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A new *Asca* (Acari: Mesostigmata: Ascidae) from Costa Rica

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Abstract

Asca nelsoni sp. nov. is described from Costa Rica, from within domatia on leaves of coffee plants, *Coffea arabica* L. (Rubiaceae), and compared with morphologically similar species *A. brachychaeta* Hurlbutt, *A. citri* Hurlbutt and *A. elongata* (Berlese).

Key words: arboreal predator, *Asca*, Ascidae, coffee, domatia, fungal spores, Rubiaceae

Introduction

A new species of *Asca* von Heyden (Acari: Mesostigmata: Ascidae) was discovered during a survey of mites occurring in the domatia of *Coffea* species at the International Coffee Germplasm Center of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Turrialba, Costa Rica (Vega *et al.* 2007). Members of this genus are predatory on other mites (Moutia 1958), eggs of insects (Moussa 1956), nematodes and other arthropods (Walter 1988; Epsky *et al.* 1988), and Collembola (Karg 1961; Hurlbutt 1963). They have been reported on the leaf domatia of several plants (Walter & O'Dowd 1992; Walter 1996), as inhabitants of the phylloplane (Walter *et al.* 1993), in bark beetle galleries (Stone & Simpson 1991), termite's and bird's nests (Ryke 1961), soil and moss (Ryke 1961), etc. Species of *Asca* are often abundant on the leaves of trees and lianas in subtropical to tropical rainforests, and several members of the genus truly prefer arboreal habitats (Walter *et al.* 1993; Lindquist *et al.* 2009).

One interesting aspect of the new species from the coffee domatia is the presence of germinated fungal spores on its cuticle (Vega *et al.* 2007). We have found no other reports of fungal spores on the body of other *Asca* species, although these have been reported on several other mites, including species of Tarsonemidae, e.g., *Daidalotarsonemus deleoni* (Smiley), *Fungitarsonemus lodici* (DeLeon), *F. peregrinus* (Beer), *Tarsonemus floridanus* (Attiah), *T. scaurus* Ewing, *T. solengrandis* Ochoa, and *Xenotarsonemus vargasi* Ochoa (Ochoa *et al.* 1991). We hereby present a description for the new *Asca* species, *A. nelsoni*.

Material and methods

Measurements in micrometres (μm) were made from specimens flattened on microscope slides using a stage-calibrated ocular micrometer, and are presented in parentheses as ranges (minimum to

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maximum). Morphological features, unless stated otherwise, were measured as follows: inside edge of setal base to inside edge of setal base, i.e. the shortest distance between two setal bases; palps measured from base of trochanter to tip of tarsus; subcapitulum measured down midline from base to level with tip of corniculi; fixed digit of chelicera length measured from dorsal lyrifissure to tip, movable digit measured along maximum length down midline; spermatodactyl shaft length measured from membranous juncture with movable digit to tip of shaft; setal length measured from midpoint of insertion to tip. The term 'pore' used in descriptions is applied to all pore-like structures, and includes both sense organs (lyrifissures, id1–x) and gland pores (gd1–9) (sensu Ragusa & Athias-Henriot 1983). Gland pores are slit-shaped and lyrifissures are generally ovoid. Adult idiosomal chaetotaxy follows that of Lindquist & Evans (1965), and our generic concept of *Asca* follows that of Lindquist & Evans (1965) and Lindquist *et al*. (2009).

List of Abbreviations

MICR: Mite Collection at Museo de Insectos, San Pedro, Universidad de Costa Rica, Costa Rica

USNM: United States National Mite Collection, US National Museum of Natural History (Smithsonian), Systematic Entomology Laboratory (SEL), Beltsville Agricultural Research Center West (BARC West), United States Department of Agriculture (USDA), Building 005, 10300 Baltimore Ave, Beltsville, Maryland, USA, 20705

Genus *Asca* von Heyden

Asca von Heyden, 1826: 610. Type species: *Gamasus aphidioides* Fabricius, 1805, by original designation (= *Acarus aphidioides* Linnaeus, 1758).

Ceratozercon Berlese, 1913: 204. Type species: *Zercon bicornis*, Berlese, 1887 (not *Gamasus* (*Sejus*) *bicornis* Canestrini & Fanzago 1876), by original designation (= *Acarus aphidioides* L., 1758).

Diagnosis

Dorsal shield divided, with pair of posterior projections (horns) on opisthosomal shield usually bearing setae *Z4* and *S5* (Figs 1, 6). Female with expanded ventrianal shield incorporating 5–6 pairs of ventral setae (usually *JV2–5*, *ZV2–3*) in addition to circumanal setae (Fig. 2); genu I lacks ventral setae *av-2* (i.e. 12 rather than 13 setae); third pair of sternal pores (stp3) on the sternal shield; fourth pair of sternal setae (st4) free on soft cuticle; movable digit of chelicerae usually bidentate (Fig. 3).

Asca nelsoni sp. nov. Beard, Ochoa & Vega

(Figs 1–9)

Material Examined

Types. Holotype. ♀. **Costa Rica**, Cartago, Turrialba, February 2005, ex. domatia on leaves of *Coffea arabica* L. (Rubiaceae) accession T.01997, International Coffee Germplasm Center, Centro Agronómico Tropical de Investigación y Enseñanza (N 09°54.012, W 083° 39.702), Fernando E. Vega (USNM).

Paratypes. Same data as holotype except ex. domatia on leaves of seven different accessions of *Coffea arabica* L. (Rubiaceae) (T.01994, T.01997, T.02248, T.02255, T.02268, T.02307, T.04492) (all on separate slides): 5 ♀♀, 2 ♂♂, deutonymph, 2 protonymphs, pharate larva (USNM); 2 ♀♀, ♂, 2 protonymph (MICR).

