Cretaceous Research 72 (2017) 100–104

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

Short communication

An exotic insect *Aethiocarenus burmanicus* gen. et sp. nov. (Aethiocarenodea ord. nov., Aethiocarenidae fam. nov.) from mid-Cretaceous Myanmar amber

George Poinar Jr. [a, *], Alex E. Brown [b]

[a] Department of Integrative Biology, Oregon State University, Corvallis, OR 97331, USA
[b] 629 Euclid Avenue, Berkeley, CA 94708, USA

ARTICLE INFO

Article history:
Received 4 October 2016
Accepted in revised form 22 December 2016
Available online 23 December 2016

Keywords:
Aethiocarenodea ord. nov.
Aethiocarenidae fam. nov.
Mid-Cretaceous Myanmar amber
Aethiocarenus burmanicus gen. et sp. nov.
Exotic insect

ABSTRACT

An exotic wingless female insect in mid-Cretaceous Myanmar amber is described as *Aethiocarenus burmanicus* sp. et gen. nov. in the order Aethiocarenodea ord. nov. and family Aethiocarenidae fam. nov. The distinguishing feature of *Aethiocarenus burmanicus* sp. et gen. nov. is its unique head, the dorsum of which is shaped like an isosceles right triangle with the hypotenuse at the top and vertex positioned at the base of the neck. While insects with triangular-shaped heads are common today, the hypotenuse of the triangle is always located at the base of the head and attached to the neck, with the vertex at the apex of the head. Other features of the fossil are the long narrow, flat body, long slender legs, especially the hind pair that are twice the length of the abdomen, lack of wings, protruding eyes, paired ocelli, secretory glands located on the dorsum of the neck and swollen abdomen bearing paired segmented cerci.

1. Introduction

Amber from Myanmar has revealed very interesting fossils, many of which represent extinct lineages that have no close association with any extant groups. Previous examples include flies with horn-like protuberances emerging from their heads (Poinar, 2009), a fossil bee with some features carried over from ancestral wasps (Danforth and Poinar, 2011) and a bizarre wingless wasp lacking any indication of a waist (Rasnitsyn et al., 2017). A number of new insect orders have been described from fossils in Myanmar amber, the most recent being a specimen with a combination of roach and mantodean features (Bai et al., 2016). Angiosperm flowers in Myanmar amber can be equally unique in having no association with any known families (Poinar et al., 2007; Poinar et al., 2016).

Here we describe a wingless insect that displays features unknown in any extant or extinct insect Order. The most obvious diagnostic character is its head, the dorsum of which is shaped like an isosceles right triangle with the hypotenuse at the top and vertex positioned at the base of the neck. Based on its body structure and mouthparts, the fossil was probably an omnivore that lived in bark fissures among moss and other epiphytes.

2. Materials and methods

The specimen originated from the Noije Bum 2001 Summit Site mine excavated in the Hukawng Valley in 2001 and located southwest of Maingkhwan in Kachin State (26°20′N, 96°36′E) in Myanmar. Based on paleontological evidence this site was dated to the late Albian of the Early Cretaceous (Cruickshank and Ko, 2003), placing the age at 97 to 110 Ma. A more recent study using U–Pb zircon dating determined the age to be 98.79 ± 0.62 Ma or at the Albian/Cenomanian boundary (Shi et al., 2012).

Observations and photographs were made with a Nikon SMZ-10 R stereoscopic microscope and Nikon Optiphot compound microscope with magnifications up to 800×.

Helicon Focus Pro X64 was used to stack photos for better depth of field.

3. Systematic paleontology

Order Aethiocarenodea Poinar & Brown ord. nov.
LSID urn: lsid: zoobank.org:pub:5A652B79-AC72-4B9E-88B0-DF7BA9302C5E

* Corresponding author.
E-mail addresses: poinarg@science.oregonstate.edu (G. Poinar), alex.brown3@comcast.net (A.E. Brown).

http://dx.doi.org/10.1016/j.cretres.2016.12.011
0195-6671/

Family Aethiocarenidae Poinar & Brown fam. nov.
LSID urn: lsid: zoobank.org:act:1AAEC146-FFF1-4BD5-9189-A41DBA492B51

Type genus *Aethiocarenus* Poinar & Brown, gen. nov.

