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Revision of the family Carabodidae (Acari: Oribatida) V (Fifth part). Redescription of *Congocepheus latilamellatus* Mahunka 1984, with complementary studies of *C. ornatus*, Mahunka 1983. Descriptions of *Tanzaniacepheus* gen. nov. and *Zimbabwecepheus* gen. nov.

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Abstract

Redescription of *Congocepheus latilamellatus*, with complementary studies of *Congocepheus ornatus*. *Congocepheus latilamellatus* is a senior synonym of *C. ornatus.* Two new genera, *Tanzaniacepheus* and *Zimbabwecepheus* are described with type species *Tanzaniacepheus ornatus* n. comb. and *Zimbabwecepheus maidii* **gen. nov., sp. nov.**

Key words: taxonomy, morphology, synonymy, new genus

Introduction

In part I of our study on the genus *Congocepheus*, Fernandez *et al*. 2016a, the authors noted that, along with type specimens of *Congocepheus ornatus* Mahunka, 1983, specimens of *Congocepheus latilamellatus* Mahunka, 1984 and *Congocepheus velatus* Mahunka, 1986 were studied in order to establish their position in the genus.

As we progressed it became evident that a redescription of *C. latilamellatus* and complementary studies of C. *ornatus* were vital in order to understand the taxonomy of these two species. Complications that arose on commencement of type material studies included: 1) observations used in original descriptions were made by use of optical microscopy only; 2) type material had previously been treated for studies, and presented variable grades of transparency, in some instances rendering observations nearly impossible; 3) several original descriptions contained errors in text, and some drawings were simplified to the point of being confusing.

The authors have studied all known species of the genus *Congocepheus* (Fernandez, Theron, Leiva 2016a; Fernandez, Theron, Leiva 2016b; Fernandez, Theron, Rollard. 2013a; Fernandez, Theron, Rollard, Tiedt. 2013b; Fernandez, Theron, Rollard, Rodrigo Castillo 2014c), except for *Congocepheus taurus* Balogh 1961, for which only the original description is available, as type material is unavailable for study.

The problematic taxonomy of *Congocepheus* was detailed in Fernandez *et al*. 2016a but the assignation of *C. latilamellatus, C. velatus and C. ornatus* had been hitherto unresolved, despite having studied the type material (Fernandez *et al.* 2014). Numerous other specimens were subsequently obtained from the Natural History Museum, Geneva, Switzerland (NHMG) and the Museum National d'Histoire Naturelles in Paris, France (MNHN), which included specimens of *Congocepheus* and related genera. This additional material encouraged us to again attempt to resolve the complex taxonomy of this genus. Two questions had to be answered: 1) are *C. ornatus* and *C.*

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latilamellatus the same, or different species? 2) should *C. ornatus*, *C. latilamellatus* and *C. velatus* be assigned to the genus *Congocepheus*? However, first we needed to establish if these were indeed different species.

Newly described *Zimbabwecepheus maidii* **gen. nov., sp. nov.** is related to *Tanzaniacepheus*. The application of both Optical and SEM-microscopy was vital for clarification and understanding of several aspects of these genera. This paper includes a discussion highlighting the problems related to genus and species descriptions, possible errors in texts and illustrations, and confusion of genera and species. (See discussion).

Materials and methods

The techniques used in the light and SEM investigations of the examined specimens follow those proposed by Fernandez *et al.* (2016b). SEM observations were made at the Laboratory for Electron Microscopy, North-West University Potchefstroom Campus, South Africa, with Scanning Electron Microscope FEI-Quanta Feg 250 (Hillsboro, Oregon, USA); with 10 Kv and working distant (WD) variable. Measurements taken: total length (tip of rostrum to posterior edge of notogaster); width (widest part of notogaster) in micrometers (μm).

Leg chaetotaxy studies using standard, polarized and phase contrast microscopes are provisional, due to the fact that only adult specimens were available for study. Setal formulae of the legs include the number of solenidia (in parentheses); tarsal setal formulae include the famulus (ε). A decision was made, for studies of *C. ornatus* and *C. latilamellatus*, to draw only problematic or poorly understood zones. Original descriptions and original drawings were used wherever possible in order to avoid redundancy.

Morphological terminology. Morphological terms and abbreviations used are those developed by F. Grandjean (1928–1974) (cf. Travé & Vachon, 1975; Norton & Behan-Pelletier (*in* Krantz & Walker 2009); Fernandez *et al*. 2013; 2013 a, b, c; 2014). For setal types Evans 1992:73 was used.

Institutions. Muséum National d'Histoire Naturelle, Paris, France (MNHN); Muséum d'Histoire Naturelles, Genève (MHNG).

Redescriptions of taxa

Type species *Congocepheus latilamellatus* Mahunka 1984
Original description: Mahunka 1984; 100–101, Figs. 8 A–C.

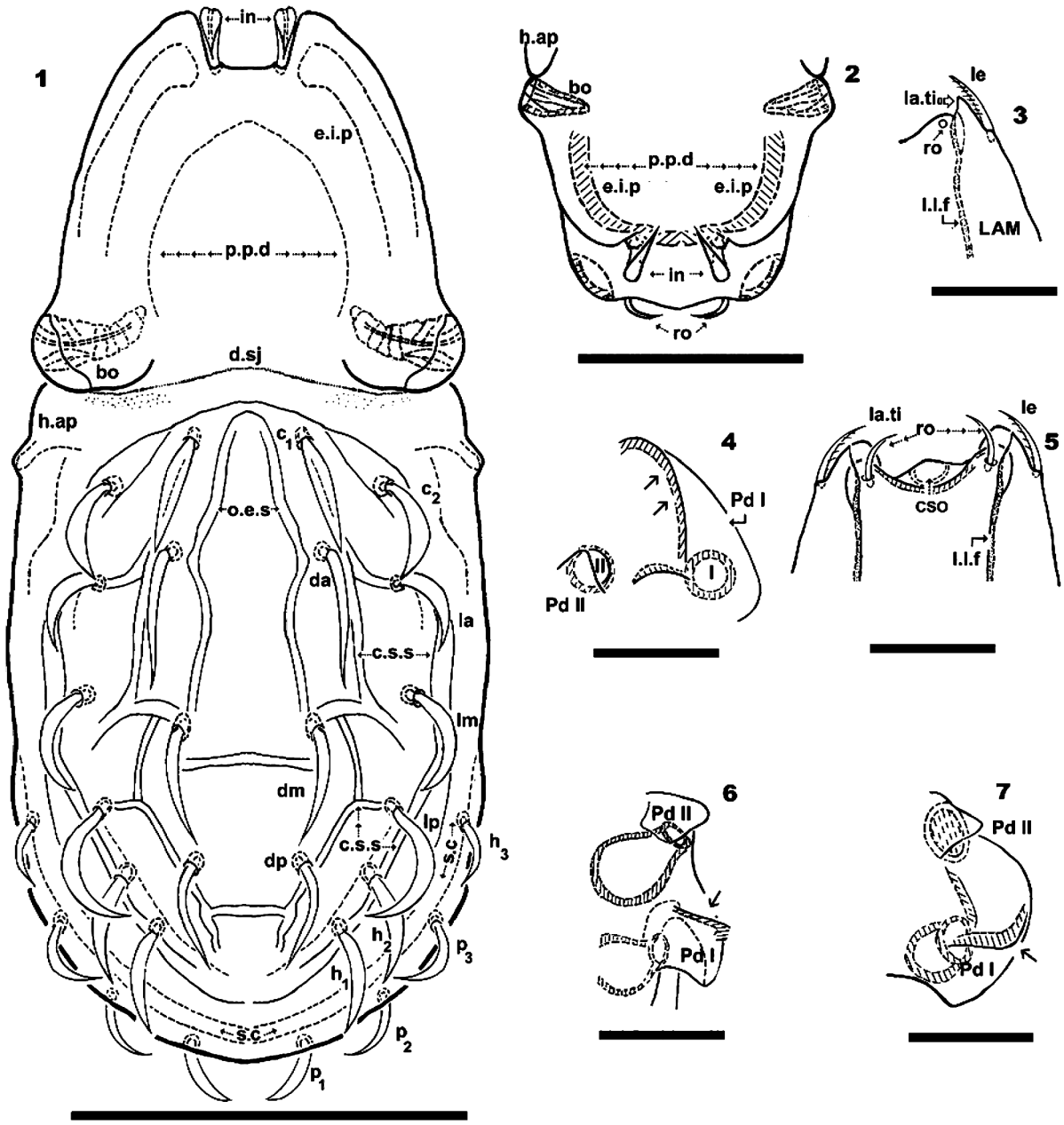
Material examined. Paratype: Tanzania–Kilimanjaro Afr. 178. Leg. Pócs Deposited: NHMG. According to Mahunka 1984 page 88:"Afr. 178. Tanzania, Mts. Kilimanjaro, 2850 mts. 19 September 1972. Leg. T. Pócs. Berlese sample from *Sphagnum* of *Erica arborea* wood, near Umbwe."

