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Genus *Acalvolia* (Acari: Winterschmidtiidae), with the description of a new species from the USA

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Abstract

The definition of the mite genus *Acalvolia* is revised. A new species, *Acalvolia americana*, with conidia of *Cladosporium* sp. in its gut, intercepted on orange from the United States is described. Currently the genus consists of only one species, and the new species is distinguished from that species by having smooth supracoxal setae, longer setae *sci* (ratio *sce*: *sci* = 2.5–2.7), and longer dorsal idiosomal setae c_1, d_1 and e_1 (reaching to or overlapping the bases of setae in the next row).

Key words: Systematics, taxonomy, Sarcoptiformes, orange, North America

Introduction

The genus *Acalvolia* comprises of only one known species, *A. squamata* (Oudemans, 1909), described from a single deutonymph (= hypopus) from *Mus jerdoni* (Blyth) (Rodentia: Muridae) collected in Holland (Fain 1972; Fain & Knülle 1981[1]). This species was subsequently discovered to be associated with house dust in Arnhem, Holland, and a bird's nest in Berlin, Germany (Fain & Knülle 1981). The biology as well as economical importance of this species is little known. An unnamed species of *Acalvolia* was found on leaves in association with nymphs of the citrus whitefly *Dialeurodes citri* (Ashmead) (Hemiptera: Aleyrodidae) infected by a fungus, *Aschersonia aleyrodis* Webber (Hypocreales: Clavicipitaceae). It was apparently developing and reproducing with *Asc. aleyrodis* as the only food source (Osborne & Landa 1992). The mite was considered mycophagous and important in dissemination of *Asc. aleyrodis* (Osborne & Landa 1992).

Mites of the genera *Oulenzia*, *Czenspinskia* and *Acalvolia* of the family Winterschmidtiidae have frequently been intercepted at the borders of New Zealand, but none have been reported from within the country (Sirvid *et al.* 2010). There are only two records of Winterschmidtiidae in New Zealand, *Calvolia* sp. listed by Spain and Luxton (1971) and *Psylloglyphus parapsyllus* described by Fain and Galloway (1993) as a new species from the nests of seabirds. The present paper describes a new species of *Acalvolia* intercepted on oranges from the United States.

Methods

Specimens were examined and measured with an interference-phase contrast microscope (Fan & Zhang 2007). All measurements are given in micrometers (μm), and illustrations made using a drawing tube attached to a Nikon interference-phase contrast microscope. Images were taken using a Zeiss AxioCam HRc camera attached to a Zeiss interference-phase contrast microscope and edited with Auto-montage and Photoshop 7.0.1 software.

1. The original locality of the species published by Oudemans (1909) was Semarang, a city on the north coast of the island of Java, Indonesia. Fain and Knülle (1981) considered that the locality was erroneously reported because they found a note "verdwaald" (="astray") on the type slide along with Oudemans' five new specimens from Arnhem, Holland.

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Terminology used for idiosomal chaetotaxy follows Griffiths *et al*. (1990), that for palp and leg chaetotaxy follows Grandjean (1939) and Griffiths (1970), and that for the copulatory organ follows Klimov and OConnor (2003).

Results

Acalvolia Fain, 1971

Acalvolia Fain, 1971, 84(3–4): 281–284; Fain & Knülle, 1981, 7: 139–140.
Type species: *Vidia squamata* Oudemans, 1909.

Diagnosis. FEMALE. Ocelli absent; prodorsal shield widened posteriorly; setae *sce* at least 2× as long as *sci*; supracoxal setae *scx* slender, smooth or slightly barbed; opisthosomal cuticle with 1 to 3 pairs of tiny tubercles (Fig. 1); idiosoma with 2 pairs of *h* setae and 3 pairs of *ps* setae; tarsi (excluding pretarsi) at least 5× as long as their basal width. Chaetotaxy of legs I–IV: trochanter 1, 1, 1, 0; femora 1, 1, 0, 0; genua 2 + 2σ, 2 + 1σ, 1σ, 0; tibiae 2 + 1φ, 2 + 1φ, 1 + 1φ, 1 + 1φ; tarsus I with 4 long setae (*wa*, *ra*, *la* and *d*) + 2 minute terminal setae (*f* and *e*) + 1 subterminal ventral spine (*s*) + 2 basally merged terminal ventral spines (*u* + *p* and *v* + *q*) + ω_1 + ω_2 + ω_3 + 1ε; tarsus II similar to tarsus I but without ω_2, ω_3 and ε; genu I solenidion σ' less than 2× as long as σ"; σ on genu III nearly reaching base of tibia III; seta *wa* on tarsi I and II situated closer to *la* and *ra* rather than to ω_1; seta *w* on tarsi III and IV situated at same level with or slightly posterior to *r* rather than far from *r*.

MALE. Ocelli absent; prodorsal shield, comparative lengths of *sce* and *sci*; structure of *scx*, number of *h* and *ps* setae, chaetotaxy of legs I–IV (except tarsi), comparative lengths of σ' and σ" on genu I, size of σ on genu III and position of *w* on tarsi III and IV same as in female. Ventral setae *3a* and *4a* absent. Tarsi I and II (excluding pretarsi) less than 4× as long as their basal width, their apicoventral portion modified into suckers, all setae situated at terminal half; tarsi I–IV with same number of setae as in female but terminal ventral spines *u* fully merged with *p*, and *v* fully merged with *q*, and subterminal ventral spine (*s*) on tarsi I and II indiscernible.

Remarks. Fain (1971) established the genus, *Acalvolia*, based on the deutonymph of *Vidia squamata* Oudemans, 1909. Ten years later, Fain & Knülle (1981) described the adult female, adult male, tritonymph, deutonymph, protonymph and larva of *Acalvolia squamata*, and also provided a detailed definition of adult and deutonymph of the genus.

This genus is very similar to *Psylloglyphus* but can be separated from the latter by having 1 to 3 pairs of small opisthosomal tubercles, having larger idiosoma length (more than 300 μm) and shorter spermathecal duct (not forming 5 or 6 loops) in female. Adults of this genus can also be readily distinguished from those in other genera of the family by the following combination of characters: ocelli absent, femur IV and genu III without setae; genu III with a dorsal solenidion.

Acalvolia americana sp. nov.
(Figs. 1–14, Plates 1–3)

Material examined. Five slides stored in the PANZ (Plant Health & Environment Laboratory, Auckland, New Zealand) insect reference collection were studied. SLIDE 1: holotype female, a paratype female, intercepted on orange (*Citrus sinensis*) from the United States of America (USA), 18 May 2006 (Accession No. 09/2006/2528); SLIDE 2: a paratype male, a paratype tritonymph and a damaged protonymph, intercepted on orange from USA, 7 Apr 2003 (Accession No. 09/2003/1734); SLIDE 3: two paratype females and a paratype male, intercepted on orange from USA, 6 Apr 2009 (Accession No. 09/2009/1785); SLIDE 4: a paratype female, intercepted on orange from USA, 18 May 2005 (Accession No. 09/2005/2986); SLIDE 5: a paratype female, intercepted on orange from USA, 31 Mar. 2010 (Accession No. 09/2010/1820).

The slide with holotype female and a paratype female will be deposited in NZAC (New Zealand Arthropod Collection). Other slides are retained in PANZ.

Diagnosis. FEMALE. Supracoxal setae *scx* smooth, without barbs, tapering from base to tip; ratio *sci*: *sce*= 2.5(2.5–2.8); setae c_1, d_1 and e_1 reaching or overlapping bases of setae in next row; coxal plates II large, extending

far beyond apex of apodeme II, posterior margin concave; spermathecal duct a cylindrical tube, widening as it connects subterminally to spermathecal sac; sclerotised base of spermathecal sac blind ended, U-shaped, a pair of bell-shaped sclerites of oviducts situated at the end of spermathecal sac.

MALE. Supracoxal setae, ratio *sci*: *sce*, comparative length and distances of setae c_1, d_1 and e_1 as in female; aedeagus medially curved, gradually tapering from base to tip; ventro-terminal sucker of tarsi I and II large, extending to bases of *wa*.

Description. FEMALE (n= 5; Figs 1–5, Plate 1).

Idiosomal length 465 (380–465), width at level between coxae II and III 297 (225–297); cuticle without obvious striation. Chelicerae (Fig 3A) robustly chelate, 78 (68–78), movable digit 28 (25–30), cheliceral seta *cha* conical, spiniform, 4 (3–4); subcapitulum (Fig 3B) bearing setae *m*, 23 (22–25); palpal supracoxal seta *elcp* absent; dorsal palptibial seta filiform, 22 (21–27), lateral palptibial seta filiform, 14 (12–15), dorsal palptarsal seta filiform, 9 (7–10), terminal palptarsal solenidion tiny, 4 (3–4).

Dorsum (Fig 1). Prodorsal shield nearly trapezoidal, faintly and evenly punctate, 85 (76–88) long, width at anterior and posterior margins 63 (50–63) and 83 (83–94), respectively; lateral margins of anterior half slightly concave, posterior margin slightly convex. Supracoxal sclerite elongate, duct of supracoxal gland prominent and opens at midway of supracoxal sclerite; Grandjean's organ (Fig 3C) smooth and short, finger-shaped, 6 (5–6); supracoxal setae *scx* (Fig 3C) smooth, setiform, tapering from base to tip, 27 (26–27). Opisthonotal gland openings *gla* closer to e_2 than to d_2. Opisthosoma with three pairs of tiny tubercles, first pair posteriad of h_1, second pair at level of rear end of anus and third pair posteriad of ps_1. External vertical setae *ve* represented by alveoli, distance between them 67 (64–76). All other dorsal idiosomal setae smooth; *vi*, *sci*, c_1, c_2, d_1, e_1, e_2 and h_1 subequal; *sce* obviously longer than *sci*, ratios: *sce*: *sci*= 2.5 (2.5–2.8), *sci–sci*: *sci–sce*= 1.1 (1.1–1.7); setal lengths: *vi* 78 (75–78), *sci* 78 (71–81), *sce* 193 (176–196); distances: *vi–vi* 10, *vi–ve* 48 (42–49), *sci–sci* 38 (32–47), *sci–sce* 34 (27–34). Hysterosomal setae, d_2 about 1.4 (1–1.4)× length of c_1; lengths: c_1 75 (75–100), c_2 84 (77–86), *cp* 135 (125–135), c_3 70 (56–7 (73–100), d_2 103 (100–103), e_1 95 (81–103), e_2 90 (78–96), f_2 68 (61–68), h_1 81 (80–105), h_2 228 (196–260), h_3 absent; distances: c_1–c_1 64 (49–64), c_1–d_1 65 (50–71), d_1–d_1 63 (48–64), d_2–*gla* 85 (62–85), d_1–e_1 75 (63–75), e_1–e_1 75 (64–83).

Venter (Fig 2). Coxal apodemes I joined at midline, forming a prosternal apodeme directed posteromedially; coxal plate I posteriorly extending beyond apex of prosternal apodeme and widely expanded laterally; coxal apodemes II directed posteromedially, plates large, extending far beyond apex of apodeme II, posterior margin concave; sejugal apodeme very faint, a simple suture; epigynal sclerite thickened, just anterior to genital opening; apodemes III and IV directed anteriomedially, apodeme IV medially connected with posterior sclerite of coxa III. Ventral setae *1a* inserted posterolaterad of coxal plate I, *3a* laterad of genital opening, *g* posterior to genital papillae, *4a* posterior to genital opening; lengths: *1a*= 43 (40–44), *3a*= 33 (25–33), *4a*= 30 (28–30), *g*= 30 (23–30). Genital opening inverted V-shaped, situated centrally between coxae III–IV. Anal opening far posterior to genital opening, about as long as genital opening, surrounded by 3 pairs of pseudanal setae, ps_1 3.9 (3.9–4.2)× as long as ps_2 and 4.3 (4.2–5.3)× as long as ps_3, lengths: ps_3= 50 (35–50), ps_2= 55 (44–55), ps_1= 215 (184–220). Copulatory opening posterior to anus (Fig 3D); spermathecal duct a cylindrical tube, widening as it reaches spermathecal sac; sclerotised base of spermathecal sac narrowly U-shaped, a pair of bell-shaped sclerites of oviducts situated at end of spermathecal sac, 4 (4–5).

