

Linzer biol. Beitr.	48/1	419-429	30.07.2016
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New genera and species of Aradidae in Cretaceous Burmese Amber (Hemiptera: Heteroptera)

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A b s t r a c t : Inclusions of Upper Cretaceous Burmese Amber contained several Aradidae which could not be placed in one of the extant or fossil genera. For them the following genera and species are proposed and described below: *Calisiomorpha yuripopovi* nov.gen. nov.sp.; *Ellenbergeria oviventris* nov.gen., nov.sp. and *Aradoleptus birmanus* nov.gen., nov.sp. In addition a second species of the monotypic genus *Archearadus* HEISS & GRIMALDI, 2001 is described: *Archearadus elongatus* nov.sp.

K e y w o r d s : Hemiptera, Heteroptera, Aradidae, new genus, new species, Mesozoic, Burmese Amber, Myanmar.

Introduction

From the rich amber deposits in Northern Myanmar the following genera and species of Aradidae have been described to date: *Archearadus burmensis* HEISS & GRIMALDI, 2001; *Kachinocoris brevipennis* HEISS, 2012; *Myanmezira longicornis* HEISS & POINAR, 2012, *Microaradus anticus* HEISS & POINAR, 2012; *Cretopiesma suukyiae* GRIMALDI & ENGEL, 2008, originally assigned to Piematidae was later recognized as belonging to Aradidae and transferred to this family by CASSIS & SCHUH 2010.

New inclusions, now available for scientific studies, contained several new taxa which could not be placed in one of the recognized extant or fossil genera. They are described here as *Calisiomorpha yuripopovi* nov.gen. nov.sp.; *Ellenbergeria oviventris* nov.gen., nov.sp. and *Aradoleptus birmanus* nov.gen., nov.sp.; in addition a second species of the monotypic genus *Archearadus* HEISS & GRIMALDI, 2001 is described and illustrated: *Archearadus elongatus* nov.sp.

Material and methods

Burmese Amber is of Upper Cretaceous age, probably from the Turonian or Cenomanian (90-100 Ma) (GRIMALDI et al. 2002). No particular locality of origin in Kachin State in Northern Myanmar is known, therefore no further stratigraphic informations are available.

This study is based on material belonging to and deposited in the collection of the authors' institution: CEHI Collection Ernst Heiss, Tiroler Landesmuseum, Innsbruck, Austria.

Measurements were taken with a micrometer eyepiece, 40 units = 1mm or are given in millimetres. Photos were partly taken with an Olympus SZX 10 binocular microscope and Olympus E 3 digital camera, processed with Helicon Focus 4.3 software, using Adobe Photoshop and Lightroom 2.3.

Abbreviations:

deltgdorsal external laterotergite (connexivum)
 mtg.....mediotergite
 mltg.....ventral laterotergite
 ptgparatergite

Systematic Paleontology

Order H e m i p t e r a LINNAEUS, 1758

Suborder H e t e r o p t e r a LATREILLE, 1810

Infraorder P e n t a t o m o m o r p h a LESTON, PENDERGRAST & SOUTHWOOD, 1954

Family A r a d i d a e BRULLÉ, 1836

Genus *Calisiomorpha* nov.gen.

Type species. *Calisiomorpha yuripopovi* nov.sp.

D i a g n o s i s : Recognized and distinguished from all Burmese amber flat bug taxa by the presence of a row of flat tubercles on the edge of deltg and vltg II-VII.

D e s c r i p t i o n : Macropterous, small, less than 4mm; surface of body with fine punctures, corium and paranota with small areolae; colouration stramineous, first and last tubercles of connexival edge, anterior and posterior margin of deltg and vltg II-VII brown.

H e a d : About as long as wide; clypeus apically enlarged and rounded, reaching apex of antennal segment II; antennae shorter than width of head, segments I-II of subequal length, IV longest; rostrum as long as head arising from an open atrium.

P r o n o t u m : About 3x as wide as long with lamellate paranota, lateral margins roundly converging anteriorly; disk with five longitudinal carinae, posterior margin concave.

