Two species of genus *Stygothrombium* are newly described from central Japan under the name of *S. grandispinigerum* sp. nov. and *S. monotrichum* sp. nov. *S. grandispinigerum* is distinguishable from congeners by the shape and position of the harpagones, odonti, parodonti, lanceae, and gladii on the palp and the existence of a central glandularium on the idiosoma. *S. monotrichum* is distinguished from congeners by the inverted condition of the second ventral glandularia placed at the back of the posterior genital acetabula, the existence of a glandularium on the center of the posterior dorsal side of the idiosoma, and the posterior associate seta with glandularia on the skin. Morphologies of glandularia on the idiosoma, distal segment of the palp, and stomatoids on the first leg are first observed in detail using SEM.

**Key words:** aquatic mites, new species, Prostigmata, SEM image, *Stygothrombium grandispinigerum, Stygothrombium monotrichum*

**INTRODUCTION**

*Stygothrombium* belongs to the aquatic mite family *Stygothrombiidae* in the superfamily Stygothrombioidea. *Stygothrombiid* mites are thought to inhabit sand interstices in fresh water, judging by their vermiform bodies and absence of swimming setae. Until now, 17 species have been reported from the Holarctic region (*e.g.*, Imamura, 1956; Habeeb, 1974; Davids et al., 2006; Tuzovskij, 2010). In Japan, only one species, *S. japonicum*, has been described by Imamura (1956) on the basis of a single immature specimen collected from a well in Aioi City in Hyogo Prefecture. Recently, the authors had an opportunity to investigate interstitial invertebrates in mountain streams in central Japan. During this survey, several stygothrombiid mites were collected from sandy sediments at the Yataro and Hinata rivers in Kanagawa Prefecture and at the Shibakawa River in Shizuoka Prefecture. The present paper aims to describe two new species of the genus *Stygothrombium* from these mountain streams and to obtain detailed information on their morphological characteristics based on Scanning Electron Microscope (SEM) observation.
MATERIALS AND METHODS

Specimens were extracted from the sandy sediment of mountain streams by means of decanting and sieving (Abé, 1990). Mites were fixed with modified Imamura’s fluid (Imamura, 1965) and dissected in a drop of pure lactic acid. For the most part, their bodies were preserved in modified Imamura’s fluid, and the appendages were mounted in glycerin jelly. In the case of several limited specimens, their whole bodies were mounted in Euparal (Schmid GMBH & Co.) after dehydration through a graded series of ethanol (70%, 75%, 80%, 85%, 90%, 95%, and 99.5%) and infiltrated with Euparal solvent. Observation was made under light microscopy (BX51, Olympus Ltd.) using oil immersion. Other than general observation, additional analysis using SEM (S3500N, Hitachi Ltd.) was also carried out for morphologies of glandularia, the distal segment of the palp, and stomatoids on the first leg. Figures were drawn with the aid of a camera lucida, and measurements were made with an ocular micrometer. The size of the idiosoma was measured before dissection, while other parts were measured after dissection and preparation.

The terms for body parts follow Vercammen-Grandjean (1980). Right or left is referred to on the basis of a dorsal view along the longitudinal axis of the body. As for the description of the features of coxal setae, only those on the right or left side are mentioned unless the number and/or the position are different between each side.

Measurements (letters in parentheses) refer to those given in Fig. 1, Idiosoma: length (a)—from the anterior-most margin of the plate corresponding to the first coxal plate to the terminal end of the idiosoma; width (b)—at a half level between the genital slit and the excretory pore. Coxal plate: length—from the anterior margin to the posterior margin; width—at the widest level. Genital acetabula: interval (c)—distance between the central base of each genital acetabulum. Chelicera: length—from the proximal end to the distal end. Basal segment of palp: dorsal length (d)—from the proximal end to the distal end along the dorsal margin; ventral length (e)—from the proximal end to the distal end along the ventral margin; proximal width (f)—along the proximal margin; distal width (g)—along the distal margin. Distal segment of palp: width (h)—at the widest level. Terminal projection of palp: length (i)—from the proximal end to the distal end. Leg: length (j)—from the proximal end of the trochanter to the distal end of the tarsus, without claw, along the dorsal margin.

