

ORIBATID MITES (ACARI: ORIBATIDA) FROM VENEZUELA,
I. MICROZETID SPECIES

S. MAHUNKA

*Department of Zoology, Hungarian Natural History Museum and
Systematic Zoology Research Group of the Hungarian Academy of Sciences
and of the Eötvös Loránd University
H-1088 Budapest, Baross u. 13, Hungary, e-mail: mahunka@zoo.zoo.nhmus.hu*

A study on microzetid oribatids, newly collected from Venezuela or from other parts of South America. Description and/or redescription of ten species are given. Discussion of the genus *Cosmozetes* BALOGH et MAHUNKA, 1969 and *Protozetes* BALOGH, 1962. Key for the heretofore known species of *Protozetes* is given. With 26 figures.

Key words: Oribatida, Microzetidae, new species, redescrptions, taxonomy, morphology, key, Venezuela

INTRODUCTION

It has been known for a long time that the species diversity of tropical rainforests' mesofauna is quite rich. This species number has further grown by the last 15 years' greatest discovery, the tropical rainforest-dwelling, arboricolous "canopy fauna". Within this fauna, the research of indigenous mites, especially the oribatids that play an important part in decomposing matter, increased their number to a new level. From an ecological point of view, it had a great significance as well to recognize and thoroughly study their role and importance. Without doubt, these studies presented countless fundamental discoveries in the fields of faunistics, taxonomy, systematics, and biodiversity-related research.

Naturally, this newly gained knowledge regarding the species composition of soil-, humus-, decomposing-matter-, and moss-dwelling communities in tropical forests, has been preceded by research conducted in the 30s and 40s of the last century. Initial studies dealing with botanical communities and vegetation types did not take into consideration, such ecological connections as water balance, humus formation, and biomass. However, starting with the vegetation of the temperate zone and eventually expanding research to the tropics, these mainly moss and lichen habitats' were thoroughly explored. Today, the accumulated literature of this topic is enormous (e.g. BALSLEV 1993, GRADSTEIN & PÓCS 1989, PÓCS 1978, 1980, 1999, SPENCE & PÓCS 1989, WALTER & BRECKLE 1991) and it has become a difficult task to read it all.

Although zoologists have been collecting and studying moss, lichen, and other living-tree-dwelling plants for several decades now, conscious focus on tropical forests' arboricolous and epiphyte habitats, in other words the canopy fauna, has only started relatively recently. Since then, within a decade, thousands of arthropods have been classified from these habitats. Similarly rich, in the past even lesser known species is the mesofauna's mite fauna, which lives in the soil generated by and together with the epiphyte moss, lichens, orchids, and ferns. The relationship between vegetation, including mosses and the mesofauna is little known despite the large volume of literature that accumulated on this topic. A number of people analyzed the methodical, taxonomic, and ecological results of these works (e.g. NADKARNI 1984, NORTON & PALACIOS-VARGAS 1987, PAOLETTI *et al.* 1990, BEHAN-PELLETIER *et al.* 1993, WALTER 1995, WALTER & BEHAN-PELLETIER 1999, MAHUNKA 2001).

According to the above-mentioned literature, not long ago large-scale research took place in similar biotopes in Venezuela. The aim of Hungarian researchers Prof. Dr. T. PÓCS well-known bryologist and Dr. Cs. CSUZDI famous earthworm specialist is partially similar. We attempt to analyze the relationship within and between vertical (distribution of tree- and soil-dwelling mosses and mites and the relationship between them) and horizontal (soil- and decomposing-matter-dwelling animals and the epiphytes) biotopes focusing on the synthesis between mosses and animals in the forests of Central and South America, and Africa.

Besides studying the epiphyte or soil-dwelling moss and the local meso- and macrofauna we are intending to investigate the moss flora and the local fauna's species diversity and other possible relationships among these organisms. These results will be made public in the future.

In this paper I will start the analysis of the taxonomical results, regarding certain species belonging to the family Microzetidae (GRANDJEAN 1936*a, b*). In line with the above-mentioned studies and based on my own observations, taxa belonging to this family like both arboricolous and soil habitats, given the locality, contains moss, lichen, or other plants, such as Bromeliaceae or fern roots, or covered by fallen leaves or humus. This observation of mine has been proven again this time. Several species of many genera (MAHUNKA 2006) were discovered exclusively in these habitats and I am fairly sure to find parallels between mosses and the local fauna.

This time, basically the collected materials of two field trips were analyzed. The first one was conducted in 1997 by T. PÓCS and his wife S. PÓCS, which was also the basis of the second field trip. The material collected during the 1997 trip served the purpose of the usual faunistic and taxonomic research. Building on this

research, the second trip was planned with the above-mentioned goals. The second field trip was a botanical- (mainly bryological-) zoological trip, which given us the necessary material to conduct combined analyses. Unfortunately, the number of the collected specimens was low, however, there was sufficient information on some of the taxa serving as a basis of a meaningful analysis, including the species belonging to the genera of the family Microzetidae of the oribatids.

In all, eight species of five genera were found. In order to identify them and find out their relationship, we needed to analyze information on already identified species. Owing to various reasons, some of that data were not available for us. Since it would have been too much work invested into this paper to reanalyze the entire family and then to describe each species, only 9 species of five genera were analyzed:

Berlesezetes auxiliaris GRANDJEAN, 1936

Cosmozetes damjanovichi sp. n.

Cosmozetes instans sp. n.

Cosmozetes simplisetosus sp. n.

Protozetes capitulum BALOGH, 1962

Protozetes clavatus MAHUNKA et PALACIOS-VARGAS, 1996

Rhopalozetes bisculpturatus sp. n.

Rhopalozetes filiferus sp. n.

Schalleria csuzdii sp. n.

Most of the holotypes and paratypes of the examined specimens and the specimens of all known evidential species are housed at the Pedozoological collection of the Arachnoidea section of the Hungarian Natural History Museum. Other paratypes as well as some of the known evidential species are located at the Muséum d'Historie Naturelle de Genève.

The entire system of the Microzetidae GRANDJEAN, 1936 family has not been made more clear-cut or well established in recent years, although without doubt SUBIAS' (2004) numerous consolidations and regroupings of the system – despite the fact that he did not do any actual research – will probably be acceptable on the level of genetics. The discovery of currently unknown species will greatly help the evaluation of existing genetic taxa.

The selection and evaluation of features used in differential diagnosis is not yet clear, but based on examinations some characteristics can already be selected, which are essential to describe species and to construct genera. These are,

- the shape of the rostrum and the rostral apex;
- the shape of the tutorium and the tutorial apex, and the rostral hair's position in relationship to the apex;

- the shape of the lamellas and their distance from one another, and the number and shape of the lamellar apex;
- the origin of the lamellar hair;
- the origin of the interlamellar hair;
- the direction and the shape of the sensillus;
- the existence, absence, and shape of the dorsosejugal suture;
- the shape of the pteromorphae;
- the location and shape of the nostrogastral hairs;
- the shape of the infracapitulum and the location of the *h* hairs;
- the number of wide and robust transversal bands (*bo.2* and *bo.4*) in the epimeral region;
- the sculpture of the ventral disc;
- the shape and the position of the genital disc;
- the existence or absence of the aggenital hair;
- the position of the adanal setae.

In this paper the morphological terminology of GRANDJEAN (1936*a, b*) is followed with some smaller modifications (e.g. LIONS 1978). I must note that this family, regarding certain morphological characteristics has the greatest variability among the oribatid taxa. Among the species described in this paper, for example, the type series of the *Cosmozetes instans* sp. n. based on the sensillus, the lamella, and the ventral sculpture, could be divided into three species given that only a limited number is available. Great variability is also a characteristic of many species of the *Protozetes* BALOGH, 1962 or other genera (e.g. *P. digitifer* MAHUNKA, 1985 or SCHATZ & PALACIOS-VARGAS 1999).

DISCUSSION ON THE STUDIED TAXA

Berlesezetes (MAHUNKA, 1980)

The establishment of the genus (MAHUNKA 1980) is based on a species type from Venezuela described by GRANDJEAN (1936*b*). GRANDJEAN collected this species in Venezuela and Panama. Despite the fact that his description is still accurate it is difficult to identify specimens discovered by later authors because they did not fully investigate a number of characteristics. At first, these later found specimens were given different species name but later were included in the above-mentioned genus. Compendiums published in recent years either did not try to separate them and describe them as undetermined species (BALOGH & BALOGH

2002) or their synonyms are dubious because the author did not actually study the types in question (SUBIAS 2004).

Diagnosis of the genus: Rostrum nasiform in dorsal and beak-shaped in lateral view. Lamellae with short inner and much longer outer cusps, set far from each other. Rostral setae setiform, arising on tubercles. Lamellar setae thick, arising on the anterior margin of lamellae, with long cilia. Interlamellar setae longer than lamellae, slightly dilated. A pair of peculiar interlamellar apophyses present. A distinct dorsosejugal suture present, pteromorphae small. Notogastral surface ornamented by longitudinal striation. Epimeral region and the ventral plate also with longitudinal striation. Anogenital setal formula: 6 – 1 – 2 – 3, the anterior genital setae much longer than the others and distinctly pilose.

Type species: *Microzetes auxiliaris* GRANDJEAN, 1936.

Berlesezetes auxiliaris (GRANDJEAN, 1936)

Examined material: Venezuela, Estado Mérida. Secondary mesic forest N of Mérida town, on the ridge above the district of Santa Maria Norte, at 1,800 m. alt. Litter. March 27, 1997. Coll. S. & T. PÓCS (No. 9741).