S c u t e l l u m : About 1.5x as long as wide, lateral margins carinate, apex rounded; disk with a median carina which is bifurcate on anterior half.

H e m e l y t r a : Corium about as long as scutellum, lateral margins angularly produced; membrane hyaline with three distinct veins.

A b d o m e n : Of oval outline, lateral margin of connexival edge with a dorsal and a ventral row of four flat tubercles, their number reduced to two on deltg II; pattern of apodemal impressions difficult to discern, apparently 2:1:1.

V e n t e r : Sternites II-VII separated by sutures, no metasternal scent gland structures and spiracles discernible with certainty.

L e g s : Unarmed, tarsi two-segmented, claws with pulvilli.

E t y m o l o g y : The rows of flat expansions along connexival edge resemble those of the flat bug genus *Calisius* and the stem < morph- > (Greek) = shape.

D i s c u s s i o n : The anteriorly roundly enlarged clypeus is only shared by the extant subfamily Calisiinae and fossil genus *Kachinocoris* described from Burmese amber, however *Calisiomorpha* nov.gen. differs at once from Calisiinae by the short scutellum not covering the whole abdomen, the wide angulate corium and the exposed membrane lacking in Calisiinae; from *Kachinocoris* by the presence of two rows of lateral tubercles on connexival margins, different pronotal structure and the macropterous alary condition. Its systematic placement is tentatively assigned to Calisiinae.

***Calisiomorpha yuripopovi* nov.sp. (Figs. 1-5, photos 1-2)**

H o l o t y p e : Female in a piece of Burmese amber from "Kachin State" in Myanmar (Burma) embedded in epoxyd resin (10x11x6mm), legs and antennae complete, left fore wing spread laterally, pro-meso- and metasternum and sternites VII-VIII partly obscured. It is designated as holotype and labeled accordingly.

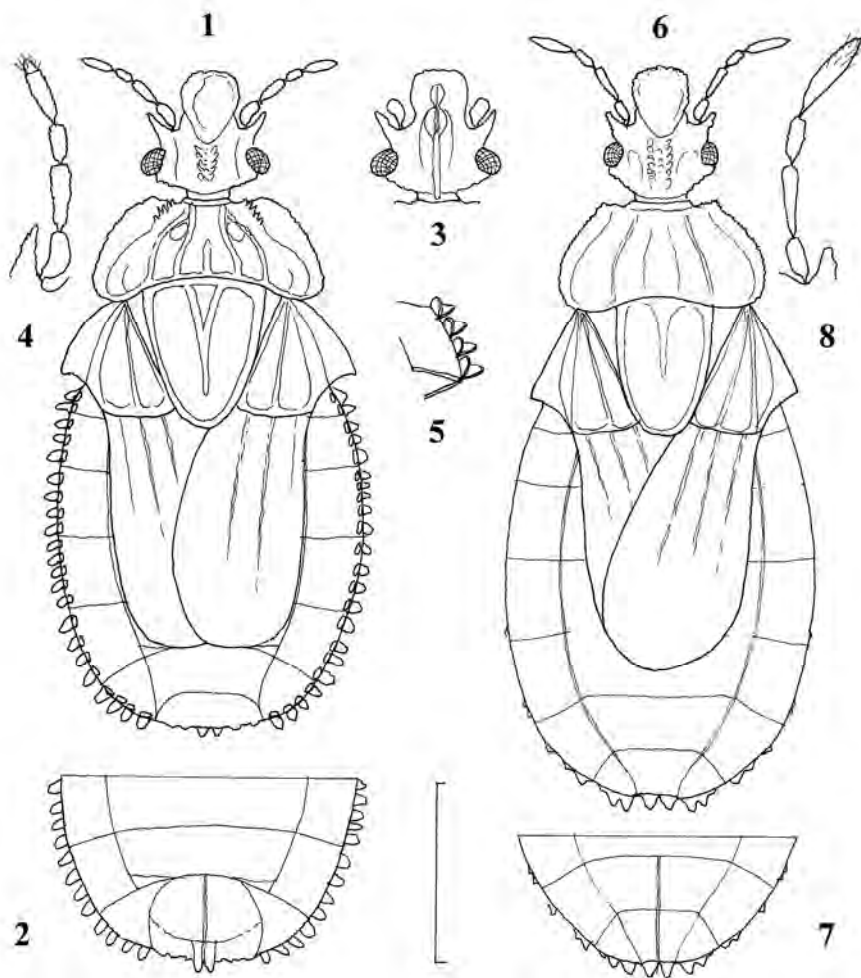
D e s c r i p t i o n : **H e a d :** Slightly wider than long (29/27); clypeus apically enlarged and rounded reaching apex of antennal segment II, surface granulate and medially depressed; antenniferous lobes long and acute, beset with conical tubercles; antennae 0.93x as long as width of head, segment I cylindrical, II tapering toward base, III shortest, IV fusiform and longest, apex pilose; length of antennal segments I/II/III/IV = 7/7/5/8; eyes subconical laterally produced; postocular lobes straightly converging posteriorly to constricted collar; vertex with longitudinal rows of tubercles, depressed between them; rostrum arising from an open atrium, reaching anterior margin of prosternum.

