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Article in *Cretaceous Research* · August 2018

DOI: 10.1016/j.cretres.2018.08.009

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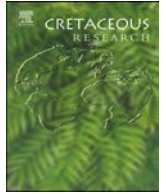
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## Short communication

## A new fossil genus of soldier beetles (Coleoptera: Cantharidae) from mid-Cretaceous Burmese amber: A probable case of adaptive convergence

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## ARTICLE INFO

## Article history:

Received 6 June 2018

Received in revised form

16 July 2018

Accepted in revised form 18 August 2018

Available online 20 August 2018

## Keywords:

Cretaceous

Burmite

Myanmar

Gondwana

New taxa

Adaptive convergence

## ABSTRACT

*Hukawngichthyurus kyawkhaingwini* gen. et sp. nov. is described and illustrated from the Cretaceous amber of Myanmar (Burmite). The new species belongs to the subfamily Cantharinae Imhoff, 1856, especially the last writes in a kind of fishtail are, similar to the representatives of tribe Ichthyurini Champion, 1915, subfamily Chauliognathinae LeConte, 1861, whose taxa are currently found mainly in the Southern Hemisphere and the Oriental region. This peculiar aspect makes us assume that we are dealing with a probable case of adaptive convergence and confirms that the arthropods (and plants) in Burmese amber have many similarities with the faunas of Gondwana.

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## 1. Introduction

The soldier beetles (Coleoptera: Cantharidae) found in Burmese amber have many unique characteristics and more related with the fauna now present in the Oriental (Sino-Indian) biogeographic region. The new species here described, although belonging to another subfamily, has strong similarities with the tribe Ichthyurini Champion, 1915, subfamily Chauliognathinae LeConte, 1861, which is currently composed of six genera: *Ichthyurus* Westwood, 1848, *Malthoichthyurus* Pic, 1919, *Microichthyurus* Pic, 1919, *Pseudocerocoma* Pic, 1919, *Trypheridium* Brancucci, 1985 and *Trypherus* LeConte, 1851 (Brancucci, 1980; Biffi, 2012), and inhabit all zoogeographic regions except for Australia (Ramsdale, 2002). In the neighbouring territories to Myanmar it is present the genus *Trypherus* that has a typical eastern Asia – eastern North American disjunct Arcto-Tertiary distribution (Brancucci, 1985b; Ramsdale, 2002). Today, the genus *Ichthyurus* is present in Myanmar and inhabits with about 190–200 taxa, particularly the Afrotropical and Oriental regions, with only seven species that have reached the North America (Arizona, Mexico, Guatemala), evidently in

successive waves during the Cenozoic, or anyway after the Cretaceous separation from South America (Miskimen, 1961b); and *Microichthyurus* present with over 40 taxa only in the Oriental (marginally Palearctic) region from Nepal, Japan to the Indonesian islands (Delkeskamp, 1977; Wittmer, 1978; Brancucci, 1983, 1985a; 2009; Mathew and Ramachandra Rao, 1986; Li et al., 2014; Li and Gao, 2015). Nonetheless, the unequal maxillary palps with the last palpomere securiform, clearly makes the new species belong to the subfamily Cantharinae, which does not have living representatives with fish tail shaped appendages. Moreover, the very short elytra and the well developed metathoracic wings, are very rare characteristics in this subfamily, particularly linked to extreme ecological circumstances (Fanti and Vitali, 2017).

## 2. Material and methods

The Holotype is imbedded in Cretaceous Burmese amber of the Hukawng Valley in northern Myanmar, approximately 20 km southwest of the Village of Tanai (Grimaldi et al., 2002; Kyaw Thu and Khin Zaw, 2017; Yin et al., 2017: fig. 1A). The Hukawng Basin is mainly comprised of sedimentary rocks with mines that exhibit clastic sedimentary rocks, limestone beds and many carbonaceous materials (Ross et al., 2000; Zherikhin and Ross, 2000; Cruickshank and Ko Ko, 2003; Kyaw Thu and Khin Zaw, 2017). Burmese amber

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from this location is currently dated, based on radiometric data, inclusions and palynology, back to the earliest Cenomanian, mid-Cretaceous, with an age of  $98.79 \pm 0.62$  Ma (Shi et al., 2012). The amber was cut, cleaned, polished and then photographed with a camera Canon EOS 750D mounted on a Leica Macroscope and Olympus BH2 Microscope. The photographs were processed with PhotoImpact Viewer SE and the reconstruction of the dorsal habitus was made free-hand with china ink. The Holotype is deposited in the SMNS Naturkunde Museum Stuttgart (Germany) amber collection, with the access code SMNS BU-336. This work is registered in Zoobank under urn:lsid:zoobank.org:pub:A9272462-2B4B-43F1-9B17-FA59FB0575AF.