Redescription of adult

Diagnosis. *Setation*. *Lanceolate*: interlamellar, rostral, notogastral; *barbate*: lamellar; *simple*: epimeral, genital, aggenital and anal.

Prodorsum. Polyhedral (dorsal view); triangular with rounded superior zone (lateral view). Rounded elevated interlamellar process, divided in two; depressed posterior prodorsal zone; *ro* setae inserted at same level as *le* setae; forward directed, curving *in* setae inserted on elevated interlamellar process; *le* setae on apical lamellar zone; *ppd* observed. Lamellae running dorsolaterally, ending abruptly in sharp tips; shallow lamellar furrow demarcating inner lamellar paraxial margin.

Notogaster. Rectangular anterior zone posterior oval (dorsal view); convex in lateral view; *d.sj* narrow, curving slightly backwards; notogastral anterior depresion absent. Circumgastric depression clearly visible, situated at level of *lm*, h_3 setal insertion, running between *lm, lp,* h_2, h_1 and h_3, p_3, p_2, p_1 setae. Fourteen pairs of similarly shaped setae: c_1, c_2, *da, dm, dp, la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3; h_3, p_3, p_2, p_1 small. All setae directing backward. Cordlike structures forming complex, irregular network; long ovoid process situated in central zone. Humeral apophysis forming large elongate projection.



FIGURES 1–7. ***Congocepheus latilamellatus*** **Mahunka 1984**. Optical microscopy. 1. dorsal view; 2. anterior prodorsal zone, inclined; 3. anterior zone of lamellae; 4. pedotecta I and II, lateral view; 5. anterior zone of prodorsum, inclined to posterior; 6. pedotecta I–II, anteroposterior view; 7. pedotecta I–II, with a large degree of inclination, anteroposterior view. Abbreviations: see Material and Methods. Scale bars: 1 = 175 μm; 2 = 110μm; 4, 5, 6, 7 = 30μm.

Tutorium: strongly curved cuticular thickening, with irregular small depressions; supratutorial depression deep; anterior tutorial depression and posterior tutorial depressions pocket-shaped. Pedotectum I: prominent extended lamina. Pedotectum II: small triangular lamina, rounded edges. Between Pedotectum I and Pedotectum II, small pocket-shaped depression. Discidium clearly visible ventrally. Bothridium ovoid to polyhedral-shaped; bothridial opening laterally; bothridial ring smooth, incomplete, bothridial tooth present. Sensillus uncinate, arching to the top. Humeral apophysis ovoid to polyhedral. Lyrifissures not discernible. Several depressions clearly discernible behind anal opening and dorsoposterior to acetabulum IV. Sharp anal tip clearly visible.

Ventral region. Subcapitular setae not discernible. Epimera slightly elevated, delimited by shallow furrow. Epimeral chaetotaxy 3-1-3-3. Anterior genital furrow anterior to genital opening.

Resdescription **(adult female). Measurements**. Length 352 μm, width 198 μm.

Shape. Ovoid.

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

Cerotegument. Amorphous, remnants only, visible laterally behind legs.

Integument. Prodorsal microsculpture. *Smooth to slightly irregularly tuberculate*: visible on elevated interlamellar process (*e.i.p*); bothridium (*bo*), lateral lamellar zone, tutorial margin. *Smooth*: bothridial ring (Figure 8). Notogastral microsculpture. *Puncticulate*: zone near dorsal dorsosejugal furrow; *tuberculate*: humeral apophysis (*h.ap*), notogaster (marginal zone). On notogastral surface, particular, irregularly-shaped cordlike structures (*c.s.s*) (indicated by5, Figures 1, 8), forming a complex network, extending to the setal insertion zone. On the central notogastral zone, *c.s.s* delimiting an ovoid elongate structure (*o.e.s*) (Figure 1). Ventral microsculpture. Slightly tuberculate: epimeral zone (hardly discernible), genital and anal plate; puncticulate: around genital and anal openings (Figure 8).

Setation. *Lanceolate*: interlamellar, rostral, notogastral (broad *in* setae); *barbate*: lamellar; *simple*: epimeral, genital, aggenital and anal.

Prodorsum. Polyhedral in dorsal view (Figure 1); triangular with rounded superior zone in lateral view (Figure 8); interlamellar process (*e.i.p*) divided into two elevated rounded (Figure 8) more or less triangular processes (in dorsal view) (Figure 1). Depressed posterior prodorsal zone (*p.p.d*) clearly discernible. Three pairs of setae; sized *in* > *le* > *ro* (Figures 2, 3, 5, 8), *ro* setae inserted at same level as *le* setae (Figures 5, 8) directing forward and converging, but apical tips not touching (Figures 5, 8); curved *in* setae, directing forward, inserted on internal side of *e.i.p* where it has split in two; *le* setae laterally on lamellar tip (Figure 8). Rostral margin rounded. Lamellae running dorsolaterally, terminating in a small sharp lamellar tip (*la.ti*) (Figure 5); shallow furrow (*l.l.f*) (Figures 3, 5) demarcating inner paraxial margin. CSO present (Figure 5).

Notogaster. In dorsal view anterior rectangular and posterior oval (Figure 1); in lateral view, convex (Figure 8); *d.sj* narrow, curving slightly backwards, well delimited (Figure 1); *n.a.d* absent. Circumgastric depression (*s.c*), clearly visible on lateral and posterior zones; originating at level of *lm*, h_3 setal insertions and running between *lm, lp* ,h_2, h_1 and h_3, p_3, p_2, p_1 setae (Figure 1). Fourteen pairs of similar setae: c_1, c_2, *da, dm, dp, la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3, but h_3, p_3, p_2, p_1 small (Figure 1); all setae directing backward. Series of irregular *c.s.s* in central zone converging to form an ovoid elongate structure (*o.e.s*) (Figure 1 indicated by 5). Externally to *o.e.s* complex irregular network of *c.s.s* (Figure 1). Very long, clearly visible large elongate projection of humeral apophysis (*h.ap*) resulting in characteristic shape of anterior notogastral zone (Figure 8).

Lateral region (Figure 8). Prodorsum: rounded elevated *e.i.p*. Clearly visible curving, backwards directing *in* setae (Figure 8). *Lam* easily discernible, terminating in a small pointed lamellar tip (*la.ti*), inner zone of *la.ti* demarcated by shallow lamellar furrow (*l.l.f*) (Figure 5); *le* setae situated laterally on *la.ti* (Figure 5); *tu* strongly curving cuticular thickening, with irregular margin and small depressions; deep supra tutorial depression (*s.tu.d*); *a.tu.d* and *p.tu.d* pocket-shaped depressions present; ovoid posterior depression (*p.tu.d*) (Figure 8) on posterior zone *tu* and close to *Pd I*.

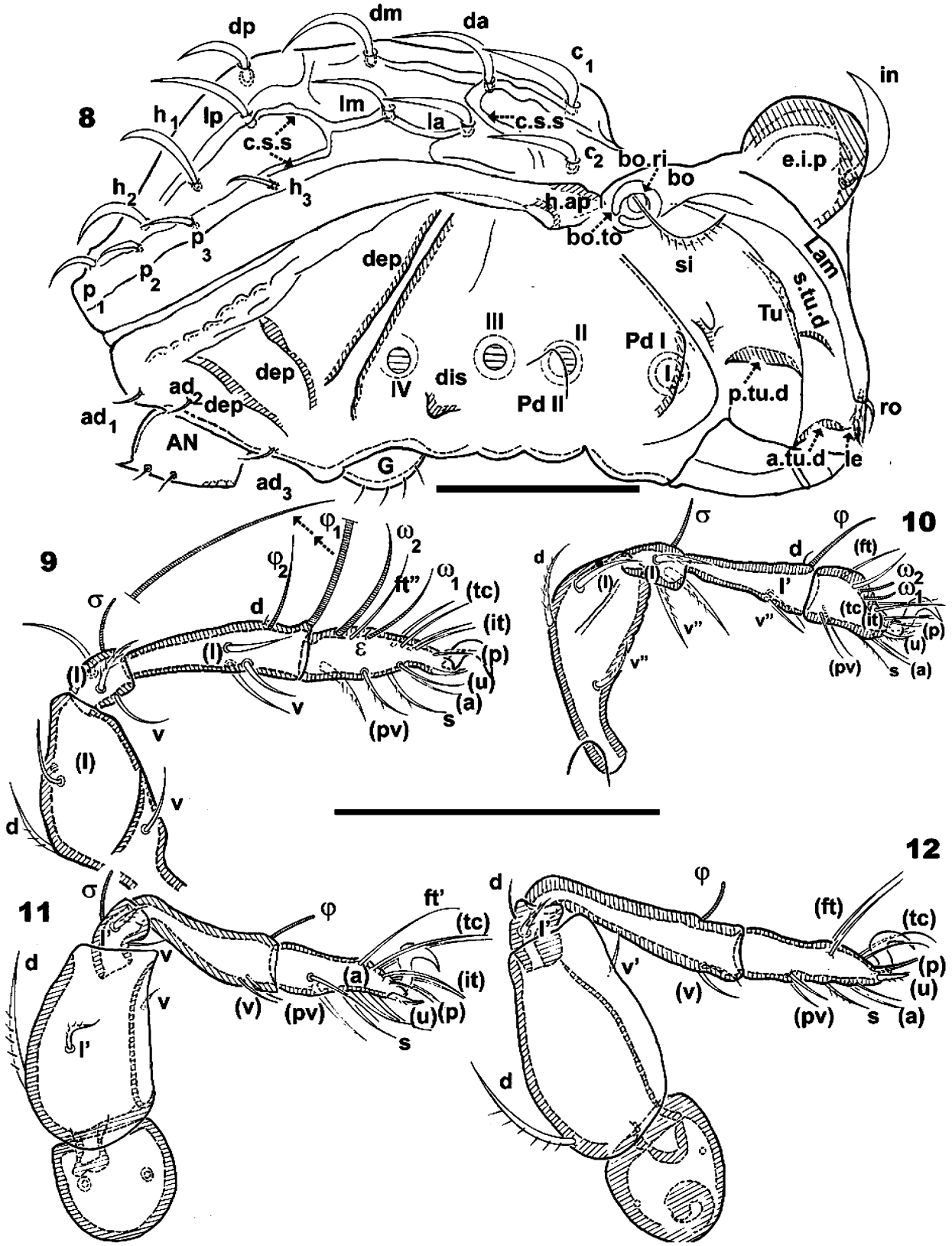
Pd I: prominent extended lamina covering acetabulum I. Also present on *Pd I*, an oblique cuticular thickening which must be observed from various angles in order to correctly determine the shape (Figures 3, 6, 7). *Pd II*: small triangular lamina, rounded edges. Discidium (*dis*) situated slightly inwards and ventrally (Figure 8), for this reason hardly discernible in lateral view. Bothridium ovoid to polyhedral (Figure 8); lateral bothridial opening; bothridial ring (*bo. ri*) clearly visible, smooth, incomplete; *bo.to* present (Figure 8).

