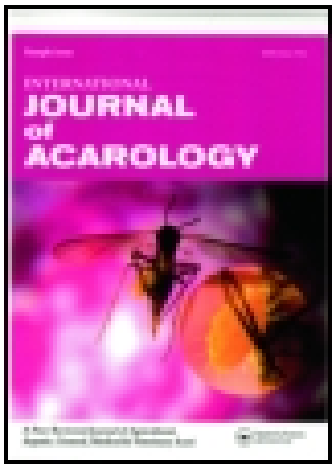


International Journal of Acarology
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/taca20

Oribatid mites (Acari: Oribatida) from deep soils of Hòn Chông limestone hills, Kien Giang Province, Vietnam. II. Descriptions of two new species, Papillacarus whitteni sp. nov. (family Lohmanniidae) and Basilobelba maidililae sp. nov. (family Basilobelbidae)

Nestor Fernandez[ab], Pieter Theron[b], Christine Rollard[c] & Sergio Leiva[d]

[a] National Council of Scientific and Technological Research (CONICET), Evolutive Genetic Laboratory FCEQyN, Misiones National University, Posadas, Argentina (email:)

[b] Research Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa (email:)

[c] Département Systématique et Evolution, Unité OSEB, Section Arthropodes, Muséum National d'Histoire Naturelle, Paris cedex 05, France (email:)

[d] Experimental Rural Agency, National Institute Agricultural Technology (INTA), Aimogasta, Argentina (email:)

Published online: 11 Mar 2015.

To cite this article: Nestor Fernandez, Pieter Theron, Christine Rollard & Sergio Leiva (2015): Oribatid mites (Acari: Oribatida) from deep soils of Hòn Chông limestone hills, Kien Giang Province, Vietnam. II. Descriptions of two new species, Papillacarus whitteni sp. nov. (family Lohmanniidae) and Basilobelba maidililae sp. nov. (family Basilobelbidae), International Journal of Acarology, DOI: 10.1080/01647954.2015.1014414

To link to this article: http://dx.doi.org/10.1080/01647954.2015.1014414

International Journal of Acarology, 2015
http://dx.doi.org/10.1080/01647954.2015.1014414

Taylor & Francis
Taylor & Francis Group

Oribatid mites (Acari: Oribatida) from deep soils of Hòn Chông limestone hills, Kien Giang Province, Vietnam. II. Descriptions of two new species, *Papillacarus whitteni* sp. nov. (family Lohmanniidae) and *Basilobelba maidililae* sp. nov. (family Basilobelbidae)

Nestor Fernandez[a,b], Pieter Theron[b], Christine Rollard[c] and Sergio Leiva[d]

[a]*National Council of Scientific and Technological Research (CONICET), Evolutive Genetic Laboratory FCEQyN, Misiones National University, Posadas, Argentina (email: nestorfernand51@yahoo.fr);* [b]*Research Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa (email: pieter.theron@nwu.ac.za);* [c]*Département Systématique et Evolution, Unité OSEB, Section Arthropodes, Muséum National d'Histoire Naturelle, Paris cedex 05, France (email: chroll@mnhn.fr);* [d]*Experimental Rural Agency, National Institute Agricultural Technology (INTA), Aimogasta, Argentina (email: sergiodanteleiva@yahoo.com)*

(*Received 8 December 2014; accepted 28 January 2015*)

In this paper, one of a series on the oribatid mite fauna of Hòn Chông limestone hills, Vietnam, we describe two new species: *Papillacarus whitteni* sp. nov. and *Basilobelba maidililae* sp. nov.

http://zoobank.org/urn:lsid:zoobank.org:pub:22D621CC-84A6-4A8E-B95A-996B533FCEEB

Keywords: Acari; Oribatida; *Papillacarus whitteni* sp. nov.; *Basilobelba maidililae* sp. nov.; Hòn Chông limestone hills; Vietnam

Introduction

The Hòn Chông-Kien Luong Hills are amongst the richest and most threatened karst systems in the world (Deharveng et al. 2009), principally due to extensive quarrying activities. These sparsely scattered minute limestone outcrops occur on the Ha Tien Plain in the extreme southwest of Vietnam near the border with Cambodia. Since several of these endemic-rich hills have already been destroyed or are under quarrying, there is a need to evaluate their fauna in order to enhance support of an action plan currently implemented by the IUCN (International Union for Conservation of Nature) and a cement company. Arthropod fauna of the remaining karst hills have been extensively sampled by several teams of Vietnamese and French researchers, and a large network of international experts is working on the collected materials. Sergey Ermilov in particular published numerous species descriptions and catalogues of oribatid mites from different sites in Vietnam, including this region. Studying the biodiversity of the Hòn Chông limestone hills is a crucial element of understanding and assessing the impacts on these small and fragile ecosystems (Deharveng et al. 2009).

The study of oribatid mites found in deep soil samples from the area commenced with a paper (Fernandez et al. 2014) describing a new genus *Bedoslohmannia* and two new species, *Bedoslohmannia anneae* and *Paulianacarus vietnamese*, which show notable particularities and adaptations compared to other genera in the Lohmanniidae family. In this second paper, two new species demonstrate interesting particularities; *Papillacarus whitteni* sp. nov. (Lohmanniidae), in terms of variety of shape of notogastral setae, and *Basilobelba maidililae* sp. nov. (Basilobelbidae), in terms of several significant characters, such as prodorsal lamella, several unusual prodorsal structures, cerotegumental layer (on body and legs), neotrichal setal shape, and particularities not seen before on tritonymphal scalps. Our studies confirm that oribatid mites described from this area include a plethora of unusual taxa.

Material and methods

Material was obtained by Louis Deharveng and Anne Bedos using Berlese extractors (see particulars under each species) in 2003.

Specimens studied with light microscopy were macerated in lactic acid and observed in the same medium using the open-mount technique (cavity slide and cover slip) described by Grandjean (1949) and Krantz and Walter (2009). Drawings were made using an Olympus BHC compound microscope (Olympus France S.A.S., Rungis, France) equipped with a drawing tube. To aid observations, some specimens were stained with chlorazol black E.

Specimens studied with the aid of scanning electron microscopy (SEM) were prepared as follows: specimens preserved in ethanol were carefully rinsed by sucking them into a Pasteur pipette several times, then transferring them for 2 hours to buffered glutaraldehyde (2.5%) in Sörensen phosphate buffer (pH 7.4; 0.1 m). After postfixation for 2 hours in buffered 2% OsO_4 solution and rinsing in buffered solution, all specimens were dehydrated in a series of graded ethanols and dried in a critical point apparatus. Specimens were mounted on Al-stubs with double-sided sticky tape, after which they were gold coated in a sputter apparatus (Alberti and Fernandez 1988, 1990a, 1990b; Alberti et al. 1991, 1997, 2007).

The critical point apparatus used was an Emitech K 850 (Quorum Technologies Ltd., Ashford, Kent, United

Kingdom) and the sputter a Jeol JFC-1200 (Jeol Ltd. Tokyo, Japan) (metalized 80″). Two different types of SEM were used in order to obtain observations of adequate quality: (1) Tescan Vega II LSU (Tescan Orsay Holdings, Kohoutovice, Czech Republic) (Direction of Collections-SEM-EDS-MNHN) and (2) Hitachi SU3500 (Hitachi High-Technologies Europe, Krefeld, Germany) (Plateau technique de Microscopie Electronique et de Microanalyse PMEM-MNHN) using accelerating voltage of 20 Kv and 10 Kv, respectively.

In the legends to figures, images obtained with Tescan Vega II LSU are indicated with (1) and those obtained with Hitachi SU3500 with (2). Measurements taken: total length (tip of rostrum to posterior edge of notogaster); width (widest part of notogaster) in micrometers (µm). Setal formulae of the legs include the number of solenidia (in parentheses); tarsal setal formulae include the famulus (ε). Measurements of setae on *Basilobelba maidililae* sp. nov. (SEM): neotrichal aggenital–adanal on 200 setae; prodorsal, subcapitular, epimeral, genital, anal on 30 setae.

Morphological terminology and abbreviations

Morphological terms and abbreviations used are those developed by Grandjean (1949, 1959); Norton and Behan-Pelletier (2009).

A number of specific morphological characters have never been described in detail, and no terminology and/or abbreviations exist for these structures. The following have been included in the text and on the figures for the sake of clarity: amorphous granulate (*a.gr*); coaptation of the arched tritonymphal buckle (*co.bu*); cuticular rib *(c.c.v)*; dorsal small rides in arc shape (*a.r*); holes (*ho*); irregular mamelonate (*i.m*); irregular mamelonate amorphous granulate (*i.m.a.g*); lateral ridges (*rc*); mamelonate columns (*m.c*); neotrichous setae (*ne*); ovoid mamelons (*o.m*); paired longitudinal ridges (*p.l.r*); ridges (*d.r*).

Institutions: MNHN: Muséum National d'Histoire Naturelle, Paris, France; IUCN: International Union for Conservation of Nature.

New taxa descriptions

Lohmaniidae Berlese, 1916
Papillacarus Kunst, 1959
***Papillacarus whitteni* sp. nov.**
(Figures 1–7; Table 1)

Etymology

The specific epithet is dedicated in honour to Tony Whitten for his tireless support for surveying and conservation of the unique karst biodiversity of Hòn Chông hills.

Material examined

Holotype: ♀ and 2 ♀ paratypes. Vietnam, Kien Giang Province; Kien Luong; Hòn Chông, Nui Hòn Chông: "nord-est de la colline, bosquet en bas de pente, terre noire fine assez sèche". 27 January 2003, secondary forest. Berlese extraction: Louis Deharveng and Anne Bedos leg. (VIET-930). X 104.649000-Y 10.139020 altitude 5 m. Deposited in the Collection of the MNHN, preserved in 70% ethanol. Material used for SEM observations not deposited.

The family Lohmanniidae reproduce parthenogenetically and thus no males exist, see Norton and Behan-Pelletier (2009, page 440).

Diagnosis – adult female

Integument: complex microsculpture, punctillate, two different sizes of points; underlain by polyhedral network. Setae: simple, bifid or trifid, notogastral neotrichy; simple barbate: prodorsum, notogaster, epimeral, genital, aggenital, anal, adanal, subcapitular, legs.

