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A new genus, two new species and a new record of Paederinae from Cretaceous Burmese amber (Coleoptera: Staphylinidae)

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Abstract. A new extinct genus *Dactylonudon* gen. nov. with the type species *D. longitarsus* sp. nov. and a new species of the extinct genus *Midinudon* Tokareva & Żyła, 2023: *M. elongatus* sp. nov., both from Burmese amber are described, illustrated and distinguished from related species. A new record of the extinct species *Diminudon schomannae* Żyła, Yamamoto & Jenkins Shaw, 2019 from Burmese amber is presented.

INTRODUCTION

The taxonomic knowledge of the subfamily Paederinae (currently includes almost 8000 named species in 238 genera included in 3 tribes and 14 subtribes (Newton 2023) is still quite incomplete.

Fossils of the subfamily Paederinae are represented by about forty species in amber inclusions and rock layers ranging from Early Cretaceous to Pleistocene (Tokareva et al. 2023, Janák 2024). Four species have been described to date from Cretaceous Burmese Kachin amber:

- tribe Pinophilini
  - one species in the extinct genus *Cretoprocirrus* Jenkins Shaw & Żyła, 2020: *C. trichotos* Jenkins Shaw & Żyła, 2020 (Jenkins Shaw et al. 2020);
- tribe Lathrobiini, subtribe Scopaeina:
  - two species in the extinct genus *Diminudon* Żyła, Yamamoto & Jenkins Shaw, 2019: *D. kachinensis* Żyła, Yamamoto & Shaw, 2019 and *D. schomannae* Żyła, Yamamoto & Shaw, 2019 (Żyła et al. 2019),
  - one species in the extinct genus *Midinudon* Tokareva & Żyła, 2023 (Tokareva et al. 2023).

There are several mining areas of Cretaceous amber deposits in Myanmar of different age:

- Hkamti site - about 110 Ma (Xing et Qiu 2020)
- Kachin site, Hukawng valley, Tanai - about 99 Ma (Shi et al. 2012) - classical locality
- Tilin site - about 72 Ma (Zheng et al. 2018).

According to Ross (2024) 2,781 animal and plants species have been recorded from Kachin amber up to the end of 2023, 16 species have been recorded from Hkamti amber,

from which two are known from both Hkamti and Kachin amber. Four additional described species are of uncertain origin - from Kachin or from Hkamti amber. Most of the animal and plant inclusions from the Tilin site have not yet been described to the species.

The aim of this paper is to describe additional Paederinae fossils and to present an additional new record of an already described species based on relatively well preserved specimens in Cretaceous Burmese amber from the Kachin site.

MATERIAL AND METHODS

Specimens were studied under a binocular stereomicroscope MBS 10 and Motic BA 410E-T compound microscope. Images were taken with a Canon EOS 700D camera mounted on a Motic BA 410E-T compound microscope in transmitted or diffused reflected light. A small fine hand saw was used to cut the amber pieces, sandpaper of varying grain sizes and tooth paste with a brush were used to polish the piece. Amber pieces were covered with a layer of clove oil before taking pictures which improved visibility of specimens. Resulting images were focus stacked using Zerene Stacker and then post-processed in Paint. Net, Paint, XnView and Live Photo Gallery.

Measurements were taken with the above mentioned microscopes. Body length was measured from the tip of closed mandibles to the end of abdomen, the length of forebody was measured from the apex of the clypeus to the lateral apical angle of an elytron, parallel to the longitudinal axis of the body.

Each piece of amber was placed in a transparent plastic bag together with relevant identification labels.

The following abbreviations is used to indicate the depository of specimens:

JJRC private collection, Jiří Janák, Rtyně nad Bílinou, Czech Republic;

NHMD Natural History Museum of Denmark, Copenhagen, Denmark.

Other abbreviations: HW = maximal width of head, PW = maximal width of pronotum, R = ratio.

Terminology of the ventral side of the body follows Bogri et al. (2020: fig. 4).