### 3. Systematic palaeontology

Order Coleoptera Linnaeus, 1758

Superfamily Elateroidea Leach, 1815

Family Cantharidae Imhoff, 1856 (1815)

Subfamily Cantharinae Imhoff, 1856 (1815)

Tribe Cantharini Imhoff, 1856 (1815)

Genus *Hukawngichthyurus* Fanti et Ellenberger gen. nov.

Type species: *Hukawngichthyurus kyawkhaingwini* Fanti et Ellenberger sp. nov. The genus is at present monotypic. The name of the genus is registered in ZooBank under urn:lsid:zoobank.org:act:39D4EA97-2D6D-4812-93C4-COAD4A18D601.

*Etymology.* From the locality of origin Hukawng Valley and from the genus name *Ichthyurus* Westwood, 1848. In reference to its aspect with a kind of fish tail. The gender is masculine.

*Diagnosis.* The new genus shows a particular combination of characters: small body size, slender habitus, small rostrum, pronotum irregular with thickenings, short elytra, metathoracic wings largely exposed, tibial spurs apparently absent and last urites in a kind of fish-tail. This last feature is currently present only in the representatives of Chauliognathinae Ichthyurini, but these taxa show palpomeres of equal length and apical palpomere bilaterally symmetrical (Brancucci, 1980; Ramsdale, 2002), while the new genus

shows unequal maxillary palpomeres with the last palpomere securiform and apically straightly truncated.

*Distribution.* Currently known only from the Cretaceous Burmese amber of the Hukawng Valley, Myanmar.

*Hukawngichthyurus kyawkhaingwini* Fanti et Ellenberger sp. nov. (Figs. 1–3)

*Etymology.* In memory of Dr. Kyaw Khaing Win (20.1.1975–20.2.2018), geologist from Myanmar. The name of this species is registered in ZooBank under urn:lsid:zoobank.org:act:93135511-2549-4391-94A8-4EA4A8DCB1D8.

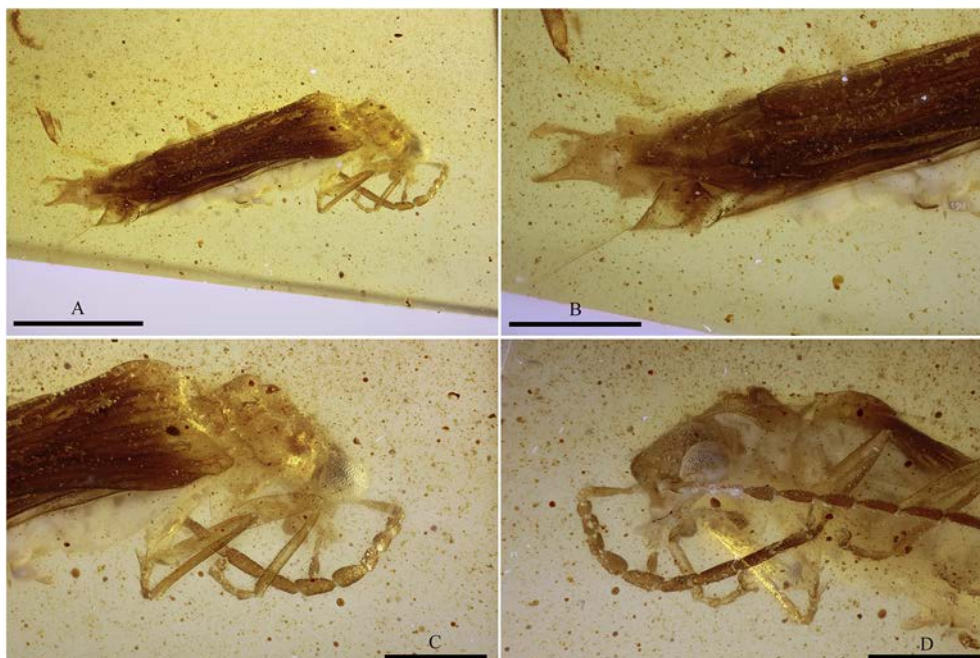
*Holotype.* Probably male, in Burmese amber, SMNS Naturkunde Museum Stuttgart amber collection, with the accession No. SMNS BU-336.

*Type locality.* Myanmar: Kachin state, Myitkyina District, Tanai Township, Hukawng Valley, Aung-Par-Hmaw mining area.

*Type horizon.* Lowermost Cenomanian ( $98.79 \pm 0.62$  Ma), mid-Cretaceous (Shi et al., 2012).