Prodorsum pyramidal truncate (dorsal view); rostrum rectilinear, medial angular incision; rostral lamellar, exostigmatal anterior, exostigmatal posterior setae present; bothridium cup-shaped, dorsally opened; sensillus pectinate with 9–13 long branches; posterior bothridial band clearly discernible in dorsal views. Notogastral transverse band not discernible; sixteen pairs of primary notogastral setae: c_1, c_2, c_3, d_1, d_2, *cp*, e_1, e_2, f_1, f_2, h_1, h_2, h_3, p_1, p_2, p_3; 64–76 pairs neotrichous setae; simple (15–19 pairs); bifid (22–26 pairs), trifid (27–31 pairs). Three pairs of lyrifissures discernible (*ia, im, ih*). Depressions housing legs I, II visible, prodorsal margin; III, IV visible, notogastral margin. Subcapitular setae, four pairs. Epimeral setal formula 8–6-4–4. Genital plate divided, ten pairs of setae. Preanal plate of typical shape. Anal, adanal plate clearly discernible with 2 and 4 setal pairs, respectively. Setal formula legs: I (0–5-2–3-16–1) (2–1–2); II (0–6-2–3-13–1) (1–1–2); III (2–4-2–2–13–1) (1–1–0); IV (2–3-1–2-12–1) (1–0-0).

Description (adult female)

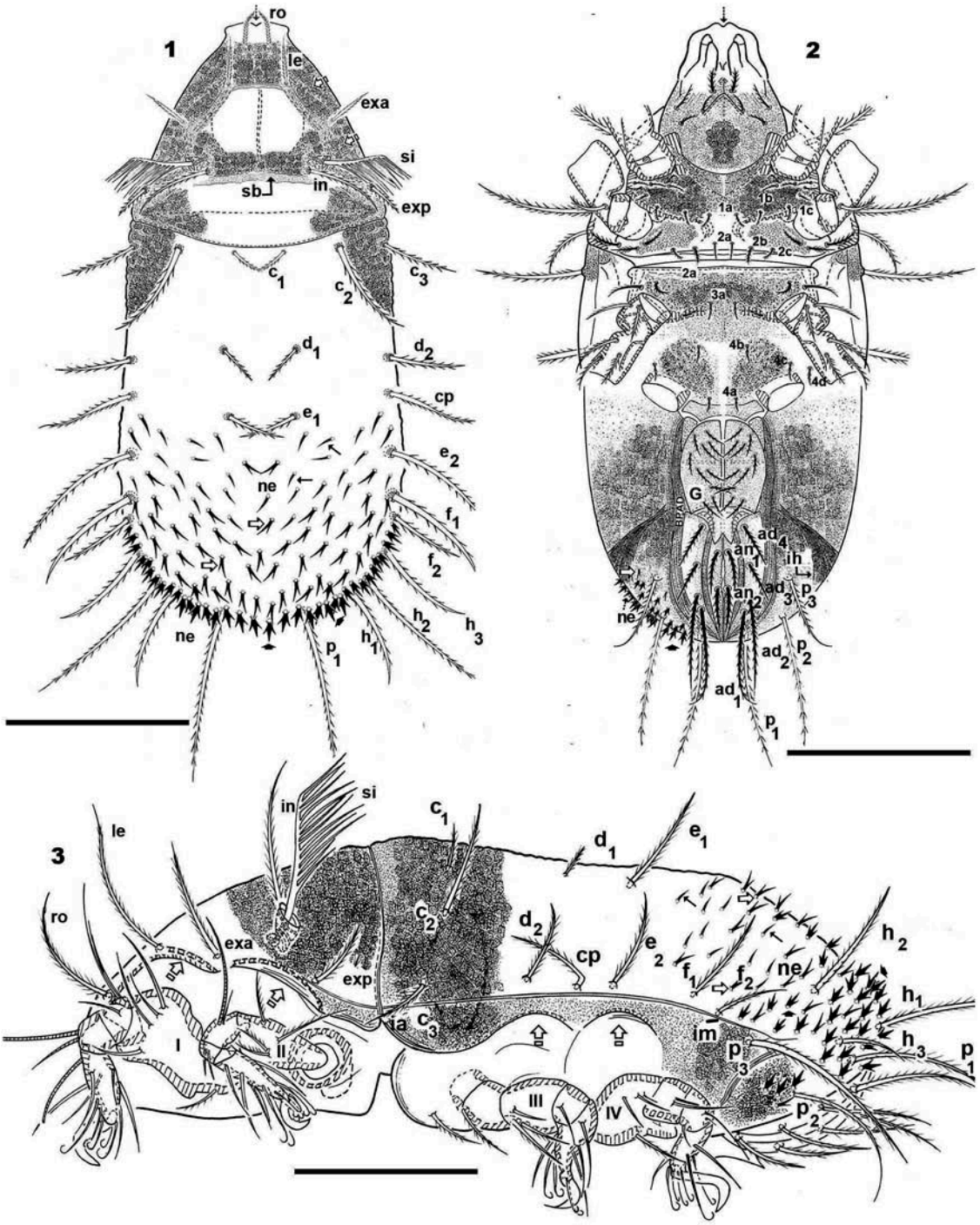
Measurements. 602 µm (580–613) × 225 µm (220–235) (on three females; deposited in MNHN).

Body shape. Elongate ovoid (Figures 1 and 2).

Colour. Yellowish to light redish-brown; slightly shiny observed in reflected light.

Cerotegument. Non existent; or disappearing during observation in lactic acid.

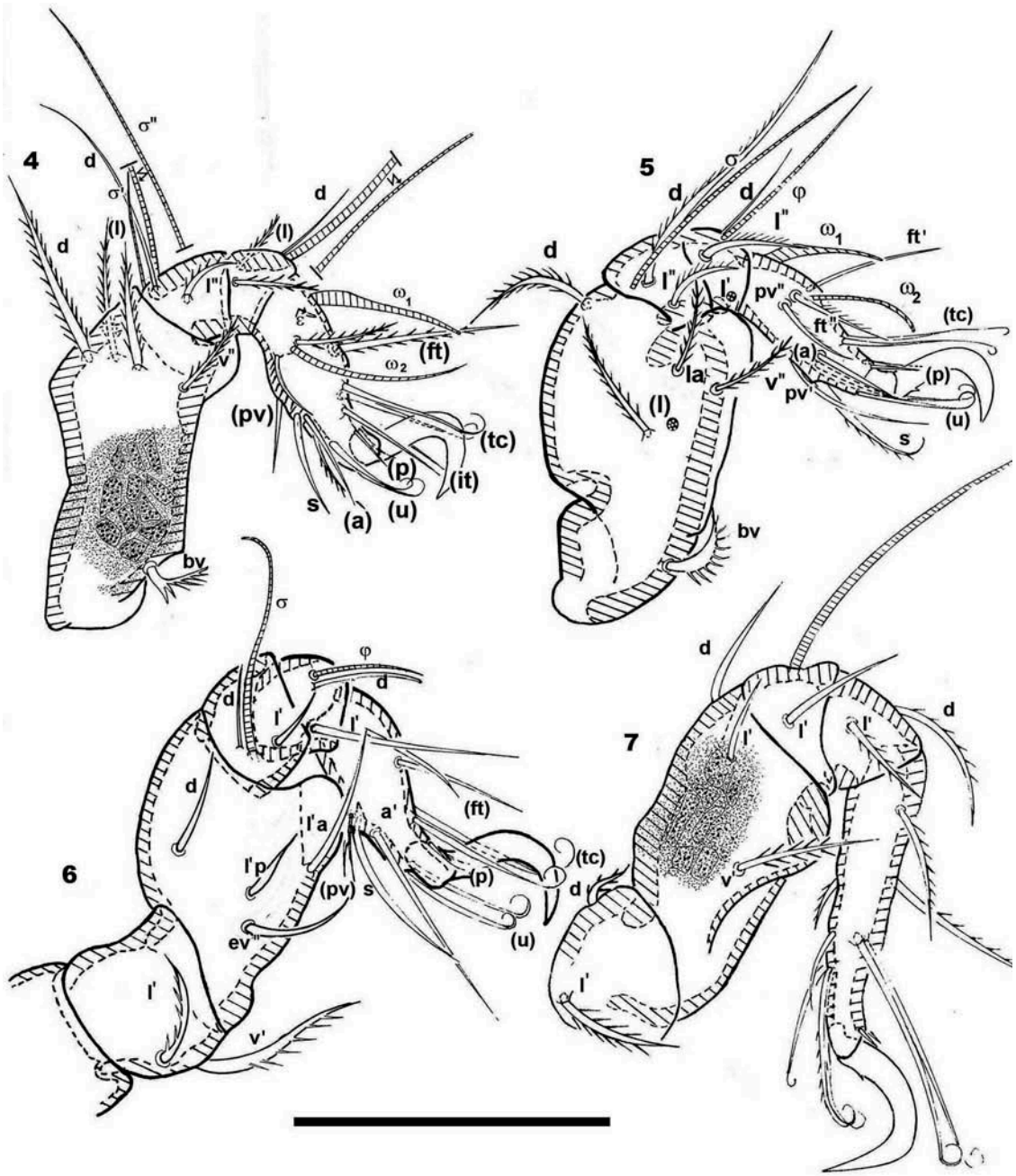
Integument. Complex microsculpture of similar type covering entire body and legs: punctulate cuticular surface with two different point sizes; polyhedral network microsculpture slightly beneath them (Figures 1–4, 7); cuticular microsculpture difficult to observe due to cuticular structures.



Figures 1–3. *Papillacarus whitteni* **sp. nov.**, adult. 1. dorsal view; 2. ventral view; 3. lateral view. Abbreviations: see "Materials and methods". Scale bars: 1–2 = 200 μm; 3 = 125 μm.

Setation. Four types: (1) simple, small, without barbs: neotrichal notogastral setae (*ne*) (Figures 1–3, indicated by long black arrow); (2) simple, barbate: prodorsal, notogastral, epimeral, genital, aggenital, anal, adanal, subcapitular, legs (Figures 1–3, 5, 6, 7); (3) bifid: neotrichal notogastral setae (Figures 1–3 indicated by white arrow); (4) trifid: neotrichal notogastral setae (Figures 1–3 indicated by short black arrow).

