

# A REVIEW OF THE GENUS *PROCTOTYDAEUS* BERLESE (ACTINEDIDA: TYDEIDAE: PRONEMATINAЕ)

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**PROCTOTYDAEUS**  
DIAGNOSIS  
NEW TAXA  
KEY  
PHYLOGENY

**PROCTOTYDAEUS**  
DIAGNOSE  
NOUVEAUX TAXONS  
CLÉ  
PHYLOGÉNÈSE

**SUMMARY:** A revised diagnosis of the genus *Proctotydaeus* Berlese, together with remarks about sexual dimorphism and systematic position of the genus within the subfamily Pronematinae are presented. Descriptions are given for the subgenera *Proctotydaeus*, *Neotydeolus*, *Oriolella* and *Proctotydulus* subgen. nov., as well as for two new species, *Proctotydaeus (Oriolella) polonicus* sp. n. and *Proctotydaeus (Oriolella) lindquisti* sp. n. Phylogenetic relationships between the subgenera are considered. A key to the species of *Proctotydaeus* and a list of all species of Pronematinae are added.

**RÉSUMÉ :** Nous présentons la révision du genre *Proctotydaeus* Berlese et de sa diagnose, en même temps que des remarques sur le dimorphisme sexuel et sur la place du genre dans la systématique de la sous-famille des Pronematinae. Nous décrivons les sous-genres *Proctotydaeus*, *Neotydeolus*, *Oriolella* et *Proctotydulus* nov. subgen., ainsi que deux espèces nouvelles, *Proctotydaeus (Oriolella) polonicus* n. sp. et *Proctotydaeus (Oriolella) lindquisti* n. sp. Nous examinons les rapports phylogénétiques entre ces sous-genres. Nous ajoutons la clé des espèces de *Proctotydaeus* et la liste des espèces de Pronematinae.

## INTRODUCTION

The genus *Proctotydaeus* was established by BERLESE (1911), based on one newly described species, *P. viator* Berlese, 1911, collected from an adult orthopteran insect from Java. In the monograph of family Tydeidae published by THOR (1933), among the 14 genera then distinguished, *Proctotydaeus* is mentioned as a monospecific genus. BAKER & WHARTON (1952) divided the Tydeidae into only six genera, treating *Proctotydaeus* as one of three subgenera of the genus *Pronematus* G. Canestrini, 1886. BAKER (1965), in his review of the genera of Tydeidae, later transferred *Proctotydaeus* to the Iolinidae. FAIN & EVANS (1966) described the second and third species of *Proctotydaeus*: *P. schistocercae* and *P. galapagensis*. ANDRÉ (1979) placed *Proc-*

*totydaeus* back in the Tydeidae as *Proctotydaeus* sensu Fain et Evans, 1966, on the basis of the chaetotaxies of the idiosoma and legs, which were common to several species previously placed in different genera.

Apart from *P. schistocercae*, the following species were assigned by ANDRÉ (1980) to *Proctotydaeus*: *pyrrohippeus* (Treat, 1961), *farbae* (Baker, 1968), *therapeuticos* (Flechtmann & Camargo, 1974), *galapagensis* Fain & Evans, 1966, *rusticus* (Meyer & Rodrigues, 1966) and *oblongus* (Kuznetsov, 1973). The last three species were not studied by ANDRÉ, but the others were verified (ANDRÉ, 1980).

In the original drawing of *P. pyrrohippeus* (see TREAT, 1975), setae *c2* (according to my nomenclature; KAZMIERSKI, 1989) were not drawn.

According to BAKER's original description of *Orio-*

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*rella farbae* the chaetotaxy of the trochanters is 1-0-1-0. It can be inferred that the type of this species has been seen by ANDRÉ, who found that its formula is 1-1-1-0, i.e. typical for *Proctotydaeus*.

In the original description of *Neotydeolus therapeuticos* (Flechtmann & Camargo, 1974), the authors give a number of setae on tarsus I and II as 6-6. The vestigial setae (*u*) on tarsus I were omitted.

The chaetotaxy of *P. rusticus* given in MEYER & RODRIGUES' description departs slightly from the pattern of *Proctotydaeus*, as far as the tarsi, tibiae and palpal tarsus are concerned. Examination of two paratypes allowed me to ascertain the full correlation with the pattern typical for the genus, but, on the other hand, femora I and II are partially divided.

In the original description of *P. oblongus*, KUZNETZOV shows 6 setae on tarsus I. Like other authors describing species of the subfamily Pronematiniae, he omits the very short unguinal setae (*u*). The leg chaetotaxy of *P. oblongus* cited in collective work by VAINSTEIN *et al.* (1978) is incompatible with their description of 1973.

In 1972, PRICE described a new species and genus: *Anolina lineata* Price, placing it in the Iolinidae. ANDRÉ (1984) correctly synonymized this genus with *Proctotydaeus*. Moreover, he found that *Proctotydaeus lineata* (Price) is very similar to *P. schistocercae*, also collected from the wings of *Schistocerca* from the Galapagos.

Later, two species were added from Brazil, *partamona* Rosa et Flechtmann, 1983 and *alveari* Rosa, André et Flechtmann, 1985, associated with stingless bees. A third species, *pteroni* (Ueckermann et Meyer, 1988), was described from South Africa.

In the description of *P. partamona*, ROSA & FLECHTMANN (1983) give the tritonymphal leg chaetotaxy as lacking setae (*u*) on tarsus I, which is typical for the deutonymph. It is possible that specimen was in fact a deutonymph.

Finally, *P. sinhai* Momen was described (MOMEN, 1990, MOMEN & SINHA, 1991)<sup>2</sup>, associated with rusty grain beetles on dried wheat. The original description gives 7 setae on tarsus I, 5 setae on palpal tarsus and describes the sensillus as possessing "a few spinules". An examination of the holotype allowed me to ascer-

tain the presence of both setae *u* on tarsus I, whereas MOMEN's drawing shows only one. They are a little longer than the areolar diameter of the large setae (*p*) bordering them and are cleft, with one of the distal arms much shorter than the other. On the palpal tarsus, a small seta *ba* is present, omitted in original description and drawing. *P. sinhai* therefore has the normal chaetotaxic pattern of this genus. The sensillae of *P. sinhai* in fact have numerous spinules, which are much longer than the breadth of the sensillum.

At present, excluding the two new species described below, the genus *Proctotydaeus* contains 13 species<sup>3</sup> from different continents and different habitats. These are, alphabetically:

1. *alveari* Rosa, André et Flechtmann, 1985—from a nest of stingless bee *Melipona pernigra* (Hymenoptera, Apidae, Meliponinae) [Zedoca, Maranhao, Brazil].
2. *farbae* (Baker, 1968)—from bark beetle tunnel (Coleoptera, Polyphaga, Ipidae) [Athens, Georgia, USA].
3. *galapagensis* Fain et Evans, 1966—from thoracic regions and wings of *Schistocerca melanocera* (Orthoptera, Acrididae) [Indefatigable Island, Galapagos].
4. *lineata* (Price, 1973)—from bases of wings of *Schistocerca* sp. (Orthoptera, Acrididae) [Santa Cruz Island, Galapagos].
5. *oblongus* (Kuznetzov, 1973)—from Greek nut tree [Nikitsky Botanical Garden, Yalta, Crimea].
6. *partamona* Rosa et Flechtmann, 1983—from a nest of stingless bee *Partamona* (*P.*) *pearsoni* (Hymenoptera, Apidae, Meliponinae) [mouth of Darroa River, Amazon, Brazil].
7. *pteroni* (Ueckermann et Meyer, 1988)—from *Pteronia paniculata* (Asterales; Compositae; Tubiflorae) [Addo Elephant National Park, Cape Province, South Africa].
8. *pyrrohippeus* (Treat, 1961)—from "ears" (=tympana) of noctuid moths: *Acronycta* sp., *Amphipyra* sp., *Apa-mea* sp. (Lepidoptera, Noctuidae) [Tyringham, Massachusetts, USA].
9. *rusticus* (Meyer et Rodrigues, 1966)—from cotton (*Gossypium* sp.) [Mozambique].
10. *schistocercae* Fain et Evans, 1966—from same locality and host as *P. galapagensis*.
11. *sinhai* (Momen, 1990)—from elytra of a rusty grain beetle, *Cryptolestes ferrugineus* (Coleoptera, Cucujidae), infesting dried and broken wheat [Winnipeg, Manitoba, Canada].

