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Brief report

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A new Eocene free-living cheyletid mite from Baltic amber

ANDRE V. BOCHKOV and EKATERINA A. SIDORCHUK

A new species of predaceous mite, *Cheletomimus* (*Hemicheyletia*) *crinitus* sp. nov. (Acariformes: Cheyletidae), is described from Eocene Baltic amber based on a fossil female. Among species of the genus, it belongs to the *C.* (*H.*) *wellsi* species group (16 extant species) and differs from the closely morphologically related species, *C. greenwoodi* by the following features. In *C. crinitus* sp. nov., setae d2 are situated on the hysteronotal shield (vs. off this shield in *C. greenwoodi*), the propodonotal and hysteronotal shields each bear five pairs of median setae (vs. 3 and 1 pairs of median setae, respectively), setae h1 and h2 are subequal in width to other lateral hysteronotal setae (vs. half the width of other hysteronotal setae).

Introduction

The mite family Cheyletidae Leach, 1815 (Acariformes: Cheyletoidea) is cosmopolitan and includes more than 440 species in 75 genera (Zhang et al. 2011). Most of these mites are free-living predators, though representatives of several taxonomic groups are permanent ectoparasites of small mammals and birds (Bochkov 2004, 2009). Fossil finds of cheyletids are extremely scarce and described inadequately: one specimen is known from Baltic amber (Koch and Berendt 1854) and another, from Cretaceous Burmese amber (Cockerell 1917).

Recently developed preparation techniques (Sidorchuk 2011, 2013) allow for much closer observation of amber inclusions, especially if the amber is transparent, as was the case for our piece. It was therefore possible to assess the morphological traits normally used for description of extant mites.

In the present paper, we describe a new species of cheyletid from Baltic amber based on a female belonging to the genus *Cheletomimus* Oudemans, 1904 (Oudemans 1904b) in tribe Cheyletini Leach, 1815. This genus is represented by about 36 extant species of the free-living predators, commonly inhabiting leaves of plants. They are known from all the continents except Antarctica, but mostly from the warmer climatic regions (Fain et al. 2002).

Institutional abbreviations.—CCHH, the private collection of Christel and Hans-Werner Hoffeins, Collection Christel & Hans-Werner Hoffeins, Hamburg, Germany; SMF, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany.

Other abbreviations.—1a–c, 2c, 3a–c, 4a–c, coxal setae of coxae 1–4, respectively; a, antelateral leg tarsus seta; acm, anteroculminal palpal eupathidia; ag1–3, aggenital setae; b.s., bush-like seta; c2, d2, e2, f2, h1–h3, dorsal setae associated with body segments C, D, E, F, H, respectively; d, dorsal seta; elc, supracoxal seta; emp, empodium; F, femur; ft, fastigial leg tarsus seta; G, genu; g1–2, genital setae; l, lateral seta; m, medial subcapitular seta; oc, ocellus; p, proral leg tarsus seta; per, peritreme; ps1–3, pseudanal setae; se, scapular external prodorsal seta; si, scapular internal prodorsal seta; sul, subultimal palpal eupathidium; tc, tectal leg tarsus seta; Ti, tibia; ti.cl, tibial claw; u, unguinal leg tarsus seta; ul, ultimal palpal eupathidium; v, ventral seta; ve, vertical external prodorsal seta; vi, vertical internal prodorsal seta; vs, ventrosagittal leg tarsus seta; ω, tarsal solenidion; φ, tibial solenidion; ′ and ″ refer to position of seta in pseudosymmetrical pair on appendage: anterior or posterior, respectively.

Material and methods

The piece of Baltic amber (SMF Be 2537, originally CCHH # 448-1), originally ca. 5 × 5 × 10 mm, was affixed with double-side sticky tape to a plastic rod and trimmed with a diamond disk saw using a Proxxon GG 12 tool. Then it was polished on four sides with the help of pit holders and an OpenScience MiniPolly polisher, as described by Sidorchuk (2013), to obtain a rectangular piece ca. 1 × 0.3 × 0.3 mm. The piece is stored in an o-ring 2 ml centrifuge tube in an aqueous solution of Thymol (2 drops of saturated Thymol solution per 1 ml of water).