The series of specimens found in Venezuela this time are nearly identical with the ones that GRANDJEAN described and drew. The only difference is that the striped fore-and-aft sculpture on the ventral side is quite faint on the animals collected this time compared to the drawings. Also, in the epimeral region there are a lot less lines on the newly acquired animals. However, these differences could be attributed to imperfect drawings.

Many authors believe in this species circumtropical distribution. I was fortunate that this time I had the chance to analyze not only Venezuelan specimens but paratypes (there are two specimens in the HNHM's collection) of the *Berlesezetes africanus* (BALOGH, 1958) species and another, possibly new species from Africa. These species are different from the ones from Venezuela, therefore data that points to their circumtropical trait is questionable.

Cosmozetes BALOGH et MAHUNKA, 1969

The genus was described from South America, its distribution is restricted to the Neotropical Region. SUBIAS (2004) supposed that the genus *Magoebazetes* ENGELBRECHT, 1973 is belonging as a subgenus to this genus, but it was not verified. In spite of this, his supposition is not impossible. The following seven species

have already belonged and the three last species describing now, also belong to the nominate subgenus:

Cosmozetes cubanus BALOGH et MAHUNKA, 1974

Cosmozetes ecuadoriensis P. BALOGH, 1989

Cosmozetes jaccoudi MAHUNKA, 1998

Cosmozetes negroi BALOGH et MAHUNKA, 1977

Cosmozetes rohri BALOGH et MAHUNKA, 1969

Cosmozetes striatissimus BALOGH et MAHUNKA, 1969

Cosmozetes vermiculatus (BALOGH et MAHUNKA, 1980)

Cosmozetes damjanovichi sp. n.

Cosmozetes instans sp. n.

Cosmozetes simplisetosus sp. n.

Diagnosis of the genus: Rostrum conical in dorsal and beak-like in lateral view. Lamellae with two cusps, between them a hollow present. Outer cusp much longer than the inner one, the latter bearing lamellar setae. Interlamellar setae short and simple arising on the lamellar surface. Sensillus clavate, directed anterolaterally. Tutorium simple, with spiniform distal end. In the epimeral region two well sclerotised, wide transversal bands (*ap.sej* and *ap. 4*) present.

Type species: *Cosmozetes striatissimus* BALOGH et MAHUNKA, 1969

Remarks: The main and typical characters of the genus: long and spiniform outer, short and truncate inner lamellar cusps, as well as the capitate sensilli directed anterolaterally direction and the two wide, transversal bands in the epimeral region.

***Cosmozetes damjanovichi* sp. n.**

(Figs 1–4)

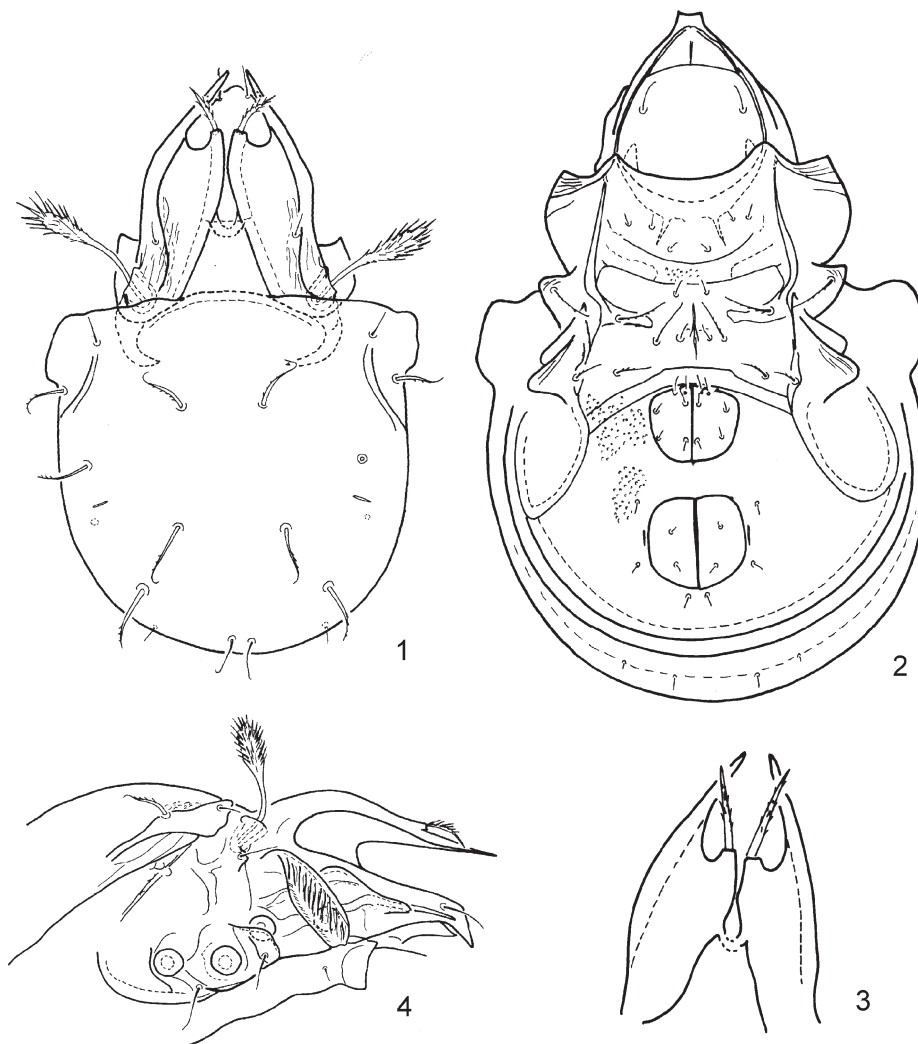
Diagnosis: Rostrum narrowed anteriorly, rostral apex blunt. Lamellae large, with a long, spiniform outer and a short, blunt inner apex. Interlamellar setae arising on the lamellar surface. Sensilli large, with clavate, well spiculate head. Tutorium broad basally, its apex short. Notogastral surface smooth, 9 pairs of notogastral setae present. Epimeral region with two broad transversal bands. Epimeral setae conspicuously long, genital setae short. Aggenital setae absent.

Material examined: Holotype: Venezuela, Parque Nacional Henri Pittier, seasonal rain forest: 20. 04. 2005 – in and around a forest stream litter and soil. Leg. Cs. CSUZDI & D. MURÁNYI (B-36), 1 paratype from the same sample; 16 paratypes: Andes, Parque Nacional Sierra Nevada La Mucuy, mountain rain forest E of Tabay, 04. 04. 2005 – in and around a forest stream epifiton mosses. Leg. Cs. CSUZDI & D. MURÁNYI (B-16), 1 paratype: Estado Mérida, Parc Nacional Sierra Nevada. Andean montane rainforest dominated by *Decussocarpus* (Podocarpaceae) near the cable car station La Montaña. At 2460 m alt. Litter and mosses. 15. Febr. 1997. Coll. S. & T. PÓCS (No. 9712). Holotype

(1683-HO-05) and 16 paratypes (1683-PO-05): deposited in the Hungarian Natural History Museum, Budapest, with identification number of the specimens in the Collection of Arachnida, 2 paratypes: deposited in the Muséum d'histoire naturelle, Geneva.

Description – Measurements: Length of body: 244–287 μm , width of body: 154–186 μm .

Prodorsum: Rostrum elongate, slightly tubuliform, like a snout of a pig. Rostral apex bent downwards, beak-shaped in lateral view (Fig. 4). Lamellae large, typical for the genus, their anterior part nearly touching medially, not connected by a true translamella. Their surface rugose. Outer apex



Figs 1–4. *Cosmozetes damjanovichi* sp. n.: 1 = body in dorsal view, 2 = body in ventral view, 3 = lamellae of a paratype, 4 = prodorsum in lateral view

very long, spiniform, converging medially. Inner apex short, truncate, they are separated by a deep U-shaped incisure from the outer one, bearing the thick and well pilose lamellar setae (Fig. 1). The latter directed outwards, to the outer apices. Spiniform, rarely bent, well spiculate or pilose. Interlamellar setae short and simple, arising on the lamellar surface, laterally. No tubercle or other protuberances in the interbothridial region. Sensillus long, directed outwards, with a large and well-spiculate head. Bothridium simple, cup shaped.

Lateral part of podosoma (Fig. 4): Tutorium wide, strongly dilated basally. Its cusp triangular, short and not covering the insertion of the comparatively short rostral seta, which are located in front of the tutoria. Pedotecta 1 large, covering the acetabulum of leg I. Its surface with some parallel running striae. Discidium broad, custodium short. Above the acetabular region a distinct crest present.

Notogaster: Dorsosejugal suture nearly straight, slightly convex medially. Pteromorphae with some rugae, their distal margin slightly rounded. Along the inner margin some small tubercles present. Notogastral surface without depression or hollow. Nine pairs of notogastral setae of different lengths, setae c_2 , h_1 and p thin, c_2 , and p much shorter than the others (Fig. 1). The remaining setae are also thicker than the previous ones and well pilose. Setae lm located far anteriorly, in one line with setae la .

Ventral regions (Fig. 2): Infracapitulum large, its anterior margin convex. Setae h , arising laterally, far from each other. The shape of apodemes and epimeral borders typical for this genus, two complete transversal bands ($bo. sej.$, $bo. 4$), and a short part of the third one ($bo. 2$) present. No longitudinal connection between them. Epimeral surface smooth, without polygonal pattern. Epimeral setal formula: 3 – 1 – 3 – 3, setae on epimeres 1 and 2 short. Setae lc originating far from pedotecta 1. Setae on epimeres 3 and 4 conspicuously long, with short cilia, their form is shown in Fig. 2. Ventral plate distinctly but finely granulate. All genital setae short and smooth. Anogenital setal formula: 6 – 0 – 2 – 3, aggenital setae absent, setae ad_1 in postanal position, they are located very near to each other. Lyrifissure iad short, they are present in adanal position.