Leg lengths (I–IV): 205 (172–208), 200 (165–200), 212 (182–230) and 250 (205–257); all setae on trochanters, femora, genua, tibiae and basal two thirds of tarsi smooth and attenuate.

Leg I (Fig 4A). Trochanter I with 8–12 minute teeth on anteromedial edge; femur I 45 (37–51), *vF* filiform, slightly longer (50 (48–54)) than femur I; genu I 35 (28–37), solenidia σ' 38 (32–38), σ'' 58 (56–66); σ'': σ'= 1.5 (1.5–2.1), setae *cG* and *mG* subequal, 35 (33–35) and 33 (30–37), respectively; tibia I 35 (30–35), φ 95 (95–98), *gT* and *hT* subequal, 28 (23–29) and 29 (26–32), respectively; tarsus I (excluding pretarsus, same as below) 69 (64–72) long, about 4.3 (4.1–5.1)× as long as its basal width (16 (14–16)), ω_1 (Fig 5A) parallel sided and gradually tapered at its apex, 19 (16–19) long, ε 5 (4–5), ω_2 6.5 (6–6.5), ω_3 28 (28–33), setae *wa* 47 (40–47), *ra* 27 (25–30), *la* 25 (20–30), *d* 21 (21–25), *e* 6 (5–6), *f* 8 (8–10); ventro-terminal spine *s* 5 (5–6), *u* basally merged with *p*, *v* basally merged with *q*, *u*= *v*= 3 (3–4), *p*= *q*= 5 (4–5); membranous empodium 13 (12–18), claw 6 (5–6).

Leg II (Fig 4B). As in trochanter I, trochanter II also has 8–12 minute teeth on anteromedial edge; femur II 45 (41–49), *vF* 55 (49–56); genu II 33 (28–34), σ 16 (16–22), *cG* 22 (20–26), *mG* 27 (24–30); tibia II 35 (28–35),

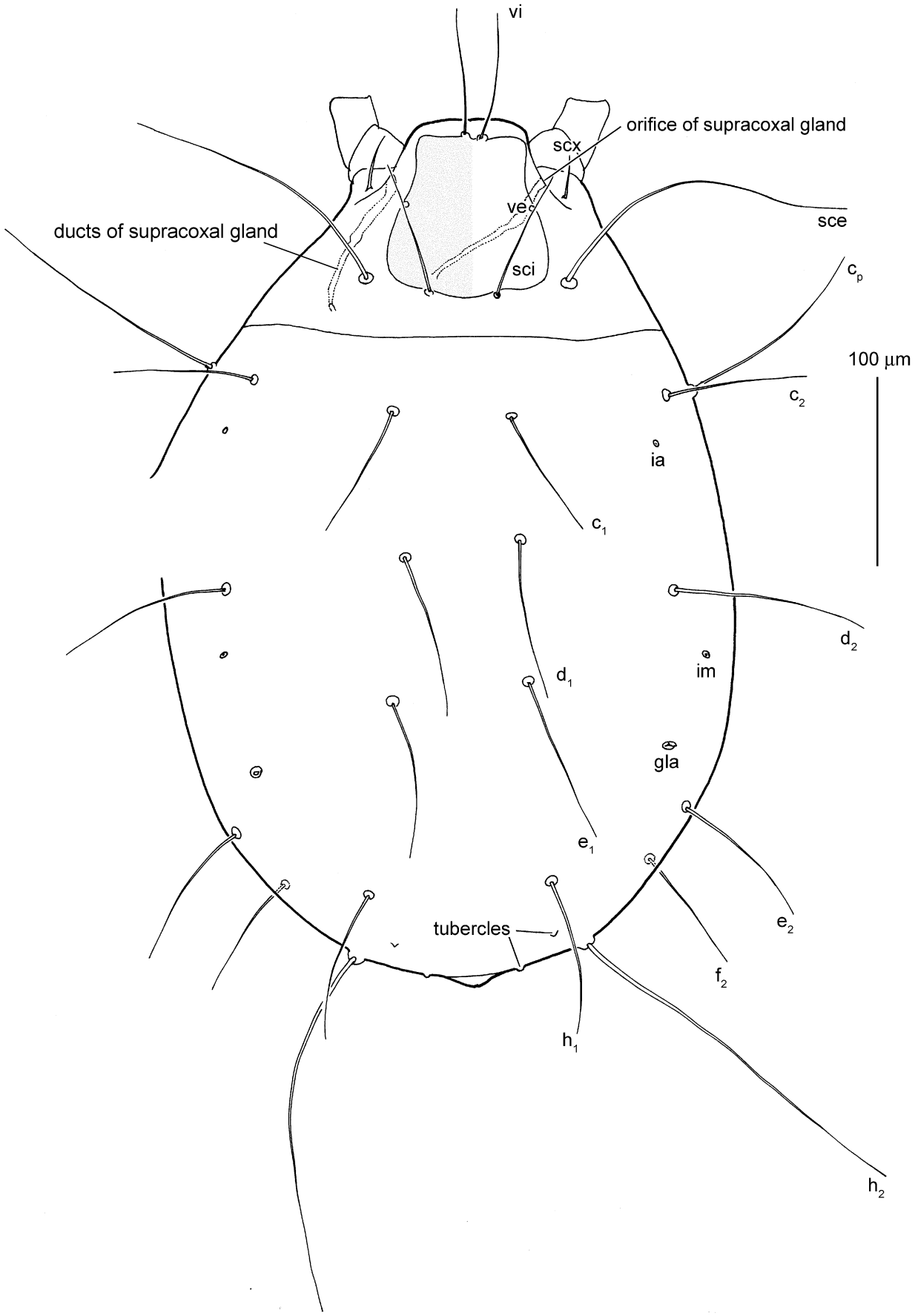

FIGURE 1. *Acalvolia americana* **sp. nov.** (female). Dorsal view of idiosoma.

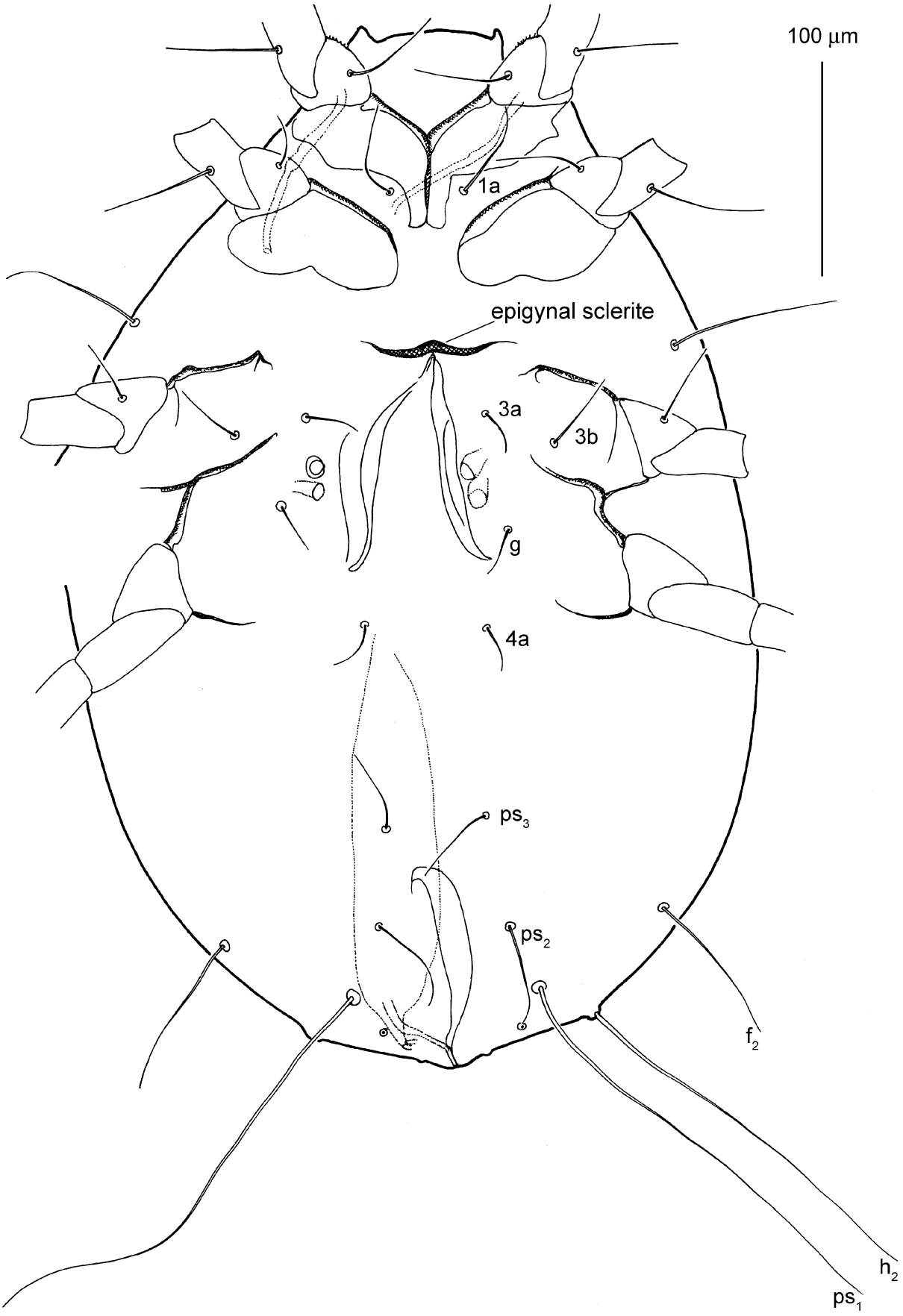

FIGURE 2. *Acalvolia americana* **sp. nov.** (female). Ventral view of idiosoma.

