A revision of the millipede tribe Apfelbeckiini Verhoeff, 1900 (Diplopoda: Callipodida: Schizopetalidae)

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Steenstrupia


The millipede tribe Apfelbeckiini (Callipodida: Schizopetalidae) is revised. After re-examination of most of the type specimens of hitherto described taxa the number of valid genera and species in the tribe is reduced to two and four, respectively. The following new synonymies and combinations are proposed for the first time: Genus *Apfelbeckia* Verhoeff, 1900 = Genus *Antropetalum* Attems, 1926 syn.n., *Antropetalum brazzanum* Attems, 1927 = *Apfelbeckia brazzana* (Attems, 1927) comb.n.; *Apfelbeckia insculpta* (L. Koch, 1867) comb.n. = *Lysiopetalum lendenfeldii* Verhoeff, 1896 syn.n.; = *Apfelbeckia enderleini* Verhoeff, 1901 syn.n.; = *A. albosignata* Verhoeff, 1901 syn.n.; = *A. silvivaga* Verhoeff, 1901 syn.n.; = *A. wohlberedti* Verhoeff, 1909 syn.n.; = *A. hesseli* Verhoeff, 1929 syn.n.; = *A. lendenfeldii var. flavipes* Attems, 1929 syn.n.; = *A. albanica* Verhoeff, 1941 syn.n.; = *A. subturreana* Verhoeff, 1943 syn.n.; = *A. hesseli var. boldorii* Manfredi, 1945 syn.n.; = *A. duplocalca* Attems, 1951 syn.n.; = *A. lendenfeldii miraculosa* Attems, 1951 syn.n.; = *Karlabsolonia mirabilis* Attems, 1951 syn.n. A new species, *Apfelbeckia synthesys*, distinguished from its congeners by having only a single row of pleurotergal setae and specific shape of male gonopods, is described from Olympos Mts., Greece. An identification key to the genera and species in the tribe is provided, along with remarks on the morphology and distribution of some species.

Keywords: *Apfelbeckia synthesys* sp. n., Olympos Mts., Greece, taxonomy, gynandromorphism

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INTRODUCTION

The tribe Apfelbeckiini Verhoeff, 1900 (Callipodida: Schizopetalidae) is a quite homogeneous group with regard to the shape of the male gonopods. The tribe is currently understood as containing the polytypic genus *Apfelbeckia* Verhoeff, 1896, and the monotypic genera *Himatiopetalum* Verhoeff, 1900 and *Antropetalum* Attems, 1926 (Hoffman 1973). The genus *Apfelbeckia* is currently known to comprise 10 nominal species, and 3 subspecies/varieties of doubtful validity, widely distributed in the western part of the Balkan Peninsula: Croatia, Bosnia and Herzegovina, Serbia and Montenegro, and Albania. *Himatiopetalum ictericum* (L. Koch, 1867) occurs on the Greek island of Corfu (Kerkira), while *Antropetalum brazzanum* Attems, 1927 was hitherto known only from caves on the Dalmatian island of Brach (Brazza) (Fig. 1).

*Apfelbeckia* was originally proposed as a subgenus of *Lysiopetalum* Brandt, 1840, with *L. (A.) lendenfeldii* Verhoeff, 1896, as type species (Verhoeff 1896). The type locality of *L. lendenfeldii* is the cave Bilek (Bileća) in Bosnia and Herzegovina, subsequently it was also recorded from other places in Croatia, Bosnia and Herzegovina, and Montenegro. Four years later, *Apfelbeckia* was elevated to full generic rank (Verhoeff 1900a). Later on, Verhoeff (1901) described three further species in the genus, *A. enderleini* (Bosnia and Herzegovina), *A. albosignata* (Dalmatia, Herzegovina and Montenegro) and *A. silvivaga* (Herzegovina), and re-
described *A. lendenfeldii*. During the next 40 years he added *A. wohlberedti* (North Albania), two varieties of *lendenfeldii* (*abbreviatum* and *herzogwinense*, both from Herzegovina) (Verhoeff 1909a), as well as *A. hessei* (Croatia) (Verhoeff 1929), *A. albanica* (Central Albania) (Verhoeff 1941), *A. subterranea* (Serbia), *A. lendenfeldii caligulifer* and *A. lendenfeldii hebes* (both from Herzegovina) (Verhoeff 1943). In addition to Verhoeff's work on the genus, Attems (1929,
1951, 1959) described the following apfelbeckiines: A. lendenfeldii var. flavipes (North Albania), A. duplocalca (Bosnia), A. lendenfeldi miraculosus (Bosnia and Herzegovina, Montenegro) and Karlabsolonia mirabilis (Dalmatia). Manfredi (1945) described A. hessei var. boldori from North Albania. Strasser (1971) proposed the synonymy of A. lendenfeldii caligulifera and A. lendenfeldii hebes under A. lendenfeldii lendenfeldii, and Mršić (1994) did the same with the subspecies abbreviatum and herzegovinense. Strasser (1971) and Hoffman (1973) suggested the synonymy of the genus Karlabsolonia and the subgenus Haplobeckia Verhoeff, 1941 under Apfelbeckia s. str.

