

Review of Mites of the Genus *Boletoglyphus* (Acariformes, Acaridae)

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Abstract—A generic diagnosis of *Boletoglyphus* Volgin, 1953, based on characters of hitherto unknown adults, is given. The genus is divided into two subgenera, *Boletoglyphus* (type species *B. (B.) boletophagi*) and *Ellipsopus* stat. n. (type species *B. (E.) ornatus* comb. n.). A new species, *Boletoglyphus extremiorientalis* sp. n., is described from Russian Far East and Japan. A key to species (adults, hypopi) and data on their biology are given.

The genus *Boletoglyphus* Volgin, 1953 has until recently been known from hypopi of *B. boletophagi* (Turk, Turk, 1952) and *B. ornatus* Fain, Ide, 1976. The former species was originally described on the beetle *Bolitophagus reticulatus* L. (Coleoptera, Tenebrionidae) in Scotland and placed in the genus *Schwiebea* Oudemans, 1916 (Turk, Turk, 1952). This species was almost simultaneously found in Russia (on the same "host") and described as a new species *B. cribrosus*, for which a new genus *Boletoglyphus* was created (Volgin, 1953). Later, the material on this species from Slovakia was used by K. Samšínák (1957) to establish a new genus *Fantovia*. Independently of these two authors, Hughes (1957) suggested that *Schwiebea boletophagi* "may belong to a different genus," but did not specify the genus or describe a new one.

In 1976, Fain and Ide described a new genus *Ellipsopus* with the type species *E. ornatus* Fain, Ide, 1976, using material from various US regions. The species and genus were described from hypopi phoretic on the beetle *Bolitorus cornutus* (Panzer, 1794) (Coleoptera, Tenebrionidae). Mahunka (1977) described a new genus and species *Lindquistia bolitotheri* Mahunka, 1977, also based on hypopi collected on the same "host" species from Canada. This genus was later recognized as a synonym of *Ellipsopus* Fain, Ide, 1976, both genera having the same type species (Fain, Mahunka, 1990); moreover, these authors suggested that *Ellipsopus* was a junior synonym of *Boletoglyphus*. The first researchers to recognize this synonymy were O'Connor and Pfaffenberger (1987), who stated that "Solenidion ω_2 is absent in the genus *Boletoglyphus*" (since the drawings of tarsi I of *B. boletophagi* are

simplified in all publications, these authors probably used the description of *B. ornatus*). In this communication, *Ellipsopus* is tentatively (until the adult stages are examined) treated as a subgenus within the genus *Boletoglyphus*.

Examination of mites collected in E Siberia and Primorskii Territory and discovered on insects from various regions of the Russian Far East, deposited at the Institute of Biology and Soil Science, Far East Division, Russian Academy of Sciences (Vladivostok), revealed all stages of *B. (B.) boletophagi* and a new species *B. (B.) extremiorientalis* Klimov, sp. n., which is described below. The morphological data on *B. (Ellipsopus) ornatus* comb. n. are based on those reported by Fain and Ide (1976).

The morphological terminology largely follows that of Griffiths (1977), with some additional terminology of leg setae and solenidia after Zakhvatkin (1941), and parts of the gnathosoma, after Akimov (1985). All measurements are presented in μm .

The holotype is deposited at the Zoological Museum, Moscow State University; paratypes and other material, at the Institute of Biology and Soil Science (Vladivostok).

Boletoglyphus Volgin, 1953

Volgin, 1953: 262; Černý, Samsinák, 1971: 508; Fain, Mahunka, 1990: 110 (*Boletoglyphus*).

Samšínák, 1957: 112 (*Fantovia*).

Type species *Boletoglyphus cribrosus* Volgin, 1953 = *Schwiebea boletophagi* F. Turk, S. Turk, 1952, by monotypy.

The genus comprises 3 species with Holarctic distribution.

