NEW FRIDERICIA SPECIES (OLIGOCHAETA: ENCHYTRAIDEAE) FROM VÉRTES MOUNTAINS OF HUNGARY

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The up to now unknown enchytraeid fauna of the Vértes Mountains (part of the Transdanubian Mountains, Hungary) was investigated. Eleven genera, 41 species and one subspecies were identified. One species, Fridericia mahunkai sp. n. and one subspecies Fridericia gamotheca hungarica ssp. n. are new to science. It is proposed to distinguish three subspecies of Fridericia gamotheca Issel, 1905: F. g. gamotheca, F. g. moroccanensis and F. g. hungarica ssp. n. The description of F. cf. alata Nielsen et Christensen, 1999 is provided. The protist Buet-schliellopsis sp. is reported for the first time from the gut of an enchytraeid from Hungary.

Key words: Fridericia, new species, subspecies, Enchytraeidae, fauna, Vértes Mountains.

INTRODUCTION

The investigation of the Hungarian enchytraeid fauna has been proceeded intensive since 2001 with the support of the Hungarian Scientific Research Fund (OTKA). First the enchytraeid faunas of the north-eastern mountain ranges (Bükk, Mátra, Zemplén, Börzsöny Mts) were investigated, resulting in the recording of 77 species belonging to 14 genera (Dózsa-Farkas 2005), including five species new to science: Marionina sexdentata Dózsa-Farkas, 2002, Acheta unibulba Graefe, Dózsa-Farkas et Christensen, 2005, Fridericia eiseni Dózsa-Farkas, 2005, F. schmelzi Cech et Dózsa-Farkas, 2005 and F. crassiductata Dózsa-Farkas et Cech, 2006. Another 14 species were new for the fauna of Hungary.

In the present paper the faunistic results from the Vértes Mountains are presented and furthermore a new Fridericia species and a new subspecies from this area are described.

MATERIALS AND METHODS

Study area. The Vértes Mountains are part of the Transdanubian Mountains. Their area occupies 314 km². Since 2005 the main part of the range has been designated as the ‘Vértes Nature Park’. The average altitude is 350 m a.s.l. Geologically the Vértes Mountains constitute a fairly uniform structure. On the surface of the entire range there are no older rocks than those from the mid-Triassic. The main parent material is dolomite from the upper Triassic. The Vértes Mountains possess a well-developed valley network (1260 km in total length), but in spite of this springs and streams are very rare. Annual sunshine duration is ca 1950–2000 hours. The average annual temperature above the height of 350 m is 8.5 °C (in January −3 °C). The average annual precipitation is between 600 and 700 mm. In winter the land is usually snow-covered (Beni & Viszló 1996).

Hungarian Natural History Museum, Budapest
Different habitats were investigated, ranging from stream banks to different forest types, from meadows to rock grasses and also to the microhabitat of decaying tree trunks. From total, 14 localities 25 macro and microhabitats were sampled (Table 2).

The animals were extracted from the soil by the wet funnel method (O’CONNOR 1962). Worms were first observed and measured alive, than anaesthetized in 30% ethanol and subsequently preserved in 70% ethanol. Later, the specimens were stained with borax-carmine, then passed through an ethanol (70% to absolute) dehydration series, mounted temporarily in clove oil, and later mounted in Euparal in a slide between two coverslips. The important morphological structures in vivo were recorded, drawn and photographed using Axio Imager.A2 microscope, using DIC (differential interference contrast) illumination and an AxioCam MRc 5 (Zeiss) digital camera with Axiovision software. The whole-mounted specimens were reinvestigated and photographed, too.

Holotypes and paratypes of new taxa are deposited in the collection of the Department of Systematic Zoology and Ecology, Eötvös Loránd University, Budapest.

RESULTS

In total 42 species and one subspecies were recorded, belonging to eleven enchytraeid genera (Table 1). Two taxa are considered new to science and described below: *Fridericia mahunkai* sp. n. and *Fridericia gamotheca hungarica* ssp. n. All species represent new records for the Vértes Mountains and two

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<tr>
<th>Table 1. A list of the enchytraeid species of the Vértes Mountains.</th>
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<td><em>Acaela</em> spp.</td>
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<tr>
<td><em>A. eiseni</em> Vej dovský, 1877</td>
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<td><em>A. pannonica</em> Graefe, 1889</td>
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<td><em>Bryadrilus ehlersi</em> Ude, 1892</td>
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<td><em>Buchholzia appendiculata</em> Buchholz, 1862</td>
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<td><em>Enchytraeus christensi</em> Dózsa-Farkas, 1992</td>
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<td><em>E. lacteus</em> Claparede, 1861</td>
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<td><em>E. buchholzi</em> sensu lato</td>
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<td><em>E. bulbosus</em> Nielsen et Christensen, 1962</td>
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<td><em>E. variatus</em> Bouguene ec et Giani, 1987</td>
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<td><em>Enchytronia christensi</em> Dózsa-Farkas, 1970</td>
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<td><em>En. parov</em> Nielsen et Christensen, 1959</td>
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<td><em>En. sp. 1</em></td>
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<td><em>Fridericia cf. alata</em> Nielsen et Christensen, 1959</td>
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<td><em>F. argil lata</em> Schmelz, 2003</td>
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<td><em>F. bitetosa</em> (Levinski, 1884)</td>
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<td><em>F. bul boid es</em> Nielsen et Christensen, 1959</td>
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<td><em>F. ch risteri</em> Rota &amp; Healy, 1999</td>
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<tr>
<td><em>F. conc ulata</em> Dózsa-Farkas, 1986</td>
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<td><em>F. connuta</em> Bretsch er, 1902</td>
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Table 2. Investigated localities, habitats, sampling date with the recorded species.

