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Revision of the family Carabodidae (Acari: Oribatida) III. Redefinition of *Meriocepheus peregrinus* Aoki, 1973; *Bathocepheus concavus* Aoki, 1978; and *Opisthocepheus kirai* Aoki, 1976

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Revision of the family Carabodidae (Acari: Oribatida) III. Redefinition of *Meriocepheus peregrinus* Aoki, 1973; *Bathocepheus concavus* Aoki, 1978; and *Opisthocepheus kirai* Aoki, 1976

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Meriocepheus peregrinus Aoki, 1973; *Bathocepheus concavus* Aoki, 1978; and *Opisthocepheus kirai* Aoki, 1976 are redescribed and illustrated based on adult specimens studied by means of optical microscopy. The three genera are redefined.

Keywords: Acari; Oribatida; Carabodidae; revision; redefinition; *Meriocepheus peregrinus*; *Bathocepheus concavus*; *Opisthocepheus kirai*

Introduction

The genus *Meriocepheus* was established by Aoki in 1973, with *Meriocepheus peregrinus* as type species. At present, the genus is considered as monotypic (Subías 2004). The genus *Bathocepheus* was established by Aoki in 1978, with *Bathocepheus concavus* Aoki 1978, as type species. Subías (2004) considered the latter genus as constituted by two species and considers the genus *Philippobodes*, established by J. and P. Balogh, 1992, as junior synonym. The genus *Opisthocepheus* was established by Aoki in 1976, with *Opisthocepheus kirai* as type species. At present, Subías (2004) considers the genus as synonymous with *Pasocepheus* Aoki, 1976 (= *Opisthocepheus* Aoki, 1976). The genus consists of five species and is divided into two sub-genera: *Pasocepheus* (*Pasocepheus*) and *Pasocepheus* (*Guineobodes*). To facilitate understanding of the situation related to genera and type species studied, we give a detailed explanation and corresponding redescription in each instance. For the sake of accuracy, original descriptions and redescrptions (including written errors) are included, in order to have all the diagnostic/characteristic elements spelled out and to simplify comparative comments.

Materials and methods

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 Europa Holding GmbH, Hamburg, Germany) equipped with a drawing tube. For better observation, very transparent specimens were stained with chlorazol black E.

Measurements taken: total length (tip of rostrum to posterior edge of notogaster), width (the widest part of notogaster) in micrometres (µm).

Morphological terminology

Morphological terms and abbreviations used are those developed by Grandjean (1928–1974) (cf. Travé and Vachon 1975; Norton and Behan-Pelletier 2009; Fernandez et al. (2013).

For the setal types, Evans (1992) was used, and for ornamentation of cuticular surfaces, Murley (1951) (ex Evans 1992) was used. When studying the relevant literature, it is striking how many synonymies occur with reference to terms applied to describe basic structures used as diagnostic criteria for genera and species within this family. Thus, in order to be able to complete a revision, we had to clearly determine existing synonyms in order to establish a homogenized terminology for the family. In many previous works, terms were re-used, sometimes not with reference to exactly the same characters. We have used these terms strictly in the sense proposed by the authors listed above. For the medial eye, see Fernandez et al. (2013).

Descriptions and redescrptions of taxa

Genus *Meriocepheus*

Aoki (1973, pp. 94–95) established:

Meriocepheus gen.n. The present new genus seems to be closely related above all to the genera *Congocepheus*, *Machadocepheus*, *Tuberocepheus* and *Diplobodes*. However, the combination of the following characters separates *Meriocepheus* from them: (1) presence of 3 pairs

of elevations on prodorsum, (2) clavate sensilli, (3) a steep swelling on posterior part of notogaster and wide hollow in front of it, and (4) 10 pairs of fine notogastral setae.

Type species: *Meriocepheus peregrinus* sp. n.

Mahunka (1986, pp. 98–99) redefined the genus, but is not clear from the text if Mahunka studied the type material or not, because there are discrepancies with the original description of Aoki (1973). It is possible that these are simply mistakes and Mahunka did not study the type material. He stated:

Meriocepheus Aoki, 1973 (Figs. 45–47) Aoki, 1973:94. Prodorsum: Three pairs of large elevations present, one of them in interlamellar position. A deep triangular concavity present basally. All prodorsal setae thin and simple. Sensillus short, clavate. Tutorium present.

Notogaster: Posteromedian part with a high elevation, anterior part excavate. Ten pairs of fine, short notogastral setae present, one pair arising on the humeral projection.

Coxisternal region: Third and fourth epimeres fused, all other well framed. Epimeral setal formula: 2-1-3-2.

Anogenital region: Strongly chitinized, some ridges also observable. Anogenital setal formula: 4-1-2-3. Setae ad_3 in adanal position (!). Lyrifissure *iad* not observable.

Type species: *Meriocepheus peregrinus* Aoki, 1973. Irimore I. (Japan).

Remarks: The description was based on the Holotype only.

Redefinition

Diagnosis

Prodorsum with elevated interlamellar process bearing three prominent protuberances. The largest of these with a more or less rounded posterior part with *in* setae. The other protuberances situated antiaxially to the larger one. Lamellae dorsolateral. Bothridia, long, cup-shaped with bothridial ring. Anterior rostral setae, medial eye clearly visible.

Notogaster with shallow anterior depression; *dsj* narrow, well-demarcated circumgastric depression present. Humeral apophysis conspicuous, triangular in shape, anterior part overlapping posterior part of bothridia. Twelve (see text “Notogaster”) pairs of setae; c_2 , c_3 anteriorly; p_1 , p_2 , p_3 , h_3 , situated laterally; *la*, *dm*, *dp*, *lm*, h_1 , h_2 (provisional notation; see text “Notogaster”) on elevated posterior zone; *gla* clearly visible near *im* lyrifissure. Four pairs of lyrifissures easily discernible (*im*, *ih*, *ip*, *ips*), probably *ia* existing on paraxial side of humeral apophysis; *tu*, curved cuticular thickening; deep supratutorial depression. Pedotecta I, II and discidium present. Lateral part of the lamella internally concave and lamellar border extending laterally; inferior antiaxial border of the bothridium concave and extending laterally, and inferior part of humeral apophysis concave, extending laterally. Above and underneath coxa IV, many cuticular thickenings and ovoid-polyhedric depressions. Epimera easily discernible;

epimeral chaetotaxy 3-1-3-3; four pairs of genital setae; aggenital setae, posterolateral genital opening; three pairs of adanal setae; lyrifissure *iad*, present; two pairs of anal setae; anal plate tipped with a small acute spine.

Type species: *Meriocepheus peregrinus* Aoki, 1973

Original description Aoki (1973, p. 96):

Meriocepheus peregrinus sp. n. (Figs. 23–26).

Prodorsum: Three pairs of prominent protuberances found near the basal parts of lamellae; the innermost pair bearing interlamellar setae are larger than remaining 2 marginal pairs. Rostral and interlamellar setae fine and simple; lamellar setae could not be detected. Medioposterior part of prodorsum, triangular in shape, deeply lowered. Sensillus clavate, being curled upward in its portion; the ventral surface of the organ densely covered with minute barbs (Fig. 24).

Notogaster. A conspicuous, steep elevation exists on the posterior part, being surrounded by a flat marginal area; the upper edge of the elevation in dorsal view forms an arch opening anteriorly; the front slope of the elevation widely concave, while the hind slope is rather swollen. Humeral projection on each side moderately developed. Except for the marginal area and the upper edge of the elevation, notogastral surface shows foveolate structure. The pairs of short fine notogastral setae are present, through the left side is deficient in seta r_3 (or p_3 ?); setae $p_1 \sim p_3$ and r_3 situated marginally, r_1 and *ms* almost on the edge of the elevation, and *te* on humeral projections.

Ventral side. Genital plate provided with 4 setae standing at nearly regular intervals. Aggenital setae widely separated from each other. Anal plate bearing 2 setae which are inserted posteriorly, i.e. even the anterior seta (an_2) located a little posterior to the midlevel of the plate. Three pairs of adanal setae; ad_2 situated closer to ad_1 than to ad_3 . Setal formula for epimerata: 2(?)–1-3-3: All the setae on the ventral side fine bristles.

Measurement. Body length: 570 μ ; breath: 340 μ .

Material examined. Holotype (NSMT-AC8342, in spirit); Sonai, Iriomote Island, 26-IX-1972, J. AOKI and S. NAKATAMARI (IR-7).

Redefinition

Diagnosis

Microsculpture. Elevated interlamellar process, irregularly tuberculate. Prodorsal protuberances and lamellae, tuberculate–punctate. Notogaster, irregularly tuberculate; near *dsj*, punctate. Tuberculate, around subcapitular setae *h*; epimeres 1 and 2 tuberculate–punctate, 3 and 4 irregularly tuberculate. Around genital and anal opening, slightly tuberculate–punctate. Tutorium and pedotectum I tuberculate. Setae: *in*, *ro*, notogastral, epimeric, subcapitular, genital, adanal and anal setiform; *le*, thick, barbate.