2. This species was described by the generic name of "*Proctotydeus*".

3. Assuming that *P. schistocercae*, *P. galapagensis* and *P. lineata* are separate species.

12. *therapeutikos* (Flechtmann et Camargo, 1974)—from hives of stingless bee *Trigona (Scaptotrigona) postica* (Hymenoptera, Apidae, Meliponinae) [Ribeirao Preto, São Paulo, Brazil].
13. *viator* Berlese, 1911—from thorax and wings of *Acri-dias parvulus* (Orthoptera, Acrididae) [Java].

As seen from the above list, most species of *Proctotydaeus* are associated with insects. The nature of these associations is unknown (phoretic only?).

#### DIAGNOSIS OF THE GENUS AND SUBGENERA. PHYLOGENETIC ANALYSIS

##### Genus *Proctotydaeus* Berlese, 1911

*Pronematus* CANESTRINI, 1886; (partim) BAKER & WHAR-TON, 1952; TREAT, 1961.  
*Pronematulus* BAKER, 1965; (partim) MEYER & RODRIGUES, 1966; TREAT, 1967, 1970; KUZNETZOV & LIVSHITZ, 1973; UECKERMAN & SMITH MEYER, 1988.

*Oriola* BAKER, 1968.

*Oriolella* BAKER, 1969.

*Anolina* PRICE, 1972.

*Neotydeolus* FLECHTMANN et CAMARGO, 1979.

*Proctotydeus* (sic) MOMEN, 1990; MOMEN & SINHA, 1991.

Diagnosis (after ANDRÉ, 1980, with modifications):

Aspidosoma. Chaetotaxy—4: *ro* (situated behind the line *la-la*; prodorsum procurved), *la*, *ex*, *bo* (bothridial setae = sensilli); the latter whip-like or club-like. No eyes.

Opisthosoma. Dorsal chaetotaxy—11: *c1*, *c2*, *d1*, *e1*, *f1*, *f2*, *h1*, *h2*, *ps1* (may be forked), *ps2*, *ps3* (on ventral side). In subgenus *Neotydeolus*—10 (no *ps2*). Poridotaxy—4: *ia*, *im*, *ip*, *ih*. Genital organotaxy—AD(0-0-4), TN(0-4), DN(0-2). One pair of genital acetabula. Paraproctal suckers more or less developed. Epimeral formula—AD, TN, DN (3-1-4-2), L(3-1-2). Ornamentation: striation only.

Legs. No apotele I. Femur IV divided or coalesced. Apophysis in shape of spurs or thumb-like processes on some leg segments. Chaetotaxy—AD, TN: I(8-3 + 1-3 - 3-1), II(7-2 - 3-3 - 1), III(7-2 - 2-2 - 1), IV(7-2 - 1 - (1-1) - 0), or (7-2 - 1-2 - 0). Tarsus I: *ft'* (short), *ft''* (often long), *ω<sub>I</sub>*, *(tc)* (often very long), *(p)* (often long), *(u)* (often undersized). Tarsus II: *(ft)*, *ω<sub>II</sub>*, *tc''*, *(u)*, *(p)*. Tarsus III: *ft'*, *(tc)*, *(u)*, *(p)*. Tarsus IV: *ft'*, *(tc)*, *(u)*, *(p)*. Tibia I with solenidion *φ<sub>I</sub>*, famulus *k''* and

setae *l'*, *l''*, *v'*. Seta *l'* situated dorsally. DN: I(8-3 + 1-3 - 3-0), II(6-2 - 3-3 - 0), III(5-2 - 2-2 - 1), IV(5-2 - 1 - (1-1) - 0) or (5-2 - 1-2 - 0) (lack of *trI*, *trII*, *tc''II*, *(tc)III* and *(tc)IV*). Larva: I(6-3 + 1-3 - 3-0), II(6-2 - 3-3 - 0), III(5-2 - 2-2 - 0), anabasis on tarsus I. Eupathidia on tarsus I: *ft''*(AD, TN), *(tc)*, *(p)*. Solenidiotaxy - 3: *ω<sub>I</sub>*, *ω<sub>II</sub>*, *φ*.

Gnathosoma. Cheliceral frame fused in great part, stilettos middle-slender. Infracapitulum: palp—(6-1 - 2) with a double eupathidium at the tip of the tarsus: *(p)*, *l'*, *l''*, *d*, *v*, *ba* (very small), + *ω*.

Type species: *Proctotydaeus viator* Berlese, 1911.

##### Subgenus: *Proctotydaeus* Berlese, 1911

Diagnosis. Femur IV coalesced. Aspidosomal bothridial setae whip-like. Setae *ps2* present. Paraproctal suckers distinctly developed (especially in females). Anus terminal, surrounded by a sucker-like papilla. Tectal setae (*tc*) on tarsus I short: shorter than the length of segment. Setae (*u*) normally developed. Males without any bifurcate setae and without spurs on legs. Other features—as in diagnosis of the genus.

Type species: *Proctotydaeus viator* Berlese, 1911.

Other species: *galapagensis*, *lineata*, *schistocercae*.

Species of this subgenus are associated with locusts (Acrididae, Orthoptera).

##### Subgenus: *Neotydeolus*

Flechtmann et Camargo, 1974, new status

Diagnosis. Femur IV coalesced. Aspidosomal bothridial setae club-like. Setae *ps2* absent. Paraproctal suckers poorly developed. No papilla. Tectal setae (*tc*) on tarsus I of medium size: approximately the double length of segment. Setae (*u*) minute, thorn-like. Males without any bifurcate setae. Spurs absent. (Tritonymphs sometimes with poorer leg chaetotaxy.) Other features as in diagnosis of the genus.

Type species: *Neotydeolus therapeutikos* Flechtmann et Camargo, 1974.

Other species: *alveari*, *partamoneae*.

The species of this subgenus are associated with stingless bees (Meliponinae; Hymenoptera).

Character		Ancestor	<i>Proctotydulus</i>	<i>Oriolella</i>	<i>Neotydeolus</i>	<i>Proctotydaeus s. st.</i>
1	Femur IV	divided 0	divided 0	not divided 1	not divided 1	not divided 1
2	Sensilli	whip-like 0	whip-like 0	whip-like 0	club-like 1	whip-like 0
3	Terminal papillae	absent 0	absent 0	absent 0	absent 0	present 1
4	Distal Ta set	short 0	long 2	long 2	not long 1	short 0
5	Fe IV male spur	absent 0	present 1	present 1	absent 0	absent 0
6	Bifurcate setae in male	absent 0	absent 0	present 1	absent 0	absent 0
7	<i>ps2</i>	present 0	present 0	present 0	absent 1	present 0
8	<i>u</i> on Tarsus I	normally developed 0	undersized 1	undersized 1	undersized 1	normally developed 0

TABLE 1: Data matrix for subgenera of the genus *Proctotydaeus* (autapomorphic characters 2, 3, 6 and 7 were excluded from the tree search).

### Subgenus: *Oriolella* Baker, 1968, new status

**Diagnosis.** Femur IV coalesced. Aspidosomal bothridial setae whip-like. Setae *ps2* present. Paraproctal suckers poorly developed. No papilla. Tectal setae (*tc*) on tarsus I long or very long: distinctly or much longer than twice the length of segment. Setae (*u*) undersized: very small and forked. Males with forked dorsal seta on femur IV, often with forked *ps1*. Some leg segments with apophysis (spurs or thumb-like processes), mainly in males. Other features as in diagnosis of the genus.

Type species: *Oriola farbae* Baker, 1968.

Other species: *sinhai*, *lindquisti* sp. n. (see below), *polonicus* sp. n. (see below).

*Oriola farbae* is associated with bark beetle (Ipidae; Coleoptera); *sinhai* with rusty grain beetle (Cucujidae; Coleoptera); *lindquisti* was found in hawks' and owls' nests, and *polonicus* in barn straw.