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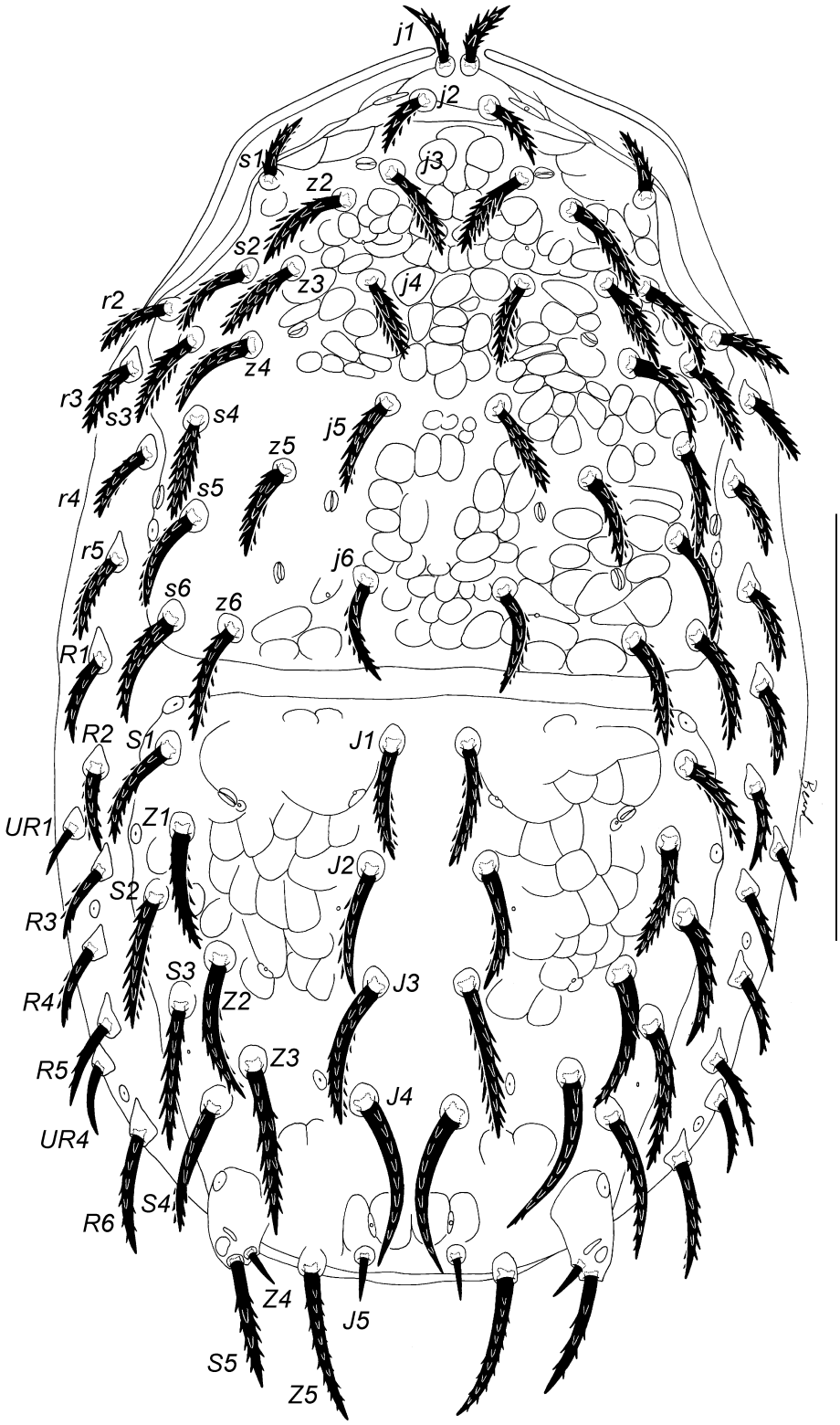

FIGURE 1. *Asca nelsoni* sp. nov. adult female dorsum. Scale bar = 100 μm.

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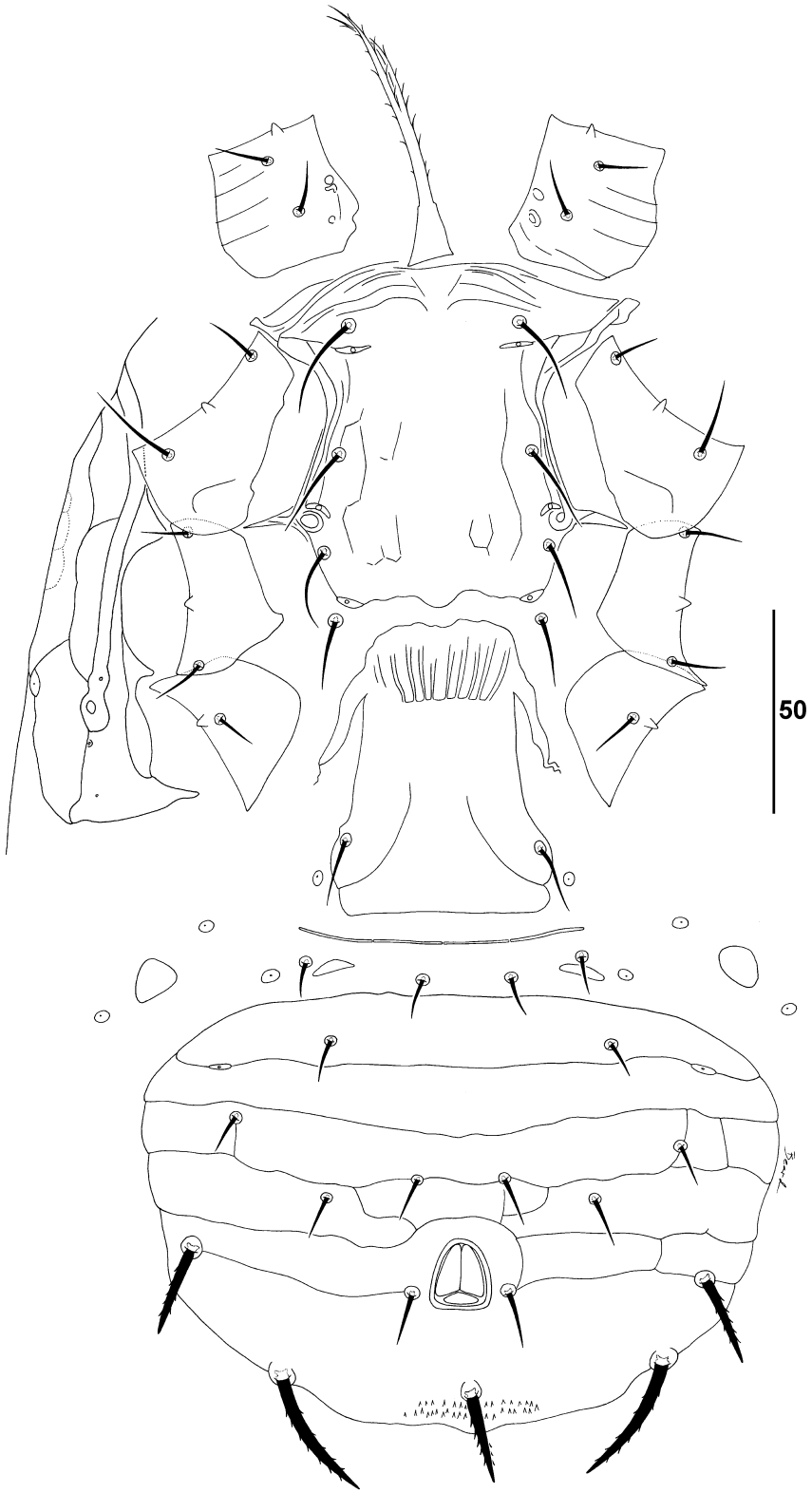