Diagnosis. Wingless female with flattened, elongate body, slender legs, wide head, polymerous non-geniculate antennae, and pentamerous tarsi. Head shaped like isosceles right triangle with hypotenuse (base) at top and vertex positioned at neck. Neck constricted, dorsum containing pair of secretory glands. Compound eyes protruding, huge in proportion to head. Paired ocelli located above antennal insertions. Thorax narrow, mesonotum and metanotum bearing long beaded setae. Abdomen swollen, with 10 segments (only seven visible dorsally), bearing two short, slightly curved segmented cerci.

Comments. The fossil is distinguished from all extinct and extant insects by its narrow body, long, slender legs, wingless condition, triangular head with 90-degree basal angles and a narrow neck with paired secretory glands. While mantids and other insects have triangular-shaped heads, the base of the triangle is attached to the neck and most movement is vertical. With the fossil, extreme horizontal movement would have been possible. It is assumed that the male also had a similar head shape but that is unknown at present, as is whether the males were wingless or not. Based on some similarities, such as the hypognathous head and leg spination, the fossil was compared with the recently described *Alienopterus brachyelytrus* Bai, Beutel, Klass, Zhang, Yang & Wipfler (2016). Aside from the different head shape, *A. brachyelytrus* is considerably larger than *Aethiocarenus* and possesses a wide subdivided pronotum and wings with the second pair extending to the tip of the abdomen, while *Aethiocarenus* (at least the female) has a narrow entire pronotum and is apterous. Also the tarsal segments of *Aethiocarenus* are distinctly longer than wide while in *A. brachyelytrus* the segments are short and stubby. Further,