TAXONOMY

Subfamily Paederinae

Diminudon Żyła, Yamamoto & Shaw, 2019

Type species. *Diminudon schomannae* Żyła, Yamamoto & Shaw, 2019

Diagnosis. Following diagnosis was published by the authors: "The new genus is distinguishable from all extant and hitherto described fossil Paederinae taxa based on the following character combination: antennomeres 4-10 strongly transverse, each antennomere connected by distinct stem; tarsal formula 4-4-4, maxillary palpomere 4 narrow, but long; mandibles produced, and its overall small size."

Diminudon schomannae Żyła, Yamamoto & Shaw, 2019
(Figs. 1, 4-12)

Diminudon schomannae Żyła, Yamamoto & Shaw, 2019: 9.

Type material. Holotype (sex indet.): amber inclusion, country of origin: Myanmar, Kachin, Hukawng valley (NHMD), not examined.

Additional material: 1 ♂: Myanmar, Kachin, Hukawng valley, (Fig. 1, JJRC).

Note. The examined specimen (total length 1.3 mm, forebody length 0.6 mm, HW 0.16 mm, PW 0.13 mm) corresponds well to the description and the pictures in the original description. In the examined specimen the following detailed characters are clearly visible: maxillary palpi (Fig. 5, *m*), with very narrow last segment with a clearly visible appendix (Fig. 10, *m4*, *ap*), eyes with long setae among ommatidia (Fig. 5, *s*), neck about 1/3 as wide as head (Fig. 5, *nc*), antennomeres 4-10 strongly transverse (Fig. 6), all tarsi 4 segmented, simple, also protarsus hardly dilated (Figs. 7-9, *pt*, *mst*, *mtt*), all tibiae apically with a strong spine (Figs. 7-9, *s*), metatibia with a ctenidium at the inner side only (Fig. 9, cn). Aedeagus apically pointed with elongate, apically curved and pointed internal structure (Fig. 12, *aed*, *is*). Apical margin of the male sternite VIII not clearly visible, sternite IX pointed apically (Fig. 11, *sIX*). Some minor differences between the holotype and the examined specimen like darker colour and slightly different shape of some parts of the body (head, pronotum, elytra) are considered as a consequence of different stage of the maturity of the specimens, of the variability in the range of the species and also as a consequence of the fossilisation process. *D. schomannae* differs from the related extinct *D. kachinensis* Żyła, Yamamoto & Shaw, 2019 by the head being densely punctate, the posterior angles of the head being more angulate (less rounded) and the head being slightly wider than the pronotum (Fig. 5).

Midinudon Tokareva & Żyła, 2023

Type species. *Midinudon juvenis* Tokareva & Żyła, 2023.

Diagnosis. Following diagnosis was published by the authors: “The new genus and species can be distinguished from all extant Paederinae by the following combination of characters: body small (< 2 mm); antenna with discoidal transverse antennomeres; area of head behind antenna flattened; Y-shaped suture present on frons; tarsal formula 4-4-4. Compared to the closely related extinct genus *Diminudon*, the body of *Midinudon* is slightly larger; posterior angles of head straighter; Y-shaped sutures present on frons; maxillary palpomere 3 of regular form, not fusiform; neck narrower, equal to or less than ¼ of head width; punctuation of head and pronotum less evident; pronotum with posterior edge slightly elevated, pronotal angles obtuse.”

Figs. 1-3. Amber pieces with inclusions. 1- *Diminudon schomannae*; 2- *Midinudon elongatus* sp. nov.; 3- *Dactylonudon longitarsus* gen. nov., sp. nov.

***Midinudon elongatus* sp. nov.**

(Figs. 2, 13-20)

