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New mid-Cretaceous earwigs in amber from Myanmar (Dermaptera)

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Abstract. Two new genera and species of mid-Cretaceous earwigs are described and figured from Burmese (Myanmar) amber. ***Zigrasolabis speciosa*** Engel & Grimaldi, new genus and species, is represented by a series of females in a single, large piece of amber. ***Toxolabis zigrasi*** Engel & Grimaldi, new genus and species, is based on a single male. Two first-instar nymphs in the same piece as *T. zigrasi* may represent early stadia for this species. In addition, two further morphospecies of isolated nymphs are recorded. Both of the described genera belong to the Neodermaptera (*Zigrasolabis* a labidurine, *Toxolabis* likely an anisolabidine) but can be excluded from the Eudermaptera clade, the latter of which likely originated and diversified in the Early Tertiary or latest Cretaceous.

INTRODUCTION

Some insects are beloved, others reviled (wrongly or rightly), and most simply ignored. The earwigs (Dermaptera) are among those that are either completely overlooked or reviled for the wrong reasons. For centuries there has been a persistent myth that earwigs enter through the human ear canal to burrow into the brain and lay eggs, giving rise to their common name (Old English, "ēare" and "wicga", meaning "ear" and "insect": Berenbaum, 2007, 2009). Naturally, such a story is patently false and although earwigs have purportedly and on rare occasion been found to crawl into

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the opening of the ear for warmth (*e.g.*, Taylor, 1978; Fisher, 1986), as do many different small arthropods, they do not lay eggs, damage the brain, or cause insanity. Aside from being a nuisance in warm, dark, and damp places in human habitats, earwigs are at most moderately destructive to some crops as they will feed on foliage as well as small arthropods and such feeding can be detrimental to seedlings or soft-fleshed fruits (*e.g.*, Bower, 1992; Alford, 2007). In fact, earwigs can be quite beneficial. For example, the common European earwig *Forficula auricularia* Linnaeus, a common tramp species, can be an effective biological control agent of woolly apple aphids [*Eriosoma lanigerum* (Hausmann)] in orchards (Carroll & Hoyt, 1984; Mueller *et al.*, 2011), as well as other common pests (Suckling *et al.*, 2006). Earwigs are also considered one of the more beneficial species for the organic control of pests on kiwi in New Zealand (*e.g.*, Maher & Logan, 2007; Logan *et al.*, 2011), in some citrus orchards (*e.g.*, Romeu-Dalmau *et al.*, 2012), and even in maize fields (Sueldo de Escaño & Virla, 2009).

The Dermaptera comprise about 2000 described living species, segregated into 11 families (Engel & Haas, 2007). All living species belong to the suborder Neodermaptera (including the former groups Arixeniina, Hemimerina, and Forficulina), characterized by trimerous tarsi, the loss of tegminal venation, and the absence of ocelli (Grimaldi & Engel, 2005), with the development of unsegmented, forcipate cerci shared with the Eodermaptera. Two further suborders, both extinct, together form a grade relative to the Neodermaptera and extend from the Late Triassic into the Early Cretaceous (Wappler *et al.*, 2005; Grimaldi & Engel, 2005; Engel & Haas, 2007). The earliest definitive Neodermaptera are from the Early Cretaceous (*e.g.*, Engel *et al.*, 2002, 2011; Engel & Chatzimanolis, 2005), and the more familiar and diverse Eudermaptera (which includes the Forficulidae) likely did not originate until the latest Cretaceous. Most interestingly, where earwigs were once largely unheard of in Cretaceous amber (*e.g.*, Cockerell, 1920), since 2004 the number of species has accumulated rapidly (Engel & Grimaldi, 2004; Engel, 2009, 2011; Perrichot *et al.*, 2011; Engel *et al.*, 2011; Engel, Peris, Chatzimanolis, & Delclòs, in prep.; Engel & Perrichot, in prep.), and most of these have come from Burmese amber. Specimens with such remarkably fidelity of preservation serve to expand considerably our knowledge of Mesozoic Dermaptera, refining our understanding of earwig relationships and the evolution of their remarkable biologies such as parental care (*e.g.*, Engel, 2009).