Prodorsum. Pyramidal truncate (dorsal view) (Figure 1); triangular-polyhedral (lateral view) (Figure 3). Rostrum more or less rectilinear, medial angular incision (Figures 1 and 2) (indicated by ⇣); *ro* setae inserted far from rostrum at level of anterior arched margin (*l.d* I) (or pedofossae, Norton 2010) (Figure 1, indicated by ⇪, observed due to transparency); *le* setae placed posterolateral to *ro* setal insertion level; *le* setal insertion found at



Figures 4–7. *Papillacarus whitteni* **sp. nov.**, adult. 4. leg I antiaxial view; 5. leg II antiaxial view; 6. leg III, antiaxial view; 7. leg IV, antiaxial view. Abbreviations: see "Materials and methods". Scale bars: 4–7 = 80 μm.

level *l.d* I-II (Figure 1 indicated by ⇧, observed due to transparency); *bo* cup-shaped, dorsally opened (Figure 1); *si* pectinate with 9–13 long branches per side (Figures 1 and 3); *in* inserted posterior to *bo* and near transverse postbothridial band *sb* (Figure 1); *exa* setae situated anteriorly to *bo; exp* clearly visible, situated marginally, posterior to *in* setal insertion level (Figures 1 and 3). Band *sb* clearly discernible in dorsal view; situated posteriorly to *in* setae (Figure 1).

Notogaster. Notogastral setation: anterior paleotrichy, posterior neotrichy; transverse band not discernible (see Remarks); sixteen pairs of primary notogastral setae: c_1, c_2, c_3, d_1, d_2, *cp*, e_1, e_2, f_1, f_2, h_1, h_2, h_3, p_1, p_2, p_3 clearly discernible (Figures 1 and 3); 64–76 pairs neotrichous setae (*ne*); simple (15–19 pairs); bifid (22–26 pairs); trifid (27–31 pairs) (Figures 1–3). Neotrichous setae posterior to e_1, *cp* setae; distribution of simple setae principally covering zone between *cp*, e_1 and f_2 setae, on lateral to medial position (Figures 1 and 3); bifid setae following distribution of simple setae; starting slightly posterior to e_1 setae on central notogastral zone, extending to posterior notogastral zone (Figures 1 and 3), with few surrounding p_3 setae (Figure 2). Trifid setae situated posteriorly to f_2 setae,

Table 1. *Papillacarus whitteni* **sp. nov.**, setae and solenidia.

Leg I	Femur	Genu	Tibia	Tarsus	Claw
Setae	*bv, d, (l), v"*	*d, l"*	*d, (l)*	*(it), (p), (u), (a), s, (φ), (tc), (pv), ε*	1
Solenidia		σ_1, σ_2	*φ*	ω_1, ω_2	
Leg II					
Setae	*bv, (l), la, v", d*	*d, l"*	*d, (l)*	*(pv), (φ), (tc), (p), (u), s, (a)*	1
Solenidia		*σ*	*φ*	ω_1, ω_2	
Leg III					
Setae	*ev", l'p, l'a, d*	*d, l'*	*d, l'*	*(u), (p), a', s, (pv), (tc), (φ)*	1
Solenidia		*σ*	*φ*	*0*	
Leg IV					
Setae	*d, l', v"*	*l'*	*l', d*	*(φ), (pv), a', s, (u), (p), (tc)*	1
Solenidia		*σ*	*0*	*0*	

on lateral and medial zone (Figures 1 and 3) and surrounding p_1–p_3 setae (Figure 2). Three pairs of lyrifissures (*ia, im, ih*) (Figures 1 and 3) (see Remarks).

Lateral region (Figure 3). Depressions (*l.d*) housing legs I, II, clearly visible in prodorsal margin (Figure 3, indicated by ⇧), notogastral margin with *ld* of legs III and IV clearly visible (Figure 3, indicated by ⇧).

Anterior zone of pleuraspis presenting rounded lobe, lyrifissure *ia* hardly discernible. Unsclerotized longitudinal line easily discernible extending to h_2 setal insertion level. Posterior zone (where unsclerotized line does not exist) very small.

Ventral region (Figure 2). Four pairs of subcapitular setae (see setation). Clearly visible ventrosejugal groove dividing coxisternal region. Apodemes clearly visible; epimeres I, II, III neotrichous; primary setae well discernible; setal formulae 8–6-4–4 (Figure 2). All setae similar in shape (see setation).

Genital plate divided (hardly discernible), with five pairs of setae in each zone. Preanal plate of typical shape. Anal and adanal plate easily discernible with 2 and 4 pairs of setae respectively. *BPAD* (adanal fold band) clearly visible in animals after lengthy soaking in lactic acid.

Legs. Setal formulae I (0–5-2–3-16–1) (2-1–2); II (0–6-2–3-13–1) (1–1-2); III (2–4-2–2-13–1) (1–1-0); IV (2–3-1-2-12–1) (1-0-0). See Table 1 for details of setae and solenidia.

Remarks. The integumental microsculpture obscures clear observation of prodorsum and notogaster, mainly of transverse bands and lyrifissures. The observation of lyrifissure *ia* on the anterior zone of pleuraspis was very difficult, and necessitated meticulous observation. The neotrichous notogastral setal distribution is very interesting, with simple setae in the anterior zone, bifid setae in the central zone and trifid setae in posterior and marginal zones. A neotrichy is principally observed on I and II of epimeral regions.

Basilobelbidae Balogh, 1961
Basilobelba Balogh, 1958
Basilobelba maidililae sp. nov.
(Figures 8–46; Table 2)

Etymology

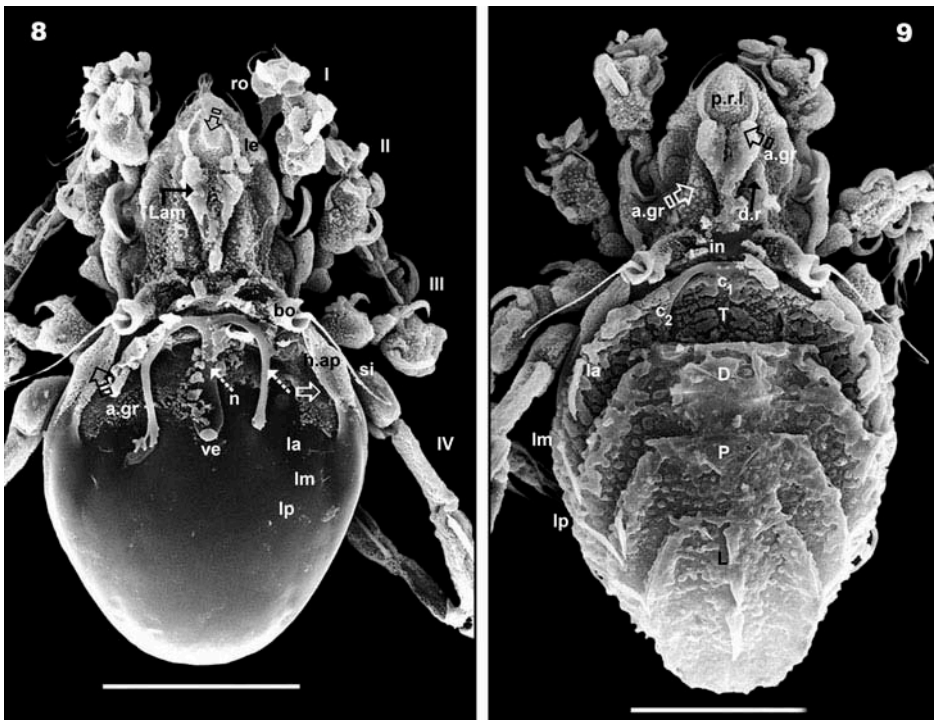
The specific epithet is dedicated to Mrs Maidi Lili Schroetlin Beling, Paraguayan artist, who has managed to survive in a harsh world, to be respected for her qualities and exceptional work.

Material examined

Holotype ♀ and 2 ♀ paratypes. Vietnam, Kien Giang Province; Kien Luong; Nui Hòn Chông "sommet est, flanc nord" 27 January 2003, secondary forest. Berlese extraction from deep mineral soil. Louis Deharveng and Anne Bedos leg. (VIET-929) X 104.647086; Y 10.140744 alt 120 m. Deposited in the Collection of the MNHN, preserved in 70% ethanol. Material used for SEM observations not deposited.

Diagnosis – adult female (male unknown)

Body and legs covered by significant and complex cerotegument. Setae: simple, smooth: notogastral, epimeric, genital, anal; simple, whip-like: aggenital, adanal; simple, small asperities: prodorsal. Rostrum pointed; lamellae Y-shaped; paired longitudinal ridges between lamellae and rostrum; lateral ridges arc-shaped; dorsal ridges L-shaped; small arc-shaped ridges anterior to insertion of interlamellar setae. Lateral bothridial opening, border with rounded depression; sensillus long, setiform. Dorsosejugal furrow rectilinear, well delimited. After exuviae removal, nine pairs of minute setae: *la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3; four pairs of lyrifissures: *im, ih, ips, ip*; cuticular wart present on anterior zone, coaptated arched tritonymphal buckle; posterior zone with dimple; large humeral apophysis; pedotectum I large lamina; cuticular rib between acetabulum IV and posterior notogastral zone. Ventral region: aggenital–adanal neotrichy 53–58 pairs.



Figures 8–9. *Basilobelba maidililae* **sp. nov.**, adult, SEM. 8. dorsal view without scalps$_{(1)}$ 9. dorsal view with scalps$_{(1)}$. Abbreviations: see "Materials and methods". Scale bars: 8–9 = 200 µm.

Description (Adult female)

Measurements. 510 µm (551–470) × 289 µm (313–265) (Holotype ♀ and 2 ♀ paratypes measured).

Body shape. Elongated oval (Figures 8–10).

Colour. Specimens without cerotegument, brown to dark brown, slightly shiny when observed in reflected light.

