



A new species of *Paradiplogynium* (Acari: Diplogyniidae) from *Titanolabis colossea* (Dohrn) (Dermaptera: Anisolabididae), Australia's largest earwig

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Abstract

Paradiplogynium nahmani sp. n. is described from three specimens taken from the Colossus Earwig *Titanolabis colossea* (Dohrn) in Australia. This new species differs from its only congeneric species, *Paradiplogynium panesthia* Womersley, by its larger body size and presence of one pair of latigynial setae (instead of two pairs). Setal designations are given for leg setae. Leg chaetotaxy for this species is compared with previous data and is generally, but not entirely, consistent with other Diplogyniidae.

Key words: Trignyaspida, Antennophorina, taxonomy, host association, leg chaetotaxy

Introduction

The Giant or Colossus Earwig, *Titanolabis colossea* (Dohrn 1864), is Australia's largest earwig and amongst the world's dermapteran leviathans (Fig. 1; Rentz & Kevan 1991). Despite their size, they are not encountered frequently but can be locally abundant. Furthermore, little is known of these beautiful earwigs: they reach 57 mm in length, live in rotting logs in wet sclerophyll and rainforests of eastern Australia, and females brood their eggs, but otherwise their habits remain unknown (Rentz & Kevan 1991; pers. obs.). In 1996, I captured a *T. colossea* that carried three mites of an attractive new species of *Paradiplogynium* (Acari: Diplogyniidae) and also one female *Heatherella callimaulos* Walter 1997 (Acari: Heatherellidae).

Diplogyniid mites are moderately large (ca. 500–1000 µm), often dark-brown or reddish-brown animals that, like most of their trigynaspid kin, have an affinity for insects. Generally, only adult male and female mites are found on insects, while immature stages are presumably free-living predators in their hosts' habitat. For example, adult *Cryptometasternum derricki* Womersley 1958 are common on several species of passalid beetle in south-eastern Queensland. Their larvae and nymphs live within the beetles' tunnels and can be reared on a diet of nematodes (pers. obs.). *Paradiplogynium* is represented by just one species, *Paradiplogynium panesthia* Womersley 1958, collected from the large wood cockroach *Panesthia cribrata* Saussure 1864. Its adult stages were found on these cockroaches in New South Wales and Queensland and although the immature life stages are unknown, they are probably free-living predators in the wood chambers of their host. Womersley (1958) gives a long diagnosis of the genus, of which its most striking feature is the membranous region surrounding the anus.

Materials & methods

Mites were killed in 80% ethanol, cleared in Nesbitt's fluid, slide-mounted in Hoyer's medium and later

sealed with Isonel 301 (O'Brien-aim, Brisbane, Australia). Measurements and drawings were made with a Nikon Eclipse 80i microscope equipped with DIC and a drawing tube. Measurements are in micrometres and are lengths when not specified as such. Photographs of the host were taken with a Canon G5 digital camera and were combined into a single image with HeliconFocus software (Helicon Soft Ltd., Kharkov, Ukraine). Leg chaetotaxy follows Evans (1963, 1965, 1969), but setal names were also assigned with reference to the chaetotaxy of *Meristomegistus vazquezus* Kim & Klompen 2002 (Acari: Paramegistidae). Chaetotactic designations were also derived from comparison with protonymphs, deutonymphs and adults of *C. derricki*. The completed chaetotaxy was later compared with that presented by Kethley (1977).

***Paradiplogynium nahmani* Seeman, sp. n.**

Material examined. Holotype female (QM S73814): AUSTRALIA, Qld, Lamington National Park, Duck Ck, 15 Nov 1996, O. Seeman coll. ex adult *Titanolabis colosseae* (Dermaptera: Anisolabididae) from beneath bark of a large rotting log (Fig. 1). Paratypes: two males (QM S73815), same data. Holotype and one paratype deposited in Queensland Museum, Brisbane, one paratype deposited in the Australian National Insect Collection, Canberra.