Sensillus uncinate, arching to the top, tips usually pointed, more coarsely barbed on lateral edge. Humeral apophysis (*h.ap*) ovoid to polyhedral; basally slightly curved; upper tip overlapping posterior bothridial part (Figure 8). Lyrifissures not discernible. Several depressions (*dep*) clearly visible behind anal opening and dorsoposterior to acetabulum IV. Clearly visible sharp anal tip.

Ventral region (compare to Figure 8B, Mahunka 1984: 100). Lamellar setae (*le*) visible on apical lamellar zone. Subcapitular setae not discernible. Epimera slightly elevated, delimited by shallow furrow (*bo.1, bo.2, bo.sj, bo.3*). Epimeral chaetotaxy 3-1-3-3. Epimeral setae *1a, 1c, 2a, 3a*, smaller, other setae *1b, 3b, 4a, 4b, 4c*, medium length, similar to *ag* and *ad* setae. All setae are simple.

Pd I with cuticular thickening. *Pd II* triangular, rounded tip, discidium triangular to rectangular in shape; anterior genital furrow (*a.g.f*) clearly discernible, situated anterior to genital opening. Genital plate more or less rectangular, four pairs of genital setae. Anal plate more or less ovoid, two pairs of small anal setae; anal plate sharply tipped. Three pairs of adanal setae. Between genital and anal plates, rounded depression (*dep*); two

elongated depressions (*dep*) laterally to anal plate; ovoid depression (*dep*) laterally to *ag* setae, other small depressions situated marginally to ventral plate (*dep*).



FIGURES 8–12. ***Congocepheus latilamellatus*** **Mahunka 1984**. Optical microscopy. 8. adult female, lateral view; 9. leg I, antiaxial view; 10. leg II, antiaxial; 11. leg III, antiaxial; 12. leg IV antiaxial. Abbreviations: see Material and Methods. Scale bars: 8 = 65 μm; 9–12 = 100μm.

Legs (Figures 9, 10, 11, 12; Table I). All legs monodactyle. Setal formulae I (1-4-3-4-15-1) (1-2-2); II (1-4-3-3-14-1) (1-1-2), III (2-3-2-2-14-1)(1-1-0); IV (1-2-2-2-13-1) (0-1-0). See Table I.

TABLE I. Setae and solenidia ***Congocepheus latilamellatus***

Leg I	Femur	Genu	Tibia	Tarsus	Claw
setae	d,(l),v"	(l),v	d,(l),v"	ε,ft",(tc),(it)(p),(u),(a),s,(pv)	1
solenidia		σ	φ_1 , φ_2	ω_1,ω_2	
Leg II					
setae	d,(l),v"	(l),v"	d,l', v"	(u),(a),s,(pv),(p),(it),(tc),(ft)	1
solenidia		σ	φ	ω_1,ω_2	
Leg III					
setae	d,v,l'	l',v	(v)	(u),(a),s,(pv),(p),(it),(tc),ft'	1
solenidia		σ	φ	-	
Leg IV					
setae	d,v'	d,l'	(v)	(p)(tc),(ft),(u),(a),s,(pv)	1
solenidia			φ		

Complementary descriptions of taxa

Type species *Congocepheus ornatus,* Mahunka 1983

Only characters not indicated by Mahunka 1983 page 168 or included on Figures 59–63 of Mahunka 1983 will be provided in order to avoid reduncancy (see below).

Material examined. Paratypes: 2 (male, female). The original sample tube included the following four labels: "*Carabodes ornatus* **sp. n**"; "*Congocepheus ornatus* rev. Mah,. 1983"; "det. S. Mahunka"; "Tanzania 1972. Leg. T. Pócs ." Deposited in MHNG.

Regarding the type material, Mahunka 1983 indicated on page 168: "Holotypus (726 HO-82): Afr.175: Tanzania; 25 paratypes: from the same sample; 2 paratypes: Afr.178: Tanzania; Holotypus and 4 paratypes (726-PO-82) deposited in the Hungarian Natural History Museum Budapest; 2 paratypes in the Museum d'Histoire Naturelle, Geneve."

Complementary diagnosis. Measurements. Female: length 382 µm, width: 189µm. Male: length 360 µm; width 175 µm.

Shape. Ovoid

Colour. Specimens without cerotegumental layer, light brown, slightly shiny when observed in reflected light.

Setation. *Lanceolate*: interlamellar, rostral, notogastral (Figure 13); *barbate*: lamellar (Figure 13); *simple*: epimeral, genital, aggenital and anal (Figure 14).

Prodorsum. Figure 59 of Mahunka 1983: 169, generally corresponds to our observations. Additional to the original description: Polyhedral in shape (dorsal view); triangular, with rounded superior zone (*e.i.p*) (Figure 13) in lateral view. Interlamellar process (*e.i.p*) divided into two rounded elevated processes. Posterior prodorsal zone depressed (*p.p.d*). Three pairs of setae; sized *in* > *le* > *ro* (Figure 13). Setae *ro* inserted more or less at same level as *le* setae (Figure 13); directed laterally and converging; apical tips not touching; *in* setae inserted on internal side of *e.i.p,* curved and directing forward (Figure 13); *le* setae on lamellar anterior zone, slightly posterolateral to *la.ti*. Rostral margin concave. Lamellae running dorsolaterally, terminating in large lamellar tip (*la.ti*); clearly visible shallow furrow (*l.l.f*) demarcating paraxial margin of lamellae.

