



Redescription of four Polish *Endonura* Cassagnau, 1979 (Collembola, Neanuridae, Neanurinae), with a nomenclature of the ventral chaetae of antennae

ADRIAN SMOLIS

Zoological Institute, University of Wrocław, Przybyszewskiego 63/77, 51–148 Wrocław, Poland. E-mail: adek@biol.uni.wroc.pl

Abstract

A new diagnosis of *Endonura* Cassagnau, 1979 is given. *E. dudichi* (Loksa, 1967) **comb. nov.**, *E. incolorata* (Stach, 1951) **comb. nov.**, *E. lusatica* (Dunger, 1966) **comb. nov.** and *E. tatricola* (Stach, 1951) are redescribed based on type and new material from Poland, Ukraine, Hungary and Slovakia. Lectotypes of *E. incolorata* and *E. tatricola* are designated. *Endonura szeptyckii* (Weiner, 1973) is synonymized with *E. tatricola*. Data of occurrence, ecological preferences, variability and morphology of the first instar of the species are provided. New morphological characters with associated nomenclature are proposed.

Key words: *Endonura dudichi*, *E. incolorata*, *E. lusatica*, *E. tatricola*, taxonomy, syn. nov., comb. nov., springtails, first instar

Introduction

Cassagnau (1979) established the subgenus *Endonura* in the genus *Neanura* MacGillivray, 1893 and designated *Achorutes tetrophtalmus* Stach, 1929 from Hungary as its type species. Later, in 1982, Deharveng raised *Endonura* to generic status. At present the genus is one of the largest within the subfamily Neanurinae and contains 34 species (Dallai 1983, Pomorski & Skarżyński 2000, Pozo & Simón 1982, Smolis & Kaprus' 2003, Smolis 2006, Smolis *et al.* 2007). Most members of *Endonura* have a European distribution and only a few species occur in the Near East, Asia Minor, Caucasus, Siberia and Alaska. Unfortunately, our knowledge on the morphology and distribution of many species of this large genus is still poor, incomplete and far from satisfactory.

During intensive field studies (1999–2002) in Poland, Ukraine and Slovakia a reach material of five species and subspecies described earlier as: *Biloba tetrophtalma tatricola* Stach, 1951, *Neanura dudichi* Loksa, 1967, *Biloba incolorata* Stach, 1951, *Neanura tetrophtalma lusatica* Dunger, 1966, *Neanurella szeptyckii* Weiner, 1973 was collected. A detailed examination of the mentioned material and types allowed to establish their taxonomic status and redescribe them using a set of modern characters. Additionally, it convinced me that the diagnosis of the genus *Endonura* should be redefined. Moreover, data of a occurrence, ecological preferences, variability and morphology of the first instar of the mentioned species, and the description of new morphological characters are provided.

Morphological remarks

Beside the features presently used in Neanurinae systematics (Deharveng 1983), the following new characters

with their nomenclature are proposed. My own observations based on Polish materials (16 species), indicate that these characters may be very useful in the taxonomy of Neanurinae.

1. Ventral chaetotaxy of antennal segment IV.

Dorsal chaetotaxy of antennal segment IV in subfamily Neanurinae was elaborated and described in detail by Deharveng (1981a, 1983). It is characterised by the presence of 8 sensilla S, 12 “mou-sensilla”, a subapical organ or, an ordinary chaeta i, and the absence of microsensillum ms (Figs 1–3). At present, the number and characteristic arrangement of these structures are used as the best diagnostic character of the whole subfamily. Surprisingly, a detailed investigation of ventral chaetotaxy of the same segment has not been carried out. The present description of chaetotaxic structures on the ventral side of ant. IV is based on the examination of several hundred individuals of 16 Neanurinae species from Poland. The following types of chaetae are indicated and named:

–conical subapical sensilla bs (Figs 4–6), with a small bulb at apex (visible under magnification x 1000), very similar in shape to rasp sensilla which were observed in many groups of Collembola, e.g. in the family Odontellidae (Deharveng 1981b).

–microchaetae miA (Fig. 4), very small ordinary chaetae, their surface is covered by minute denticles (visible under large magnification only);

–ordinary chaetae iv1 and iv2 (Fig. 6), very similar in shape to the dorsal ordinary chaeta i (Fig. 1), their surface is covered by distinct denticles;

–border sensilla brs1–7, most of them are located laterally, on the “border” of dorsal and ventral side of antenna (Figs 4–6), very similar in shape to guard sensilla (sgd and sgv) of antennal segment III.

I propose to classify these sensilla and ordinary chaetae into four groups: ap (apicales), ca (centroapicales), cm (centromediales) and cp (centroposteriores) (Figs 4–6).

2. Chaetotaxy of antennal segment III.

I propose to separate all ordinary chaetae on antenna III into four groups: d (dorsal), ve (ventroexternal), vc (ventrocentral) and vi (ventrointernal) (Figs 2, 4, 28–29).

3. Ventral chaetotaxy of head.

In order to complement of description of the existing group Ve (ventroexternal), I propose to divide this chaetal group into three: Vea (ventroexternoanteriores), Vem (ventroexternomediales) and Vep (ventroexternoposteriores) (Figs 15, 30, 43, 59).

4. Ventral chaetotaxy of abdomen IV.

Similarly, in order to complement of description of the group Ve, I propose to distinguish the group into three smaller ones: Vel (ventroexternolaterales), Vec (ventroexternocentrales) and Vei (ventroexternointernales) (Figs 21, 36, 49).

Terminology

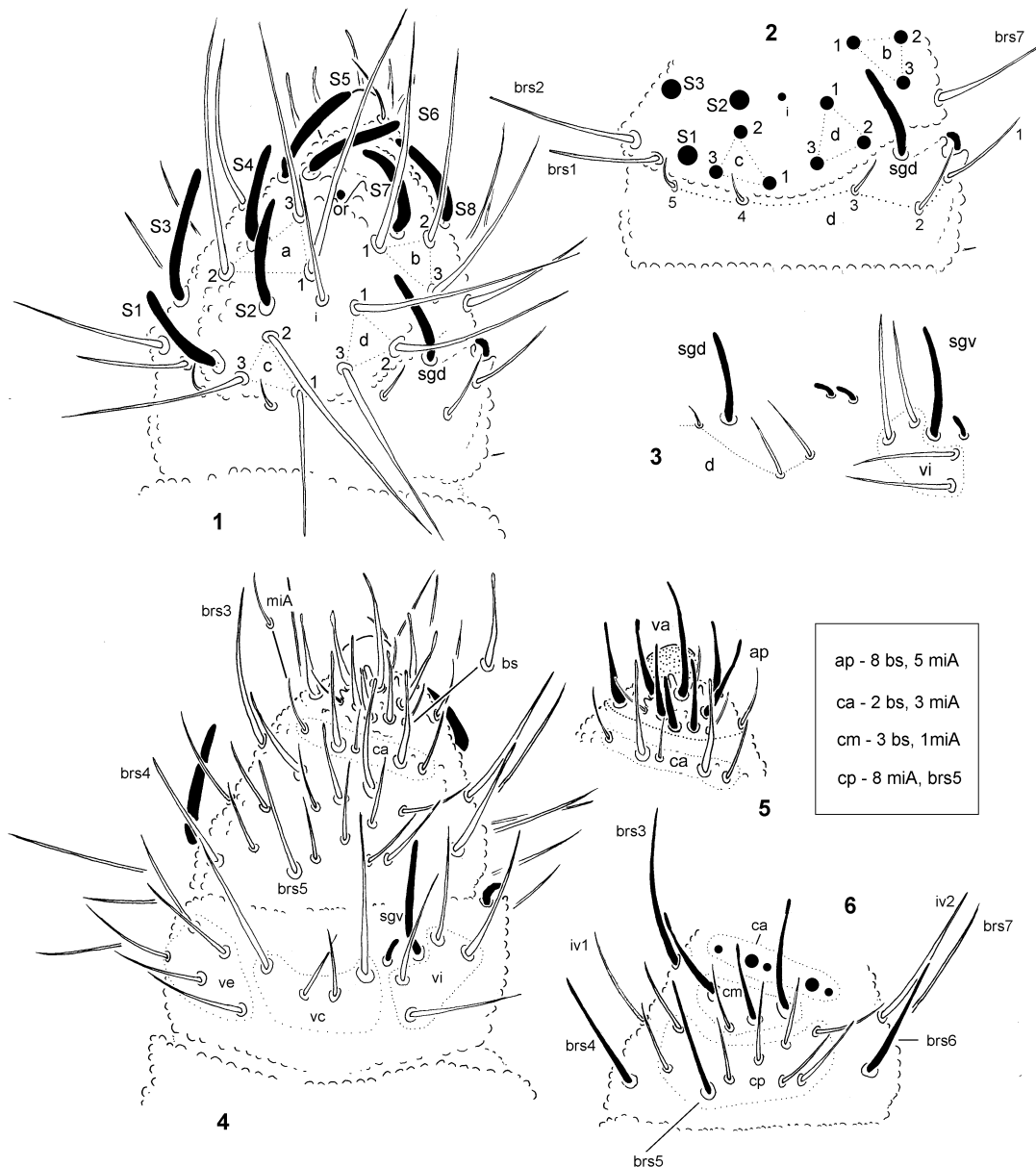
Apart from the nomenclature introduced and outlined above, the terminology and layout of the tables used in this paper follow Deharveng (1983), Deharveng & Weiner (1984), Greenslade & Deharveng (1990) and Lawrence (1977).

Abbreviations used:

General morphology: abd.—abdomen, ant.—antenna, AOIII—sensory organ of antennal segment III, Cx—coxa, Fe—femur, Scx2—subcoxa 2, T—tibiotalar, th.—thorax, Tr—trochanter, VT—ventral tube.

Groups of chaetae: Ag—antegenital, An—anal lobes, Fu—furcal, Ve—ventroexternal, Vi—ventrointernal, Vl—ventrolateral. Tubercles: Af—antenna-frontal, Cl—clypeal, De—dorsoexternal, Di—dorsointernal, Dl—dorsolateral, L—lateral, Oc—ocular, So—subocular.

Types of chaetae: Ml—long macrochaeta, Mc—short macrochaeta, Mcc—very short macrochaeta, me—mesochaeta, ms—microsensillum, S or s—chaeta s or sensillum, or—organite of ant. IV, i—ordinary micro- or mesochaeta on ant. IV, mou—cylindrical sensilla on ant. IV („soies mousses” after Deharveng 1981a), x—labial papilla x, L’—ordinary chaeta on abd. V, B4, B5—ordinary chaetae on tibiotarsi.



FIGURES 1–6. *Endonura tatricola*: 1, dorsal chaetotaxy of ant. III–IV, adult (terminology after Deharveng 1983); 2, dorsal chaetotaxy of ant. III–IV, group d and sensilla brs; 3, chaetotaxy of AOIII, groups vi and d of ant. III; 4, ventral chaetotaxy of ant. III–IV, adult; 5, ventral chaetotaxy of ant. IV, groups va and ap; 6, ventral chaetotaxy of ant. IV, groups cm and cp.

Endonura Cassagnau, 1979

Neanura (*Endonura*) Cassagnau, 1979: 192.

Type species: *Achorutes tetrophtalmus* Stach, 1929: 282.

Diagnosis. Collembola, Neanurinae, Neanurini. 0–2 + 0–2 eyes, pigmented or not. Colour of body blue or

white, never yellow or red. Dorsal tubercles present, well developed. Mouth part reduced: maxilla styliform, mandible slender or rarely strong. Labrum chaetotaxy: 4/2, 4 or 0/2, 2. Sensilla S on ant. IV of similar size. Head with 10 or 12 tubercles. Tubercles Af and Cl separate or sometimes fused. Tubercles Di and De on head separate, sometimes Di not differentiated. Arrangement of chaetae Di and De on head of the uncross-type (Deharveng 1983). Tubercles L and So on head fused. S-chaetae present in typical arrangement and number; 22/11111 on each half tergite from th. II to abd. V. Abdomen IV with 8 tubercles: 2 Di, 2 De, 2 D1 and 2 L, or 5 tubercles: (Di+Di), 2 (De+D1) and 2 L. Abdomen V with 3 tubercles: 2 (De+D1+L) and (Di+Di) or 2 tubercles: 2 (Di+De+D1+L). Tubercles Di on abd. V fused or separate. Cryptopygy absent or rarely present. Tibio-tarsal chaetotaxy 19, 19, 18. Claw with inner tooth or untoothed.

Discussion. Till now, a definition of the genus *Endonura* was mainly based on the following characters: 0–2 + 0–2 eyes, reduced mouth part, the uncross-type of chaetotaxy on head, separate tubercles Di and De on head, 8 tubercles (2 Di, 2 De, 2 D1, 2 L) on abdomen IV and 3 tubercles on abdomen V (tubercles Di fused). *E. incolorata* and *E. dudichi* possess all mentioned characters except the number of tubercles on abdominal segments (in *dudichi* 5 tubercles: (Di+Di), 2 (De+D1) and 2 L on abd. IV; in *incolorata* 2 tubercles (Di+De+D1+L) on abd. V). However, the uniqueness of both characters does not seem to be a sufficient reason to erect a new genera, especially a monotypic one. Moreover, both mentioned species are closely related to *Endonura tatricola* and altogether form a group of species well separated morphologically from other members of the genus (see: Discussion of *E. tatricola*). In addition, their distribution is strictly limited to the Carpathians which were probably the centre of their origin. In the light of the facts presented above I decided to place *E. incolorata* and *E. dudichi* within this genus and to modify its diagnosis accordingly.