FIGURE 1. *Titanolabis colosseae* (Dohrn), host specimen for *Paradiplogynium nahmani* sp. n. Host specimen length = 45 mm.

Description. FEMALE (Figs 2, 4, 6–9): *Dorsal idiosoma* 910 long, 660 wide. Podosoma with 20 pairs of setae (*j1*, *j3–6*, *z1*, *z3–6*, *s2–6*, *r2–6*) and one unpaired seta (*j2*); opisthosoma with 13 pairs of setae (*J1–5*, others tentatively designated as *Z1*, *S1–3*, *S5*, *R1–3*). Setae *j1* 53, barbed, setae *S5*, *Z5*, *J5* postero-marginal, *S5* at least 115, barbed, *Z5* 83, smooth. Other setae in series *jJ*, *zZ* and *sS* 17–30, *rR* series 25–33, all weakly barbed. Dorsal shield covered with fine reticulation. *Sternal shield* with anastomosing network of reticulation, concave posteriorly, 100 long in midline, 173 long from anterolateral to posterolateral corner, 235 wide at widest point; with 3 pairs of setae and 2 pairs of lyrifissures. Setae *st1* 33, *st2* 33, *st3* 23, smooth, *st1* and *st2* stout. Distance between setae *st1–st1* 108, *st2–st2* 100, *st3–st3* adjacent, *st1–st2* 13, *st1–st3* 95. Setae *st4* 18, on free paired metasternal shields, which have their anterior edges beneath the posterior margin of the sternal shield. Tritosternum lost during dissection. *Genital shields.* Latigynial shields each 143 long, 88 wide, with 1 pair of pores and 1 pair of setae, anterior and medial margins (to mesogynial shield) thickened, anterior margin invaginated, shields covered with linear to anastomosing pattern of reticulation. Mesogynial shield rectangular, 55 long, 25 wide, overlapped by latigynial shields in anterolateral region. Vaginal sclerites present, meet-

ing medially at a porose plate; bent in specimen. *Ventral shield* fused with exopodal shield and embracing a membranous anal region; reticulation linear-anastomosing; with 4 pairs of smooth setae 18–25 long, and 6