Description. Adults. Chelicera short and massive, 1.5 times as long as high; main part of chelicera with blunt frontal tooth; each of its digits bears 3 teeth, bent backward (stationary digit has additional inner tooth in the middle). Gnathosoma short and massive, no more than 1.5 times as long as wide. Hypostome with rounded-triangular median incision and finely punctate sclerotized area within it; pecten with forked distal end; hypopharynx well-sclerotized, with almost rectangular distal end. Idiosoma elongate. Chaetome of meiotrichous type. Scutum of propodosoma entire, short and wide, with setae *sce* (longest setae of idiosoma) positioned at its posterior angles. *sci*, if any, represented by microchaetae; rudiments of *ve* located in incisions of scutum (approximately at its middle level); *scx* long, setiform. *d*₁, *l*₁, and *sh* absent in female (*d*₁ present as alveoli) and present as microchaetae in male. Other hysterosomal setae short or medium-sized. Hind part of hysterosoma covered by opistosomal scutum, shaped in female as "visor" concealing genital opening. Oviduct opening long, with arcuate sclerite (epigynium) lying anterior to it, with free ends of the arc touching epimerites II. Anal opening of female shifted posteriad, with its posterior part reaching the level of hind margin of hysterosoma and extending somewhat dorsally. "Anal" setae *aP*₃, *aP*₂, and *aP*₁ [*ps*₁, *h*₃, and *ps*₂, in the terminology of Hammen (1982)] present in males and absent in females (with *aP*₃ and *aP*₂ observed as rudiments). *l*₅ in females positioned approximately at the level of ²/₃ anus length from its anterior margin. Anal copulatory sucker in male simple, surrounded by sclerotized ring (as in *Acarus* L.); *aP*₂ lying at anterior margin of suckers. Legs short in both sexes, with tibiae longer than genua. Tibiae I-II with only one inner lateral seta; genua III without setae; all setae on tibiae and genua thin, acicular. Tarsus I short, with pretarsus covering about ¹/₃ of rather large claw; ω_1 (α), ω_2 (γ), *ba* (ϵ), and ζ (δ) close together; ω_1 and ω_2 cylindrical, rounded apically; Solenidion *ba* acicular; *aa* (8) absent; *la* (*i*), *ra* (*e*), and *wa* (*m*) close together and shifted distally, lying near ventral claw-associated spines (*s*, *v*, *u*); *wa* elongate-spiniform; *la* and *ra* setiform; *u* very small; *e* spiniform; *f* and *d* setiform; ω_3 (δ) short, not reaching to claw apex. Seta *ba* on tarsus II short, acicular, located near ω_1 . Tarsal copulatory suckers in male located distally, with rod-shaped base

and wider, flat disc. Chaetotaxy of legs I-IV: 1-1-2+(2)-1+(1)-12+(3+1), 1-1-2+(1)-1+(1)-12+(1), 1-0-1-1+(1)-10,0-1-0-1+OHO.

Larva. Claparede's organs well-developed.

Hypopus. Various subgenera were described by Volgin (1953), Samsinak (1957), Fain and Ide (1976), and Mahunka (1977). Below, the distinctive characters of both subgenera are given, together with the insufficiently described structure of tarsi and suctorial plate, and the Chaetotaxy. *d*₁-*d*₅ setiform (subgenus *Boletoglyphus*) or dilated-lanceolate (subgenus *Ellipsopus*). *cx* I absent, *cx* III-IV as rounded traces (subgenus *Boletoglyphus*); or *cx* I, III-IV setiform (subgenus *Ellipsopus*). Suctorial plate with 3+1 pairs of suckers, central ones occupying nearly 50% of plate surface. Median and lateral posterior suckers positioned almost at the same level, with sclerites of irregular shape; bases of median suckers lie on common sclerite with narrow anterior protrusion; each lateral sucker lies on separate sclerite. Tarsus I: *ba*, ζ (famulus), ω_1 , and ω_2 ¹ positioned along a line drawn obliquely toward base of tarsus. *ba*, ζ , ω_1 , and *d* form a group, with *d* located somewhat distally, with base of ω_2 , lying separately. Solenidion *ba* slightly shorter than w_1 ; ω_2 several times shorter than w_1 , rod-shaped; *aa* absent; *ra* (*e*) and *la* (*i*) setiform; *wa* (*m*) acicular, located anteriorly to them; *e* and / setiform, positioned laterally at apex of tarsus, on outer and inner surfaces, respectively. Paired *vs*c lie below these setae, under claw-supporting sclerites; dilated setae absent. Tarsi II-IV have similar arrangement of setae *e*, *l*, and *d*, except for very long *d* on tarsus III and especially IV. Seta *ba* on tarsus II filiform. Solenidion *fi* on tibia II shorter than that on tibia I; with this Solenidion on tibia IV shorter than that on tibia III. Tibiae bear only one seta *gT* (*hT* absent). Femora (especially II) with long setae. Ventroapical setae *vs*c of tarsi III-IV setiform (subgenus *Boletoglyphus*) or spiniform (subgenus *Ellipsopus*).