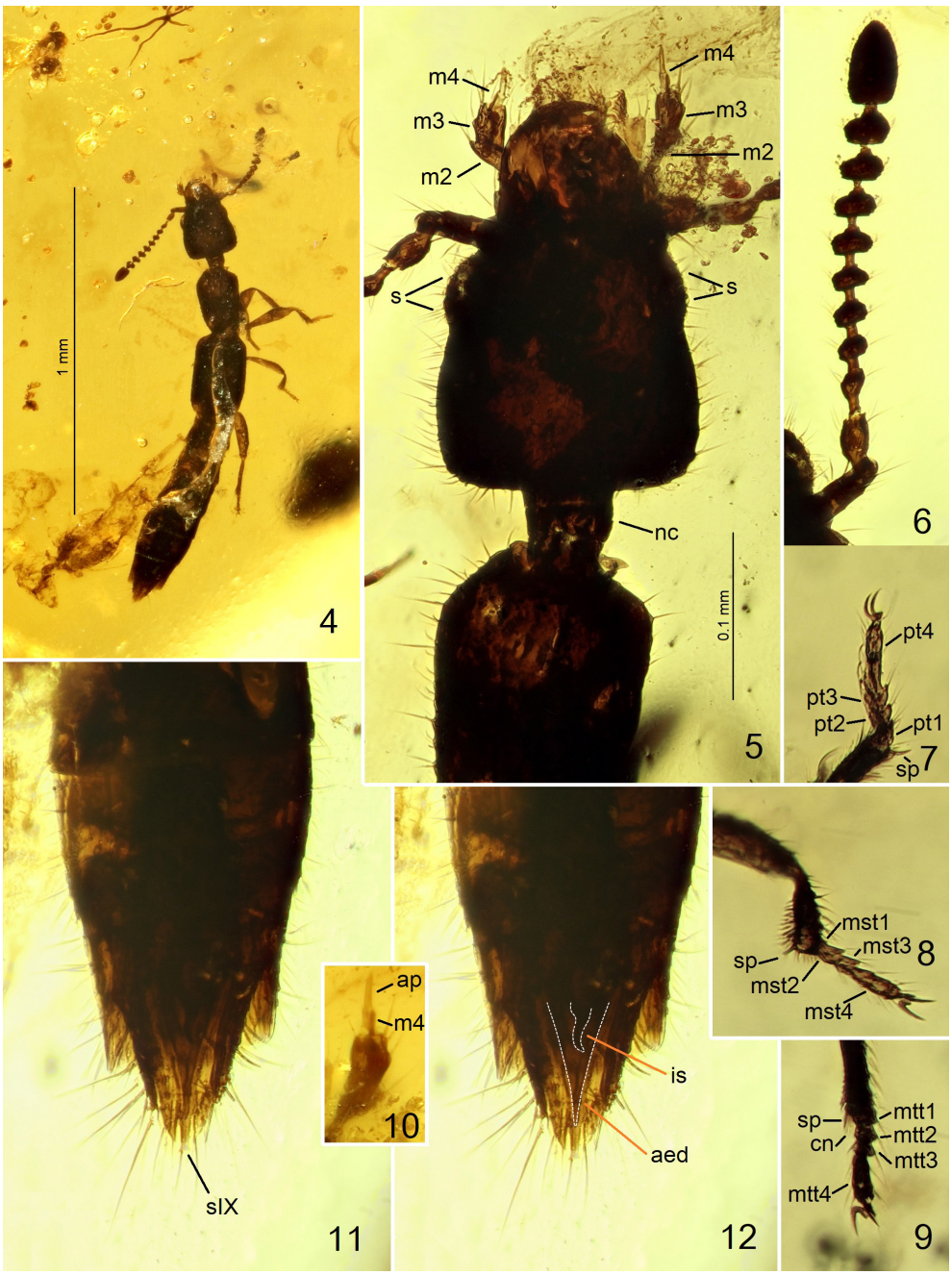
Type material. Holotype (sex unknown): Myanmar, Kachin State, Tanai env., Hukawng valley, in a transparent plastic bag together with a red identification label: "Midinudon elongatus sp. nov., J. Janák det. 2024", (JJRC). Slightly trapezoid piece of light yellow transparent amber, size: approx.16 mm x 15 mm x 3 mm (Fig. 2).

Preservation. Relatively well preserved. Apical part of abdomen hidden behind a shining layer of amber, a few parts of body covered by small parts of dirt, head moderately flattened dorso-ventrally, basal part of pronotum probably slightly damaged.

Description. Body length 2.1 mm, forebody length 1.2 mm. Reddish brown, maxillary palpi and legs reddish yellow (Figs. 13-14).

