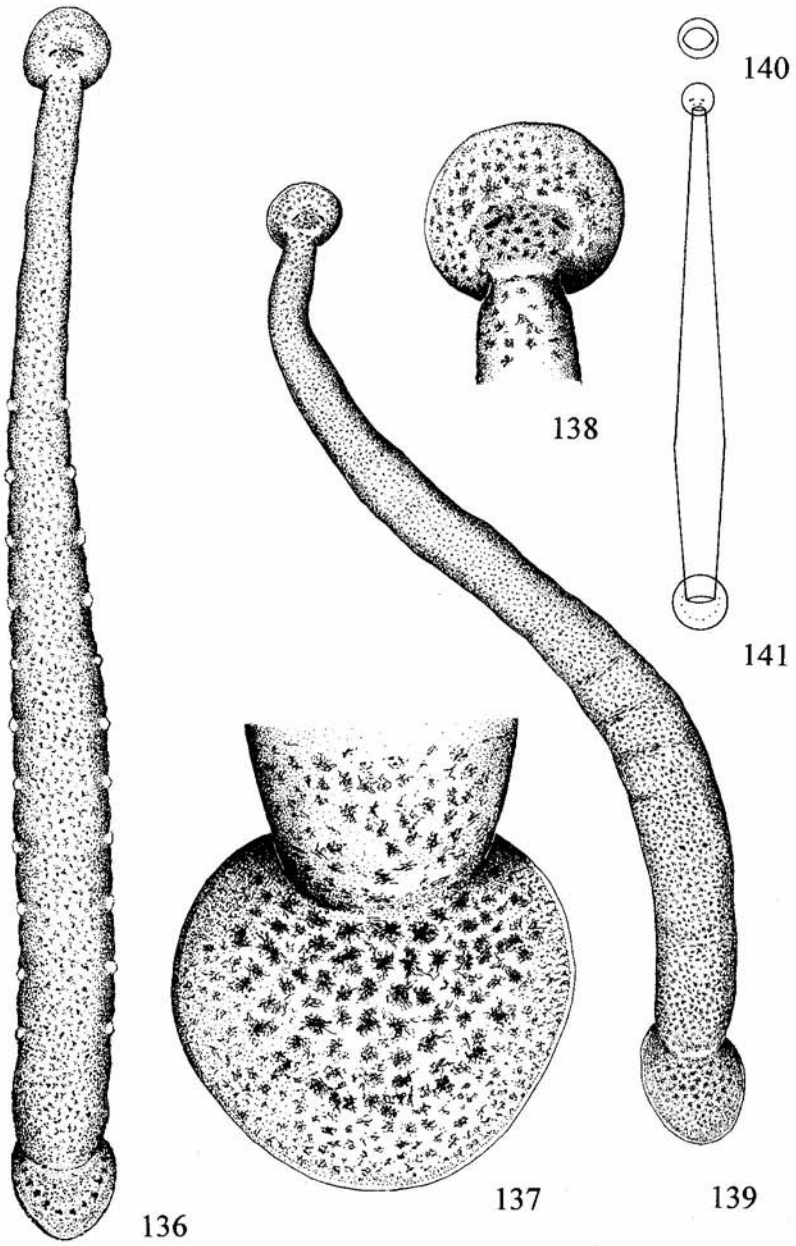
TYPE MATERIAL

Holotype: Poland, Lędyczek near Czarne, rivers Czernica and Gwda, 13-II-1987, from *Salmo trutta fario* L., leg. S. CIOS, 26 paratypes: same data. Holotype deposited at the Museum of Natural History, Wrocław Uniwersity; paratypes - author's collection.

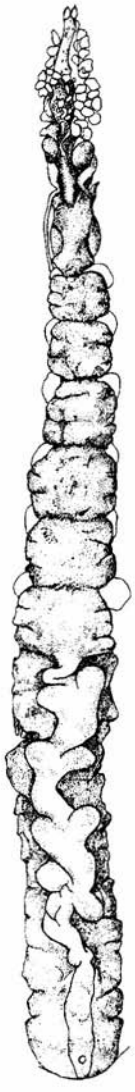
DIAGNOSIS

Considering morphotypes of all the analysed species, and also other genera, in its body form *P. annae* sp. n. is most similar to *P. jarai* sp. n., less so to *P.geometra* (fig. 34). Considering only morphotypes of members of *Piscicola*, it is very similar to *P. jarai* (fig. 243). It differs from *P. jarai* sp. n. in a cylindrical trachelosome and urosome section, smaller posterior sucker (ratio of horizontal diameter of posterior sucker to the largest body width).

It is non-metric characters *P. annae* sp. n. is most similar to *P. geometra* (fig. 35). Both share the following characters: papillae (sensillae, tangoreceptors) absent, copulatory area as an ellipse parallel to the body long axis, spermatheca opening at the level of the first pair of respiratory vesicles, intestine poorly developed, prostatic glands well developed, ejaculatory ducts bent towards anterior part of trachelosome, vasa deferentia straight, not coiled, seminal vesicles classically U-shaped, 6 pairs of testes, ovaries long, reaching testes 2, their posterior ends between testes, intertwined, ovaries cylindrical, vector tissue as elliptical plate longitudinal relative to body long axis, conducting strands short, narrow, entering mid part of vector tissue. *P. annae* sp. n. differs from *P. geometra* in the following characters: somite 14-annulate, all annuli of equal length (in *P.geometra* 14-annulate - 4 groups of annuli of different length), gonopores separated by 2 annuli (in *P.geometra* 5 annuli), splanchnomeres of 3 equal diverticles (in *P.geometra* splanchnomeres of 5 diverticles, diverticle 1 longer, further divided in 4 secondary diverticles), intestine walls not folded (in *P.geometra*



136-141. *Piscicola annae* sp. n.: 136, 139 - dorsal view, 137-138 - suckers dorsal view, 140-141 - body form.



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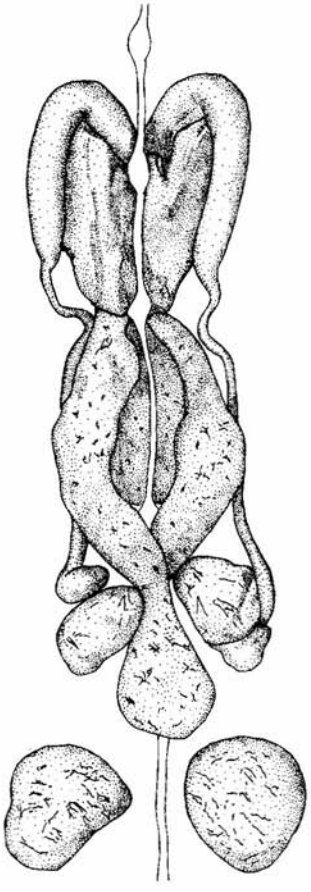

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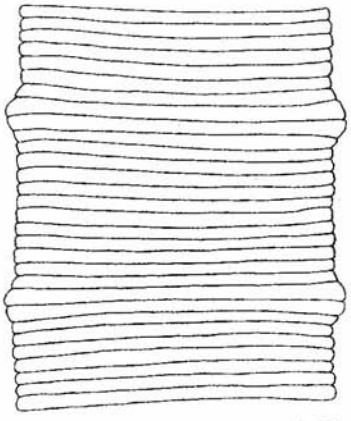

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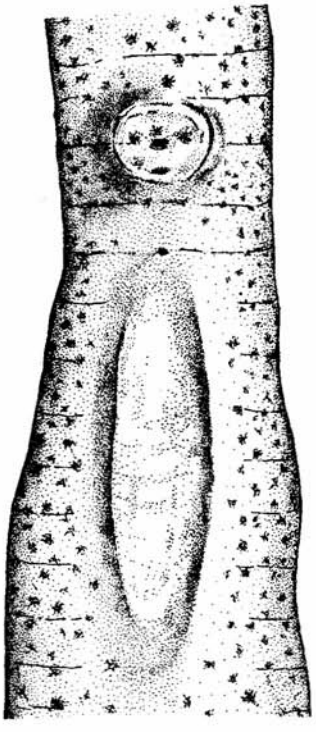

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142-145. *Piscicola annae* sp. n.: 142 - somite, 143 - alimentary tract, 144-145 - reproductive systems.

folded), ejaculatory ducts between ganglia 4 and 5 (in *P.geometra* at the level of ganglion 4), seminal vesicles reach testes 1 (in *P.geometra* they reach testes 2).

ETYMOLOGY

Dedicated to Prof. dr hab. Anna OKULEWICZ - an outstanding parasitologist.

DESCRIPTION

Body shape and size as in figs 136-139 and Table 1. Body length 56.7-23.2 mm, L/D_2 - 9.6, C^1_1/d_1 - 2.4, C^1_1/D_1 - 1.4, R_1/M_1 - 5.7, C^1_1/C_1 -1.0, L_1/D_1 - 5.3, D_1/N_1 - 1.0, S_1/S_2 - 0.9, L_2/D_2 - 7.3, D_2/N_2 - 1.2, K_1/K_2 - 1.2, C^1_2/d_7 - 1.7, C^1_2/D_2 - 1.0, R_2/M_2 - 1.3, C^1_2/C_2 - 1.0, L_2/L_1 - 3.2, D_2/D_1 - 2.3, N_2/N_1 - 1.9, C^1_2/C^1_1 - 1.6.

Body form (figs 140-141). Cylindrical and elongate, division into trachelosome and urosome not marked. Anterior and posterior suckers circular, not very deep, poorly muscled, their connection strongly eccentrical. Posterior sucker width equal or nearly equal to the largest body width.

Body coloration (figs 136-139). It results from the arrangement of two kinds of melanophores: brown and black, which produce a dark coloration, with no pattern. Whole body with suckers splashed densely and uniformly with dark brown or black, stellate pigment cells. Dorsal side darker, since melanophores of a thick body and long processes prevail. On ventral side fewer melanophores. On anterior sucker 2 white spots, first large semicircular, second much smaller, as a transverse band, just before sucker connection with trachelosome. On posterior sucker radial streaks absent.

Eyes. On anterior sucker 2 pairs of eyes of equal size, on posterior sucker up to 14 or 16 eye-like spots, which are large but poorly visible since they lie rather deep (figs 136- 139).

Segmentation (fig. 142). Mid-body somite of 14 annuli of equal length. Respiratory vesicles white (11 par), small but well visible. Papillae (sensillae, tangoreceptors) absent.

Alimentary tract (fig. 143). Mouthpore located centrally. Proboscis base situated at ganglion 3. Oesophageal glands well developed, round. Crop built of 7 splanchnomeres, each with 3 diverticles of equal length, no secondary diverticles. Intestine poorly developed, with gently folded walls, almost completely covering the posterior crop caecum, 5 pairs of diverticles: 4 pairs large and well developed, the 5th small.

Reproductive system (figs 144-145). Gonopores separated by 2 annuli. Male gonopore larger, female gonopore smaller, both well visible. Copulatory area in the shape of a narrow, well marked ellipse, parallel to the body long axis. Spermatheca opening distinct in the centre of the area. Male reproductive system. 6 pairs of testes. Seminal vesicles as short and thick bends, situated longitudinally relative to trachelosome at the level of testes 1. Vasa deferentia straight, not coiled. Ejaculatory ducts wide, elongated half-loop towards anterior part of trachelosome, do not reach ganglion 4 (most often they occupy half, less often three quarters distance between

ganglia 4 and 5). On atrium prostatic glands well developed as large lobes. Female reproductive system. Ovaries elongate, cylindrical, long, their distal ends intertwined, touch testes 2. They always pass testes 1 on their inner side. Anterior ends of ovaries (before passing into oviducts) cover vector tissue. Vector tissue as an elliptical large plate, parallel to the long body axis. Conducting strands as short, narrow strands of fibres connecting each ovary with the mid part of vector tissue.

DISTRIBUTION

SW Poland. Upper and mid course of the rivers Czernica and Gwda.

BIOLOGY

The leeches were found on fins and body of brown trout, *Salmo trutta fario* L., grayling, *Thymallus thymallus* (L.), rainbow trout, *Oncorhynchus mykiss* (WALBAUM), and pike, *Esox lucius* L. On the pike the leeches were fewer. Not found on gills and in gill cavity. The largest leeches were found in the second half of April; in May the fishes are devoid of them.

***Piscicola elishebae* sp. n.**

(Figs 146-153; Table 1)

TYPE MATERIAL

Poland, Lędyczek, Gwda River, 14-IV-1988, from *Salmo trutta fario* L., leg. A. BIELECKI, 3 paratypes: same data. Holotype deposited at the Museum of Natural History, Wrocław University, paratypes in author's collection.

DIAGNOSIS

See diagnosis of *P. margaritae* sp. n.

ETYMOLOGY

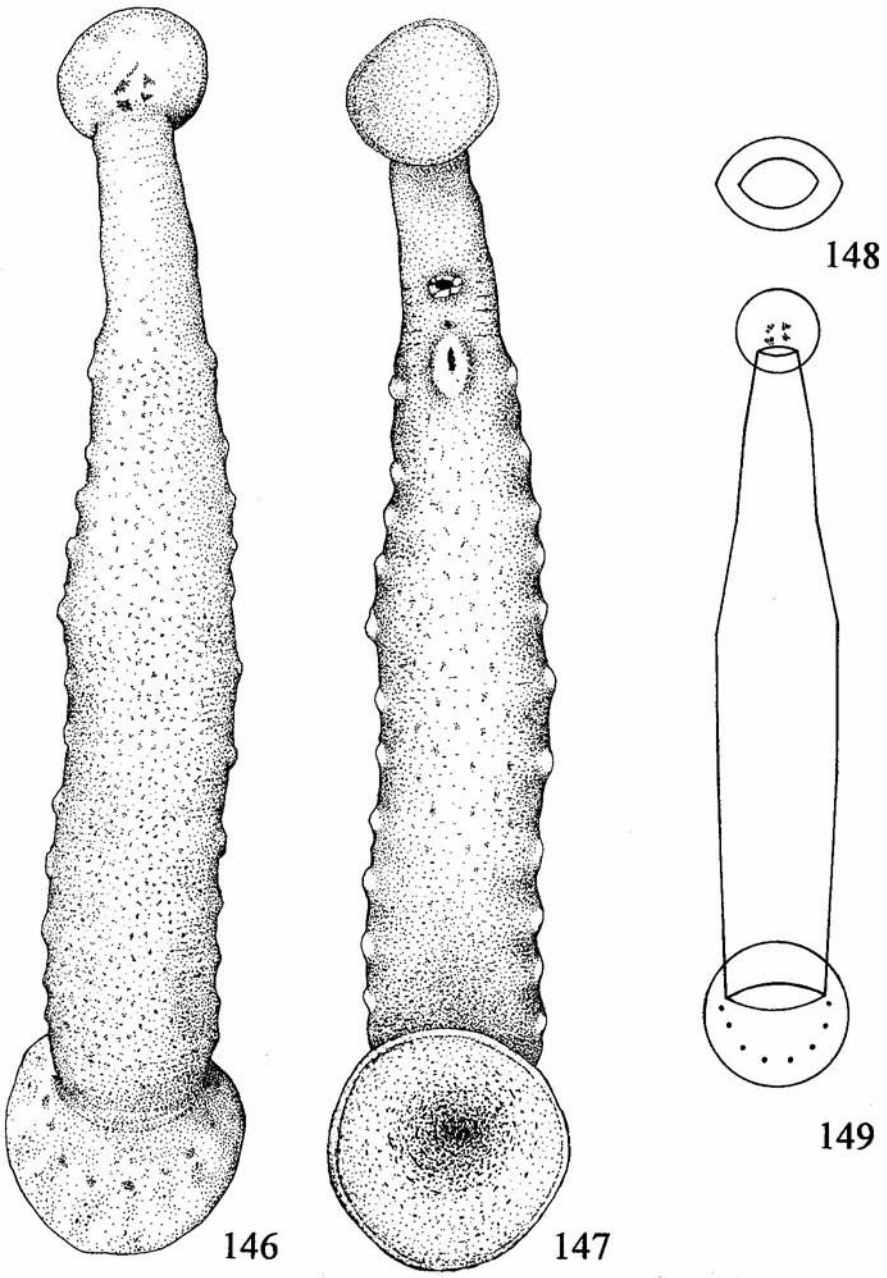
The new species is dedicated to Prof. dr hab. Elżbieta LONC, an outstanding parasitologist. Elżbieta - in Hebrew - Elisheba.

DESCRIPTION

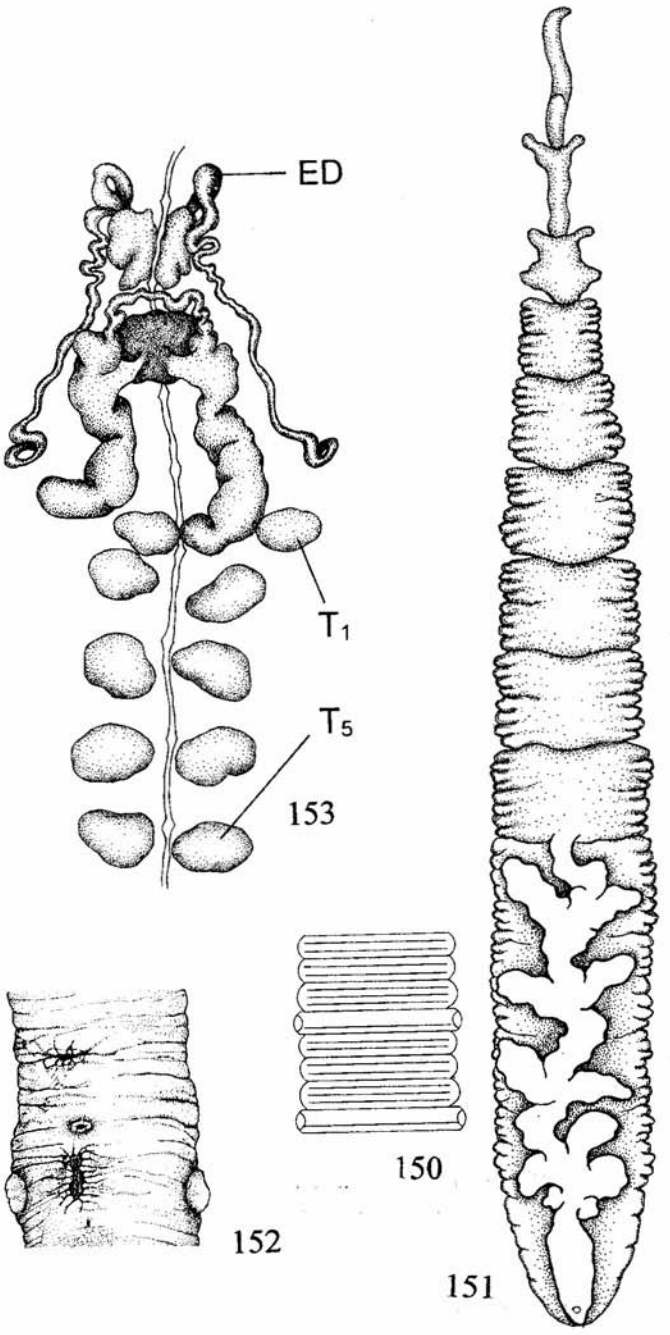
Body shape and size as in figs 146-147 and Table 1. Body length 11.4-11.7 mm. L/D_2 - 5.23, C^1_1/d_1 - 2.0, C^1_1/D_1 - 1.2, R_1/M_1 - 3.3, C^1_1/C_1 - 1.0, L_1/D_1 - 2.5, D_1/N_1 - 1.3, S_1/S_2 - 1.0, L_2/D_2 - 3.9, D_2/N_2 - 1.3, K_1/K_2 - 0.3, C^1_2/d_7 - 1.4, C^1_2/D_2 - 1.1, R_2/M_2 - 2.0, C^1_2/C_2 - 1.0, L_2/L_1 - 2.8, D_2/D_1 - 1.8, N_2/N_1 - 1.9, C^1_2/C^1_1 - 1.8.

Body form (figs 148-149). Division into trachelosome and urosome visible. Body short, rather cylindrical. Anterior and posterior suckers round, connected strongly eccentrically.

Body coloration (figs 146-147). It results from arrangement of light brown melanophores on a yellowish background. On trachelosome, urosome and suckers



146-149. *Piscicola elishebae* sp. n.: 146-147 - dorsal and ventral view, 148-149 - body form.



150-153. *Piscicola elishebae* sp. n.: 150 - somite, 151 - alimentary tract, 152-153 - reproductive systems.

melanophores in the form of very fine dots, along annuli. No transverse white streaks on trachelosome and urosome somites. Ventral side lighter because of a much lower number of light brown melanophores. On anterior sucker no spots, posterior sucker with white and light brown, poorly marked radial streaks, 14 of each kind. Light brown melanophores on suckers as fine dots with no processes.

Eyes. On anterior sucker 2 pairs of distinct large eyes - both similarly located, as irregular triangles, of almost equal size. On posterior sucker 10 eye-like spots situated in its central part on the edge of dark radial streaks (fig. 146).

Segmentation (fig. 150). Mid-body somite 4 (12)-annulate, annuli of unequal length: annulus 1 the widest, divided with very shallow grooves in 4 parts, 2 vesicular, divided in two parts of unequal length - the first much wider, annuli 3 and 4 of equal length and each divided in 3 parts. Lateral respiratory vesicles (11 pairs) not large, but well visible.

Alimentary tract (fig. 151). Mouthpore situated centrally. Proboscis base at ganglion 3. Oesophageal glands small. Crop of 7 splanchnomeres, each of 2 equal diverticles, further divided in 4 secondary diverticles. Intestine poorly developed, not covering completely posterior crop caecum, with strongly folded walls; it has 5 diverticles: the first four well developed, the fifth very small and poorly visible.

Reproductive system (figs 152-153). Gonopores separated by 3 annuli. Male gonopore large, female gonopore small, well visible. Copulatory area as an elongate ellipse, slightly encroaching on the first somite of urosome posterior to the first pair of respiratory vesicles. In the centre of copulatory area spermatheca opening. Male reproductive system. 5 pairs of testes (pair 1 absent). Seminal vesicles as single, circular, small loops, located near ganglion 7 (where testes 1 should be situated). Vasa deferentia slightly coiled. Ejaculatory ducts as 3 bends reaching half distance between ganglia 4 and 5. Female reproductive system. Ovaries long, reaching testes 2. Vector tissue as elliptical plate, transverse to the body long axis. Conducting strands as short, wide strands of fibres, connecting each ovary with vector tissue.

DISTRIBUTION

North-central Poland.