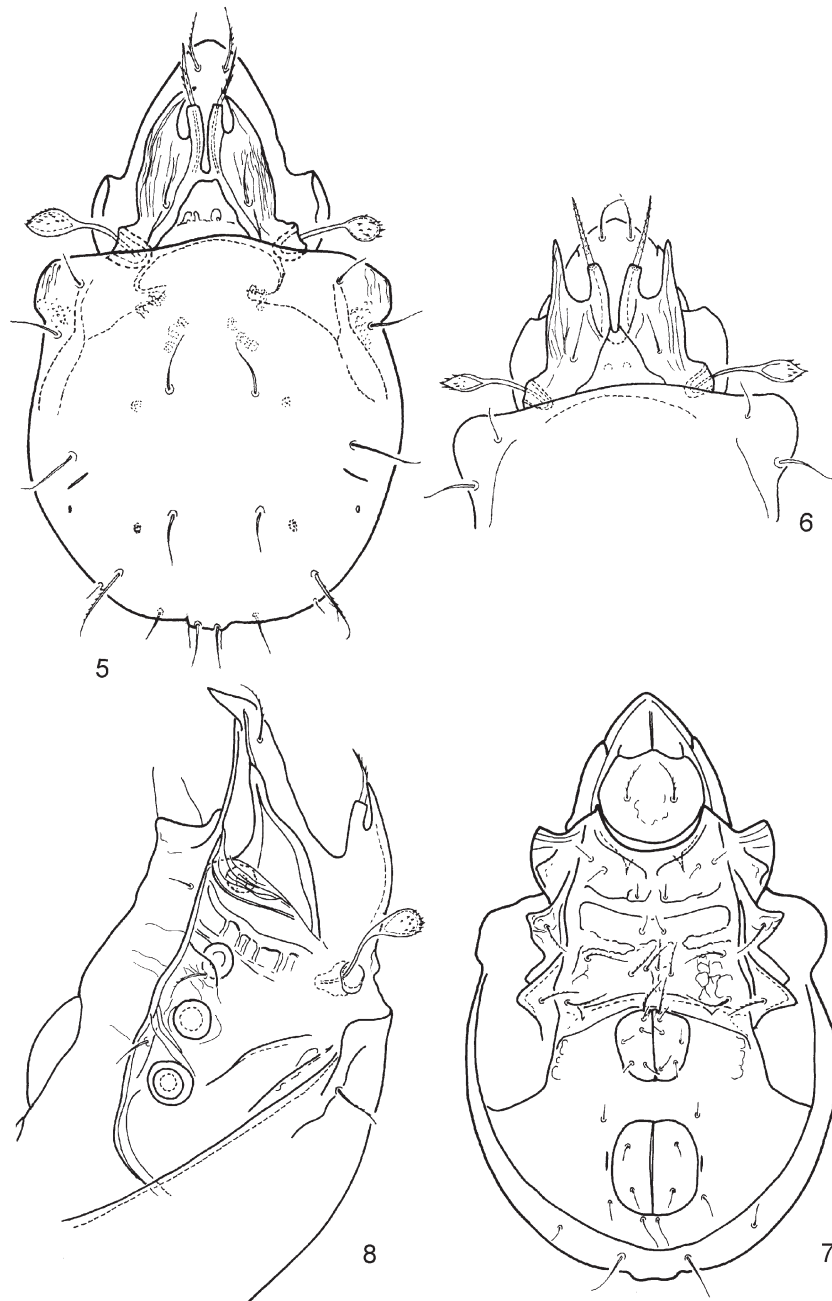
Legs: Claws of all legs conspicuously long.

Remarks: Very variable species, the length and form of the lamellar apices and the thickening of the sensillar head varying. Its relationships: see after the description of the last *Cosmozetes* species.

Etymology: I dedicate the new species to my friend, Dr. SÁNDOR DAMJANOVICH, the renowned biophysicist, the head of the Biological Section of the Hungarian Academy of Sciences.

***Cosmozetes instans* sp. n.**
(Figs 5–8)

Diagnosis: Lamellae comparatively small, originating medially and not covering the rostral and marginal region of the prodorsum. Lamellar cusps long, outer ones slightly curving inwards. Sensillus capitate, its head round, aciculate. Notogastral surface with porose (?) fields. Nine pairs of notogastral setae. Tutorium wide basally, with a triangular apex. Two strong transversal bands in epimeral region present. Aggenital setae absent.



Figs 5–8. *Cosmozetes instans* sp. n.: 5 = body in dorsal view, 6 = prodorsum of a paratype, 7 = body in ventral view, 8 = podosoma in lateral view

Material examined: Material examined: Holotype: Venezuela, Andes, Parque Nacional Sierra Nevada, páramo and *Polylepis* stand below Cross Pass, SW of Loma Redonda cable car station and ULA research house, 06. 04. 2005 – in the páramo vegetation and in the forest litter, soil and moss. Leg. Cs. CSUZDI & D. MURÁNYI (B-22), 7 paratypes from the same sample, 12 paratypes: Estado Mérida. Parque Nacional Sierra Nevada. 3–5 m tall *Polylepis seriacea* (Rosaceae) páramo forest below Alto de la Cruz pass, at 3900–4100 m. alt. Litter. 22. Febr. 1997 (Coll. S. & T. Pócs) (9718). Holotype (1685-HO-05) and 15 paratypes (1685-PO-05): HNHM and 4 paratypes: MHNG.

Measurements: Length of body: 291–300 μm , width of body: 193–197 μm .

Prodorsum: Rostral part conical, comparatively rounded. Rostral setae arising on the prodorsal surface, far from one another. Lamellae comparatively small, not touching medially, a short translamella present (Fig. 6). Outer cusp mostly curving inwards, only somewhat longer than inner one. Lamellar setae thick, spiniform, well ciliate, like the rostral setae. Lamellar surface well rugose, interlamellar setae arising on them, conspicuously long. Two-three irregular tubercles in the interlamellar region. Head of the sensillus round, its distal end aciculate.

Notogaster: Dorsosejugal suture slightly convex. Pteromorphae small, rounded laterally. Notogastral surface pustulate along the pteromorphae, a few irregular porose areas present in the median surface. Nine pairs of notogastral setae present, all thin, varying in length, some of them with flagellate distal end. Setae h_1 arising on low tubercles, very near to each other (Fig. 5).

Lateral part of podosoma: Rostral apex beak-shaped in lateral view. Tutorium very wide basally, with a short triangular cusp, in front of it a long, thin crest present. Rostral setae arising far from the cusp of tutorium. Pedotecta 1 comparatively small, with transversal lines. Median margin of the acetabular region well sclerotised (Fig. 8). Circumpedal carina also strong, reaching the margin of the ventral plate.

Ventral regions: Setae h of infracapitulum long, originating far from the anterior margin, well pilose. The shape of apodemes and epimeral borders typical for this genus, two complete transversal bands (*bo. sej.*, *bo. 4*), and a short part from the third one (*bo. 2*) present (Fig. 7). No longitudinal connection between them. Epimeral surface smooth, a polygonal pattern visible only epimere 4. Epimeral setal formula: 3 – 1 – 3 – 3, setae on epimeres 1 and 2 comparatively short. Setae *1c* originating far from pedotecta 1. Setae on epimeres 3 and 4 long, ciliate. Anterior pair of genital setae longer than the others and well ciliate. Anogenital setal formula: 6 – 0 – 2 – 3, aggenital setae absent, seate ad_1 in postanal, ad_3 in preanal position, seate ad_1 located very near to each other. Lyrifissure *iad* short, located in adanal position.

Remarks: One of the most variable *Cosmozetes* species. Its relationship: see the key of the *Cosmozetes* species.