Herein we describe two new genera of earwigs preserved in mid-Cretaceous amber from Myanmar. This account brings the number of named earwig species in this deposit up to six (Table 1). In addition, early-instar nymphs are similarly described, one morphospecies perhaps being early stages of one of the species described herein based on an adult (*Toxolabis zigrasi* Engel & Grimaldi, n. gen. et sp.) and included in the same piece of amber. Although earwigs are gregarious and females oversee and protect early-instar nymphs (*e.g.*, Lamb, 1976; Sasamoto, 1978; Vancassel, 1984; Rankin *et al.*, 1996; Costa, 2006), it is unlikely that these particular nymphs were aggregated with the adult as the individual is a male, the gender not associated with parental care in Dermaptera. Adults can frequently be cannibalistic (*e.g.*, Klostermeyer, 1942; Shepard *et al.*, 1973; Miller & Zink, 2012), and indeed even nymphs may kill 'nest'-mates ('siblicide') or, in rare cases, commit matricide as an aid to their survivorship (*e.g.*, Kohno, 1984, 1997; Suzuki *et al.*, 2005; Dobler & Kölliker, 2010; Meunier & Kölliker, 2012). It is more likely that the adult male in the piece would have attacked and killed these nymphs rather than care for them. For the other species (*Zigrasolabis speciosa* Engel & Grimaldi, n. gen. et sp.), numerous adults are included in the same, large piece of amber. Again, rather than being indicative of gregarious behavior this dense capture

Table 1. Described Cretaceous amber Dermaptera.

Taxon	**Locality**	**Family**
Astreptolabis ethirosomatia Engel, 2011	Myanmar	Pygidicranidae
Burmapygia resinata Engel & Grimaldi, 2004	Myanmar	Pygidicranidae
Gallinympha walleri Perrichot & Engel in Perrichot *et al*., 2011	France	Pygidicranidae
Myrrholabia electrina (Cockerell, 1920)	Myanmar	Labiduridae
Rhadinolabis phoenicica Engel *et al*., 2011	Lebanon	?
Toxolabis zigrasi n. gen., n. sp.	Myanmar	Anisolabididae?
Tytthodiplatys mecynocercus Engel, 2011	Myanmar	Diplatyidae
Zigrasolabis speciosa n. gen., n. sp.	Myanmar	Labiduridae
Nymph (Engel *et al*., 2011)	Lebanon	?
Nymph (Engel, 2009)	France	Labiduridae?
Nymph sp. 1 (herein)	Myanmar	Anisolabididae?
Nymph sp. 2 (herein)	Myanmar	?
N. gen., n. sp. (Engel, Peris, Chatzimanolis, & Delclòs, in prep.)	Spain	Labiduridae?
N. gen., n. sp. (Engel & Perrichot, in prep.)	France	?

of individuals perhaps resulted from aggregating pheromones frequently emitted by earwigs (*e.g*., Walker *et al*., 1993; Sauphanor & Sureau, 1993), although admittedly this behavior and its occurrence broadly across Dermaptera is poorly understood.

