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# The water mite family Aturidae Thor, 1900 from Southeast Asia (Acari: Hydrachnidia) with the description of one new genus and 14 new species

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**ABSTRACT** — New records are given of members of the water mite family Aturidae from Thailand and Malaysia. The subgenus *Javalbicula* K.O. Viets, 1974 of the genus *Javalbia* is synonymized with *Javalbiopsis* Cook. One new genus is described, viz. *Siamaxonopsis* n. gen., and the following new species are described: *Albaxona elongata* n. sp., *Brachypodopsis thailandicus* n. sp., *Hexaxonopsis reticulata* n. sp., *H. monouncata* n. sp., *Javalbia discrepans* n. sp., *J. lineata* n. sp., *J. siamis* n. sp., *J. magna* n. sp., *J. nova* n. sp., *J. rotunda* n. sp., *Paraxonopsis separata* n. sp., *Siamaxonopsis ypsilon* n. sp., *Sinaxonopsis siamicus* n. sp. and *Vicinaxonopsis costata* n. sp. A (partial) redescription is given for the male of *Brachypodopsis baumi* (Halík). The female of *Javalbia solitaria* Smit and Pešić is described for the first time. New records are given for the genera *Aturus* Kramer, *Axonopsis* Piersig, *Brachypodopsis* Piersig, *Javalbia* Viets and *Albia* Thon from Thailand and/or Malaysia.

**KEYWORDS** — Oriental region; systematics; new species

## INTRODUCTION

The water mite family Aturidae has a worldwide distribution. Currently, the family has four subfamilies, Aturinae Thor, 1900, Albiinae Viets, 1915, Axonopsinae Viets, 1929 and Notoaturinae Besch, 1964. Apart from the latter subfamily, which has a Gondwanan distribution, all subfamilies occur worldwide. Cook (1974) stated that the Aturidae are a "dumping ground" of mites with heavily sclerotized idiosoma, which cannot be assigned to other families. Also the subfamily classification is not satisfactory, as there are species known nowadays which bridge the gap between the two subfamilies. Even the separation with the Hygrobatidae is not always clear (Cook 1974).

In the Oriental region aturids are a major part of the water mite fauna. Smit and Pešić (2014) found

that 30 % of their specimens from Borneo were aturids. On a generic level, however, it is not the richest faunal region (Di Sabatino *et al.* 2008). Large areas of the Oriental region, however, are understudied. Pešić and Smit (2015) published a checklist of the water mites of Thailand. Aturids were lacking in this checklist, but the records of Piersig (1906) were not included. Therefore the following species should be added to the checklist of Thailand: *Hydrachna semiscutata* Piersig, 1906, *H. volzi* Piersig, 1906 (Hydrachnidae), *Neumania (Ecpolopsis) multiscutata* (Piersig, 1906) (Unionicolidae), *Piona pachydermoidea* Viets, 1956 (Pionidae) and *Brachypodopsis coerulea* Piersig, 1906 (Aturidae).

This paper deals with collections of water mites from Thailand and Malaysia. For the generic classification Smith *et al.* (2015) is followed. Female

aturids are sometimes difficult to identify, especially when no specific characters are present, and a number of specimens are left undescribed.

## MATERIALS AND METHODS

All material has been collected by the author. Type material and non-type material is lodged in Naturalis Biodiversity Center, Leiden. Numbers are given as males/females/deutonymphs. The following abbreviations have been used: P1-P5 = palp segment 1-5; Cx-I = first coxal plates; cxgl-4 = coxoglandularium 4; vgl-4 = ventroglandularium 4; I-leg-4-6 = fourth-sixth segments of first leg; A2 = postantenniform glandularia; dgl-1 = dorsoglandularia 1; a.s.l. = above sea level; L = length; W = width; NP = National Park. Measurements of paratypes are given in brackets. All measurements are in  $\mu\text{m}$ , measurements of palp and leg segments are of the dorsal margins. Length of the venter is measured from the tip of the first coxae till the posterior idiosoma margin. Coordinates were obtained with a GPS. When no measurements were made or were not possible, coordinates are derived sometimes from Google Earth (given as degrees and minutes).

## SYSTEMATICS

### Family Aturidae Thor, 1900 Subfamily Aturinae Thor, 1900 Genus *Aturus* Kramer, 1875

The genus *Aturus* is widespread, and occurs in all faunal regions except Australasia. Within the Oriental region they have been reported from Java, India, South Korea and Borneo (Viets 1935; Cook 1967; Lundblad 1971; Kim and Chung 1993, 1995; Smit and Pešić 2014). Unfortunately, only females have been collected, and males are necessary to identify or describe the species. As the genus has not been reported previously from Thailand and Malaysia, I will give the locations where these females have been collected.

Material examined — **Thailand**. 0/1/0, Stream downstream of Huoay Meng Waterfall, between Chiang Saen and Chiang Khong, 20°18.095N

100°22.454E, 20-xi-2007; 0/1/0, River at km. 13, Doi Inthanon NP, Thailand, 18°31.532N 98°39.091E, alt. 465 m a.s.l., 25-xi-2007; 0/1/0, Stream downstream of Siriphum Waterfall, Doi Inthanon NP, 18°31.532N 98°39.091E, alt. 1300 m a.s.l., 26-xi-2007.

### Genus *Bharatalbia* Cook, 1967

From the genus *Bharatalbia* ten species are known from India, Japan, Malaysia and the USA (Smith *et al.* 2015, Wiles 1991).

### *Bharatalbia* (*Japonalbia*) *darbyi* Wiles, 1991

Material examined — **Thailand**. 0/1/0, Thorn-tip Waterfall, Kaeng Krachan NP, 12°50.952N 99°18.498E, 29-xi-2007. **Malaysia**. 1/0/0, Small stream crossing New Road, 3 km from Fraser's Hill, Malaysia, 3°43.382N 101°44.923E, alt. 1067 m a.s.l., 13-ii-2009.

Remarks — Previously known only from mainland Malaysia, and here reported for the first time for Thailand.

### Subfamily Axonopsinae Viets, 1929 Genus *Albaxona* Szalay, 1944

The genus *Albaxona* is widely distributed, and known from the Palaearctic, Oriental, Ethiopian and Nearctic regions (Cook 1974).

### *Albaxona elongata* n. sp. (Figure 1)

Material examined — Holotype female, Lam Takhong Creek, Khao Yai NP, Thailand, 14°27'N 101°21'E, 10-xi-2007.

Diagnosis — Small size (L/W 348/251), acetabulum 2 lying directly posterior to acetabulum 1.

Description — Female: Idiosoma yellowish, dorsally 332 long and 251 wide, ventrally 348 long. Dorsal shield 323 long and 200 wide, with four pairs of glandularia; postocularia lying anteriorly of dgl-1. A2 not fused with dorsal shield. Cx-I and -II pointed, Cx-III more rounded; coxal suture lines obliterated. Cxgl-4 lying halfway between fourth leg sockets and genital field. Genital field 124 wide,

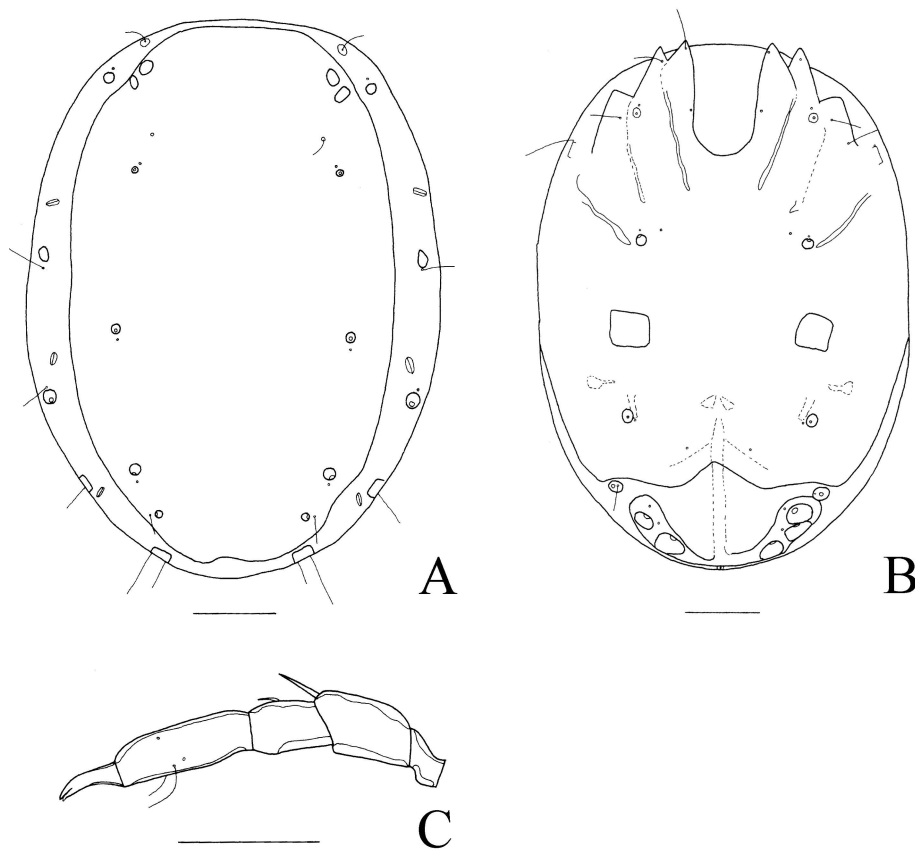


FIGURE 1: *Albaxonona elongata* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

with three acetabula on the right side and two acetabula on the left side. Acetabulum 2 lying directly posterior to acetabulum 1. Vgl-4 not fused with ventral shield. Excretory pore on a small platelet posterior to and not fused with postgenital sclerite. Length of P1-5: 19, 36, 27, 51, 24. Length of I-leg-4-6: -, 58, 60. Length of IV-leg-4-6: 62, 70, 58. Legs without swimming setae. Male: Unknown.

**Etymology** — Named for its slender idiosoma.

**Remarks** — The lack of one acetabulum is a phenomenon observed in other aturid genera as well, e.g. in *Javalbia* (Smit and Pešić 2014). However, it may be expected that normally three pairs will be present in a configuration as shown in the right side of the genital field. Due to its small size and the configuration of the acetabula, the new species is most close to *Albaxona hexapora* (Viets, 1935) from Java. However, the new species is more slender, L/W of

the idiosoma is 1,26 in *A. hexapora* and 1,32 in the new species. *Albaxona kurtoietsi* Gledhill and Wiles, 1997 from Sri Lanka is another small species. This species has the acetabula lying in a line and the postocularia are lying closer to dgl-1 compared to the new species.

#### Genus *Axonopsis* Piersig, 1893

The genus *Axonopsis* is widespread and only absent from Australasia and the Neotropical regions (Smith *et al.* 2015).

#### *Axonopsis gracilipalpis* Viets, 1935

**Material examined** — **Thailand.** 2/0/0, Slow flowing stream, Man Mao NP, 15°44.422N 101°34.774E, alt. 1190 m a.s.l., 15-xi-2007; 1/1/0, Stream crossing road to Phu Goom Khao, Nam Nao NP, 16°38.410N 101°34.886E, alt. 803 m a.s.l., 16-xi-2007; 0/5/0,

Stream near Haewsai Waterfall, Nam Nao NP, 16°40.668N 101°41.856E, alt. 425 m a.s.l., 16-xi-2007.

Remarks — Previously known from Java and Borneo (Viets 1935, Wiles 1999, Smit and Pešić 2014) and here reported for the first time for Thailand.

**Genus *Brachypodopsis* Piersig, 1903**

The genus *Brachypodopsis* is widespread, and absent only from the Australasian region (Smith *et al.* 2015).