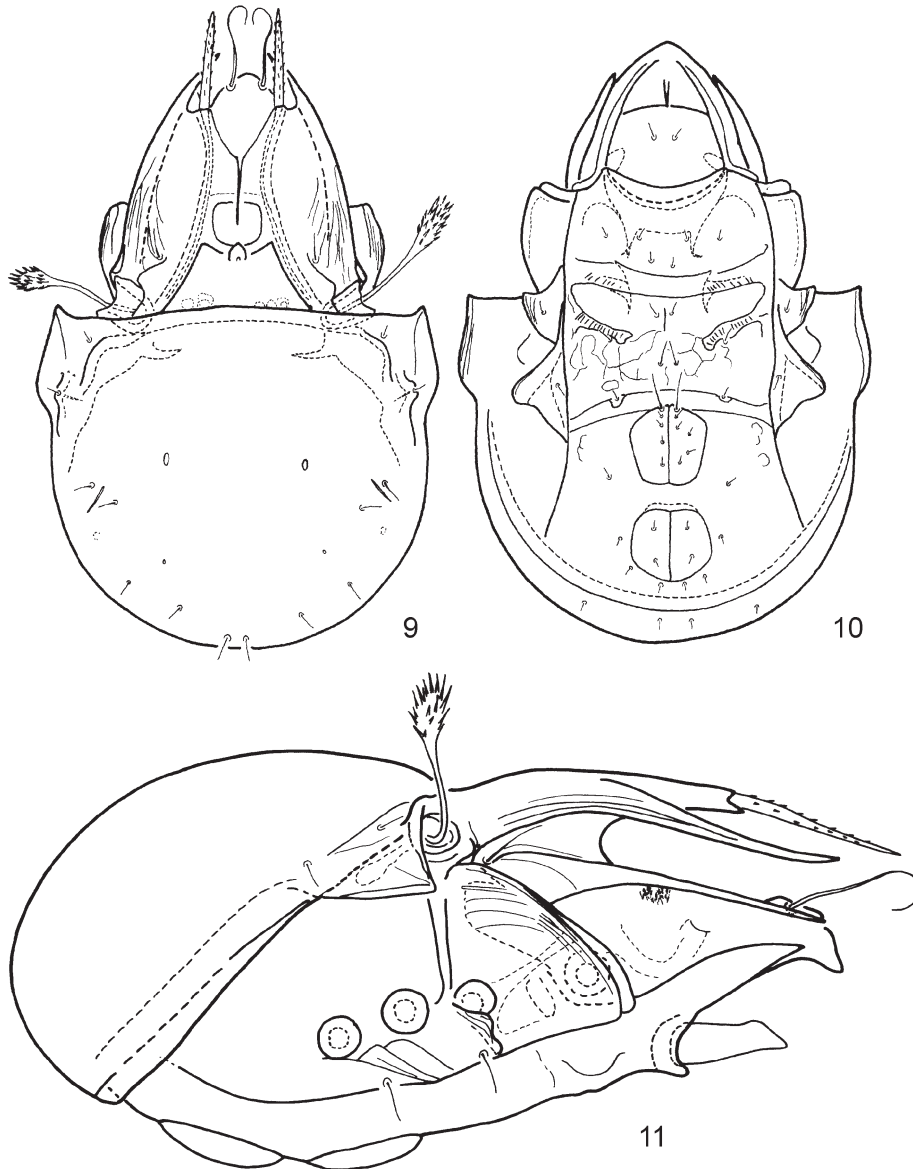
Etymology: Named after the characteristic opposite outer lamellar cusps.

***Cosmozetes simplisetosus* sp. n.**

(Figs 9–11)

Diagnosis: Rostrum simple, conical in dorsal and beak-shaped in lateral view. Lamellae very large, touching medially. Translamella present. Outer lamellar apices spiniform and long, inner ones very short, truncate. Interlamellar setae

arising on the lamellar surface, medially. Sensillus clavate, spiculate. Nine pairs of short and simple notogastral setae. Tutorium very long, with a spiniform distal end.



Figs 9–11. *Cosmozetes simplisetosus* sp. n.: 9 = body in dorsal view, 10 = body in ventral view, 11 = podosoma in lateral view

Material examined: Holotype: Venezuela, Sierra de La Culata, submontane rain forest dominated by *Decusocarpus* (experimental forest of ULA), La Carbonera, 11. 04. 2005. Leg. Cs. CSUZDI & D. MURÁNYI (No. 26). 1 paratype from the same sample. Holotype (1684-HO-05) and 1 paratype (1684-PO-05): HHNM.

Measurements: Length of body: 231–237 μm , width of body: 153–165 μm .

Prodorsum: Rostrum widely conical, projected in dorsal view, beak-shaped in lateral view (Fig. 11). Lamellae very large, typical for the genus, touching antero-medially in a parallel line, and connected by a well-developed translamella in the basal part (Fig. 9). Interlamellar region wide basally, on the translamella a large apophysis present medially. Lamellae with a very long spiniform outer, and a very short, truncate median apex, the latter bearing straight, spiniform lamellar setae. No deep hollow between the outer and the median apices. Bothridia comparatively small, well sclerotized. Sensillus directed outwards and forwards, its peduncle long, the head covered by long spines. Rostral setae setiform, simple, with a flagellate distal part, arising on large tubercles. Interlamellar setae very short, setiform, arising on the middle of lamellar surface.

Lateral part of podosoma (Fig. 11): Tutorium very long, simple, spiniform, reaching over the insertion of the rostral seta. Rostral seta arising on a wide tubercle. Pedotecta 1 with weak parallel lines on the distal margin. Pedotecta 2–3 and discidia well developed. No granulate or pustulate field in this region. Circumpedial carina reaching to the margin of the ventral plate.

Notogaster: Dorsosejugal suture nearly straight. Pteromorphae small, triangular. All notogastral setae very short, thin and simple, no essential difference among them. No setae in the median part, their position as show on Fig. 9. Setae *la* arising on well-discernible tubercles.

Ventral regions (Fig. 10): The shape of apodemes and epimeral borders characteristic, typical for the genus. Two complete transversal bands (*bo. sej.* and *bo. 4*) present. No longitudinal connection between them. Surface of epimer 4 ornamented by a weak polygonal pattern, all others nearly smooth. Epimeral setal formula: 3 – 1 – 3 – 3. All setae simple, short, setiform. Setae *lc* arising far from pedotecta 1. Surface of epimeres 1–3 smooth, a well-discernible polygonal pattern visible on epimeres 4. Among the genital setae, the anterior ones much longer and thicker than the others. Anogenital setal formula: 6 – 1 – 2 – 3. Setae *ad*₃ in paraanal position. Lyrifissure *iad* in adanal position.

Etymology: Named after the uniformly short and simple notogastral setae.

Protozetes BALOGH, 1962

The genus *Protozetes*, together with its type species (*Protozetes capitulum* BALOGH, 1962) was described by BALOGH from Peru. Although he (1962), and his co-worker (BALOGH & BALOGH 1988, 2002) discussed the species several times and placed the genus into various identification keys, in every instance they simply considered the inaccurate description and figures and had not studied the specimen anew.

At this time, the discovery of closely allied new species made it inevitable to study the type species of the genus, and to revise the type series of the so far described other species.

So far the genus comprises the following species (SUBIAS 2004):

Protozetes digitifer alticola P. BALOGH, 1989*

Protozetes capitulum BALOGH, 1962

Protozetes clavatus MAHUNKA et PALACIOS-VARGAS, 1996

Protozetes digitifer MAHUNKA, 1985

Protozetes longicornis P. BALOGH, 1989

It is without doubt that the species are closely related, excepting *P. longicornis*. All are distributed in the Neotropical Region.

A short diagnosis of the genus: Rostrum conical in dorsal, beak-like in lateral view. Rostral setae arising on the dorsal surface. Lamellae large, but not touching medially, a weak translamella present. Lamellar setae arising on the inner margin of lamellae, slightly ventrally. Interlamellar setae located on the dorsal surface of lamellae. Sensillus fusiform, ciliate or spiculate, directed anteriorly. Some notogastral setae blunt at tip. Epimeral region with one wide, transversal border (*bo. 4*). Ventral plate with some longitudinal lines and one pair of roundish spot.

Type species: *Protozetes capitulum* BALOGH, 1962

Protozetes capitulum BALOGH, 1962

(Figs 12–13)

Diagnosis: Rostrum wide, conical in dorsal view. Lamellae comparatively narrow, covering only the lateral prodorsal margin. A pair of weak, short, horizontal apophysis and an Y-shaped, narrow, unpaired median apophysis also present. Sensillus clavate, distal margin with short bristles. Epimeral borders – excepting *bo. 4*. – thin and divided into some short parts. Along genital plates some longitudinal lines present.

Complementary redescription (holotype): Lamellae mostly with one outer apex, sometimes an other, much shorter apex also exist near to it. Transversal apophyses weak, short, ending far from each other. Longitudinal apophysis distinctly Y-shaped, its lateral part long, not narrower than longitudinal ones (Fig. 12). Peduncle of sensillus short, its head elongated, fusiform with barbs on the anterior margin. Notogastral surface with a peculiar design, it consisting of thin, hardly observable laths. Notogastral setae short, blunt at tip, some of them nail-shaped, with dilated apex. Anterior transversal and longitudinal borders of the epimeral region indented, they consists from touching parts (Fig. 13). Wide, posterior border with a pair of small hollows near to setae *4b*. Behind them 3 longitudi-

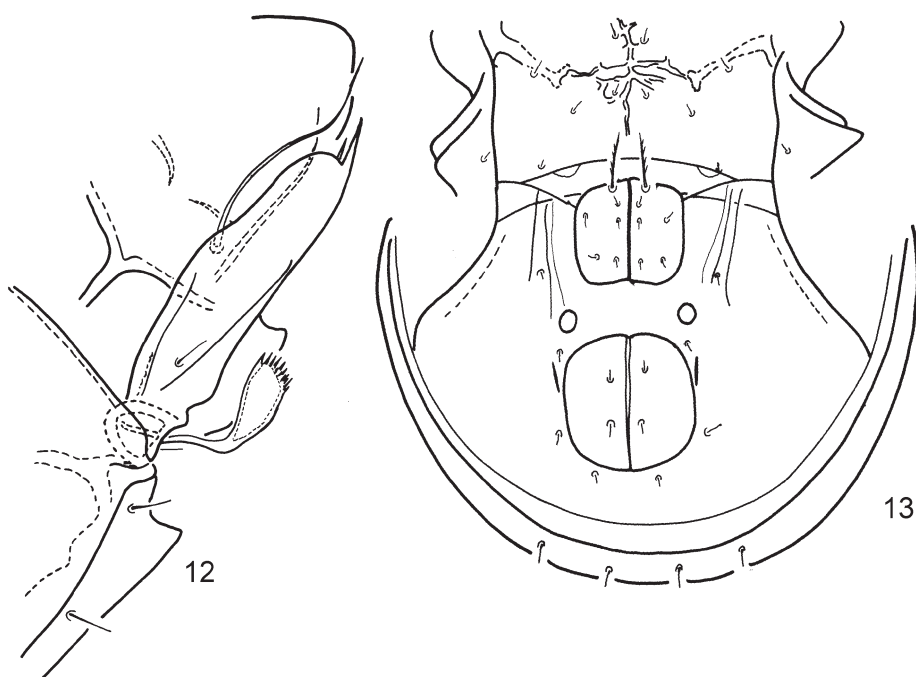
* P. BALOGH (1989) described it as a subspecies. SUBIAS (2004) approved its status.

nal lines running from a secondary transversal line to the comparatively large spots. Anogenital setae – excepting the anterior genital ones – minute.

