CONTRIBUTION TO THE STUDY OF THE TRIBE TYPHLOTRICHOLIGIOIDINI RIOJA, 1953 (ISOPODA, ONISCIDEA, TRICHONISCIDAE)

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Abstract. Following a historical review of the tribe Typhlotricholigioidini, we define the tribe and the genera which, according to our view, are included in it. The genus *Brackenphiloscia* Ortiz, Garcia Debraz & Lalana, 1999 we interpret as part of this tribe. The examination of the holotype of the species *Caucasonethes borutzkyi* Verhoeff, 1932, the type species of the genus *Caucasonethes*, as well as individuals from the type series of several species attributed to the genus *Amerigoniscus* Vandel, 1950, allowed us to endorse the viability of the synonymy established by Vandel (1953a): *Caucasonethes* Verhoeff, 1932 syn. *Amerigoniscus* Vandel, 1950. The study of several species of *Caucasonethes* led us to the conclusion that *Tauronethes lebedinskyi* Borutzky, 1949 should be included in the genus *Caucasonethes* and we suggested the synonymy *Caucasonethes* Verhoeff, 1932 syn. *Tauronethes* Borutzky, 1949 nov. syn. We establish an identification key for the genera included in the Tribe Typhlotricholigioidini.

Key words: Isopoda, Oniscidea, Trichoniscidae, Typhlotricholigioidini definition, distribution and identification key of the genera included.

1. INTRODUCTION

ENRIQUE RIOJA (1953) described a remarkable stygobitic oniscid, which he named *Typhlotricholigioides aquaticus*, from a cave in Mexico, at the same time erecting for the genus *Typhlotricholigioides* a new subfamily: Typhlotricholigioidae. Subsequently, this subfamily was not recognized, the genus *Typhlotricholigioides* being included in the family Trichoniscidae, close to the genus *Protrichoniscus* (currently *Brackenridgia*). In the classification for the genera of the subfamily Trichoniscinae, VANDEL (1953B, 1960) included these two genera in the group he named the First Tribe (1953) or the First Division (1960) along with the genera *Caucasonethes*, *Finaloniscus*, *Escualdoniscus*, *Trichonethes* and *Tauronethes*. The name Tribe Protrichoniscini was used for this group (BORUTZKY, 1962, 1969, 1972; SCHMÖLZER, 1965; TABACARU, 1969; STROUHAL, 1971) but according to the International Code of Zoological Nomenclature (ICZN, 2000) Art. 35. 1 (family-group) and Art. 23. 3. 1 (Law of priority), we considered (TABACARU, 1993) that the name Typhlotricholigioidini Rioja, 1953 should be used.

The species included in this tribe are, with very few exceptions, all troglobitic. The species *Cantabroniscus primitivus* Vandel, 1965 and *Typhlotricholigioides aquaticus* Rioja, 1953 are stygobitic while the species *Brackenridgia bridgesi* (Van Name, 1942) may be regarded as amphibious (SKET, 1986; ARGANO, 1994; KARAMAN, 2003; PALACIOS-VARGAS & AL., 2015).

Considering the structure of the first male pleopod, it can be assumed that this tribe contains the most basal representatives of the family Trichoniscidae. Among the Typhlotricholigioidini, *Cantabroniscus primitivus* Vandel, 1965 has a basal position in the family Trichoniscidae (ERHARDT, 1997, p. 6–7). In this genus, the first male pleopod strongly resembles the same appendage in *Mesoniscus*, a fact that endorses the phylogenetic hypothesis maintained by us (TABACARU & DANIELOPOL, 1996A, 1996B, TABACARU & GIURGINCA, 2019, 2020), which regards the Section Microcheta as the plesiomorphic sister-group of the Section Synocheta.

The tribe has a vast North-Atlantic distribution (as VANDEL, 1953C showed) from Caucasus to the Pacific Coast of North America (BORUTZKY, 1962 FIG. 5; HORVATOVIC, 2014, FIG. 4.24). This fact argues for the ancient origin of the sub-order Oniscidea (BROLY & AL., 2013).

In this paper, we define the Tribe Typhlotricholigioidini and the genera included in this tribe in our opinion.

2. TRIBE TYPHLOTRICHOLIGIOIDINI – HISTORY

ALBERT VANDEL published in 1950 the results of the study of the terrestrial Isopods from the Biospeologica collection entrusted to him by PIERRE ALFRED CHAPPUIS after the death of EMILE RACOVITZA. The material contained the Oniscidea collected by the speleological expedition of C. Bolivar and R. Jeannel (1928) in North America to which Vandel added the material collected subsequently by D. Henrot (1946). The study also included the description of two new cavernicolous species, namely a species of the genus *Miktoniscus* Kesselyak, dedicated to Emile Racovitza, *M. racovitzai*, and a species found from a cave in Virginia for which Vandel established a new genus, *Amerigoniscus*, naming it *A. henroti*. At the same time, Vandel suggested a new grouping of the genera of the sub-family Trichoniscinae and considered that the new genus *Amerigoniscus* along with the genera *Caucasonethes* and *Escualdoniscus* form a separate group. The genus *Caucasonethes* was established by the German zoologist KARL WILHELM VERHOEFF (1932) for a species discovered by E. V. Borutzky in two caves in the Kutaissi region (Transcaucasia, Georgia) while the genus *Escualdoniscus* was established by Vandel (1948) for two species found in the Western Pyrenees.

But in 1953, studying a new species of Trichoniscidae collected under broken rock and moss in a dense forest east of Gold Beach, Oregon, Vandel decided the genus *Amerigoniscus* Vandel, 1950 to be synonymous with the genus *Caucasonethes* Verhoeff, 1932 (VANDEL, 1953A). Vandel redefined the genus *Caucasonethes* and provided an identification key for the three known species: *C. borutzkyi* Verhoeff, 1932, *C. henroti* (Vandel, 1950) and *C. rothi* Vandel, 1953.

The same year, Vandel published the classification of the family Trichoniscidae, a classification he subsequently supported in the volume *Isopodes terrestres* from the series *Faune de France* (1960). He classified the genera of the sub-family Trichoniscinae in three Tribes (the second Tribe contains 5 legions) (VANDEL, 1953B). In the first Tribe, Vandel included the genera: *Protrichoniscus* Arcangeli, *Finaloniscus* Brian, *Escualdoniscus* Vandel, *Caucasonethes* Verhoeff and possibly the incompletely known genera *Brackenridgia* Ulrich and *Cylindroniscus* Arcangeli. The genus *Protrichoniscus* was established in 1932 by the Italian zoologist Alceste Arcangeli for the species *P. heroldi* Arcangeli, 1953 collected by Prof. Filipo Silvestri in North America in deep cracks at San Mateo (California). The genus *Finaloniscus* Brian, 1951 was proposed by the Italian zoologist Alessandro Brian to replace the name *Marioniscus* Brian, 1951 (preoccupied name) he established for the species *M. franciscoloi* Brian, 1951 collected in the cave Arma de Fate at Finalpia in Western Liguria. Vandel emphasized that this is an ancient, basal group, with a Mesogean distribution, stretching from the Caucasus to the American Pacific Coast and he also describes the characters and the distribution of the genera he included in this tribe (VANDEL, 1953C).

In the volume *Isopodes terrestres* (*Première partie*) from the series *Faune de France*, VANDEL (1960) presented the classification he proposed in 1953 but used the term Division instead of Tribe because he applied the name Tribe for taxa higher than super-family. This use does not correspond with the International Code of Zoological Nomenclature. In the First Division, Vandel included the genera: *Protrichoniscus*, *Typhlotricholigioides*, *Escualdoniscus*, *Finaloniscus*, *Trichonethes* and *Caucasonethes*. Thus, in comparison with the 1953 classification, Vandel added in this Division the genera *Typhlotricholigioides* and *Trichonethes*. The genus *Typhlotricholigioides* was established by the Spanish zoologist, emigrated to Mexico, Enrique Rioja, for the remarkable aquatic species, *T. aquaticus* Rioja, 1953, collected in a cave near Cordoba in the state of Vera Cruz, Mexico. The genus *Trichonethes* was also established in 1953 by the Austrian zoologist Hans Strouhal for the species *T. kosswigi* Strouhal, 1953 collected by Prof. Curt Kosswig in a cave in South-Western Anatolia.

The Russian zoologist Evgenii Vladimirovich Borutzky provided in 1962 a re-description of the species *Tauronethes lebedinsky* Borutzky, 1949 originating in a cave in Crimea, for which he instituted the genus *Tauronethes* Borutzky, 1949 and included the genus *Tauronethes* in the group established by Vandel under the name the First Tribe or the First Division, which Borutzky calls the Tribe Protrichoniscini.

Vandel published an ample study on the cavernicolous Trichoniscidae from North America in 1965 based on a rich collection entrusted to him by Dr. Thomas C. Carr from the Kentucky University. Vandel noted that the material included numerous species but solely from the First Division (the genera *Protrichoniscus* and *Caucasonethes*) and from the Third Division (the genus *Miktoniscus*). Of foremost importance is the exact description by Vandel of the problematic species

Brackenridgia cavernarum Ulrich, 1902 based on material collected from numerous caves in Texas including the type locality Ezell Cave at San Marcos. Vandel concluded that *Brackenridgia cavernarum* Ulrich, 1902 belongs without any doubt to the same genus as *Protrichoniscus heroldi* Arcangeli, 1932. But Vandel maintained the genus name *Protrichoniscus* Arcangeli, 1932 claiming that the definition of *Brackenridgia* by Ulrich lacks any taxonomic value as it includes general characters applying to all genera of cavernicolous Trichoniscidae. This is explainable, in our opinion, by the fact that the American zoologist described this genus in 1902 before Racovitza specified, in 1908, the important differential characters of the Trichoniscidae genera especially by the study of the pleopods. Besides, the American zoologists Willard Gibbs Van Name, Stanley B. Mulaik and Enrique Rioja described new species also within the genus *Protrichoniscus* Arcangeli. Vandel re-described the species *P. bridgesi* Van Name and *P. villalobosi* Rioja, described the new species *P. reddelli* and elaborated an identification key for the species of the genus *Protrichoniscus*: *P. cavernarum* (Ulrich, 1902), *P. heroldi* Arcangeli, 1932, *P. bridgesi* Van Name, 1950, *P. villalobosi* Rioja, 1950, *P. acostai* Rioja, 1951 and *P. reddelli*. Also, Vandel described two new species of the genus *Caucasonethes*, respectively *C. nicholasi* and *C. gipsocolus* and provided an identification key for the species of this genus: *C. borutzkyi* Verhoeff, *C. henroti* (Vandel), *C. rothi* Vandel, *C. nicholasi* and *C. gipsocolus*.

In three successive papers, VANDEL (1965B, 1966, 1967) presented a remarkable troglobitic trichoniscid with an exclusively aquatic way of life, distributed in numerous caves in the Cantabrian Mountains (the regions Ramales, Matiezo, Bustablado, Ason) in the Northern Spain for which he established the new genus *Cantabroniscus* with the species *C. primitivus*. Vandel considered this isopod as the most basal trichoniscid, close to two aquatic troglobitic species, respectively *Typhlotricoligioides aquaticus* and *Mexiconiscus laevis*, known from Mexico.

In 1969, BORUTZKY established the genus *Psachonethes* for the species *P. czerkessicus* Borutzky, 1969, collected from a cave in Western Transcaucasia. He included the new genus in the tribe Protrichoniscini and established an identification key for all the genera united within this tribe: *Protrichoniscus* Arcangeli, 1932, *Typhlotricholigioides* Rioja, 1953, *Escualdoniscus* Vandel, 1948, *Cantabroniscus* Vandel, 1965, *Finaloniscus* Brian, 1951, *Psachonethes* Borutzky, 1969, *Trichonethes* Strouhal, 1953, *Antennulonethes* Verhoeff, 1957, *Caucasonethes* Verhoeff, 1932, *Tauronethes* Borutzky, 1949.

Presumably not being aware of the papers published in Russian by BORUTZKY (1949, 1962) which established the Tribe Protrichoniscini, the Austrian zoologist KARL SCHMÖLZER (1965) established again the tribe by writing *Protrichoniscini* nov. trib., in the volume *Ordnung Isopoda* from the series Bestimmungsbücher zur Bodenfauna Europas, referring to the genera *Protrichoniscus* Arc., *Caucasonethes* Verh. = *Amerigoniscus* Vandel, *Escualdoniscus* Vandel and *Finaloniscus* Brian,

In 1971, HANS STROUHAL published a study on the Isopoda collected by Dr. Klaus Dobat from caves situated in Northern Anatolia (Bithynia). STROUHAL provided a detailed description of a new genus *Chasmatoniscus*, with the species *C. oculatus*, included by him in the Subfamily Trichoniscinae, Tribe *Protrichoniscini* Schmölzer, 1965 and compared it with the genera *Antennulonethes* Verhoeff and *Trichonethes* Strouhal. However, based on an ample material collected by Italian expeditions, zoologists Roberto Argano and Claudio Manicastri (1988), synonymize the genus *Antennulonethes*, respectively the species *Antennulonethes nitidus* Verhoeff, 1967 but also *Trichonethes cavicola* Strouhal, 1953 with the species *Trichonethes kosswigi* Strouhal, 1953 found in caves in South-West Turkey (Pisidia) and in Rhodes Island and, in the same time, underlined the obvious affinity between this species and the species *Caucasonethes borutzkyi* Verhoeff, 1932.

In 1977, VANDEL analyzing a material collected by a team of American biospeleologists led by late Dr. John R. Holsinger, re-established the genus *Amerigoniscus*, separating it from *Caucasonethes* and succinctly presents 4 new species: *A. georgensis*, *A. proximus*, *A. curvatus* and *A. centralis*. But in this paper, we have to point out, Vandel described and provided drawings only for the end portion of the male pleopod 1 exopodite. Concerning the genus *Caucasonethes* Verhoeff, 1932, a new species, *C. vandeli* Tabacaru, 1993 was described based on material collected by Prof. Margareta Dumitrescu and Prof. Traian Orghidan in caves from Dobrogea (Romania) and, subsequently, a new subspecies, *C. vandeli pygmaeus* Giurginca, 2020 was discovered in Movile Cave (Mangalia, Southern Dobrogea).

In an analysis of the distribution of the cavernicolous Oniscidea in the Balkan Peninsula and in the Carpathians, one of us (TABACARU, 1969), used the name Tribe *Protrichoniscini* Borutzky as Borutzky introduced the name for the first time in 1962, and Schmölzer in 1965. Subsequently (TABACARU, 1993A, 1993B), we considered that the name of the tribe should be Typhlotricholigioidini, taking into account that Rioja established for the genus *Typhlotricholigioides* the subfamily Typhlotricholigioidinae, within the family Trichoniscidae.

The Cuban zoologist Manuel Ortiz, trained in Romania by the well-known carcinologist Mihai Băcescu, established in 1999, together with Alfredo Garcia Debras and Rogelio Lalana, a new genus of troglobitic dulcaquicolous oniscids *Brackenphiloscia* with the species *B. vandeli* collected in gours from Gran Caverna de Fuentes, Luis Lazo, Pinar del Rio, Cuba. In our opinion, this species fits inside the tribe Typhlotricholigioidini.

Contrary to the opinion of Vandel, namely to maintain the name *Protrichoniscus*, it was argued (Reddell, 1970; Schultz, 1984; Leistikow & Wägele, 1999) for the obligatory use of the priority principle and the name *Protrichoniscus* Arcangeli, 1932 with *Brackenridgia* Ulrich, 1902. The American zoologist George Schultz described the species *Brackenridgia sphinxensis* Schultz, 1984, while Julian Lewis described in 2004 the species *Brackenridgia ashley*. In the same paper,

Lewis presents the distribution of the known species of the genus *Brackenridgia* and provides an identification key for these species, respectively: *B. acostai*, *B. sphinxensis*, *B. cavernarum*, *B. villalobosi*, *B.* a*shleyi*, *B. bridgesi* and *B. reddelli*.

3. MATERIAL EXAMINED

Caucasonethes borutzkyi Verhoeff, 1932 – Holotype 4 slides in Canada balsam, mounted by Verhoeff, Zoologische Staatssammlung München (Giurginca & Tabacaru – this volume).

Caucasonethes vandeli Tabacaru, 1993 – males and females, caves from Dobrogea (Dumitrescu & Orghidan leg.), Dobrogea, Romania (Tabacaru, 1993).

Caucasonethes vandeli pygmaeus Giurginca, 2020 – males and females, Movile Cave (Serban M. Sarbu leg.), Dobrogea, Romania (Giurginca & Sarbu, 2020).

Finaloniscus berberensis Vandel, 1959 – one male, one female, Morocco, Biospeologica Collection.

Cantabroniscus primitivus Vandel, 1965 – specimens collected in Cueva del Agua de Ason, Spain, leg. Dr. Ana Isabel Camacho.

Caucasonethes – material from the type series loaned from Smithsonian Institution, National Museum of Natural History:

Caucasonethes centralis Vandel USNM cat. 144064 1 lot, 11 spms, Wagon Wheel Cave, Muray Co., Oklahoma, June 13 1964, R. Norton and J. Holsinger, 4 males, 6 females.

Caucasonethes gipsocolus Vandel USNM cat. 19713 1 lot, 1spm, Batman Cave, Texas, V 1963, J. Reddell/W. Russell. Specimen from three fragments, lacking pleopods 1 and 2.

Caucasonethes henroti Vandel USNM cat. 113638 1 lot, 3 spms, Spangler Cave, Lee Co., Va XI-26-65, O. Zinley, G. Holsinger Colle, 1 male 2 females, det. G. Holsinger, 1966 1 male 5.25 mm Part. Disec. (G. Holsinger).

Caucasonethes nicholasi Vandel USNM cat. 119715 1 lot 6 spms, Columbia Caverns, Tennessee, 22.VI.1957, T. C. Barr, 6 females.

Caucasonethes proximus Vandel USNM cat. 144066 1 lot 6 spms, Blowing Spr. Cave 2.5 mi NE Cloudland Chatooga Co., Ga June 11 1967, J. Holsinger, S. Peck, A. Fiske, R. Baroody, 6 females.

4. DEFINITION OF THE TRIBE TYPHLOTRICHOLIGIOIDINI

ALBERT VANDEL (1960, p. 141–142) defined the group of genera which he firstly named (1953B, 1953C) First Tribe and afterwards (1960, 1965) First Division by the following characters: 1) pleopod 1 male endopodite unisegmented, small, ovoid (*Protrichoniscus*), or, most frequently, shaped like an elongated blade but always lacking the terminal rod; 2) pleopod 1 male exopodite lobed or divided at the tip.

But analyzing the characters of the genera included in this tribe, we can note (TABACARU, 1993A) that the second character pointed out by Vandel is not always valid. Firstly, within the tribe, the genus *Cantabroniscus* but also the species *Brackenridgia cavernarum* and *Brackenridgia sphinxensis* have the pleopod 1 male exopodite with a rounded tip but without any differentiation, lobe-shaped or split. On the other hand, we note that the triangular-shaped and apically differentiated exopodite of the pleopod 1 male, similar with that of the representatives of this tribe, is also present at some species included in the tribe Spelaeonethini.

Moreover, by analyzing the types of the species *Hyloniscus pilifer* Verhoeff and *Hyloniscus parnesius* Verhoeff from the Zoologische Staatssammlung München confirmed (TABACARU, 1993B) the affirmation of VANDEL (1960, p. 152): in some species of the genus *Hyloniscus* the pleopod 1 male endopodite may lack the terminal rod. In this case, it represents a secondary reduction and the inclusion of those species within the genus *Hyloniscus* is demonstrated by the male pereopod VII and pleopod 2 male endopodite which are characteristic for this genus.

In the definition of the tribe Typhlotricholigioidini, we have to emphasize the absence of sexual differentiations at the pereopod VII (TABACARU, 1994). But the essential character of this tribe, used also by SCHMÖLZER (1965, p. 30) and by STROUHAL (1971), remains the simple conformation of the pleopod 1 male endopodite: unisegmented and lacking the terminal rod, as it is also recorded in Microcheta (Mesoniscidae).