*Description.* Adult, winged, very slender. Probably male for the penultimate ventrite short and concave at centre and the last ventrite elongated and triangular. Head, pronotum and legs testaceous, with elytra darker (brown), antennae brown with the basal antennomeres paler. Body length: 3.1 mm, elytra: around 1.7 mm.

Head elongated, slightly convex, rounded behind the eyes, surface finely wrinkled and without setae. Eyes very large and prominent, convex, sub-elliptical, inserted laterally to the head; interocular distance about as long as the eye diameter. Rostrum elongated and robust. Mandibles not well visible, seemingly elongated and falciform. Maxillary palps 4-segmented with the first palpomere short and narrow, second palpomere elongated and very robust, third around two times shorter than second article and thinner, last palpomere elongated, securiform with apex straightly-truncated. Labial palps 3-segmented, with the last palpomere stout, strongly rounded and slightly securiform. Antennae 11-segmented, short, filiform with the central antennomeres slightly enlarged, grainy, without setae, slightly surpassing the first



**Fig. 1.** *Hukawngichthyurus kyawkhaingwini* Fanti et Ellenberger gen. et sp. nov. in Burmese amber. Holotype, SMNS BU-336, A. dorsal view (Bar = 1.0 mm); B. detail of last abdominal tergites (Bar = 500  $\mu$ m); C. detail of head and pronotum (Bar = 400  $\mu$ m); D. detail of palps and antenna (Bar = 400  $\mu$ m).



Fig. 2. *Hukawngichthyurus kyawkhaingwini* Fanti et Ellenberger gen. et sp. nov. in Burmese amber. Holotype, SMNS BU-336, ventral view (Bar = 500  $\mu$ m).

abdominal ventrites and reaching almost the half of elytra, insertion of the antennae near the eyes; scape thin and elongated, club-shaped; pedicel short, robust, moniliform; antennomeres III–V moniliform, sturdier and longer than pedicel; antennomeres VI–XI, filiform with antennomeres VI–VII shorter and sturdier than subsequent ones.

Pronotum transverse, slightly wider than head, with apical margin undulate, basal margin strongly undulating and bordered, lateral margins that narrows near the apical margin, surface irregular with depressions and without setae and punctation.

Scutellar-shield small, triangular with pointed apex.

Elytra at the base wider than pronotum, strongly restricted posteriorly, parallel-sided, rounded at apex, very short and revealing various tergites, surface without punctation and seemingly without pubescence but equipped with some little and thin striae, particularly on the basal half and shaded near the apex. Metathoracic wings dark, folded, surpassing the elytra, not reaching the last tergites.

Metasternum large, stout, sub-quadrate; ventrites narrow, strongly transverse and acute at margins, with the penultimate segment concave at centre and the last one elongated. Last urite with two asymmetrical apical lobes, in a kind of fish tail, one of which is large at base and posteriorly thinner with apex rounded, and the other one is inserted laterally and slender and longer.

Legs short, without pubescence; coxae elongated and robust; trochanters slightly elongated, globular-shaped with apex rounded;

pro- and mesofemora robust and curved, sturdier and shorter than tibiae, metafemora straight, more elongated than pro- and mesofemora; tibiae cylindrical, thin, longer than femora, without spurs; tarsal formula 5-5-5, with the first two tarsomeres triangular and subequal; third tarsomere shorter, about one-half as long as previous; fourth tarsomere bilobed; fifth elongated and thin; claws simple and seemingly without denticles or lobes.

*Syninclusions.* Wood remains.

*Differential diagnosis.* In the landscape of fossil taxa, the new species shows particular and unique characters. Only two fossil species as adpression/compression from the Eocene (Chadronian) Florissant Formation in Colorado, USA, are similar: *Chauliognathus pristinus* Scudder, 1876 (*Chauliognathinae* *Chauliognathini* LeConte, 1861), which shows a larger body size, seemingly twelve antennomeres but without fish-tail shaped urites, and *Trypherus aboriginalis* Wickham, 1913 (*Chauliognathinae* *Ichthyurini* Champion, 1915) which shows filiform antennae, shorter elytra and different pronotal shape (Scudder, 1876, 1885; 1887, 1900; Wickham, 1913; Fanti, 2017). The new species is also easily recognizable from the extant representatives of *Ichthyurini* for the unequal maxillary palpomeres with the last palpomere securiform.

*Remarks.* The yellow amber piece is flat and in the shape of a half-moon. It measures 12  $\times$  7  $\times$  2 mm and the matrix is transparent. The inclusion is complete and well visible.

