



Diplogyniidae (Acari: Mesostigmata) associated with *Panesthia* cockroaches (Blattodea: Blaberidae)

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Abstract

Five new Australian species of *Paradiplogynium* and one new species of *Lobogyniella* are described from *Panesthia*, a genus of subsocial wood cockroaches. *Paradiplogynium panesthia* Womersley, originally collected from *Panesthia cribrata* in New South Wales, is redescribed. The new mite species are *Paradiplogynium caitlinae* sp. nov., *Paradiplogynium damieni* sp. nov. and *Paradiplogynium elizabethae* sp. nov. from *Panesthia tyroni tryoni*; *Paradiplogynium isaaci* sp. nov. from *Panesthia cribrata*; *Paradiplogynium kaii* sp. nov. from *Panesthia sloanei*; and *Lobogyniella harrinahmani* sp. nov. from *Panesthia ancaudellioides*. *Paradiplogynium* and *Lobogyniella* are re-diagnosed and a key to *Paradiplogynium* is provided. Each *Panesthia* species has a large and a small species of diplogyniid mite associated with it. In two instances, geographically distant host populations had different species of mite. Mites are restricted to a single host, except the widespread species *Paradiplogynium nahmani*, which is now known from *Titanolabis colossea* (Dermaptera), *Pan. ancaudellioides*, *Pan. cribrata* and *Pan. sloanei*.

Key words: Host associations, identification key, morphology, Trigynaspida, Celaenopsidea

Introduction

The Diplogyniidae is the most diverse family of Trigynaspida, with 66 species and 40 genera, of which 26 are monotypic (Hallan, 2005; Kazemi *et al.*, 2008). Like most trigynaspid mites, the adult stage is associated adult arthropods (e.g., Trägårdh, 1950; Elsen, 1974, 1975, 1981; Seeman, 2007), on which they are almost certainly phoretic. Immature stages are not described, but are presumably free-living in their host's larval habitat (usually wood), similar to the immature stages of Fedrizziidae (Seeman, 2000) and Celaenopsidae (Kinn, 1971). I have collected and reared immature life stages of the passalid beetle associate *Cryptometasternum derricki* Womersley from rotting logs. All active life stages fed on nematodes, similar to the fedrizziid mite *Neofedrizzia camini* Womersley (Seeman, 2000).

Paradiplogynium Womersley was first described from specimens collected from the subsocial wood cockroach *Panesthia cribrata* Saussure, with *Paradiplogynium panesthia* as its type – and then only – species (Womersley, 1958). The type material was collected from Porter's Retreat, approximately 120 km inland from Sydney, but also included supplementary material from *Pan. cribrata* collected from Dalby, approximately 200 km inland from Brisbane. A second species, *Paradiplogynium nahmani* Seeman, was described from three specimens collected from the Colossus Earwig *Titanolabis colossea* (Seeman, 2007). This second species differed in several respects from *Par. panesthia*, but most notably bore one pair of setae on the latigynal shields instead of two (Seeman, 2007). Here, I describe another six new species of *Paradiplogynium* and one species of *Lobogyniella*, all collected from *Panesthia* cockroaches.

Materials and Methods

Cockroaches were collected from rotting logs and killed in 80% ethanol. Mites were removed from their hosts, cleared in Nesbitt's solution and slide-mounted in Hoyer's medium. Specimens were examined and measured

under a Nikon Eclipse 80i microscope; all measurements are in micrometres. Nomenclature for the idiosoma and leg setae generally follows Lindquist & Evans (1965) and Evans (1963), respectively. The Z and/or S series is hypotrichous, hence designation of these series are tentative and do not follow the ontogenetic development of the Ascidae (i.e., larval setae of the Ascidae are not forced upon designations for the opisthosoma). Instead, the marginal setae are designated as *R1–5* and the series between *J* and *R* are designated as *Z* setae. These designations are merely practical for descriptions and comparisons in this manuscript and will need to be reviewed once an ontogenetic series for these mites is discovered.

I also examined dried, pinned *Panesthia* specimens from the Queensland Museum: 20 *Pan. ancaudellioides* (two with mites), 30 *Pan. australis* (no mites), 100 *Pan. cribrata* (four with mites), 20 *Pan. parva* (no mites), 12 *Pan. obtusa* (no mites), 100 *Pan. sloanei* (five with mites) and 20 *Pan. tyroni* (three with mites). Each specimen was examined under a stereomicroscope. If mites were seen, the specimen was jetted with 80% ethanol from a squirt bottle and pipette, and the mites dislodged with fine forceps; this process was repeated until the mites were removed. These specimens were cleared and mounted in the same way as ethanol-preserved specimens. Abbreviations for institutions: ANIC (Australian National Insect Collection, Canberra); QM (Queensland Museum, Brisbane); SAMA (South Australian Museum, Adelaide).

Taxonomy

Diplogyniidae Trägårdh

Diagnosis

Sternal shield with one or more pairs of setae; jugular shields absent; metasternal shield fused with sternal shield, separate and entire, or separate and paired, bearing *st4* and *stp3* or a pair of pores and *stp3*. Primary genital shields the paired latigynal shields; mesogynal shield much smaller than latigynal shields, rectangular or triangular, may be fused with ventrianal shield. Paired ventromarginal shields flank a ventrianal shield. Ventrianal shield usually entire (sometimes a separate ventral and ventrianal shield present) and fused with exopodal shields. Hypostomal region unspecialised, similar in male and female. Excrescences on the moveable digit of the chelicera in the male different from those of female, bearing at least one scoop-like process.

Lobogyniella Krantz

Type species: *Lobogyniella tragardhi* Krantz, 1958, p. 127, by original designation.

Diagnosis

Sternal shield with three pairs of setae, setae *st2* and *st3* placed behind posterior margin of shield. Metasternal shields separate and free from sternal shield, bearing one pair of setae and pores. Latigynal shields with two pairs of setae. Anterolateral margins of latigynal shields broadly invaginated. Mesogynal shield free from ventral shield. Marginal shields not meeting posteriorly, narrowly separated by ventrianal shield. Peritreme not extending past coxa II. Genu IV with a long seta.

Remarks

The unpaired seta *j2* is not illustrated in *L. tragardhi*, but this is a feature of the Celaenopsoidea and is therefore probably present.

Lobogyniella harrynahmani sp. nov.

Specimens examined. Holotype female, Queensland, Curtain Fig, 2 km SW Yungaburra, 8 Dec 1988, 700 m alt., Monteith & Thompson, ex pinned *Panesthia ancaudelloides* (in QM). Paratypes, 2 females, 3 males, same data as holotype. All in QM except 1 female and 1 male paratype in ANIC.

Description

Female

Dorsal idiosoma 405–515 long, 275–290 wide (Fig. 1). Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); opisthosoma with 15 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *R1–5*). Setae *j1* 62–66, smooth, setae *Z5* 89–100, smooth, *R5* 12, smooth. Other setae in series *j–J* and *z–Z* 8–15 long, *s1* 22–24, *s2* 20–23, *s3* 21–26, *s4* 64–68, *s5* 84–88, *s6* 10–11, *r3* 20–25, *r4* 16–18, *r5* 18–25, *r6* 16–18, *R1–5* 13–15, smooth. Lyrifissures *idz1* present, large pore in place of *idr3*; 21 other idiosomal pores, none obviously lyrifissures. Dorsal shield covered with fine reticulation.

Ventral idiosoma (Fig. 2). Sternal shield reticulate, concave posteriorly, 46–47 long in midline, 101–105 long from anterolateral to posterolateral corner, 159–160 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 31–40, *st2* 28–37, weakly barbed, *st3* 26–28, smooth. Distance between setae *st1–st1* 52–57, *st2–st2* 65–68, *st3–st3* 20–23, *st1–st2* 6–7, *st1–st3* 19–22; setae *st3* 25 from posterior margin of sternal shield. Setae *st4* 5, on free paired metasternal shields. Tritosternum 90–95 long, base 12 long, laciniae pilose, dividing 40–45 from base. Latigynal shields each 85–90 long, 62–64 wide, with one pair of tiny pores and two pairs of setae, 5–7 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin concave, shields reticulated. Mesogynal shield rectangular, 25 long, 18 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 55 long, meeting medially at a small porose plate. Ventrianal shield fused with exopodal shield, reticulate, embracing anus; with four pairs of smooth setae 5 long (*Jv1–2*, *Zv2–3*), and four pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*pa*, *Jv5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal opening 31–33 long, 20–23 wide. Marginal shields with 11–13 pairs of pores and one pair of setae (*Zv4*); shields just meeting behind, or just separated by, ventral shield. Peritremes extending to posterior margin of coxa II.

Gnathosoma. Hypostome with four pairs of smooth setae, *h1* 12–14, *h2* 30, *h3* 6–8, palpcoxal seta 7–8 (Fig. 3). Corniculi slender, 20–24 long. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele 2-tined. Gnathotectum triangular, with ventro-median keel, coming to a point (Fig. 4). Fixed digit of chelicera (Fig. 5) with nine teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with six teeth and four excrescences: one large and membranous, 45–47 long; one with minute papillae, 25 long; two with large papillae, one as long as chelicerae, the other longer than the chelicerae.

Legs. Chaetotaxy similar to *Paradiplogynium* except: seta *ad3* absent on Ge I, Ti I, Ge II; seta *pd3* absent on Ge IV; seta *pv1* absent on Fe III. Femur I not elongate, seta *pd1* 21–23, *pd2* 10.