MATERIAL AND METHODS

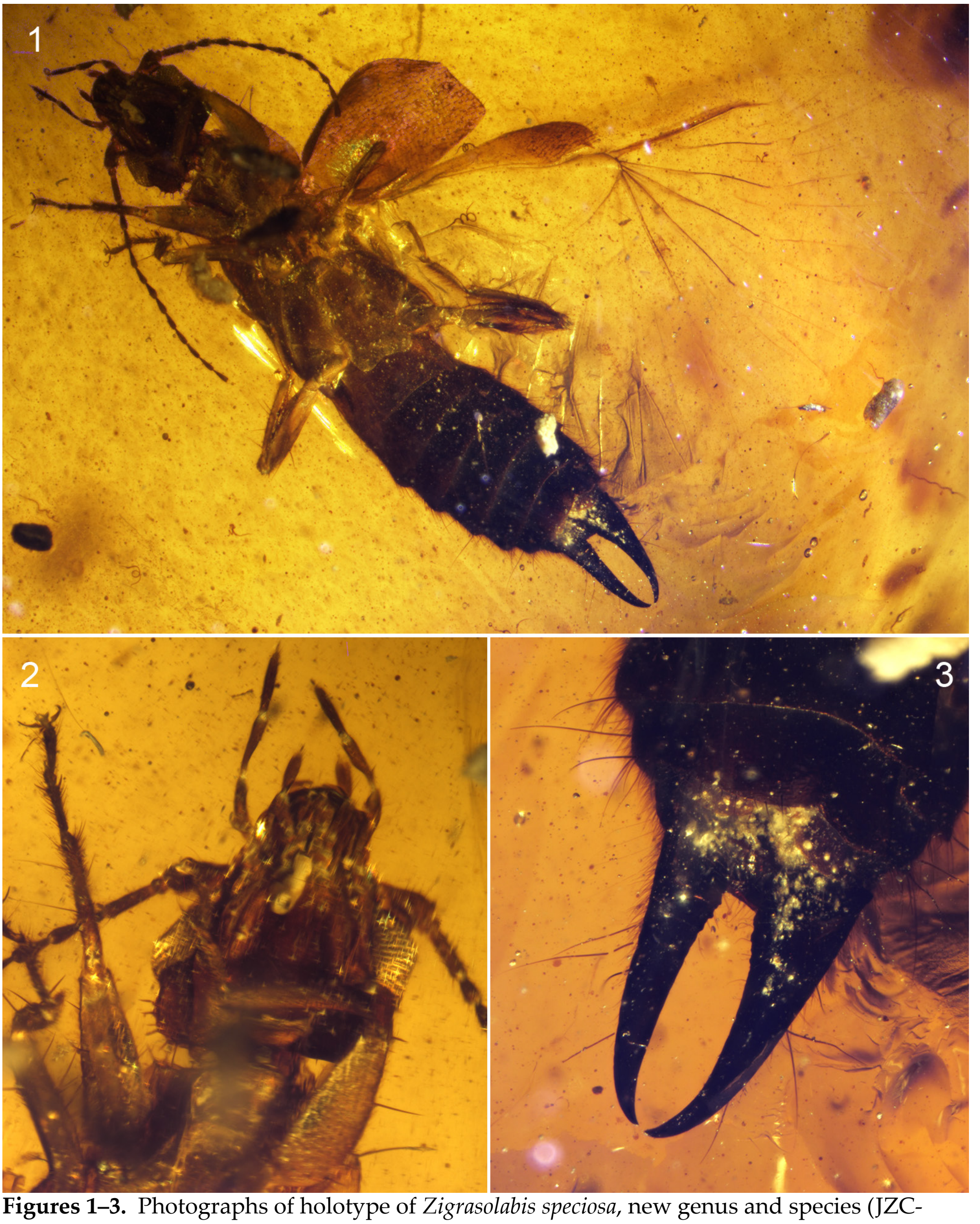
The age, origin, and paleobiota of Burmese amber have been recently reviewed by Grimaldi *et al*. (2002), Ross *et al*. (2010), and Shi *et al*. (2012). The material discussed herein is in the private collection of Mr. James S. Zigras, who kindly loaned the pieces for study and description, and is available for study through the American Museum of Natural History (AMNH), New York. Morphological terminology follows that of Giles (1963), Günther & Herter (1974), and Haas (1995, 2003). The higher classification adopted herein is that of Engel & Haas (2007). Photomicrography and measurements were done with Nikon SMZ1500 stereomicroscope and NIS-Elements software.