Because of chaetotaxy and arrangement of tubercles on head, *Endonura* is most similar to the European genus *Cryptonura* Cassagnau, 1979. Nevertheless, they can be easily distinguished by the number of tubercles on abd. V (in *Endonura* two or three tubercles, in *Cryptonura* four tubercles). In addition, most species of *Cryptonura* are characterised by strong cryptopygy (in *Endonura* absent or weak developed) and massive mandibles (in *Endonura* rather thin).

***Endonura lusatica* (Dunger, 1966) comb. nov.**

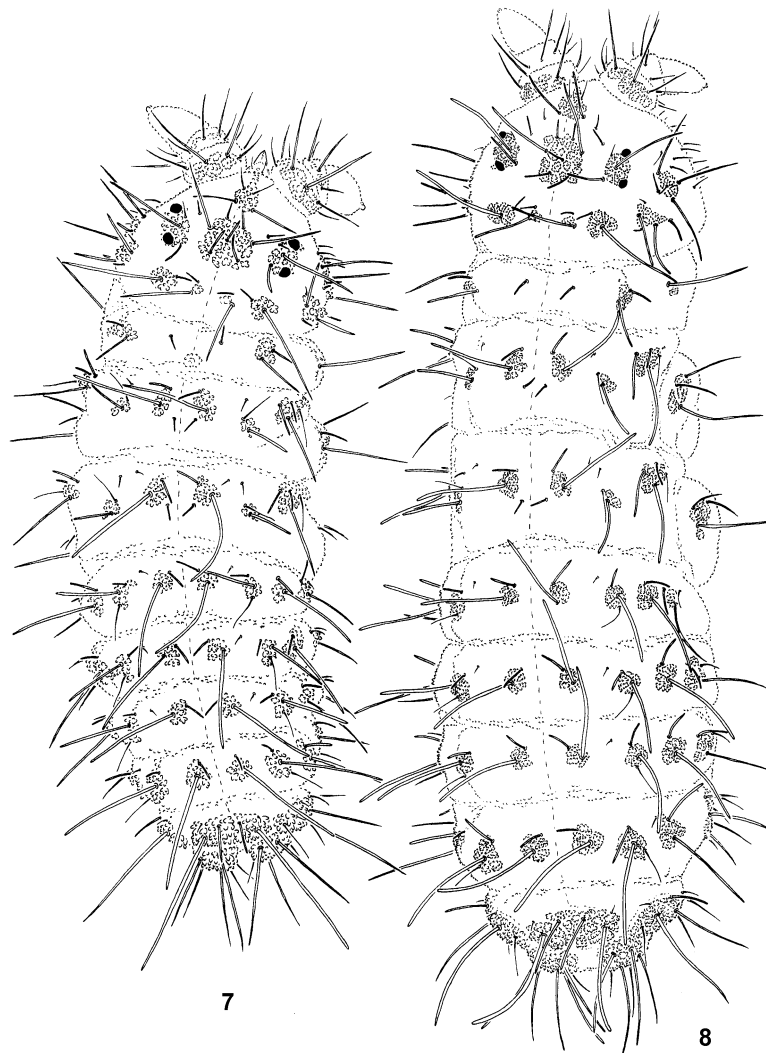
Figs 7–22, Tab. 1

Neanura tetrophtalma lusatica Dunger, 1966: 5

Type material. Holotype, adult female on slide, Germany, Halbendorf /Oberlausitz, north of Bautzen, peat bog, 20.X.1958, leg. Schlegel, det. Dunger. Paratype, juvenile on slide, same data as holotype.

Other material. Poland, Baltic Coast, Wolin Island, near Sułomino, flood debris on the bank of Szczeciński Flood, 23.III.1962, leg. A. Szeptycki, 2 females, male and juvenile on slides; Baltic Coast, Wolin island, reed communities on the bank of Kamiński Flood, flood debris, 10.IV.1991, leg. R. J. Pomorski, D. Skarżyński, male on slide; Nizina Wielkopolsko-Kujawska (lowland), near Trzciel, reed communities on the bank of Wielkie Lake, flood debris, IX.1994, leg. M. Woźny, adult male on slide; Pojezierze Pomorskie (Lakeland), Charzykowska Plain, peat bogs, 3.XI.96, 28.IV.97, 19.IX.97, leg. M. Sławska, det. M. Sławska, 2 females and 9 males on slides; Polesie, Poleski National Park, peat bog, soil, 12.VI.1996, leg. R. J. Pomorski, female and 4 juveniles on slides; same locality, soil in sedge bog, 2.VI.1996, leg. R. J. Pomorski, female and juvenile on slide; Podlasie, Białowiecki National Park, litter in alder forest, 9.IX.2000, leg. A. Smolis, numerous specimens on slides and in alcohol; Nizina Śląska (lowland), nature reserve "Zabór", near Miękinia, alder forest, litter and rotting wood, 1.IV.2001, 24.IV.2001, 1.IX.2001, leg. D. Skarżyński, A. Smolis, leg. A. Smolis, 3 females and 2 males on slides. Ukraine, Roztocze, near Iwano–Frankowsk, nature reserve "Zalyvky", the river Vereszycia, wet willow shrubland on low river terrace, litter and soil, 5.VI.1987, leg. I. Kaprus', male on

slide. Material is deposited in the Department of Biodiversity and Evolutionary Taxonomy of Wrocław University, Poland.



FIGURES 7–8. *Endonura lusatica*: 7, chaetotaxy and distribution of tubercles, first instar (dorsal view); 8, chaetotaxy and distribution of tubercles, adult (dorsal view).

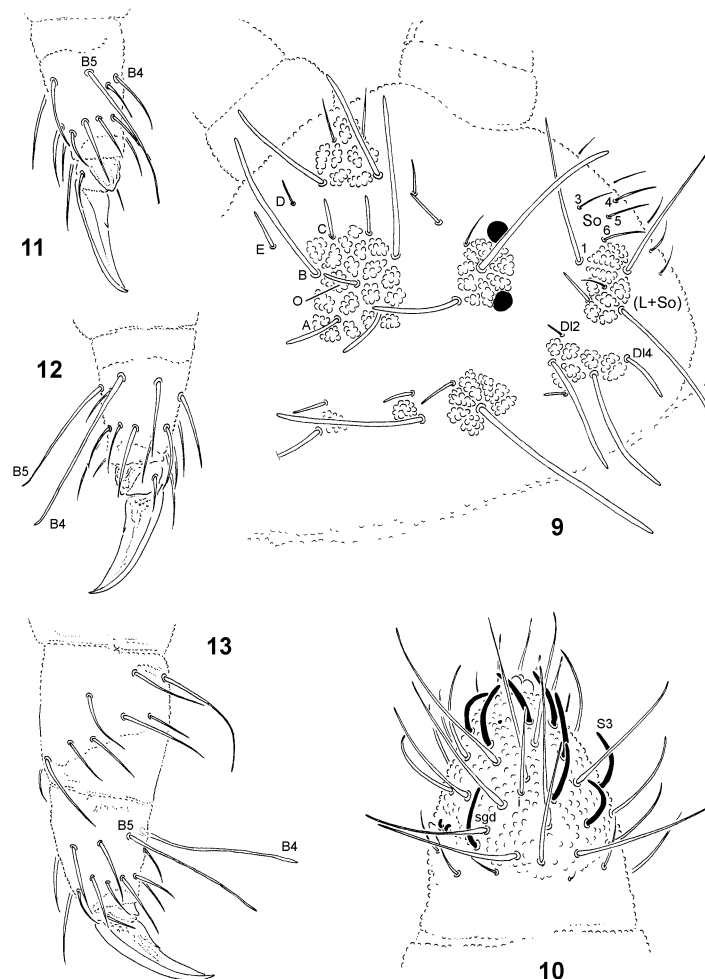
Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed, except tubercles Di on th. I. 2+2 pigmented eyes present. Buccal cone elongated. Labral chaetotaxy 4/2, 4. Mandible thin with 3 teeth. Head with 3 chaetae Oc, chaetae A, B, C, D, E and O. Tubercles Di and (L+So) on head with 5 and 9 chaetae respectively. Tubercles De on thoracic terga II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 3–4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw with inner tooth. Tibiotarsi I, II with long and slightly clavate chaetae B4 and B5. Tibiotarsus III with only one long and slightly clavate chaeta B5.

Redescription. Habitus typical of the genus. Body length (without antennae): females 1.6–3.1 mm, males 1.4–2.6 mm, I instars 0.6–0.9 mm. Colour of the body dark blue. 2+2 large, dark pigmented eyes (Figs 7–9).

Types of dorsal ordinary chaetae. Macrochaetae Ml relatively thin, arc-like or straight, narrowly sheathed, apically rounded or rarely pointed (Figs 8, 16, 22); macrochaetae Mc and Mcc thin, straight, apically rounded or pointed; mesochaetae and microchaetae short, thin and pointed. Macrochaetae in I instars thin, arc-like or straight, narrowly sheathed, apically pointed (Fig. 7). Same number and arrangement of chaetae in adults and I instars, except chaetotaxy of ant. IV (see Tab. 1b) and genital plate (complete absence of chaetae in first

instars).

Head. Buccal cone strongly elongated (Fig. 14). Labrum pointed, with ventral sclerifications ogival as in Figs 14, 15, 18. Labrum chaetotaxy 4/2, 4 (Fig. 19). Chaetotaxy of labium as in Fig. 14. Maxilla styliform, mandible thin and tridentate. Chaetotaxy of antennae in adults and I instars as in Tab. 1c and in Fig. 10. Apical vesicle distinct, trilobate. Sensilla S on ant.IV subequal, long and thin (Fig. 10). Chaetotaxy of head as in Tab.1a and b, and Figs 9, 15. Tubercles Cl and Af separate (Fig. 9). Chaeta O present, chaetae D and E free. Tubercle D1 with 5 chaetae, chaeta D13 absent (Fig. 9). Chaeta A shorter than B.

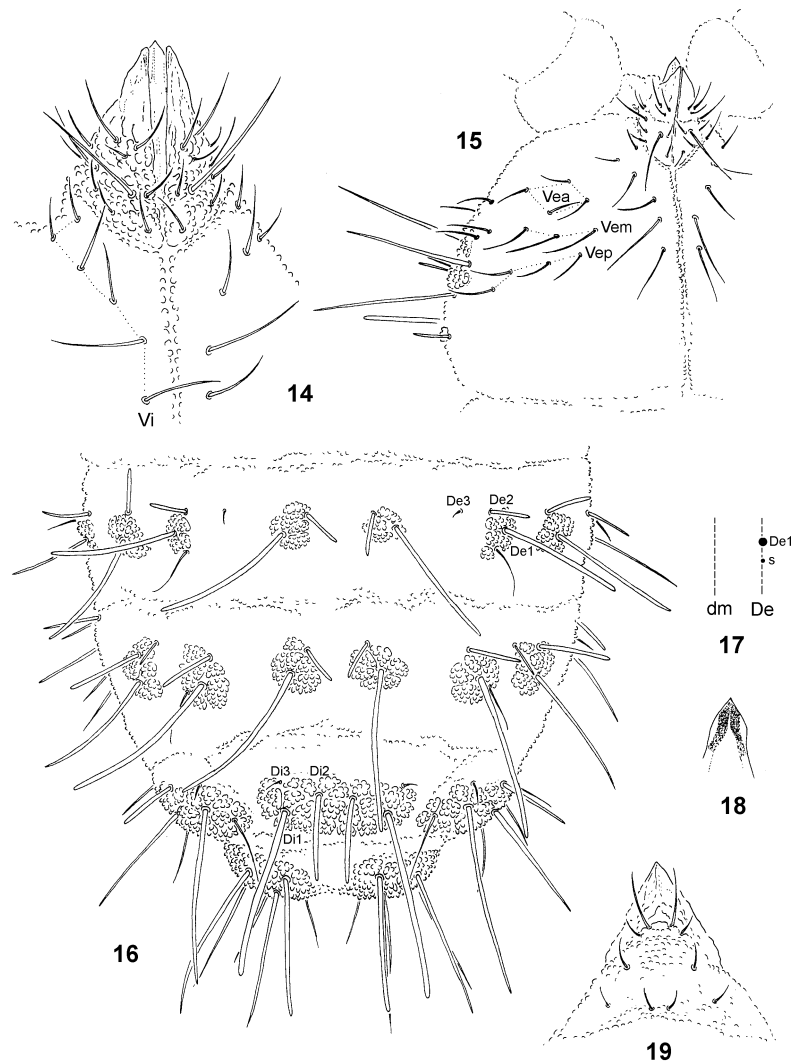


FIGURES 9–13. *Endonura lusatica*: 9, dorsolateral chaetotaxy of head; 10, dorsal chaetotaxy of ant. III–IV; 11, tibiotarsus and claw III (ventrolateral view); 12, tibiotarsus and claw II (ventrolateral view); 13, femur, tibiotarsus and claw III (lateral view).