FIGURE 2. *Asca nelsoni* sp. nov. adult female venter, with detail of tritosternum and peritreme.

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Diagnosis

Anterior margin of tectum denticulate with 9–13 small teeth. Subcapitulum with 6–8 rows of 2–3 of deutosternal denticles (most commonly 7 rows of 2 denticles). Dorsal shields colliculate anteriorly; all dorsal setae inserted on small tubercles. Podonotal shield with 18–20 pairs of thick, densely spiculate setae; setae *j1* similar in size to *j2*; setae *r2* captured by shield, setae *r3–r4* inserted in soft cuticle or rarely captured by shield. Opisthonotal shield with 15 pairs of densely spiculate setae (except *Z4*, *J5* short, smooth) on raised insertions; *J1–J1 = J2–J2 = J3–J3 = J4–J4*; setae *Z4* significantly shorter than *S5*; *J4>J3*; *UR2*, *UR4* present. Female ventrianal shield with six pairs of ventral setae (*JV2–5*, *ZV2–3*); setae *JV4* and *JV5* (inserted on posterior margin shield) and postanal seta longer, thick, barbed. Male ventrianal shield with seven pairs of setae (*JV1*–5, *ZV1–2*); setae *ZV3* absent. Leg setae short, blunt.

Adult female

Dorsal idiosoma (Fig. 1). Body measurements: *j1–J5* (275–294), *r2–r2* (120–125), *s6–s6* (104–125), *J1–J1* (10–14), *J2–J2* (20–24), *J3–J3* (16–20), *J4–J4* (15–19), *S1–S1* (115–123), *S4–S4* (87–96). Two dorsal shields; all dorsal setae inserted on small tubercles. Anterior podonotal shield (*j1–j6* 114–129) colliculate-reticulate with 18–20 pairs of thick, densely spiculate setae: *j1* 14–16, *j2* 13–17, *j3* 18–21, *j4* 19–23, *j5* 17–23, *j6* 19–26, *z2* 20–27, *z3* 18–20, *z4* 19–23, *z5* 18–23, *z6* 21–25, *s1* 10–15, *s2* 18–25, *s3* 18–25, *s4* 19–23, *s5* 22–27, *s6* 23–29, *r2* 18–21, *r3* 17–21, *r4* 17–21. Setae *r2* captured by shield; setae *r3–r4* inserted in soft cuticle or captured by shield; setae *r5* (18–24) in soft cuticle laterad shield. Podonotal shield (*J1–J5* 122–126) with nine pairs of discernable pore-like structures, of which five appear secretory (gland pores: gd1 laterad *j3*; gd2 mesad *z4*; gd4 on shield margin laterad *s5*; gd5 posteromesad *z5*; gdx laterad *j6*) and four appear non-secretory (lyrifissures: id1 laterad *j2*; id1a anteriad *j4*; id4 on shield margin laterad *s5*; id6 laterad *j6*). Posterior opisthonotal shield ornamentation less pronounced than anterior shield, light reticulations anterolaterad from level with setae *J1–S1* to *J3–Z2*; with 15 pairs of densely spiculate setae (except *Z4*, *J5* short, smooth) on raised insertions: *J1* 22–28, *J2* 25–30, *J3* 28–34, *J4* 32–39, *J5* 8–10, *Z1* 19–28, *Z2* 26–36, *Z3* 32–37, *Z4* 8–9, *Z5* 30–35, *S1* 23–29, *S2* 25–32, *S3* 27–32, *S4* 26–35, *S5* 24–33. Setae *R1* inserted in soft cuticle laterad junction of two shields, setae *R2–R6* and *UR1*, *UR4* in soft cuticle laterad posterior shield: *R1* 19–25, *R2* 18–23, *R3* 18–21, *R4* 17–19, *R5* 20–27, *R6* 27–31, *UR1* 10–12, *UR4* 15–19. Opisthosomal setae gradually increasing in length towards posterior, posterior setae less spiculate than anterior setae. Opisthonotal shield with pairs of discernable pore-like structures, of which two appear secretory (gland pores: gd6 mesad *Z1*; gd9 distally on seta-bearing horn) and nine appear non-secretory (lyrifissures: idm1 mesad *Z1*; idm2 posterad *J1*; idm3 posterad *J2*; idx mesad *Z2*; idm4 mesad *Z3*; idm5 distal on seta-bearing horn; idm6 anterad *J5*; is1 anterad *S1* on shield margin; idl2 laterad *Z1* on shield margin; idl4 at base of seta-bearing horn). Two pores in soft cuticle laterad shield (posterad *R3*, posterad *UR4*). Peritreme extends to setae *j1*; peritrematal shield fused to dorsal shield from *j1* to level with *s1* anterolaterally.