Male

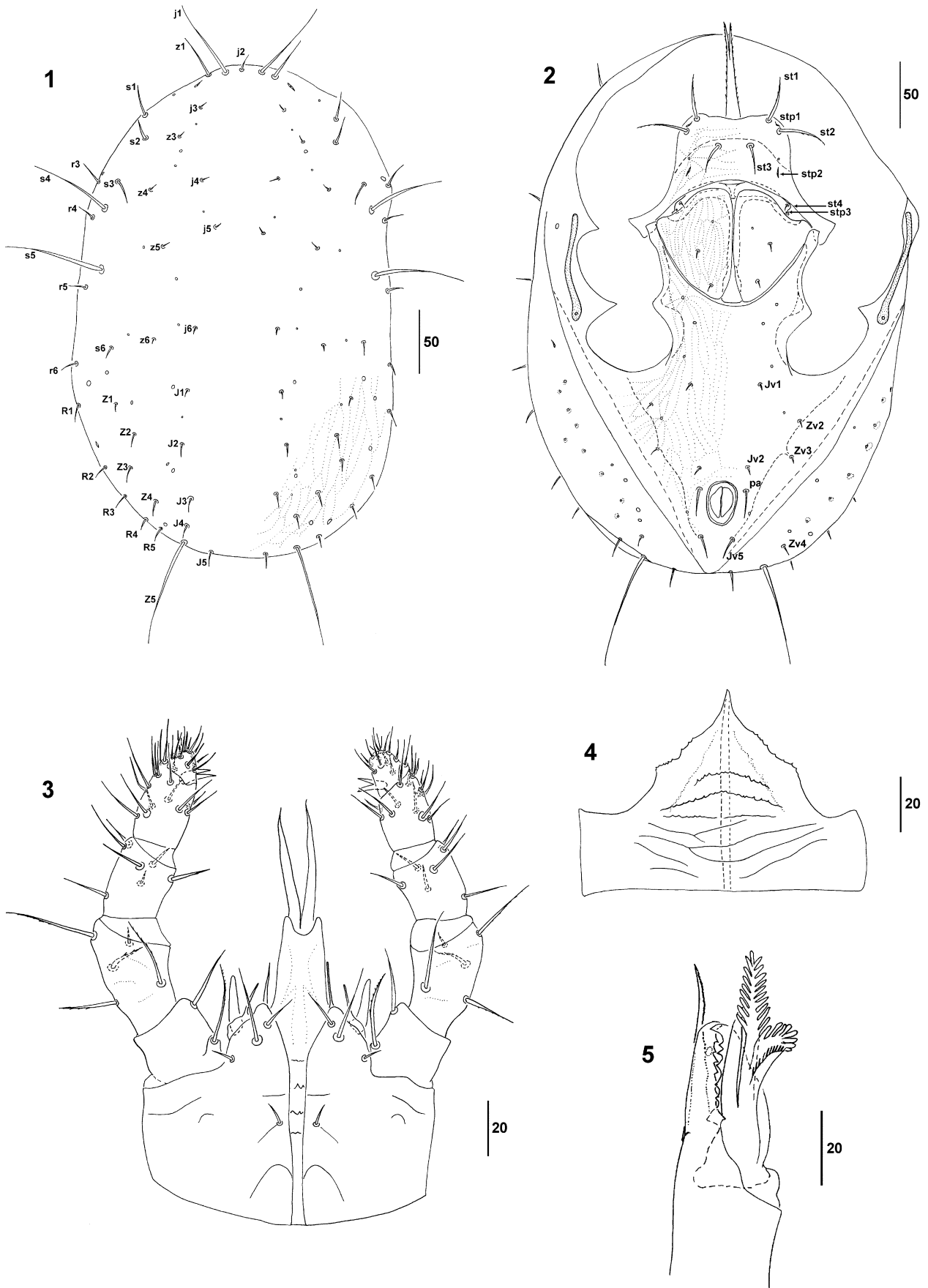
Dorsal idiosoma 390–405 long, 270–280 wide. Dorsal setae as in female except setae *s1–3* longer: *s1* 32–45, *s2* 47–55, *s3* 45–60. Holoventral shield reticulate (Fig. 6). Setae *st1* 24–25, *st2* 22–24, *st3* 20–23, smooth; setae *st3* 55 posterior to *st2*. Setae *st4* 5–7. Setae *st5* 7–10 long. Genital opening beneath anterior margin of holoventral shield. Marginal shield with 11–12 pairs of pores and 1 pair of setae; shields not meeting, separated by ventral shield. Hypostome with four pairs of setae, *h1* 13, *h2* 30–33, *h3* 8, palpcoxal seta 8–9, smooth. Corniculi 15–16 long, slender, blunt-tipped. Gnathotectum blunt-tipped (Fig. 7). Chelicerae as in female, except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera with 1 tiny lobe and a larger (34–38 long) somewhat sclerotised scoop-like excrescence (Fig. 8). Legs as for female.

Etymology

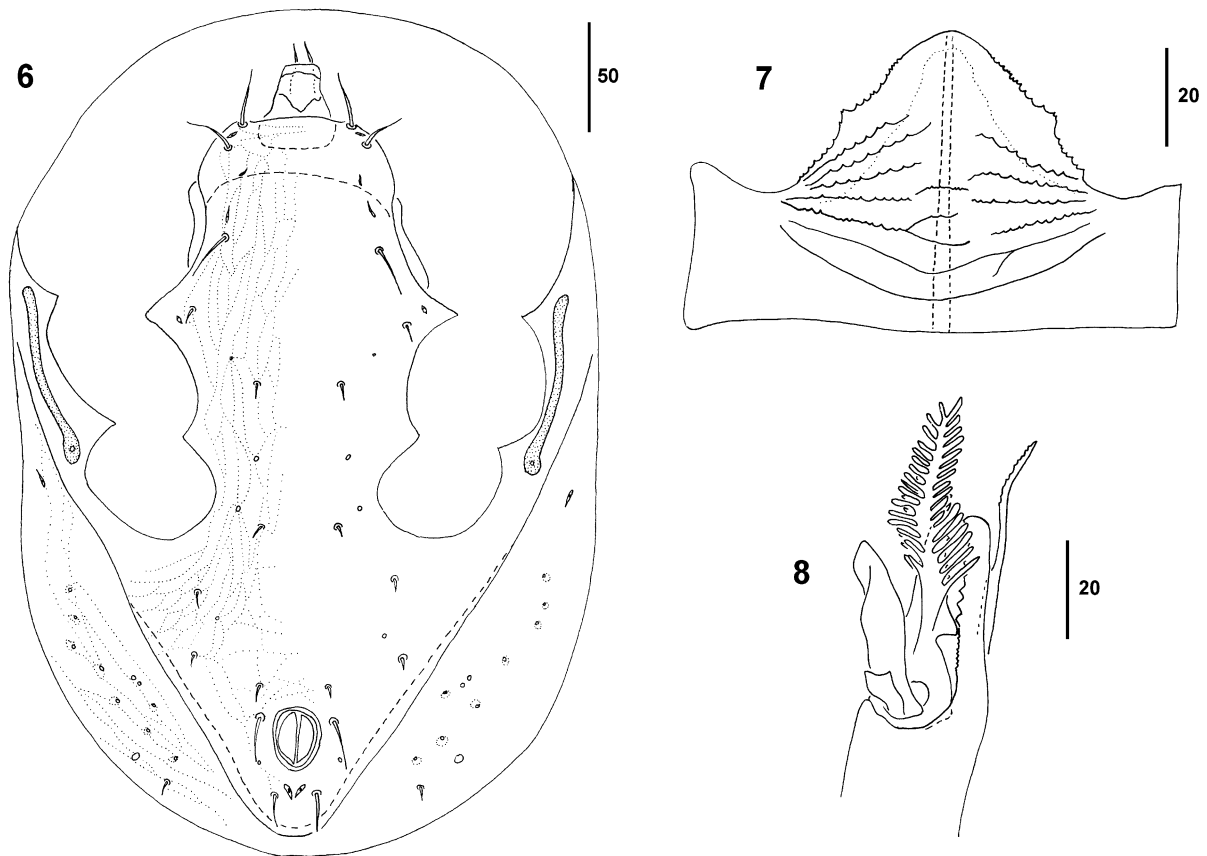
It is with great pleasure that I name this species for my second son, Harry Nahman.

Remarks

The new species has many more idiosomal setae than *L. tragardi*. *Lobogyniella tragardi* was collected from the termite *Zootermopsis angusticollis* (Hagen) (Hodotermitidae) (Krantz, 1958).



FIGURES 1–5. *Lobogyniella harrinahmani* sp. nov., adult female: 1, dorsal idiosoma; 2, ventral idiosoma; 3, ventral gnathosoma; 4, gnathotectum; 5, chelicera.



FIGURES 6–8. *Lobogyniella harrynahmani* sp. nov., adult male: 6, ventral idiosoma; 7, gnathotectum; 8, chelicera.

Paradiplogynium Womersley, 1958

Type species: *Paradiplogynium panesthia* Womersley, 1958, by original designation.

Diagnosis

Idiosoma with 20 pairs of podosomal setae and 13–14 pairs of opisthosomal setae, plus unpaired seta *j*2. Marginal setae *j*1, *r*3–6, *R*1–4 and *Z*5 longer than other idiosomal setae; 0–1 pairs of setae in series *S*. Sternal shield with three pairs of setae, setae *st*2 placed behind margin of shield, setae *st*3 at or behind sternal margin. Metasternal shields separate and free from sternal shield, bearing one pair of setae and pores. Latigynal shields with one or two pairs of setae. Anterolateral margins of latigynal shields broadly or narrowly invaginated, or irregular. Mesogynal shield free from ventral shield. Marginal shields just meeting posteriorly, sometimes narrowly separated by ventri-anal shield. Ventral shield embracing a membranous anal region. Marginal shields meeting posteriorly. Peritreme extending to coxa II or coxa I. Genu IV and Tarsus IV with a long seta.

Remarks

While most of the characters in the above diagnosis can be found in other taxa, the anus set into a membranous anal region is uniquely diagnostic for *Paradiplogynium*.

Paradiplogynium caitlinae sp. nov.

Specimens examined: Holotype, female, Queensland, Beech Forest Circuit, Lamington National Park, 2 Dec 1996, O. Seeman, ex *Panesthia tryoni tryoni* (in QM). Paratypes: three females, three males, same data as holotype. All in QM except one female and one male paratype in ANIC.

Description

Female

Dorsal idiosoma 540–600 long, 400–425 wide (Fig. 9). Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); opisthosoma with 14 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *R1–4*). Setae *j1* 68–73, barbed, setae *Z5* 73–83, smooth, barbed. Other setae in series *jJ* and *zZ* 5 long, *s* 10–15 long (*S3* absent), *r3* 45–48, *r4* 95, *r5* 110, *R1* 130–132, *R2* 96, *R3* 68–84, *R4* 113–128, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield covered with fine reticulation.

Ventral idiosoma (Fig. 10). Sternal shield reticulate, concave posteriorly, 54–58 long in midline, 118–120 long from anterolateral to posterolateral corner, 176–192 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 25–28, curved, *st2* 43–45, *st3* 40–43, smooth. Distance between setae *st1–st1* 76–78, *st2–st2* 73–75, *st3–st3* adjacent, *st1–st2* 5–8, *st1–st3* 40–43; seta *st3* 18–22 from posterior margin of sternal shield. Setae *st4* 15–17, on free paired metasternal shields. Tritosternum 118–120 long, base 10–12 long, laciniae pilose, dividing 80 from base. Latigynal shields each 110–120 long, 69–72 wide, with one pair of pores and two pairs of setae, 10–15 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin weakly invaginated, shields reticulated. Mesogynal shield rectangular, 44–50 long, 20–24 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 78–85 long, meeting medially at a small porose plate. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; setae *Jv1–3*, *Zv2* smooth 13–20 long; 3–4 pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4–5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus; paranal seta expressed asymmetrically in place of pore in holotype specimen. Anal plates surrounded by membranous region 73–76 long, 83–88 wide. Marginal shield with 10–12 pairs of pores and one pair of setae (*Zv4*); shields just meeting behind ventral shield. Peritreme extending to coxa II.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 18–23, *h2* 43–45, *h3* 13–17, palpcoxal seta 29–33 (Fig. 11). Corniculi slender, 30–36 long. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele 2-tined. Gnathotectum triangular, with ventro-median keel, coming to a blunt point (Fig. 12). Fixed digit of chelicera with 11–12 teeth (anterior two tiny) (Fig. 13), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with eight teeth (most anterior tiny) and three excrescences: one short and brush like, one with minute papillae and only slightly longer than cheliceral digits, the other extending 8–12 past tip of moveable digit and covered with numerous papillae.