Length. *le* > *in* = *ro*; other setae more or less equal length. Shallow lamellar furrow easily discernible, originating near

the large protuberance; fovea in middle zone of prodorsum; *le*, situated laterally, not apically; lamellar tip rounded. Setae *ro* inserted slightly in front of *le* insertion. Sensillus spatulate, barbate; *dsj* narrow, well delimited. Tutorial margin irregularly foveate. Pedotectum I, large extended lamina, ovoid end. Pedotectum II, prominent lamina, partially covering acetabulum II; discidium large protuberance near acetabulum III extends laterally. Lyrifissure *iad*, situated anteriorly and at the same level as *ad*₃.

Material examined

Meriocepheus peregrinus Aoki, 1973 (holotype) NsMT-AC 8342-1527 Material deposited in Department of Zoology, National Museum of Nature and Science, Tokyo, Japan. Holotype (only existing specimen) was studied. Internal calcium carbonate crystals had to be eliminated to allow proper study (Judson 2007).

Description

Measurements. 582 µm × 354 µm

Colour. Specimens very transparent. Impossible to establish original colour.

Cerotegument. Exists, but degraded by clearing process; impossible to describe.

Integument. Microsculpture: complicated. **Prodorsal microsculpture:** *e.i.p.* irregularly tuberculate. Near *dsj*, ovoid depressed area with punctate microsculpture; three protuberances and lamellae, tuberculate-punctate; *l.l.f.*, punctate; parallel to *l.l.f.* aligned to fovea (Figure 1). **Notogastral microsculpture:** irregularly tuberculate with tubercles of varying size, and punctate microsculpture between tubercles; near *dsj*, punctate. **Ventral microsculpture:** Tuberculate, zone around *h* subcapitular seta (Figure 2). Punctate microsculpture central epimeric zone to sejugal furrows. Epimeres 1 and 2 tuberculate-punctate; epimeres 3 and 4 irregularly tuberculate (Figure 2). Zone around genital and anal opening slightly tuberculate-punctate. Behind acetabulum IV and laterally to genital and anal opening prominent depressions. **Lateral zone:** tutorial zone and pedotectum I tuberculate. Prominent depressions lateral to anal and genital openings. Many cuticular thickenings on margin ventral shield (Figure 6). **Posterior zone:** Notogaster, tuberculate.

Setation. Setae: *in*, *ro*, notogastral, epimeric, sub-capitular, genital, adanal and anal setiform (Figures 1, 2, 6, 7, 8); *le* thick, minute basal barbs, large apical barbs (Figure 6). Length: *le* > *in* = *ro*; other setae more or less equal length.

Prodorsum: Complex elevated interlamellar process (*e.i.p.*) with three prominent protuberances (Figures 1, 3, 4). The largest protuberance more or less rounded with an irregular surface and many small bulging areas; the *in* setae located on posterior part of protuberance (Figures 1, 6). Other protuberances situated antiaxially to the largest protuberance; one forward and another more or less at the same level or

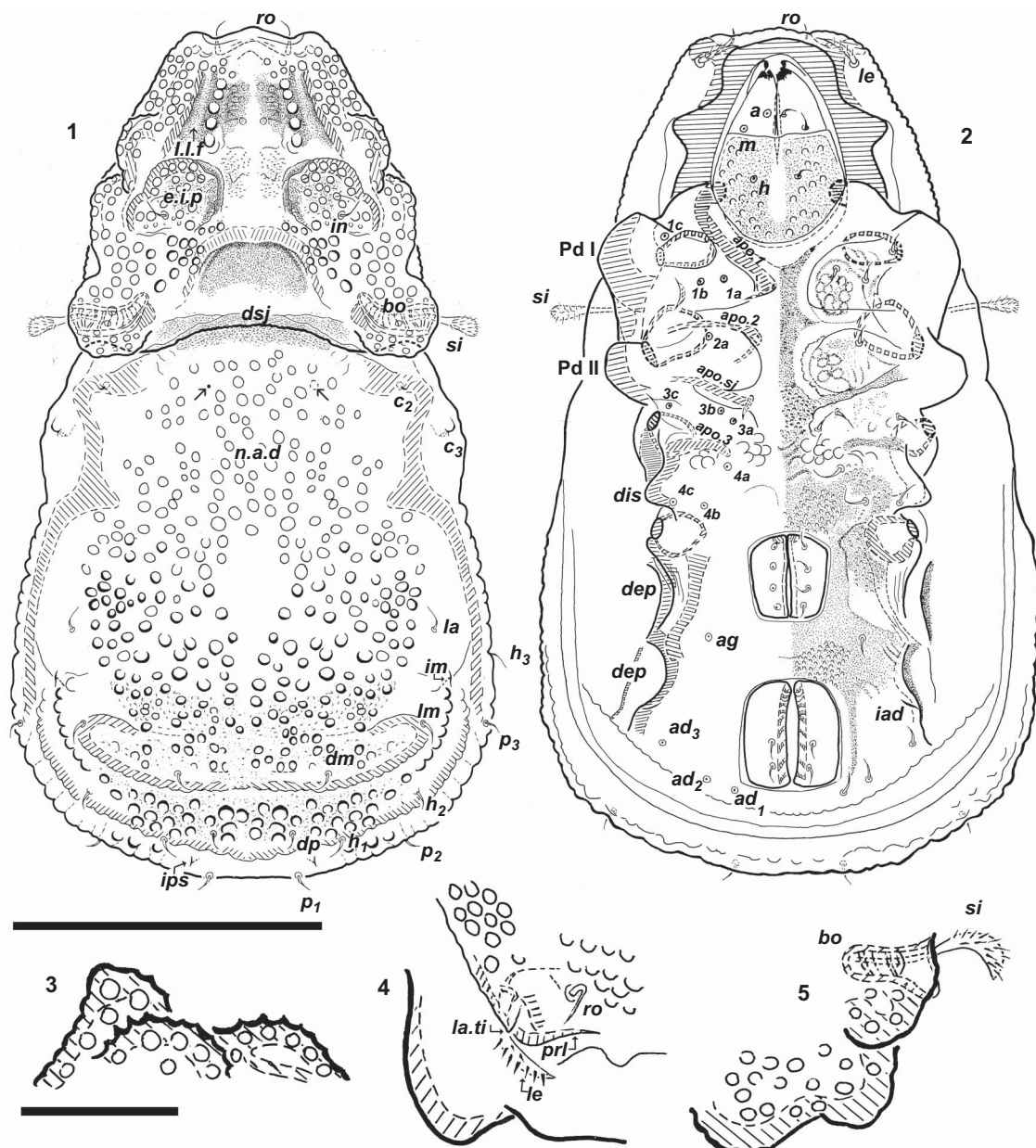
slightly backwards (Figure 3). Lamellae dorsolateral; well defined (Figure 1); in dorsal view, *l.l.f.* easily discernible as a longitudinal furrow, delimited antiaxially by a longitudinal cuticular thickening and paraxially by a linearly aligned fovea (Figures 1, 7); *l.l.f.* originating near the large protuberance (Figure 1). In the central zone of prodorsum, an aligned series of fovea visible (Figure 1), in zone between the two aligned fovea complex microsculpture, consisting of punctate-pustulate with foveate zones (Figures 1, 7). Lamellar setae clearly visible in frontal and lateral view (Figures 4, 6) as large barbate setae, situated laterally (not apically) on lamellae. Lamellar tip rounded (Figures 6, 7). Seta *ro*, inserted at the same level of *le* setae insertion. Bothridia long, cup-shaped, with bothridial ring (*bo.ri*) (Figure 7). Sensillus spatulate barbate (Figures 1, 2, 5). In front of rostral setae, medial eye (*oc*) clearly visible (Figure 7).

Notogaster: Oval shape; shallow notogastral anterior depression (*n.a.d.*); *dsj* narrow, clearly delimited (Figure 1); *s.c.* present, easily discernible in posterior view (Figure 8). Posterior notogastral zone elevated, clearly visible in lateral view (Figure 6); in dorsal view the more elevated zone presenting an internal cuticular thickening (Figure 1). Humeral apophysis (*h.ap.*) prominent, easily discernible in lateral view (Figure 6). Setal number difficult to establish due to asymmetric disposition, setae *h*₃ may be present on one side but the counterpart is lacking. In the central zone of *n.a.d.*, a setal insertion possibly exists (indicated by arrow in Figure 1), hardly discernible due to poor preservation condition of material; thus the established "twelve pairs of setae" should be seen as provisional, as a probable insertion was not included in the twelve pair count; *c*₂, *c*₃ situated in the anterior depressed zone; *p*₁, *p*₂, *p*₃, *h*₃, situated laterally; *la*, *lm*, *dm*, *dp*, *h*₁, *h*₂ situated on elevated posterior zone (Figures 1, 6); *gla* clearly visible near *im* lyrifissure. Four pairs of lyrifissures easily discernible (*im*, *ih*, *ip*, *ips*), and in the internal part of *h.ap.* a structure exists which may be the *ia* lyrifissure (see lateral region).