Ventral idiosoma (Fig. 2). Sternal shield with three pairs of setae (*st1–st3*) and three pairs of pores (stp1–3); shield measurements: *st1–st1* 38–41, *st2–st2* 42–50, *st3–st3* 51–57, *st1–st3* 50–56; posterior margin with small medial expansion; setae *st4* in soft cuticle posterad shield. Epigynial shield truncate posteriorly, membranous anterior margin crenulate, *st5–st5* 43–48, anterior margin to posterior margin 70–76. Single pair metapodal platelets broadly triangular-oval. Ventrianal shield with light reticulate pattern, six pairs of ventral setae (*JV2–5*, *ZV2–3*); setae *JV4* (21–29), *JV5* (27–35) and postanal seta (21–23) thick, barbed; postanal seta longer than paranal setae (12–14); two pairs of pores visible. Peritrematal shield (see Fig. 2) with five pores visible along length (one level with dorsal seta *s1*, one level with seta *r3*, three distally surrounding stigma). Shield measurements:

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ZV2–ZV2 62–77; *ZV3–ZV3* 104–123; *JV4–JV4* 99–121, *JV5–JV5* 88–97. Setae *JV1*, *ZV1* inserted in soft cuticle anterad shield. Cribrum narrow, 2–3 rows of moderate spicules.

Spermathecal apparatus indistinct.

Gnathosoma. Movable digit (25–26) of chelicerae (Fig. 3) with two large teeth. Fixed digit (18–20) with short dorsal seta (6–7), row of 5–6 serrations, short setiform pilus dentilis, and subapical off-set bifid tooth (Fig. 3). Palps (85–102) (Fig. 4A,B) less than twice the length of subcapitulum (72–76); palp setation tr–ti 2-5-6-12; setae simple, except for genu with setae *al1* thick blunt (5–6), *al2* thick spatulate (8); femur with setae *al1* thick spatulate seta (9–10); palp apotele two-tined. Subcapitulum (Fig. 4A) with 6–8 rows of 2–3 of deutosternal denticles (most commonly 7 rows of 2 denticles). Tritosternum (see Fig. 2A) 68–72 long, length from base to fork 28–36; base with a few faint transverse striations. Tectum (Fig. 4C) anterior medial margin denticulate, with 9–13 fine teeth.

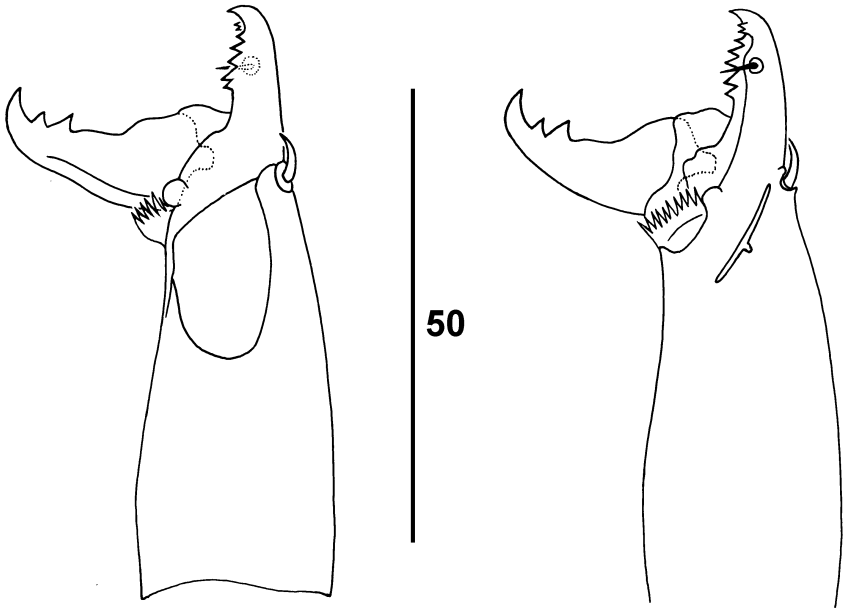

FIGURE 3. *Asca nelsoni* sp. nov. adult female chelicerae, abaxial and adaxial aspects presented.

Legs (Fig. 5). Setation of legs I–IV: cx 2-2-2-1, tr 6-5-5-5, fe 12-10-6-6, ge 12-11-7-9, ti 13-10-8-10, ta II-IV 16-16-16. Genu III on one female with 8 setae, seta *al2* present. Dorsal setae short, blunt; ventral setae finer and slightly longer than dorsal setae. Length of legs from base of trochanter to tip of tarsus (excluding pretarsus): I 193–231; II 168–189; III 144–174; IV 211–234.

Male

Dorsal idiosoma (Fig. 6) Body measurements: *j1–J5* (222–231), *j1–j6* (94–104), *J1–J5* (94–97), *r2–r2* (105–114), *s6–s6* (97–103), *S1–S1* (97–101), *S4–S4* (69–70). All dorsal setae inserted on small tubercles. Two dorsal shields: anterior podonotal shield lightly colliculate-reticulate medially with 19 pairs of thick, spiculate setae: *j1* 12–13, *j2* 13–14, *j3* 14–17, *j4* 14–16, *j5* 15–16, *j6* 17–18, *z2* 18–19, *z3* 16–17, *z4* 17–18, *z5* 16–17, *z6* 18–19, *s1* 12, *s2* 16–17, *s3* 12–19, *s4* 20–22, *s5* 17–19, *s6* 18–20, *r2* 15–19, *r3* 15–16. Setae *r4* 16–18, *r5* 17–18 in soft cuticle laterad shield. Podonotal shield with nine pairs of discernable pore-like structures, of which five appear secretory (gland pores: gd1 laterad *j3*; gd2 mesad *z4*; gd4 on shield margin laterad *s5*; gd5 posteromesad *z5*; small circular pore gdx anterolaterad *j6*) and four appear non-secretory (lyrifissures: id1 laterad *j2*; id1a anterad *j4*; id4 on shield margin laterad *s5*; id6 laterad *j6*). Posterior opisthosomal shield