**Subgenus *Brachypodopsis* Piersig, 1903**

***Brachypodopsis baumi* (Halík, 1930)  
(Figure 2)**

Material examined — **Thailand.** 1/0/0, Lam Takhong Creek, Khao Yai NP, Thailand, 14°27'N 101°21'E, 10-xi-2007; 3/3/0, Slow flowing stream, Mam Nao NP, 15°44.422N 101°34.774E, alt. 1190 m a.s.l., 15-xi-2007; 7/1/0, Stream crossing road to Phu Goom Khao, Nam Nao NP, 16°38.410N 101°34.886E, alt. 803 m a.s.l., 16-xi-2007; 0/1/0, Stream downstream of Huoay Meng Waterfall, between Chiang Saen and Chiang Khong, 20°18.095N 100°22.454E, 20-xi-2007. **Malaysia.** 1/0/0, Unnamed stream crossing road 59, between Ringlet and Iskandar, 4°21.410N 101°20.156E, alt. 795 m a.s.l., 22-ii-2009.

Description — Male: Idiosoma yellowish, dorsally 389 long and 320 wide. Dorsal shield 300 wide, posteriorly tapering, anteriorly fused with ventral shield, with six pairs of glandularia. Dorsal furrow lacking glandularia. Postocularia slightly posteromedially of dgl-1; excretory pore fused with dorsal shield. In anterior part of dorsal shield a drop-shaped structure visible. Suture lines of coxae obliterated. A lateral ridge extending anteriorly of fourth leg sockets. Between fourth leg sockets and genital field two pairs of glandularia present, one pair very close to genital field. Genital field terminal, with three pairs of acetabula. Palp not mounted and measured. Length of I-leg-4-6: 44, 50, 54. Length of IV-leg-4-6: 68, 66, 54. Legs not modified. III-leg-5 and IV-leg-5 with three swimming setae, IV-leg-4 with one swimming seta.

Remarks — *Brachypodopsis baumi* is insufficiently described, and therefore a redescription is given for the male. Halík (1930) didn't illustrate the pair of glandularia close to the genital field (although these were mentioned by Cook 1967). The male of Lam Takhong Creek is here described. This is a widespread species, known from Malaysia, Burma, Java and Borneo and here reported for the first time from Thailand.

***Brachypodopsis* (?) *thailandicus* n. sp.  
(Figure 3)**

Material examined — Holotype female, Stream crossing road to Phu Goom Khao, Nam Nao NP, Thailand, 16°38.410N 101°34.886E, alt. 803 m a.s.l., 16-xi-2007. Paratype: one female, same data as holotype.

Diagnosis — Genital field with four pairs of acetabula, anterior three pairs in a line more or less perpendicularly to lateral idiosoma margin. Dorsal shield with A2 and six pairs of glandularia. Between the fourth leg sockets and genital field two pairs of glandularia.

Description — Female: Idiosoma brownish, dorsally 454 long and 332 wide, ventrally 421 long. Dorsal shield 332 wide, anteriorly fused with ventral shield, and with A2 and six pairs of glandularia (the most posterior pair not visible in dorsal view). No glandularia platelets present in dorsal furrow. Postocularia far distanced from dgl-1; excretory pore fused with dorsal shield. Anterior coxae distanced from anterior idiosoma margin, coxal suture lines obliterated. A ridge present anterolaterally of fourth leg sockets. Between the fourth leg sockets and genital field two pairs of glandularia, these lying closer to genital field than to fourth leg sockets. Genital field with four pairs of acetabula, the anterior three pairs in a line more or less perpendicularly to lateral idiosoma margin. An undulating ridge present between anterior three pairs and most posterior pair of acetabula. Gonopore large, 80 long and 102 wide. Length of P1-5: 26, 50, 26, 68, 28. P4 lineated, without heavy setae, but maybe broken off. Length of I-leg-4-6: 45, 66, 70 (till tip of segment). Length of IV-leg-4-6: 70, 84, 76.

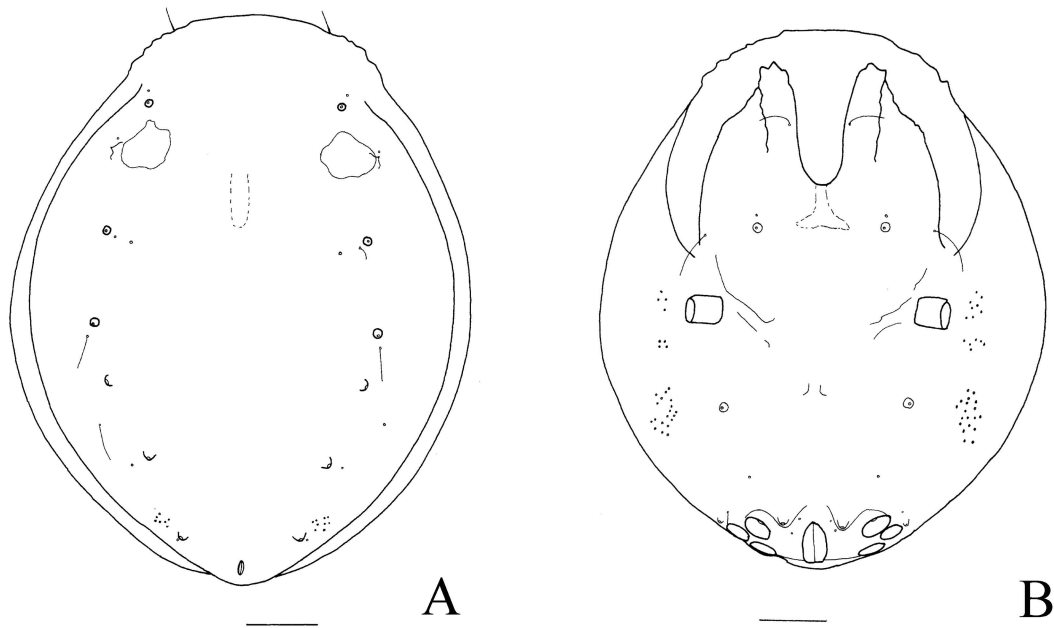


FIGURE 2: *Brachypodopsis baumi* (Halík), male: A – dorsum; B – venter. Scale bars = 50 µm.

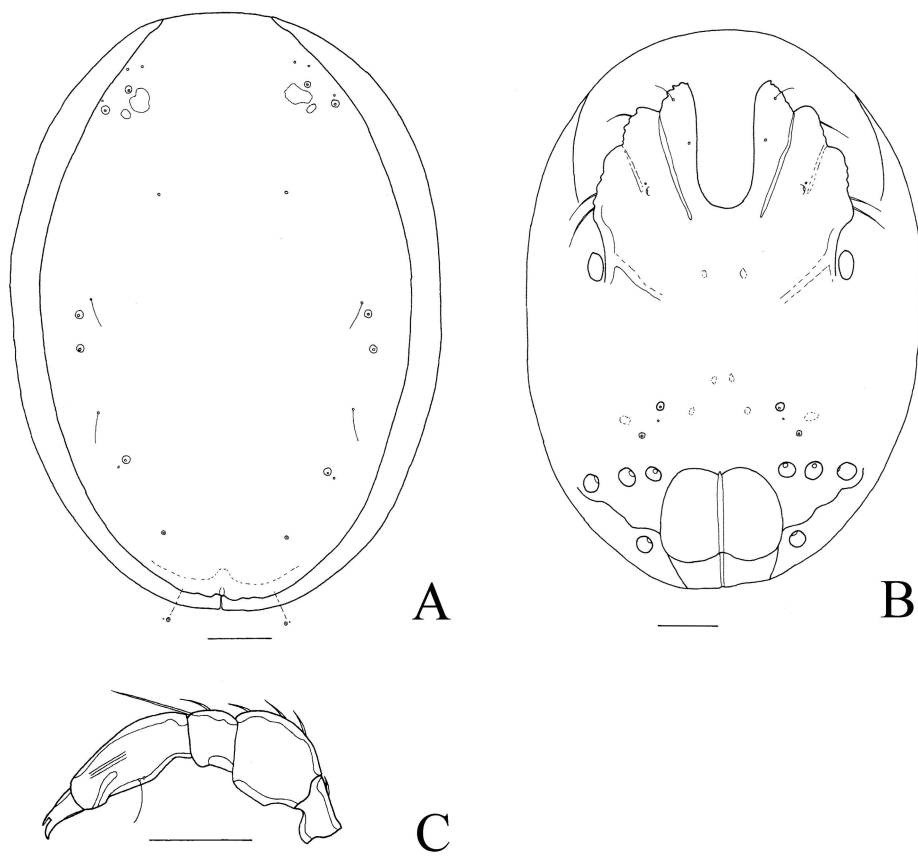


FIGURE 3: *Brachypodopsis thailandicus* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

Swimming setae: III-leg-4 and IV-leg-4 two, III-leg-5 four and IV-leg-5 three. Male: Unknown.

Etymology — Named after the country where the species was collected.

Remarks — The new species is assigned to the genus *Brachypodopsis* due to the absence of glandularia platelets in the dorsal furrow, the presence of seven pairs of glandularia on the dorsal shield and two pairs of glandularia between the fourth leg sockets and genital field. The new species is somewhat similar to *Paraxonopsis vivarna* (Cook, 1967) from India in the configuration of the acetabula. However, this species has the dorsal shield with four pairs of glandularia and only one pair of glandularia between the fourth leg sockets and genital field. Due to the absence of a male subgeneric placement of the new species is not possible.

#### **Genus *Hexaxonopsis* Viets, 1926**

A widespread genus, but not reported from the Neotropical and Australasian regions (Smith *et al.* 2015).

##### ***Hexaxonopsis (Hexaxonopsis) reticulata* n. sp. (Figure 4)**

Material examined — Holotype male, Slow flowing stream, Nam Nao NP, Thailand, 15°44.422N 101°34.774E, alt. 1190 m a.s.l., 15-xi-2007. Paratypes: one male, one female, same data as holotype.

Diagnosis — Central dorsoglandularia pair closer to each other than other dorsoglandularia pairs.

Description — Male: Idiosoma dorsally 340 (348) long and 293 (300) wide, ventrally 324 (340) long. Dorsal shield anteriorly fused with ventral shield, 270 (283) wide. Dorsal furrow without glandularia. Dorsal shield with A2 and six pairs of glandularia, central pair closer to each other than other pairs; associated setae of this central pair not visible (or lacking?). Excretory pore fused to dorsal shield. Anterior part of dorsal shield reticulated. Coxal suture lines obliterated. First and second coxae drawn into hooks, first coxae not extending to anterior idiosoma margin. An indistinct ridge extending from

fourth leg sockets to lateral idiosoma margin. Between fourth leg sockets and genital field two pairs of glandularia, these closer to genital field than to fourth leg sockets. Genital field with three pairs of acetabula; gonopore 36 long and 28 wide. Length of P1-P5: 28, 40, 24, 70, 24; P2 somewhat bulging anteroventrally. Length of I-leg-4-6: 46, 60, 64. Length of IV-leg-4-6: 64, 74, 70. Swimming setae: II-leg-5 three, III-leg-5 four, III-leg-4 two, IV-leg-5 three and IV-leg-4 two. Legs not modified.

Female: Idiosoma dorsally 366 long and 323 wide, ventrally 364 long. Dorsal shield anteriorly fused with ventral shield, 297 wide. Female similar to male except in shape of genital field and first coxae almost extending to frontal margin. Gonopore 76 long and 80 wide. Length of P1-5: 31, 44, 24, 70, 24; palp as in male. Length of I-leg-4-6: 50, 64, 66. Length of IV-leg-4-6: 62, 76, 70. Numbers of swimming setae as in male.