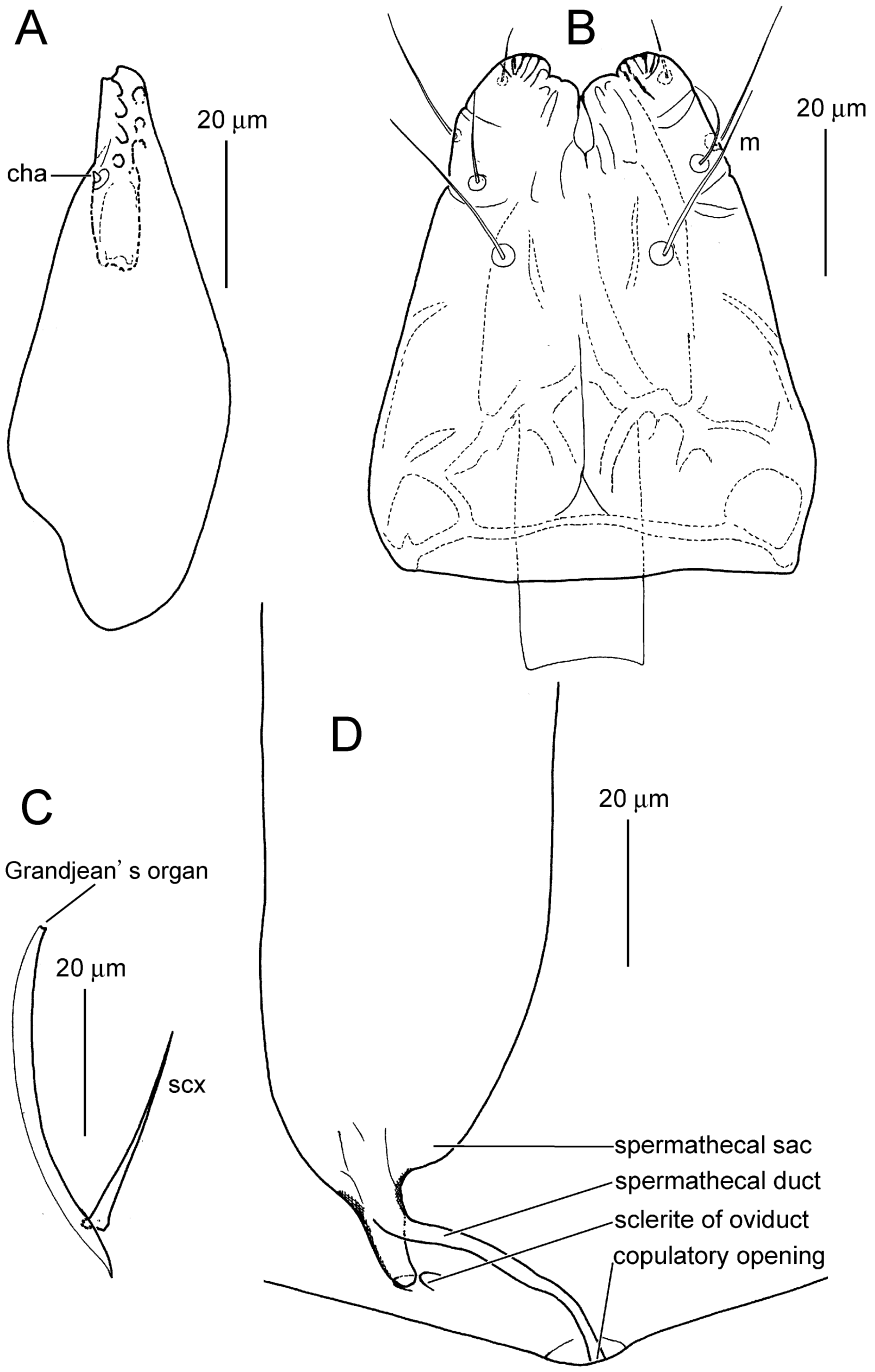

FIGURE 3. *Acalvolia americana* **sp. nov.** (female). **A,** ventral view of chelicera; **B,** subcapitulum; **C,** supracoxal sclerite, supracoxal seta *scx* and Grandjean's organ; **D,** copulatory opening and spermatheca.

φ whip-like, 126 (105–127), *gT* 27 (23–32), *hT* 25 (20–25); tarsus II 67 (61–71) long, about 4.5 (4.0–5.1)× as long as its basal width (15 (14–17)); ω parallel sided and gradually tapered at its apex, 19 (19–20) long, *wa* 44 (37–44), *ra* 28 (24–32), *la* 25 (23–27), *d* 33 (29–35), *e* 5 (4–5), *f* 7 (6–8), *s* 5 (4–5), *u* basally merged with *p*, *v* basally merged with *q*, *u*= *v*= 3 (3–4), *p*= *q*= 5 (4–5), empodium 13 (11–16), claw 6 (5–6).

Leg III (Fig 4C). Femur III 42 (35–44); genu III 31 (26–32), σ 10, *nG* absent; tibia III 33 (28–37), φ whip-like, 117 (96–117), *kT* 36 (28–36); tarsus III 82 (73–82) long, 13 (12–15) wide at base, ratio length: width= 6.3 (5.4–6.3), *w* 39 (30–39), *r* 19 (15–18), *d* 48 (37–48), *e* 3 (3–4), *f* 4 (4–6), *s* 5 (4–5), *u* basally merged with *p*, *v* basally merged with *q*, *u*= *v*= 2 (2–3), *p*= *q*= 4, empodium 14 (12–16), claw 6 (5–6).

Leg IV (Fig 4D). Femur IV 47 (41–50), *wF* absent; genu IV 35 (30–39); tibia IV 36 (31–37), φ whip-like, 114

(98–117), *kT* 38 (34–40); tarsus IV 97 (91–198) long, 15 (13–17) wide at segment base, ratio length: width= 6.5 (5.8–7.4), *w* 33 (30–37) long, *r* 20 (18–22) long, *d* 44 (44–51), *e* and *f* absent, *s* 5 (5–6), *u* basally merged with *p*, *v* basally merged with *q*, *u*= *v*= 2, *p*= *q*= 4 (4–5), empodium 15 (12–16), claw 6 (6–6.5).

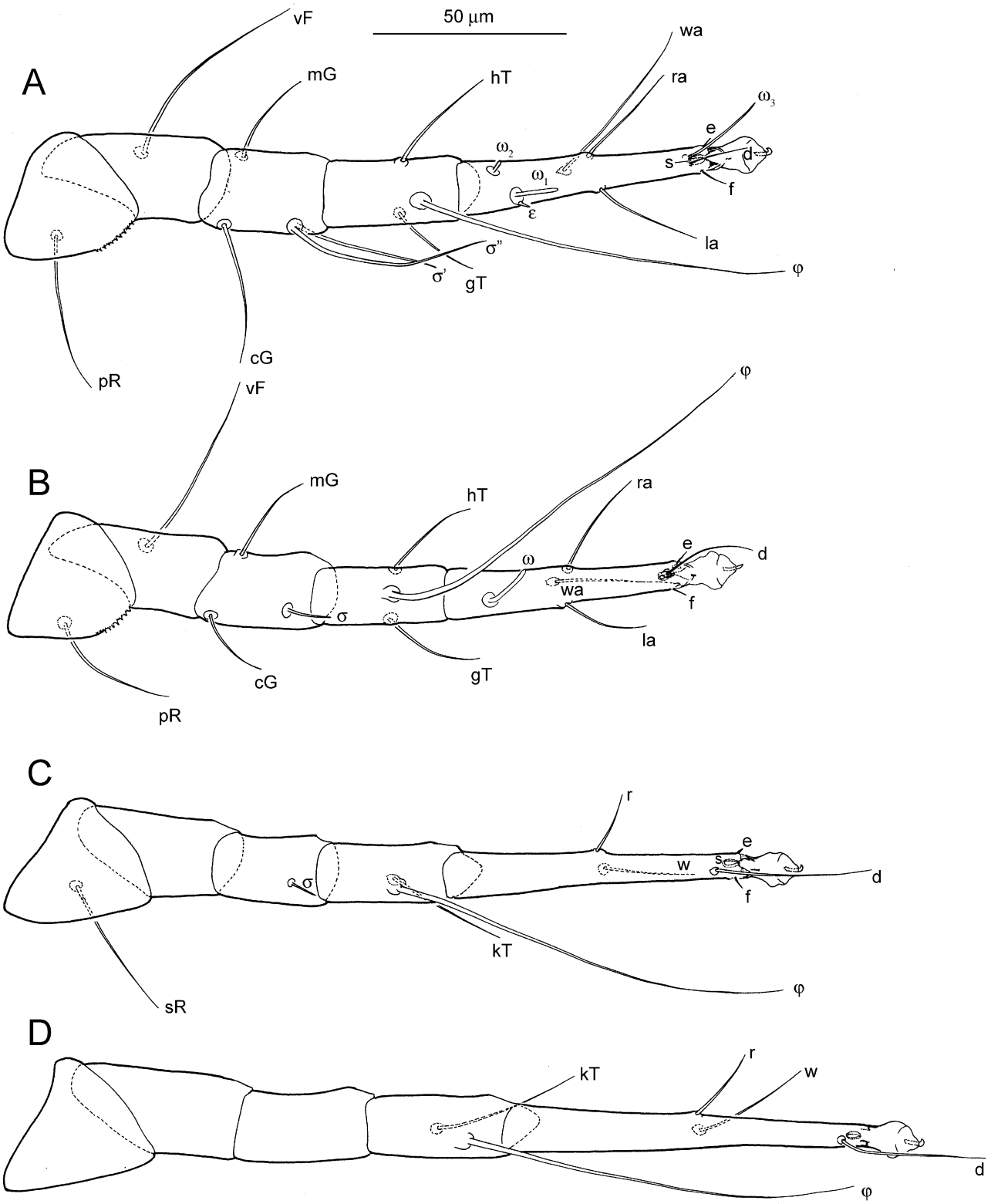

FIGURE 4. *Acalvolia americana* **sp. nov.** (female). **A,** leg I; **B,** leg II; **C,** leg III; **D,** leg IV.

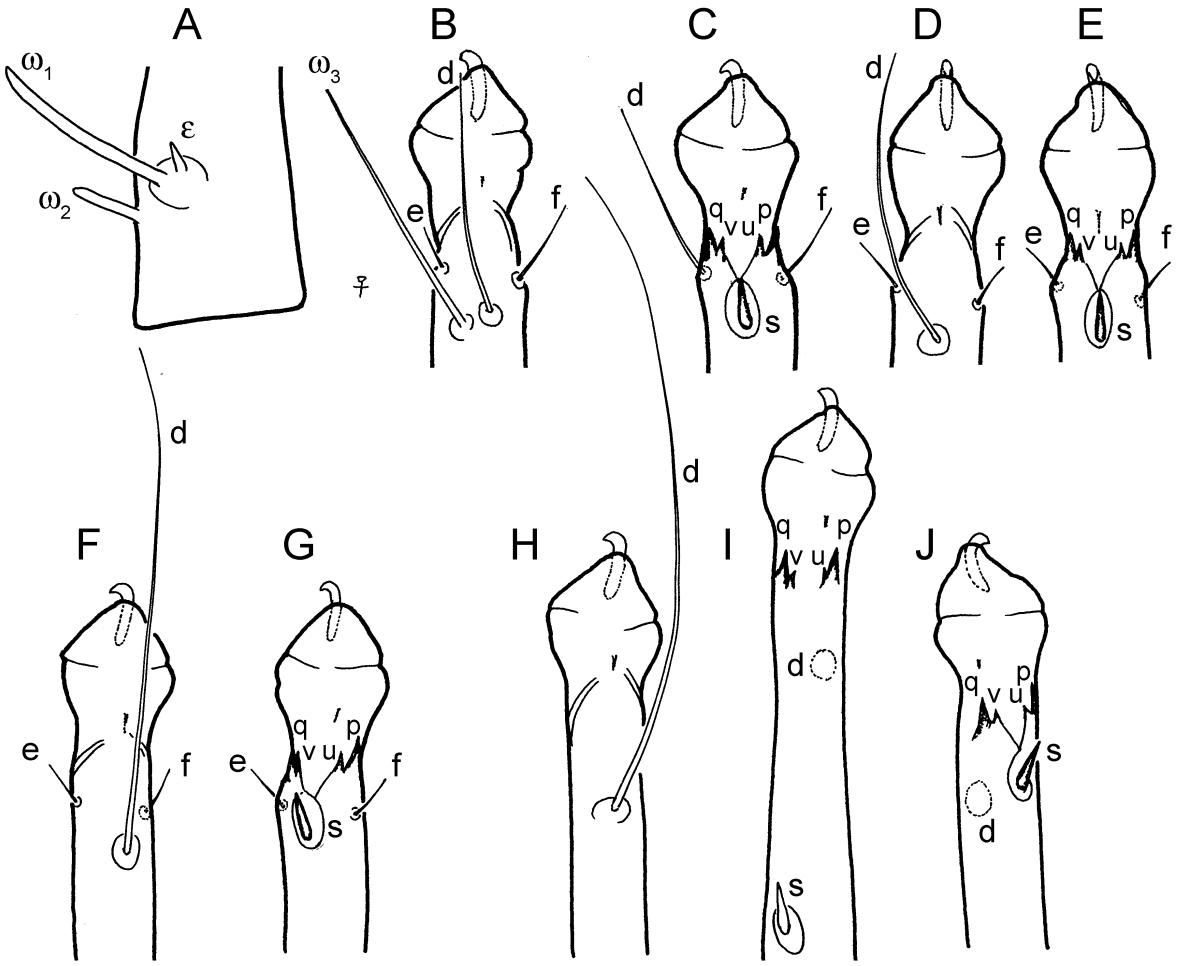

FIGURE 5. *Acalvolia americana* **sp. nov.** (female). **A,** solenidia and famulus of tarsus I; **B,** dorsal view of terminal part of tarsus I; **C,** ventral view of terminal part of tarsus I; **D,** dorsal view of terminal part of tarsus II; **E,** ventral view of terminal part of tarsus II; **F,** dorsal view of terminal part of tarsus III; **G,** ventral view of terminal part of tarsus III; **H,** dorsal view of terminal part of tarsus IV; **I** and **J,** ventral view of terminal part of tarsus IV (indicating the variation in the position of conical seta *s*).