Thorax, abdomen, legs. Body sensilla fine and smooth, distinctly shorter than nearby macrochaetae (Figs 8, 16, 20). Chaetotaxy of th. and abd. as in Tab. 1d and in Figs 7–8, 16–17, 20–21. Tubercles Di on th. I not differentiated (Figs 7–8). Chaetae De3 on abd. I–III shorter than De2. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Figs 7–8, 16). The line of chaetae De1-sensillum parallel the dorso-median line on abd. I–III (Figs 16–17). Tubercle L on abd. III and IV with 3–4 and 7 chaetae respectively (see: Variability, Fig. 21). Tubercles Di on abd. V fused (Fig. 16). Chaeta L' on abd. V present (Fig. 21). Cryptopygy absent or slightly developed. Chaetotaxy of legs as in Tab. 1d and Figs 11–13. Tibiotarsi I–II with elongate and slightly clavate chaetae B4 and B5. Tibiotarsi III with elongate and slightly clavate chaeta B5. Claw with distinct inner tooth (Figs 11–13).

Discussion. Because of the presence of tooth on claw and elongate chaetae B5 and B4 on tibiotarsi,

Endonura lusatica appears to be close to *Endonura tetrophtalma* (Stach, 1929) and *Endonura dentifera* Smolis *et al.* 2007, described from Hungary and Ukraine respectively. Nevertheless, they significantly differ in the following combination of characters: number of chaetae on tubercle D1 on head (in *lusatica* 5 chaetae, in *dentifera* 6 chaetae, in *tetrophtalma* 3 chaetae), edge of labrum (in *lusatica* ogival, in *dentifera* non-ogival, in *tetrophtalma* unknown), number of chaetae Di on th. II–III (in *lusatica* and *dentifera* 3 chaetae, in *tetrophtalma* 2 chaetae), number of chaetae De on th. III (in *lusatica* and *dentifera* 4 chaetae, in *tetrophtalma* 3 chaetae) and number of chaetae L on abd. IV (in *lusatica* 7 chaetae, in *dentifera* 8–9 chaetae, in *tetrophtalma* 4 chaetae).



FIGURES 14–19. *Endonura lusatica*: 14, chaetotaxy of labium and group Vi; 15, ventral chaetotaxy of head; 16, dorsal chaetotaxy of abd. III–VI; 17, scheme of position of sensillum and chaeta De1 on abd. I–IV (dm—dorsomedian line); 18, ventral sclerifications of labrum; 19, chaetotaxy of labrum.

Variability. The number of chaetae on tubercle L of abd. III is variable, e.g. among studied material from Poland (34 individuals), 10 (29,4%) specimens have 3+3 chaetae, 17 (49%) spp. 3+4 chaetae and 7 (20,6%) spp. 4+4 chaetae.

Distribution. The species known to date from Germany, Ukraine (as *E. tetrophtalma*, Kaprus'1998) and Poland (as *E. tetrophtalma lusatica*, Sławska 2000, 2001). More localities of the species from Poland are herein added (see: Other material). The Polish record of *E. tetrophtalma* from a alder forest in Kampinoski National Park (Nizina Mazowiecka, Kaczmarek 1973) probably pertains to this species.

TABLE 1. Chaetotaxy of *Endonura lusatica*:

a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		me	G
Af	11	Ml	B
		Mc	A
		Mcc or mi	C, E, O
		mi	D
Oc	3	Ml	Ocm
		Mc	Ocp
		mi	Oca
Di	2	Ml	Di1
		Mcc or mi	Di2
De	2	Ml	De1
		Mcc or mi	De2
Dl	5	Ml	Dl1, Dl5
		Mc	Dl4
		Mcc or mi	Dl6
		mi	Dl2
(L+So)	9	Ml	L1, L4, So1
		Mcc	L2
		mi	L3
		me	So3–6

b) Cephalic chaetotaxy-ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae	
I	7	IV	Adult	I instar
II	12		or, 8 S, i, 12 mou, 6 brs, 2 iv	or, 2 S, i, 6 mou, 1 brs, 2 iv
III	5 sensilla AO III			
ve	5	ap	8 bs, 5 miA	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA	3 bs, 1 miA
d	5	cp	8 miA, 1 brs	8 miA

d) Postcephalic chaetotaxy.

	Terga						Legs		
	Di	De	DI	L	Scx2	Cx	Tr	Fe	T
th. I	1	2	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
Sterna									
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5	Ve1 -	present		
abd. III	2	3+s	2	3–4	Vel: 5			Fu: 5 me	0 mi
abd. IV	2	2+s	3	7	Vel: 4	Vec: 2	Vei: 2	VI: 4	
abd. V	(3+3)		7+s		Ag: 3			VI: 1	L': 1
abd. VI		7			Ve: 13–14			An: 1mi	

Ecological remarks. A lowland hydrophilous species, occurs in damp and wet habitats, e.g. alder forests, willow shrub, bogs and reed communities on a bank of rivers, lakes and hyaline floods. It inhabits wet or submerged litter and soil, mosses, flood debris and rooting wood. First instars were collected in July and September.

Remarks. Stach (1929) described *Achorutes tetrophtalmus* from Hungary (the bank of Balaton Lake). Later, in 1951, he classified the mentioned species to newly established genus *Biloba* (later placed as synonymous of *Neanura*) and described a new subspecies *Biloba tetrophtalma tatricola* from Tatra Mts. (Polish Carpathians). Additionally, in the same paper, Stach treated the Hungarian species as *Biloba tetrophtalma* f. *principialis*. Gisin (1960) elevated the Polish subspecies to the species rank and this taxonomic act was usually accepted by other authors. Later Dunger (1966) described the further subspecies *Neanura tetrophtalma lusatica* on the basis of two specimens collected in the extreme south-eastern Germany (Oberlausitz, near German–Polish border). Cassagnau (1979) established the subgenus *Endonura* and designated *Neanura tetrophtalma* as its type species.

A detailed analysis of original descriptions, type and new material (types of *E. tetrophtalma* have been lost, W. M. Weiner pers. comm.) showed that *E. tetrophtalma*, *E. lusatica* and *E. tatricola* are a good and distinct species clearly differing in many important taxonomic characters (see: Discussions of *E. lusatica* and *E. tatricola*). At the same time it turned out that all mentioned taxa needed a comment and modern redescription to establish and explain their identity. In my opinion, however, the redescription of *E. tetrophtalma* is presently impossible and should be prepared by a study of a new material from the type locality.

According to the original description and figures (Dunger 1966), macrochaetae of *E. lusatica* are densely covered by large oval scale-like structures. However, a study of available material (types have been checked) did not confirm the presence of such structures. In addition, the type material of the species is generally in a bad condition and the present redescription and figures are therefore based mainly on a new material.

***Endonura tatricola* (Stach, 1951)**

Figs 1–6, 23–39, Tab. 2–3

Biloba tetrophtalma tatricola Stach, 1951: 35

Neanurella szeptyckii Weiner, 1973: 531 **syn. nov.**

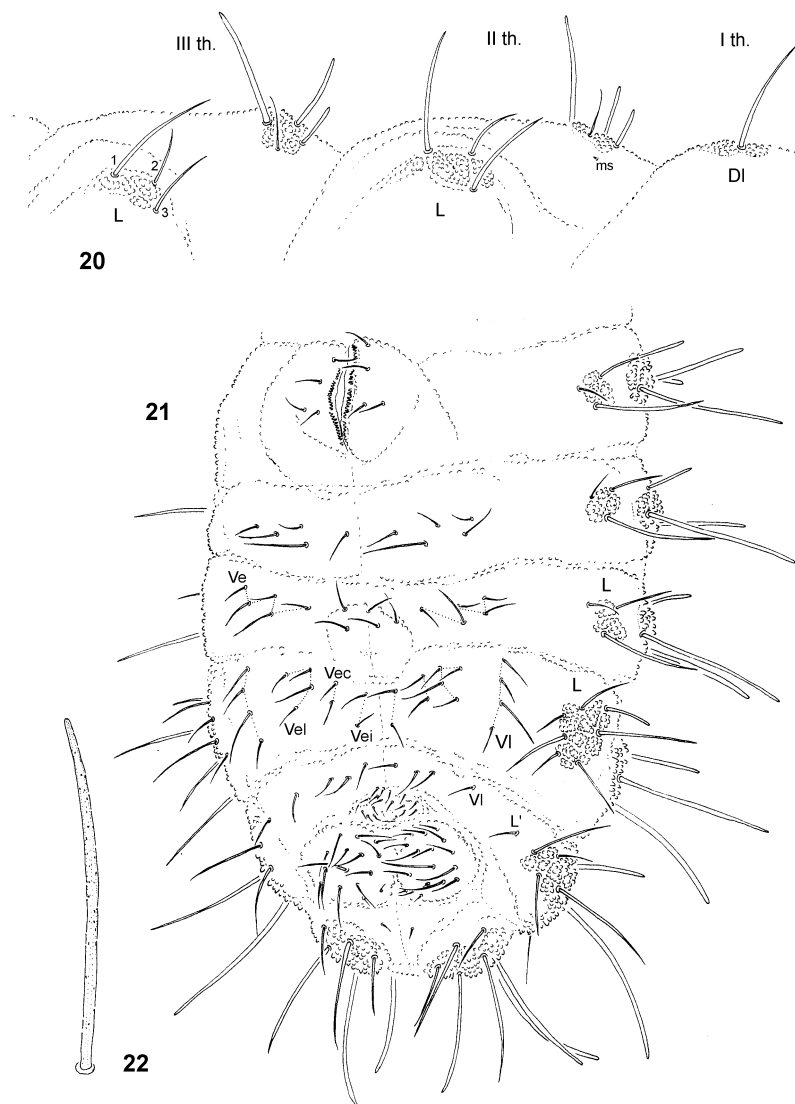
Type material. Lectotype juvenile on slide by present designation, originally labelled “Polonia Tatry”, 1933,

leg. J. Stach, det. J. Stach (collection of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow, Poland).

Stach described *B. tetrophtalma tatricola* on the basis of five specimens collected in three localities in the Polish part of Tatra Mts, but he did not designate the holotype. Consequently two specimens from the first marked locality are syntypes. One of them was designated here as the lectotype, the second probably has been lost (W. M. Weiner pers. comm.).

Other material. Poland, East Carpathians, Bieszczady Mts., near Komańcza village, nature reserve "Przełom Osławy pod Duszatynem", north-east slope of Karnaflów Mt., 500–600 m alt., Carpathian beech–fir forest, under bark of rotting logs, decaying wood, 30.IV–2.V.2001, leg. A. Smolis, 4 females and 10 juveniles on slides; East Carpathians, Bieszczady Mts., near Prełuki village, 450 m alt., juv., Osława valley, Carpathian alder forest, decaying wood, 2.V.2001, leg. A. Smolis, juvenile on slide; West Carpathians, Beskid Niski Mts., Magurski National Park, near Huta Polańska village, valley of Zimna Woda stream, 500 m alt., Carpathian beech forest, decaying wood, 14.VI.2001, leg. A. Smolis, male on slide; West Carpathians, Beskid Niski Mts., Magurski National Park, near Folsz village, valley of Kłopotnica stream, 500 m alt., Carpathian beech forest, decaying wood, 15.VI.2001, leg. A. Smolis, female on slide; West Carpathians, Beskid Niski Mts., nature reserve "Kornuty", 700 m alt., Carpathian beech forest, decaying wood, 15.VI.2001, leg. A. Smolis, female on slide; West Carpathians, Beskid Sądecki Mts., near Krynica, north slope of Dubne Mt., 850 m alt., Carpathian beech forest, decaying wood, 27.IV.1999, leg. A. Smolis, 3 females and male on slides; West Carpathians, Beskid Sądecki Mts., nature reserves "Łabowiec" and "Uhryń", near Łabowiec village, 800 m alt., Carpathian beech forest, decaying wood, litter, 3.V.2000, leg. A. Smolis, D. Skarżyński, 14 females, 2 males and 3 juveniles on slides; West Carpathians, Pieniny Mts., Pieniński National Park, north-east slopes of Nowa Góra Mt., 890 m alt., Carpathian beech forest, litter, 25.viii.1971, leg. W.M. Weiner, det. W.M. Weiner, holotype (female) of *Neanurella szeptyckii* Weiner, 1973 on slide; West Carpathians, Pieniny Mts., Pieniński National Park, valley of Ociemny stream, 600 m alt., Carpathian beech forest, under bark of rotting log, 26.V.1994, leg. R. J. Pomorski, det. R. J. Pomorski, 7 females, 3 males and 5 juveniles on slides; West Carpathians, Pieniny Mts., Pieniński National Park, valleys of Pieniński and Huliński stream, 600–700 m alt., Carpathian beech forest, under bark of rotting logs, in decaying wood and litter, 30.IV.1999, 2.V.1999, leg. A. Smolis, numerous individuals on slides; West Carpathians, Tatra Mts., Tatrzński National Park, Jaworzynka valley, 1300–1400 m alt., Norway spruce forest (subalpine belt), decaying wood, 14.VI.2000, leg. D. Skarżyński, A. Smolis, numerous individuals on slides; Beskid Żywiecki Mts., Babiogórski National Park, north slope of Babia Góra Mt., 1000–1250 m alt., Norway spruce forest (subalpine belt), fir–spruce forest and Carpathian beech forest (montane belt), decaying wood, litter, 3–4.VI.1999, leg. A. Smolis, numerous individuals on slides; West Carpathians, Beskid Śląski Mts., near Ustroń, north-east slope of Wielka Czantoria Mt., valley of Suchy stream, 650 m alt., Carpathian beech forest, decaying wood, litter, 16.IV.2001, leg. A. Smolis, 4 females and 7 males on slides; West Carpathians, Beskid Śląski Mts., near Ustroń, valley of Sucha Dobka stream, 500 m alt., spruce forest, decaying wood, 16.IV.2001, leg. A. Smolis, female on slide. Slovakia, Slovenský Raj National Park, mixed forest, under bark of decomposed logs, decaying wood, 1.v.2000, leg. A. Smolis, 4 females, 6 males and 2 juveniles on slides. Other material (except for holotype of *Neanurella szeptyckii* Weiner, 1973) is housed in the collection of the Department of Biodiversity and Evolutionary Taxonomy, Wrocław University, Poland.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed, except tubercles Di on th. I. 0–2+0–2 eyes, when present: small and unpigmented (Figs 23, 32, 37). Buccal cone rather short. Labral chaetotaxy 4/2, 4. Mandible thin with 3 teeth. Head with 3 chaetae Oc, chaetae A, B, C and D. Chaeta O absent. Tubercles Dl and (L+So) on head with 6 and 10 chaetae respectively. Tubercles De on thoracic terga II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 3 and 6 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 short.