Individual focal planes were taken using a Nikon Eclipse 800 microscope in brightfield mode with water immersion lenses (40× and 60×). In some cases, a green interference filter was used to reduce chromatic aberration. Clarity-enhanced and noise-reducted stacks of images (focal planes) were taken with an AmScope MU 900, and then processed with Adobe Photoshop Lightroom 5. Layers were combined with Helicon Focus Pro 4 and 5.3 software, always with some manual addition of significant details from the individual focal planes to the combined images. Micropanoramas were created with GIMP software, with correction of the colour levels when necessary.

Drawings were made using a phase contrast Leica microscope with a camera lucida. In the descriptions below, the idiosomal chaetotaxy follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The nomenclature for leg setae follows that of Grandjean (1944). All measurements are in mikrometers (μm).

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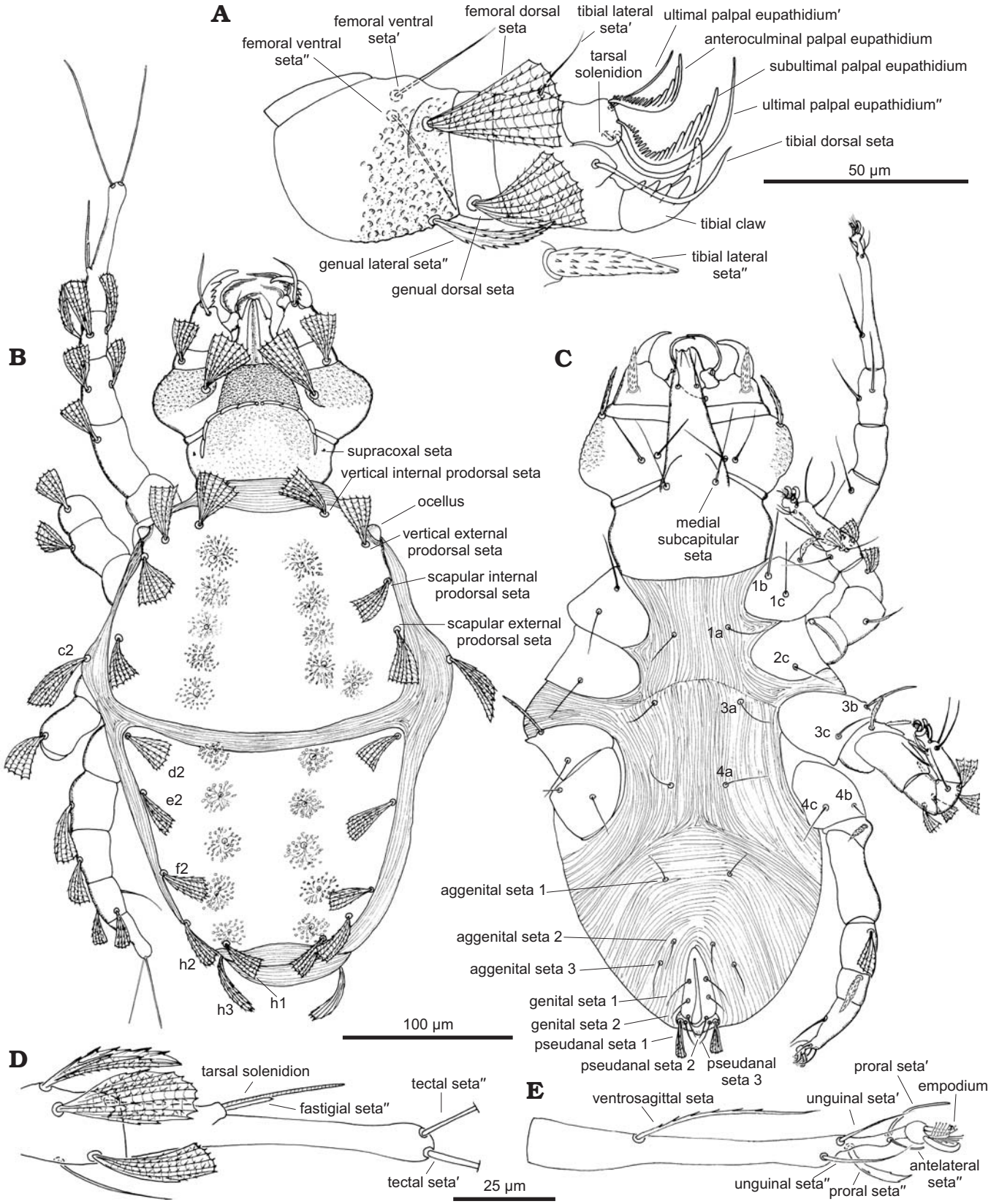