Chaetotaxy of legs I-IV: 1-1-2+(1)-1+(1)-8+(3+1), 1-1-2+(1)-1+(1)-9+(1), 1-0-0-1+(1)-8, 0-1-0-1+(1)-8.

¹ According to O'Connor and Pfaffenberger (1987), this species lacks the Solenidion ω_2 . This structure is also absent on drawings by Fain and Ide (1976) and Mahunka (1977). Since the presence of ω_2 is an important character of all Acaridae, a more detailed investigation of this aspect appears to be necessary.

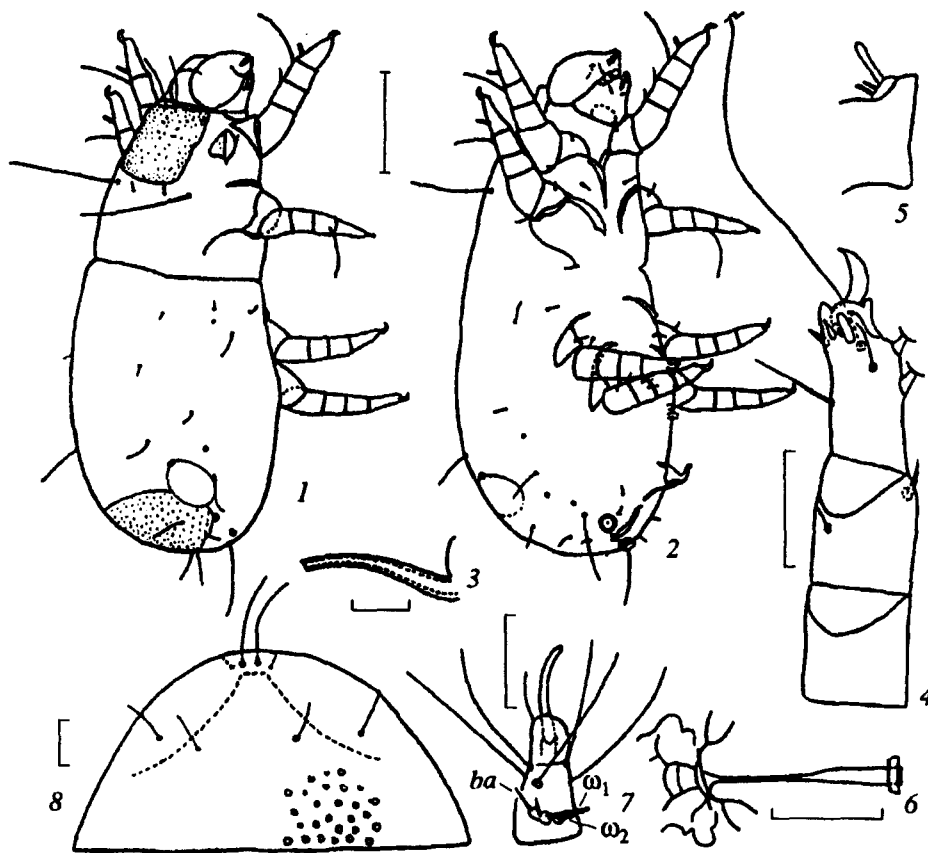


Fig. 1. *Boletoglyphus boletophagi*: male (1-4), female (5, 6) and hypopus (7, 8). (1) Dorso-lateral view; (2) ventro-lateral view; (3) penis; (4) leg IV (trochanter and femur not shown); (5) proximal part of tarsus I in lateral view; (6) bursa copulatrix in dorsal view; (7) tarsus I in dorsal view; (8) propodosoma in dorsal view. Scale bars: 100 μ m in 1, 2; 20 μ m in 4-8; 10 μ m in 3.