### Subgenus: *Proctotydulus* subgen. nov.

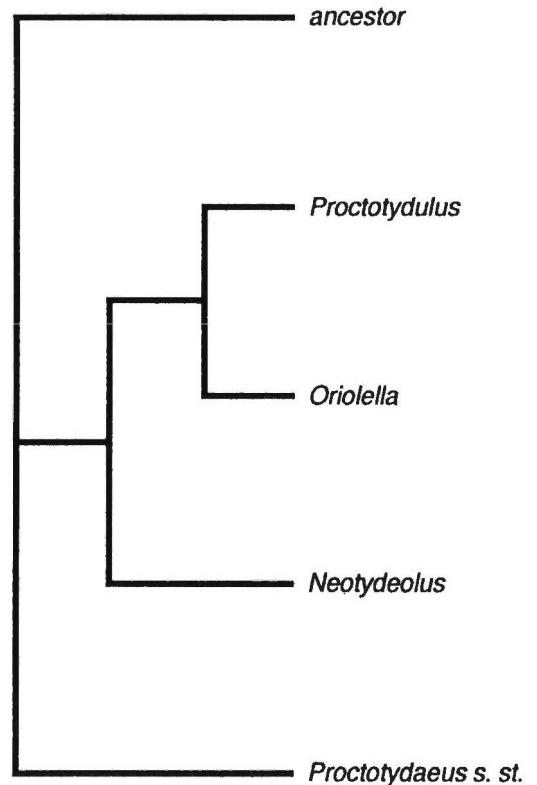
**Diagnosis.** Femur IV not coalesced: divided into basi — and telofemur. Aspidosomal bothridial setae whip-like. Setae *ps2* present. Paraproctal suckers poorly developed. No papilla. Tectal setae (*tc*) on tarsus I long: distinctly or much longer than twice the length of segment. Setae (*u*) minute: thorn-like, or very small-forked. Males without forked setae. Leg segment apophyses may occur. Other features as in diagnosis of the genus.

Type species: *Pronematus rusticus* Meyer et Rodrigues, 1966.

Other species: *oblongus*, *pteroni*, *pyrrohippeus*.

Found on different plants, only *pyrrohippeus* found on noctuid moths (Noctuidae; Lepidoptera)

The eight differentiating features listed in Table 1 were used to construct the cladogram below, which shows the phylogenetic relations between the above subgenera. It can be concluded that the most closely related subgenera are *Oriolella* Baker and *Proctotydulus* subgen. nov., and that accretion of basi- and telofemur took place independently among three subgenera. The hypothetical prototype can be characterized by the features given in Table 1 ("Ancestor").



Phylogenetic hypothesis (cladogram) of relationships among member subgenera of *Proctotydaeus*.

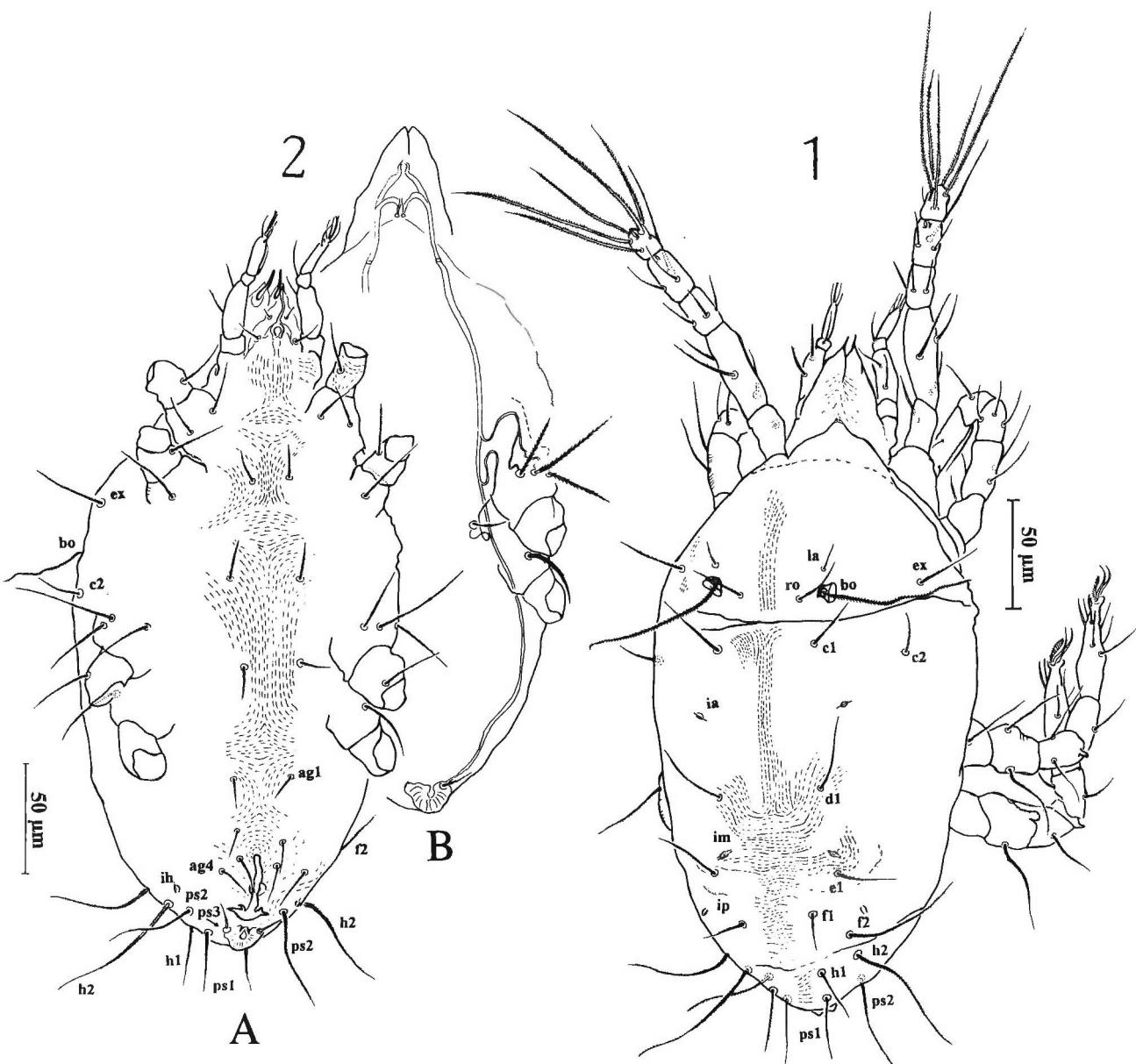


FIG. 1-2: *Proctotydaeus (Oriolella) polonicus* sp. nov.

1. — Female (holotype), dorsal view. 2. — Female: A, ventral view; B, Some internal details.

#### DESCRIPTIONS OF NEW SPECIES

All measurements in the following descriptions are given in micrometers ( $\mu\text{m}$ )

#### *Proctotydaeus (Oriolella) polonicus* sp. nov. (Figs 1-4)

Idiosoma. Holotype female: length 272, width 149.  
Paratype female: 290/152.

Dorsal ornamentation (Fig. 1) consisting of striae running longitudinally on aspidosoma and on central part of opisthosoma (to level of  $d1-d1$ ); posterior half of opisthosoma covered by transverse striae.