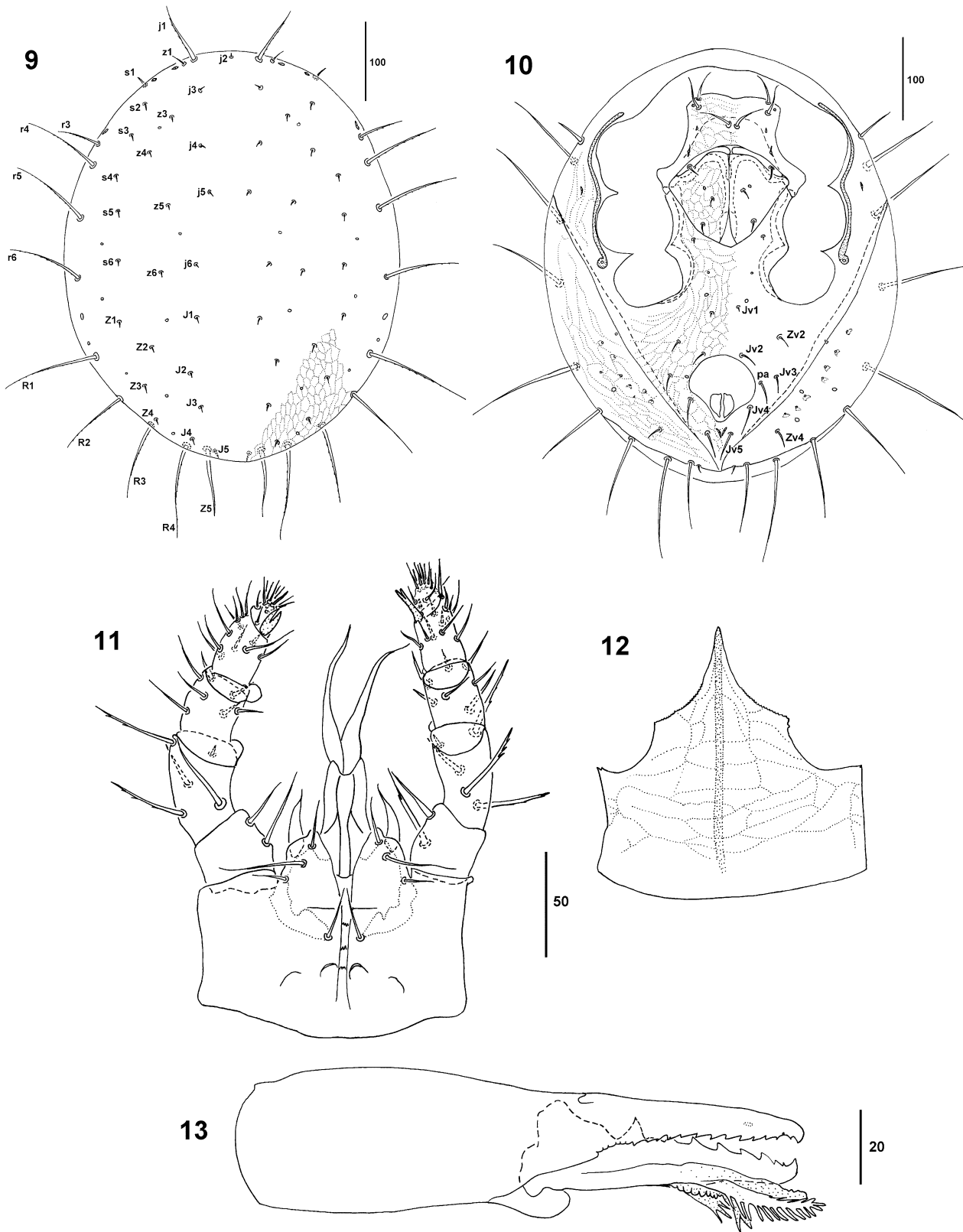
Legs. Chaetotaxy typical for the genus. Femur I stout, with hunched appearance, seta *pd1* 28–35, *pd2* 12–18.

Male

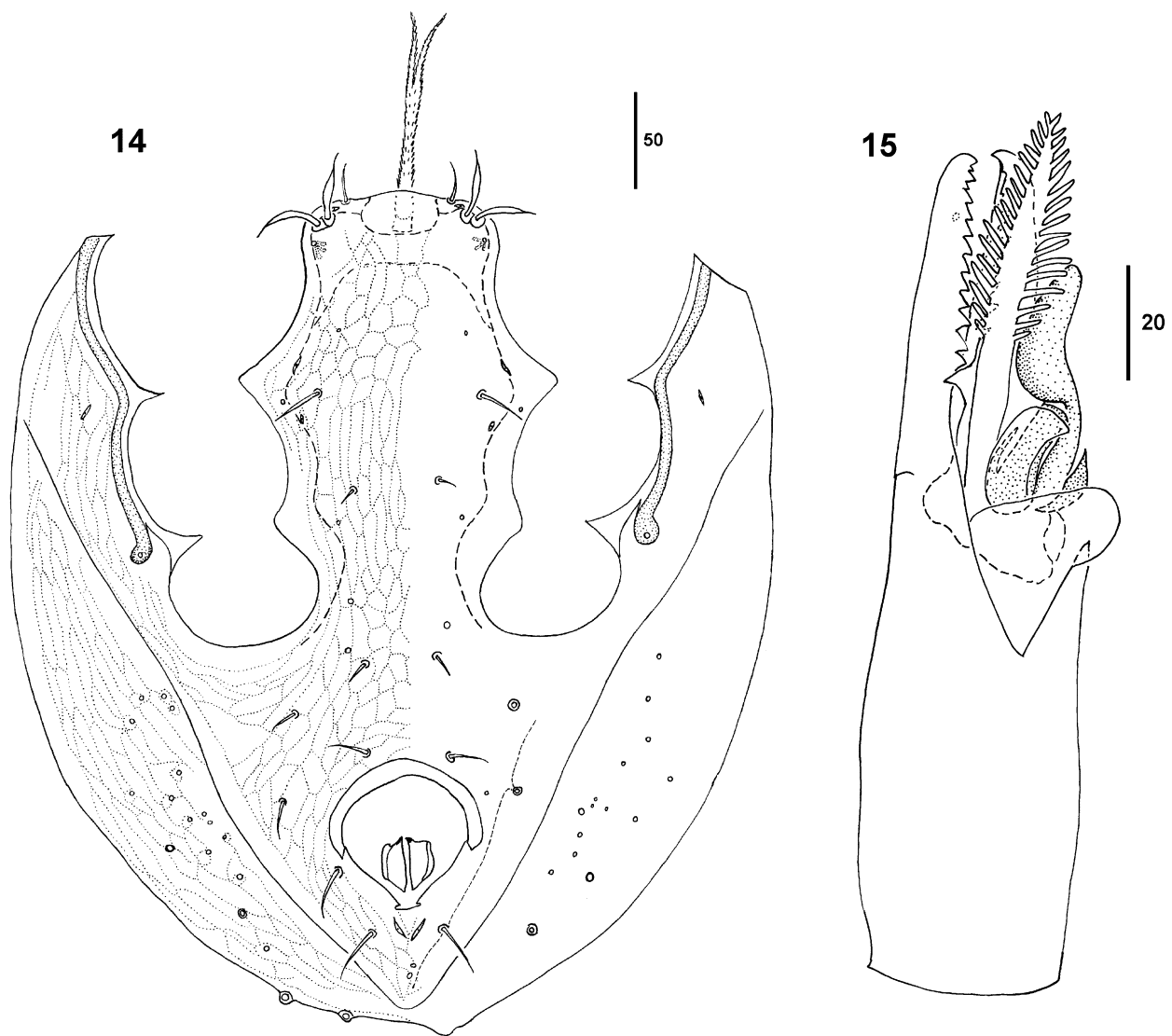
Dorsal idiosoma 515–530 long, 380–405 wide (Fig. 14). Dorsal setae as in female, *R4* 110–113, barbed, and *Z5* 70–75, smooth. Holoventral shield reticulate. Setae *st1* 15–20, base of *st1* clearly visible, *st2* 35–48, *st3* 35–40, both blade-like medially, not on tubercles. Setae *st4* 18–25, well behind (85–88) *st2* and *st3*. A cluster of glands and their associated pore opening posterior to *st3*. Setae *st4* 26–28, well behind (81–85) *st2* and *st3*. Setae *st5* 8–10 long. Tritosternum bifurcate, laciniae barbed. Genital opening beneath anterior margin of holoventral shield. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and three pairs of irregularly placed pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 71–76 long, 75–80 wide. Marginal shield with 9–14 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 18–20, *h2* 35–43, *h3* 13–15, palpcoxal seta 18. Corniculi slender, 25 long. Gnathotectum with rounded tip. Chelicerae (Fig. 15) as in female, except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has three small lobes and a larger (41–45 long) somewhat sclerotised scoop-like excrescence. Legs as for female.

Etymology

It is with great pleasure that I name this species for my niece, Caitlin Nahrung.



FIGURES 9–13. *Paradiplogynium caitlinae* sp. nov., adult female: 9, dorsal idiosoma; 10, ventral idiosoma (note that the illustrated specimen possesses asymmetrically expressed seta where there is usually a pore); 11, ventral gnathosoma; 12, gnathothectum; 13, chelicera.



FIGURES 14–15. *Paradiplogynium caitlinae* sp. nov., adult male: 14, ventral idiosoma; 15, chelicera.