BIOLOGY

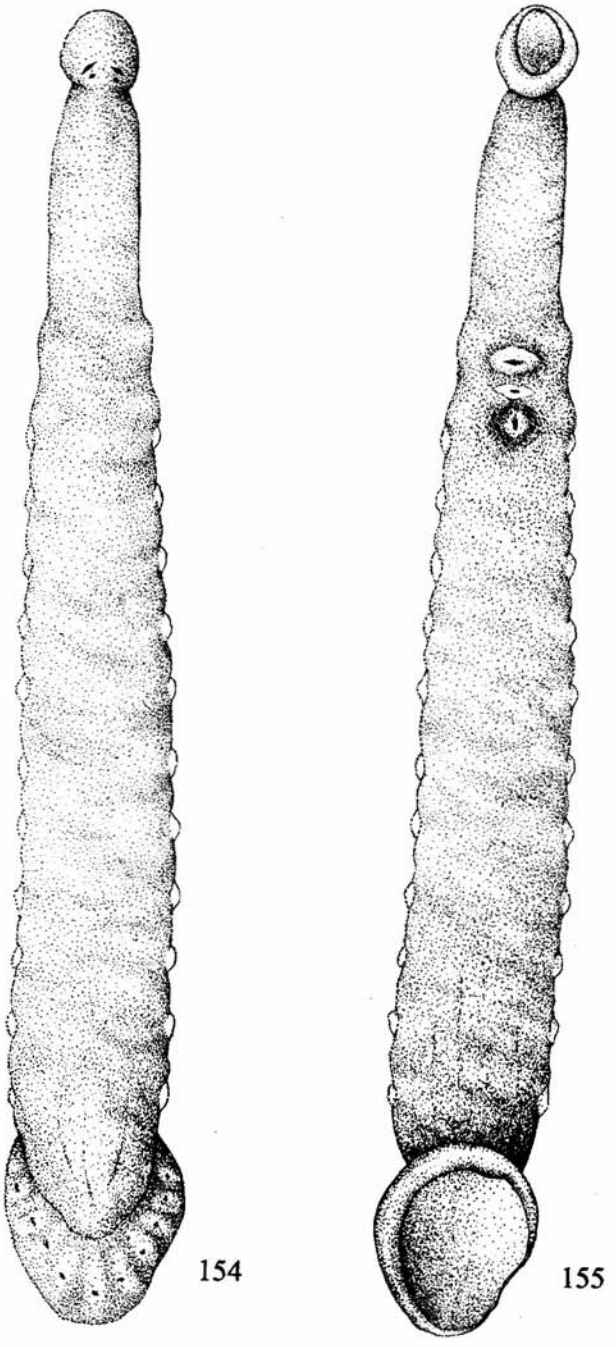
The leeches were found on caudal fins and body of brown trout, *Salmo trutta fario* L., 40 and 42 cm.

Piscicola pojmanskae BIELECKI, 1994

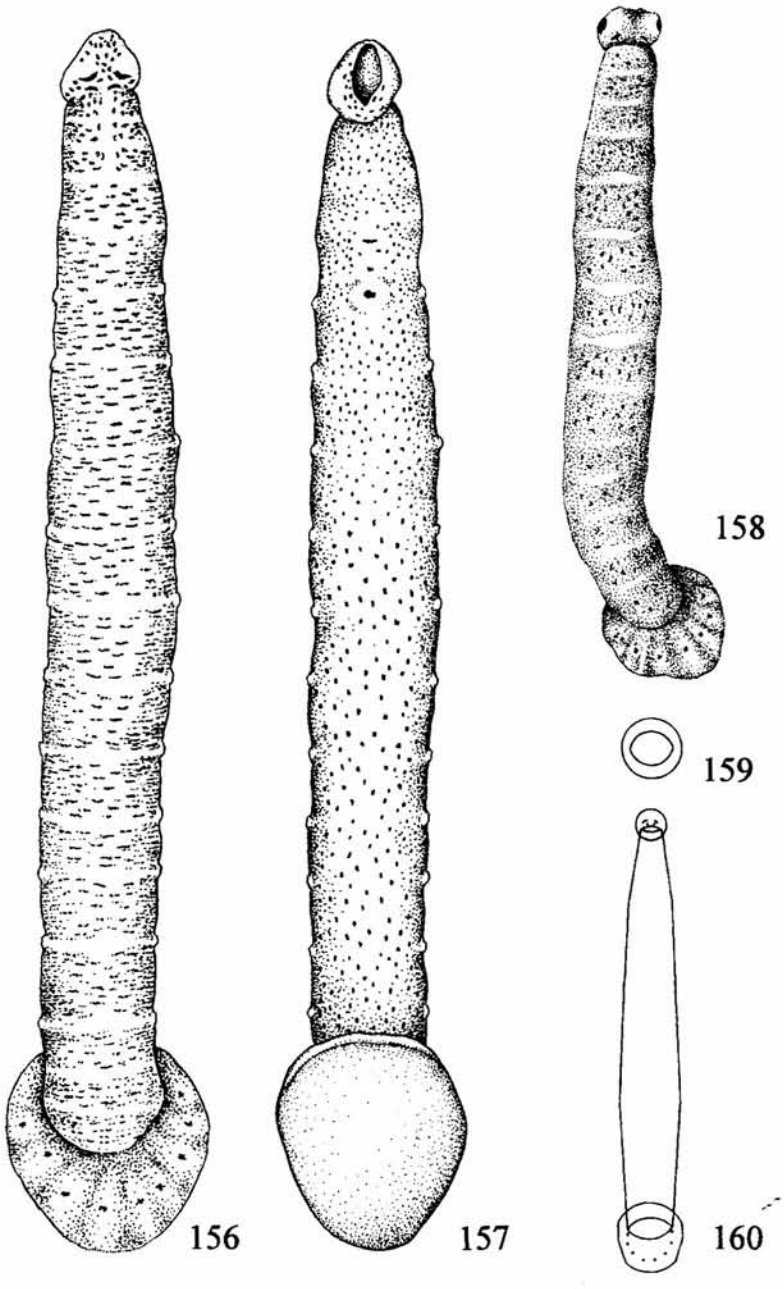
(Figs 154-167; Table 1)

MATERIAL EXAMINED

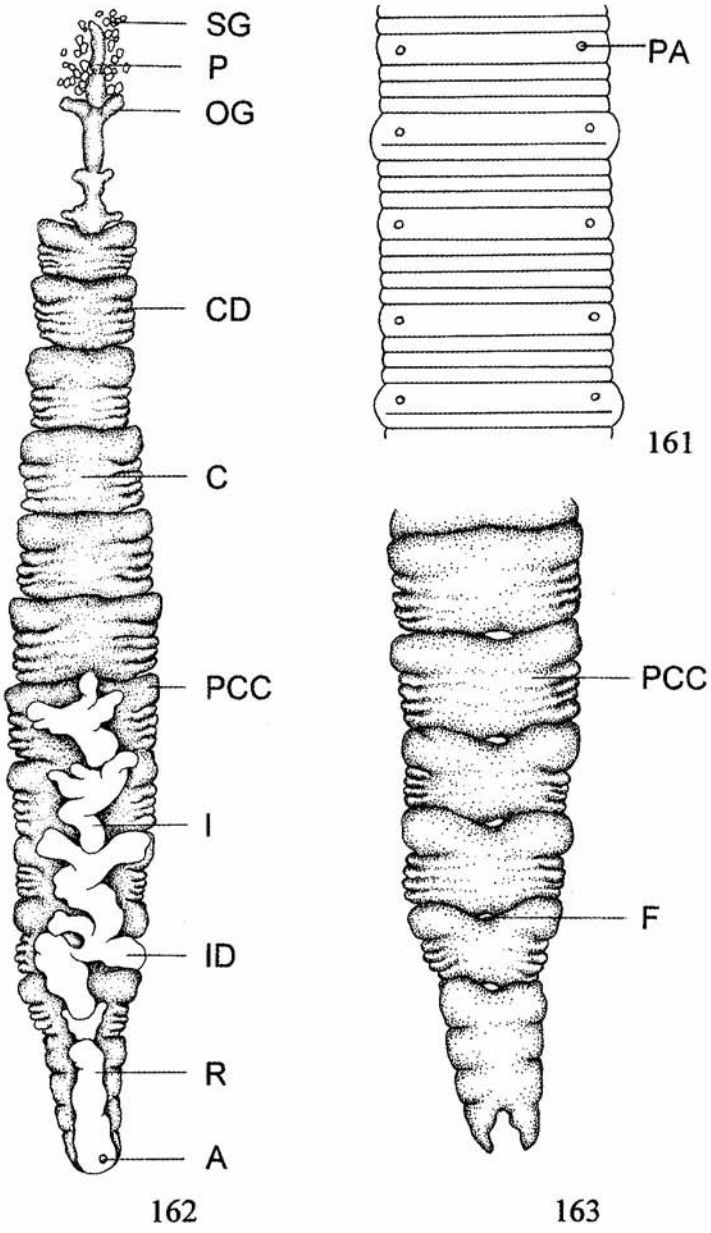
Poland, Przemków near Legnica, fish ponds, 7 specimens from *Cyprinus carpio* L., 14-II-1986, leg. A. BIELECKI; Żabieniec near Warsaw, fish ponds, 3 specimens from *Cyprinus carpio* L. and *Ctenopharyngodon idella* Val., 5, 7-IV-1989, leg.



154-155. *Piscicola pojmanskae*: 154 - dorsal view 155 - ventral view.



156-160. *Piscicola pojmanskae*: 156, 158 - dorsal view 157 - ventral view, 159-160 - body form.



161-163. *Piscicola pojmanskae*: 161 - somite, 162-163 - alimentary tract.

T. POJMAŃSKA; 16 specimens - border of Gorzów and Szczecin voyevodeships, fish ponds fed by the Ina River, on *Cyprinus carpio* L., 22-XII-1994, leg. J. BŁACHUTA; 12 specimens - Zegrzyński Reservoir 14-IX-1988 to 30-XII-1990, leg. K. HUMIĘCKI. Deposit of material - in author's collection.

Type locality: Przemków near Legnica, Poland.

DIAGNOSIS

See diagnosis of body form of *P. witkowskii* sp. n.

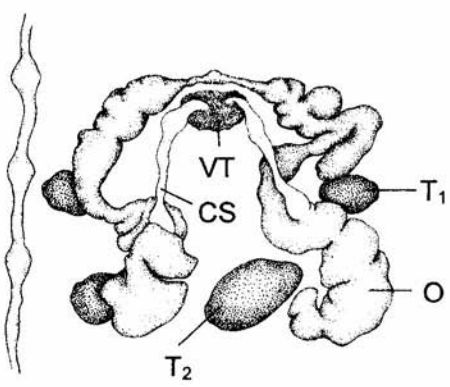
With respect to non-metric characters *P. pojmanskae* is not close to any species, which testifies to its peculiarity (fig. 35). It shows some similarity to a group of 4 species: *P. margaritae* sp. n., *P. elishebae* sp. n., *P. jarai* sp. n. and *P. pomorskii* sp. n. and is most similar to *P. margaritae* sp. n. Both share the following characters: spermatheca opening at the level of the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 5 unequal diverticles. Intestine poorly developed, with strongly folded walls, prostatic glands very large, well developed, vasa deferentia slightly coiled, 6 pairs of testes, seminal vesicles reaching testes 1, ovaries reaching testes 2, vector tissue as a well marked ellipse transverse to the body long axis, conducting strands narrow. It differs in the following characters: papillae (sensillae, tangoreceptors) present (in *P. margaritae* absent); copulatory area circular (in *P. margaritae* as a well marked ellipse, parallel to the body long axis); mid-body somite of 14 unequal annuli (in *P. margaritae* 14 equal annuli); gonopores separated by 6 annuli (in *P. margaritae* 5 annuli); ejaculatory ducts between ganglia 4 and 5, bent sharply once perpendicular to the body long axis (in *P. margaritae* reach ganglion 4, multiply bent); seminal vesicles classically U-shaped (in *P. margaritae* multiply bent); ovaries strongly looped, their posterior ends between testes free (in *P. margaritae* sac-like, located on testes); conducting strands very long, enter mid part of vector tissue (in *P. margaritae* long, enter anterior part of vector tissue).

DESCRIPTION

Body shape and size as in figs 154-158 and Table 1. Body length of 21.2-14.6 mm. L/D_2 - 6.67, C^1_1/d_1 - 1.1, C^1_1/D_1 - 0.7, R_1/M_1 - 2.7, C^1_1/C_1 - 0.8, L_1/D_1 - 2.1, D_1/N_1 - 1.1, S_1/S_2 - 2.2, L_2/D_2 - 5.3, D_2/N_2 - 1.0, K_1/K_2 - 1.8, C^1_2/d_7 - 1.4, C^1_2/D_2 - 1.0, R_2/M_2 - 2.2, C^1_2/C_2 - 0.9, L_2/L_1 - 4.0, D_2/D_1 - 1.6, N_2/N_1 - 1.6, C^1_2/C^1_1 - 2.5.

Body form (figs 159-160). Division into trachelosome and urosome poorly visible, but at a detailed examination it is clearly seen that the first pair of respiratory vesicles is situated just posterior to a slight constriction between the trachelosome and urosome. Body short, stout, cylindrical, somewhat flattened. Anterior sucker small elliptical or very small, deep, its longer diameter being parallel to the long body axis, and on all the perimeter has its margins curled inwards. Posterior sucker, eccentrically connected, whether straight or contracted, has a very characteristic form - it is elliptical or heart-shaped, very strongly muscled, fairly deep.

Body coloration (figs 154-158). It is little variable in adult and juvenile specimens. The pattern of dorsal side is formed of brown pigment cells, especially in the parts of somites that are devoid of respiratory vesicles. For this reason there are



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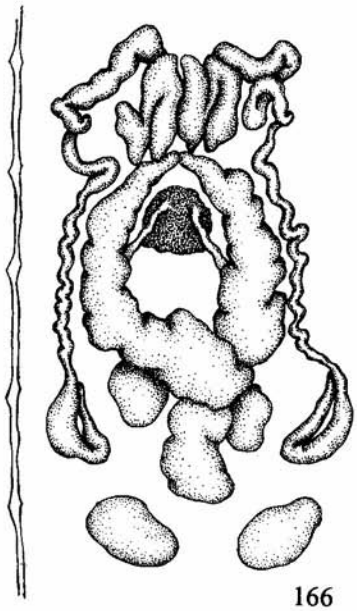

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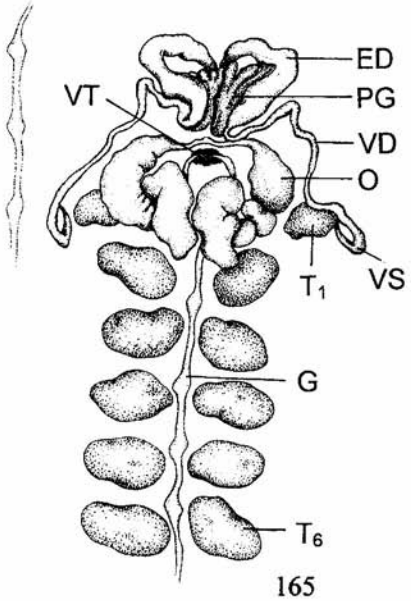

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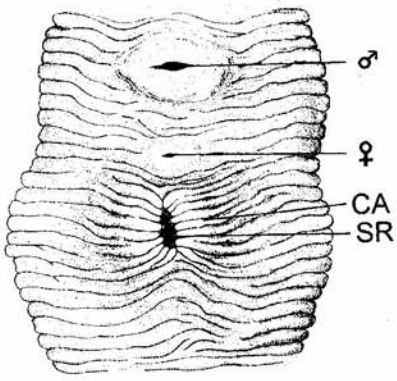


164

164-167. *Piscicola pojmanskae*, reproductive systems.

lighter, very narrow transverse streaks devoid of such cells in the region of vesicle-bearing annuli, and wide streaks with brown or black pigment cells. The cells are situated transversely relative to the body long axis, devoid of processes which are characteristic of stellate pigment cells e.g. in *P. geometra*. They are also situated inside, in the last layer of the dermal-muscular sac, in the same arrangement as on the dorsal side. Ventral side lighter, brown pigment cells prevail, white transverse streaks absent.

Eyes. On anterior sucker 2 pairs of eyes - the first much larger, linear in shape, arranged obliquely relative to the long body axis; the second pair, arranged transversely, small, in the form of dots. On posterior sucker 10 eye-like spots, situated in its central part on the borders between white and brown-black radial streaks (figs 154, 156, 158).

Segmentation (fig. 161). Mid-body somite of 14 annuli of unequal width: annuli 2, 6 and 11 longer than the remaining ones. All specimens have well distinct tubercles - tangoreceptors, their sequence being repeated on all the mid-body (14-annulate) somites. The largest and best visible tubercles occur on vesicular annuli (6th annulus of each somite), just next to respiratory vesicles; they are also well visible in the anterior and posterior body region, where the number of annuli per somite is reduced. Respiratory vesicles white (11 pairs), fairly small but well visible.

Alimentary tract (figs 162-163). Proboscis base between ganglia 1 and 3. Crop built of 7 splanchnomeres, each divided into 5 diverticles, the first diverticle being much broader and longer than the remaining ones and further divided into four smaller and shorter secondary diverticles. Intestine poorly developed, not covering completely posterior crop caecum, with folded walls; it has 5 diverticles: the first three pairs well developed, the fourth not much smaller, the fifth very small and poorly visible.

Reproductive system (figs 164-167). Gonopores well visible, separated by 6 annuli. Male gonopore very large, female gonopore much smaller. Copulatory area round or somewhat elliptical, and then parallel to the body long axis. Spermatheca opening distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes. Vasa deferentia with several bends just before joining ejaculatory ducts. Seminal vesicles with a single bend in the body long axis, situated at the level of testes 1. Ejaculatory ducts somewhat protruding beyond ganglion 5, thick and forming several loops; their proximal sections often transverse to the body long axis. Prostatic glands present on atrium. Female reproductive system. Ovaries strongly twisted and coiled, not cylindrical but polylobate, with posterior ends touching testes 2. When extended during dissection, they reach testes 3. Anterior ends of ovaries (before passing into oviducts) cover vector tissue. Vector tissue as a narrow ellipse, transverse to the body long axis. Oviducts open to female gonopore anterior to the vector tissue. Vector tissue as an elliptical narrow plate transverse to the body long axis. Conducting strands as long strands of fibres connecting each ovary with the mid part of vector tissue. Thus the space between the converging oviducts and testes 1 (ganglia 6 and 7) is partly unoccupied.

DISTRIBUTION

It is known only from four localities in Poland: Żabieniec and Zegrzyński Reservoir near Warsaw in the central part of the country, Przemków and Brodno near Legnica in the south-western part of the country.

BIOLOGY

Till now known only from fish ponds where it is a parasite of carp (*Cyprinus carpio* L.) and grass carp (*Ctenopharyngodon idella* VAL.); also silver carp (*Hypophthalmichthys molitrix* VAL.) and big head carp (*Aristichthys nobilis* RICH.) from fish ponds (POJMAŃSKA, pers. com.); on the body, fins and gills.

***Piscicola niewiadomskae* sp. n.**

(Figs 168-176; Table 1)

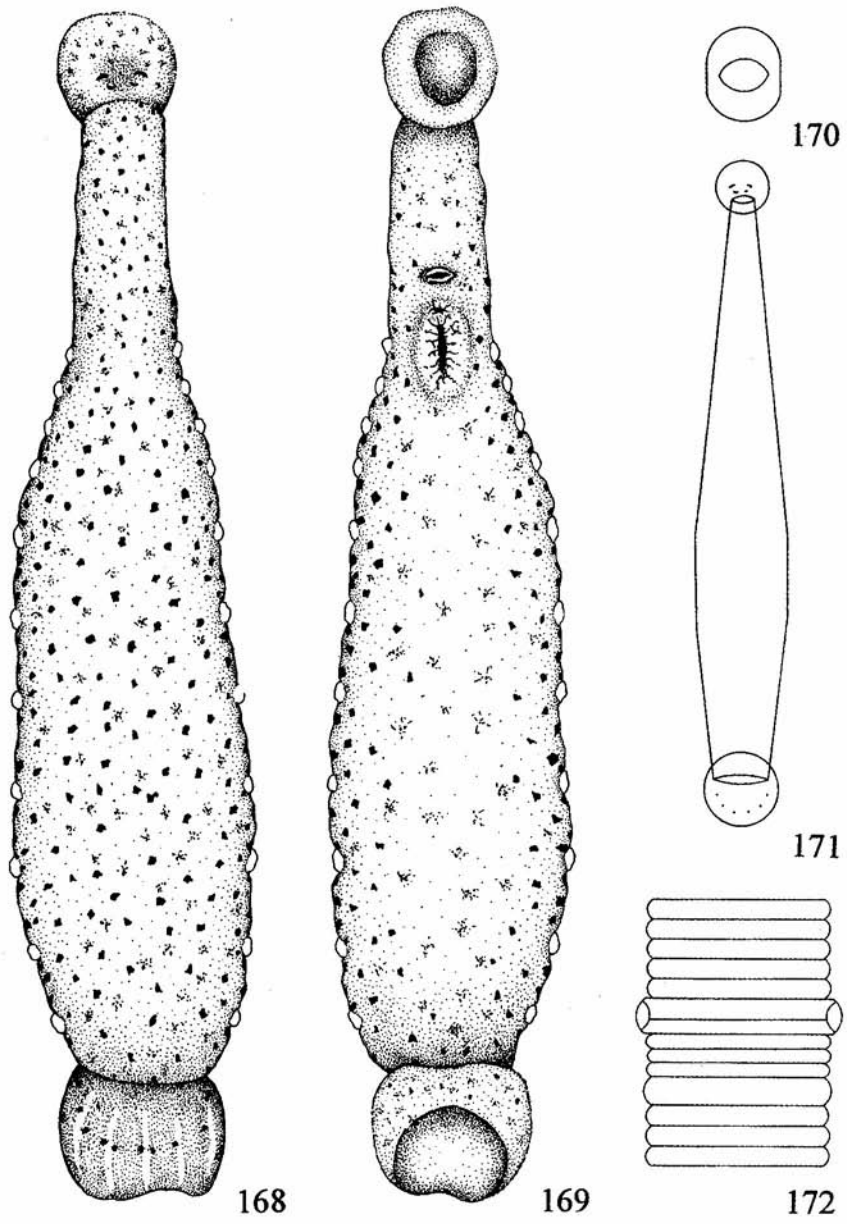
TYPE MATERIAL

Holotype: Poland, Chełst, Wel River, 9-IV-1995, from *Salmo trutta fario* L., leg. S. CIOS, 10 paratypes: same data. Holotype deposited at the Museum of Natural History, Wrocław University; paratypes - author's collection.