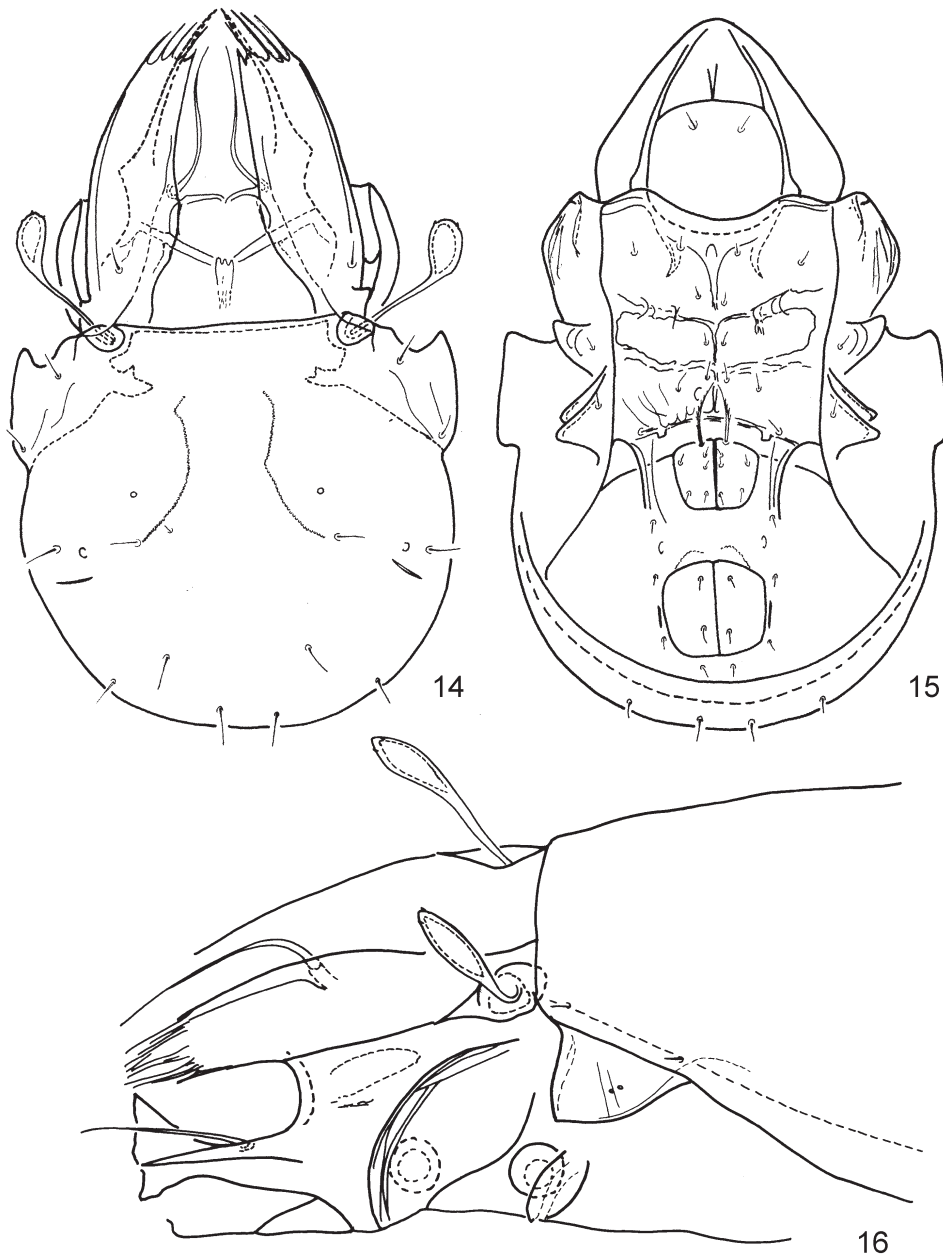
Protozetes clavatus MAHUNKA et PALACIOS-VARGAS, 1996
(Figs 14–16)

Diagnosis: Rostrum conical dorsally, resembling a pig's-snout laterally. Lamellae large, covering the lateral margin, originating far from each other, without true cusps, their distal part divided, bearing some strong spines. No true translamella present, a pair of well-sclerotised horizontal apophysis present. Lamellar setae arising at the median part of the inner lamellar margin. Interlamellar setae short, inserted on the lamellar surface. Sensillus clavate, with 2–3 minute acicules. Interlamellar region with long, tricuspidate longitudinal apophysis.

Material examined: Complementary redescription based on type series deposited in HHNM.



Figs 12–13. *Protozetes capitulum* BALOGH, 1962: 12 = lateral part of prodorsum, 13 = anogenital region



Figs 14–16. *Protozetes clavatus* MAHUNKA et PALACIOS-VARGAS, 1996: 14 = body in dorsal view, 15 = body in ventral view, 16 = podosoma in lateral view

Prodorsum: Rostrum conical in dorsal, and broad, snout-like in lateral view. Lamellae very large, originating laterally far from each other. Their distal part without apices, bearing some thin, digitiform appendages. Between the lamellae a pair of curved apophyses and a weak translamella present. In the interbothridial region an odd apophyses also present basally (Fig. 14), its distal end mostly with three small teeth*. Lamellar setae arising on small tubercles at the inner margin of the lamellae, they are long and curved. Interlamellar setae short, simple, arising on the lamellar surface laterally. Sensillus capitate, directed outwards and forwards, two-three small spicules on its distal margin.

Notogaster: Dorsosejugal suture straight, without hollow. Pteromorphae small, triangular, with sharp lateral corner. Dorsal surface of notogaster with a pair of "S"-shaped lines, consisting of small pustules, like a collar of pearls. Nine pairs of short and nail-shaped notogastral setae, all nearly equal in length. Setae *lm* originating in the posterior part of notogaster.

Lateral part of podosoma: Tutorium long, spiniform, reaching to the rostral apex. Insertion of rostral setae covered by it (Fig. 16). Pedotecta 1 with strong, parallel lines running on the anterior margin. Pedotecta 2–3 and discidium well developed, they are ornamented with a similar pattern as pedotecta 1.

Ventral regions: The shape of apodemes and epimeral borders typical for this genus, only one complete transversal band (*bo. 4*) and two shorter and divided apodemes (*bo. 2* and *bo. sej.*) present (Fig. 15). Between them exists a weak and also divided longitudinal connection. Epimeral surface 4 with an irregular polygonal pattern, rest of surface smooth. Epimeral setae short and simple, setae *1c* located far from the pedotecta 1. Epimeral setal formula: 3 – 1 – 3 – 3. Along genital plates a few lines on the ventral plate, they reaching to the aggenital setae. Anterior pair of the genital setae well ciliate and much longer than the remaining ones. A pairs of roundish spots, behind the aggenital setae visible. Anogenital setal formula: 6 – 1 – 2 – 3. Lyrifissure *iad* long, located in adanal position.

Legs: Typical for the family.

Remarks: The species is distinguished by the following key.

IDENTIFICATION KEY FOR THE PROTOZETES BALOGH, 1962 SPECIES**

- 1 (2) Sensillus very long, with narrow, fusiform head, much longer than pedotectum 1 in dorsal view, reaching over its anterior margin. Median prodorsal apophysis absent *longicornis* P. BALOGH, 1989
- 2 (1) Sensillus short, with clavate head, shorter than pedotectum 1 in dorsal view. Median prodorsal apophysis present.
- 3 (6) Median prodorsal apophyses short, ending far from each other.

* Originally it was erroneously figured.

** The type of *Protozetes digitifer alticola* P. BALOGH, 1989 is presumably lost. Its true position for the time being is undefinable.

- 4 (5) Longitudinal interlamellar apophyses narrow, lath-like. Lamellar apices only with 1 or 2 digitiform appendages. *capitulum* J. BALOGH, 1962
- 5 (4) Longitudinal interlamellar apophyses wide, medially broad. Lamellar apices with 3 or more digitiform appendages. *digitifer* MAHUNKA, 1985
- 6 (3) Median prodorsal apophyses long, crossing over to each other. Median longitudinal apophyses convex, mostly with three apices
clavatus MAHUNKA et PALACIOS-VARGAS, 1996

Rhopalozetes BALOGH, 1962

The original interpretation of the genus was altered by SUBIAS (2004) in his catalogue. Only a small portion of the relegated species comes from the Neotropics, consequently, the genus may be considered as circumtropical, although its representatives have not yet been ascertained from the Australian faunal region. The elaboration of this comparatively species-rich genus needs a larger revisionary work, which surpasses the limits of the present contribution. The herewith described two new species are easily distinguished from the other congeners anyway.

***Rhopalozetes bisculpturatus* sp. n.**

(Figs 17–19)

Diagnosis: Rostrum conical. Lamellae typical for the genus, large excepting the small interlamellar region covering the whole prodorsum. A weak translamella present. Rostral setae minute, arising on the rostrum, lamellar setae are set on the distal end of lamellae, while interlamellar setae on the lamellar surface. Sensillus capitate, its head with long bristles. Notogaster with short, vermiform secretion granules anteriorly, same pustuliform ones posteriorly. Two transversal band on the epimeral region, a few longitudinal lines on the ventral plate.