The postembryonic development in Apfelbeckia was studied by Lang (1935), who described eight stadia in this species. Analysing Lang’s data, Enghoff et al. (1993) concluded that Apfelbeckia probably develops through teloanamorphosis.

Carnivory of A. lendenfeldii was studied by Verhoeff (1900c) (see also Hoffman & Payne 1969), as the species was reported to feed on earthworms, flies, spiders and centipedes.

Additional faunistic and taxonomic information concerning this or that species of Apfelbeckiini can be found in the papers of Latzel (1884, 1888), Karlinski (1894), Verhoeff (1897, 1899, 1909b, 1932), Kovačević (1931), Lang (1939), Strasser (1962, 1970), Ceuca (1964), Tomić-Jovanović (1964), Mauries et al. (1997), Guéorguiev et al. (2000), Makarov et al. (2004), and Stagl & Stoever (2005).

The overall picture gathered from the reviewed literature is that the current taxonomy of the group is highly outdated, with all taxa lacking adequate descriptions, often misidentified by subsequent researchers, and types, though well preserved and completely accessible in European museums, having never been re-examined. Starting this project as a simple description of a new, quite distinct species of Apfelbeckia found by a Danish zoological expedition in Greece, during the work the need in revising the whole tribe became evident. Along with the description of the new species we have re-examined the type specimens and older collections of apfelbeckiines preserved in the Museum für Naturkunde, Humboldt Universität zu Berlin (ZMB), Naturhistorisches Museum Wien (NHMW), Zoologische Staatssammlung München (ZSM), and American Museum of Natural History, New York (AMNH). In addition to these collections, Dr. Richard Hoffman (Virginia Museum of Natural History, Martinsville, USA) kindly placed at our disposal his unpublished observations and sketches of the type of Lysiopetalum insculptum L. Koch he had made during a visit to the Natural History Museum, London (BMNH). New collections comprising unidentified specimens were studied from the Muséum d’Histoire Naturelle, Genève (MHNG), Zoological Museum of the University of Amsterdam (ZMAN), National Museum of Natural History (Naturalis), Leiden (NNM), the Natural History Museum of Denmark (ZMUC), and the National Museum of Natural History, Sofia (NMNHS).

MATERIAL AND METHODS

The holotype and some paratypes of the new species are preserved in ZMUC, male and female paratypes are deposited in NMNHS. All specimens are preserved in 70% ethanol. The illustrations were made with a camera lucida.
Abbreviations:
M – male
F – female
t. loc. – type locality
PT – pleurotergite

TAXONOMY

Family Schizopetalidae Verhoeff, 1909a
Subfamily Acanthopetalinae Hoffman & Lohmander, 1964
Tribe Apfelbeckiini Verhoeff, 1900a, p. 50, char. emend.

Diagnosis
Moderate-sized to large callipodidans. Females usually larger than males. Body length ca. 50–100 mm; diameter of midbody PTs ca. 2.5–4.8 mm. Number of PTs in adults usually 46–50. Body colour from dark brown to brown-yellow; usually a row of yellowish lateral spots stretching along body just below level of ozopores (Fig. 2). PT slightly higher than broad in cross-section. Male PTs 6 and 7 not enlarged. Metazonites slightly elevated compared to prozonites; dorsal crests either moderately (Apfelbeckia) or well developed (Himantiopetalum); poriferous crests normal (not enlarged like in, e.g., Caspiopetalidae or Paracortinidae). Ozopores visible from sixth to antepenultimate PT lying either on crest 8 or 9 (on midbody PTs). Chaetotaxy: setae long and apically pointed, usually 8–10 on each hemipleurite (possibly more), anterior PTs with an anterior as well as a posterior row of setae. Head either convex in both sexes or concave (males of A. brazzana), usually densely covered with minute setae. All legs very long, ending with conspicuous claw. Coxae of all pre-gonopodal legs without any particular modifications, tarsi bipartite. Coxal sacs present on legs 3–16. Hypoproct either tripartite (Apfelbeckia) or undivided (Himantiopetalum); paraprocts divided into small dorsal and larger ventral sclerites, dorsal sclerites with a pair of macrosetae, ventral sclerites covered with numerous macrosetae along free margins.

