

A NEW GENUS AND NEW SPECIES OF FEATHER MITE OF THE FAMILY PTEROLICHIDAE (ACARI: ASTIGMATA) FROM *GALLUS GALLUS* (GALLIFORMES: PHASIANIDAE) IN THE GALÁPAGOS ISLANDS

S. V. Mironov¹, T. M. Pérez² and R. L. Palma³

¹ Zoological Institute, Russian Academy of Sciences, Universitetskaya Quay 1, 199034, Saint Petersburg, Russia; e-mail: astigmata@zin.ru

² Instituto de Biología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán 04510, México, D.F., México; e-mail: tilam@ibiologia.unam.mx

³ Museum of New Zealand Te Papa Tongarewa, P.O. Box 467, Wellington, New Zealand; e-mail: RicardoP@tepapa.govt.nz

ABSTRACT: *Epistomolichus reticulatus* (Pterolichidae: Pterolichinae), gen. nov., sp. nov., is described from a domestic chicken *Gallus gallus* (Aves: Phasianidae) from Santa Cruz Island, Galápagos Islands, Ecuador. Males and females of the new species have a rostrum-like extension above the gnathosoma, a character rarely found in members of the Pterolichidae and other feather mite taxa. *Epistomolichus reticulatus* is morphologically different from pterolichids associated with other domesticated galliform birds, but resembles pterolichid genera restricted to megapodes (Galliformes: Megapodiidae). The presence of *E. reticulatus* on a domestic chicken in the Galápagos Islands is enigmatic: it may be either a mite specific to *G. gallus* inherited from its wild ancestor, or a mite transferred from an unknown galliform species kept in farmyards in South America, which established successfully on domestic chickens.

KEY WORDS: *Epistomolichus reticulatus*, new genus, new species, feather mites, Pterolichidae, *Gallus gallus*, domestic chickens, Galápagos Islands

INTRODUCTION

Several species of feather mites (Astigmata: Psoroptidia) have been recorded from the plumage and skin of domestic chickens, *Gallus gallus* Linnaeus (Galliformes: Phasianidae), including representatives of eight families: Analgidae, Cytoditidae, Dermationidae, Dermoglyphidae, Epidermoptidae, Gaudoglyphidae, Laminosioptidae, and Pterolichidae (Fain 1960, 1965, 1981; Gaud 1965, 1974a, 1974b; Fain and Elsen 1967; Bruce and Johnston 1976; Lombert et al. 1984; Gaud et al. 1985; Atyeo and Gaud 1992). Although most of these species have been apparently inherited from the jungle fowl, the wild ancestor of domestic chickens, it is possible that some of those species of feather mites originated from other domesticated galliform birds such as turkeys, guinea fowl, peafowl, pheasants and quail. The common practice of breeding and keeping in captivity a mixture of those bird species in farmyards, aviaries and zoos would have presented many opportunities for feather mites and other ectoparasites to transfer among different host species (Atyeo and Gaud 1992; Sychra et al. 2008). For example, six species of the feather mite genus *Megninia* Berlese, 1881 (Analgidae) have been recorded from domestic chickens, but it is doubtful that all of them were indeed parasites of their wild ancestors (Gaud 1974b; Gaud et al. 1985). The original natural hosts of some feather mite taxa recorded from domestic galliform birds are still unknown, and can only be revealed with certainty by studying the feather mite diversity of their wild relatives.

In this paper we describe a new feather mite of the family Pterolichidae found on a domestic chicken collected in Santa Cruz Island, Galápagos Islands, Ecuador. The sample of feather mites from that chicken contained small numbers of *Megninia crinita* Gaud, Atyeo et Barré, 1985 and *Pterolichus obtusus* Robin, 1877 as well as *Epistomolichus reticulatus* gen. nov., sp. nov. The first two species have been previously recorded from domestic chickens in many parts of the world, and both appear to be descendants of feather mites that live on wild varieties of *G. gallus*. Mites of the genus *Megninia* living on chickens were revised by Gaud et al. (1985) and mites of the genus *Pterolichus* Robin, 1877 (Pterolichidae) and related genera living on most domestic and some wild galliform birds were revised by Atyeo and Gaud (1992). The new pterolichid genus described here is characterized by some unique features and, in general appearance, is surprisingly more similar to pterolichid genera specific to mound builders or brush turkeys (Galliformes: Megapodiidae) than to any known pterolichid genera recorded from species of Phasianidae.