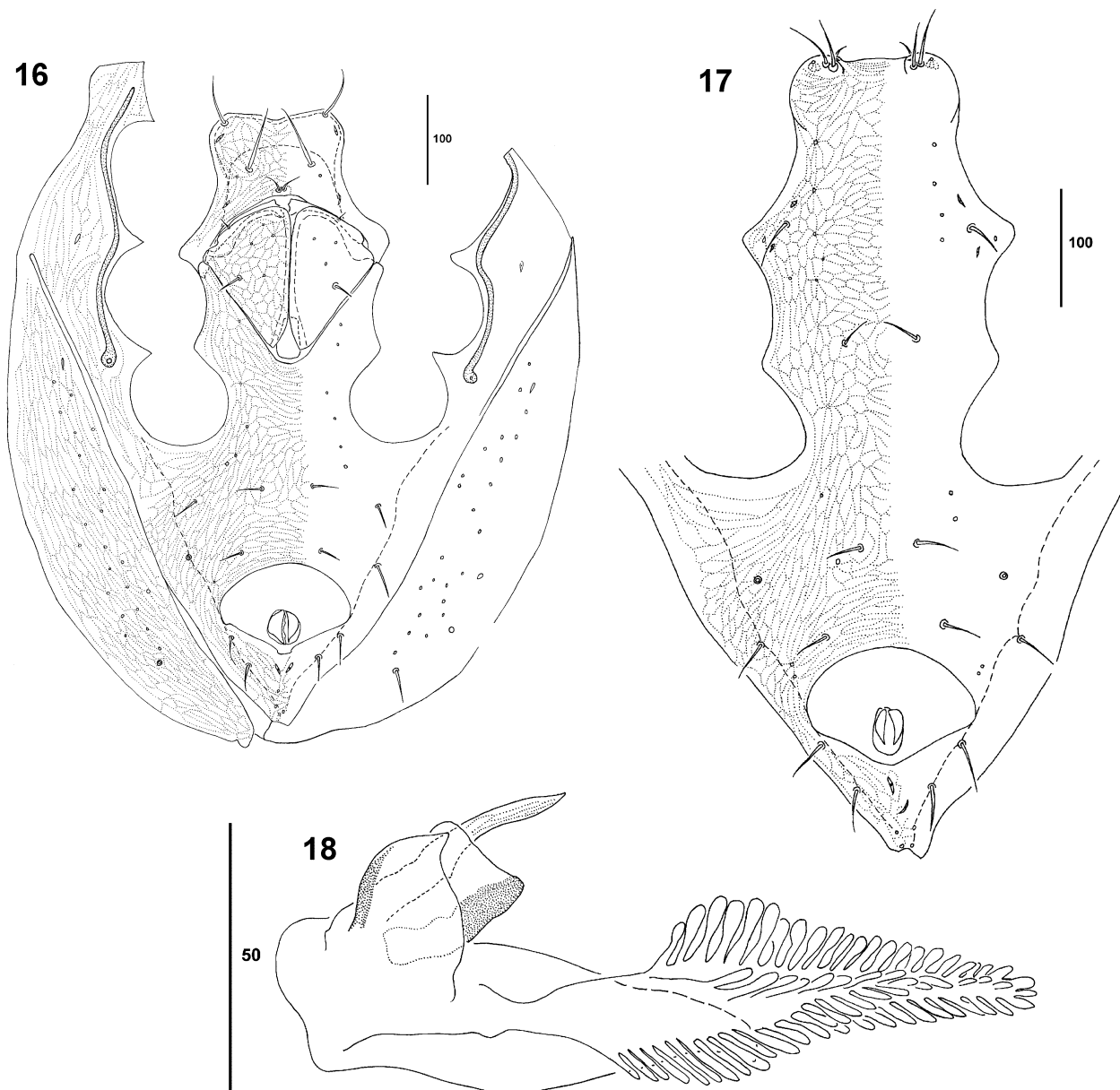
***Paradiplogynium damieni* sp. nov.**

Specimens examined: Holotype female, Queensland, Blue Pool Circuit, Lamington National Park, 25 Feb 1996, O. Seeman, ex *Panesthia tryoni tryoni* (in QM). Paratypes: one female, one male, same data as holotype; one female, one male, same data as holotype except at Duck Ck Rd, 15 Nov 1996; one male, same data as holotype except at Wishing Tree, ex *Mastachilus quaestionis* (Coleoptera: Passalidae); five females, five males, same data as holotype except at Beech Forest, 2 Dec 1996; two males, same data as holotype except at Sunday Ck, Jimna State Forest, 18 Feb 1997, H. Proctor. All paratypes in QM except one female and one male in ANIC.

Description

Female

Dorsal idiosoma 890–930 long, 590–620 wide (Fig. 16). Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); opisthosoma with 15 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *S3*, *R1–4*). Setae *j1* 80–88, barbed, *Z5* 113–128, thickened, smooth, *J5* 25. Other setae in series *jJ* and *zZ* 30–40 long, *sS* 25–43 long (*S3* present), *r3* 90–98, *r4* 93–95, *r5* 88–90, *r6* 70–85, *R1* 49–58, *R2* 85–95, *R3* 108–109, *R4* 228–260, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 18 pairs of glands. Dorsal shield covered with fine reticulation.



FIGURES 16–18. *Paradiplonyium damieni* sp. nov., adult female: 16, ventral idiosoma. Adult male: 17, ventral idiosoma; 18, chelicera.

Ventral idiosoma (Fig. 17). Sternal shield reticulate, concave posteriorly, 85–88 long in midline, 168–180 long from anterolateral to posterolateral corner, 238–243 wide at widest point; with three pairs of setae, two pairs of lyrifissures, and one pair of pores, setae *st1* and *st2* on raised region. Setae *st1* 60–68, curved, *st2* 75–78, *st3* 24–28, smooth. Distance between setae *st1–st1* 106–115, *st2–st2* 55–66, *st3–st3* adjacent, *st1–st2* 45–50, *st1–st3* 83–93; seta *st3* 5–7 from posterior margin of sternal shield. Setae *st4* 13–15, on free paired metasternal shields, medial margin hooked in one specimen. Tritosternum 170–195 long, base 12–15 long, laciniae pilose, dividing 125–140 from base. Latigynal shields each 155–168 long, 93–98 wide, with 2–4 pairs of tiny pores and one pair of setae, 22–25 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin irregular, shields reticulate. Mesogynal shield rectangular, 48–53 long, 26–29 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 130–133 long, meeting medially at a small porose plate. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; setae *Jv1–3*, *Zv2* smooth, 28–44 long; 5–7 pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4–5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 105–120 long, 148–150 wide.

Marginal shield with 25–28 pairs of pores, one lyrifissure and one pair of setae (*Zv4*); shields just meeting behind ventral shield. Peritreme extends to coxa I.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 38–41, *h2* 68–75, *h3* 41–50, palpcoxal seta 43–45. Corniculi slender, 50 long. Gnathotectum triangular, with ventro–median keel, coming to a sharp point. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele with two strong tines and tiny basal prong. Fixed digit of chelicerae with 11 teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with nine teeth (most anterior tiny) and proximal row of minute teeth, and three papillate excrescences: one short, one with minute papillae and 5-10 longer than cheliceral digits, the other extending 45-49 past tip of moveable digit and covered with numerous papillae.

Legs. Chaetotaxy typical for the genus. Femur I elongate, seta *pd1* 33–36, *pd2* 30–35.

Male

Dorsal idiosoma 880–940 long, 570–620 wide (Fig. 17). Dorsal setae as in female, *R4* 200–255, barbed, and *Z5* 95–123, smooth. Holoventral shield reticulate. Setae *st1* 16-18, at or just under margin, *st2* 38–45, *st3* 50–58, setiform, adjacent and on raised tubercles 48–50 wide that also bear a cluster of glands and their associated pore opening. Setae *st4* 38–45, well behind (133–148) *st2* and *st3*; setae *st5* 24–33 long; 7–8 pairs of pores and two pairs of lyrifissures between *st3* and *st5*. Tritosternum bifurcate, laciniae barbed. Genital opening beneath anterior margin of holoventral shield, sometimes extruded on slide-mounted specimens. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and one pair of irregularly placed pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 103–113 long, 135–153 wide. Marginal shield with 25–27 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 26–33, *h2* 58, *h3* 38, palpcoxal seta 26–30. Corniculi slender, 38–45 long. Gnathotectum with rounded tip. Chelicerae as in female (Fig. 18), except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has 3 lobes (23–25, 31–33 and 50–51 long) and a 48–57 long, somewhat sclerotised scoop-like excrescence. Legs same as female.

Etymology

It is with great pleasure that I name this species for my nephew, Damien Nahrung.

Paradiplonyium elizabethae sp. nov.

Specimens examined: Holotype, female, Queensland, Lamington National Park, Kroombit Tops, 9–19 Dec 1983, G. B. Monteith & G. I. Thompson, ex *Panesthia tryoni* (in QM). Paratypes, three males, same data as holotype. All in QM except one paratype male in ANIC.

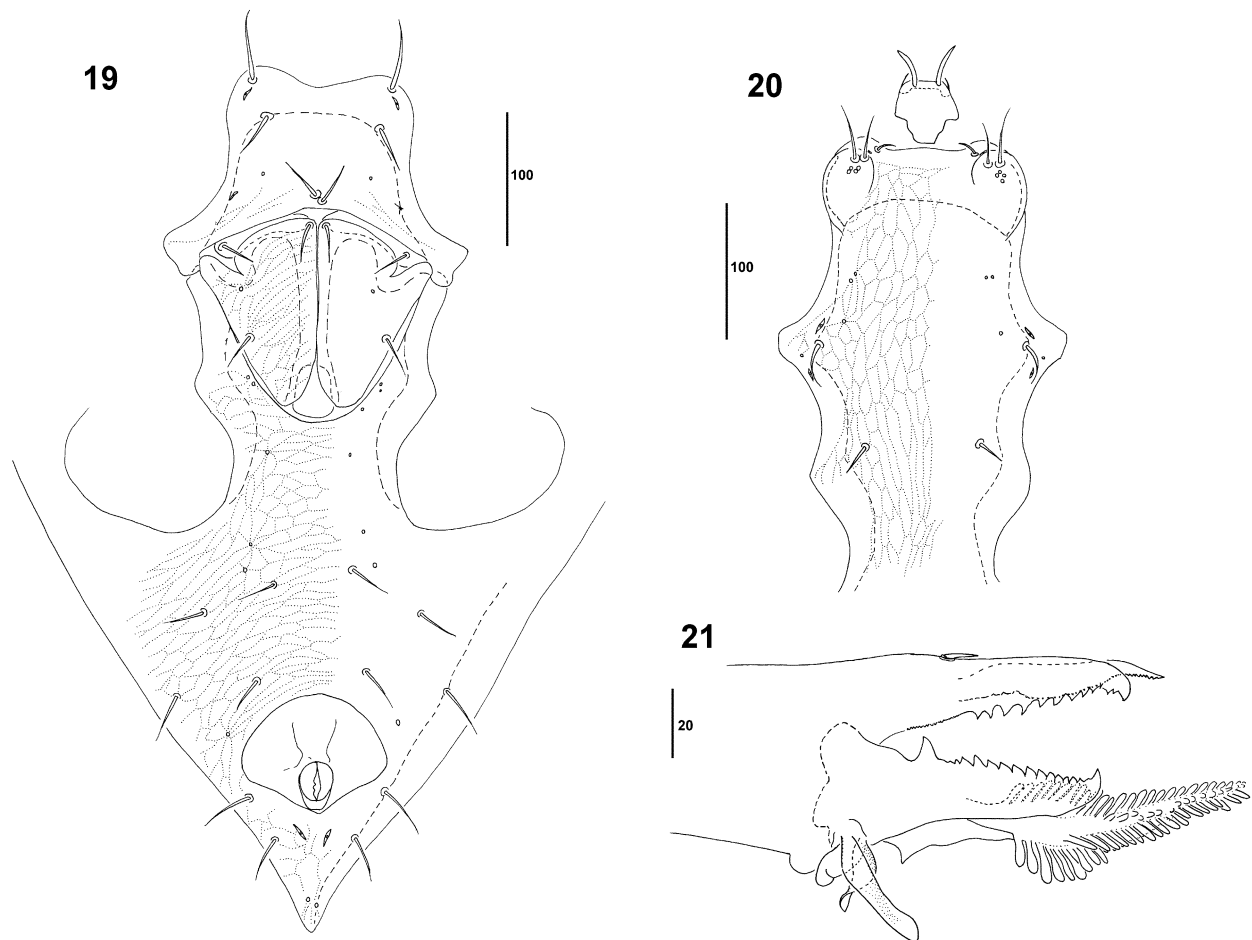
Description

Female

Dorsal idiosoma 820 long, 620 wide. Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); seta *z6* displaced posteriorly, closer to *Z1* than *j6*. Opisthosoma with 15 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *S3*, *R1–4*). Setae *j1* 70, barbed, *Z5* 95, thickened, smooth, *J5* 16. Other setae in series *jJ*, *zZ* and *Ss* 15–20 long (*S3* present), *r3* 22, *r4* 23, *r5* 20, *r6* 23, *R1* 20, *R2* 23, *R3* 21, *R4* 183, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield weakly reticulate, the intersections of reticulation with punctations.