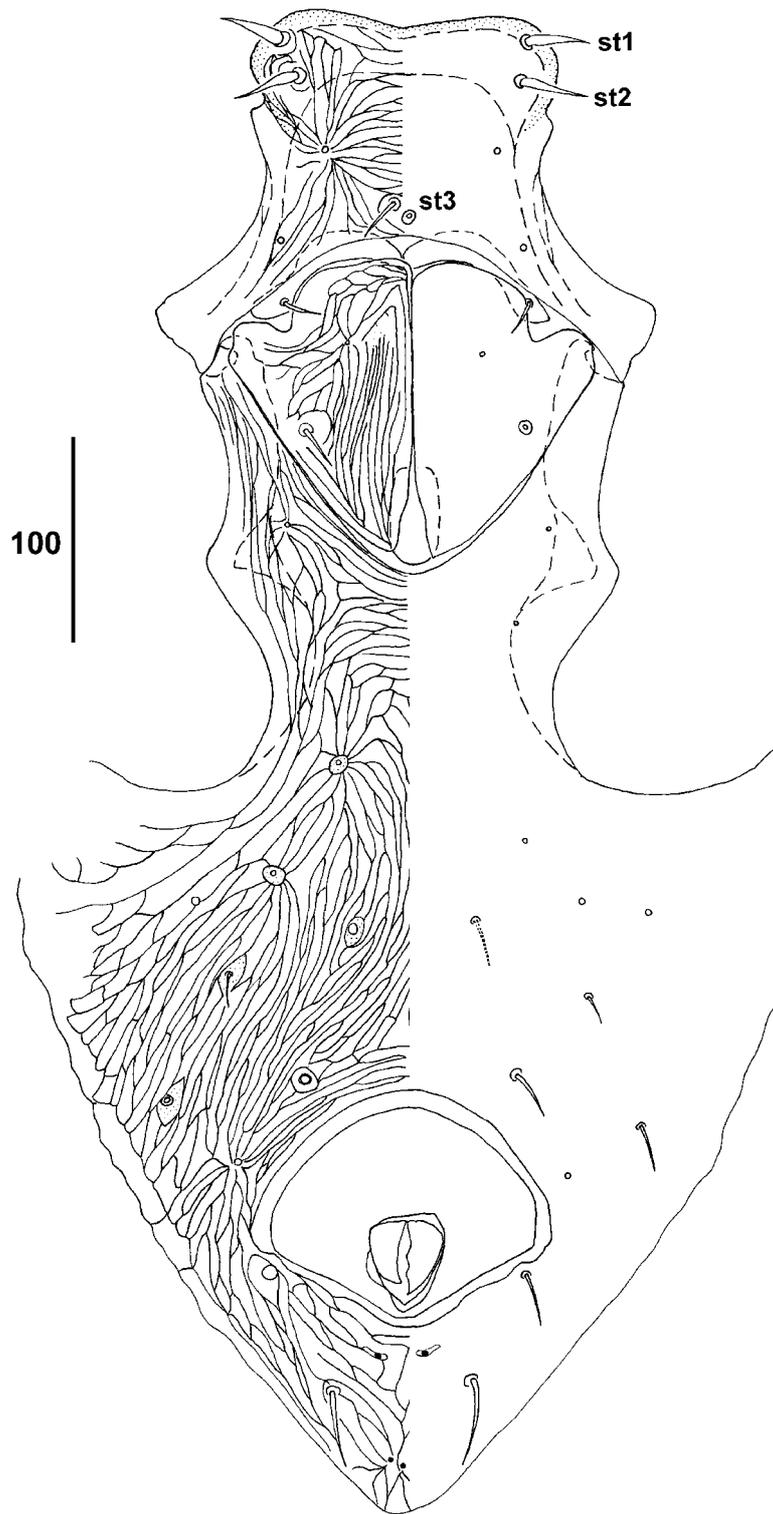


FIGURE 2. Sternal, genital and ventral shields of *Paradiplogynium nahmani* **sp. n.**, female. Marginal shields are not shown.

pairs of irregularly placed pores anterior of anus; 2 pairs of smooth setae 28–30 long, one pair of pores and a pair of lyrifissures laterad and posterior of anus. Anal plates surrounded by membranous region 113 long, 143 wide. Without an unpaired postanal seta. Marginal shield with 6–7 pairs of pores and 1 pair of setae; shields

meeting behind ventral shield and posteriorly fused with dorsal shield. *Gnathosoma* with 4 pairs of weakly barbed setae, *h1* 40, *h2* 55, *h3* 35, palpcoxal seta 30. Corniculi horn-like, 53 long. Gnathotectum triangular, with ventro-median keel, mounted laterally so tip not discernable. Palps unspecialised, setal counts from trochanter 2-5-7-15 setae; tarsus unclear, with 15-16 setae, apotele 2-tined. Fixed digit of chelicerae with 9 teeth (anterior 2 tiny), minute pilus dentilis, cheliceral seta, and serrated process; moveable digit with 7 teeth (most anterior tiny) and 3 excrescences: one short and brush like, one with minute papillae and only slightly longer than cheliceral digits, the other extending 45 past tip of moveable digit and covered with numerous papillae.