At the 8th International Congress of Speleology (Bowling Green, Kentucky University, U.S.A., 1981), the zoologist GEORGE A. SCHULTZ presented a synthesis concerning the Isopoda Oniscidea from the caves of North America. He showed that two families, respectively Trichoniscidae and Philoscidae, are well represented in caves, but the greatest number of exclusively cavernicolous species belongs to the family Trichoniscidae: *Amerigoniscus* Vandel (7 species), *Cylindroniscus* Arcangeli (4 species), *Mexiconiscus* Schultz (1 species), *Brackenridgia* Ulrich (6 species), *Typhlotricoligioides* Rioja (1 species).

In 2004, in a last paper describing a representative of the tribe Typhlotricholigioidini in America, Julian Lewis maintained that excepting the genus *Amerigoniscus*, other North American genera for consideration were listed variously in the First Division Trichoniscinae by VANDEL (1965) or Tribe Typhlotricholigioidini (TABACARU, 1993, SCHULTZ, 1994): *Brackenridgia*, *Typhlotricholigioides*, *Cylindroniscus* and *Mexiconiscus*.

But, following an analysis of the tribe Typhlotricholigioidini based on the literature and the available material, we reached a series of conclusions regarding the composition of this tribe:

1. The genus *Mexiconiscus* Schultz, 1964

In a study concerning the morphology, ecology and the distribution of the genus *Mexiconiscus*, VANDEL (1970, p.168) maintains: "*Mexiconiscus* appartient incontestablement à la première Division des *Trichoniscidae*, qui rassemble les

types les plus primitifs de cette famille et qui comprend les genres *Cantabroniscus*, *Mexiconiscus*, *Protrichoniscus*, *Finaloniscus*, *Escualdoniscus*, *Trichonethes* et *Caucasonethes*" (*Mexiconiscus* belongs incontestably to the First Division of the Trichoniscidae which gathers the most primitive types of this family and which comprises the genera *Cantabroniscus*, *Mexiconiscus*, *Protrichoniscus*, *Finaloniscus*, *Escualdoniscus*, *Trichonethes* et *Caucasonethes*).

The genus *Mexiconiscus* contains a single species *M. laevis* (Rioja, 1956). Initially, this species was described as *Cordioniscus laevis*, based on a female collected by F. Bonet in a cave in the Xilitla region of Mexico. Assigning this species to the genus *Cordioniscus*, Rioja considered it as a member of the family Styloniscidae. MULAIK (1960) follows the description provided by Rioja and also includes the species in the family Styloniscidae.

Based on a sole male individual, SCHULTZ (1964) described a new species from a cave close to Xilitla, for which he establishes a new genus within the family Trichoniscidae: *Mexiconiscus tlamayensis*. He considered the genus *Mexiconiscus* as being close to the genus *Hyloniscus*.

In 1965, THOMAS BOWMAN studied isopods collected in caves from the Xilitla region, rediscovered the species described by Rioja and, not being aware of the paper of SCHULTZ, and, having male individuals, established for this species a new genus named *Xilitloniscus* within the family Trichoniscidae. Bowman considered the genus *Xilitloniscus* as close to the genus *Protrichoniscus* and included it in the First Division established by VANDEL (1960).

In 1968, SCHULTZ realized that the names *Mexiconiscus tlamayensis* Schultz, 1964 and *Xilitloniscus laevis* (Rioja, 1956) had been established for the same species. He showed that the genus name *Mexiconiscus* Schultz, 1964 has priority over *Xilitloniscus* Bowman, 1965 but the species name given by Rioja has priority thus the species has to be named *Mexiconiscus laevis* (Rioja, 1956). SCHULTZ (1968, 1994) argued clearly that *Mexiconiscus* is not close to the genus *Protrichoniscus* and is not part of the tribe established by Vandel but as he had described it in 1968, this genus is close to the genus *Hyloniscus* and is part of tribe II.

In conclusion, as stated before (TABACARU, 1993A, 1993B, 1996), contrary to the opinion maintained by BOWMAN (1965) and by VANDEL (1970) and in agreement with the opinion of SCHULTZ (1964, 1968, 1994), we consider the genus *Mexiconiscus* as belonging to the tribe Spelaeonethini and not to the Typhlotricholigioidini. BOWMAN's opinion was based on examination and drawing of (1965, FIG. 26) the pleopods of a male specimen which had lost the pleopod 1 exopodites and he presented the endopodite as an exopodite asserting that there is no endopodite. Vandel's opinion was influenced by the amphibious habits of the species *Mexiconiscus laevis*, as he intended to argue for the hypothesis of the persistence of the original aquatic way of life in Synocheta and the hypothesis of the polyphyly of the terrestrial Isopoda.

The genus *Mexiconiscus* is the only representative of the tribe Spelaeonethini which is endemic for America. As shown before (TABACARU, 1996, 2021) the tribe

Spelaeonethini has numerous species in the Mediterranean region, from Lebanon to Portugal, and has only one genus in Central America and two genera in Japan (*Hondoniscus* Vandel, 1968 and *Nippononethes* Tabacaru, 1996).

2. Genus *Cylindroniscus* Arcangeli, 1929

ALBERT VANDEL in the classification he proposed for the subfamily Trichoniscinae (1953B) asserts that the incompletely known genus *Cylindroniscus* might belong to the First Tribe. Subsequently, VANDEL (1953C, 1965) included the genus *Cylindroniscus* in the First Tribe and arguing that it presents incontestable affinities with the genus *Finaloniscus*. SCHULTZ (1970), describing a new species, *Cylindroniscus vallesensis*, confirms the placement of the genus *Cylindroniscus* in the First Division (Tribe) of the subfamily Trichoniscinae.

In 2004, LEWIS also mentions the genus *Cylindroniscus* in the First Division Trichoniscinae or Tribe Typhlotricholigioidini.

The genus *Cylindroniscus* was established by Alceste Arcangeli based on several female individuals collected by Filipo Silvestri in Guyanabal in Cuba. Arcangeli described the species *C. seurati* Arcangeli, 1929 and included the genus within the family Trichoniscidae. But the taxonomic position of the genus was very controversial.

K. W. VERHOEFF (1938), based on the description provided by Arcangeli, considering the general shape of the body, established the family Cylindroniscidae for the genus *Cylindroniscus*. But this family was not recognized and most of the authors include the genus *Cylindroniscus* as part of the family Trichoniscidae (VAN NAME, 1936; VANDEL, 1953B, 1953C, 1965, 1973; RIOJA, 1957; SCHULTZ, 1979, 1994; LEISTIKOW & WÄGELE, 1999; SCHMALFUSS, 2003, 2004; SCHMIDT & LEISTIKOW, 2004; LEWIS, 2004; JASS & KLAUSMEIER, 2004, 2006). MULAIK (1960) includes the genus *Cylindroniscus* along with the genera *Cordioniscus*, *Protrichoniscus* and the genus which he proposed, *Antroniscus*, within the family Styloniscidae. We note this placement is not sustained as Mulaik considers the presence of a penicillum on the *pars molaris* of the right mandible at the Styloniscidae as the main difference between the Trichoniscidae and the Styloniscidae!

Studying the Oniscidea collected by the Cuban-Romanian biospeleological expeditions in Cuba, VANDEL (1973) mentions the species *Cylindroniscus seurati* and maintains the genus in the family Trichoniscidae. In a posthumous paper, reporting on the material collected by a new Cuban-Romanian expedition, VANDEL (1981) states he found the species *Cylindroniscus seurati* again and by studying both males and females he argues for the definitive inclusion of the genus *Cylindroniscus* in the family Philoscidae.

Only in 2017, CAMPOS-FILHO & AL., describing a new species from Brazil, provided a new diagnosis for the genus *Cylindroniscus* and established its systematic position within the family Styloniscidae based on the structure of pleopod 1 male. In their argued opinion, similar with that of SCHULTZ (1994), the

description and the drawings provided by VANDEL in 1981, evidently belong to a philosciid species and not to the species *Cylindroniscus seurati*.

Currently, the following 7 species are considered within the genus *Cylindroniscus* Arcangeli, 1929 (syn. *Antroniscus* Mulaik, 1960):

C. seurati Arcangeli, 1929 – Guyanabal, Cuba.

C. maya Rioja, 1958 (syn. *Antroniscus balamensis* Mulaik, 1960) – Cenote de Sambulha, Motul, Yucatan, Mexico and Cueva Balam-Canché, Chichen-Itzá, Yucatan, Mexico.

C. cavicola (Mulaik, 1960) (= *Antroniscus cavicola* Mulaik, 1960) – Gruta del Palmiti, Bustamante, Nuevo León in northern Mexico.

C. yucatanensis (Mulaik, 1960) (= *Antroniscus yucatanensis* Mulaik, 1960) – Santa Maria, Tecax, Yucatan, Mexico.

C. vallesensis Schultz, 1970 – Cueva Pinta, Valles, San Luis Potosi, Mexico.

C. flaviae Campos-Filho, Araujo & Taiti, 2017 – from several caves in the Açungui karst area, Iporange, state of Sao Paulo, Brazil.

C. platoi Fernandes, Campos-Filho & Bichuette, 2018 – three caves of Pedro Leopoldo municipality, state of Minas Gerais, Brazil.

We note that the male pleopods have been described only in the last two species (CAMPOS-FILHO & AL., 2017; FERNANDES & AL., 2018) and we consider that the precise composition of the genus might be established only by knowing the conformation of the male pleopods in the remainder of the species as well.

As the isopodologists I. S. Campus-Filho. M. E. Bichuette, P. B. Araujo and S. Taiti included the genus *Cylindroniscus* within the family Styloniscidae, a fact argued by the structure of the male pleopods in the species *C. flaviae* and *C. platoi*, the genus *Cylindroniscus* can no longer be included in the tribe Typhlotricholigioidini. Besides, in the description of the tribe Typhlotricholigioidini we did not consider the genus *Cylindroniscus* (TABACARU, 1993A, 1993B).

3. Genus *Brackenphiloscia* Ortiz, Garcia-Debrás & Lalana, 1999

The authors of the genus *Brackenphiloscia* do not specify the family for this genus, but it can be stated (SCHMALFUSS, 2003; SCHMIDT & LEISTIKOW, 2004; JASS & KLAUSMEIER, 2006; TAITI & XUE, 2012) that the genus belongs to the family Trichoniscidae. The presence of *pars molaris* on the mandibles, three penicilli on the inner lobe of the maxillula, the conformation of the antennule and the antennal flagellum, as well as the conformation of the first male pleopod endorse this statement. In our opinion, the structure of the pleopod 1 endopodite (unisegmented and lacking a terminal rod) points to the belonging of this genus to the tribe Typhlotricholigioidini.

4. Genus *Amerigoniscus* Vandel, 1950

The genus *Amerigoniscus* was established by Albert Vandel for a troglobitic oniscid collected (2 males and 2 females) by René Jeannel and Henri Henrot from Gilly's Cave, Pennington Gap, Virginia, U.S.A.

VANDEL provided the following diagnosis for this genus: "Right mandible with a ciliated rod; left mandible with two ciliated rods. Maxilliped: palpus with three lobes on the internal side; short endite, equaling in size half of the palpus, ending in a fusiform, ciliated rod and a hair. Elongated genital apophysis, with an inflated distal tip and provided with a terminal inserted button. Pleopod 1 male: unisegmented endopodite, shaped like an elongated blade and *lacking a terminal rod*; very big exopodite, completely covering the endopodite, with a forked tip ending in two lobes. Pleopod 2 male: endopodite bisegmented, distal article ending in a fine tip; exopodite containing a muscle inside".

Concerning the affinities and the position of the genus *Amerigoniscus* within the subfamily Trichoniscinae, VANDEL stated that the new genus presents clear affinities with the genera *Caucasonethes* Verhoeff, 1932 and *Escualdoniscus* Vandel, 1948. He specified *Amerigoniscus* is closer to *Escualdoniscus* due to the shape of the pleopod 1 male endopodite and is especially close to *Caucasonethes* by the structure and size of the first and second male pleopods. But VANDEL did not provide differential characters in relation with these genera.

The comparison of the species described by VANDEL in 1950 as *Amerigoniscus henroti* with the two known species of the genus *Escualdoniscus*, show that they share, as Vandel specified, the unisegmented pleopod 1 male, with endopodite lacking a terminal rod. However, there are clear differences between the species of *Escualdoniscus* and *Amerigoniscus henroti*. In *Escualdoniscus* the exopodite of pleopod 1 male has no terminal lobes and presents a notch on the external edge and the pleopod 2 male endopodite ends with a very long flagellum.

Comparing the species *A. henroti* with the species described by Verhoeff, *Caucasonethes borutzkyi*, we note that at the species established by Vandel, the pleopod 1 male exopodite presents an elongated apical external lobe clearly exceeding the internal lobe while the pleopod 2 male exopodite has a semicircular shape. But these differential characters do not exist in the other species attributed subsequently to the genus *Amerigoniscus* and, as such, in our opinion, they are characters belonging only to *A. henroti*.

In 1953, VANDEL described a new blind and depigmented species, similar to the species described by him under the name *Amerigoniscus henroti*, but collected not from a cave but from under broken rocks and moss in a dense forest East of Gold Beach in Oregon. VANDEL (1953A) included the new species in the genus *Caucasonethes* Verhoeff, 1932 and regarded the genus *Amerigoniscus* Vandel, 1950 as synonymous with the genus *Caucasonethes*.

In a study of a North-Atlantic group of Trichoniscinae, referring to the genus *Caucasonethes*, VANDEL (1953C, p. 372) stated that: "L'étude renouvelée de ce genre m'a convaincu que le genre *Amerigoniscus* que j'avais institué en 1950 (VANDEL, 1950, P. 185) ne saurait être maintenu; il est, en fait synonyme de *Caucasonethes* Verh. (The study of this genus convinced me that the genus *Amerigoniscus* established by me in 1950, should not be maintained; it is, in fact, synonymous with *Caucasonethes* Verh.).

VANDEL (1965) held the same opinion in a study concerning the cavernicolous Trichoniscidae from North America and described two new species of the genus *Caucasonethes*. He provided a definition of the genus *Caucasonethes* and an identification key for the species *C. borutzkyi* Verh., from Caucasus, along with the species from North America: *C. henroti* (Vandel, 1950), *C. rothi* Vandel, 1953, *C. nicholasi* Vandel, 1965 and *C. gipsocolus* Vandel, 1965.

Studying the holotype of *C. borutzkyi* led us to the conclusion that this species is very close to the American species and, as we have pointed out previously (TABACARU, 1993), the differential character used by Vandel in the identification key, in opposition with *C. rothi*, is not valid: considering the figure provided by VERHOEFF (1932, FIG. 17), Vandel stated that the presence of two "widely separated" lobes at the pleopod 1 male exopodite in *C. borutzkyi*, but in reality the lobes are very close and even superposed (GIURGINCA & TABACARU, THIS VOLUME, FIG. 9), as it is also the case in the American species (Fig. 1A, 6, 12).

But in 1977, VANDEL turned back to his 1950 opinion and re-established the genus *Amerigoniscus*: in his opinion, only the tip of the pleopod 1 male exopodite allows the division of this genus. In the same paper, Vandel presented 4 new species, collected from caves from North America, for which he described and drew only the apical tip of the pleopod 1 male exopodite.

The study of the pleopod 1 male exopodite led us to conclude that there are certain differences between the species but there are no reasons to separate the American species from the two known species of *Caucasonethes*, respectively *C. borutzkyi* Verhoeff and *C. vandeli* Tabacaru (Fig. 1, 6, 11C, 12).

In his paper, VANDEL (1977, p. 304) maintains: "La définition du genre *Amerigoniscus* a été donné à plusieurs reprises par l'auteur du présent mémoire (VANDEL, 1950, 1953 A ET B, 1965)" (The definition of the genus *Amerigoniscus* was provided several times by the author of this memoir (VANDEL, 1950, 1953 A ET B, 1965). However, it is obviously clear that this assertion does not correspond to reality as in his two papers from 1953, as well as in his paper from 1965 (VANDEL, 1953A, 1953B, 1965A) there is no definition of the genus *Amerigoniscus*, of contrary, this genus is abolished as it is considered as synonymous with *Caucasonethes* and the author provides new definitions for the genus *Caucasonethes.* On the other hand, in the diagnosis established initially by VANDEL (1950) for the genus *Amerigoniscus* there are no characters that might distinguish it from the genus *Caucasonethes*.

In conclusion, based on examining the existing descriptions and the investigated material, we conclude that we did not find any character shared by the species considered as part of the genus *Amerigoniscus*, that could argue for a separation from the species of the genus *Caucasonethes*. As such, we regard as valid the synonymy between *Amerigoniscus* Vandel, 1950 and *Caucasonethes* Verhoeff, 1932, established by VANDEL (1953A) and argued by him subsequently (1953B, 1953C, 1965).

5. Genus *Tauronethes* Borutzky, 1949

The genus *Tauronethes* was established by E. V. Borutzky for the species *Tauronethes lebedinskyi* Borutzkyi, 1949, described from female individuals collected by the zoologist Yakov Avadievich Birstein from the Skelskaya Cave from Crimea. In 1962, Borutzky redescribed the species, including the male, based on new individuals collected by Birstein from the same cave. Borutzky emphasized the close relationship between the genus *Tauronethes* and the genera *Caucasonethes* Verhoeff and *Finaloniscus* Brian. He included the genus *Tauronethes* in the First Tribe of the subfamily Trichoniscinae established by VANDEL (1953B), for which he used the name Protrichoniscini. Also, Borutzky designated all the species that could be included in this tribe and provided a map with the North-Atlantic distribution of the tribe.

But by comparing the description of the species *T. lebedinskyi* with the species of the genus *Caucasonethes*, we cannot find any morphological character which could justify their separation in two different genera.

In 1969, BORUTZKY described a new genus, *Psachonethes* for the species *P. czerkessicus* Borutzky, 1969, from a cave on the Psacho River, tributary of the Kudepsta River in West Transcaucasia. He also included this genus in the tribe Protrichoniscini and devised an identification key for all the genera of this tribe. In this identification key, the genus *Tauronethes* was placed close to the genus *Caucasonethes*, and the sole differential character given was the conformation of the terminal article of the pleopod 2 male endopodite. But analyzing the structure of the pleopod 2 male endopodite in the species of *Caucasonethes*, we find different shapes according with each species and, as such, the difference specified by Borutzky does not separate his species from the species of *Caucasonethes*.

In conclusion, we can hold the genus *Tauronethes* Borutzky, 1949 is synonymous with the genus *Caucasonethes* Verhoeff, 1932.

6. Genus *Oregoniscus* Hatch, 1947

The fauna of North America contains after JASS & KLAUSMEIER, 2000, p. 790–791, several genera of the family Trichoniscidae: *Amerigoniscus*, *Brackenridgia*, *Haplophthalmus*, *Hyloniscus*, *Miktoniscus*, *Oregoniscus*, *Trichoniscoides* and *Trichoniscus*. Among these genera, *Amerigoniscus*, *Brackenridgia* and *Oregoniscus* are recorded only in America. In our attempt to classify (TABACARU, 1993B) the genera of the Trichoniscinae, we tried to establish in which tribe the genus *Oregoniscus* fits. In the present paper, our interest is to see if it fits within the tribe Typhlotricholigioidini, and we have reviewed the literature accordingly.

At present, *Oregoniscus* Hatch, 1947 is regarded as an accepted genus (LEISTIKOW & WÄGELE, 1999; SCHMALFUSS, 2003, 2004; SCHMIDT & LEISTIKOW, 2004) within the Trichoniscidae family with the type species: *Trichoniscus nearcticus* Arcangeli, 1932 unaccepted (basionym).