Etymology — Named for the reticulate pattern of the anterior dorsal shield.

Remarks — All similar *Hexaxonopsis* species (e.g. *H. bharatensis* (Cook, 1967), *H. alpa* (Cook, 1997) and *H. niraensis* (Cook, 1967)), have two dorsal (third and fourth) pair of glandularia close to each other, while in the new species such closely lying glandularia are absent. Moreover, the fourth pair of dorsal glandularia lying much closer to each other is not found in other *Hexaxonopsis* species.

#### **Subgenus *Plesiobrachypoda* Viets, 1942**

A subgenus with thus far only two species known from Sudan and India (Smith *et al.* 2015).

##### ***Hexaxonopsis monouncata* n.sp. (Figure 5)**

Material examined — Holotype male, Slow flowing stream, Nam Nao NP, Thailand, 15°44.422N 101°34.774E, alt. 1190 m a.s.l., 15-xi-2007. Paratype: one male, same data as holotype.

Diagnosis — Only first coxae drawn into hooks; a pair of dorsal glandularia directly lateral to excretory pore; P2 ventrally with a large nose-shaped extension.

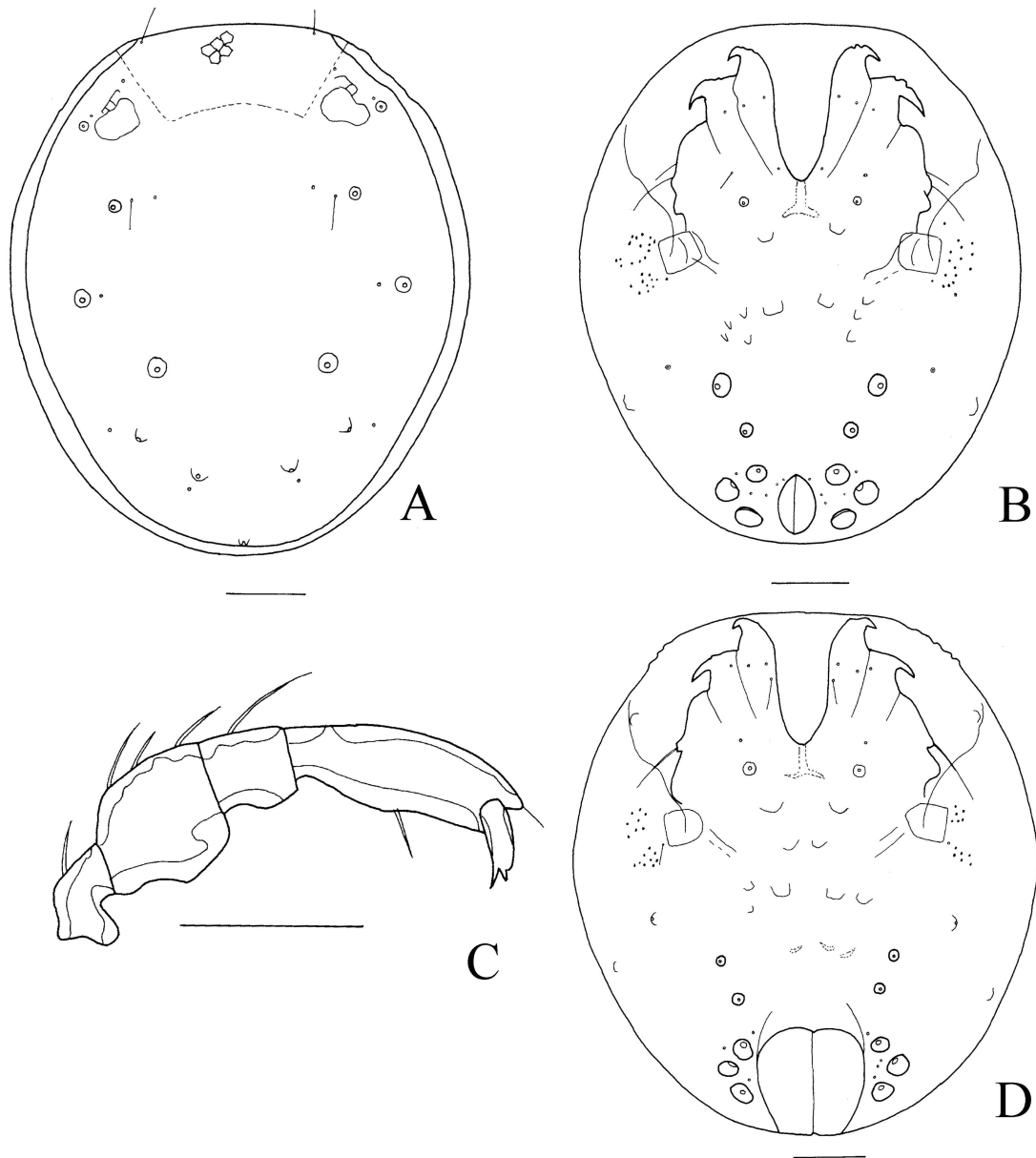


FIGURE 4: *Hexaxonopsis reticulata* n. sp., A – C holotype male, D – paratype female: A – dorsum; B – venter; C – palp; D – venter. Scale bars = 50  $\mu$ m.



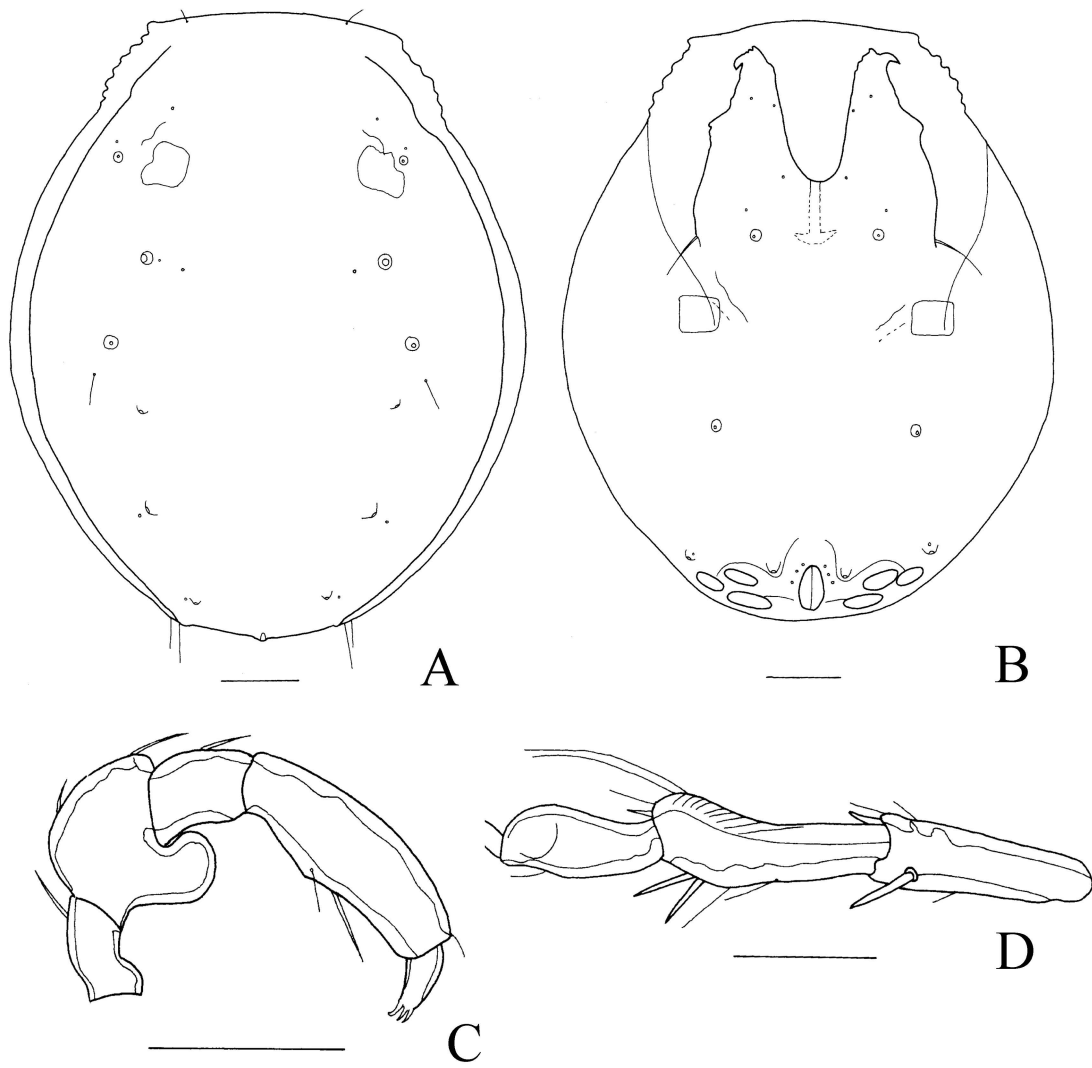


FIGURE 5: *Hexaxonopsis monouncata* n. sp., holotype male: A – dorsum; B – venter; C – palp; D – IV-leg-4-6. Scale bars = 50 µm.

Description — Male: Idiosoma dorsally 397 (397) long and 328 (324) wide, ventrally 381 (373) long. Dorsal shield 300 (300) wide, fused anteriorly with ventral shield, and with A2 and six pairs of glandularia, the most posterior pair directly lateral of excretory pore; postocularia close to dgl-2. Coxal suture lines almost completely obliterated. Only first coxae drawn into hooks. Between fourth leg sockets and genital field two pairs of glandularia, but one pair very close to genital field and only visible in posteromedial view. Genital field terminal, with three pairs of acetabula; gonopore 28 long. Length of P1-5: 27, 40, 26, 64, 22; P1 relatively long, P2 ventrally with a large nose-shaped extension. Length of I-leg-4-6: 46, 60, 60 (till tip of segment). Length of IV-leg-4-6: 78, 83, 58 (till tip of segment). IV-leg modified, IV-leg-5 elongated and slightly curved and striated, IV-leg-6 stocky. Numbers of swimming setae: II-leg-5 three, II-leg-4 two, III-leg-5 four, IV-leg-4 two, IV-leg-5 three. Female: Unknown.

Etymology — Named for the presence of only one pair of coxal hooks.

Remarks — The two other *Plesiobrachypoda* species have both the first and second coxae drawn into hooks. *Axonopsis periyar* Pesic and Ranga Reddy, 2009 from India has very stocky IV-leg-5 and -6 (Pesic and Ranga Reddy 2009).

### Genus *Javalbia* Viets, 1935

The genus *Javalbia* is known from Europe (two species), Turkey (one species) and Africa (two species), but most species are known from the Oriental region (13 species). Especially the high number of eight species from Borneo is striking (Smit and Pešić 2014). Two "*Axonopsalbia*" species described by Cook (1967) from India might as well belong to this genus.

Four subgenera are known currently, *i.e.* *Javalbia*, *Javalbiopsis* Cook, 1967, *Javalbicula* K.O. Viets, 1974 and *Megapes* Smit and Pešić, 2014. The subgenus *Javalbicula* differs only in the number of acetabula (four pairs instead of three). The two Asian species, *i.e.* *J. ovata* Kim and Chung, 1996 and the 4-acetabulate species described below, have the excretory pore on a separate platelet. The African

species *J. lata* K.O. Viets, 1974 and the Turkish *J. turcica* Esen, Pešić and Erman, 2011 have the excretory pore fused with the dorsal shield (K.O. Viets and Böttger 1974, Esen *et al.* 2011). Therefore I propose to synonymize *Javalbicula* with *Javalbiopsis*, and assign the two Asian species to *Javalbia* s.s.