SYSTEMATIC PALEONTOLOGY

Suborder Neodermaptera Engel
Infraorder Epidermaptera Engel
Zigrasolabis Engel & Grimaldi, new genus
ZooBank: urn:lsid:zoobank.org:act:CFF9134A-9763-4E76-B9DF-8E149DDAFF4A

Type species: *Zigrasolabis speciosa* Engel & Grimaldi, new species.

Diagnosis: Moderate-sized earwigs (*ca*. 8–8.3 mm), somewhat dorsoventrally compressed; with scattered setae, not chaetulose; integument matt and largely imbricate, without strong sculpturing. Head prognathous, broad but slightly narrower

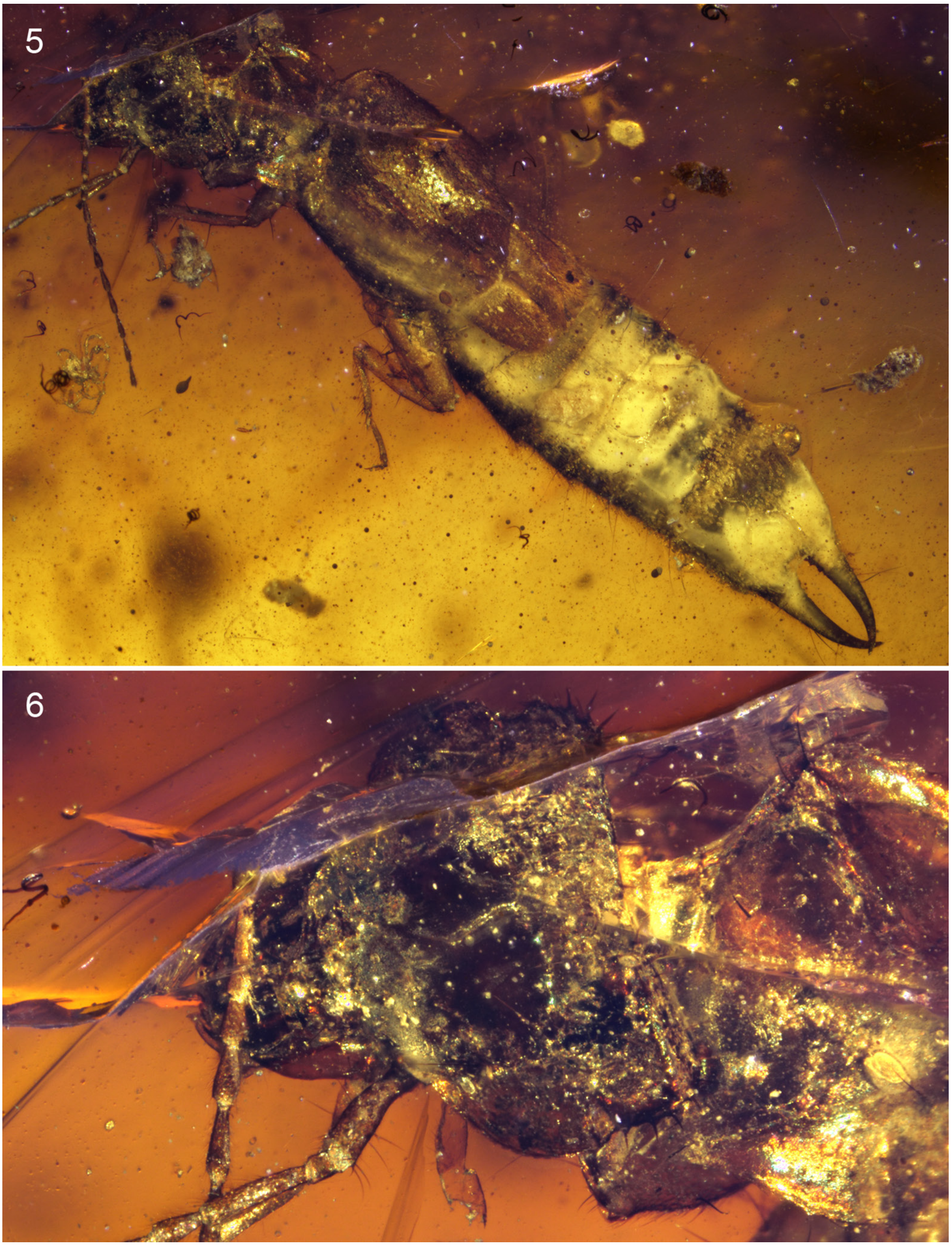


Figures 1–3. Photographs of holotype of *Zigrasolabis speciosa*, new genus and species (JZC-Bu232). **1.** Ventral view. **2.** Detail of venter of head. **3.** Detail of cercal forceps.

than pronotum, surface not tumid, relatively flat, posterior border faintly concave medially, otherwise relatively straight; compound eyes large, separated from posterior border by less than compound eye length, inner margins of compound eyes separated by 2.6 times compound eye length; ocelli absent; ecdysial cleavage lines not evident; antenna with at least 14–15 antennomeres (14 in holotype but both antennae appear incomplete, 15 on one side of paratype but both appear incomplete); scape slightly broader than flagellomeres, about 2.5 times as long as wide; pedicel slightly longer

Figure 4. Photograph of unfolded hind wing of holotype of *Zigrasolabis speciosa*, new genus and species (JZC-Bu232).

than wide; flagellomeres longer than wide, first flagellomere longest, length about 3.9 times width, about as long as scape; second and third flagellomeres about twice as long as wide and about half length of first flagellomere; temple corners rounded with series of short, stiff spines (Figs. 2, 6, 7); submentum large; genal sulcus strongly carinate; cervical sclerites of 'forficuloid' type (posterior ventral sclerite distinctly larger than anterior ventral sclerite