ALCESTE ARCANGELI (1932) described on a female specimen collected by Prof. Filipo Silvestri in Macleay Park, Portland, Oregon, the species *Trichoniscus* (subgenus?) *nearcticus*. WILLARD VAN NAME (1936) provided the description in English and the figures given by Arcangeli under the name *Trichoniscus nearcticus* Arcangeli, 1932. But in 1947, MELVILLE H. HATCH established for the species *Trichoniscus nearcticus* Arcangeli, 1932 a new genus, *Oregoniscus* Hatch. He defined the new genus (1947, p. 185) in comparison with the genus *Trichoniscus* by the following characters: "Eyes and pigment absent; body opaque, the surface roughened with granulations each consisting of a conoidal group of serrate scales; generitype *Trichoniscus nearcticus* Arcangeli". But we must point out that these characters are also found in other species of *Trichoniscus*.

Describing the species *Caucasonethes rothi* on a male specimen coming also from Oregon and having eyes and pigment absent, and referring to *Oregoniscus nearcticus* (Arcangeli), ALBERT VANDEL (1953A, p. 178) maintained: "It is difficult to recognize the species of terrestrial isopods based only upon females, but I think that *Oregoniscus nearcticus* (Arcangeli) and *Caucasonethes rothi* n. sp. are distinct."

In a study concerning the species of the genus *Miktoniscus* Kesselyak, 1930 in New World, GEORGE SCHULTZ (1976, p. 28) stated: "*Trichoniscus nearcticus* Arcangeli, 1932 was described from leaf litter in a park in Portland, Oregon (see Van Name, 1936, p. 509). It was placed in *Oregoniscus* (Hatch, 1947, p. 190). The species is described on one blind, pigmentless female and is closely related to, if not within, the genus *Miktoniscus*." SCHULTZ (1982, p. 89), describing the species *Amerigoniscus malheurensis*, found in a cave from Oregon, maintained: "The relation of *Amerigoniscus* Vandel to *Oregoniscus* Hatch (1947) as discussed by Vandel (1953a: 177) is still unsettled since *O. nearcticus* (Arcangeli) is based on a female."

As it is well known, the difference between the family Trichoniscidae Sars and the family Styloniscidae Vandel (= Patagoniscidae Verhoeff) can be done only based on the characters of male specimens (VANDEL, 1960; ERHARDT, 1979; SOUZA & AL., 2015). For biogeographical reasons, we suppose that *Trichoniscus nearcticus* Arcangeli is a trichoniscid. The problem is if we can define the species and establish the genus to which it belongs. It clearly isn't a species of the genus *Brackenridgia* as in this genus both the male and the female have a characteristic tuft of hairs on the propodus of the pereopod VII. Taking into account the specific differences mentioned by VANDEL (1953A) we can assume it is not the female of *Caucasonethes rothi* but it can be other species of *Caucasonethes*. Of course, it can be a species of *Trichoniscus* as Arcangeli described it. On the other side, it might be a species of *Miktoniscus* as Schultz suggested. It is not excluded either to be the female of a species whose male has the characters of a new genus, as Hatch pointed out.

Clearly, the description of *Trichoniscus nearcticus* cannot define a species and, implicitly, the genus to which it belongs. In any case, we cannot find in this

description a character that might justify the erection of a new genus. In conclusion, in our opinion *Trichoniscus nearcticus* Arcangeli, 1932 cannot represent a basionym and *Oregoniscus* Hatch, 1947 is a nomen dubium.

5. MEMBERS OF THE TRIBE TYPHLOTRICHOLIGIOIDINI, DEFINITION AND DISTRIBUTION

Following the data presented anteriorly, we include in the tribe Typhlotricholigioidini Rioja, 1953 the genera: *Brackenridgia* Ulrich, 1902 (Syn. *Protrichoniscus* Arcangeli, 1932), *Caucasonethes* Verhoeff, 1932 (Syn. *Tauronethes* Borutzky, 1949; *Amerigoniscus* Vandel, 1950), *Finaloniscus* Brian, 1951 (= *Marioniscus* Brian, 1951 nom. praeocc.), *Typhlotricholigioides* Rioja, 1953, *Trichonethes* Strouhal, 1953 (Syn. *Antennulonethes* Verhoeff, 1967), *Cantabroniscus* Vandel, 1956, *Psachonethes* Borutzky, 1969, *Chasmatoniscus* Strouhal, 1971, *Escualdoniscus* Séchet & Noël, 2015 (= *Escualdoniscus* Vandel, 1948 – nomen nudum, ICZN, Art. 13.3).

1. Typhlotricholigioides Rioja, 1953

Type species by monotypy: *Typhlotricholigioides aquaticus* Rioja, 1953

Type locality: Cueva de Ojo de Agua Grande, Mexico, Veracruz, Córdoba.

Species: a single species known.

Distribution: Mexico, Veracruz: Cueva de Ojo de Agua Grande, near Córdoba, and Cueva del Oztoc, Sierra de Zongolica (SCHULTZ, 1994; PALACIOS-VARGAS, & AL., 2015).

Literature used: RIOJA (1953, FIGS., 1955, FIGS.); MULAIK (1960); VANDEL (1965B, FIGS.; 1966, FIGS.); SCHULTZ (1994, FIGS.); ERHARDT (1997); LEISTIKOW & WÄGELE (1999); TABACARU (1993, 1999); SCHMALFUSS (2003, 2004).

Main characters of the genus *Typhlotricholigioides* Rioja, 1953

Size: 3–9 mm. White, completely depigmented. Smooth, translucent tegument. Pleonites without glandular fields. Telson, apically rounded.

Eyes absent.

Antennule with elongated articles; last article longer and presents 2–3 aesthetascs.

Antenna with very long flagellum with 8–12 or sometimes even 14 articles.

Mouthparts: Right mandible with a penicillum, left mandible with two penicilli; both mandibles without molar penicilli. Inner endite of maxillula with a characteristic structure. Generally, in Synocheta, the inner endite of maxillula with three penicilli with a similar structure. At this species, the lower penicillum is very different: much wider, with parallel series of hairs, with a forked tip with the lower part strongly elongated. Maxilla with two distinct lobes with numerous hairs.

Maxilliped with long and narrow palpus, with a convex outer edge and concave inner edge. Maxilliped palpus made up by three articles: a short basal one,

a long median and a short, conical end article, doubled inwards by another conical tip. Endite of maxilliped shorter than the palpus, with a wide base, rectangular with rounded corner.

Pereopod with no sexual differentiations and no tuft of setae on the propodus unlike the species of the genus *Brackenridgia*.

Pleopod 1 male with elongated, triangular exopodite, apically with a sexual differentiation. At both sexes, the endopodite is strongly reduced and oval-triangular and in male framing the base of the genital apophysis.

Pleopod 2 male with protopodite and exopodite fused in a single blade. Biarticulated endopodite with distal article longer than the basal one and gradually narrowed toward the tip.

Long uropods, with very close insertions; endopodite somewhat narrower and slightly shorter than the exopodite.

Affinities and differences

The genus *Typhlotricholigioides* shares with the genus *Brackenridgia* the strong reduction of the pleopod 1 endopodite and at the pleopod 2 male the fusion of the exopodite with the protopodite. But *Typhlotricholigioides* differs clearly by the distinctive characters of the mouthparts and the absence of the tuft of hairs from the pereopod VII propodus, a specific feature of *Brackenridgia*.

The elongation of the antennule, the antenna and the uropods as well as the shape of the maxillipedal palpus, narrow, curved and longer than the endite, may possibly represent adaptive characters linked to an aquatic environment. Such characters are found at *Cantabroniscus* as well as in stygobitic species of *Alpioniscus* described more recently (SCHMALFUSS, 2005; TAITI & AL., 2018; BEDEK, 2019) like *A. kuehni* (Schmalfuss, 2005), *A. stochi* Taiti & Argano, 2018 and *A. sideralis* Taiti & Argano, 2018. But the distinctive aspect of the maxillula inner endite, the maxillipedal palpus ending in two conic tips, maxilla with clearly divided lobes are characteristic for the genus *Typhlotricholigioides*.

2. Brackenridgia Ulrich, 1902

Syn. *Protrichoniscus* Arcangeli, 1932; nec *Brackenridgia* Eigenmann, 1900 (nomen nudum); nec *Brackenridgia* Busck, 1903 – junior homonym accepted as *Paraclemensia* Busck, 1904 (Lepidoptera, Incurvariidae).

Type species: *Brackenridgia cavernarum* Ulrich, 1902.

Type locality: Ezell's Cave and Beaver's Cave near San Marcos, Texas (collected by Dr. C.H. Eigenmann, 1899).

Species: nine species: *Brackenridgia cavernarum* Ulrich, 1902, *B. heroldi* (Arcangeli, 1932); *B. bridgesi* (Van Name, 1942); *B. villalobosi* (Rioja, 1950); *B. acostai* (Rioja, 1951); *B. palmitensis* (Mulaik, 1960); *B. reddelli* (Vandel, 1965); *B. sphinxensis* Schultz, 1984; *B. ashleyi* Lewis, 2004.

Distribution: This genus inhabits North America (U.S.A. and Mexico – map in LEWIS, 2004): *B. ashleyi* – U.S.A., Missouri and Arkansas; *B. heroldi* – U.S.A.,

California; *B. cavernarum* – U.S.A., Texas and New Mexico; *B. reddelli* – U.S.A, Texas; *B. sphinxensis* – U.S.A., Arizona; *B. bridgesi* – Northern Mexico, Tamaulipas; *B. palmitensis* – Northern Mexico; *B. villalobosi* – Mexico, Veracruz; *B. acostai* – Mexico, Chiapas. All species are depigmented and blind. Excepting the species *B. heroldi* which is humicolous, all the other species are troglobitic.

Literature used: ULRICH, 1902, FIGS.; RICHARDSON (1905); ARCANGELI (1932, FIGS.); VAN NAME (1936, 1942, FIGS.); RIOJA (1950, FIGS.; 1951, FIGS.; 1955, FIGS.); VANDEL (1953C, FIGS.; 1965A, FIGS.); MUCHMORE, 1970; MULAIK (1960); SCHMÖLZER, 1965; REDDELL (1970, 1981); SCHULTZ (1984, FIGS.); LEISTIKOW & WÄGELE (1999); LEWIS (2004, FIGS.); SCHMALFUSS (2004); SLAY & TAYLOR (2011).

Main characters of the genus *Brackenridgia* Ulrich, 1902

Size varying according to species from 1.4 mm (*B. sphinxensis* Schultz) to 6–7.2 mm (*B. bridgesi* Van Name).

Body completely depigmented. Smooth tegument except in *B. acostai* Rioja which presents a row of tubercles on the posterior edge of the pereionites.

Eyes absent. Antennule with a varying number of aesthetascs: 5–6 (*B. sphinxensis*, *B. ashleyi*), 10–12 (*B. cavernarum*, *B. heroldi*), 20 (*B. bridgesi*). Antennal flagellum with weakly marked articles varying according to species between 3 and 7.

Right mandible with a penicillum posterior to the lacinia mobilis and another one on pars molaris. Left mandible with two penicilli. Maxilliped with a robust palpus with indistinct segmentation and the basis much wider than the base of the endite, sometimes overlapping the base of the endite (*B. heroldi*, *B. villalobosi*).

Pereopod VII in both sexes with a protuberance bearing a tuft of hairs on the propodus.

Pleopod 1 male with a triangular exopodite, elongated and narrowed toward the tip. Apically, the exopodite can be rounded and with no differentiation (*B. cavernarum*, *B. sphinxensis*) or with a slight differentiation (LEWIS, 2004, fig. 6). In both sexes, the pleopod 1 endopodite is strongly reduced, shaped like a small lobe at the base of the interior side of the exopodite.

Pleopod 2 exopodite fused with the endopodite in both sexes. Pleopod 2 male endopodite is bisegmented with the distal segment much longer than the basal one and narrowed toward the tip.

Affinities and differences

The strongly reduced pleopod 1 endopodite and the pleopod 2 exopodite fused to the protopodite point to a close relationship between the genus *Brackenridgia* and *Typhlotricholigioides*. But the species of the genus *Brackenridgia* clearly differ from *Typhlotricholigioides aquaticus* especially by lacking the remarkable characters of the mouthparts of this strictly aquatic species.

Identification keys for the genus *Brackenridgia* exist in RIOJA (1955), MULAIK (1960) and VANDEL (1965) for the species known at that moment. JULIAN J. LEWIS

(2004) wrote an identification key for all species excepting the species *B. palmitensis* (MULAIK, 1960) which cannot be identified by the characters provided by the author as underlined by VANDEL (1965).

Species distribution:

***B. cavernarum* Ulrich, 1902**

Syn.: *Protrichoniscus cavernarum* – Vandel, 1965

Distribution: U.S.A., caves in Texas and New Mexico (VANDEL, 1965; LEWIS, 2004).

B. heroldi (Arcangeli, 1932)

Syn.: *Protrichoniscus heroldi* Arcangeli, 1932

Distribution: U.S.A., California, San Mateo

***B. bridgesi* (Van Name, 1942)**

Syn.: *Protrichoniscus bridgesi* Van Name, 1942; *Protrichoniscus potosianus* Mulaik, 1960.

Distribution: Mexico: caves in the Sierra de El Abra, san Luis Potosi and Tamaulipas and Sierra de Guatemala, Tamaulipas (PALACIOS-VARGAS & AL., 2015).

***B. villalobosi* (Rioja, 1950)**

Syn.: *Protrichoniscus villalobosi* Rioja, 1950.

Distribution: Mexico, caves Cordoba and Orizaba (REDDELL, 1981)

***B. acostai* (Rioja, 1951)**

Syn.: *Protrichoniscus acostai* Rioja, 1951

Distribution: Mexico, Chiapas, Cueva del Tio Ticho and Grutas de Zapaluta.

***B. palmitensis* (Mulaik, 1960)**

Syn.: *Protrichoniscus palmitensis* Mulaik, 1960

Distribution: Grutas del Palmito, Nuevo Leon, Northern Mexico.

***B. reddelli* (Vandel, 1965)**

Syn.: *Protracheoniscus reddelli* Vandel, 1965

Distribution: U.S.A., Texas.

***B. sphinxensis* Schultz, 1984**

Distribution: U.S.A., Arizona, Sphinx Cave, Wood Canyon, 16.1 km southeast of San Simon, Cochise County, Arizona (on or very near the northeastern corner of the Chiricahua National Monument, Cochise Co.).

***B. ashleyi* Lewis, 2004**

Distribution: U.S.A., Missouri: Tumbling Creek Cave, Taney County (LEWIS, 2004); caves in Pulaski County, Missouri, Newton County and Izard County, Arkansas (SLAY & TAYLOR, 2011).

3. *Cantabroniscus* Vandel, 1965

Type species by monotypy: *Cantabroniscus primitivus* Vandel, 1965.

Type locality: Spain, Santander prov., Cullalvera Cave, near Rambas.

Distribution: Northern Spain. Recorded in many caves from Eastern Cantabria, Valencia, Burgos, Araba, Bizkaia (CIUFENTES & AL., 2021).

Literature used: VANDEL, 1965B (FIGS..), 1966 (FIGS.), 1967; ERHARD, 1987 (FIGS.); TABACARU, 1999; TABACARU & GIURGINCA, 2003 (FIGS.).

Main characters of the genus *Cantabroniscus* Vandel, 1965

Size: 9–12 mm.

Body completely depigmented. Tegument smooth and transparent. Pleonites 4 and 5 present on each side a field of glandular pores.

In large individuals, the body has an ovoid shape. The limit pereion-pleon is clearly defined as the pleon is much narrower than the pereion. Telson trapezoidal with slightly concave sides and truncated posterior edge. Both rami of the uropods are narrow and elongated and inserted at the same level, the endopodite being 2/3 from the length of the exopodite.

Eyes absent. Antennule with elongated and narrow distal article presenting 8 terminal and 1 subterminal aesthetascs. Long antenna with the flagellum (following the image provided by Vandel) made up by 10 articles.

Mouthparts: Right mandible with two penicilli, left mandible with three penicilli; both mandibles without molar penicilli. Maxilla with strongly unequal lobes: the inner lobe is narrower and shorter. The outer lobe has a series of approximately 15 hairs with a bent tip. Maxillula with inner endite with three similar penicilli. Maxilliped with long, narrow and strongly bent palpus, formed by three articles: a short, well defined basal article, a long, gradually narrowing second article while the third article, poorly defined from the second one, presents a tuft of hairs at its tip; triangular endite with a basis wider than the base of the palpus.

Pereopod VII with no sexual differentiations.

Genital apophysis gradually narrowing toward the tip and bordered at the base by the endopodites of the first pleopods.

Pleopod 1 male with a large exopodite, triangular with rounded corners and without apical differentiation. Small, narrow, triangular endopodite, barely reaching half the length of the exopodite.

Pleopod 2 male with a triangular exopodite with rounded corners. Biarticulated endopodite, with the narrowed and slightly wavy toward the tip distal article smaller than the basal article.

Affinities and differences

Since the pleopod 1 endopodite is shorter than exopodite, we can regard the genus *Cantabroniscus* as close to the genera *Typhlotricholigioides*, *Brackenridgia* and *Escualdoniscus*.

VANDEL (1965, p. 496) maintained: “Le genre *Cantabroniscus* correspond incontestablement *au type le plus primitif* que l’on connaisse dans la famille des *Trichoniscidae*” (The genus *Cantabroniscus* incontestably corresponds to the *most primitive type* known in the *Trichoniscidae* family). Clearly, the structure of the pleopod 1 male at *Cantabroniscus* is similar with the structure of pleopod 1 male from *Mesoniscus* (Microcheta). The view concerning the phylogeny of the Super-

section Orthogonopoda as argued by us (TABACARU, 1994, 2021; TABACARU & DANIELOPOL, 1996A, 1996B, TABACARU & GIURGINCA, 2019, 2020) agrees with this assertion as we consider the Section Microcheta as the plesiomorphic sister-group of the Section Synocheta.

Conversely, considering the strictly aquatic way of life, in his intention to argue for a separate origin for the Trichoniscidae, Vandel regarded the genus *Cantabroniscus* as closer to the genus *Typhlotricholigioides*.

The study of the morphological characters of the species *Cantabroniscus primitivus* (TABACARU, 1999) revealed numerous differences between these two genera:

Cantabroniscus primitivus Vandel, 1965

- Right mandible with two penicilli, left mandible with three penicilli;
- Maxilliped palpus ending with a single tip, the endite is conical;
- Pleopod 1 male with rounded exopodite, with no differentiation;
- Pleopod 2 male with exopodite clearly defined from the protopodite;
- Pleopod 2 male endopodite basal article longer than the distal article;
- Maxilla with unequal lobes, the inner lobe being shorter and narrower;
- Inner endite of maxillula with 3 similar penicilli.

Typhlotricholigioides aquaticus Rioja, 1953

- Right mandible with one penicillum, left mandible with two penicilli;
- Maxilliped palpus ending with two tips, the endite is truncated;
- Pleopod 1 male exopodite with an apical lobe;
- Pleopod 2 male exopodite fused with the protopodite;
- Pleopod 2 male endopodite with the distal article much longer than the basal article;
- Maxilla with two sub-equal lobes;
- Inner endite of maxillula with the lower penicillum with a clearly different structure than the other two penicilli.

4. *Escualdoniscus* Séchet & Noël, 2015

Syn. *Escualdoniscus* Vandel, 1948 – unavailable name (ICZN, 1999, art.13.3 – genus published after 1930 but no type species selected – SCHMIDT & LEISTIKOW, 2004, p. 33).

Type species (established by SÉCHET & NOËL, 2015, p. 17): *Escualdoniscus triocellatus* (Vandel, 1948).

Type locality: entrance of Gouffre d' Ustarbé (Larrau, Pyrénées-Atlatiques, France).

Species: *E. triocellatus* (Vandel, 1948) – endogeous species; *E. coiffaiti* (Vandel, 1948) – troglobitic species.

Distribution: Pyrénées- basques (SW-France, Northern Spain).

Literature used: VANDEL, 1948 (FIGS.), 1953C, 1960 (p. 147–151, FIGS.); SCHMÖLZER, 1965; ESCOLA, 1980; CRUZ, 1991; SÉCHET & NOËL, 2015.