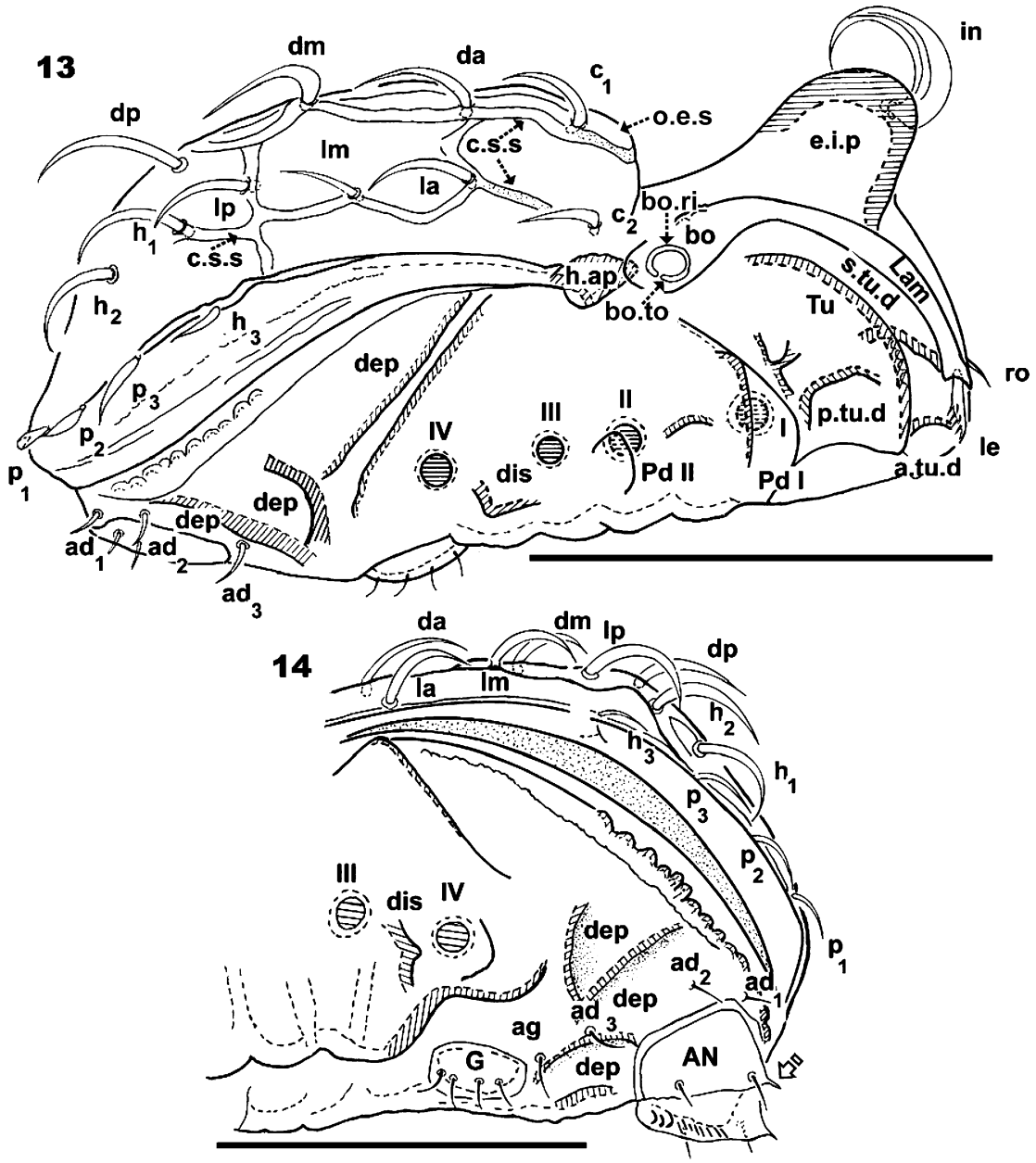
Notogaster. Figure 59 of Mahunka 1983 generally corresponds to our observations, however the accompanying text is simplified, stating only "Notogaster with a strong chitinised polygonal structure." ¨

Additional to the original description: Shape: in dorsal view anterior rectangular and posterior oval; convex in lateral view; *d.sj* narrow, slightly forward curving, well delimited; *n.a.d* not present. Circumgastric depression (*s.c*) clearly visible. Fourteen pairs of similarly shaped setae: c_1, c_2, *da, dm, dp, la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3, but h_3, p_3,

p_2, p_1 small (Figure 13), all setae directing backward. Series of irregular *c.s.s* in central zone converging to form a long ovoid process (*o.e.s*). Irregular network formed by *c.s.s* externally to *o.e.s* (Figure 13).

Lateral region (Figures 13, 14). Prodorsum: rounded elevated *e.i.p*. Setae *in* clearly visible, curved, directing backwards; inner zone of *la.ti* demarcated by shallow lamellar furrow (*l.l.f)*; setae *le* situated laterally on *la.ti*; *tu* strongly curved cuticular thickening; deep supra tutorial depression (*s.tu.d*); *a.tu.d* and *p.tu.d* pocket-shaped depressions present; open ovoid posterior depression (*p.tu.d*) in posterior zone *tu* close to *Pd I*.

Pd I: prominent extended lamina, with oblique anterior cuticular thickening. Observations from various angles are necessary to fully understand the shape of the oblique cuticular thickening (similar to Figures 4, 6, 7 of *C. latilamellatus*). *Pd II* medium sized triangular lamina, rounded edges. Triangular discidium (*dis*) clearly discernible. Bothridium ovoid; lateral bothridial opening; bothridial ring (*bo.ri*) clearly discernable, smooth, incomplete. Sensillus uncinate. Ovoid to polyhedral humeral apophysis (*h.ap*), basally slightly curved, upper tip overlapping posterior bothridial part. Lyrifissures not discernible. Several depressions (*dep*) clearly visible behind anal opening and doroposterior to acetabulum IV (Figure 14). Sharp anal tip clearly visible.



FIGURES 13–14. ***Congocepheus ornatus*** **Mahunka 1983.** Adult female. Optical microscopy. 13. lateral view; 14. posterior view, inclined to ventral. Abbreviations: see Material and Methods. Scale bars: 13 = 170 μm; 14 = 150 μm.

Ventral region (Figure 14). Figure 14 in posterior inclined to ventral view is supplied in order to show observations lacking in Mahunka 1983 Figure 61, page 169. In text, Mahunka supplied characters common to the majority of *Congocepheus* and related genera.

Additional: Epimera slightly elevated, delimited by shallow furrow (*bo.1, bo.2, bo.sj, bo.3*). Epimeral chaetotaxy 3-1-3-3. Epimeral setae *1a, 2a, 3a* smaller than other epimeral setae, which are medium length, similar to *ag* and *ad* setae. All setae are simple. *Pd I* with clearly visible cuticular thickening. *Pd II*: triangular with rounded tip, discidium triangular; easily discernible anterior genital furrow (*a.g.f*) situated anterior to genital opening. Genital plate more or less rectangular; anal plate more or less polyhedral with two pairs of small anal setae; anal plate sharply tipped. Between genital and anal plates, rounded depression (*dep*); two elongated depressions (*dep*) laterally to anal plate; ovoid depression (*dep*) laterally to *ag* setae.

Legs. Exactly the same characteristics as in *C. latilamellatus* (Figures 9, 10, 11, 12).

Congocepheus velatus Mahunka 1986:

Material examined. Paratype**:** Tanzania, W Usambara mts., Matundsi-mashidei ridge at 1300 m alt. 04.02.1985. Sumbmontane rain forest of the rocky Matundsi-Mashindei ridge, SW of Ambangulu Tea Estate. Berlese-funnel sample consisting of mass of fallen epiphytes. Leg.l.PEREGOVITS. The material is deposited in MHNG.

The description by Mahunka in 1986 corresponds to material studied by the authors. Using the supplied text and figures it was possible to identify *C. velatus* without any difficulty, therefore a redescription is unnecessary. Mahunka 1986 stated: "Finally, *C. velatus* has 13 pairs of notogastral setae". The 13 pairs of setae are correctly described and the regression of setae c_2 is confirmed. Additional: Prodorsum with presence of *p.p.d*.

New taxon descriptions

Tanzaniacepheus gen. nov.

Etymology. The generic prefix refers to Tanzania, the country where type material was collected.

Diagnosis (adult female). Body shape ovoid.

Prodorsum. Elevated interlamellar process divided in two; interlamellar setae situated on elevated interlamellar process; lamellar setae situated laterally on apical zone of lamella, setae generally barbate. Lamellar apical tip small, sharp. Rostral setae present. Prodorsal posterior depression present. Bothridium with bothridial ring more or less visible; commonly with bothridial tooth.

Notogaster. Notogastral anterior depression absent; 13 to 14 pairs of setae. Regression, if present, involving setae *c*. Notogastral setae directing backward. Notogaster mostly ovoid, slightly elevated in lateral view. Dorsal microsculpture: cord-shaped irregular-polygonal network.

Lateral zone. Tutorium well developed; supratutorial depression present, with various types of other depressions (anterior, posterior or numerous), all pocket-shaped. *Pd I*, *II*, discidium present.

Ventral region. Epimeres 1, 2 and 3, 4 unfused. Epimeral formulae generally 3-1-3-3. Anterior genital furrow present, more or less noticeable. Four pairs of genital setae; aggenital setae present. Three pairs of adanal setae; two pairs of anal setae. Lyrifissure *iad* generally visible. Several depressed areas at level of genital and anal openings or between them. Anal plate sharply tipped.

Type species: *Tanzaniacepheus ornatus* (Mahunka 1983) **nov. comb**.

Other species: *Tanzaniacepheus velatus* (Mahunka 1984). **nov. comb**.

Zimbabwecepheus gen. nov.

Etymology. The specific epithet is derived from Zimbabwe, the country where the type material was collected.

Diagnosis (adult female). Body ovoid. Fourteen pairs of setae: c_1, c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2, h_3, p_1, p_2, p_3; c_2 setae directing laterally to medial zone; other setae directing backwards; all setae more or less similar length.