Ventral idiosoma (Fig. 19). Sternal shield smooth medially, weakly reticulate laterally, concave posteriorly, 89 long in midline, 160 long from anterolateral to posterolateral corner, 229 wide at widest point; with three pairs of setae, two pairs of lyrifissures, and one pair of pores, setae *st1* and *st2* on raised region. Setae *st1* 53, *st2* 35, *st3* 35, smooth. Distance between setae *st1–st1* 98, *st2–st2* 80, *st3–st3* adjacent, *st1–st2* 25, *st1–st3* 90; seta *st3* 3–7 from posterior margin of sternal shield. Setae *st4* 28, on free paired metasternal shields. Tritosternum 178 long, base 22

long, laciniae pilose, dividing 120 from base. Latigynal shields each 145 long, 88 wide, with one pair of tiny pores and two pairs of setae, 33 long, most anterior pair of setae set in anteromedial margins; anterior and medial margins (to mesogynal shield) thickened, anterior margin deeply incised, shields reticulated obliquely. Mesogynal shield rectangular, 38 long, 35 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites not measurable. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; reticulation transverse between *Jv* setae; setae *Jv1*–3, *Zv2* smooth, 28–38 long; five pairs of irregularly placed pores anterior to anus; 2 pairs of smooth setae (*Jv4*–5), 1 pair of lyrifissures and two pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 95 long, 110 wide. Marginal shield with 18–19 pairs of pores, one lyrifissure and one pair of setae (*Zv4*); shields just meeting behind ventral shield. Peritreme extending to mid-coxa I.



FIGURES 19–21. *Paradipogynium elizabethae* sp. nov., adult female: 19, ventral idiosoma. Adult male: 20, ventral idiosoma; 21, chelicera.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 33, *h2* 58, *h3* 28, palpcoxal seta 38. Corniculi slender, 50 long. Gnathotectum triangular, with ventro-median keel, coming to a sharp point. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele with two strong tines and tiny basal prong. Fixed digit of chelicera with 11 teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with 13 teeth (most anterior tiny) and proximal row of minute teeth, and three papillate excrescences: one short, one with minute papillae and 20 longer than cheliceral digits, the other extending 49 past tip of moveable digit and covered with numerous papillae.

Legs. Chaetotaxy typical for the genus. Femur I elongate, seta *pd1* 35, *pd2* 19.

Male

Dorsal idiosoma 810–820 long, 620–650 wide. Dorsal setae as in female, *R4* 165–171, weakly barbed, and *Z5* 98, smooth. Holovenral shield reticulate (Fig. 20). Setae *st1* 12–18, at or just under margin, *st2* 18–27, setiform,

st3 30–38, weakly blade-like to setiform, adjacent and on raised tubercles 44–50 wide that also bear a cluster of glands and their associated pore opening. Setae *st4* 28–32, well behind (108–128) *st2* and *st3*; setae *st5* 23 long; four pairs of pores and one pair of lyrifissures between *st3* and *st5*. Tritosternum bifurcate, laciniae barbed. Genital opening beneath anterior margin of holovenral shield, sometimes extruded on slide-mounted specimens. Holovenral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and 1–2 pairs of pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 90–98 long, 95–106 wide. Marginal shield with 13–18 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 25, *h2* 45–53, *h3* 18–23, palpcoxal seta 18–20. Corniculi slender, 40–44 long. Gnathotectum with pointed tip. Chelicerae as in female (Fig. 21), except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has 2–3 lobes and a 38–45 long, somewhat sclerotised scoop-like excrescence. Legs same as female.

Etymology

It is with great pleasure that I name this species for my niece, Elizabeth Armstrong.

Paradiplogynium isaaci sp. nov.

Specimens examined: Holotype, female, Queensland, Fire Tower Rd, Jimna State Forest, 16 Feb 1999, O. Seeman, ex *Panesthia cribrata* (in QM). Paratypes, four females, three males, same data as holotype; one male, same data except Peter's Rd. All in QM except one female and one male paratype in ANIC.

Description

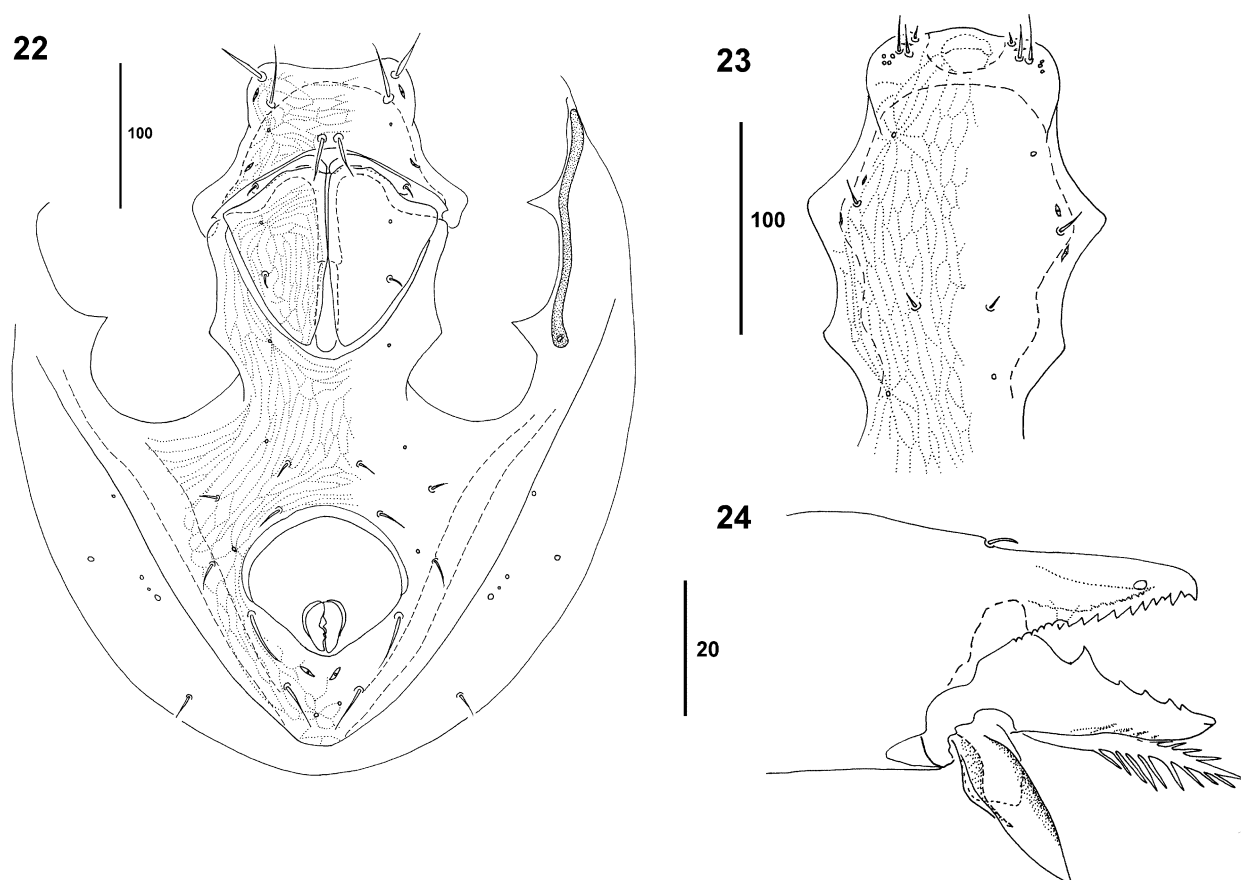
Female

Dorsal idiosoma 520–565 long, 410–450 wide. Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); opisthosoma with 14 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *R1–4*). Setae *j1* 60–70, barbed, *Z5* 60–70, smooth. Other setae in series *jJ*, *zZ* and *s* 5–7 long (*S3* absent), *r3* 20–21, *r4* 90–103, *r5* 93–103, *R1* 105–110, *R2* 110–125, *R3* 65–70, *R4* 110–125, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield covered with fine reticulation.

Ventral idiosoma (Fig. 22). Sternal shield reticulate, concave posteriorly, 48–52 long in midline, 113–120 long from anterolateral to posterolateral corner, 185–188 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 25–33, *st2* 35–38, *st3* 28–30, smooth. Distance between setae *st1–st1* 74–85, *st2–st2* 68–73, *st3–st3* 4–5, *st1–st2* 5–10, *st1–st3* 48–50; seta *st3* 3–5 from posterior margin of sternal shield. Setae *st4* 8–11, on free paired metasternal shields. Tritosternum 85–95 long, base 8–10 long, laciniae pilose, dividing 63–70 from base. Latigynal shields each 110–123 long, 70–73 wide, with one pair of pores and one pair of setae, 12 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin weakly invaginated, shields reticulated, longitudinal–reticulate medially. Mesogynal shield rectangular, 50–63 long, 14–20 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 75–82 long, meet medially at a small porose plate. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; setae *Jv1–3*, *Zv2* smooth, 10–18 long; two pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4–5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 93–105 long, 103–116 wide. Marginal shield with 2–4 pairs of pores and 1 pair of setae (*Zv4*); shields just meeting behind ventral shield. Peritremes extending to mid coxa II.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 12–18, *h2* 30–33, *h3* 15, palpcoxal seta 25–32. Corniculi slender, 27 long. Gnathotectum triangular, with ventro-median keel, coming to a blunt point. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele 2-tined, plus minute basal tine. Fixed digit of chelicerae with nine teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with six teeth and three excrescences: one short and brush like, one with minute papillae and as long as cheliceral digits, the other extending 8–10 past tip of moveable digit and covered without papillae.

Legs. Chaetotaxy typical for the genus. Femur I stout, with hunched appearance, seta *pd1* 30–33, *pd2* 13–15.



FIGURES 22–24. *Paradiplogynium isaaci* sp. nov., adult female: 22, ventral idiosoma. Adult male: 23, ventral idiosoma; 24, chelicera.