Gonopods comprising modified male leg-pair 8 only; exposed ventrally beyond pleurotergal edge; tracheal apodemes strongly expanded; sternum either soft membrane or a chitinized, subtrapezoidal plate lying perpendicularly between leg-pair 7 and gonopods; femorar arising from posterior part of coxa, divided into a large, broad, shield-like outer branch (“Tibialab schnitt” in German literature) and a subterminal inner branch (“Kanalast”). Inner branch ending with solenomere and parasolenomere. Outer branch (shield) with a very characteristic sponge-like process (“Blasiges bestacheltes Organ”) covered with spines and lying posterolaterally on its outer surface. In Apfelbeckia the outer branch forms a long, anteromedial process of a characteristic boot-like shape (tarsus).

Female second leg-pair unmodified. Vulvae extrusable, long, reaching leg-pair 8 when folded backwards (in A. insculpta).

Remarks
Apfelbeckiini differ from the other two acanthopetaline tribes, Acanthopetalini (with three genera, Acanthopetalum Verhoeff, 1900, Balkanopetalum Verhoeff, 1926 and Eurygyrus C.L. Koch, 1847) and Prolysiopetalini (with a single genus, Prolysiopetalum Verhoeff, 1909) by having male pre-gonopodal legs unmodified and by the existence of a sponge-like organ on the outer branch of the gonopods.

Distribution
The tribe Apfelbeckiini shows a quite compact distribution in the western part of the Balkan Peninsula, from the central Dalmatian coastline in the north to Olympos Mts. in the south, and from the Ionic island Korfu and the Dalmatian islands of Brach, Hvar, Korchula and Vis in the west to western Serbia and Olympos in the east. A gap in the range existing in south Albanian mountains and the nearest parts of Pindus Mts. in northwestern Greece (Fig. 1) could be explained by insufficient sampling in the region.

Genus Apfelbeckia Verhoeff, 1896

**THE MILLIPEDE TRIBE APFELBECKIINI**

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**Antropetalum** Attems, 1926: 180, 222. Type species: *A. brazzana* Attems, 1927, by subsequent designation of Attems (1927). **Syn. n.**


**Diagnosis**

A genus of Apfelbeckiini with smooth collum, tripartite hypoproct, and outer femoroidal branch of gonopods solid.

**Distribution**

Greece, Albania, Montenegro, Bosnia and Herzegovina, Croatia (including the Dalmatian islands of Brach, Hvar, Korchula, Mljet and Vis), and Serbia.

**Remarks**

In the original description of *Antropetalum*, Attems (1926, 1927) did not clearly distinguish this genus from *Apfelbeckia*. Even more, in his quite confusing key to the genera of Schizopetalidae he noticed that the gonopod conformation of the
new genus is similar to that of Apfelbeckia. The characters that he used to separate Antropetalum from Apfelbeckia, like the length of tarsi of male postgonopodal leg-pair, shape of analog segment, etc., are certainly of very little or no value in Callipodida, and hardly could justify the erection of a genus. The presence of a frontal concavity in males of Antropetalum is the only character that seems to genuinely separate the genus from Apfelbeckia and Himatiopetalum. However, it seems that in Callipodida this character is significant only at the species level, as analogues can be found in the schizopetalid genus Prolysipetalum Verhoeff, 1909 and the caspiopetalid genus Bollmania Silvestri, 1896. In the latter, males usually have a frontal knob on the head, but there are also exceptions, e.g., Bollmania oblonga Golovatch, 1979 from Tajikistan. In B. nodifrons Lohmander, 1933, the frontal knob exists only in adult males, being absent in subadults (cf. Golovatch 1979, Stoëv & Enghoff 2005). Examination of the type material of Antropetalum brazzanum in the NHMW confirmed that the gonopods differ only in minor details from those of Apfelbeckia insculpta, so the erection of a genus solely on the basis of head conformation and other insignificant features appears unjustifiable. Therefore, we herewith formalize the synonymy of Antropetalum under Apfelbeckia.

Apfelbeckia brazzana (Attems, 1927) comb. n.
Figs 1, 3, 9A

Antropetalum brazzana Attems, 1927: 114, figs 122–124. Type locality: caves near Milna and Nerezišće, Brach Island, Dalmatia, Croatia.