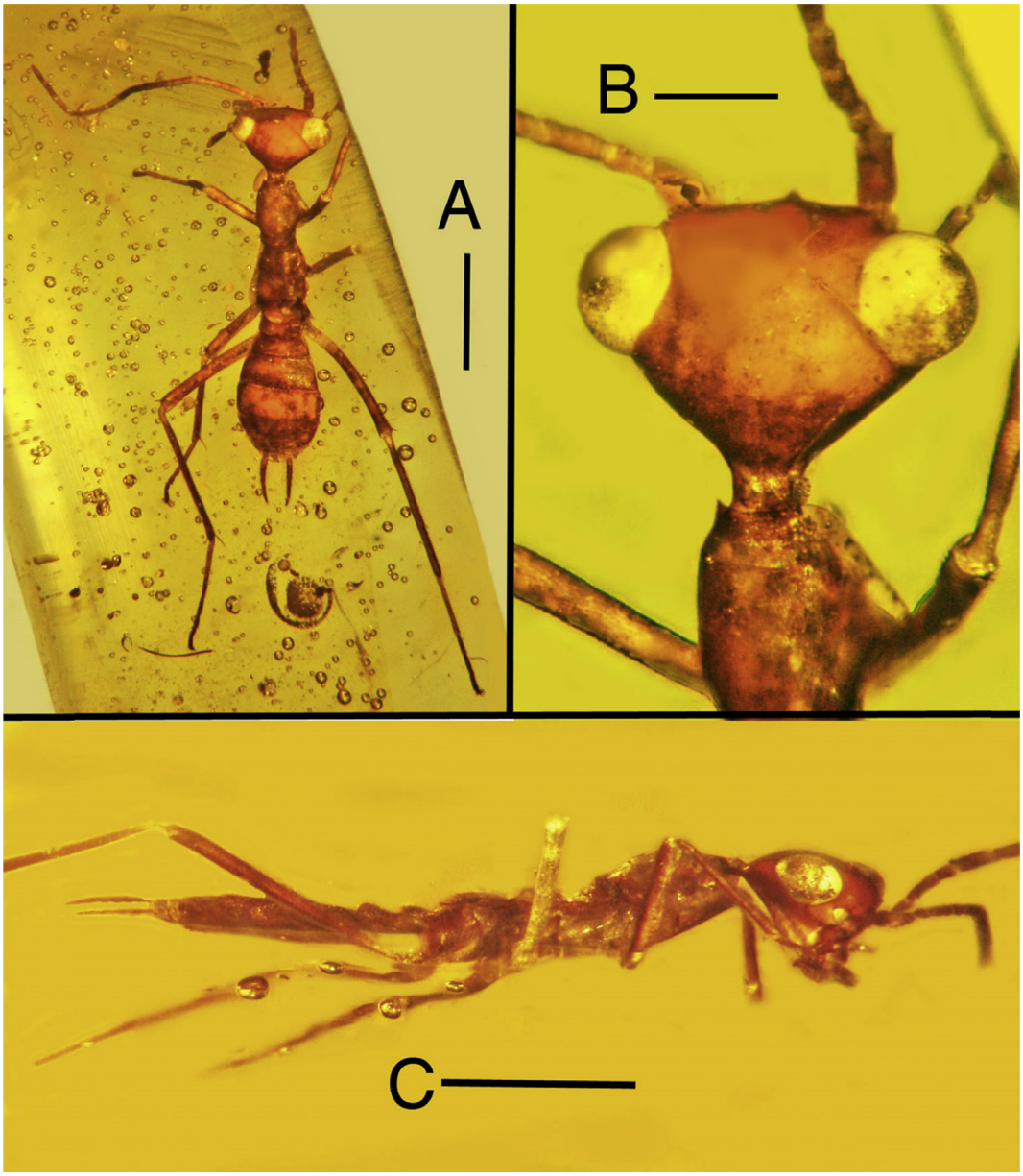

Fig. 1. Holotype of *Aethiocarenus burmanicus* gen. et sp. nov. in Myanmar amber. A. Dorsal view of entire specimen. Scale bar = 1.5 mm. B. Dorsal view of head, neck and anterior portion of pronotum. Scale bar = 0.4 mm. C. Lateral view of entire specimen. Scale bar = 1.1 mm.

A. brachyelytrus has large protarsal arolia between the claws, the 4 proximal tarsomeres each bear paired pad-like euplantulae, and tarsomere 5 is bent strongly upwards. None of these features are present on the tarsi of *Aethiocarenus*. The cerci of the two fossils are also different. While *A. brachyelytrus* has 5-segmented glabrous straight cerci with the terminal cercomere long and slender, the cerci of *A. burmanicus* are 12-segmented, densely setose, slightly curved inward and the terminal three cercomeres are minute (Fig. 3G,I).

Genus *Aethiocarenus* Poinar & Brown, gen. nov.
LSID urn: lsid: zoobank.org:pub:5A652B79-AC72-4B9E-88B0-DF7BA9302C5E
Type species: *Aethiocarenus burmanicus* Poinar & Brown, gen. et sp. nov.

Diagnosis. As for order and family (by monotypy).
Etymology. The generic name is derived from the Greek "aethes" = strange and the Greek "kara" = head.

Aethiocarenus burmanicus Poinar & Brown, sp. nov.
Figs. 1–3
LSID Zoobank C77C01A2-CA56-40FE-93DE-82213968A5B0.

Included species. Type species only.
Etymology. The specific epithet refers to the location of the fossil.
Type material. Holotype female deposited in the Poinar amber collection (accession # B-De- 2) maintained at Oregon State University.
Type locality. Hukawng Valley southwest of Maingkhwan in Kachin State (26°20′N, 96°36′E), Myanmar.
Description. The specimen is complete except for the terminal portion of the right foreleg, the right middle leg and the terminal portion of the right antennae.

Body and appendages reddish brown, body length, exclusive of antennae and cerci, 4.5 mm.

Head. Hypognathous, smooth, triangular-shaped with widest portion at apex; length head, 0.9 mm; width head, including eyes, 1.2 mm; compound eyes large, spherical, protruding, eye diameter, 0.35 mm; width between eyes, 0.6 mm; two ocelli located above antennal insertions; mouth mandibulate; labial palps 3-segmented; maxillary palps 5-segmented; neck narrow, width, 0.2 mm, bearing two small spherical secretory glands (diameter = 0.06 mm) on dorsum; antennae 3.5 mm long, 18-segmented with 7th segment largest, followed in size by 3 terminal segments; lengths of articles: first, 190 μm; second, 126 μm; third, 126 μm; fourth, 107 μm; fifth, 132 μm; sixth, 208 μm; seventh, 330 μm; eighth, 158 μm; ninth, 189 μm; tenth, 202 μm; eleventh, 189 μm; twelfth, 189 μm; thirteenth, 189 μm; fourteenth, 220 μm; fifteenth, 207 μm; sixteenth, 252 μm; seventeenth, 242 μm; eighteenth, 284 μm.
Thorax. Thorax narrow, elongate; pronotum cylindrical, length, 0.9 mm; width, 0.5 mm, anterior edge extended slightly to form short collar around neck; antero-lateral margins and posterior lateral angles slightly rounded; mesonotum transverse, 0.4 mm in length, 0.7 mm in width; metanotum transverse, 0.4 mm in length, 0.7 mm in width; dorsum of meso- and metanotum bearing long beaded setae arranged in fan-leaf pattern; legs slender, profemora 0.9 mm long, protibia 0.6 mm long, with single spine 190 μm in length at tip; protarsus 5-segmented; length protarsomeres, first, 252 μm; second, 126 μm; third, 126 μm; fourth, 126 μm (including extension); fifth, 190 μm; mesofemora 1.0 mm in length, mesotibia 1.2 mm in length, with single terminal spine 190 μm in length; mesotarsus 1.2 mm in length, 5-segmented; length mesotarsomeres, first, 180 μm; second,