Bothridial setae whip-like and setulose. Dorsal body setae slender, serrate, with exception of nude  $ps3$ . Setae  $ps1$  situated terminally,  $ps2$  situated latero-ventrally, and  $ps3$  set on lips of anus ventrally. Length of setae:  $bo$ : 76,  $ro$ : 26,  $la$ : 14,  $ex$ : 32,  $c1$ : 31,  $c2$ : 22,  $d1$ :

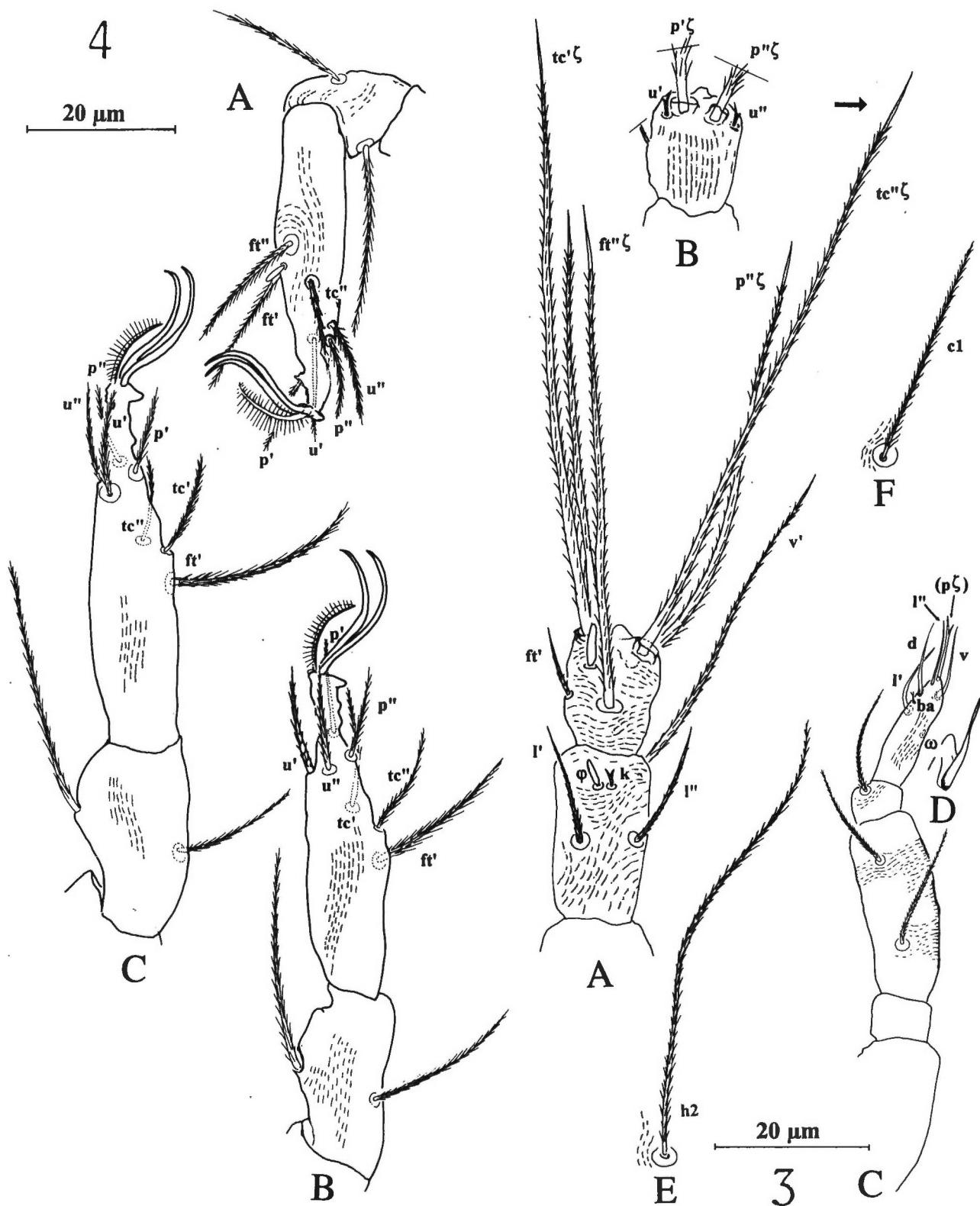


FIG. 3-4: *Proctotydaeus (Oriolella) polonicus* sp. nov., female.

3. — A, tibia and tarsus I (right, dorsal); B, tarsus I (ventral side); C, right palpus; D, cheliceral stiletto; E, seta *h2*; F, seta *cl*. 4. — female: A, tibia and tarsus II (left, antiaxial); B, tibia and tarsus III (left, antiaxial); C, tibia and tarsus IV (left, paraxial).

36, *e1*: 31, *f1*: 19, *f2*: 60, *h1*: 29, *h2*: 64, *ps1*: 34, *ps2*: 48, *ps3*: 14.

Ventral surface (Fig. 2A) strongly striated than dorsal surface; striae run longitudinally between setae (*1a*)=(*pt*), (*3a*)=(*mt $\alpha$* ), (*4a*)=(*mt $\beta$* ) and (*ag1*); striae form a circle anterior to longitudinal genital opening. All ventral setae, together with aggenital ones, similar serrate. Genu III, genu IV and femur IV each with apophysis. Apophysis on femur IV broad and blunt (Fig. 1), situated in dorso-paraxial position. Genual apophyses spur-like and situated dorso-antiaxially.

Gnathosoma. Cheliceral stiletto (Fig. 3D): 14. Palpal tarsus (Fig. 3C): length 17, width 4.8. Eupathidium (*p $\zeta$* ) cleft (length 9), *ba* and  $\omega$  very small.

Differentiating diagnosis: see key, couplets 11–12.

Remarks. Fig. 2B shows part of route of tracheae inside body. A twisted, opalescent (filled with air?) duct runs to each ventral seta leaving main longitudinal stem. The latter—left and right—run from base of chelicerae backwards, terminating at the base of setae *ps3*.

*Locus typicus*. Poland, Grodzisk Wielkopolski settlement (Wielkopolska region), from sweepings of barn straw. 8 Feb. 1979, A. JANKOWSKI leg.

Holotype female and paratype female. Holotype (Slide no. T-0141/P-1) is deposited in Zoological Institute and Zoological Museum of Hamburg University. Paratype in Department of Animal Morphology, A. Mickiewicz University, Poznań.

#### *Proctotydaeus (Oriolella) lindquisti* sp. nov.

(Figs 5–10)

Idiosoma. Holotype female: length 202, width 108. Paratypes: female: 200/111, male: 200/97. Other types: male: 246/110, male: 253/148, deutonymph: 200/93. Length includes backward protruding paraprocts (males, deutonymph).

Female. Idiosoma (Fig. 5). Arrangement of striae as in *P. polonicus* sp. n. Bothridial setae whip-like and setulose. Dorsal body setae serrate, with exception of nude *ps3*. Setae *ps1* and *ps2* situated ventro-terminally and *ps3* ventrally. Length of setae: *bo* 64, *ro* 24, *la* 13, *ex* 36, *c1* 30, *c2* 19, *d1* 31,

*e1* 28, *f1* 20, *f2* 44, *h1* 22, *h2* 64, *ps1* 20, *ps2* 35, *ps3* 9.

Ventral striation as in *P. polonicus* sp. n. Ventral setae, together with aggenital ones, serrate, similar in shape. Aggenitals (especially *ag3* and *ag4*, length 19  $\mu\text{m}$ ) slightly longer than *1a*, *3a* and *4a*. Genital opening, as well as some internal aspects of genital region, shown in Fig. 6 A, B, C.

Legs. Tarsus I (Fig. 7A, B): Length 16, width 10. Setae: *ft'* 10, *ft'' $\zeta$*  56, *tc' $\zeta$*  75, *tc'' $\zeta$*  70, (*p $\zeta$* ) 55, (*u*) 2.8. Solenidion  $\omega_I$  9.5. Seta *ft'* relatively small, slender and only slightly serrate. Setae: *ft'' $\zeta$* , (*tc $\zeta$* ) and (*p $\zeta$* ) distinctly serrate all along their length, including the tips. Setae (*u*) minute and cleft, close to (*p $\zeta$* ). Solenidion  $\omega_I$  longer than half length of tarsus I, set near summit of tarsus (visible before anterior margin of segment). Tibia I (Fig. 7A): Length 19, width 12. Setae: (*l*) 18, *v'* 33, *k''* 2.8. Solenidion  $\varphi_I$  4.5. Seta *v'* strong, with similar serration as the long distal tarsal setae. Setae (*l*) more delicate, without strong serration. Famulus *k''* forked. Tarsus II (Fig. 8C): Solenidion  $\omega_{II}$  4.5. All leg setae distinctly serrate. Apophysis: genu III with small process based dorso-antiaxially. Genu IV with small process (blunt, distally rounded spur) set in dorso-antiaxial position. Femur IV with evident dorso-paraxial spur.

Gnathosoma. Cheliceral stiletto (Fig. 8B) 11 long. Palpal tarsus (Fig. 8A): length 14, width 4. Eupathidium (*p $\zeta$* ) cleft (length 6.8), *ba* and  $\omega$  very small.