MALE (n= 2; Figs. 6–10, Plate 2)

Idiosomal length 350 (326–350), width at level between coxae II and III 205; cuticle without obvious striation. Chelicerae (Fig 8A) robustly chelate, 75 (64–75), movable digit 28 (27–28), cheliceral seta *cha* conical, spiniform, 4; subcapitulum (Fig 8B) bearing a pair of subcapitular setae *m*, 23; palpal supracoxal seta *elcp* normally at dorso-lateral sides absent; dorsal palptibial seta filiform, 15 (12–15) long, lateral palptibial seta filiform, 14 (13–14), dorsal palptarsal seta filiform, 11, terminal palptarsal solenidion tiny, 4.

Dorsum (Fig 6). Prodorsal shield as in female, faintly punctate, with posterior half wider than anterior half, 75 (75–76) long, width at anterior and posterior margins 59 and 86, respectively; Supracoxal sclerite elongate, duct of supracoxal gland prominent and opens at midway of supracoxal sclerite; Grandjean's organ (Fig 8C) smooth and short, finger-shaped, 4 long; supracoxal setae *scx* smooth, setiform, tapering from base to tip, 28 (27–28). Opisthonotal gland openings *gla* closer to e_2 than to d_2. One pair of tiny tubercles posteriad of h_1. External vertical setae *ve* represented by alveoli, distance between them 72. All other dorsal idiosomal setae filiform, without barbs; *sce* about 2.5 (2.5–2.7)× as long as *sci*; distance *sci–sci* 1.5× as wide as *sci–sce*; lengths: *vi* 66 (66–69), *sci* 72 (67–72), *sce* 181 (181–182); distances: *vi–vi* 9, *sci–sci* 39 (37–39), *sci–sce* 25. Hysterosomal setae, d_2 about 1.2× length of c_1; lengths: c_1 75 (69–75), c_2 74 (74–76), *cp* 117 (110–117), c_3 54 (44–54), d_1 (69), d_2 89 (81–89), e_1 80 (80–81), e_2 84 (78–84), f_2 67 (67–71), h_1 78 (74–78), h_2 235 (232–235), h_3 absent; distances: c_1–c_1 41 (41–44), c_1–d_1 54, d_1–d_1 45 (30–45), d_2–*gla* 55 (54–55), d_1–e_1 40 (40–44), e_1–e_1 57 (44–57).

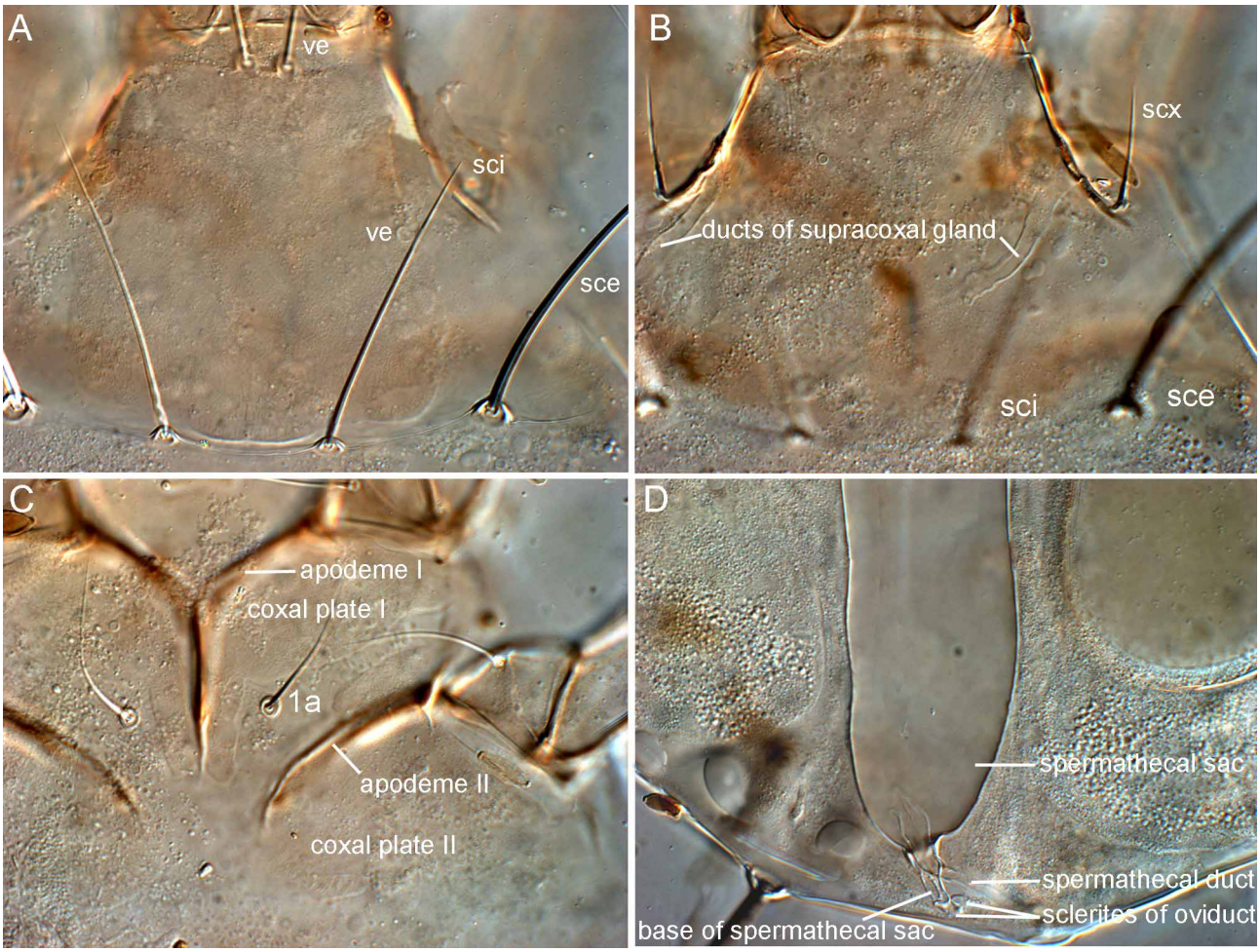

PLATE 1. *Acalvolia americana* **sp. nov.** (female). **A,** prodorsal shield; **B,** supracoxal setae and ducts of supracoxal gland; **C,** coxae I and II; **D,** copulatory opening and spermatheca.

Venter (Figs 7 and 8). Coxal apodemes I joined at midline as in female; coxal plates II larger than those in female, their posterior edges rounded, nearly reaching sejugal suture, sejugal apodeme represented by a simple suture; epigynal sclerite thickened, inverted U-shaped, its anterior rim contiguous with medial part of apodemes IV which is medially fused together. Ventral setae *3a* and *4a* absent, genital setae *g* anterior to genital papillae; lengths: *1a*= 32 (30–32), *g*= 30 (27–30). Genital opening situated between coxae IV, aedeagus (Figs 8D and 8E) gradually tapering from base to tip and medially curved. Anal opening surrounded by 3 pairs of pseudanal setae, about 1.3× as long as distance between anterior rim of anus and posterior end of basal region of aedeagus: pseudanal setae ps_1 4.2× as long as ps_2 and 4.0 (4.0–4.6)× as long as ps_3, lengths: ps_3= 43 (37–43), ps_2= 41 (41–42), ps_1= 172.

Legs I and II slightly thicker than legs III and IV, tarsi I and II obviously shorter than those in female, each bearing a subterminal ventral sucker; lengths of legs I–IV: 165 (165–167), 165 (165–171), 202 (181–202) and 210 (198–210); all setae on trochanters, femora, genua and tibiae smooth and attenuate.

Leg I (Figs 9A and 10A, B). Trochanter I with 8–12 minute teeth on anteromedial edge; femur I 42 (42–44), *vF* filiform, 53 (47–53); genu I 30, solenidia σ' 37 (34–37), σ'' 55 (55–56); σ'': σ'= 1.5 (1.5–1.6), setae *cG* 35 (34–35), *mG* 31 (27–31); tibia I 32, φ 100 (100–102), *gT* 27 (25–27), *hT* 25 (20–25); tarsus I 45 (44–45), about 2.3 (2.3–2.6)× as long as its basal width (20 (17–20)), ω_1 parallel sided and gradually tapered at its apex, 18 (17–18) long, ε 4, ω_2 8 (7–8), ω_3 28 (28–32), setae *wa* 25 (25–30), *ra* 20, *la* 20, *d* 24 (22–24), *e* 6 (6–7), *f* 10; ventro-terminal sucker large, extending to base of *wa*, spine *s* indiscernible, *u* fully merged with *p*, *v* basally merged with *q*, about 4 (3.5–4) in length; membranous empodium 15, claw 5.5 (5.5–6).

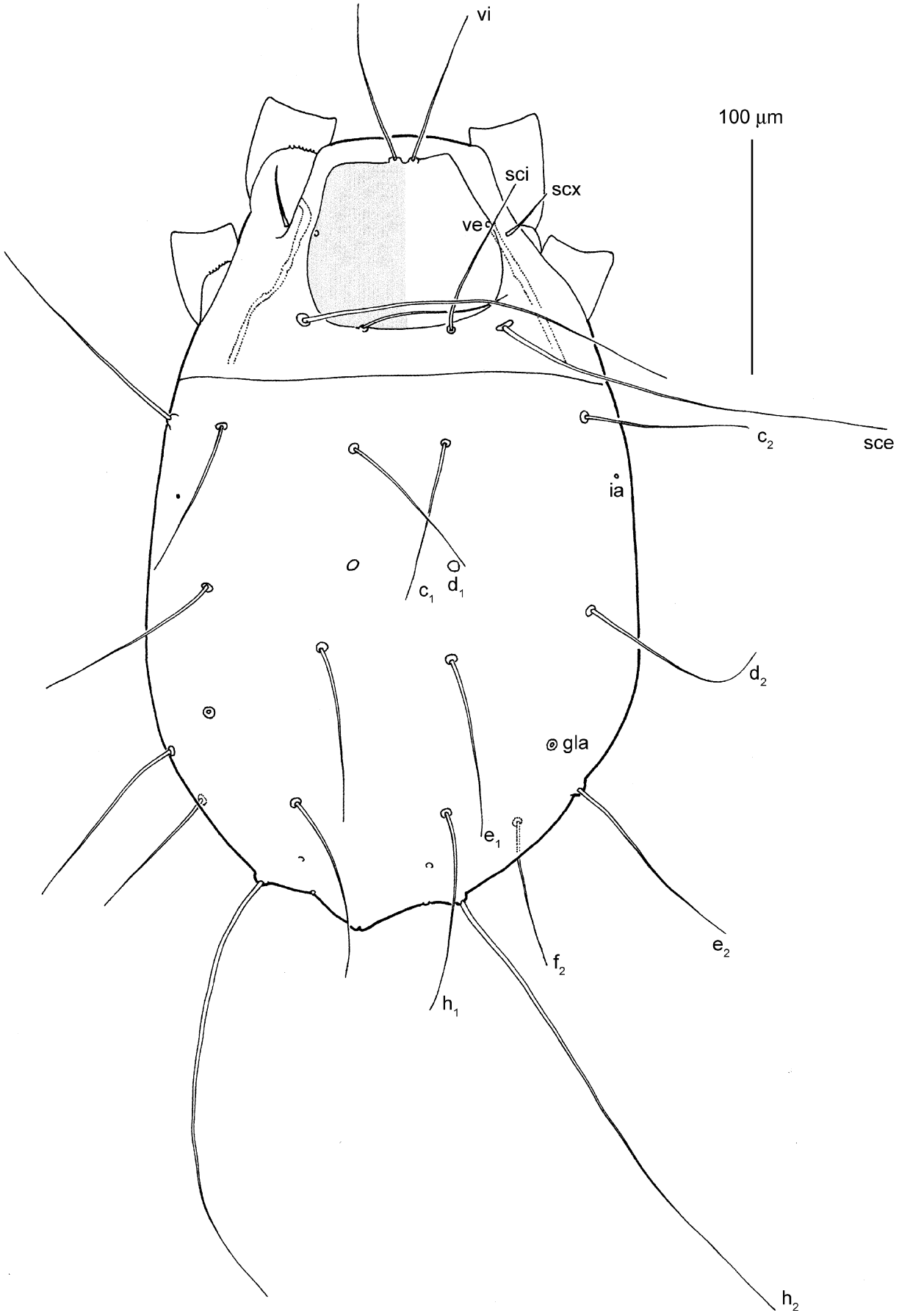

FIGURE 6. *Acalvolia americana* **sp. nov.** (male). Dorsal view of idiosoma.