Cerotegument. Significant, complex cerotegument covering entire body and legs. Thick basal layer (*c.b*) (0.5–1 µm), with structures rising above the surface. The *c.b* is an amorphous coat with holes (*ho*) present (Figures 16, 24, 29, 30) or absent (Figures 23 and 25) at random. Surface structures in high relief: (a) amorphous granulate (*a.gr*) on lamellar surface, lateral posterior zone to lamellae, between and anterior to *le* setae; prodorsal lateral margin; bothridium; humeral apophysis (Figures 8 and 9 indicated by ⇪); (b) irregular mamelonate (*i.m*) (Figures 21–24, 26–28 indicated by ↑↑) on subcapitulum, epimeres, genital plate, anal plate, ventral shield, legs, leg setae; (c) ovoid mamelons (*o.m*) (Figure 25 indicated by ⇪) on lateral border of ventral shield; (d) mamelonate columns (*m.c)* (Figures 31 and 32 indicated by ➧) with variable number of mamelons (between three and several tens), on subcapitulum, epimeric furrows; (e) irregular mamelonate, amorphous granulate (*i.m.a.g*) (Figures 29 and 30, indicated by ⇨) on legs.

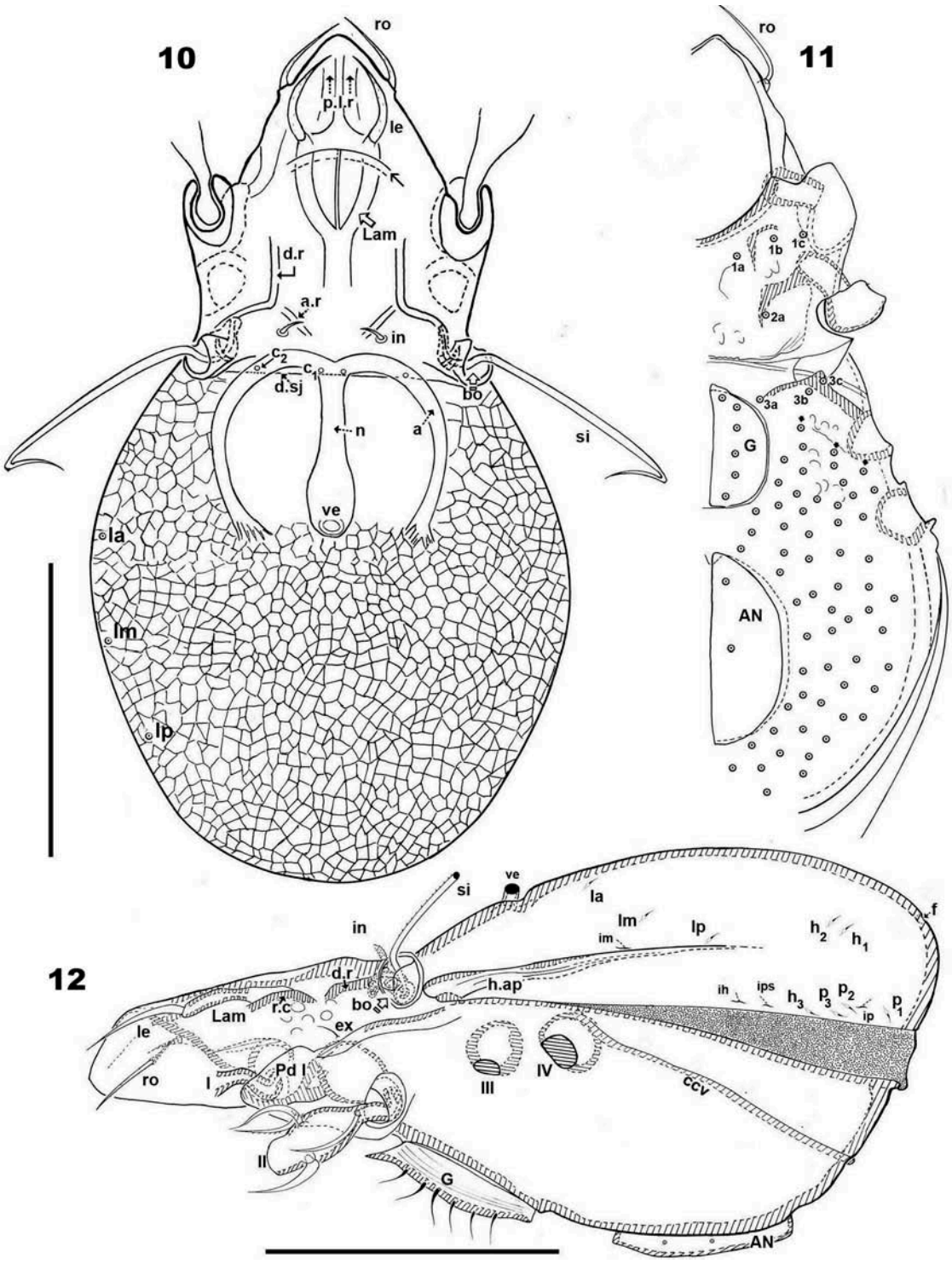
Cerotegumental layer on legs covering segments and setae. Segments: very complex microsculpture with *ho, i.m, a.gr* (Figures 15–17, 27, 28). Cerotegumental layer covering large setae (principally on femur, genu and tibia) is thick and has particular disposition: opaque on ventral zone, but on dorsal and lateral zones permitting observation of barbs or asperities. Cerotegumental layer results in unusual appearance of setae, which appear much larger, sausage-shaped (Figures 15–17). Other setae (principally on tarsus): cerotegumental layer thin, permitting observation of setae, generally simple, elongated, with or without barbs (Figures 8, 9, 20).

Other characteristic features of cerotegumental layer: (1) setae with cerotegument in basal zone and remaining setae only a very thick basal layer (*ro*) (Figure 18); (2) setae without cerotegument on proximal zone and remaining setae with thick layer (epimeral, genital, aggenital, adanal) (Figures 21, 22, 24); 3) anal setae entirely covered in cerotegument (Figure 26).

Integument. Smooth.

Setation. Simple, smooth: notogastral, epimeral, genital, anal (Figures 10 and 12); simple whip-like: aggenital, adanal (Figures 20 and 24); simple, small asperities: *ro, in, le* (Figures 9, 12, 18); barbate: several leg setae (Figures 16, 40, 43–45).

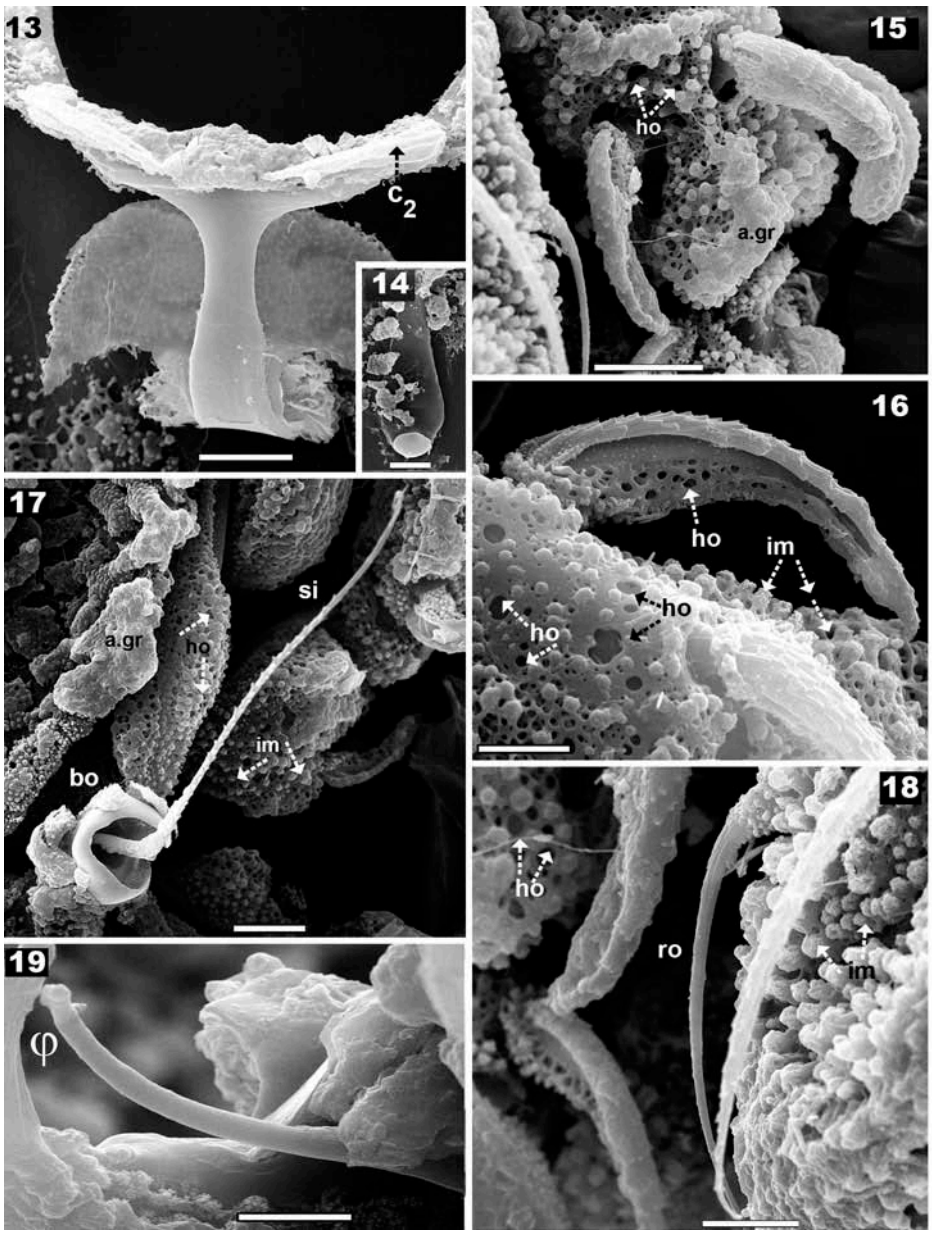
Prodorsum. Rostrum pointed (Figures 8 and 9). Rostral setae (*ro*) situated laterally, inserted on small promontories; inserted anterior to lamellar insertion level (Figures 9, 10, 12); from alveoli of *ro* setae a very long canal, clearly visible due to transparency, extends to *le*



Figures 10–12. *Basilobelba maidililae* **sp. nov.**, adult. 10. dorsal view with tritonymphal scalp; 11. ventral view; 12. lateral view, without legs. Abbreviations: see "Materials and methods". Scale bars: 10–11 = 180; 12 = 200 μm.

setal insertion level (Figure 12); lamellae prominent, Y-shaped *le* setae present in apical zone (Figure 10).