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ornamentation less pronounced than anterior shield, light reticulations between the *J*-series and *Z*-setae to level with *J3*; with 15 pairs of thick, spiculate setae on small tubercles, setae gradually increasing in length towards posterior and becoming decreasingly spiculate: *J1* 18–20, *J2* 18–22, *J3* 20–24, *J4* 24–28, *J5* 6–10, *Z1* 18–21, *Z2* 19–24, *Z3* 21–29, *Z4* 6–12, *Z5* 25–29, *S1* 17–19, *S2* 21–22, *S3* 23–21, *S4* 21–24, *S5* 21–25. Setae *R1* 15–16, *R2* 14–15, *R3* 16–17, *R4* 14–16, *R5* 13–18, *R6* 19–20. Setae *UR1* 9, *UR2* 8 (often absent on males) inserted in soft cuticle laterad shield. Podonotal shield with 12 pairs of discernable pore-like structures, of which two appear secretory (gland pores: gd6 mesad *Z1*; gd9 distally on seta-bearing horn) and 10 appear non-secretory (lyrifissures: idm1 mesad *Z1*; idmx and idm2 laterad *J1*; idm3 posterad *J2*; idm4 laterad *J4*; idm5 distally on seta-bearing horn; is1 anterior corner of shield; idl2 laterad *Z1*; idl3 posterad *S3*; idl4 at base of horn). Two pores in soft cuticle laterad shield (posterad *R3*, posterad *R5*). Peritreme extends to setae *j1*.

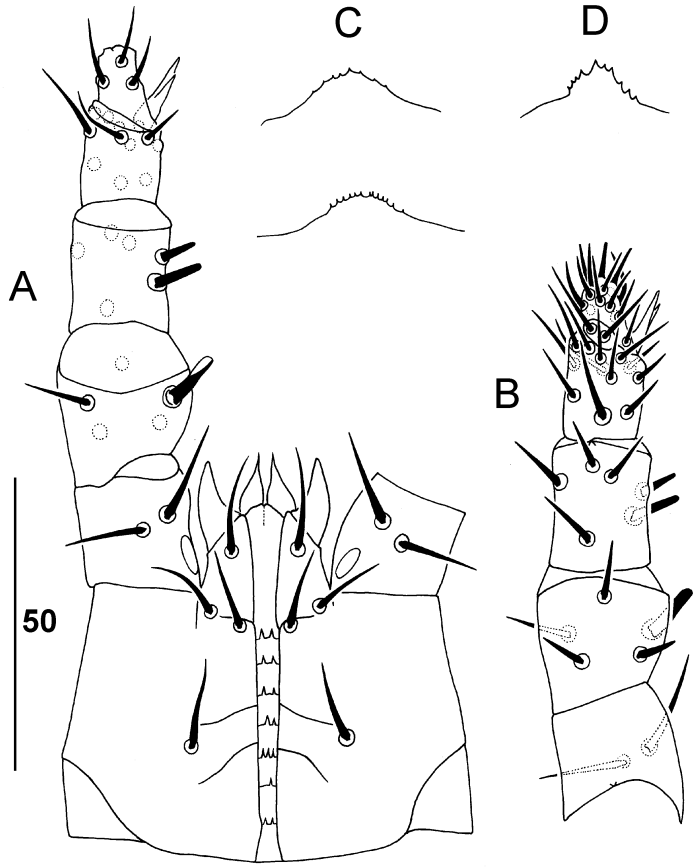

FIGURE 4. *Asca nelsoni* sp. nov. A. adult female subcapitulum with palp, ventral setae on palp segments in detail, dorsal setae dotted; B. adult female palp, detail of setae, dorsal aspect; C. adult female tectum variation; D. protonymph tectum.

Ventral idiosoma (Fig. 7) Sternitogenital shield smooth (rarely with faint longitudinal striae visible); shield measurements: *st1–st1* (32–34), *st3–st3* (40–45), *st5–st5* (28–30), *st1–st5* (95–96); three pairs pores on shield (stp1–3), pair pores in soft cuticle posterolaterad *st5* (stp5). Ventrianal shield reticulate, broadly ovate, *ZV1–ZV1* (48–52), *JV4–JV4* (90–99), *ZV1*–paranal seta (59–62),

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with seven pairs of setae (*JV1*–5, *ZV1–2*); setae *ZV3* absent. Setae *JV4* (13–14), *JV5* (20–26) and postanal seta (18–19) thick barbed; postanal seta longer than paranal setae (10–11); three pairs of pores visible. Cribrum narrow, finely speculate, in 2 rows.