Main characters of the genus *Escualdoniscus* Séchet & Noël, 2015

Size: 5–6 mm; body weakly pigmented (*E. triocellatus*) or completely depigmented (*E. coiffaiti*).

Eyes made up by three pigmented ommatidia (*E. triocellatus*) or absent (*E. coiffaiti*).

Tegument with granules arranged in rows, more evident on vertex and the anterior pereionites. Granules are formed by a sensilla and scale surrounded by additional scales.

Pleonites 4 and 5 with a pair of glandular fields.

Telson trapezoidal with slightly concave sides. Uropods with exopodite and endopodite of almost the same length.

Antenna with the flagellum made up by 4–5 articles.

Mouthparts: Right mandible with one penicillum, left mandible with two penicilli. Maxilliped palpus with weakly defined segments.

Pereopod VII with no sexual differentiations.

Pleopod 1 male: triangular exopodite with rounded corners and concave external edge, the inner edge with a notch delineating a rounded terminal lobe; endopodite shaped like a triangular, narrow, elongated blade, clearly shorter than the exopodite.

Pleopod 2 male: exopodite shaped like a trapezoidal blade, clearly separated from the protopodite, overlapping with the internal side the edge of the endopodite; Biarticulated endopodite with the distal article prolonged by a long, thin flagellum.

Affinities and differences

Distinctly shorter than the exopodite and without a terminal rod, the structure of the pleopod 1 male endopodite, brings the genus *Escualdoniscus* closer to the genera *Typhlotricholigioides*, *Brackenridgia* and *Cantabroniscus*. It differs from these three genera by the structure of pleopod 2 male endopodite with the distal article prolonged by a very long and thin flagellum. It also differs from the genera *Typhlotricholigioides* and *Brackenridgia* by the pleopod 2 male exopodite clearly separated from the protopodite. The genus *Escualdoniscus* is particularly close to *Cantabroniscus* by the apical part of the pleopod 1 male exopodite (rounded and without differentiations) but at *Escualdoniscus*, it has a notch on the inner side.

Species distribution:

***Escualdoniscus triocellatus* (Vandel, 1948)**

Distribution: SW-France: dépt. Basse-Pyrénées: Larrau, entrance of Ustarbé Cave, 700m; NE-Spain: Valcarlos, Navarra (VANDEL, 1948; 1960; CRUZ, 1991; SÉCHET & NOËL, 2015).

***Escualdoniscus coiffaiti* (Vandel, 1948)**

Distribution: SW-France: Sare, "Grande Grotte de Sare", dépt. Basse-Pyrénées; Northern Spain: Cueva de Landarbaso Renteria, Guipuscoa (VANDEL, 1948; 1960; ESCOLA, 1980; SÉCHET & NOËL, 2015; CIFUENTES & AL., 2021).

5. *Finaloniscus* Brian, 1951

Syn. *Marioniscus* Brian 1951a, nom. praeoccup. *Marioniscus* Barnard, 1932 pro *Marioniscus spatulifrons* (Oniscidea, Fam. Sciphacidae).

Type species by monotypy: *Marioniscus franciscoloi* Brian, 1951.

Type locality: Italy: Cave "Arma de fate N. 33Li", Liguria occidentale, Rio Ponci, Finalpia.

Species: 2 (3?).

Distribution: Italy: Liguria, Tuscany, Sicily; France: Corsica.

Literature used: BRIAN, 1951A, FIGS., 1951B; VANDEL, 1953D FIGS., 1959, FIGS.; 1960; SCHMÖLZER, 1965; TAITI & FERRARA, 1996 (FIGS.).

Main characters of the genus *Finaloniscus* Brian, 1951

Size: 3.5–4 mm. Completely depigmented body. Eyes absent.

Tegument with granules on pereionites. Vertex and pereionites with a pair of paramedian tubercles (*F. briani*) or without tubercles (the other species).

Triangular telson with widely rounded tip.

Antennule with 3–4 aesthetascs. Antenna with the flagellum made up by 5 articles.

Mouthparts: Right mandible with two penicilli and a molar penicillum; left mandible with two penicilli. Maxilliped with triangular palpus, with a wide base and no distinct delineation.

Pereopod VII with a tuft of hairs on the propodus at both sexes.

Pleopod 1 male exopodite is triangular, apically divided in two rounded lobes; endopodite shaped like a narrow blade, equal in length with the exopodite.

Pleopod 2 male exopodite reduced at both sexes and partly fused with the protopodite. Endopodite formed by two sub-equal articles with the distal one gradually narrowed but slightly widened and rounded at the tip.

Affinities and differences

VANDEL (1953, 1960) regarded this genus as certainly very close to the American genus *Protrichoniscus* (*Brackenridgia* at present). In fact, *Finaloniscus* is close to *Brackenridgia* by the presence of a tuft of hairs on the propodus of the VII pereopod at both sexes and by the partial fusion of the exopodite with the protopodite at the pleopod 2 male. In our opinion, the genus *Finaloniscus* is very close to the genus *Caucasonethes* Verhoeff, 1932 due to the structure of the pleopod 1 male. But it differs from *Caucasonethes* by the structure of the pleopod 2 male with a reduced exopodite partly fused with the protopodite and the endopodite with the distal article slightly widened at the tip.

Species distribution:

***Finaloniscus franciscoloi* (Brian, 1951)**

Syn.: *Marioniscus franciscoloi* Brian, 1951

Distribution: After TAITI & FERRARA, 1996 (p. 465): *F. franciscoloi* was previously recorded from some caves of Savona Province (Liguria) (BOLOGNA & VIGNA TAGLIANTI, 1985), from Tuscany (TAITI & FERRARA, 1989A, 1995B) and

Sicily (CARUSO & ALL., 1987); also France: Corsica (Taiti & Pogi leg.). These specimens correspond in all details to the descriptions of *F. franciscoloi* by BRIAN (1951) and VANDEL (1953B). Besides the two species present in Corsica, the genus *Finaloniscus* includes also *F. berberensis* Vandel, 1959 from Algeria and Morocco, which, according to its description (VANDEL, 1959), is probably synonymous with *F. franciscoloi*.

***Finaloniscus briani* Vandel, 1953**

Distribution: Pietracorbara, north of Brando; Grotte Corte at Ponticello, Corsica (France).

***Finaloniscus berberensis* Vandel, 1953**

Distribution: NE-Morocco, northern Algeria.

6. *Caucasonethes* Verhoeff, 1932

Syn.: *Amerigoniscus* Vandel, 1950, synonymy established in 1953a; *Tauronethes* Borutzky, 1949-junior synonym, nov.syn.

Type species by monotypy: *Caucasonethes borutzky* Verhoeff, 1932

Type locality: Rion Cave near Kutaisi, Transcaucasia, Georgia.

Species: As in this paper we consider as valid the synonymy of the genus *Amerigoniscus* with the genus *Caucasonethes* (synonymy established by VANDEL, 1953A, P.175) and we establish the synonymy of *Tauronethes* with *Caucasonethes*, this means there are 12 species and a subspecies included in the genus *Caucasonethes*. However, we must point out that in his last paper in which he reconsiders the genus *Amerigoniscus*, VANDEL (1977) named 4 species providing only the description of the apical part of the exopodite of pleopod 1 male. The *Caucasonethes* specimens loaned from the Smithsonian Institute contained male individuals only for the species *Caucasonethes centralis* Vandel, 1977. The other three species, namely *C. georgensis*, *C. curvatus* and *C. proximus*, need to be redescribed to know the characters useful in the species description.

Distribution: As VANDEL (1953C) pointed out the genus *Caucasonethes* has a wide North-Atlantic distribution from the Caucasus to the Pacific Coast of America. There are 3 species described from the northern area of the Black Sea (Transcaucasia, Crimea, Dobrogea) and 8 species described from the United States (Virginia, Georgia, Tennessee, Oklahoma, New Mexico, Oregon).

Literature used: VERHOEFF, 1932 FIGS.; VANDEL, 1950, FIGS., 1953A, FIGS.; 1965, FIGS., 1977; SCHULTZ, 1982, FIGS.; TABACARU, 1993; GIURGINCA & SARBU, 2020, FIGS; GIURGINCA & TABACARU, THIS VOLUME, FIGS.

Main characters of the genus *Caucasonethes* Verhoeff, 1932

Size varying from species to species from 1.5–1.75 mm (*Caucasonethes vandeli pygmaeus*), 3–3.5 mm (*C. nicholasi*, *C. malheurensis*, *C. vandeli*) and 4–6 mm at the other species.

Body completely depigmented. Usually, the tegument presents rows of granules but there are no prominent tubercles at any species.

Telson: rounded triangular (Fig. 10A).

Eyes: absent.

Antennule with a varying number of aesthetascs: from 3–4 (*C. borutzkyi*, *C. henroti*), 5–6 (*C. nicholasi*, *C. centralis*, *C. vandeli*) (Fig. 3A, 9B), 8 (*C. malheurensis*) up to 10 (*C. rothi*). Antenna: flagellum with weakly distinct articles, varying from species to species: 2 (*C. nicholasi*, *C. centralis*) (Fig. 9A), 3 (*C. henroti*, *C. malheurensis*, *C. vandeli*), 4 (*C. borutzkyi*), 6 (*C. rothi*, *C. gipsocolus*).

Right mandible with two penicilli between the lacinia mobilis and pars molaris (Fig. 10B), only at *C. henroti* and *C. centralis* there is only one penicillum (Fig. 4A); usually, the left mandible with 3 penicilli (Fig. 4B, 10C) only the species *C. henroti* and *C. malheurensis* present only 2 penicilli. Some species present also a molar penicillum on the right mandible, but at *C. lebedinskyi* there is one molar penicillum on both mandibles.

Pereopod VII male without sexual differentiations (Fig. 5, 11A).

Pleopods 1 and 2 male with sexual differentiations in comparison with the pleopods 1 and 2 female (Fig. 7).

Pleopod 1 male exopodite shaped like big oval triangular blade covering the endopodite. Apically, there are two fused or partially overlapping lobes varying according to species (Fig. 1, 6, 11C, 12). At *C. henroti*, the outer lobe is much longer than the internal lobe (Fig. 1). Pleopod 1 male endopodite, shaped as a narrow, elongated blade, is unisegmented and without a terminal rod or other differentiations. It is as long as, or slightly shorter, than the exopodite and has a rounded end or it is strongly narrowed toward the tip.

Pleopod 2 male exopodite has a rectangular shape with rounded corners. At *C. borutzkyi*, *C. lebedinskyi* and *C. malheurensis*, the internal distal corner of the exopodite is slightly extended. More rarely, the exopodite has an oval shape (*C. henroti*, *C. gipsocolus*) (Fig. 2A). Pleopod 2 male endopodite bisegmented, with the distal article strongly narrowed toward the tip. At most species, the two articles are equal in length (Fig. 2A, 11D). Only at *C. gipsocolus* and *C. centralis*, the distal article is much shorter than the basal article, with a pointed tip and curved toward the external edge (Fig. 8).

Affinities and differences

Considering the structure of pleopod 1 male, the genus *Caucasonethes* is close to the genus *Finaloniscus* but differs from this genus by the structure of pleopod 2 male. At *Finaloniscus* the pleopod 2 male presents a reduced exopodite partly fused with the protopodite and the endopodite has the distal article widened at the tip.

Also based on the first male pleopod, ARGANO & MANICASTRI (1988) maintained that the genus *Trichonethes* has clear affinities with the genus *Caucasonethes*. In their opinion, the sole differentiating character between the two genera is the presence at *Trichonethes* of a small, pointed tooth on the distal article of the pleopod 2 male endopodite. From our point of view, the essential difference

between the two genera is the differentiation of the pleopod 1 male endopodite at *Trichonethes*. At *Caucasonethes*, the pleopod 1 male endopodite is simple, more or less narrowed toward the tip. At *Trichonethes*, the pleopod 1 male endopodite is widened at the tip and has a tooth – as such the endopodite seems apically bilobed. The character mentioned by ARGANO & MANICASTRI (1988) was also noted by STROUHAL (1953, 1971) but also by VERHOEFF & STROUHAL (1967).

The genus *Caucasonethes*, by the structure of the pleopods, seems to be close to the genera *Psachonethes* and *Chasmatoniscus*, each represented by a sole species which, although collected from caves, have 3 pigmented ocelli.

Species distribution

***Caucasonethes borutzkyi* Verhoeff, 1932**

Distribution: Rion Cave near Kutaisi; Zehal-Ziteli Cave, Transcaucasia, Georgia.

Caucasonethes lebedinskyi (Borutzky, 1949) – Syn.: *Tauronethes lebedinskyi* Borutzky, 1949

Distribution: Described from Skelskaya Cave in the western spurs of Ai-Petri Plateau (Crimea) and, subsequently, repeatedly reported from this cave (BORUTZKY, 1962A; VARGOVICH, 2004).

***Caucasonethes henroti* (Vandel, 1950)** – Syn.: *Amerigoniscus henroti* Vandel, 1950

Distribution: Gillie's Cave, Pennington Gap, Lee Co., Virginia (type locality); Kinzer Hollow Cave, Lee Co., Virginia; Gallohan Cave no.1, Lee Co., Virginia, Spangler Cave, Lee Co., Virginia.

***Caucasonethes rothi* Vandel, 1953**

Distribution: Eight miles east of Gold Beach, on the north bank of the Rogue River, Oregon.

***Caucasonethes nicholasi* Vandel, 1956** – Syn.: *Caucasonethes paynei* Muchmore, 1970.

Distribution: Columbia Caverns, Dickson Co., Tennessee (type locality), Offutt's Cave, Anderson Co., Tennessee.

***Caucasonethes gipsocolus* Vandel, 1956**

Distribution: Bateman Cave, King. Co., Texas.

***Caucasonethes curvatus* (Vandel, 1977)** – Syn.: *Amerigoniscus curvatus* Vandel, 1977.

Distribution: Horseshoe Cave, Walker Co., Georgia.

***Caucasonethes proximus* (Vandel, 1977)** – Syn.: *Amerigoniscus proximus* Vandel, 1977.

Distribution: Blowing Spring Cave, Chattooga Co., Georgia (type locality); Byers Cave, Dade Co., Georgia.

***Caucasonethes centralis* (Vandel, 1977)** – Syn.: *Amerigoniscus centralis* Vandel, 1977.

Distribution: Wagon Wheel Cave, Murray Co., Oklahoma.

***Caucasonethes malheurensis* (Schultz, 1982)** – Syn.: *Amerigoniscus malheurensis* Schultz, 1982.

Distribution: Malheur Cave, Harney Co., Oregon.

***Caucasonethes vandeli* Tabacaru, 1993**

Distribution: Peştera Liliecilor de la Gura Dobrogei (type locality); Peştera Casian, Cheia village, Central Dobrogea, Romania.

***Caucasonethes vandeli pygmaeus* Giurginca, 2021**

Distribution: Movile Cave, Mangalia, Southern Dobrogea, Romania.

IDENTIFICATION KEY FOR THE SPECIES OF THE GENUS *CAUCASONETHES* VERHOEFF, 1932

1(4) Pleopod 2 male endopodite bisegmented with unequal articles, the distal article half the length of the basal article and pointed at the tip and curved toward the external edge……2

2 (3) Pleopod 2 male exopodite has an oval shape; antennal flagellum made up by 6 articles……...*C. gipsocolus* Vandel, 1965

3 (2) Pleopod 2 male exopodite has a rectangular shape; antennal flagellum made up by 2 articles……...*C. centralis* (Vandel, 1978)

4 (1) Pleopod 2 male endopodite bisegmented with sub-equal articles, the distal article is not curved……..5

5 (6) Pleopod 1 male exopodite with an elongated external lobe clearly exceeding the internal lobe; pleopod 2 male exopodite has an oval, semicircular shape and does not exceed the edge of the endopodite; right mandible with a sole penicillum between molar process and pars incisiva……...*C. henroti* (Vandel, 195)

6 (5) Pleopod 1 male exopodite has no elongated external lobe; pleopod 2 male exopodite has a rectangular shape and covers partially the basal part of the endopodite; right mandible with two penicilli between molar process and pars incisiva……...7

7 (12) Pleopod 2 male exopodite has an elongated internal distal angle..8

8 (9) Pleopod 2 male endopodite is apically truncated; left mandible with two penicilli between molar process and pars incisiva……*C. malheurensis* (Schultz, 1982)

9 (8) Pleopod 2 male endopodite is apically narrowed; left mandible with three penicilli between molar process and pars incisiva……10

10 (11) Genital apophysis terminally narrowed; distal article of antennule with 3–4 aesthetascs……*C. borutzkyi* Verhoeff, 1932

11 (10) Genital apophysis terminally truncated; distal article of antennule with 7–8 aesthetascs……..*C. lebedinskyi* (Borutzky, 1949)

12 (7) Pleopod 2 male exopodite without an elongated internal distal angle ……13

13 (14) Pleopod 1 male endopodite has a pointed tip and is curved toward the external edge; distal article of antennule with 10 aesthetascs…*C. rothi* Vandel, 1953

14 (13) Pleopod 1 male endopodite is not curved toward the external edge; distal article of antennule with 5–6 aesthetascs…….....15

15 (16) Pleopod 1 male endopodite is shorter than the exopodite and apically rounded……..*C. nicholasi* Vandel, 1965

16 (15) Pleopod 1 male endopodite of sub-equal length than the exopodite and strongly narrowed toward the tip……...*C. vandeli* Tabacaru, 1993

Analyzing the species included in the genus *Caucasonethes* as a whole, we can point out that the species *C. gipsocolus* and *C. centralis* differ by the distal article of pleopod 2 male endopodite which is shorter than the basal article, has a pointed tip and is curved toward the external edge.

7. *Psachonethes* Borutzky, 1969

Type species by monotypy: *Psachonethes czerkessicus* Borutzky, 1969.

Type locality: Cave at Psacho River, tributary of Kudespst River, Krasnod District, West Transcaucasus SW-Russia (leg. Levushkin).

Species: Except for *Psachonethes czerkessicus* Borutzky, 1969, the type species of the genus, a second species, *Psachonethes elbursanus* Schmalfuss, 1986, was described from Northern Iran (Elburz Mountains). In fact, BORUTZKY (1969, 1972), in the description of the genus, specified that the pleopod 1 male endopodite has the tip curved toward the external side and presents hairs and a short spine at the tip. Considering the description and the figures given by SCHMALFUSS (1986), we can say that *Psachonethes elbursanus* is a species with brown-violaceous pigmentation, with 3 ocelli and which due to the structure of the protopodite and the exopodite of the pleopod 1 male is close to the genera *Psachonethes* Borutzky and *Chasmatoniscus* Strouhal, but we cannot assign it to neither of the two genera.

Literature used: BORUTZKY, 1969 (FIGS.), 1972 (FIGS.); SCHMALFUSS, 1986 (FIGS.).

Main characters of the genus *Psachonethes* Borutzky, 1969

Size: male 3.5 mm; female 5–5.5 mm. White color.

Telson: posterior edge rounded and with 5–6 hairs.

Eyes: pigmented, made up of 3 ommatidia.

Antennule with 7 aesthetascs.

Right mandible with 2 penicilli, left mandible with 3 penicilli.

Pereopod without sexual differentiations.

Pleopod 1 male with prominent, rounded angular protopodite. The rounded triangular exopodite is apically bilobed. As BORUTZKY specifies, the posterior third of the exopodite presents a transversal suture running from the internal edge

to the middle of the exopodite width. The tip of the endopodite curved like a hook and presents hairs and a short spine.

Pleopod 2 male with a rounded rectangular exopodite with the internal distal corner slightly elongated. Endopodite bisegmented with the robust and apically rounded distal segment much longer than the basal one.

Uropods with the endopodites inserted more anteriorly than the exopodites; endopodites much shorter and thinner than the exopodites.

