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ORIGINAL ARTICLE

A new species of the genus *Stygothrombium*, representing a newly recorded superfamily Stygothrombioidea Mullen & Vercammen-Grandjean, 1980 (Acari: Stygothrombiae) from China

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Abstract The paper deals with a species new to science, *Stygothrombium garzensis* Li & Guo, **sp. nov.**, collected from Qinghai-Tibet Plateau, P.R. China, which represents a newly recorded superfamily Stygothrombioidea Mullen & Vercammen-Grandjean, 1980 to Chinese fauna. The new species is described and illustrated in detail, especially the quantity and characteristic of idiosomal glandularia, with the diagnosis of infracapitulum base approximately 3.5 times as long as rostrum, the second pair of posterior setae on prodorsal plate about half length of posterior portion of prodorsal plate and the second ventroglandularia between the third acetabula and inner posterior angle of the fourth coxae, located at one-third of interval near the third acetabula approximately.

Key words Taxonomy, aquatic mite, Parasitengonina, new record.

1 Introduction

Stygothrombioidea Mullen & Vercammen-Grandjean, 1980 (Stygothrombiae, Acari) is an enigmatic group without eyes and with vermiform bodies in order to facilitate locomotion in interstitial spaces, which was recorded only in Holarctic Region (Smith *et al.*, 2001; Di Sabatino *et al.*, 2008; Walter *et al.*, 2009; Nagasawa & Abé 2014). Aquatic larvae of stygothrombioids search their plecopteran hosts (the nymph stage) in the substratum and attach to the adults of hosts as they emerge (Mullen & Vercammen-Grandjean, 1980; Smith *et al.*, 2001; Yasick *et al.*, 2003). Deutonymphs and adults live in interstitial aquatic habits and crawl through the spaces between particles, in addition, they could be predators, but we don't know what the prey is (Smith *et al.*, 2001).

All along, the phylogenetic relationship of stygothrombioid mites is ambiguous. The biggest controversy is whether it belongs to Hydrachnidiae. Many acarologists consider that it is a primitive group of water mites, because they live in interstitial aquatic habitats, their larvae have two setae on the pedipalpal genu, and deutonymphs and adult present the modified glandularia-like lyrifissures on the idiosoma (Mullen & Vercammen-Grandjean, 1980; Jin, 2000; Di Sabatino *et al.*, 2008). But some acarologists classify it in Parasitengonina as a separate branch with Hydrachnidiae (Smith *et al.*, 2001; Walter *et al.*, 2009). Recently, Dabert *et al.* (2016) concluded a result by molecular means that Stygothrombioidea was close to water mites but was not nested within Hydrachnidiae, but their phylogenetic relationship to the true water mites is still unclear.

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Up to now, the superfamily Stygothrombioidea only contains a single family Stygothrombiidae comprising of 19 species in the single genus *Stygothrombium* (Tuzovskij, 2010; Zhang *et al.*, 2011; Nagasawa & Abé, 2014). However, some species of the genus are in doubt. Both Mullen & Vercammen-Grandjean (1980) and Yasick *et al.* (2003) thought that most of the previous descriptions and illustrations donot provide enough details for a meaningful taxonomic study. Pešić *et al.* (2006) also thought some species named previously representing a species complex. All of these works indicate that the study of this group is very scarce, more materials should be found for phylogenetic studies and more attentions should be paid on ecological research.

During a field survey of water mites from Qinghai-Tibet Plateau, a new species, *Stygothrombium garzensis* Li & Guo, **sp. nov.**, was collected from Chaqingsongduo National Nature Reserve, Sichuan Province, which is located on the boundary of the Oriental and the Palaearctic Regions. It is also the first time that Stygothrombioidea is reported in China.

2 Materials and methods

A dip net with a wide opening (40–60 cm in diameter) and fine mesh size (250 μm) is positioned and secured in the river so that flowing water could carry dislodged organisms and particles of substrate into it. Then, two stacked sieves (mesh size 4 mm above, 250 μm below) are used to remove leaves and other large impurities. Finally, a 2 mL dropper and a white tray are used to capture water mites. Specimens are preserved in Koenike's fluid and mounted in gelatin mounting fluid (Jin, 1997).