### Subgenus *Javalbia*

#### *Javalbia discrepans* n. sp.

(Figure 6)

Material examined — Holotype female, River at km. 13, Doi Inthanon NP, Thailand, 18°31.532N 98°39.091E, alt. 465 m a.s.l., 25-xi-2007. Paratypes: four females, Stream W of Bankrang Camp, Kaeng Krachan NP, Thailand, 12°48.106N 99°26.786E, 20-xi-2007.

Diagnosis — Dorsal shield with a posterior extension; three platelets in dorsal furrow fused to one elongated platelet, A2 fused with dorsal shield.

Description — Female: Idiosoma pale yellow, dorsally 405 (381 – 405) long and 300 (284 – 292) wide, ventrally 344 (247 – 251) long. Dorsal shield separated with a posterior extension, separated from ventral shield, and appears therefore in dorsal view as incomplete; dorsal shield 251 (247 – 251) wide. A2 fused with dorsal shield. Three pairs of glandularia lying in dorsal furrow on an elongated platelet. Postocularia lying posteromedially of dgl-1, the latter lying close to margin of dorsal shield. Suture lines of coxae obliterated, only suture lines of Cx-III and Cx-IV present to some extent, other suture lines nearly absent. Cxgl-4 between fourth leg sockets and genital field, lying somewhat closer to genital field. Genital field 126 wide, with three pairs of acetabula lying in a line, genital plates connected by a small strip of sclerotization. Vgl-4 lying on a small platelet, not fused to coxae. Excretory pore not lying on a small platelet, posterior to the genital field, touching postgenital sclerite but not fused. Length of P1-P5: -, 30, 22, 46, 24. Length of I-leg-4-6: 40, 46, 42 (till tip of segment). Length of IV-leg-4-6: 42, 48, 42 (till tip of segment). Swimming setae absent. Male: Unknown.

Etymology — Named for the very different dorsal shield compared to other *Javalbia* species.

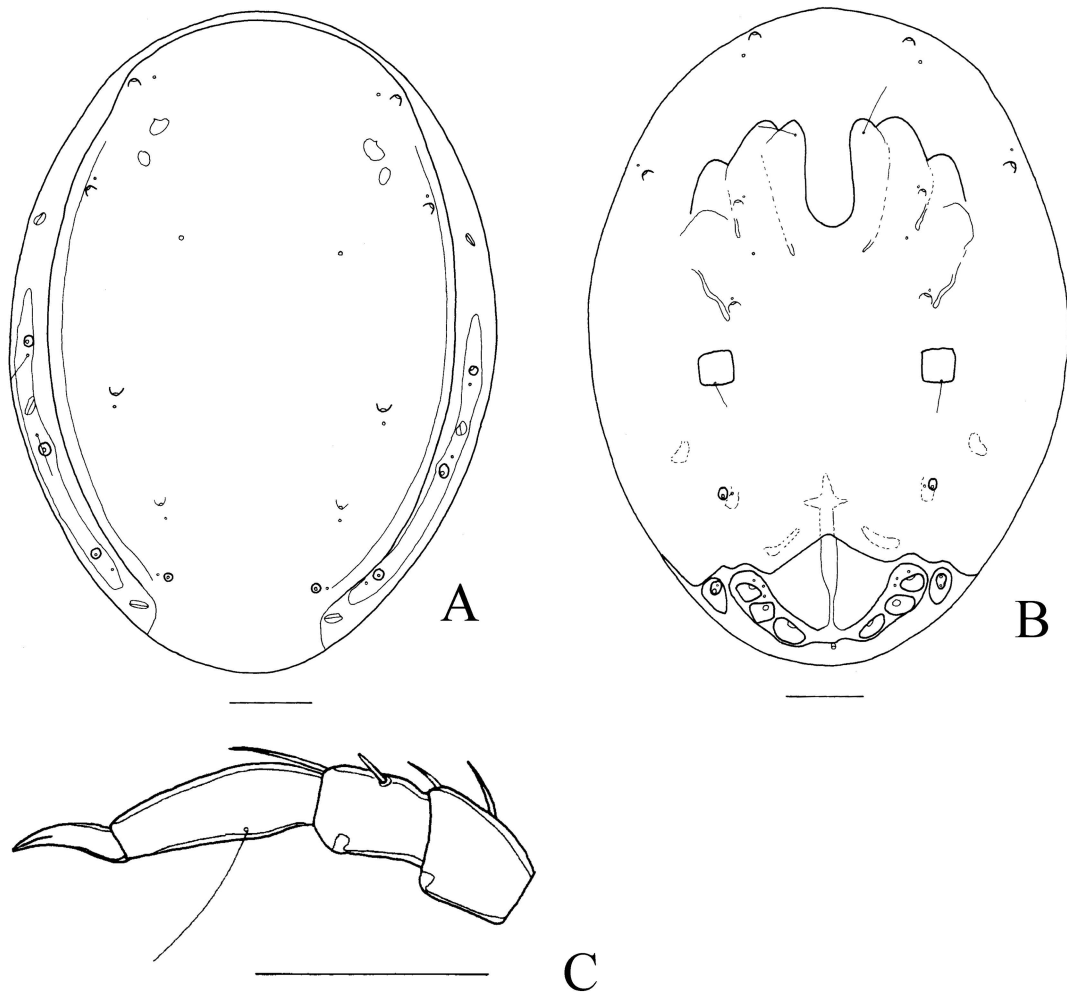


FIGURE 6: *Javalbia discrepans* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

Remarks — The dorsal shield with a posterior extension is not found in any other *Javalbia* species. Moreover, the fused glandularia platelets in the dorsal furrow are also unique.

***Javalbia lineata* n. sp.  
(Figure 7)**

Material examined — Holotype male, Small stream crossing New Road, 3 km from Fraser's Hill, Malaysia, 3°43.382N 101°44.923E, alt. 1067 m a.s.l., 13-ii-2009 (RMNH). Paratypes: One male, two females, same data as holotype (RMNH); one male, Jeriau Stream, Fraser's Hill, Malaysia, 3°43.479N 101°42.935E, alt. 1011 m a.s.l., 14-ii-2009; one female, Small forest stream near Lutheran Mission Bungalow, Cameron Highlands, Malaysia, 4°29.580N 101°22.577E, alt. 1549 m a.s.l., 21-ii-2009; one female, Unnamed creek crossing road 59, between Ringlet and Lata Iskander, Malaysia, 4°21.410N 101°20.156E, alt. 795 m a.s.l., 22-ii-2009.

Diagnosis — Postocularia more or less in a line with the three dorsal pairs of glandularia; Cxgl-4 fused with ventral shield in male, but separated in female. Fourth legs of male with sexual dimorphism.

Description — Male: Idiosoma yellowish, dorsally 413 (389 – 393) long and 298 (284 – 296) wide, ventrally 397 (356 – 365) long. Dorsal shield 404 (379 – 381) long and 251 (235 – 251) wide, with three pairs of glandularia; postocularia posteriorly of dgl-1, more or less in a line with the three dorsal pairs of glandularia. A2 not fused with dorsal shield. Three pairs of relatively small glandularia platelets in dorsal furrow. Coxal suture lines incomplete. Cxgl-4 halfway between insertion of IV-leg sockets and genital field. Gonopore 28 long. Genital field fused with ventral shield, with three pairs of glandularia. Vgl-4 fused with ventral shield. Length of P1-5: -, 38, 36, 54, 30. Length of I-leg-4-6: 66, 62, 64 (till tip of segment). Length of IV-leg-4-6: 73, 62, 66 (till tip of segment); IV-leg-5 anterodorsally with a large curved seta. Swimming setae absent.

Female: Idiosoma yellowish, dorsally 437 (405 – 454) long and 348 (316 – 356) wide, ventrally 397 (373 – 413) long. Dorsal shield 421 (385 – 429) long

and 279 (259 – 280) wide, with three pairs of glandularia. Configuration of dorsal glandularia and postocularia as in male. Three pairs of relatively small glandularia platelets in dorsal furrow. Coxal suture lines incomplete. Cxgl-4 halfway between insertion of IV-leg sockets and genital field. Genital field 160 wide, with three pairs of glandularia, connected by a small strip of sclerotization. Excretory pore not fused with this strip. Vgl-4 lying free lateral of genital field. Length of P1-5: 20, 28, 38, 50, 34. Length of I-leg-4-6: -, 49, 50 (till tip of segment). Length of IV-leg-4-6: 60, 64, 56; no special setae present on IV-leg-5. Swimming setae absent.

Etymology — Named for the dorsal glandularia and postocularia lying in a line.

Remarks — No other *Javalbia* species has the postocularia lying in a line with the dorsal glandularia. Moreover, the sexual dimorphism of the fourth leg is not found in other species of the subgenus *Javalbia*.

***Javalbia siamis* n. sp.  
(Figure 8)**

Material examined — Holotype male, Stream downstream of Huoay Meng Waterfall, between Chiang Saen and Chiang Khong, Thailand, 20°18.095N 100°22.454E, 20-xi-2007.

Diagnosis — Genital field with four pairs of acetabula, A2 not fused with dorsal shield, excretory pore on a separate platelet.

Description — Male: Idiosoma yellowish, dorsally 478 long and 343 wide, ventrally 405 long. Dorsal shield 463 long and 287 wide; postocularia far distanced from dgl-1, the latter lying close to margin of dorsal shield. A2 not fused with dorsal shield. Three pairs of relatively small glandularia platelets present in dorsal furrow. Suture lines of coxae obliterated. Cxgl-4 halfway between fourth leg sockets and genital field. Genital field 150 wide, with four pairs of acetabula. Gonopore 65 long and 40 wide. Vgl-4 fused with ventral shield. Excretory pore on a small platelet posteriorly of genital field. Length of P1-5: -, 36, 36, 56, 31. Length of I-leg-4-6: 58, 60, 54 (till tip of segment). Length of IV-leg-4-6: 68, 72, 56. Swimming setae absent. Female: Unknown.

