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BEMBIDIACARIDAE, A NEW FAMILY OF MITES (ACARI: HETEROSTIGMATA) ASSOCIATED WITH CARABID BEETLES OF THE GENUS *BEMBIDION* (COLEOPTERA: CARABIDAE)

BEMBIDIACARIDAE — НОВОЕ СЕМЕЙСТВО КЛЕЩЕЙ (ACARI: HETEROSTIGMATA), СВЯЗАННЫХ С ЖУЖЕЛИЦАМИ ИЗ РОДА *BEMBIDION* (COLEOPTERA: CARABIDAE)

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ABSTRACT

A new family of heterostigmatic mites, Bembidiacaridae, is described on the basis of *Bembidiacarus eidelbergi*, gen. et sp. nov. The adult females of this species are found to be foretic on adult carabid beetles *Bembidion saxatile* Gyll. from Crimea.

РЕЗЮМЕ

Описывается новое семейство гетеростигматических клещей Bembidiacaridae на основе *Bembidiacarus eidelbergi*, gen. et sp. nov. Самки нового вида форезируют на жужелицах *Bembidion saxatile* Gyll. в Крыму.

During investigation of mites associated with carabid beetles M.Eidelberg collected several females of mites from the carabid beetle *Bembidion saxatile* Gyll. from Salgir river bank. These mites represent a new species, a new genus, and a new family that belongs to the superfamily Trochometridioidea.

In the descriptions the terminology of morphological structures and Grandjean's system of setal notations for the idiosoma and legs are given according to Lindquist [1986]. The host beetle was identified by Dr. M.Eidelberg. All measurements are given in micrometers (μm). The type material is deposited in the collections of the Department of Agroecology, State Nikita Botanical Gardens, Yalta, Crimea, Ukraine.

Bembidiacaridae Khaustov, new family

Type genus: *Bembidiacarus*, **new genus.**

Description of adult female

Gnathosoma (Figs. 1–3). Stylophore coalesced with subcapitulum to form gnathosomal capsule; prognathous. Dorsal surface of stylophore with a pair of simple cheliceral setae, ch_1; palpcoxal setae inserted laterally, at bases of palpi. Ventral surface of subcapitulum with 2 pairs of setae inserted on its anterior half; adoral setae absent. Cheliceral stylets stout, strongly curved, retractable. Pharynx surrounded by a smooth-walled, weakly defined musculature, not subdivided as in pygmephoroid-scutacaroid families. Palpi projecting freely anteriad of the stylophore apex, somewhat convergent but well separated apically; palpi 3-segmented, with distinct trochanter, femorogenu with 2 setae dorsolaterally (1 femoral, 1 genual), tibiotarsus with 2 clavate solenidia ventroproximally, a tibial claw distally, 1 distinct seta laterodistally and 2 minute seta-like structures (usually difficult to discern).

Idiosomal dorsum (Fig. 1). Body fusiform in dorsoventral aspect, widest at midlevel near posterior margin of tergites C. Dorsal setae simple, attenuated, slightly barbed. Prodorsal shield subrectangular, with lateral processes. Stigmata circular, positioned on dorsal surface on the middle part of a distance between bases of setae v_1 and v_2. The tracheal trunk of each stigmata short and poorly developed. Prodorsum with 3 pairs of well developed setae and a pair of capitate bothridial setae in large, circular bothridia. Setae v_1 closely spaced and positioned on the anterior margin of the prodorsal shield. Tergite C subdivided into a pair of lateral plates, each bearing setae c_2, and a middorsal plate with setae c_1. Tergites D, EF, H each entire, well developed, wider than long, successively overlapping the next plate posteriorly; posterior edges of tergites D, EF, H smooth and straight, middorsal plate of tergite C concave. Tergite D with paired setae *d* and cupules *ia*. Tergite EF with paired setae *e* and *f* in oblique alignment and cupules *im*; cupules *ip* not visible.