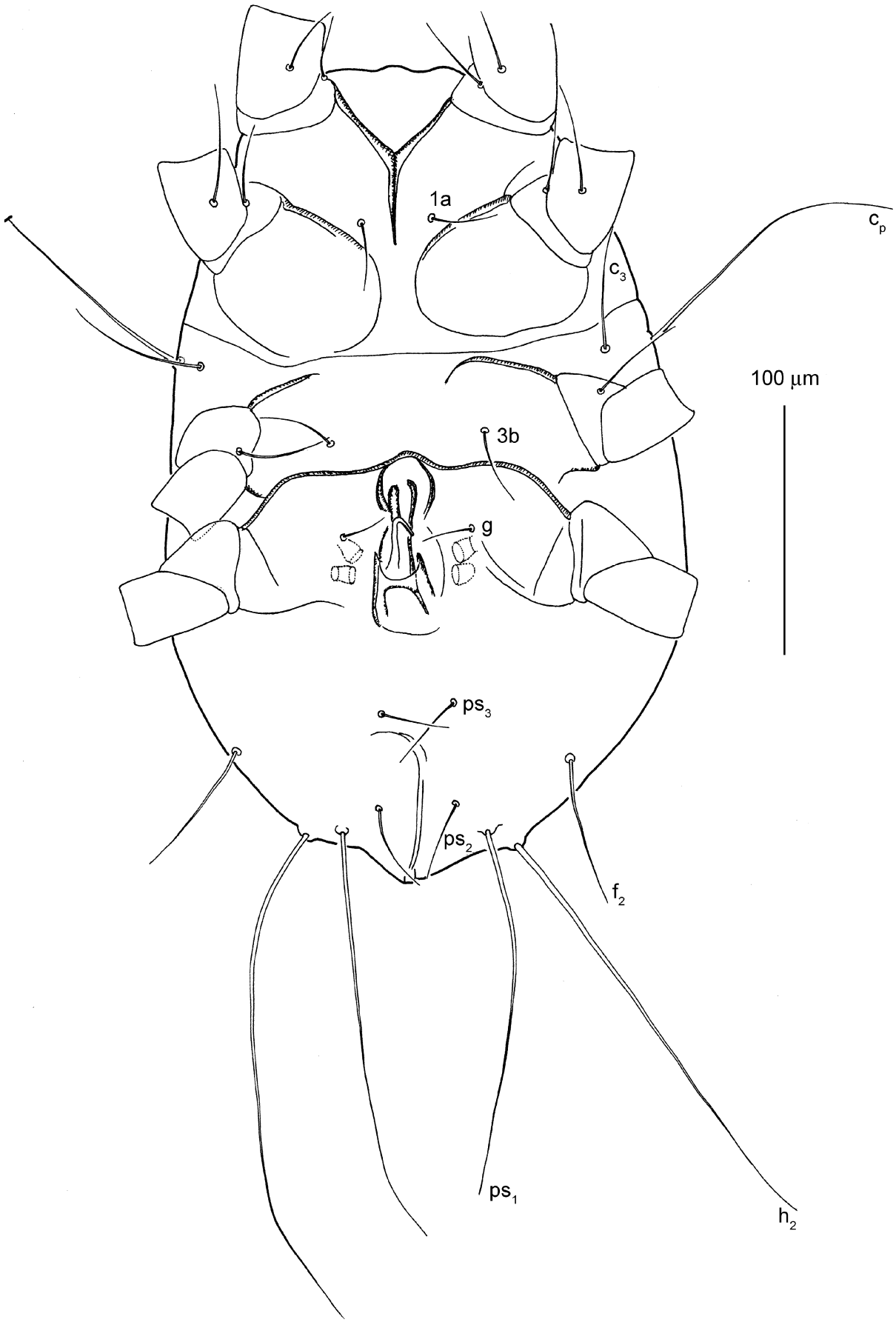

FIGURE 7. *Acalvolia americana* **sp. nov.** (male). Ventral view of idiosoma.

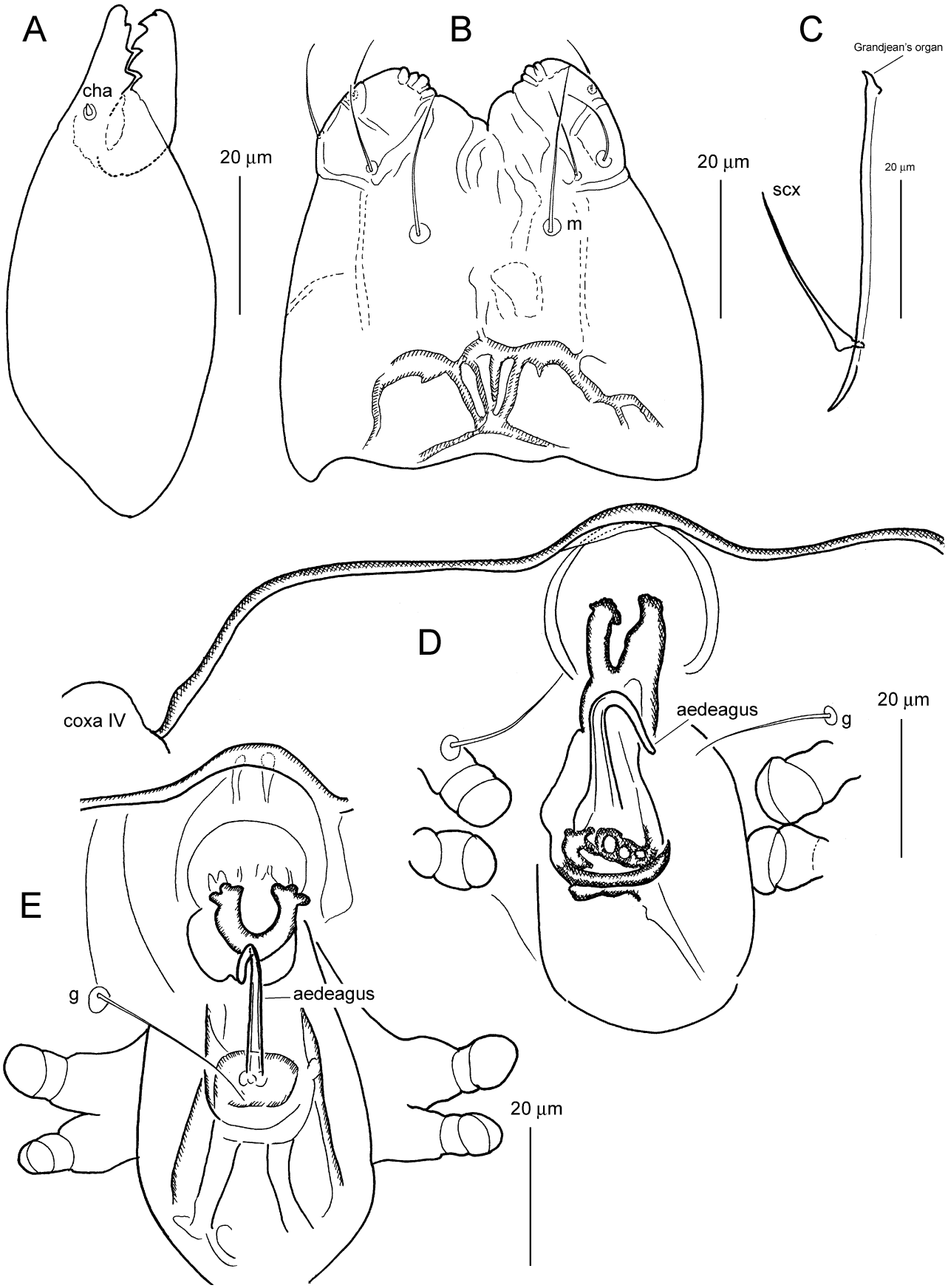

FIGURE 8. *Acalvolia americana* **sp. nov.** (male). **A,** ventral view of chelicera; **B,** subcapitulum; **C,** supracoxal sclerite, supracoxal seta *scx* and Grandjean's organ; **D,** aedeagus and apodeme IV; **E,** variation of aedeagus.

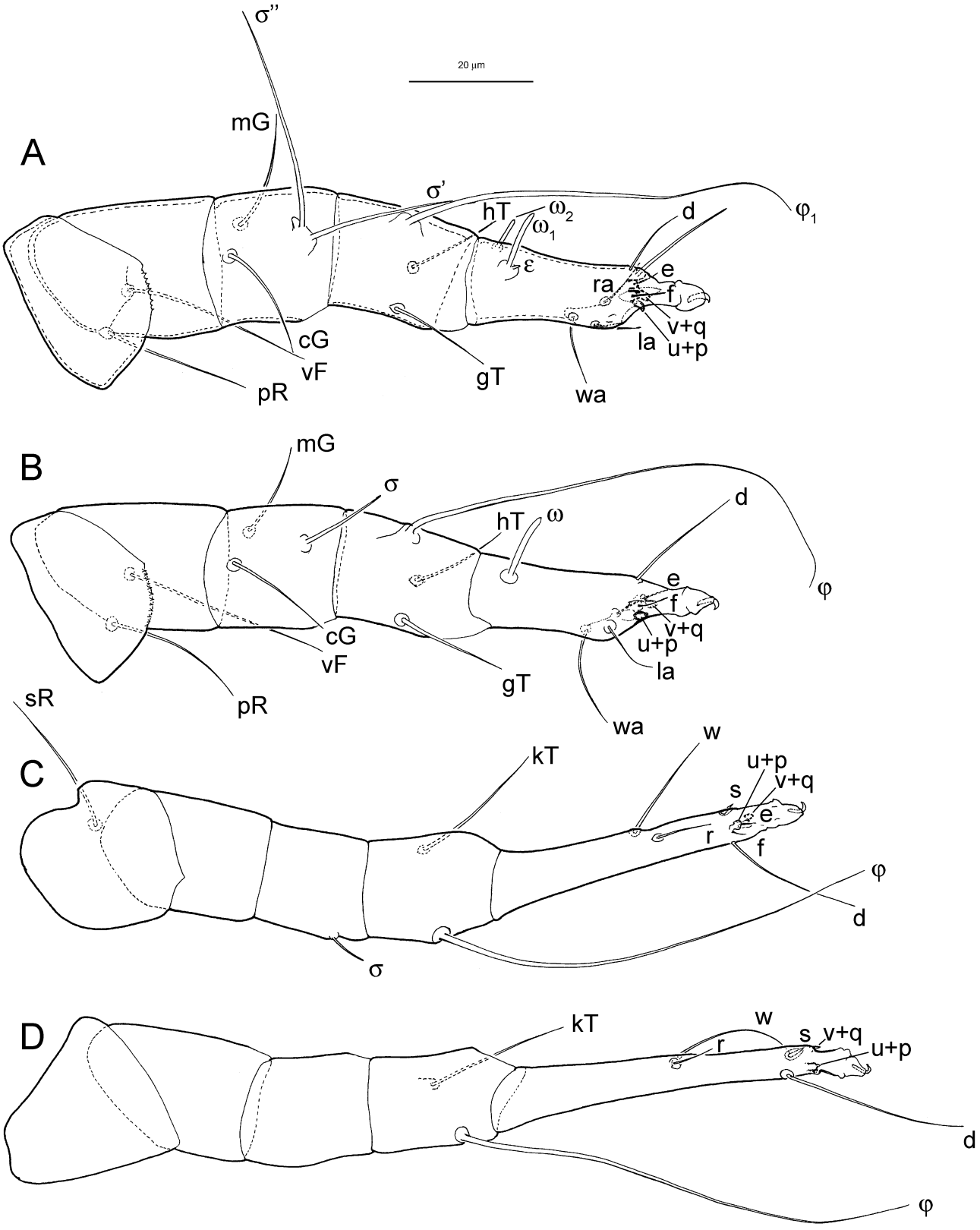

FIGURE 9. *Acalvolia americana* **sp. nov.** (male). **A,** leg I; **B,** leg II; **C,** leg III; **D,** leg IV.