Lateral region: Humeral apophysis (*h.ap.*), more or less triangular shape; apical zone *h.ap.* overlapping posterior part of *bo* (Figure 6). The *h.ap.* presenting a prominent internal thickening. External part of *h.ap.* extending laterally and a structure, probably the *ia* lyrifissure, is situated in the internal zone on the lateral extended part. Lamellae broad, margin well delimited and concave to permit concealment of leg I (similar to *Bovicarabodes deharvengi*); *le* seta in concave depression and situated towards apical lamellar tip (Figure 6); *tu* clearly visible as curved cuticular thickening (Figure 7). Tutorial margin irregularly foveate. Between and parallel to *lam* and *tu* a deep *s.tu.d* (Figure 7).

Pedotectum I, large extended lamina, ovoid end, with prominent posterior thickening. Pedotectum II, large lamina, partially covering acetabulum II (Figure 6). Discidium (*dis*) large protuberance between acetabulum III and IV (Figure 6), extending laterally (Figure 6).

Border of *lam*, inferior part of *bo*, and inferior part of *h.ap.* form an extended concave lateral expansion. Above



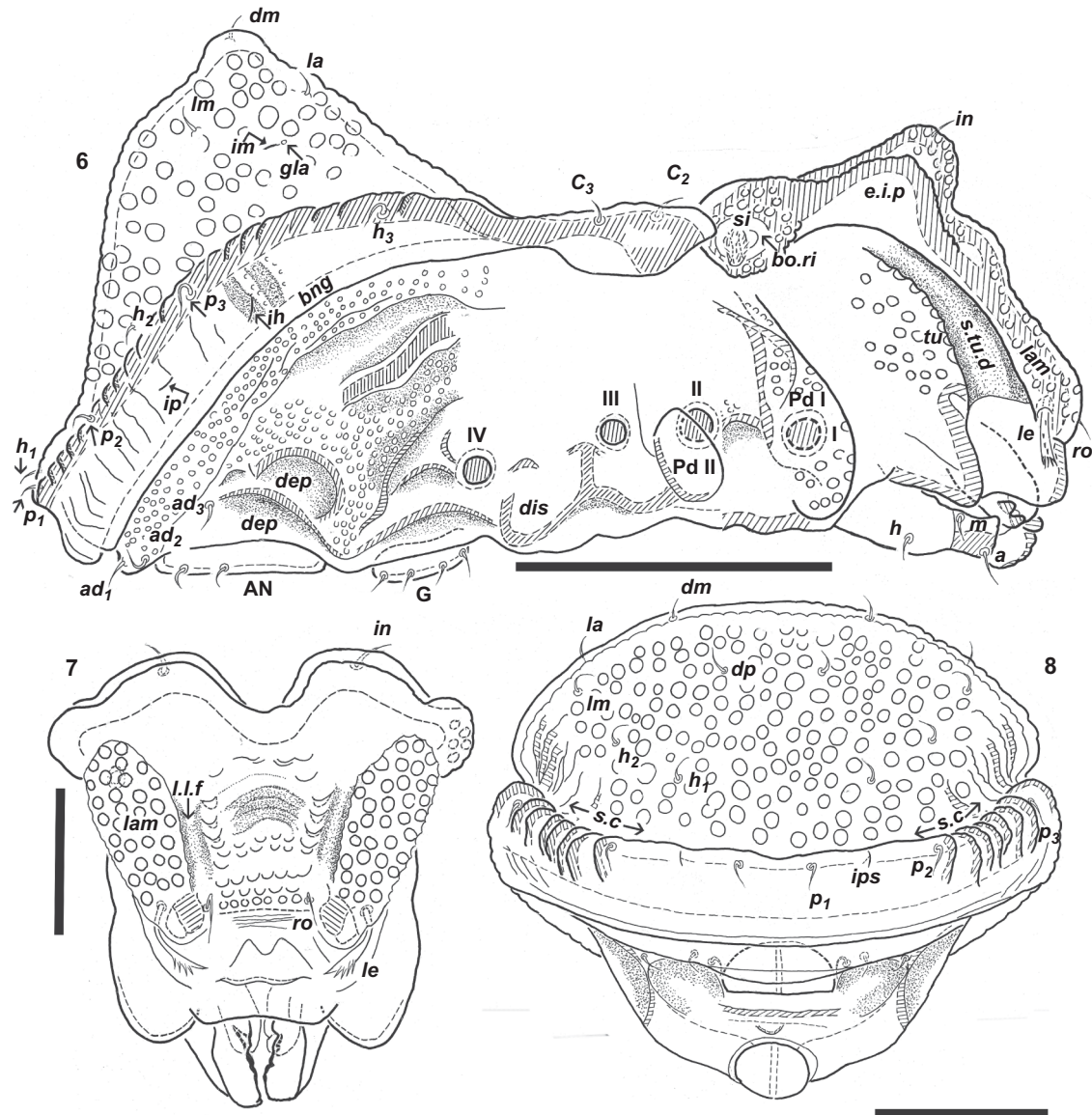
Figures 1–5. *Meriocephus peregrinus* Aoki, 1973. Adult: 1. dorsal aspect; 2. ventral view; 3. protuberances lateral view; 4. frontal view, rostrum; 5. protuberances and bothridium, dorsal view. Abbreviations: See Materials and methods. Scale: 1–2 = 200 μ m; 3–5 = 120 μ m.

and underneath coxa IV, many cuticular thickenings and ovoid to polyhedral shaped depressions (Figure 6).

Ventral region. Epimera well discernible; epimera 1 and 2 delimited by a smooth area towards the medial shallow furrow (Figure 2). These two epimera are more or less rounded in shape with elevated surfaces containing round protuberances and pustulate microsculpture (Figure 2); epimera 3 and 4 less defined and no clear margin exists between them; microsculpture protuberances, pustulate, punctate. Epimeral furrow, antiaxially well delimited and in the paraxial zone with a depressed rhomboid zone (Figure 2). Epimeral chaetotaxy 3-1-3-3. Apodemata 1, 2, *sj* and 3 clearly visible (Figure 2). Four pairs genital setae

in unique line. Aggenital setae posteriolateral to genital opening (Figure 2). Three pairs of similar adanal setae. Lyrifissure *iad*, situated anteriorly at same level as *ad*₃. Two pairs of simple anal setae. Cuticular depressions only clearly visible behind legs and laterally to anal and adanal opening.

Posterior aspect. (Figure 8) On account of the shape of the notogaster and the great number of setae, it is necessary to incline the specimen in order to observe the setae on the notogastral margin. The *s.c.* is a prominent, well-delimited furrow; many more or less parallel cuticular thickenings are found in notogastral margin. Lyrifissure *ips* easily discernible.



Figures 6–8. *Meriocephheus peregrinus* Aoki, 1973. Adult: 6. lateral aspect; 7. frontal view; 8. posterior view. Abbreviations: See Materials and methods. Scale: 6 = 200 μ m; 7 = 50 μ m; 8 = 100 μ m.

Gnathosoma. Subcapitulum diarthric, three pairs of subcapitular setae present

Legs. Not in observable condition.

Genus *Bathocephus*

Aoki (1978, pp. 86–87) established:

Bathocephus gen. n. [Heko-ibushidani Zoku] Notogaster broadly concave anteriorly and convex posteriorly. Suture between prodorsum and notogaster indistinct. Thirteen pairs of notogastral setae are present, seven pairs among them being situated in the middle field and the remaining six pairs arranged peripherally; these two groups of setae quite different in shape and size. A deep concavity exists between genital and anal apertures. Genito-anal chaetotaxy 4-0-2-3. Legs monodactyle.

TYPE-SPECIES: *Bathocephus concavus* sp. n.

REMARKS: The present new genus resembles the genus *Opisthocephus* Aoki, 1976 especially in the shape of notogaster as well as in the shape and arrangement of notogastral setae. But, the latter is distinguishable from the former by the fused lamellae and the sensilli directed forward.

Mahunka (1986, p. 86) redefined the genus; in text it is not stated clearly, but he seems to not have viewed the type material:

Bathocephus Aoki, 1978 (Figs 11–12, 83) Aoki, 1978:86.

Prodorsum: Median surface convex but without transversal apophysis. Lamellae separated, their cusps rounded, lamellar setae originating on the outer margin of lamellae, the narrow phylliform rostral setae resembling these.

Sensillus with dilated end, recurved. Tutorium well observable.

Notogaster: Dorsosejugal suture indistinct, a large, ω -shaped concavity existing in the anterior part of notogaster, covered by a thick cerotegument layer. Posteromedian part of notogaster highly convex, without chitinous structure. Thirteen pairs of phylliform notogastral setae of different sizes, two pairs of them originating on the shoulders.

Coxisternal region: No reference in Aoki's original description.

Anogenital region: A deep concavity existing between the genital and anal apertures. Anogenital setal formula: 4-0-2-3. Lyrifissure *iad* was neither mentioned nor figured.

Type species: *Bathocephus concavus* Aoki, 1978. Bonin I. (Japan).