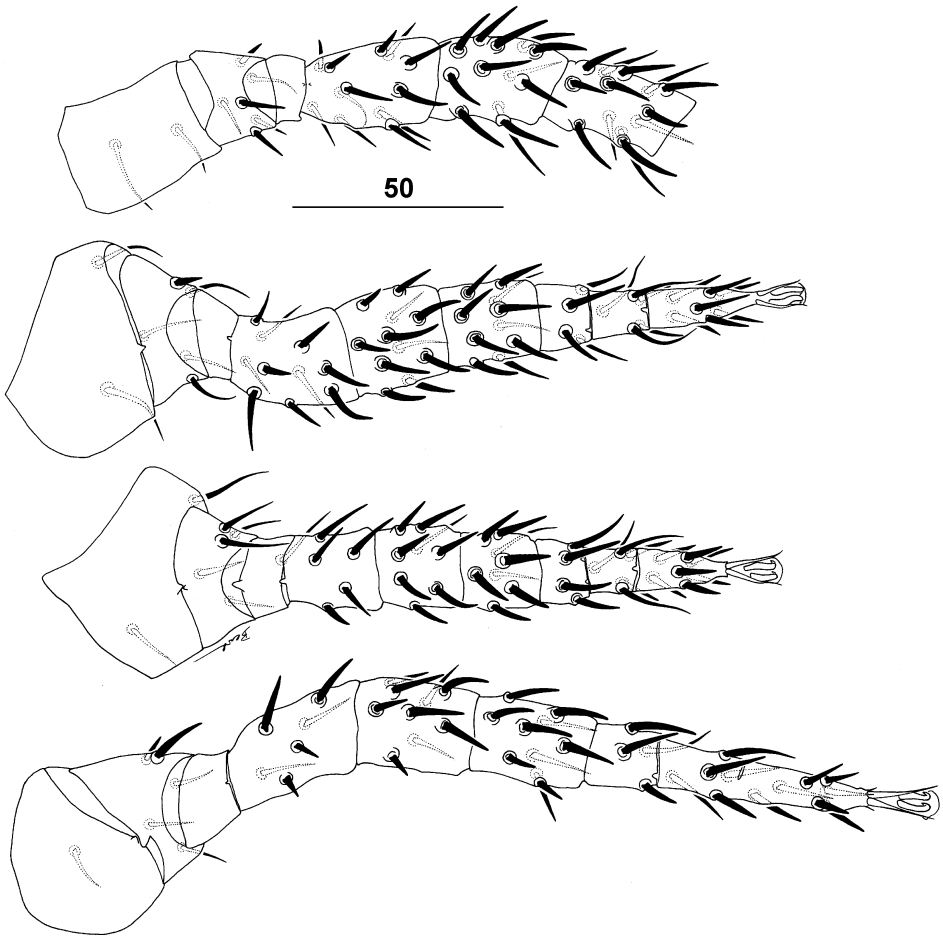

FIGURE 5. *Asca nelsoni* sp. nov. adult female legs I–IV (tarsus I not drawn).

Gnathosoma. Movable digit (18–19) with one tooth; fixed digit (13) with short dorsal seta (5–6), row of three serrations, short setiform pilus dentilis, and subapical off-set bifid tooth (Fig. 8A). Spermatodactyl short (11–12), slightly longer than fixed digit, truncate (Fig. 8A,B). Palps (84–87) less than twice the length of subcapitulum (60–63); palp setation tr–ti same as adult female; palp setae simple except for genu setae *al1* thick blunt (5), *al2* thick spatulate (8), femur setae *al1* thick spatulate (9); palp apotele two-tined. Subcapitulum with 7 rows of 1–4 deutosternal denticles (most often 2 denticles). Tectum (Fig. 8C) anterior medial margin denticulate, with approximately 7–8 fine teeth. Tritosternum (see Fig. 7) 52–58 long, length from base to fork 21–34.

Legs. Leg setation same as adult female. Length of legs from base of trochanter to tip of tarsus, excluding pretarsus: I 190, II 171, III 153, IV 187.

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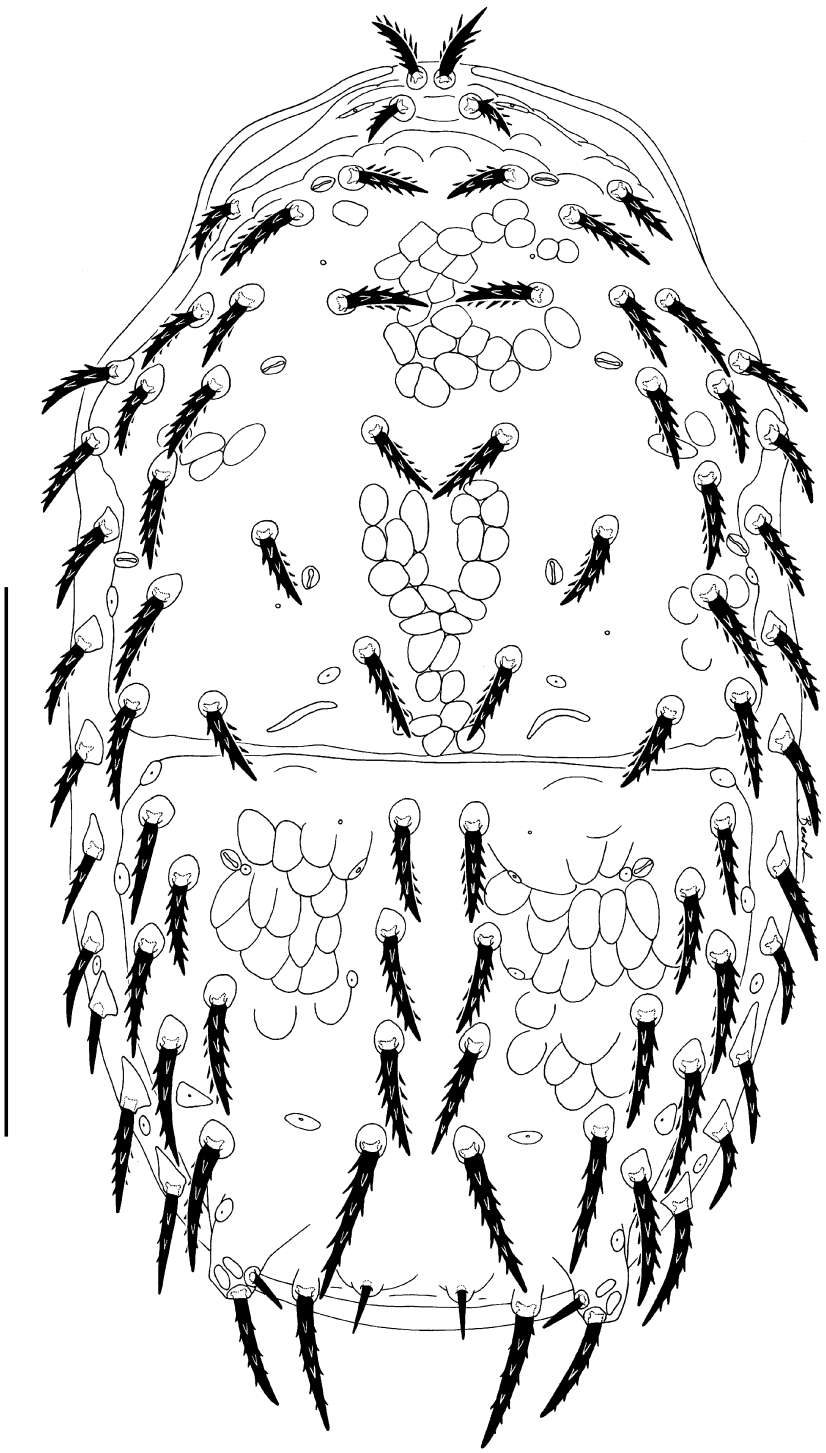

FIGURE 6. *Asca nelsoni* sp. nov. adult male dorsum. Scale bar = 100 μm.