Male

Dorsal idiosoma 440–460 long, 325–350 wide. Dorsal setae as in female, *R4* 79–93, barbed, and *Z5* 48–55, smooth. Holoventral shield reticulate (Fig. 23). Setae *st1* 8–10, base of *st1* clearly visible, *st2* 14–18, *st3* 13–19, slender, not on tubercles. A cluster of glands and their associated pore opening posterior to *st3*. Setae *st4* 15–20, well behind (53–72) *st2* and *st3*. Setae *st5* 9–14 long. Genital opening beneath anterior margin of holoventral shield. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and 1–2 pairs of irregularly placed pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 75–85 long, 81–100 wide. Marginal shield with 2–3 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 12–15, *h2* 25–33, *h3* 12–15, palpcoxal seta 13–15. Corniculi slender, 20–25 long. Gnathotectum with blunt tip. Chelicerae as in female (Fig. 24), except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has at least 1 small lobe and a larger (28–30 long) somewhat sclerotised scoop-like excrescence. Legs as for female.

Etymology

It is with great pleasure that I name this species for my nephew, Isaac Armstrong.

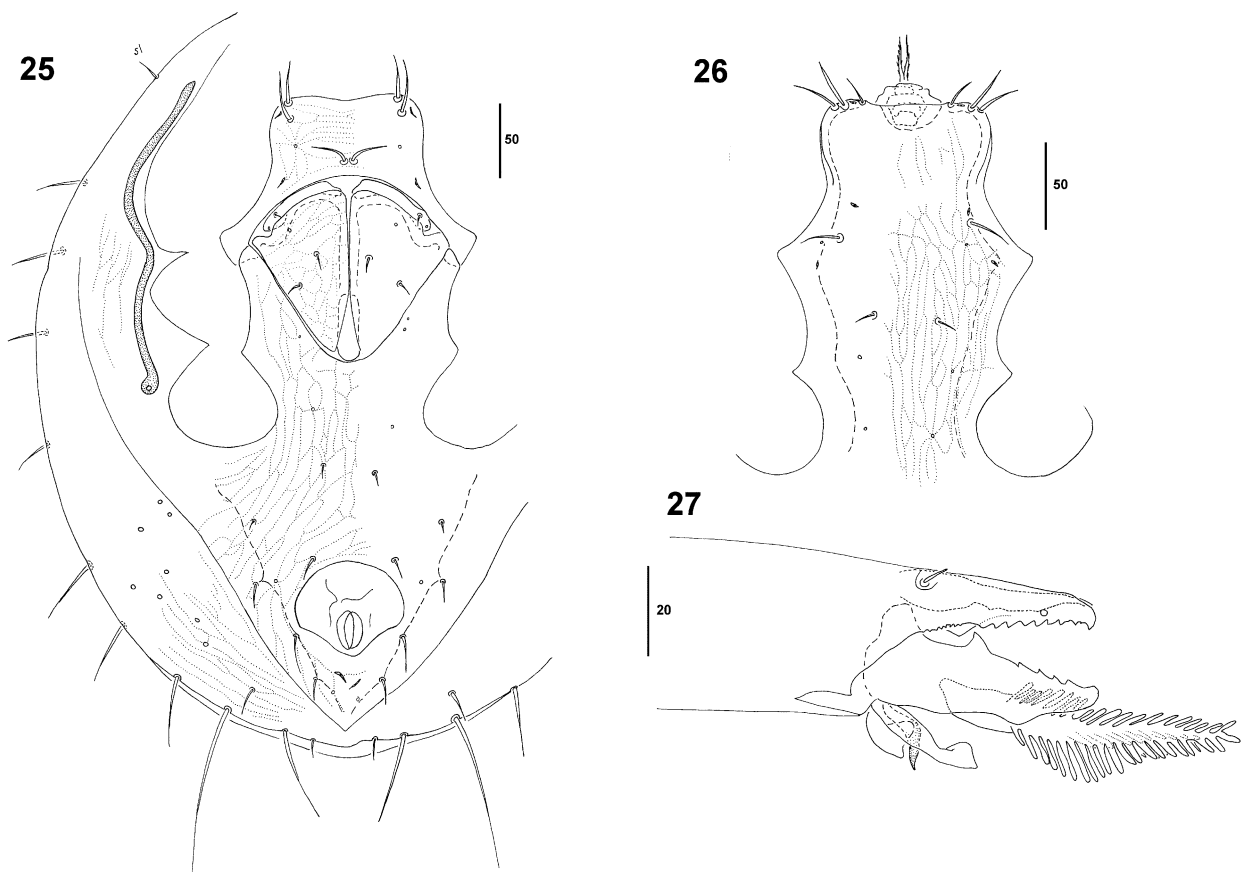
Paradiplonyium kaii sp. nov.

Specimens examined: Holotype, female, Queensland, Mt Belleden Ker, Centre Peak Summit, 10–12 Apr 1979, 1500 m alt., GB Monteith, ex pinned *Panesthia sloanei* (in QM). Paratypes, two females, one male, same data as holotype; two females, six males, same data as holotype except from another cockroach; one male, North-South Bell Pk Saddle, Malbon-Thompson Range, northeast Queensland, 19–21 Nov 1990, 800–900 m alt., GB Monteith & GI Thompson, ex pinned *Pan. sloanei*; one male, Carbine Tableland, Roots-Francis Ck divide, northeast Queensland, 28 Nov 1990, 1250 m alt., Monteith, Thompson, Cook, Sheridan, Janetzki coll., ex pinned *Pan. sloanei*; three females, one male, 7.5 km N of Mt Lewis via Julatten, 8 Sep 1981, 1200 m alt., Monteith & Cook, ex pinned *Pan. sloanei*; eight females, seven males, Lamb's Head, 10 km N Edmonton, 4 Dec 1988, 1200 m alt., Monteith & Thompson, ex pinned *Pan. sloanei*. All in QM except one female and one male paratype in ANIC.

Description

Female

Dorsal idiosoma 480–515 long, 370–410 wide (Fig. 25). Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s1–6*, *r3–6*) and one unpaired seta (*j2*); opisthosoma with 14 pairs of setae (*J1–5*, others tentatively designated as *Z1–5*, *R1–4*). Setae *j1* 30–39, barbed, *Z5* 60–65, smooth. Other setae in series *jJ*, *zZ* and *s* 3–10 long (*S3* absent), *r3* 30–33, *r4* 38–46, *r5* 45–50, *r6* 48–54, *R1* 38–50, *R2* 35–40, *R3* 45–48, *R4* 120–128, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield covered with fine reticulation laterally, smooth medially.



FIGURES 25–27. *Paradiplonyium kaii* sp. nov., adult female: 25, ventral idiosoma. Adult male: 26, ventral idiosoma; 27, chelicera.

Ventral idiosoma (Fig. 25). Sternal shield reticulate, concave posteriorly, 48–53 long in midline, 113–120 long from anterolateral to posterolateral corner, 175–178 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 28, *st2* 38, *st3* 29, smooth. Distance between setae *st1–st1* 69, *st2–st2*

69–72, *st3–st3* adjacent, *st1–st2* 5, *st1–st3* 45; setae *st3* 4–10 from posterior margin of sternal shield. Setae *st4* 8–10, on free paired metasternal shields. Tritosternum 105–110 long, base 8–10 long, laciniae pilose, dividing 80–85 from base. Latigynal shields each 109–110 long, 66–70 wide, with one pair of tiny pores and two pairs of setae, 10–12 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin invaginated, shields reticulated. Mesogynal shield rectangular, 40–45 long, 15–18 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 75–80 long, meet medially at a small porose plate. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; setae *Jv1–3*, *Zv2* smooth, 10–18 long; 1–2 pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4–5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 65–78 long, 73–80 wide. Marginal shield with 7–10 pairs of pores and one pair of setae (*Zv4*); shields just meeting behind, or just separated by, ventral shield. Peritremes extending to anterior coxa II to mid coxa I.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 17–19, *h2* 35–40, *h3* 13–15, palpcoxal seta 23–26. Corniculi slender, 33–41 long. Gnathotectum triangular, with ventro-median keel, coming to a point. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele 2-tined, plus minute basal tine. Fixed digit of chelicerae with nine teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with six teeth and three excrescences: one short and brush like, one with minute papillae and as long as cheliceral digits, the other extending 30–33 past tip of moveable digit and covered with papillae.

Legs. Chaetotaxy typical for the genus. Femur I slightly elongate, seta *pd1* 22–25, *pd2* 18–20.

Male

Dorsal idiosoma 480–560 long, 380–410 wide. Dorsal setae as in female, *R4* 108, barbed, and *Z5* 58, smooth. Holoventral shield reticulate, becoming weaker anterior to *st4* (Fig. 26). Setae *st1* 19–24, base of *st1* on margin of shield, just visible, *st2* 26–38, *st3* 28–36, blade-like, not on tubercles. A cluster of glands and their associated pore opening posterior to *st3*. Setae *st4* 25–28, well behind (60–78) *st2* and *st3*. Setae *st5* 12–15 long. Genital opening beneath anterior margin of holoventral shield. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and 1–2 pairs of irregularly placed pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 70–78 long, 83–85 wide. Marginal shield with 6–10 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of setae, *h1* 18–20, *h2* 30–35, *h3* 12–16, smooth, palpcoxal seta 12–15, weakly barbed. Corniculi slender, 25–32 long. Gnathotectum with sharp tip. Chelicerae as in female (Fig. 27), except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has at least one small lobe and a larger (25–33 long) somewhat sclerotised scoop-like excrescence. Legs as for female.

Etymology

It is with great pleasure that I name this species for my nephew, Kai Armstrong.