Head (Fig. 14) elongate, about 1.7 times as long as wide, about 1.2 times as wide as pronotum, eyes moderately large, 0.44 times as long as temples and between ommatidia with distinct moderately long setae, sides slightly widened behind eyes, flattened, with distinct median longitudinal furrow and two divergent furrows leading from frons to ocular region, partly damaged due to fossilisation process, sides with very long setae, shiny, punctation or microsculpture not visible. Neck very narrow about 1/7 as wide as head (Fig. 14, *nc*). Antennae (Fig. 16) moderately long, first three antennomeres markedly longer than wide, first antennomere wide, moderately longer and wider than antennomere 2, antennomere 3 longer and narrower than antennomere 2, antennomere 4 about as long as broad, following antennomeres conical, slightly to moderately transverse, last antennomere about as long as two preceeding combined (Figs. 13-16). Labrum not visible. Maxillary palpi slender, elongate, segment 1 small, curved, segment 2 longer, curved, markedly widened apically, segment 3 slightly longer and slightly narrower than preceeding, last segment very narrow,

Figs. 4-12. *Diminudon schomannae*. 4- habitus dorsal; 5- head and anterior part of pronotum dorsal; 6- left antenna; 7- right protarsus; 8- right mesotarsus; 9- right metatarsus; 10- right maxillary palpus; 11-12- apical part of abdomen ventral; aed- aedeagus; ap- appendix; cn- ctenidium; is- internal structure; m- maxillary palpus; mttb- metatibia; mtt- metatarsus; nc- neck; pt- protarsus; s- setae between ommatida; sp- spine; sIX- sternite IX. Scales: 1 mm: 4; 0.1 mm: 5-12.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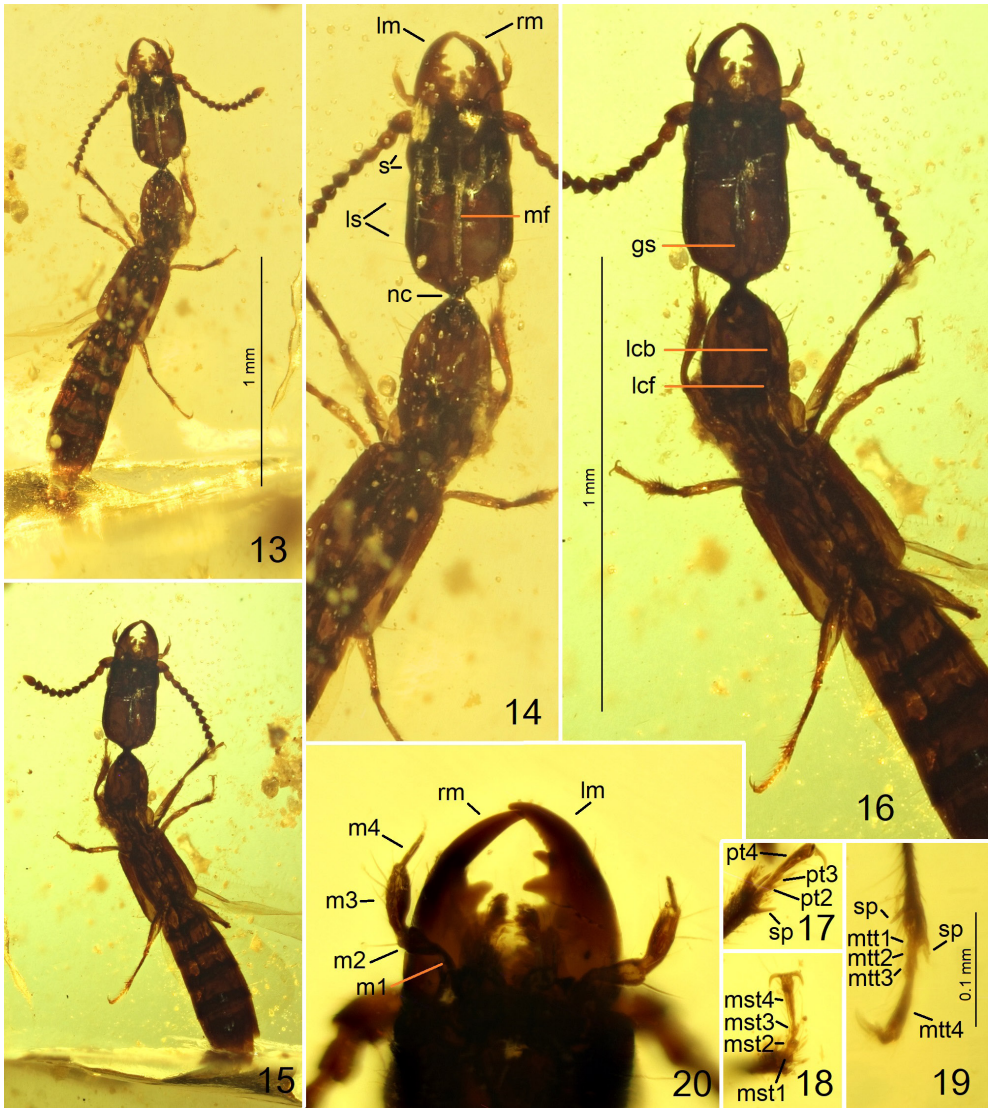
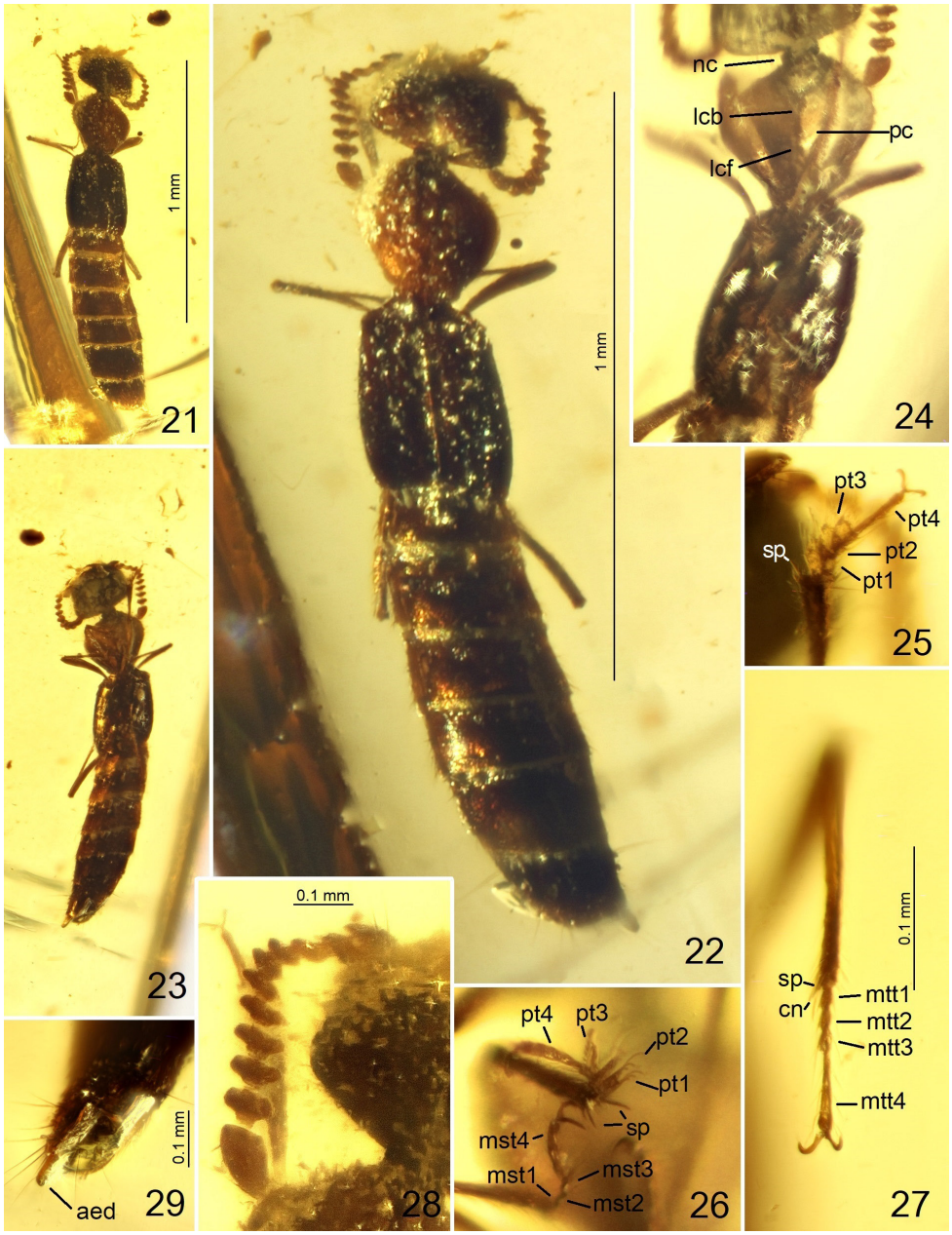