Between lamellae and rostrum paired longitudinal ridges (*p.l.r*), extending to vicinity of rostrum. Semicircular cuticular thickening (Figure 10 indicated by ↑) posterior to *le* setal insertion level. Lateral ridges (*rc*) form an arc, clearly visible in lateral view; another ridge (*d.r*) dorsally situated, L-shaped, extending antiaxially (Figure 10) originating at level of Y-lamella bifurcation, extending to bothridium (Figure 10). Small arc-shaped ridge (*a.r*) situated anterior to *in* setae insertion. Cerotegumental layer covering *lam, d.r* and *a.r* clearly allowing differentiation between these structures (Figures 8 and 9); *in* setae small, phylliform, small



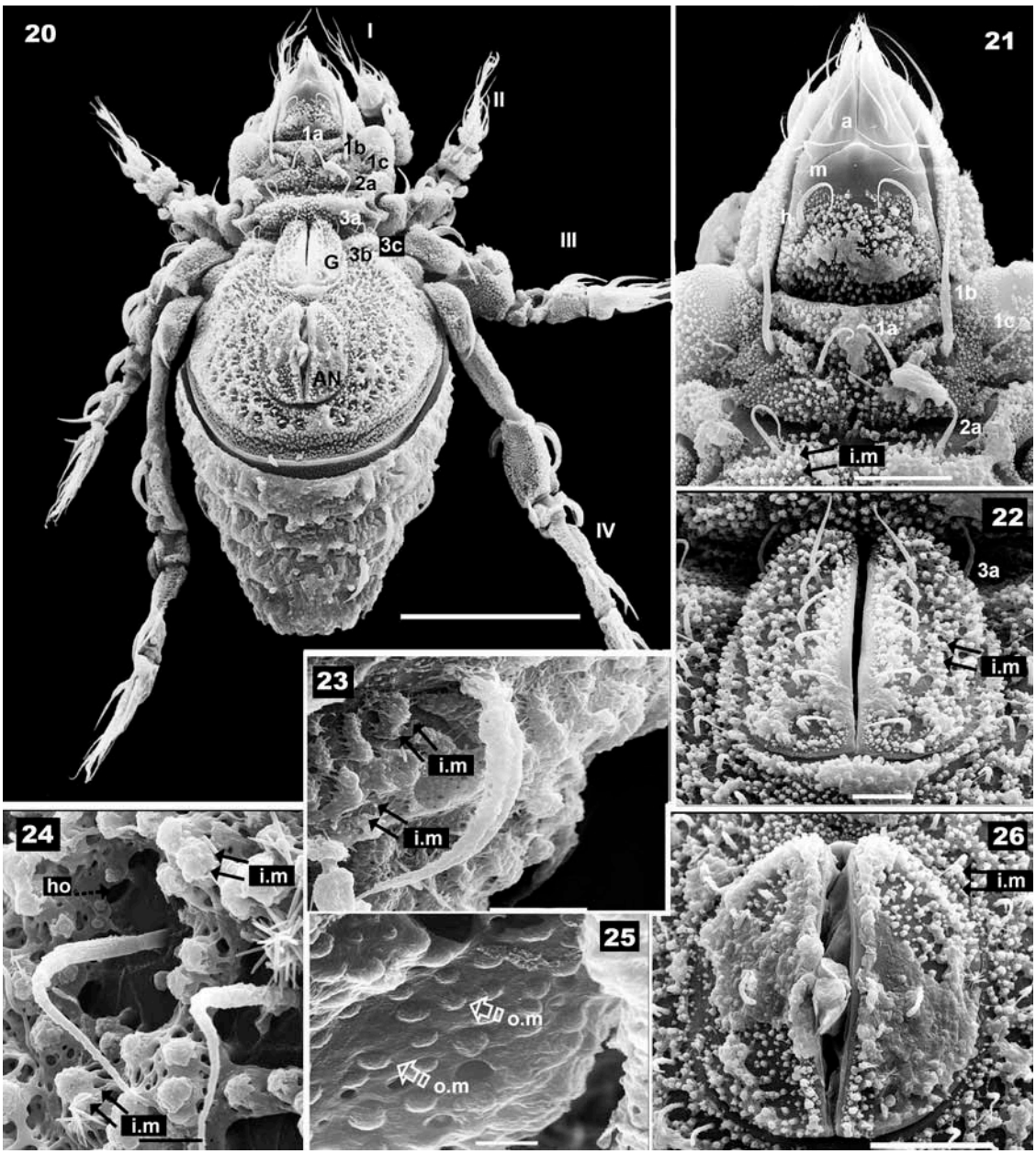
Figures 13–19. *Basilobelba maidililae* **sp. nov.**, adult, SEM. 13. tritonymphal buckle$_{(2)}$; 14. thong of tritonymphal buckle$_{(2)}$; 15. genu II, dorsal view with cerotegument$_{(1)}$; 16. tarsus II, *ft″* setae, with cerotegument$_{(1)}$; 17. bothridium and sensillus$_{(2)}$ 18. rostral setae with cerotegument$_{(1)}$ 19. leg, tibia III solenidion (*fi*)$_{(1)}$. Abbreviations: see "Materials and methods". Scale bars: 13–15, 17 = 20 μm; 16, 18 = 10 μm; 19 = 2 μm.

dentitions; *ex* setae small, simple, curving; relative sizes of setae *le* > *ro* > *in* ≥ *ex*.

Bothridial opening laterally, rounded depression situated on border (Figures 8, 9, 12, 17). Sensillus long, setiform, angle bent near base; spiny on both sides; radix of sensillus roughened (Figure 17).

Notogaster. Swollen, hemispheric, bearing four-layered exuviae (larval, protonymphal, deutonymphal and tritonymphal), stacked up to resemble a flat tower. Dorsosejugal furrow rectilinear, well delimited (Figure 10). After removal of exuviae, glabrous notogastral surface becomes visible, bearing nine pairs of minute setae *la, lm, lp, h$_1$, h$_2$, h$_3$, p$_1$, p$_2$, p$_3$*; four pairs of lyrifissures *im, ih, ips, ip* (Figures 8 and 12). Anterior notogastral zone bearing cuticular wart (*ve*) that hooks the arched tritonymphal buckle (*co.bu*) by coaptation; dimple (*f*) in the posterior zone (Figure 12).

Lateral region. Only pedotectum I present; *Pd I* large lamina, with slight contraction anterior to *ex* setae; the border can be followed a short distance to the *ex* setae (Figure 12), from that point a tectum extends, reaching close to the humeral apophysis; *h.ap* clearly discernible as a finger-like structure. Notogastral setae *la, lm, lp, h$_1$, h$_2$, h$_3$, p$_1$, p$_2$, p$_3$* and lyrifissures *im, ih, ips, ip* clearly discernible.



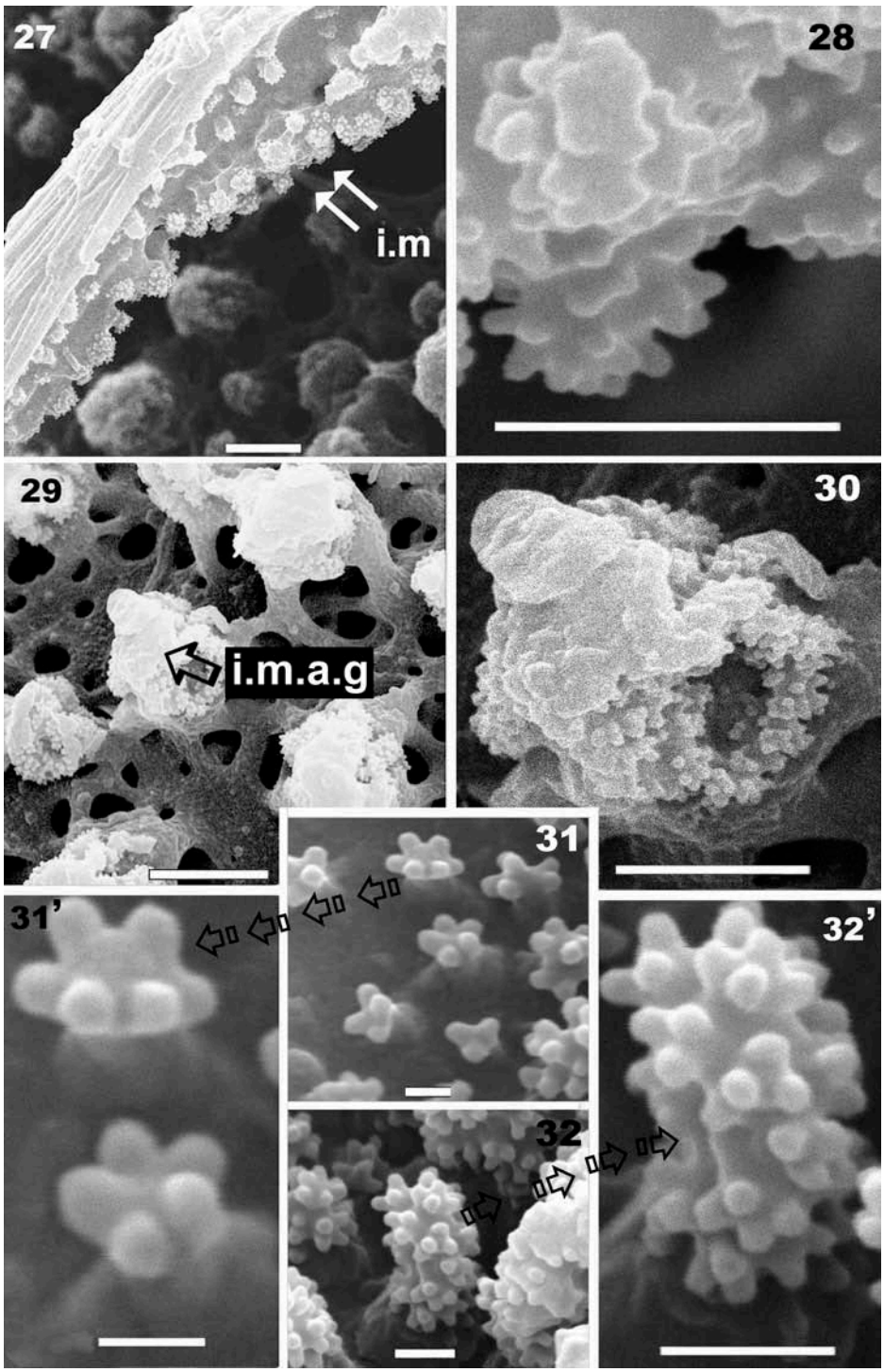
Figures 20–26. *Basilobelba maidililae* **sp. nov.**, adult, SEM. 20. ventral view with cerotegument$_{(1)}$; 21. Subcapitulum$_{(1)}$; 22. genital plate$_{(1)}$; 23. setae *lm* tritonymphal scalp$_{(1)}$; 24. adanal setae$_{(1)}$; 25. anal plate$_{(1)}$; 26. cerotegumental detail, ventral zone$_{(1)}$. Abbreviations: see "Materials and methods". Scale bars: 20 = 200 μm; 21 = 50 μm; 22 = 20 μm; 23 = 20 μm; 24 = 5 μm; 25 = 2 μm; 26 = 20 μm.