Material examined:

New records: Croatia: 2 MM, 1 F, 2 juv., island of Hvar, village of Hvar, cave Markova spilja (= Grčka spilja), N43°11.451 E16°24.170, alt. 68 m, 15.viii.2006, t=18°C, under stones, B. Petrov, S. Lazarov leg. (NMNHS); 1 M, 2 subad., same island, village of Humac, cave Grabčina spilja, alt. 230 m, N43°08.080 E16°45.222, under stones, t=16°C, 16.viii.2006, B. Petrov, S. Lazarov leg. (NMNHS).

Diagnosis
Well distinguished from the other species in the tribe by the modified head in males, and from the other congeners by the presence of an outgrowth on the inner surface of the outer branch of the gonopod femoroid (g in Fig. 3B).

Distribution
Croatia: Brach Island: caves near the villages of Milna and Nerezišće; Hvar Island: caves near the villages of Humac and Hvar (see also below under A. insculpta’s distribution).

Apfelbeckia insculpta (L. Koch, 1867) comb. n.
Figs 1, 4, 5, 9B

Lysiopetalum insculptum L. Koch, 1867: 893. Type locality: unspecified sites in Montenegro and Dalmatia.


Apfelbeckia Lendenfeldii. – Verhoeff 1901: 275, figs 3, 6.

Apfelbeckia Enderleinii Verhoeff, 1901: 275, figs 1, 4. Type locality: “Grabovica Höhle, Radoboljathal bei Mostar, Buchenwald am Prenj”, Bosnia and Herzegovina. Syn. n.


Apfelbeckia wohleredti Verhoeff, 1909a: 717, 720, figs 1–6. Type locality: Taubenhöhle (Tauben Cave) near Rei, Albania. Syn. n.


Fig. 4. Apfelbeckia insculpta. – A–B. Syntype of Lysiopetalum insculptum L. Koch, 1867, BMNH, drawings by R. Hoffman. A. Gonopod, mesal view. B. Same, posterior view. – C. Syntype of Lysiopetalum lendenfeldii Verhoeff, 1896, ZMB. Gonopod, mesal view. – D. Syntype of Apfelbeckia duplocalca Attems, 1951, NHMW. Gonopod, posterior view. – E. Syntype of A. lendenfeldi miraculosa Attems, 1951, NHMW. Gonopod, lateral view. – F. Syntype? of Karlabsolonia mirabilis Attems, 1951, NHMW. Gonopod, posterior view. – b, coxal process 2; h, process on t; ib, inner branch; p, coxal process 1; ps, parasolenomere; sg, seminal groove; t, tarsal process. – A–C, F without scale.


**Type specimens?:** Lysiopetalum cognatum: slide with leg pairs 7–9; Inv. No. 3990 (NHMW); adult intact F and one F broken into pieces, 1 dissected M, gonopods in separate microtube, Inv. No. 4382 [Dalmatia, Bosnien, don. R. Latzel 1919] (NHMW) (see also Stagi & Stoev 2005).


sculpitius Cave) (ZMAN); 1 F (48 PTs), Dalmatia: Cave Mociljska spilja near village Pobrezje, near Dubrovnik, 17.vi.1961, Ellis leg. (ZMAN); 1 M (48 PTs) Dalmatia: Cave Mociljska spilja near village Pobrezje, near Dubrovnik, 16.vi.1961, Exc. Zoöl. Mus. (ZMAN); 1 M, 2 FF, Dalmatia: Cave Vilina Kuča in Omla-dal, 16.vi.1961, Ellis leg. (ZMAN); 5 MM, 8 FF (one ad. M and one ad. F each with 47 PTs; one ad. F 92 mm) Zoöl. Mus. Amsterdam, Excursie Jugoslawia, 1954, station 41, Cave Vilina Pecina, cave at the eastern end of the Omla valley, 60 m depth? N42º40’, E18º07’E, 16.v.1954 (ZMAN); 1 ad. M (48 PTs), cave near Močilje (or Močelje) near Dubrovnik, 28.v.1962, Yugoslavia exc. 1962 (NNM); 1 subad. M (47 PTs; undeveloped gonopods), same locality, 28.v.1962, J. Wiebes leg., Yugoslavia exc. 1962 (NNM); 1 ad. M, 47 PTs, same locality, 28.v.1962, exc. Leidse Biologen (NNM); M, F, island of Mljet, vill. Ropa, cave Spilja pri Nereznom dolu, N42º45.512’E17º26.163’, alt. 200 m, under stones, 13.viii.2006, B. Petrov, S. Lazarov leg. (NNMHS); 1 M, 1 F, Dalmatia: Cave Vilina Kucica near village Pobrezje, near Dubrovnik, 28.v.1962, Yugoslavia exc. 1962 (NNM); 1 ad. M, 47 PTs, same locality, 28.v.1962, exc. Leidse Biologen (NNM); M, F, island of Mljet, vill. Ropa, cave Spilja pri Nereznom dolu, N42º45.512’E17º26.163’, alt. 200 m, under stones, 13.viii.2006, B. Petrov, S. Lazarov leg. (NNMHS); 1 M, 1 F, island of Mljet, village of Humac and Nerezinšće on Brach, as well as those from Hvar, are probably erroneous, being most likely referable to A. brazzana.