Paradiplogynium panesthia Womersley, 1958

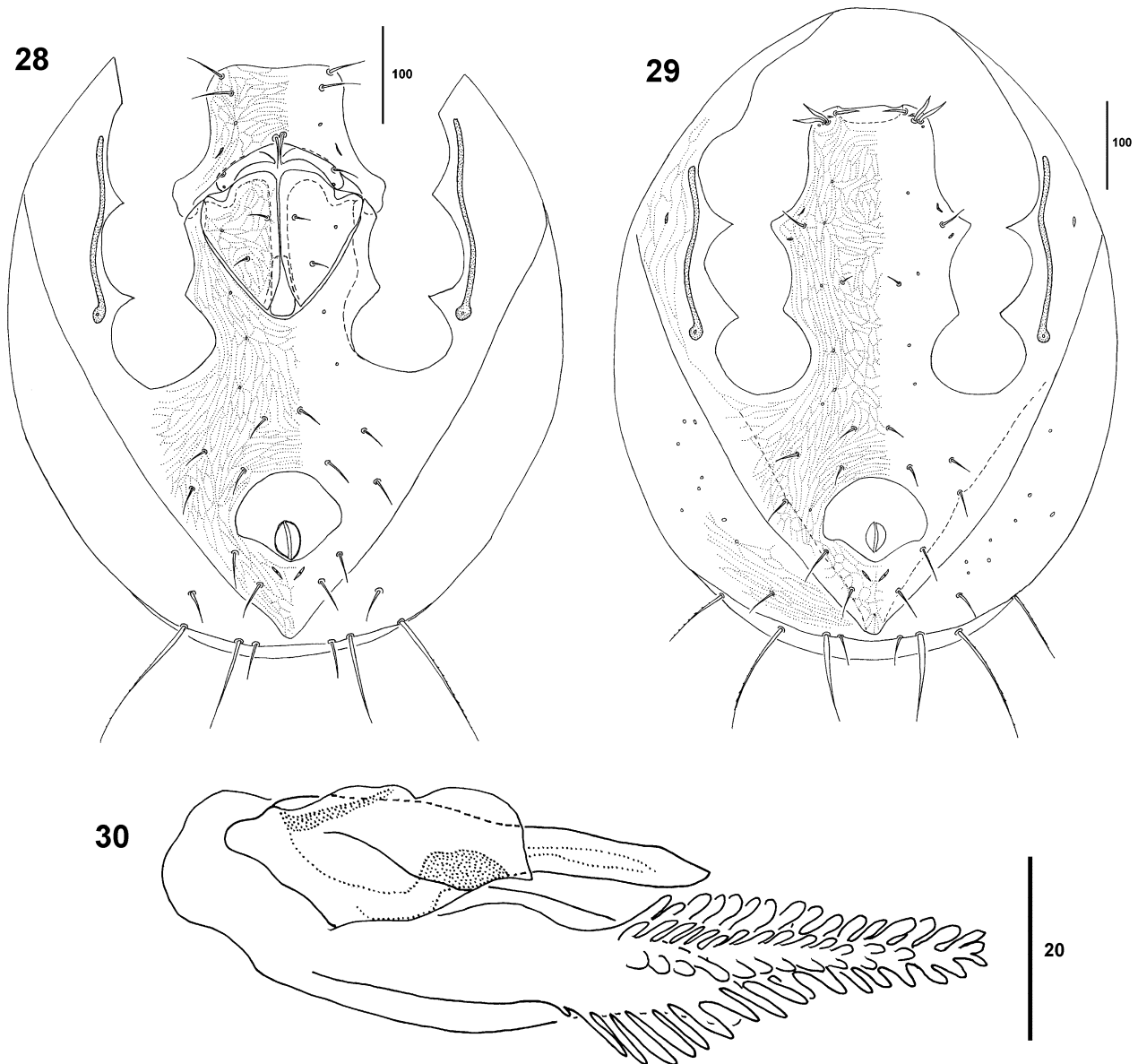
Type specimens examined: Holotype, female, Porter's Retreat, ca. 60 miles from Jenolan Caves, New South Wales, 26 Nov. 1956, G.F. Bornemissza, ex *Panesthia laevicollis* (= *Pan. cribrata*) from a rotten eucalypt log (ARA7322, J12234). Paratypes, five males, two females, same data as holotype (J12235-41). All in SAMA.

Other specimens examined: Three males, one female, same data as holotype (J12242); one female, Hampton, Queensland, 3 Oct 1956, ex *Pan. laevicollis* (= *Pan. cribrata*) from eucalypt log (J12254) (all in SAMA); two females, Kanangra Walls, Kanangra-Boyd NP, NSW, 14 Nov 1997, O. Seeman & C. Bryant, ex *Pan. cribrata*; four males, four females, Mt Canobolas Park, Northern Boundary Rd, near Orange, NSW, 14 Nov 1997, O. Seeman, ex *Pan. cribrata* (in QM).

Redescription

Female

Dorsal idiosoma 700 long, 545–550 wide. Podosoma with 20 pairs of setae (*j1*, *j3*–6, *z1*, *z3*–6, *s1*–6, *r3*–6) and one unpaired seta (*j2*); opisthosoma with 14 pairs of setae (*J1*–5, others tentatively designated as *Z1*–5, *R1*–4). Setae *j1* 68–73, barbed, *Z5* 79–90, smooth, thickened, *J5* 33. Other setae in series *jJ* and *zZ* 5–8 long, *s* 8–10 long (*S3* absent), *r3* 73, *r4* 70–112, *r5* 68–93, *r6* 102, *R1* 75, *R2* 48–70, *R3* 73–80, *R4* 140–155, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield smooth medially, reticulate laterally.



FIGURES 28–30. *Paradiplogynium panesthia* Womersley, adult female: 28, ventral idiosoma. Adult male: 29, ventral idiosoma; 30, chelicera.

Ventral idiosoma (Fig. 28). Sternal shield reticulate, concave posteriorly, 76–78 long in midline, 153–163 long from anterolateral to posterolateral corner, 223–227 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 34–35, curved, *st2* 35–38, *st3* 29–37, smooth. Distance between setae *st1*–*st1* 88–103, *st2*–*st2* 85–89, *st3*–*st3* adjacent, *st1*–*st2* 8–10, *st1*–*st3* 68–78. Setae *st4* 23–31, on free paired metasternal shields. Tritosternum 148 long, base 10–15 long, 12–14 wide. Latigynal shields each 140–152 long, 91 wide, with one pair of pores and two pairs of setae, 15–16 long, anterior and medial margins (to mesogynal shield)

thickened, anterior margin weakly invaginated, shields reticulated. Mesogynal shield rectangular, 63 long, 28–35 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 78 long, meeting medially at a small porose plate. Ventral shield fused with exopodal shield, reticulate, and embracing a membranous anal region; setae *Jv1*–*3*, *Zv2* smooth, 25–28 long; four pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4*–*5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 85–95 long, 105–110 wide. Marginal shield with one pair of setae (*Zv4*), pores unclear; shields just meeting behind ventral shield. Peritreme extending to mid coxa II.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 25–30, *h2* 30–33, *h3* 20–26, palpcoxal seta 30. Corniculi slender, 34 long. Gnathotectum triangular, with ventro–median keel, point unclear. Palps unclear. Chelicerae not clearly visible, but papillate excrescence extends at least 25 from tip of chelicerae.

Legs. Chaetotaxy typical for the genus. Femur I elongate, seta *pd1* 30–36, *pd2* 30–35.

Male

Dorsal idiosoma 670–750 long, 480–565 wide. Dorsal setae as in female, *R4* 148–160, barbed, *Z5* 95–100, smooth, *J5* 38–44, barbed. Marginal setae *r3* 65–78, *r4* 88–90, *r5* 81–90, *r65* 88–100, *R1* 75–78, *R2* 68–75, *R3* 63–65. Holoventral shield reticulate, network becoming denser laterally (Fig. 29). Setae *st1* 26–34, base clearly visible, *st2* 30–38, *st3* 30–40, both blade-like medially, adjacent and on weak tubercles that also bear a cluster of glands and their associated pore opening. Setae *st4* 25–37, well behind (103–117) *st2* and *st3*. Setae *st5* 13–22 long. Tritosternum bifurcate, 103–110 long, bifurcate after 65–70, laciniae barbed. Genital opening at anterior margin of holoventral shield, 38–40 wide, 40 long. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and 0–1 pairs of pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 81–98 long, 88–112 wide. Marginal shield with three pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 22–25, *h2* 30–35, *h3* 20, palpcoxal seta 15–18. Corniculi slender, 33–38 long. Gnathotectum with sharp tip. Moveable digit of chelicera with eight teeth (anterior two tiny), fixed digit with nine teeth, plus proximal row of six tiny teeth; moveable digit with long papillate excrescence, a thick prong-like excrescence 53–58 long, and two scoop-like excrescences 28 and 15 long (Fig. 30). Legs as for female.

Paradiplogynium nahmani Seeman

Type specimens examined: Holotype female, Duck Ck, Lamington National Park, Qld, 15 Nov 1996, O. Seeman, ex *Titanolabis colossea*, QMS 73814. Paratype male, same data as holotype, QMS 73815.

Other specimens examined: Southeast Queensland: Ten males, six females, Hampton, 3 Oct 1956, G.F.B., ex *Panesthia laevicollis* (= *Pan. cribrata*) from eucalypt log (J12243–51, J12253–59); two males, one female, Dalby Banga, 25 Dec 1925, H. Geary, ex blattid (these misidentified by Womersley (1958) as *Par. panesthia*); three males, one female, Fire Tower Rd, Jimna State Forest, 16 Feb 1999, O. Seeman, ex *Pan. cribrata*; one male, five females, Plank Bridge, Jimna State Forest, 18 Feb 1999, O. Seeman, ex *Pan. cribrata*; three males [Lamington] National Park, R. Illidge, ex pinned *Pan. cribrata*; one female, Brisbane, 21 Aug 1918, H. Hacker, ex pinned *Pan. cribrata*; one male, Brisbane, 20 Jul 1918, H. Hacker, ex pinned *Pan. cribrata*; one female, same data except from different *Pan. cribrata* specimen. All in QM. **Northeast Queensland:** Three females, four males, Bluewater Range, 50 km WNW Townsville, 6–8 Dec 1986, 7–800 m alt., RF, Monteith, Thompson & Hamlet coll., ex pinned *Pan. sloanei*; one female, Curtain Fig, 2 km S Yungaburra, 8 Dec 1988, 700 m. alt, Monteith & Thompson, ex pinned *Pan. ancaudellioides*; one male, Bloomfield Rd, via Helenvale, 20–27 July 1974, Monteith & Cook, ex pinned *Pan. ancaudellioides*. All in QM.

Description (based on Southeast Queensland specimens from *P. cribrata*)

Female

Dorsal idiosoma 715–790 long, 550–605 wide. Podosoma with 20 pairs of setae (*j1*, *j3*–*6*, *z1*, *z3*–*6*, *s1*–*6*, *r3*–*6*) and one unpaired seta (*j2*); opisthosoma with 14 pairs of setae (*J1*–*5*, others tentatively designated as *Z1*–*5*,

R1-4). Setae *j1* 58–63, barbed, *Z5* 85–95, smooth, *J5* 25. Other setae in series *jJ*, *zZ*, and *s* 17–25 long (*S3* absent), tending to be longest in *s* series. Setae *r3* 35–38, *r4* 45–50, *r5* 40–45, *r6* 40–50; *R1* 25–34, *R2* 25–30, *R3* 60–70, *R4* 155–185, all weakly barbed. Lyrifissures *idz1* and *idr3* present; dorsum with 13 pairs of glands. Dorsal shield covered with fine reticulation, weaker medially.