Measurements are carried out only for the specimens in measurable condition for each body part. Metric characters are always given in micrometers (μm). Meristic characteristics are sometimes given as ranges.

Abbreviations used in the descriptions and figure legends: as-gl, an anterior associate seta with glandularia; ps-gl, a posterior associate seta with glandularia; gld, a pair of glandularia on the dorsal side of the idiosoma; glv, a pair of glandularia on the ventral side of the idiosoma; gll, a pair of glandularia on the lateral side of the idiosoma; glc, a glandularium on the center of the posterior dorsal side of the idiosoma; Cx-I, II, III, IV, the first to fourth coxal plates; Ds, dorsal view; Vr, ventral view; Lat, lateral view; R, right appendage; L, left appendage.

Type deposition: The type series has been deposited in the arachnid collection (Tsukuba) of the
TAXONOMY

Family *Stygothrombiidae* Thor, 1935  
Genus *Stygothrombium* Viets, 1932

*Stygothrombium grandispinigerum* sp. nov.  
(Japanese name: Ootoge-chikakedani, new)  
(Figs. 2–4)

**Type series.** Holotype (NSMT-Ac 13738–13740): female, at sandy sediment in mountain stream, Hinata River (35°26’17”N, 139°15’10”E), Kanagawa Pref., Japan, 26-IV-2011, T.
Nagasawa coll. Allotype (NSMT-Ac 13741–13742): male, data same as the holotype. Paratypes (NSMT-Ac 13743–13758): 1 male, 1 female, data same as the holotype; 1 male, 1 female, same locality as the holotype, 9-III-2008, T. Nagasawa coll.; 1 female, same locality as the holotype, 14-XI-2009, T. Nagasawa coll.; 1 male, at sandy sediment in mountain stream, Shibakawa River (35°21’0.02’’N, 138°33’55.47’’E), Shizuoka Pref., Japan, 29-V-2010, T. Nagasawa coll.

**Etymology.** The specific epithet is derived from “grandi” (pref.), which means “large,” and “spinigerum” (adj., nom.), which means “spine.”

**Description.** *Female* (Holotype, NSMT-Ac 13738–13740). Idiosoma (Fig. 2A–B): 1910 long, 450 wide, with nine gl$\ell$ and gl$\ell$ ($gl\ell$-1 to -9, gl$\ell$-1 to -9 in Fig. 2A), eight gl$\nu$ ($gl\nu$-1 to -8 in Fig.

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**Fig. 2.** *Stygothrombium grandispinigerum* sp. nov., female (Holotype: NSMT-Ac 13738–13740). A, idiosoma (Ds); B, idiosoma (Vr). Scale bar: 500 μm.
2B). Glv-2 located between median and posterior genital acetabula in genital area. Glc present (Fig. 2A). As-gl and ps-gl located on glandularia except for gll-I (Figs. 3A, 4A). Gll-I lacking in as-gl (Figs. 3B, 4B). As-gl 28 long and ps-gl 2 long. Excretory pore present on posterior ventral portion of idiosoma, 100 long. Skin covered with round papillae (Fig. 3C). Anterior portion of crista metopica covered with chitinous plate with seven setae (Fig. 3D).

**Coxal plates** (Fig. 3E–F): Cx-I fused with Cx-II, constructing an anterior single coxal plate on right and left sides of the idiosoma, 95 long, 75 wide. Cx-III fused with Cx-IV, constructing a posterior single coxal plate on each side of the idiosoma, 150 long, 50 wide. Coxal setae long and filiform. Anterior coxal plate with seven and nine setae near anteroventral margin of right and left plates, respectively; one seta on anteromedial portion; two setae on anterolateral margin; one seta near posterolateral margin; and one seta on posterolateral corner. Posterior coxal plate with one seta near anteromedial margin and one seta on posteromedial portion.

**Genital area** (Fig. 3F): Genital area placed between right and left posterior coxal plates. Genital area with three stalked, round genital acetabula on each side. Anterior and median acetabula close to genital slit, and posterior acetabula separated posterolaterally from the others. Interval between anterior genital acetabulum and median genital acetabulum, 50 on right side, 45 on left side. Interval between median and posterior genital acetabula, 90 on right side, 80 on left side. Two genital setae located anteriorly to genital slit. Five and three genital setae on right and left sides of genital slit, respectively.