Male (Fig. 9). Genitals showed in Fig. 10B. Anal region protrudes a little beyond the hind edge of the body. Setae *ps1* bifurcate (!), relatively short, and not strongly serrated (Fig. 8H). Five rounded organs in shape of small nodes found on dorsal side between setae *f1* of the caudal part of opisthosoma (Fig. 9, Fig. 10A). Dorsal seta on femur IV bifurcated and relatively small (Fig. 8I). Femur IV with large, strong spur, situated distally on dorsal side of segment and curved outside. Genu IV (Fig. 8I) with small distal spur situated dorsally. Seta on genu IV evidently thinner and shorter than that of female (Fig. 8F).

Deutonymph (Fig. 10C). Anal region situated terminally. Two genital pores, the terminal one underdeveloped. Two pairs of aggenital setae. Other features as in female.

Differentiating diagnosis: see key, couplets 10–13.

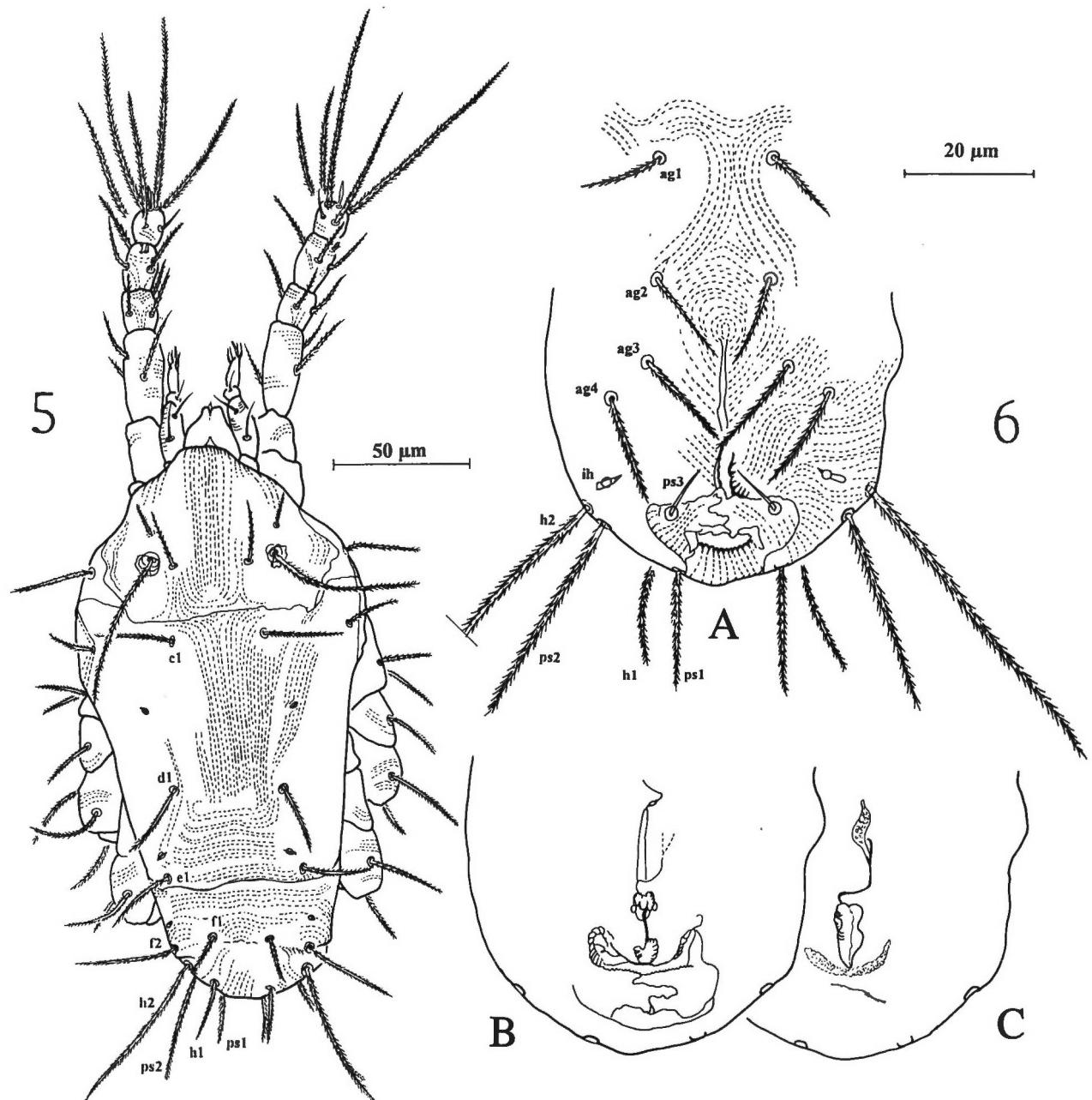


FIG. 5-6: *Proctotydaeus (Oriolella) lindquisti* sp. nov.

5.— Female (holotype), dorsal view. 6.— Female genital region: A, external view; B, C, internal views.

*Locus typicus.* U.S.A., Syracuse, New York. Screech Owl (*Otus asio*) nest. 3 Dec. 1976, T. PHILIPS leg., Holotype female (slide no. 4), and paratypes: female (slide no. 3), male (slide no. 2).

Paratypes: U.S.A., Canton, Mass. Red-tailed Hawk (*Buteo jamaicensis*), 7 Sept. 1977, T. PHILIPS leg., 2 males, 1 deutonymph (slide no. 5).

All types are in Canadian National Collection of Insects, Arachnids and Nematodes (CNC), Centre for Land & Biological Resources Research, Ottawa, Ontario.

KEY TO SPECIES OF *Proctotydaeus*

1. — Bothridial setae whip-like. Setae *ps2* present..... 4

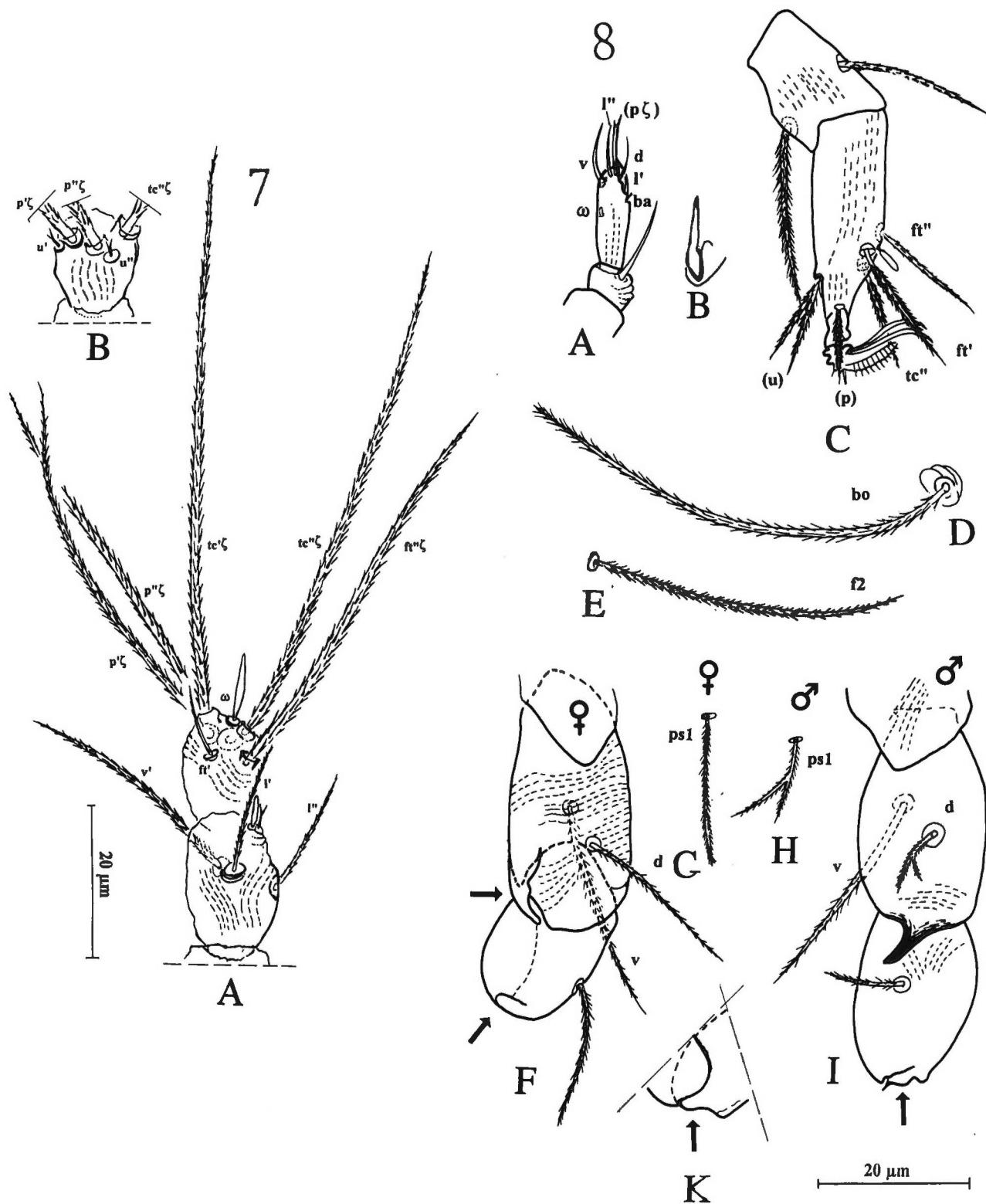


FIG. 7-8: *Proctotydaeus (Oriolella) lindquisti* sp. nov.