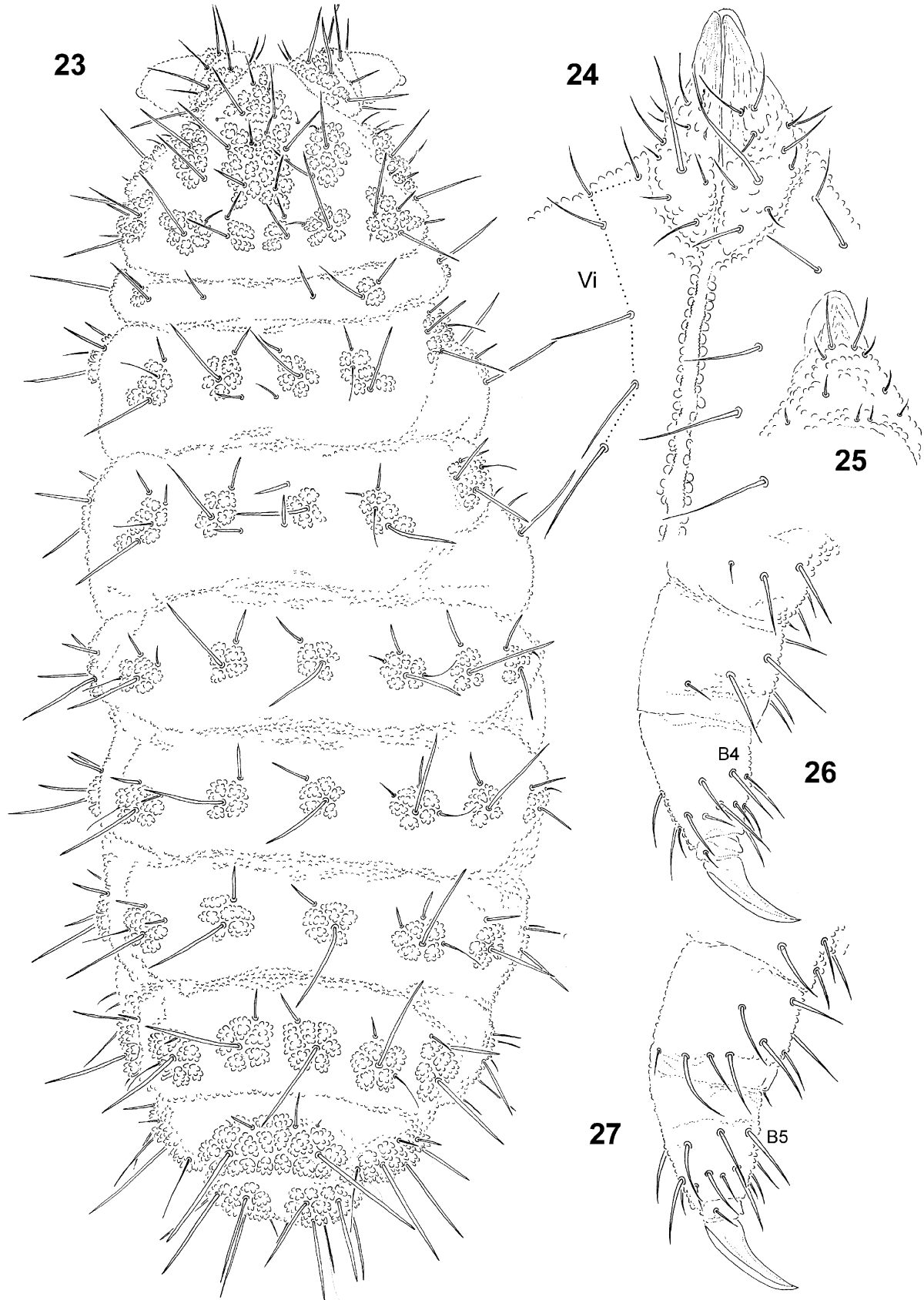


FIGURES 20–22. *Endonura lusatica*: 20, chaetotaxy of thorax (lateral view); 21, chaetotaxy of abdomen (ventrolateral view); 22, chaeta Di1 of abd. V (adult).

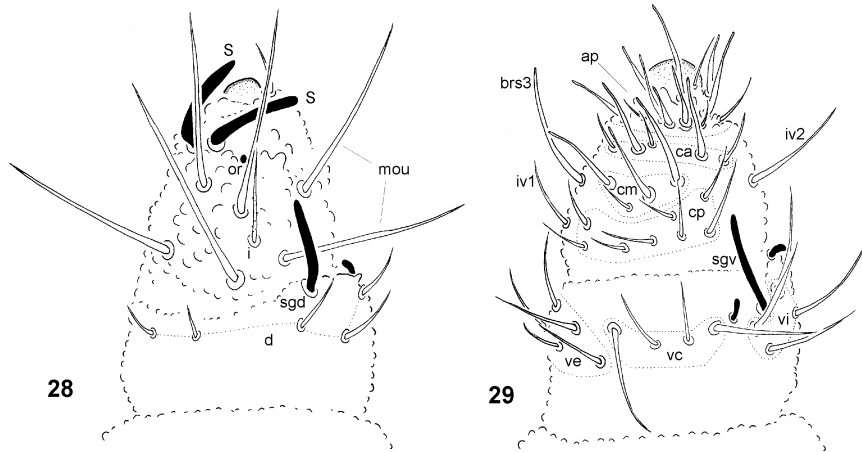
Redescription. Habitus typical of the genus. Body length (without antennae): females 0.9–2.0 mm, males 0.8–1.3 mm, I instars 0.5–0.7 mm. Colour of the body white. 0–2+0–2 small unpigmented eyes (Figs 23, 32, 37). Number of eyes variable (see: Variability).

Types of dorsal ordinary chaetae. Macrochaetae M1 thin, relatively short, straight, narrowly sheathed, gradually tapered and apically pointed (Figs 23, 34, 39); macrochaetae Mc and Mcc thin, straight, apically pointed; mesochaetae and microchaetae short, thin and pointed. Macrochaetae very similar in I instars and in adults (Fig. 32). All macrochaetae feebly serrated. Number and arrangement of chaetae in adults and I instars same, except chaetotaxy of ant. IV (see: Tab. 2c and Figs 1–6, 28–29) and genital plate (complete absence of chaetae in first instars).

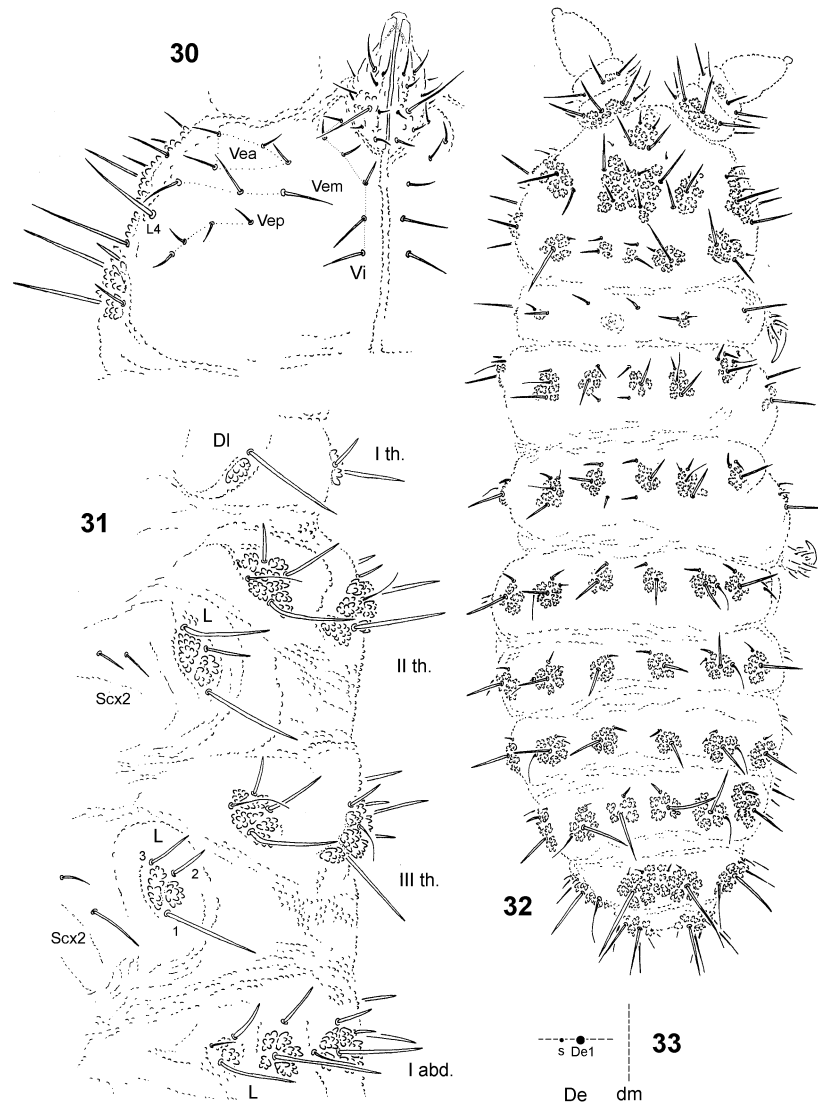
Head. Buccal cone short (Figs 25, 30). Labrum rounded, with ventral sclerifications as in Fig. 30. Labrum chaetotaxy 4/2, 4 (Fig. 25). Chaetotaxy of labium as in Fig. 24. Maxilla styliform, mandible thin tridentate. Chaetotaxy of antennae in adults and I instars as in Tab. 2c and in Figs 1–6, 28–29. Apical vesicle distinct, simple. Sensilla S on ant. IV subequal, short and rather thick (Figs 1, 28). Chaetotaxy of head as in Tab. 2a, b, and Figs 23, 24, 30, 32, 35, 37. Tubercles Cl and Af separate (Figs 35, 37). Chaetae O and E absent. Chaetae D and L4 free (Fig. 37). Tubercle DI with 6 chaetae, chaeta DI3 present (Fig. 37). Elementary tubercle BE absent, rarely present (see: Variability, Figs 35, 37). Chaeta A shorter than B.