Redefinition

Diagnosis

Small elevated interlamellar process. Three pairs of setae. Lamellae dorsolateral, rounded apex; shallow lamellar furrow, originating near bothridia, terminating near lamellar apex; prolamellae antiaxial *ro*, situated near edge of rostral margin; bothridial ring smooth, incomplete with bothridial tooth. In front of rostral setae, medial eye. Notogastral anterior depression, ω -shaped; posterior notogastral zone elevated; circumgastric furrows present, easily discernible; humeral apophysis prominent, anterior part overlapping posterior part of bothridium. Thirteen pairs of setae; tutorium curved cuticular thickening; deep supra-tutorial depression; Pedotecta I, II, discidium, present; lamellar margin, inferior part bothridia and inferior part of humeral process an extended concave lateral expansion; many cuticular thickenings and irregular depressions. Epimera convex, well delimited by shallow furrows. Epimeral chaetotaxy 3-1-3-3; apodemata 1, 2, *sj* and 3 well visible. Four pair genital setae; aggenital setae laterally to genital opening. Three pairs of adanal, two anal; lyrifissure *iad*, anterior to *ad*₃.

Type species: *Bathocephus concavus* Aoki, 1978

Original description (Aoki 1978, pp. 87–88):

Bathocephus concavus sp. n. [Heko-ibushidani] (Fig. 4)

MEASUREMENT. Body length: 343 (390) 455 μ , width: 202 (231) 280 μ .

PRODORSUM. Lamellae separated, interspace between them being narrowest at the level nearly mid-distance between rostral setae and interlamellar setae. Lamellar setae inserted each on the outer margin of lamella, a short distance behind the tip; it bending inward and downward. Rostral setae strongly curved downward, their mutual distance being as wide as their length. Interlamellar setae broad and leaf-like. The posterior half of prodorsum partly covered by irregular granules, while the anterior half is foveolate. Sensillus directed partly upward and then inward; the distal half strongly barbed like a "tooth-brush".

NOTOGASTER. Dorsosejugal suture indistinct. Convex middle field and flat marginal area clearly distinguished. Humeral region on each side weakly projecting. A large round (somewhat ω -shaped) concavity exists on the anterior part of notogaster; a thick layer of cerotegument covering the middle part of concavity. Thirteen pairs of notogastral setae consist of two types of setae distinctly different in size; two pairs on humeral region and four pairs on posterolateral margin are small; among seven pairs on middle field, six pairs are large and only anteromedian one pair of setae are small; these small setae inserted on the upper edge of notogastral concavity. Surface of notogaster covered by polygonal granules, which seem to be arranged irregularly or sometimes in polygonal network.

ANO-GENITAL REGION. Genital opening longer than wide and a little shorter than interspace between genital and anal openings; four pairs of genital setae very minute. Anal opening as long as wide; mutual distance of the anterior anal setae wider than that of the posterior ones. Three pairs of adanal setae leaf-like; *ad*₃ inserted at a level anterior to the anterior margin of anal opening. Aggenital setae could not be detected. A deep concavity exists between genital and anal apertures; at the bottom of the concavity found an indistinct oval structure.

TYPE-SERIES. *Holotype* (NSMT-Ac 9071, in spirit): S of Nakanotaira, Haha-jima Island, 23-VI-1977, J.AOKI and H.HARADA, from litter. *Paratopotypes* (4 exs.): The same data as holotype. *Paratypes*: Mt. Sekimon, Haha-jima, 1 ex., 24-VI-1977, J.AOKI and H.HARADA, from litter; Oki-mura, Haha-jima, Is., 24-VI-1977, J.AOKI and H.HARADA, from litter; NE of Minami-zaki, Haha-jima Is., 3 exs., 23-VI-1977, J.AOKI and H.HARADA, from litter; Mt. Yoake, Chichi-jima Island, 2 exs., 1-VII-1977, J.AOKI, from litter; Mt. Chuo, Chichi-jima Is., 1 ex., 2-VII-1977, J. AOKI, from litter; Mt. Mikazuki, Chichi-jima Is., 1 ex., 23-VI-1977, J.AOKI and H. HARADA, from litter.

Redefinition

Diagnosis

Integument microsculpture: lamella, bothridial zone, irregularly tuberculate; shallow lamellar furrow clearly visible. Notogaster, irregularly round to polyhedral structures; around subcapitular seta *h*, irregularly tuberculate; epimeres 1 and 2, tuberculate-pustulate; 3 and 4 pustulate. Setae, *ro*, *le*, notogastral, adanal, lanceolate, slightly barbate; *le*, barbate; setae: sub-capitular, epimeric, genital and anal, simple. Prodorsum: elevated interlamellar process with small elevated transversal zone in front of *in* insertion. Three pairs setae *le* > *in* > *ro*; *in* setae near shallow lamellar furrow. Sensillus barbate, similar to "toothbrush". Notogaster: *dsj* narrow, arched, well delimited. Thirteen pairs tiny lanceolate barbed setae; six pairs, *c*₃, *lm*, *h*₃, *p*₃, *p*₂, *p*₁, laterally; *da*, in margin notogastral anterior depression; *dm*, *dp*, *h*₂, *h*₁, on elevated zone; *da*, smallest; *gla* and lyrifissures not discernible, cuticular microsculpture and remainder of cerotegumental layer obscuring observation. Humeral apophysis rectangular shape; *le*, seta near apical lamella; tutorial margin foveate. Pedotectum I, extended lamina, rounded tip; pedotectum II, curved small lamina, rounded apex, partially covering acetabulum II; sejugal depression deeper; lamellar margin, inferior bothridial part, inferior part humeral process, extending to form concave

lateral expansion. Discidium triangular, rounded apex, near acetabulum IV. Ventral region: setae, *3b*, *3c* antiaxially, close to each other; apodemata 1, 2, *sj* and 3 clearly visible; genital plate situated in elevated area; in front of genital opening in middle epimeric zone, a triangular area. Between genital and anal openings an oval depression with rounded central structure; anal plate slightly pointed tip; lyrifissure *iad*, anterior to *ad*₃.

Material examined

Bathocephus concavus Aoki, 1978 (holotype) QM11F, NsMT-Ac 9071

Description

Measurements. 371 µm × 242 µm

Colour. specimens very transparent, impossible to establish original colour.

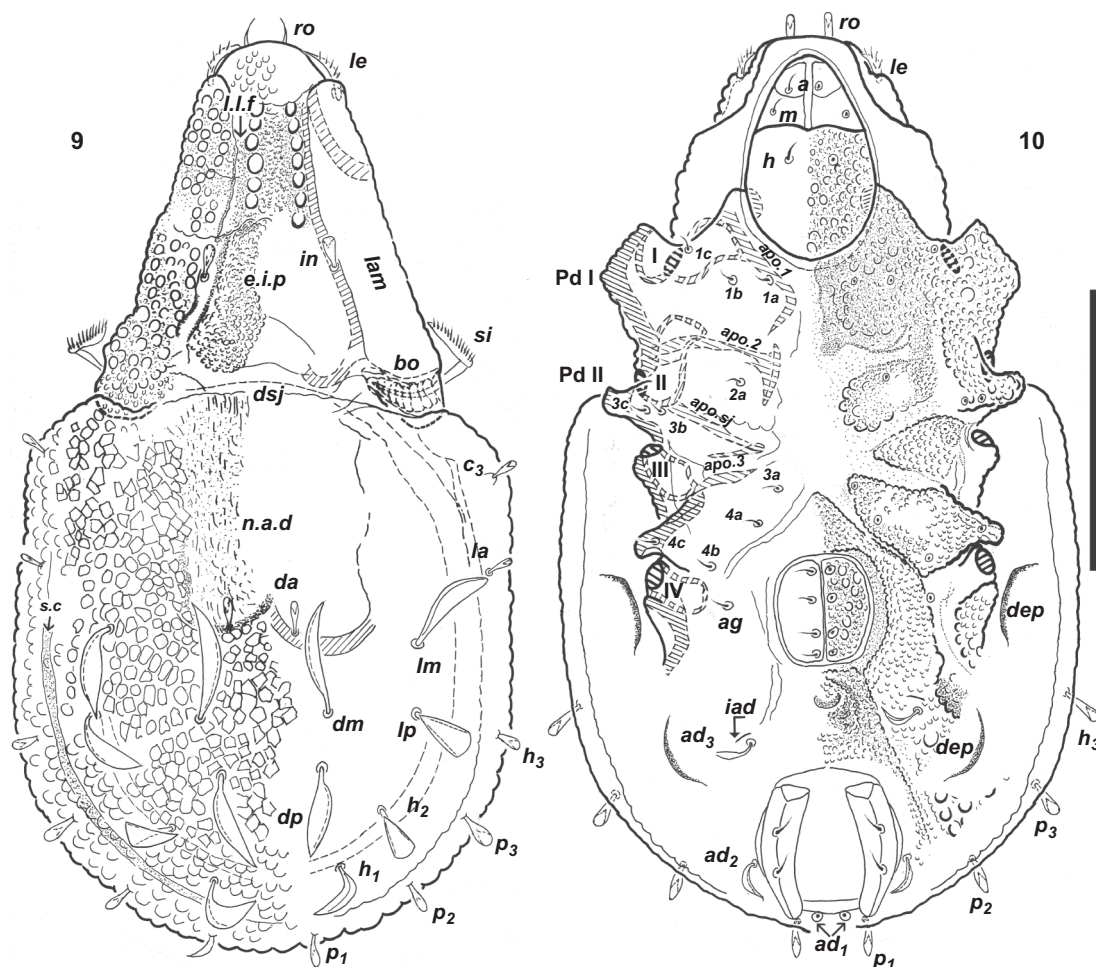
Cerotegument. Exists, but degraded by clearing process; impossible to describe.