Specimens are examined and illustrated under a Leica DM3000 microscope, and the illustrations are edited with Adobe Photoshop CS6®. Specimens are measured using Nikon DS-Ri2 (Gu *et al.*, 2020). Type specimen is deposited in the Institute of Entomology, Guizhou University, Guiyang, P.R. China (GUGC) (Zhang, 2018). All measurements are given in micrometer (μm).

Terminology of setae on segments of the pedipalp follows Vercammen-Grandjean (1980):

a—alantoid;
g—gladius;
h—harpagones;
l—lancea;
od—odontus;
pod—parodontus;
tct—tectala;

Besides, the following abbreviations are used:

Ac-1–3—acetabula 1–3;
ACG—anterior coxal group (Cx-I+Cx-II);
Cx-I–IV—coxae I–IV;
dL—dorsal length;
gld-1–8—dorsoglandularia 1–8;
gll-1–7—lateroglandularia 1–7;
glv-1–6—ventroglandularia 1–6;
I-L-1–6; *etc.* —first–sixth segments (trochanter; basifemur; telofemur; genu; tibia and tarsus) of the first leg; *etc.*;
L—length;
P-A–B—pedipalp fused segments;
P-A—trochanter + femur + genu;
P-B—tibia + tarsus;
PCG—posterior coxal group (Cx-III+Cx-IV);
s—solenidion;
se—second pair of posterior seta of prodorsal plate;
si—a pair of bothridia of prodorsal plate;
ve—first pair of posterior seta of prodorsal plate;
vi—unpaired anteromedial seta of prodorsal plate;
W—width.

3 Systematics

Superfamily Stygothrombioidea Mullen & Vercammen-Grandjean, 1980
Family Stygothrombiidae Motas & Tanasachi, 1946
Genus *Stygothrombium* Viets, 1932

***Stygothrombium garzensis* Li & Guo, sp. nov.** (Figs 1–5)

Habitat. Interstitial waters.

Material examined. Holotype female, Chaqingsongduo National Nature Reserve, Sichuan, China (31°00′88″N, 99°24′71″E, elev. 3523 m), water depth 30–40 cm, located at the hillside, running water with organic detritus, dead wood and leaves on the bottom, collected by Boyan Li, 30.VIII.2020, Slides No. SC-ST-2020080101.

Etymology. "*garze*-" is derived from the name of the Garze Tibetan Autonomous Prefecture, Sichuan Province, China, where the specimen was collected.

Diagnosis. Soft and papillate idiosoma vermiform; eyes completely absent; infracapitulum base approximately 3.5 times as long as rostrum; P-A with two stout subventrodistal harpagones, above harpago seta thicker than other one; on one