Prominent cuticular rib (*c.c.v*) running from superior area of acetabulum IV, extending to the posterior zone (Figure 12).

Ventral region. Subcapitulum diarthric, cerotegumental layer only around *h* setal insertions (Figure 21); subcapitular setae (Figure 21) faintly barbate on either side, differing greatly in shape: *a* (29.8 μm ± 3 μm), simple, sharply tipped; *m* (40 μm ± 3 μm), whip-like; *h* (43,2 μm ± 3 μm), ovoid, nearly circular in shape. Chelicera (Figure 46) elongated, with small movable digit (see Discussion).

Epimeres I, II of typical morphology, ventrosejugal furrow well discernible (Figures 11, 20, 21). Other epimeres are not visible. Epimeral setation is 3–1–3, and probably 3 for setae of epimere IV (indicated by black arrow, Figure 11), but neotrichous aggenital setae are not separated from epimeral setae; for this reason, establishing exact number of setae was impossible (Figures 11 and 20).

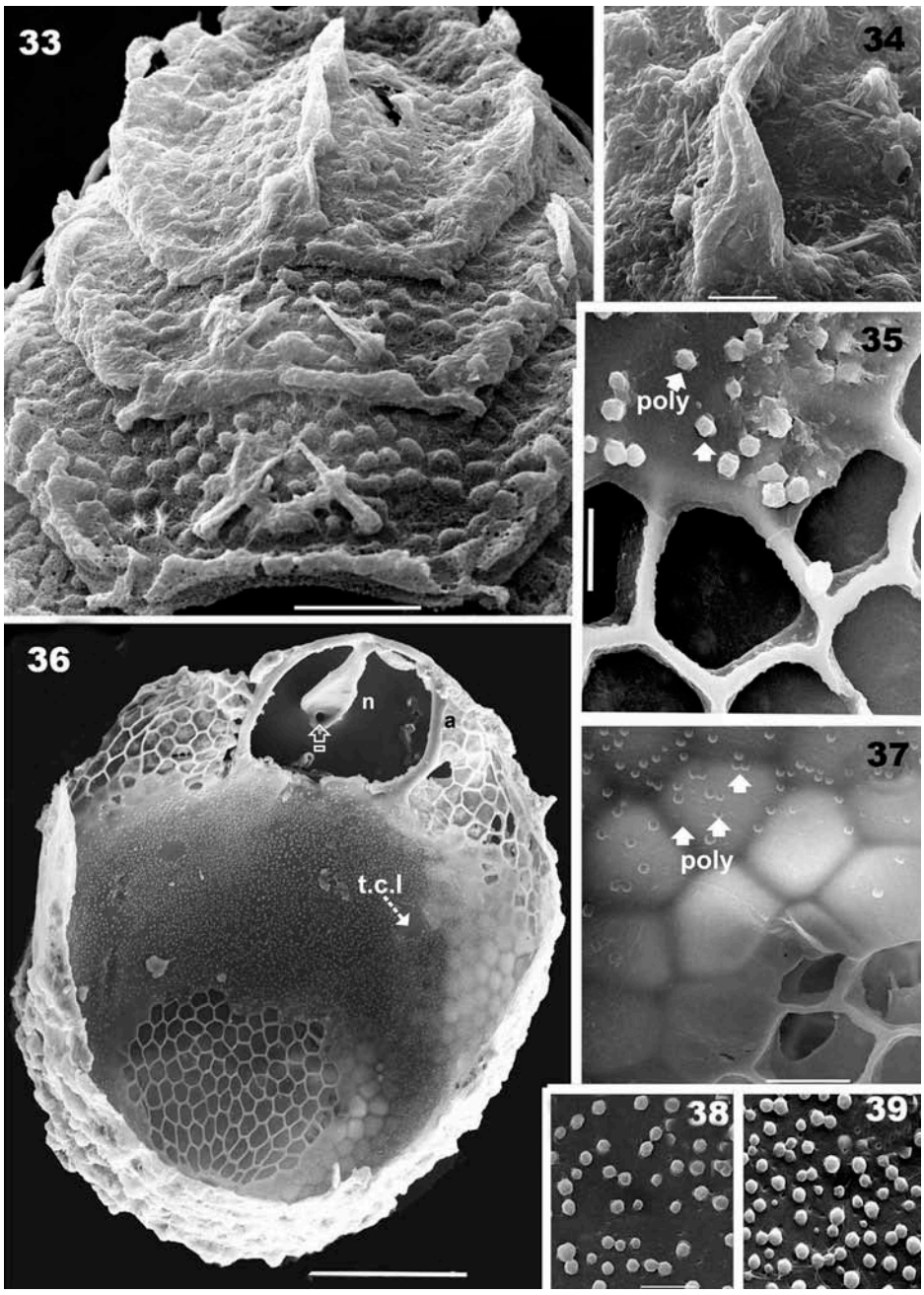
Seta *1a* of medium length (36 μm ± 3 measurement on 24 setae) with curving tip; *1b* a robust seta (68 μm ± 3 μm), straight, sharply tipped; and *1c* seta small (27 μm ± 3), straight, sharply tipped; *2a* thin, whip-like (60 μm ± 3 μm); 3*a* (27.3 μm ± 3 μm), straight, sharply tipped; 3*b* (35 μm ± 3 μm) thin whip- like setae; 3*c* (32.5 μm ± 3 μm) curving sharp tip. Other epimeral setae (4*a*, 4*b*, 4*c*), aggenital and adanal setae similar, with sharp whip-like tip, length 25.7 μm (28.6 μm–23.9 μm on 200 setae measured) (Figures 20 and 21). Four pairs of simple genital setae,



Figures 27–32. *Basilobelba maidililae* **sp. nov.**, adult, SEM. Cerotegumental layer. 27. irregular mamelonate $(i.m)_{(1)}$; 28. detail *i.m,* high augmentation$_{(1)}$; 29. cerotegument ventral lateral body zone irregular, mamelonate, amorphous, granulate $(i.m.a.g.)_{(1)}$; 30. detail, $i.m.a.g_{(1)}$; 31. mamelonate columns (*m.c*), cerotegument ventral zone$_{(1)}$; 31′. detail hight augmentation of *m.c* cerotegumental structures$_{(1)}$; 32. cerotegumental mamelonate columns$_{(1)}$; 32′. Detail high augmentations $m.c_{(1)}$. Abbreviations: see "Materials and methods". Scale bars: 27, 29 = 2 μm; 28 = 1 μm; 30, 31, 32 = 500 nm; 31′ = 200 nm; 32′ = 500 nmμ.

curving, sharply tipped: g_1: 32–36 μm, g_2–g_3: 24–32 μm; g_4–g_6: 16–24 μm. Two pairs of anal setae: an_1: 7 μm; an_2: 13–14 μm. Aggenital and adanal neotrichy, 53–58 setae.

Legs. Legs I, II small, more or less similar in size (Figures 40 and 43); III medium sized and IV largest. Leg shape similar to *Basilobelba retiarius* (Grandjean 1959), moniliform with bulbous segments and large peduncles (Figures 40 and 43), with femoral peduncles being largest. Tarsi particularly shaped with a narrow part between bulb and claw on legs I–IV (Figures 40, 43–45).