Remarks

The most recent comprehensive work on Apfelbeckia so far is that of Attems (1959), where, along with some re-descriptions, the author provided a key to the then recognized species belonging to the nominal subgenus, and having a broader sponge-like process (k), thus excluding wohlberedti, albicana and subterranea. Two other “species”, namely A. silvivaga and A. mirabilis, were not included in the key either. Attems regarded Verhoeff’s subdivision as unsatisfactory because he used the length of the antennae as the primary classification criterion. Strasser (1962) first concluded that some of the characters used for species separation are not reliable and that the genus badly needs re-evaluation. He also mentioned that the angle of view of the illustrations of gonopods has never been taken into account by Attems, while in Verhoeff (1943) it was indicated wrongly, and also expressed doubts about the precision of their drawings made from fragmented gonopodal parts mounted on slides.

Having studied material from almost the whole range of Apfelbeckia, we can conclude that the importance of the shape of the sponge-like process k has been overestimated by Attems. This feature seems to characterize only different populations and, taken separately, has no value for species distinction. We did not find any clear clinal variation in its shape, although it seems that more southern specimens (e.g., those from Albania and Montenegro) usually have larger and more elongated k (Fig. 4F), while smaller and more equally ovoid k (like that of “A. enderleinit”) exist in specimens from the region of Mostar, Bosnia and Herzegovina, which forms the north-northwestern border of the species’ distribution (Fig. 1). This and some other gonopodal characters, like the shape of the gonotarsus and the setation on the inner and outer surface of...
the gonopods, do seem to vary between populations and cannot be regarded as species-specific. The colour and length of the antennae that were used by Verhoeff (e.g. 1909a, 1943) cannot provide enough support for clear separation of the taxa that are here synonymized under A. insculpta. Moreover, it is well known that coloration of specimens fades with the time of preservation of material. Although we cannot entirely exclude the possibility of some of the taxa which are here synonymised with A. insculpta being valid, the available evidence in our opinion allows recognition of neither several species nor even subspecies in this complex.

A similar situation concerns Acantopetalum (Petalysium) carinatum (Brandt, 1840), another callipodidan millipede confined to the western part of the Balkan Peninsula and showing a distribution pattern similar to that of Apfelbeckiini. In this species, the shape of the gonopodal so-called U-process shows significant inter-populational variability, also without any clinal pattern. Six of the nominal (sub-)species forming the subgenus Petalysium Strasser, 1976 were thus recently synonymised by Mauriès et al. (1997).

Lysiopetalum insculptum was described by L. Koch (1867) from specimens collected in Dalmatia and Montenegro by Josef Erber. This species remained in oblivion for a long time and its taxonomic position has not been re-evaluated since its original description. The sketches of the gonopods made by Dr. R. Hoffman from the type specimens in the BMNH (Fig. 4D, E) and the examination of the female (type?) specimen in the NHMW (see Stagl & Stoev 2005) leave no doubt that this species is conspecific with Apfelbeckia lendenfeldii. The latter, described by Verhoeff in 1896, is the type species of Apfelbeckia and, after studying syntype specimens from ZMB, we introduce here the new combination and synonymy: Apfelbeckia insculpta (L. Koch, 1867) comb. n. = Apfelbeckia lendenfeldii (Verhoeff, 1896) syn.n. Another possible synonym of Apfelbeckia insculpta is Lysiopetalum cognatum Latzel, 1884 (cf. Verhoeff 1896), described from a single female collected near Dobrovnik (= Ragusa), Croatia.

There are neither gonopodal nor somatic characters, on the basis of which the nominal taxa Apfelbeckia albanica, A. albosignata, A. duplocalca, A. enderleini, A. hessei, A. hessei var. boldori, A. lendenfeldii var. flavipes, A. lendenfeldi miraculosa, A. subterranea and A. wohlberedti could be distinguished from A. insculpta. So, having studied the respective type specimens, we propose here their synonymy under the latter.