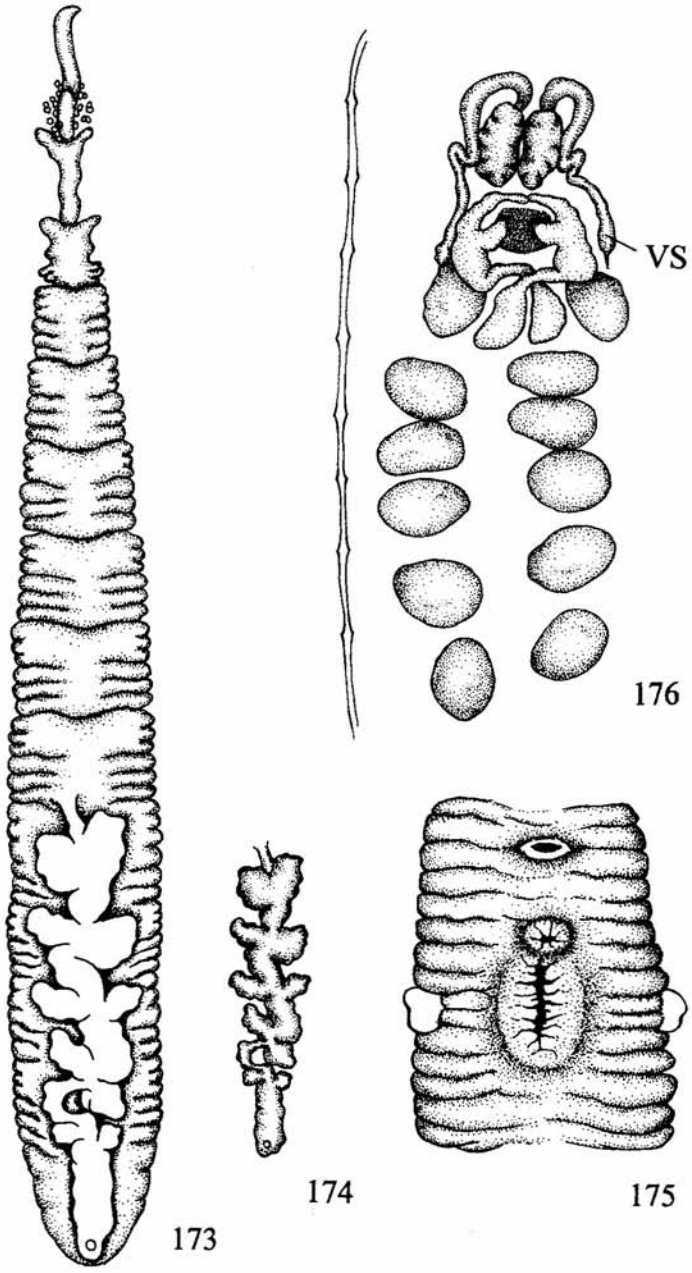
DIAGNOSIS

Considering morphotypes of all the analysed species, and also of other genera (fig. 34), in its body form *P. niewiadomskae* sp. n. is most similar to *C. fadejewi*. Considering only morphotypes of members of *Piscicola* it is most similar to *P. elishebae* sp. n. (fig. 243). Both have the following characters in common: flattening of trachelosome, anterior and posterior suckers round, their connections strongly eccentrical. It differs in the cross-section of urosome, which is a laterally flattened cylinder (in *P. elishebae* urosome dorso-ventrally flattened); posterior sucker smaller than the largest body width (in *P. elishebae* larger); division into trachelosome and urosome strongly marked (in *P. elishebae* less distinct).

With respect to non-metric characters, *P. niewiadomskae* is not directly close to any species, which testifies to its peculiarity. It shows some similarity to two species: *P. annae* sp. n. and *P. geometra*, but is more similar to *P. annae* (fig. 243). Both have the following characters in common: papillae (sensillae, tangoreceptors) absent, copulatory area as a well marked ellipse parallel to the body long axis, spermatheca opening at the level of the first pair of respiratory vesicles, intestine poorly developed, prostatic glands very large, well developed, ejaculatory ducts between ganglia 4 and 5, half-loop towards anterior part of trachelosome, vasa deferentia straight, not coiled, 6 pairs of testes, seminal vesicles reaching testes 1, ovaries cylindrical, long, reaching testes 2, their posterior ends between testes, conducting strands short, enter mid part of vector tissue. *P. niewiadomskae* differs from *P. annae* in the following characters: mid-body somite of 14 unequal annuli (in *P. annae* 14 annuli equal); gonopores separated by 4 annuli (in *P. annae* 2 annuli); crop and posterior crop



168-172. *Piscicola niewiadomskae* sp. n.: 168-169 - dorsal and ventral view, 170-171 - body form, 172 - somite.



173-176. *Piscicola niewiadomskae* sp. n.: 173-174 - alimentary tract, 175-176 - reproductive systems.

caecum splanchnomeres of 4 unequal diverticles (in *P. annae* of 3 equal diverticles); intestine walls strongly folded (in *P. annae* gently folded); seminal vesicles as rods situated parallel to the long body axis (in *P. annae* classically U-shaped); ovaries with posterior ends free, not intertwined (in *P. annae* strongly intertwined); vector tissue as a well marked transverse ellipse (in *P. annae* parallel); conducting strands wide (in *P. annae* narrow).

ETYMOLOGY

The new species is dedicated to Professor dr hab. Katarzyna NIEWIADOMSKA, an outstanding parasitologist, who has made me realize that the science develops not only through its immanent methods but also through breaking hostility towards its objects in the cognition process.

DESCRIPTION

Body shape and size as in figs 168-169 and Table 1. Body length 24.1-30.7 mm. L/D_2 - 6.13, C^1_1/d_1 - 2.2, C^1_1/D_1 - 1.3, R_1/M_1 - 4.0, C^1_1/C_1 - 1.1, L_1/D_1 - 3.1, D_1/N_1 - 1.3, S_1/S_2 - 0.9, L_2/D_2 - 4.8, D_2/N_2 - 0.9, K_1/K_2 - 0.9, C^1_2/d_7 - 1.3, C^1_2/D_2 - 0.8, R_2/M_2 - 2.0, C^1_2/C_2 - 1.1, L_2/L_1 - 3.5, D_2/D_1 - 2.3, N_2/N_1 - 2.9, C^1_2/C^1_1 - 1.4.

Body form (figs 170-171). Division into trachelosome and urosome distinct, trachelosome somewhat flattened, urosome very characteristic and species-specific, as a laterally flattened cylinder. First slight widening of urosome at the first pair of respiratory vesicles, second more distinct at the fourth pair. Anterior and posterior suckers round, very strongly muscled, fairly deep, connected somewhat eccentrically. Posterior sucker smaller than the largest urosome width. Anterior and posterior suckers of almost equal width, both deep.

Body coloration (figs 168-169). A uniform pattern (no transverse light streaks even in the region of vesicular annuli) formed by superficially situated brown melanophores, and deeper situated black melanophores. Brown melanophores stellate, with a small body, black melanophores polygonate. Ventral side lighter because of the smaller number of black melanophores which are located only paramedially. Anterior sucker also uniformly splashed with brown melanophores, which are darker and with short processes, their density in the mid part of the sucker forms a darker, round spot.

Eyes. Two pairs: first larger, as black dashes, second smaller as shorter dashes. Posterior sucker with 14 dark wide streaks and 14 very narrow light streaks, at the edge of dark streaks 10 eye-like spots (fig. 168).

Segmentation (fig. 172). Mid-body somite of 14 annuli of unequal length. Three groups of annuli: annulus 11 the longest; 1, 2, 3, 4, 5, 6, 12, 13, 14 not much shorter; 7, 8, 9 and 10 the shortest. Papillae (sensillae, tangoreceptors) absent. Respiratory vesicles fine but visible, 11 pairs.

Alimentary tract (figs 173-174). Mouthpore located centrally. Proboscis base at the level of ganglion 3. Oesophageal glands small and thin. Crop splanchnomeres of 4 unequal diverticles: the first larger and broader, divided in 3 barely discernible

secondary diverticles. Intestine poorly developed, not covering completely posterior crop caecum, walls folded; 4 large diverticles, of which the first 3 pairs are well developed, 4th pair not much smaller, the 5th small.

Reproductive system (figs 175-176). Gonopores separated by 4 annuli. Male gonopore large, female gonopore fairly large, very clearly visible, located at the beginning of copulatory area. Copulatory area elliptical, parallel to the body long axis. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes, vasa deferentia straight, short, not coiled. Seminal vesicles as short and thick rods, parallel to the body long axis, reaching testes 1. Ejaculatory ducts as gentle, roundish, semicircular bends in the plane of the body long axis, not reaching ganglion 4, they most often occupy 3/4 distance between ganglia 4 and 5. On atrium prostatic glands well developed in the form of lobes. Female reproductive system. Ovaries cylindrical, long, their distal ends almost touching testes 2, not intertwined, located between testes. Vector tissue as a well marked small ellipse, transverse to the body long axis. Conducting strands as short, wide strands of fibres connecting each ovary with the mid part of vector tissue.

DISTRIBUTION

NC Poland. Mid section of the Wel River.

BIOLOGY

The leeches were found on finds and body of *Salmo trutta fario* L., 39 and 42 cm long.

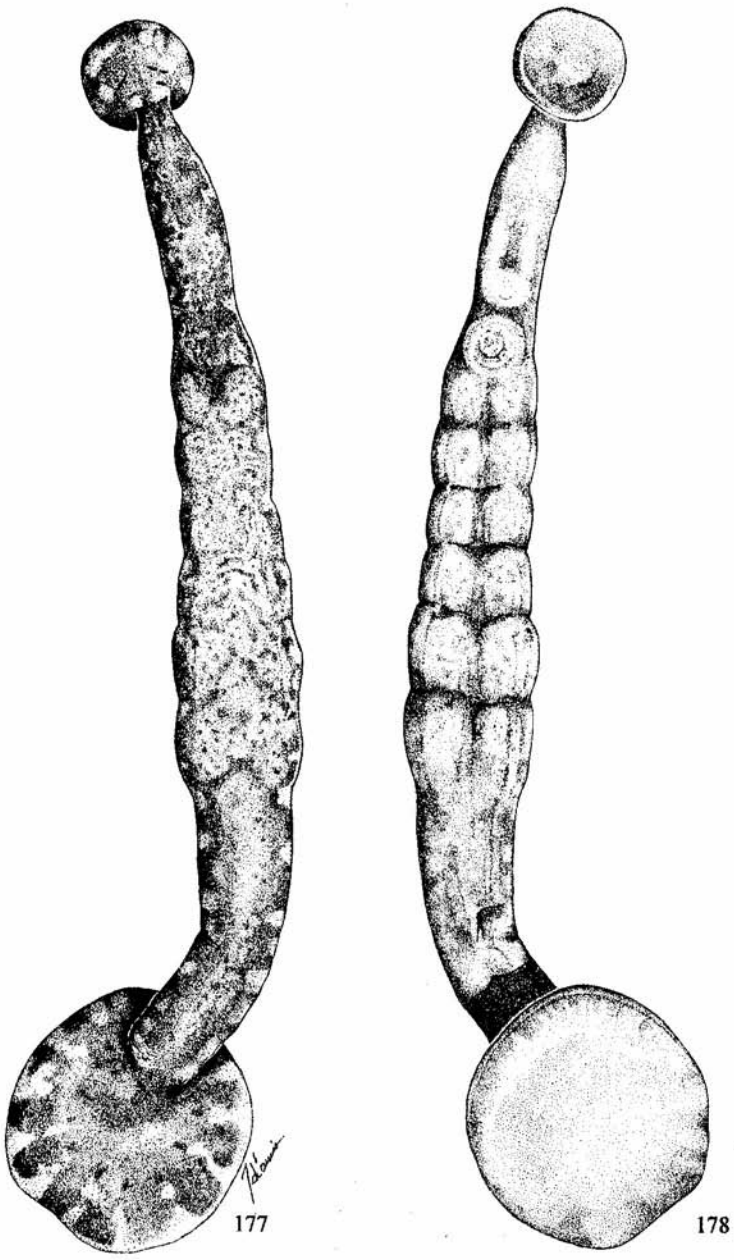
Piscicola fasciata KOLLAR, 1842

(Figs 177-187; Table1)

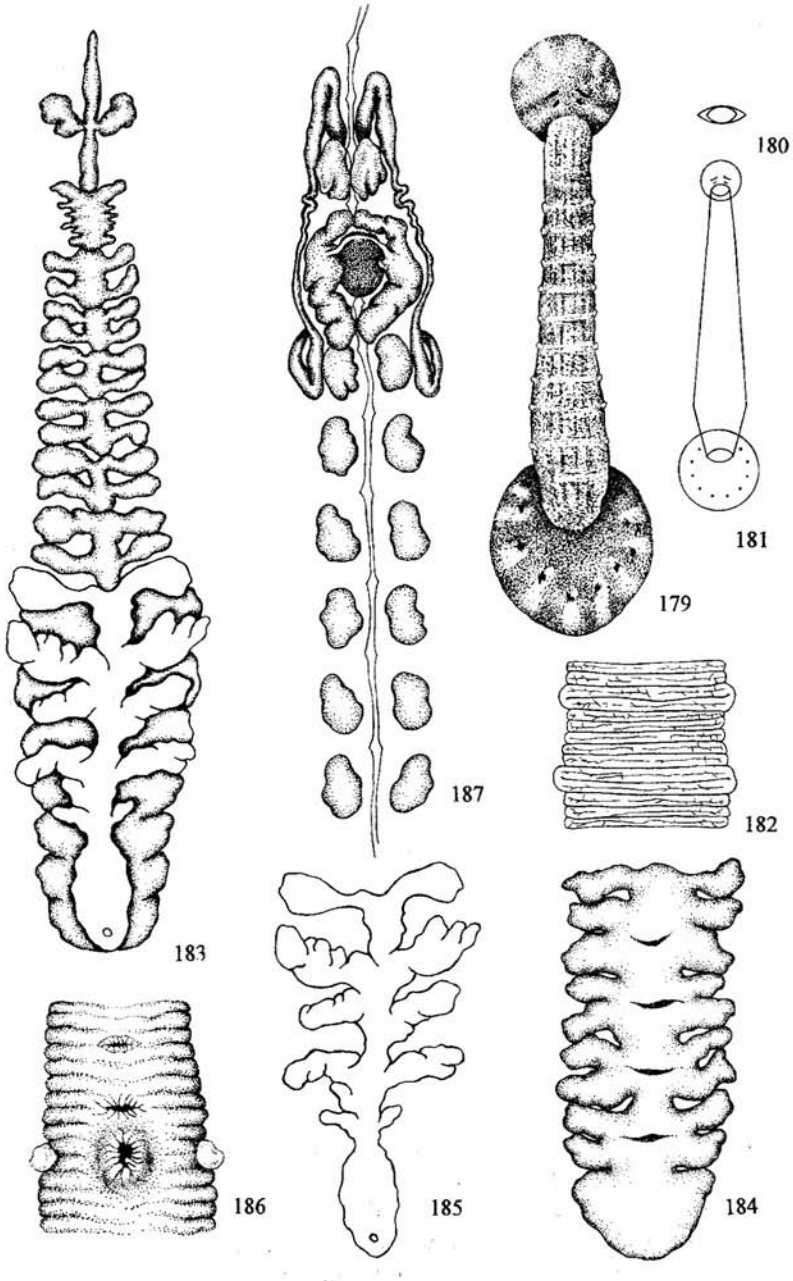
Piscicola fasciata KOLLAR, 1842:101, pl. CCXXVIII, figs h-k.
Piscicola fasciata: DIESING 1850: 441.
Ichthyobdella fasciata: BLANCHARD 1893: 3-5, figs 3-4.
Cystobranchus fasciatus: BRUMPT 1900b: 700-701, fig. 11; LISKIEWICZ 1934: 6-9, tab. II (II), figs 25-27, tabl. III (III), figs 40-41; PAWLOWSKI 1936: 92-94, figs 63-65, 1947a: 1-16, figs. 1-9; DOGIEL and BYCHOWSKIJ 1939: 101-102; SHCHEGOLEV 1949: 76, 141, 146; AUTRUM 1958: 11, figs 28b, 31; PAWLOWSKI et HOFFMANN 1959: 188-191, figs 1-2; LUKIN 1962b: 117-120, figs 74-76; EPSHTEIN 1962: 624, fig. 1545, 1969: 286; SOÓS 1965: 435; *Cystobranchus fasciatus*: BIELECKI 1977: 141-143, 1978: 249-251.

MATERIAL EXAMINED

Poland, Bug River 9-I, 5-X, 1-XII-1982, 15-IX-1982, 20-XI-1983, Krzna River, 15-II-1984, 43 specimens, from *Silurus glanis* L.. Leg. Z. DANILKIEWICZ. Biebrza River, 27-II-1985, 40 specimens, from *Silurus glanis* L., leg. A. BIELECKI.



177-178. *Piscicola fasciata*: 177- dorsal view, 178 - ventral view.



179-187. *Piscicola fasciata*: 179 - dorsal view, 180-181 - body form, 182 - somite, 183-185 - alimentary tract, 186-187 - reproductive systems.

DIAGNOSIS

See diagnosis of *P. respirans*.

DESCRIPTION

Body size and form as in figs 177-179 and Table 1. Body length 25.7-50.8 mm, width 8.2 mm. L/D_2 - 5.0, C^1_1/d_1 - 2.1, C^1_1/D_1 - 1.3, R_1/M_1 - 5.0, C^1_1/C_1 -1.0, L_1/D_1 - 3.2, D_1/N_1 - 1.7, S_1/S_2 - 1.2, L_2/D_2 - 3.7, D_2/N_2 - 2.9, K_1/K_2 - 2.7, C^1_2/d_7 - 2.9, C^1_2/D_2 - 2.5, R_2/M_2 - 2.5, C^1_2/C_2 - 1.0, L_2/L_1 - 2.7, D_2/D_1 - 1.6, N_2/N_1 - 1.0, C^1_2/C^1_1 - 2.0.

Body form (figs 180-181). Body very strongly flattened, division into trachelosome and urosome poorly visible. Anterior sucker medium-sized and flat, with 2 pairs of large eyes posterior sucker very large and also flat. Suckers connected strongly eccentrically. Body very much flattened, division into trachelosome and urosome poorly visible. Anterior sucker large, posterior sucker very large.

Body coloration (figs 177-179). Live leeches grey-brownish, often with a violetish tint, or grey-yellow. On anterior sucker a spot in the shape of a more or less distinct cross, with its longer, anterior part crossed by two transverse streaks. The pattern is formed of very fine, light brown pigment cells. On trachelosome 6 pigmented streaks. The first one, behind the sucker, is trapezial. The last two streaks have fused margins, so that between them only two light, transversely elongated irregular spots appear. On urosome 13 or 14 pigmented streaks, rather wide and partly connected by small "rungs". Very fine brown pigment cells form the streaks; large, black-brown pigment cells situated deep. The latter are few and situated mainly along the margin of bundles of longitudinal muscles, forming lines along the dorsal and ventral body side. Ventral side lighter, with no or only poorly marked segmental streaks. In the intervals between the streaks yellow pigment cells. Black-brown pigment cells present also on proboscis, seminal vesicles and terminal sections of atrium.

Eyes. On anterior sucker 2 pairs of large eyes, on posterior sucker up to 14 wide radial pigmented streaks, eye-like spots situated between them; the number of spots variable: from 8 to 10 (figs 177, 179).

Segmentation (fig. 182). Mid-body somite of 7 annuli of equal length which may be separated by additional, shallower grooves to make a total number of up to 14. Papillae (sensillae, tangoreceptors) absent.

Alimentary tract (figs 183-185). Proboscis base situated between ganglia 3 and 4. Crop built of 7 splanchnomeres, of 2 equal diverticles, further undivided. Intestine strongly developed, with folded walls, almost completely covering posterior crop caecum, it has 5 pairs of diverticles: 4 pairs large and well developed, the 5th small.

Reproductive system (figs 186-187). Gonopores separated by 4 annuli. Male gonopore large, female gonopore small, often poorly visible, though in some specimens very distinct. Copulatory area circular or somewhat elliptical, and then parallel to the body long axis. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes. Vasa deferentia simple, not coiled. Seminal vesicles at the level of testes 1, with a single bend in the body long axis. Ejaculatory ducts reach ganglia 3 and 4. On

atrium prostatic glands well developed as large lobes. Female reproductive system. Ovaries elongate, flattened, short, their distal ends touch testes 1. Oviducts open to female gonopore anterior to the vector tissue. Vector tissue as a round and rather small plate or somewhat elliptical and then transverse to the body long axis. Conducting strands as short, narrow strands of fibres connecting each ovary with the anterior part of vector tissue.

DISTRIBUTION

In rivers falling into the Black, Caspian, Azov Seas and the Baltic basin, Dneper, Don (thier tributaries and dam reservoirs), Volga, Ural, Kura, recorded from the eastern part of Taganrovski Reservoir.

Poland. Rivers: Bug, Biebrza, Nida, Mierzawa - on the last two rivers collected near Pińczów (PAWŁOWSKI and JAŻDŻEWSKA 1970, DANILKIEWICZ 1981, BIELECKI 1978, 1988).

BIOLOGY

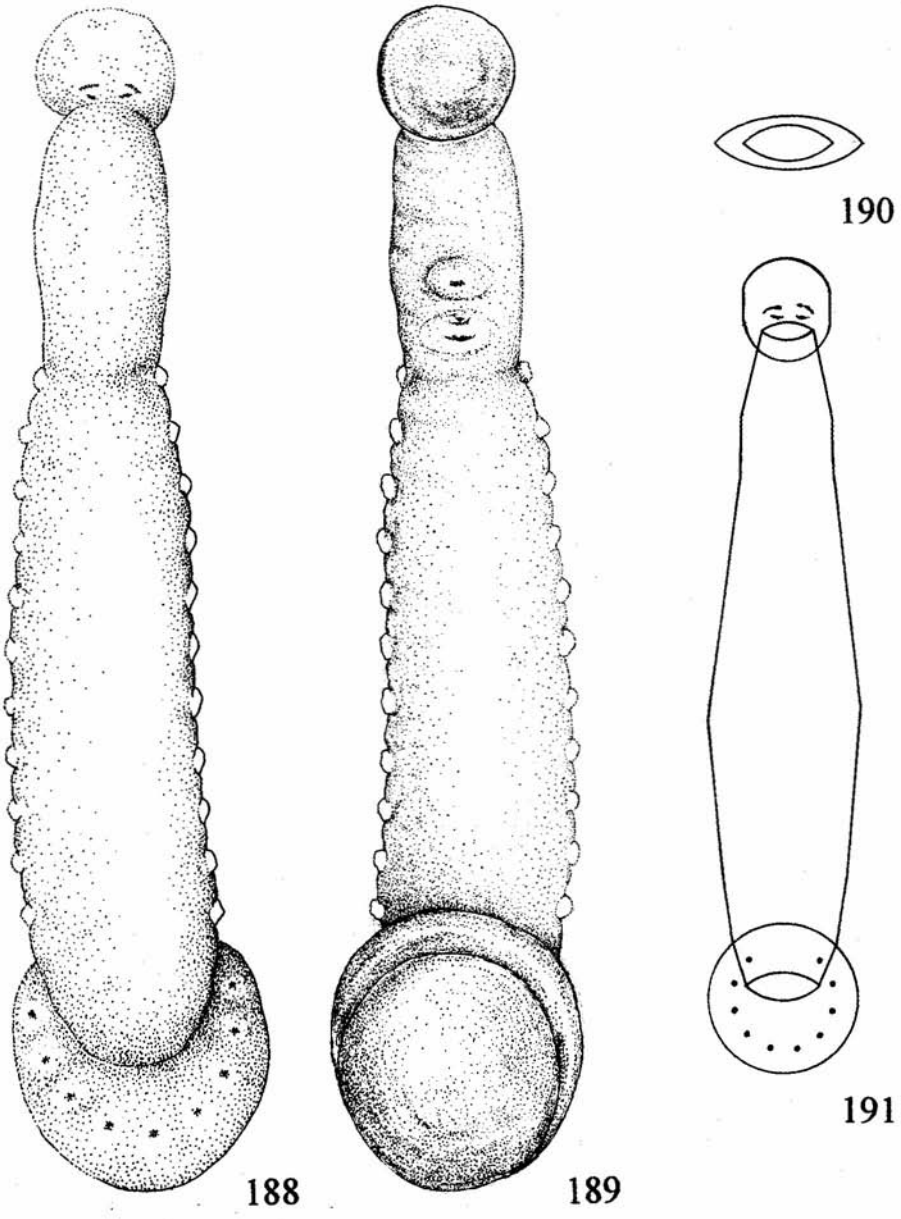
A specific, semi-constant parasite of catfish, *Silurus glanis* L., (BLANCHARD 1893, PLOTNIKOV 1909, LISKIEWICZ 1925, 1934, SPET 1928, JOHANSSON 1935, PAWŁOWSKI 1936, 1947a, b, 1968, PAWŁOWSKI and JAŻDŻEWSKA 1970, MIKULSKI and TARWID 1951, KARASSOWSKA and MIKULSKI 1960, HERTER 1968, SKET 1968, ZENKEVICH 1968, LUKIN 1976, BIELECKI 1978, DANILKIEWICZ 1981). Most often it is attached to the fish's head. Single cases of attachement to zobel, *Abramis ballereus* (L.), vimba, *Vimba vimba* (L.), and nase, *Chondrostoma nasus* (L.), (LUKIN 1976) are also known.