Lateral margins of tergite EF not extended ventrally to overlap anterolateral margins of aggenital plate. Tergite H with paired setae h_1 and h_2 aligned transversely and with cupules *ih* positioned mediad of setae h_2. Pseudanal plate PS is a terminal caudal capsule with a protruding, bivalved opening; plate with 2 pairs of setae of which ps_1 is spine-like, setae ps_2 prominent, attenuated; plate lacking cupules.

Idiosomal venter (Fig. 2). Ventral setae simple, attenuate, smooth or slightly barbed. Coxisternal plates I and II united to each other medially where they form a prosternal apodeme that extends from its union with apodemes 1 to posterior margin of plates II; apodemes 1 greatly thikened, V-shaped; apodemes 2 fully developed united with prosternal apodeme; sejugal apodeme reduced, with lateral remnants on either side. Coxisternal plates I and II each with 3 pairs of setae; setae 1*a* inserted near lateral extremities of apodemes 1; setae 1*b* and 1*c* obliquely aligned in a middle of field of plates I; setae 2*b* and 2*c* obliquely aligned on lateral part of plates II, setae 2*a* inserted mediad of this alignment. Coxisternal plates III and IV well separated from plates I and II by broad, transverse band of soft cuticle. Plates III and IV separated from each other medially by a soft cuticle, which bears a separate triangular midsternal plate (tegula). Anterior margins of plates III not overlapping sejugal furrow; medial margins of plates III narrowly overlapping each other medially and closely approaching midsternal plate; lateral margins of plates III and IV not expanded dorsally to overlap lateral margins of tergite EF. Posterior margins of plates IV closely approaching but not overlapping expansive aggenital plate; posterior margin of midsternal plate narrowly overlapping aggenital plate. Coxisternal plates III with 3 pairs of setae, plates IV with 2 pairs, excluding 3rd pair on midsternal plate. Setae 3*a* inserted anteriad of apodemes 3; setae 3*b* and 3*c* obliquely aligned in a middle of field of plates III. Setae 4*b* on midsternal plate inserted posteriad of transverse alignment with 4*a* and 4*c*. Apodemes 3 well developed, extending medially from the anterior condyle of trochanters III and continuing posteromediad of insertions of setae 3*a* to unite with apodemes 4; apodemes 3 also extending to a short distance laterad of these condyles. Apodemes 4 fully developed directed anteromedially from anterior condyle of trochanters IV to level slightly mediad of insertions of setae 3*b*. Apodemes 5 fully developed, directed anteromedially from posterior condyle of trochanters IV to unite with apodemes IV at level slightly mediad of insertions of setae 3*b*. A single expansive aggenital plate covers entirely the primary genital opening, whose soft elongate valves are discernible underneath and attached to a short crescent-shaped genital apodeme anteriorly. Aggenital plate with 2 pairs of well developed aggenital setae and a pair of small genital setae. Primary genital opening with 2 minute eugenital setae (difficult to discern). Posterior margin of aggenital plate slightly concave, narrowly overlapping the base of a caudal pseudanal capsule PS.

Legs (Figs. 5–8). Legs I to IV with ambulacra; leg I more massive than legs II to IV. Leg IV longer than leg III, which in turn is longer than leg II, but shorter than leg I. Leg I 5-segmented, with tibia shorter than tarsus; a single claw of tarsus I only slightly curved (Fig. 5). Legs II to IV each 5-segmented, with femur and tarsus being subequally the longest segments, and with genu and tibia subequal in size on each leg. Tarsi II to IV each with paired claws and empodium with a long stalk and a smooth, expanded apex. Segments of all legs lacking spur-like or flange-like outgrowths, and lacking spine-like setae.

Number of setae (and solenidia in parentheses) on segments of legs I-IV, respectively, trochanters: 1–1–1–1; femora 5–3–2–2; genua: 5–3–3–2; tibiae: 6(2)–4(1)–4(1)–4(1); tarsi: 12(2)–7(1)–7(0)–5(0); homologies of leg setae denoted in Figs. 5–8.