MATERIAL AND METHODS

The specimens studied for this paper were collected from a single chicken searched by R.L.P. in the course of collecting feather lice (Phthiraptera) and other ectoparasitic arthropods from various avian hosts in the Galápagos Islands. Feather mites and lice were removed with the as-

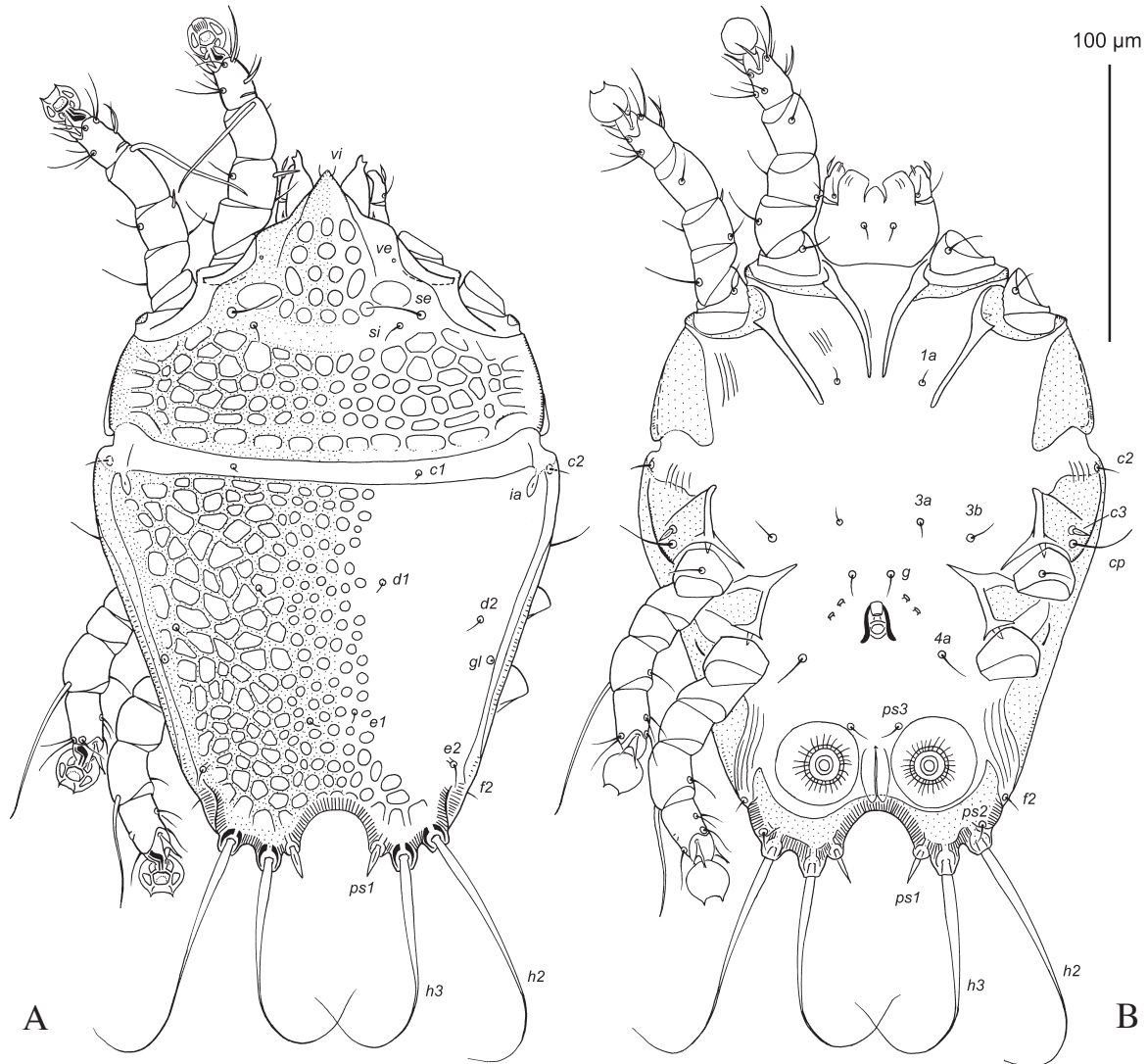


Fig. 1. *Epistomolichus reticulatus* sp. n., male. A — dorsal view, B — ventral view.

sistance of a mild insecticide and placed into a tube with 70% ethanol. The mites were subsequently mounted on microslides in Faure medium according to a standard technique (Evans 1992).

Terminology for general morphology, including idiosomal and leg chaetotaxy, follows Gaud and Atyeo (1996). Descriptions of taxa follow recent standards used for pterolichid mites (Aty eo and Gaud 1992; Mironov 1997; Dabert et al. 2008). All measurements are in micrometers. The distance between different pairs of setae is measured as the shortest distance between the transverse levels formed by setae of respective pairs.

Type specimens are deposited in the following institutions: Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand (MONZ); Instituto de Biología, Universidad Nacional Autónoma de México, México (CNAC); and Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia (ZISP).