Life cycle is not known exactly. Leeches with formed clitellum were found both at the beginning of summer and in autumn (PAWŁOWSKI 1936, 1947a, b, 1950, 1968). Perhaps the leech lays cocoons throughout the warm part of the year. Adult leeches are found on fishes not only in summer, but also in winter. Based on this and considering that *P. fasciata* is a permanent parasite, it can be supposed that it stays on catfish during a long period: from summer till spring, when it leaves its host to lay cocoons. It was observed to be attached to the host for more than a year. The leech occurs most of all in rivers, but perhaps it inhabits also lakes, where its hosts are present.

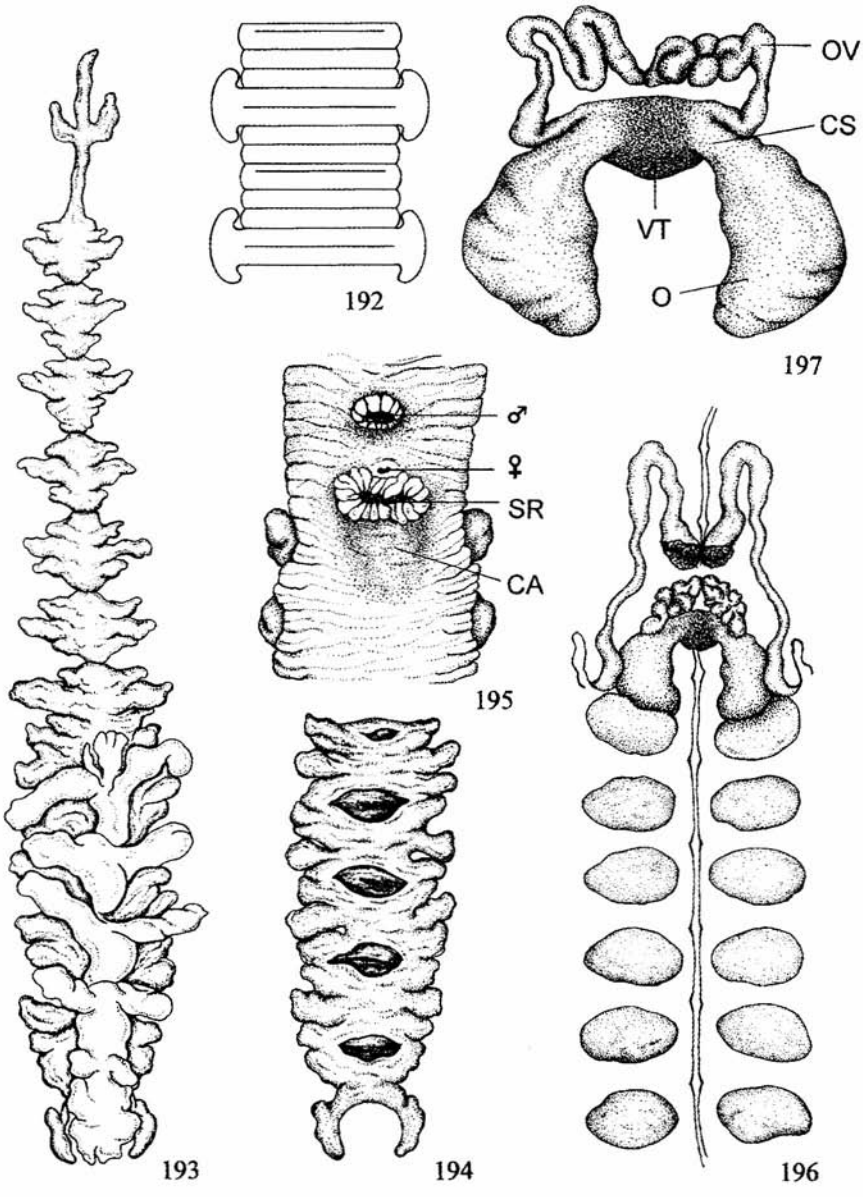
Piscicola respirans TROSCHEL, 1850

(Figs 188-197; Table 1)

Piscicola respirans TROSCHEL, 1850: 17-26, pl. II, figs A-E; DIESING, 1850: 441.
Piscicola respirans: DIESING 1850: 441; EPSHTEIN 1969: 286.
Ichthyobdella stellata BLANCHARD, 1893: 2-3, figs 1-2,
Cystobranchus respirans: BRUMPT 1900b: 700-701, fig. 9; PAWŁOWSKI 1936: 91-92, figs 61, 62; EPURE 1945: 558-563; HOFFMANN 1955c: 223-225, figs 1-7; 1956: 209-239, figs 1-13, 36, 41, pl. I-VIII, figs 14-35, 37-40, 1959: 237-243, figs 1-4; AUTRUM 1958: 11Abb. 3c, 28a; PAWŁOWSKI et HOFFMANN 1959: 187-193, figs 1-4; WOJTAS 1960: 153-159, figs 1-2; LUKIN 1926b: 114-117, figs 71-72; EPSHTEIN, 1962: 625, fig. 1547, 1969: 286; SOÓS 1965: 435-436; BIELECKI 1977: 141-145, 1988: 53-57, 1988a, b.



188-191. *Piscicola respirans*: 188-189 - dorsal and ventral view, 190-191 - body form.



192-197. *Piscicola respirans*: 192 - somite, 193-194 - alimentary tract, 195-197 - reproductive systems.

Terra typica: Palaearctic.

MATERIAL EXAMINED

Poland, Gorzanów near Kłodzko, Nysa Kłodzka River 28-V-1994, 50 specimens; 14-II-1995, from *Salmo trutta fario* L. and *Thymallus thymallus* (L.), leg. A. BIELECKI. Pławna 27-V-1976, Nysa Kłodzka 27-V-1976 Nysa Kłodzka 28-V- 1986, Nysa Kłodzka 14-VI-1986, Nysa Kłodzka 13-V-1987, Duna Dolna 4-V-1987, Bystrzyca Dusznicka 13-V-1987; together 117 specimens, same fish species. Leg. A. WITKOWSKI, J. BŁACHUTA, A. JABŁOŃSKI, A. BIELECKI.

DIAGNOSIS

Considering morphotypes of all the analysed species and also of other genera, in its body form *P. respirans* is most similar to *Cystobranchus mammillatus* (fig. 34). Considering only morphotypes of members of the genus *Piscicola* it is most similar to *P. fasciata* in its strongly flattened body and round suckers (fig. 243). It differs from the latter species in smaller anterior and posterior suckers (in *P. fasciata* suckers larger), width of posterior sucker equal to the greatest body width (in *P. fasciata* much larger), division into trachelosome and urosome distinct (in *P. fasciata* indistinct).

In non-metric characters *P. respirans* is most similar to *P. fasciata* (fig. 35). Both have the following characters in common: papillae (sensillae, tangoreceptors) absent, gonopores separated by 4 annuli, intestine strongly developed, with strongly folded walls, 6 pairs of testes, ejaculatory ducts bent sharply once perpendicular to the body long axis, seminal vesicles reaching testes 1, classically U shaped, ovaries short reaching testes 1, their posterior ends free, not intertwined, conducting strands short. It differs from *P. fasciata* in the following characters: mid-body somite of 7 unequal annuli (in *P. fasciata* 7 equal annuli), copulatory area triangular (in *P. fasciata* circular) spermatheca opening perpendicular to the body long axis, anterior to the first pair of respiratory vesicles (in *P. fasciata* parallel to the body long axis at the level of the first pair of respiratory vesicles), crop and posterior crop caecum splanchnomeres of 3 diverticles (in *P. fasciata* 2 diverticles), prostatic glands reduced or poorly developed (in *P. fasciata* very large, well developed), ejaculatory ducts reaching ganglion 4 (in *P. fasciata* between ganglia 3 and 4), vasa deferentia straight, ovaries sac-like (in *P. fasciata* as flattened cylinders), vector tissue as a marked ellipse transverse to the body long axis (in *P. fasciata* vector tissue circular), conducting strands wide, enter mid part of vector tissue (in *P. fasciata* narrow, enter anterior part of vector tissue).

DESCRIPTION

Body shape and size as in figs 188-189 and Table 1. Body length 11.9-37.8 mm. L/D_2 - 4.36, C^1_1/d_1 - 1.6, C^1_1/D_1- 0.9, R_1/M_1 - 3.0, C^1_1/C_1 - 0.8, L_1/D_1 - 1.5, D_1/N_1 - 2.4, S_1/S_2 - 1.9, L_2/D_2 - 3.4, D_2/N_2 - 2.8, K_1/K_2 - 0.9, C^1_2/d_7 - 1.9, C^1_2/D_2 - 1.0, R_2/M_2 - 1.6, C^1_2/C_2 - 1.0, L_2/L_1 - 3.7, D_2/D_1 - 1.7, N_2/N_1 - 1.4, C^1_2/C^1_1 - 1.7.

Body form (figs 190-191). Flattened and shortened, urosome wider than trachelosome, especially in larger specimens. Anterior sucker round, not very deep. Posterior sucker also round, very strongly muscled, fairly deep. Suckers connected somewhat eccentrically

Body coloration (figs 188-189). Body and suckers grey-green, grey-rusty, reddish or black, with evenly scattered small stellate melanophores. The cells are distributed in the middle of annuli, being more numerous on the dorsal side. Large stellate pigment cells are situated in deeper body layers and on male efferent ducts. Lateral respiratory vesicles white (11 pairs) and well visible. On posterior sucker no radial streaks.

Segmentation (fig. 192). The number of annuli per mid-body somite (mid part of urosome) 7, first annulus longer than the remaining ones and divided by an additional groove in two unequal parts. Papillae (sensillae, tangoreceptors) absent.

Eyes. On anterior sucker 2 pairs of eyes. On posterior sucker 10 eye-like spots situated closer to the margin. Eyes and eye-like spots very distinct (fig. 188).

Alimentary tract (figs 193-194). Proboscis base situated anterior to ganglion 3. Crop splanchnomeres, each divided in 3 diverticles of equal length but unequal width - the first narrower, the second wider, the third as narrow as the first. Intestine strongly developed, folded walls, almost covering the posterior crop caecum. It has 5 pairs of diverticles: 4 pairs large, well visible, the 5th small.

Reproductive system (figs 195-197). Gonopores separated by 4 annuli. Male gonopore large, female gonopore small, poorly visible. Copulatory area as an inverted triangle, parallel to the body long axis. Spermatheca opening large, distinct in the anterior part of the area, just anterior to the first pair of respiratory vesicles, transverse to the body long axis. Male reproductive system. 6 pairs of testes. Vasa deferentia straight, not coiled. Seminal vesicles at the level of testes 1, with a single bend in the body long axis, passing into ejaculatory ducts which reach ganglion 4. On atrium prostatic glands present but poorly developed or reduced. Female reproductive system. Ovaries sac-like. Distal ends of ovaries touch testes 1. Oviducts open to female gonopore anterior to the vector tissue. Vector tissue as a narrow elliptical plate arranged transverse to the body long axis. Conducting strands form very short and wide strands of fibres connecting ovaries with the mid part of vector tissue. Thus the space between the converging oviducts and testes 1 (ganglia 6 and 7) is partly unoccupied.

DISTRIBUTION

Widespread in countries of Western Europe, till the western borders of the former USSR. Constant and abundant in various regions of the Rhine River basin (HOFFMANN 1956; AUTRUM 1958, and also data under "Biology"). Outside this basin it was recorded from the northern part of Italy (BLANCHARD 1894). However, these data could pertain to *Italobdella ciosi* BIELECKI, 1993, a parasite of trout and rheophilous cyprinids in the Adda River. Recorded from the Tatra Mts (SITOWSKI 1936, PAWŁOWSKI 1936, 1968; BIELECKI and WITKOWSKI 1988) and Sudetes (BIELECKI 1977; 1988a, b, c)

in Poland; also northern Romania (EPURE 1945), and Belgium (LESTAGE 1936). Thus all the credible data on the distribution of this species pertain to water bodies which are associated with mountain rivers of Central Europe. All the other records of *P. respirans* are doubtful. BLANCHARD (1984) erroneously stated that *C. mammillatus*, described by Malm from water bodies in Sweden, was identical with *P. respirans*. JOHANSSON (1896, 1898) in his extensive papers on leeches of Sweden confirmed the occurrence of *C. mammillatus* in that country and did not mention *P. respirans*. The record of that species from Finland is also very doubtful (JÄÄSKELÄINEN 1913). In northern Europe (Scandinavian Peninsula, Finland, Karelia) *C. mammillatus*, which is confused with *P. respirans*, is very common. The possibility of such a mistake results also from the conviction, widespread in the literature, that *C. mammillatus* never has eyes on anterior sucker. However sometimes, in some specimens of this species, eyes are present, though rather poorly developed (see description of external morphology), thus it is quite certain that such specimens of *C. mammillatus* can be misidentified as *P. respirans*.

In the former USSR *P. respirans* was recorded from the Gulf of Finland near Kronshtad (KESSLER 1868), Estonia (SUKACHEV 1911), Oka River (ZHADIN 1940), St. Petersburg district (MARKEVICH 1934), Donbass, eastern Ukraine (JAROSHENKO 1937; LUBJANOV and FEDKO 1953). In the light of the above-cited facts all these records should be regarded as doubtful. JAROSHENKO (1937), and also LUBJANOV and FEDKO (1953), apparently confused *P. respirans* with other fish leeches (either *Caspiobdella fadejewi*, or *Piscicola geometra*). ZAKHVATKIN's (1936) record of *P. respirans* on *Lota lota* from the Kama River is also very uncertain. No doubt that author dealt with *C. mammillatus* - a specific parasite of the burbot. It is also unclear on what grounds AUTRUM (1958) based his statement that the distribution area of *P. respirans* extended "to the Caspian Sea, inclusive".

In this context there are no sufficiently credible data on the occurrence of *P. respirans* in the former USSR. However, considering the fact that it was found in mountain localities of Poland and Romania, it is possible that it lives in the west of Ukraine, in water reservoirs associated with the Carpathians (LUKIN 1976).

The above information on ecological peculiarities and distribution of *P. respirans* make it possible to suggest that the species is a post-glacial relict, which was preserved in water bodies associated with central European mountains.

BIOLOGY

Single specimens, unattached to hosts, were found in outlets of rivers that fall into the Baltic (GEDROYĆ 1916). Besides, found on salmon, *Salmo salar* L.; sea trout, *Salmo trutta trutta* L.; grayling, *Thymallus thymallus* (L.); carp, *Cyprinus carpio* L. (carp pond supplied with water from the Krośnica stream - tributary to the Dunajec River (SITOWSKI, 1937); barbel, *Barbus barbus* (L.); dace, *Leuciscus leuciscus* (L.); bitterling, *Rhodeus sericeus amarus* (BLOCH) - locality data not given (PAWŁOWSKI 1968); brook minnow, *Phoxinus phoxinus* (L.); eel, *Anguilla anguilla* (L.) (GRABDA 1971).

Location on the host: most of all fins, less often skin, eyes, oral cavity, gills. A semi-permanent parasite of salmonid fishes and rheophilous *Cyprynidae* and other species (SCHPERCLAUS 1954). On caudal and dorsal fins, less often on other fins and body surface, sometimes in oral cavity (BIELECKI, in press).

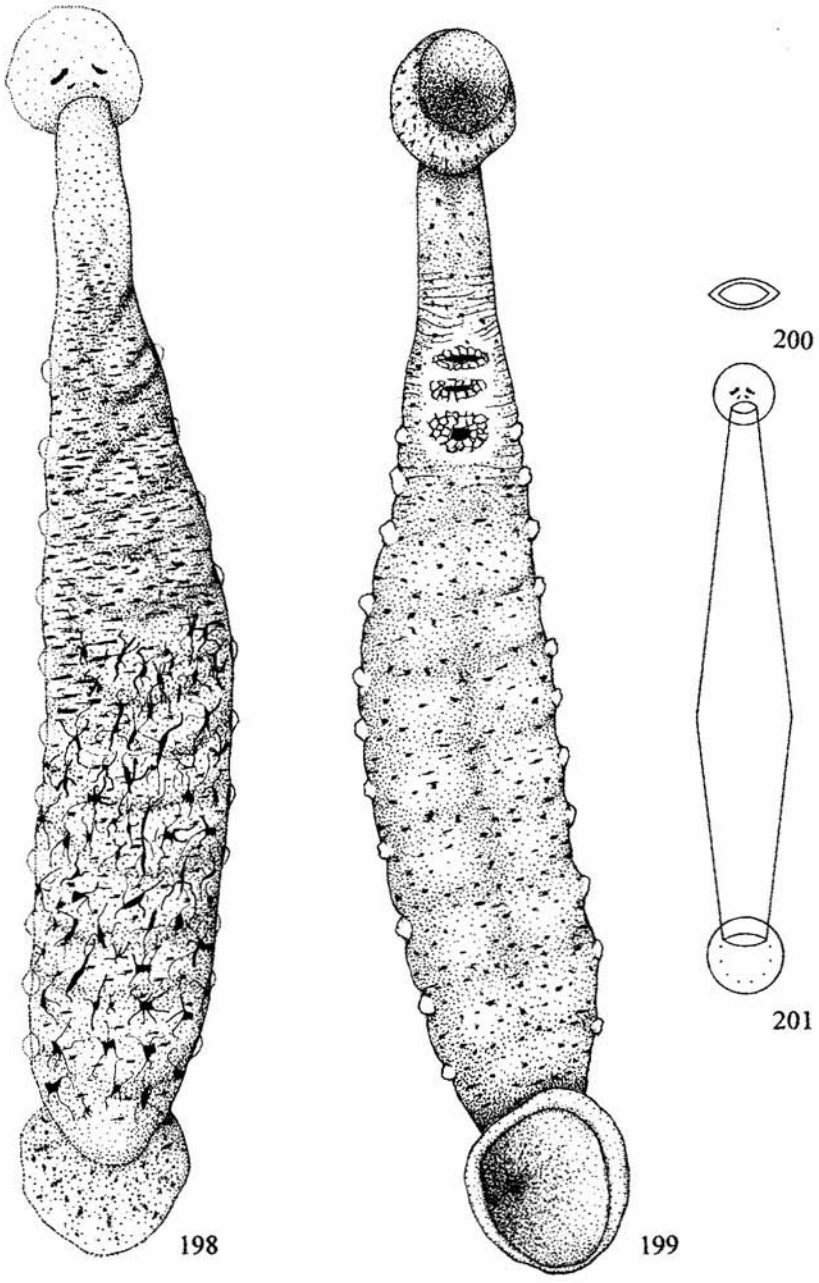
Life cycle was first described by HOFFMANN (1956), based on observations of *P. respirans* in water bodies of Luxembourg and aquarium culture. Hatching takes place in the first weeks of March, and the young leeches immediately attack fish. The parasites attach mostly to the caudal and dorsal fins, in groups of 15-20 individuals. At that time leeches, attached with their posterior suckers, make characteristic body movements. After 2-3 weeks they move to definite places on the fins which they will occupy till reproduction. Sometimes they make movements of coiling, twisting etc., while anterior suckers attach to many places on the fins. Moulting takes place fairly often and the moulting individuals free themselves from the old cuticle making peculiar movements. The growth is very fast, and in 6 weeks the leeches reach maturity. In mid May, still attached to their host, the leeches copulate and then quickly suck the last portion of blood; then they leave their hosts in search of stones on which cocoons will be deposited; they choose places with very rapid water flow. The structure of cocoons was described by PAWŁOWSKII and HOFMANN (1959), based on materials collected in the water bodies of Luxembourg and by WOJTAS (1960), based on materials from tributaries of the Dunajec River. The length of cocoons from Luxembourg reached 1.5 mm, the greatest width being 1.2 mm. According to WOJTAS, the length of cocoons laid in aquaria ranges from 1.6-2.0 mm, width 1.2-1.5 mm, thickness from 0.5 to 0.8 mm. The period of cocoon laying in aquaria lasts ca. 1 month, the duration of intervals between consecutive cocoons varies and the greatest number of cocoons is laid on the first day. The number of cocoons per individual ranges from 14 to 21 (WOJTAS 1960). After the cocoon-laying period the leeches die soon, in Luxembourg at the beginning of June, in Poland in July. Because of this (according to WOJTAS 1960) the life cycle of *P. respirans* in Central and Western Europe is shifted in time. Thus, in the leech life cycle the following traits are characteristic: beginning of development in the spring, quick growth, long resting stage of cocoons - from June or July till March of the following year. Because of this LUKIN (1976) asserts that the species has its origins in a colder period , as a result of which the present high water temperature in the water bodies inhabited by the leech turned out to be optimum. Perhaps for this reason the active part of the cycle shifted to the spring, and a prolonged diapause stage appeared.

***Piscicola pomorskii* sp. n.**

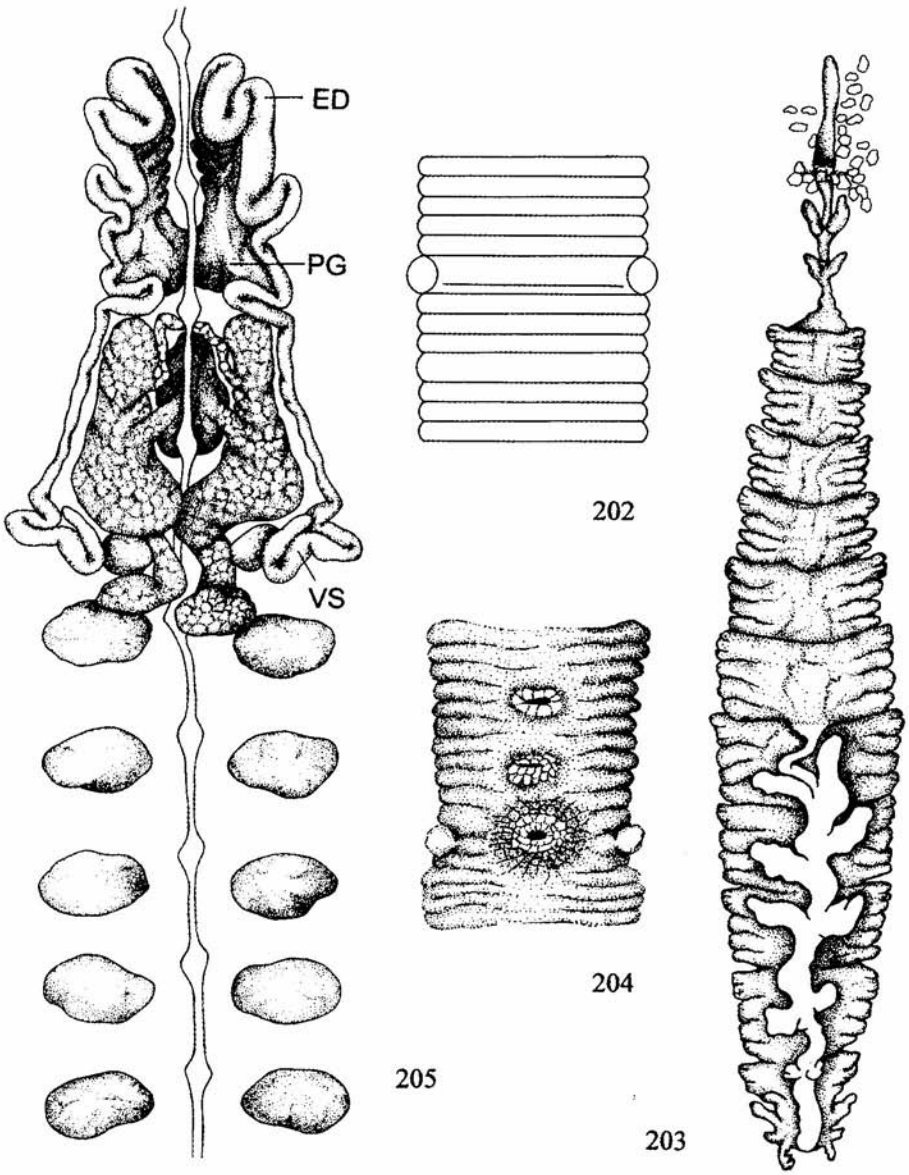
(Figs 198-205; Table 1)

TYPE MATERIAL

Holotype: Poland, Wysoka Kamieńska near Wołczennica River, 17-IV-1990, from *Salmo trutta fario* L., leg. J. POMORSKI, paratype: same data. Holotype deposited at the Museum of Natural History, Wrocław University; paratype in authors collection.