Leg II (Figs 9B and 10C–E). Trochanter II with 8–12 minute teeth as in trochanter I; femur II 42 (42–44), *vF* 43 (42–43); genu II 32 (32–34), σ 22 (20–22), *cG* 30 (23–30), *mG* 19 (19–20); tibia II 32 (32–33), φ whip-like, 112 (112–124), *gT* 27 (23–27), *hT* 26 (22–26); tarsus II 43 long, about 2.5 (2.5–2.8)× as long as its basal width (17

(15–17)); ω parallel sided and gradually tapered at its apex, 17 (15–17) long, *wa* 26 (26–29), *ra* 21 (18–21), *la* 21 (17–21), *d* 37 (35–37), *e* 4 (4–5), *f* 8; ventro-terminal sucker large, extending to base of *wa*, spine *s* indiscernible , *u* fully merged with *p* and *v* basally merged with *q*, about 4 (3.5–4) in length; membranous empodium 16 (15–16), claw 5.5 (5.5–6).

Leg III (Figs 9C and 10F, G). Femur III nude, 42 (35–42); genu III 27 (25–27), σ 10 (9–10), *nG* absent; tibia III 31 (30–31), φ whip-like, 119 (114–119), *kT* 34 (34–35); tarsus III 69 (69–72) long, 15 wide at base, ratio length: width= 4.6, *w* 35 (33–35), *r* 15 (11–15), *d* 45 (45–46), *e* 3, *f* 4, *s* 4, *u* fully merged with *p* and *v* with *q*, about 4.5 (4–4.5) in length, empodium 14 (12–14), claw 5.5 (5.5–6).

Leg IV (9D and 10H, I). Femur IV nude, 45 (42–45); genu IV nude, 30 (23–30); tibia IV 29 (29–31), φ whip-like, 120 (120–129), *kT* 40 (39–40); tarsus IV 77 (72–82) long, 15 wide at segment base, ratio length: width= 5.1 (5.1–5.5), *w* 36 (36–40) long, *r* 14 (13–14) long, *d* 51 (44–51), *e* and *f* absent, *s* 4 (3–4), *u* fully merged with *p*, *v* with *q*, about 4 (3–4) in length, empodium 12 (11–12), claw 5.5 (5.5–6).

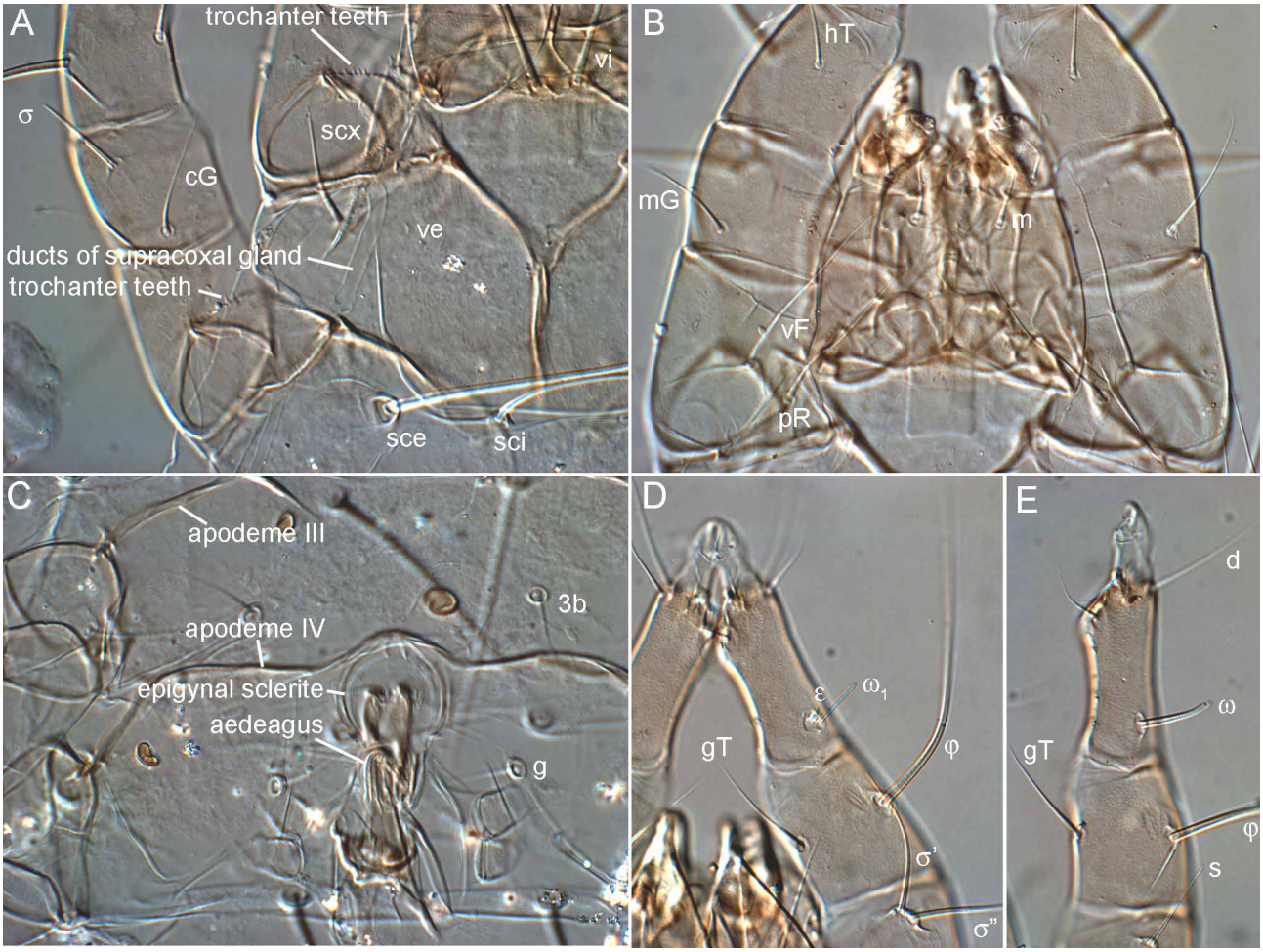

PLATE 2. *Acalvolia americana* **sp. nov.** (male). **A,** prodorsal shield and supracoxal setae; **B,** subcapitulum; **C,** genital area; **D,** tibia and tarsus of leg I; **E,** tibia and tarsus of leg II.

TRITONYMPH (n= 1; Figs. 11–14)

Idiosomal length 241, width at level between coxae II and III 156; cuticle without obvious striation. Chelicerae (Fig 13A) robustly chelate, 54, movable digit 20, cheliceral seta *cha* conical, spiniform, 3; subcapitulum (Fig 13B) bearing a pair of subcapitular setae *m*, 24; palpal supracoxal seta *elcp* normally at dorso-lateral sides absent; dorsal palptibial seta filiform, 18 long, lateral palptibial seta filiform, 12, dorsal palptarsal seta filiform, 7, terminal palptarsal solenidion tiny, 2.5.

Dorsum (Fig 11). Prodorsal shield indiscernible. Supracoxal setae *scx* smooth, setiform, tapering from base to tip, 24. Opisthonotal gland openings *gla* very close to e_2. Opisthosomal tubercles perceptible. External vertical

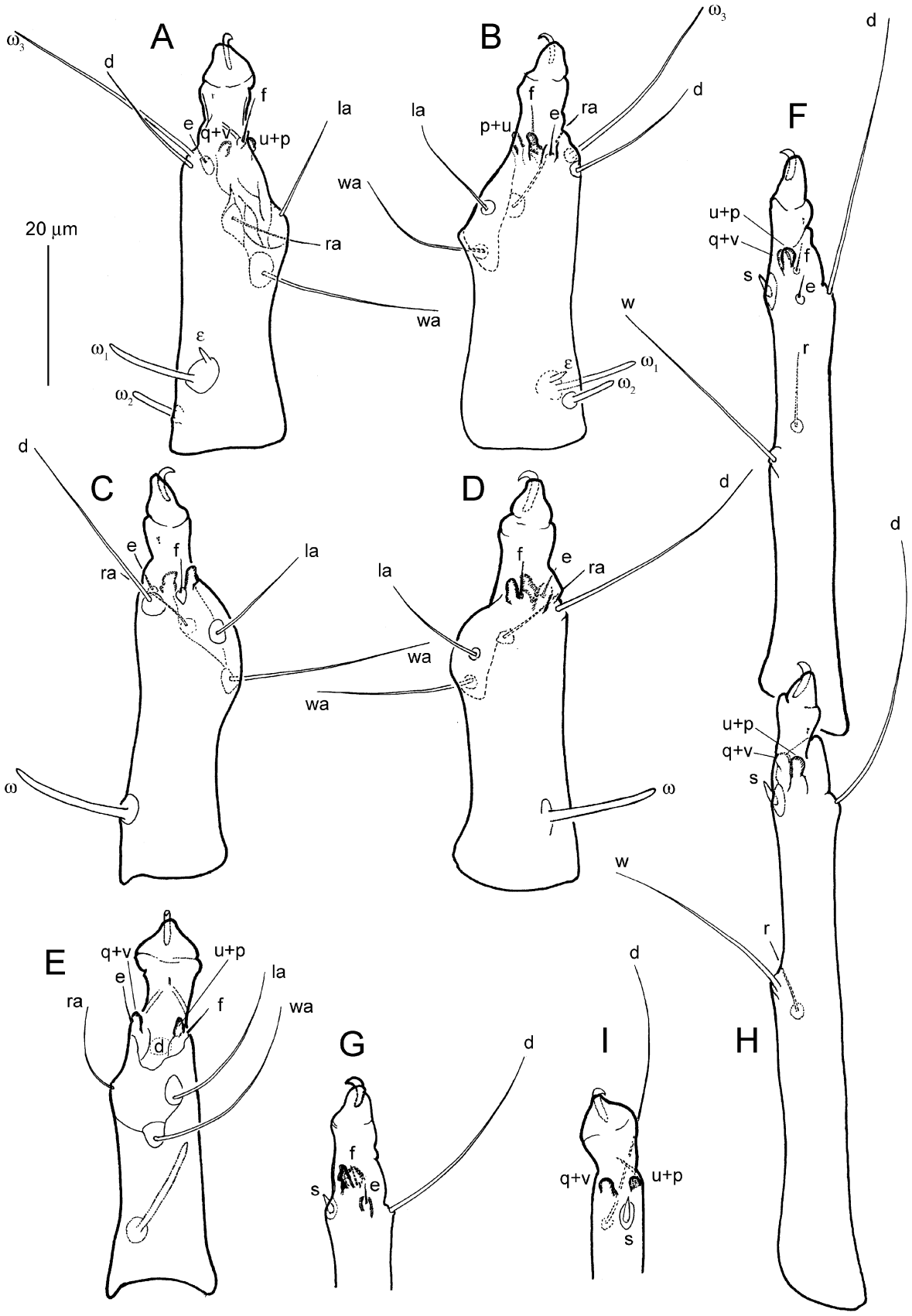

FIGURE 10. *Acalvolia americana* **sp. nov.** (male). **A,** left tarsus I; **B,** right tarsus I; **C,** left tarsus II; **D,** right tarsus II; **E,** ventral view of tarsus II; **F,** right tarsus III; **G,** ventral view of terminal part of tarsus III; **H,** right tarsus IV; **I,** ventral view of terminal part of tarsus IV.