and abutting medially anterior margin of prosternum). Pronotum large, broader than long and broader than head, anterior margin straight, anterolateral corners relatively sharp, orthogonal, lateral margins weakly convex and parallel, posterolateral angle broadly rounded, posterior border straight. Tegmina well developed, together with squama covering basal abdominal segments, outer margins relatively straight and parallel, inner margin gently and shallowly convex, apical margin obliquely straight from outer border to midline, with longest point at midline, with setae and not chaetulose; hind wings present, squama extending well beyond tegiminal apex, about twice as long as apical width. Prosternum nearly twice as long as wide, with procoxa positioned near posterior end; mesosternum subquadrangular, with anterior and posterior margins relatively straight, lateral margins very faintly converge posteriorly, with mesocoxae positioned near posterior margin; metasternum large, with anterior margin relatively straight, lateral borders diverging from anterior margin to about two-thirds length, then deeply concave for reception of metacoxae, posterior margin very faintly concave and only slightly wider than mesosternum, otherwise metasternum much broader than mesosternum just before position of meta-



Figures 5–6. Photographs of one paratype of *Zigrasolabis speciosa*, new genus and species (JZC-Bu232). **5.** Dorsal habitus of entire individual. **6.** Dorsal detail of head.

coxae. Femora not carinulate or keeled; tarsi trimerous, second tarsomere shortest, slanted such that dorsal surface slightly shorter than ventral surface, not lobed or greatly projecting beneath distalmost tarsomere; pretarsal claws long, simple; arolium present, large. Abdomen with 8 segments visible (female), although basal segments largely obscured by tegmina and squamata, lateral margins weakly convex, broadest