Figs. 13-20. *Midinudon elongatus* sp. nov. 13- habitus dorsal; 14- forebody dorsal; 15- habitus ventral; 16- forebody ventral; 17- left protarsus; 18- left mesotarsus; 19- right metatarsus; 20- head dorsal; gs- gular sutures; lc- long setae; lcb- longitudinal carina of basisternum; lcf- longitudinal carina of furcasternum; lm- left mandible; m- maxillary palpus; mf- middle furrow; mttb metatibia; mtt- metatarsus; nc- neck; pt- protarsus; rm- right mandible; s- setae between ommatida; sp- spine. Scales 1 mm: 13, 15; 14, 16; 0.1 mm: 17-20.

much narrower and about half as long as preceeding (Fig. 20, *m1-m4*). Labial palpi not visible. Mandibles stout, right with one tooth, left with three teeth (Fig. 14, Fig. 20, *rm*, *lm*). Gular sutures strongly converging, on anterior part probably fused (16, *gs*).



Figs. 21-29. *Dactylonudon longitarsus* gen. nov., sp. nov. 21-22- habitus dorsal; 23- habitus ventral; 24- part of forebody ventral; 25- left protarsus; 26- right protarsus and mesotarsus; 27- right metatarsus; 28- left antenna; 29- apical part of abdomen ventro-lateral; aed- aedeagus; cn- ctenidium; lcb- longitudinal carina of basisternum; lcf- longitudinal carina of furcasternum; mst- mesotarsus; mtt- metatarsus; nc- neck; pc-prosternal carina; pt- protarsus; sp- spine. Scales 1 mm: 21, 23; 22, 24; 0.1 mm: 25-27; 28; 29.

Pronotum (Fig. 14) very long, about 1.9 times as long as broad, slightly narrower than head (R = 0.83), sides markedly narrowed anteriad and moderately narrowed posteriad, basal part of pronotum not clearly visible, seems to be damaged during fossilisation process, sculpture not visible, sides with numerous long erect setae. Longitudinal carinae of basisternum and furcasternum sharp (Fig. 16, *lcb*, *lcf*).

Elytra (Figs. 13, 14) long and narrow, slightly longer (R = 1.07) and markedly wider (R = 1.33) than pronotum, and about 1.5 times as long as wide, shoulders narrowly rounded, lateral sides slightly widened behind. Long lateral seta visible behind left shoulder. Sculpture not visible.

Abdomen (Fig. 13, 15) slightly widened to segment VI, details of sculpture and puncttion not visible.

Sex unknown, sternite VIII not visible.

Tarsal formula 4-4-4, first tarsomeres partially hidden behind apex of tibiae due to its positions, all tarsi simple, not widened (Figs. 17-19), fourth tarsomere longer as three preceeding tarsomeres combined (Fig. 17, *pt4*; Fig. 18, *mst4*, Fig. 19, *mtt4*). All tibiae with spines on apical part (Figs. 17-19, *sp*), apical part of metatibia with ctenidium not clearly visible (Fig. 19).