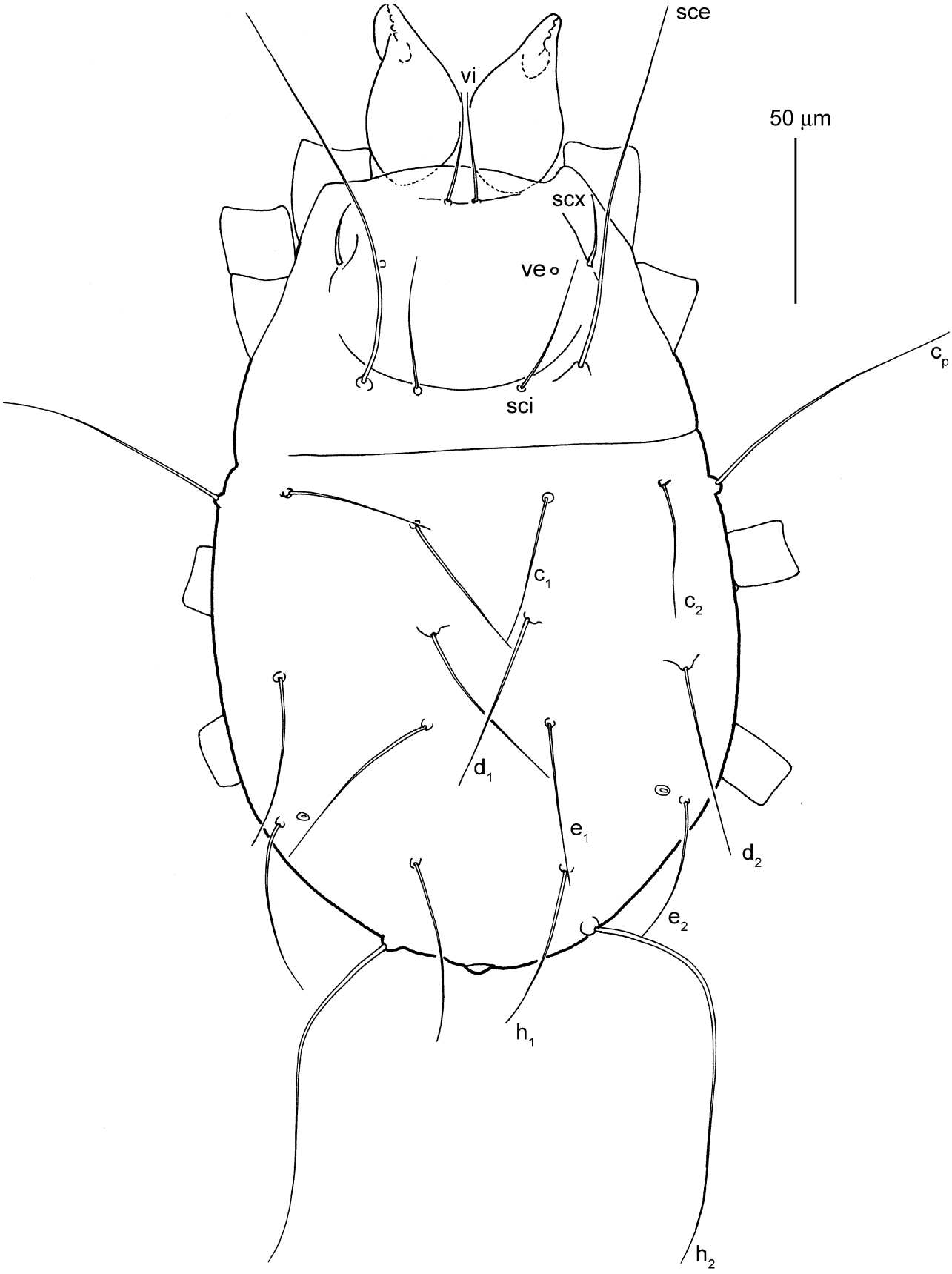

FIGURE 11. *Acalvolia americana* **sp. nov.** (tritonymph). Dorsal view of idiosoma.

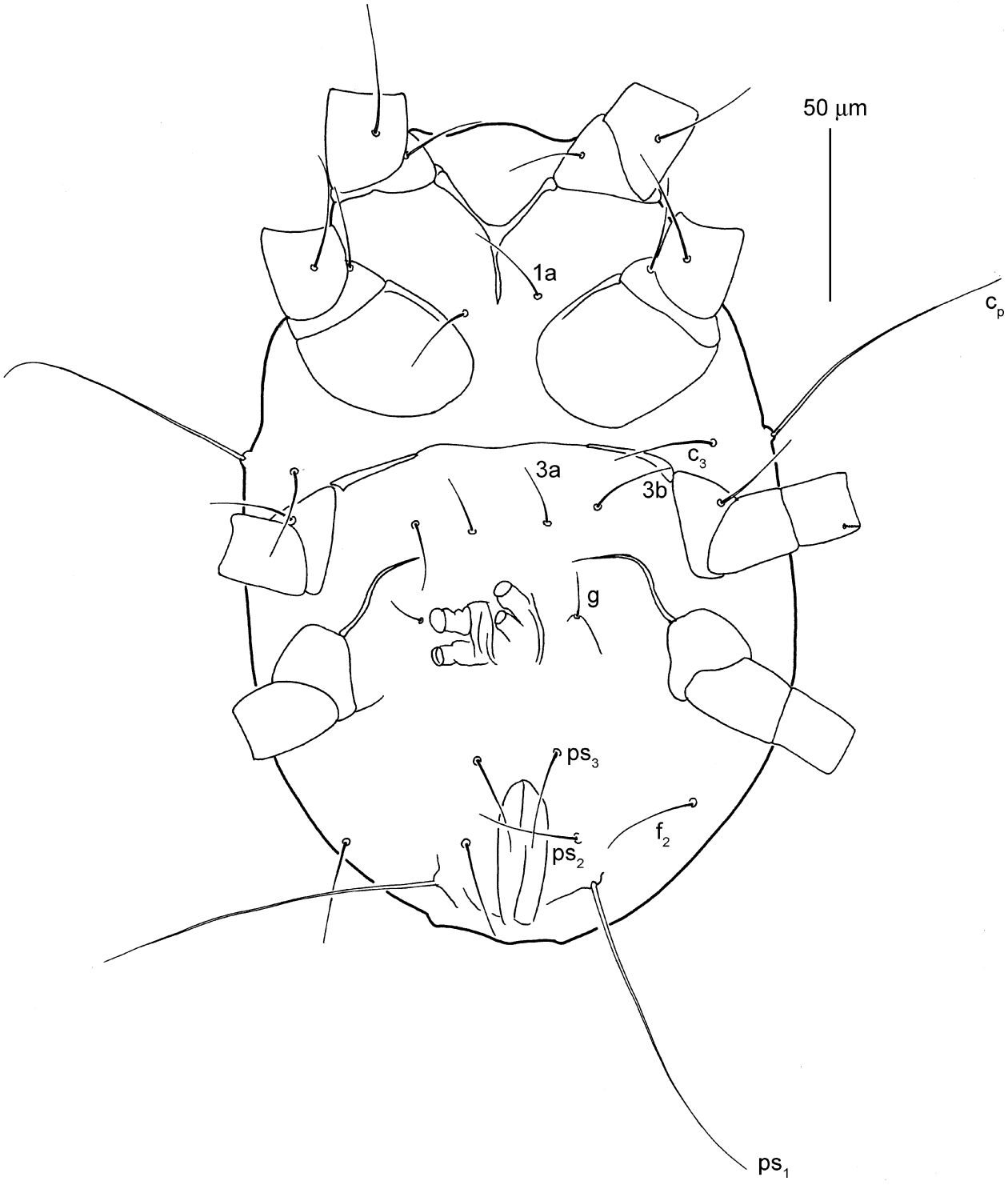

FIGURE 12. *Acalvolia americana* **sp. nov.** (tritonymph). Ventral view of idiosoma.

setae *ve* represented by alveoli, distance between them 63. All dorsal idiosomal setae (except *ve*) smooth, *vi*, *sci*, c_1, c_2, d_1, e_1, e_2 and h_1 subequal; *sce* obviously longer than *sci*, ratios: *sce*: *sci* = 3.1, *sci–sci*: *sci–sce* = 1.8; lengths: *vi* 55, *sci* 48, *sce* 147; distances: *vi–vi* 7, *sci–sci* 33, *sci–sce* 18. Hysterosomal setae, d_2 about 1.3× length of c_1; lengths: c_1 50, c_2 51, *cp* 77, c_3 44 d_1 58, d_2 64, e_1 55, e_2 52, f_2 34, h_1 54, h_2 146, h_3 absent; distances: c_1–c_1 33, c_1–d_1 30, d_1–d_1 30, d_2–*gla* 38, d_1–e_1 34, e_1–e_1 38

Venter (Figs 12 and 13c). Coxal apodemes I joined at midline, forming a prosternal apodeme directed posteromedially; coxal apodemes II directed posteromedially, plates large, extending far beyond apex of apodeme

II, posterior margin convex; epigynal sclerite absent; apodemes III and IV directed medially, apodeme IV not connected with posterior sclerite of coxa III. Ventral *3a* anteriorad of genital opening, *g* at same level with anterior pair of genital papillae (Fig 13C), *4a* absent; lengths: *1a*= 21, *3a*= 29, *g*= 23. Genital opening a longitudinal slit, situated between coxae IV. Anal opening surrounded by 3 pairs of pseudanal setae, ps_1 4.4× as long as ps_2 and 4.0× as long as ps_3, lengths: ps_3= 35, ps_2= 32, ps_1= 141. Copulatory opening and spermathecal duct absent.

Legs lengths (I–IV): 130, 129, 128 and 149; all setae on trochanters, femora, genua, tibiae and basal two thirds of tarsi smooth and attenuate.

Leg I (Figs 14A and 13D). Trochanter I with 8–12 minute teeth on anteromedial edge; femur I 31, *vF* filiform, longer (45) than femur I; genu I 21, solenidia σ' 23, σ'' 41; σ'': σ'= 1.8, setae *cG* 29, *mG* 24; tibia I 22, φ 73, *gT* and *hT* subequal, 23 and 25, respectively; tarsus I 47 long, about 3.1× as long as its basal width (15), ω_1 parallel sided and tapered at its apex, 15 long, ε 3.5, ω_2 6, ω_3 27, setae *wa* 33, *ra* 17, *la* 19, *d* 19, *e* 3, *f* 6; ventro-terminal spine *s*, 4.5, *u* basally merged with *p* and *v* basally merged with *q*, about 3 long; membranous empodium 10, claw 4.5.

Leg II (Figs 14B and 13E). Trochanter II also has 8–12 minute teeth on anteromedial edge; femur II 27, *vF* 41; genu II 23, σ 15, *cG* 21, *mG* 16; tibia II 23, φ whip-like, 95, *gT* 15 *hT* 24; tarsus II 43 long, about 3.3× as long as its basal width (13); ω parallel sided and gradually tapered at its apex, 18 long, *wa* 29 *ra* 16, *la* 16, *d* 18, *e* 3, *f* 6, *s* 4, *u* basally merged with *p* and *v* basally merged with *q*, about 3 long, empodium 11, claw 5.5.

Leg III (Fig 14C and 13F). Femur III 25; genu III 21, σ 7, *nG* absent; tibia III 21, φ whip-like, 88, *kT* 24; tarsus III 51 long, 12 wide at base, length: width= 4.3, *w* 20, *r* 11, *d* 30, *e* 2.5, *f* 3, *s* 4, *u* basally merged with *p* and *v* basally merged with *q*, about 3.5 long, empodium 9, claw 5.