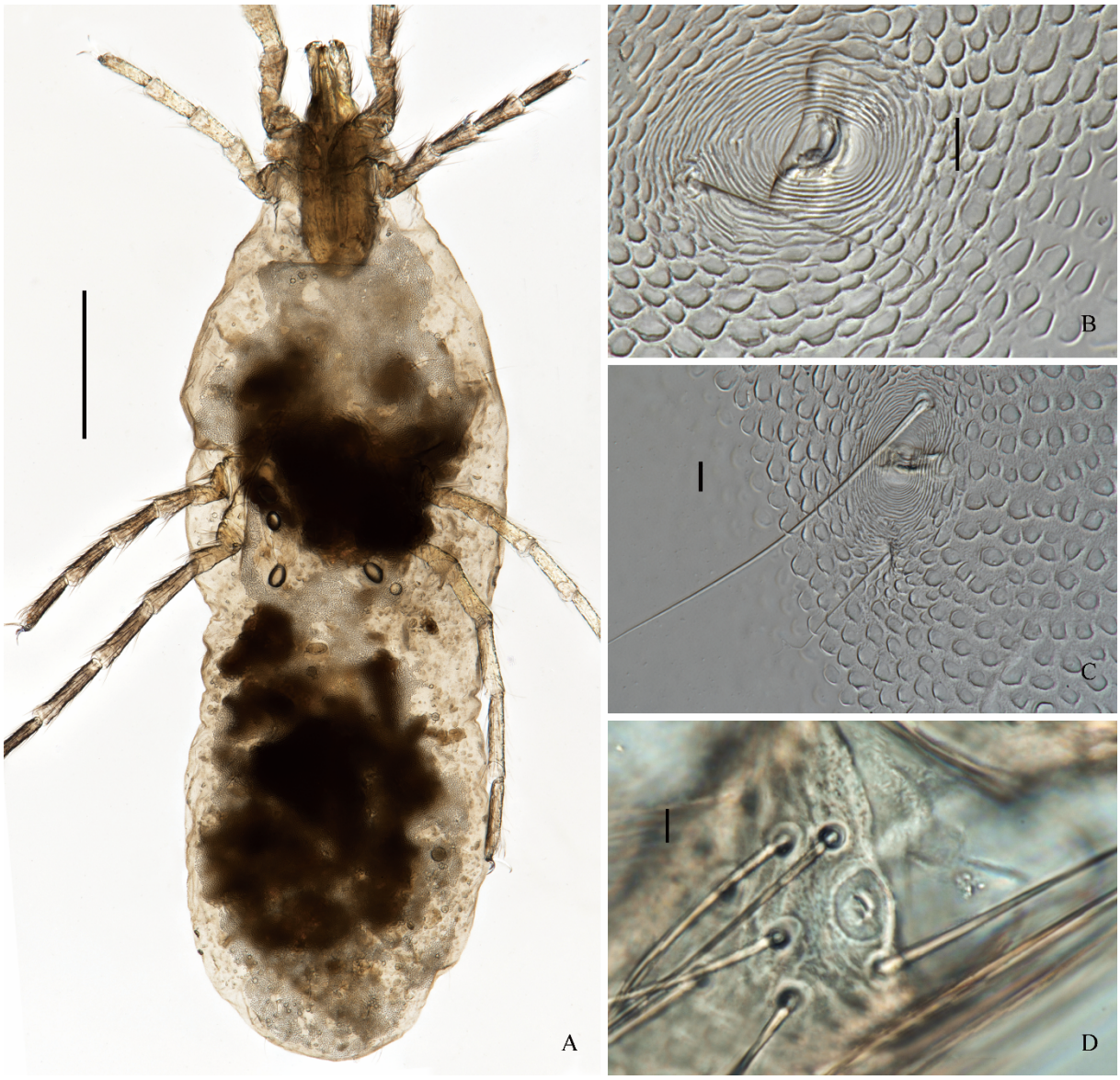

Figure 1. *Stygothrombium garzensis* Li & Guo, **sp. nov.**, ♀, holotype (SC-ST-20200801). A. Ventral view. B. *Gll*-1. C. *Gll*-2. D. I-L-4, stomatoid lyrifissures. Scale bars: A = 500 μm; B–D = 10 μm.

side of P-B, tibia with one four-pronged odontus claws bulging above tarsus; *se* about half length of posterior portion of prodorsal plate; one seta and two rather long setae at lateral margin of Cx-I; stalked Ac-1–3 arranging in an almost straight line, *glv*-2 between Ac-3 and inner posterior angle of Cx-IV, located at one-third of interval near Ac-3 approximately; empodium considerably smaller than lateral claws.

Description. Female (SC-ST-2020080101). Soft and papillate idiosoma vermiform (Fig. 1A); eyes completely absent (Fig. 2A); with eight pairs of *gld* and seven pairs of *gll* (*gld*-1–8, *gll*-1–7 in Fig. 2A), six pairs of *glv* (*glv*-1–6 in Fig. 2B); idiosomal glandularia (or modified stomatoid lyrifissures) without sclerite platelets but surrounded by unpapillate cuticle, a long seta and short seta associated with glandularia except *gll*-1 with only a short seta (Figs 1B–C); excretory pore placed near posterior end of ventral surface and between *glv*-5 (Fig. 2B).