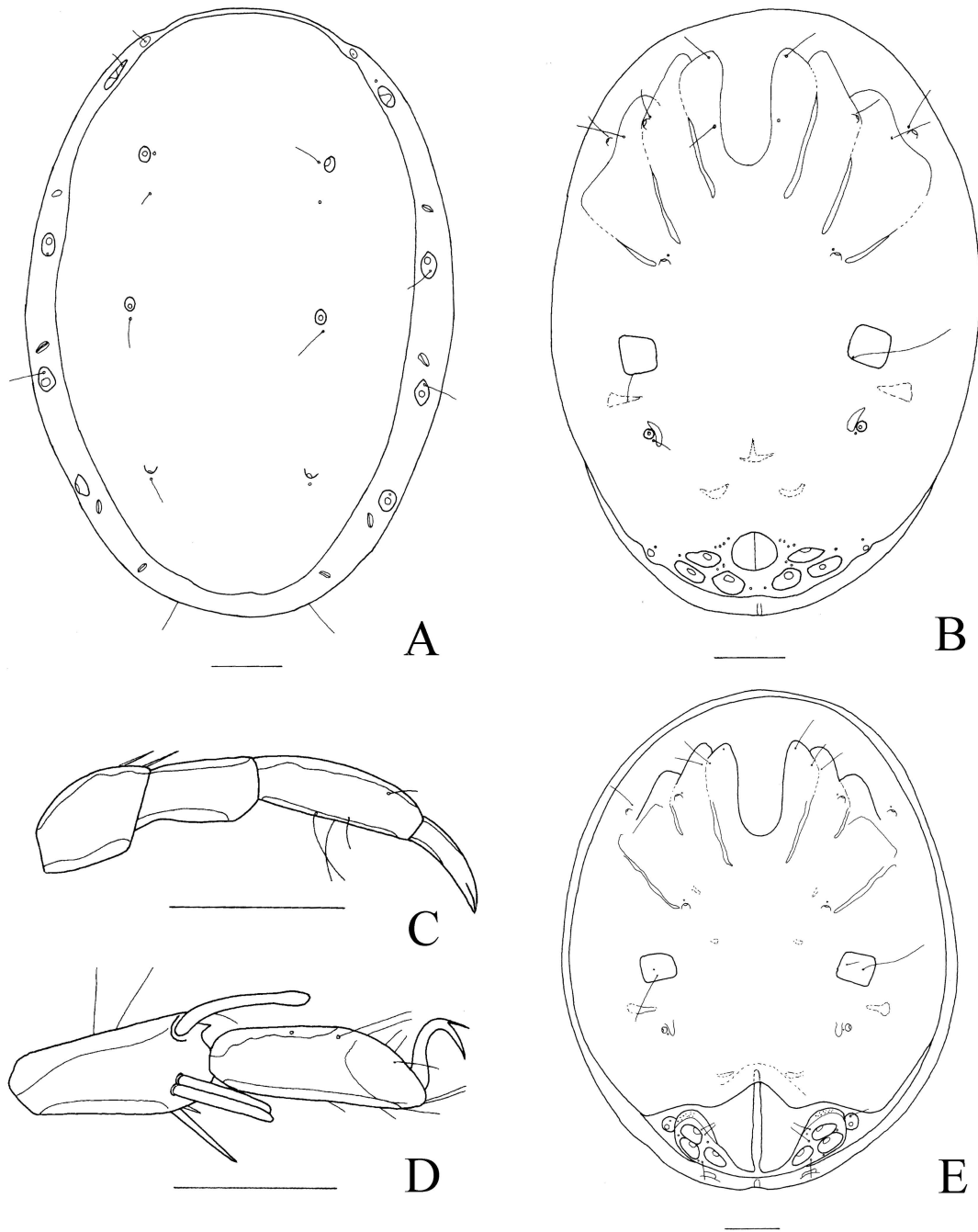


FIGURE 7: *Javalbia lineata* n. sp., A — D holotype male, E paratype female: A – dorsum; B – venter; C – palp; D – IV-leg-5-6; E – venter .  
Scale bars = 50 µm.

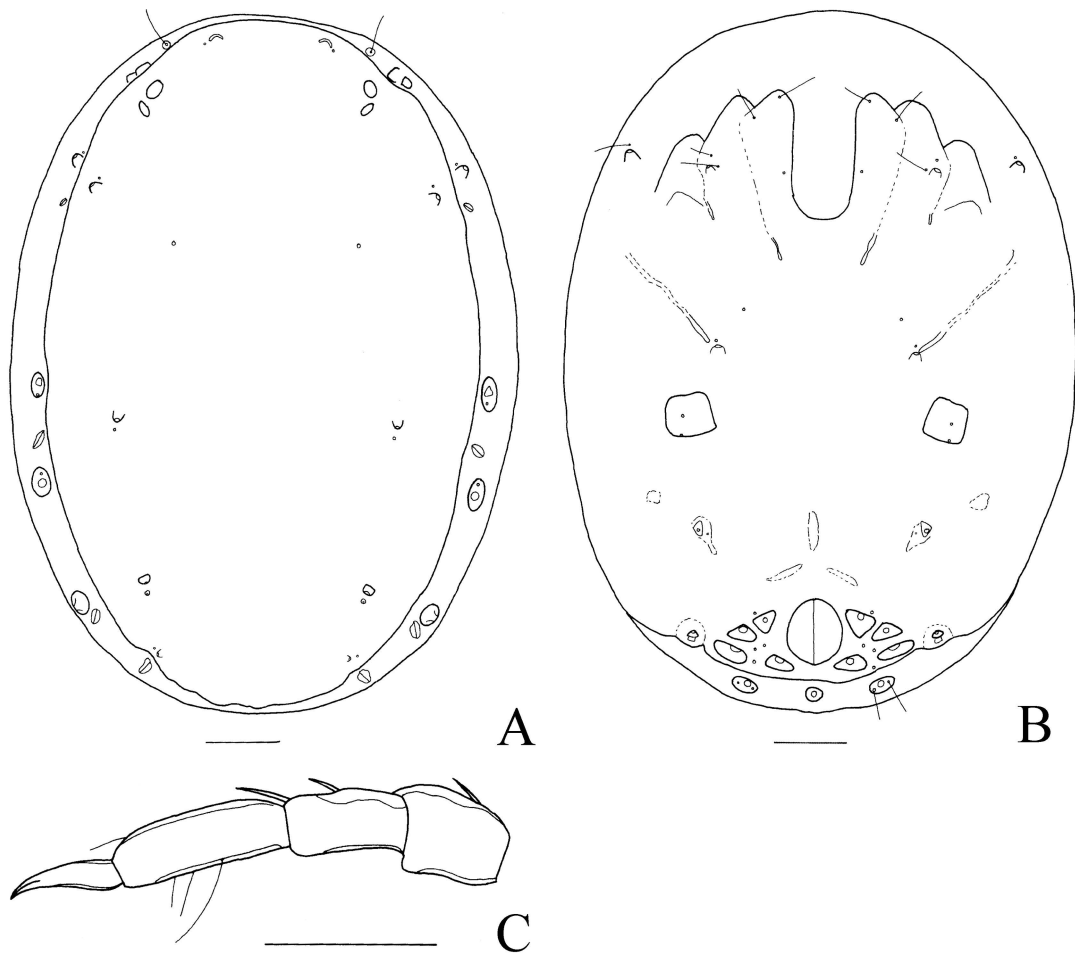


FIGURE 8: *Javalbia siamis* n. sp., holotype male: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

Etymology — Named after the old name for Thailand.

Remarks — The new species differs from *J. ovata* Kim and Chung, 1996 from Korea (Kim and Chung 1996) in the free-lying anterolateral dorsal glandularia (fused in *J. ovata*), and the postocularia distanced and posteromedially from the nearest pair of dorsal glandularia (lying much closer and at the same line of glandularia pair).

***Javalbia solitaria* Smit and Pešić, 2014**

Material examined — **Malaysia.** 1/2/0, Small unnamed stream crossing Mt Brinchang Road, Cameron Highlands, 4°31.458N 101°23.353E, alt. 1860 m a.s.l., 19-ii-2009.

Description — Male: Idiosoma dorsally 478 long and 360 wide, ventrally 421 long. Dorsal shield 463 long and 308 wide. Female: Idiosoma yellowish, dorsally 454 – 478 long and 332 – 356 wide, ventrally 413 – 421 long. Dorsal shield 441 – 464 long and 284 – 308 wide, with three pairs of glandularia and a pair of setae without accompanying glandularia. Dgl-1 close to margin of dorsal shield, postocularia widely separated and distanced from dgl-1. A2 not fused with dorsal shield. Glandularia platelets in dorsal furrow small. Suture lines of coxae obliterated. Cxgl-4 halfway fourth leg sockets and genital field. Genital field 166 – 172 wide, with three pairs of acetabula lying in a triangle. Vgl-4 not fused with ventral shield. Excretory pore fused with postgenital sclerite. Length of P1-5: -, -, 38, 64, 36. Length of I-leg-4-6: 57, 58, 56 (till tip of segment). Length of IV-leg-4-6: 60, 69, 48. Legs without swimming setae.

Remarks — In all characters the male specimen of this study is identical with the holotype (and thus far only known specimen) from Borneo (configuration of the dorsal glandularia and postocularia, anterolateral pair of dorsal not fused with dorsal shield, relatively wide gonopore, vgl-4 fused with ventral shield). The female is described here for the first time.

**Subgenus *Javalbiopsis* Cook, 1967**  
***Javalbicula* K.O. Viets, 1974 new. syn.**

***Javalbia magna* n. sp.**  
**(Figure 9)**

Material examined — Holotype female, Stream crossing road to Phu Goom Khao, Nam Nao NP, Thailand, 16°38.410N 101°34.886E, alt. 803 m a.s.l., 16-xi-2007.

Diagnosis — Relatively large size (L/W 478/365), dgl-1 and postocularia more or less in a line, A2 not fused with dorsal shield, vgl-4 lying free.

Description — Female: Idiosoma yellowish, dorsally 478 long and 365 wide, ventrally 446 long. Dorsal shield with a short posterior extension, and with four pairs of glandularia; postocularia more or less in a line with dgl-1. Excretory pore fused with dorsal shield. A2 not fused with dorsal shield. Three pairs of small glandularia platelets in dorsal furrow. Suture lines of coxae obliterated. Cxgl-4 halfway between fourth leg sockets and genital field. Genital field with three pairs of acetabula, acetabula 2 lying directly posterior to acetabula 1. Vgl-4 not fused with coxae. Length of P1-5: 24, 40, 38, 60, 34. Length of I-leg-4-6: 60, 60, 56. Length of IV-leg-4-6: 80, 80, 72. Legs without swimming setae. Male: Unknown.

Etymology — Named for its relatively large size.

Remarks — Other *Javalbiopsis* species with the postocularia lying in a line with dgl-1 are *J. africana* Cook, 1966, *J. antama* Cook, 1967, *J. persica* Pešić, Smit and Saboori, 2012 and *J. borneoensis* Smit and Pešić, 2014, but all these species have A2 fused with the dorsal shield.

***Javalbia nova* n. sp.**  
**(Figure 10)**

Material examined — Holotype female, Stream crossing road to Phu Goom Khao, Nam Nao NP, Thailand, 16°38.410N 101°34.886E, alt. 803 m a.s.l., 16-xi-2007.

Diagnosis — Postocularia lying anteromedially of dgl-1, A2 not fused with dorsal shield, associated setae of dgl-2 distanced of glandularia.