Differential diagnosis. Adults. The genus is closely related to *Michaelopus* Fain, Johnston, 1975 (Acaridae, Rhizoglyphinae), differing in the following (with the respective characters of *Michaelopus* given in parentheses): scutum of propodosoma uniformly sculptured, not striated (heterogeneous sculpture, including striation); *sci* present as microchaetae or absent (absent); ω_1 , ω_2 , and *ba* on tarsus I lying within a common area (ω_2 separated from common area of ω_1 and *ba*); epigynium with thick lateral processes (processes thin); tibiae I-II bear 1 seta (1-2 setae); d_1 - d_3 present (absent); l_5 located in posterior third of anal opening (l_5 , or a_1 in the notation of Fain, 1982, located in anterior third of anal opening).

Differential characters of hypopi are described by Volgin (1953), Samšínák (1957), Fain and Ide (1976), and Mahunka (1977).

Notes. Samšínák (1957) placed this genus in the family Acaridae; however, he stated that it resembles

the subfamily Chaetodactylinae (Glycyphagidae) sensu Zakhvatkin (1941) in some characters of hypopi (large claws). An investigation of adults confirmed that this genus belongs to Acaridae.

It is generally assumed that the characters of adults do not correspond to those of hypopi in Acaridae. However, in this case, the relative length of setae *sci* and *sci* in adults correlates with that in hypopi, for both species of the subgenus *Boletoglyphus*.

In some hypopi, the scutum of propodosoma is separated from that of hysterosoma by an unpigmented, finely striated epidermal area (Fig. 3, 3), which probably becomes visible when the scutum is displaced during preparation.

Subgenus **BOLETOGLYPHUS** Volgin, 1953

Volgin, 1953: 262; Černý, Samsinák, 1971: 508 (*Boletoglyphus*).

Fain, Mahunka, 1990: 110 (*Boletoglyphus*, part.).

Samsinak, 1957: 112 (*Fantovia*).

The subgenus is known from males, females, and hypopi, and includes 2 species with Palaearctic distribution.

Boletoglyphus (Boletoglyphus) boletophagi
(F. Turk, S. Turk, 1952) (Fig. 1)

Turk, Turk, 1952: 501, figs. 33, 34 (*Schwiebea boletophagi*).

Volgin, 1953: 263, figs. a-c (*Boletoglyphus cribrosus*).

Samsinak, 1957: 112, fig. 113 (*Fantovia boletophagi*).

Material. Irkutsk Province, Bratsk, decomposing hymenophore of a polypore from fallen birch tree, 15.X.1995 (P. Klimov) (6 preparation): 17 hypopi; 11 hypopi; 15 hypopi from polypore and *Cis lineatocribratus* Mell. (Coleoptera, Ciidae) from the same polypore; ♀; 5 ♀, 3 ♂ 43 hypopi on *Bolitophagus reticulatus* L. (Coleoptera, Tenebrionidae), Irkutsk Province, Bratsk District, Podvyezdnoe, VIII.1996, (P. Klimov).

Description. Adults. Idiosoma elongate; *sci* present as microchaetae, well-developed; ω 2.8 times as long as ω_1 .

Female. Idiosoma 420-527; *sci* 4.8. Inner part of bursa copulatrix strongly narrowing; its dilated part 3.7 in diameter. Lengths: w_1 9.0, ω 3.2, ω 14.8. *ba* slightly shorter than ω_1 . Length ratio of leg segments (with idiosoma 527): I 1.8 : 1.0 : 1.1 : 1.7 (length of leg without claw 132); II 2.3 : 1.0 : 1.1 : 1.9 (121); III 1.6 : 1.0 : 1.1 : 1.7 (95); IV 1.8 : 1.0 : 1.1 : 1.7 (103).

Male. Idiosoma 449-453; *sci* up to 8.0. Penis gradually dilating toward base (from 1.7 to 4.2). Tarsus IV as in Fig. 1, 4. Length ratio of leg segments (with body length 496): I 1.8 : 1.0 : 1.0 : 1.6 (length of leg without claw 126); II 1.9 : 1.0 : 1.1 : 1.7 (119); III 1.9 : 1.0 : 1.3 : 1.6 (100); IV 1.9 : 1.0 : 1.1 : 1.8 (104).

Hypopus. Idiosoma 242-277 x 155-181 (300 x 180 Samsinak, 1957). *see* (29), *sci* (22), and *scx* lying almost precisely on the same transverse line. Common sclerite of posterior median suckers irregular-pentagonal, extending beyond posterior margin of suctorial plate.