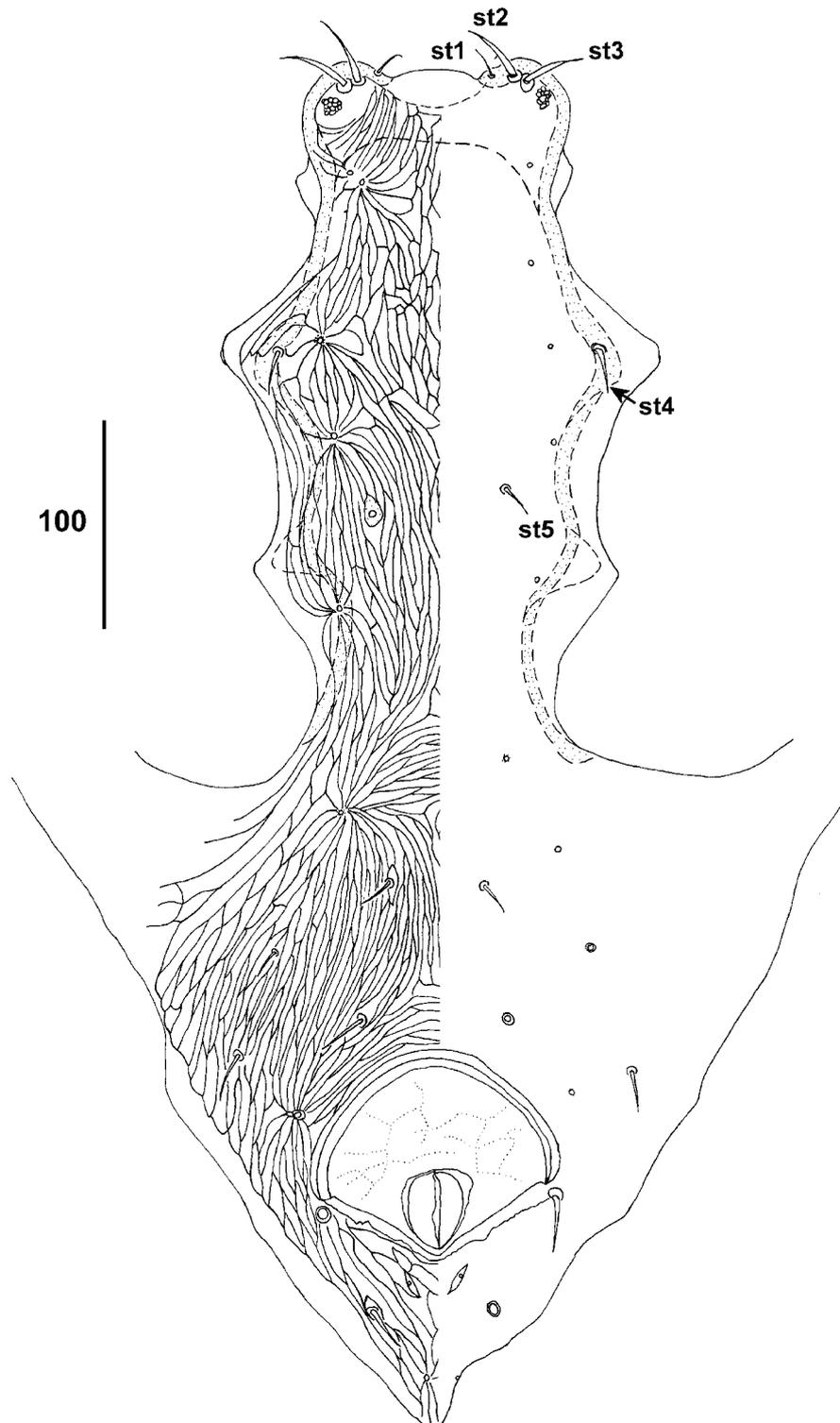