Vértestolna, mixed deciduous forest (mostly with oak trees) 01.11.2005 (Buchholzia appendiculata, Enchytraeus buchholzi sensu lato, E. bulbosus, Fridericia paroniana).

Near Majk-creek. 47°29'23"N, 18°20'44"E, 245 m a.s.l., 18.10. 2007.

a: Alnus trees (Enchytraeus buchholzi sensu lato, Henlea perpusilla, Marionina argentea, Globulidrilus riparius).

b: under an old oak tree (Acta pannonica, Buchholzia appendiculata, Enchytraenia christenseni, Fridericia ratzeli, Marionina argentea, M. brendae).

Near Kőhányás village. 47°25'31"N, 18°20'18"E, 293 m a.s.l., 18.11.2007, 27.03.2008.

a: mixed deciduous forest (with hornbeam and beech dominance) (Acta pannonica, Acta eiseni, A. pannonica, Buchholzia appendiculata, Enchytraeus lacteus, E. buchholzi sensu lato, Enchytraenia christenseni, En. parva, En. sp.1, Fridericia galba, F. maculatiformis, F. sylatica, Marionina brendae, M. communis).

b: Decaying tree trunks (Mesenchytraeus pelicensis).


After Labanc-dűlő under Hosszú-Hill. 47°27'21"N, 18°22'08"E, 268 m a.s.l., 18.11.2007.

a: Meadow, with thorn- and sloe-bush (Enchytraenia christenseni, En. parva, Fridericia bulboidea, Henlea ventriculosa).

b: Decaying tree trunks (Globulidrilus riparius).

c: Beech wood (Fridericia bulboidea).

Csákvrá, on the hillside. 47°23'30"N, 18°26'05"E, 230 m a.s.l., mixed deciduous forest (mostly with linden, oaks and ash). 21.11.2006 (Acta pannonica, Buchholzia appendiculata, Fridericia maculatiformis, F. paroniana).


Vértessomló. 47°30'42"N, 18°22'31"E, 243 m a.s.l., young Turkey oak wood on the top of a hill, 27.03.2008. (Buchholzia appendiculata, Enchytraeus buchholzi sensu lato, E. variatus, Enchytraenia christenseni, Fridericia conmuta, Fratzei, Stercutus niveus).


a: Decaying tree trunks (Bryodrilus eiersi, Buchholzia appendiculata, Enchytraeus buchholzi sensu lato, Fridericia paroniana).

b: Soil near to a small creek (Acta pannonica, Enchytraenia christenseni, Marionina argentea).
LEG.:

Vértesboglár.
Várgesztes.
Gánt.

Table 2 (continued)

Várgezes, 47°28’58” N, 18°23’51” E, 325 m a.s.l., ravine, 27.03.2008.
a: Oak-hornbeam wood (Buchholzia appendiculata, Enchytraeus christenseni, E. buchholzi sensu lato, Fridericia Eiseni, F. galba, F. tubulosa, Henlea nasuta).
b: Decaying tree trunks (Buchholzia appendiculata, Fridericia galba, E. buchholzi, Henlea nasuta).
c: On the rocky outcrop (Sedum) (Buchholzia appendiculata, Fridericia rendsinata, Henlea ventriculosa).

Gánt. 47°27’00” N, 18°23’01” E, 233 m a.s.l., meadow, 27.03.2008 (Buchholzia appendiculata, Enchytraeus christenseni, E. buchholzi sensu lato, Fridericia connata, F. maculatiformis, F. paroniana, F. tubulosa, Marionina communis, Henlea ventriculosa).

c: Meadow with field bindweed (Enchytraeus buchholzi sensu lato, Fridericia gamotheca hungarica ssp. n., F. cf. alata, Henlea ventriculosa).
d: Soil near to a water canal (Achaeta Eiseni, A. pannonica, Enchytraeus bulbosus, Friderica hege-mon, F. cf. alata, Henlea nasuta).