Number, size, shape and position of setae similar on equivalent segments of legs II to IV, though femur II retaining 1 more seta *l'*, than femora III and IV, genu IV with 1 less seta (lacking *l'*) than genua II and III, and tarsus IV with 2 less setae (lacking *p''* and *tc'*) than tarsi II-III. Femur I with all setae setiform. Legs without extremely long setae. Tibia I with eupathidial seta *k''* setiform, long, tapered, at least as long as tibial segment; solenidia φ_1 and φ_2 long, subequal, but lanceolate φ_1 at least 3 times wider than rod-like φ_2. Tarsus I with solenidia $\omega_{1\text{-}2}$ long; lanceolate ω_1 at least 3 times wider and 1.5 longer than rod-like ω_2. Tarsal setae *pl'*, *pv'*, *pv''*, *u'*, *u''*, *s* similarly short and setiform, seta *pl''* absent, eupathidia *ft'-ft''* and *tc'-tc''* of moderate lengths, *p'-p''* shorter. Tarsus II with solenidion ω long, lanceolate in shape, inserted proximally. Tarsi III and IV lacking ω.

Bembidiacarus Khaustov, gen. n.

Figs. 1–8.

Type species: *Bembidiacarus eidelbergi,* **sp.n.** A new genus based on adult females representing the only species.

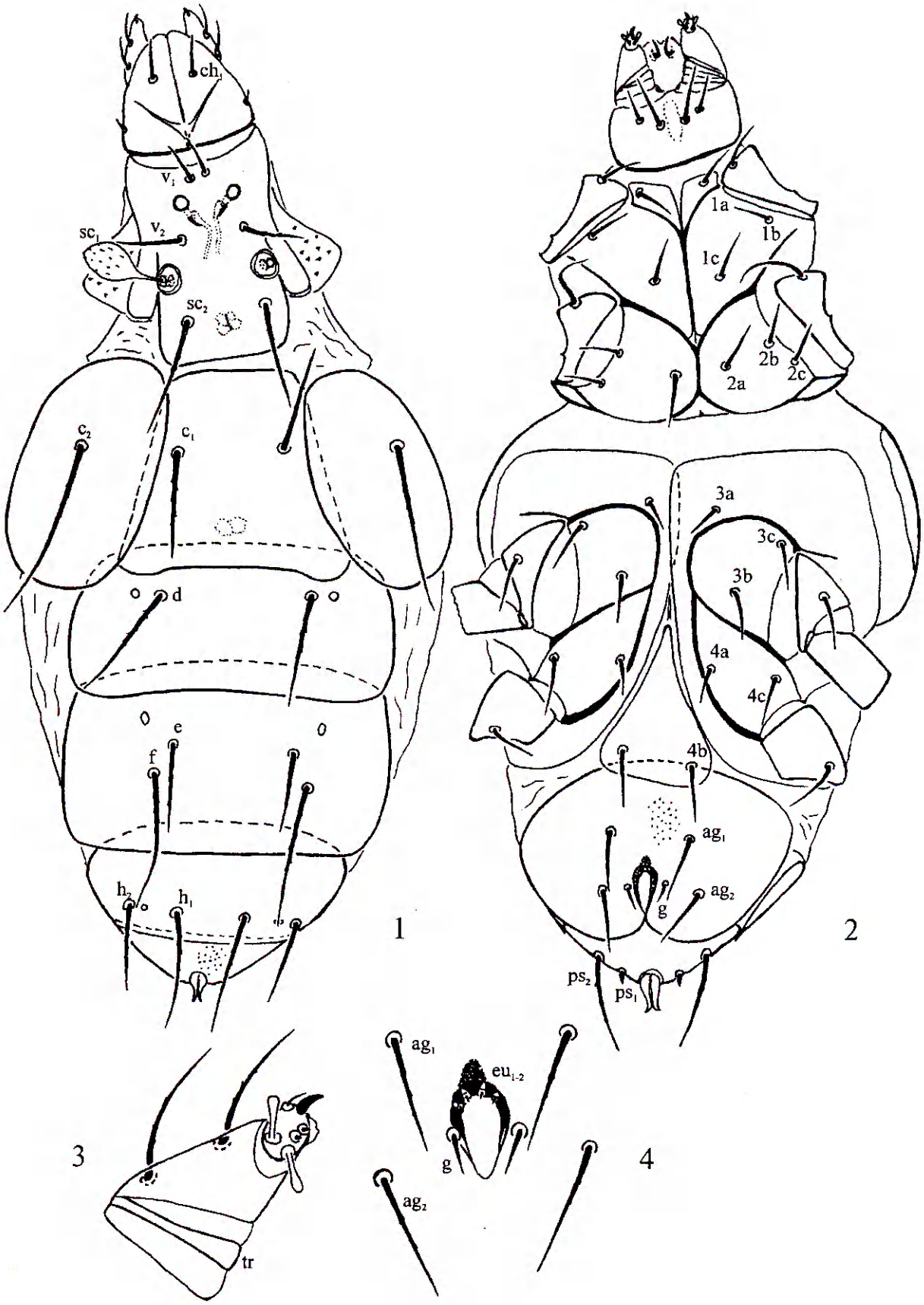
Diagnosis. With the character states of the family Bembidiacaridae.