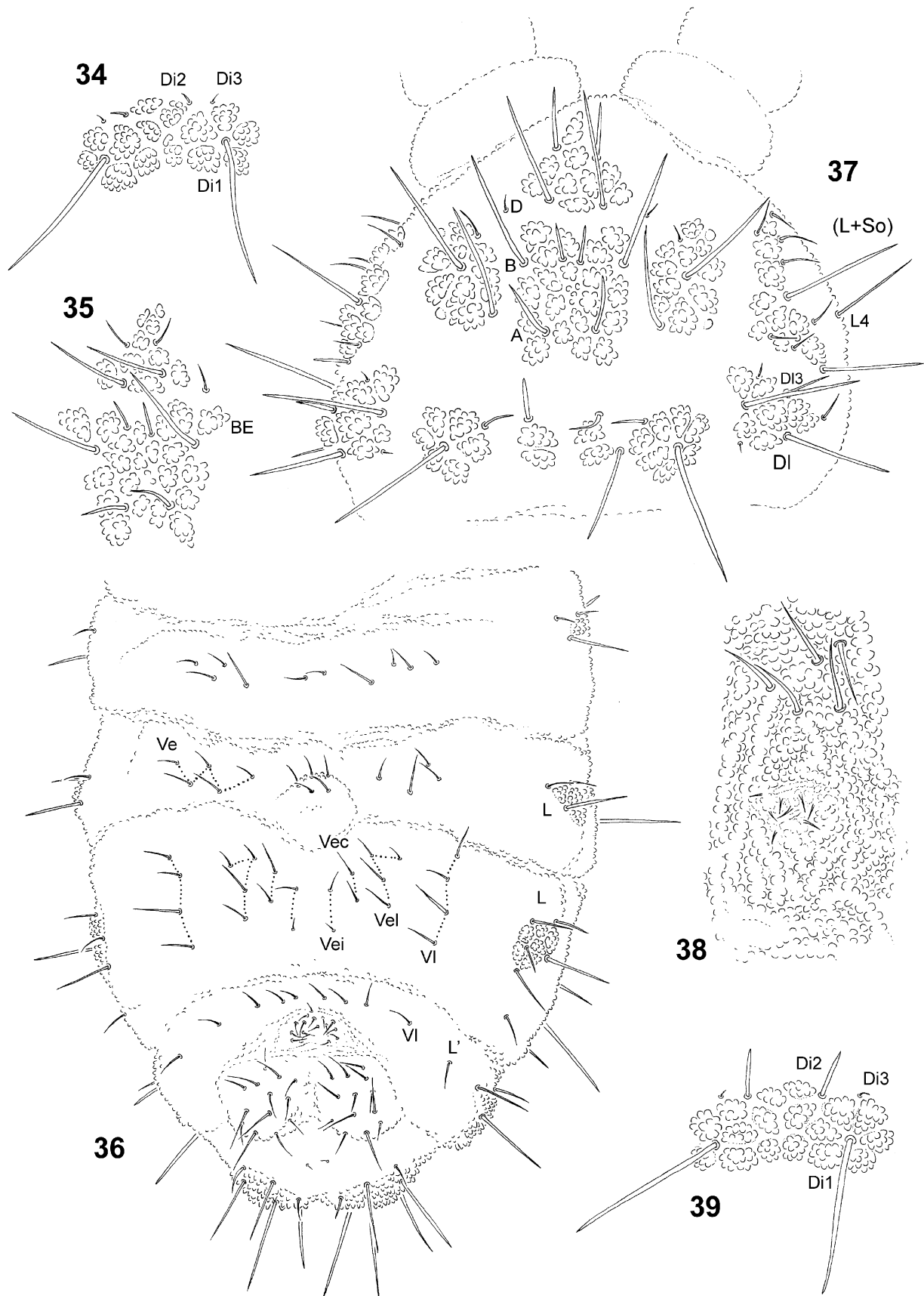
FIGURES 23–27. *Endonura tatricola*: 23, chaetotaxy and distribution of tubercles (adult female from Tatra Mts., dorsal view); 24, chaetotaxy of labium and group VI; 25, chaetotaxy of labrum; 26, trochanter, femur, tibia and claw III (ventrolateral view); 27, trochanter, femur, tibia and claw III (lateral view).



FIGURES 28–29. *Endonura tatricola*: 28, dorsal chaetotaxy of ant. III–IV, first instar; 29, ventral chaetotaxy of ant. III–IV, first instar.



FIGURES 30–33. *Endonura tatricola*: 30, ventral chaetotaxy of head; 31, chaetotaxy of thorax, abd. I and subcoxae 2 (lateral view); 32, chaetotaxy and distribution of tubercles (dorsal view, first instar); 33, scheme of position of sensillum and chaeta De1 on abd. I–IV (dm—dorsomedian line).



FIGURES 34–39. *Endonura tatricola*: 34, tubercle (Di+Di) of abd. V; 35, tubercles Af and Cl on head (specimen from Bieszczady Mts.); 36, chaetotaxy of abd. II–VI (ventrolateral view); 37, dorsal chaetotaxy of head; 38, furca rudiment; 39, tubercle (Di+Di) of abd. V.

Thorax, abdomen, legs. Body sensilla fine and smooth, shorter than nearby macrochaetae (Figs 23, 31, 32). Chaetotaxy of th. and abd. as in Tab. 2d and in Figs 23, 31–34, 36, 38–39. Tubercles Di on th. I not differentiated or present (see: Variability, Figs 23, 32). Chaetae De3 on abd. I–III shorter than De2. Chaetae De2 on th. II–III and De3 on th. III connected with tubercle De. Chaetae De3 on abd. I–III connected with tubercle De (Figs 23, 31–32). The line of chaetae De1–sensillum perpendicular to the dorsomedian line on abd. I–IV (Figs 23, 33). Tubercle L on abd. III and IV with 3 and 6 chaetae respectively (Fig. 36). One chaeta L on abd. IV free. Furca rudiment with 6–8 microchaetae, variable in size (Fig. 38). Tubercles Di on abd. V fused, with chaeta Di2 as Mc, Mcc or mi (Figs 23, 32, 34, 39). Chaeta L' on abd. V present (Fig. 36). Cryptopygy absent. Chaetotaxy of legs as in Tab. 2d and Figs 26–27, 31. Tibiotarsi with short chaetae B4 and B5. Claw without inner tooth (Figs 26–27).

Discussion. *Endonura tatricola* is the most similar and closely related to *E. incolorata* (Stach, 1951) and *E. dudichi* (Loksa, 1967). All mentioned species form a very distinct and peculiar group within the genus *Endonura* characterised by the following features: body white, eyes small and unpigmented or absent, absence of chaetae O and E on head, chaeta L4 on head free and absence of non-reticulate areas between chaetae A and B on head. Nevertheless, they can be easily separated by the number of tubercles on abdominal segments IV and V (in *tatricola* 8 and 3 tubercles respectively, in *incolorata* 8 and 2 tubercles, in *dudichi* 5 and 3 tubercles). Moreover, these species differ in a presence/absence of elementary tubercle BE on head (in *tatricola* absent or rarely present, in *incolorata* absent, in *dudichi* present), presence/absence of tubercles Di on th. I (in *tatricola* absent or rarely present, in *incolorata* absent, in *dudichi* present) and the length of macrochaetae M1 (in *tatricola* and *incolorata* relatively short, in *dudichi* long).

Variability. The number of eyes is highly variable within Polish populations of *E. tatricola* and specimens with 2+2, 2+1, 1+1, 0+1 or 0+0 eyes were observed in the same population (Tab. 3). Specimens from Bieszczady Mts. (Eastern Carpathians) differ from other populations in a presence of elementary tubercle BE on head and tubercles Di on th. I. The taxonomic status of this geographic polymorphism remains to be investigated.

Distribution. Up to now *E. tatricola* was reported from the Slovakia (Low Tatra Mts., Nosek 1964, 1969) and Polish Carpathians (Tatra Mts., Stach 1951; Pieniny Mts., as *Neanurella szeptyckii*, Weiner 1981; Beskid Sądecki Mts., Smolis & Skarżyński 2006; Beskid Żywiecki Mts., Skarżyński & Smolis 2006). More localities of the species from Poland and Slovakia are herein added (see: Other material). Additionally Gruia (1974) reported this species from the Rumanian Carpathians and described a morphology of all its instars. Nevertheless, a detailed analysis of figures in the paper (see: Gruia 1974, 214: Figs 1, 4 and 217: Figs 13, 14) showed that these specimens represented another genus and species, probably closely related to *Neanura minuta* Gisin, 1963. Data of the occurrence of *E. tatricola* suggest that it is widely distributed in the Western and scattered in the Eastern Carpathians. However, its eastern and southern limits are not known precisely and needed further studies.

Ecological remarks. A mountain saproxylic species, occurs mainly in the belts of mountain forests, sporadically (Stach 1951) in dwarf mountain-pine shrubs (subalpine belt). It prefers shady and humid forests e.g. stands of beech, fir and spruce. Found predominantly in humid rotting wood and under bark of decaying logs, but also in litter with fine woody debris. Moreover, a numerous specimens were observed on roots of a new-fallen spruce (W.M. Weiner pers. comm.). First instars were collected in April, May and July.

Remarks. Stach (1951) described *Biloba tetrophtalma tatricola* on the basis of specimens collected in the Tatra Mts. (Polish Carpathians). Later in “Collembolenfauna Europas” Gisin (1960) raised this subspecies to species status. Nevertheless, Salmon (1964) and Dunger (1966) still considered it as a subspecies of *Neanura tetrophtalma*. Massoud (1967) again elevated this taxon to specific rank: *Neanura tatricola*. Cassagnau (1979) placed the species in the subgenus *Endonura*. Since the original description is devoid of information on variability and chaetotaxy of many parts of body I decided to make a modern redescription of the species based on all current available material.

TABLE 2. Chaetotaxy of *Endonura tatricola*:

a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	MI	F
		Mc or Mcc	G
Af	8	MI	B
		Mc	A
		Mcc or mi	C
		mi	D
Oc	3	MI	Ocm, Ocp
		mi	Oca
Di	2	MI or Mc	Di1
		Mcc or mi	Di2
De	2	MI	De1
		Mcc or mi	De2
DI	6	MI	D11, D15
		Mcc or mi	D13, D14
		mi	D12, D16
(L+So)	10	MI	L1, So1
		MI or Mc	L4
		me	So3–6
		mi	L2, L3, So2

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae
I	7	IV	Adult I instar
II	11		or, 8 S, i, 12 mou, 6 brs, 2 iv
III	5 sensilla AO III		or, 2 S, i, 6 mou, 1 brs, 2 iv
ve	5	ap	8 bs, 5 miA 8 bs, 5 miA
vc	4	ca	2 bs, 3 miA 2 bs, 3 miA

vi	4	cm	3 bs, 1 miA	3 bs, 1 miA
d	5	cp	8 miA, 1 brs	8 miA

d) Postcephalic chaetotaxy.

	Di	Terga				Scx2	Cx	Legs		
		De	Dl	L	Tr			Fe	T	
th. I	1	2	1	-	0	3	6	13	19	
th. II	3	2+s	3+s+ms	3	2	7	6	12	19	
th. III	3	3+s	3+s	3	2	8	6	11	18	
							Sterna			
abd. I	2	3+s	2	3	VT: 4					
abd. II	2	3+s	2	3	Ve: 5	Ve1 -	present			
abd. III	2	3+s	2	3	Vel: 5			Fu: 4–7 me	5–8 mi	
abd. IV	2	2+s	3	6	Vel: 4	Vec: 2	Vei: 2	VI: 4		
abd. V	(3+3)		5+s		Ag: 3			VI: 1	L': 1	
abd. VI		7			Ve: 11–13			An: 1mi		

TABLE 3. Variability of the number of eyes in Polish populations of *Endonura tatricola* from: Tatra Mts. (32 specimens), Beskid Żywiecki Mts. (36 specimens) and Pieniny Mts. (30 specimens).

Specimens	Number of eyes				
	2+2	2+1	1+1	1+0	0+0
Tatra Mts.	25 (78,2%)	5 (15,6%)	0 (0%)	1 (3,1%)	1 (3,1%)
Beskid Żywiecki Mts.	17 (47,2%)	10 (27,8%)	3 (8,3%)	4 (11,1%)	2 (5,6%)
Pieniny Mts.	3 (10%)	7 (23,3%)	7 (23,3%)	10 (33,4%)	3 (10%)

Weiner (1973) described *Neanurella szeptyckii* based on specimens from Pieniny Mts. (Polish Carpathians). A detailed examination of types of both mentioned species allowed to ascertain that they differed in the number of eyes only (in *szeptyckii* 0+0 eyes, in *tatricola* 2+2 eyes). In the light of the variability of this feature observed in *E. tatricola* (see: Variability) *E. szeptyckii* is a junior synonym of the species.