Gnathosoma retractable into idiosoma; infracapitulum base approximately 3.5 times as long as rostrum; two pairs of setae on rostrum, posterior one longer than anterior one (Fig. 3A); chelicera two-segmented, basal segment expanded and long (Fig. 3B); fused pedipalp two-segmented: first segment including trochanter + femur + genu (P-A); P-A with numerous dorsal setae, a thin ventrodistal seta, two stout subventrodistal harpagones (above harpago seta thicker than other one) and

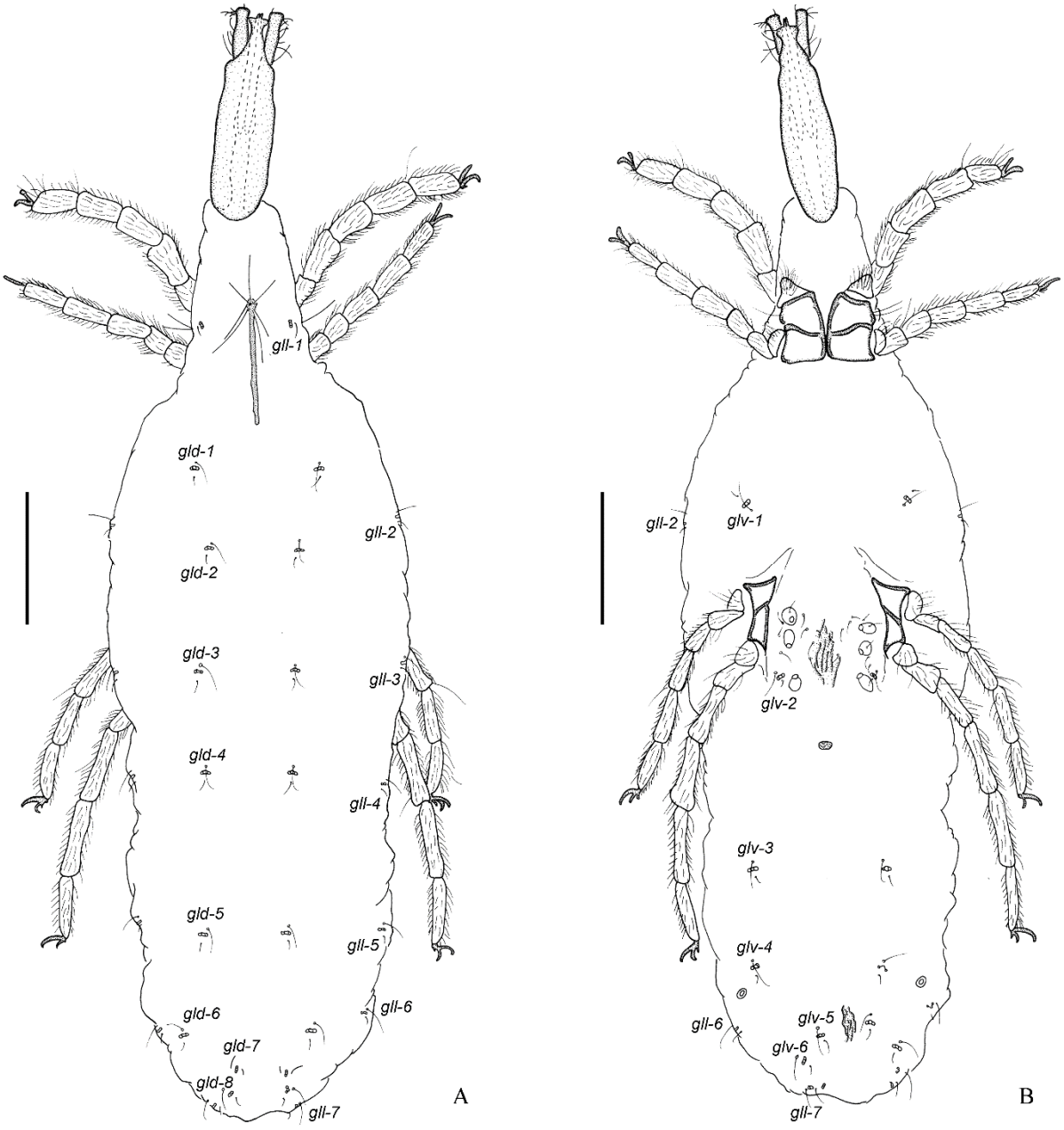

Figure 2. *Stygothrombium garzensis* Li & Guo, **sp. nov.**, ♀, holotype (SC-ST-20200801). A. Dorsal view. B. Ventral view. Scale bars = 500 μm.

two ventroproximal setae (one normal seta and one long curved seta); tibia + tarsus fused into short second segment (P-B); on one side of P-B, tibia with one four-pronged odontus claws bulging above tarsus, one stout gladius seta, one thick and short lancea seta, one parodontus, and two normal setae on tarsus; P-B with six normal setae on another side, single solenidion on dorsum and alantoid seta with rounded tip at terminus (Figs 3C–D).