Affinities and differences

Describing the species *Psachonethes elbursanus*, SCHMALFUSS (1986) stated it is possible that *Tauronethes* and *Psachonethes* might be synonymous with *Caucasonethes* Verhoeff, 1932.

As we pointed out the study of the holotype of the genus *Caucasonethes* and the study of other species belonging to this genus, allowed us to establish that the differential character designated by BORUTZKY between *Tauronethes* and *Caucasonethes* represents a differential character among the species of *Caucasonethes* and we could not find any character that might argue for the separation of *T. lebedinskyi* in a distinct genus.

Concerning the species *Psachonethes czerkessicus* Borutzky, we consider that the presence of ocelli and the structure of the male pleopods point to a clear distinction from the species of the genus *Caucasonethes*. We think there is an obvious closer relationship between the genus *Psachonethes* Borutzky, 1969 and the genus *Chasmatoniscus* Strouhal, 1971.

8. *Chasmatoniscus* Strouhal, 1971

Type species by monotypy: *Chasmatoniscus oculatus* Strouhal, 1971.

Type locality: Turkey, near Black Sea coast; Cave no. 2 near Egreli, under stones and wood.

Species: a sole species known only from the type locality.

Literature used: STROUHAL, 1971, FIGS.

Main characters of the genus *Chasmatoniscus* Strouhal, 1971

Size: male 5.3–5.5 mm; female 5.4–8 mm. Smooth tegument with weak granulation made up by a sensilla and scale; no prominent tubercles. Color: light brown with lighter, elliptic spots.

Trapezoidal telson, apically truncated with rounded corners and concave sides.

Eyes: 3 ocelli with merged pigmentation.

Antennule with 13–16 aesthetascs. Antennal flagellum made up by 7 articles.

Right mandible with 2 spaced penicilli and 1 molar penicillum. Left mandible with 2 penicilli near the lacinia mobilis.

Pereopod without obvious sexual differences.

Pleopod 1 male with a rounded triangular, prominent protopodite. The rounded triangular exopodite is apically differentiated into lobes. Ventrally, close

to the external edge, there are 5 small, distanced spines. Endopodite as long as the exopodite and gradually narrowed toward the tip. Apically, slightly curved toward the external side and with a very small spine at the tip. Narrow genital apophysis, situated between the endopodites and only three quarters of their length.

Pleopod 2 male exopodite is rounded rectangular with a prominent internal distal angle. Pleopod 2 male endopodite is bisegmented, with the distal article slightly shorter than the basal one and strongly thinned in the end region.

Uropods with endopodites narrower and much shorter than the exopodites.

Affinities and differences

Describing the genus *Chasmatoniscus*, HANS STROUHAL (1971, p. 357) included this genus in the group of genera reunited by VANDEL (1953B, 1960) within the first tribe of the subfamily Trichoniscinae and which was named *Protrichoniscini* by Schmölzer (1965, p. 30). Clearly, Strouhal did not know the papers published in Russian by BORUTZKY (1949, 1962, 1969) in which the tribe name Protrichoniscini is used and the genera *Tauronethes* Borutzky, 1949 and *Psachonethes* Borutzky, 1969 are described. The genus *Chasmatoniscus* Strouhal, 1971 is very close to the genus *Psachonethes* Borutzky, 1969 by the presence of three ocelli and the very similar structure of the first male pleopod. The species' descriptions also point out the difference concerning the pleopod 2 male endopodite. At *Psachonethes*, the distal article is clearly longer than the basal one, more robust and apically rounded. At *Chasmatoniscus*, the pleopod 2 male endopodite has the distal article slightly shorter than the basal one and strongly thinned terminally.

9. *Trichonethes* Strouhal, 1953

Syn.: *Antennulonethes* Verhoeff, 1967 – synonymy established by Argano & Manicastri, 1988.

Type species by original designation: *Trichonethes kosswigi* Strouhal, 1953.

Type locality: Turkey, SW Anatolia, Vilayet Denizli, Dodurgköyü village, near Acipayam, in a cave (leg. Kosswig).

Species: According to the revision of ARGANO & MANICASTRI, 1988 the genus is represented by a single species *Trichonethes kosswigi* Strouhal, 1953 (Syn.: *Trichonethes cavicola* Strouhal, 1953; *Antennulonethes nitidus* Verhoeff & Strouhal, 1967).

Distribution: 16 caves in Western Turkey (Pisidia); a cave in the Greek island of Rhodes.

Literature used: STROUHAL, 1953 (FIGS.); VERHOEFF & STROUHAL, 1967 (FIGS.); ARGANO & MANICASTRI, 1988 (FIGS.).

Main characters of the genus *Trichonethes* Strouhal, 1953

Size: male 8 mm, female 9 mm. STROUHAL (1953) maintains the pigment is absent except for a pigmented eye spot but the ocelli cannot be differentiated. ARGANO & MANICASTRI (1988) maintain the eyes and pigment are completely absent.

Tegument: smooth, without granulation.

Telson: trapezoidal, apical part slightly concave in the middle. Uropodal endopodite inserted in a slightly anterior position than the exopodite and it is much more narrow and shorter than the exopodite.

Antennule with 10–14 aesthetascs. Antennal flagellum with indistinct articles, varying in number from 4 (individuals from Rhodes) to 8 (individuals collected in caves from Turkey).

Right mandible with two penicilli between pars incisiva and pars molaris and one penicillum on pars molaris. Left mandible with 3 penicilli between pars incisiva and pars molaris.

Pereopod with no sexual differentiations.

Pleopod 1 male with a rounded triangular exopodite covering the endopodite. Apically, the exopodite is divided in three lobes: a rounded external lobe, an apically pointed median lobe and a narrow internal lobe with small, fine hairs. The endopodite is narrow, its length sub-equal to that of the exopodite. The endopodite seems apically bilobed due to a rounded lobe with fine hairs and, laterally, a tooth.

Pleopod 2 male with a rounded rectangular exopodite with the internal distal corner slightly elongated. Pleopod 2 male endopodite biarticulated with sub-equal articles. The terminal part of the distal article is strongly narrowed and presents, laterally, a small, pointed tooth.

Affinities and differences

Within the tribe Typhlotricholigioidini, the genus *Trichonethes* Strouhal, 1953 can be included in the group of genera characterized by a male pleopod 1 endopodite sub-equal in length versus the exopodite (*Caucasonethes*, *Psachonethes*, *Chasmatoniscus*). However, the genus *Trichonethes* is clearly different by the terminal structure of the pleopod 1 male endopodite which seems apically bilobed and by the presence of a sharp tooth on the distal article of pleopod 2 male endopodite.

10. *Brackenphiloscia* Ortiz, Garcia Debrás & Lalana, 1999

Type species by monotypy: *Brackenphiloscia vandeli* Ortiz, Garcia Debrás & Lalana, 1999.

Type locality: collected in a “gour” (rimstone) in Gran Caverna de Fuentes, Luis Lazo, San Juan y Martinez, Pinar del Rio, Cuba.

Species: a sole species known only from the type locality.

Literature used: ORTIZ, GARCIA DEBRÁS & LALANA, 1999 (FIGS.); JASS & KLAUSMEIER, 2006; ORTIZ & LALANA, 2018; TAITI & XUE, 2012.

Main characters of the genus *Brackenphiloscia* Ortiz, Garcia Debrás & Lalana, 1999

Size: male 5.9 mm. Smooth tegument.

Pleon clearly narrower than the pereion. Telson with a convex posterior edge with 4 spines. Uropods with sub-equal rami.

Antennule: terminal article, with two aesthetascs, longer than the second article. Antennal flagellum made up by 3 articles.

Right mandible with one penicillum and left mandible with two penicilli.

Pereopod with narrow, elongated articles with numerous hairs.

Genital apophysis: cylindrical, apparently made up by two articles having a line marking a short, terminal article.

Pleopod 1 male exopodite is triangular, apically slightly curved toward the external part, bilobed and with a subterminal spine; the narrow endopodite less than half of the exopodite length.

Pleopod 2 male exopodite ovoidal. Pleopod 2 male endopodite is bisegmented. Distal article much longer than the basal article, gradually narrowed and ends in a long flagellum.

Affinities and differences

As we have pointed out, the genus *Brackenphiloscia* by the structure of the pleopod 1 male endopodite (with a sole article and without terminal rod) can be clearly included in the tribe Typhlotricholigioidini Rioja, 1953. The authors of the genus mentioned that some characters of the new genus correspond with species of *Brackenridgia*. But the pereopod do not present a tuft of hairs on the propodus, a characteristic of the species of *Brackenridgia*. Also, we have to specify the pleopod 1 male endopodite is narrow, less than half the length of the exopodite but it is not vestigial as it is the case at the genera *Brackenridgia* and *Typhlotricholigioides*. Pleopod 2 male is similar with that of the *Brackenridgia* species, but the description provided by the authors of the genus does not specify if the exopodite is fused with the protopodite.

The structure of the maxillipede with the external distally elongated basis and the narrow, curved palpus longer than the endite, is more similar with that of the aquatic living Trichoniscinae like *Typhlotricholigioides* and *Cantabroniscus*.

IDENTIFICATION KEY FOR THE GENERA OF THE TRIBE TYPHLOTRICHOLIGIOIDINI

We have deliberately selected here, just like in previous papers, the identification key system in which we do not present the adjacent obligatory opposite point but indicate by the number adjacent the place of the opposite point. Certainly, this identification key system is sometimes more difficult for the understanding of the opposite point but allows an easier understanding of the character succession which clusters the taxa and, as such, represents a first step towards a phylogenetic diagram. In this identification key, each point comes from the preceding point or from the opposite point.

Despite being close to genera with an aquatic way of life like *Typhlotricholigioides* and *Cantabroniscus* through certain characters, but also close

to the genus *Brackenridgia* through other characters, the genus *Brackenphiloscia* was not included in the identification key as the authors of its description did not specify if the pleopod 2 male exopodite is fused with the protopodite.

1 (4) Pleopod 1 male endopodite vestigial, reduced to a small, triangular oval appendage; pleopod 2 male exopodite completely fused with the protopodite…….2

2 (3) Maxillipedal palpus elongated and curved, with the basis narrower than the base of the endite, ending with two points; inferior penicillum of the maxillula inner endite with a structure very different from that of the other two penicilli……..*Typhlotricholigioides* Rioja, 1953

3 (2) Triangular maxillipedal palpus, with the basis wider than the basis of the endite and ending with a single tip; inner endite of the maxillula with three penicilli having the same structure……..*Brackenridgia* Ulrich, 1902

4 (1) Pleopod 1 male endopodite shaped like an elongated, narrow, unisegmented blade lacking a terminal rod; pleopod 2 male exopodite distinct from the protopodite or, rarely, partially fused with it at most……...5

5 (8) Pleopod 1 male exopodite is apically rounded, with no differentiation; pleopod 1 male endopodite much shorter than the exopodite…….6

6 (7) Pleopod 1 male exopodite with a broadly rounded internal side without a notch; pleopod 2 male endopodite with the distal article much shorter than the proximal article……..*Cantabroniscus* Vandel, 1965

7 (6) Pleopod 1 male exopodite with a notch on the internal side; pleopod 2 male endopodite with the distal article much longer than the proximal one and ending with a long, flabelliform portion……..*Escualdoniscus* Séchet & Noel, 2015.

8 (5) Pleopod 1 male exopodite is always apically differentiated; pleopod 1 male endopodite has almost the same length as the exopodite……...9

9 (10) Pleopod 2 male exopodite reduced and partially fused with the protopodite; the distal article of the endopodite with a slightly widened tip…….*Finaloniscus* Brian, 1951

10 (9) Pleopod 2 male exopodite distinct from the protopodite; distal article of endopodite is narrowed, rounded or truncated but not widened at the tip…….11

11 (16) Pleopod 1 male endopodite may be rounded or narrowed apically or with a spine at the tip but not bilobed; pleopod 2 male endopodite distal article without a lateral tooth……..12

12 (13) Eyes absent; pleopod 1 male endopodite with a rounded or narrowed tip but without an apical spine……...*Caucasonethes* Verhoeff, 1932

13 (12) Eyes with three pigmented ocelli; pleopod 1 male endopodite with a small, apical spine…….14

14 (15) Apically rounded telson; pleopod 2 male endopodite robust and apically rounded, with the distal article clearly longer than the basal one……. *Psaconethes* Borutzky, 1969

15 (14) Apically truncated, trapezoidal telson; pleopod 2 male endopodite distal article shorter than the basal one and pointed at the tip……...*Chasmatoniscus* Strouhal, 1971

16 (11) Pleopod 1 male endopodite apically bilobed; pleopod 2 male endopodite distal article narrowed in the terminal part and presents laterally a pointed tooth……..*Trichonethes* Strouhal, 1953.

Acknowledgments: I.G. Tabacaru extends his gratitude toward the Alexander von Humboldt Foundation and Zoologische Staatssammlung München for their support which allowed us to study the Verhoeff Collection Our gratitude goes to the late Dr. Brian Frederick Kensley, Curator Department of Invertebrate Zoology-National Museum of Natural History-Smithsonian Institution (Washington, D.C., USA) who kindly loaned us material of the *Caucasonethes* species described from North America. Also, our gratitude extends towards Dr. Ana Isabel Camacho (Madrid, Spain) who generously offered us the material of *Cantabroniscus primitivus*.

We are greatly indebted to all those who helped us with the literature needed for this paper: late Dr. Gisela Mauermayer (Munich), late Prof. Dr. Hans Strouhal, Dr. Jürgen Gruber, Dr. Verena Stagel, Dr. Peter Dworschak (Vienna), Dr. Henri Dalens (Toulouse), late Dr. Christian Juberthie (Moulis), Emmanuel Séchet (Paris), Dr. Alejandro Manuel Maeda-Martinez (Mexico), Prof. Dr. Manuel Ortiz-Touzet (Havana), Dr. Konstantin Gongalsky (Moscow), Dr. Stefano Taiti (Florence), Dr. Gabriele Gentile (Rome).

The authors are grateful to Prof. Dr. D. L. Danielopol (Karl-Franzens Universität, Nawi Graz Geocenter, Austria) for his suggestions which greatly improved the manuscript of this paper.

Our study has been undertaken within the framework of Program 1 of the "Emile Racovitza" Institute of Speleology of the Romanian Academy.

REFERENCES

ARCANGELI, A., *Isopodi terrestri raccolti in Cuba dal Prof. F. Silvestri.* Bollettino di Laboratorio di Zoologia generale e Agraria della R. Scuola superiore d'Agricultura in Portici, **23**, 129–148, 1929.

ARCANGELI, A., *Isopodi terrestri raccolti dal Prof. Silvestri nel Nord-America.* Bolletin del Laboratorio de Zoologia generale ed Agraria, Reale Istituto Superorio Agraria in Portici, **26**, 121–141, 1932.

ARGANO, R., *Isopoda terrestria: Oniscidea.* In: Juberthie et Decu (Eds.) *Encyclopaedia Biospeologica*, Moulis-Bucarest, **I**, 141–146, 1994.

ARGANO, R. & MANICASTRI C., *Il genere Trichonethes Strouhal, 1953 di Turchia (Isopoda, Oniscidea, Trichoniscidae).* Fragmenta Entomologica, Roma, **21** (1), 9–16, 1988.

BEDEK, J., *Morphology and molecular phylogeny of the cave dwelling subgenus Illyrionethes Verhoeff, 1927 (Isopoda, Trichoniscidae) in the Dinaric Karst.* Doctoral dissertation, University of Zagreb, Faculy of Science, Depart. Biology, IX +198 p., 2019.

BORUTZKY, E. V., *Tauronethes lebedinskyi gen. nov. et sp.nov. (Isopoda terrestria) iz Skelskoi peshcheri v Krimu.* Doklady Akademii Nauk SSSR. (N.S.), **LXVI** (3), 487–490, [in Russian] 1949.

BORUTZKY, E. V., *Fauna of terrestrial isopods (Isopoda, Terrestria) in the caves of the Crimea in zoogeographical aspect.* Zoologicheskii. Zhurnal, **XLI** (2) 193–202 [in Russian with English summary], 1962.

BORUTZKY, E. V., *Psachonethes czerkessicus gen. et sp. n. (Isopoda terrestria) from caves of the West Transcaucasus.* Zoologicheskii. Zhurnal, **48**, 1618–1622 [in Russian with English summary], 1969.

BORUTZKY, E. V., *Isopoda Oniscoidea pestcher tchernomorskogo poberejia krasnodarskogo kraia [Isopoda Oniscoidea of the caves on the Black Sea coast in Krasnodar Region]*. Sbornik Trudov zoologicheskogo Muzeya. **12**, 19–36 [in Russian], 1972.

BOWMAN, T. E., *Xilitloniscus, a new genus for the Mexican troglobitic isopod, Cordioniscus laevis Rioja (Oniscoidea: Trichoniscidae).* Proceedings of the Biological Society of Washington, **78**, 209–216, 1965.

BRIAN, A., *Descrizioni di un nuovo genere di Trichoniscidae raccolto in una grotta Ligure da Mario Franciscolo.* Bollettino della Società Entomologica Italiana, **81** (1–2), 22–25, 1951 a.

BRIAN, A., *Sostituzione di nome al gen. Marioniscus mihi (nec Barnard)(Isopoda Trichoniscidae).* Bollettino della Società Entomologica Italiana, **81**(3–4), 48, 1951 b.

BROLY, P., DEVILE, P., MAILLET, S., *The origin of terrestrial isopods Crustacea: Isopoda: Oniscidea).* Evolutionary Ecology, Springer Netherlands, **27**(3), 461–467, 2013.

CAMPOS-FILHO, I. S., BICHUETTE, M. E., ARAUJO, P. B., TAITI, S., *Description of a new species of Cylindroniscus Arcangeli,* 1929 (*Isopoda: Oniscidea) from Brazil, with considerations on the family placement of the genus*. North-Western Journal of Zoology, Oradea,**13** (2), 227–233, 2017.

CIFUENTES, J., BERUETE, E. & PRIETO, C.E., *Isópodos oniscideos en cuevas de la región Vasco-Cantábrica, España (Crustacea : Isopoda).* Boletino de la Sociedad Entomológica Aragonesa (S E A), **68**, 270–288, 2021.

CRUZ, A., *Especies nuevas o poco conocidas de Isópodos terrestres de la Peninsula Ibérica II. Isópodos epigeos de España y Portugal (Crustacea, Oniscidea).* Bull. Soc. Hist. Nat. Toulouse, **127**, 71–75, 1991.

ERHARDT, F., *Das pleonale Skelet-Muskel-System von Titanethes albus (Synocheta) und weiterer Taxa der Oniscidea (Isopoda), mit Schlußfolgerungen zur Phylogenie der Landasseln.* Stuttgarer Beitr. Naturk. Ser. A, No 550, 1–70, 1997.

ESCOLA, O., *Crustacea* In: X.Belles, M.Blas, J.Comas, O.Escola, F.Español, J.Estany, R.Rambla, C.Ribera, A.Serra, M.C.Vicente y E.Vives, *Contribución al conocimiento de la fauna cavernicola del Pais Vasco.* Kobie (Bilbao), Boletin no 10, 1980.

FERNANDES, C.S., CAMPOS-FILHO, I. S. & BICHUETTE, M. E., *Cylindroniscus platoi (Isopoda:Oniscidea: Styloniscidae), a new cave-dweling species from Lagoa Santa Karst, Southeastern Brazil.* Zootaxa, 4461 (3), 411–420, 2018.

GIURGINCA, A., SARBU, S., *Caucasonethes vandeli pygmaeus n.ssp. (Crustacea, Isopoda, Oniscidea) from Movile Cave (Southern Dobrogea, Romania).* Travaux de l'Institut de Speologie "Emile Racovitza", **LIX**, 33–41, 2020.

HATCH, M. H., *The Chelifera and Isopoda of Washington and adjacent regions.* University of Washington Publications in Biology, **10** (5), 155–274, 1947.

HOLSINGER, J. R., *Annotated Checklist of macroscopic troglobites of Virginia with notes on their geographic distribution.* Bulletin of the National Speological Society **25**, Part 1, 23–36, 1963.