Biology. These mites live within the tubules of decomposing hymenophore of polypores (*Aphyllopho-*

rales, Polyporaceae), feeding on their tissues (as indicated by the intestine contents). In these habitats, the species co-occurs with other mites: *Mezorhizoglyphus colchicus* Kadzhaja (Acaridae), *Mezorhizoglyphus bratskensis* Klimov, *Schwiebea longibursata* Fain, Wauthy (Acaridae), *Bakerdania* sp. (Pygmephoridae), *Liochthonius laetepictus* (Berlese) (Brachichthonidae), and *Dendrolaelaps* sp. (Digamasellidae). The hypopi are phoretic on beetles *Bolitophagus reticulatus* L. (Coleoptera, Tenebrionidae) and *Cis lineatocribratus* Mell. (Coleoptera, Ciidae); in the latter case, they were found together with the hypopi of *Boletacarus sibiricus* Volgin, Mironov (Acaridae).

Distribution. Great Britain (Scotland); Slovakia; Russia (Leningrad and Irkutsk Provinces).

Boletoglyphus (Boletoglyphus) extremiorientalis
Klimov, sp. n. (Figs. 2, 3)

Material. Holotype ♂ (marked on preparation): Vladivostok, Botanical Garden, in decomposing tubular hymenophore of the polypore *Ganoderma applanatum* (Pers. ex Wallr.) Pat. (*Aphyllophorales*, Polyporaceae) from birch, 20.VII.1995 (P. Klimov). Paratypes (12 preparations): 8 ♀, 1 ♂ (poorly preserved), 12 hypopi, same preparation as holotype. Russia, Primorskii Territory: about 60 hypopi, on *Bolitophagus reticulatus*, Partizansk District, 24 km from Molchanovka, 30.VIII.1971 (Z.A. Konovalova); about 140 hypopi, on *B. reticulatus*, Nadezhdinsk District, 7 km up El'duga River from Pornoe, mixed forest, polypore, 11.VI.1975 (A.V. Plutenko); 22 hypopi, Vladivostok, near Botanical Garden, mixed forest, in hymenophore of decomposing polypore, 26.VIII.1995 (P. Klimov); about 50 hypopi, same locality, 27.VIII.1995 (P. Klimov); 2 hypopi on *Cis jacquemarti* Mell., same locality, 23.VI.1996 (P. Klimov); about 110 hypopi, Komsomolsk Reserve, reared *B. reticulatus*, 28.VII.1978 (V.A. Mutin). Russia, Sakhalin: 49 hypopi on *Boletoxenus incurvatus* Lew. (Coleoptera, Tenebrionidae), "Centr. Exp. Station," 20.VIII.1936 (coll. unknown); about 180 hypopi, with same collection data; about 130 hypopi on *B. incurvatus*, Ulegorsk District, Krasnopol'e, polypore *Fomitopsis pinicola* (Sw. ex Fr.) Karst (*Aphyllophorales*, Polyporaceae), 28.VII.1954 (coll. unknown); 2 hypopi on *Atasthalomorpha dentifrons* Lew. (Coleoptera, Tenebrionidae), Konuma, 24.VI.1933 (K. Tamanuki); 3 hypopi on *Boletoxenus bellicum* Lew., Japan, Hokkaido, "Nopporo Forest Park, 10 km SE of Sapporo," 2.VII.1992 (G. Lafer).

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Klimov, sp. n. (Figs. 2, 3)