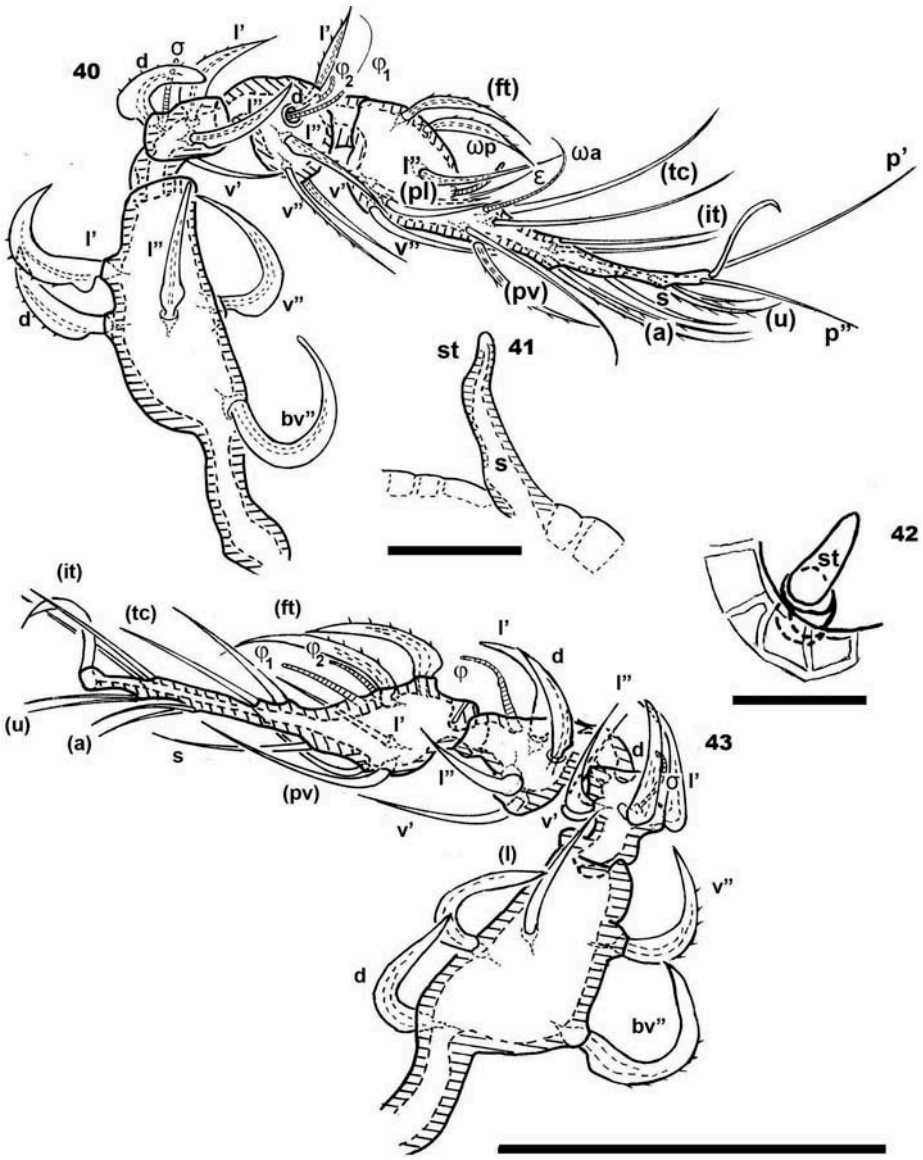


Figures 33–39. *Basilobelba maidililae* **sp. nov.**, adult, SEM. 33. frontal view, scalps, proto, deuto, tritonymph$_{(1)}$; 34. details central setae, larval scalp$_{(1)}$; 35. interior zone of tritonymphal scalp$_{(1)}$; 36. ventral general view, tritonymphal scalp$_{(1)}$; 37. internal view, tritonymphal scalp$_{(1)}$; 38. details interior tritonymphal scalp$_{(1)}$; 39. detail interior tritonymphal scalp$_{(1)}$. Abbreviations: see "Materials and methods". Scale bars: 33 = 50 µm; 34, 37 = 10 µm; 35, 38, 39 = 5 µm; 36 = 100 µm.

Setal formulae: I (1–5-4–5-20–1) (1-2–2); II (1–5-4–4-14–1) (1–1-2); III (2–2-2–5-13–1) (1–1-0); IV (1–3-2–4-10–1) (0–1-0). Setae *d* present on all genua and tibiae. On tibia I, seta *d* is small, situated in same round insertion cavity as solenidion φ_2. On other genua and tibiae setae *d* are large, with small barbs (Figures 40, 43–45). Setae (*p*) absent on tarsi II, III, IV. Setae (*it*), (*tc*), (*ft*) present on tarsi I, II, III; (*it), ft* absent on tarsus IV. Solenidion of each segment is particular, as in tibia III (Figure 19) with inflated apical zone.

Nymphal scalps. Scalps are coated by significant cerotegumental layer (Figures 9 and 33). Due to limited specimen numbers and the necessity of dissection, comprehensive study of scalps was impeded. Our study was therefore limited to tritonymphal scalps.

Tritonymphal scalps. Heart-shaped structure (tritonymphal buckle) fixing scalp to adult notogaster. Two loops (*a*) (Figures 8–10, 12, 14, 36), curving outwards then inwards forming a heart-shaped structure, meeting in the plane of



Figures 40–43. *Basilobelba maidililae* **sp. nov.**, adult. 40 leg I antiaxial view 41 lateral view of style and stylet; 42 apical view of stylet 43 leg II, antiaxial view. Abbreviations: see "Materials and methods". Scale bars: 40, 43 = 80 μm; 41, 42 = 10 μm.

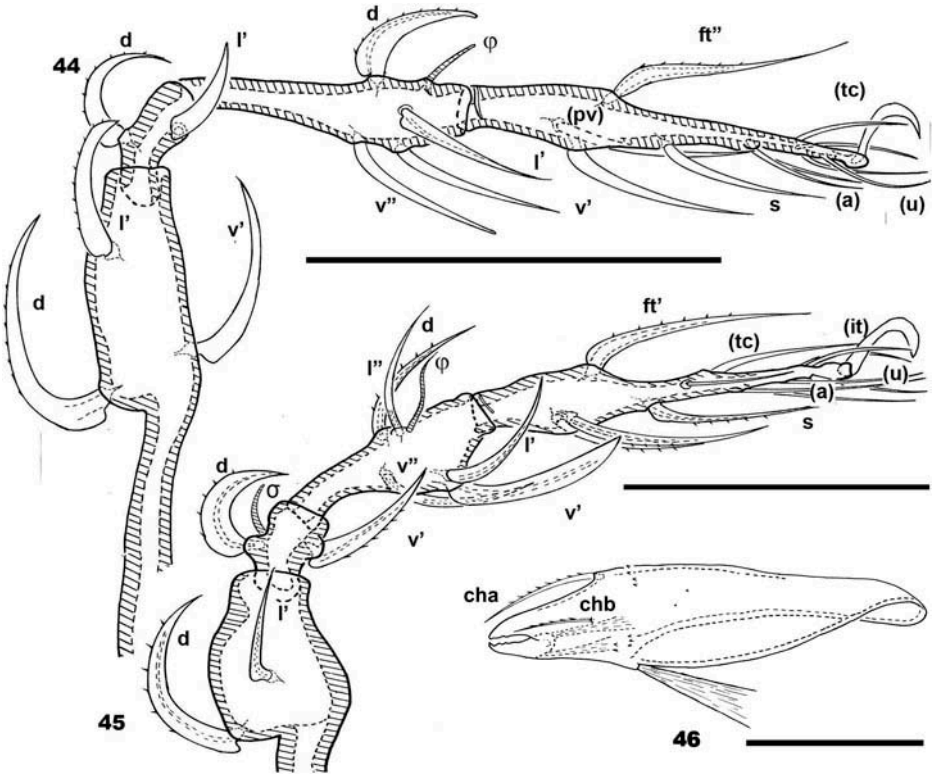
symmetry, forming a thong-like structure (*n*) (94–96 μm) (Figures 12–14, 36). Capsule present on *n* (Figure 36 indicated by ⇧) (diameter 2.7 – 3 μm) receiving *ve* (Figures 10 and 12). Scalps are reticulate (Figures 10, 35–37) with polygonal structures, principally with five or six sides (Figures 10, 35–37), internally scalps present a very thin cuticular layer (*t.c.l*) (Figures 35–37) partially covering polygonal structures. Central posterior and lateral zone not covered by *t.c.l.* The *t.c.l.* is not smooth, being covered in small polyhedral structures (*poly*) (Figures 35, 37–39 indicated by ♠). High magnification is necessary for observation of detail of these structures, as in normal SEM they appear spherical.

Particular distribution of *poly*, with zones of higher and lower density. Zones with higher density, larger *poly* (diameter 1.2–2.5 μm) observed in central zone of scalps (Figure 39); zones with lower density, smaller *poly* (diameter 0.7–1.25 μm) observed in lateral zone (Figure 38).

Setae c_1, c_2, *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 present; c_1; c_2 setae on two loops (*a*) (Figure 10); c_1, only insertion visible (cerotegumental layer must be removed for observation) (Figure 9); c_2 setae (41–43 μm), covered by cerotegument (Figure 13); *la*, *lm*, *lp*, h_1, h_2, h_3, p_1 covered by cerotegumental layer (76–82 μm).

On posterior scalp border, there is a horn-like structure (Figures 41 and 42) aiding in hooking the deutonymphal scalp. These horns are divided into two zones (Grandjean 1959, p. 189), the proximal style (*s*) and the distal stylet (*st*) (Figures 41 and 42). This structure has a finger-like shape. Medial setae on larval scalp (Figure 33) totally immersed in cerotegument.

Remarks. The study of *Basilobelba maidililiae* sp. nov. is provisional, other samples from Hòn Chông limestone



Figures 44–46. *Basilobelba maidililae* **sp. nov.**, adult. 44. leg IV, antiaxial view; 45. leg III, antiaxial view; 46. chelicera, lateral view. Abbreviations: see "Materials and methods". Scale bars: 44 = 150 μm; 45 = 70 μm; 46 = 40 μm.

hills may contain more specimens and immatures, which would enable us to augment our studies.

Discussion

Papillacarus whitteni sp. nov.

In their recent paper, Vu et al. (2014) reviewed the genus *Papillacarus* from Vietnam and established the presence of nine species. These authors reviewed the taxonomic status of *P. arboriseta* Jeleva and Vu, 1987, which was considered by Ermilov et al. (2011) to be a synonym of *P. hirsutus* (Aoki, 1961). Vu et al. (2014) indicated that *P. arboriseta* clearly differs from *P. hirsutus*, adding a tenth species.

Papillacarus whitteni sp. nov. presents some characters in common with others species found in Vietnam, but the particularities of the cuticular microsculpture, the notogastral neotrichy (with three types of setae: simples, bifid and trifid), and the epimeral neotrichy, make this new species clearly distinguishable from other congeners.

Basilobelba maidililae sp. nov.

Initially we had difficulty establishing differences between *Basilobelba* Balogh, 1958 and *Xiphobelba* Csiszár, 1961. Csiszar indicated in the definition of the new genus (1961, p. 353): "Rostrum pointed, chelicerae attenuated to a point, chela very small reduced" and a little later in the text "The new genus is an ally of *Basilobelba* Bal.1958, differing from it by the peculiar oral organs, resembling those of *Eupelops"*. The problem is that the oral organs were not drawn, and the other characteristics indicated, such as the cerotegument, were neither described nor figured. Only two figures were given, one dorsal with scalps, the other dorsal without scalps.

The second species described in the genus was *X. setosa* Aoki, 1968; in this case the chelicera was partially illustrated with the rest of the subcapitulum (p. 271, Figure 14).

In *Basilobelba maidililae* sp. nov. the rostrum is pointed as indicated in the genus description of *Xiphobelba*; we dissected one specimen and observed an elongated chelicera, with attenuate chelae, but it is not exactly a Pelopsidae chelicera. A comparison was made with *Basilobelba retiarius,* Grandjean (1959), and we had the opportunity to also compare it with the material studied by the cited author. There were differences at cheliceral level between *B. maidililae* and *B. retiarius*, and we consider the chelicera of *B. maidililae* to be normal but elongated. We therefore include this species in the genus *Basilobelba*.