P r o n o t u m : 2.94x as wide as long (53/18), ring-like collar carinate and raised; areolate paranota widening anteriorly, lateral margins roundly converging anteriorly; disk with five carinae, the median one not exceeding posterior lobe, lateral and sublateral ones reaching collar; posterior margin carinate and concave.

S c u t e l l u m : Longer than wide (32/26), basal and lateral margins carinate, apex rounded; disk with a median carina which is bifurcate anteriorly.

H e m e l y t r a : Corium short, about as long as scutellum, truncate posteriorly; lateral margins expanded and angularly produced at a lower level over abdomen; membrane hyaline with three straight veins discernible.

A b d o m e n : Oval, lateral margin of connexival edge of deltg III-VII with a dorsal and vltg III-VII with a ventral row of four flat tubercles, the first and last one brown as the adjacent anterior and posterior margins of respective laterotergites, those inbetween are stramineous; number of tubercles is reduced to two on deltg and vltg II, increased to five in one row of two segments (V left, IV right); tergite VIII truncate posteriorly.



Figs. 1-8 Reconstruction of described taxa. **1-5:** *Calisiomorpha yuripopovi* nov.gen., nov.sp.; (1) habitus; (2) ventral terminal segments; (3) head, ventral view; (4) left antenna; (5) arrangement of lateral connexival expansions; **6-8:** *Ellenbergeria oviventris* nov.gen., nov.sp.; (6) habitus; (7) ventral terminal segments; (8) right antenna. Scale = 1mm.

Venter: Pro-, meso- and metasternum flat at middle, separated by transverse sutures; sternite VII split medially, vltg VII subtriangular; no metathoracic scent gland structures and no spiracles discernible with certainty.

Legs: Femora fused to trochanters, moderately incrassate; tibiae cylindrical shorter than femora, tarsi two-segmented with long, apically enlarged pulvilli.

Measurements: Length 3.8mm; length of antennae 0.675mm; width of corium at angulate expansion 1.75mm; width of abdomen 1.82mm.

E t y m o l o g y : It is a great pleasure to dedicate this unique amber taxon to my dear friend and eminent paleontologist Yuri Popov (Paleontological Institute, Russian Academy of Sciences, Moscow) honouring and sharing the 80th birthday earlier this year.

***Ellenbergeria* new genus**

Type species: *Ellenbergeria oviventris* nov.sp.

D i a g n o s i s : Differing from all known cretaceous Burmese amber Aradidae by a combination of characters: wide rounded clypeus, structure of antennae, trapezoidal pronotum, oval abdomen and laterally angularly produced corium only reaching apex of scutellum.

D e s c r i p t i o n : (Sub)-macropterous, small size less than 5mm; surface of body and appendages with fine granulation, corium with deep punctures, colouration uniformly dark brown, membrane hyaline.

H e a d : Longer than wide; clypeus apically enlarged and rounded, nearly reaching apex of antennal segment II; antenniferous lobes long and acute; antennae longer than width of head, segment I and III of subequal length, II longer than I, IV longest; rostrum as long as head arising from an open atrium.