HOLSINGER, J. R., *New data on the range of the troglobitic trichoniscid Isopod, Caucasonethes henroti.* Journal of the Tennessee Academy of Science. **42**, 15, 1967.

HORVATOVIĆ, M., *Phyletic relations within Synocheta Legrand, 1946 section (Crustacea, Isopoda, Oniscidea) of Balkan Peninsula.* PhD thesis, University of Novi Sad, Faculty of Sciences, VII + 248 p., 164 fig. (serbian, english abstact), 2014.

JASS, J., KLAUSMEIER, B., *Endemics and immigrants North American terrestrial isopods (Isopoda, Oniscides) North Mexico.* Crustaceana, **73** (7), 771–799, 2000.

JASS, J., KLAUSMEIER, B., *Terrestrial isopod (Crustacea: Isopoda) atlas for Canada, Alaska and the contiguous United States.* Milwaukee Public Museum Contributions in Biology and Geology, **95**, 1–105, 2001.

JASS, J., KLAUSMEIER, B., *Terrestrial isopod (Crustacea: Isopoda) atlas for Canada, Alaska and the contiguous United States.* Milwaukee Public Museum Contributions in Biology and Geology, **100**, 1–80, 2004.

JASS, J., KLAUSMEIER, B., *Terrestrial Isopod (Crustacea: Isopoda) of the West Indies.* Insight, A Milwaukee Public Museum Series in Natural History, **3**, 36 p., 2006.

KARAMAN, I.M., *Macedonethes stankoi n.sp., a rhithral oniscidean isopod (Isopoda: Oniscidea: Trichoniscidae) from Macedonia.* Organisms, Diversity & Evolution, **3**, Electr.Suppl. 8, 1–15, 2003.

LEISTIKOW, A., WÄGELE, J. W., *Checklist* of *the terrestrial isopods of the new world (Crustacea, Isopoda, Oniscidea).* Revista Brasileira de Zoologia, **16** (1), 1–72, 1999.

LEWIS, J.J., *Brackenridgia ashleyi a new species of terrestrial isopod from Tumbling Creek Cave, Missouri (Isopoda: Oniscidea: Trichoniscidae).* Proceedings of the Biological Society of Washington, **117** (2), 176–185, 2004.

MUCHMORE, W. B., *A new troglobitic trichoniscid Isopod of the genus Caucasonethes.* Journal of the Tennesse Academy of Science, **45** (1), 27–28, 1970.

MULAIK, S. B., *Contribución al conociemento de los Isópodos terrestres de México (Isopoda, Oniscoidea).* Revista de la Sociedad Mexican de Historia Natatural, **XXI**, 79–292, 1960.

ORTIZ, M., GARCIA DEBRÁS, LALANA, R., *Un nuevo género y una nueva especie de isópodo (Isopoda, Oniscidea) troglobio dulciacuicola, de la Isla de Cuba.* Revista de Investigaciones Marinas, Nota cientifica, **20** (1–3), 108–112, 1999.

ORTIZ, M., LALANA R., *Lista de especies y distribución de los Isópodos (Crustacea: Peracarida) de Cuba.* Novitates Caribaea, Santo Domingo, **12**, 102–126, 2018.

PALACIOS-VARGAS, J. G., JUBERTHIE, C., REDDELL, J., *Encyclopaedia Biospeologica, Vol. II A México.* Mondos Subterráneos, No **25-26**, 1–101, 2015.

RACOVITZA, E. G., *Isopodes terrestres (Seconde Série).*Biospeologica IX, Arch. Zool. exp. et gén., 4e série, 239–415, 1908.

REDDELL, J.R., *A checklist of the cave fauna of Texas. IV. Additional records os invertebrata (exclusive Insecta).* The Texas Journal of Sciences. **XXI** (4), 389–415, 1970.

REDDELL, J.R., *A preliminary bibliography of Mexican cave biology with a Checklist of Published Records.*, Association for Mexican Cave Studies, Bulletin **3**, 1–184, The Speleo Press, Austin, 1971 (PDF reprint 2005).

REDDELL, J.R., *A review of the cavernicole fauna of Mexico, Guatemala, and Belize.* Texas Memorial Museum, Bulletin **27**, 1–327, 1981.

RICHARDSON, H., *A monograph on the isopod of North America.* Bulletin of the Unites States National Museum, Washington, No. **54**, 1–727, 1905.

RIOJA, E., *Estudios carcinológicos XXII. Los Triconiscidos cavernicolas de México del género Protrichoniscus y descripción de una nueva especie del mismo.* Anales del Instituto de Biologia Universidad Autonoma de México, **XXI** (1), 127–146, 1950.

RIOJA, E., *Estudios carcinológicos XXVI Descripción de Protrichoniscus acostai n. sp. (Crust. Isópodo) de Comitán. Chiapas.* Anales del Instituto de Biologia Universidad Autonoma de México, **XXII**, 181–189, 1951.

RIOJA, E., *Estudios carcinológicos XXIX Un nuevo genero de isopodo trichoniscido de la Cueva de Ojo de Agua Grande, Paraje Nuevo, Cordoba, Ver.* Anales del Instituto de Biologia, Universidad Autonoma de México, **XXIII**, 227–241, 1953.

RIOJA, E., *Trichoniscidae cavernicolas de México.* Revista de la Sociedad Mexicana de Entomologia **1** (1–2), 39–62, 1955.

SCHMALFUSS, H., *Landasseln aus Nord-Iran (Crustacea: Isopoda: Oniscidea).* Senckenbergiana biol., **66** (4/6), 377–397, 1986.

SCHMALFUSS, H., *World catalog of terrestrial isopods (Isopoda: Oniscidea).* Stuttgarter Beitr. Naturk. Ser. A (Biologie) Nr. 654, 1–341, 2003.

SCHMALFUSS, H., *World catalog of terrestrial isopods (Isopoda: Oniscidea).* Revised and updated version of the hard-copy publication. (Online http://www.oniscidea-catalog.naturkundemuseumbw.de, 296 pp., 2004.

SCHMALFUSS, H., *Utopioniscus kuehni n. gen., n. sp. (Isopoda: Oniscidea: Synocheta) from submarine caves in Sardinia.* Stuttgarter Beitr. Naturk. Ser. A, Nr.677, 21 pp., 2005.

SCHMIDT, C. & LEISTIKOW, A., *Catalog of genera of the terrestrial Isopoda (Crustacea: Isopoda: Oniscidea).* Steenstrupia, Copenhagen, **28** (1), 1–118, 2004.

SCHMÖLZER, K., *Ordnung Isopoda (Landasseln).* In: FRANZ, H. (Hgb.) Bestimmungsbűcher zur Bodenfauna Europas. Lieferung 4 und 5. Akademie-Verlag, Berlin, 468 pp., 1965.

SCHULTZ, G. A., *Mexiconiscus tlamayaensis, a new genus and species of terrestrial cave isopode from San Luis Potosi, México.* Transactions of the American Microscopical Society, **83** (4), 376–380, 1964.

SCHULTZ, G. A., *Xilitloniscus Bowman a synonym of Mexiconiscus Schultz with notes on the species involved (Isopoda, Oniscoidea).* Crustaceana, **14** (3), 255–258, 1968.

SCHULTZ, G. A., *Cylindroniscus vallesensis sp. nov.: Description with review of genus (Isopoda, Trichoniscidae).* Transactions of the American Microscopical Society, **89** (3), 407–412, 1970.

SCHULTZ, G. A., *Miktoniscus halophilus Blake, M. medcofi (Van Name) and M. morganensis n. comb., Reconsidered with Notes on New World Species of the Genus (Crustacea, Isopoda, Trichoniscidae).* The American Midland Naturalist, **95** (1), 28–41, 1976.

SCHULTZ, G. A., *Isopods (Oniscoidea) from Caves in North America and Northern South America.* Proceedings of the Eighth International Congres of Speleology, **2**, 551–552, 1981.

SCHULTZ, G. A., *Amerigoniscus malheurensis, new species, from a cave in western Oregon (Crustacea: Isopoda: Trichoniscidae.* Proceedings of the Biological Society of Washington, **95** (1), 89–92, 1982.

SCHULTZ, G. A., *Brackenridgia sphinxensis n. sp. from a cave with notes on other species from Arizona and California (Isopoda, Oniscoidea).* The Southwestern Naturalist, **29** (3), 309–319, 1984.

SCHULTZ, G. A., *Typhlotricholigioides and Mexiconiscus from México and Cylindroniscus from North America (Isopoda: Oniscidea: Trichoniscidae).* Journal of Crustacean Biology, **14** (4), 763–770, 1994.

SÉCHET, E. & NOËL, F., *Catalogue commenté des Crustacés Isopodes terrestres de France métropolitaine (Crustacea, Isopoda, Oniscidea).* Mémoire de la Société Linnéenne de Bordeaux, **16**, 1–156, 2015.

SKET, B., *Isopod: Oniscidea.* In: Stigofauna Mundi, L. Botosananu ed., J.E. Brill, Leiden, 482–485, 1986.

SLAY, M.E. & TAYLOR, S. J., *Brackenridgia ashleyi (Isopoda: Trichoniscidae): Range extension with notes on ecology.* Journal of Cave and Karst Studies, **73** (3), 197–200. 2011.

SOUZA, L.A., FERREIRA, R.L., SENNA, A.R., *Amphibius shelter-builder Oniscidea species from the New World with description of a new subfamily, a new genus and a new species from Brazilian cave (Isopoda, Synocheta, Styloniscidae).* PloS ONE, 10 (5), e115021, 2015.

STROUHAL, H., *Neue Trichonisciden aus Türkischen Höhlen.(2. Beitrag zur Kenntnis der türkischen Isopoden).* Notes Biospéologiques, **VIII** (2), 167–183, 1953.

STROUHAL, H., *Die Isopoda terrestria der Höhlen von Ereğli am Schwarzen Meer. (5. Beitrag zur Kenntnis der tükischen Isopoden.* International Journal of Speleology., **3** (3–4), 351–385, 1971.

TABACARU, I., *Über die Verbreitung der cavernicolen Landisopoden der Balkanhalbinsel und der Karpatengebiete.* V. Int. Kongr. Speläologie Stuttgart, Abh., **4**, 20, 1–5, München, 1969.

TABACARU, I., *Caucasonethes vandeli n.sp. (Crustacea, Isopoda, Oniscidea). Isopodee terrestre cavarnicole de Roumanie.* Mćmoire de Biospćologie, Moulis, XX, 231–238, 1993a.

TABACARU, I., *Sur la classification des Trichoniscidae et la position systématique de Thaumatoniscellus orghidani Tabacaru, 1973 (Crustacea, Isopoda, Oniscidea).* Travaux de l'Institut de Speologie "Emile Racovitza", **XXXII**, 43–85, 1993b.

TABACARU, I., *Les Trichoniscides des grottes de Roumanie. Description d'une nouvelle espéce troglogbie: Trichoniscus racovitzai n.sp. (Crustacea, Isopoda, Oniscidea).* Travaux de l'Institut de Speologie "Emile Racovitza", **XXXIII**, 49–61, 1994.

TABACARU, I., *Contribution à l'étude du genre Hyloniscus (Crustacea, Isopoda) II. Diagnoses des genres Hyloniscus et Nippononethes nov. gen. La tribu des Spelaeonethini.* Travaux de l'Institut de Speologie "Emile Racovitza", **XXXV**, 21–62, 1996.

TABACARU, I., *L'adaptation à la vie aquatique d'un remarquable Trichoniscide cavernicole, Cantabroniscus primitivus Vandel, et le problème de la monophylie des Isopodes terrestres.* Travaux de l'Institut de Speologie "Emile Racovitza", **37** (1998) **– 38** (1999), 115–131, 2002.

TABACARU, I., *Contribution à l'étude des Spelaeonethini (Isopoda, Oniscidea, Trichoniscidae).* Travaux de l'Institut de Speologie "Emile Racovitza", **LX**, 19–34, 2021.

TABACARU, I., DANIELOPOL D.L., *Phylogenie des isopodes terrestres.* C.R.Séanc. Acad. Sci. Paris, Ser.D, **319**, 71–80, 1996a.

TABACARU, I, DANIELOPOL, D.L., *Phylogenèse et convergence chez les Isopodes Terrestres.* Vie et Milieu, **46**, 2, 171–181, 1996b.

TABACARU, I., GIURGINCA, A., *The stomach in Oniscidea: Structure end evolution.* The Biology of Terrestrial Isopods, **V**, Crustaceana Monographs, 2, Brill, Leiden-Boston, 69–83, 2003.

TABACARU, I., GIURGINCA, A., *Contributions to the study of the Trichoniscidae (Isopoda, Oniscidea) I. Definition and taxonomic position.* Travaux de l'Institut de Speologie "Emile Racovitza", **58**, 47–63, 2019.

TABACARU, I., GIURGINCA, A., *The monophyly and the classification of the Terestrial Isopods (Crustacea, Isopoda, Oniscidea).* Travaux de l'Institut de Speologie "Emile Racovitza", **59**, 3–23, 2020.

TAITI, S. & FERRARA, F., *The terrestrial Isopoda of Corsica (Crustacea, Oniscidea).* Bull. Mus. Nat. Hist. Nat. Paris, 4e série, **18**, Section A, no 3–4, 459–545, 1996.

TAITI, S., XUE. Z., *The cavernicolous genus Trogloniscus nomen novum, with descriptions of four new species from southern China (Crustacea, Oniscidea, Styloniscidae).* Tropical Zoology, **25**(4), 183–209, 2012.

TAITI, S., ARGANO, R., MARCIA, P., SCARPA, F., SANNA, D., CASU, M., *The genus Alpioniscus Racovitza, 1908 in Sardinia: taxonomy and natural history (Isopoda, Oniscidea, Trichoniscidae).* In: Hornung E., Taiti S., Szlavecz K. (Eds.) Isopods in a Changing World. ZooKeys, **801**, 229–263, 2018.

ULRICH, C. J., *A contribution to the subterranean fauna of Texas.* Transactions of the American Microscopical Society, Lincoln, Nebraska, **XXIII**, 83–101, 1902.

VANDEL, A., *Espèces nouvelles d'Isopodes terrestres cavernicoles et endogés. Espèces françaises, nouvelles ou peu connues de Trichoniscidae. 4e Note.* Notes Biospéol., **2**, 7–27, 1948.

VANDEL, A., *Isopodes terrestres recueillis par C. Bolivar et R. Jeannel (1928) et le Dr Henrot (1946).* In: *Biospeologica LXXI, Campagne spéologique de C. Bolivar et R. Jeannel dans l'Amérique du Nord (1928). No 14.* Archiv. Zool. expér. gén, **87** (3), 183–210, 1950.

VANDEL, A., *A new terrestrial Isopod from Oregon, Caucasonethes rothi n.sp.* Pacific Science, **VII** (2), 175–178, 1953 a.

VANDEL, A., *La classification de la famille des Trichoniscidae (Crustacés; Isopodes Terrestres).* Bull. Mus. Nat. Hist. Nat. Paris, 2e Série, **XXV**, 276–278, 1953 b.

VANDEL, A., *Remarques systématiques, morphologiques et biogéograpuiques sur un groupe de Trichoniscidae nord-atlantique (Crustacés, Isopodes terrestres).* Bull. Mus. Hist. Nat. Paris, XXV, 368–375, 1953 c.

VANDEL, A., *Isopodes terrestres récoltés dans les grottes de la Corse, par le Professeur P.- A. Remy, en 1942 et 1948.* Notes biospéologiques, **8** (2), 153–166, 1953 d.

VANDEL, A., *Les Styloniscidae et les Trichoniscidae de l'Afrique du Nord (Crustacés : Isopodes Terrestres).* Bull. Mus. Hist. Nat. Paris, **XXXI**, 159–167, 1959.

VANDEL, A., *Isopodes terrestres (Première partie).* Faune de France, **64**, 1–416, 1960.

VANDEL, A., *Les Trichoniscidae cavernicoles (Isopoda Terrestria*; *Crustacea) de l'Amérique du Nord.* Ann. Spéléol., **XX** (3), 347–389, 1965 a.

VANDEL, A., *Sur l'existence d'oniscoïdes très primitifs menant une vie aquatique et sur le polyphylétisme des Isopodes terrestres.* Ann. Spéléol., **XX** (4), 489–518, 1965 b.

VANDEL, A., *Observations complémentaires sur Cantabroniscus primitivus Vandel.(Crustacés; Isopodes; Oniscoïdea; Trichoniscidae).* Ann. Spéléol., **XXI** (3), 643–650, 1966.

VANDEL, A., *La répartition de Cantabroniscus primitivus (Crustacé; Isopode; Oniscoïde.* Ann. Spéléol., **XXII** (4), 787–795, 1967.

VANDEL, A., *Un troisième Oniscoïde cavernicole menant une vie aquatique: Mexiconiscus laevis (Rioja).* Ann. Spéléol., **XXV,** (1), 161–171, 1970.

VANDEL, A., *Les Isopodes terrestres et cavernicoles de l'île de Cuba.* Résultats des expéditions biospéologiques cubano-roumaines à Cuba. Bucureşti, I, 153–188, 1973.

VANDEL, A., *Les espèces appartenant au genre Amerigonisus Vandel, 1950 (Crustacés, Isopodes, Oniscoïdes).* Bull. Soc. Hist. Nat. Toulouse, **113** (3–4),(1977), 303–310, 1978.

VANDEL, A., *Les Isopodes terrestres et cavernicoles de l'île de Cuba second mémoire).* . Résultats des expéditions biospéologiques cubano-roumaines à Cuba. Bucureşti, 3, 35–76, 1981.

VAN NAME, W. G., *The American land and fresh-water isopod Crustacea.* Bull. Amer. Mus. Nat. Hist.,New York, **LXXI**, 1–535, 1936.

VAN NAME, W. G., *A second supplement to the American land and fresh-water isopod Crustacea.* Bull. Amer. Mus. Nat. Hist., New York, **LXXX**, (Art. VIII), 299–329, 1942.

VERHOEFF, K. W., *Cavernicole Oniscoideen. 44. Isopoden-Aufsatz.* Mitt. Hőhlen u. Karstfschg., **1**, 12–24, 1932.

VERHOEFF, K. W., *Weltstellung der Isopoda terrestria, neue Familien derselben und neues System.* Zool. Jahrb. Syst., **71**, 253–264, 1938.

VERHOEFF, K. W., Neubearbeitet von STROUHAL H., *Isopoda terrestria der Türkei, 4. Aufsatz, und über Anpassungen an die Volvation bei den Kuglerfamilian Armadillidiidae, Eubelidae und Armadillidae.* Zool. Jahrb. Syst., **93**, 465–506, 1967.