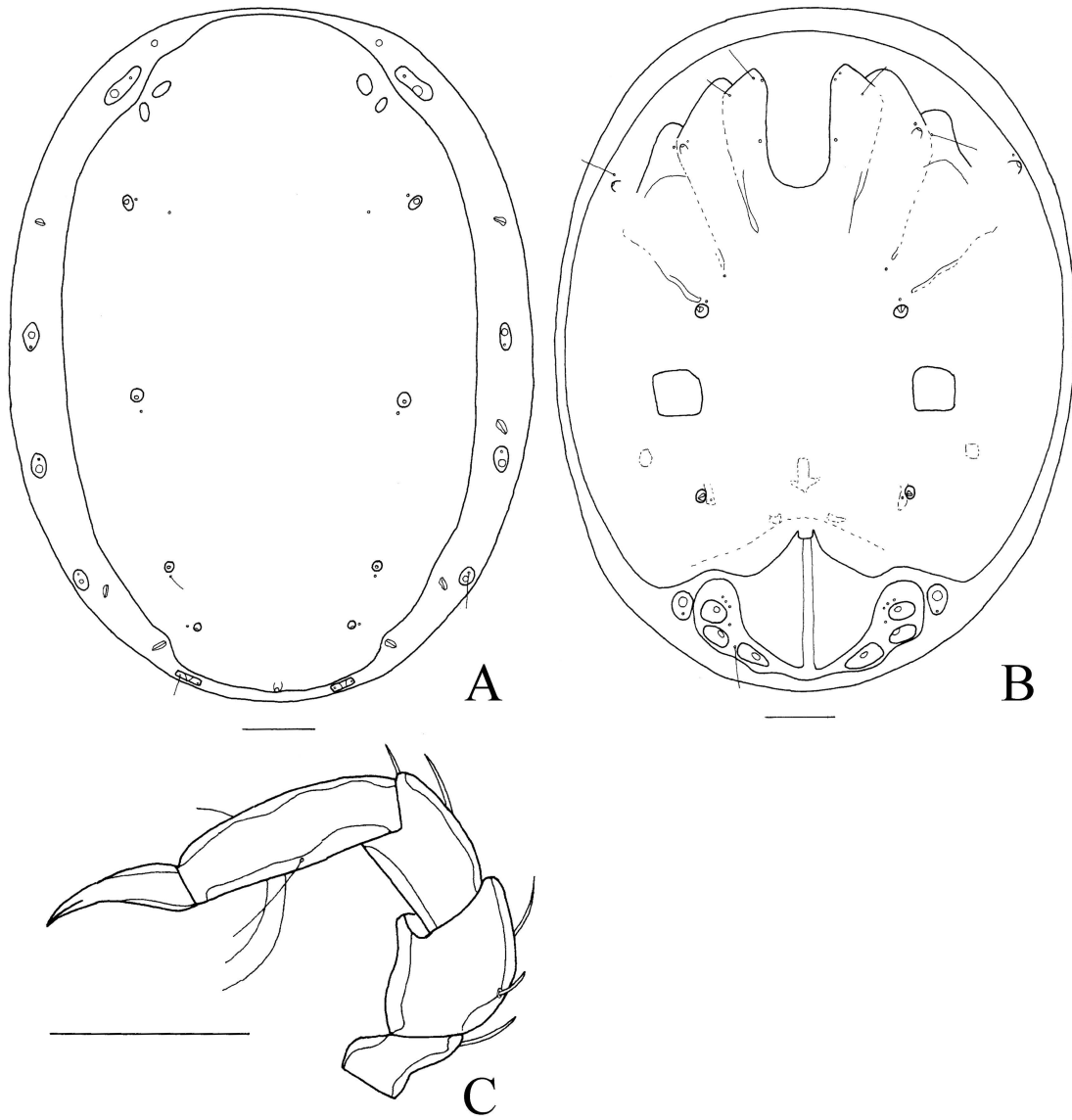


FIGURE 9: *Javalbia magna* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.



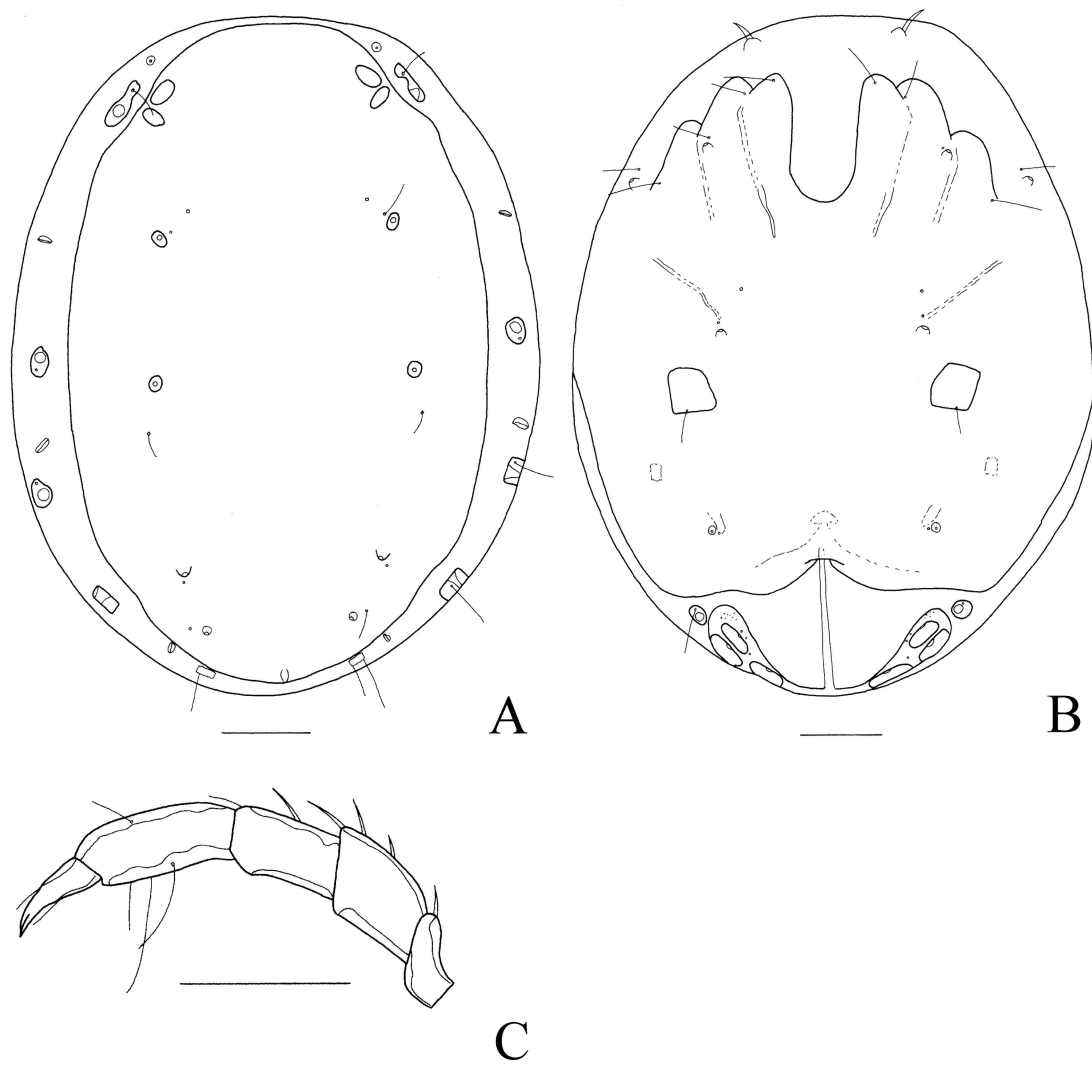


FIGURE 10: *Javalbia nova* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

Description — Female: Idiosoma yellowish, dorsally 381 long and 296 wide, ventrally 373 long. Dorsal shield 373 long and 235 wide, with four pairs of glandularia; postocularia lying anteromedially of dgl-1; associated setae of dgl-2 distanced of glandularia. A2 not fused with dorsal shield, excretory pore fused with dorsal shield. Dorsal furrow with three pairs of small glandularia platelets. Cxgl-4 lying closer to genital field than to fourth leg sockets. Genital field 144 wide, with three pairs of acetabula; acetabulum 2 lying directly posterior to acetabulum 1. Length of P1-5: 22, 34, 30, 50, 30. Length of I-leg-4-6: 50, 54, 52 (till tip of segment). Length of IV-leg-4-6: 68, 72, 50. Legs without swimming setae. Male: Unknown.

Etymology — An obvious name for a new species.

Remarks — The combination of the postocularia lying anteromedially of dgl-1, A2 not fused with the dorsal shield and the setae of dgl-2 distanced is characteristic for the new species, and not found in any other member of *Javalbiopsis*.

***Javalbia rotunda* n. sp.**  
(Figure 11)

Material examined. Holotype male, Stream near Haewsai Waterfall, Nam Nao NP, Thailand, 16°40.668N 101°41.856E, alt. 425 m a.s.l., 16-xi-2007.

Diagnosis — A2 not fused with dorsal shield; postocularia lying anteromedially of dgl-1; dgl-4 absent, only associated setae present; anterior coxae close to anterior idiosoma margin; gonopore nearly rounded.

Description — Male: Idiosoma yellowish, dorsally 421 long and 275 wide, ventrally 413 long. Dorsal shield 405 long and 235 wide; excretory pore fused with dorsal shield. A2 not fused with dorsal shield, postocularia lying anteromedially of dgl-1; dgl-4 absent, only associated setae present. Glandularia platelets in dorsal furrow small. Coxae lying far anteriorly, but not reaching anterior idiosoma margin. Coxal suture lines incomplete. Cxgl-4 lying closer to fourth leg sockets than to genital field. Genital field with three pairs of acetabula, fused with ventral shield. Gonopore nearly rounded, 44

long and 40 wide. Vgl-4 fused with ventral shield. Length of P1-5: 20, 40, 30, 56, 29. Length of I-leg-4-6: 70, 68, 66 (till tip of segment). Length of IV-leg-4-6: 88, 96, 72. Legs without swimming setae. Female: Unknown.

Etymology — Named for the nearly rounded gonopore.

Remarks — Few *Javalbiopsis* species have the postocularia anteromedially of dgl-1: *Javalbia kinaluensis* Smit and Pešić, 2014 has the genital field separate from the ventral shield, *J. magniseta* Smit and Pešić, 2014 has very large dorsal setae and the coxae lying less anteriorly, *J. reticulata* Smit and Pešić, 2014 has a less rounded gonopore and dgl-2 and -3 without glandularia and *J. nova* n. sp. has dgl-4 with glandularia.

**Genus *Paraxonopsis* Motaş and Tanasachi, 1947**

A widespread genus absent only in Australasian and the Neotropical regions (Smith *et al.* 2015)

***Paraxonopsis separata* n. sp.**  
(Figure 12)

Material examined. Holotype male, Small unnamed stream crossing Mt Brinchang Road, Cameron Highlands, Malaysia, 4°31.458N 101°23.353E, alt. 1860 m a.s.l., 19-ii-2009.

Diagnosis — Genital field with four pairs of acetabula, acetabula widely separated.

Description — Male: Idiosoma rugose, dorsally somewhat rectangular anteriorly, 373 long and 292 wide; idiosoma reticulated. Dorsal shield fused anteriorly with ventral shield, with three longitudinal ridges and A2 and four pairs of dorsoglandularia. First coxae extending beyond anterior idiosoma margin, most coxal suture lines obliterated. A ridge extending anteriorly from fourth legs sockets to lateral idiosoma margin. Between fourth leg sockets and genital field a pair of glandularia, lying closer to genital field than to fourth leg sockets. Genital field with four pairs of acetabula, the most lateral pair extending far laterally. Gonopore 30 long, lying on a bulge. Length of P1-5: 24, 38, 30, 56, 20.; ventral margin of P2 with an extension, ventral margin of P4 with a setal tubercle. Length

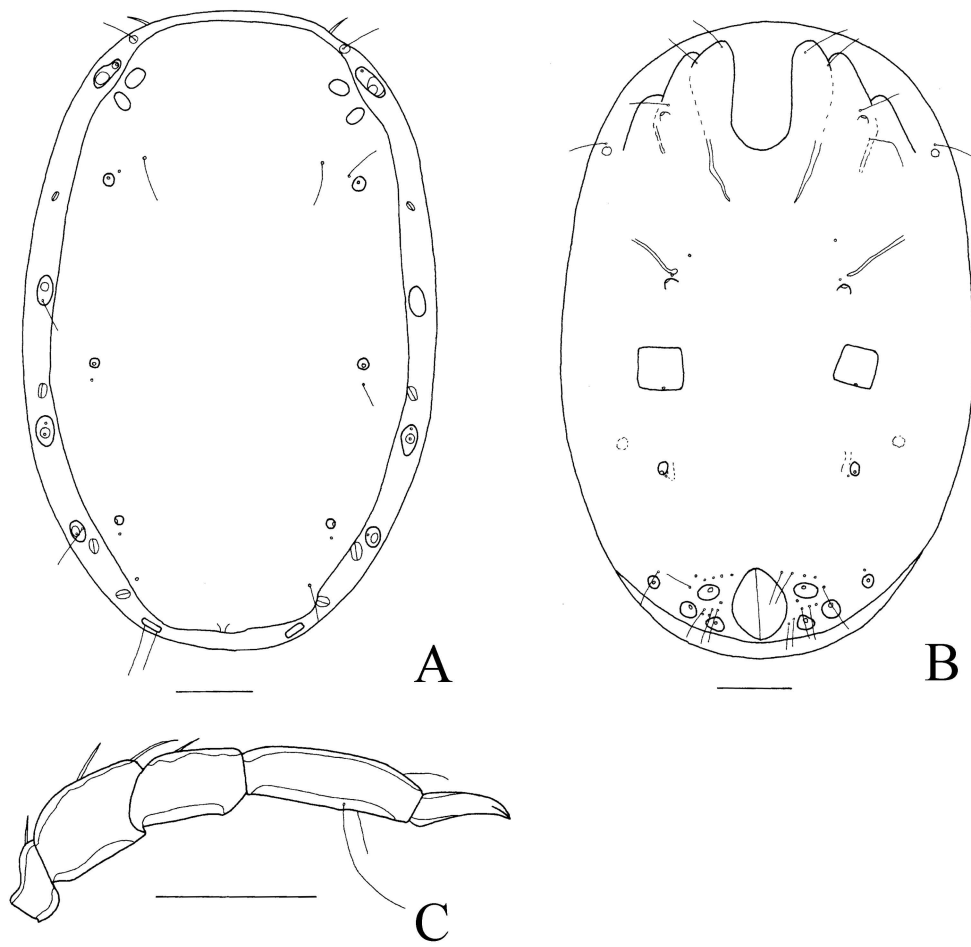


FIGURE 11: *Javalbia rotunda* n. sp., holotype male: A – dorsum; B – venter; C – palp. Scale bars = 50  $\mu$ m.