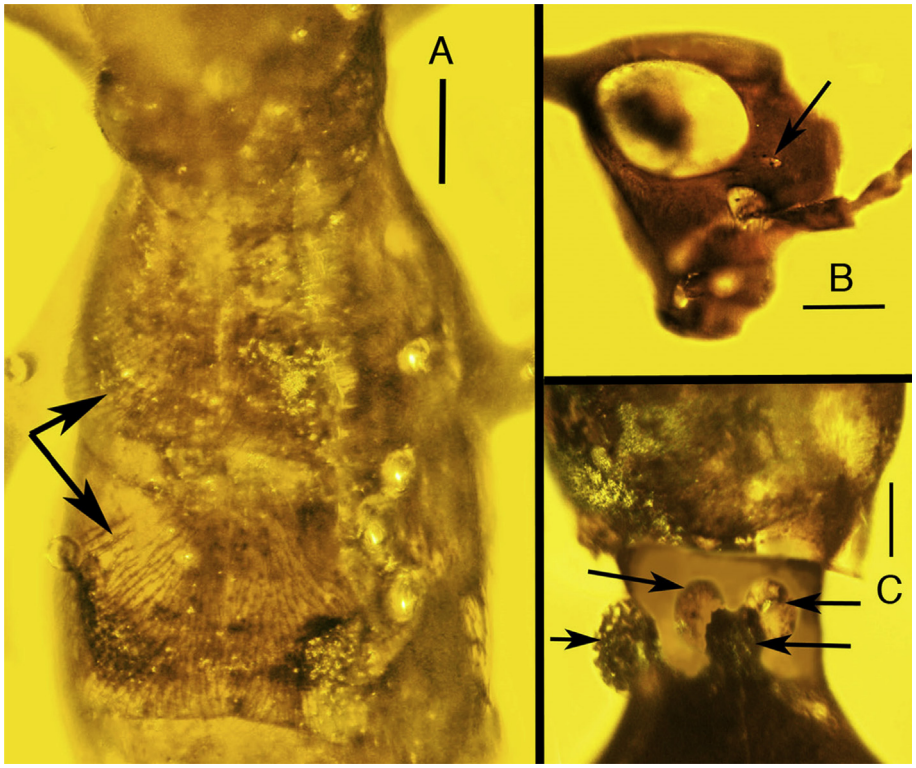

Fig. 2. Holotype of *Aethiocarenus burmanicus* gen. et sp. nov. in Myanmar amber. A. Dorsal view of base of pronotum, mesonotum and metanotum. Arrows show strange setal pattern on dorsum of mesonotum and metanotum. Scale bar = 0.2 mm. B. Lateral view of head showing antennal insertion and ocellus (arrow). Scale bar = 167 μm. C. Secretory glands (upper arrows) and secretion deposits (lower arrows) on neck. Scale bar = 68 μm.