SYSTEMATICS

Family Pterolichidae Trouessart et Mégnin, 1884

Subfamily Pterolichinae Trouessart et Mégnin, 1884

***Epistomolichus* Mironov, Pérez et Palma, gen. n.**

Type species: *Epistomolichus reticulatus* Mironov, Pérez et Palma sp. n.

Diagnosis. Both sexes. Small-sized pterolichine mite. Idiosoma short and wide. Anterior end of prodorsoma with angular rostral extension protruding over gnathosoma and bearing minute setae *vi* (Figs. 1A, 2A). Prodorsal shield covering all prodorsum including rostral extension, posterolateral part of this shield completely fused with scapular shields. Lateral margins of prodorsal shield without incisions around scapular setae. Hysteronotal shields covering almost all hysterosoma, fused with humeral shields. Hysteronotal gland grooves developed. Prodorsal and

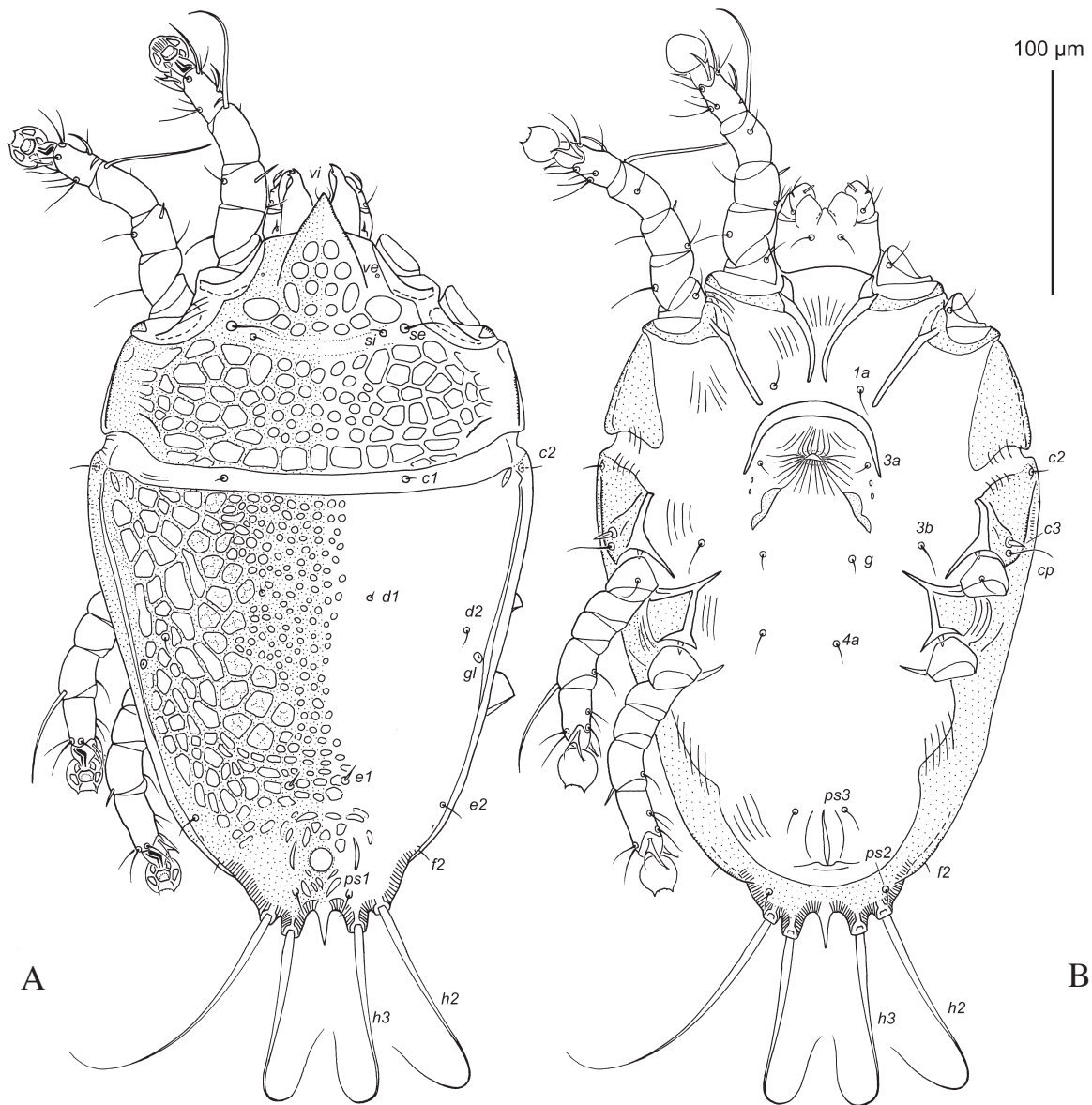


Fig. 2. *Epistomolichus reticulatus* sp. n., female. A — dorsal view, B — ventral view.