Fig. 1. Cheyletid mite *Cheletomimus crinitus* sp. nov., female holotype (SMF Be 2537, ex. CCHH 448-1) from Baltic amber (Baltic Sea coast, most likely Sambian Peninsula, middle to upper Eocene, 37–54.5 Mya), reconstruction (leg positions altered for clarity). Dorsal (**B**) and ventral (**C**) views, right palp (**A**) and left tibia and tarsus I (**D**) in dorsal views, left tarsus I in ventral view (**E**). Abbreviations: 1a–c, 2c, 3a–c, 4a–c, coxal setae of coxae 1–4, respectively; c2, d2, e2, f2, h1–h3, dorsal setae, associated with body segments C, D, E, F, H, respectively; ′ and ″ refer to position of seta in pseudosymmetrical pair on appendage: anterior or posterior, respectively.

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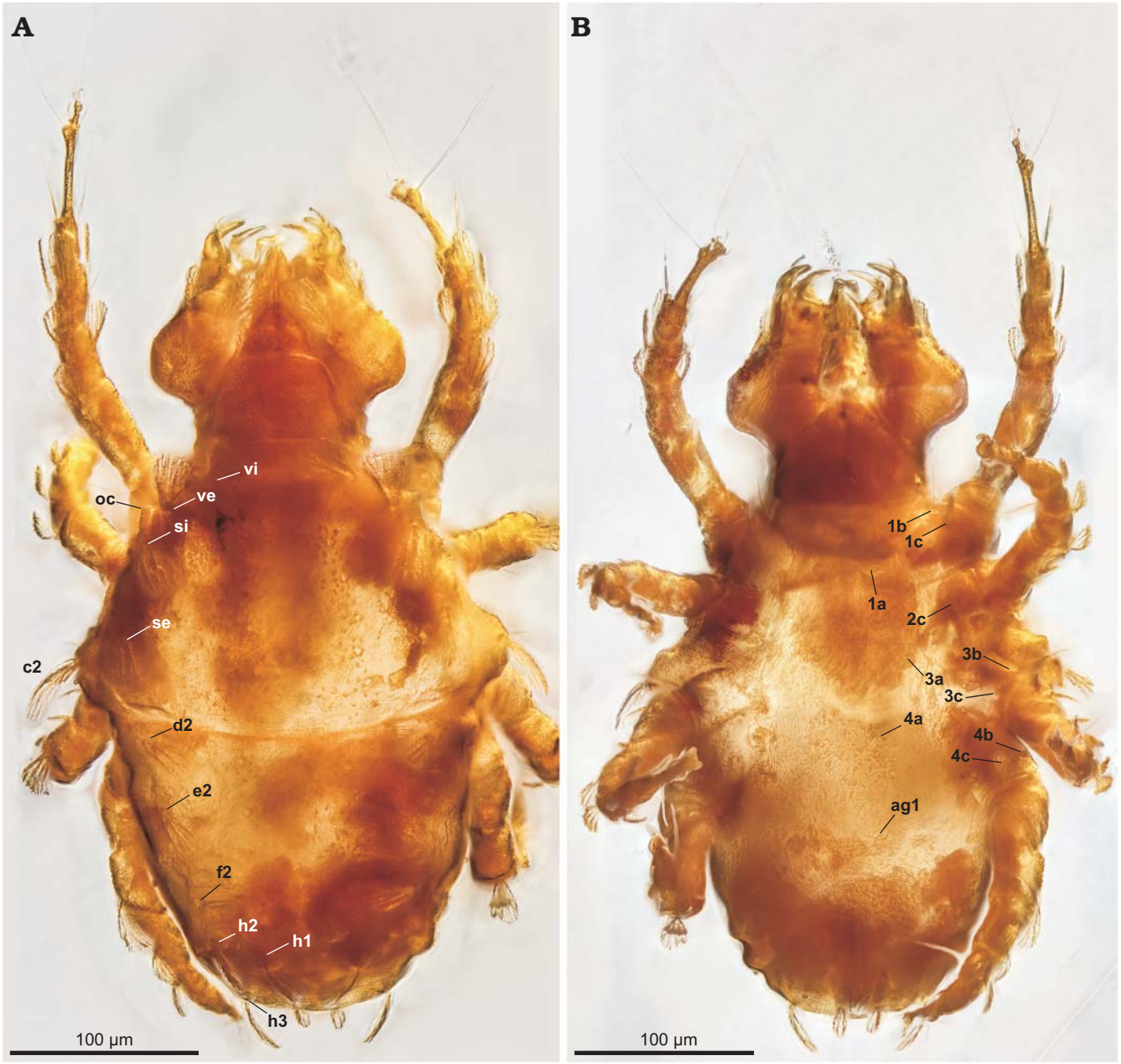