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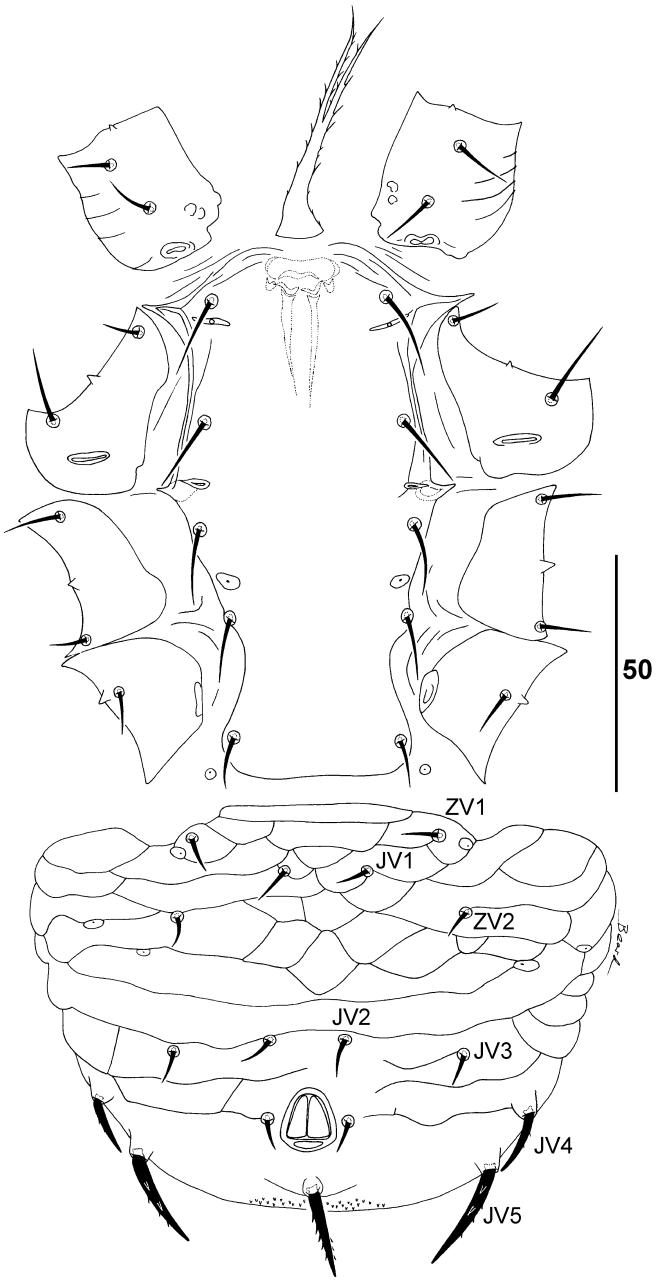

FIGURE 7. *Asca nelsoni* sp. nov. adult male venter, with detail of tritosternum.

Protonymph

Dorsal idiosoma (Fig. 9). Body measurements: *j1–j6* 91–97, *J3–J5* 36–41, *s6–s6* 86–88, *S4–S4* 55–56. Most dorsal setae short, barbed (11–17), except *J4* (21–22), *Z4* (16–20), *Z5* (24–26), *S4* (20–22), *S5* (18–21); 29 dorsal setae present. Podosomal shield (*j1–j6* 91–97) with longitudinal band of colliculate ornamentation medially between setae *j3–j6*; setae *j1* 9–10; 8 pairs of small pores visible. Setae *r2*, *r3* inserted laterad shield. Seven small platelets and 3 pairs of small pores in soft cuticle

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between podosomal and pygidial shield. Pygidial shield (*J3–J5* 36–41) with 8 pairs of setae and 3 pairs of pores on anterior margin; setae *Z4* inserted on seta-bearing horn; setae *S5* inserted on pygidial shield separately to horn; setae *Z4* barbed, longer than that of adult female; setae *J5* lightly barbed; five pairs of small platelets or pores in soft cuticle posterolaterad pygidial shield. Peritreme extends to setae *r2*.

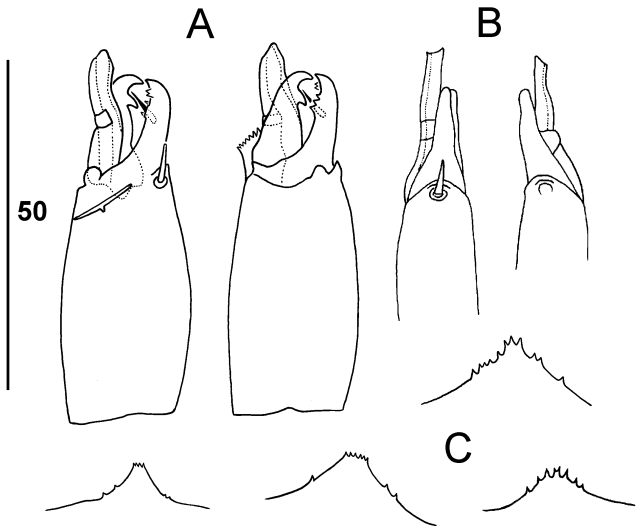

FIGURE 8. *Asca nelsoni* sp. nov. adult male, A. cheliceral digits, abaxial and adaxial aspects; B. cheliceral digits, dorsal and ventral aspects; C. variation in tectum.

Ventral idiosoma. Body measurements: *st1–st1* 25–26, *st2–st2* 38–40, *st3–st3* 34–35, *st5–st5* 16–20, *JV1–JV1* 13–14, *JV2–JV2* 8–14, *ZV2–ZV2* 34–41. Anal shield present; *JV2* captured by anal shield; postanal seta thick, barbed (15–16), longer than paranal setae (10–11); setae *JV5* thick, barbed (16–17). Tritosternum 50–53 long, length from base to fork 24–32. Cribrum not arranged in rows, spicules surrounding postanal seta.

Gnathosoma. Moveable digit (16–17) with 2 teeth; fixed digit (13) with 5 teeth (4 teeth forming a row with one offset tooth distally); cheliceral seta short (5). Palps (75–77) less than twice as long as subcapitulum (52–59); palp setation tr-ti 1-4-5-10; palp setae simple except genu seta *al1* short peg-like (4–5); femur *al1* thick (6–8). Subcapitulum with 6 rows of 2 deutosternal denticles. Tectum small with 9–10 teeth (Fig. 4D).