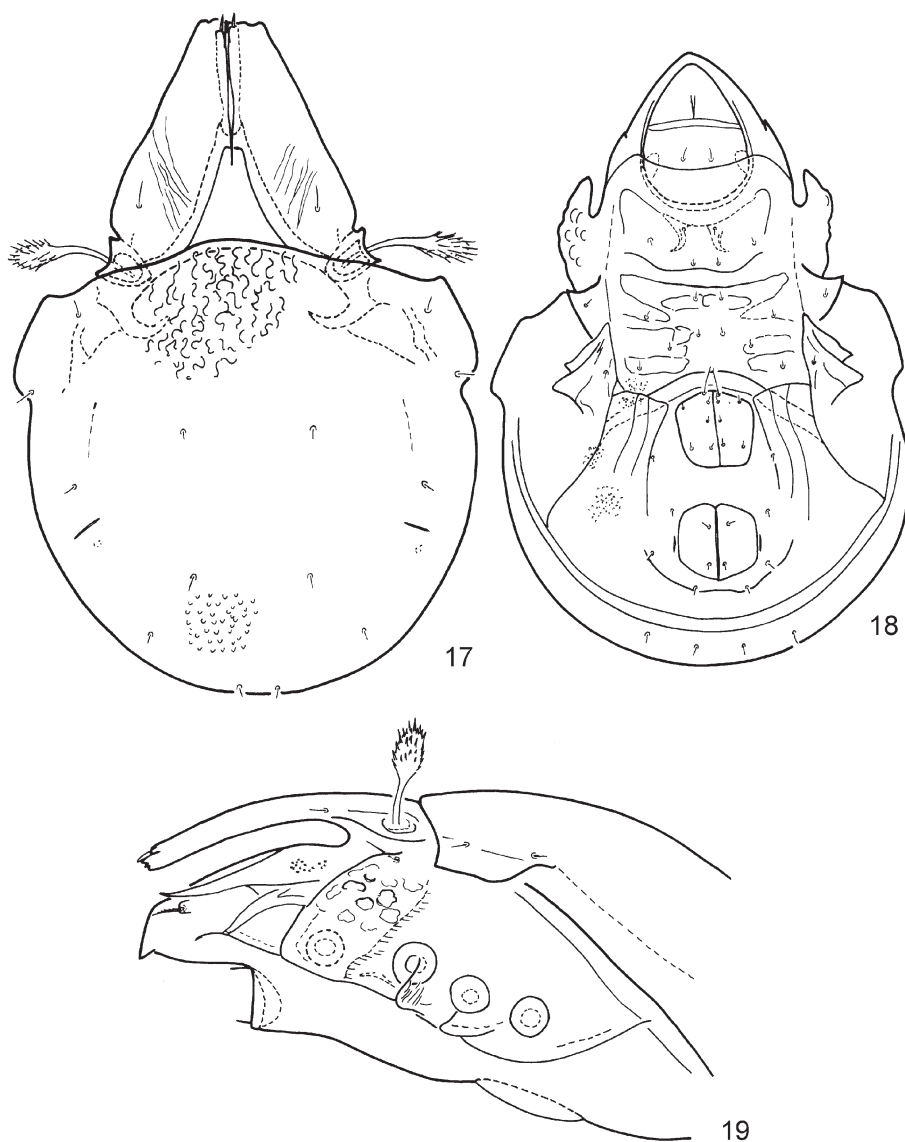
Material examined: Holotype: Venezuela, Estado Mérida, Parc Nacional Sierra Nevada. Andean montane rainforest dominated by *Decussocarpus* (Podocarpaceae) near the cable car station La Montaña. At 2460 m alt. Litter and mosses. 15. Febr. 1997. Coll. S. & T. Pócs (No. 9712), 3 paratypes from the same sample. Holotype (1687-HO-05) and 2 paratypes (1687-PO-05): HNHM, 1 paratype: MHNG.

Measurements: Length of body: 197–210 μm , width of body: 137–146 μm .

Prodorsum: Conical, simple in dorsal view, beak-shaped in lateral view. Lamellae large, touching medially, a weak translamella between them present. True lamellar cusps absent, distal part

serrate, lamellar seta arising on a short apophysis (Fig. 17). Lamellar surface rugose, interlamellar setae very thin, located on it. Sensillus clavate, directed outwards, its head well spiculate.

Notogaster: Pteromorphae small, rounded in dorsal view. Dorsosejugal suture well visible, medially not interrupted. Notogastral surface with a distinct pattern, it consisting of secretion gran-



Figs 17–19. *Rhopalozetes bisculpturatus* sp. n.: 17 = body in dorsal view, 18 = body in ventral view, 19 = podosoma in lateral view

ules. Their form is mostly S-shaped or curved anteriorly, simple pustuliform posteriorly. Nine pairs of notogastral setae present, all minute and simple, equal in length.

Lateral part of podosoma: Rostral setae minute, but spiniform, with some short cilia, arising on small tubercles. Tutorium spiniform, with long apex, reaching over the insertion of rostral setae (Fig. 19). Pedotecta 1 very large, its surface covered by large pustules. Pedotecta 2–3 ornamented by transversal striae. Circumpedal carina reaching the margin of ventral plate.

Ventral regions: Infracapitulum large, setae *h* arising medially. Epimeral region with two wide transversal bands (*bo.* 2 and *bo.* 4), they are not connected by longitudinal parts. Epimeral and ventral surface covered by small granules. Epimeral setae simple and short, their position as shown in Fig. 18. On the lateral part of *bo.* a characteristic formation visible, from here are running some lines, along the genital aperture posteriorly. Anogenital setal formula: 6 – 1 – 2 – 3. Anterior genital setae much longer than the others. Anal aperture framed a weak crest posteriorly.

Remarks: The new species is well characterised by the sculpture of the notogaster and that of pedotecta 1. Both are unique in this genus.

Etymology: Named after the sculpture of the notogaster.

Rhopalozetes filiferus sp. n.

(Figs 20–22)

Diagnosis: Rostrum conical. Lamellae large, typical for the genus, touching anteriorly, excepting a small interlamellar region covering nearly the whole prodorsum. A weak translamella present. Rostral setae minute, arising on the rostrum. Lamellar setae spiniform, interlamellar setae very thin. Sensillus long, stick-shaped, distal end with some long bristles. Dorsosejugal suture well developed, pteromorphae small. Notogastral surface ornamented by filiform curved sculpture. Two transversal bands on the epimeral region.

Material examined: Holotype: Venezuela, Estado Mérida, Parc Nacional Sierra Nevada. Andean montane rainforest dominated by *Decussocarpus* (Podocarpaceae) near the cable car station La Montaña. At 2460 m. alt. Litter and mosses. 15. Febr. 1997. Coll. S. & T. Pócs (No. 9712). 1 paratype from the same sample. Holotype (1688-HO-05) and 1 paratype (1688-PO-05): HNHM.

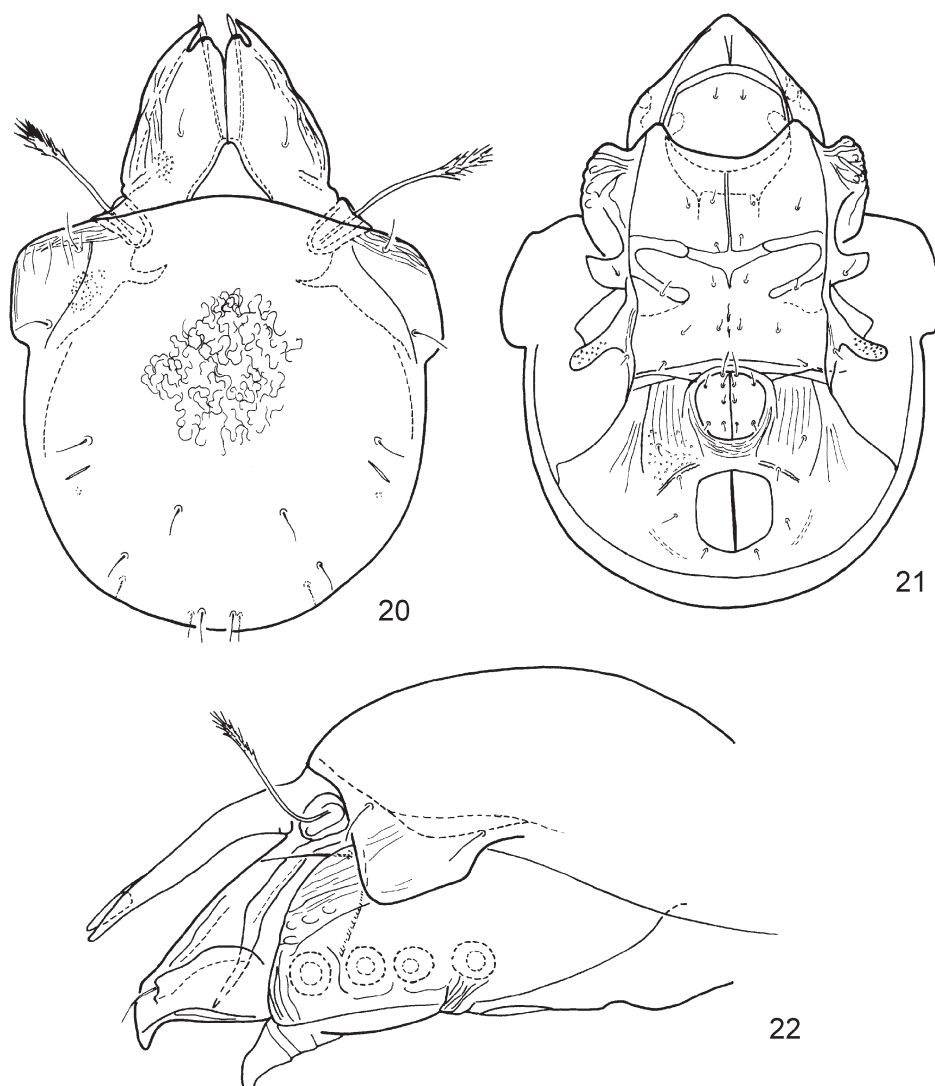
Measurements: Length of body: 246–259 μm , width of body: 172–184 μm .