Integument. Microsculpture, complicated, varying according to body region. Prodorsal microsculpture: lamella, irregularly tuberculate; bothridial zone, irregularly

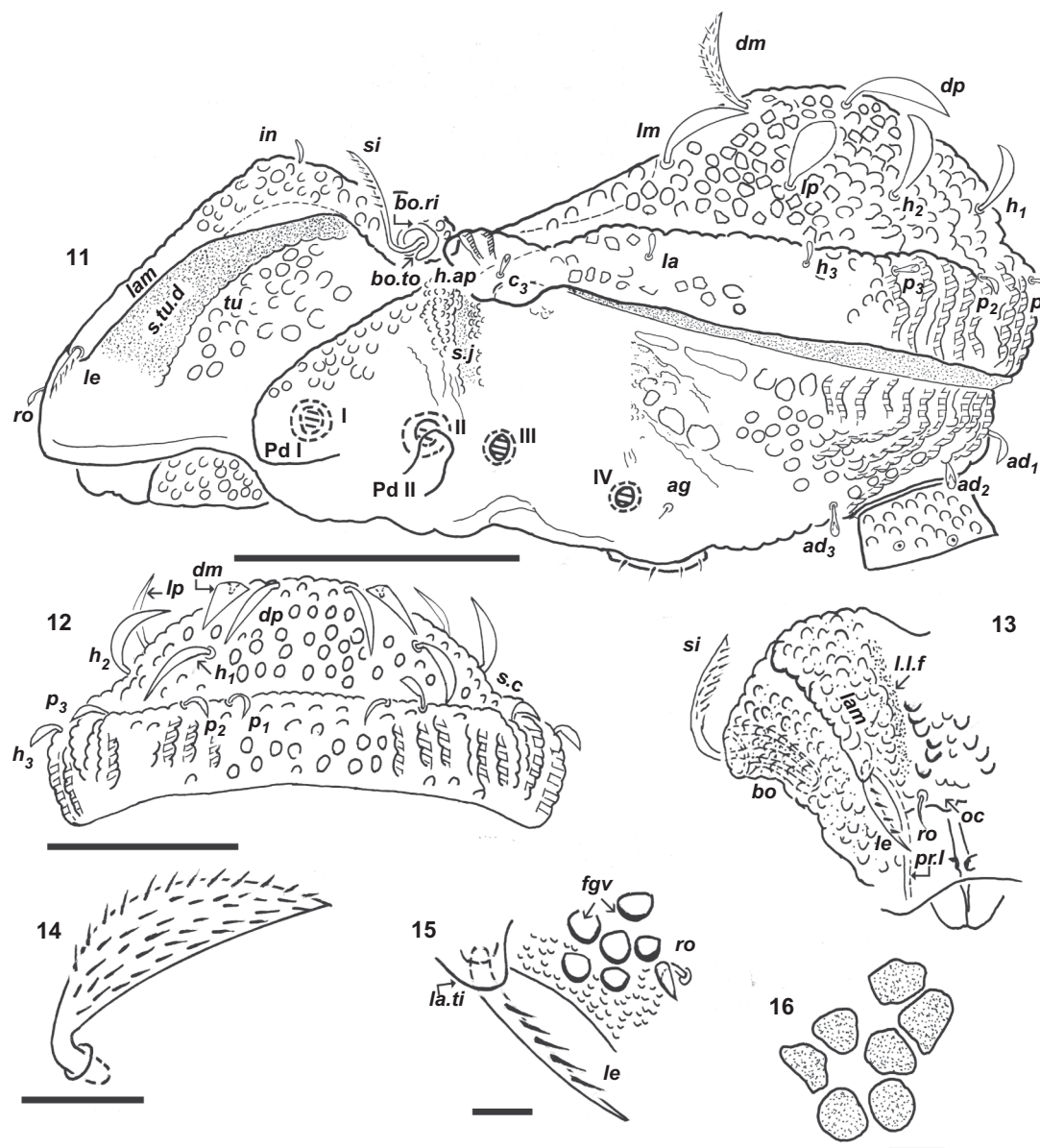
tuberculate–pustulate. Between both lamellae and anterior zone *in* setae insertion in a transversal faintly elevated zone, tuberculate microsculpture (Figures 9); behind this last zone, near *dsj*, postulate microsculpture. In front of the transversal zone, *l.l.f* originating as a clearly visible shallow furrow (Figure 13). Paraxial to *l.l.f*. aligned fovea. Close to the rostrum tuberculate microsculpture (Figure 13). Notogaster, *n.a.d.*, with cerotegument, observation obscured; microsculpture formed by irregular round to polyhedric structures (Figures 9, 16).

Ventral microsculpture. surrounding subcapitular setae *h*, irregularly tuberculate; epimeres 1 and 2, tuberculate–pustulate; 3 and 4 pustulate; epimeres medial zone punctate (Figure 10). Lateral zone: Tutorium zone, foveate; pedotectum I, tuberculate, sejugal zone, faintly tuberculate; *h.ap.* many parallel thickenings (Figure 11). Lateral acetabulum IV, slightly tuberculate, and behind irregularly tuberculate (Figure 11). Posterior zone: many irregular thickenings near *bng* (Figure 12).

Setation. Setae *ro*, *le*, notogastral and adanal, lanceolate, slightly barbate; *le*, barbate; setae: subcapitular, epimeric, genital and anal, simple (Figures 9, 10, 11, 12, 13, 14, 15).



Figures 9–10. *Bathocephus concavus* Aoki, 1978. Adult: 9. dorsal aspect; 10. ventral aspect. Abbreviations: See Materials and methods. Scale: 9–10 = 100 µm.



Figures 11–16. *Bathocepheus concavus* Aoki, 1978. Adult: 11. lateral aspect; 12. posterior view; 13. frontal view; 14. Sensillus; 15. apical lamellar zone; 16. notogastral microsculpture. Abbreviations: See Materials and methods. Scale: 11–12 = 100 μ m; 13 = 50 μ m; 14 = 10 μ m; 15–16 = 1 μ m.

Prodorsum. Convex shape with small elevated interlamellar process (*e.i.p.*) (Figures 9, 11); *e.i.p.* with a very tiny elevated transversal zone, situated in front of the *in* insertion (Figure 9). Three pairs of setae *le* > *in* > *ro*. Lamellae dorsolateral; in dorsal view, well delimited; *l.l.f.* beginning near bothridia and ending near lamellar apex (*la.ti*) (Figure 13); *l.l.f.* a slight furrow on cuticular surface with clearly visible internal cuticular thickening; *in* setae situated somewhat paraxial to lamellar limit on *l.l.f.* (Figure 9). Lamellae ending in a rounded *la.ti* (Figure 15). A prolamella (*prl*) antiaxial to *ro* seta extending from the internal zone of *la.ti*, to rostral margin (Figure 13). Lamellar seta lateral (Figure 13). Rostral margin rounded. Bothridia cup-shaped with smooth incomplete *bo.ri* with bothridial tooth (*bo.to*) (Figure 11). Sensillus barbate resembling a “tooth-brush”

(Figure 14), medial eye (*oc*) clearly visible anterior to rostral setae insertion (Figure 13).

Notogaster. Shape, oval; *dsj* narrow, arched, well delimited *n.a.d.* present, ω -shaped (Figure 9); posterior notogastral zone elevated (Figure 11); *s.c.* present, easily discernible (Figure 12); from *s.c.* to top, concave shape; *h.ap.* prominent (Figure 11), easily discernible in lateral view. Thirteen pairs of setae; all lanceolate, slightly barbate; six pairs, *c3*, *la*, *h3*, *p3*, *p2*, *p1*, more or less even in length, laterally; *da*, small, situated in margin of *n.a.d.*; *dm*, *dp*, *lm*, *lp*, *h1*, *h2*, , situated on elevated zone (Figure 11); *gla* and lyrifissures not discernible, cuticular microsculpture and remnants of cerotegumental layer obscure observation.

Lateral region. Humeral process prominent, rectangular shape; *h.ap.* anterior part overlapping posterior part of *bo* (Figure 11). Lamellar margin clearly visible; seta *le* situated near apical end of lamella (Figures 13, 15); inner zone of lamella concave (visible due to transparency), to permit concealment of leg I (similar to *Bovicarabodes deharvengi*); *tu* clearly visible as curved cuticular thickening. Tutorial margin, foveate. Between *lam* and *tu* parallel to both structures a deep *s.tu.d* (Figure 11). Pedotectum I, prominent extended lamina, rounded end, covering the first acetabulum. Pedotectum II curved small lamina, round apex, partially covering acetabulum II. Sejugal depression (*sj*), deep, clearly visible (Figure 11). Margin of *lam*, inferior part of *bo*, and inferior part of *h.ap.* extending as a concave lateral expansion, playing an important role in protection mechanism.