Interlamellar process slightly elevated, undivided; large anteriorly situated setae *in*, directed forward, curving backward; small, clearly visible *ro* setae, curving, directed to medial zone; serrate *le*, dentitons small; *ro* setal insertion at same level as *le* setal insertion. Sensillus uncinate. Well defined, smooth bothridial ring with bothridial tooth. Lamellae running laterally; lamellar tip truncated; shallow lamellar furrow not discernible, prodorsal posterior depression, narrow. Anterior notogastral zone polyhedral, posterior oval. Lateral view: notogastral anterior depression absent; humeral apophysis easily discernible. Deep supratutorial depression, large pocket-shaped depression present. *Pd I* prominent extended lamina. *Pd II* small ovoid lamina; discidium clearly discernible. Slightly elevated epimeral delimited by shallow furrow.

Epimera 3–4 fused. Epimeral chaetotaxy 3-1-3-3. Aggenital furrow well visible. Genital plate small relative to anal plate; four pairs of genital setae in a simple line; aggenital setae situated posterior to genital opening. Three pairs of adanal setae; ad_3 far from *ag* setae. Sharply tipped polyhedral anal plate. Two pairs of anal setae. Lyrifissures *iad* situated laterally between ad_3 and ad_2. Depressions clearly visible.

***Zimbabwecepheus maidii* gen. nov., sp. nov.**
(Figs.15–50)

Etymology. The specific epithet is dedicated to Mrs Maidi Lili Schroetlin Beling, Paraguayan plastic artist, who managed to survive in a harsh world, and was respected for her qualities and remarkable work. Exceptional wife, inseparable companion, recently passed away.

Material examined. Holotype Female. "Zimbabwe Umtali. II.1969. LEG R.MUSSARD; material deposited in the Collection of the MHNG; preserved in 70% ethanol". (Umtali is now Mutare, Zimbabwe). **Two Paratype** adult females, same locality and date as Holotype; deposited in Collection of MHNG; preserved in 70 % ethanol. Material studied with SEM: three specimens, not deposited.

Diagnosis. *Prodorsum.* Trapezoidal; slightly elevated interlamellar process; large, anteriorly situated setae *in* initially directing forward, but then curving backward; *in* setae inserted antiaxially to medial plane, slightly internally to *ro* insertion level; *ro* setae curved, directing to medial zone; apical tips distanced from each other; sensillus uncinate. Smooth bothridial ring with bothridial tooth; lamellar tip not observed; lamellar furrow not discernible.

Notogaster. In dorsal view, anterior polyedral and posterior oval; convex in lateral view; *d.sj* narrow, slightly rectilinear; notogastral anterior depression absent.

Fourteen pairs of setae: c_1, c_2, *da, dm, dp, la, lm, lp,* h_1, h_2, h_3, p_1, p_2, p_3; c_2 setae directing laterally to medial zone; other setae directing backwards; all setae more or less similar length. Circumgastric depression clearly visible anterior to p_1, p_2, p_3, h_3 setae. Easily observed humeral apophysis; excavated V-shaped depression present.

Lateral region. Truncated lamellar tips; tutorium (*tu*) a prominent lamina with curving margin. Bothridium cup-shaped, opening directing downwards.

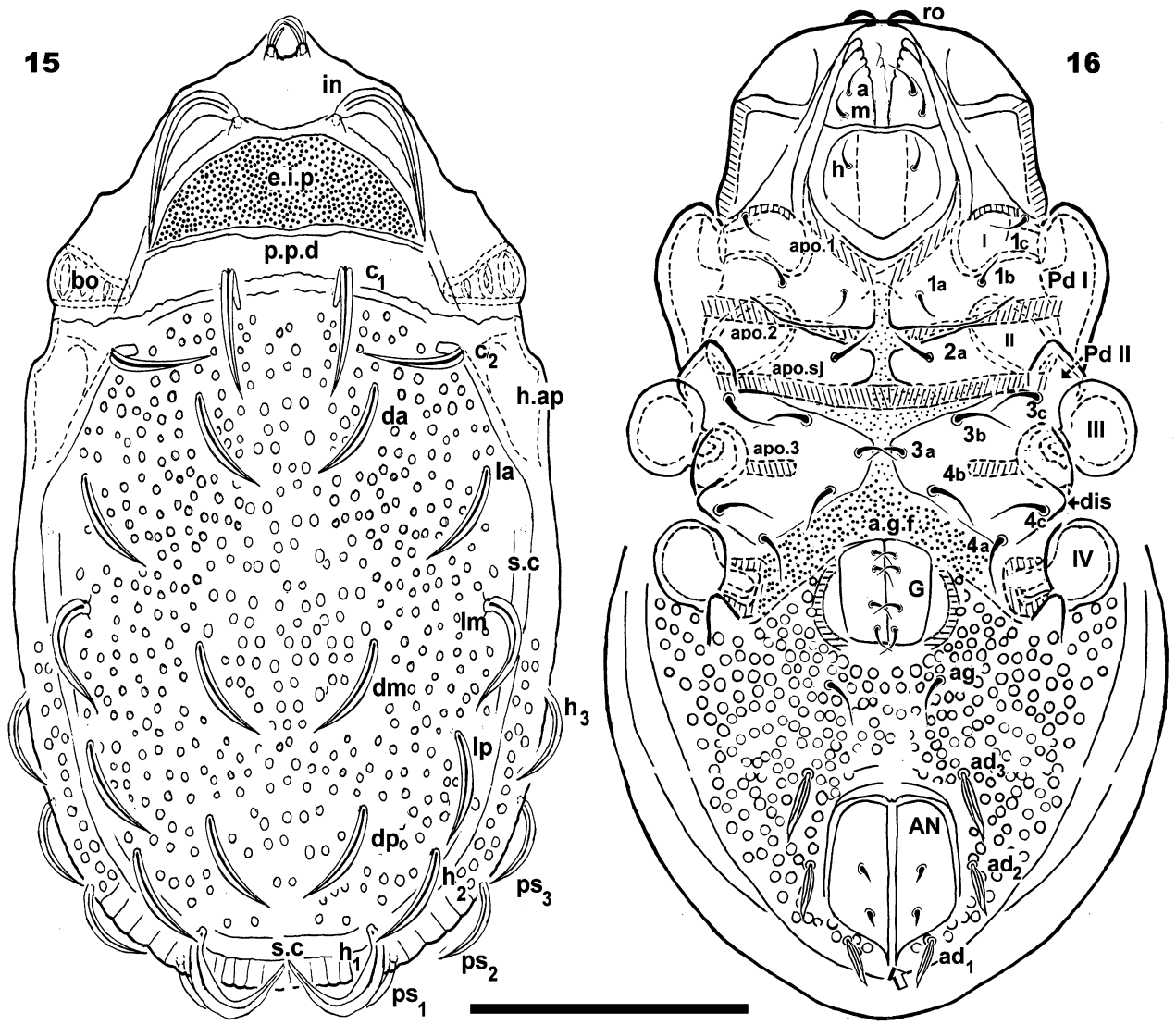
Ventral region. Slightly elevated epimera delimited by shallow furrow. Epimera 3–4 fused, epimeral chaetotaxy 3-1-3-3. Genital plate small relative to anal plate; four pairs of genital setae present in a simple line; all setae of more or less equal length. Aggenital setae observed posterior to genital opening. Three pairs of adanal seta; ad_3 distanced from *ag* setae. Clearly visible lyrifissures *iad* situated laterally and between ad_3 and ad_2.

Description. Measurements. SEM 528 μm (539–519) x 228 μm (223–231) (measurements on three specimens). Light microscopy: 536 μm (542–534) x 301 μm (297–305).

Shape. Elongate oval (Figures 15–17).

Colour: Specimens without cerotegument, light brown to brown when observed in reflected light.

Cerotegument. Present: consistently thick layer with adhering soil particles, present all over body, femora I, II, and trochanter and femora III, IV. *Rugous*: prodorsum, anterior notogastral zone; c_1, c_2 setae insertion zones (Figure 17) and femora I, II and trochanter and femora III, IV; tuberculate rugous-porous: notogaster behind c_1, c_2 setal insertions (Figure 17), *h.ap*; amorphous: subcapitular zone surrounding *h* setae, epimeral zone, genital and anal plates (39–42). Absent: anterolateral border of lamellae (*Lam*) (Figure 31), bothridial ring (*bo.ri*) (Figure 31), anterior subcapitular zone (Figure 36); tibiae and tarsi (Figures 45, 46); posterior zone of femur I and posterior superior zone of femur II (Figure 45, 46).



FIGURES 15–16. ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.** Adult female. Optical microscopy. 15. dorsal view; 16. ventral view. Abbreviations: see Material and Methods. Scale bars: 15–16 = 190 μm.

Setation. Elongate lanceolate with two elevated medial veins: *ro*, *in* (Figure 24); elongate lanceolate with one elevated medial vein: notogastral setae (Figure 27); ad setae (Figure 26); both sides serrate, finely dentate: *le* setae (Figures 19, 20, 22)(observations from different angles were necessary to understand the shape and characteristics of these setae); flabellate: *ge* (Figures 42, 43), *ag* (figure 44); barbate: epimeral (Figure 38); simple: subcapitular (Figure 36), anal (Figure 39).