7.— Female: A, tibia and tarsus I (right, dorsal, slightly twisted); B, tarsus I (ventral side). 8.— A, left palpus (female); B, cheliceral stiletto (female); C, tibia and tarsus II (right, paraxial; female); D, bothridial seta  $bo$  (female); E, seta  $f2$  (female); F, femur and genu IV (right, dorsal; female); G, seta  $ps1$  (female); H, seta  $ps1$  (male); I, femur and genu IV (left, dorsal; male); K, spur on genu III (ventral, antiaxial, female).

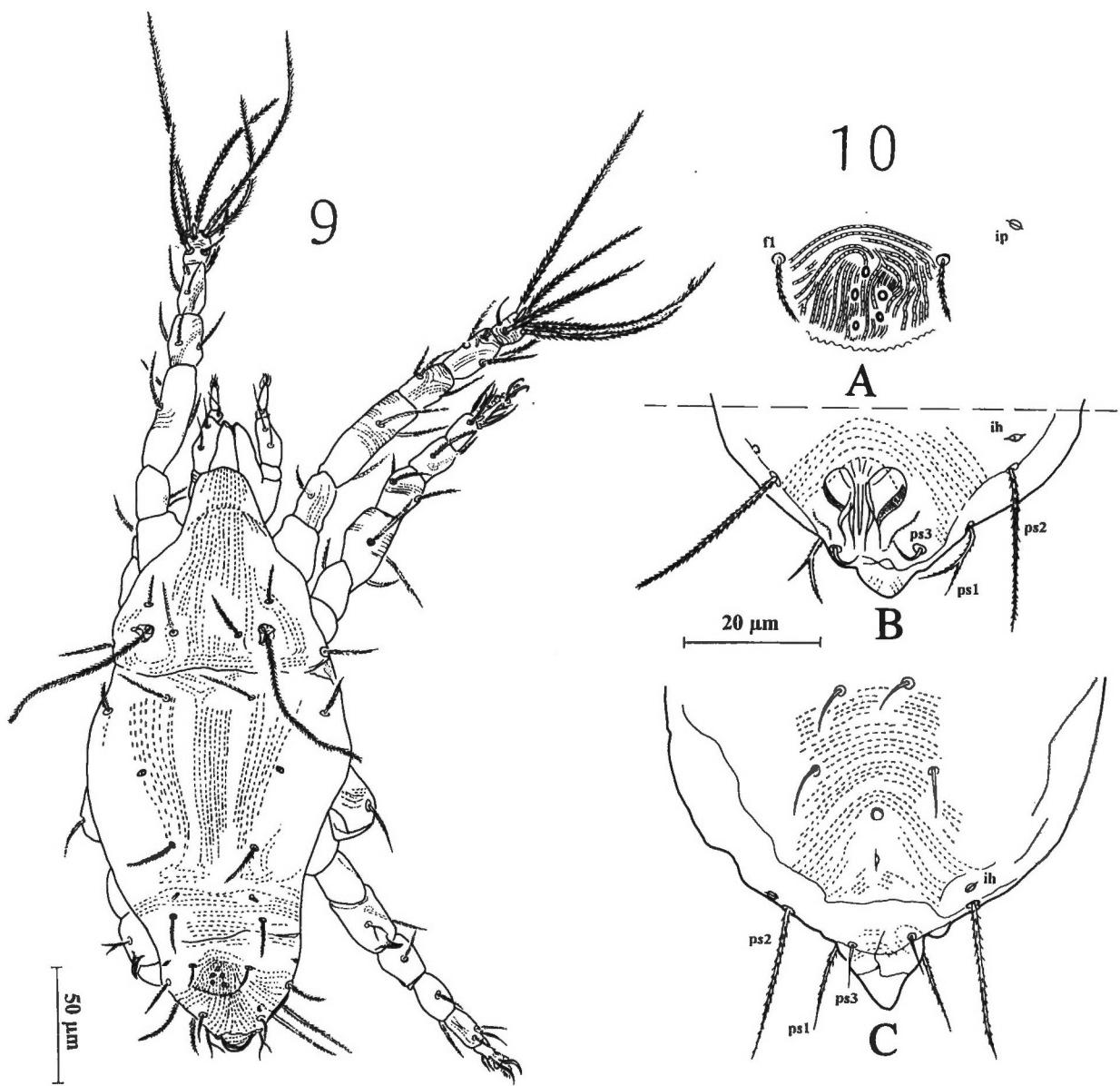


FIG. 9–10: *Proctotydaeus (Oriolella) lindquisti* sp. nov.

9. — Male (paratype), dorsal view. 10. — A, male: five nodes on dorsal side between setae *fl*; B, male, ventral view: genital region, C, deutonymph, ventral side: genital region.

- Bothridial setae club-like. Setae *ps2* absent (subgen. *Neotydeolus*) ..... 2
- 2. — Tip of bothridial seta rounded. Solenidion  $\omega_1$  rounded terminally, short. Striae between setae *ro* on aspidosoma transverse. Striae between setae *el* transverse, irregular ..... *therapeuticos*
- Tip of bothridial seta acute. Solenidion  $\omega_1$  long, acute. Striae between *ro* longitudinal. Striae between *el* longitudinal ..... 3
- 3. — Ventral seta on genu II finely serrate. Famulus *k''* on tibia I simple ..... *partamonae*

- Ventral seta on genu II smooth. Famulus *k''* on tibia I furcate ..... *alvearii*
- 4. — Paraproctal suckers distinctly developed (especially in females): anus terminally surrounded by sucker-like papilla. Distal setae of tarsus I (*tc'*) relatively short: not longer than the length of the segment. Setae *u* on tarsus I normally developed (subgen. *Proctotydaeus*) ..... 5
- Paraproctal suckers weakly developed. Distal setae of tarsus I (*tc'*) much longer than length of segment. Setae *u* on tarsus I distinctly smaller than others .. 9