Discidium triangular, rounded apex, protuberance (clearly visible in ventral view), between acetabulums III and IV (Figure 10), but closer to IV. Many cuticular thickenings and irregular shallow ovoid depressions present from level of coxa IV upwards and to the rear.

Ventral region. Epimera convex and well delimited by shallow furrows, (Figure 10). Epimeral chaetotaxy 3-1-3-3; setae *3b*, *3c* situated antiaxially and close to each other. Epimeric borders clearly visible; *bo.sj* across medial plan. Apodemata 1, 2, *sj* and 3 clearly visible (Figure 10). Genital opening surrounded by elevated area; immediately anterior to genital opening. Triangular area directed towards middle epimeric zone (Figure 10) (hardly discernible, probably an anterior genital furrow (*a.g.f.*)). Close to genital opening, between that and anal opening, an oval depression with a rounded central portion. Four pairs genital setae in unique line. Aggenital setae situated laterally to genital opening (Figure 10). Discidium, prominent structure, situated near acetabulum IV (Figure 10).

Three pairs of adanal setae; all lanceolate, slightly barbate. Anal plate small sharp tip. Two pairs of anal setae; lyrifissure *iad*, anterior to *ad*₃. Cuticular depressions clearly visible antiaxially and posterior to acetabulum IV (Figure 10).

Posterior aspect. Notogaster round; *s.c.* prominent furrow well delimited, many more or less parallel cuticular thickenings (Figure 12). Lyrifissures not discernible.

Gnathosoma. Subcapitulum diarthric, three pairs of subcapitular setae (Figure 10).

Genus *Opisthocephus*

The genus was established by Aoki (1976, pp. 45–46) stating:

Opisthocephus * gen nov.

Lamellae except for the apical parts fused to each other to form a broad area covering prodorsum. In lateral view, the anteriormost as well as posteriormost part of body strongly elevated, leaving on the middle part a broad excavated area. Sensillus directed antieriad, forming an elbow near the base.

Interlamellar setae absent. Thirteen pairs of notogastral setae are present; seven pairs among them arranged peripherally and the remaining 6 pairs all situated on the posterior swelling of notogaster; the former and the latter setae quite different in shape. Genito-anal chaetotaxy: 4-1-2-3. legs monodactyle.

Type-species: Opisthocephus kirai sp. nov.

Remarks: In having fused lamellae, 13 pairs of notogastral setae and a pair of hook-like ventral ridges, the genera *Opisthocephus* and *Pasocephus* are closely related to each other. They should, however, be treated each as independent genus, because of some important differences between them. The most characteristic feature of *Opisthocephus* is the shape and the direction of sensilli; in the genera *Machadocephus*, *Congocephus*, *Tuberocephus*, *Diplobodes*, *Apotomocephus* and *Pasocephus* which have close relationships to *Opisthocephus* sensilli are all directed laterally and curled up at their tip. The anteriorly directed and uncurled sensilli of *Opisthocephus* must, therefore, be highly evaluated as a genus-separating character. Both the genera, *Opisthocephus* and *Pasocephus*, have 13 pairs of notogastral setae, but their arrangements are quite different: *Opisthocephus* has one humeral seta on each side and no other seta near the anterior margin while *Pasocephus* lacks humeral setae, but has two pairs of setae along the anterior margin of notogaster. In *Opisthocephus*, notogastral setae are differentiated into two different types, but they are uniform in *Pasocephus*."

**Opisthocephus* Οπισθα (rear) +Cepheus

Mahunka (1986, p. 101) redefined the genus as follows:

Opisthocephus Aoki, 1977 (Figs. 54–56) Aoki, 1977:45.

Prodorsum: Lamellae fused medially and covering the greatest part of prodorsum, their anterior part highly elevated, lamellar setae arising here; interlamellar setae absent*. Sensillus gradually dilated, directed forwards. Tutorium well observable.

Notogaster: Dorsejugal area strongly excavated, dorsejugal suture indistinct. Posterior median part of notogaster highly projecting. Thirteen pairs of notogastral setae present, one pair in humeral position. All notogastral setae more or less phylliform.

Coxisternal region: Epimeral setal formula: 3-1-2-3. Epimeral borders well developed, so all epimeres well framed.

Anogenital region: A pair of strong longitudinal ribs ending in a tubercle present. Anogenital setal formula 4-1-2-3. Lyrifissure *iad* was not mentioned in the original description.

Type species: *Opisthocephus kirai* Aoki, 1977, Malaysia.

Remark: Only the holotype is known.

*It is also possible, that in fact the 'lamellar setae' are the interlamellar ones, and the true lamellar setae are reduced or hardly visible.

Redefinition

Diagnosis

Most of prodorsum covered by elevated interlamellar process; apically divided in two separated ear-like processes,

rounded, extending forward; *in* setae, situated near apical tip. Central basal zone open V-shaped. Short, dorsolateral lamellae of unusual shape situated on anterior part of prodorsum; *le* setae situated apically; *ro* setae simple. Bothridia, cup-shaped; bothridial ring present; medial eye visible, posterior to rostral setae. Tutorium and supratutorial depression clearly visible. Shallow anterior notogastral depression, posterior notogastral part elevated; *dsj* recitilinear, narrow. Humeral apophysis prominent. Thirteen pairs of setae; lyrifissures *im*, *ih*, *ip*, *ips*, present. Epimeral chaetotaxy 3-1-3-3. Anterior genital plate furrow present. Four pairs of genital setae. Aggenital setae present, posterior to genital opening. Three pairs of adanal setae. Two pairs of anal setae. Lyrifissure *iad*, lateral to *ad*₃. Cuticular depressions behind legs and laterally to anal and adanal opening.

Type species: *Opisthocephus kirai* Aoki, 1976

Original description (Aoki 1976, pp. 46–48):

Opisthocephus kirai * **sp. nov.** (Figs. 1014)

Material examined

Holotype (NSMT-Ac 8633, in spirit): Near the entrance of Pasoh Study Area, 17-I-1971, M. Shiba, from litter. The type is deposited in the collection of National Science Museum, Tokyo.

Measurement. Body length: 305 µ; width 160 µ

Prodorsum. Prodorsum completely covered by trapezoidal structure produced by a fusion of lamellae. Lamellae separated only in their apical parts, between which rostrum is seen from above. Lamellar seta inserted near the tip of strongly elevated anterior part of lamella and curved ventrad. Rostral setae very small. Interlamellar setae absent. Sensillus almost of the same thickness throughout its length, being directed anteriorly along the lateral margin of lamella; the apical half of the organ barbed.

Notogaster. Humeral part forms a rounded lobe anteriorly and a broadly rounded protrusion posteriorly. The posterior part of notogaster strongly swollen to form a high mound.

In total 13 pairs of notogastral setae are present; 6 pairs among them are broad and leaf-like, with rough surface structure (Figure 11) and situated on the mound; the remaining 7 pairs of setae small and a little broadened, being arranged on or near the marginal area. Notogastral surface except marginal area covered by granules. Lyrifissure *im* detected laterally on the marginal area.

Ventral side Genital aperture only slightly longer than wide; each plate with 4 setae along its median margin. Anal plate bearing 2 setae, of which the posterior one situated more closer to median margin of the plate than the anterior one. Interspace between both the apertures longer than the length of genital aperture. Adanal setae *ad*₃ situated anterior to anal aperture, while the remaining two (*ad*₁ and *ad*₂) inserted posterior to the aperture. A prominent hook-shaped ridge exists on each side of genital aperture. Ventral plate deeply excavated on each side of anal aperture. Epimeral chaetotaxy: 3-1-2-3; seta *4b* inserted

closer to *4a* than to *4c*; two epimeral setae on epimera III situated close together and near the anterolateral edge of the epimera.

Legs All the legs monodactyle. Femora I-IV each with an irregularly notched ventral keel. Ultimate setae all short and bud-like, the type: S-S-S-S." (Aoki 1976)

*The new species is dedicated to Prof. Tatuo Kira of Osaka City University who as the chairman of Southeast Asia Committee of JIBP, made facilities available for carrying out our studies.

Redefinition

Diagnosis

Setae. prodorsal, *in*, slightly lanceolate; *ro*, simple; *le*, slightly lanceolate, tiny, barbate; notogastral, lanceolate, slightly barbate; *c*₃, *la*, *da*, *lm*, *h*₃, *p*₁, *p*₂, *p*₃, small size; *dm*, *dp*, *lp*, *h*₂, *h*₁, large; epimeric, anal, and genital simple; adanal, faintly lanceolate. Prodorsum, shallow lamellar furrow present; three pairs of setae; size *in* > *le* > *ro*. Bothridium, anterior lobate zone of humeral apophysis overlapping posterior part; bothridial ring clearly visible; sensillus phylliform barbate, extending forward; humeral apophysis large, lobate. Notogaster, ovate in dorsal view, posterior view rounded; notogastral setae *da*, *dm*, *dp*, *lm*, *lp*, *h*₁ *h*₂, situated on elevated posterior notogastral zone; *c*₃, *la*, *h*₃, *p*₁, *p*₂, *p*₃, situated marginally. Circumgastric depression clearly visible in posterior view. Seta *3b*, closer to *3c* and *4b* closer *4c*, all situated marginally. Apodemata 1, 2, *sj*, 3 clearly visible.