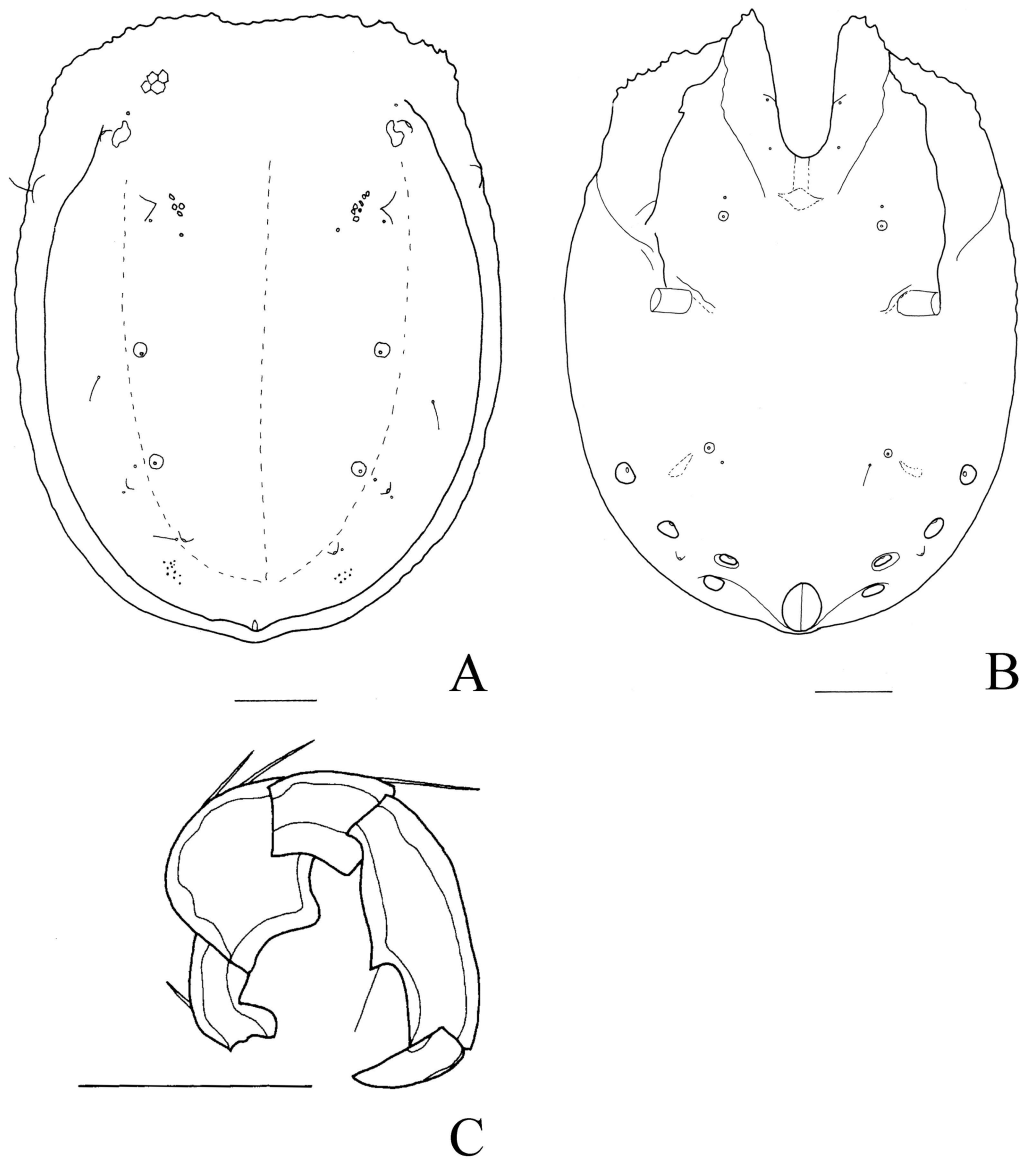


FIGURE 12: *Paraxonopsis separata* n. sp., holotype male: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.

of I-leg-4-6: 38, 40, 52 (till tip of segment). Length of IV-leg-4-6: 58, 72, 60. Legs without swimming setae, legs and palp striated. Female: Unknown.

Etymology — Named for the widely separated acetabula.

Remarks — None of the known four-acetabulate *Paraxonopsis* species has the acetabula separated as widely as in the new species.

### **Genus *Siamaxonopsis* n. gen.**

Diagnosis — Dorsal and ventral shields present. Dorsal shield fused anteriorly with ventral shield. Dorsal shield with A2, postocularia and four pairs of glandularia, the most posterior pair flanking the excretory pore (the latter fused with dorsal shield) and visible only in posteromedial view. Anterior coxal plates not extending to anterior idiosoma margin, without hook-like structures. Anterior to fourth leg sockets a ridge extending to lateral idiosoma margin. Between fourth leg sockets and genital field with two pairs of glandularia, lying closer to genital field than to fourth leg sockets. Genital field numerous pairs of acetabula. P2 with a large nose-shaped extension.

Type species — *Siamaxonopsis ypsilon* n. sp.

Remarks — The only known axonopsine genus with more than three or four pairs of acetabula is *Omanaxonopsis* Smit and Pešić, 2010. However, this genus has one pair of glandularia between the fourth leg sockets and the genital field, has no dorsal glandularia flanking the excretory pore, has a truncate lateral projection of the ventral shield and leg claws with dorsal and ventral clawlets (Smit and Pešić 2010).

### ***Siamaxonopsis ypsilon* n. sp. (Figure 13)**

Material examined — Holotype female, Stream near Haewsai Waterfall, Nam Nao NP, Thailand, 16°40.668N 101°41.856E, alt. 425 m a.s.l., 16-xi-2007.

Diagnosis — As for genus.

Description — Female: Idiosoma dorsally 365 long and 285 wide, ventrally 356 long. Dorsal shield 259 wide, with two Y-shaped structures. Genital

field with 16 pairs of acetabula, most acetabula ellipsoid, but more rounded acetabula do occur as well. Cxgl-2 lateral of genital field, but not visible in ventral view. Length of P1-5: 24, 42, 26, 56, 30. P2 with a somewhat medially located large nose-shaped extension, P4 stocky and bulging ventrally. Length of I-leg-4-6: 42, 46, 52. Length of IV-leg-4-6: 60, 70, 64. Legs simple, claws with ventral clawlet. Swimming setae: III-leg-4 two, III-leg-5 three, IV-leg-4 two, IV-leg-5 three. Male: Unknown.

Etymology — Named for the Y-shaped structures on the dorsum.

### **Genus *Sinaxonopsis* Yi and Jin, 2012**

From the recently described genus *Sinaxonopsis* one species is known only from Anhui Province, China (Yi and Jin 2012). A second species is described below.

### ***Sinaxonopsis siamicus* n. sp. (Figure 14)**

Material examined — Holotype female, Stream near Haewsai Waterfall, Nam Nao NP, Thailand, 16°40.668N 101°41.856E, alt. 425 m a.s.l., 16-xi-2007.

Diagnosis — Ridge anterolaterally of fourth leg sockets very short; setae associated with dgl-2 and dgl-3 distanced from glandularia; lgl-2 not on large posterior dorsal shield, lgl-3 and -4 on small humps.

Description — Female: Idiosoma colourless, dorsally 429 long and 389 wide, ventrally 429 long. Dorsum with three plates, smaller paired anterior plates and a large unpaired posterior plate. Anterior plates with the postocularia and two pairs of glandularia, posterior plate with five pairs of glandularia. Setae associated with dgl-2 and dgl-3 distanced from glandularia. This large posterior pair fused to ventral shield, but most of the posterior part of the dorsal furrow not visible due to rugosity of the idiosoma. Suture lines of coxae incomplete, first coxae not extending beyond anterior idiosoma margin, posterior margin of fourth coxae incomplete. Cxgl-4 lying posterior to fourth leg sockets. Excretory pore posterior to genital field but visible only in dorsal view. Gonopore relatively large, 102 long. Genital field with approximately 20 pairs

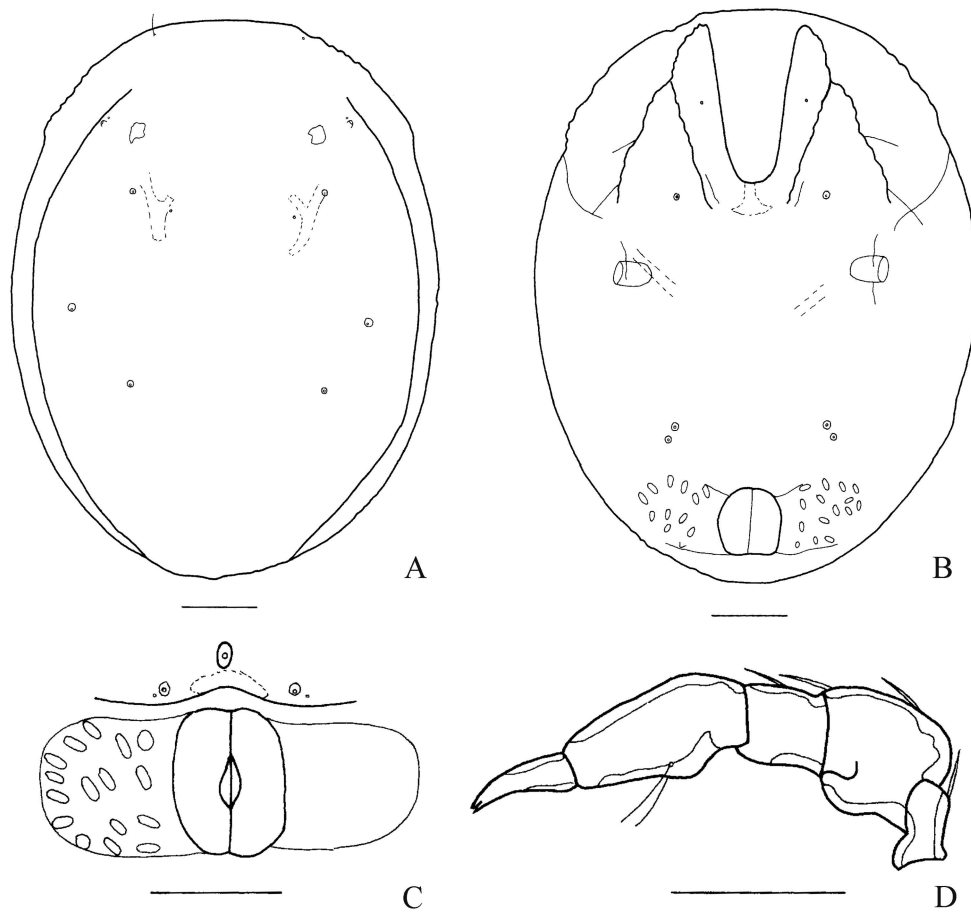


FIGURE 13: *Siamaxonopsis ypsilon* n. sp., holotype female: A – dorsum; B – venter; C – posteromedial view of genital field and posterior margin of dorsal shield; D – palp. Scale bars = 50  $\mu$ m.