Fig. 2. Cheyletid mite *Cheletomimus crinitus* sp. nov., female holotype (SMF Be 2537, ex. CCHH 448-1) from Baltic amber (Baltic Sea coast, most likely Sambian Peninsula, middle to upper Eocene, 37–54.5 Mya), brightfield layered micropanaramas, each combined from ca. 170 focal planes. Dorsal (**A**) and ventral (**B**) views. Abbreviations: 1a–c, 2c, 3a–c, 4a–c, coxal setae of coxae 1–4, respectively; ag1, anterior aggenital seta; c2, d2, e2, f2, h1–h3, dorsal setae, associated with body segments C, D, E, F, H, respectively; oc, ocellus; se, scapular external prodorsal seta; si, scapular internal prodorsal seta; ve, vertical external prodorsal seta; vi, vertical internal prodorsal seta.

Systematic palaeontology

Class Arachnida Lamarck, 1801

Order Acariformes Zakhvatkin, 1952

Family Cheyletidae Leach, 1815

Tribe Cheyletini Leach, 1815

Genus *Cheletomimus* Oudemans, 1904

Type species: *Cheletes berlesei* Oudemans, 1904; Recent, Italy.

Subgenus *Hemicheyletia* Volgin, 1969

Type species: *Paracheyletia bakeri* Ehara, 1962; Recent, Japan.

Cheletomimus (*Hemicheyletia*) *crinitus* sp. nov.

Figs. 1–3.

Etymology: From Latin *crinitus*, fluffy; in reference to numerous bush-like median setae on the dorsal shields of the idiosoma; masculine gender.

Holotype: Female, SMF Be 2537 (originally CCHH # 448-1).

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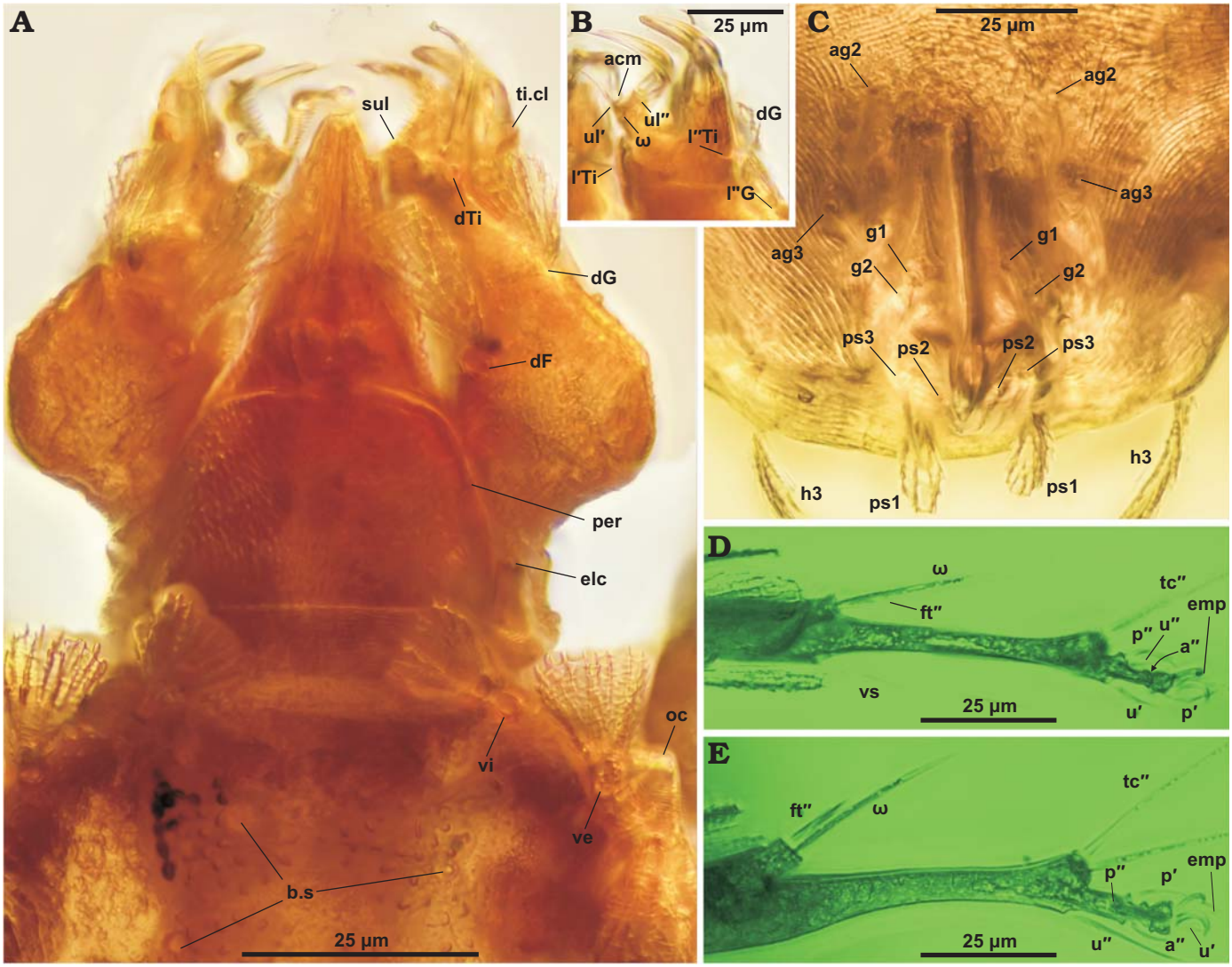