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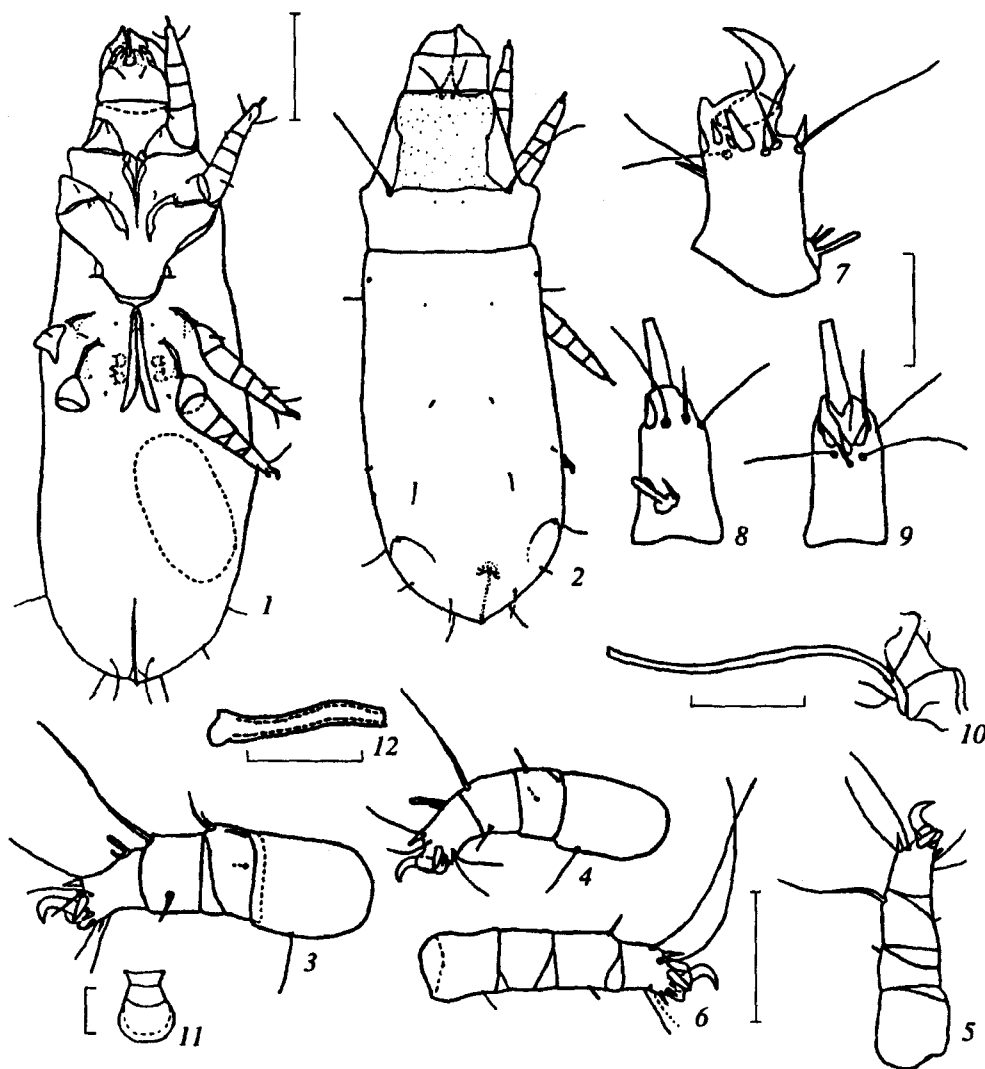


Fig. 2. *Boletoglyphus extremiorientalis* Klimov, sp. n.: female (1-11) and male (12). (1) Ventral view of holotype; (2) dorsal view of paratype; (3-6) legs I-IV; (7-9) tarsus I; (10) bursa copulatrix in lateral view; (11) genital "tentacle"; (12) penis. Scale bars: 100 μ m in 1, 2; 50 μ m in 3-6; 20 μ m in 7-10 and 12; and 10 μ m in 11.

Description. Adults. Idiosoma elongate; *sci* reduced; ω 1.8 times as long as ω_7 .

Female. Idiosoma 478-559, 2.7-2.9 times longer than wide. Genital setae and *cx* III shorter than in the above species. Canal of bursa copulatrix not narrowing. Length ratio of leg segments (with idiosoma 478): I 1.9 : 1.0 : 1.1 : 1.4 (length of leg without claw 107); II 2.0 : 1.0 : 1.1 : 1.4 (102); III 1.7 : 1.0 : 1.2 : 1.4 (83); IV 1.9 : 1.0 : 1.2 : 1.5 (93).

Male (description based on a single poorly preserved specimen). Penis uniformly thick (3.5) along its entire length, diameter of its canal exceeding thickness of its walls. Tarsal suckers in distal position.