- 5. – Aedagus present, composed of two sclerotized blades (males) ..... 8
  - Aedagus absent (females) ..... 6
- 6. – Setae *f1* and *f2* lie in one transverse row. Idiosoma not longer than 300 µm. Dorsal body setae longer than 1/10 length of idiosoma (ca 35 µm) ..... *viator*
  - Setae *f1* and *f2* lie in two transverse rows (*f2* behind *f1*). Idiosoma longer than 400 µm. Dorsal body setae shorter than 1/10 length of idiosoma (ca 25 µm) .. 7
- 7. – Setae *h* approximately three times longer than *f*. Setae *h* reaching at least the end of vulva ..... *schistocercae*
  - Setae *h* twice longer than *f*, not reaching the end of vulva ..... *lineata*
- 8. – Dorsal body setae short (*d1* not longer than distance *d1-e1*) (homomorphic) ..... *schistocercae* or *lineata*
  - Dorsal body setae long (*d1* much longer than distance *d1-e1*) (heteromorphic)..... *galapagosensis* or *lineata*
- 9. – Femur IV not divided. Males with some setae bifurcate (subgen. *Oriolella*) ..... 10
  - Femur IV divided into basi- and telofemur. Males without bifurcate setae (subgen. *Proctotydulus*) .. 14
- 10. – Dorsal seta on femur IV forked (Y-like) (males) . 13
  - Dorsal seta on femur IV simple (females) ..... 11
- 11. – Solenidion  $\omega_1$  (6 µm) shorter than half length of tarsus I, not protruding beyond anterior margin of segment. Tips (7–10 µm) of distal setae on tarsus I nude..... 12
  - Solenidion  $\omega_1$  (9–10 µm) longer than half length of tarsus I, set nearly at summit of tarsus (visible before anterior margin of segment). Distal tarsal setae serrate almost to the ends..... *lindquisti*
- 12. – Length of body less than 200 µm. Apophyses on genu III and IV poorly developed. Setae (*u*) on tarsus I slightly longer than diameter of areolae of setae (*p*) ..... *sinhai*
  - Length of body nearly 300 µm. Genual apophyses spur-like, well developed. Setae (*u*) on tarsus I very small: shorter than diameter of areolae of (*p*)..... *polonicus*
- 13. – Femur II with a large thumb-like process ventrally, on two-third of length of the segment. Dorsal Y-like seta on femur IV with strongly serrated branches. Long distal setae of tarsus I serrate on proximal two-thirds ..... *farbae*
  - Femur II without process. Branches of Y-like seta on femur IV not stronger serrate than basis. Setae of tarsus I serrate nearly to apices ..... *lindquisti*
- 14. – Solenidion  $\omega_1$  long, extending past anterior margin of segment.  $\omega_1$  not shorter than the width of tarsus..... 15
  - Solenidion  $\omega_1$  shorter, not extending past anterior margin of segment. Length of  $\omega_1$  subequal to half width of tarsus ..... 16
- 15. – Bothridial setae (*bo*) smooth and subequal in length to setae *ex*. Tarsus I and tibia I of equal length..... *pteroni*
  - Bothridial setae (*bo*) serrate and much longer than *ex*. Tarsus I shorter than tibia I..... *pyrrohippeus*
- 16. – Setae *ro* and *la* equal in length. Setae *c1* and *d1* short: *c1* shorter than quarter length of distance *d1-c1*. Setae on tarsus I nude ..... *oblongus*
  - Setae *ro* twice as long as *la*. Setae *c1* and *d1* longer: *c1* reaches nearly half distance to the base of *d1*. Setae on tarsus I serrate ..... *rusticus*

#### SEXUAL DIMORPHISM AND HETEROMORPHIC MALES

Generally, in Tydeidae, sexual dimorphism is limited to the form of the genital region, or additionally to differences in the number of eugenital, genital and aggenital setae of this region. The genus *Proctotydaeus* is exceptional in this respect: in some species, males have a well-formed spur-like apophysis on femur IV (a spiniform excrescence according to ANDRÉ, 1981) and some of their setae are bifurcated. Another difference concerns the anal envelope. These dimorphisms have not been emphasized previously, since most species were described solely on the basis of either females (*pteroni*, *pyrrohippeus*, *therapeuticos* and *alveari*) or males (*farbae* and *galapagosensis*).

The male of *P. oblongus* (Kuznetzov, 1973) has three pairs of dorsal setae distinctly shorter and a different striation. Males of *P. lindquisti* have a special organs in shape of five small nodes on the caudal dorsum of the opisthosoma. Other male features are mentioned in description of this species. The significance of these male features is unclear. They may represent a kind of unknown adaptation connected with biology of species (perhaps involving copulation or phoresy).

Another problem concerns the existence of heteromorphic males in the subgenus *Proctotydaeus*. PRICE (1972) describes two male forms of *Anolina lineata* (= *Proctotydaeus* (*P.*) *lineata* (Price)): one homomorphic and the other heteromorphic. The latter is larger and has longer setae on the idiosoma and legs. On the other hand, FAIN & EVANS (1966) described another

species, *Proctotydaeus galapagosensis*, based on males that only differ from those of *P. schistocercae* in the same way as the homo- and heteromorphic males of *P. lineata*. Therefore, the males described by PRICE as heteromorphic may in fact belong to another species, or else FAIN & EVANS incorrectly described a distinct species (*P. galapagosensis*) on the basis of heteromorphic males of *P. schistocercae*. I leave this matter open, though intuitively I incline to PRICE's interpretation. Moreover, I do not see any important differences between males of *P. schistocercae* and *P. lineata* (see key, couplet 8). However, I treat them in this paper as distinct, since a comparison of the types discussed has not been carried out.

#### SYSTEMATIC POSITION OF *PROCTOTYDAEUS* WITHIN THE SUBFAMILY PRONEMATINAE

The genus *Naudea* seems to be the most primitive one among the eleven genera of subfamily Pronematinae. It is characterized by the richest chaetotaxy of the legs, the femur divided into two parts and the presence of an apotele with vestigial claws on tarsus I. Apotele I also remains in the genera *Pausia*, *Neonaudea* and *Pronecupulatus*. However, in *Neonaudea* and *Pausia* the chaetotaxy of the tarsi is already incomplete. In *Pronecupulatus*, the chaetotaxy of legs is yet poorer, and femur IV is coalesced. In all the above-mentioned genera, setae *ft*" $\zeta$ ", (*tc*" $\zeta$ ") and (*p*" $\zeta$ ) on tarsus I are still relatively short. However, in *Naudea* one pair of setae *ps* has disappeared<sup>4</sup>.

The genera *Pausia*, *Neonaudea* and *Pronecupulatus* all have three pairs of *ps* setae, whereas *Neonaudea* has only two pairs of aggenital setae (*ag1* + *ag4?*). The hypothetical prototype of these four genera probably had all the features of *Naudea*, while retaining a complete chaetotaxy of idiosoma.

In the remaining seven genera of Pronematinae,

4. It is probably setae *ps2* that are lacking, whereas setae *ps1* have moved aside, occupying the former place of *ps2* - just as in the case of setae *e1* in Tydeinae. This interpretation will however be speculative until larvae can be examined. In the remaining Pronematinae also lack *ps* setae: one pair (*ps1* or *ps2*) in *Pronematus* and *Metapronematus*; two pairs (*ps1* or *ps2*, and *ps3*) in *Parapronematus*. Only the lack of *ps3* in *Parapronematus* is unquestionable. The problem of whether the missing pair is *ps1* or *ps2* remains open. ANDRÉ (1980) in diagnoses of the genera *Naudea*, *Pronematus*, *Metapronematus* and *Parapronematus* states that *ps1* (= *h1* according ANDRÉ's nomenclature) is lacking. I think, however, that it is setae *ps2* that has disappeared. It is difficult to imagine that in one species *ps1* disappeared, and in another, closely related species of the same genus, it was *ps2*. We should rather assume the eccentric migration of *ps1* in some species (e.g. *Naudea richinda*, *Parapronematus acaciae*, *Parapronematus geminus*, *Pronematus ubiquitus*), whereas in part of species left with incomplete chaetotaxy of caudal region, remained setae *ps* occupy original place for *ps1* - so they must be *ps1* (e.g. in *Metapronematus leucohippus*, *Parapronematus citri*, *Pronematus rykei*, *Pronematus sextoni*).

there is no trace of apotele I, but the primitive (i.e. complete) chaetotaxy of the legs characterizes the genus *Proctotydaeus*, as in *Naudea*. This genus is the largest within subfamily, being at the same time the most differentiated. It is currently the only known genus of Tydeidae comprising species with differently formed aspidosomal bothridial setae (whip-like or club-like), with divided or undivided femur IV, and finally with or without *ps2*. ANDRÉ (1980) cites this genus as an example of evolutionary variations on a chaetotactic theme.

The lack of *ps2* in species of the subgenus *Neotydeolus* makes chaetotaxy of this subgenus identical with that of the genus *Naudea*. Assuming that both these groups represent different evolutionary lines within Pronematinae (see below), it must be concluded that the loss of *ps2* in *Naudea* and *Neotydeolus* took place independently.