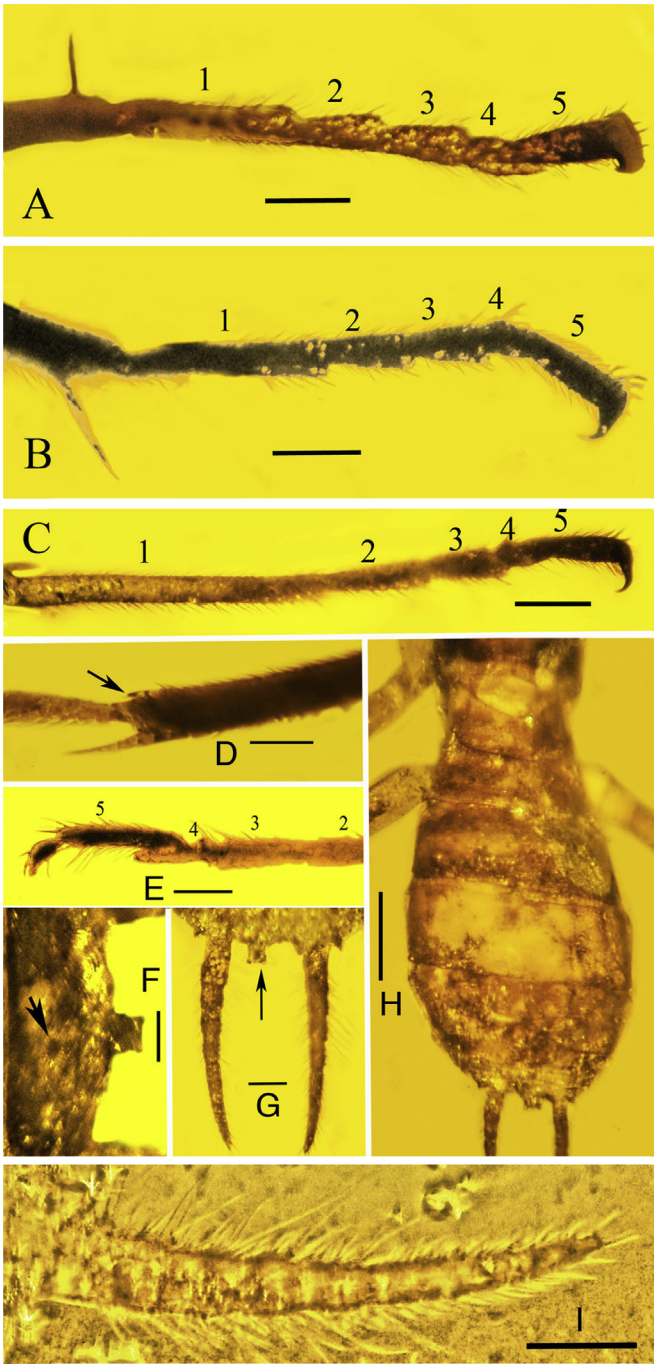

Fig. 3. Holotype of *Aethiocarenus burmanicus* gen. et sp. nov. in Myanmar amber. A. Numbered protarsal segments. Scale bar = 120 μm. B. Numbered mesotarsal segments. Scale bar = 85 μm. C. Numbered metatarsal segments. Scale bar = 153 μm. D. Hind leg showing apical tibial spurs (arrow shows small dorsal spur). Scale bar = 147 μm. E. Lateral view of tip of metatarsus showing tarsal segments with 4th segment extending distally beneath the base of 5th segment. Scale bar = 100 μm. F. Gonopore (arrow) on ventral sternite. Scale bar = 130 μm. G. Dorsal view of cerci. Arrow shows epiproct (= telson). Scale bar = 140 μm. H. Dorsal view of abdomen. Scale bar = 0.5 mm. I. Detail of left 12-segmented cercus. Scale bar = 130 μm.

70 μm; third, 67 μm; fourth, 45 μm; fifth, 135 μm; metafemur 1.9 mm in length, metatibia 1.8 mm in length, with two spurs (lengths, 220 μm and 87 μm) at tip; metatarsus, 1.6 mm in length; tarsus 5- segmented; length metatarsomeres, first, 652 μm; second, 218 μm; third, 164 μm; fourth, 120 μm; fifth, 218 μm. Claws curved, arolia present.

Abdomen. Swollen in middle, with 10 segments (only 7 visible dorsally); length abdomen, 1.8 mm, width at base, 0.7 mm, width at widest area, 1.2 mm; cerci 0.7 mm long, 0.37 as long as abdomen, densely setose, 12-segmented with terminal three cercomeres minute (Fig. 3I).

Remarks. It is not possible to place *Aethiocarenus burmanicus* gen. et sp. nov. in any extant or extinct order. Aside from the head shape, some features of *A. burmanicus* gen. et sp. nov. are found in the dermapteran Suborder Archidermaptera, but members of this group are winged, have transverse or rectangular pronotums, short legs with swollen femora (especially the profemur) and multi-segmented long cerci that are from 0.7 to 1.0 as long as the body (Xing et al., 2016). The cerci of *Aethiocarenus burmanicus* gen. et sp. nov. are relatively short and only 0.15 as long as the body. The narrow thorax of *A. burmanicus* gen. et sp. nov. is probably associated with its wingless condition, as occurs in extant Dermaptera that lack wings (Tillyard, 1926). The gonopore positioned behind the 8th sternum confirms the specimen as an adult female (Snodgrass, 1935) (Fig. 3F).