Bembidiacarus eidelbergi Khaustov, sp. n.

Figs. 1–8.

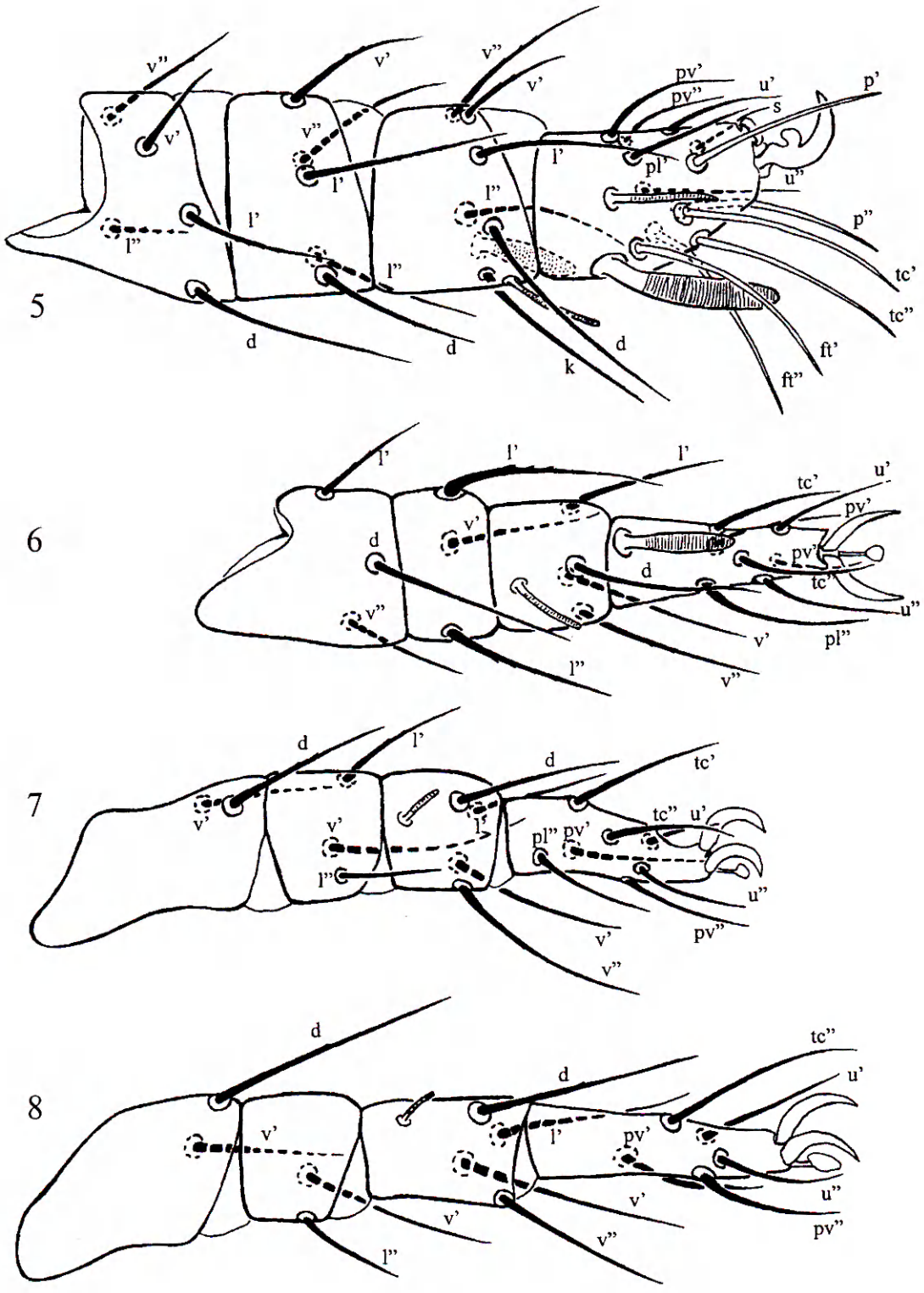
Description of adult female

Length of idiosoma 240 (230–240), width 122 (111–122). Measurements from 5 specimens.



Figs. 1–4. *Bembidiacarus eidelbergi* sp.n., female: 1 – dorsal view of body, 2 – ventral view of body, 3 – palpus, 4 – genital region.

Рис. 1–4. *Bembidiacarus eidelbergi* sp.n., самка: 1 – дорсальная сторона тела, 2 – вентральная сторона тела, 3 – пальпа, 4 – генитальная область.



Figs. 5–8. *Bembidiacarus eidelbergi* sp.n., female: 5–8 – legs I–IV, respectively.

Рис. 5–8. *Bembidiacarus eidelbergi* sp.n., самка: 5–8 – ноги I–IV, соответственно.

Gnathosoma (Figs. 1–3). Gnathosomal capsule, excluding palpi, subquadrangular in ventral aspect. Dorsal face of stylophore with setae ch_1 slightly barbed, 12–13 long. Dorsomedial apodeme evident internally. Palpcoxal setae blunt-tipped, 5 in length. Ventral face of subcapitulum with 2 pairs of setae inserted on its anterior half, the median pair 18–19 long and longer than lateral one which 11–12 long. Pharyngeal region outlined by weakly sclerotized walls, with hardly discernible musculature. Palpi projected freely anteriad of apex of stylophore, palpal femoro-