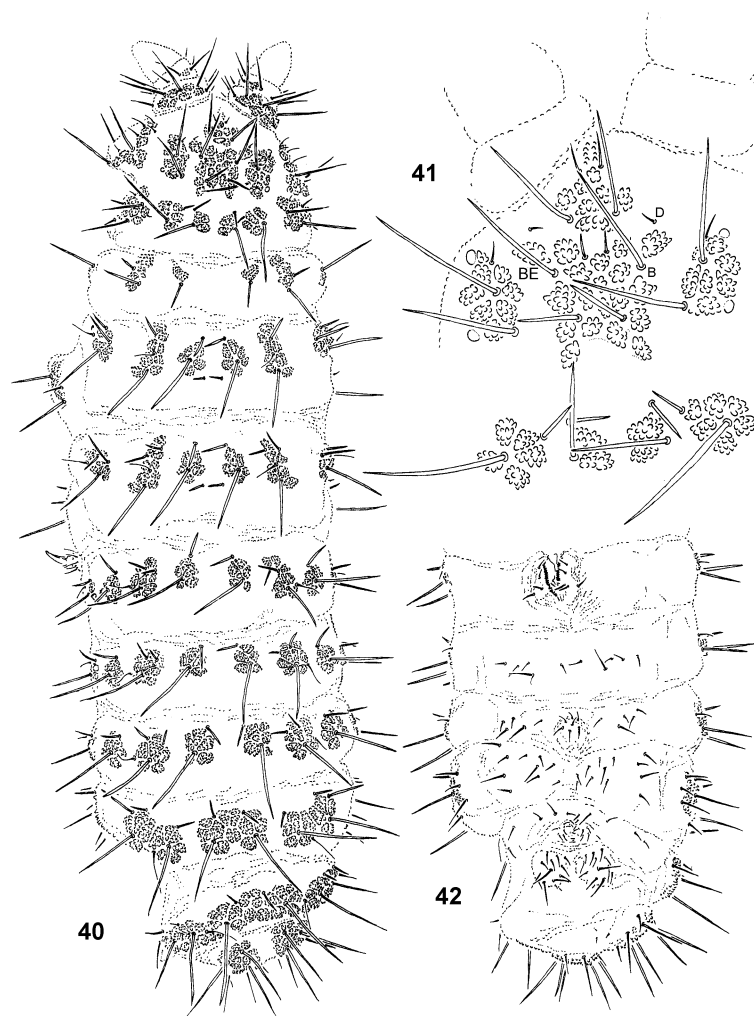
***Endonura dudichi* (Loksa, 1967) comb. nov.**

Figs 40–49, Tab. 4

Neanura dudichi Loksa, 1967: 289

Material examined. Hungary, West Carpathians, Aggtelek National Park, alder forest, litter with fine woody debris, 1988, leg. Gy. Traser, det. Gy. Traser, juvenile on slide. Poland, West Carpathians, Beskid Sądecki Mts., near Muszyna village, nature reserve "Las lipowy Obrożyska", west slope of Mikowa Mt., 500–600 m alt., oak-hornbeam and beech-fir forest, under bark of decomposed log, decaying wood, 26–28.IV.1999, leg. A. Smolis, numerous specimens on slides; West Carpathians, Beskid Sądecki Mts., near Krynica, north slope of Dubne Mt., 850 m alt., Carpathian beech forest, decaying wood, 27.IV.1999, leg. A. Smolis, 3 females and juvenile on slides. Slovakia, Slovenský Raj National Park, mixed forest, under bark of decomposed logs, decaying wood, 1.V.2000, leg. A. Smolis, female and 3 juveniles on slides. Słowacja, National Park Slov-

enský Raj, rotting wood and under bark, 1.V.2000, leg. A. Smolis. Material is preserved in the collection of the Department of Biodiversity and Evolutionary Taxonomy, Wrocław University, Poland.

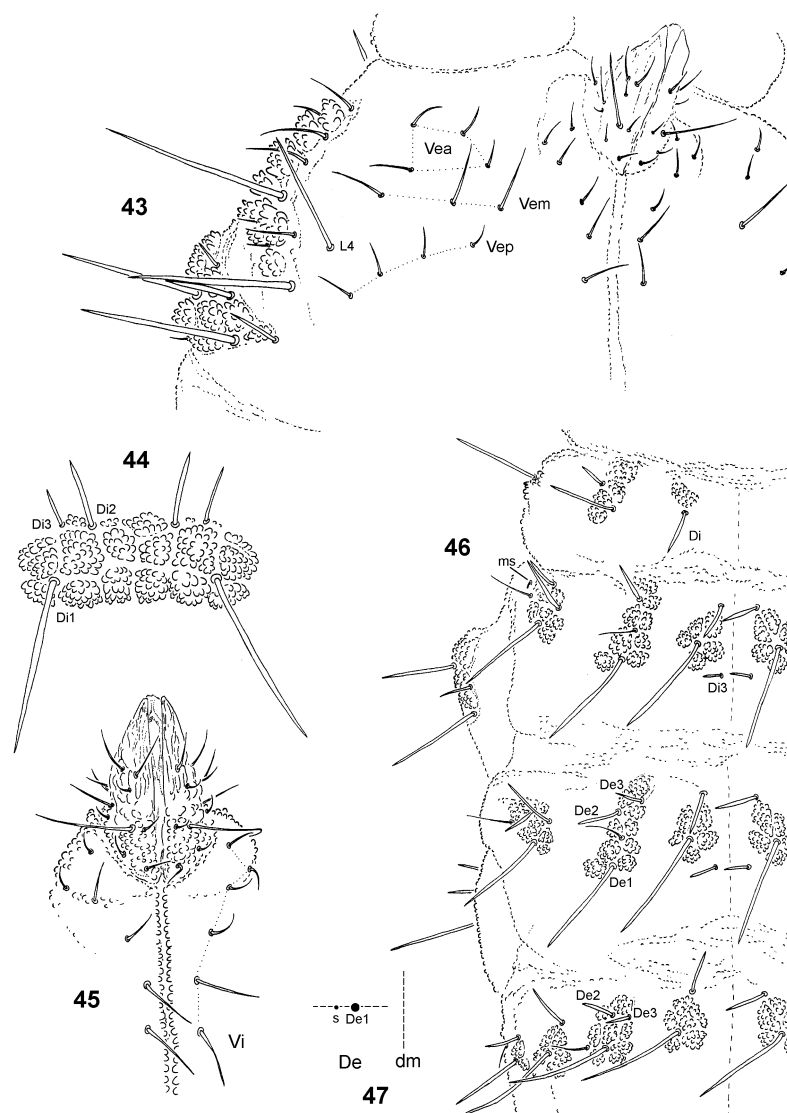


FIGURES 40–42. *Endonura dudichi*: 40, chaetotaxy and distribution of tubercles, adult (dorsal view); 41, chaetotaxy of central area of head; 42, chaetotaxy and distribution of tubercles on abdomen, adult (ventral view).

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed, except tubercles Di on th. I. 2+2 unpigmented eyes present. Buccal cone rather short. Labral chaetotaxy 4/24. Mandible thin with 3 teeth. Head with 3 chaetae Oc, chaetae A, B, C and D. Chaeta O absent. Tubercles Di and (L+So) on head with 6 and 10 chaetae respectively. Tubercles De on thoracic terga II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 3 and 6 chaetae respectively. Abd. IV and V with 5 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 short.

Redescription. Habitus typical of the genus. Body length (without antennae): females 1.5–1.7 mm, males 1.0–1.3 mm, I instars 0.5–0.8 mm. Colour of the body white. 2+2 small unpigmented eyes (Figs 40–41).

Types of dorsal ordinary chaetae. Macrochaetae Ml thin, relatively long, straight, narrowly sheathed, gradually tapered and apically pointed (Figs 40–41, 44, 46, 48); macrochaetae Mc and Mcc thin, straight, apically pointed; mesochaetae and microchaetae short, thin and pointed. Macrochaetae very similar in I instars and in adults. All macrochaetae feebly serrated. Same number and arrangement of chaetae in adults and I instars, except chaetotaxy of ant. IV (see: Tab. 4c) and genital plate (complete absence of chaetae in first instars).

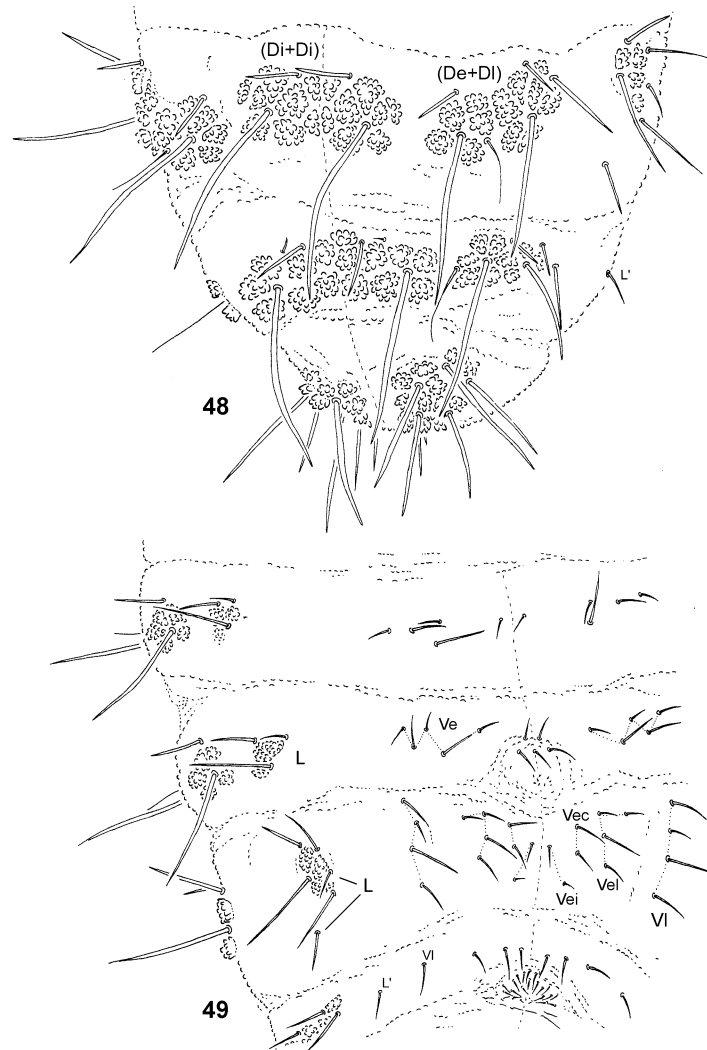


FIGURES 43–47. *Endonura dudichi*: 43, chaetotaxy of head (ventrolateral view); 44, tubercle (Di+Di) of abd. V; 45, chaetotaxy of labium and group Vi; 46, dorsal chaetotaxy of th. and abd. I; 47, scheme of position of sensillum and chaeta De1 on abd. I–IV (dm—dorsomedian line).

Head. Buccal cone short (Fig. 43). Labrum rounded, with ventral sclerifications as in Fig. 45. Labrum chaetotaxy 4/24. Chaetotaxy of labium as in Fig. 45. Maxilla styliform, mandible thin tridentate. Chaetotaxy of antennae in adults and I instars as in Tab. 4c. Apical vesicle distinct, simple. Sensilla S on ant. IV subequal, short and rather thick. Chaetotaxy of head as in Tab. 4a, b, and Figs 41, 43, 45. Tubercles Cl and Af separate (Fig. 41). Chaetae O and E absent. Chaetae D and L4 free. Tubercle D1 with 6 chaetae, chaeta D13 present (Fig. 43). Elementary tubercle BE present (Fig. 41). Chaeta A shorter than B.

Thorax, abdomen, legs. Body sensilla fine and smooth, shorter than nearby macrochaetae (Figs 40, 46, 48). Chaetotaxy of th. and abd. as in Tab. 4d and in Figs 40, 42, 44, 46–49. Tubercles Di on th. I present (Fig. 40). Chaetae De3 on abd. I–III shorter than De2. Chaetae De2 on th. II–III and De3 on th. III connected with tubercle De. Chaetae De3 on abd. I–III connected with tubercle De (Figs 40, 46). The line of chaetae De1–sensillum perpendicular to the dorsomedian line on abd. I–IV (Figs 46–48). Tubercle L on abd. III and IV with 3 and 6 chaetae respectively (Fig. 49). One chaeta L on abd. IV free. Furca rudiment with 4–8 microchaetae (Fig. 49). Tubercles De and D1 on abd. IV fused. Tubercles Di on abd. IV and V fused (Fig. 48). Chaeta L' on abd. V present (Fig. 49). Cryptopygy absent. Chaetotaxy of legs as in Tab. 4d. Tibiotarsi with short chaetae B4 and B5. Claw without inner tooth.

Discussion. See: Discussion of *E. tatricola*.



FIGURES 48–49. *Endonura dudichi*: 48, chaetotaxy of abd. IV–VI (dorsolateral view); 49, chaetotaxy of abd. II–IV (ventrolateral view).

Distribution. *E. dudichi* was recorded from Hungary (Western Carpathians, Loksa 1967, Traser 1999) and for the first time from Poland (Western Carpathians, Beskid Sądecki Mts.) and Slovakia (Western Carpathians, Slovenský Raj National Park).

Ecological remarks. A mountain saproxylic species, in Hungary found in cave and in litter of alder stand. In Poland and Slovakia, it occurs in beech and oak–hornbeam forests at lower altitudes. Found predominantly in humid rotting wood and under bark of decaying logs, sporadically in litter with fine woody debris. First instars were collected in April.

Remarks. Loksa (1967) described *Neanura dudichi* based on a one specimen collected from a Hungarian cave “Öz–Schachthöhle” (Aggtelek National Park, Carpathians). Traser (1999) recollected it in same area (Aggtelek National Park, juvenile in alder wood) and clasified this species to the genus *Albanura*. In 1999 and 2000, numerous specimens of the species from three localities in Polish and Slovak Carpathians were collected by me. A detailed examination of mentioned material (holotype probably has been lost, Gy. Traser pers. comm.) allowed to ascertain that the species belonged to genus *Endonura* (see: Discussion of *Endonura*) and necessarily needed a modern redescription.