P r o n o t u m : Trapezoidal, more than twice as wide as long, paranota and lateral margins roundly converging anteriorly; disk with 4 carinae; posterior margin concave.

S c u t e l l u m : Distinctly longer than wide, lateral margins carinate, apex rounded; disk with a median carina on anterior half.

H e m e l y t r a : Corium about as long as scutellum, truncate posteriorly; lateral margins angularly produced over abdomen; membrane with three distinct veins.

A b d o m e n : Elongate oval, lateral margins rounded, small triangular lateral expansions are visible on deltg VI-VIII; pattern of apodemal impressions not discernible.

V e n t e r : Sternites II-VII separated by transverse sutures; metathoracic scent gland structures not discernible.

L e g s : Unarmed; claws with pulvilli.

E t y m o l o g y : This interesting genus is dedicated to Siegfried Ellenberger, successfully searching and processing Burmese amber inclusions of Heteroptera, of which he made this specimen and many other bugs available for scientific study.

D i s c u s s i o n : Because of the combination of characters (see diagnosis), this taxon cannot be placed into one of the recognized extant subfamilies of Aradidae and does also not share essential characters of fossil Archeoradinae. Its general habitus resembles that of Mezirinae genus *Neuroctenus*, shape of head that of Calisiinae and pronotum is very *Aradus*-like, the latter genus not possessing tarsal pulvilli. The laterally angularly expanded corium does not occur in extant Aradidae. An eventually necessary assignment to a new subfamily will be considered, when other conspecific inclusions are available for comparison.



1



2



3



4



5

Photos 1-5: *Calisiomorpha yuripopovi* nov.gen., nov.sp.; (1) habitus dorsal view; (2) ventral view; (3) *Ellenbergeria oviventris* nov.gen., nov.sp., dorsal view; (4) *Archearadus elongatus* nov.sp., dorsal view; (5) *Aradoleptus birmanus* nov.gen., nov.sp., dorsal view with attached exuvia.

***Ellenbergeria oviventris* nov.sp. (Figs 6-8, photo 3)**

H o l o t y p e : Submacropterous female in a piece of Burmese amber from "Kachin State" in Myanmar (Burma) embedded in epoxyd resin (14x20x6mm), legs and antennae complete, both hemelytra spread laterally, head and thoracic structures partly obscured. It is designated as holotype and labeled accordingly.

D e s c r i p t i o n : **H e a d :** Longer than wide (31/27); clypeus apically enlarged and rounded, nearly reaching apex of antennal segment II, surface beset with small tubercles; antenniferous lobes long and acute, lateral margins serrate; antennae 1.17x as long as width of head, segment I cylindrical, II longer and tapering toward base, III shortest, IV longest and fusiform, length of antennal segments I/II/III/IV = 6/8/5.5/12; eyes oval inserted in head; postocular lobes not reaching outer margin of eyes, straightly converging posteriorly, lateral margins serrate.

P r o n o t u m : Trapezoidal, 2.14x as wide as long (47/22); paranota distinct, lateral margins rounded at humeri then straight and converging anteriorly, anterolateral angles blunt; disk with four carinae, obscured by dark colour.

S c u t e l l u m : 1.6x as long as wide, lateral margins carinate, subparallel on anterior half, apex rounded; disk with a median carina on basal half.

H e m e l y t r a : Short posteriorly truncate corium nearly reaching apex of scutellum, lateral angulate expansion at a lower level produced over abdomen; disk with two distinct carinate veins; membrane hyaline with three veins reaching half of mtg VI.

A b d o m e n , v e n t e r a n d l e g s as generic description.

M e a s u r e m e n t s : Length 4.3mm; length of antennae 0.78mm; width of corium at angulate expansion 1.5mm; length of abdomen 2.55mm, width across tergite V 1.70mm.

E t y m o l o g y : Refers to the oval abdomen of this taxon.

***Aradoleptus* new genus**

Type species: *Aradoleptus birmanus* nov.sp.