Leg.: on 01.11.2005 Kontschán, J; on 27.03.2008 and on 24.11.2009 Dózsa-Farkas, K. and Kontschán, J., on 23.07.2013 Dózsa-Farkas, K. and Nagy, G.

species are also new for the Hungarian fauna (Fridericia argillae Schmelz, 2003 and F. cf. alata Nielsen et Christensen, 1959). Because the specimens differ in some characters from the description of F. alata given by Schmelz (2003) a detailed description is also provided below. The status of two Achaeta species, the Enchytronia sp.1 and Fridericia sp.1 have not been ascertained yet. These probably represent new species for science, but further investigations are needed to clarify their status. A list of species collected in the individual samples is given in Table 2.

DESCRIPTION OF TAXA

Fridericia mahunkai sp. n.
(Figs. 1A–C, 2A–D, 3A–E)


Etymology: Named in honour of my late colleague Dr. Sándor Mahunka.
Fig. 1. A–C: Fridericia mahunkai sp. n. A = spermatheca, B = penial slits, C = coelomocytes. D–G: F. gamotheca hungarica spp. n. D = spermathaeae, E = oesophageal appendage, F = coelomocytes, G = penial slits. H–J: F. cf. alata H = spermatheca, I = coelomocytes, J = penial slits (all figures were made from living specimens; scale bars = 50 μm).
Diagnosis. The new species can be recognized by the following combination of characters: (1) medium size (13–16 mm in vivo), segments 51–58; (2) max. 4 chaetae per bundle; (3) clitellum girdle-shaped: hyalocytes and granulocytes arranged in transverse rows dorsally; (4) four preclitellar nephridia; (5) coelomo-mucocytes a type, lenticytes small; (6) bursal slit longitudinal; (7) large seminal vesicle; (8) no subneural glands; (9) sperm funnel cylindrical, approximately half as long as body diameter, collar as wide as the funnel body, sperm ca 150–160 μm long; (10) spermathecae separate entally; have two globular diverticula with stalks oriented endad.

Description. Holotype 10.7 mm long, 360 μm wide at VIII and 400 μm at the clitellum (fixed), segments 58. Body length of the three paratypes 12.8–15.4 mm, width 290–300 μm at VIII and 350–390 μm at the clitellum (in vivo), length of fixed specimens 8.6 mm (in two specimens the body-end is missing), width 280–380 μm at VIII, 310–420 μm at the clitellum, segments 51–52. Chaetae: 4 – 4,3,2,(1) : 4 – 4,3,2,(1). As in other Fridericia species the chaetae within a bundle are arranged in pairs with the outer being longer and thicker than the inner (35 × 3.5 μm against 25 × 2.5 μm in the first six segment, later 45 × 4.5 μm against 30 × 3 μm alike in ventro-lateral and dorso-lateral bundles; only two chaetae per bundle from XX (chaetae in the bundles close to the body end somewhat longer: about 50–52 ×

**Fig. 2.** Micrograph of *Fridericia mahunkai* sp. n. A = brain (marked with arrow), B = epidermal gland cells, C = clittellar region (e = egg, sv = seminal vesicle, sperm funnels marked with arrows), D = segments XIII–XVI (chylus cells marked with arrows, e = egg). (A and D stained, B and C in vivo; scale bars = 50 μm).

*Acta zool. hung. 59, 2013*
4.2–5 μm). Head pore at 0/I. Dorsal pores from VII. Epidermal gland cells arranged in 2–3 transverse rows per segment (Fig. 2B). Clitellum in XII–1/2 XIII, girdle-shaped, hyalocytes and granulocytes arranged in rows dorsally (Fig. 2C), weakly developed between the bursal slits. Thickness of body wall 27–37 μm (dorsally and preclitellarly thicker, cuticle about 1 μm in fixed specimens). Brain egg-shaped, 125–150 μm long (fixed), about 2 times longer than wide (Fig. 2A).

Oesophageal appendages (peptonephridia) long, with 2–3 elongated terminal branches. Pharyngeal glands all united dorsally, all with ventral lobes, these well developed in