hysteronotal shields with pattern of polygonal and circular lacunae. Humeral shields developed ventrally, fused with bases of epimerites III and with hysteronotal shield. Hysteronotal setae *h1* absent. Vertical setae *ve* rudimental. Setae *c3* lanceolate, short. Setae *cp* much shorter than idiosoma width. Setae *h2*, *h3* represented by long simple macrosetae. Cupules *ia* well developed, situated in anterior angles of hysteronotal shield; cupules *im*, *ip*, *ih* indistinct. Epimerites I free, posterior ends converging. Tarsi of all legs without apical spines. Tarsi and tibiae I, II approximately subequal in length. Segments of legs I, II not modified (without processes, thickenings etc.). Ambulacral discs of tarsi I with rounded anterior margin, ambulacral discs of tarsi II–IV each with 2 points (Figs. 3A–D). Seta *ba* of tarsi

I, II close to base of corresponding solenidion $\omega 1$. Solenidion $\sigma 1$ of genu III and solenidion $\sigma 2$ of genu I absent.

Male (Figs. 1A, 1B). Opisthosomal lobes short and wide, with short extensions bearing bases of setae *h2*, *h3*; ventral side of lobes sclerotized. Terminal cleft semicircular, short. Setae *ps1* lanceolate, short. Base of genital apparatus at level of trochanters IV. Aedeagus much shorter than genital arch. Anal suckers circular, poorly sclerotized, surrounded by radially striated membrane. Paragenital apodemes absent. Adanal apodemes absent. Lateral margins of hysteronotal shield extending to ventral side of opisthosoma. Legs III, IV subequal in size and form, positioned ventrally, not modified. Tarsus IV not modified, without subapical claw.

Female (Figs. 2A, 2B). Opisthosoma attenuate to posterior end. Posterior margin with short extensions bearing setae *h2*, *h3*, and with small terminal cleft between setae *h3*. Hysteronotal shield extending to ventral side of opisthosoma. Epigynum bow-shaped, situated at level of sejugal furrow, its anterior end close to tips of epimerites I, II. External copulatory tube present, situated on margin of terminal cleft. Legs III, IV situated ventral.

Differential diagnosis. *Epistomolichus* is similar to a group of pterolichid genera associated with Megapodiidae (Galliformes), which are characterized by a relatively short and wide body and extensive prodorsal and hysteronotal shields with strongly pronounced pattern of circular or variously shaped lacunae. Among the 18 pterolichid genera associated with megapodiids (Atyeo 1990, Pérez and Atyeo 1990; Atyeo 1992), *Epistomolichus* is closest to *Ascetolichus* Pérez et Atyeo, 1990 by having the prodorsal shield fused with the scapular shields, and by the absence of adanal apodemes in males. Both sexes of *Epistomolichus* differ from those of *Ascetolichus* and also from two other close genera, *Leipobius* Atyeo, 1992 and *Pereziella* Atyeo, 1990, by the following combination of characters: anterior end of propodosoma with a triangular rostral extension above the gnathosoma, setae *vi* minute and situated near the apex of rostral extension, idiosomal setae *h1* absent, and solenidion $\sigma 1$ of genu III absent. In both sexes of *Ascetolichus*, the anterior end of propodosoma is normal (truncate), setae *vi* are well developed, setiform or narrowly lanceolate, idiosomal setae *h1* are present, and solenidion $\sigma 1$ of genu III is also present.

Among other pterolichids associated with megapodiids, the median extension of the prodorsum is also present in males of the genus *Phyciferus* Atyeo et Pérez, 1991, but the extension is rounded terminally and may be asymmetric (Atyeo and Pérez 1991). Considering other groups of Pterolichidae, the angular extensions of the prodorsum are present in the genus *Ceratolichus* Dabert, Mironov et Ehrnsberger, 2004, although this genus belongs to the *Rhytidelasma* generic group and is specific to species of Loriinae (Psittaciformes: Psittacidae) (Dabert et al. 2004).

Etymology. Contraction of *epistom* (= upon mouth, Greek) referring to the angular extension above gnathosoma, and *-olichus*, suffix of the type genus for the family Pterolichidae; gender masculine.

***Epistomolichus reticulatus* Mironov, Pérez et Palma, sp. n.**

Figs. 1–3

Type material. Male holotype, 4 male and 4 female paratypes from *Gallus gallus* Linnaeus, 1758, Bellavista, Santa Cruz Island, Galápagos Islands, Ecuador; 1 April 1992; collectors R.L. Palma and E. Vilema. Holotype, 2 male and 2 female paratypes (MONZ), 1 male and 1 female paratypes (CNAC), 1 male and 1 female paratypes (ZISP).