Prodorsal plate bearing *vi*, *si*, *ve* and *se*; long and narrow posterior portion of prodorsal plate approximately six times as long as short and wide anterior portion; *se* about half length of posterior portion, longer than *vi*, *si* and *ve* (Fig. 3E).

Coxal plates in four groups; two ACG not fused but close, two PCG widely separated; Cx-I trapezoidal, with numerous setae near inner apical angles and three setae (one seta and two rather long setae) at lateral margin; Cx-II trapezoidal, with one seta near outer posterior angles (Fig. 4A); Cx-III and Cx-IV nearly triangular, with some setae respectively (Fig. 4B).

Genital field with about twenty tiny setae; stalked Ac-1–3 arranging in an almost straight line, interval from Ac-1 to Ac-2 and Ac-2 to Ac-3 almost equal; gonopore surrounded by three or four setae on each side; *glv*-2 between Ac-3 and inner posterior angle of Cx-IV, located at one-third of interval near Ac-3 approximately (Fig. 4B).

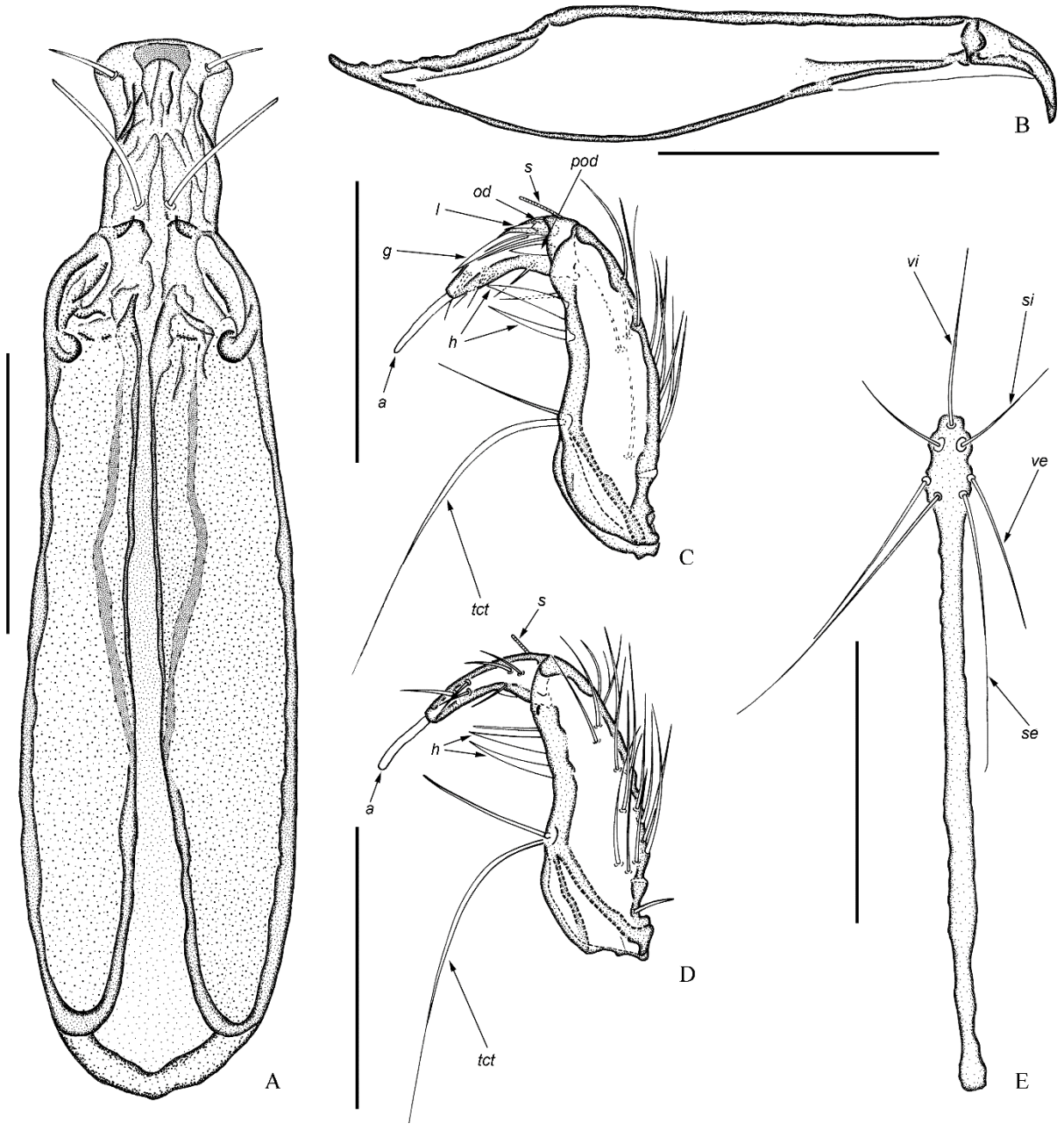

Figure 3. *Stygothrombium garzensis* Li & Guo, **sp. nov.**, ♀, holotype (SC-ST-20200801). A. Infracapitulum, dorsal view. B. Chelicera. C. Pedipalp, one lateral view. D. Pedipalp, another lateral view. E. Prodorsal plate. Scale bar = 200 μm.