Fig. 3. Micrograph of Fridericia mahunkai sp. n.: A = spermathecae (marked with black arrows, oesophageal appendage marked with white arrow, ph = pharyngeal glands), B = spermathecae, C = nephridium preclitellarly, D = spermathecae in stained slide, E = male copulatory organ (marked with arrow, e = egg). (A–C in vivo, D–E stained; scale bars = 50 μm).
V and VI. Chloragocytes from V, brown in vivo. Dorsal vessel from XIX–XX, blood colourless. Midgut pars tumida unusually long from XXVIII–XLIV occupying 5–9 segments. Four pairs of precitrellar nephridia from 6/7 to 9/10, length ratio antesepal / postsepal 1:1.5–2, anterior origin of efferent duct (Fig. 3C). Coelomo-mucocytes scarce (length 15–34 \( \mu \text{m} \), fixed) with slightly wavy outline and the matrix blurred but clearly visible nucleus, a type, lenticytes small: 5–7 \( \mu \text{m} \) long. Chylus cells (Fig. 2D) between XIV–XV, occupying 2 segments. Seminal vesicle large in XI–XII. Sperm funnels cylindrical (Fig. 2C), about 140–170 \( \mu \text{m} \) long and 100–132 \( \mu \text{m} \) wide (in vivo) 1.5 times as long as wide. The funnel length in fixed specimens 120–150 \( \mu \text{m} \). Collar slightly narrower or as wide as the funnel. Spermatzoa 150–160 \( \mu \text{m} \) long, heads 65–70 \( \mu \text{m} \) (in vivo). Diameter of sperm ducts 6 \( \mu \text{m} \) (fixed). Male copulatory organs (Fig. 3E) 105–110 \( \mu \text{m} \) long, 55–80 \( \mu \text{m} \) wide and 70–75 \( \mu \text{m} \) high (fixed), the laterally bent bursal slits are longitudinal (Fig. 1B). No subneural glands. Spermathaeceae (Figs 3A, B, D): a small sessile ectal gland at the orifice, ectal ducts about 130–190 \( \mu \text{m} \) long and 13 \( \mu \text{m} \) wide in the fixed specimens, widened proximally and projecting into the ampullae (ental bulb about 28–30 \( \mu \text{m} \) wide in vivo), canal not widened. Ampullae with two short stalked diverticula inserting on opposite sides of ental bulbs at bases of ampullae and oriented entad. Ampullae open separately into oesophagus. Inner surface of ampullae and stalks of diverticula thick-walled with granular texture. Diverticula have a spherical sperm-containing chamber (37–45 \( \mu \text{m} \) in diameter, fixed). Maximum width of spermathaeceae (ampulla + diverticula) 110–120 \( \mu \text{m} \) (in vivo). One or two mature eggs at a time.

Distribution and habitat: Only known from the type locality.

Differential diagnosis. Seven Fridericia species have similar spermathaeceae with two spermathecal diverticula oriented entad and separately connected with the oesophagus (listed in Dózsa-Farkas 2009, Tab. 9 and in addition the variant of F. galba (Hoffmeister, 1843) with two diverticula). The main differences between other species of this Fridericia sub-group and the new species are as follows: F. heliota Zalesskaya, 1990 (Rota et al. 2003), F. alata Nielsen et Christensen, 1959, and F. galba (Schmelz 2003) have 5 pairs of precitrellar nephridia and the spermathecal ectal ducts are longer than in the new species. F. nanningensis Xie, Liang et Wang, 2001 (Xie et al. 2001) and F. bubalus Sesma et Dózsa-Farkas, 1993 (Sesma & Dózsa-Farkas 1993) have also 5 pairs of precitellar nephridia and in addition the oesophageal appendages are different: c type in F. bubalus and b type in F. nanningensis. F. sylvatica Healy, 1979 (Healy, 1979) has 4 pairs of precitellar nephridia but the clitellum is only laterally developed and there is an additional pair of ventral pharyngeal gland lobes in VII. F. conculta Dózsa-Farkas, 1986 (Dózsa-Farkas 1986) has also 4 pairs of precitellar nephridia but also small subneural glands in XIII–XIV and is lacking lateral chaetae postclitellarly down to XXIV–XXVII.

Fridericia gamotheca hungarica ssp. n.
(Figs 1D–G, 4A–F, 5A–G, 6A–F)


Etymology: The name refers to the country of origin, geographically distant from the sampling sites of the other two subspecies.

Diagnosis. (1) medium-sized species: about 7–11 mm long in vivo (6–8 mm fixed), segments 31–37; (2) maximum of chaetae 4–6; (3) coelomocytes b type, lenticytes small; (4) oesophageal appendage with short branches proximally as well as terminally; (5) clitellum girdle-shaped, hyalocytes also present ventrally; (6) dorsal vessel origin in XIII; (7) 5 pairs preclitellar nephridia; (8) sperm funnel pear-shaped, seminal vesicle absent; (9) the two spermathecal ampullae united completely, with two rounded diverticula with short stalks on each side; ectal duct long, with a small sessile ectal gland at the orifice; (10) several mature eggs at a time.

Description. Holotype 5.8 mm long, 340 μm wide at VIII and 350 μm at the clitellum (fixed), segments 37. Body length of paratypes 7–10.4 mm, width 300–450 μm at VIII and 350–490 μm at the clitellum (in vivo), length of fixed specimens 5.6–8.6 mm, width 240–400 μm at VIII, 310–460 μm at the clitellum, segments (29), 31–37. Chaetae: 3, 3.2, 4, 5, 3, 2; 5, 6, 7, 8, 9. In some specimens with a maximum of only four chaetae per bundle. Three and two chaetae only in posterior segments, but two chaetae in a bundle occur not only terminally in the specimens with a maximum four chaetae. Two (rarely one) small chaetae also in XII, laterally (25–35 μm long, 2.5 μm wide). The outer chaetae longer and thicker than the inner ones within a bundle (the outer ca 50 μm long, and 4–5 μm wide, the inner ones 30–38 μm long and 3–3.2 μm wide) but in the last 6–10 segments all chaetae are of equal length. Maximum length of the chaetae 57–65 μm in the terminal segments. Head pore at 0/1 (Fig. 4C), dorsal pores from VII (Fig. 4D). Epidermal gland cells arranged in 3 transverse rows per segments. Clitellum in XII–1/2XIII, girdle-shaped, hyalocytes and granulocytes arranged in rows (Fig. 5B). In the fully developed adult specimens with eggs the hyalocytes and granulocytes are similarly arranged between the bursal slits too. Thickness of body wall 22–37 μm, the longitudinal layer of muscles 10–17 μm thick, cuticle about 1 μm or <1 μm (fixed specimens). Brain posteriorly slightly concave, 100–130 μm long (fixed), about 1.7–2 times longer than wide (Figs 4A–B).