Hypopus. Idiosoma 260-285 x 165-196. Length ratio of propodosoma and hysterosoma 0.53. Gnathosoma 17 x 12; arista more than twice as long as gnathosoma. *sce* (22); *sci* (14) located caudally to the level of *sce*. Setae *sce*, *sci*, and *l*₅ among the longest setae of idiosoma, *l*₅ constituting about $\frac{1}{3}$ of idiosoma length. Distances: *sce-sce* 96, *sci-sci* 36, *d*₁-*d*₁ 74, *d*₂-*d*₂ 28, *d*₃-*d*₃ 39, *d*₄-*d*₄ 44. Genital "tentacles" rounded with short proximal part. Posterior median suckers surrounded by tetragonal sclerite with narrow caudal process (visible with immersion lens) (Fig. 3, 7). Segment length ratio for legs I-IV (length of leg with and without claw indicated in parentheses; idiosoma 282): I 1.6 : 1.0 : 1.1 : 1.5 (88-104); II 1.8 : 1.0 : 1.1 : 1.7

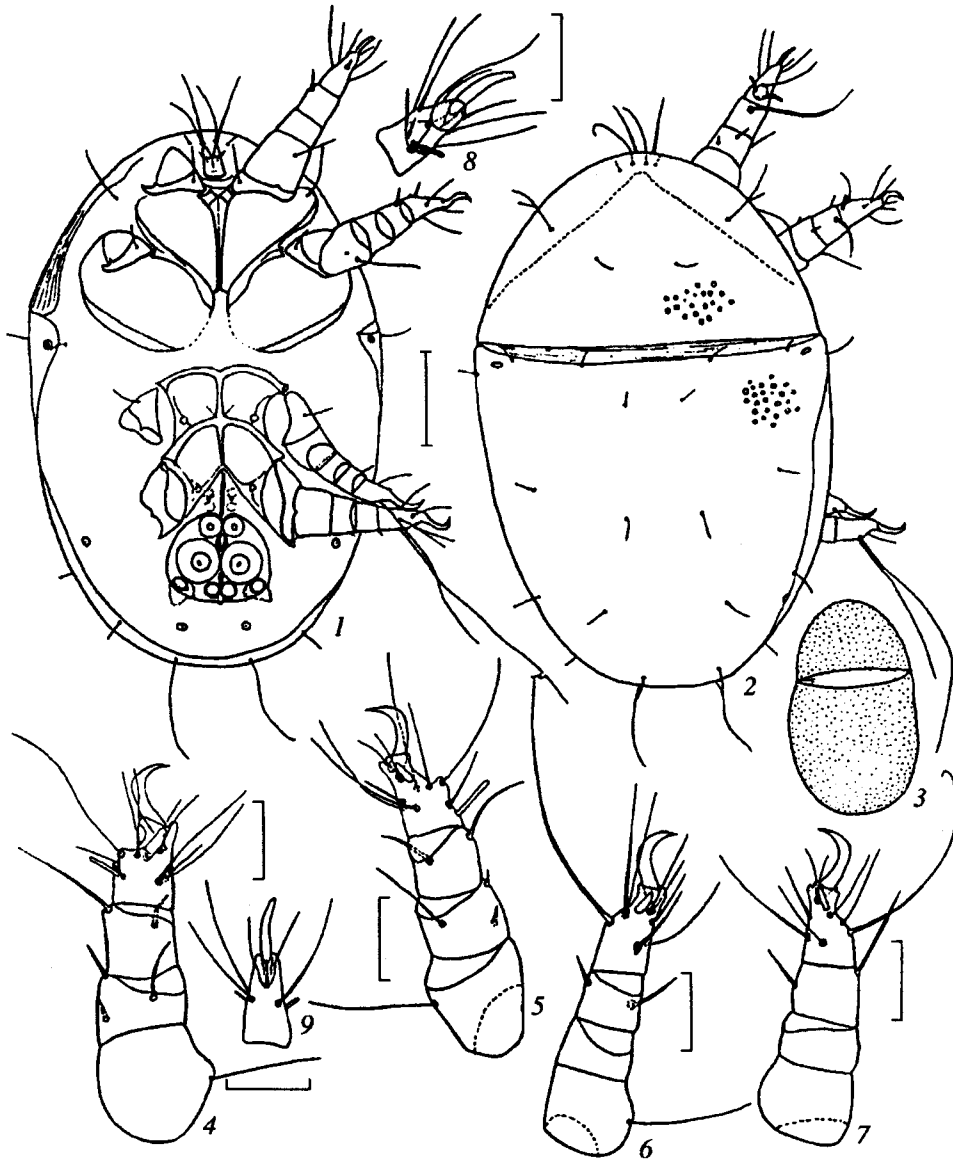


Fig. 3. *Boletoglyphus extremiorientalis* Klimov, sp. n.: hypopus. (7) ventral view; (2) dorsal view; (5) scheme showing the area of tegument between propodosomal and hysterosomal scuta, in dorsal view; (4-7) legs I-IV; (8 and 9) tarsus I. Scale bars: 50 μm in 1, 2; 20 μm in 4-9.