Description. Male (Figs. 1A, B, 3A–D) (holotype, range of measurements for 4 paratypes in parentheses). Idiosoma: length from rostral apex to lobar apices, 250 (248–258), greatest width at level of humeral shields 166 (155–170). Gnathosoma: length including palps 33 (33–38), width 46 (44–47). Prodorsal shield: fused with scapular shields, rostral apex extending to level of palpal apices, median part with large circular lacunae, lateral parts ins polygonal lacunae, length along midline 105 (104–108), width including scapular shields 155 (153–162). Distance between setae *se* 66 (65–70), length 20 (15–20); distance between *si* 51 (46–53), length 6 (5–8). Vertical setae *vi* minute, about 5 long, situated near rostral apex; vertical setae *ve* rudimentary.

Length of hysterosoma 150 (150–160). Sub-humeral setae *c3* narrowly lanceolate, 9 (7–9) × 2.5 (2–2.5); humeral setae *cp* 12 (11–14). Hysteronotal shield: covering all hysterosoma, extending laterally onto ventral side of hysterosoma, anterior angles fused with humeral shields, median part with small circular lacunae, lateral parts; greatest length 139 (137–157), greatest width 155 (155–160). Cupules *ia* in anterior angles of hysteronotal shield, hysteronotal gland openings at level of trochanters IV; lateral margins of shield with well expressed hysteronotal gland groove. Setae *c1* on band of striated tegument between prodorsal and hysteronotal shields. Setae *c1–e1* and *c2–f2* simple setiform. Opisthosomal lobes wide and short, their posterior margins with pair of extensions bearing bases of setae *h2*, *h3*. Terminal cleft between lobes semicircular, 22 (21–24) long. Setae *ps1* narrowly lanceolate, 12 (11–13) × 3 (3–3.5), situated on lateral margins of terminal cleft. Distance between setae: *c2:d2* 62 (57–64), *d2:e2* 51 (49–55), *e2:h3* 32 (32–34), *h2:h2* 73 (71–79), *h3:h3* 49 (42–51), *ps1:ps1* 31 (27–32).

Epimerites I convergent, but tips clearly distant from each other. Epimerites III fused with humeral shields. Epimerites I–IV without sclerotized areas. Genital apparatus 13 (12–13) × 11 (10–13),