Legs without swimming setae but numerous setae present; I-L thicker than other pairs of legs, I-L-3–5 with stomatoid lyrifissures on one side (Figs 5A–D); tarsus of I–IV-L with two pectinate lateral claws and one smooth middle empodium, empodium considerably smaller than lateral claws (Fig. 1D).

Male. Unknown.

Measurements (holotype). Idiosoma L 3857 (from peak of protrusible integument to bottom), W 1114; excretory pore L 108; Infracapitulum L 783, base L 607, rostrum 176; Chelicera base segment L 477, claw L 102; P-A dL 253, P-B dL 97, alantoid seta L 60, above harpago seta L 64, nether harpago seta L 66; prodorsal plate L 478, anterior portion L 73, posterior portion L 405; ACG L 274; PCG L 346; gonopore L 119, Ac-1 L 76, Ac-2 L 66, Ac-3 L 80; Legs segments dL: I-L-1 100, I-L-2 164, I-L-3 173, I-L-4 182, I-L-5 189, I-L-6 159, claw dL 88; II-L-1 88, II-L-2 134, II-L-3 136, II-L-4 166, II-L-5 190, II-L-6 140, claw dL 84; III-L-1 123, III-L-2 134, III-L-3 139, III-L-4 186, III-L-5 205, III-L-6 153, claw dL 78; IV-L-1 101, IV-L-2 173, IV-L-3 213, IV-L-4 259, IV-L-5 280, IV-L-6 191, claw dL 81.

Remarks. The present new species is similar to *S. monotrichum* Nagasawa & Abé, 2014 from Japan in quantity and