D i a g n o s i s : This genus is distinguished from all known Burmese Amber Aradidae by a combination of characters e.g. elongate slender body, structure of antenniferous lobes and clypeus without dorsal carina and triangular scutellum with acute apex.

D e s c r i p t i o n : Submacropterous, small size about 4mm, surface of body and appendages with fine granulation; colouration uniformly reddish brown, membrane hyaline.

H e a d : Longer than wide, clypeus long with subparallel lateral margins nearly reaching ½ of antennal segment II; antenniferous lobes wide, apically serrate; antennae distinctly longer than width of head, segment I and II shortest, III and IV longer and of equal length; rostrum arising from an open atrium as long as head.

P r o n o t u m : Trapezoidal, about 1.6x as wide as long, paranota narrow, lateral margins sinuately converging anteriorly; disk with four carinae; posterior margin concave.

S c u t e l l u m : Triangular, about 1.5x as long as wide, lateral margins carinate, apex acute; disk with a median elevation on anterior half.

Hemelytra: Corium about as long as scutellum, posterolateral angles narrowly rounded; membrane with four faint veins.

Abdomen: Elongate oval, lateral margins evenly rounded; deltg VI-VIII attenuated posteriorly; pattern of apodemal impressions not discernible.

Venter: Sternites II-VII separated by transverse sutures; metathoracic scent gland structures not discernible.

Legs: Unarmed, claws with pulvilli.

Etymology: This epithet refers to the *Aradus*-like habitus and slender body, from >leptos< (Greek) = slender.

Discussion: Because of the combination of characters (see diagnosis), this taxon cannot be placed into one of the recognized extant subfamilies of Aradidae and does also not share essential characters of fossil Archearadinae. Its general habitus and structure of clypeus resemble that of Aradidae, however the latter possess no tarsal pulvilli. Its systematic placement is uncertain to date.

***Aradoleptus birmanus* nov.sp. (Figs. 11-12, photo 5)**

Holotype: Submacropterous female in a piece of Burmese amber from "Kachin State" in Myanmar (Burma), legs and antennae complete and bent ventrally; the exuvia of the last moulting stage is still attached to the specimen obscuring partly ventral segments. It is designated as holotype and labeled accordingly.

Description:

Head: Longer than wide (30/25), clypeus subparallel, dorsally not carinate, apex rounded reaching $\frac{1}{2}$ of antennal segment II; antenniferous lobes widening anteriorly, margins serrate; antennae 1.68x as long as width of head, segments I-III cylindrical, I shortest, II longer, III and IV of equal length, the latter fusiform; length of antennal segments I/II/III/IV = 7/10/13/13; eyes oval; postocular lobes not reaching outer margins of eyes, roundly converging posteriorly, lateral margins granulate; vertex beset with dense granulation.

Pronotum: Trapezoidal 1.63x as wide as long (36/22); paranota narrow, lateral margins finely serrate, sinuately converging anterolaterally, anterolateral angles blunt not reaching level of anterior margin; disk with four carinae, the two median ones lower, longer and straight, the sublateral ones more prominent, shorter and converging anteriorly.