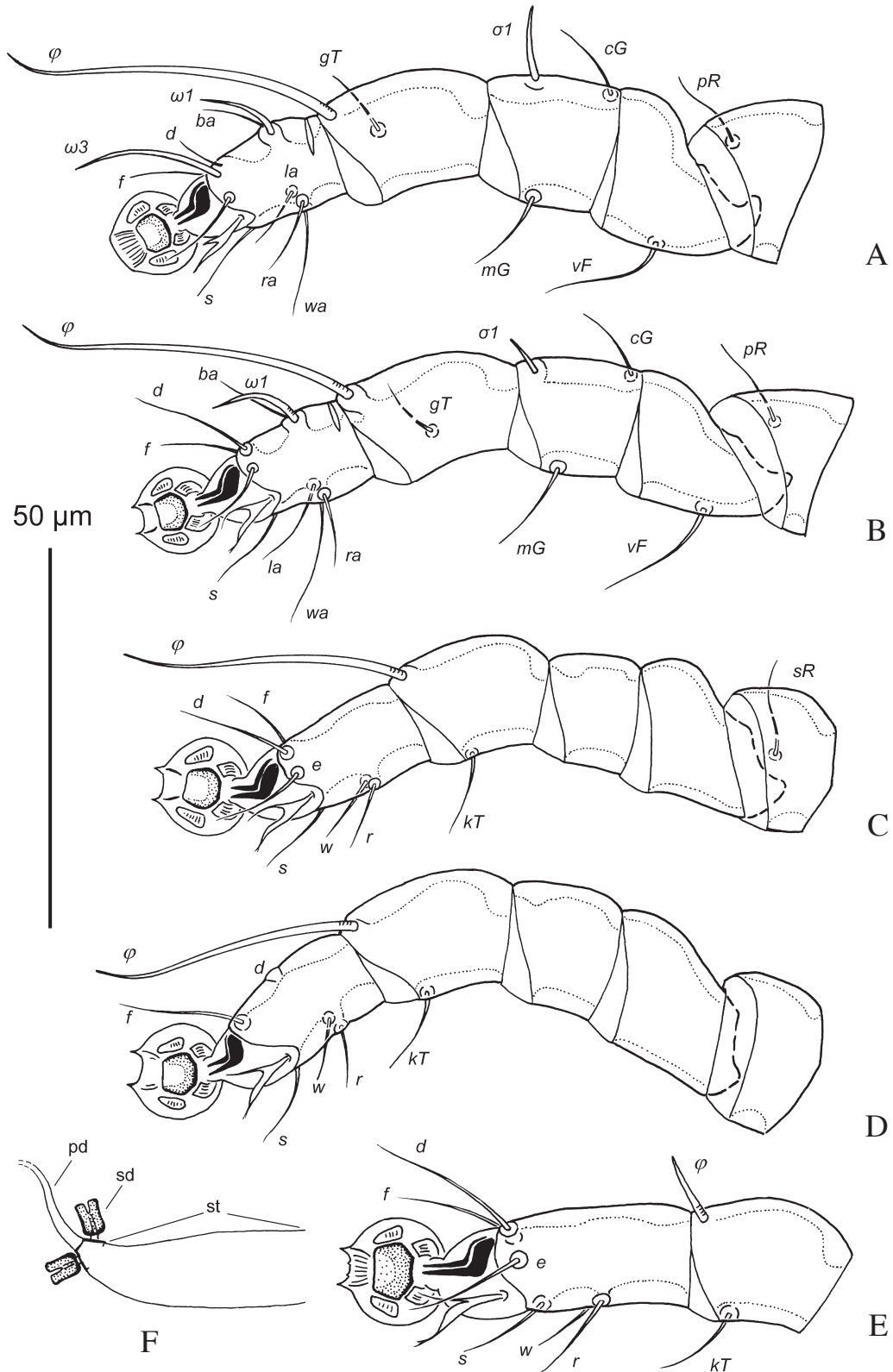


Fig. 3. *Epistomolichus reticulatus* sp. n., details. A–D — legs I–IV of male, respectively, E — tibia and tarsus IV of female, F — spermatheca and spermatheca. pd — proximal part of primary spermatheca, sd — secondary spermatheca, st — spermatheca.

its base at midlevel of trochanters IV. Anterior pair of genital papillae at level of genital arch apex. Setae $3a$ slightly anterior to setae $3b$. Genital setae g anterior to genital arch apex. Setae $4a$

slightly posterior to level of genital arch base. Setae $ps2$ situated ventrally, posterior to level of setae $f2$. Anal suckers circular, 14 (14–15) in diameter, surrounding membrane with sparse radial

striae. Ventral surface of opisthosomal lobes sclerotized. Distance between ventral setae: $3a:3b$ 8 (7–9), $3a:g$ 20 (17–22), $g:4a$ 28 (24–28), $4a:ps3$ 26 (26–29), $ps3:h3$ 46 (44–50). Tarsi I–IV subequal in length to corresponding tibia, tarsus I 16 (15–15), tarsus II 17 (17–18), tarsus III 18 (18–20), tarsus IV 17 (17–19). Length of solenidia: ωI 19 (9–10), ωI II 11 (11–12), σI I 9 (8–11), σI II 4 (3–4). Tarsus IV without apical claw, setae d button-like, approximately at midlevel of segment. Solenidia ϕ of tibiae III, IV subequal, extending slightly beyond distal margin of ambulacral discs.

Female (Figs. 2A, B, 3E, F) (range of measurements for 4 paratypes). Idiosoma: length from rostral apex to bases of setae $h3$ 303–330, greatest width at level of humeral shields 185–195. Gnathosoma: length 38–40, width 47–53. Prodorsal shield: shape, dorsal pattern and position of setae as in male, rostral apex extending to midlevel of palps, length along midline 113–126, width including scapular shields 157–185. Distance between setae se 75–80, length 20–23; distance between si 55–60, length 5–7.

Length of hysterosoma 205–225. Subhumeral setae $c3$ narrowly lanceolate, 9–10 \times 2.5–3; humeral setae cp 13–15. Hysteronotal shield: covering all hysterosoma, extending laterally onto ventral side of hysterosoma, anterior angles fused with humeral shields, median part with small circular lacunae, lateral parts with polygonal lacunae; greatest length 195–215, greatest width 175–190. Cupules ia in anterior angles of hysteronotal shield, hysteronotal gland openings at level of trochanters IV; lateral margins of shield with well expressed hysteronotal gland groove. Setae $c1$ on band of striated tegument between prodorsal and hysteronotal shields. Setae $c1-e1$, $c2-f2$, and $ps1$ simple setiform. Opisthosoma narrowed posteriorly, with pair of extensions bearing bases of setae $h3$ and separated by small terminal cleft 11–13 long. Supranal concavity circular. Setae $ps1$ setiform, situated between levels of supranal concavity and anterior end of terminal cleft. Distance between setae: $c2:d2$ 70–75, $d2:e2$ 73–82, $e2:h3$ 55–60, $h2:h2$ 44–53, $h3:h3$ 27–31.