Material examined

Opisthocephus kirai Aoki, 1975 (Holotype) MsMT-AC 8633 1684

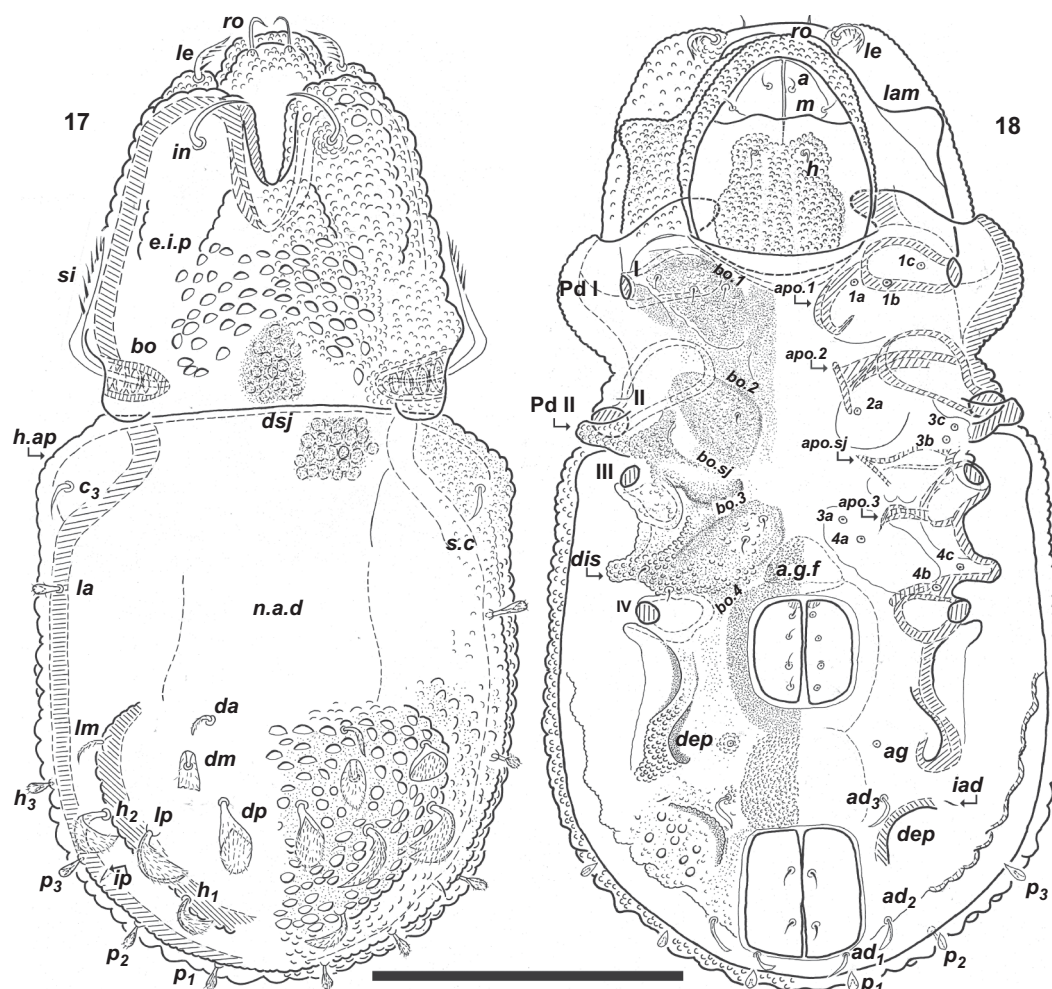
Description

Measurements. length: 315 µ; width 168 µ

Colour. specimens very transparent, impossible to establish original colour.

Cerotegument. Exists, but damaged by clearing process; impossible to describe.

Integument. Microsculpture: complicated. **Prodorsal:** irregularly tuberculate, mediodorsal zone extended between dorsosejugal suture (*dsj*) and elevated interlamellar process (*e.i.p*), tubercles of varying size; largest in middle zone; smaller around insertion of *in* setae and bothridial zone (Figure 17). Lamellae, medium sized tubercles; rostral tubercles of medium size aligned in two more or less parallel ridges; shallow lamellar furrow (*l.l.f*), depressed zone, punctate microsculpture. (Figure 21). **Notogastral:** irregularly tuberculate with tubercles of uneven size, with punctate microsculpture between tubercles, notogastral anterior depression and elevated posterior notogastral zone (Figure 17). **Ventral:** Pustulate, zone around subcapitular setae *h* (Figure 18). Pustulate, punctate, accentuate, epimeric middle zone. Pustulate, small punctate antiaxial



Figures 17–18. *Opisthocephus kirai* Aoki, 1976. Adult: 17. dorsal aspect, 18. ventral aspect. Abbreviations: See Materials and methods. Scale: 17, 18 = 100 μ m.

epimeric zone. Punctate, anterior and surrounding genital plate. Small pustulate anterior zone anal plate (Figure 18). Large depressions, posterior acetabulum IV, antiaxial genital and anal plate. **Lateral zone:** behind legs and sejugal zone, smooth. Tuberculate-pustulate: tutorial zone, behind anal plate; pustulate: around anal plate and near ventral margin. Large depression zone behind anal opening and around genital opening.

Many cuticular thickenings on border ventral shield (Figure 19). **Posterior zone:** Notogaster, tuberculate; laterally many irregular thickenings near *bng*. (Figure 20). Ventral, cuticular thickenings around cuticular depressions.

Setation. Prodorsum: *in* setae, slightly lanceolate; *ro*, setae simple; *le*, slightly lanceolate barbate. Notogaster, lanceolate, faintly barbate. Setae *c*₃, *la*, *da*, *lm*, *h*₃, *p*₁, *p*₂, *p*₃, small; *dm*, *dp*, *lp*, *h*₁, *h*₂, large. (Figure 17).

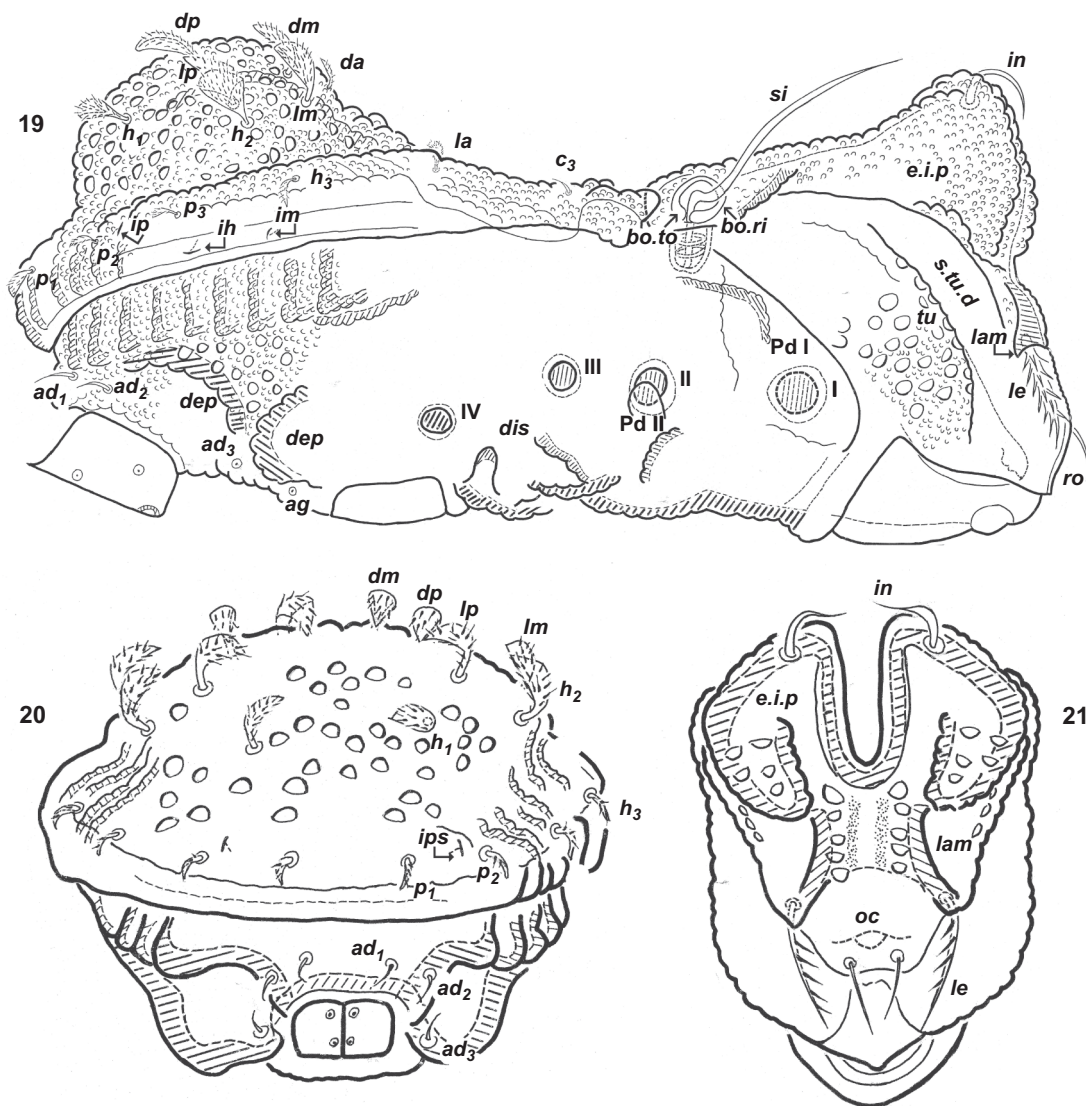
Epimeric, anal, and adanal setae simple; adanal, slightly lanceolate (Figure 18); aggenital setae, only insertion points visible.