TABLE 4. Chaetotaxy of *Endonura dudichi*:

a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mcc or me	G
Af	8	Ml	B
		Mc	A
		Mcc or mi	C
		mi	D
Oc	3	Ml	Ocm, Ocp
		mi	Oca
Di	2	Ml or Mc	Di1
		Mcc or mi	Di2
De	2	Ml	De1
		Mcc or mi	De2
Dl	6	Ml	Dl1, Dl5
		Mcc	Dl3, Dl4
		mi	Dl2, Dl6
(L+So)	10	Ml	L1, So1
		Mc	L4
		me	L3, So3–6
		mi	L2, So2

b) Cephalic chaetotaxy–ventral side.

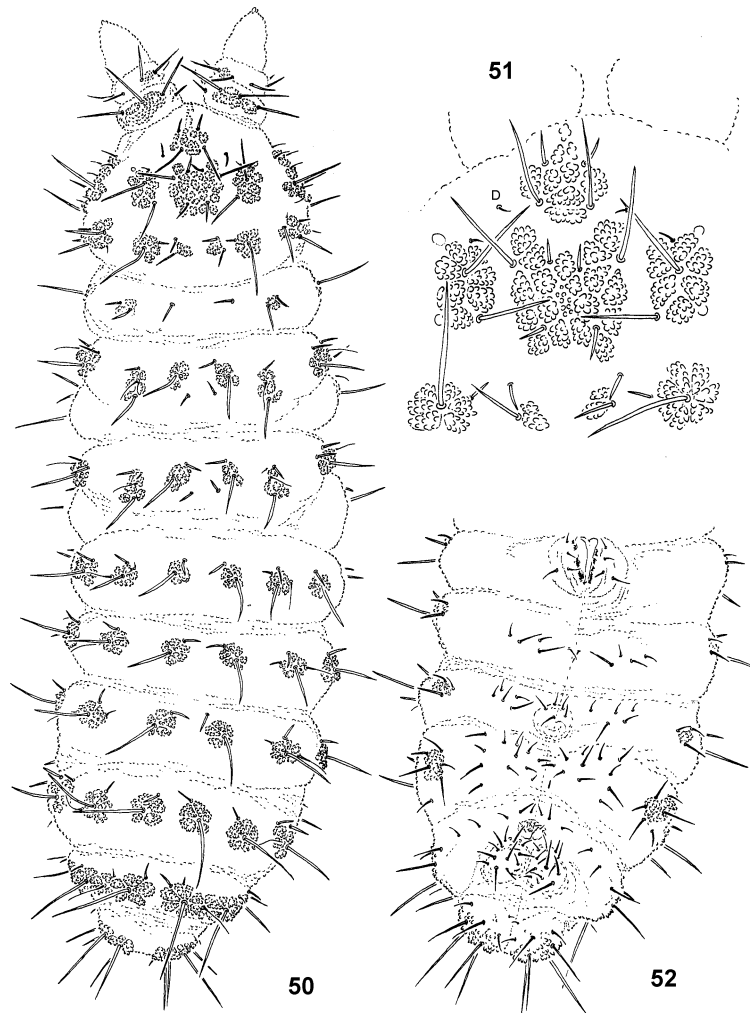
Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae	
I	7	IV	Adult	I instar
		ap		
II	11		or, 8 S, i, 12 mou, 6 brs, 2 iv	or, 2 S, i, 6 mou, 1 brs, 2 iv
III ve	5 sensilla AO III		8 bs, 5 miA	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA	3 bs, 1 miA
d	5	cp	8 miA, 1 brs	8 miA

d) Postcephalic chaetotaxy.

	Di	Terga			Scx2	Cx	Legs		
		De	DI	L			Tr	Fe	T
th. I	1	2	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
							Sterna		
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5	Ve1 -	present		
abd. III	2	3+s	2	3	Vel: 5			Fu: 5-7	4-6 mi
								me	
abd. IV	(2+2)	5+s		6	Vel: 4	Vec: 2	Vei: 2	VI: 4	
abd. V	(3+3)		5+s		Ag: 3			VI: 1	L': 1
abd. VI		7			Ve: 12-13			An: 1mi	



FIGURES 50–52. *Endonura incolorata*: 50, chaetotaxy and distribution of tubercles, adult (dorsal view); 51, chaetotaxy of central area of head; 52 chaetotaxy and distribution of tubercles on abdomen, adult (ventral view).

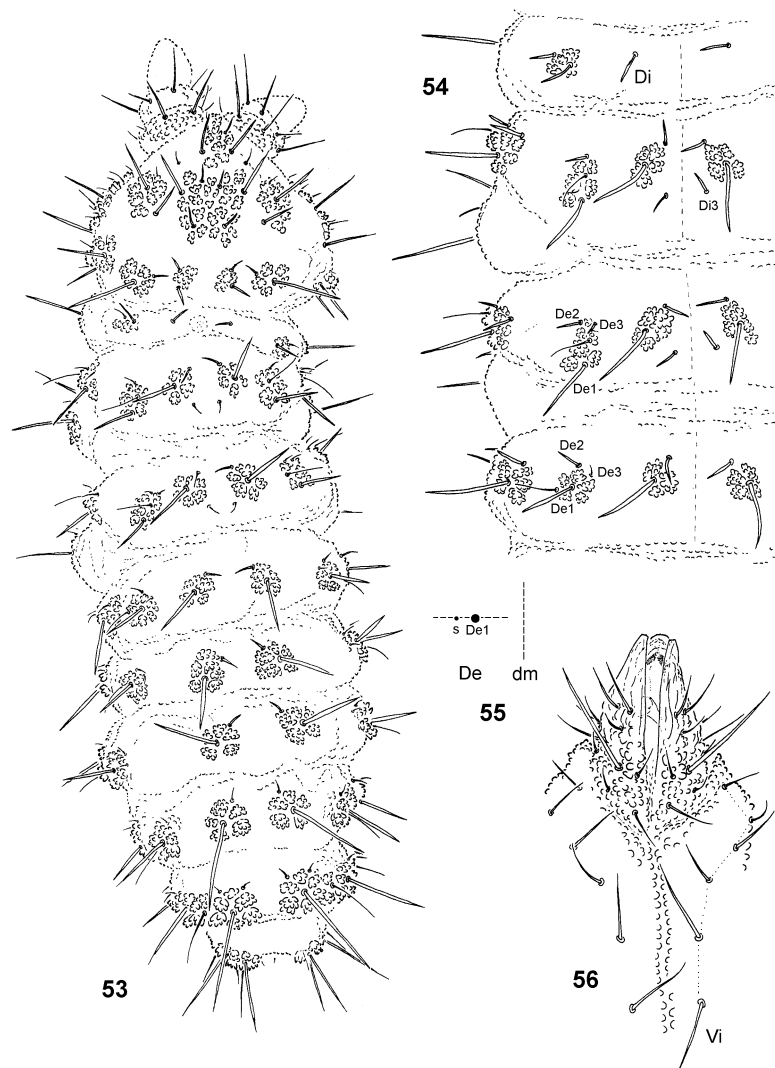
Endonura incolorata Stach, 1951 comb. nov.

Figs 50–59, Tab. 5

Biloba incolorata Stach, 1951: 31

Type material. Lectotype male on slide by present designation, Ukraine, East Carpathians, Chornohora Range, “Zaroślak”, 1935, leg. J. Stach, det. J. Stach., Paralectotypes, female and 2 juveniles on slides, same data as lectotype.

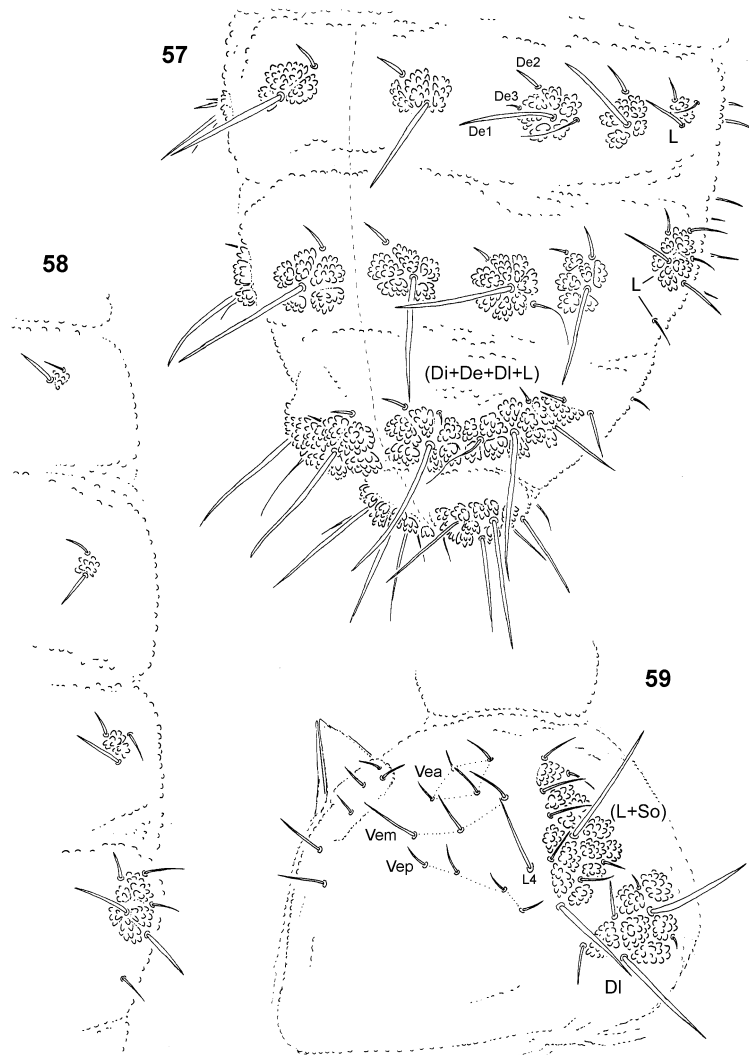
Stach described *Biloba incolorata* based on numerous specimens collected in the forest reserve “Zaroślak” in the Chornohora Mts., but he did not designate the holotype. In Stach’s collection, housed at the Institute of Systematics and Evolution Animals PAS (Cracow), 4 syntypes on slides were found. One of them, in a best condition, was designated here as the lectotype.



FIGURES 53–56. *Endonura incolorata*: 53, chaetotaxy and distribution of tubercles, first instar (dorsal view); 54, dorsal chaetotaxy of th. and abd. I; 55, scheme of position of sensillum and chaeta De1 on abd. I–IV (dm—dorsomedian line); 56, chaetotaxy of labium and group Vi.

Other material. Ukraine, East Carpathians, Chornohora Range, „Zaroślak”, 1400 m alt., Norway spruce forest (subalpine belt), decaying wood, under bark of rotting logs, 7.ix.1999, 10.ix.1999, 12.ix.1999, leg. R. J. Pomorski, D. Skarżyński, A. Smolis, numerous individuals on slides; East Carpathians, Chornohora Range, south slope of Howerla Mt., 1000 m alt., Carpathian beech forest (montane belt), under bark of logs and in

rooting wood, 11.ix.1999, leg. A. Smolis, 3 females and 3 juveniles on slides. Other material is deposited in the Department of Biodiversity and Evolutionary Taxonomy of Wrocław University, Poland.



FIGURES 57–59. *Endonura incolorata*: 57, chaetotaxy of abd. III–VI (dorsolateral view); 58, chaetotaxy of tubercles L of abd. I–IV (left side); 59, chaetotaxy of head (ventrolateral view).

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed, except tubercles Di on th. I. 2+2 unpigmented eyes present. Buccal cone rather short. Labral chaetotaxy 4/2, 4. Mandible thin with 3 teeth. Head with 3 chaetae Oc, chaetae A, B, C and D. Chaeta O absent. Tubercles Di and (L+So) on head with 6 and 10 chaetae respectively. Tubercles De on thoracic terga II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 3 and 6 chaetae respectively. Abd. IV and V with 8 and 2 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 short.

Redescription. Habitus typical of the genus. Body length (without antennae): females 1.0–1.7 mm, males 1.0–1.2 mm, I instars 0.5 mm. Colour of the body white. 2+2 small unpigmented eyes (Figs 50–51, 53).

Types of dorsal ordinary chaetae. Macrochaetae M1 thin, relatively short, straight, narrowly sheathed, gradually tapered and apically pointed (Figs 50–51, 54, 57); macrochaetae Mc and Mcc thin, straight, apically pointed; mesochaetae and microchaetae short, thin and pointed. Macrochaetae very similar in I instars and in adults (Fig. 53). All macrochaetae feebly serrated. Same number and arrangement of chaetae in adults and I instars, except chaetotaxy of ant. IV (see: Tab. 5c) and genital field (complete absence of chaetae in first instars).

TABLE 5. Chaetotaxy of *Endonura incolorata*:

a) Cephalic chaetotaxy—dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc or Mcc	G
Af	8	Ml	B
		Mc or Mcc	A, C
		mi	D
Oc	3	Ml	Ocm
		Ml or Mc	Ocp
		mi	Oca
Di	2	Mc	Di1
		Mcc or mi	Di2
De	2	Ml	De1
		Mcc or mi	De2
Dl	6	Ml	D11, D15
		Mcc	D13, D14
		mi	D12, D16
(L+So)	10	Ml	L1, So1
		Ml or Mc	L4
		me	So3–6
		mi	L2, L3, So2

b) Cephalic chaetotaxy—ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae	
I	7	IV	Adult	I instar
II	11	ap	or, 8 S, i, 12 mou, 6 brs, 2 iv	or, 2 S, i, 6 mou, 1 brs, 2 iv
III	5 sensilla AO III			
ve	5		8 bs, 5 miA	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA	3 bs, 1 miA
d	5	cp	8 miA, 1 brs	8 miA

d) Postcephalic chaetotaxy.