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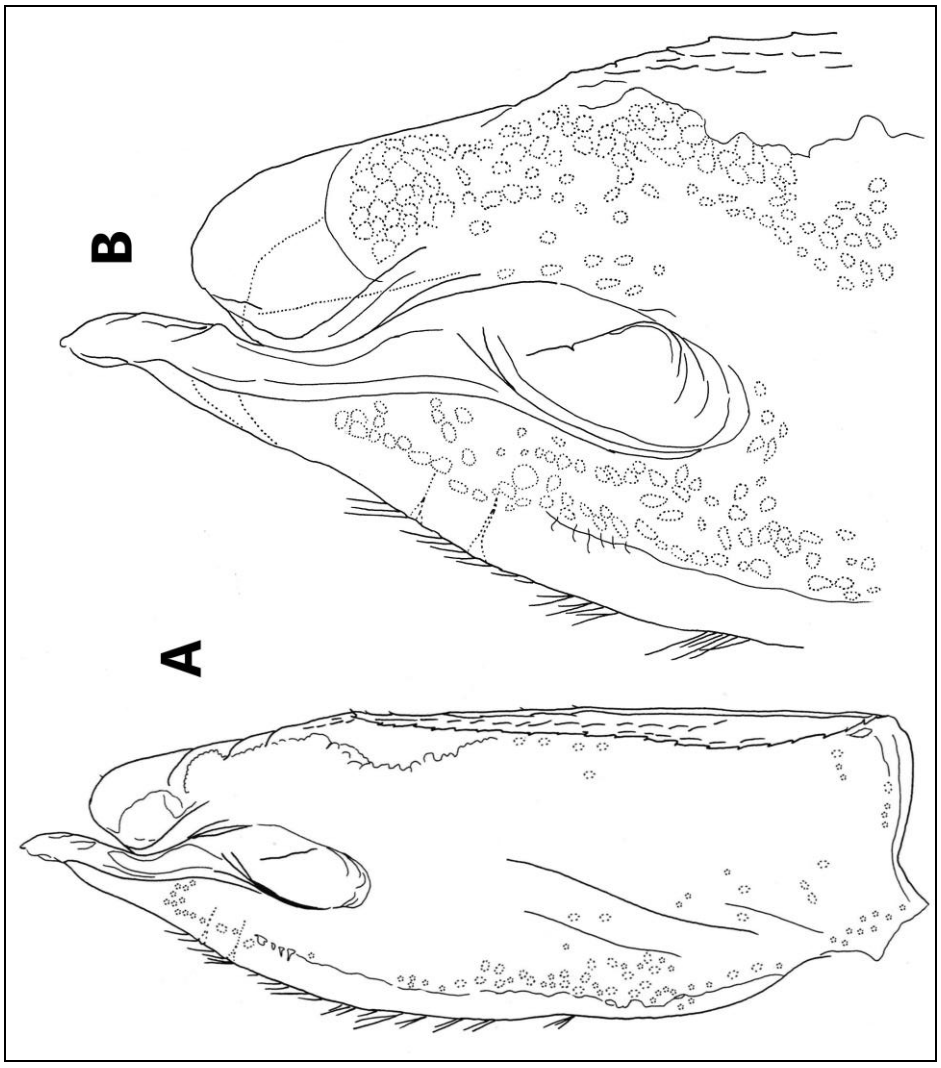

Fig. 1. *Caucasonethes henroti*: A. Pleopod 1 male exopodite; B. Tip of pleopod 1 male exopodite.

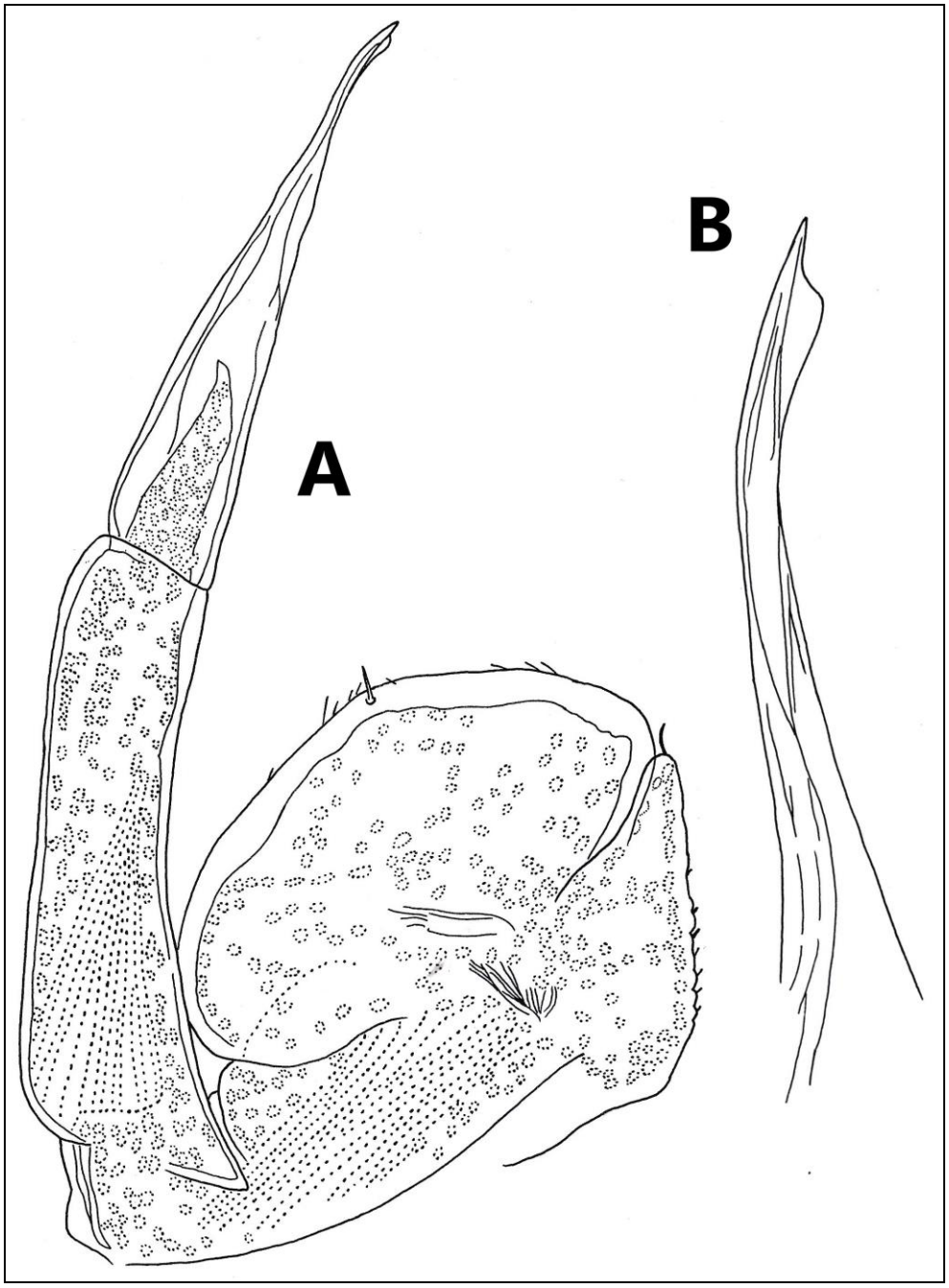

Fig. 2. *Caucasonethes henroti*: A. Pleopod 2 male; B. Tip of distal article of pleopod 2 male endopodite.

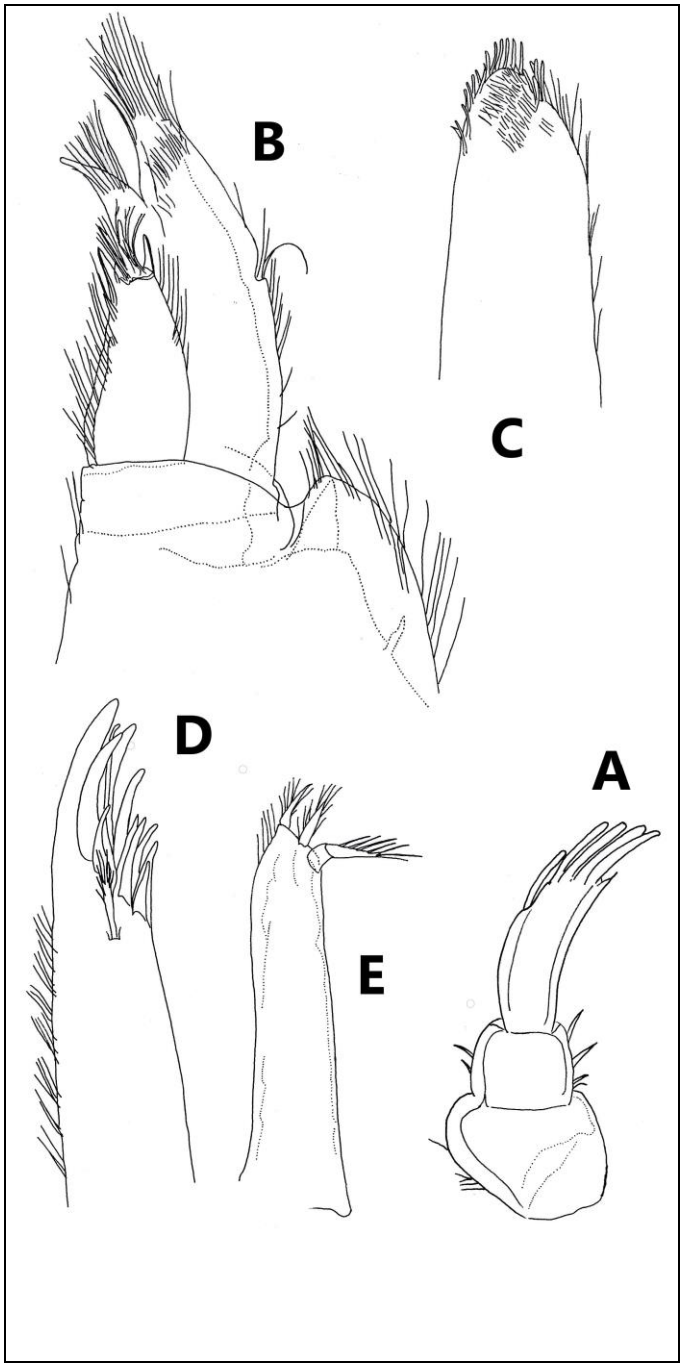

Fig. 3. *Caucasonethes centralis*: A. Antennule; B. Maxilliped; C. Maxilla; D. Maxillula, outer endite; E. Maxillula, inner endite.

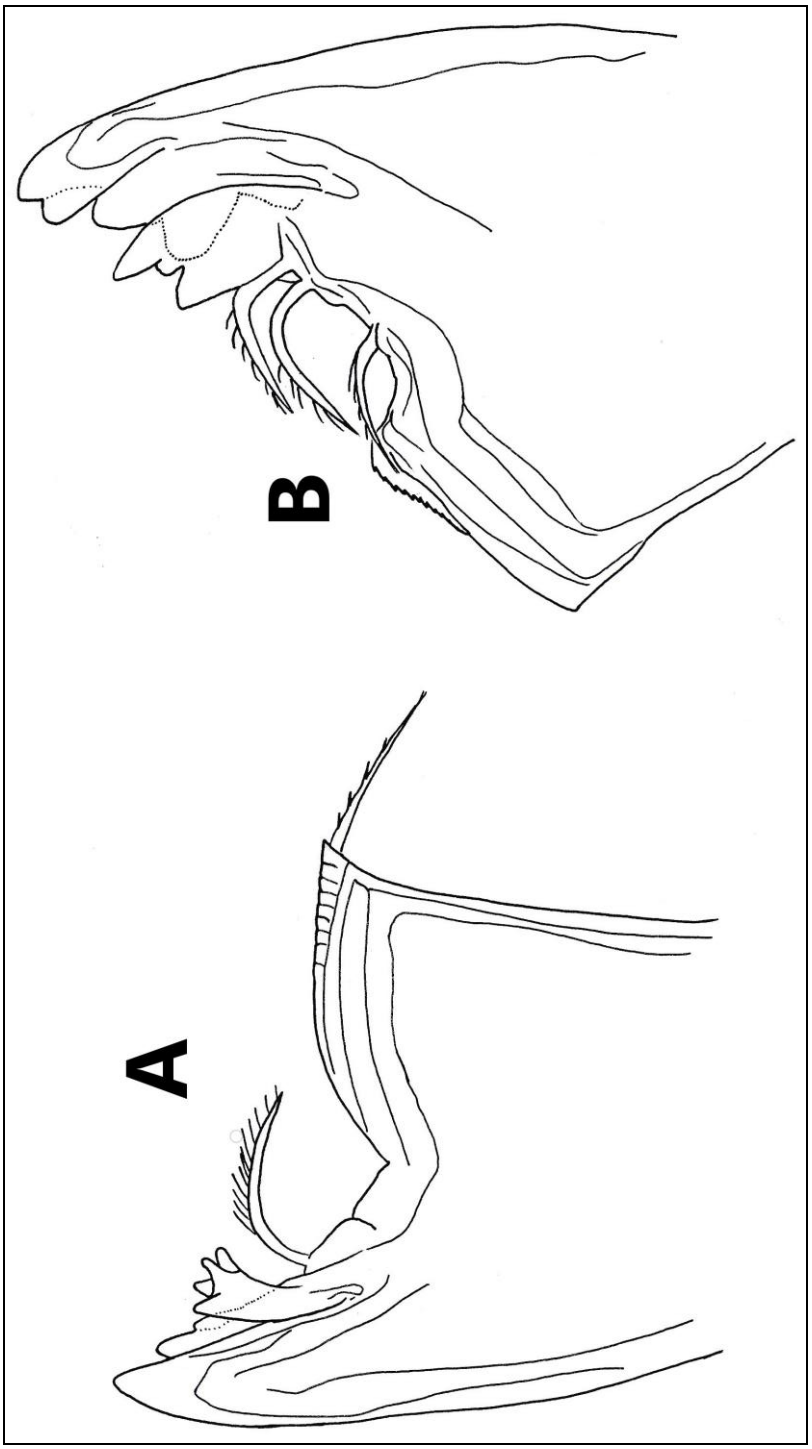

Fig. 4. *Caucasonethes centralis*: A. Right mandible B. Left mandible.

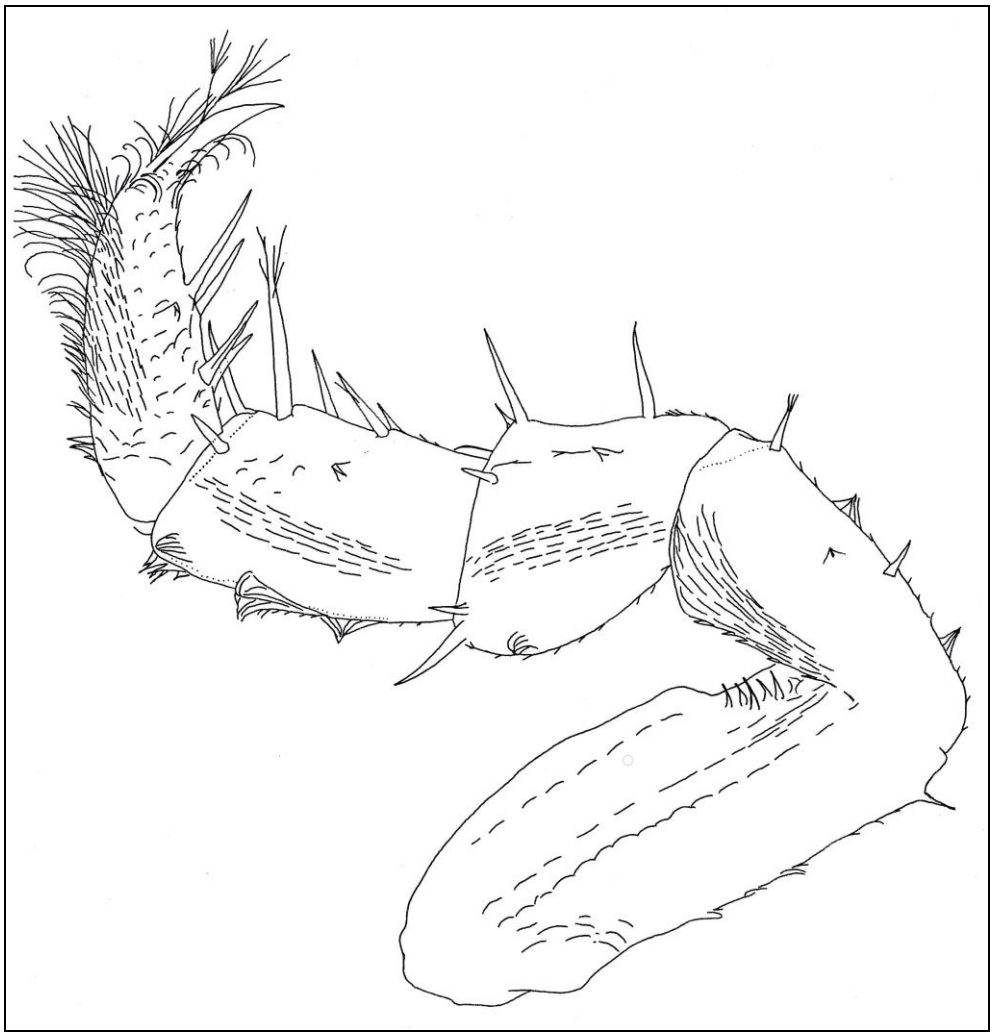

Fig. 5. *Caucasonethes centralis*: Pereopod VII.

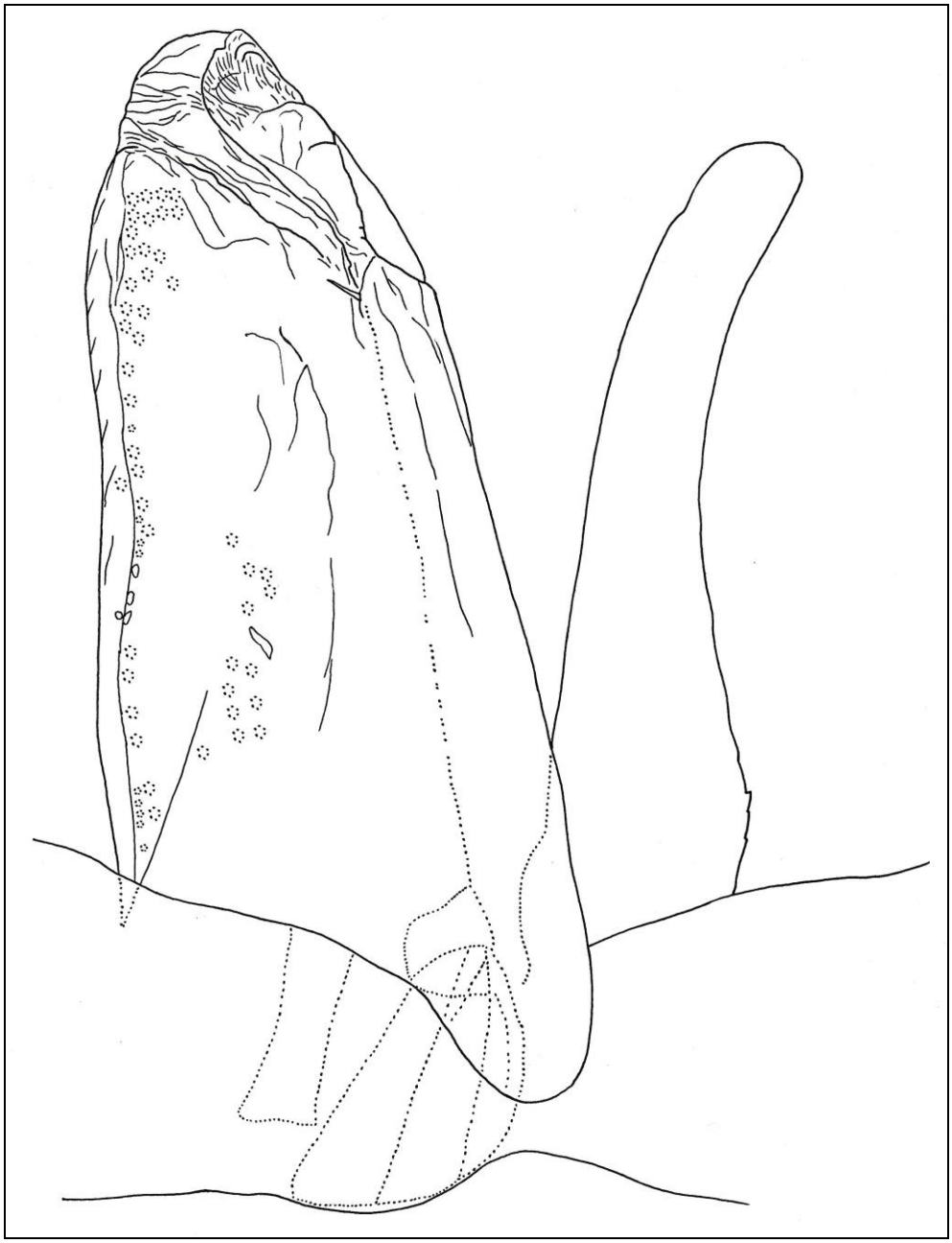

Fig. 6. *Caucasonethes centralis*: Pleopod 1 male.