genu with 2 subequal setae (14–15), both setae slightly barbed. Palpal tibiotarsus with 2 strongly developed clavate solenidia.

Idiosomal dorsum (Fig. 1). Dorsal shields finely punctate. Prodorsal shield with setae v_1 (15) slightly barbed and closely located to each over, setae v_2 (22–23) and sc_2 (33–37) barbed. Bothridial setae sc_1 (length 25, width 11) covered with small spines and inserted in well-developed bothridia. Dorsomedial apodeme weakly developed in the area between setae sc_2. Opisthosomal dorsal setae barbed, attenuate, their lengths: c_1 26–29, c_2 43–46, *d* 33–35, *e* 20, *f* 38–40, h_1 32–34, h_2 24–25.

Idiosomal venter (Figs. 2, 4). Ventral shields finely punctate as the idiosomal dorsum. Most setae of ventral shields attenuate and finely barbed, excluding spine-like ps_1. Length of ventral idiosomal setae: 1*a* 11–12, 1*b* 12–13, 1*c* 12–14, 2*a* 14–15, 2*b* 10–12, 2*c* 14–15, 3*a* 12–13, 3*b* 12, 3*c* 13–14, 4*a* 13, 4*b* 14, 4*c* 15–16, ag_1 14–15, ag_2 16–18, *g* 6, ps_1 4–5, ps_2 24–26. Primary genital opening with 2 pairs of minute (1–2) eugenital setae, inserted on its anterior walls (Fig. 4).