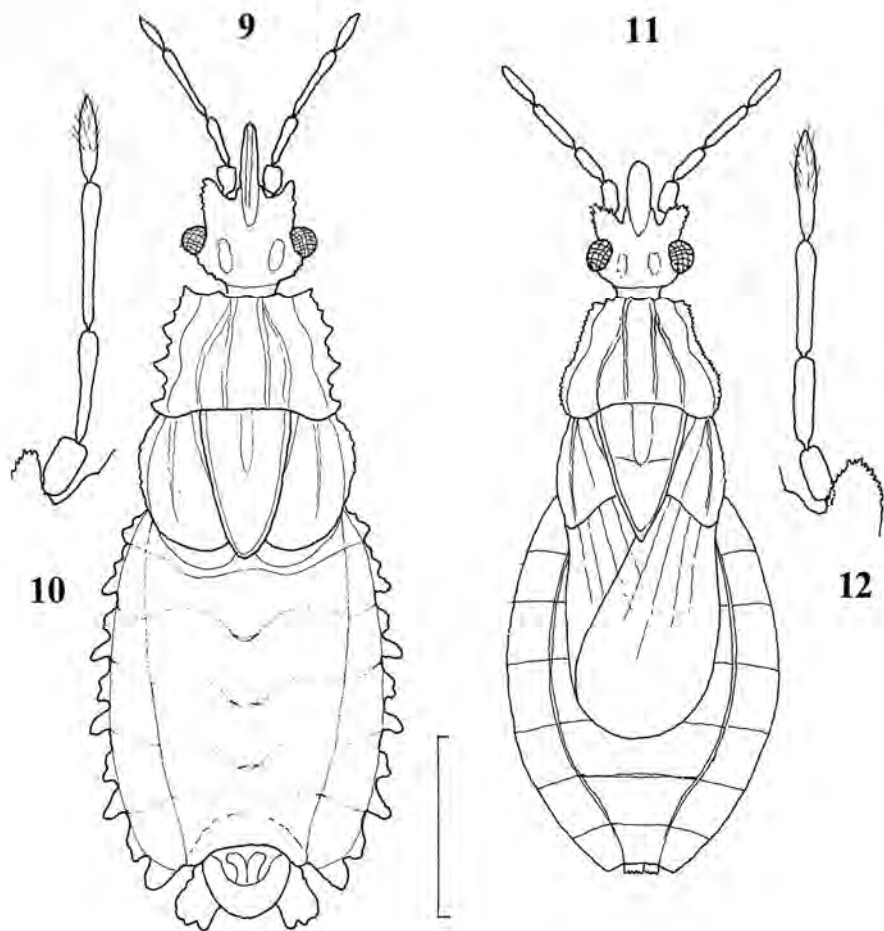
Scutellum: 1.5x as long as wide, lateral margins carinate, apex acute; disk with a median elevation on basal half, depressed posteriorly.

Hemelytra: Corium nearly reaching apex of scutellum, posterolaterally angularly rounded; disk with 2 veins; membrane hyaline reaching half of mtg VI with four faint veins, surface wrinkled.

Abdomen, venter and legs as generic description.

Measurements: Length 4.0mm, including exuvia 6.25mm; length of antennae 1.05mm; width of corium 1.0mm; length of abdomen 2.25mm, width across tergite V 1.55mm.

Etymology: Refers to Birma, the former historical English name for Myanmar.



Figs 9-12: Reconstruction of described taxa. **9-10:** *Archearadus elongatus* nov.sp.: **(9)** habitus; **(10)** left antenna; **11-12:** *Aradoleptus birmanus* nov.gen., nov.sp.: **(11)** habitus; **(12)** right antenna. Scale = 1mm.

***Archearadus elongatus* nov.sp. (Figs 9-10, photo 4)**

H o l o t y p e : Brachypterous male in a piece of Burmese amber from "Kachin State" in Myanmar (Burma) embedded in epoxyd resin (8x10x4mm), legs and antennae complete. It is designated as holotype and labeled accordingly.

D i a g n o s i s : Differs from the male of *Archearadus burmensis* HEISS & GRIMALDI 2001, the type species and only taxon of this fossil genus, by larger size, brachypterous hemelytra, shorter antennae and distinctly more elongate and slender abdomen.

D e s c r i p t i o n : Brachypterous male, body surface flat with dense fine granulation; colouration stramineous; apices of antennal segments II and III brown.

H e a d : Longer than width across eyes (37/28.5); clypeus long and slender dorsally keeled, reaching about $\frac{3}{4}$ of antennal segment II; antenniferous lobes blunt, reaching $\frac{1}{2}$ of antennal segment I; antennae 1.61x as long as width of head, segment I thickest and shortest, II and III thinner and longer tapering toward base, III longest, IV fusiform; length of antennal segments I/II/III/IV = 6/13/17/10; eyes laterally produced; postocular lobes roundly converging posteriorly; vertex with two rows of larger tubercles, depressed laterally; rostrum arising from an open atrium, shorter than head.

P r o n o t u m : Wider than long (41/25), lateral margins dentate, anterolateral angles acute, paranota distinct; disk with 2 straight median and 2 weakly developed sublateral carinae; posterior margin slightly concave.