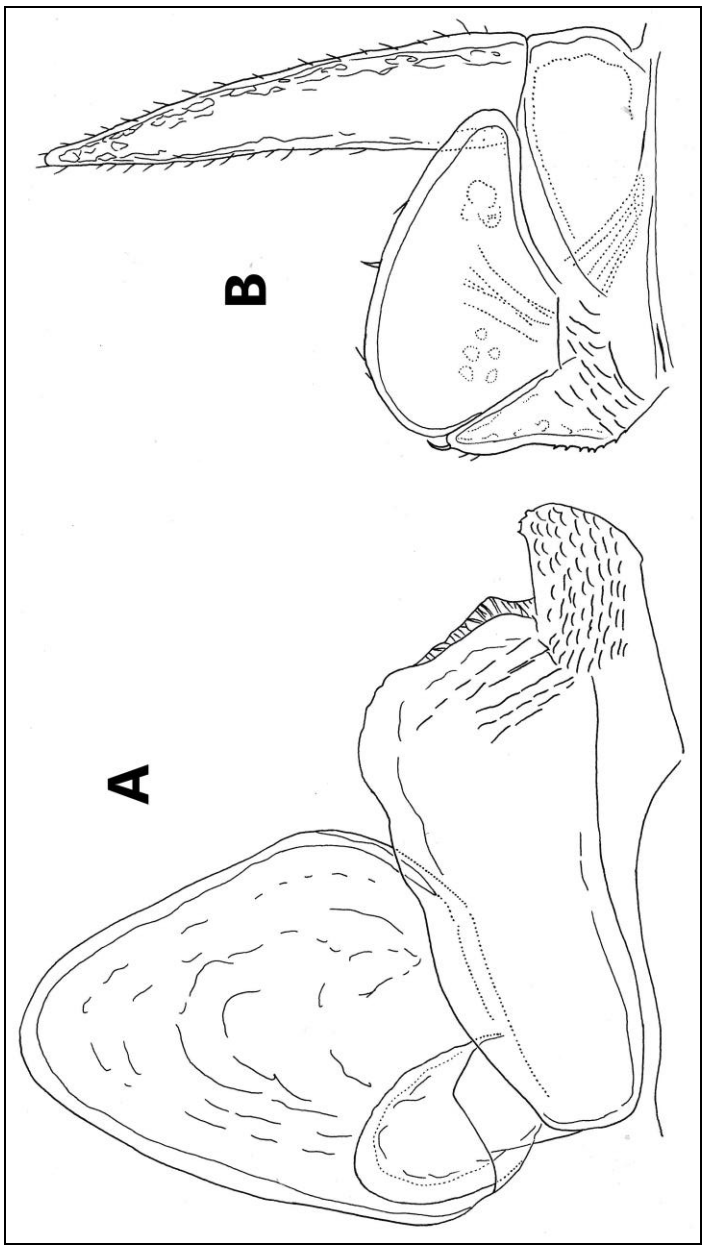

Fig. 7. *Caucasonethes centralis*: A. Pleopod 1 female; B. Pleopod 2 female.

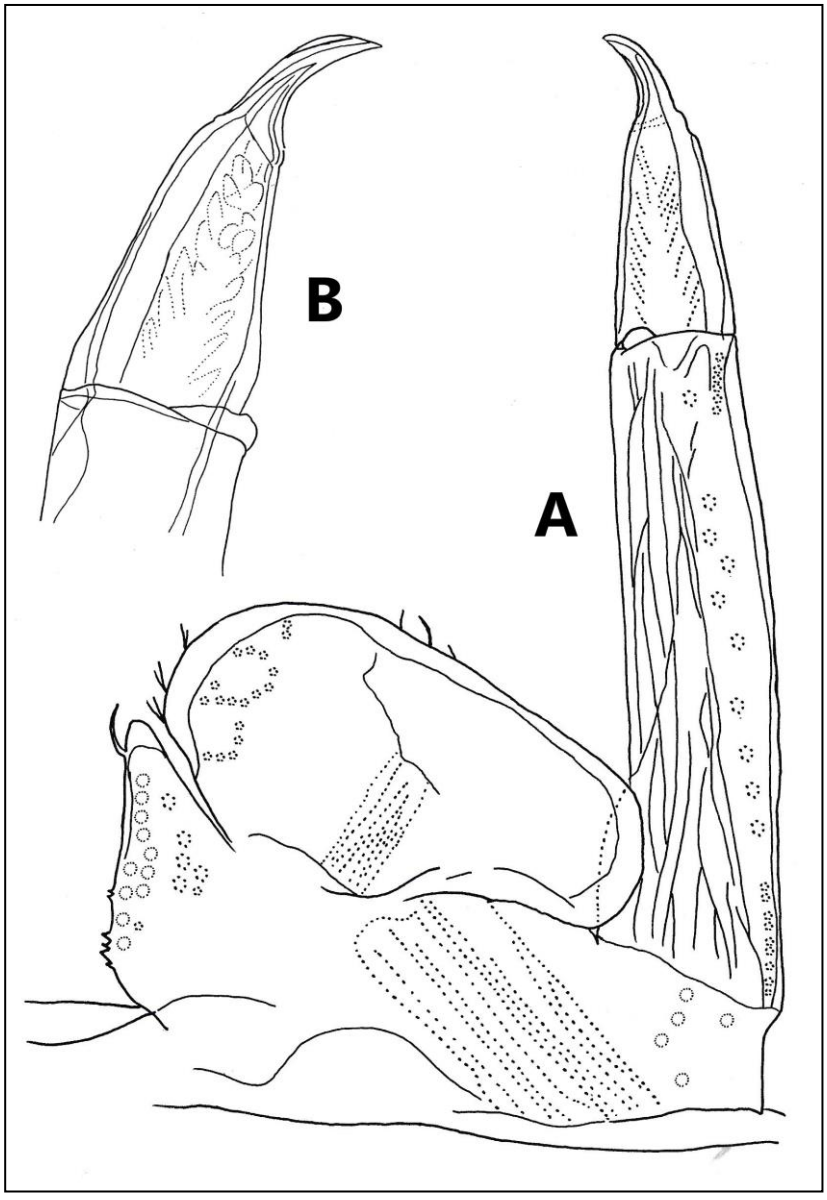

Fig. 8. *Caucasonethes centralis*: A. Pleopod 2 male;
B. Tip of distal article of pleopod 2 male endopodite.

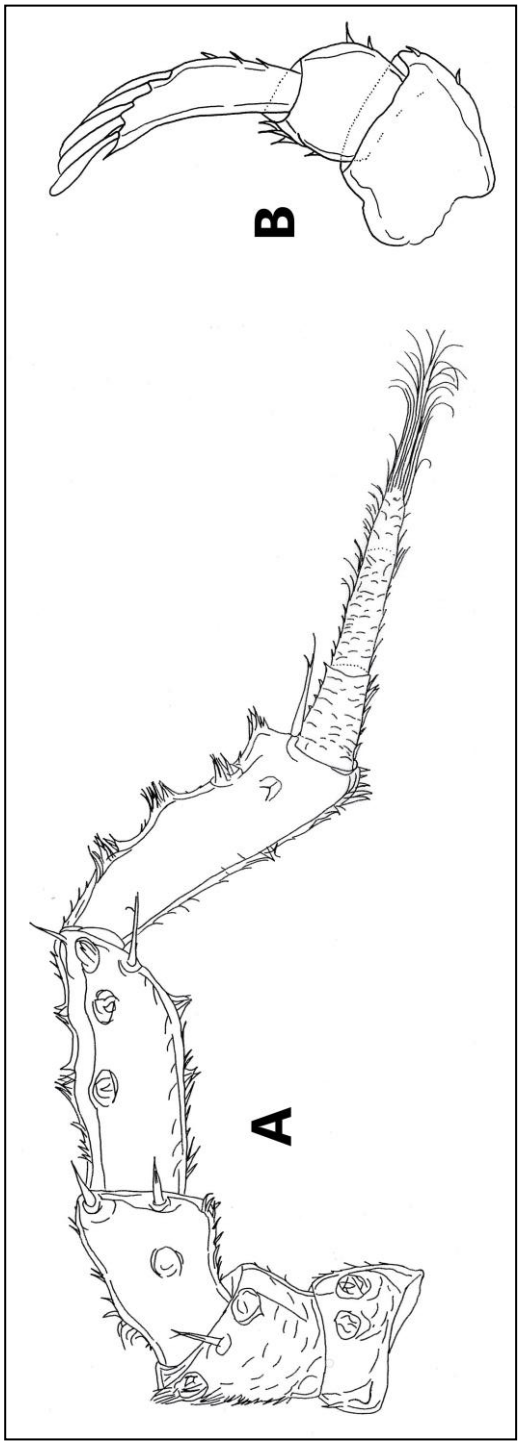

Fig. 9. *Caucasonethes nicholasi*: A. Antenna; B. Antennule.

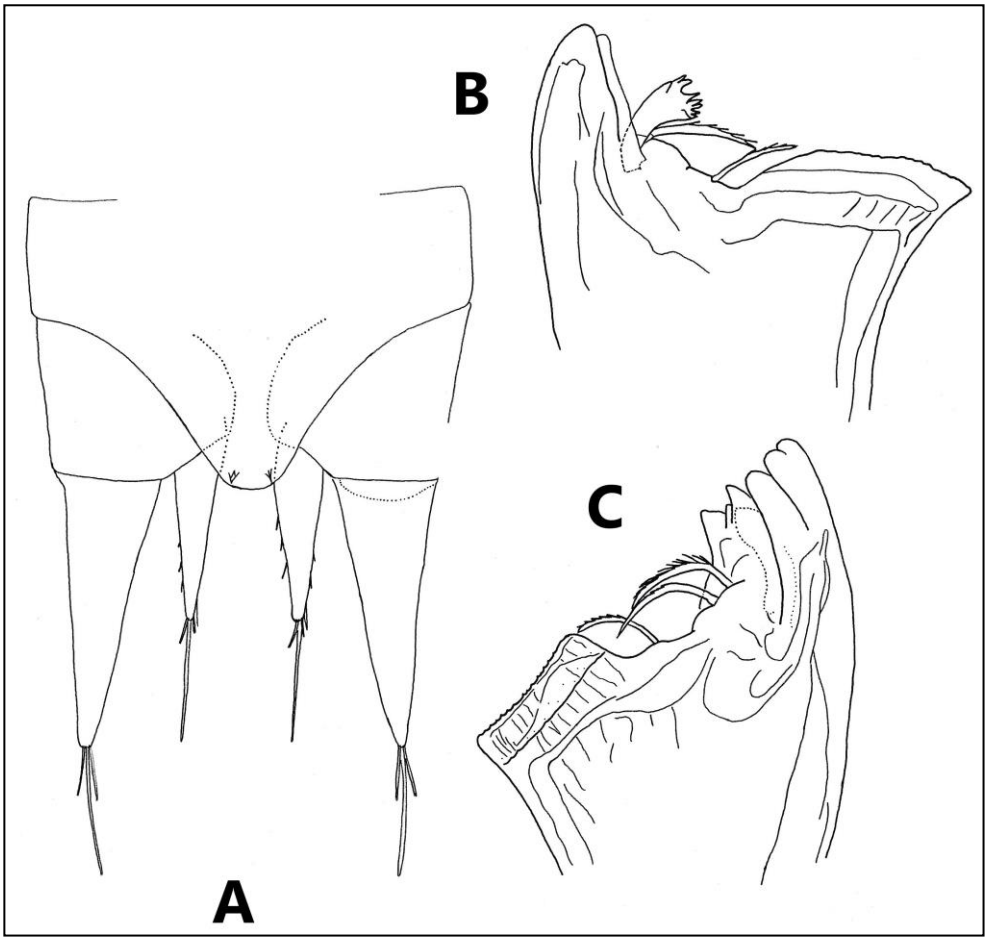

Fig. 10. *Caucasonethes nicholasi*: A. Telson; B. Right mandible; C. Left mandible.

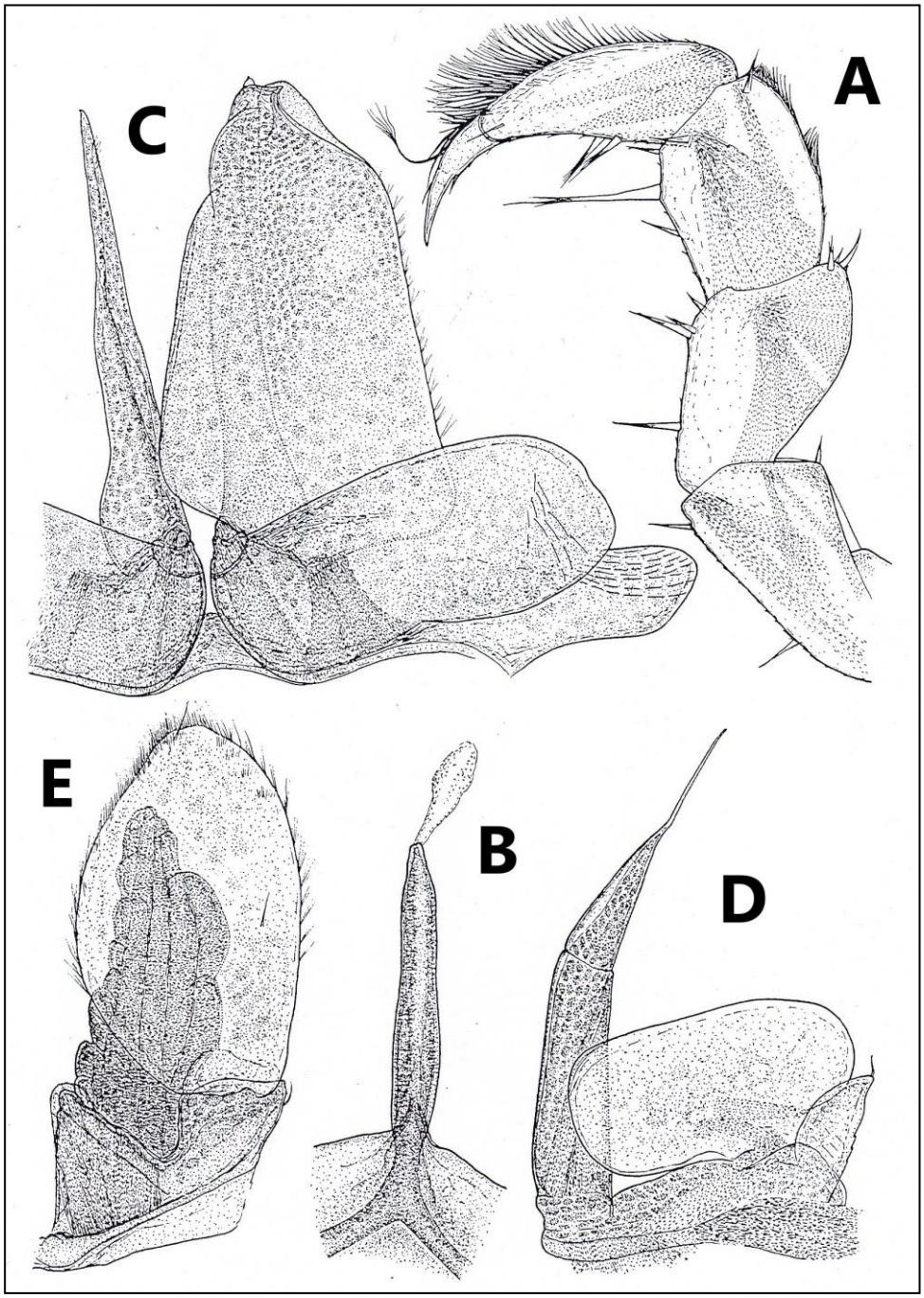

Fig. 11. *Caucasonethes vandeli*: A. Pereopod VII; B. Genital apophysis;
C. Pleopod 1 male; D. Pleopod 2 male; E. Pleopod 5 (following Tabacaru, 1993a).

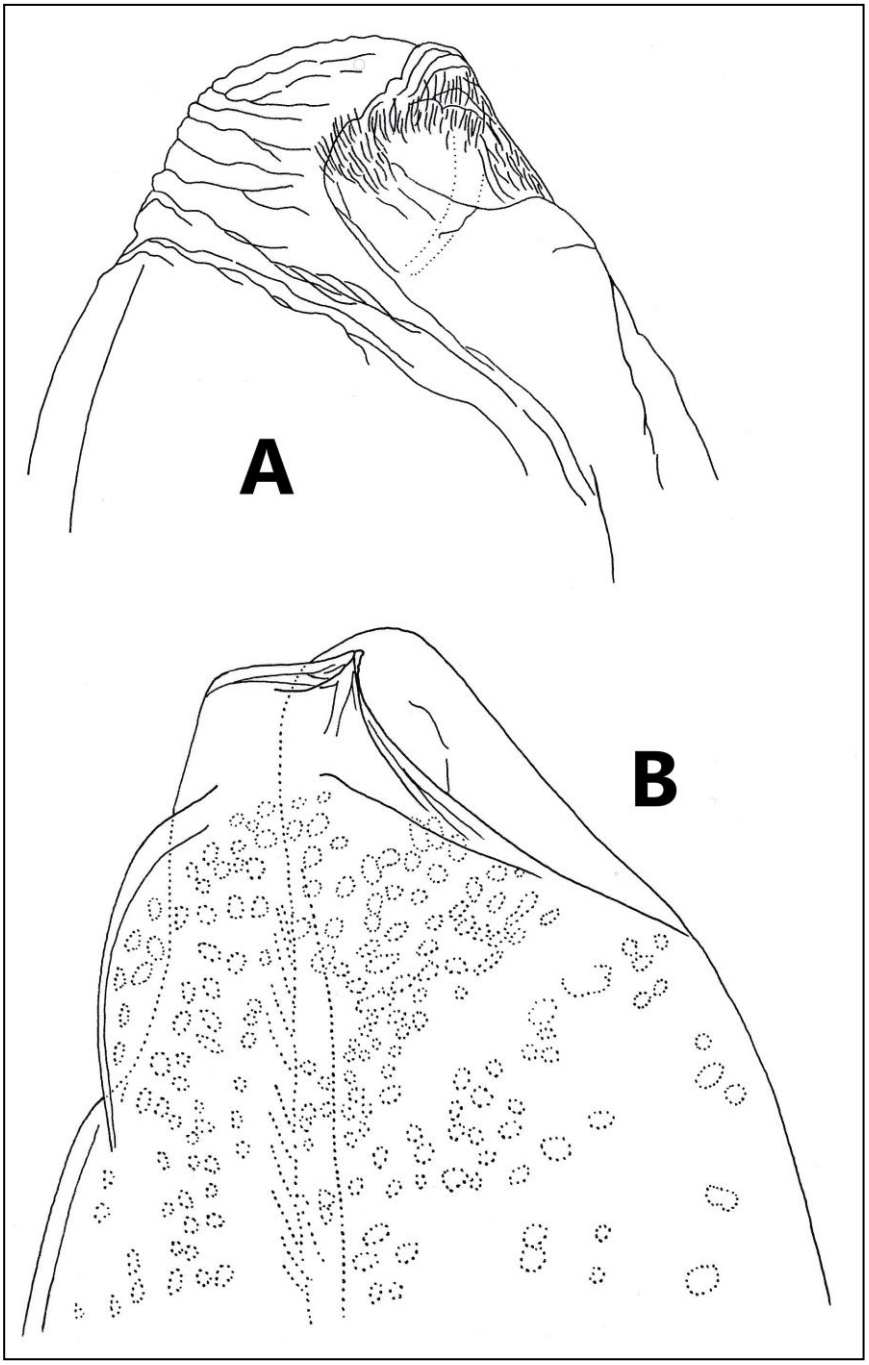

Fig. 12. Tip of pleopod 1 male exopodite in *C. centralis* (A) and *C. vandeli* (B).