Epimerites I as in male. Epimerites I–IV without sclerotized areas. Epigynum bow-shaped, 29–37 \times 55–60, close to posterior tips of epimerites I, II, tips extending beyond setae $3a$. Genital papillae slightly posterior to tips of epigynum. Folds of egg opening sclerotized in posterior part. Setae g slightly posterior to level of setae $3b$. Setae $ps2$

situated ventral, anterior to level of setae $h2$. Posterior and lateral margins of opisthosoma with narrow sclerotized band (formed by hysteronotal shield extended to ventral side of body). External copulatory tube 13–18 long, situated on margin of terminal cleft. Spermatheca and spermatheca as in Fig. 3F. Distance between ventral setae: $3a:3b$ 30–41, $3a:g$ 29–40, $g:4a$ 33–37.

Tarsi I–II subequal in length to corresponding tibia; tarsi III, IV nearly 1.5 longer than corresponding tibiae; tarsus I 23–24, tarsus II 20–22, tarsus III 20–24, tarsus IV 24–26. Length of solenidia: ωI I 10–11, ωI II 12–13, σI I 9–10, σI II 3–4.

Etymology. The specific epithet derives from *reticulum* (= a net, network, Latin) and refers to the reticulate pattern on the prodorsal and hysteronotal shields.

DISCUSSION

Epistomolichus reticulatus has a unique combination of character states not shared with any species of other pterolichid genera associated with chickens and other domesticated galliform birds in the families Phasianidae, Numididae and Meleagrididae (e.g. *Contolichus* Atyeo et Gaud, 1992, *Pseudalloptes* Trouessart, 1884, *Pseudolichus* Atyeo et Gaud, 1992, *Pterolichus* Robin, 1877, and *Pterygocrusolichus* Dubinin, 1955). As mentioned above the genus *Epistomolichus* has features which show a morphological similarity with pterolichid genera associated with species of Megapodiidae.

Domestic chickens were introduced from continental Ecuador into the Galápagos Islands probably at least 50 years ago, but there may have been additional introductions. They are present on all islands where humans have settled, but have become feral only on Floreana Island (Hoeck 1984). In the Bellavista district of Santa Cruz Island, where our mite sample originated, chickens are semi-feral, to the extent that trained dogs are needed to catch them. At present, there is no other species of the order Galliformes in the Galápagos Islands (David Steadman, University of Florida, pers. comm.). Since *Epistomolichus reticulatus* is based on only one collection from a host introduced by human agency into the Galápagos Islands, the question remains: is *G. gallus* a secondary host after a successful transfer of mites from another bird species, or is this the discovery of yet another pterolichid feather mite inherited from ancestral chickens despite their domestication and

world wide distribution by humans? This question may be solved with an extensive study of the feather mite fauna from all species of *Gallus* in their native ranges, as well as those of other galliform birds, particularly species of curassows, chachalacas and guans (Galliformes: Cracidae) kept in farmyards in South America (Board on Science and Technology ... 1991: Chapter 13). Pterolichids and other feather mites associated with cracids are almost unknown at present. Only two pterolichid species have been described from them: *Pterolichus pustulatus* Mégnin et Trouessart, 1884 and *P. forficula* Trouessart et Neumann, 1888, provisionally referred by Gaud and Atyeo (1996) to the genus *Tetraolichus* Atyeo and Gaud, 1992. However, these two species do not resemble *Epistomolichus reticulatus*.

ACKNOWLEDGEMENTS

The authors thank Dr. Heather C. Proctor (University of Alberta, Edmonton, Canada) for critically reviewing the manuscript. The investigation was supported in part (for SVM) by the Russian Foundation for Basic Research (project No 07-04-00426a). We are indebted to Stewart B. Peck (Carleton University, Ottawa, Canada) and the “Grupo Peck”, especially Eduardo Vilema (Puerto Ayora, Galápagos Islands, Ecuador), for their valuable assistance in collecting ectoparasite samples from birds during the 1992 Galápagos Expedition.