198-201. *Piscicola pomorskii* sp. n.: 198-199 - dorsal and ventral view, 200-201 - body form.



202-205. *Piscicola pomorskii* sp. n.: 202 - somite, 203 - alimentary tract, 204-205 - reproductive systems.

DIAGNOSIS

Considering morphotypes of all the analysed species, also of other genera, in its body form *P. pomorskii* sp. n. is most similar to *P. kusznierzi* sp. n. (fig. 34). Considering only morphotypes of members of the genus *Piscicola*, it is also most similar to *P. kusznierzi* (fig. 243). Both share the following characters: body strongly flattened, suckers round and connected eccentrically, posterior sucker equal or nearly equal to the greatest body width, size of anterior and posterior suckers almost identical. It differs from *P. kusznierzi* in a well marked division into trachelosome and urosome (in *P. kusznierzi* poorly marked), larger anterior sucker (in *P. kusznierzi* anterior sucker smaller), anterior and posterior suckers of almost equal size (in *P. kusznierzi* anterior sucker distinctly smaller than posterior).

In non-metric characters *P. pomorskii* is most similar to *P. jarai* sp. n. (fig. 35). Both share the following characters: papillae (sensillae, tangoreceptors) absent, mid-body somite of 14 unequal annuli, gonopores separated by 4 annuli, spermatheca opening at the level of the first pair of respiratory vesicles, crop and posterior crop caecum splanchnomeres of 4 unequal diverticles: the first larger and broader, divided in 3 barely discernible secondary diverticles, and 3 small and narrow diverticles. Intestine walls strongly folded, 6 pairs of testes, vasa deferentia slightly coiled, seminal vesicles reaching testes 1, ovaries sac-like, their posterior ends free, not intertwined, vector tissue as a well marked ellipse parallel to the body long axis, conducting strands short, wide. It differs from *P. jarai* in the following characters: copulatory area circular (in *P. jarai* as a marked ellipse parallel to the body long axis), spermatheca opening perpendicuar to the body long axis (in *P. jarai* parallel), intestine poorly developed (in *P. jarai* very large well developed), ejaculatory ducts reaching ganglion 4, five times bent (in *P. jarai* reaching ganglion 5, once bent), seminal vesicles bent more than 4 times (in *P. jarai* classically U-shaped), ovaries long reaching testes 2, between testes (in *P. jarai* ovaries short, reaching testes 1), conducting strands enter posterior part of vector tissue (in *P. jarai* they enter mid part of vector tissue).

ETYMOLOGY

The new species is dedicated to Dr. Romuald Jacek POMORSKI, an outstanding entomologist, who collected the material and was so kind to forward it to me.

DESCRIPTION

Body size and form as in figs 198-199 and Table 1. Body length 13.8-13.9 mm. L/D_2 - 5.56; C^1_1/d_1 - 2.3; C^1_1/D_1 - 1.6; R_1/M_1 - 3.3; C^1_1/C_1 -1.0; L_1/D_1 - 3.1; D_1/N_1 - 1.7; S_1/S_2 - 0.9; L_2/D_2 - 4.3, D_2/N_2 - 3.1; K_1/K_2 - 0.8; C^1_2/d_7 - 1.6; C^1_2/D_2 - 0.8; R_2/M_2 - 2.6; C^1_2/C_2 - 0.9, L_2/L_1 - 3.5; D_2/D_1 - 2.5; N_2/N_1 - 1.3; C^1_2/C^1_1 - 1.2.

Body form (figs 200, 201). Body rather strongly flattened. Division into trachelosome and urosome well marked. Anterior suckers of nearly equal size, round, deep, anterior sucker somewhat smaller than posterior, eccentrically connected.

Body coloration (figs198-199). Very characteristic, no light transverse streaks. In superficial layers of body covers on dorsal side there are fine round brown pigment

cells, with no processes, and black, enormous stellate melanophores. Trachelosome lighter, especially its anterior part, since fine, round brown pigment cells are loosely arranged. In posterior part of trachelosome, besides these cells, here and there black melanophores appear, larger and located transversely to annuli, with no processes. Such cells are present also on anterior part of trachelosome, on four anterior somites, but in a much higher concentration. Beginning with the fifth somite till the end of urosome there are black, enormous, stellate melanophores. Their bodies are very large, and they have long processes. On ventral body side both superficial and deep situated dark brown cells concentrate. Such cells are also found on the ducts of reproductive system and on proboscis. Anterior sucker light, with no additional pigmentation, evenly covered with fine, round pigment cells. On posterior sucker radial streaks very poorly expressed.

Eyes. On anterior sucker 2 pairs of eyes - the first larger, situated obliquely to the long body axis, the second pair posterior to, much smaller, in the form of dots. On posterior sucker 10 eye-like spots, in its central part situated on the very poorly marked edges of dark radial streaks (fig. 198).

Segmentation (fig. 202). Mid-body somite of 14 annuli, in three groups of different length: 6 and 11 the longest, 7 the shortest, the remaining annuli of medium length.

Alimentary tract (fig. 203). Proboscis base at ganglion 3. Oesophageal glands large, fairly wide, located obliquely to the body long axis. Crop splanchnomeres, of 4 diverticles, the first diverticle being much broader and longer than the remaining ones and further divided into 3 smaller and shorter secondary diverticles. First crop splanchnomere smaller than the remaining ones and of a slightly different structure. Intestine poorly developed, not covering completely posterior crop caecum, with strongly folded walls; it has 5 diverticles: the first three pairs are well developed, the fourth not much smaller, the fifth very small and poorly visible.

Reproductive system (figs 204-205). Gonopores separated by 4 annuli. Male gonopore large, female gonopore small, but very clearly visible. Copulatory area circular. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes, the first pair much smaller than the remaining pairs. Seminal vesicles short, at the level of testes 1, to the body long axis, with about 5 bends. Vasa deferentia slightly coiled. Ejaculatory ducts thick, their apices reach ganglion 4, characteristically sharply bent 5 or 6 times. Bends located in a plane parallel to atrium. On atrium prostatic glands very well developed as large lobes. Female reproductive system. Ovaries long, reaching testes 2; they pass testes 1 on the inner side, larger, sac-like, their distal ends free, not intertwined. When passing between the testes, they are strongly constricted. Oviducts straight and narrow. Anterior ends of ovaries (before passing into oviducts) cover vector tissue, which is situated posterior to oviduct outlet, as a well marked small elliptical plate, parallel to the body long axis. Conducting strands in the form of short, wide strands of fibres connecting each ovary with the posterior part of vector tissue.

DISTRIBUTION

It was collected in the Wołczennica River which belongs to the Baltic basin and has a direct connection with the sea.

BIOLOGY

Two specimens were collected from pectoral fins of the brown trout (*Salmo trutta fario* L.), 18 cm long.

Piscicola kusznierzi sp. n.

(Figs 206-213; Table 1)

TYPE MATERIAL

Poland, Darłowo, Wieprza River, 11-XI-1991, from *Salmo trutta trutta* L., leg. J. KUSZNIERZ, 2 paratypes: same data. Holotype - Museum of Natural History, Wrocław University; paratypes - author's collection.

DIAGNOSIS

See diagnosis of *Piscicola witkowskii* sp. n.

ETYMOLOGY

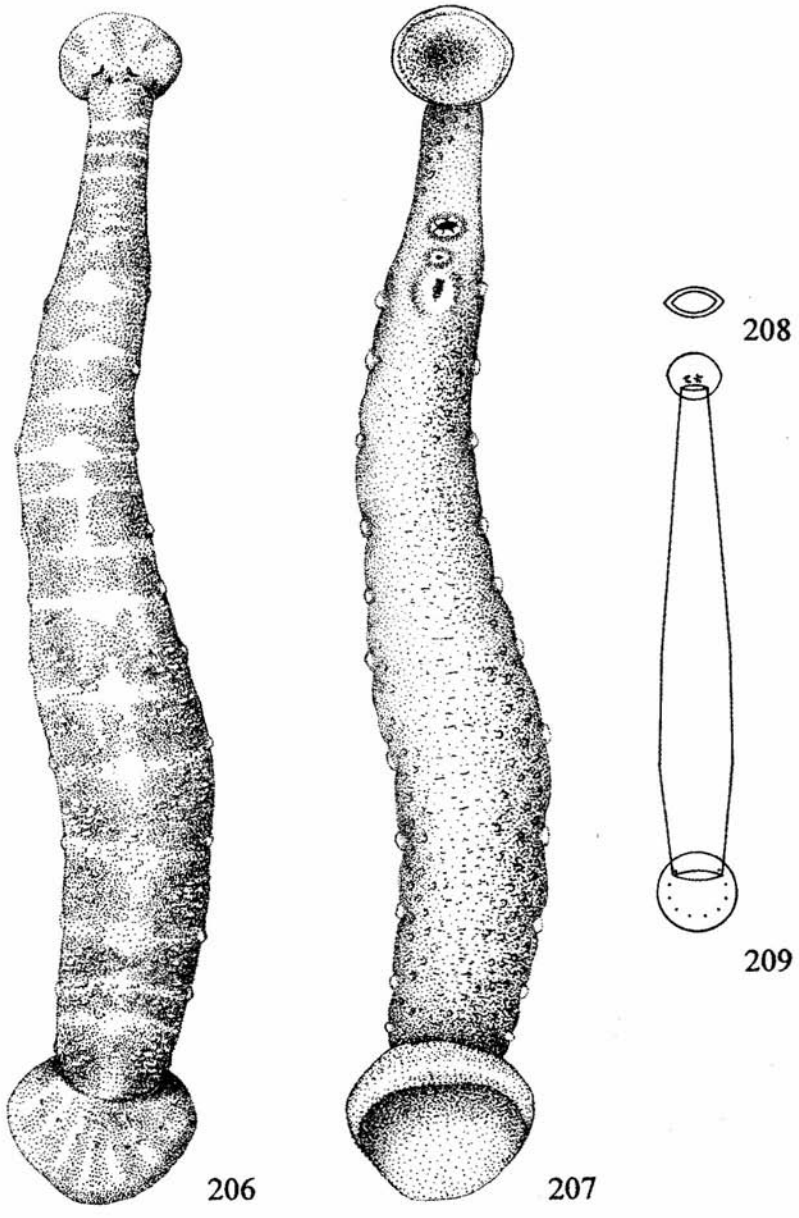
Dedicated to Mr. Jan KUSZNIERZ, M. Sc., an ichthyologist who presented me with his material.

DESCRIPTION

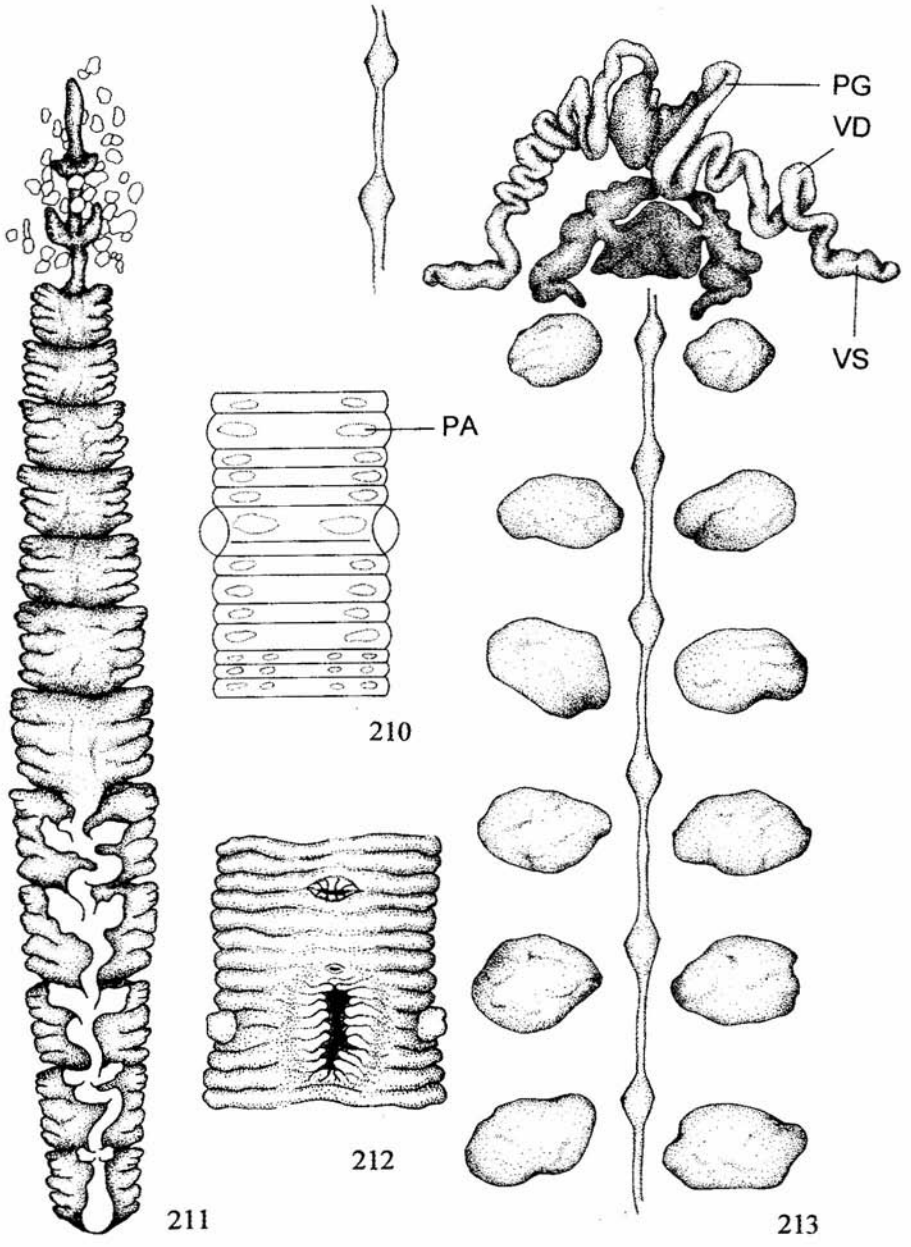
Body shape and size as in figs 206-207 and Table 1. Body length 9.7-11.7 mm. L/D_2 - 6.62, C^1_1/d_1 - 2.0, C^1_1/D_1 - 1.5, R_1/M_1 - 3.5, C^1_1/C_1 - 1.2, L_1/D_1 - 3.2, D_1/N_1 - 1.6, S_1/S_2 - 1.2, L_2/D_2 - 5.0, D_2/N_2 - 2.7, K_1/K_2 - 2.1, C^1_2/d_7 - 1.6, C^1_2/D_2 - 1.1, R_2/M_2 - 2.7, C^1_2/C_2 - 1.1, L_2/L_1 - 3.1, D_2/D_1 - 2.0, N_2/N_1 - 1.2, C^1_2/C^1_1 - 1.5.

Body form (figs 208-209). Body elongate, rather strongly flattened. Division into trachelosome and urosome poorly marked. Anterior and posterior suckers medium-sized, both connected strongly eccentrically.

Coloration (figs 206-207). It results from arrangement of black and dark brown melanophores on grey background. On trachelosome and urosome melanophores in the form of long dashes located along annuli prevail. Some of them, only on urosome, are stellate. Their arrangement results in a characteristic cross-shaped pattern on each urosome somite. Since in midline of dorsal side light streaks unite, there is a light streak along the midline of dorsum, crossed by transverse light streaks. The number of segmentally repeated transverse streaks or spots on trachelosome is 6 or 7, on urosome 12 or 13. Ventral side lighter. On anterior sucker 5 triangular spots formed of black and dark brown melanophores. One situated centrally and two laterally on each side, right and left. On posterior sucker very narrow white and wide brown-black radial streaks, 14 of each kind. Black and dark brown melanophores on suckers as fine dots with no processes.



206- 209. *Piscicola kusznierzi* sp. n.: 206-207 - dorsal and ventral view, 208-209 - body form.



210- 213. *Piscicola kusznierzi* sp. n.: 210 -somite, 211 - alimentary tract, 212-213 - reproductive systems.

Eyes. On anterior sucker 2 pairs of eyes - first larger, located centrally, obliquely relative to saggital plane, second smaller, located perpendicularly. On posterior sucker 10 eye-like spots, in its central part located on the margin of dark radial streaks (fig. 206).

Segmentation (fig. 210). Mid-body somite of 14 annuli of unequal length. Annuli 2 and 6 (vesicular) the longest; 9 and 11 slightly shorter; 1, 3, 4, 5, 8, 10 and 14 shorter, 12 and 13 the shortest. Respiratory vesicles (11 pairs) not large but well visible. On body numerous papillae in the form of elongate ellipses, transverse to the body long axis on all somite annuli. On the shortest annuli papillae the most numerous but smaller, on longer annuli fewer and larger. Their highest concentration visible in anterior part of trachelosome, and especially in posterior part of urosome. On mid-body, somites of urosome papillae distributed more regularly.

Alimentary tract (fig. 211). Mouthpore situated centrally. Proboscis base at the level of ganglion 3. Oesophageal glands short and rather wide. Crop splanchnomeres of 4 unequal diverticles: the first larger and broader, divided in 3 barely discernible secondary diverticles, and 3 small and narrow diverticles. The first crop splanchnomere considerably departs in its structure from the remaining six. Posterior crop caecum splanchnomeres well developed. Intestine poorly developed, not covering completely the posterior crop caecum, its walls strongly folded; 3 large diverticles, 4 th smaller and the 5th small.

Reproductive system (figs 212-213). Gonopores separated by 4 annuli very clearly visible. Male gonopore large, female gonopore small. Copulatory area elliptical, situated parellel to the body long axis. Spermatheca opening distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes, pair 1 smaller than the remaining pairs. Seminal vesicles short, with no bend, as small rods located anterior to testes 1, perpendicular to the body long axis at the level of terminal parts of ovaries. Vasa deferentia very much coiled. Ejaculatory ducts thin, as single small, sharp bends located in a plane parallel to atrium, reaching ganglion 5. On atrium prostatic glands well developed. Female reproductive system. Ovaries short, flatened, their distal ends free, not intertwined, bent paramedially, almost touching testes 1. Oviducts straight and wide. Vector tissue as a well marked small triangular plate, parallel to the body long axis, posterior to oviduct outlet. Conducting strands as short, wide strands of fibres connecting each ovary with the mid part of vector tissue.

DISTRIBUTION

NC Poland.

BIOLOGY

The leeches were found on the pectoral fin of the sea trout (*Salmo trutta trutta* L.), 40 and 42 cm.

Piscicola margaritae sp. n.

(Figs 214-222; Table 1)

TYPE MATERIAL

Holotype: Poland, Szczodre near Wrocław, in fish ponds, from *Cyprinus carpio* L. 15-IV-1987, leg. A. Bielecki, 4 paratypes: same data. Holotype deposited at the Museum of Natural History, Wrocław University; paratypes in author's collection.

DIAGNOSIS

Considering morphotypes of all the analysed species, also of other genera, in its body form *P. margaritae* sp. n. is close to a species group comprising *P. elishebae* sp. n., *P. niewiadomskae* sp. n. and *C. fadejewi* (fig. 34). However, it departs considerably from the closest species *P. elishebae*. Considering only morphotypes of members of *Piscicola* it is most similar to *P. witkowskii* sp. n. and *P. pojmanskae* (fig. 243). It differs from both these species in considerable flattening of trachelosome and urosome, smaller anterior and posterior suckers, ratio of posterior sucker to the greatest body width.

In non-metric characters it is most similar to *P. elishebae* (fig. 35). Both share the following characters: papillae (sensillae, tangoreceptors) absent, copulatory area on clitellum long, encroaches on the first somite of urosome, as a well marked ellipse parallel to the body long axis, spermatheca opening at the level of the first pair of respiratory vesicles, intestine poorly developed with strongly folded walls, prostatic glands very large, well developed, vasa deferentia moderately coiled, seminal vesicles reaching testes 1, ovaries long, reaching testes 2, their ends free, rather remote from conducting strands and running separately, vector tissue elliptical, parallel to the body long axis.