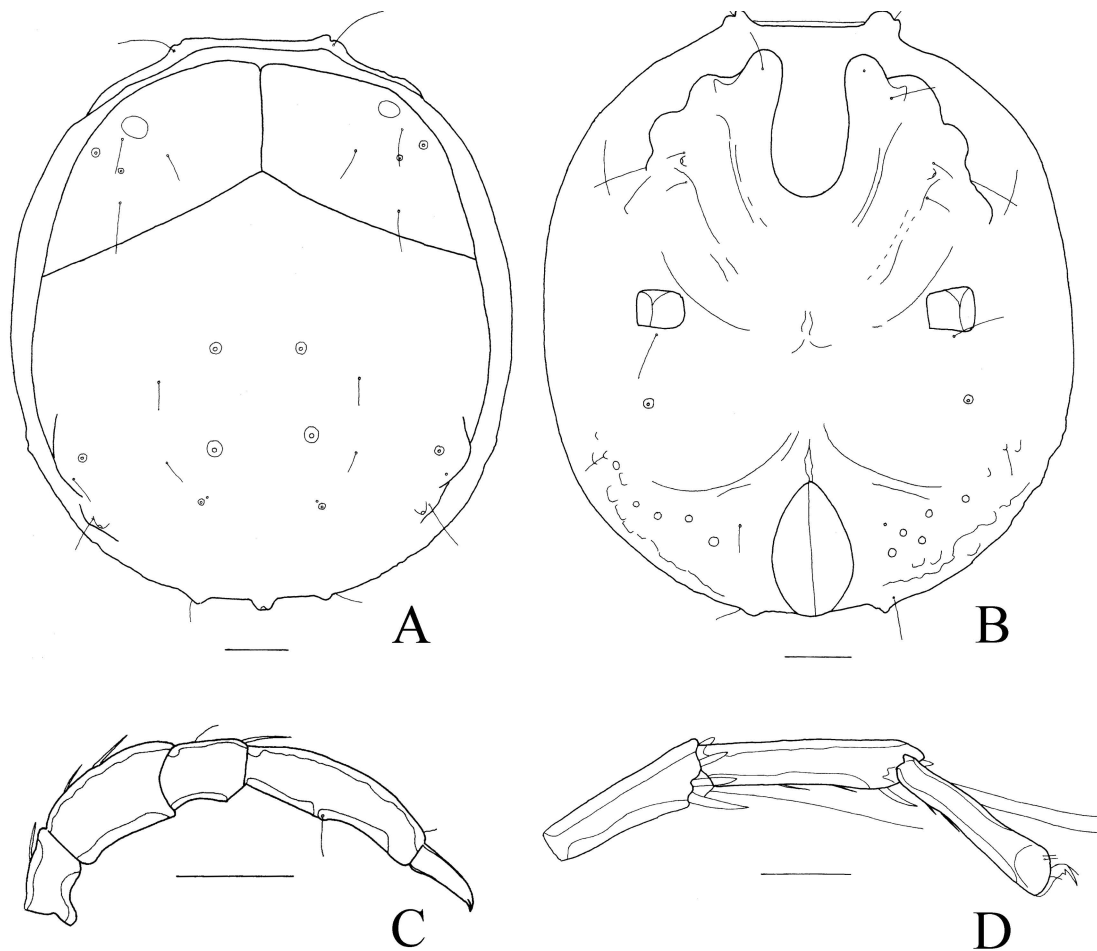


FIGURE 14: *Sinaxonopsis siamicus* n. sp., holotype female: A – dorsum; B – venter; C – palp; D – IV-leg-4-6. Scale bars = 50 μm.

of acetabula on indistinct genital plates, but due to rugosity of idiosoma most of these not visible in ventral view. Length of P1-5: 35, 64, 32, 84, 36. Length of I-leg-4-6: 80, 84, 78. Length of IV-leg-4-6: 98, 116, 96. Legs without modifications, IV-leg segments slender. Swimming setae: II-leg-4 one, II-leg-5 three, III-leg-4 one, III-leg-5 three, IV-leg-4 with one swimming seta and IV-leg-5 with two swimming setae.

**Etymology** — Named after the old name of Thailand.

**Remarks** — The new species differs from *S. unicucrus* Yi and Jin, 2012 in the smaller size (564 – 594 for *S. unicucrus*), A2 posteromedially of dgl-1

(A2 anteromedially of dgl-1 in *S. unicucrus*) and the characters mentioned in the diagnosis of the new species. Yi and Jin (2012) placed the new genus tentatively in the Axonopsinae, which is a correct placement in my opinion.

#### **Genus *Vicinaxonopsis* Cook, 1974**

The genus *Vicinaxonopsis* is known from the Holarctic and Oriental regions (Smith *et al.* 2015).

#### ***Vicinaxonopsis costata* n. sp. (Figure 15)**

**Material examined** — Holotype female, Thorntip Waterfall, Kaeng Krachan NP, Thailand, 12°50.952N

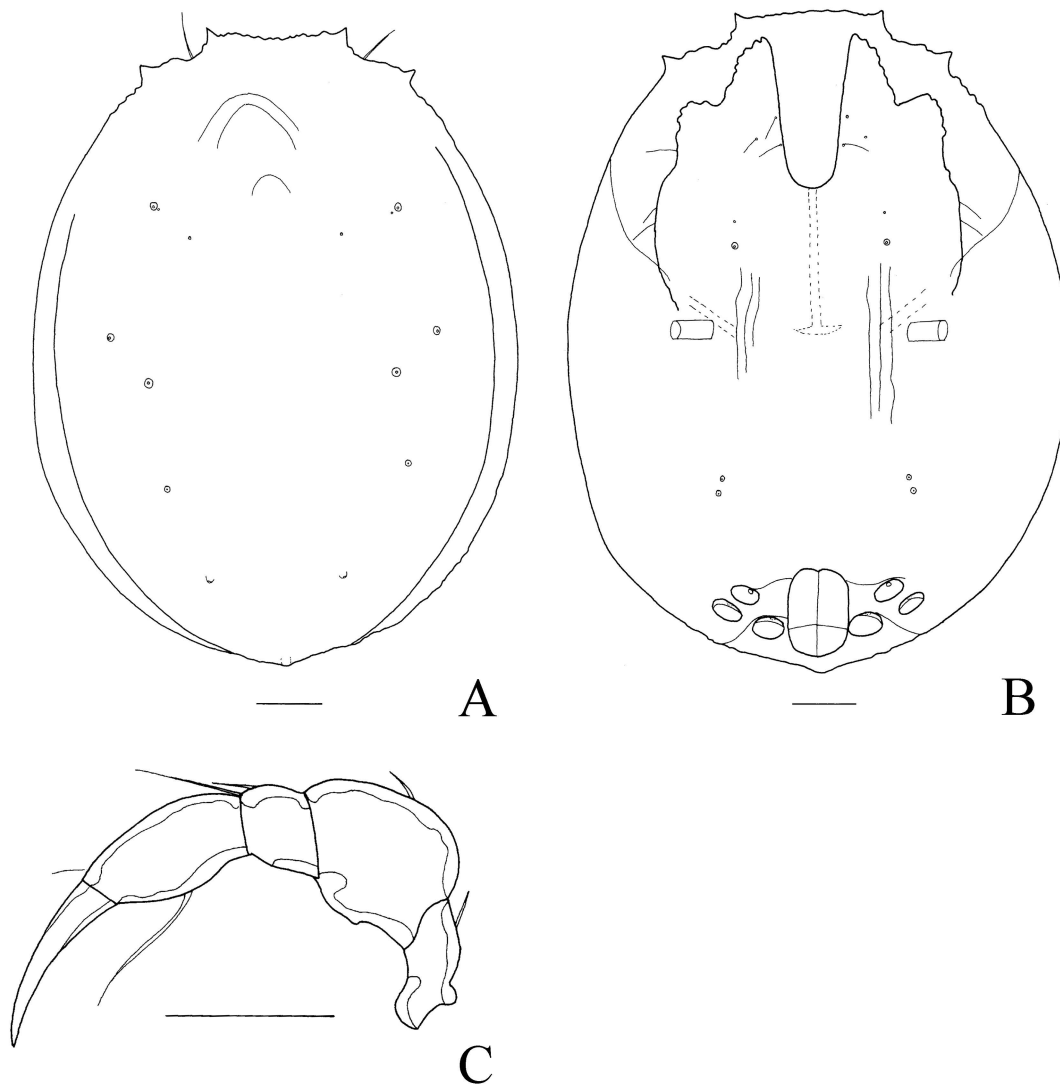


FIGURE 15: *Vicinaxonopsis costata* n. sp., holotype female: A – dorsum; B – venter; C – palp. Scale bars = 50 µm.



Smit H.

99°18.498E, 29-xi-2007.

Diagnosis — Eyes absent, venter with distinctive longitudinal ridges.

Description — Female: Idiosoma brown coloured, dorsally 489 long and 373 wide, ventrally 467 long; eyes absent. Dorsal shield fused anteriorly with ventral shield, 373 wide; excretory pore fused with dorsal shield. Dorsal shield with A2, postocularia and four pairs of glandularia; due to rugosity of integument associated setae of dorsoglandularia not visible. Body pores of integument arranged in a rounded pattern in anterior part of dorsal shield; anterior part of dorsum with two pairs of large lateral papillae. Anterior coxae not extending to anterior idiosoma margin. Coxal suture lines obliterated. Apodemes of gnathosoma very long. Anterior to the fourth leg sockets a ridge extending to the lateral idiosoma margin. Venter with numerous distinctive longitudinal ridges. Between fourth leg sockets and genital field two pairs of glandularia, lying close to each other. Genital field with three pairs of acetabula; gonopore 60 long and 46 wide. Length of P1-5: 30, 50, 24, 50, 53. P4 stocky and ventrally somewhat bulging, with a long ventral seta; P5 long and slender. Length of I-leg-4-6: 52, 54, 56 (till tip of segment). Length of IV-leg-4-6: 80, 78, 56. Numbers of swimming setae: IV-leg-4 one, IV-leg-5 two. Male: Unknown.

Etymology — Named for the distinctive ridges of the venter.

Remarks — The combination of absence of eyes and the presence of longitudinal ridges is characteristic for the new species. *Vicinaxonopsis caeca* (Smit and Pešić, 2014) from Borneo has reduced lateral eyes and a different patterns of the anterior dorsal shield (Smit and Pešić 2014). Despite the absence of eyes, the distinctive brown colour of the idiosoma shows that this species is not hyporheic.

#### Subfamily Albiinae Viets, 1915

##### Genus *Albia* Thon, 1899

##### *Albia rectifrons* Viets, 1930

Material examined. **Malaysia.** 1/0/1, Lake Chini, 3°26.103N 102°55.801E, alt. 22 m a.s.l., 11-ii-2009.

Remarks — A widely distributed species, previously reported from Indonesia, Australia, Malaysia, Burma, India and China (Viets 1935, Uchida and Imamura 1951, Cook 1967, 1986, Wiles 1992).

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