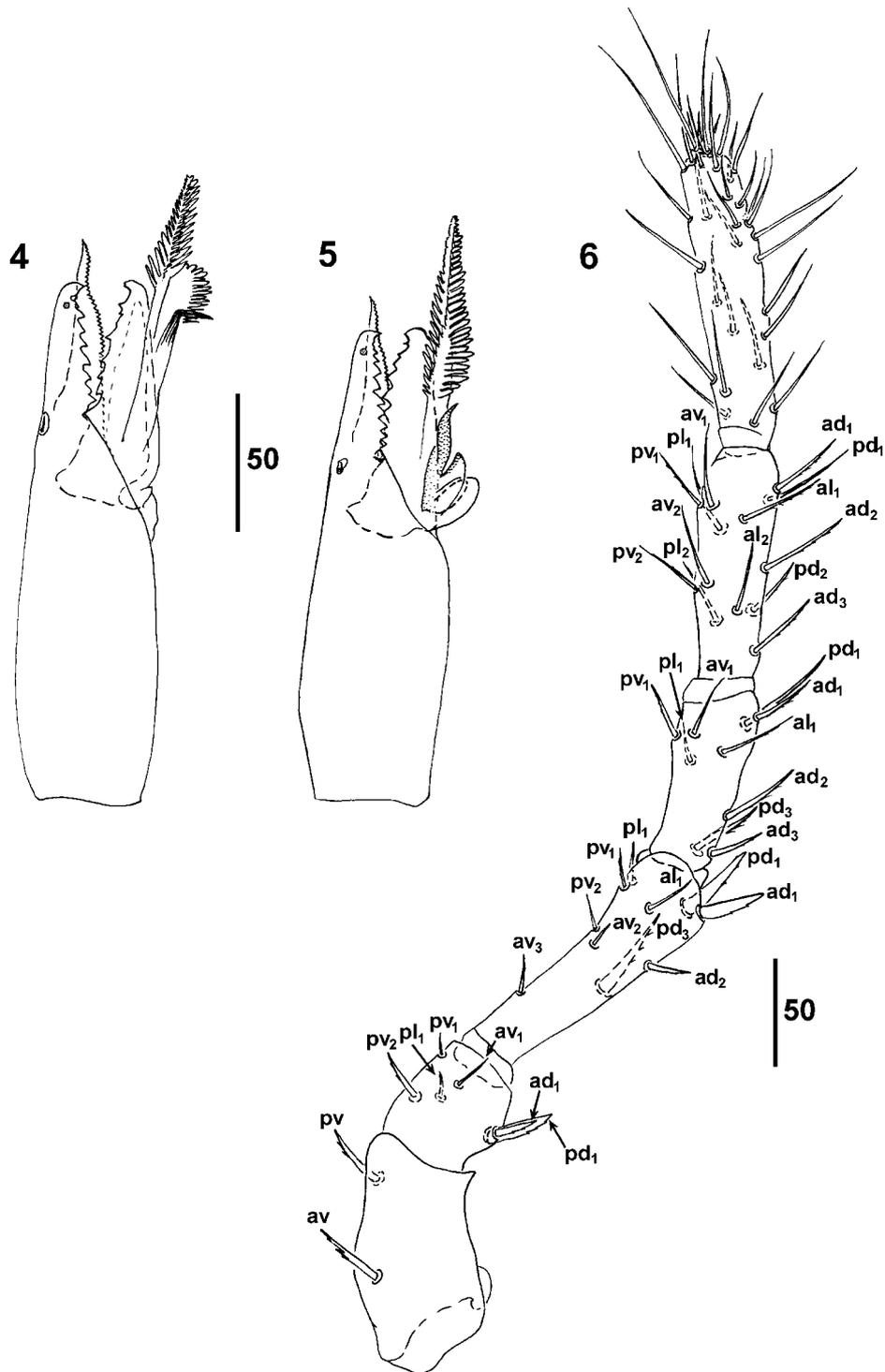