**Chelicera** (Fig. 3G): 168 long, crescent shaped.

**Palp** (Fig. 3H): Consisting of two unequal segments. Trochanter, femur, and genu fused into a single basal segment, 45 long at dorsal side, 33 long at ventral side, 25 wide at proximal margin, 25 wide at distal margin. Basal segment with a dorsal groove and three dorsoproximal, one lateroproximal, and five ventroproximal filiform setae and two laterodistal stout harpagones. Tibia and tarsus fused into a single distal segment, 33 wide, oriented at right angle to basal segment, with odontus and lancea proximally and parodontus and gladius medially. Odontus not furcated, close to lancea (Fig. 4C). Distal segment bearing three setae on proximal portion and three setae on mediodistal portion. Terminal projection, clubiform, 5 long.

**Legs** (Fig. 3I): Numerous setae present. First leg, 395 long. Stomatoid (Fig. 4D) present on tefolium, genu, and tibia of first leg. Each tarsus with two pectinate lateral claws and one smooth middle empodium. Claws and empodium same length.

**Male** (Allotype, NSMT-Ac 13741–13742). Idiosoma: 1755 long, 380 wide. Morphological characteristics similar to those of female except for arrangement of genital setae. Excretory pore, 75 long. Anterior coxal plate (Cx-I+II), 105 long, 75 wide. Posterior coxal plate (Cx-III+IV), 150 long, 50 wide. Interval between anterior and median genital acetabula, 55 on right side, 65 on left side. Interval between median and posterior genital acetabula, 80 on right side, 85 on left side. Five pairs of genital setae located anteriorly to genital slit (Fig. 3J). Basal segment of palp, 43 long at dorsal side, 30 long at ventral side, 20 wide at proximal margin, 25 wide at distal margin. Distal segment of palp, 30 wide. Terminal projection, clubiform, 8 long. First leg, 390 long.

**Morphological variation and abnormality.** Length of idiosoma: male (n = 2) 1660–1755, female (n = 3) 1910–2045. Width of idiosoma: male (n = 3) 380–460, female (n = 2) 450–480. Length of Cx-I+II: male (n = 3) 100–105, female (n = 5) 95–115. Width of Cx-I+II: male (n = 3) 55–65.
Fig. 3. *Stygothrombium grandispinigerum* sp. nov., female (Holotype: NSMT-Ac 13738–13740). A, glandularium (glv-3) with associated setae (as-gl, ps-gl); B, glv-1 with associated single seta (ps-gl); C, papilliform integument; D, crista metopica; E, anterior coxal plate (Cx-I+II); F, posterior coxal plate (Cx-III+IV) and genital area; G, chelicera (Lat); H, left palp (Lat) (H: harpago, O: odontus, pO: parodontus, L: lancea, G: gladius); I, right first leg with stomatoids (Lat); J, male (Allotype: NSMT-Ac 13741–13742), genital area. Scale bars: 50 μm.
75, female (n = 5) 70–80. Distance between anterior and median acetabula (left/right): male (n = 3) 45–65/45–55, female (n = 5) 45–60/50–60. Distance between median and posterior acetabula (left/right): male (n = 3) 85–95/80–95, female (n = 4) 90–95/90. Number of genital setae (left/right): male (n = 2) 5–6/5, female (n = 4) 4–5/3–7. Length of Cx-III+IV: male (n = 3) 150, female (n = 5) 150–155. Width of Cx-III+IV: male (n = 3) 50, female (n = 5) 50–60. Number of setae on Cx-III+IV (left/right): male (n = 3) 2/2, female (n = 4) 2/2. Length of excretory pore: male (n = 2) 75–100, female (n = 4) 95–110. Length of chelicera: male (n = 3) 155–160, female (n = 5) 160–175. Length of basal segment of palp (dorsal/ventral): male (n = 3) 43–45/30–38, female (n = 5)

**Remarks.** *Stygothrombium grandispinigerum* closely resembles *S. minor* André, 1949, in the same length of the empodium of the legs and the nearly identical length at the dorsal side of the basal segment of the palp. André (1949) did not mention the existence of a glandularium on the center of the posterior dorsal side of the idiosoma in the original description or figuration of *S. minor*. Therefore, it would be assumed that *S. minor* lacks the central glandularium. In addition, the new species is distinct from *S. minor* in the following characteristics (the corresponding condition in the latter species is in parentheses): (1) *glc* present (absent), (2) two long harpagones present laterodistally on the basal segment of the palp (two short harpagones placed ventrodistally on the segment), (3) distal segment of palp, 25–33 wide (50 wide), (4) odontus of palp close to lancea (distant from lancea).