4. Discussion

Based on the non-specialized mouthparts, *A. burmanicus* gen. et sp. nov. was probably omnivorous. The narrow, flattened body suggests it could have explored bark fissures and epiphytes on tree surfaces. Wings would have been a hindrance in such a habitat. The long slender polymerous antennae were probably used to explore the surroundings and the long, slender legs indicated that it could move quickly if threatened. The dorsal neck glands presumably were used for defense. Evidence that these glands were secretory is the presence of two spherical bodies with irregular borders adjacent to the paired glands (Fig. 2C). These spherical bodies are considered to represent secretions released when the fossil entered the resin.

In *A. burmanicus* gen. et sp. nov., there is clear physical evidence that all tarsi are 5-segmented (Fig. 3A,B,C). It is interesting that the 4th tarsal segment extends distally beneath the base of the fifth in all legs of *Aethiocarenus burmanicus* gen. et sp. nov (Fig. 3E). This condition also occurs in some extant dermapterans (Forficulidae and Chelisochidae), although in these groups, the tarsi are reduced to 3 segments and it is the second tarsal segment that extends distally beneath the base of the third (Borror et al., 1989).

5. Concluding remarks

The head of *A. burmanicus* gen. et sp. nov., is unique in the insect world. It would be interesting to know if the head shape occurred in the predecessors of *A. burmanicus* gen. et sp. nov. and how long it was maintained in future lineages. The advantages of having a triangular head and narrow neck as *A. burmanicus* gen. et sp. nov. would be to provide extreme flexibility by allowing the head to swivel almost 180° horizontally while keeping the body stationary. If this adaptation was related to a particular food source, then the removal of that source could have been critical. If the preferred habitat of *A. burmanicus* gen. et sp. nov. was dense coniferous forests, a changing domain caused by diversification of the angiosperms could have been a significant factor in its disappearance (Poinar et al., 2007, 2016).

Acknowledgements

The authors would like to thank two anonymous reviewers for their detailed comments that greatly enhanced the paper.

References

Bai, M., Beutel, R.G., Klass, K.-D., Zhang, W., Yang, X., Wipfler, B., 2016. Alienoptera- a new insect order in the roach-mantodean twilight zone. Gondwana Research 39, 317–326.

Borror, D.J., Triplehorn, C.A., Johnson, N.F., 1989. An Introduction to the Study of Insects, sixth ed. Saunders College Pub, Philadelphia.

Cruickshank, R.D., Ko, K., 2003. Geology of an amber locality in the Hukawng Valley, northern Myanmar. Journal of Asian Earth Sciences 21, 441–455.

Danforth, B.D., Poinar Jr., G.O., 2011. Morphology, Classification, and Antiquity of *Melittosphex burmensis* (Apoiodea: Melittosphecidae) and implications for early bee evolution. Journal of Paleontology 85, 882–891.

Poinar Jr., G.O., 2009. *Cascoplecia insolitis* (Diptera: Cascopleciidae), a new family, genus and species of flower-visiting, unicorn fly (Bibionomorpha) in Early Cretaceous Burmese amber. Cretaceous Research 31, 71–76.

Poinar Jr., G.O., Chambers, K.L., Buckley, R., 2007. *Eoëpigynia burmensis* gen. and sp. nov., an Early Cretaceous eudicot flower (Angiospermae) in Burmese amber. Journal of the Botanical Research Institute of Texas 1, 91–96.

Poinar Jr., G.O., Buckley, R., Chen, H., 2016. A primitive mid-Cretaceous angiosperm flower, *Antiquifloris latifibris* gen. & sp. nov., in Myanmar amber. Journal of the Botanical Research Institute of Texas 10, 155–162.

Rasnitsyn, A.P., Poinar Jr., G., Brown, A.E., 2017. Bizarre wingless parasitic wasp from mid-Cretaceous amber (Hymenoptera, Ceraphronoidea, Apteroperissidae fam. nov.). Cretaceous Research 69, 113–118.

Shi, G., Grimaldi, D.A., Harlow, G.E., Wang, J., Wang, J., Yand, M., Lei, W., Li, Q., Li, X., 2012. Age constraint on Burmese amber based on U-Pb dating of zircons. Cretaceous Research 37, 155–163.

Snodgrass, R.E., 1935. Principles of Insect Morphology. McGraw-Hill, New York, 667 pp.

Tillyard, R.J., 1926. The Insects of Australia and New Zealand. Angus & Robertson, Ltd., Sydney, 560 pp.

Xing, A., Shih, C., Yunyun, Z., Ren, D., 2016. New protodiplatyids (Insecta: Dermaptera) from the Lower Cretaceous Yixian Formation of northeastern China. Cretaceous Research 64, 59–66.