Fig. 3. Cheyletid mite *Cheletomimus crinitus* sp. nov., female holotype (SMF Be 2537, ex. CCHH 448-1) from Baltic amber (Baltic Sea coast, most likely Sambian Peninsula, middle to upper Eocene, 37–54.5 Mya). **A**. Dorsal view of gnathosoma and anterior opisthosoma (micropanorama assembled from ca 80 images). **B**. Detail of left palp in ventral view (assembled from 18 images). **C**. Posterior of ano-genital area in lateral antiaxial view in lateral antiaxial view (assembled from ca. 40 images). **D**. Left leg I tarsus in lateral antiaxial view (from 22 focal planes). Note extremely poor visibility of seta p″ against the background of the leg. Abbreviations: a, antelateral seta; acm, anteroculminal palpal eupathidia; ag1–3, aggenital setae, b.s., bush-like seta; d, dorsal seta; elc, supracoxal seta; emp, empodium; F, femur; ft, fastigial seta; G, genu; g1–2, genital setae; h3, seta of segment H; l, lateral seta; oc, ocellus; p, proral seta; per, peritreme; ps1–3, pseudanal setae; tc, tectal seta; Ti, tibia; ti.cl, tibial claw; u, unguinal seta; ul, ultimal palpal eupathidium; ve, vertical external prodorsal s4eta; vi, vertical internal prodorsal seta; vs, ventrosagittal seta; ω, tarsal solenidion; ′ and ″ refer to position of seta in pseudosymmetrical pair on appendage: anterior or posterior, respectively.

Type locality: Baltic Sea coast, most likely Sambian Peninsula.

Type horizon: Middle to upper Eocene in amber, 37–54.5 Mya (Poinar 1992; Weitschat and Wichard 2010).

Diagnosis.—This new species belongs to the *C.* (*H.*) *wellsi* species group (16 species) of the subgenus *Hemicheyletia* Volgin, 1969. In females of this group, dorso-median setae of the idiosoma are aberrant, strongly different from lateral setae, and the hysteronotal shield is entire. Among species of this group, female of *C.* (*H.*) *crinitus* sp. nov. morphologically similar to those of *C. greenwoodi* Fain, Bochkov, and Corpuz-Raros, 2002 known from England (Fain et al. 2002). In these species, tibia I bears five setae (excluding solenidion), seta l″Ti on the palp tibia is thickened serrate, the hysteronotal shield bears median bush-like setae and lateral fan-like setae, including h1 and h2, seta ft of tarsus I present. Female of the new species differs from those of *C. greenwoodi* by the following features. In *C. crinitus* sp. nov., setae d2 are situated on the hysteronotal shield (vs. off this shield in *C. greenwoodi*), the propodonotal and hysteronotal shields each bear five pairs of median setae (vs. 3 and 1 pairs of median setae, respectively), setae h1 and h2 are subequal in width to the other lateral hysteronotal setae (vs. half the width of other hysteronotal setae).