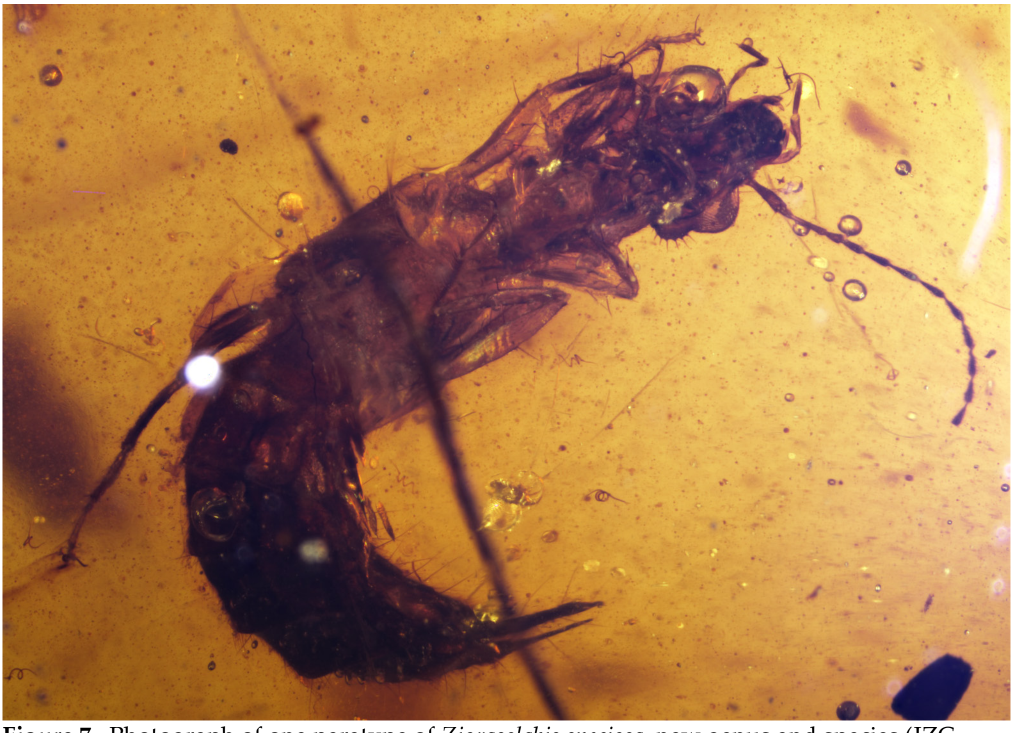


Figure 7. Photograph of one paratype of *Zigrasolabis speciosa*, new genus and species (JZC-Bu232).

at segments III–IV, segments transverse, apicalmost segment much broader than long, with apical margin straight, without tubercles or spines; ultimate sternum relatively simple, with apical margin straight and unmodified. Cerci symmetrical, long, slender, and relatively straight, tapering gradually from base to acutely rounded apex, apically slightly incurved (Figs. 3, 5), with few sparse very long, stiff setae on outer and upper margins, without tubercles, with very short blunt serrations on inner margin near base, cercal bases broadly separated; pygidium not evident (perhaps bent ventrad as in many labidurids).

Etymology: The new genus-group name is a combination of Zigras, honoring James S. Zigras, and *labis* (meaning, "forceps"). The name is feminine.

Zigrasolabis speciosa Engel & Grimaldi, new species
ZooBank: urn:lsid:zoobank.org:act:ABE340CB-9B88-41EE-9FEF-CD19EEAAD91D
(Figs. 1–8)

Diagnosis: As for the genus (*vide supra*).

Description: ♀: As for the genus with the following additions: Total length as preserved (including cerci) *ca*. 8–8.3 mm (holotype 8.0 mm, most well preserved paratype 8.3 mm). Integument brown to dark brown except lighter on legs and mouthparts, abdominal terga particularly dark and cerci black; not densely setose, most setae scattered, short, appressed to subappressed, distinctly not chaetulose; integument imbricate and impunctate. Head length 1.2 mm, width 1.17 mm; width between compound eyes 0.94 mm; compound eye length 0.36 mm; temple length 0.26 mm; scape length