Prodorsum. Prominent elevated interlamellar process (*e.i.p*) dividing into two separate ear-like processes, apically

rounded, extending anteriorad. Fused in central zone, open V shaped. Setae *le*, situated near apical zone of *e.i.p* (Figures 17, 21).

Lamellae, dorsolateral, well delimited; clearly visible in frontal and lateral view (Figures 19, 21); observation from above mostly obscured by the forward-extending *e.i.p* (Figure 17). Lamellae short with particular shape (see Figure 19), situated on the anterior part of prodorsum (Figures 19, 21); *l.l.f*, clearly visible as a longitudinal depression situated laterally to aligned tubercles (Figure 21). In dorsal view the *e.i.p* is visible in the junction zone of ear-like process, in margin of V-shape, an internal cuticular thickening, and because of transparency, extension of this process is visible (see lateral view). Three pairs of setae; clearly visible, size *in* > *le* > *ro*.

Bothridia, cup-shaped; *bo.ri*, smooth, incomplete, with *bo.to*; bothridial posterior part overlapped by the humeral process (Figure 19); sensillus phylliform, barbate (Figure 17) extending forward. Rostral margin more or less rounded (Figures 17, 21); *ro* curving (Figure 19). Posterior to rostral setae, medial eye (*oc*) clearly visible (Figure 21).



Figures 19–21. *Opisthocephus kirai* Aoki, 1976. Adult: 19. lateral aspect; 20. posterior view; 21. frontal view. Abbreviations: See Materials and methods. Scale: 19–21 = 100 μ m.

Notogaster. Shape, oval, with shallow notogastral anterior depression (*n.a.d.*); *dsj* narrow, rectilinear, well delimited (Figure 17) *s.c.* hardly discernible in dorsal view; easily discernible in posterior view (Figure 20).

Humeral apophysis prominent (Figure 19), clearly discernible in lateral view.

Thirteen pairs of setae; all lanceolate, slightly barbate; *gla* not visible; lyrifissures, 4 pairs *im*, *ih*, *ip*, *ips*; *im* situated posterior to *la* setae, *ih* near *im*; *ips* between *p*₁ and *p*₂.

Lateral region. Apical zone *h.ap.* overlapping posterior part of *bo* (Figure 19).

Lamellae short, well defined; *le* setae in apical position, situated in concave tutorial depression, curved cuticular thickening, easily discernible; tutorial margin foveate; *s.tu.d*, deep (Figure 19). Bothridial ring clearly visible, with round *bo.ri*. Pedotectum I, prominent extended lamina, rounded tip, with prominent cuticular thickening situated posterior zone. Pedotectum II, small lamina, rounded apex.

Sejugal depression (*sj*), hardly visible (probably because of transparency of specimen). Anal plate with small acute spine, clearly visible (Figure 19).

Upper and lower part of coxa IV, many cuticular thickenings and irregular deep polyhedric-ovoid depressions.

Ventral region. Epimera easily discernible, defined by elevated area with pustulate surface. Epimeral chaetotaxy 3-1-3-3. Setae 3*b*, 3*c* and 4*b*, 4*c*, situated marginally (Figure 18). Apodemata 1, 2, *sj* and 3 clearly visible. Internal cuticular thickening situated anterior to acetabulum IV. Anterior of genital plate zone with hardly visible furrow (*a.g.f.*). Four pairs genital setae in unique line. Aggenital setae posterior to genital opening at same longitudinal level as *ad*₃ (Figure 18). Three pairs of adanal setae; all setae lanceolate faintly barbated *ad*₂ = *ad*₃ > *ad*₁, (Figure 18). Two pairs of simple anal setae. Lyrifissure *iad*, situated laterally to *ad*₃. Cuticular depressions clearly visible, behind acetabulum IV and laterally to anal and adanal opening.

Posterior aspect. Notogaster rounded; *s.c* well delimited, many more or less parallel cuticular thickenings. Lyrifissures *ips* and setae *p*₁, *p*₂, *p*₃, *h*₁, *h*₂, *h*₃, *dp*, *lp*, *dm* easily discernible (Figure 20).

Gnathosoma. Subcapitulum diarthric, three pairs of subcapitular setae, region around subcapitular setae *h*, elevated with pustulate surface (Figure 18).

Legs. not in condition to be studied.

Discussion

With reference to all three genera, the situation is complex with many errors. We studied all type material and produced detailed redescrptions for each type specimen, viz. *Meriocepheus peregrinus* Aoki, 1973; *Bathocepheus concavus* Aoki, 1978; and *Opisthocepheus kirai* Aoki, 1977. We considered it unnecessary to analyse all the differences found. A new situation exists, and many previous considerations previously made on generic level are no longer of any value.

Meriocepheus peregrinus Aoki, 1973: In our study, we detected many discrepancies and differences compared to the original descriptions (genus and type species) by Aoki (1973, pp. 94–95) as well as the redefinition (of the genus) by Mahunka (1986, pp. 98–99).

Aoki (1973, p. 94), considered the genus *Meriocepheus* related to *Congocepheus* Balogh, 1958; *Machadocepheus* Balogh, 1958; *Tuberocepheus* Balogh and Mahunka, 1969 and *Diplobodes* Aoki, 1958, and indicated the same characteristics to allow separation of *Meriocepheus*, viz. “(1) Presence of 3 pairs of elevations on prodorsum, (2) clavate sensilli, (3) a steep swelling on posterior part of notogaster and wide hollow in front of it, and (4) 10 pairs of fine notogastral setae”.

Mahunka 1986 (pp. 98–99), indicated the same characteristics cited by Aoki (1973) and in the redescription of the genus, added the same characteristics as in the original species description and others, without clearly stating in text if he studied the type material.

In the original description by Aoki (1973, p. 96), the author indicated the asymmetric notogastral setal disposition on type specimens; we found 12 pairs of setae (not 10 as in the original description); but our observation is provisory, due to doubt about the exact number of existing notogastral setae, as a pair of probable setal insertion points exist on the notogastral anterior depression; but it is not possible to establish with certainty; for this reason, the “twelve pairs of setae” is conditional.

We endorse the doubt expressed by Aoki (1973), with reference to the epimeric formulae: 2(?)–1–3–3. We determined: 3–1–3–3; but Mahunka (1986) established it as 2–1–3–2.

For us, the characteristics established by Aoki (1973) and Mahunka (1986), to define *Meriocepheus* as a new genus are not sufficient.

It is possible that many diagnostic characters are only specific and not generic. Our opinion, however, is not

definitive and some doubts exist pertaining to many aspects, with reference to the condition of material and variability found in the type material and number of specimens (only one).

Opisthocepheus kirai Aoki, 1975: In the original description by Aoki (1976, pp. 45–46), and the redescription by Mahunka, 1986 (p. 101), a mistake related to the different structures is evident. The latter author indicated the possible erroneous description of structures by Aoki (1975), but the description was reproduced, possibly without studying the type material.

We consider *Opisthocepheus kirai* a typical caraboid species with the full complement of prodorsal structures and setae; however, the elevated interlamellar process was initially mistaken for the lamella, with consequential inaccuracies related to prodorsal structures and setae (for example: mistaking interlamellar setae for lamellar setae, amongst others). However, we are in a new situation and previous considerations on the genus are to be discarded.

Bathocepheus concavus Aoki 1978: The original description (genus and type species; Aoki 1978, pp. 87–88) and the redescription by Mahunka (1986, p. 86) are both incomplete.

In the original description, the author considers that the genus *Bathocepheus* resembles the genus *Opisthocepheus*, but is distinguishable by the fused lamellae and the forward directed sensillus (Aoki 1978, pp. 87–88). Mahunka (1986, op.cit.) does not comment on these aspects. The characters suggested for use in distinguishing between *Opisthocepheus* and *Bathocepheus* are of no value, given the erroneous naming of structures when defining *Opisthocepheus kirai* (see above).

Acknowledgements

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