Oesophageal appendages (peptonephridia) (Figs 1E & 4E) with some short branches in the proximal part and 3–4 branches terminally. First pair of pharyngeal glands united dorsally, the second and third pairs dorsally separate, all with ventral lobes and even the ventral lobes in IV are not separate from the dorsal lobes. Chloragocytes from V, dark brown (in vivo), diameter 25–35 μm in vivo, 25 μm when fixed. Dorsal vessel from XIII, blood colourless. Midgut pars tumida (Fig. 6A) from XXI–XXVI occupying 3 segment groups. Five pairs of preclitellar nephridia from 6/7 to 10/11, length ratio anteseptale : postseptale 1 : 1.5, anterior origin of efferent duct. Coelomomucocytes (length 22–40 μm in vivo, 20–25 μm, fixed) variable, with a few or many refractile granules (Figs 1F & 4F), dark when accumulated, b type, lenticytes small: 5–10 μm long. Chylus cells between X–XII, occupying 2 segments (Fig. 5A). Seminal vesicle absent. Sperm funnels pear-shaped (Figs 5C–E), about 100–162 μm long in vivo, 87–150 μm when fixed, and 1.4–1.6 times longer than wide, collar narrower than funnel body and about 10–14 μm high. Spermatozoa about 100 μm long, heads 40 μm (in vivo). Diameter of sperm ducts 5 μm (fixed). Male copulatory
organs (Fig. 5F) 60–87 μm long, 50–60 μm wide and 40–50 μm high (fixed), the bursal slits with longitudinal and transverse components, the latter branching off the posterior end (Figs 1G & 5G). No subneural glands. Spermataecae (Figs 1D & 6B–D): one small sessile ectal gland at the orifice of ectal duct (in one case two glands, Fig. 6C), ectal ducts long (about 170–266 μm long and 14–18 μm wide in the fixed specimens), the two ampullae merging mostly completely. Two rounded diverticula with short stalks on each side of the ampullae. One common dorsal opening into oesophagus. The diverticula and ampullae

Fig. 4. Micrograph of Fridericia gamotheca hungarica ssp. n. A–B = brain, C = head pore (marked with arrow), D = dorsal pores (the coelomocytes coming out, marked with arrows), E = oesophageal appendages (terminal branches marked with white arrows, proximal branches marked with black arrows), F = coelomocytes (coming out). A, C, E and F in vivo, B and D stained; scale bars = 50 μm.

Acta zool. hung. 59, 2013
mostly empty but sometimes also containing low quantities of sperm. Two to four mature
eggs at a time (Fig. 6E).

In some specimens (including holotype) several protists were observed in the gut in
front of the clitellum (Fig. 6F), identified by Dr Júlia Török as Buetschiellopsis sp (Ciliophora:
Actinomatida: Hoplitophryidae). Till now a single species, Buetschiellopsis enchytrae, has been
described from Fridericia sp. (Puytorac 1954). In Hungary this genus of protist had not
been found in enchytraeids up to now.

Fig. 5. Micrograph of Fridericia ganotheca hungarica ssp. n.: A = chylus cells (marked with
white arrows, penial apparaite marked with black arrow), B = clitorial gland cells laterally,
C = clitorial field: sperm funnels (marked with arrows, e = egg), D and E = sperm funnels
(marked with arrows, F = male copulatory organ (marked with arrow), G = bursal slit
(marked with arrow). (A, C, D and G in vivo, B and F fixed but not stained; scale bars = 50 μm).
Distribution and habitat: Only known from the type locality.

Differential diagnosis. The new taxon belongs to *F. gammotheca* Issel, 1904. The differences of this species with other closely related species (they belongs to the group of 12 species characterized by proximally fused sper-