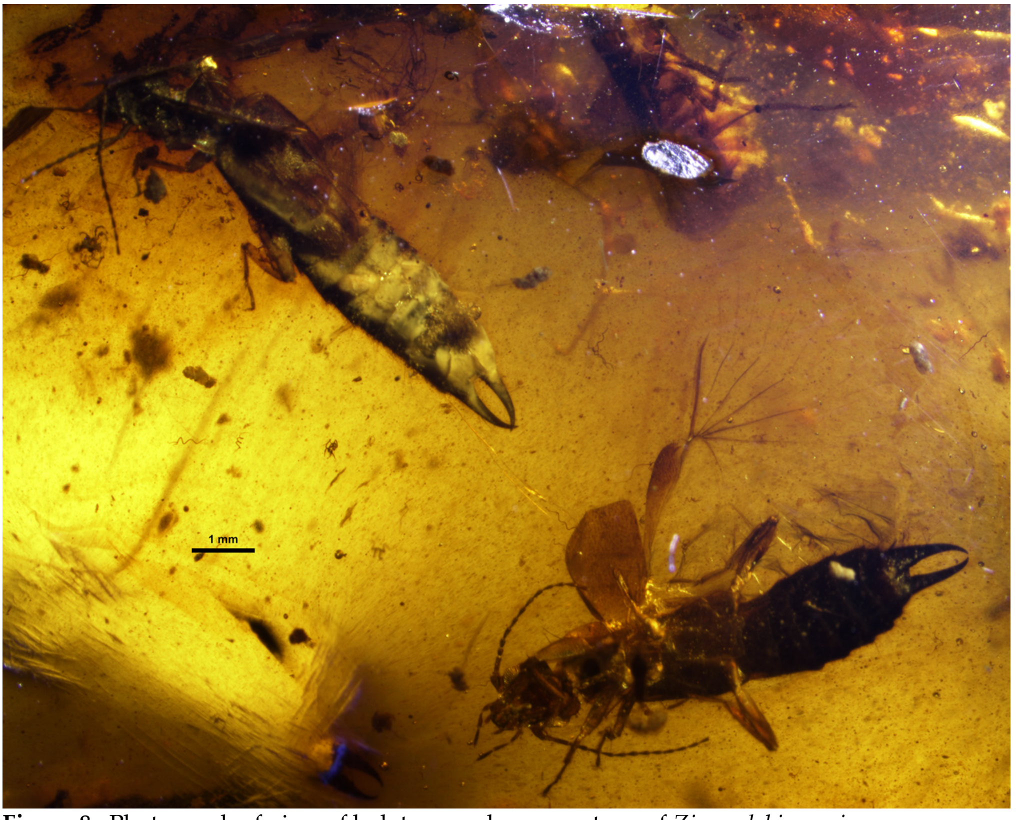


Figure 8. Photograph of view of holotype and one paratype of *Zigrasolabis speciosa*, new genus and species (JZC-Bu232) in single, large piece of Burmese amber.

0.31 mm, width 0.10 mm; pedicel length 0.08 mm; first flagellomere length 0.31 mm, second flagellomere length 0.15 mm; third flagellomere length 0.18 mm; fourth flagellomere length 0.20 mm; individual widths of flagellomeres I–IV each 0.08 mm. Head with series of short, stiff setae or spines laterally on temples from behind compound eye rounding onto posterior border of head but not extending full length of posterior border, with a few similar setae more medially on posterior border of head; a prominent, elongate seta posterior to antenna and near inner border of compound eye; a similar prominent, elongate seta near lateral basal border with clypeus; clypeus with pair of similar setae paramedially, otherwise with sparse, minute, fine setae on clypeus and labrum. Legs with scattered, fine, short, appressed to subappressed setae and femora and tibiae with scattered elongate, stiff, setae on dorsal, anterior, and posterior surfaces. Pronotum length 0.89 mm, width 1.28 mm, with elongate, prominent, stiff setae at anterolateral corners and directed forward, with much shorter, stiff setae on anterior margins slightly inward from apicolateral corner seta and with another paramedially on anterior margin, laterally with scattered short, stiff setae posteriorly directed and extending around posterolateral corner along posterior margin; disc with pair of similar prominent setae paramedially in posterior quarter, otherwise with sparse, minute, fine, appressed to subappressed setae. Tegmina and squamata with scattered short, fine, appressed to suberect setae; squama length 0.77 mm, width 0.51 mm; tegmina length 2.17 mm, width 0.77 mm. Abdominal length 4.5 mm, maximal width 1.53 mm, with scattered very short largely appressed to suberect posteriorly-directed setae, those apicolaterally slightly longer; posterior margins of abdominal terga relatively straight; cerci long, length 1.15 mm, basal width 0.28 mm, separation between bases 0.26 mm.