Prodorsum. Trapezoidal in dorsal view (Figures 15, 17), slightly convex in lateral view (Figure 28), trapezoidal in frontal view (Figure 30). slightly elevated interlamellar process (*e.i.p*) (Figure 28); setae *in* situated anteriorly on *e.i.p*; large twisting *in* setae, initially directing forward, but later curving backward; *in* setae inserted antiaxially to medial plane and slightly internally to *ro* insertion level (Figure 30); clearly visible *ro* setae, curved, directing to medial zone; apical tips distanced from one another (Figures 18, 30); *le* setae laterally (Figures 19, 20, 33); *ro* setal insertion at same level as *le* setal insertion. Sensillus (*si*) uncinate (Figure 31). Smooth, well defined bothridial ring (*bo.ri*) with bothridial tooth (Figure 31); *p.p.d* narrow, clearly visible. Rostral margin rounded to hexagonal (Figure 30). Lamellae running laterally; lamellar tips absent.

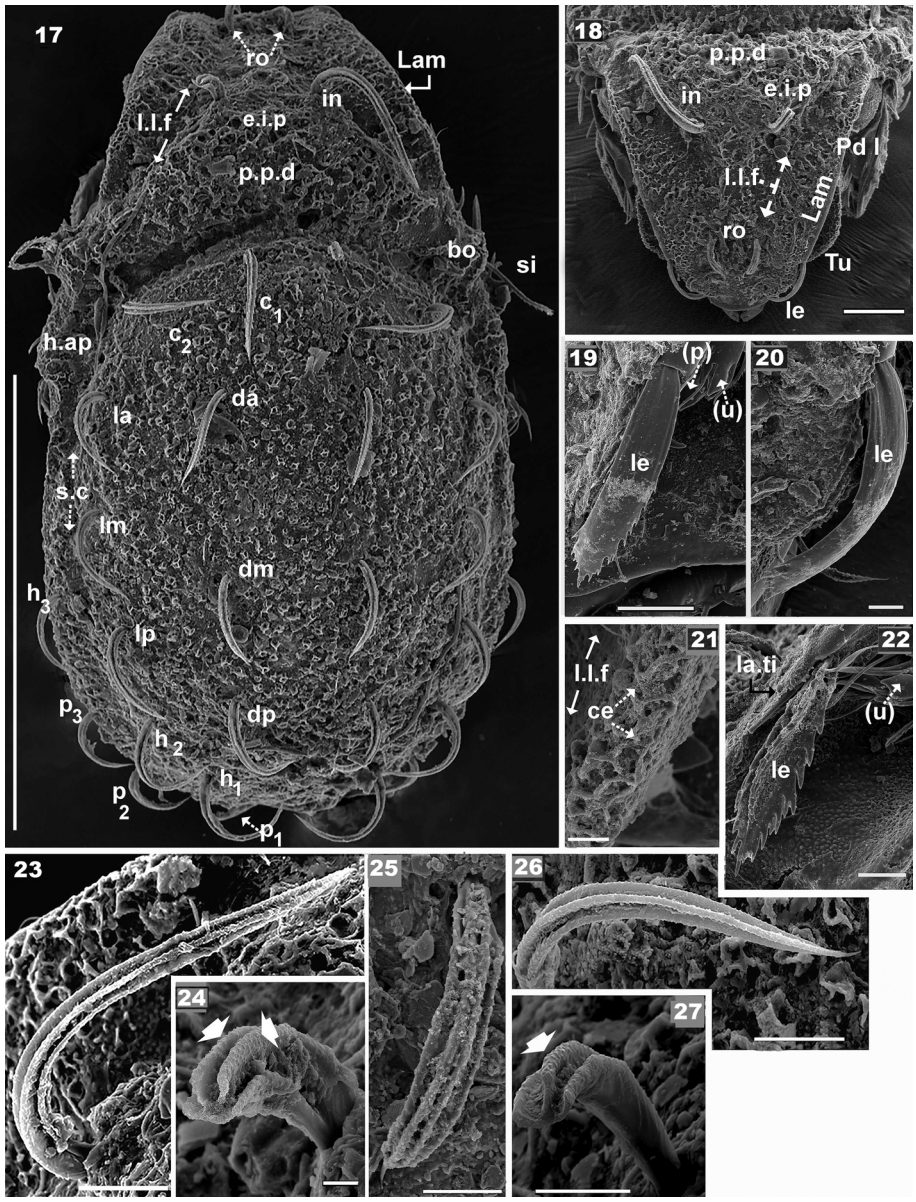
Notogaster. Shape: in dorsal view anterior part polyedral and posterior part oval (Figures 15, 17); convex in lateral view (Figure 28); *d.sj* narrow, curving slightly, well delimited; notogastral anterior depression (*n.a.d*) not present.

Fourteen pairs of setae: c_1, c_2, *da*, *dm*, *dp*, *la*, *lm*, *lp*, h_1, h_2, h_3, p_1, p_2, p_3; c_2 setae directed laterally to medial zone

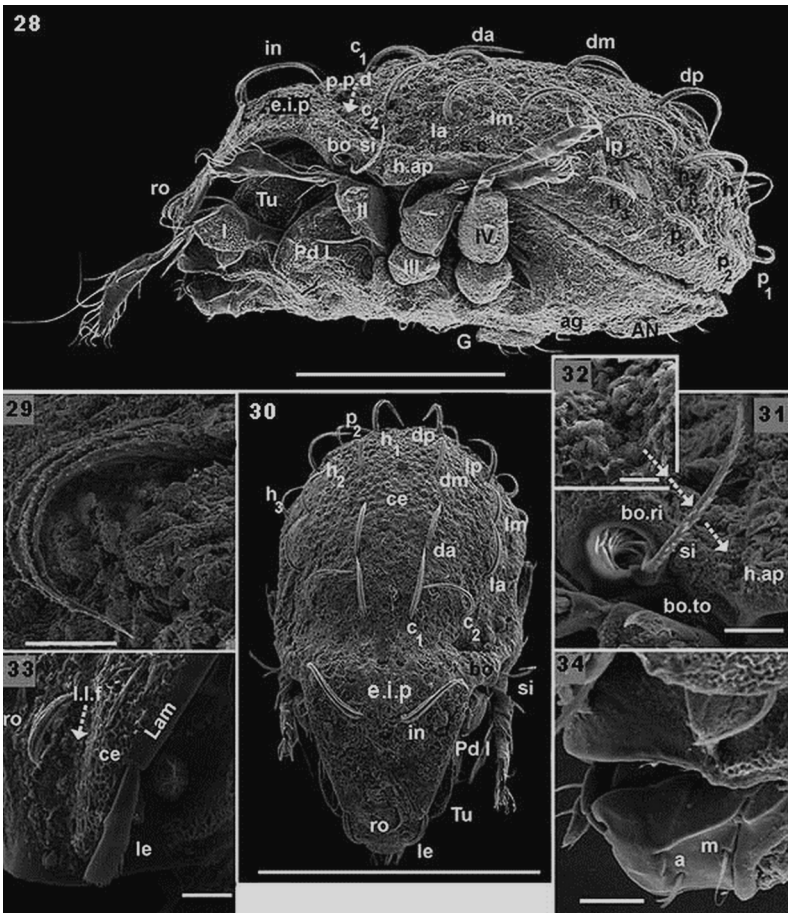
(Figures 15, 17, 30); other setae directing backward (Figures 15, 17), all seate more or less the same length. Easily discernible circumgastric depression (*s.c*) observed in notogastral posterior part, in front of p_1, p_2, p_3, h_3 setae (Figures 15, 17). Humeral apophysis (*h.ap*) easily visible (Figures 28, 31); excavated V-shaped depression present (Figure 28).

Lateral region (Figure 28). Lamellae (*lam*) with truncated tips clearly discernible. Tutorium (*tu*): a prominent lamina, margin curved (Figure 28). Deep supratutorial depression (*s.tu.d*) running parallel to and between lamellae and tutorium; large pocket-shaped depression (*a.tu.d*) in anterior position. *Pedotectum I*, prominent extended lamina covering acetabulum I, rounded apex. *Pd II* small, ovoid lamina; small, triangular discidium (*dis*) visible, rounded apex.

Cup-shaped bothridia; bothridial opening directing downwards (Figures 28, 31); smooth bothridial ring (*bo.ri*), incomplete with bothridial tooth (*bo.to*) well discernible. Barbed, cylindrical sensillus, arching to the top (Figure 31). Long, extended humeral apophysis (*h.ap*), rounded apex, basally curved; anterior tip overlapping posterior bothridial part. Clearly observed large depression (*dep*) behind leg IV.