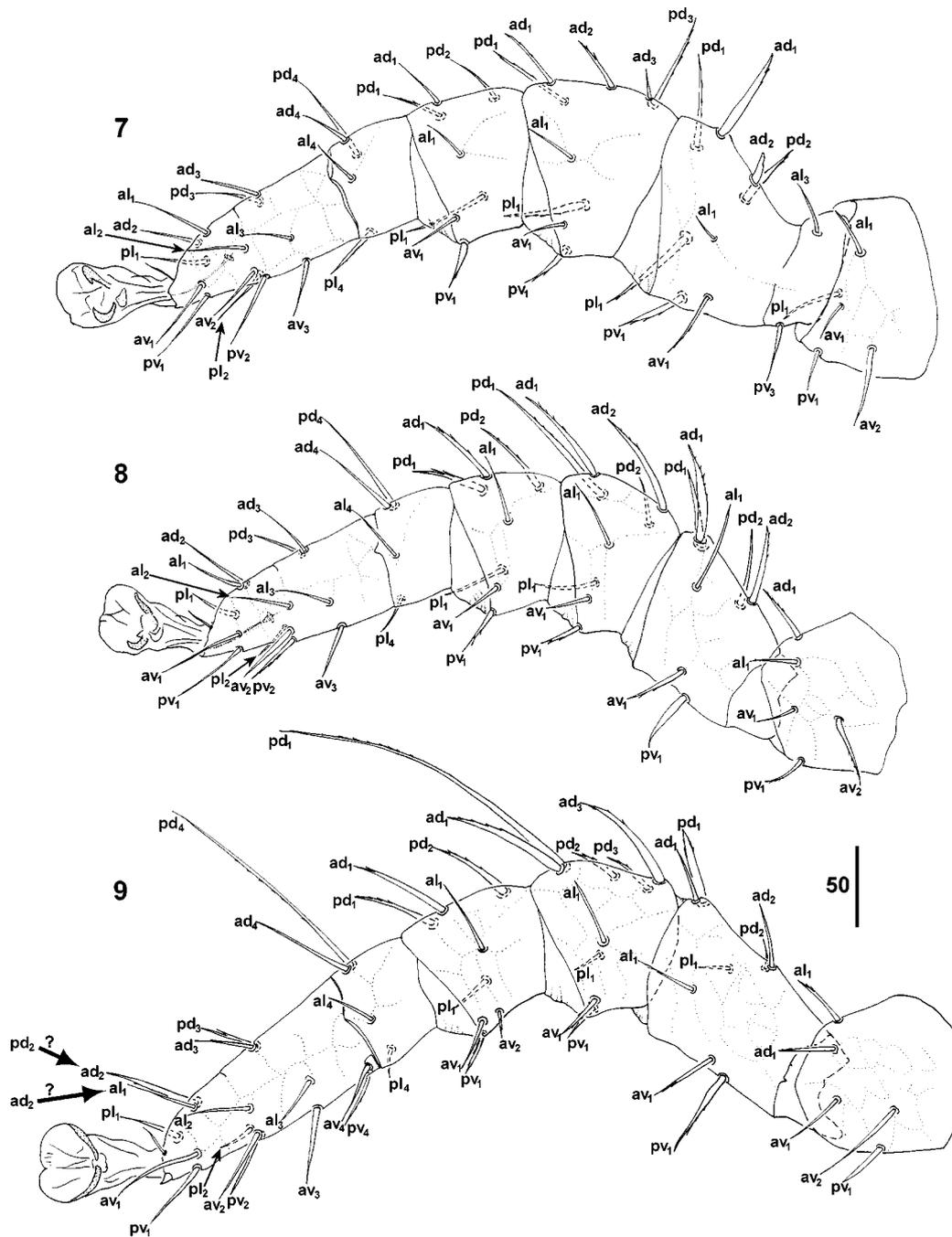
FIGURE 3. Sternoventral shield of *Paradiplogynium nahmani* sp. n., male. Marginal shields are not shown.