More complicated is the case of A. silvivaga, the type species of the subgenus Haplobeckia, whose holotype is in poor condition (a very clumsy slide preparation of the gonopods, currently dried out and blackened) and cannot provide additional information about the status of the species. Described from a single specimen coming from the region where A. insculpta is also known to occur (cf. Verhoeff 1909a sub A. lendenfeldii abbreviatum), A. silvivaga can be presumed as having been based on a not fully mature
male specimen with incompletely developed gonopods (without process k). Only further collecting from the type locality could answer this question, but for purely practical reasons we formalize here the synonymy with *A. insculpta*.

Examination of the type of *Karlabsonia mirabilis* revealed a morphological aberration. In the introduction of the catalogue of millipedes of Yugoslavia, Strasser (1971) wrote that Hoffman, after checking the type specimen in the NHMW, had informed him in a letter that the presumable penis of the species (figs 165–166 in Attems 1959) was actually the female ovipositor which had inadvertently been mounted on the slide together with male parts. We have also examined the type material and can confirm that the slide comprises a male cyphopod ("ovipositor") together with the male gonotarsus. The remaining part of the gonopods, preserved in alcohol, consist of a not fully developed, somewhat shrunk part of the gonopods, preserved in alcohol, comprising a female cyphopod ("ovipositor") together with the male gonotarsus. The remaining part of the gonopods, preserved in alcohol, consist of a not fully developed, somewhat shrunk half, and a rudimentary second half (Fig. 4E). Neither the brief original description (Attems 1951) nor the subsequent, more detailed one supplied with illustrations (Attems 1959), which was compiled and published by Hans Strouhal nearly 7 years after Attems’ death, has any indication of the number and sex of the type specimens. Having strongly malformed gonopods, as well as cyphopods at the same time, it is very likely that Attems actually studied only one specimen sharing both female and male sexual characters, thus having mistaken the cyphopods for a penis. This could be the first case of gynandromorphism in the Callipodida (see Discussion). Since currently there is not enough evidence to support a separate status of *K. mirabilis*, we formalize its synonymy under *A. insculpta*.

**Apfelbeckia synthesys** sp. n.

Figs 1, 2, 6, 7, 9C

Material examined:

*Holotype*: adult male; 49 PTs, length 52 mm, width of midbody PT 3.23 mm; Greece, Olympos Mt., 700–2,100 m, 21–26.v.1990, Zool. Mus. Copenh. Exp. (ZMUC) – *Paratypes*: 1 ad. male, 4 ad. females, 1 juvenile, same date, locality and collector (ZMUC, ad. male & one female in the NMNHS). – *Non-type material*: 1 F, 50 PTs, Greece, Macedonia, Olympos, 2100 m, Spilios Agapitos, 28.vii.–5.viii.1965, L.H.M. Blommers leg. (ZMAN). There is a second label inside the tube, "*Acanthopetalum* sp. det. Strasser, 1974".

**Etymology**

The species is named after the Integrated Infrastructure Initiative SYNTHESYS (SYNSTHEsis of SYStematic resources), funded by the European Commissions’ 6th framework programme.

### Table 1. Partial chaetotaxy in *A. synthesys* sp. n.

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<thead>
<tr>
<th>Anterior setae</th>
<th>Posterior setae</th>
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<td>Collum</td>
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<td>a, b, c, d, e, f, g, h+</td>
<td>-</td>
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<td>a, b, c, d, e, f, g, h</td>
<td>or</td>
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<td>2nd PT</td>
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<td>a, b, c, d, e, f, g, h+</td>
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<td>a, b, c, d, e, f, g, h</td>
<td>or</td>
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<tr>
<td>3rd PT</td>
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<td>a, b, c, d, e, f, g, h+</td>
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<td>a, b, c, d, e, f, g, h</td>
<td>or</td>
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<tr>
<td>4th PT</td>
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<td>or</td>
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<td>5th PT</td>
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<td>d, e, f, h+</td>
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<td>a, b, c, d, e, f, g, h</td>
<td>or</td>
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<tr>
<td>6th PT</td>
<td></td>
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<tr>
<td>a+a</td>
<td>b, c, d, e, f, g, h+</td>
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<tr>
<td>7th PT</td>
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<td>a+a</td>
<td>b, c, d, e, f, g, h+</td>
</tr>
<tr>
<td>8th PT</td>
<td>usually all in posterior position</td>
</tr>
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through the support of which the realization of this project was made possible.

**Diagnosis**

Distinguished from congers by the smaller body size, the existence of only a single row of pleurotergal setae and the following gonopodal characters: apical part of femoroid strongly incised (vs. slightly or not incised) and process \( t \) with a pointed hook-like process \( h \) (Fig. 6B, vs. a more or less oval or notched process, Figs 3C,
4B). A single row of setae is also found in *Himatiopetalum ictericum*, but this taxon is well distinguished from the other *apfelbeckiines* by a number of characters.