FIGURES 17–27. ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.** Adult female SEM. 17. dorsal view; 18. frontal view; 19. apical zone, lamella with *le* seta; 20. *le* seta, dorsal view; 21. cerotegumental layer, lamellar zone; 22. *le* seta, dorsolateral view; 23. interlamellar seta; 24. interlamellar seta, broken, showing ridges; 25. rostral seta; 26. notogastral seta; 27. notogastral seta, broken, showing ridges. Abbreviations: see Material and Methods. Scale bars: 17 = 300 μm; 18 = 50 μm; 19 = 20 μm; 20 = 10 μm; 21 = 5 μm; 22 = 10 μm; 23 = 40 μm; 24 = 5 μm; 25 = 10 μm; 26 = 10 μm; 27 = 10 μm.



FIGURES 28–34. ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.. Adult female, SEM observations**. 28. lateral view; 29. notogastral setae; 30. frontal view; 31. bothridium and sensillus; 32. depressed zone of *h.ap*., higher magnification; 33. apical zone, prodorsum, showing *ro* and *le* setae; 34. subcapitulum apical zone. Abbreviations: see Material and Methods. Scale bars: 30 =400 μm; 28 = 170 μm; 31, 33, 34 = 20 μm; 29 = 10 μm; 32 = 5 μm.

TABLE II. Setae and solenidia ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.**

Leg I	Femur	Genu	Tibia	Tarsus	Claw
setae	d,l",v	l",v	v,l",d	(ft),ε,(tc),(it),(p),(u),(a),s,(pv)	1
solenidia		σ	φ_1,φ_2	ω_1,ω_2	
Leg II					
setae	dp,da,l,v	d,l',v	v,d,l"	(pv),s,(a),(u),(p),(it),(tc),(ft)	1
solenidia		σ	φ	ω_1,ω_2	
Leg III					
setae	d,l',v	l'	l",v	(pv),s,(a),(u),(p)(it),(tc),ft"	1
solenidia		σ	φ	-	
Leg IV					
setae	d,v	d,l'	l"(v)	(pv),s,(a),(u),(p),(tc),(ft)	1
solenidia		-	φ	-	

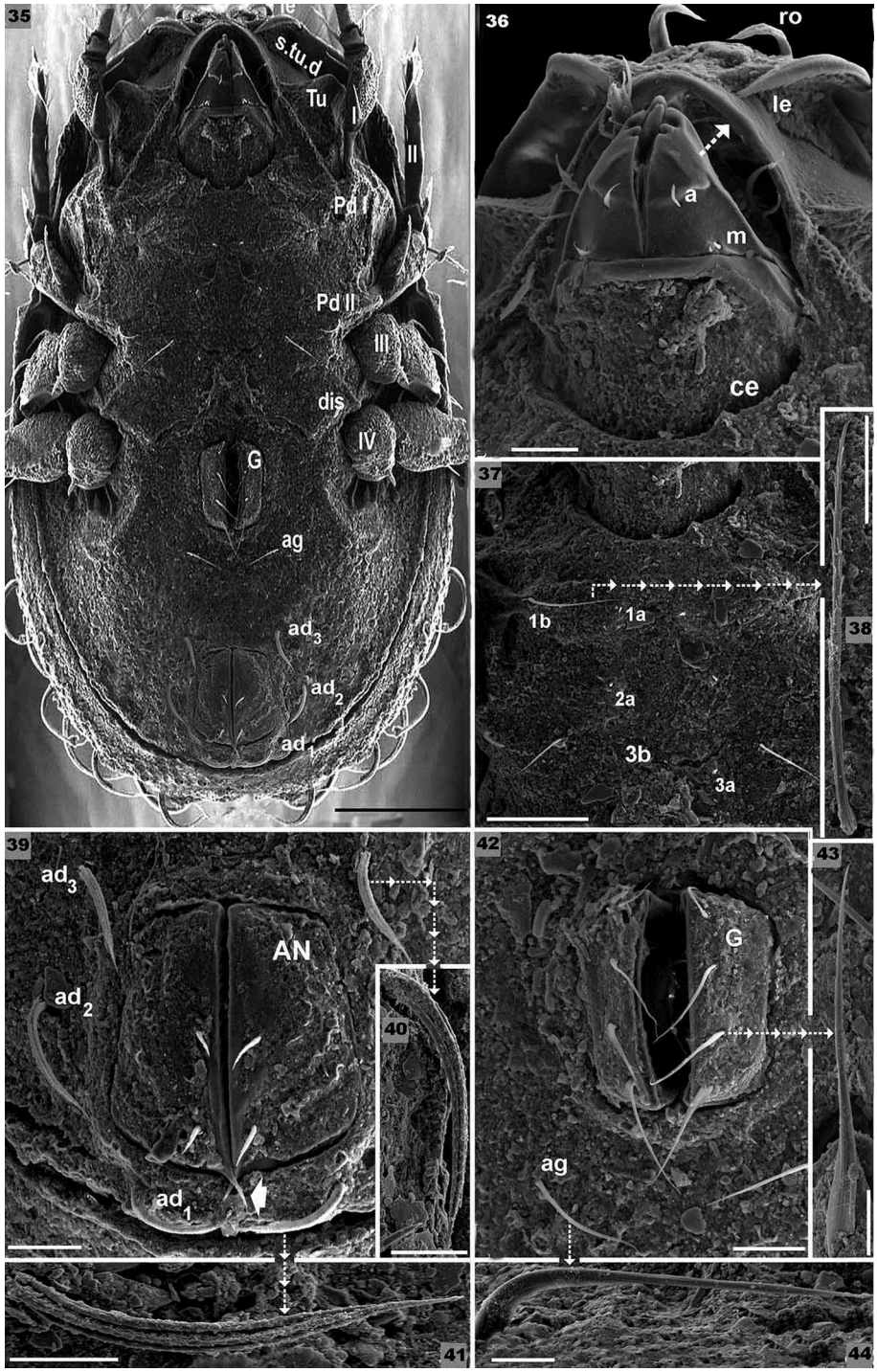
Ventral region (Figures 16, 35). Slightly elevated epimera delimited by shallow furrow (*bo.1*, *bo.2*, *bo.sj*). Epimera 3–4 fused, small epimeral furrow (*bo.3*); *apo.1*, *apo.2*, *apo.sj* and *apo.3* clearly discernible. Epimeral chaetotaxy 3-1-3-3. Discidum well discernible; *a.g.f* clearly visible situated anterior to genital plate.

Genital plate small relative to anal plate; four pairs of genital setae in a simple line; all setae of more or less equal length; aggenital (*ag*) setae situated posterior to genital opening. Three pairs of adanal seta; ad_3 distant from

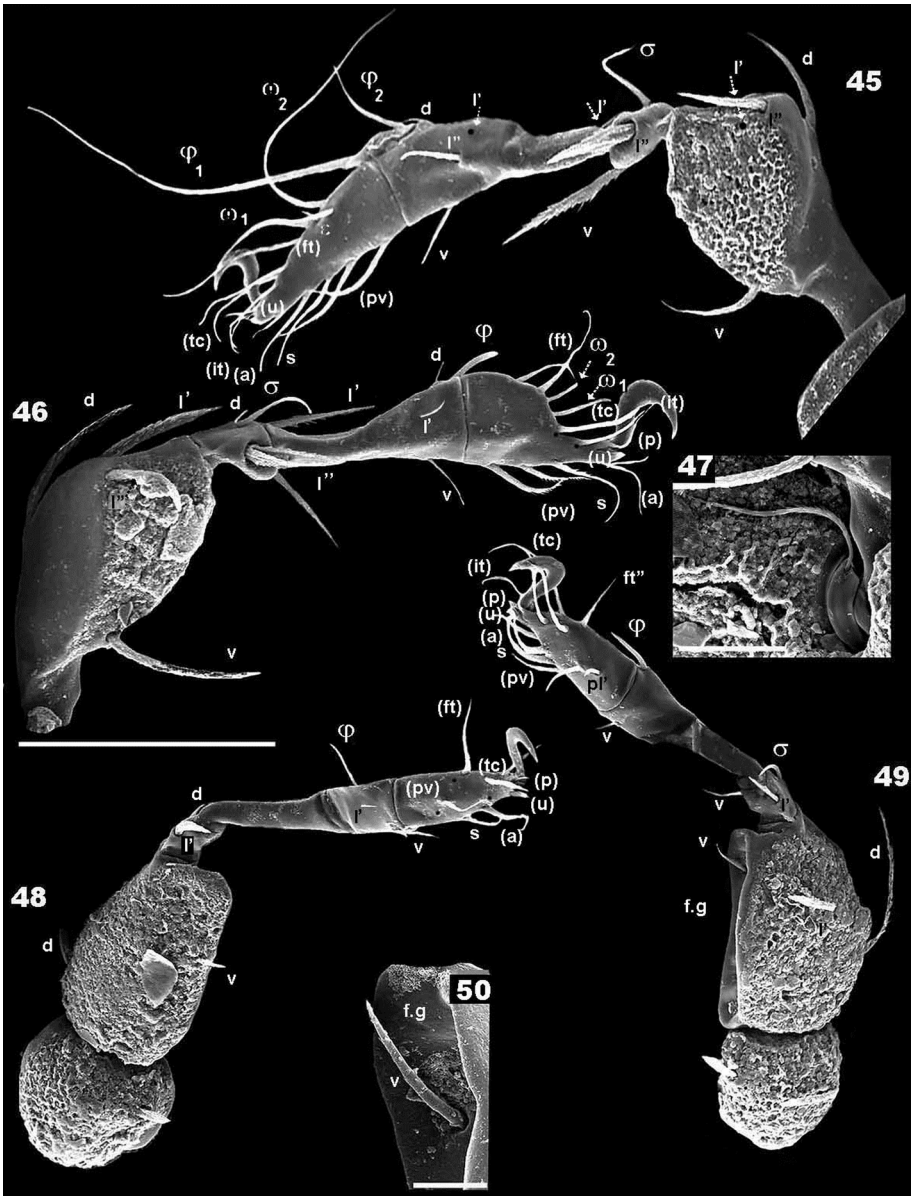
ag setae. Sharply tipped polyhedral anal plate, two pairs of anal setae. Lyrifissures *iad* well discernible, situated laterally and between ad_3 and ad_2. Depressions (*dep*) clearly visible, situated laterally to genital and anal openings.