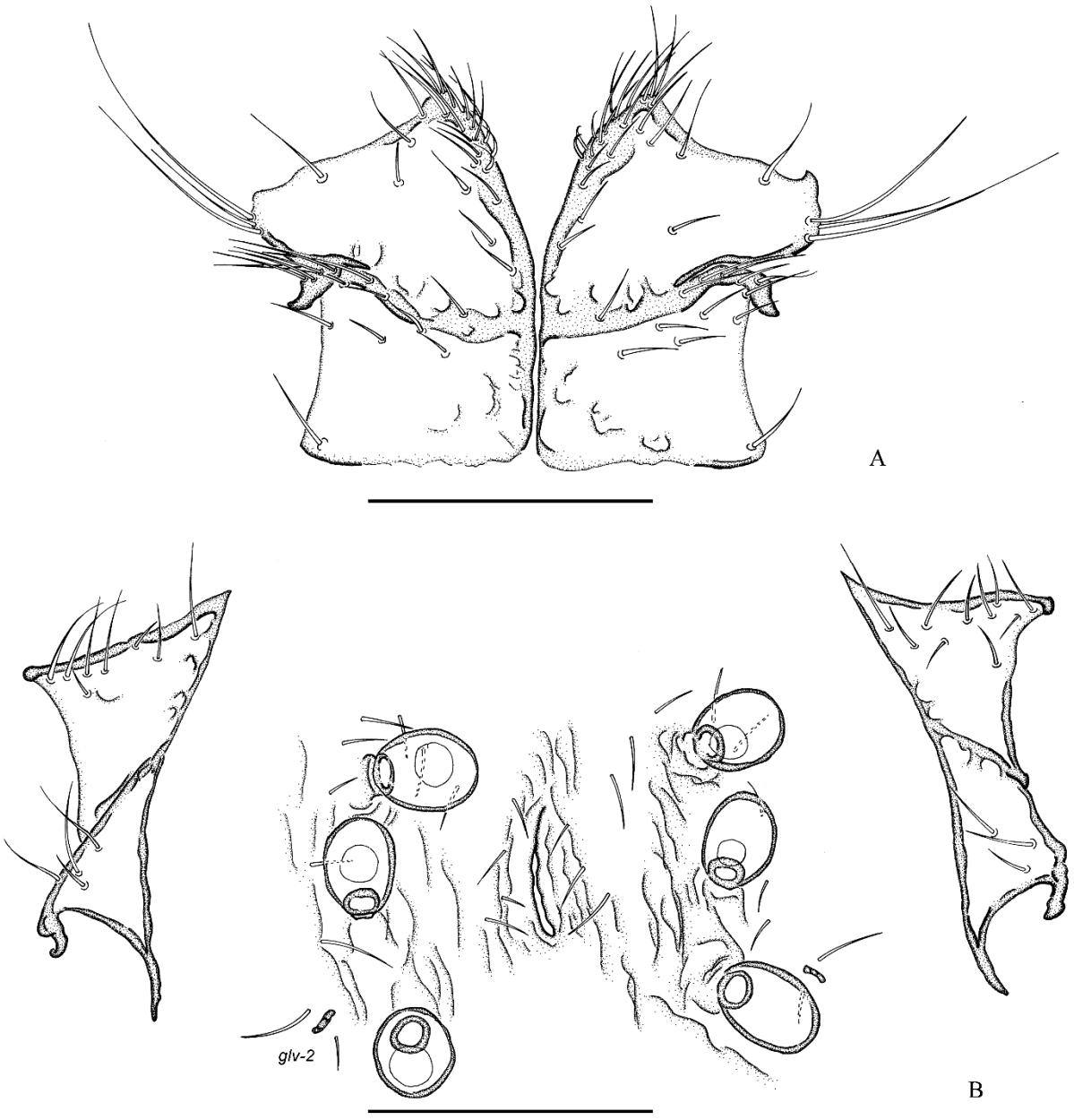

Figure 4. *Stygothrombium garzensis* Li & Guo, **sp. nov.**, ♀, holotype (SC-ST-20200801). A. Anterior coxal group (Cx-I+Cx-II). B. Posterior coxal group (Cx-III+Cx-IV), genital field. Scale bar = 200 μm.

location of idiosomal glandularia and pedipalp structures. The new species differs from the latter in the following aspects: (1) idiosoma L 3857 in *S. garzensis* Li & Guo, **sp. nov.**, but 1560–1830 in *S. monotrichum*; (2) *glv*-1 between ACG and PCG in *S. garzensis* Li & Guo, **sp. nov.**, while absent in *S. monotrichum*; (3) *glv*-2 between Ac-3 and inner posterior angle of Cx-IV in *S. garzensis* Li & Guo, **sp. nov.**, but located posteromedially to the posterior acetabula in *S. monotrichum*; (4) setae on ACG and pedipalp much more multiple than *S. monotrichum*; (5) P-A dL 253 in *S. garzensis* Li & Guo, **sp. nov.**, while P-A dL 88 in *S. monotrichum*. (Nagasawa & Abé 2014)