A hypothetical, primitive, poorly specialized *Proctotydaeus*-like ancestor seems to be the prototype of the remaining, related genera: *Homeopronematus*, *Pronematulus*, *Pronematus*, *Metapronematus*, *Apopronematus* and *Parapronematus*. These genera, characterized by gradually poorer leg chaetotaxy, are generally monospecific, or consist of two or three species. Some of the species, described mainly as "*Pronematus*", are difficult to classify within any of the known genera, since the described chaetotaxy is different or because no information is available about the number of setae on the respective leg segments. In conclusion, it can be said that two evolutionary lines exist within the subfamily Pronematinae, these being represented by two groups of genera. The first group is composed of the genera *Naudea* (the oldest), *Pausia*, *Neonaudea* and *Pronecupulatus*. The second group consists of the remaining genera. Both lines must have had a common ancestor with a well-developed apotele, well-developed claws on tarsus I and a complete chaetotaxy.

LIST OF THE GENERA AND SPECIES OF PRONEMATINAE

*Naudea* Meyer et Rodrigues, 1966

1. *Naudea richinda* Meyer et Rodrigues, 1966

*Pausia* Kuznetzov et Livshitz, 1972

2. *Pausia taurica* Kuznetzov et Livshitz, 1972

3. *Pausia magdalena* (Baker et Delfinado, 1976)

*Neonaudea* El Bagoury et Abou Awad, 1986

4. *Neonaudea gossypii* El Bagoury et Abou Awad, 1986

*Pronecupulatus* Baker, 1944

5. *Pronecupulatus anahuacensis* Baker, 1944

*Proctotydaeus* Berlese, 1911

subgen. *Proctotydaeus* s. str.

6. *Proctotydaeus* (*Proctotydaeus*) *schistocercae* Fain et Evans, 1966

7. *Proctotydaeus* (*Proctotydaeus*) *galapagosensis* Fain et Evans, 1966

8. *Proctotydaeus* (*Proctotydaeus*) *lineata* (Price, 1973)

9. *Proctotydaeus* (*Proctotydaeus*) *viator* Berlese, 1911  
subgen. *Neotydeolus*

10. *Proctotydaeus* (*Neotydeolus*) *therapeutikos* (Flechtmann et Camargo, 1974)

11. *Proctotydaeus* (*Neotydeolus*) *alveari* Rosa, André et Flechtmann, 1985

12. *Proctotydaeus* (*Neotydeolus*) *partamonae* Rosa et Flechtmann, 1983  
subgen. *Oriolella* Baker, 1968

13. *Proctotydaeus* (*Oriolella*) *farbae* (Baker, 1968)

14. *Proctotydaeus* (*Oriolella*) *sinhai* Momen, 1990

15. *Proctotydaeus* (*Oriolella*) *lindquisti* sp. n.

16. *Proctotydaeus* (*Oriolella*) *polonicus* sp. n.  
subgen. *Proctotydulus*

17. *Proctotydaeus* (*Proctotydulus*) *pyrrohippeus* (Treat, 1961)

18. *Proctotydaeus* (*Proctotydulus*) *oblongus* (Kuznetzov, 1973)

19. *Proctotydaeus* (*Proctotydulus*) *pteroni* (Ueckermann et Meyer, 1988)

20. *Proctotydaeus* (*Proctotydulus*) *rusticus* (Meyer et Rodrigues, 1966)

*Homeopronematus* André, 1980

21. *Homeopronematus vidae* André, 1980

22. *Homeopronematus staerkii* (Schrift, 1972)

23. *Homeopronematus anconai* (Baker, 1944) (see also KUZNETZOV, 1972; KNOP & HOY, 1983; and CASTAGNOLI, 1984)

*Pronematulus* Baker, 1965

24. *Pronematulus vandus* Baker, 1965

25. *Pronematulus brachytarsus* (Baker, 1946)

26. *Pronematulus vandykei* (Baker, 1946)

*Pronematus* Canestrini, 1886 sensu Baker, 1965

27. *Pronematus ubiquitus* (McGregor, 1932)

syn.: *Pronematus pruni* Meyer et Ryke, 1959

28. *Pronematus rykei* Meyer et Rodrigues, 1966

29. *Pronematus sextoni* Baker, 1968

*Metapronematus* André, 1980

30. *Metapronematus leucohippeus* (Treat, 1970)

*Apopronematus* André, 1980

31. *Apopronematus bakeri* André, 1980

*Parapronematus* Baker, 1965

32. *Parapronematus acaciae* Baker, 1965

33. *Parapronematus geminus* Meyer et Rodrigues, 1966

34. *Parapronematus citri* Salviejo, 1969

Generic unit 1 (cf. *Pronematulus*)

35. “*Pronematulus*” *lagunovi* Kuznetzov, 1978

Generic unit 2 (cf. *Pronematus*)

36. “*Pronematus*” *rimandoi* Salviejo, 1969

Generic unit 3 (cf. *Pronematus/Homeopronematus*)

37. “*Pronematus*” *neglectus* Kuznetzov, 1972

38. “*Pronematus*” *rapidus* Kuznetzov, 1972

Generic unit 4 (cf. *Pronematus*)

39. “*Pronematus*” *testatus* Kuznetzov, 1972

Species, whose generic status is unclear (requiring redescription)

40. “*Pronematus*” *bonatii* Canestrini, 1886

41. “*Pronematus*” *tenuisetosus* Meyer et Rodrigues, 1966

42. “*Pronematus*” *curtipilus* Baker, 1968

43. “*Pronematus*” *fleschneri* Baker, 1968

44. “*Pronematus*” *elongatus* Baker, 1968

45. “*Pronematus*” *neoelongatus* Baker, 1968

46. “*Pronematus*” *mcgregori* Baker, 1968

47. “*Pronematus*” *biminiensis* Baker, 1968

48. “*Pronematus*” *curtitarsus* Baker, 1968

49. “*Pronematus*” *bachewingi* Baker, 1968

50. “*Pronematus*” *davisi* Baker, 1968

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## CORRIGENDA

KAZMIERSKI (A.), 1998. — A review of the genus *Proctotydaeus* (Actinedida: Tydeidae: Pronematiinae). — *Acarologia*, 39 (1): 33–47.

Due to a printing error, a portion of text was inadvertently lost from the description of *Proctotydaeus (Oriolella) polonicus*. The first paragraph of page 39 should be replaced by:

Ventral surface (Fig. 2A) more strongly striated than dorsal surface; striae run longitudinally between setae (1a)=(pt), (3a)=(mta), (4a)=(mtb) and (ag1); striae form a circle anterior to longitudinal genital opening. All ventral setae, together with aggenital ones, similar in shape (slender, slightly serrate), but different in length: ag2, ag3 and ag4 longer (19–22) than 1a, 3a, 4a and ag1 (about 16).

Legs. Tarsus I (Fig. 3A, 3B): length 18, width 12.

KRANTZ (G. W.), 1998. — Observations on five rarely collected genera of Macrochelidae (Acari: Mesostigmata) associated with insects. — *Acarologia*, 39 (2): 95–109.

Setae:  $f'_1$  9.5,  $f''_1\zeta$  67, ( $tc\zeta$ ) 87,  $p'\zeta$  60,  $p''\zeta$  64, ( $u$ ) 3.5,  $\omega_I$  6. Seta  $f'_1$  relatively small, slender and slightly serrate. Setae:  $f''_1\zeta$ , ( $tc\zeta$ ) and ( $p\zeta$ ) distinctly serrate, but their tips without serration for about 1/10 of total length. Setae ( $u$ ) minute and cleft, inserted close to ( $p\zeta$ ). Solenidion  $\omega_I$  shorter than half length of tarsus I, not protruding beyond anterior margin of segment. Tibia I (Fig. 3A). Length: 23, width: 12. Setae:  $l'$  17,  $l''$  18,  $v'$  52,  $k''$  2.8. Solenidion  $\phi_I$  4. Seta  $v'$  visibly serrated, ( $l$ ) slightly serrated, famulus  $k''$  forked. Tarsus II (Fig. 4A): solenidion  $\omega_{II}$  3.5. All leg setae distinctly serrate. Genu III, genu IV and femur IV each with apophysis. Apophysis on femur IV broad and blunt (Fig. 1), situated in dorso-paraxial position. Genual apophyses spur-like and situated dorso-antiaxially.

On page 105 (first paragraph, last sentence), the generic name *Holostaspella* was inadvertently used in place of *Holocelaeno*, and the reference citation that immediately follows should read 1967a, rather than 1967.