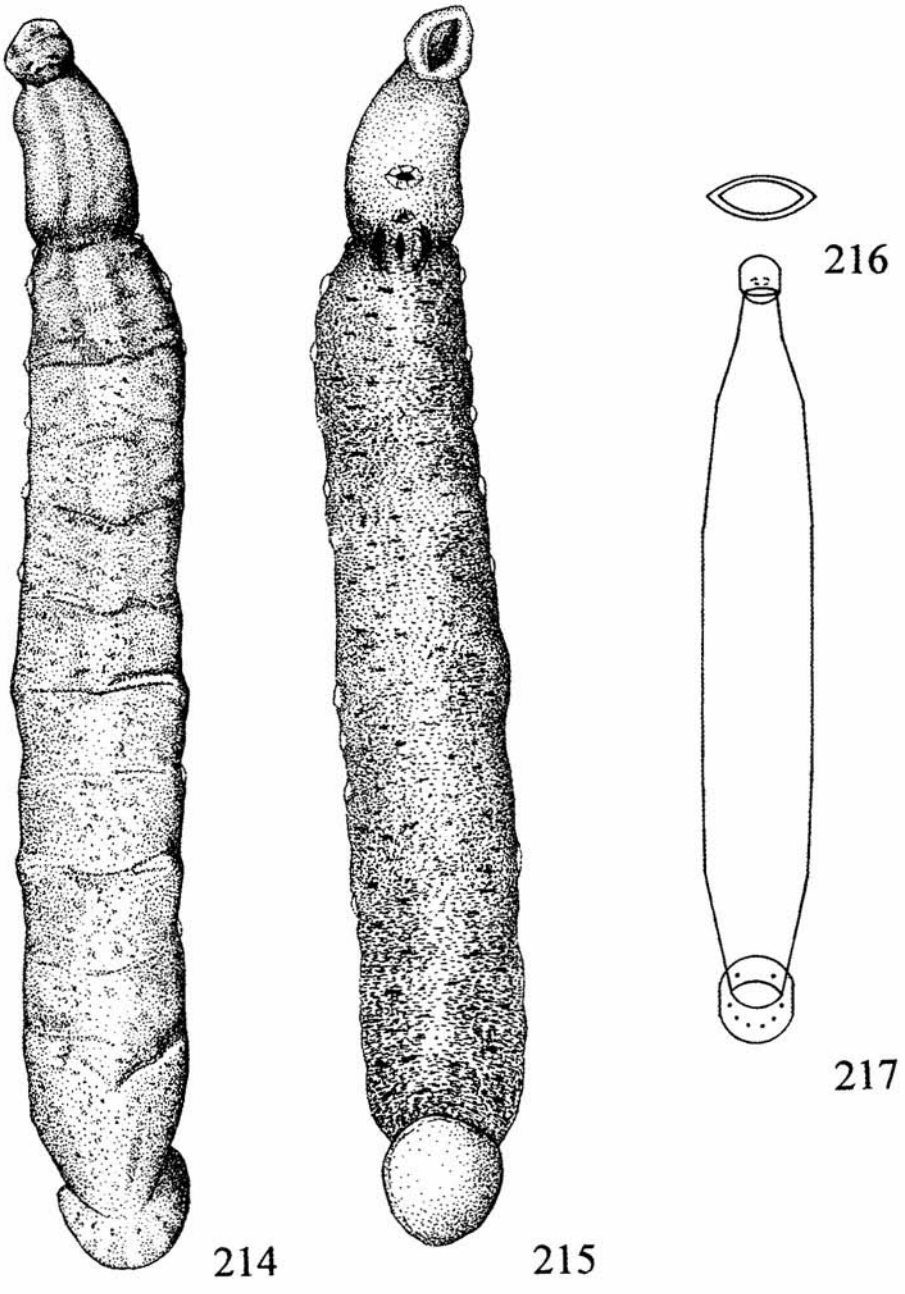
P. margaritae sp. n. differs from *P. elishebae* in the following characters: midbody somite 14-annulate (in *P. elishebae* 4-annulate), gonopores separated by 5 annuli (in *P. elishebae* 3 annuli), crop and posterior crop caecum splanchnomeres of 5 unequal diverticles (in *P. elishebae* of 2 equal diverticles), ejaculatory ducts reach ganglion 4, bent more than 5 times (in *P. elishebae* between ganglia 4 and 5, bent 3 times), 6 pairs of testes (in *P. elishebae* 5 pairs), seminal vesicles bent more than 4 times (in *P. elishebae* not bent, round), ovaries on testes, sac-like (in *P. elishebae* ovaries between testes, cylindrical, conducting strands very long, narrow, enter anterior part of vector tissue (in *P. elishebae* short, wide, enter posterior part of vector tissue).

ETYMOLOGY

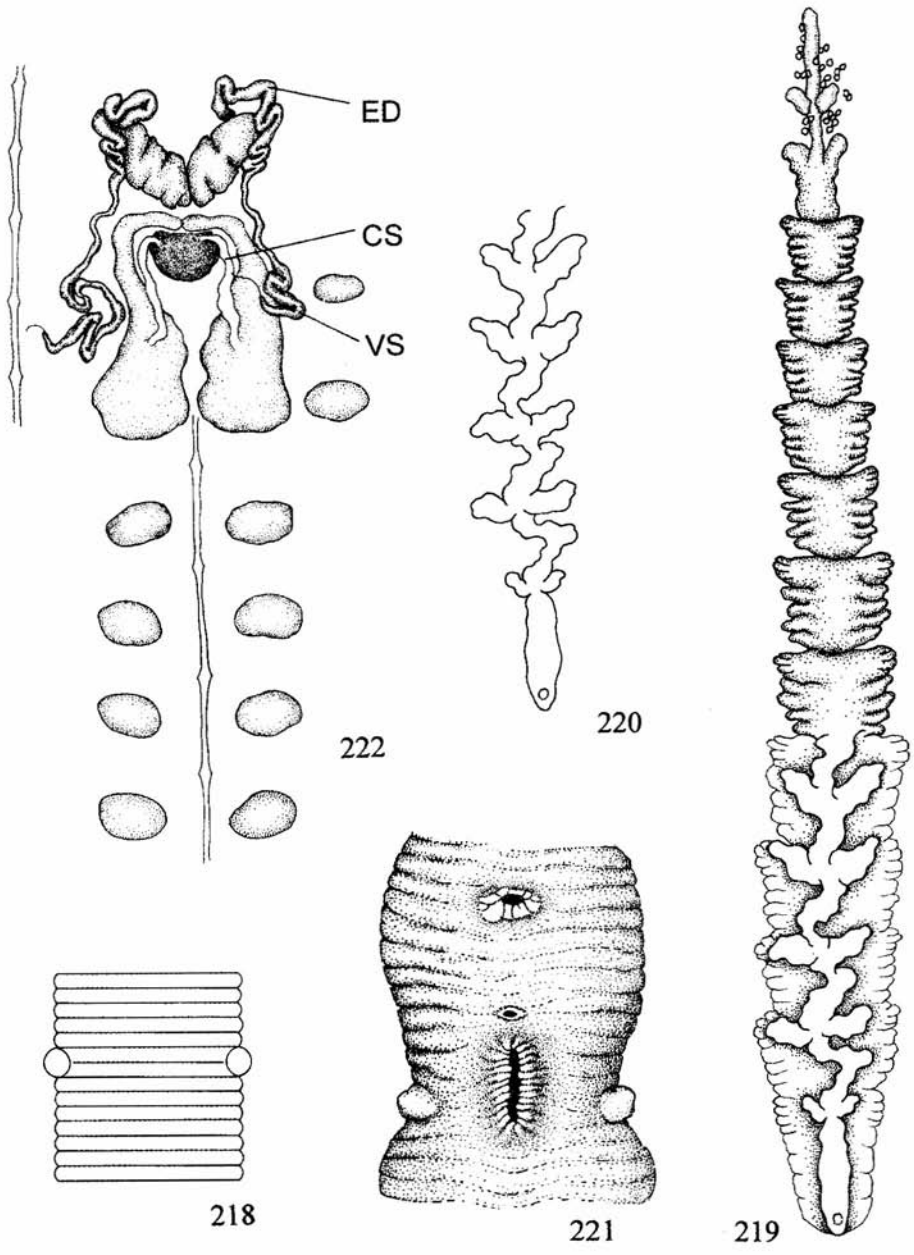
Dedicated to my wife Małgorzata ŁUKOWIAK-BIELECKA (in Latin Margarita), who has made many drawings for this and my other papers.

DESCRIPTION

Body shape and size as in figs 214-215 and Table 1. Body length 16.2-16.4 mm. L/D_2 - 6.52, C^1_1/d_1 - 1.3, C^1_1/D_1 - 0.8, R_1/M_1 - 4.0, C^1_1/C_1 - 0.8, L_1/D_1 - 2.4, D_1/N_1 - 1.4,



214- 217. *Piscicola margaritae* sp. n.: 214-215 - dorsal and ventral view, 216-217 - body form.



218- 222. *Piscicola margaritae* sp. n.: 218 - somite, 219-220 - alimentary tract, 221-222 - reproductive systems.

S_1/S_2 - 0.9, L_2/D_2 - 5.5, D_2/N_2 - 2.5, K_1/K_2 - 0.3, C^1_2/d_7 - 1.4, C^1_2/D_2 - 0.7, R_2/M_2 - 1.3, C^1_2/C_2 - 0.8, L_2/L_1 - 5.3, D_2/D_1 - 2.3, N_2/N_1 - 1.3, C^1_2/C^1_1 - 1.9.

Body form (figs 216-217). Body elongate, relatively flattened. Division into trachelosome and urosome rather well marked. Anterior and posterior suckers small, both connected strongly eccentrically.

Body coloration (figs 214-215). It results from arrangement of black and light brown melanophores on grey background; melanophores as long dashes, parallel to annuli. Only some of them on urosome have processes. Their arrangement results in a characteristic pattern. No transverse white streaks on trachelosome and urosome somites. In median line of dorsal side a light streak, the most distinct on trachelosome and greater part of urosome; in its posterior part the streak is blurred and less distinct. Ventral side much darker, since black melanophores are larger and more distinct, and the brown ones are identical as on the ventral side. On anterior sucker 3 delicate spots: one situated centrally, and two on each, left and right side. On posterior sucker white and brown-black radial streaks, 14 of each kind. Black and dark brown melanophores on suckers as fine dots with no processes.

Eyes. On anterior sucker 2 pairs of eyes - of nearly equal size. On posterior sucker 10 eye-like spots, situated, rather high on the edge of dark radial streaks (fig. 214).

Segmentation (fig. 218). Mid body somite of 14 annuli of equal length. Respiratory vesicles (11 pairs) not large but well visible.

Alimentary tract (figs 219-220). Mouthpore located centrally. Proboscis base at the level of ganglion 3. Oesophageal glands small. Crop splanchnomeres of 5 unequal diverticles: the first larger, long and broader, divided in four barely discernible secondary diverticles, and four small and narrow diverticles. Intestine poorly developed, not covering completely posterior crop caecum, walls strongly folded; 4 large diverticles the 5th small, all directed laterally.

Reproductive system (figs 221-222). Gonopores separated by 5 annuli. Male gonopore larger, female gonopore smaller, well visible. Copulatory area as a narrow, well marked ellipse, parallel to the body long axis. Spermatheca opening distinct in the centre of the area. Male reproductive system. 6 pairs of testes. Seminal vesicles as many loops with a bend, multiply coiled, situated near testes 1. Vasa deferentia slightly coiled. Ejaculatory ducts narrow, reach ganglion 4, multiply bent (more than 5 times). On atrium prostatic glands well developed as large lobes arranged in a rosette, with arms directed towards anterior of trachelosome. Female reproductive system. Ovaries elongate, cylindrical, long, their distal ends touch testes 2. Ovaries large, sac-like, slightly flattened, reaching testes 2 (they lie on testes 1 and 2). Anterior ends of ovaries (before passing into oviducts) cover vector tissue. Oviducts open to female gonopore anterior to the vector tissue. Vector tissue as an elliptical plate, located perpendicular to the long body axis. Conducting strands as very long, narrow strands of fibres connecting each ovary with the anterior part of vector tissue

DISTRIBUTION

It is known only from one locality in Poland: Szczodre near Wrocław in the south-western part of the country. Fish ponds.

BIOLOGY

The leeches were found on the ventral fins and body of 47 and 52 cm carp, *Cyprinus carpio* L.

Piscicola jarai sp. n.

(Figs 223-230; Table 1)

TYPE MATERIAL

Holotype: Poland, near Milicz, 15-IV-1986, from *Silurus glanis* L., leg. A. BIELECKI, 3 paratypes: same data. Holotype is deposited at the Museum of Natural History, Wrocław Uniwersity; paratypes in authors collection.

DIAGNOSIS

See diagnosis of *P. pomorskii* sp. n.

ETYMOLOGY

Dedicated to Prof. dr hab. Zbigniew JARA, the referee of my doctoral thesis who has influenced my imagination in the following way: Besides the most modern world's laboartories, there are laboratories as old as the world itself. These are our mind's laboratories.

DESCRIPTION

Body size and form as in figs 223-224 and Table 1. Body length 14.0-14.7 mm. L/D_2 - 10.92, C^1_1/d_1 - 1.3, C^1_1/D_1 - 0.8, R_1/M_1 - 6.0, C^1_1/C_1 -1.0, L_1/D_1 - 3.1, D_1/N_1 - 2.5, S_1/S_2 - 1.8, L_2/D_2 - 8.5, D_2/N_2 - 2.6, K_1/K_2 - 0.3, C^1_2/d_7 - 1.7, C^1_2/D_2 - 1.5, R_2/M_2 - 1.3, C^1_2/C_2 - 1.0, L_2/L_1 - 3.6, D_2/D_1 - 1.3, N_2/N_1 - 1.3, C^1_2/C^1_1 - 2.4.

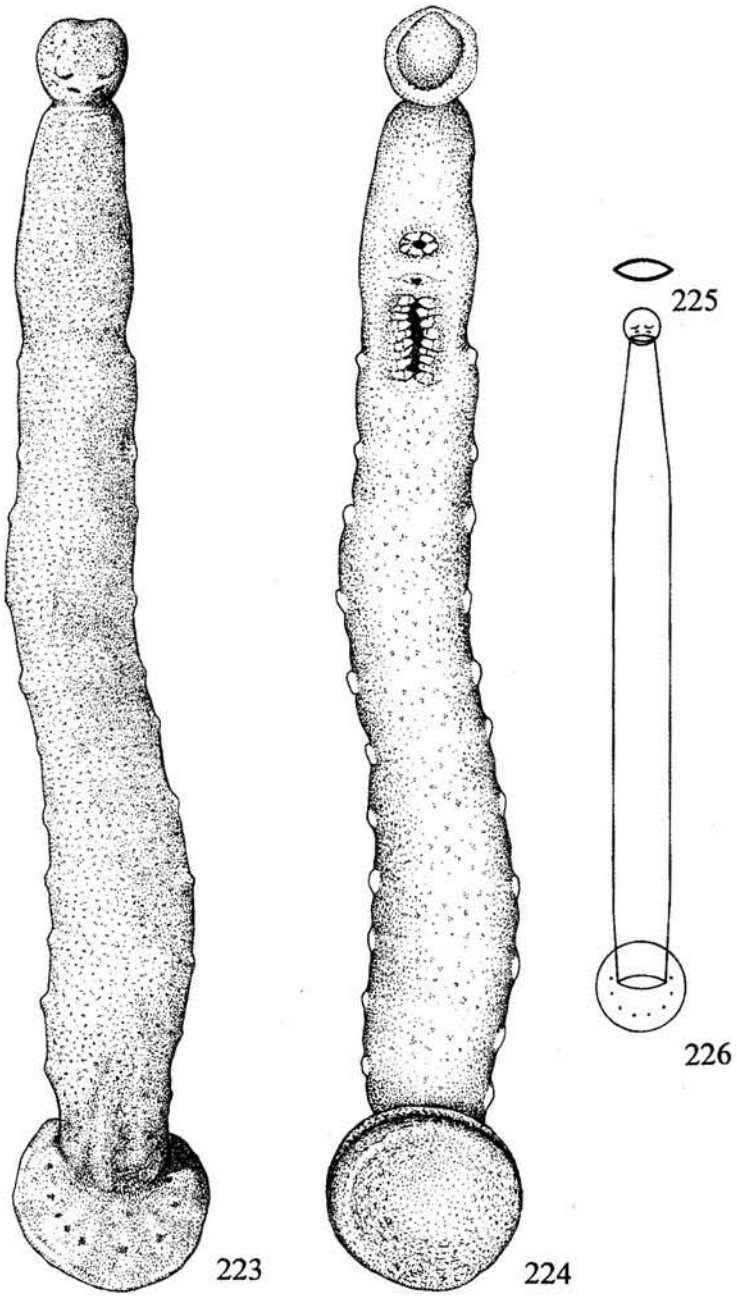
Body form (figs 225-226). Body elongate, very strongly flattened. No division into trachelosome and urosome. Anterior and posterior suckers connected strongly eccentrically, with no concavity, flat.

Body coloration (fig. 223-224). It results from arrangement of light brown melanophores on grey background. On trachelosome and urosome melanophores as dots with no processes. along annuli. No transverse white streaks on particular somites of trachelosome and urosome. Ventral side lighter because of much fewer light brown melanophores. On anterior sucker no spots. Posterior sucker with white and light brown, poorly marked radial streaks, 14 of each kind. Light brown melanophores on suckers in the form of fine dots with no processes.

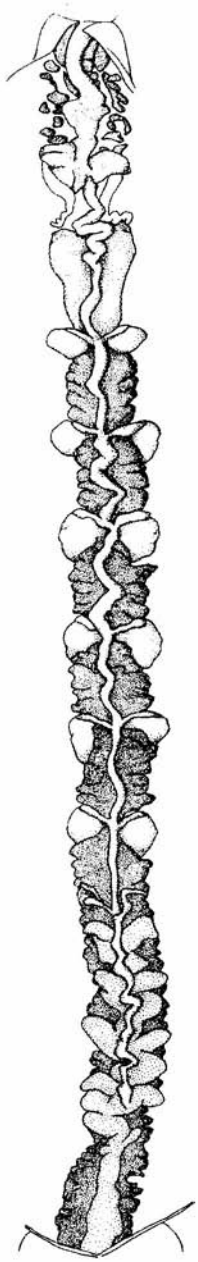
Eyes. On anterior sucker 2 pairs of distinct large eyes - the first larger, as arches, with ends directed towards anterior part of sucker, the second situated slightly posterior to, somewhat smaller, as dashes. On posterior sucker there are 10 eye-like spots, in situated its central part on the edge of dark radial streaks (fig. 223).

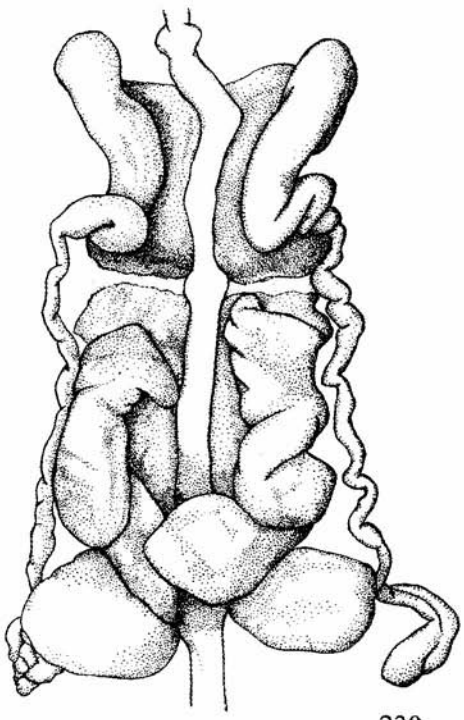
Segmentation (fig. 227). Mid body somite of 14 annuli of unequal length. Respiratory vesicles (11 pairs) small but well visible.

Alimentary tract (fig. 228). Mouthpore centrally located. Proboscis base at ganglion 3. Oesophageal glands large, as rather wide triangles, transverse to the body



223- 226. *Piscicola jarai* sp. n.: 223-224 - dorsal and ventral view, 225-226 - body form.





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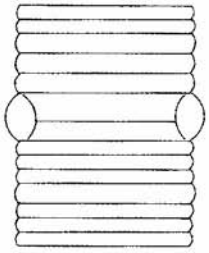

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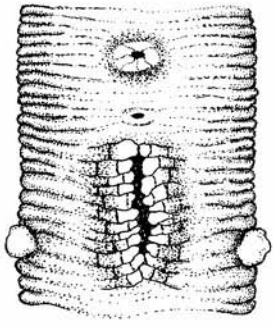

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229

227- 230. *Piscicola jarai* sp. n.: 227 - somite, 228 - alimentary tract, 229-230 - reproductive systems.

long axis. Crop of 7 splanchnomeres, each of 4 diverticles, the first diverticle being much broader and longer than the remaining ones and further divided into 3 smaller and shorter secondary diverticles. Intestine poorly developed, not covering completely posterior crop caecum, with rather strongly folded walls; it has 5 diverticles: the first three well developed, the fourth not much smaller, the fifth very small and poorly visible. Excellently visible lacunae of secondary body cavity: dorsal and lateral, segmental.

Reproductive system (figs 229-230). Gonopores separated by 4 annuli. Male gonopore large, female gonopore small, not clearly visible. Copulatory area elliptical, parallel to the body long axis. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive system. 6 pairs of testes. Seminal vesicles, classically U-shaped, at the level of testes 1, situated parallely to the body long axis. Vasa deferentia slightly coiled. Ejaculatory ducts thick, once sharply bent, their apices reach ganglion 5 or slightly protrude anterior to it. Bends located in a plane parallel to atrium. On atrium prostatic glands very well developed as large lobes. Female reproductive system. Ovaries short, sac-like, large, fairly wide and flattened, reaching testes 1, their distal ends free, not intertwined. Anterior ends of ovaries (before passing into oviducts) cover vector tissue, which is situated below outlet of oviducts as a well marked wide ellipse parallel to the body long axis. Oviducts narrow. Conducting strands as short, wide strands of fibres connecting each ovary with the mid part of vector tissue.

DISTRIBUTION

SW Poland.

BIOLOGY

The leeches were found on pectoral fins and body of catfish (*Silurus glanis* L.) collected in fish ponds.

Piscicola wiktori sp. n.