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**Fig. 6.** Micrograph of *Fridericia gamotheca hungarica* ssp. n.: A = midgut pars tumida (marked with arrows, B–D = spermathecae marked with arrows (an extra small figure shows the ectal duct, which in this case shows exceptionally two glands), D = four mature eggs in the body, F = *Buetschliellopsis* sp. protist in the gut (marked with arrow). A and F stained, B–F *in vivo*; scale bars = 50 μm).
mathaeae (Dózsa-Farkas 2009, Tables 1–2, Schmelz & Collado 2013) are as follows: F. connata Breitscher, 1902, F. monochaeta Rota, 1995 and F. brunensis Schlaghamerský, 2007 differ from the new subspecies in the maximum of chaetae in a bundle [only 2 (3)], F. waldenstroemi Rota et Healy, 1999 is much larger (9–15 mm and 40–54 segments). Most similar to F. gamotheca is F. argil-lae Schmelz, 2003, but the latter smaller and slender (only 3–4 mm long and 150–230 μm wide) and differs from it by its first pair of pharyngeal glands without ventral lobes and the third pair having a posterior projection; in addition, the two spermathecal ampullae are cylindrical, elongate and joining only at their proximal ends. Likewise in F. marginata Schmelz et Collado, 2013 and F. roembecki Schmelz et Collado, 2013 the spermathecal ampullae are united only proximally and chylus cells are located postclitellarily. F. montafonensis Schmelz, 1998 and F. nemoralis Nurminen, 1970 are much larger (60–70 and 40–53 segments, respectively) and their spermathecal diverticula much larger, moreover the chylus cells are present far back postclitellarily in these species.

Two species (F. bernini Dózsa-Farkas, 1988 and F. profundicola Dózsa-Farkas, 1991) belong also to the group defined above but they differ from the new subspecies because in F. bernini the spermathecae have more than two diverticula and in F. profundicola there are very few mucocytes but numerous large lenticytes, moreover in the latter the spermathaeal diverticula are large, oriented entad and have further small pouch-like protrusions.

The new subspecies can be easily distinguished from the other two subspecies (F. gamotheca gamotheca Issel, 1905 and F. gamotheca maroccoiensis Dózsa-Farkas, 1989, see discussion) mainly by the following characters: by their size (the length smaller than the length of F. g. gamotheca and larger than the length of F. g. maroccoiensis) and segment number (it is in F. g. gamotheca higher than in the new subspecies, but lower in F. g. maroccoiensis), the presence of chaetae in XII laterally, oesophageal appendages with branches not originating not only terminally, coelomocytes of b type, dorsal vessel origin more anteriorly in XIII, a different connection of the dorsal lobes of pharyngeal glands, and by the pear-shaped and smaller sperm funnels (Table 3).

Fridericia cf. alata Nielsen et Christensen, 1959
(Figs 1H–J, 7A–F, 8A–F, 9 A–D)

In the locality Vértesboglár (47°25'59"N, 31°23'49"E, 160 m a.s.l., meadow) the dominant species was F. alata, but the specimens assigned to this species differed in some respects from the descriptions by Nielsen and Christensen (1959) and Schmelz (2003). Therefore an account of characters in agreement and disagreement with the above descriptions is given.

Size about the same: 10–14 mm long, diameter 330–400 μm at VIII and 370–450 μm at the clitellum [similarly in Schmelz (2003): 12–19 mm and up to 400 μm in XII] (in vivo),
length of fixed specimens 8–13 mm, segments 42–54 [in Schmelz (40)–48–58–(67)]. Similarly the maximum number of chaetae 5 or 6 and in the bundles of the posterior body part mostly two chaetae. In Nielsen and Christensen (1959) the innermost pair of chaetae much smaller than the outer pairs, in Schmelz (2003) the inner chaetae in the preclitellar bundles almost as long as the outer ones (this is a mistake, R. M. Schmelz, pers. comm.). In our specimens the outer chaetae longer and thicker than the inner within a bundle (e.g. in a bundle with 6 chaetae in the preclitellar segment the outermost pair of chaetae 63 μm long and 5 μm wide, the middle one 55 μm long and 4.5 μm wide and the inner-

Fig. 7. Micrograph of Fridericia cf. alata: A = brain, B = head pore (marked with arrow), C = epidermal gland cells, D = nephridium preclitellarly, E = oesophageal appendage of b type, F = colomocytes. (A–D and F in vivo, E fixed but not stained; scale bars = 50 μm).
most only 30 μm long and 2.5 μm wide). In the terminal segments the maximum length of the chaetae 90–100 μm, width 5–7 μm. Head pore at 0/I (Fig. 7B), dorsal pores from VII. Contrary to Schmelz (2003) the epidermal gland cells not indisting but in the Hungarian specimens large and arranged in 3 transverse rows per segments (Fig. 7C). Body wall 30–40 μm, cuticula < 1 μm. Clitellum in XII–1/2XIII, girdle-shaped, hyalocytes and granulocytes

Fig. 8. Micrograph of Fridericia cf. alata: A = pharyngeal glands (the hindmost lobes of the 3rd glands marked with arrows), B = midgut pars tumida (marked with arrows), C = clitellar glands in rows dorsally, D = clitellar glands ventrally (before and between the bursal slits weakly developed glands marked with white arrows, the epidermal glandular thickening in XIII marked with black arrow), E = chylus cells in XII–XIV, F = epidermal glandular thickening in XIII (marked with arrow). (A, C, E, F in vivo, B and D stained; scale bars = 50 μm).
arranged in rows (Fig. 8C). Ventrally before and between the male openings the gland cells weakly developed and mostly only granulocytes, after that hyalocytes and granulocytes are present alike (Fig. 8D). Brain (Fig. 7A) anteriorly convex, posteriorly slightly concave or truncate, about 150 μm long, 1.8 times longer than wide in vivo, 100–135 μm long, 1.4–1.7 times longer than wide in the fixed specimens. Oesophageal appendages (Fig. 7E) unbranched, coiled, long (β type) may extend into VII. First and second pair of pharyngeal glands united but the third pair separated dorsally; the 2nd and 3rd pair have long