**Description**

Length: adult males: *ca.* 52 mm, adult females: *ca.* 72 mm. Width of midbody PT: 3.2 mm (males), 4.1 mm (females), 49–52 PTs + telson, subadult male with 47 PTs.

Colour (Fig. 2): generally dark brownish; all prozonites and posterior part of metazonites dark brown, anterior part of metazonites light brown-yellowish, more evenly yellowish around middorsal suture; lateral yellow spots present from 5th to ultimate pleurotergite, lying mostly on prozonite. Frons dark brown with four small, slightly lighter spots near antennal bases and in the middle of the frontal part; stipes, cardo and epicranial region marbled with yellow spots on dark brown background; labrum chestnut, the zone above it lighter. Antennae and legs dark brown, telson chestnut.

Frontal part of head convex in both sexes, densely covered with moderately dense, dark setae. Ocellaria subtriangular, composed of *ca.* 35–40 (36 in holotype) black ocelli in 6–7 rows. Tömösváry organs about three times larger than an ocellus, placed between anterior line of ocellar triangle and antennal base, well separated from both. Antennae relatively short, extending to the mid of PT 5 when folded backward (Fig. 7A).

All pleurotergal crests moderately developed; crests on anterior PTs (excl. collum) flattened, getting more pronounced caudad. Eighteen crests between ozopores on PT 7. Ozopores usually on the 8th crest, placed at posterodorsal corner of a yellow spot. Chaetotaxy: see Table 1.

First and second leg-pairs markedly shorter, third slightly shorter than subsequent legs. Tarsi of leg-pairs 1–3 single; bi-articulated from 4th to
ultimate pair. All legs ending with a long and curved claw. Coxal sacs present on legs 3–16. Coxae of leg-pair 2 with posterior gonopores. Coxae of leg-pair 2 with posterior gonopores. Coxa 7 short, subquadrate, without any particular modifications; tibiae and tarsi in males with stout, whitish pads (Fig. 9C). Tarsal pads larger on anterior legs, getting smaller caudad. Hypoproct tripartite, medial sclerite largest, trapezoidal, bearing two paramedian macrosetae situated close to each other; lateral sclerites with a seta each. Paraprocts divided into small dorsal and larger ventral sclerites, ventral sclerites bearing ca. 14–20 scattered macrosetae along free borders. Spinnerets thin and short, ending with a long macroseta.

Male gonopods (Fig. 6): in situ extending well beyond pleurotergal edge, telopodites in touch with each other. Sternum (st) – chitinized, subtrapezoidal, medially slightly incised, lying between 7th leg pair and telopodites. Coxa with two processes – a large, apically rounded process (p) covering the base of femoroid and about 1/3 of its length, and a smaller, somewhat broadened and apically slightly serrated one (a). Femoroid strongly enlarged, divided into a large outer branch (ob) and an inner branch (ib) ending with a solenomere (s). Outer branch terminally incised (i), bearing a sponge-like process (k), a large anteromesal process (= tarsus, t), and an inner hook-like process (h) pointing towards ib. Lateral side of outer branch densely covered with macrosetae. Sponge-like process ovoid, placed on posterior side of femoroid at about its midlength, attached horizontally to it, and covered with stout dark spines contrasting against a lighter background. Tarsus darkly coloured, pointing downwards. Inner branch emerging at about 1/4 of femoroidal length, basal part strongly broadened, forming a process (n). Inner branch bifid; parasolenomere (ps) as long as solenomere (s), both pointing towards inner surface of ob. Seminal groove (sg) ending in upper branch.

Females: clearly larger than males, PTs 2 and 3 normal. Second leg-pair unmodified (Fig. 7B).

Apfelbeckia sp.

Material examined:

Remarks
Having only females and/or juveniles at our disposal, the above material could not be identified closer to species.

Genus Himatiopetalum Verhoeff, 1900

Himatiopetalum Verhoeff, 1900a: 50. Type species: Lysio-petalum ictericum L. Koch, 1867, by monotypy.

Diagnosis: A genus of Apfelbeckiini with crest-ed collum, undivided hypoproct, and outer femoroidal branch of gonopods flexible.

Himatiopetalum ictericum (L. Koch, 1867)

Figs 8, 9D

Lysiopetalum ictericum L. Koch, 1867: 895. Type locality: Corfu, Greece.