#### 4. Discussion

The species is known from only one single specimen included in a piece of amber not containing syninclusions of insects or traces of pollen; therefore, it does not allow deducing the type of habitat or the feed sources. However, the current *Cantharinae* are predominantly predators, which supplement the diet with pollen, nectar, sprouts and sometimes fruit (Fiori, 1948–1949; Ramsdale, 2002; Onaral and Tezcan, 2017), while the current *Ichthyurini* are essentially carnivorous (Miskimen, 1961a, 1961b; Ramsdale, 2002) or omnivorous (Pérez-Hernández, 2018), without showing maxillary parts particularly suitable for pollen or nectar as in *Chauliognathus* Hentz, 1830 (Miskimen, 1961a; Ramsdale, 2002). For these reasons, including the shape of mandibles and palps, it is easily to hypothesize that also *Hukawngichthyurus kyawkhaingwini* gen. et sp. nov. was a predator of arthropods and probably pollinivorous-nectarivorous as well, and therefore, it had a diurnal activity (see: Pérez-Hernández, 2018). The elytra that properly cover the abdomen of many representatives of *Chauliognathini*, seem to be a

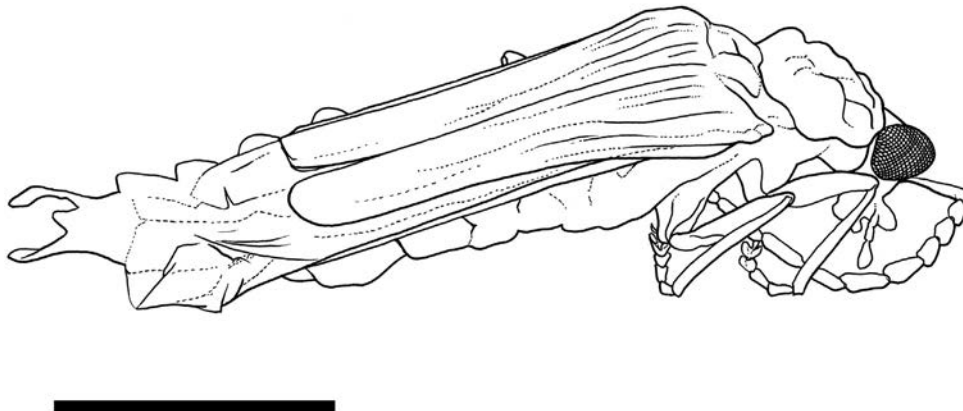


Fig. 3. *Hukawngichthyurus kyawkhaingwini* Fanti et Ellenberger gen. et sp. nov. in Burmese amber. Reconstruction, dorsal view (Bar = 1.0 mm).

primitive condition with respect to the short elytra (Miskimen, 1961a), while in the Cantharinae, the brachyptery seems to be recent and linked to particular ecological conditions, such as those of the high mountains (Fanti and Vitali, 2017; Fanti et al., 2018). Thus, with *Hukawngichthyurus* we are probably facing a case of adaptive convergence to environmental and climatic conditions common to Chauliognathinae and Cantharinae, even though the ecological pressure, which forced this convergence, remains unknown.

## 5. Conclusion

It is well known that Burmese amber mines are located on the West Burma Block, which was originally part of Gondwana; therefore many insects and plants trapped in this resin have closer living relatives only in Gondwana (Poinar, 2018). Also the fossil Cantharidae of this deposit, including *Hukawngichthyurus kyawkhaingwini* gen. et sp. nov., show particular characters that today are no longer present or rare and only in taxa of the Southern Hemisphere or of the Oriental region, confirming and supporting the Gondwanan origin. The diversification of the fossil soldier beetles of Burmese amber (Ross, 2018), as well as the current distribution of the Chauliognathinae suggests and confirms that the probable origin of Cantharidae is older than it was hypothesized so far (Fanti, 2017; Fanti et al., 2018), i.e. before the middle Cretaceous (Miskimen, 1961b). This also supports the hypothesis that Chauliognathinae (and probably, at least partly, Cantharinae Imhoff, 1856, although this case is much more uncertain, as this subfamily is present almost exclusively in Laurasia) originated in the Oriental region and then dispersed into Australia, North Eastern Asia and from there, into North and South America, and finally, before the Eocene, from the Oriental region further into Africa (Miskimen, 1961b).

## Acknowledgements

We are grateful to Gabriel Biffi (Museum of Zoology, São Paulo University, Brazil) and Yun Hsiao (Department of Entomology, National Taiwan University, Taiwan) for the suggestions. We extend our thanks also to Alessio Morelli (Pianella, Pescara, Italy) for the excellent reconstruction of the habitus and two anonymous reviewers for the comments.

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