(83-104); III 1.7 : 1.0 : 1.3 : 2.0 (65-77); IV 1.8 : 1.0 : 1.1 : 2.1 (75-88).

Differential diagnosis. The features distinguishing this species from *B. boletophagi* are given in the key.

Etymology. The name *extremiorientalis* (Latin for Far Eastern) reflects the distribution of this species.

Biology. Resembles that of the above species. These mites were found in polypores together with *Schwiebea rossica* Zachv. Hypopi are phoretic on

beetles *Bolitophagus reticulatus*, *Atasthalomorpha dentifrons*, *Boletoxenus incurvatus*, *B. bellicum*, and *Cisjacquemarti*.

Distribution. Russia: Primorskii and Khabarovsk Territories, Sakhalin; Japan: Hokkaido.

Subgenus *ELLIPSOPUS* Fain, Ide, 1976

Fain, Ide, 1976: 233 (*Ellipsopus*).

Mahunka, 1977: 69 (*Lindquistia*).

Fain, Mahunka, 1990: 110 (*Boletoglyphus*, part.).

Type species *Ellipsopus ornatus* Fain, Ide, 1976 = *Lindquistia bolitotheri* Mahunka, 1977, by monotypy.

This subgenus includes 1 species with Nearctic distribution; known from hypopi.

Boletoglyphus (Ellipsopus) ornatus

Fain, Ide, 1976, comb. n.

Fain, Ide, 1976: 233, figs. 1-4 (*Ellipsopus ornatus*).

Mahunka, 1977: 69, figs. 1-4 (*Lindquistia bolitotheri*).

Note. The descriptions published by Mahunka (1977) and Fain and Ide (1976) disagree in some details: morphology of seta d_5 , relative length and thickness of setae on tarsi and tibiae I-II, and thickness of setae vsc on tarsus IV. The type specimens from the US and Canada need to be compared.

Biology. Phoretic on the beetles *Bolitotherus cornutus* (Panzer, 1794). The adults "will probably be found to live in polypores" (Fain, Ide, 1977).

Distribution. N America: US (Fain, Ide, 1976) and Canada (Mahunka, 1977).

Key to Species of the Genus Boletoglyphus

Males and females (females of *B. ornatus* unknown)

- 1 (2) *sci* well-developed, short. Lengths of $\omega_1 : \omega_2 : \omega_3$ relate as 2.8 : 1.0 : 4.6. Canal of bursa copulatrix with narrowing inner part. Penis long, narrowing distally, with canal diameter approximately equal to thickness of its walls *B. boletophagi*
- 2 (1) *sci* strongly reduced. Lengths of $w_1 : \omega_2 : w_3$ relate as 1.8 : 1.0 : 2.7. Bursa copulatrix of approximately the same diameter along its entire length. Penis shorter, not narrowing distally, with canal diameter exceeding thickness of its walls *B. extremiorientalis* sp. n.

Hypopi

- 1 (2) d_1-d_4 , (d_5) lanceolate; *cx* I, III-IV setiform; ventroapical setae (*vsc*) of tarsi III-IV spiniform (Subgenus *Ellipsopus*) *B. ornatus*
- 2 (1) All idiosomal setae setiform; *cx* I absent, *cx* III-IV reduced (seen as rounded spots); ventroapical setae (*vsc*) of tarsi III-IV setiform (Subgenus *Boletoglyphus*) 3

- 3 (4) *sce* and *sci* of about the same length and positioned at the same level. Common sclerite of posterior median suckers irregular-pentagonal, extending beyond hind margin of plate *B. boletophagi*
- 4 (3) *sci* shorter than *sce* and positioned caudally to them. Sclerite tetragonal, not extending beyond hind margin of plate, with narrow process protruding caudally beyond plate margin (use immersion lens)..... *B. extremiorientalis* sp. n.

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