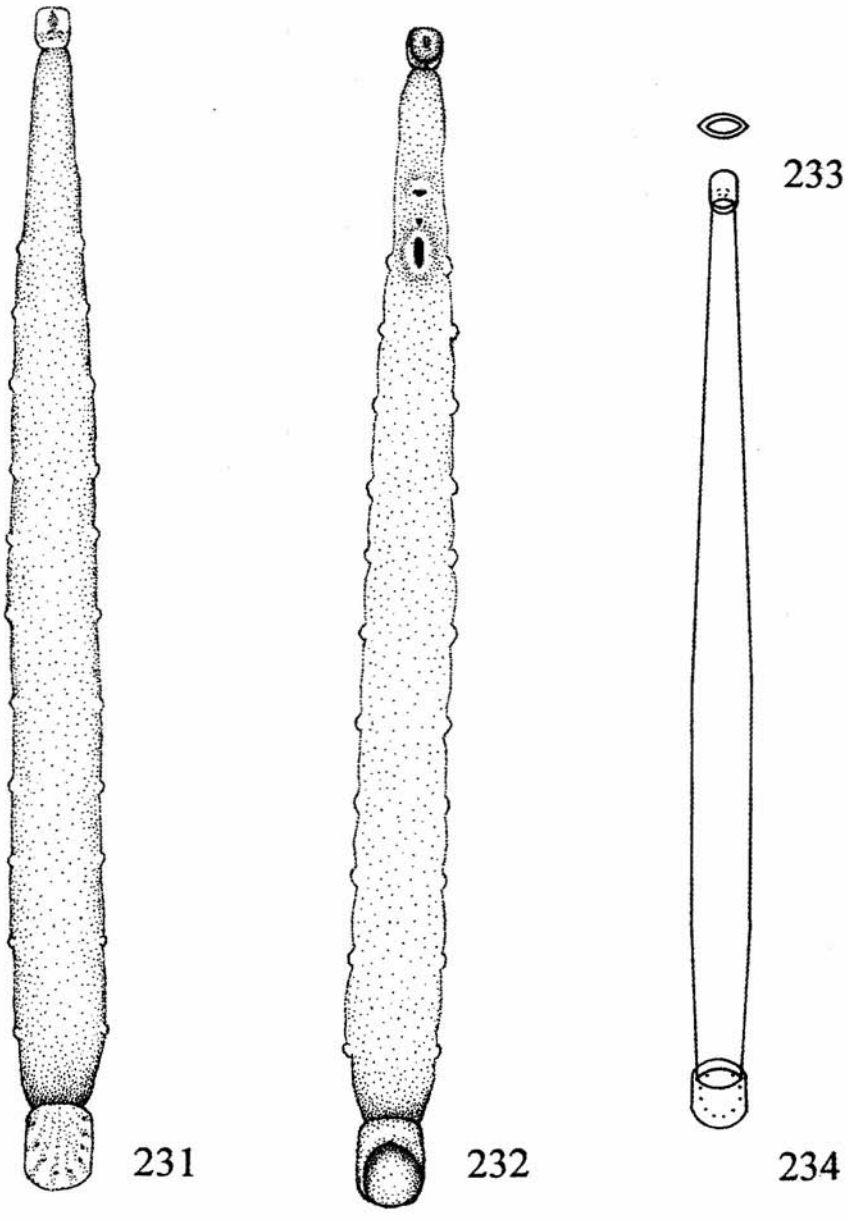
(Figs 231-242; Table 1)

TYPE MATERIAL

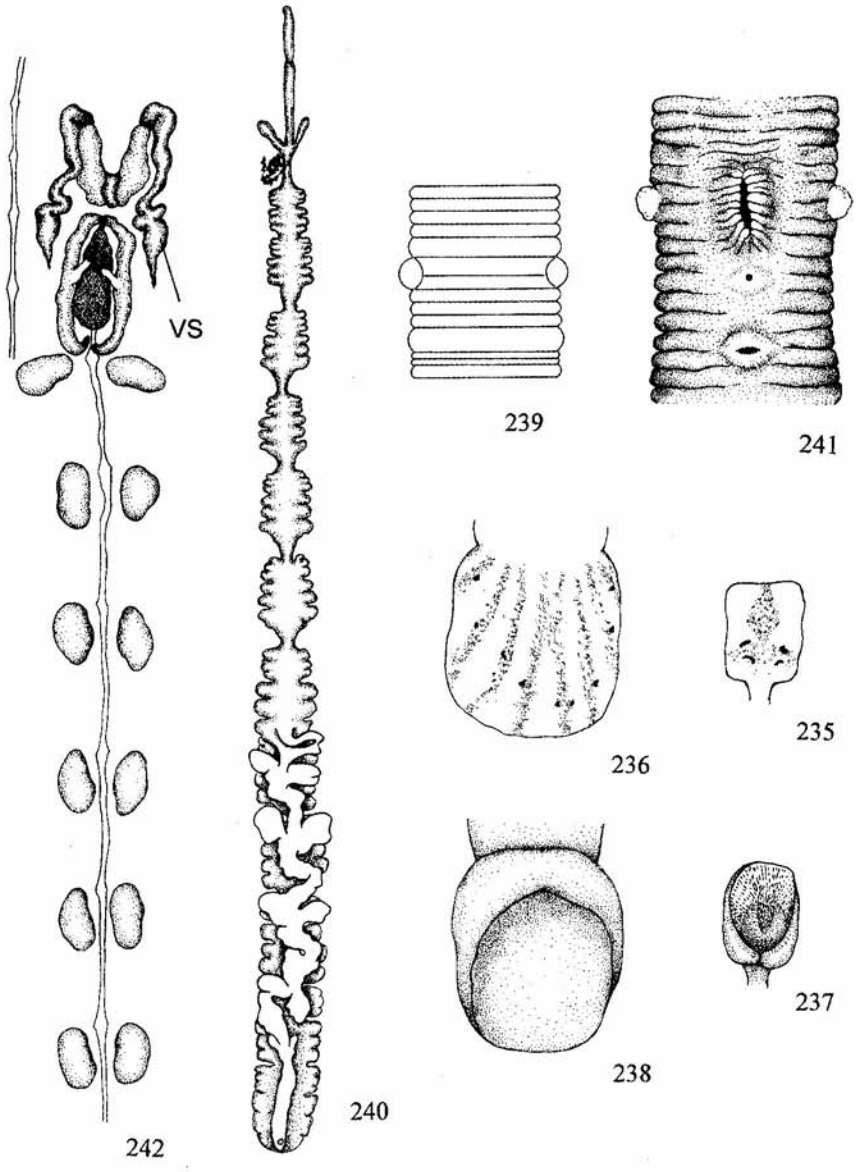
Holotype: Poland, Przemków near Legnica, 17-XII-1992, from *Cyprinus carpio* L., leg. A. BIELECKI, 6 paratypes: 4 from *Cyprinus carpio* L., and 2 from *Perca fluviatilis* L., in fish ponds. Holotype deposited at the Museum of Natural History, Wrocław University; paratypes in author's collection.

DIAGNOSIS

See diagnosis of *P. borowieci* sp. n.



231- 234. *Piscicola wiktori* sp. n.: 231-232 - dorsal and ventral view, 233-234 - body form.



235- 242. *Piscicola wiktori* sp. n.: 235-238 - suckers dorsal and ventral view, 239 - somite, 240 - alimentary tract, 241-242 - reproductive systems.

ETYMOLOGY

The species is dedicated to Prof. dr hab. Andrzej WIKTOR who long ago helped me to start my scientific career despite his own objections.

DESCRIPTION

Body shape and size as in figs 231- 232, 235-238 and Table 1. Body length 12.1-17.8 mm. L/D_2 - 14.8, C^1_1/d_1 - 1.0, C^1_1/D_1 - 0.8, R_1/M_1 - 5.0, C^1_1/C_1 -0.6, L_1/D_1 - 6.2, D_1/N_1 - 1.7, S_1/S_2 - 0.9, L_2/D_2 - 11.7, D_2/N_2 - 2.5, K_1/K_2 - 0.9, C^1_2/d_7 - 1.1, C^1_2/D_2 - 0.9, R_2/M_2 - 3.5, C^1_2/C_2 - 0.8, L_2/L_1 - 3.8, D_2/D_1 - 2.0, N_2/N_1 - 1.3, C^1_2/C^1_1 - 2.3.

Body form (figs 233-234). Division into trachelosome and urosome very poorly visible. Body elongate, fairly much flattened. Anterior and posterior suckers very characteristic, of peculiar form - spade-shaped, different from those in all other members of the *Piscicolinae*. Such suckers are characteristic of marine species of the subfamily *Platybdellinae*, genus *Oceanobdella*. Both suckers small, connected strongly eccentrically.

Body coloration (figs 231-238). Suckers white, anterior sucker almost unpigmented, on its margins a few brown melanophores as delicate dots. Similarly, on posterior sucker ten streaks of delicate brown dots, most streaks having two rows of dots each. On trachelosome five wider transverse streaks, of the same brown delicate dot-like melanophores, and five narrower white streaks. Urosome evenly splashed with brown, round melanophores, which are larger and more rusty than those on suckers and on trachelosome. On urosome, contrary to trachelosome, no transverse white streaks. Ventral side of identical colouration as the dorsal one, except that there are no transverse white streaks on trachelosome. On inner side of body wall of trachelosome and urosome round dark brown melanophores. They are present also on all parts of male reproductive system.

Eyes. On anterior sucker 2 pairs of eyes, of equal size, located centrally, oblique relative to saggital plane. On posterior sucker 10 inconspicuous eye-like spots, situated in its peripheral part, betwen the radial streaks (figs 235-236).

Segmentation (fig. 239). Annuli distinct, mid-body somite of 14 annuli in 4 groups of different length: annulus 11 the longest; 5 and 6 somewhat shorter; 1, 2, 3, 4, 7, 8, 9, 10, 14 shorter; 12 and 13 the shortest. Papillae (sensillae, tangoreceptors) absent. Respiratory vesicles (11 pairs) rather small, fine, poorly visible.

Alimentary tract (fig. 240). Mouthpore situated centrally. Proboscis base at the level of ganglion 3. Crop splanchnomeres of 4 unequal diverticles: the first larger and broader, divided in 3 barely discernible secondary diverticles, and 3 small and narrow diverticles. Intestine poorly developed, not covering completely posterior crop caecum, its walls folded; 4 large diverticles, the 5th small.

Reproductive system (figs 241-242). Gonopores separated by 4 annuli. Male gonopore large, female gonopore small, very clearly visible. Copulatory area elliptical, parallel to the body long axis. Spermatheca opening, distinct in the centre of the area, exactly at the level of the first pair of respiratory vesicles. Male reproductive

system. 6 pairs of testes. Ejaculatory ducts placed in a plane parallel to atrium, as single small, sharp bends reaching (or almost reaching) ganglion 4. Vasa deferentia very short, simple, not coiled, almost immediately passing into seminal vesicles. On atrium prostatic glands well developed. Their proximal parts directed laterally, almost perpendicular to atrium. Seminal vesicles unique, with no bend, small ampullae located far anterior to testes 1, at the level of oviducts (ganglion 6). Female reproductive system. Ovaries elongate, cylindrical, short, their distal ends reach testes 1, free, not intertwined, paramedially bent. Oviducts straight. Vector tissue as a fairly long, well marked ellipse parallel to the body long axis. Conducting strands as short, narrow strands of fibres connecting each ovary with mid part of vector tissue.

DISTRIBUTION
NC Poland.

BIOLOGY
The leeches were found on fins and body of carp, *Cyprinus carpio* L. and perch, *Perca fluviatilis* L., in fish ponds.

Genus: *Baicalobdella* DOGIEL et BOGOLEPOVA, 1957

Piscicola GRUBE, 1871: 117-119, fig. 5; DOGIEL, BOGOLEPOVA and SMIRNOVA 1949: 19.
Baicalobdella DOGIEL and BOGOLEPOVA 1957: 449, fig. 14a.
Trachelobdella EPSHTEIN 1959: 935-937, fig. 1; LUKIN 1960: 489-491, EPSHTEIN 1962: 624, fig. 1538.
Baicalobdella: EPSHTEIN 1968a: 138; 1973: 337-340, figs 1, 2, 3.

Type species: *Piscicola torquata* GRUBE, 1871.

DESCRIPTION
Size very small (4-6 mm). Body short, flattened, covered with papillae. Division into trachelosome and urosome very well visible. Anterior sucker small, medium-sized or very small, posterior sucker also small and connected somewhat eccentrically or nearly centrally. Respiratory vesicles (11 pairs) white, rather small but well visible. Eyes (2 pairs) on anterior sucker and eye-like spots on posterior sucker present. Mid-body somite 3-annulate, annuli equal, with no additional grooves. On clitellum spermatheca opening visible 1 annulus posterad to male gonopore. Spermatheca as a pocket, opening anteriorly with a wide transverse slit. Its margin bordered by a fold of raised cuticle, which constitutes copulatory area. Copulatory area on clitellum short (small), limited to covers surrounding spermatheca opening anterior to the first pair of respiratory vesicles. Mouthpore situated centrally. Base of proboscis at ganglion 3, proboscis medium-sized. Oesophageal gland present. Crop and posterior crop caecum splanchnomeres undivided. Posterior crop caecum built of 5 splanchnomeres which are not completely fused; 5 fenestrae remain at the level of ganglia. Intestine poorly developed. 4 or 5 pairs of testes. Seminal vesicles situated at the level of testes 1 as a

glomerus of loops, at the level of ganglia 7 - 9. Ejaculatory ducts thin, small, slightly protruding beyond ganglion 6. Prostatic glands on atrium well developed, cover whole atrium. Vector tissue as a narrow plate transverse to long body axis, posterior to oviduct outlet (oviducts open to the female gonopore anterior to vector tissue). Ovaries short, reaching testes 1. Paired conductive tissue, conducting strands as very short, wide strands of fibres, connecting each ovary with vector tissue (LUKIN and EPSHTEIN 1959, LUKIN 1962, 1976, EPSHTEIN 1959, 1968, 1987, EPSHTEIN et al. 1994).

On fish and *Gammmaridae*, in the Lake Baikal two species of the genus.

Note! The following key is given after EPSHTEIN (1987), with some modifications.

KEY TO THE SPECIES

1. Horizontal diameter of anterior sucker equal to the largest width of trachelosome. Posterior sucker calyx-shaped, connected eccentrically, its horizontal diameter equal to half of the largest width of urosome. Body covers smooth or barely discernible tubercles on mid annuli of somites ..... ***torquata***

-, Horizontal diameter of anterior sucker smaller than the largest width of trachelosome. Posterior sucker disc-shaped when unattached, connected more or less centrally, its horizontal diameter much smaller than half of the largest width of urosome. On all annuli of somites fine tubercles ..... ***cottidarum***

Baicalobdella torquata (GRUBE, 1871)

Piscicola torquata GRUBE, 1871: 117-119, fig. 5.

Widely distributed in the Lake Baikal; from water surface to 130 m. Before the Angara River was regulated, it was very abundant there over a distance of 220 km from the source. After the regulation it was only rarely found. On amphipods *Eulimnogammarus verrucosus* and possibly also on other species of the order. On ventral body side, gill lamellae and pleopods. On body surface and fins of yellowfin Baikal sculpin, *Cottocomephorus grewingki* (DYBOWSKI).

Baicalobdella cottidarum DOGIEL et BOGOLEPOVA, 1957

Baicalobdella cottidarum DOGIEL and BOGOLEPOVA, 1957: 449, fig. 14a.

Numerous on stones, from several metres to considerable depths. It parasitises *Cottocomephorus* sp. and perhaps some other species of Baikal cottids. On body surface and fins. Often found on freshly laid eggs of yellowfin Baikal sculpin, *Cottocomephorus grewingki* (DYBOWSKI). Not found on amphipods.

V. DISCUSSION

Methodological and historical-scientifc studies demonstrate that the systemic approach to the problems of systematics is a necessary stage in the development of traditional approach in those sciences.

The systemic approach to cognition of living organisms (description area) implies presenting their organization within the quality of the system and distinguishes systemic concepts: subsystems, structure, programme, space of logical possibilities, implementation space, objective aspect (BIELECKI and EPSHTEIN 1994, 1995).

Implementation of the systemic approach as complementary to traditional approach makes it possible to:

- distinguish, in the infinity of systematic characters, those that are necessary and sufficient for species description at a given stage of science development;
- propose a complex of characters as a standard of description, so that specialists can present comparable descriptions which is necessary for implementation of systemic approach in areas of classification;
- present the whole object using a number of characters;
- prognose theoretically acceptable forms by constructing space of logical possibilities (systemically credible way of systematist's thinking within the description area);
- improve analysis of adaptation processes by comparing space of logical possibilities with implementation space (objective aspect of systematist's studies).

V. 1. MODEL OF LEECH BODY FORM AS A SYSTEM

The model described is considered in agreement with basic systemic concepts. The figure describing the leech body form characterizes it as a whole and constitutes a system, composed of mutually related subsystems: anterior sucker, trachelosome, urosome and posterior sucker. Based on the pictures obtained, the following invariants (structure components) are distinguished:

1/ $D_1/N_1 \geq 1$; $D_2/N_2 \geq 1$. Trachelosome breadth and urosome breadth equal to or exceeding the height of those body sections;

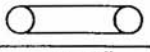
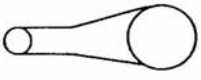
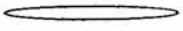
2/ $D_2/D_1 \geq 1$; $N_2/N_1 \geq 1$. Urosome breadth and height equal to or exceeding the greatest breadth and height of trachelosome.

3/ $D_1/N_1 = D_2/N_2$; $D_2/D_1 = N_2/N_1$. Transverse sections of urosome and trachelosome are similar. When sections of trachelosome and urosome are similar, only three values can change independently - form of transverse section $D_2/N_2 = D_1/N_1$, relative size of transverse section of urosome and trachelosome $D_2/D_1 = N_2/N_1$ and relative body length L/D_2 (programme components). The total of possible theoretical connections between those ($D_2/N_2 = D_1/N_1$ and ($D_2/D_1 = N_2/N_1$) components illustrates the space of logical possibilities in the form of matrix (tab. 3). Applicability of this approach to the description of animal body form, including vertebrates: fish and terrestrial vertebrates - raises no doubts (BIELECKI and EPSHTEIN 1994, 1995). Such a model includes not only body-forms characteristic of *Piscicolidae* and *Acanthobdellidae*, but also of other

leech groups and other types and classes of "worms" (*Turbellaria, Monogenea, Trematoda, Cestoda, Nemertini, Polychaeta, Oligochaeta* and slugs).

Implementation ranges proposed for various leech groups characterize their life forms distinguished according to the way of translocation of these animals and position of their body relative to the substratum. It appears that within the space of logical possibilities there are four areas (implementation areas) (BIELECKI and EPSHTEIN 1994, 1995) corresponding to (tab. 2):

Tab. 2. Space of logical possibilities and space of implementation of leech body

D_2/N_2 / D_2/D_1	$D_2/N_2 = 1$	$D_2/N_2 > 1$	$D_2/N_2 < 1$
$D_2/D_1 = 1$	„cylinder" 	„tape" 	prohibited
$D_2/D_1 > 1$	„retort" 	„leaf" 	prohibited
$D_2/D_1 < 1$	prohibited	prohibited	prohibited

1. very long, worm-shaped leeches (long cylindrical body, "cylinder"), crawling like oligochaets;
2. leeches with a comparatively long, flattened, tape-like body, able to swim ("tape");
3. leeches with cylindrical body of medium size - parasitic leeches not attached to the host with the entire body surface;
4. leeches attaching to the substratum or host with the entire body surface - leaf-shaped body ("leaf").

Within the space of logical possibilities, implementation areas can be also distinguished corresponding to many taxa. For example *Acanthobdellidae* use only the third area, flat leeches - *Glossiphoniidae* - the fourth, *Arhynchobdellea* - the first and the second. The implementation area for the fish leeches (*Piscicolidae*) of the Palaearctic is drop-shaped, the upper part being situated in the first, and the lower in the fourth area. No leech has a retort-shaped body ("retort"); this is characteristic of

some parasitic phytonematods. Though in some leech species with flattened body and partly or completely accreted posterior crop caecum, allowing them to take up large amounts of blood, the body assumes a nearly retort-like form when the alimentary canal is filled. As the leech uses the blood from the caecum, the body returns to the previous form.

Below I present a more detailed analysis of the leech body form (tab. 3).

In the space of logical possibilities of the sections of trachelosome and urosome in leeches (*Piscicolidae*) 15 morphotypes were distinguished, of which **9** (morphotypes **1 - 9**) are contained in the implementation space, and 6 in the critical space (morphotypes **1 - 6**).

The implementation space contains 6 morphotypes (**1-6**), which are actually implemented, 3 morphotypes (**7**, **8** and **9**) with no actual representatives till now, and included in the implementation space based on the interpretation of the morphotype of *P. niewiadomskae* (**6** in tab. 3).

Implementation space;

Morphotype **1** (trachelosome cross-section $D_1/N_1 = 1$ and urosome cross-section $D_2/N_2 = 1$): *C. fadejewi, P. pojmanskae, P. annae, P. borowieci, P. witkowskii, Pawlowskiella minima.*

Morphotype **2** (trachelosome cross-section $D_1/N_1 > 1$ and urosome cross-section $D_2/N_2 > 1$): *C. mammillatus, P. margaritae, P. respirans, P. fasciata, P. pomorskii, P. kusznierzi, P. wiktori, P. elishebae.*

Morphotype **3** (trachelosome and urosome cross-section identical $D_1/N_1 = D_2/N_2 = 1$): only one species: *P. geometra.*

Morphotype **4** (trachelosome and urosome cross-section identical $D_1/N_1 = D_2/N_2 > 1$): also only one species: *P. jarai.*

Morphotype **5** (trachelosome and urosome cross-section different $D_1/N_1 \neq D_2/N_2$); *I. ciosi, I. epshteini* and *A. volgensis.*

Morphotype **6** (trachelosome and urosome cross-section different $D_1/N_1 \neq D_2/N_2$; $D_1/N_1 > 1$ and $D_2/N_2 < 1$) known only in *P. niewiadomskae.*

Morphotypes **7**, **8**, **9** (trachelosome and urosome cross-sections different $D_1/N_1 \neq D_2/N_2$, morphotype **7** - $D_1/N_1 = 1$; $D_2/N_2 > 1$, morphotype **8** - $D_1/N_1 < 1$; $D_2/N_2 > 1$, morphotype **9** - $D_1/N_1 < 1$; $D_2/N_2 = 1$) are not known in nature till now. All of them are characterized by the greatest width of urosome larger than the greatest width of trachelosome; the value characterizes most of the implemented morphotypes and hence a high probability that they may exist in nature, especially morphotype **7**.

Morphotypes **8** and **9** are characterized by trachelosome from the border of the implementation space and critical space; most probably any further flattening of trachelosome is impossible.

Critical space - trachelosome and urosome cross-sections $D_1/N_1 \neq D_2/N_2$.

Morphotypes: 1 - trachelosome cross-section $D_1/N_1 < 1$ and urosome cross-section $D_2/N_2 < 1$ equal in width, different in height; 2 trachelosome and urosome cross-sections identical $D_1/N_1 = D_2/N_2 < 1$, characterized by a strong lateral flattening of the body and from the viewpoint of interactions leech-environment, including host environment, are paradoxical.

Tab. 3. Space of logical possibilities and space of implementation of body form of 20 piscicolid species. Light grey shapes - actually implemented; dar grey shapes - unknown but probable; white shapes - critical, not implemented.

Space of logical possibilities									
Implementation space							Critical space - morphotypes not implemented		
Urosome and trachelosome cros-sections		Species	Urosome and trachelosome cros-sections		Species		Urosome and trachelosome cros-sections		
1			2				1		
T	$D_1/N_1 = 1$	*Cas. fadejewi* *P. pojmanskae* *P. annae* *P. borowieci*	T	$D_1/N_1 > 1$	*Cys. mammillatus* *P. margaritae* *P. respirans* *P. fasciata*	T	$D_1/N_1 < 1$		
U	$D_2/N_2 = 1$	*P. witkowskii* *Paw. stenosa*	U	$D_2/N_2 > 1$	*P. pomorskii* *P. kusznierzi* *P. wiktori* *P. elishebae*	U	$D_2/N_2 < 1$		
3			4				2		
T	$D_1/N_1 = D_2/N_2 = 1$		T	$D_1/N_1 = D_2/N_2 > 1$		T	$D_1/N_1 = D_2/N_2 < 1$		
U		*P. geometra*	U		*P. jarai*	U			
5			6				3	4	
T	$D_1/N_1 \neq D_2/N_2$		T	$D_1/N_1 \neq D_2/N_2$		T	$D_1/N_1 \neq D_2/N_2$		
U		*I. ciosi* *I. epshteini* *A. volgensis*	U		*P. niewiadomskae*	U			
7			8	9			5	6	
T	$D_1/N_1 \neq D_2/N_2$		T	$D_1/N_1 \neq D_2/N_2$		T	$D_1/N_1 \neq D_2/N_2$		
U		?	U		?	U			

Morphotypes: 3 - $D_1/N_1 > 1$, $D_2/N_2 = 1$; 4 - $D_1/N_1 > 1$, $D_2/N_2 > 1$; 5 - trachelosome cross-section $D_1/N_1 = 1$ and urosome cross-section $D_2/N_2 = 1$; 6 - trachelosome cross-section $D_1/N_1 = 1$ and urosome cross-section $D_2/N_2 > 1$, characterized by a wider trachelosome compared with urosome. These morphotypes, in reference to the model of body form, are also paradoxical and not implemented in nature.

Based on the studies on an extensive material it was demonstrated that the model makes it possible to describe the body form of various leech species with adequate accuracy. It contains characters of external morphology of leeches used by systematists. Because of this, modelling the external leech morphology at this stage of studies can be regarded as completed. Literature data and earlier data from our original studies reveal a significant diversity of the above structures and associations of such a diversity with the size and body form of the leeches which result from their peculiar ecology (see below). Using the model on a computer with graphic display, a large number of pictures of leech specimens was obtained, as a result of their measurements and also statistical analysis of data for 20 species of *Piscicolidae*.