FIGURES 4–6. *Paradiplogynium nahmani* sp. n. 4, female chelicera; 5, male chelicera; 6, female leg I.

Leg chaetotaxy: CxI 2 (*av*, *pv*), TrI 6 (*ad1*, *pd1*, *pl1*, *av1*, *pv1*, *pv2*), FeI 1-2/2;2/2-1 (*ad1*, *ad2*, *pd1*, *pd3*, *al1*, *pl1*, *av2*, *av3*, *pv1*, *pv2*), GeI 1-3/1;2/1-1 (*ad1*, *ad2*, *ad3*, *pd1*, *pd3*, *al1*, *pl1*, *av1*, *pv1*), TiI 2-3/2;2/2-2 (*ad1*, *ad2*, *ad3*, *pd1*, *pd2*, *al1*, *al2*, *pl1*, *pl2*, *av1*, *av2*, *pv1*, *pv2*); TaI with ca. 28 setae before tarsal tip; tip with 2 long setae and about 6 sensilla. CxII 2, TrII 5, FeII 2-2/1;2/2-1 (*ad1*, *ad2*, *pd1*, *pd2*, *al1*, *al3*, *pl1*, *av1*, *pv1*, *pv3*), GeII 1-3/1;2/1-1 (*ad1*, *ad2*, *ad3*, *pd1*, *pd3*, *al1*, *pl1*, *av1*, *pv1*), TiII 1-1/1;2/1-1 (*ad1*, *pd1*, *pd2*, *al1*, *pl1*, *av1*, *pv1*), TaII 4+15 (*ad1*, *ad2*, *ad3*, *ad4*, *pd2*, *pd3*, *pd4*, *al1*, *al2*, *al3*, *al4*, *pl1*, *pl2*, *pl4*, *av1*, *av2*, *av3*, *pv1*, *pv2*). CxIII 2, TrIII 5, FeIII 1-2/1;2/1-0 (*ad1*, *ad2*, *pd1*, *pd2*, *al1*, *av1*, *pv1*), GeIII 1-2/1;2/1-1 (*ad1*, *ad2*, *pd1*, *pd2*,

al1, pl1, av1, pv1), TiIII 1-1/1;2/1-1 (*ad1, pd1, pd2, al1, pl1, av1, pv1*), TaIII 4+15 (same as TaII). CxIV 1, TrIV 5, FeIV 1-2/1;2/1-1 (*ad1, ad2, pd1, pd2, al1, pl1, av1, pv1*), GeIV 1-2/1;3/1-1 (*ad1, ad3, pd1, pd2, pd3, al1, pl1, av1, pv1*), TiIV 1-1/2;2/1-1 (*ad1, pd1, pd2, al1, pl1, av1, av2, pv1*), TaIV 4+(2)+15 (same as TaII-III but with *av4* and *pv4* on intercalary sclerite that is fused with tarsus).



FIGURES 7–9. *Paradiplogynium nahmani* sp. n., female. 7, leg II; 8, leg III; 9, leg IV. Arrows designate an alternative interpretation of tarsal setae applicable to tarsi II–IV.

MALE (Figs 3, 5): *Dorsal idiosoma* 850–860 long, 600–610 wide. Dorsal setae as in female, *S5* 198, barbed, and *Z5* 85–98, smooth. *Holoventral shield* with anastomosing network of reticulation. Setae *st1* 15–18, flanking tritosternum base, *st2* and *st3* 33, stout, adjacent and on raised tubercles that also bear modified *stp1*. Setae *st4* 20–23, well behind (130) *st2* and *st3*. Setae *st5* 18–20 long. Tritosternum bifurcating, laciniae barbed. Genital opening beneath anterior margin of holoventral shield. Holoventral shield fused with exopo-

dal shield and embracing a membranous anal region; 4 pairs of setae and 3 pairs of irregularly placed pores between anterior margin of anal membrane and CxIV; 1 pair of pores and 1 pair of setae lateral to anal membrane; 1 pair of setae, lyrifissures and pores posterior of anal membrane. Anal membrane 103–108 long, 120–125 wide. Marginal shield with about 10 pairs of pores and 1 pair of setae; shields meeting behind ventral shield and posteriorly fused with dorsal shield. *Gnathosoma* with 4 pairs of weakly barbed setae, *h1* 25–30, *h2* 58–60, *h3* 28–30, palpcoxal seta 30. Corniculi horn-like, 38–40 long. Gnathotectum with rounded tip. Chelicerae as in female, except the short brush-like and short papillate excrescences are absent; instead, the base of the chelicera has 3 small lobes and a larger (40–43 long) somewhat sclerotised blade-like excrescence. *Legs* same as female.