REFERENCES

- Atyeo, W.T. 1990. Ornate feather mites (Acari, Pterolichidae) from the Megapodiidae (Aves, Galliformes). *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg*, 10 (139–140): 67–74.
- Atyeo, W.T. 1992. The pterolichoid feather mites (Acarina, Astigmata) of the Megapodiidae (Aves: Galliformes). *Zoologica Scripta*, 21: 265–305.
- Atyeo, W.T. and Gaud, J. 1992. The identity of *Pterolichus obtusus* Robin, 1887 with descriptions of new genera and species of feather mites (Acarina, Pterolichidae). *Acarologia*, 33: 193–206.
- Atyeo, W.T. and Pérez, T.M. 1991. *Phycoferus*, a new genus of pterolichid feather mites (Acarina, Pterolichidae) from the Megapodiidae (Aves). *The Journal of Parasitology*, 77: 32–37.
- Board on Science and Technology for International Development and National Research Council. 1991. *Microlivestock. Little-known small animals with a promising economic future*. National Academy Press, Washington, D.C., 449 pp.
- Bruce, W.A. and Johnston, D.E. 1976. *Gaudoglyphus* n. gen., based on *Analges minor* Nörner (Acari: Gaudoglyphidae n. fam.). *International Journal of Acarology*, 2: 29–33.
- Dabert, J., Mironov, S.V. and Ehrnsberger, R. 2004. New feather mite taxa of the *Rhytidelasma* generic group (Astigmata; Pterolichidae) from the Red-flanked Lorikeet *Charmosyna placensis* (Psittacidae). *Systematic parasitology*, 58: 91–104.
- Dabert, J., Mironov, S.V. and Ehrnsberger, R. 2008. Systematic revision of the feather mite genera *Apexolichus* Gaud et Atyeo and *Titanolichus* Gaud et Atyeo (Astigmata: Pterolichidae), parasites of parrots of the Old World (Psittaciformes: Psittacidae). *Acta Parasitologica*, 53: 46–80.
- Evans, G.O. 1992. *Principles of Acarology*. CAB International, Wallingford, 563 pp.
- Fain, A. 1960. Révision du genre *Cytodites* Mégnin et description de deux espèces et un genre nouveaux dans la famille Cytoditidae Oudemans. *Acarologia*, 2: 238–249.
- Fain, A. 1965. A review of the family Epidermoptidae Trouessart parasitic on the skin of birds (Acarina: Sarcoptiformes). *Verhandelingen van de Koninklijke vlaamse academie voor wetenschappen, letteren en schone kunsten van België; Klasse der wetenschappen*, 84: 1–176 (Part I, text), 1–144 (Part II, illustrations).
- Fain, A. 1981. Notes on the genus *Laminosioptes* Mégnin 1880 (Acari: Astigmata) with description of three new species. *Systematic Parasitology*, 2: 123–132.
- Fain, A. and Elsen, P. 1967. Les acariens de la famille Knemidocoptidae producteurs de gale chez les oiseaux. *Acta Zoologica et Pathologica Antverpiensia*, 45: 1–142.
- Gaud, J. 1965. Acariens Sarcoptiformes plumicoles (Analgoidea). Parasites sur les oiseaux Galliformes d’Afrique. *Annales du Musée Royal de l’Afrique Centrale, Série 8, Sciences zoologiques*, 136: 1–77.
- Gaud, J. (1973) 1974a. Quelques espèces nouvelles de Sarcoptiformes plumicoles (Analgoidea et Dermoglyphidae) parasites d’oiseaux d’Europe. *Acarologia*, 15: 727–758.
- Gaud, J., 1974b. Une espèce nouvelle du genre *Megninia* (Analgoidea) trouvée sous la peau d’un poulet domestique en Australie. *Acarologia*, 16: 325–330.
- Gaud, J. and Atyeo, W.T. 1996. Feather mites of the world (Acarina, Astigmata): The supraspecific taxa. *Annales du Musée Royal de l’Afrique Centrale, Sciences Zoologiques*, 277: 1–193 (Part I, text), 1–436 (Part II, illustrations).
- Gaud, J., Atyeo, W.T. and Barré, N. 1985. Les Acariens du genre *Megninia* (Analgoidea) parasites de *Gallus gallus*. *Acarologia*, 26: 171–182.
- Hoeck, H.N. 1984. Introduced Fauna. Chapter 16: 233–245. In: R. Perry (Ed.), Key environments. Galapagos. Pergamon Press Ltd, Oxford, i-x + 321 pp.

- Lombert, H.A.M.P., Gaud, J. and Lukoschus, F.S. 1984. Six new species of quill wall mites (Astigmata: Laminosioptidae: Faincoptidae). *Acarologia*, 25: 55–56.
- Mironov, S.V. 1997. Contribution to the feather mites of Switzerland with descriptions of five new species (Acarina: Sarcoptiformes). *Bulletin de la Société Entomologique Suisse*, 70: 455–471.
- Pérez, T.M. and Atyeo, W.T. 1990. New taxa of feather mites (Acarina, Pterolichidae) from Megapodes (Aves, Megapodiidae). *Tijdschrift voor Entomologie*, 133: 245–249.
- Sychra, O., Harmat, P. and Literák, I. 2008. Chewing lice (Phthiraptera) on chickens (*Gallus gallus*) from backyard flocks in the eastern part of the Czech Republic. *Veterinary Parasitology*, 152: 344–348.