Legs. Setation of legs: cx 2-2-2-1, tr 4-4-4-4, fe 10-8-5-4, ge 8-6-6-5, ti 8-7-7-7, ta II-IV 15-15-15. Chaetotaxy fe I 2-2/1-2/2-1; ge I I 1-2/1-2/1-1, ge II-III 1-2/0-2/0-1 ge IV 1-2/0-2/0-0; ti I 1-2/1-2/1-1, ti II-IV 1-1/1-2/1-1. Length of legs from base of trochanter to tip of tarsus: I 140–142, II 122–132, III 102–112, IV 125–143. No macrosetae present on legs.

Etymology

Named in honor of Robert F. Nelson, President and CEO of the National Coffee Association of the United States of America, for his strong support of coffee research at the U. S. Department of Agriculture, Agricultural Research Service.

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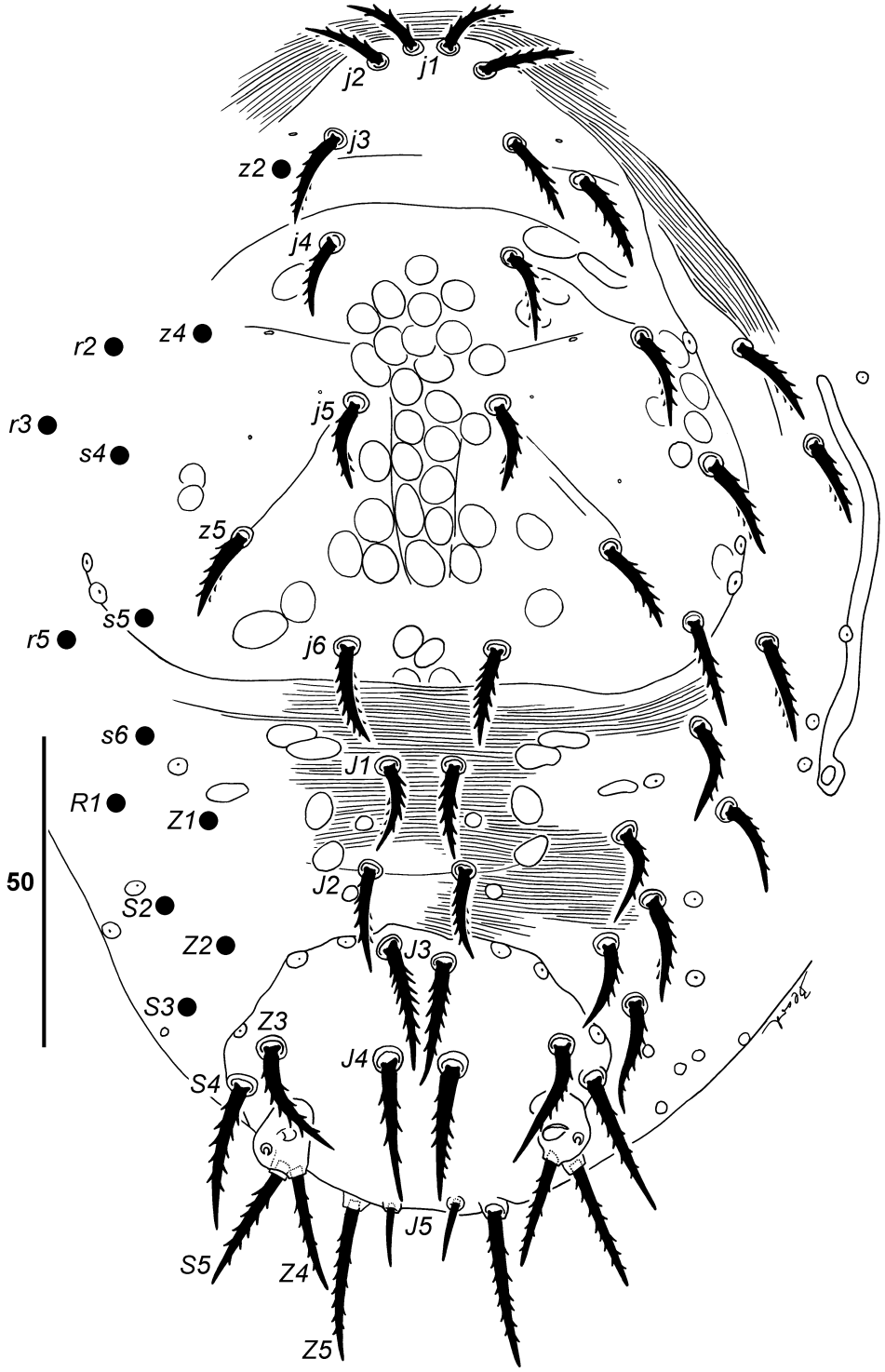

FIGURE 9. *Asca nelsoni* sp. nov. protonymph dorsum; setae on left side of dorsum indicated by black dots.

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Remarks

Relatively small species, body noticeably convex dorsally. Marginal setae *r2* captured by the propodosomal shield, a character also shared by the North American species *Asca brachychaeta* Hurlbutt 1963, *A. citri* Hurlbutt 1963 and *A. elongata* (Berlese) 1910. Based on the description provided in Hurlbutt (1963), adult females of *A. nelsoni* sp. nov. can be separated from *A. brachychaeta* (A.b.), *A. citri* (A.c.) and *A. elongata* (A.e.) by having opisthosomal setae *Z4* significantly shorter than *S5* (more or less subequal in A.b., A.c. and A.e.), and the distance *J4–J4* subequal to *J1–J1* (*J4–J4* > *J1–J1* in A.b. (38 > 13), A.c. and A.e.). In addition, setae *J4* (32–39) are much shorter on *A. nelsoni* than on *A. brachychaeta* (54). Some observed aberrations in the morphology of *A. nelsoni*: dorsal setae *z6* are absent on one female; setae *S1* are absent on one male.

Biology

All specimens were obtained from the leaf domatia of seven different *C. arabica* L. accessions maintained at the International Coffee Germplasm Center of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Turrialba, Costa Rica. *Asca* species associated with domatia are predators of mites and other small invertebrates (Walter & Proctor 1999).

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