V. 2. Analysis of morphotype adaptations to various habitats

Since the body form of the studied leech species is not genus-specific, and many species of various genera display very similar morphotypes (fig. 34, marked with asterisk*), first I looked for similarity between different body forms in one genus - *Piscicola*. Then I attempted to demonstrate dependences between the morphotypes displayed by particular members of the genus, and the water bodies in which they occur (fig. 243).

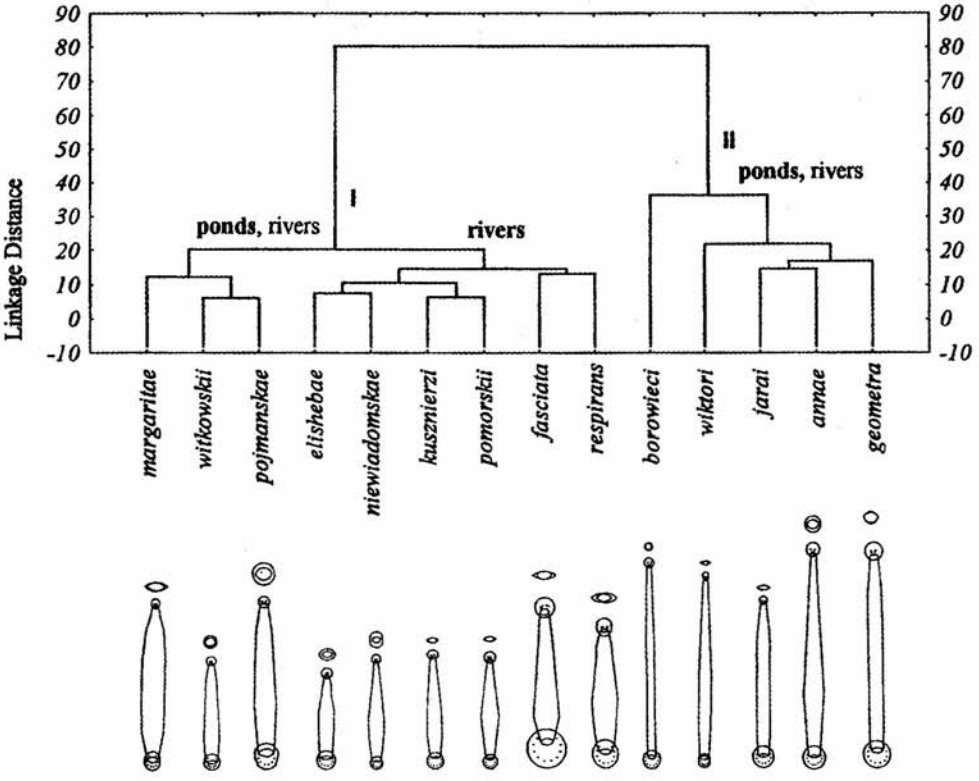
Morphotypes of 14 species are grouped in 2 polytypic clusters (fig. 243).

In cluster I two distinct sub-clusters can be distinguished. One comprises *P. margaritae*, *P. witkowskii* and *P. pojmanskae*. Their morphotypes are characterized by a rather short, stout body (small relative body length) in a shape of cylinder (except *P. margaritae*) and by rather small suckers. *P. margaritae* and *P. pojmanskae* are known from fish ponds, *P. pojmanskae* occurring also in dam reservoirs. *P. witkowskii* is most probably a fluviatile species.

Another sub-cluster includes 6 species (*P. elishebae*, *P. niewiadomskae*, *P. kusznierzi*, *P. pomorskii*, *P. fasciata* and *P. respirans*), with hydrodynamic morphotypes. Their body is stout and short (small relative length), strongly dorsoventrally flattened (except *P. niewiadomskae*), with distinct trachelosome and urosome. The suckers are rather small or large, strong and often deep (especially the posterior one). The posterior sucker is smaller than, equal to, wider or markedly wider than the greatest urosome width. *P. fasciata* and *P. respirans* depart the most in their body forms from the remaining members of the sub-cluster. Members of the second sub-cluster are fluviatile. Most of them inhabit lowland rivers, only *P. respirans* being found also in mountain rivers. They are not known from lakes, dam reservoirs and fish ponds, though *P. respirans* and *P. fasciata* were described long ago.

P. respirans is typical of mountain streams and rivers. It is characterized by the most hydrodynamic morphotype. Its body is strongly flattened, posterior sucker fairly

large (as wide as the greatest urosome width), strong and rather deep. It parasitises mostly brown trout and grayling and rheophilous cyprinids. For this reason it prefers rivers of quick water flow and low temperature. With increasing proportion of phytophilous cyprininds along the river course, its abundance decreases (own, unpublished results).



243. Tree diagram for 14 species (*Piscicolinae*) based on mean value of 19 body proportion indices (Wards method, Manhattan distances) in relation to habitat.

P. fasciata is typical of lowland rivers and other catfish habitats. It is a specific catfish parasite. Its body form is also hydrodynamic. The posterior sucker is much wider than the urosome.

P. elishebae, *P. kusznierzi*, *P. pomorskii*, and especially *P. niewiadomskae*, have a less hydrodynamic body form than *P. respirans* and *P. fasciata*. These are new species and thus poorly known with respect to habitat and host preferences.

Cluster II includes: *P. borowieci*, *P. wiktori*, *P. jarai*, *P. annae* and *P. geometra* of the most similar body form. The morphotypes of all these species are characterized by a strongly elongate body (high relative length), approaching cylindrical (except *P. jarai* which is much flattened), which is not differentiated into trachelosome and urosome. The suckers are relatively large, the posterior sucker wider than the greatest urosome width. *P. geometra*, *P. borowieci*, *P. wiktori* and *P. jarai* are hitherto known from fish ponds. Two species, *P. annae* and *P. geometra* occur also in rivers. However, they have never been found in mountain and submontane rivers. *P. annae* inhabits lowland rivers, being a parasite of brown trout, grayling and pike. For this reason, the leech chooses both river sections with quickly flowing water, and oxbows. *P. geometra* is a typical parasite of non-rheophilous cyprinids. Thus it occurs mainly in oxbows, which have conditions close to those of natural and artificial ponds. Morphotypes of these two species are close to morphotypes of species limited to fish-ponds.

In my opinion the above described morphotypes of members of the genus *Piscicola*, have been formed under the effect of aquatic habitat. Effect of other factors can not be excluded. The parasitic mode of life of these organisms seems also important.

V. 3. Evaluation of taxonomic decisions at the generic level

Sawyer (1986), analysing earlier diagnoses of 8 genera of the Palaearctic *Piscicolinae* (Epshtein 1968a, 1969, 1973), considered only five of them to be distinct: *Limnotrachelobdella* Epshtein, 1968; *Baicalobdella* Dogiel et Bogolepova, 1957; *Caspiobdella* Epshtein, 1966; *Piscicola* De Blainville, 1818 and *Cystobranchus* Diesing, 1859. He did not accept the generic distinctness of *Taimenobdella* Epshtein, 1964; *Codonobdella* Grube, 1873 and *Acipenserobdella* Epshtein, 1969. Below I discuss the generic system of the *Piscicolidae* occurring in the Palaearctic, in the light of my own studies and facts known to me from literature.

Genus *Limnotrachelobdella* Epshtein, 1968.

Sawyer (1986, vol. II: 673) gives the following description of the genus, based on the papers of Epshtein (1973): "Genus: *Limnotrachelobdella* Epshtein, 1968. *Piscicolinae*; 10-13 pairs of large conspicuous vesicles; no vector tissue; eyes diffuse, appearing as one pair; marked urosome; size large, 20-50 mm or more; southern Asian lakes to Japan; brackish and freshwater; = *Taimenobdella* Epshtein 1964 [partim]". In this genus he recognized the following species: type species: *L. sinensis*

(BLANCHARD, 1896) - China, Amur River, *L. okae* (MOORE, 1924) - Japan, *L. taimeni* (EPSHTEIN, 1957) - Amur River and *L. turkestanica* (SCHEGOLEV, 1912) - Turkestan. He included ?*L. amurensis* (EPSHTEIN, 1964) with a reservation.

Genus *Taimenobdella* Epshtein, 1964.

SAWYER (1986) questioned the generic distinctness of *Taimenobdella*. His objections, however, may be ungrounded. The genus shares only two characters with *Limnotrachelobdella*: absence of both vector tissue and prostatic glands. I think that the morpho-anatomical characters (7-annulate somite, common, unpaired part of atrium as an elongate trumpet, large suckers, very fine pulsatile vesicles, 11 pairs), and physiological-behavioural characters-specificity towards an endemic fish *Hucho hucho taimen* (PALLAS) of *Taimenobdella amurensis* - are sufficient to admit its generic distinctness (EPSHTEIN 1964).

Genus *Codonobdella* Grube, 1872.

SAWYER (1986, vol. II: 673) gives the following description of the genus, based on the paper of LUKIN (1976): "Genus: *Codonobdella* GRUBE, 1872. "? *Piscicolinae*: 11 pairs of small vesicles (? pulsatile): oral sucker a thick-walled cup, bearing two pairs of eyes; caudal sucker small and terminal, barely distinguishable from body; caudal ocelli; annulation variable, usually six or seven (3-14); body cylindrical, no urosome; five pairs of testisacs; endemic to Lake Baikal, to 1100 m deep; associated with amphipods". SAWYER (1986) expressed doubts as to whether the genus should be classified within the *Piscicolinae*. In his opinion *C. truncata* GRUBE, 1872 had no respiratory vesicles, and the reports on their presence might result from mistaking this structure for papillae, which are numerous in this species. Also earlier data on food relations of that leech with crustaceans 'amphipods' (LUKIN 1976) suggest its transfer to another subfamily. In the Arctic and adjacent seas there occurs *Mysidobdella borealis* (JOHANSSON, 1898b) of the monotypic genus *Mysidobdella* ZELENSKII, 1927, subfamily *Platybdellinae*. The leech has no respiratory vesicles and is an ectoparasite of crustaneans *Neomysis americanus* and *Mysis* spp. (EPSHTEIN 1962a; BURRESON and ALLEN 1978, ALLEN and ALLEN 1981). This would indicate a possibility of inclusion of *C. truncata* in the genus *Mysidobdella*. However, recent histological analyses confirmed the presence of respiratory vesicles in this species (FINOGENOVA 1992). Besides, *C. truncata* parasitises not only crustaceans, but also fish of the genus *Batrachocottus* spp. (EPSHTEIN 1987). Because of this I think that the genus *Codonobdella* should remain in the subfamily *Piscicolinae*.

Genus *Acipenserobdella* EPSHTEIN, 1969.

SAWYER (1986) questioned the distinctness of this monotypic genus and consequently transferred *Acipenserobdella volgenesis* (ZYKOFF, 1903) to the genus *Piscicola*. In my opinion the controversies result from an erroneous interpretation of the structures of reproductive system, in both members of the genus *Piscicola*, and of *A. volgenesis* (SAWYER 1986: vol. II: 672, fig. 17.12, 4). *A. volgenesis* differs distinctly from members of the genus *Piscicola*. The species has oviducts and conducting strands entering the vector tissue, which is transverse to the body long axis, and a short copulatory area with an invisible female gonopore (EPSHTEIN 1966). On the other hand, *A. volgenesis* shows a high similarity to *Caspiobdella fadejewi*. In the reproductive system of *C. fadejewi*, like in *A. volgenesis*, the oviducts and conducting strands enter the vector tissue, and the female gonopore is not visible. The similarity of these species is also confirmed by the analysis of non-metric characters. Thus perhaps the genera *Acipenserobdella* and *Caspiobdella* should be synonymised. At present however, this is impossible, since the genus *Caspiobdella* comprises also two other poorly known species: *C. caspica* and *C. tuberculata*, based on which the genus was described. I suppose that these leeches, like *Acanthobdellidae* LIVANOV, 1905 (EPSHTEIN 1987), have no conducting strands, and their oviducts enter the vector tissue. If this is confirmed for *C. fadejewi*, it will be necessary to transfer it to the genus *Acipenserobdella*.

Genus *Caspiobdella* EPSHTEIN, 1966.

SAWYER (1986, vol. II: 673) gives the following description of the genus based on the papers of EPSHTEIN (1961b, 1965, 1969). "Genus: *Caspiobdella* EPSHTEIN, 1966b. *Piscicolinae*; brackish and freshwater; basically 14-annulate; vector tissue and copulatory area present, but no conducting tissue; Caspian Basin". EPSHTEIN (1966, 1987 vol. II: 368, fig. 451 E), when describing *C. fadejewi*, did not notice conducting strands that pass very close to the oviduct; in consequence he treated the two ducts as an oviduct entering the vector tissue. An identical description of the structure can be found in SAWYER (1986, vol. II: 672, figs 17.12.7). Since *C. tuberculata* and *C. caspica* are much smaller than *C. fadejewi*, correct identification of their conducting strands may be even more difficult. The genus requires a thorough revision.

Genus *Cystobranchus* DIESING, 1859.

SAWYER (1986, vol. II: 673) gives the following description of the genus based on the papers of BRUMPT (1900b), HOFFMANN (1956), and PAWŁOWSKI (1947, 1950b): "*Cystobranchus* DIESING, 1859; *Piscicolinae*; freshwater; respiratory vesicles large, conspicuous; basically 7-annulate; vector tissue and copulatory area positioned well posterior to female gonopore at about XII/XIII, with copulatory tissue leading to ovisac". He included in the genus: type species *Cystobranchus respirans* (TROSCHEL,

1850) - Europe, *C. fasciatus* (KOLLAR, 1842) - Europe, *C. verrilli* MEYER, 1940 - North America, *C. meyeri* HAYUNGA et GREY, 1976 - North America, and also ?*C. virginicus* HOFFMAN, 1964 - North America, ?*C. moorei* (MOORE 1936) - Mexico, ?*C. sciacchitanoi* (SCIACCHITANO, 1960) - Africa and *C. mammillatus* (MALM, 1863) (with apparent affinities with the genus *Calliobdella* in having male bursa with conducting tissue leading to ovisacs) - Boreal Holarctic. If *C. verrilli*, *C. meyeri* and ?*C. virginicus* really had characters stated in SAWYER's (1986) diagnose, they should be placed in the genus *Piscicola*. Perhaps also the remaining two species (?*C. moorei*, ?*C. sciacchitanoi*) will in future be classified with other genera. The situation was similar with the Southern Hemisphere species: ?*Piscicola platensis* CORDERO, 1933 - at present *Myzobdella platensis* (CORDERO, 1933), ?*Piscicola olivacea* (India, China) - at present "*Calliobdella*" *olivacea* (HARDING, 1920) and ?*Piscicola caeca* - at present "*Aestabdella*" *caeca* (KABURAKI, 1921). SAWYER's (1986) suggestion to place *C. mammillatus* in the genus *Calliobdella* VAN BENEDEN et HESSE, 1863 is interesting. However, at present only one character is known, which distinguishes these genera - absent (*Cystobranchus*) or present (*Calliobdella*) accessory glands on atrium.

EPSHTEIN (1994) included 4 species in the genus *Cystobranchus*: *C. mammillatus* (MALM, 1863); *C. verrilli* MEYER, 1940, *C. meyeri* HAYUNGA et GREY, 1976 and *C. salmositicus* (MEYER, 1946). *C. salmositicus* was originally described as *Piscicola salmositica* MEYER, 1946. *Cystobranchus* has an array of important characters in its reproductive system which distinguish it from the remaining genera. These are: long bursa, well developed conductive tissue (long and narrow), no accessory glands on atrium and copulatory area located on bursa (see above). It is interesting that in the figure included in MEYERS (1946: 476, pl. III, fig. 3) paper conducting tissue can be seen, connecting ovaries with atrium, and accessory glands on atrium are absence. This justifies transfer of *P. salmositica* to the genus *Cystobranchus*, as EPSHTEIN (1994) did.

I think that leaving *P. respirans* TROSCHEL, 1850 and *P. fasciata* KOLLAR, 1842 in the genus *Cystobranchus* by SAWYER (1986) was not right. Much earlier BRUMPT (1900b), analysing the structure of the reproductive system of these two species, found that they had characters of the genus *Piscicola*. Likewise, EPSHTEIN (1969), after revising the genera *Piscicola* and *Cystobranchus*, transferred them to the genus *Piscicola*. The results of phenetic analysis indicate a possibility to distinguish within *Piscicola* two subgenera (fig. 35). Then *P. respirans* and *P. fasciata*, grouped together on the phenograms, would be placed in one of them.

Genus *Piscicola* DE BLAINVILLE in LAMARCK, 1818.

The type species of the genus is *Piscicola geometra* (LINNAEUS, 1761) of Palaearctic distribution (natural?). In Nearctic there occur: *P. milneri* (VERRILL, 1871), *P. punctata* (VERRILL, 1871) - North America, ?*P. salmositica* MEYER, 1946 = *C. salmositicus* (MEYER, 1946) - western North America and introduced *P. geometra* (SAWYER 1986, DAVIES 1991). The genus has a transpalaearctic, Holarctic distribution.

SAWYER (1986, vol. II: 674) gives the following description of the genus *Piscicola* DE BLAINVILLE, 1818, based on the papers of JOHANSSON (1896), BRUMPT (1900b), ZELENSKII (1907), and MALECHA (1979): "Genus: *Piscicola* DE BLAINVILLE, 1818. *Piscicolinae*; freshwater, vesicles not especially large; basically 14-annulate, vector tissue and copulatory area, with conductive tissue; vector tissue may be entered by the oviducts in vicinity of female gonopore. Apparently allied to brackish - water species of *Calliobdella*". The diagnose is very general. It should be stressed that the characters given in it are characteristic also for several other genera: *Cystobranchus*, *Caspiobdella*, *Pawlowskiella*, *Codonobdella* and *Acipenserobdella*, and considering only reproductive system characters, also *Baicalobdella*. SAWYER's (1986: vol. II: 672) diagram of the reproductive system of *Piscicola* (fig. 17.12, 4) is in sharp contradiction to the earlier (BRUMPT 1900b, PAWŁOWSKI1936), and also the present knowledge of that system (LUKIN 1976; EPSHTEIN 1969, 1987, 1993; BIELECKI 1993). And thus, in *Piscicola*, copulatory area is long, but never reaches the male gonopore (it ends just before the female gonopore), the ovaries never enter vector tissue, and vector tissue never reaches the male gonopore (see also my diagnose, p. 284). It is interesting, that the diagram shown by SAWYER (1986) reproduces rather exactly topographic dependences between the structures of the reproductive system of the genus *Pawlowskiella* gen. n. (see diagnoses, p. 280, fig. 97). I suppose that also Nearctic species, *P. milneri* and *P. punctata*, may be members of *Pawlowskiella* (see below).

?*Piscicola hadzii* SKET, 1985 (from the source of Buna River nr. Mostar, Hercegovina, former Yugoslavia. Outside the host, most probably endemic). SKET (1985) classified it in the genus *Piscicola* however, not justifying his decision. From the figures in his paper (93, figs 3, 4) it is clear that the species shares an array of characters with the genus *Caspiobdella*. These are: copulatory area short, anterior to the first pair of respiratory vesicles, oviduct and conductive tissue enter vector tisue and female gonopore on atrium absent. This decided about the transfer of *P. hadzii* to *Caspiobdella*.

According to numerous authors (SOOS 1965, EPSHTEIN 1968, 1987, 1989, PAWŁOWSKI 1968, 1970, LUKIN 1976, SAWYER 1986, BIELECKI 1994, WILKIALIS, pers. com.) ?*P. haranti* JARRY, 1960 is a synonym of *P. geometra*, and ?*P. pawlowskii* (SKET, 1968) - of *P. respirans*.

?*P. haranti* JARRY (1960). JARRY described the species only based on its morphology. The structure of the reproductive and alimentary systems is insufficiently known, the figures of those systems being very imprecise which might suggest that JARRY actually dealt with *P. geometra*. Future studies on *P. haranti* may demonstrate its specific distinctness (NESEMANN, pers. com.).

?*P. pawlowskii* (SKET, 1968) was originally described in the genus *Cystobranchus*, and then transferred by the same author to the genus *Piscicola*, though with no comment. The species description is insufficient, the same pertains to its later descriptions (SKET 1981, SKET and SAPKAREV 1992). My recent observations on large populations of European "piscicolids" indicate that *P. pawlowskii* is a good species with a much wider distribution than formerly bielieved (BIELECKI 1994).

Genus *Italobdella* Bielecki, 1993.

The leeches of the genus *Italobdella* have reproductive organs similar to those of marine leeches of the monotypic genus *Galatheabdella* Richardson and Meyer, 1973 (Sawyer 1986; vol. II:. 672, figs 17.12, 2). The vector tissue of those leeches is also situated anterior to oviduct outlets, but the conducting strands connect the vector tissue with the ovaries on one hand, and with the posterior part of atrium on the other. The latter connection is absent in *Italobdella*.

Recent hydrobiological studies in the upper and mid Danube River demonstrated a wider distribution area of the genus (Nesemann 1994). Nesemann (1994: 11, figs 13-16) identified specimens of the genus *Italobdella* as juvenile *P. fasciata*. He found them in Germany, downstream Regensburg, in the Danube River - one specimen, and Austria, Thaya/Dyje near Hohenau - 3 specimens. Five new localities are known from the Hungarian Danube, between Esztergom and Budapest, collected by Béla Csányi (Nesemann, pers. com.). At present it is difficult to say if these specimens, no doubt of the genus *Italobdella*, represent *I. ciosi*, *I. epshteini* or a new species.

Genus *Pawlowskiella* gen. n.

This (monotypic) genus shows a high similarity to the genera *Caspiobdella* and *Acipenserobdella*, it is much less similar to *Italobdella*, and quite different from the genera *Piscicola* and *Cystobranchus* (fig 35). As was already mentioned above, the reproductive system of *Pawlowskiella stenosa* and Nearctic *P. milneri* and *P. punctata* seems to be identical. This would mean that the latter two species may belong to the genus *Pawlowskiella* gen. n. The generic position of *P. milneri* and *P. punctata* may be solved by future studies.

Genus *Baicalobdella* Dogiel et Bogolepova 1957.

Sawyer (1986, vol. II: fig. 17.12, 6, 672, 673) gives the following description of the genus, based on the papers of Epshtein (1973) and Lukin (1976). "Genus: *Baicalobdella* Dogiel and Bogolepova 1957. *Piscicolinae*; freshwater; distinctly three-annulate; well expressed copulatory area positioned well posterior to female gonopore at about XII/XIII; conducting tissue leading to ovisacs; endemic to Lake Baikal". The generic distinctness of *B. torquata* Grube, 1871 and *B. cottidarum* Dogiel et Bogolepova, 1957 has not raised greater difficulties. However, the leeches were described only on the basis of morphological data. An additional support for the specific distinctness of *B. torquata* and *B. cottidarum* may be provided by future analyses of their reproductive and alimentary systems.

The changes in the classification of the Palaearctic *Piscicolidae* proposed in this paper require further studies. A good test for these proposals would be a molecular phylogenetic analysis. Recently Trontelj et al. (1996), using this method, presented

probable phylogenetic relationships among the European erpobdellid leeches. The studies confirmed what was suggested by AGAPOW and BIELECKI (1992) - only on the basis of morphological and anatomical data - elevating *Erpobdella testacea* (SAVIGNY 1820) and *Erpobdella monostriata* (LINDENFELD et PIETRUSZYŃSKI 1890) to species rank. This indicates the credibility of the method of morpho-anatomical analyses. In this connection it can be hoped that the system of the Palaearctic *Piscicolinae* proposed by me has a high degree of verisimilitude or at least a chance for a high degree of corroboration.

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