Etymology. This species is described to celebrate the birth of Archie Oliver Nahman.

Remarks. This species is considerably larger than *P. panesthia* (910 vs 696 long), has one seta on each latigynial shield (instead of two), only two pairs of long marginal setae (instead of several pairs), and lacks a fine line linking the membranous anal region with the ventral shield. The species also differs in host, but I regard this host association as tentative because only three specimens were collected from a single earwig. However, I have collected extensively from logs in Lamington National Park (e.g., Walter *et al.* 1998), including numerous cockroaches that have their own species of *Paradiplogynium* allied to *P. panesthia* (Seeman 2002), and I have not encountered this species elsewhere, thus strengthening the possibility that this mite is closely associated with Colossus Earwigs.

Discussion

Most Diplogyniidae and Euzerconidae have identical leg chaetotaxy, a finding based on nine diplogyniid genera and three euzerconid species (Kethley 1977). This is true for *Paradiplogynium*, which has identical leg chaetotaxy compared with *Lobogynioides andreinii* (Berlese 1909), *Ophiocelaeno sellnicki* Johnston & Fain 1964 and *Cryptometasternum queenslandense* Womersley, 1958 (Masán & Kalúz 1998; Johnston & Fain 1964; pers. obs., respectively). The only difference relates to femora I, where I have interpreted the most proximal seta as *av3* instead of *pv3*, based on its position in the protonymph and deutonymph of *C. derricki*. However, not all Diplogyniidae have identical leg chaetotaxy because *C. derricki* has an extra seta, *pd2*, on femora I. This seta is added in the deutonymph (all other dorsal setae are present in the protonymph) and is therefore likely to be the seta absent in Diplogyniidae with 10 setae on femora I.

Comparing leg chaetotaxy in the Trigynaspida is somewhat frustrating. In one respect there are few detailed studies of leg chaetotaxy, such as Kim and Klompen (2002) and Kim (in press), where all setae are illustrated and named. In contrast, Kethley (1977) presented a phylogeny of the Trigynaspida based entirely on leg chaetotaxy. This work ought to have provided a comprehensive chaetotactic survey of the Trigynaspida, but instead is lacking detail for what must have represented a voluminous amount of study. Indeed, a recent phylogeny of the Trigynaspida did not use leg chaetotaxy (within the Trigynaspida) because of ambiguities arising from different authors' deriving variable setal interpretations (Kim 2004), demonstrating a lack of confidence in Kethley's data in the absence of verifiable evidence.

Kethley (1977) did not present the chaetotaxy of his hypothetical trigynaspid ancestor, but some comparison between his and my interpretations can be made from compiling a list of variable setae that should be present or absent in the Diplogyniidae, according to Table 2 and Figure 2 of Kethley (1977). Curiously, we agree on 25 of the 27 setal losses that define the Diplogyniidae. *Paradiplogynium* is not lacking *pd3* on genua II, nor *ad3* on genua IV, where I interpret *ad2* as missing, not *ad3*. However, of the 37 setae that should be present 5 are missing: *pl3* and *pv3* on femora I and *al2*, *v2* (i.e. *av2* or *pv2*) and *pl1* on femora III. These differences presumably represent differences in interpretation of the setation of the femoral segments.

My designation of setae on the distal tarsus is tentative and here I have elected to preserve the designa-

tions of Evans (1965, 1969) for the Antennophorina. Nevertheless, I also offer an interpretation that setae *all* may be missing, rather than *pd2* (Fig. 9). This suggestion has, at least, an aesthetic appeal as it preserves separate setal whorls (i.e. no “1” setae are adjacent to a “2” seta) and *ad3* and *pd3* are in line with setae *ad2* and *pd2*.

Leg chaetotaxy can be highly informative, but detailed illustrations are required to allow other acarologists to make their own judgment on setal designations. Without such information, future workers – especially those investigating phylogenetic relationships – must begin their understanding of trigynaspid leg chaetotaxy where Kethley (1977) started, instead of where he left us.

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