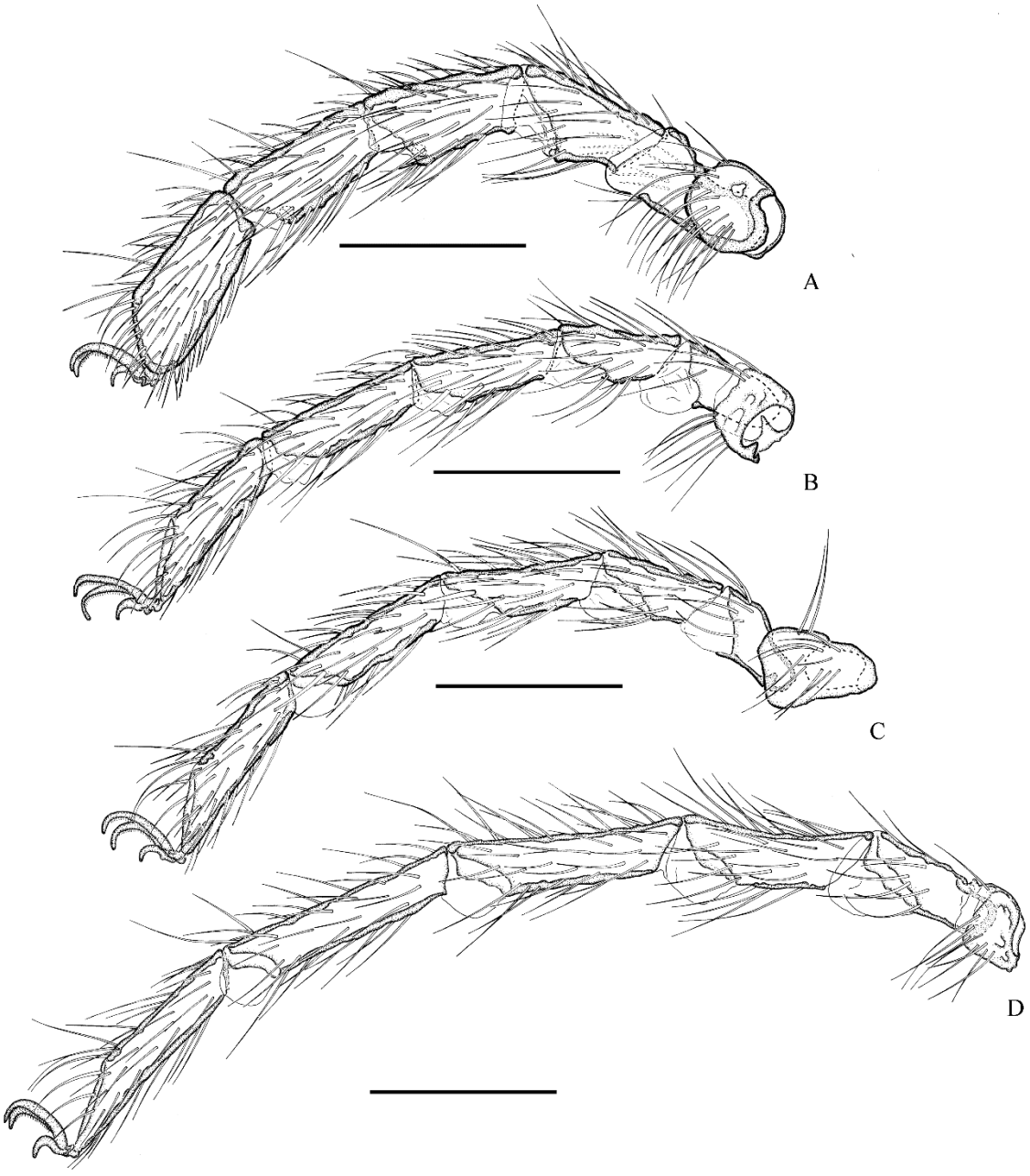

Figure 5. *Stygothrombium garzensis* Li & Guo, **sp. nov.**, ♀, holotype (SC-ST-20200801). A. I-L-1–6. B. II-L-1–6. C. III-L-1–6. D. IV-L-1–6. Scale bar = 200 μm.

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