Legs (Figs. 5–8). Length of legs (including trochanter and apotele): I 105–106, II 77–88, III 100–103, IV 116–117. Length of solenidia on tarsus I: ω_1 20, ω_2 16; on tibia I: φ_1 13, φ_2 16; on tarsus and tibia II: ω 17, φ 10–11; on tibia III: φ 6; on tibia IV: φ 6.

Male and immatures. Unknown.

DIFFERENTIAL DIAGNOSIS

Adult females of Bembidiacaridae are closely related to Athyreacaridae Lindquist, Kaliszewski and Rack, 1990 in having a tripartite tergite C and tripartite coxisternal plates IV, the same set of setiform setae on coxisternal plates I–IV, all legs having 5 segments and ambulacra, leg I being thickened, with 5 setae both on its femur and genu, leg IV with subquadrangular trochanter, fusiform body, protuberant caudal opening but differ from the latter by the presence of propodosomal bothridia and bothridial setae, the absence of setae *pl″* on tarsus I and *pl″* and *tc′* on tarsus IV, not enlarged claw and setae *u′–u″* on tarsus I, 3-segmented palpi, 2 pairs of *ps*-setae. They also differ by the presence of genital and eugenital setae and by the absence of extremely long setae on legs.

Bembidiacarid females are also similar with Trochometridiidae Mahunka (1970) in having a tripartite tergite C and tripartite coxisternal plates IV, the same set of setiform setae on coxisternal plates I–IV, all legs having 5 segments and ambulacra, leg I thickened, with 5 setae both on its femur and genu, leg IV with subquadrangular trochanter. Females of Bembidiacaridae differ from those of Trochometridiidae in having 3-segmented palpi, the idiosoma being fusiform, the setae of tergite EF obliquely aligned, the pseudanal tergite PS bearing protuberant ventrocaudal opening, the metapodosomal venter without a pair of sporothecae within coxisternal plates IV, the aggenital plate with 3 pair of setae, the subunguinal setae *s* not enlarged and spine-like, claw on tarsus I being not enlarged, tarsi II–III bearing 7 setae, and tarsi IV bearing 5 setae.

REMARKS

The phylogenetic relationships of Bembidiacaridae with other families of heterostigmatic mites are not clear. Hypothesis on the relationships of Bembidiacaridae will be developed further on, in light of comparisons with other new family-group taxa of Heterostigmata (as discussed by Lindquist et al. [1990] for Athyreacarid mites).

The family Bembidiacaridae is currently known only from adult females which are found to be foretic on the first abdominal tergite (covered by elythrae) of carabid beetles of the genus *Bembidion*, tribe Bembidiinae.

The feeding habits and type of symbiotic associations that these mites may have with their beetle hosts are unknown. The soft cuticle between the dorsal and ventral plates of the body is not plicated and probably indicates that adult females are not capable of very expansive physogastry.

Description of the family is lengthy, because the adult female of the only species and genus is known. If mites representing other genera of this family are discovered as associates of other taxa of insects, the family description will perforce be shortened and broadened, with many characteristics described for the family becoming the generic-level characteristics.

Type material. Holotype, slide № 1020 (c), female, Crimea, near settl. Perevalnoye, Salgir river bank, from the first abdominal tergite of carabid beetle *Bembidion saxatile* Gyll., 9.07.1989, leg. M.M. Eidelberg. Paratypes: 9 females from the same locality and host as holotype.

ETYMOLOGY

The name of the family and the genus is a compound word originated from the tribal name of the beetle associates, and *"acarus"*, a common name for mites latinized form of Greek word. The species is named for Dr. M.M. Eidelberg for his contributions to the knowledge of mites associated with carabid beetles.

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