Material examined:
Type specimens: 1 male lectotype, 1 male, two females and one specimen of unknown sex, paralectotypes, by present designation, Inv. No. 1913.7.25.713-717 [Corfu, Erber 346] (BMNH; R. Hoffman & J. Beccaloni, in litt.). Other specimens: entire undissected M [Corfu, K.W. Verhoeff Coll.] (ZMB); slide of gonopods [Corfu, K.W. Verhoeff Coll.] (ZMB); 1 F, Inv. No. 472 [Corfu, Verhoeff Coll.?] (AMNH); ad. M [Corfu] (NHMW); 1 F, no data, bought from Verhoeff (ZMUC).

Distribution
Known only from the island of Corfu, Greece. (There is, however, material in the NHMW collected from the Llogorasë Pass, south of the city.
of Vlorë, Albania, putatively referred to as *H. ictericum* by Attems.)

**Remarks**
Since all existing illustrations of the species come from earlier works of Verhoeff, and for consistency with the descriptions of other species of Apfelbeckiini, here we provide new illustrations of the head and anterior PTs, male leg-pair 7 and gonopods.

**Key to the species of Apfelbeckiini**
1. Outer femoroidal branch (*ob*) of gonopods flexible, entirely enveloping the inner branch; coxal process (*cp*) membranous, enveloping the femoroidal base; sponge-like process (*k*) with elongated spines, spines not tapering, equally broad along their length; tarsal process (*t*) missing; (Fig. 8B–D); trochanter of male leg-pair 7 expanded dorsally (Fig. 9D); hypoproct undivided; collum with well pronounced crests (Fig. 8A); midbody PTs with crests below the level of ozopores …………. *Himatiopetalum ictericum* – *ob* solid, partly enveloping the inner branch; coxal process (*p*) hard, not membranous, placed laterally; sponge-like process with short tapering spines; tarsal process (*t*) present; trochanter of male leg-pair 7 normal (Fig. 9A–C); hypoproct
THE MILLEPEDE TRIBE APFELBECKIINI

tripartite; collum smooth; midbody PTs without crests bellow the level of ozopores ..............
Genus Apfelbeckia ........................................... 2

2. Male head concave frontally; inner surface of ob with an apical outgrowth bearing thick setae (g in Fig. 3B) ......................... A. brazzana
– Male head convex; inner surface of ob without outgrowth ........................................ 3

3. Terminal part of ob strongly incised; hook-like process (h) pointed; sponge-like process (k) small; inner side of ob devoid of setae (Fig. 6); PTs 1–4 with a single row of setae in anterior position; small species (up to 50–60 mm); antennae in males short, reaching the mid of PT 5 when folded backward ...................... A. syntheses

– Terminal part of ob slightly incised; h rounded or notched; k larger; inner side of ob with setae (Fig. 4A–D); PTs 1–4 with two rows of setae in anterior and posterior position; larger species (up to 100 mm); antennae in males long, extending beyond PT 7 when folded backward ..................... A. insculpta

DISCUSSION

In their paper on Turkish Callipodida, which constitutes the starting point of modern callipodidan taxonomy, Hoffman & Lohmander (1964) remarked about the family Schizopetalidae that “Species in this family are moderate to fairly...
large in size, and offer good materials for the study of geographic dispersal and variation. A beginning of such work is herewith made, in the form of a preliminary revision of *Eurygyrus* and it is to be hoped that someday similar studies can be made on such large genera as *Acanthopetalum* and *Apfelbeckia*. The present paper is a partial fulfillment of Hoffman & Lohmander’s hope, although the outcome of our work on *Apfelbeckia* et al. is quite different from that of theirs on *Eurygyrus*. Whereas the latter genus is still regarded as being composed of a large number of species (18, according to the most recent contribution (Stoev 2007)), we have synonymized all previously described species of *Apfelbeckia* under one name. In this respect, our study is more in line with the recent detailed studies on the genus *Rhymogona* Cook, 1896 (Chordeumatida: Craspedosomatidae), in which previous authors (notably Verhoeff) had described a host of taxa which, on closer scrutiny, turned out to fall within a single biological species (Pedroli-Christen & Scholl 1996, but see Spelda 2005 for a contrasting view). Without doubt, revision of several other genera of European millipedes will result in similar massive synonymisations.

Of the three species we recognize in *Apfelbeckia*, gonopodal similarity is particularly strong between the insular species *A. brazzana* and the mainland species *A. insculpta*, suggesting recent separation of the island populations from the mainland ones. We are, however, unable to present a proper phylogenetic analysis of relationships between apfelbeckiines, the available evidence being too meagre for this.

One specimen (type specimen of *Karlabosolina mirabilis*) seems to be the first example of gynandromorphism in Callipodida. Gynandromorphism in millipedes has so far been documented only in species of the order Julida (e.g., Bigler 1920; Enghoff 1985).

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