Prodorsum: Conical, simple in dorsal and beak-like in lateral view. Lamellae large, touching anteriorly, a weak translamella between them present. Short, but well separated outer apex present, a blunt inner one much shorter, bearing the spiniform lamellar seta (Fig. 20). Lamellar surface rugose, interlamellar setae very thin, located on it, near to the median part of the lamellae. Interlamellar region comparatively small, without any tubercles. Sensillus very long, stick-shaped, hardly widened distally. Directed outwards and forwards, its distal end with long bristles.

Notogaster: Pteromorphae small, rounded laterally in dorsal view. Well sculptured by transversal and longitudinal lines, covered by granules. Dorsosejugal suture well observable, medially not interrupted, slightly convex. Notogastral surface with very fine filiform pattern, consisting of twisted,

mostly short lines variable length (Fig. 20). Nine pairs of notogastral setae present, all short and simple, straight, nearly equal in length.

Lateral part of podosoma: Rostral setae minute, with some short cilia, arising on a short tubercles. Tutorium with blunt apex, bearing the short and thin, simple rostral setae (Fig. 22). Pedotecta 1 very large, its dorsal and lateral surface covered by large pustules connected with rugae. Pedotecta 2–3 ornamented by transversal striae. Circumpedal carina reaching to the margin of ventral plate.



Figs 20–22. *Rhopalozetes filiferus* sp. n.: 20 = body in dorsal view, 21 = body in ventral view, 22 = podosoma in lateral view

Ventral regions: Infracapitulum large, its anterior margin convex and well sclerotised. Setae *h* arising medially, near to each other. Epimeral region with two wide transversal bands (*bo. 2* and *bo. 4*), they are not connected with a longitudinal ones. Transversal band *bo. 2* slightly weaker medially, than the other or its lateral part. Epimeral and ventral surface covered by small granules. Epimeral setae simple and short, their position as shown in Fig. 21. On the lateral part of *bo. 4* a characteristic formation observable, consisting of transversal margin on both sides and from here some fine lines are running along the genital aperture posteriorly. Anogenital setal formula: 6 – 1 – 2 – 3. Anterior genital setae longer than the others. In front of the anal aperture a pair of nearly transversal crests present, setae *ad*₃ arising on them. Behind the anal aperture a weak crest also visible.

Remarks: The new species is well characterised by the fine, lineate sculpture of the notogaster and the stick shaped sensillus. Similar notogastral sculpture has been unknown in this genus.

Etymology: Named after the characteristic, filiform sculpture of the notogaster.

Schalleria BALOGH, 1962

The taxon includes for the time being species from the Neotropics, but the large number of species – similarly to the previous genus – again needs a great of revisionary work. Here almost all the types of the species will have to be examined, since the descriptions, in the majority of the cases, had inadequately been prepared. This work will have to be made in the future, here, only the description of the new species is given. The distinguishing of the new species from its congeners is rather easy.

***Schalleria csuzdii* sp. n.**

(Figs 23–26)

Diagnosis: Body very wide, much wider than long. Rostral apex nasiform, divided by a narrow split, rostral setae arising on its basal part. Lamellae large, covering each other medially, lamellar setae arising from below, thick, with long, filiform, brush-like cilia. Interlamellar region hollowed, with curved apophysis. Sensillus setiform, directed anteriorly, well ciliate. Pteromorphae very large, with a serrate anterior margin. Notogastral setae minute. Epimeral region with one transversal band and some extremely long epimeral, genital and aggenital setae.

Material examined: Holotype: Venezuela, Estado Mérida. Cordillera del Norte. Relatively dry submontane rainforest on calcareous ground, in the limestone gorge of Chorrera de las González, 5 km NE of Jaji, at 1850 m. alt. 15. March 1997. Coll. S. & T. Pócs (No. 9733B). 5 paratypes from the same sample, 1 paratype: Venezuela, Estado Mérida. Cordillera del Norte. Wet submontane rainforest on calcareous ground, near waterfalls, in the limestone gorge of Chorrera de las González, 5

km NE of Jaji, at 1730 m. alt. 15. March 1997. Coll. S. & T. Pócs (No. 9732). (No. 9732). Holotype (1689-HO-05) and 5 paratypes (1689-PO-05): HNHM, 1 paratype: MHNG.

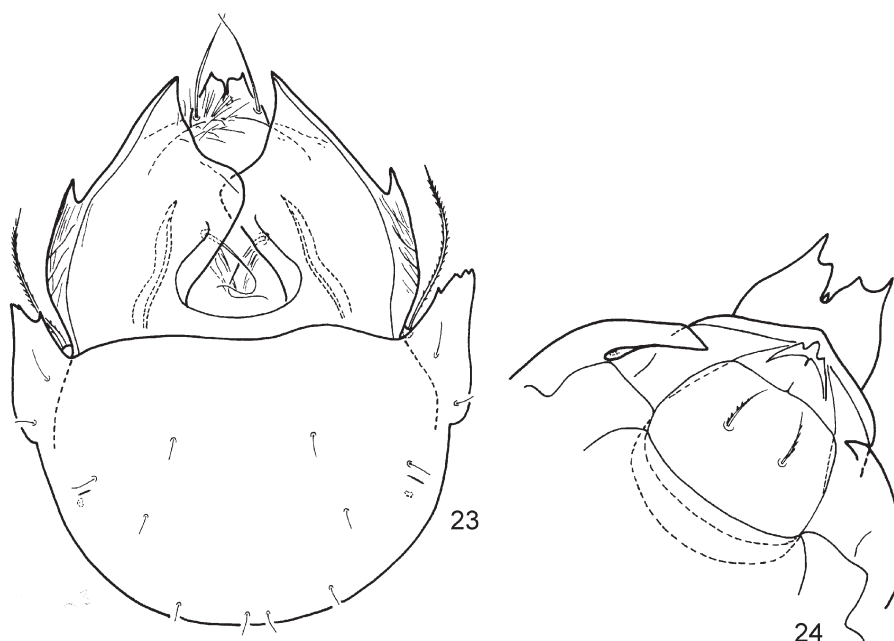
Measurements: Length of body: 427–471 μm , width of body: 364–390 μm .

Prodorsum: Rostrum having a complicate structure with several apices and appendages, as shown in Figs 23–24. Rostral apex bifurcate, with a deep and narrow split. Rostral setae arising on its basal part. From each side of the anterior part of rostrum reaching a characteristic apophysis directed medially, covered by tousled cilia. Lamellae very large, overlapping each other medially. Median cusp absent, this part rounded, lateral cusp very long, sharply pointed. A short, but also sharp indentation visible laterally. Lamellar setae arising beneath the lamellae, directed backwards, crossing each other, their distal part flagellate (Fig. 23). Along the lamellar setae one pair of narrow and bent apophysis present. Basal part in the interbothridial region without apophyses, interlamellar setae absent. Sensillus long, setiform, directed forwards and conspicuously ciliate.

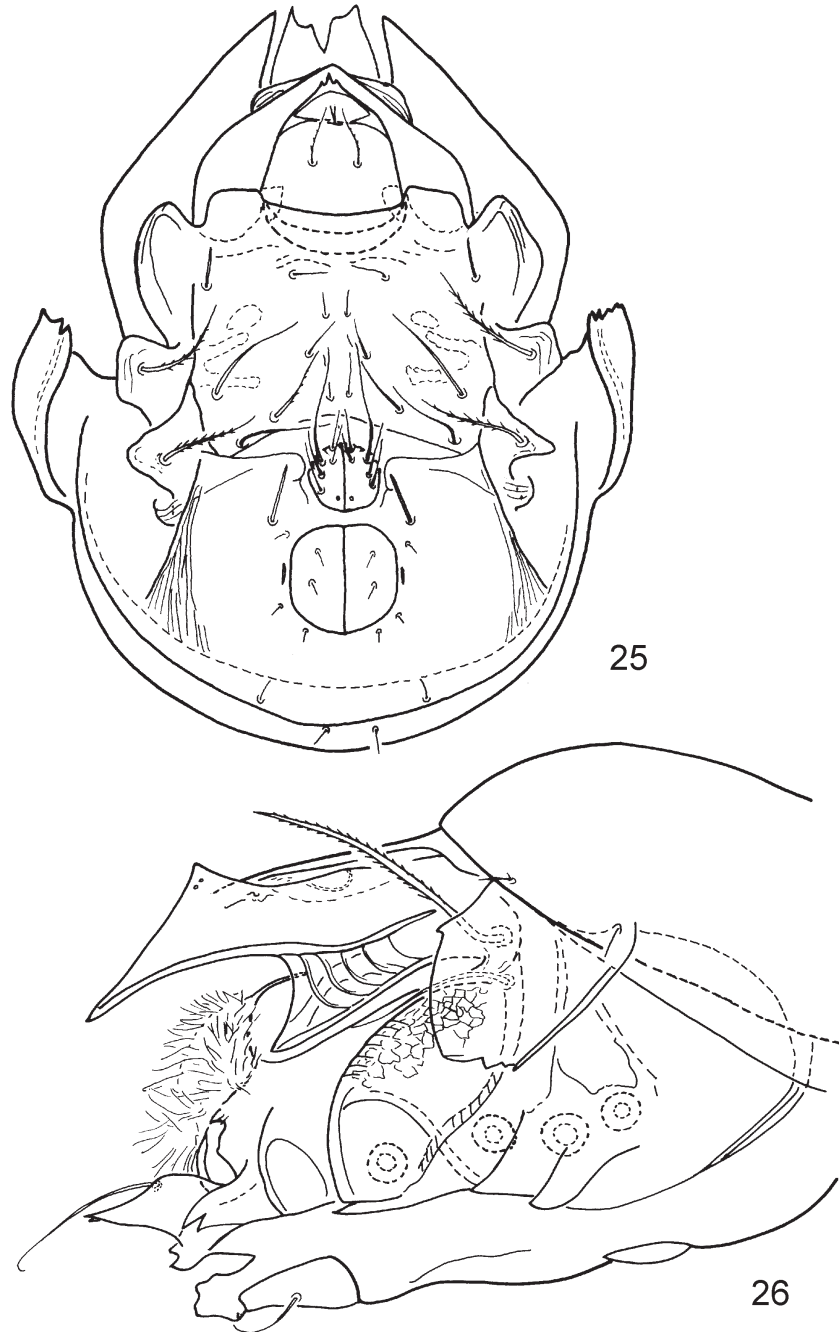
Notogaster: Dorsosejugal suture waved, slightly concave medially. Pteromorphae well developed, their anterolateral margin varying, mostly with sharp teeth (Fig. 23). Notogaster with nine pairs of smooth, simple and smooth setae, c_2 longest of all.