*Stygothrombium monotrichum* sp. nov.

*(Japanese name: Hitoge-chikakedani, new)*

(Figs. 5–7)


**Etymology.** The specific epithet is derived from “mono” (pref.), which means “single,” and “trichum” (adj., nom.), which means “seta.”

**Description.** Male (Holotype, NSMT-Ac 13759–13762). Idiosoma (Fig. 5A–B): 1830 long, 540 wide, with eight *gll* (*gll*-1 to -8 in Fig. 5A), seven *gld* (*gld*-1 to -7 in Fig. 5A), and four *glv* (*glv*-2 to -5 in Fig. 5B), *glv* absent. *Glv*-2 inverted (upside down) at the back of the posterior genital acetabula in the genital area. *Glc* present (Fig. 5A). *As-gl* located on glandularia except for *gll*-1 (Fig. 6A). *Gll*-1 lacking in *as-gl* (Fig. 6B). *Ps-gl* located on skin (Figs. 6A, 7A). *Ps-gl* of *gll*-1 placed close to glandularia (Figs. 6B, 7B). *As-gl* 83 long and *ps-gl* 13 long. Excretory pore, 80 long, present on posterior ventral portion of idiosoma. Skin covered with round papillae (Fig. 6C). Anterior portion of crista metopica not covered with chitinous plate and with seven setae, posterior-most two setae twice as long as the others (Fig. 6D).

**Coxal plates** (Fig. 6E–F): *Cx-I* fused with *Cx-II*, constructing an anterior single coxal plate on right and left sides of idiosoma, 150 long, 85 wide. *Cx-III* fused with *Cx-IV*, constructing a posterior single coxal plate on each side of idiosoma, 165 long, 65 wide. Coxal setae long and
filiform. Anterior coxal plate furnished with five setae near anteroventral margin, one seta on anteromedial portion, two long setae on anterolateral margin, one seta on lateromedial portion, one seta on ventromedial portion, and one seta on posterolateral corner. Posterior coxal plate with one seta on anteroventral corner and two setae on posterolateral portion.

**Genital area** (Fig. 6F): Genital area placed between right and left posterior coxal plates. Genital area with three stalked, round acetabula on each side. Interval between anterior and median genital acetabula, 40 on right side, 40 on left side. Interval between median and posterior genital acetabula, 25 on right side, 25 on left side. Genital setae found anteriorly to genital slit. Six setae on right side and five setae on left side of genital slit. One seta between anterior and median genital acetabula.

**Chelicera** (Fig. 6G): 188 long, crescent shaped.

**Palp** (Fig. 6H): Two unequal segments. Trochanter, femur, and genu fused into a single basal segment, 88 long at dorsal side, 53 long at ventral side, 23 wide at proximal margin, 23 wide at

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**Fig. 5.** *Stygothrombium monotrichum* sp. nov., male (Holotype: NSMT-Ac 13759–13762). A, idiosoma (Ds); B, idiosoma (Vr). Scale bar: 500 μm.
Fig. 6. *Stygothrombium monotrichum* sp. nov., male (Holotype: NSMT-Ac 13759–13762). A, glandularium (gld-1) with setae (as-gl, ps-gl); B, gll-1 with associated single seta (ps-gl); C, papilliform integument; D, crista metopica; E, anterior coxal plate (Cx-I+II); F, posterior coxal plate (Cx-III+IV) and genital area; G, chelicera (Lat); H, left palp (Lat) (H: harpago, O: odontus, pO: parodontus, L: lancea, G: gladius); I, right first leg with stomatoids (Lat). Scale bars: A, B, D, E, F, G, H, I = 50 μm; C = 10 μm.
distal margin. Basal segment furnished with a dorsal groove and one lateroproximal, two dorsal, three long unequal ventral, and one thin ventrodistal setae in addition to two stout ventrodistal harpagones. Tibia and tarsus fused into a single distal segment, 33 wide, oriented at right angle to basal segment. Distal segment consisting of furcate odontus (Figs. 6H, 7C–D), subequal lancea and gladius, short ventrodistal parodontus, and one proximal and seven medial setae. Terminal projection, clubiform, 25 long.