	Terga					Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T	
th. I	1	2	1	-	0	3	6	13	19	
th. II	3	2+s	3+s+ms	3	2	7	6	12	19	
th. III	3	3+s	3+s	3	2	8	6	11	18	
							Sterna			
abd. I	2	3+s	2	2	VT: 4					
abd. II	2	3+s	2	2	Ve: 5	Ve1 -	present			
abd. III	2	3+s	2	3	Vel: 5			Fu: 4–5 me	4–6 mi	
abd. IV	2	2+s	3	6	Vel: 4	Vec: 2	Vei: 2	VI: 4		
abd. V			8+s		Ag: 3			VI: 1	L': 1	
abd. VI		7			Ve: 12–13			An: 1mi		

Head. Buccal cone short (Fig. 59). Labrum rounded, with ventral sclerifications as in Fig. 56. Labrum chaetotaxy 4/2, 4. Chaetotaxy of labium as in Fig. 56. Maxilla styliform, mandible thin tridentate. Chaetotaxy of antennae in adults and I instars as in Tab. 5c. Apical vesicle distinct, simple. Sensilla S on ant.IV subequal, short and rather thick. Chaetotaxy of head as in Tab. 5a, b, and Figs 51, 56, 59. Tubercles Cl and Af separate (Fig. 51). Chaetae O and E absent. Chaetae D and L4 free. Tubercle Dl with 6 chaetae, chaeta Dl3 present (Fig. 59). Elementary tubercle BE absent. Chaeta A shorter than B.

Thorax, abdomen, legs. Body sensilla fine and smooth, shorter than nearby macrochaetae (Figs 54, 57). Chaetotaxy of th. and abd. as in Tab. 5d and in Figs 50, 52–55, 57–58. Tubercles Di on th. I not differentiated (Figs 50, 53–54). Chaetae De3 on abd. I–III shorter than De2. Chaetae De2 on th. II–III and De3 on th. III connected with tubercle De. Chaetae De3 on abd. I–III connected with tubercle De (Figs 54, 57). The line of chaetae De1–sensillum perpendicular to the dorsomedian line on abd. I–IV (Figs 54–55). Tubercle L on abd. III and IV with 3 and 6 chaetae respectively (Figs 57–58). One chaeta L on abd. IV free. Furca rudiment with 4–6 microchaetae. Tubercles Di on abd. V separate, fused with tubercles De, Dl and L (Figs 50, 53, 57). Chaeta L' on abd. V present. Cryptopygy absent. Chaetotaxy of legs as in Tab. 5d. Tibiotarsi with short chaetae B4 and B5. Claw without inner tooth.

Discussion. See: Discussion of *E. tatricola*.

Variability. According to the original description (Stach 1951), chaeta Di3 on abd. V was absent. Analysis of available material showed that the chaeta was absent only in approx. 50% specimens and present in remaining ones.

Distribution. *E. incolorata* was recorded from Ukraine (Eastern Carpathians, Stach 1951, Kaprus' *et al.* 2006), Slovakia (Western Carpathians, Low Tatra Mts., Nosek 1964, 1969), Poland (Western Carpathians, Beskid Żywiecki Mts., Stach 1964) and recently from Rumania (Eastern Carpathians, Dányi *et al.* 2006).

Ecological remarks. A mountain saproxylic species, occurs in beech, fir–spruce (montane belt) and spruce forests (subalpine belt), not reported above tree line. Found mostly in humid rotting wood and under bark of decaying logs, but also in litter and soil with fine woody debris. First instars were collected in September.

Remarks. Stach (1951) described *Biloba incolorata* based on specimens from Czornohora Mountains (Ukrainian Carpathians). Later the species was considered as member of *Neanura* (e.g. Gisin 1960, Salmon 1964, Stach 1964, Massoud 1967), *Adbiloba* (Cassagnau 1979) or as “*Biloba*” *incolorata* (Babenko *et al.* 1988). A detailed analysis of types and a new material (collected in the type locality) made it possible to ascertain that *B. incolorata* undoubtedly belonged to the genus *Endonura* (see: Discussion of *Endonura*). Furthermore, this allowed me to redescribe this species using a set of modern, diagnostic characters.

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References

- Babenko, A. B., Kuznetsova, N. A., Potapov, M. B., Stebaeva, S. K., Khanislimova, G. M. & Chernova, N. M. (1988) Opriedielitel kollembol fauny SSSR. Nauka, Moscow, 214 pp. [in Russian]
- Cassagnau, P. (1979) Les Collemboles Neauridae des Pays Dinaro-Balkaniques: leur intérêt phylogénétique et biogéographique. *Biologia Gallo-Hellenica*, 8, 185–203.
- Cassagnau, P. (1989) Les Collemboles Neaurinae; éléments pour une synthèse phylogénétique et biogéographique. In: Dallai, R. (Ed.). *3rd International Seminar on Apterygota, Siena*, 171–182.
- Dallai, R. (1983) Interesse biogeografico dei Neauridi (Collembola) della Sardegna e delle isole dell'Arcipelago Toscano. *Lavori della Società Italiana di Biogeografia, (N.S.)*, 8, 417–465.
- Dányi, L., Traser, Gy., Fiera, C. & Radwański J. M. (2006) Preliminary data on the Collembola Fauna of the Maramureş (Romania). *Studia Universitatis Vasile Goldis, Seria St. Vietii*, 17, 47–51.
- Deharveng, L. (1981a) La chétotaxie dorsale de l'antenne et son intérêt phylogénétique chez les Collemboles Neauridae. *Nouvelle Revue d'Entomologie*, 11 (1), 3–13.
- Deharveng, L. (1981b) La famille des Odontellidae: phylogénèse et taxonomie. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques, Toulouse*, 3 (1), 1–21.
- Deharveng, L. (1982) Clé de détermination des genres de Neaurinae (Collemboles) d'Europe et de la région méditerranéenne, avec description de deux nouveaux genres. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques, Toulouse*, 3 (4), 7–16.
- Deharveng, L. (1983) Morphologie évolutive des Collemboles Neaurinae en particulier de la lignée neaurienne. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques, Toulouse*, 4 (2), 1–63.
- Deharveng, L. & Weiner, W. M. (1984) Collemboles de Corée du Nord III—Morulinae et Neaurinae. *Travaux du Laboratoire d'Écobiologie des Arthropodes Édaphiques, Toulouse*, 4, 1–61.
- Dunger, W. (1966) Zur Kenntnis von *Neanura tetraphthalma* (Stach) (Collembola: Apterygota). *Abhandlungen und Berichte des Naturkundemuseums Görlitz*, 41 (4), 1–11.
- Gisin, H. (1960) Collembolenfauna Europas. *Muséum d'histoire naturelle, Genève*, 312 pp.
- Gisin, H. (1963) Sieben neue Arten von Collembolen aus Bosnien und Wiederbeschreibung von *Onychiurus serratotuberculatus* Stach. *Godisnjak Bioloskog Instituta Univerziteta u Sarajevu*, 14, 3–13.
- Greenslade, P. & Deharveng, L. (1990) Australian species of the genus *Australonura* (Collembola, Neauridae). *Invertebrate Taxonomy*, 3, 565–593.
- Gruia, M. (1974) Quelques observations morphologiques sur le développement de *Neanura tatricola* (Insecta Apterygota, Collembola). *Pedobiologia*, 14, 213–220.
- Lawrence, P. N. (1977) Studies on the tibiotarsal chaetotaxy of Collembola. *Systematic Entomology*, 2, 313–317.
- Loksa, I. (1967) Vier neue Höhlencollembolen aus Ungarn (Biospeologica Hungarica, XXIII). *Opuscula Zoologica Budapest*, VI (2), 289–296.
- Kaczmarek, M. (1973) Collembola in the biotopes of the Kampinos National Park distinguished according to the natural succession. *Pedobiologia*, 13, 257–272.
- Kaprus' I. J. (1998) The fauna of springtails (*Collembola*) from selected habitats in Roztocze. *Fragmenta faunistica*, 41 (3), 15–28.
- Kaprus' I. J., Shrubovych J. J. & Tarashchuk, M. V. (2006) Catalogue of the Collembola and Protura of Ukraine. *National Academy of Sciences of Ukraine, State natural History Museum, L'viv*, 164 pp. [in Ukrainian]
- MacGillivray, A. D. (1893) North American *Thysanura*, I–IV. *The Canadian Entomologist*, 25, 313–318.
- Massoud, Z. (1967) Monographie des Neauridae, Collemboles Poduromorphes à pièces buccales modifiées. In: Delamare Deboutteville, C. & Rapoport, E. H. (Eds.) *Biologie de l'Amérique Australe*, Paris, CNRS, III, 7–399.
- Nosek, J. (1964) Some records of Protura and Collembola from the Carpathian mountains. *Časopis Československé Společnosti Entomologické*, 61 (1), 7–18.

- Nosek, J. (1969) The investigation on the Apterygotan fauna of the Low Tatras. *Acta Universitatis Carolinae, Biologica*, [1967], 5/6, 349–528.
- Pomorski, R. J. & Skarżyński, D. (2000) A new species of *Endonura* Cassagnau, 1979 from Bulgaria with remarks on *Endonura centaurea* (Cassagnau & Peja, 1979) (Collembola, Neanuridae). *Zoosystema*, 22, 117–120.
- Pozo, J. & Simón, J. C. (1982) Colémbolos del País Vasco I. *Neanura (Endonura) occidentalis alawensis* nov. ssp. y *Neanura (Deutonura) plena* ssp. *plena* Stach, 1951. *Eos*, [1981] 57, 221–229.
- Salmon, J. T. (1964) An index to the Collembola. Vol. 1–2, *Society Victoria University of Wellington, Wellington*, 644 pp.
- Skarżyński, D. & Smolis, A. (2006) Skoczogonki (*Collembola*) rezerwatu „Śrubita” w Beskidzie Żywieckim. *Parki Narodowe i Rezerwaty Przyrody* 25 (2), 41–50. [in Polish]
- Sławska, M. (2000) Nowe i rzadkie w faunie Polski gatunki skoczogonków (*Collembola*) z Puszczy Białowieskiej. *Przegląd zoologiczny*, 54 (3–4), 237–240. [in Polish]
- Sławska, M. (2001) Interesujące skoczogonki (*Collembola*) torfowisk środkowej części Pojezierza Pomorskiego. *Wiadomości Entomologiczne*, 20 (1–2), 5–15. [in Polish]
- Smolis, A. (2006) *Endonura carpatica*, a new species from Poland (Collembola: Neanuridae: Neanurinae). *Genus*, 17 (4), 471–476.
- Smolis, A. & Kaprus', I. J. (2003) A new species of the genus *Endonura* Cassagnau, 1979 from Israel (Collembola: Neanuridae). *Genus*, 14 (3), 325–329.
- Smolis, A. & Skarżyński, D. (2006) Springtails (Collembola) of the „Barnowiec” reserve in the Beskid Sądecki Mountains (Polish Carpathians). *Proceedings of the State Natural History Museum, L'viv*, 22, 69–77.
- Smolis, A., Skarżyński, D., Pomorski, R. J. & Kaprus' I. J. (2007) Redescription of *Endonura taurica* (Stach, 1951) and *E. quadriseta* Cassagnau & Péja, 1979, and description of two new species of the genus *Endonura* Cassagnau, 1979 (Collembola: Neanuridae: Neanurinae) from the Crimea (Ukraine). *Zootaxa*, 1442, 19–35.
- Stach, J. (1929) Verzeichnis der Apterygogenea Ungarns. *Annales Musei Nationalis Hungarici, Budapest*, 26, 282–283.
- Stach, J. (1951) *The Apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Family: Bilobidae*. Polska Akademia Umiejętności, Acta monographica Musei Historiae Naturalis, Kraków, 97 pp.
- Stach, J. (1964) *Owady bezskrzydłe (Apterygota)*. Katalog fauny Polski 15, M. Mroczkowski (Ed.), PWN, Warszawa, 103 pp. [in Polish]
- Traser, Gy. (1999) Springtails of the Aggtelek National Park (Hexapoda: Collembola). In: Mahunka, S. (Ed.) *The fauna of the Aggtelek National Park*. I–II, HNHM, Budapest, pp. 49–59.
- Weiner, W. M. (1973) Une nouvelle espèce du genre *Neanurella* Cass. des Pieniny (Carpatés, Pologne), Collembola, Neanuridae. *Bulletin de l'Académie Polonaise des Sciences, Série des Sciences Biologiques, Warszawa*, 21 (7–8), 531–534.
- Weiner, M. W. (1981) *Collembola* of the Pieniny National Park in Poland. *Acta zoologica cracoviensia*, 25, 417–500.