Fig. 9. A–D. Micrograph of Fridericia cf. alata: A = sperm funnels (marked with black arrows, male copulatory organ marked with white arrow, B = penial slit (marked with arrow), C and D = spermathecae; E–F micrograph of Fridericia tubulosa paratype: E = spermatheca, F = male copulatory organs (A–C in vivo, D fixed but not stained, E and F stained; scale bars = 50 μm).

<table>
<thead>
<tr>
<th></th>
<th>F. gamotheca gamotheca Issel, 1905</th>
<th>F. gamotheca marocociensis Dözsá-Farkas, 1989</th>
<th>F. gamotheca hungarica ssp. n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments</td>
<td>(37–42–50)</td>
<td>28–33</td>
<td>(29)–31–37</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>I: 10–12; R: 10–15</td>
<td>5–7</td>
<td>7–10.4</td>
</tr>
<tr>
<td>Diameter in XII (μm)</td>
<td>R: 409–613</td>
<td>400</td>
<td>350–490</td>
</tr>
<tr>
<td>Max. no. of chaetae</td>
<td>6</td>
<td>4</td>
<td>6 (4)</td>
</tr>
<tr>
<td>Lateral chaetae in XII</td>
<td>absent</td>
<td>absent</td>
<td>present</td>
</tr>
<tr>
<td>Oesophageal appendage</td>
<td>unbranched or with short terminal branches</td>
<td>1–2 short terminal branches</td>
<td>short proximal and terminal branches</td>
</tr>
<tr>
<td>Coelomo-mucocytes</td>
<td>I: 40–50 μm, R: 37–43 μm, with very few granules, not at cell periphery</td>
<td>no size data, a type granules absent</td>
<td>22–40 μm, b type with few granules at cell periphery or many in the whole cell</td>
</tr>
<tr>
<td>Dorsal vessel from Precitellar nephridia</td>
<td>I: XVI; R: (XV)–XVI–XVII</td>
<td>XIV–XVII</td>
<td>XIII</td>
</tr>
<tr>
<td>Pharyngeal glands</td>
<td>S: all united dorsally and all with ventral lobes</td>
<td>S: all separate dorsally</td>
<td>in IV united, in V–VI separate dorsally, all with ventral lobes</td>
</tr>
<tr>
<td>Sperm funnel, length : diameter ratio</td>
<td>cylindrical, 3:1, collar as wide as funnel body</td>
<td>cylindrical, 3:1, collar as wide as funnel body</td>
<td>pear-shaped, 1.4–1.6:1, collar narrower then funnel body</td>
</tr>
<tr>
<td>Bursal slits</td>
<td>longitudinal with transverse component</td>
<td>S: longitudinal, transverse component not seen</td>
<td>longitudinal with transverse component</td>
</tr>
<tr>
<td>Shape of diverticula of spermathecae, sperm in it</td>
<td>R: oval (square), S: no sperm in lumina of ampullae and diverticula</td>
<td>globular, rarely sperm in lumina of diverticula</td>
<td>rounded, sometimes sperm in diverticula and ampullae</td>
</tr>
<tr>
<td>Ectal glands of spermathecae</td>
<td>S: absent, R: absent except 2 specimens</td>
<td>present</td>
<td>present</td>
</tr>
<tr>
<td>Mature eggs at a time</td>
<td>R:2, S: 1</td>
<td>2</td>
<td>2–4</td>
</tr>
<tr>
<td>Occurrence</td>
<td>Italy I: Appennins SW of Modena, R: Toscanab, Latiun, Calabria, S: Galicia: la Coruña</td>
<td>Marocco (Rif, central Atlas)</td>
<td>Hungary (Vértes Mountains)</td>
</tr>
</tbody>
</table>