Lateral part of podosoma (Fig. 26): Tutorium with complicated structure, a long, snout-like appendage observable medially, directed backwards. Pedotecta 1 large, its surface with several short rugae and polygonate sculpture. In lateral view is the lateral part of the lamella with a well-developed teeth well observable.

Ventral regions: Infracapitulum large, its anterior margin with short apices (Fig. 24). Surface of epimeral region smooth, apodemes normally developed, only one thick transversal band (*bo. 4*)



Figs 23–24. *Schalleria csuzdii* sp. n.: 23 = body in dorsal view, 24 = infracapitulum in ventral view



Figs 25–26. *Schalleria csuzdii* sp. n.: 25 = body in ventral view, 26 = podosoma in lateral view

present. Epimeral setal formula: 3 – 1 – 3 – 3, epimeral setae rather varying in length and shape. Setae *1c* spiniform, *3c* and *4c* well ciliate and long, *3b*, *4a* and *4b* also much longer than *3a*. Ventral plate also smooth, but circumpedal carina divided into some thin lines, yielding a characteristic pattern. Setae in the anogenital region peculiar, aggenital setae spiniform, form and length of the genital setae also unique (Fig. 25). All anal and adanal setae short and fine.

Remarks: The investigation of this species well shows what problems there are in distinguishing some genera of the family Microzetidae. The relegation of this species is not simple into any of the known genera. Some of the studied characters have been unknown for the genus *Schalleria* BALOGH, 1962, but the species also problematically identifiable with the genus *Phylacozetes* GRANDJEAN, 1936. However, some peculiar characters (e.g. the form of the tutorium, the form and direction of the lamellar setae and/or the form of the epimeral and anogenital setae), which are unknown elsewhere in the whole family. Therefore, I describe the species as new and on the basis of the lack of interbothridial setae and the form of the rostrum I place the new species into the genus *Schalleria*.

Etymology: I dedicate the new species to my friend, Dr. CSABA CSUZDI, who collected for me many very interesting soil samples from all over the world.

*

Acknowledgements – This work was supported by the Hungarian Scientific Research Fund (OTKA numbers T38319 and T45889). I should like to thank the organisers Dr. TAMÁS PÓCS and Dr. CSABA CSUZDI, also as collectors and DÁVID MURÁNYI. I am also very grateful for the reviewing my manuscript and for the linguistic correction Dr. LAJOS and ANDOR ZOMBORI.

REFERENCES

- BALOGH, J. (1962) An outline of the family Microzetidae Grandjean, 1936 (Acari: Oribatei). *Opuscula Zoologica Budapestiensis* **4**: 35–58.
- BALOGH, J. & BALOGH, P. (1992) *The oribatid mites genera of the World. I–II*. Hungarian Natural History Museum, Budapest, 263+375 pp.
- BALOGH, J. & BALOGH, P. (2002) *Identification keys to the oribatid mites of the Extra-Holarctic Regions. I–II*. Well-Press Publishing Limited, Budapest, 453+504 pp.
- BALSLEV, H. (ed.) (1993) Neotropical montane forests. Biodiversity and conservation. Abstracts. *Symposium at the New York Botanical Garden, June 21–26, 1993. AAU Reports* **31**.
- BASSET, Y. (1991) The taxonomic composition of the arthropod fauna associated with an Australian rainforest tree. *Australian Journal of Zoology* **39**: 171–190.
- BEHAN-PELLETIER, V. M., PAOLETTI, M. G., BISSET, B. & STINNER, B. R. (1993) Oribatid mites of forest habitats in northern Venezuela. *Tropical Zoology, Special issue* **1**: 39–54.
- GRADSTEIN, S. R. & PÓCS, T. (1989) Bryophytes. Pp. 311–325. In: LIETH, H. & WERGER, M. J. A. (eds): *Tropical rain forest ecosystems. Biogeographical and ecological studies*. Elsevier, Amsterdam.

- GRANDJEAN, F. (1936a) Les Microzetidae nov. fam. (Oribates). *Bulletin de la Société Zoologique de France* **61**: 60–93.
- GRANDJEAN, F. (1936b) *Microzetes auxiliaris* n. sp. (Oribates). *Bulletin du Muséum National d'Histoire Naturelle, Paris* **8**: 138–145.
- LIONS, J.-C. (1978) Sur le genre *Miracarus* Kunst 1959 Oribate: *Miracarus abeloosi* sp. n. 1^{re} partie: la stase adulte. *Acarologia* **20**(3): 404–418.
- MAHUNKA, S. (1980) Data to the knowledge of mites preserved in the “Berlese Collection” (Acari: Tarsonemina, Oribatida). II. – *Folia entomologica hungarica* **41**: 105–121.
- MAHUNKA, S. (2001) Arborescent oribatid mites (Acari: Oribatida) from Kenya. – *Folia entomologica hungarica* **62**: 11–22.
- MAHUNKA, S. (2006) Oribatid mites (Acari: Oribatida) from Venezuela, II. New or rare oribatids from the montane forests. Microzetid species. *Acta Zoologica Academiae Scientiarum Hungaricae* [in print]
- NADKARNI, N. M. (1984) Epiphyte biomass and nutrient capital of a neotropical elfin forest. *Biotropica* **16**: 249–256.
- NADKARNI, N. M. & LONGINO, J. T. (1990) Invertebrates in canopy and ground organic matter in a neotropical montane forest, Costa Rica. *Biotropica* **22**: 286–289.
- NORTON, R. A. & PALACIOS-VARGAS, J. G. (1987) A new arboreal Scheloribatidae, with ecological notes on epiphytic oribatid mites of Popocatepetl, Mexico. *Acarologia* **28**(1): 75–89.
- PAOLETTI, M. G., STINNER, B. R., STINNER, D., BENZING, D. & TAYLOR, R. (1990) Diversity of soil fauna in the canopy of Neotropical rain forest. *Journal of Tropical Ecology* **7**: 135–145.
- PÓCS, T. (1978) Epiphyllous communities and their distribution in East Africa. In: SUIRE, C. (ed.): *Congres International de Bryologie, Bordeaux, 21–23 Novembrte 1977, Comptes Rendus. Bryophytorum Bibliotheca* **13**: 681–714.
- PÓCS, T. (1980) The epiphytic biomass and its effect on the water ballance of two rain forest types in the Uluguru Mountains (Tanzania, East Africa). *Acta Botanica Academiae Scientiarum Hungaricae* **26**: 143–167.
- PÓCS, T. (1999) Bryophyte speciation and diversity in the East African mountains. *Bryobothera* **5**: 237–245.
- SCHATZ, H. & PALACIOS-VARGAS, J. G. (1999) Microzetidae (Acari: Oribatida) from the Galápagos Islands. *Acarologia* **40**(1): 69–83.
- SPENCE, J. R. & PÓCS, T. (1989) Distribution patterns in the Afroalpine moss flora of East Africa. Pp. 291–307. In: MAHANEY, W. C. (ed.): *Quaternary and environmental research on E African Mountains*. Balkema, Rotterdam.
- SUBÍAS, L. S. (2004) Listado sistemático, sinónimo y biogeográfico de los ácaros oribátidos (Acari-formes, Oribatida) del Mundo (1758–2002). *Graellsia* **60**: 3–305.
- WALTER, D. E. (1995) Dancing on the head of a pin: mites in the rainforest canopy. *Record of the Western Australian Museum Suppl.* **52**: 49–53.
- WALTER, H. & BRECKLE, S.-W. (1991) *Ökologische Grundlagen in globaler Sicht. 10: Beispiel eines Vegetationsmosaiks in den Tropen: Venezuela*. Fischer Verlag, Jena, pp. 199–215.
- WALTER, D. E. & BEHAN-PELLETIER, V. (1999) Mites in forest canopies: Filling the size distribution shortfall? *Annual Review of Entomology* **44**: 1–19.

Revised version received November 1, 2005, accepted November 16, 2005, published December 29, 2005