S c u t e l l u m : 1.6x as long as wide (32/20), lateral margins carinate, apex narrowly rounded; disk with a median carina on anterior half.

H e m e l y t r a : Corium about as long as scutellum, lateral margins slightly reflexed, veins of disk indistinct; posterior margin rounded with a vestige of membrane.

A b d o m e n : Elongate oval, about 1.36x as long as wide across tergite V; lateral margins of deltg II-VII each with two lamellate expansions, the anterior one bilobate, the posterior one larger directed posterolaterally and rounded; mtg III-V medially roundly produced posteriorly, dorsal scent gland scars visible; ptg VIII wide, posterolaterally expanded and bilobate; pygophore dorsally exposed, a pair of hook like parameres is recognizable.

V e n t e r : Partly obscured by impurities; position of apodemal impressions and spiracles not discernible; pit-like metapleural scent gland discernible on the right side between meso- and metacoxae.

L e g s : Long and slender, unarmed; tarsi 2-segmented, claws with pulvilli.

M e a s u r e m e n t s : Length 4.45mm; length of antennae 1.15mm, width of abdomen 1.75mm; width of ptg VIII 0.80mm.

E t y m o l o g y : This epithet refers to the elongate habitus of this taxon.

D i s c u s s i o n : *Archearadus elongatus* nov.sp. shares the essential characters of this genus (very long clypeus, rostrum arising far from apex, abdominal tergites separated and not fused to tergal plate, metapleural scent gland developed, claws with pulvilli) based on a single male: *Archearadus burmensis* HEISS & GRIMALDI, 2001. Later, a female was tentatively assigned to *A. burmensis*, although lacking the lateral expansions of deltg II-VII (HEISS & GRIMALDI 2002).

Comparison of both males show, that the holotype of *A. burmensis* is of smaller size than *A. elongatus* nov.sp. (3.85/4.45mm), antennae are longer (1.68 / 1.61x as long as width of head), abdomen is much wider, ratio length of dorsally visible abdomen / width across tergite V= 1.12 (1.36 in *A. elongatus*) and posterior margins of mtg II-V are not roundly produced posteriorly. The different outline of head results from an obvious deformation during fossilization process in *A. burmensis*.

Acknowledgments

My sincere thanks go to Siegfried Ellenberger (Kassel, Germany), Carlos Ramiro (Krabi Town, Thailand) and Huarong Simon Chen (Etobicoke, Canada) who supplied the interesting material. I

also thank Frauke Stebner (Bonn, Germany) for cutting and embedding the inclusions, Stefan Heim (TLMF Innsbruck, Austria) who prepared the photos, Fritz Gusenleitner and Karin Traxler of the editorial team of Linzer Biologische Beiträge for their efforts to get published this important journal.

Zusammenfassung

Der im Teilstaat Kachin im Nordosten von Myanmar (Burma) abgebaute kreidezeitliche Burmesische Bernstein enthält ausgezeichnet erhaltene Insekten, deren Alter mit 90-100 Ma angegeben wird (GRIMALDI et al. 2002). Davon sind bisher vier Gattungen und Arten der Rindenwanzenfamilie Aradidae beschrieben worden.

Neue Inkluden aus der Sammlung des Autors enthalten bisher unbekannte Taxa, welche zu keiner der bekannten rezenten oder fossilen Gattungen gestellt werden können. Sie werden daher nachstehend als *Calisiomorpha yuripopovi* nov.gen., nov.sp.; *Ellenbergeria oviventris* nov.gen., nov.sp. und *Aradoleptus birmanus* nov.gen., nov.sp. beschrieben und abgebildet. Weiters wird eine zweite Art der bisher monotypischen Gattung *Archearadus* HEISS & GRIMALDI, 2001: *Archearadus elongatus* nov.sp. beschrieben.

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Jahr/Year: 2016

Band/Volume: [0048_1](#)

Autor(en)/Author(s): Heiss Ernst

Artikel/Article: [New genera and species of Aradidae in Cretaceous Burmese Amber \(Hemiptera: Heteroptera\) 419-429](#)