Differential diagnosis and discussion. The new species is placed in the genus *Midinudon* Tokareva & Żyła, 2023 which is supported by: tarsal formula 4-4-4 (Figs. 17-19), the head with a longitudinal median furrow (Fig. 14, *mf*) and two divergent furrows leading from frons to ocular region (partly damaged due to fossilisation process), the neck narrow, equal to or less than ¼ of the head width (Fig. 14, *nc*), last maxillary palpomere simple, not fusiform (Fig. 20, *m4*), all tarsi simple (Figs. 17-19) and mandibles stout (Fig. 20, *lm*, *rm*). The two following characters mentioned in the diagnosis of the genus (Tokareva et Żyła, 2023): body small (< 2 mm) and antenna with discoidal transverse antennomeres, do not have value at the generic level. *Midinudon elongatus* sp. nov. differs from *M. juvenis* Tokareva & Żyła, 2023 by the elongate head, pronotum and elytra, by the narrower neck and by the slender tarsi with the last tarsomere longer than the three preceeding segments combined.

Derivatio nominis. The name of the species refers to the elongate body.

Dactylonudon gen. nov.

Type species. *Dactylonudon longitarsus* sp. nov., here designated.

Diagnosis. The new genus can be distinguished from all extant and extinct Paederinae by the following combination of characters: tarsal formula 4-4-4, anterior tarsi markedly dilated, Y-shaped structure on frons absent.

Description. Body small < 2 mm, elongate, slightly convex, shaped as in other Paederini (Fig. 22). Head short, slightly or moderately transverse. Neck about 1/4 as wide as head (Figs. 22, 23). Antennae 11 segmented (Fig. 28), antennomeres 4-10 strongly transverse, antennomere 11 elongate, each antennomere connected with distinct stem. Mandibles stout

(Fig. 23). Pronotum about as long as wide, anterior angles of pronotum rounded. Legs long and slender, tarsal formula 4-4-4, protarsus markedly dilated, protarsomeres 1-3 markedly transverse, long and densely setose (Figs. 25, 26, *pt1-pt3*), protarsomere 4 long and slender, longer than three preceeding segments combined, sparsely setose (Figs. 25, 26, *pt4*), meso- and metatarsomeres 4 simple, not dilated, sparsely setose (Figs. 26-27, *mst*, *mtt*), apical part of probitia with at least with 2 spines (Fig. 26, *sp*), apical part of metatibia with one spine and with ctenidium only on internal side (Fig. 26, *sp*, *cn*). Elytra longer than wide. Abdomen (Figs. 22) widest at segment VI.

Derivatio nominis. The name of the species refers to dilated protarsi (dactylus = finger) and similarity with *Diminudon* and *Midinudon*.

Discussion. A description of the new genus cannot be completed in all characters as some body parts of the unique type specimen are not clearly visible (see below for details). But there is no doubt that this genus is a member of Paederini and is related to two previously described extinct genera of Paederini from cretaceous Burmese amber - *Diminudon* and *Midinudon. Dactylonudon* gen. nov. shares with these two genera the tarsal formula 4-4-4 and small size, but differs from both of them by the strongly dilated protarsi.

Dactylonudon longitarsus **sp. nov.**

(Figs. 3, 21-29)

Type material. Holotype (♂): Myanmar, Kachin State, Tanai env., Hukawng valley, in a transparent plastic bag together with a red identification label: "Dactylonudon longitarsus sp. nov., J. Janák det. 2024", (JJRC). Trapezoid piece of light yellow transparent amber, size: approx. 16 mm x 7 mm x 2.5 mm (Fig. 3).

Preservation. Relatively well preserved. Anterior part of head including mouthparts not visible - covered by dirt. Head and elytra mediobasally flattened. A few parts of body covered by small parts of dirt.

Description. Body length 1.5 mm, forebody length 0.8 mm. Head brown, pronotum reddish, elytra black, abdominal segments III-VI reddish, VII-VIII black, antennae and legs reddish brown (Fig. 22).

Head (Fig. 22) rounded trapezoidal, transverse (R cca 0.7-0.8), slightly narrower than pronotum (R 0.95), eyes not visible due to layer of dirt, temples slightly widened behind, markedly convex, densely, coarsely granulate and setose, moderately shiny. Neck about 1/4 as wide as head. Dorsal side of head not clearly visible (Fig. 23). Antennae (Fig. 28) short, first two antennomeres wide and moderately long, antennomere 3 longer than wide, following antennomeres transverse, antennomere 5 about twice as wide as long, antennomere 10 about 2.5 times as wide as long, antennomere 11 about 1.5 times as long as wide. Mouthparts not visible. Mandibles relatively short and stout (Fig. 23).