Description.—Female (holotype, SMF Be 2537). Body 435 long and 225 wide at the level of setae c2.

Gnathosoma: 135 long from the rostral apex to posterior margin of subcapitulum from ventral side and 90 wide at the

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level of supracoxal setae (elc). Peritremes arch-like, with five or six pairs of segments. Protegmen densely ornamented with tubercles. Tegmen (rostral shield) strongly punctate. Comb-like eupathidia acm and sul each with numerous teeth (>15). Palpal claw with four teeth. Setae of palp tibia: dTi smooth, thickened; l″Ti thickened serrate, l′Ti filiform. Setae of palp genu: dG fan-like, 18 long and maximum 7 wide; l″G displaced on femur, lanceolate, 20 long. Palpal femur 30 long and maximum 28 wide, covered by tubercles in the anterior half. Setae of palp femur: dF fan-like, 24 long and maximum 16 wide; setae v′F and v″F filiform.

Idiosoma: 315 long. Lateral setae of the idiosoma fan-like, subequal in size, about 25 long and maximum 23 wide; median setae of the idiosoma aberrant, bush-like. Length of propodonotal shield 135 along midline and 175 wide at level of the posterior margin; bearing four pairs of lateral setae and five pairs of median setae. Setae c2 fan-like, 45 long. Hysteronotal shield well developed, length 125 along midline, 170 wide at the level of the anterior margin, and 65 wide at level of the posterior margin; bearing five pairs of lateral setae, including d2 and h1, and five pairs of median setae. Setae h1 situated posterior to the level of setal bases h2. Distance between propodonotal and hysteronotal shields 10. Setae h3 fan-like, 35 long, situated terminally off the hysteronotal shield. Setae ps1 fan-like, 12 long, other pseudoanal setae filiform.

Legs: Solenidion ω1 22 long, companion seta ft present, 12 long. Tibia I with five setae and solenidion φ (three fan-like setae, d, l′, l″ and two smooth filiform setae, v′, v″); tibia II with two lanceolate setae, two smooth filiform setae and solenidion φ; tibiae III and IV each with two fan-like setae, one lanceolate seta, and one smooth filiform seta. Genua I–IV with two fan-like setae each (genu I with solenidion σ). Femur I with one fan-like seta and one smooth filiform seta; femora II and III with one fan-like seta and one barbed seta each; femur IV with one fan-like seta. Coxal seta 3b strongly barbed. Legs I 220 long; legs IV 155 long.

Geographic and stratigraphic range.—Type locality and horizon only.

Discussion

According to rough estimates made with a molecular clock (18S rDNA), the family Cheyletidae diverged with the Syringophilidae from a common ancestor approximately 180 Mya at the beginning of the Jurassic (Dabert et al. 2010). Despite this long age estimate, only two records of fossil cheyletids are known: *Cheyletus portentosus* Koch and Berendt, 1854 from Baltic amber (middle to upper Eocene of the Baltic coast, 37–54.5 Mya; Poinar 1992; Weitschat and Wichard 2010) and *C. burmiticus* Cockerell, 1917 from the Cretaceous Burmese amber (Hukawng Valley in North Myanmar, Cenomanian–Albian boundary, 100 Mya; Shi et al. 2012). The specimen of *C. portentosus* is a female, which certainly does not belong to the genus *Cheyletus* Latreille, 1796 because its anterior legs are too short. It could belong to the genus *Cheletomimus* or closely related genera. Unfortunately the fine morphological details of this specimen are not described and the type was not available for study, so its generic assignment cannot be determined with confidence and comparison at the species level is impossible. We propose, therefore, to consider this species as nomen dubium. From the description of *C. burmiticus*, we can only conclude that this is a heteromorphic male of some free-living cheyletid.

We are the first, for *Cheletomimus crinitus* sp. nov., to study the external morphology of an extinct cheyletid species in detail. Its specialized structures (aberrant dorso-median setae of the idiosoma, granulated rostrum, leg setation, etc.) are comparable to those of extant representatives of the morphologically derived *C.* (*H.*) *wellsi* group, and this species has no plesiomorphic character states that would allow us to put it to the base of the *wellsi* group phylogeny. We speculate, therefore, that the genus *Cheletomimus* probably appeared earlier than 50 Mya, and that many modern genera of free-living cheyletids existed in the Eocene.

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