Legs (Figures 45, 46, 48, 50, Table II). All legs monodactyle. Setal formulae I(1-3-2-3-16-1) (1-2-2); II(1-4-3-3-15-1) (1-1-2); III(2-3-1-2-14-1) (1-1-0); IV(1-2-2-3-13-1) (0-1-0). Trochanter of Leg II with one clearly discernible seta (Figure 47). Femoral groove (Femur III) large (Figure 50).

Remarks. The cerotegumental layer impeded clear observation of the *c.s.s* and the *f.l.p*. Observation of notogastral setae was complicated, due to their length and the fact that they are twisted; sticky residue on the setal surface also impeded clear observation.



FIGURES 35–44. ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.** Adult female, SEM observations. 35. ventral view; 36. subcapitulum; 37. epimeral zone; 38. epimeral setae *1b*; 39. anal-adanal zone; 40. ad_3 setae; 41. ad_1 setae; 42. genital zone; 43. genital setae; 44. aggenital setae. Abbreviations: see Material and Methods. Scale bars: 35 = 100 µm; 36 = 1.3 µm; 37 = 40 µm; 38 = 10 µm; 39 = 20 µm; 40 = 10 µm; 41 = 20 µm; 42 = 20 µm; 43 = 5 µm; 44 = 5 µm.



FIGURES 45–50. ***Zimbabwecepheus maidii*** **gen. nov., sp. nov.** Adult female, SEM observations. 45. leg I, antiaxial view; 46. leg II, antiaxial; 47. trochanter II; 48. leg III, antiaxial; 49. leg VI antiaxial; 50. femoral groove, setae *v*. Abbreviations: see Material and Methods. Scale bars: 45, 46, 48, 49 = 50 μm; 47, 50 = 10 μm.

Discussion

After many years of studying the genus *Congocepheus*, and having studied all type material except for *C. taurus*, the authors hope to clarify the taxonomy of the genus. The following species were studied: *Congocepheus heterotrichus* Balogh, 1958, *Congocepheus orientalis* Mahunka, 1989, *Congocepheus involutus* Mahunka, 1997, *Congocepheus gabonensis* Fernandez, Theron, Rollard, 2013, *Congocepheus extactastesi* Fernandez, Theron, Rollard, 2013, *Congocepheus germani* Fernandez, Theron, Rollard, 2014, *Congocepheus rwandensis* Fernandez, Theron, Leiva, 2016, *Congocepheus kayoveae,* Fernandez, Theron, Leiva, 2016, *Congocepheus cardiae* Fernandez, Theron, Leiva, 2016. *Cavaecarabodes*, a related genus, was proposed with *Cavaecarabodes pulchritude* Fernandez, Theron, Rollard, Rodrigo Castillo, 2014 as type species, and containing *Ca. anouchkae* Fernandez, Theron, Rollard, Rodrigo Castillo, 2014 *Ca. hauseri* (Mahunka, 1989) and *Ca. orientalis* (Mahunka, 1987).

Taxonomy of *C. ornatus* and *C. latilamellatus*. From the original description of *C. latilamellatus* Mahunka 1984: 100 Figures 8A, B, C the following is noted.

Prodorsum. Figure 8A in Mahunka 1984 is in dorsal view. The prodorsal zone differs from our observations (Figures 1, 2, 8). We used various observation angles, but could not match the observations of Mahunka. The differences are: an elevated, rounded *e.i.p* was observed (Figure 8), were *in* setal insertions occur. Dorsolaterally running lamellae, ending in a *la.ti*, with *le* setae inserted on the apical lamellar zone were observed. This is also the case with the *p.p.d*, which in our observations differed in shape to that of the original description.

The lateral drawing by Mahunka (Figure 8C) is very simplified, but the prodorsal zone presents some similar aspects to our observations: the *e.i.p* is a rounded elevated process and the lamellae are visible laterally. The locality of setae *le* in Figure 8C is unusual, Mahunka noted these setae as: "lamellar setae with long spines". These unique setae are situated on the lamellar margin, some distance from the apical lamellar zone where *le* setae are normally situated in *Congocepheus* and related genera. Mahunka did not remark on this particular position of *le* setae, however, in the ventral view (Figure 8B), setae *le* are in the apical, lateral zone of lamellae. This differs from what is illustrated in Figure 8C.

Notogaster. Mahunka 1984: dorsal view (Figure 8A) and text. The original description does not differ greatly from ours. Lateral view: Mahunka 1984 Figure 8C is simplified, giving little information. The lateral view is ignored in the text.

Mahunka stated: "The new species stands very near to *C. ornatus* Mahunka, 1982, but the lamellae of the latter species are thinner and the ornamentation of the notogaster and ventral plate are highly different".

Mahunka 1984 did not note the number of notogastral setae (fourteen in *C. latilamellatus*). With reference to *C. ornatus* Mahunka 1983: 168 (Figures 59–63): "Thirteen pairs phylliform (Fig. 62) marginally serrated notogastral setae", however, in drawing 59, there are thirteen on one side and fourteen on another, and setae h_2 are absent.

Fourteen pairs of setae were visible during our study, however, in one instance, thirteen setae were observed. Setae h_2 were not discernible and were probably lost. We searched for setal insertions but, due to the transparent nature of the material, were unable to identify them with certainty.

Referring to *C. ornatus*, Mahunka indicated "The notogaster with a strong chitinised polygonal structure" but did not further discuss characteristics. Our observations revealed similarities to the illustrations for *C. latilamellatus*. The lateral view was ignored in the original description, but was found to show many similarities to *C. latilamellatus.* Mahunka did not mention the fact that the number of notogastral setae differs. In *C. ornatus* he indicated "thirteen pairs of setae" and in *C. latilamellatus* "fourteen pairs of setae".

The differentiation between these two species was very superficial, but given the present redescription of *C. latilamellatus*, complementary studies of *C. ornatus,* and the correction of errors in the original description of *C. latilamellatus*, we consider them to be the same species.

Assignation of *C. ornatus* and *C. velatus* to the genus *Congocepheus*. In the original short description of *Congocepheus ornatus* Mahunka, 1983, this species was included in the genus without any further comment. In the description of *Congocepheus latilamellatus* Mahunka, 1984, the author remarked: "The new species is conditionally ranged to the genus *Congocepheus* Balogh (p. 101), 1958, because of notogasters not completely identical. The known *Congocepheus* species display a much larger hollow between the prodorsum and notogaster, the new species stands very near to *Co. ornatus* Mahunka, 1982 but the lamellae of the latter species are thinner, and the ornamentation of the notogaster and the ventral plate are highly different".

This phrase is confusing as, for example, *Congocepheus ornatus* was described by Mahunka in 1983 not 1982, and it is unclear if the much larger hollow between the prodorsum and notogaster refers to the posterior prodorsal depression or the anterior notogastral depression, or both of them. While studying the type material, we discovered the following: (1) the tube containing *C. ornatus* included two labels, one marked "*Carabodes ornatus* **sp. nov.**", and the other "rev. Mah. 1983 *Congocepheus ornatus*". Our interpretation is that Mahunka originally ascribed this species to *Carabodes*, but later included it in *Congocepheus.* This was not mentioned in the description of *C. ornatus*, but in 1984, in the description of *C. latilamellatus*, he expressed his doubts. (2) the notogastral anterior depression does not exist. With regard to *C. latilamellatus*, the situation is even more complex. These species cannot be included in the genus *Congocepheus*, due to major differences, mainly on the notogaster, and therefore they are included in the new genus *Tanzaniacepheus.*

In our opinion *Congocepheus latilamellatus* is a senior synonym of *Congocepheus ornatus* , while *Congocepheus velatus* is a valid species. However, these two species should be accommodated in the new genus, *Tanzaniacepheus*. The new combinations are *Tanzaniacepheus ornatus* (Mahunka 1983), and *Tanzaniacepheus velatus* (Mahunka 1986).

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