The comparison between different species of the two genera is complex. Aoki (1968) indicated in his remarks that

> Csiszár (1961) established the genus *Xiphobelba*, considering the following characters as distinguishing features of it from genus *Basilobelba*, i.e, the peloptoid chelicerae, the poited rostrum and the strong neotrichy on the ventral plate. Having found a new congener, *X. setosa* n. sp., the author believes that the relatively large body size and the genital

> aperture distinctly larger than anal one may also be included in the generic characters of *Xiphobelba*. The tritonymphal buckles of a rather triangular shape seem to be peculiar for the genus, as was noted by Balogh (1961). (p. 274)

Aoki (*op.cit*) set up a comparative table on generic and species level and included the following species: *Basilobelba retiarius, Basilobelba africana, Xiphobelba hamanni* and *Xiphobelba setosa*. He took into consideration the type of chelicera, related size of genital and anal apertures, buckle of tritonymphal scalps, numbers of setae on ventral plate and body size.

Okayama (1980) in his description of *Basilobelba parmata* took up the problem between *Xiphobelba* and *Basilobelba* and compared *B. retiarius, B. pacifica* Hammer, 1971*, B. parmata, B. baltazarae* Corpuz-Raros, 1979*, X. setosa* and *X. hamanni* and indicated

> If we evaluate the shape of chelicera as the most important character, the present new species clearly belongs to the genus *Basilobelba.* However, some characters of the species show some inconsistency with what was revised by Aoki (1968). The new species shows the strongest ventral neotrichy which even exceeds that of members of the genus *Xiphobelba.* The tritonymphal arms of the new species as well as *Basilobelba pacifica,* Hammer, 1971, are very long and as wide as prodorsum. Hereby the two characters, ventral neotrichy and shape of tritonymphal arm, should be treated not as generic but specific ones. (p. 295)

Finally Okayama indicated:

> The author also reexamined the paratype specimen of *Xiphobelba setosa* Aoki, 1968, deposited in the National Science Museum, Tokyo, and found that solenidion φ_2 on tibia I is setiform (Figure 19). According to Grandjean (1959), *Basilobelba retiarius* (=*Hammation sollertius*) has a spindle-shaped solenidion φ_2 on tibia I. Although it is assumed only from three species *(B. parmata, B. retiarius* and *X. setosa*), the shape of solenidion φ_2 seems to be generic character, whereas the length of φ_1 is specific one.

A new revision of the family Basilobelbidae is shown in Table 2, where chelicera, genital aperture size, body length, number of pairs of ventral setae, solenidion φ_2 on tibia I, solenidion φ_1 on tibia I are compared. We are in concordance with the opinion of Okayama, with relation to several characters that should be treated not as generic, but specific ones. We also concur with his opinion that chelicera are the most important character difference between the two genera. Likewise, *B. maidililae* shares similar characteristics with respect to solenidions φ_1 and φ_2 as observed by Okayama 1980.

Basilobelba maidililae sp. nov. presents a series of characters observed in both *Basilobelba* and *Xiphobelba*, as well as other particular characters not previously observed such as: elongated but not peloptoid chelicera, Y-shaped prodorsal lamellae, very prominent aggenital–adanal neotrichy, almost double than that previously known. Other very interesting characteristics such as the cerotegument have not been studied in detail in either *Basilobelba* or *Xiphobelba*. We consider that *Basilobelba maidililae* should be placed in the genus *Basilobelba* based on current knowledge, also demonstrating that the presence of a pointed rostrum necessitates dissection in order to corroborate cheliceral type.

Table 2 compares *Basilobelba maidililae* sp. nov., *Basilobelba aethiopica* Bernini, 1988 and *Basilobelba barbata* Mondal and Kundu, 1984; in addition to the comparison made by Okayama 1980 between *B. retiarius, B. pacifica, B. parmata, B. baltazarae, Xiphobelba setosa, X. hamanni*, and the comparison made by Aoki 1968 between *B. retiarius, B. africana, X. setosa* and *X. hamanni.*

We agree with Okayama that ventral neotrichy and shape of tritonymphal buckle should be treated not as generic, but rather as specific characters. The presence of the particular Y-shaped lamellae and cerotegumental layer are specific characters. The chelicera is normal, but elongate and the solenidion is of the same type as in *Basilobelba retiarius = Hammation sollertius* Grandjean (1959).

Table 2. Comparison between *B. maidililae* **sp. nov.**, *B. aethiopica* and *B. barbata.*

	Basilobelba maidililae sp. nov.	*Basilobelba aethiopica* Bernini, 1988	*Basilobelba barbata* Mondal and Kundu, 1984
Rostrum	Pointed	Rounded	Rounded
Lamellae	Y-shaped	Absent	Longitudinal
Chelicera	Elongate	Normal	Normal
Genital apertures	Smaller than anal opening	More or less same length	Smaller than anal opnening
Each arm of tritonynphal scalp	Rounded	Rounded	Rounded
Number in pairs of setae on ventral plate	53–58	16	9–10?
Body size	Length 550	Length 455	Length 421–485
Length	Width 300	Width 255	Width 253–300
Width			
Solenidion φ_2, tibia I	Sausage shape	Sausage shape	?
Relation solenidon φ_2, setae d.	Short, longer than *d* setae	Short, shorter than *d* setae	?
Solenidion φ_1, tibia I	Long. longer than *d* setae	Long. longer than *d* setae	?

Acknowledgements

We are indebted to Anne Bedos and Louis Deharveng for the opportunity to study the mites they collected in Kien Giang Province in South of Vietnam as well as for information about the sampling localities. Field trips were organized by colleagues from the National University of Ho Chi Minh City and of the Institute of Tropical Biology of Ho Chi Minh City, in the frame of various small-scale projects that followed their 1993 warning about serious quarrying threats to Hòn Chông limestone hills. Any opinion, findings and conclusions or recommendations expressed in the material are those of the authors and therefore the NRF does not accept any liability in regard thereto.

Funding

This work is based on research supported in part by the National Research Foundation of South Africa (UID) [85288].

References

Alberti G, Fernandez NA. 1988. Fine structure of a secondarily developed eye in the fresh water moss mite, *Hydrozetes lemnae* (Coggi 1899) (Acari: Oribatida). Protoplasma 146:106–117.

Alberti G, Fernandez NA. 1990a. Aspects concerning the structure and function of the lenticulus and clear spot of certain oribatids (Acari: Oribatida). Acarologia 31:65–72.

Alberti G, Fernandez NA. 1990b. Fine structure and function of the lenticulus and clear spot of Oribatids (Acari: Oribatida). In: Andre HM, Lions J-C, editors. L'ontogènese et le concept de stase chez les Arthropodes. Wavre: Agar Publishers; p. 343–354.

Alberti G, Fernandez NA, Coineau Y. 2007. Fine structure of spermiogenesis, spermatozoa and spermatophore of Saxidromus delamarei (Saxidromidae, Actinotrichida, Acari). Arthropod Structure & Development 36:221–231.

Alberti G, Fernandez NA, Kümmel G. 1991. Spermatophores and spermatozoa of oribatid mites (Acari: Oribatida). Part II. Functional and systematical considerations. Acarologia 32:435–449.

Alberti G, Norton R, Adis J, Fernandez N, Franklin E, Kratzmann M, Moreno AI, Ribeiro E, Weigmann G, Woas S. 1997. Porose integumental organs of oribatid mites (Acari: Oribatida). Zoologica 48:33–114.

Aoki JI. 1968. A new species of the genus *Xiphobelba* from New Britain Island (Acari, Cryptostigmata). Bulletin Natural Science Museum Tokyo 11:269–274.

Csiszár J. 1961. New oribatids from Indonesian soils (Acari). Acata Zoologica Academiae Scientiatum Hungaricae 7:345–367.

Deharveng L, Bedos A, Kiet LC, Cong Man LE, Tam TQ. 2009. Endemic arthropods of the Hon Chong hills (Kien Giang), an unrivalled biodiversity heritage in Southeast Asia. In: Kiet LC, Tam TQ, Sam LN, editors. Beleaguered Hills: managing the Biodiversity of the Remaining Karst Hills of Kien Giang, Vietnam. TP. Ho Chi Minh: Nha Xuat Ban Nong Nghiep; p. 31–57.

Ermilov S, Shimano S, Vu QM. 2011. Redescription of *Papillacarus hirsutus* with remarks on taxonomic status of *Papillacarus arboriseta* (Acari: Oribatida: Lohmanniidae). Acarologia 51:155–163.

Fernandez N, Theron P, Rollard C, Rodrigo Castillo E. 2014. Oribatid mites from deep soils of Hòn Chông limestone hills, Vietnam : the family Lohmanniidae (Acari: Oribatida), with the descriptions of Bedoslohmannia anneaen. gen., n. sp., and Paulianacarus Vietnamesen. sp. Zoosystema. 36:771–787.

Grandjean F. 1949. Observation et conservation des très petits Arthropodes. Bulletin du Muséum d'histoire Naturelle, Paris 21:363–370.

Grandjean F. 1959. *Hammation sollertius* n.g., n.sp. (Acarien, Oribate). Memoires du Museum National d'Histoire Naturelles Serie A. Zoologie 16:173–198.

Krantz GW, Walter DE. 2009. A manual of Acarology. 3rd ed. Lubbock, TX: Texas Tech University Press; 807 p.

Norton R. 2010. Systematic relationships of Lohmanniidae (Acari: Oribatida). In: Sabelis MW, Bruin J, editors. Trends in Acarology. Proc. XII Int. Con. Acarol. Springer Science and Business Media, Amsterdam: 2006. p. 175–178.

Norton R, Behan-Pelletier V. 2009. Suborder Oribatida. In: Krantz GW, Walter DE, editors. A manual of Acarology. 3rd ed. Lubbock, TX: Texas Tech University Press; p. 430–564.

Okayama T. 1980. Taxonomic studies on the Japanese oribatid mites wearing nymphal exuviae. II. *Basilobelba parmata* sp. nov. Annotationes Zoologicae Japonenses 53:285–296.

Vu MQ, Nguyen TH, Lv V. 2014. A review of the genus *Papillacarus* (Acari: Lohmanniidae) in Vietnam with remarks on the taxonomic status of *P. arboriseta*. Acta Zoologica Bulgarica 66:165–172.