Pronotum (Fig. 22) about as long as wide, cordiform, sides markedly narrowed behind, posterior angles short, angular, sparsely, coarsely and rugosely granulate with short setae (Fig. 22.) Lateral margins with long erect setae. Prosternal carina (Fig. 24, *pc*) visible,

longitudinal carina of basisternum (Fig. 24, *lcb*) and longitudinal carina of furcasternum (Fig. 24, *lcf*) sharp. Tarsal formula 4-4-4, protarsus markedly dilated, protarsomeres 1-3 markedly transverse, long and densely setose (Figs. 25, 26, *pt1-pt3*), protarsomere 4 long and slender, longer than three preceeding segments combined, sparsely setose (Figs. 25, 26, *pt4*), meso- and metatarsomeres 4 simple, not dilated, sparsely setose (Figs. 26-27, *mst*, *mtt*), much longer than segments 1-3 combined, metatarsomere 4 very long, about a third longer than preceeding three segments combined (Fig. 27, *mtt1-4*), apical part of probitia with at least 2 spines (Fig. 26, *sp*), apical part of metatibia with one spine and with ctenidium only on internal side (Fig. 26, *sp*, *cn*).

Elytra (Fig. 22) long, markedly longer (R = 1.35) than and about as wide as pronotum and 1.36 times as long as wide, shoulders angular, sides slightly widened to posterior quarter, along lateral margins with visible short setae.

Abdomen (Figs. 22) widest at segment VI, with basal transversal impressions on tergites III-V, densely and finely punctate and with short setae.

Male. Posterior margin of sternite VIII not visible, aedeagus apically pointed (Fig. 29, *aed*).

Differential diagnosis. The species has the same tarsal formula 4-4-4 and similar short antennae with transverse antennomeres 4-10 as *Diminudon kachinensis*, *D. schomannae* and *Midinudon juvenis*, but differs from all three species by the shape of the head, the pronotum and the elytra, and by the dilated protarsi and very long metatarsi.

Derivatio nominis. The name of the species refers to the very long metatarsi.

CONCLUSIONS

Tokareva et al. (2023) placed the genera *Diminudon* and *Midinudon* in the subtribe Scopaeina based on a phylogenetic analysis.

Herman (2023) redescribed Scopaeina and described the tribe Sphaeronina and published following diagnosis:

Scopaeina: “The Scopaeina can be separated from all other subtribes by the cephalic trichobothrium that is contiguous with the dorsal margin of the eye, in a rounded depression or canal or in a short cavity behind and nearly touching the eye or moderately, but distinctly separated from it, and the tripartite ligular lobe, absence of the pronotal marginal ridge, long, posteriorly tapered profurcasternum, and trilobed anterior margin of abdominal sternite II. Each of these characters is homoplasic and found in other genera of the Paederinae. No other genus or subtribe possesses them all.”

Sphaeronina: “Spaeronina can be separated from all other subtribes and genera by the wide, triangular, deep ctenidal concavity of the protibia that has three, wide, diagonally transverse combs, the large, heavily sclerotized, dorsally directed, basally wide, apically tapered and obtuse hypopharyngeal peg, the denticle arising from the ventral surface of the left mandible, and the groove on the outer edge of the mandibles. The hypopharyngeal peg and ventral mandibular denticle appear to be unique features.”

Dactylonudon gen. nov. does not show "wide, triangular, deep ctenidal concavity of the protibia that has three, wide, diagonally transverse combs" (cf. Fig. 25) and that's why it cannot belong to the tribe Sphaeronina. Characters used for identification of Scopaeina by Herman (2023) are unfortunately not visible in amber inclusion of *Dactylonudon* gen. nov. by light microscopy.

The new genus shows the same tarsal formula 4-4-4 as *Diminudon* and *Midinudon* which is unique for these three extinct genera and is not known in extant Paederinae. As *Diminudon* and *Midinudon* is currently placed in Scopaeina, it is reasonable to place currently *Dactylonudon* gen. nov. also in Scopaeina even if all these three extinct genera share tarsal formula 4-4-4, a character which is not known in any extant Paederinae.

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