Legs (Fig. 6I): Numerous setae present. First leg, 410 long. Stomatoid (Figs. 6I, 7E) present on telofemur, genu, and tibia of first leg. Each tarsus furnished with two pectinate lateral claws and

Fig. 7. *Stygothrombium monotrichum* sp. nov. (SEM observation). A, glandularium (*glv*-5) with setae (*as-gl, ps-gl*); B, *gll*-1 with associated single seta (*ps-gl*); C, distal segment of palp (Lat) (*O*: odontus, *pO*: parodontus, *L*: lancea, *G*: gladius); D, distal segment of palp (Ds); E, stomatoid. Scale bars: 10 μm.
one smooth middle empodium. Empodium, half-length of claws.


**Remarks.** *Stygothrombium monotrichum* sp. nov. closely resembles *S. orientalis* Tuzovskij, 2010, in the half-length of the claws in the empodium of the legs and the furcate odontus of the palp. Tuzovskij (2010) did not refer to the existence of a glandularium on the center of the posterior dorsal side of the idiosoma in the original description and figuration of *S. orientalis*. Therefore, *S. orientalis* should be assumed to lack the central glandularium. Furthermore, the new species is distinct from *S. orientalis* in the following characteristics (the corresponding condition in the latter species is in parentheses): (1) idiosoma 420–620 wide (670–690 wide), (2) glv-1 absent (present), (3) glv-2 located posteromedially to the posterior acetabula (placed between the median and posterior acetabula), (4) glc present (absent), (5) ps-gl located on skin (located on glandularia), (6) two or three setae present on posterior single coxal plate Cx-III+IV (four setae present on the plate), (7) distal segment of palp 33–35 wide (72–85 wide).

In addition to the taxonomic characters mentioned above, *S. monotrichum* sp. nov. may differ from *S. orientalis* due to the presence of stomatoids on the first leg. Tuzovskij (2010) did not refer to the existence of stomatoids in the original description and figuration of *S. orientalis*. However, regarding the existence of stomatoids, Vercammen-Grandjean (1980) and Davids et al. (2006) suggested that all the members of Stygothrombiidae should have stomatoids on the first leg. Therefore, it is highly possible that Tuzovskij (2010) overlooked the existence of stomatoids on the first leg of *S. orientalis*. It will be decided in the future, based on the examination of specimens of the stygothrombiids known thus far, whether the existence of stomatoids can be regarded as a specific distinguishing character.

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**REFERENCES**

Two new species of *Stygothrombium* from Japan


摘要

本州中部から採集されたチカケダニ属（ダニ目：チカケダニ科）の未記載種2種について

神奈川県の丹沢山塊を流れる日向川と谷太郎川、静岡県富士宮市を流れる芝川の3河川から採集したチカケダニ属の未記載種を *Stygothrombium grandispinigerum* (和名：オオトゲチカケダニ)、*S. monotricum* (和名：ヒトゲチカケダニ)として記載した。オオトゲチカケダニはフランスから報告されている *S. minor* に類似しているが、触肢の鈎棘（harpago）、歯状棘（odontus）、後歯状棘（parodontus）、柄棘（lancea）、剣棘（gladius）の形態と位置、胴体背面前中央腺孔（glc）が存在することなどで後者と区別できる。また、ヒトゲチカケダニはロシアから報告されている *S. orientalis* と類似しているが、胴体腹面の第2腺孔（glv-2）の向きが他の腺孔と逆であること、胴体背面前方に中央腺孔が存在すること、腺孔の後部付属毛（ps-g/l）が腺孔上ではなく表皮上にあることなどで後者と区別できる。また、2種の記載にあたり、表皮の腺孔、触肢の末端節、第1脚の裂孔（stomatoid）などの形態について、初めて電子顕微鏡を用いた詳細な観察を行った。