*Acta zool. hung. 59, 2013*
ventral lobes, their distal end lobated and slightly extend into VII (Fig. 8A). Chloragocytes from V, light brown (in vivo), diameter 20–25 μm. Dorsal vessel from XVI–XVIII (XIX–XX in Schmelz), blood colourless. Midgut pars tumida from XXIX–XXXVII, occupying 5–8 segments (not given in the original description). Five pairs of preclitellar nephridia (Fig. 7D) from 6/7 to 10/11 (but sometimes only four, in one case three pairs were observable), postseptate a little longer than anteseptal, efferent duct rising anteriorly. Coelomocytes (Figs 11 & 7F) numerous, mucocytes with blurred pale vesicles (type a/c) length 28–32 μm in vivo, 20–25 μm fixed) lentiocytes small, 5–6 μm long. Chylus cells between XII–XV, occupying 2.5–3 segments (Fig. 8E) (contrary to this in Schmelz: XIV−1/2XVII). Seminal vesicle large (occupying IX–XII or X–XII). Sperm funnel (Fig. 9A) large, 300–450 μm long in vivo, 250−360 μm when fixed, and 2–3 times longer than broad, collar slightly narrower than funnel body; vas deferens 12–15 μm wide, spermatozoa ca 400 μm long, heads 100−150 μm (in vivo) (no dimensions given by Schmelz). Male copulatory organs (Fig. 9A) large, flattened, 220–270 μm long, 75–88 μm wide and 70–75 μm high (fixed), the bursal slits (Figs 1J & 9B) with longitudinal and transverse components (H-shaped after Schmelz 2003). No subneural glands, but a glandular thickening of the epidermis occurs in XIII behind the ventral chaetal bundles (Figs 8D, F), having no connection with the ventral nerve cord. Spermatothecae (Figs 1H & 9C−D) nearly agree with the original description: one small (20–25 μm long) sessile ectal gland at the orifice of spermathecal ectal duct, ampullae have two elongate diverticula (about 55–75 μm long), all three chambers with distinct lumen. The ectal ducts widening proximally into conical projection into ampullar lumen. Separate openings into oesophagus. The only difference is the length of the ectal ducts: ‘the ducts ca. 1.5x body diameter, 400 μm’ according to Schmelz (2003) but in the present specimens without exception the length of the duct not longer than the body diameter (220–310 μm long and 18−20 μm wide, fixed). One to two mature eggs at a time.

67 specimens investigated in vivo, than fixed in 70% ethanol, 26 specimens were mounted in Euparal.

Differential diagnosis. These specimens, found in the Vértes Mountains differed from the description of F. alata given by Schmelz (2003) in the following characteristics: the epidermal gland cells well developed in three transverse rows (not indistinct); the distal end of ventral lobes at the third pair of pharyngeal glands lobated and slightly extend into VII; dorsal vessel from XVI–XVIII (in contrast to XIX–XX); chylus cells between XII–XV (in contrast to XIV−1/2XVII); a glandular epidermal thickening in XIII midventrally, and finally the length of the spermathecal ectal duct, which is not longer than the diameter of the body (in contrast to 1.5x).

The specimens of F. alata described by Chalupský (1986) (which identity after opinion of Schmelz (2003) is unknown) also differs from our specimens among other things, in occurence of lateral chaetae in XII and reddish blood.

Because F. tubulosa Dózsa-Farkas, 1972 is somewhat similar in respect to its spermadeca (especially when alive), and oesophageal appendage, which is also of б type, I made some stained slides of several paratypes of F. tubulosa (P. 6). Differences were well visible: the spermadecal diverticula are larger in F. tubulosa, the ectal gland very large and duct shorter and stouter, gradually
but remarkably widening proximad, canal also widening, as also pointed out by Schmelz (2003) (Fig. 9E). The male copulatory organ in *F. tubulosa* is also rather large, but of a quite different shape (Fig. 9F).

**DISCUSSION**

Based on the 42 species found in the Vértes Mountains we can say that the enchytraeid fauna of this area is quite diverse, and in its majority represented by species typical of the Hungarian, or wider Central European fauna. This mountain geologically shows a fairly uniform structure with dolomite rock-bed, but in some parts of the mountains: the southern foothills of the range, we can find submediterranean, and in the north-facing slopes alpine-like climatic conditions. Probably, this is reflected in the occurrence of the newly described subspecies (*F. gamotheca hungarica*). The main distribution area of this species is specifically in the Mediterranean region (Italy, Spain and Morocco). On the other hand, the presence of, e. g., *F. cf. alata* (if it is not a new species) may be connected to the colder climatic conditions, because *F. alata* has been found mainly in northern Europe so far.

*F. gamotheca hungarica* ssp. n. effectively showed the typical traits presented in the original species description (Issel 1905), its supplementary description made on the basis of more recent Italian material (Rota 1995, Rota & Healy 1999), and the same description supplemented by Schmelz (2003) on the basis of Spanish material. However, it simultaneously differed in several traits from the latter and from the form I described from Morocco (Dózsa-Farkas 1989). As Schmelz (2003) has already proposed that these differences ‘suggest at least a geographic differentiation of the species into a European and a North African subtaxon’, I propose to separate this species into three subspecies: *F. gamotheca gamotheca* Issel, 1905, *F. gamotheca maroccoensis* Dózsa-Farkas, 1989 and *F. gamotheca hungarica* ssp. n. I described the new subspecies accordingly. For a better interpretation I summarized the typical characteristics of the three subspecies in Table 3.

The specimens, found in the Vértes Mountains and described as *F. cf. alata*, differed from the description given by Nielsen and Christensen (1959) and Schmelz (2003) but at present I can’t decide that these differences are within what can be considered intraspecific variance or a new species come into question, but additional foreign material is necessary to assess the taxonomic status of the Vértes population.

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