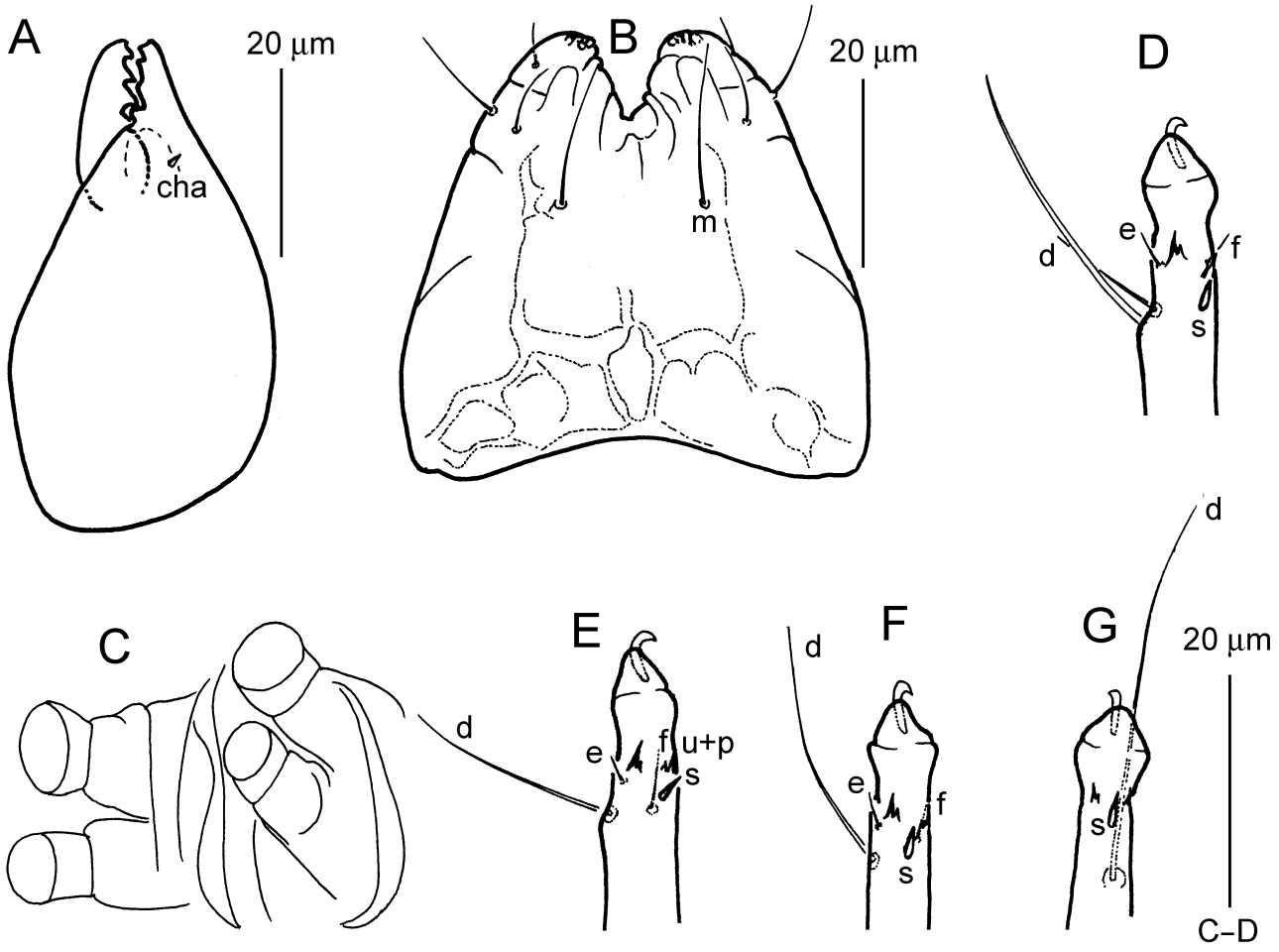

FIGURE 13. *Acalvolia americana* **sp. nov.** (tritonymph). **A,** ventral view of chelicera; **B,** subcapitulum; **C,** genital area; **D,** ventral view of terminal part of tarsus I; **E,** ventral view of terminal part of tarsus II; **F,** ventral view of terminal part of tarsus III; **G,** ventral view of terminal part of tarsus IV.

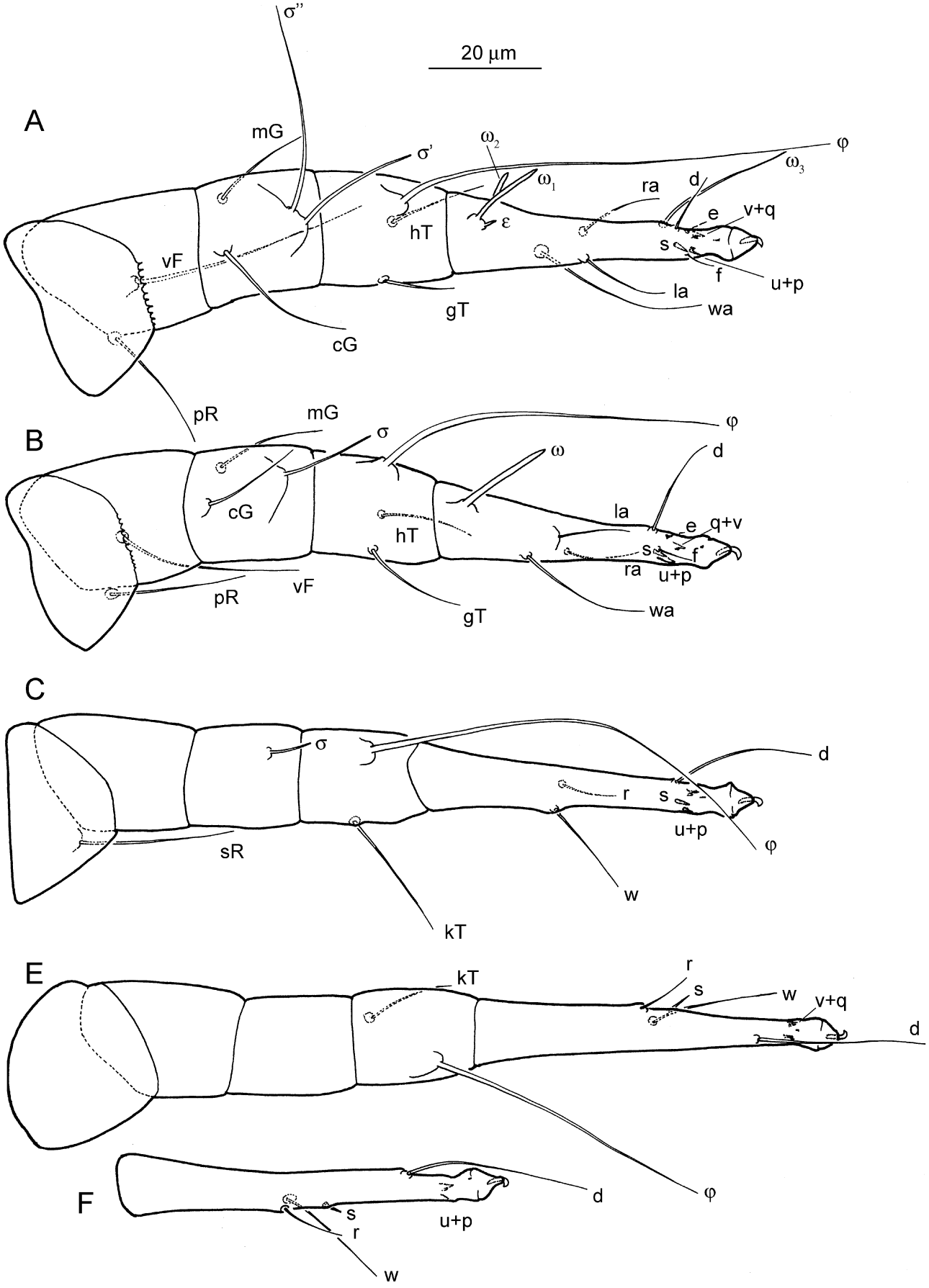

FIGURE 14. *Acalvolia americana* **sp. nov.** (tritonymph). **A,** leg I; **B,** leg II; **C,** leg III; **D,** leg IV; **E,** right tarsus IV.

Leg IV (Fig 14D and 13G). Femur IV 29, *wF* absent; genu IV 21; tibia IV 21, φ whip-like, 54, *kT* 19; tarsus IV 58 long, 12 wide at segment base, length: width= 4.8, *w* 17, *r* 14, *d* 31, *e* and *f* absent, *s* positioned close to midventral seta *w*, 3 long, *u* basally merged with *p* and *v* basally merged with *q*, *u*= *v*= 3, *p*= *q*= 2, empodium 9, claw 4.5.

EGG (n= 9; Plate 3)

Elongate-oval in shape, 136.5 (124.9–139.7) long, about 2.2 (1.9–2.2)× of width (61.3 (61.0–72.3)); shell of newly formed egg smooth; shell of fully developed egg ornamented with scattered and linear tubercles and surmounted longitudinally by a crenulated band (8.7 wide).

Distribution. USA (type locality not provided).

Biology. This mite species was collected from orange fruit, near the calyx where mites were usually seen hiding. Conidia of *Cladosporium* sp. were found in the pigmented guts suggesting that this mite species is a fungus feeder.

Etymology. The species name *americana* refers to the origin of this species in the United States of America.

Remarks. Three characters (the well-developed duct of supracoxal gland, serrations on anteromedial edges of trochanters I and II in both sexes and the subterminal attachment of spermathecal duct to the spermatheca in female) with taxonomic importance at family level, are recognized in this paper. *Acalvolia americana* **sp. nov.** and specimens of the genera *Calvolia*, *Czenspinskia*, *Neocalvolia* and *Oulenzia* in PANZ share these characters.

This species can be readily distinguished from the only known species, *Acalvolia squamata* (Oudemans, 1909), by the following key.

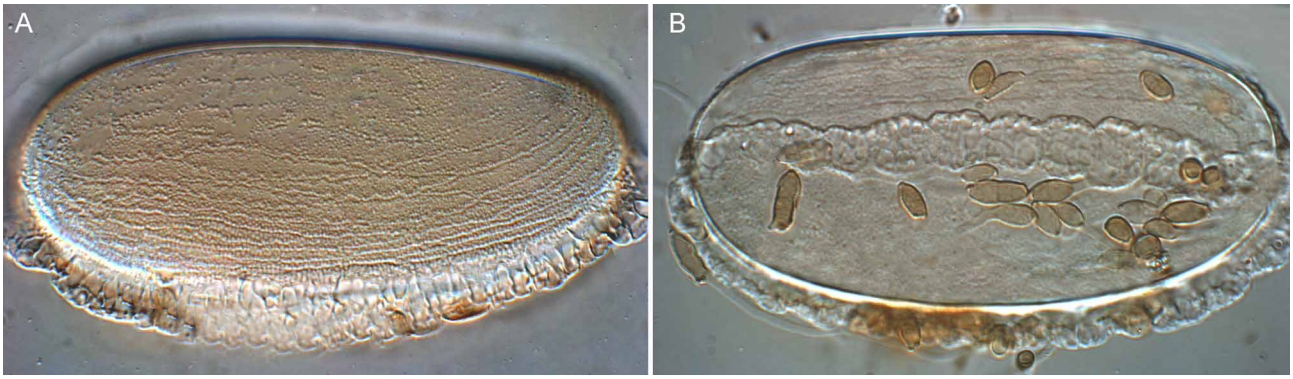

PLATE 3. *Acalvolia americana* **sp. nov.** (fully developed egg). **A,** surface ornamentation and half view of the longitudinal circular band of unknown substance; **B,** surface ornamentation and the longitudinal circular band of unknown substance.

Key to the known species of genus *Acalvolia*

1. Ratio *sce*: *sci*= 4.6; dorsal idiosomal setae c_1, d_1 and e_1 length less than two thirds the distance between their bases and the bases of setae in next row; supracoxal setae barbed ..... *Acalvolia squamata* (Oudemans, 1909)
   Ratio *sce*: *sci*= 2.5 (Figs. 1 and 6); setae c_1, d_1 and e_1 reaching or overlapping bases of setae in next row (Figs. 1 and 6); supracoxal setae smooth (Figs. 3 and 8) ..... *Acalvolia americana* **sp. nov.**

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