Ventral idiosoma. Sternal shield reticulate, concave posteriorly, 80–86 long in midline, 145–173 long from anterolateral to posterolateral corner, 209–231 wide at widest point; with three pairs of setae, two pairs of lyrifissures and one pair of pores. Setae *st1* 31–35, curved, *st2* 33–36, *st3* 29–31, smooth. Distance between setae *st1-st1* 98–105, *st2-st2* 94–100, *st3-st3* adjacent, *st1-st2* 5–8, *st1-st3* 78–90. Setae *st4* 18–20, on free paired metasternal shields, which have their anterior edges beneath the posterior margin of the sternal shield. Tritosternum 145–162 long, base 12 long, laciniae pilose, dividing 110 from base. Latigynal shields each 123–135 long, 83–89 wide, with one pair of pores and one pair of setae, 18–20 long, anterior and medial margins (to mesogynal shield) thickened, anterior margin strongly invaginated, shields reticulated. Mesogynal shield rectangular, 48–57 long, 18–21 wide, overlapped by latigynal shields in anterolateral region. Vaginal sclerites 95–101 long, meet medially at a small porose plate. Ventral shield fused with exopodal shield, with dense reticulation medially becoming sparser laterally; ventral shield embraces a membranous anal region; setae *Jv1-3*, *Zv2* smooth, 20–28 long; 4–5 pairs of irregularly placed pores anterior to anus; two pairs of smooth setae (*Jv4-5*), one pair of lyrifissures and one pair of pores laterad and posterior to anus. Anal plates surrounded by membranous region 83–100 long, 90–113 wide. Marginal shield with 2–3 pairs of pores and one pair of setae (*Zv4*); shields just meeting behind ventral shield. Peritreme extending to coxa I. Body holding up to four eggs.

Gnathosoma. Hypostome with four pairs of weakly barbed setae, *h1* 33–40, *h2* 50–58, *h3* 25–35, palpcoxal seta 25–30. Corniculi slender, 43–45 long. Gnathotectum triangular, with ventro-median keel, coming to a sharp point. Palps unspecialised, setal counts from trochanter 2-5-7-15-16 setae; apotele 2-tined, but with tiny basal prong. Fixed digit of chelicerae with 11 teeth (anterior two tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with 9–10 teeth (most anterior tiny), proximally with 7–8 minute teeth, and three excrescences: one short and brush like, one with minute papillae and only slightly longer than cheliceral digits, the other extending 30–42 past tip of moveable digit and covered with numerous papillae.

Legs. Chaetotaxy typical for the genus. Femur I elongate, seta *pd1* 35–37, *pd2* 30–36.

Male

Dorsal idiosoma 655–740 long, 490–570 wide. Dorsal setae as in female, *R4* 170–173, barbed, and *Z5* 83–100, smooth. Holoventral shield reticulate, with densest reticulation medially. Setae *st1* 18–20, curved, flanking tritosternum base, *st2* 22–25, *st3* 22–25, weakly blade-like, adjacent and on bulbous projection 48–52 wide, also bearing a cluster of glands and their associated pore opening. Setae *st4* 20, well behind (108–130) *st2* and *st3*. Setae *st5* 13–17 long. Tritosternum bifurcate, laciniae barbed; base broad, 49–40 wide, plus a smaller basal plate and broader area of soft cuticle. Genital opening beneath anterior margin of holoventral shield. Holoventral shield fused with exopodal shield and embracing a membranous anal region; four pairs of setae and 3–4 pairs of irregularly placed pores between anterior margin of anal membrane and CxIV; one pair of pores and one pair of setae lateral to anal membrane; one pair of setae, lyrifissures and pores posterior to anal membrane. Anal membrane 85–94 long, 95–108 wide. Marginal shield with 4–5 pairs of pores and one pair of setae; shields just meeting behind ventral shield. Hypostome with four pairs of weakly barbed setae, *h1* 25–31, *h2* 38–56, *h3* 25–32, palpcoxal seta 23. Corniculi slender, 32–38 long. Gnathotectum with rounded tip. Chelicerae as in female, except the base of the moveable digit of the chelicera has two scoop-like lobes (one is 25 long), and a larger (40–45 long) somewhat sclerotised scoop-like excrescence; large papillate excrescence extends 45 past tip of moveable digit. Legs as for female.

Remarks

Paradiplogynium nahmani occurs in southeast and northeast Queensland and has been recorded from four host species: the type host, *Titanolabis colossea*, and *Pan. cribrata* in southeast Queensland; and *Pan. ancaudellioides* and *Pan. sloanei* in northeast Queensland. These may represent three new species — from *T. colossea*, *Pan. cribrata* and both host species in northeast Queensland — but the differences seemed too minor to warrant description without extensive collections throughout the range of their host species. Characters that vary are the size of the idiosoma, length of marginal setae, and number of pores on the marginal shields (Table 1). *Paradiplogynium nah-*

mani from northeast Queensland (n = 9) are the smallest, irrespective of host, but have longer marginal setae and more pores on the marginal shield than their southern conspecific specimens. *Paradiplogynium nahmani* from *Pan. cribrata* (n = 25) are intermediate in size between the northeastern *Par. nahmani* and *Par. nahmani* from the Colossus Earwig (n = 3), and have only 2–3 pores on the marginal shield.

TABLE 1. Comparison of measurements that differ between collections of *Paradiplogynium nahmani* from *Titanolabis colossa* (Dermaptera), *Panesthia ancaudellioides*, *Pan. cribrata* and *Pan. sloanei* (Blattodea) in southeast and northeast Queensland. All measurements are in micrometres and are presented as ranges; F = number of female mites examined; M = number of male mites examined.

	Southeast Queensland		Northeast Queensland	
	<i>Titanolabis colossa</i> (F = 1; M = 2)	<i>Panesthia cribrata</i> (F = 15; M = 20)	<i>Panesthia ancaudellioides</i> (F = 1; M = 1)	<i>Panesthia sloanei</i> (F = 3; M = 4)
Female				
Idiosoma length	910	715–790	650	650–700
Idiosoma width	660	550–605	490	480–510
jJ length	17–30	17–25	12–18	12–18
zZ length	17–30	17–25	12–18	12–18
r3 length	31	35–38	40	35–53
r4 length	40	45–50	58	61–70
r5 length	30	40–45	60	55–73
r6 length	38	40–50	65	70–76
R1 length	27	25–34	48	48–58
R2 length	broken	25–30	43	48–55
R3 length	broken	60–70	53	58–68
st2–st2 distance	100	94–100	80	83–88
st1–st3 distance	95	78–90	63	60–66
Latigynal length	143	123–135	103	120–125
Latigynal width	88	83–89	75	80–85
Pores on marginal	6–7	2–3	10	9
Peritreme length	to coxa I	to coxa I	to coxa II	to coxa I
Male				
Idiosoma length	850–860	655–740	590	585–660
Idiosoma width	600–610	490–570	480	450–485
Gnathotectum tip	very blunt	very blunt	moderately blunt	narrowly blunt

Key to species of *Paradiplogynium*

1. **Female:** Two pairs of setae on latigynal shields. **Male:** Setae *st2*–*3* blade-like, not on tubercles. 2
- **Female:** One pair of setae on latigynal shields. **Male:** Setae *st2*–*3* slender, set on tubercles 4
2. **Female & Male:** Idiosoma 670–750; reticulation transverse-lineate between *Jv2* setae. Host *Panesthia cribrata*
Paradiplogynium panesthia Womersley
- **Female & Male:** Idiosoma < 600; reticulation polygonal between *Jv2* setae 3
3. **Female & Male:** Setae *R1* > 100 long. **Female:** Setae *st3* > 15 behind posterior margin of sternal shield. Host *Panesthia tyroni*
tyroni *Paradiplogynium caitlinae* sp. nov.
- **Female & Male:** Setae *R1* 38–50 long. **Female:** Setae *st3* < 10 behind posterior margin of sternal shield. Host *Panesthia sloanei*
sloanei *Paradiplogynium karii* sp. nov.
4. **Female & Male:** Opisthosoma with 15 pairs of setae (seta *S3* present) 5
- **Female & Male:** Opisthosoma with 14 pairs of setae (seta *S3* absent) 6

5. **Female & Male:** Dorsal idiosoma with 20 pairs of pores. **Female:** Sternal shield completely covered in reticulation; latigynal shields with mostly polygonal reticulation. Host *Panesthia tyroni*. *Paradiplogynium damieni* **sp. nov.**
- **Female & Male:** Dorsal idiosoma with 13 pairs of pores. **Female:** Sternal shield with reticulation posteriorly only; latigynal shields with mostly lineate reticulation. Host *Panesthia tyroni*. *Paradiplogynium elizabethae* **sp. nov.**
6. **Female & Male:** Idiosoma > 650 long. *r*-series setae < 55 long; *RI*-2 < 60 long. Various host species *Paradiplogynium nahmani* Seeman
- **Female & Male:** Idiosoma < 600 long. *r*-series setae > 90 long; *RI*-2 > 100 long. Host *Panesthia cribrata*. *Paradiplogynium isaaci* **sp. nov.**

Discussion

Higher taxa of Trigynaspida show some degree of specificity to host families. For example, the Aenictequoidea and Antennophoroidea are found on Formicidae, the Parantennuloidea are found on Carabidae, and the Megisthanoidea and Fedrizzioidea are found on Passalidae (Kim, 2004). This is not so with the Celaenopsoidea, and especially its largest family, the Diplogyniidae. Some families of Celaenopsoidea do seem to be specific, such as the Euzerconidae associated with Passalidae, but the Diplogyniidae are rather more flexible regarding host associations. Beetles are the most common hosts, but even within genera diplogyniid mites can have very different hosts. For example, *Cryptometasternum derricki* is a common mite on Passalidae in southeast Queensland, as is *Cryptometasternum queenslandense* Womersley, an associate of pill millipedes (Sphaerotheriidae) (Womersley, 1958; Seeman, 2001).

Thus, it did not seem unusual that *Par. nahmani* occurred on a different host order to its congeneric species *Par. panesthia*. However, the discovery *Par. nahmani* from *Pan. cribrata* is a strong indication that this species is the usual host of *Par. nahmani*. Both hosts are inhabitants of rotting logs, so it is not unreasonable that a few could have become accidentally associated with a Colossus Earwig. Nevertheless, the *Par. nahmani* associated with Colossus Earwigs could also represent a cryptic species or the observed differences in size and pore numbers really are consistent with them being separate species. Further collections of this unusual host and its mites are required to answer this question.

Where two species of mite were collected from a single host species (within a general geographical location), there was always a large and a small species. From *Pan. tyroni tyroni* are the large species *Par. damieni* (idiosoma 880–940) and a small species *Par. caitlinae* (idiosoma 515–600); from *Pan. cribrata* in southeast Queensland are *Par. nahmani* (idiosoma 655–790) and *Par. isaaci* (idiosoma 440–565); from *Pan. sloanei* are *Par. nahmani* (idiosoma 655–790) and *Par. karii* (idiosoma 480–560); and from *Pan. ancaudellioides* are *Par. nahmani* (590–650) and *L. harrynahmani* (390–515). In the case of *Pan. tyroni tyroni*, when host cockroaches are killed in ethanol, the *Par. damieni* fall easily from between the legs of their hosts. In contrast, only two specimens of *Par. caitlinae* were originally mounted, and it was not until the legs of the host were extended that the remaining specimens were found, suggesting that this smaller species reside deeper under the coxae of their host.

With the exception of one specimen, *Par. nahmani* is found only in Queensland and *Par. panesthia* only in New South Wales. I speculate that Womersley's single specimen of *Par. panesthia* in his Queensland material is an error—through mounting or labelling—and that these species do not co-occur.

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