♂: Unknown.

Holotype: ♀ (individual with left hind wing spread: Figs. 1–4), JZC-Bu232, in amber from the earliest Cenomanian/latest Albian of Kachin Province, northern Myanmar (Grimaldi *et al*., 2002; Shi *et al*., 2012); specimen in collection of Mr. James Zigras, available for study through the Division of Invertebrate Zoology, American Museum of Natural History, New York.

Paratypes: Two adult ♀♀ in same piece as holotype (Figs. 5, 7, 8).

Additional material: In the same amber piece as the type series there is a third partial adult at the amber surface and represented only by the cerci and apical margin of the ultimate abdominal segment. The structure of the cerci is identical with those of the others and presumably this was of the same species.

Etymology: The specific epithet is based on the Latin word *speciosus*, meaning "splendid".

Toxolabis Engel & Grimaldi, new genus

ZooBank: urn:lsid:zoobank.org:act:2ADB574A-4E44-4B4F-B89D-E2CCA796B15B

Type species: *Toxolabis zigrasi* Engel & Grimaldi, new species.

Diagnosis: Small earwigs (*ca*. 6.2 mm); somewhat dorsoventrally compressed; with scattered short setae (Fig. 9), not chaetulose; integument dull and matt throughout. Head prognathous, broad, as wide as anterior border of pronotum; slightly tumid, posterior border gently and broadly concave; compound eyes relatively small, separated from posterior border by approximately twice compound eye length, inner margins of compound eyes separated by slightly more than three times compound eye length; ocelli absent; ecdysial cleavage lines not evident; antenna with at least 14 antennomeres (neither antenna is complete, left antenna preserved only by scape, right preserved to antennomere 12 which is clearly not the apicalmost antennomere as evidenced by its shape and open apex); scape slightly broader than flagellomeres, about 2.5 times as long as wide; pedicel slightly longer than wide; flagellomeres longer than wide, first flagellomere longest, length about four times width, about as long as scape; second and third flagellomeres about twice as long as wide and about one-half length of first flagellomere; submentum particularly large and circular; cervical sclerites of 'forficuloid' type. Pronotum relatively large, anterior margin relatively straight (Fig. 11), anterolateral corners relatively sharp, orthogonal, lateral margins parallel and relatively straight, posterolateral angle broadly rounded, posterior border relatively straight. Tegmina relatively short, at most reaching to first abdominal tergum but not covering it, outer margins straight and parallel, inner margin gently and shallowly convex, apex blunt and very weakly convex, integument not densely setose or chaetulose; hind wings present (as evidenced by presence of squama), squama exposed from tegminal apex and broadly rounded, exposed section about as long as wide. Femora not carinulate or keeled; tarsi trimerous, second tarsomere shortest and simple, not strongly projecting beneath distalmost tarsomere or strongly slanted; pretarsal claws long, simple; arolium absent. Abdomen with 10 segments visible (male), lateral margins very weakly convex, broadest at segment VI, most segments broader than long, apicalmost segment much broader than long, with apical margin relatively straight, with small, weak, bluntly rounded tubercles slightly extending over cercal bases; ultimate sternum relatively simple, with apical margin between cerci slightly extended caudad, with blunt and straight apical margin across medial third. Cerci roughly symmetrical, long and slender, strongly incurved just beyond midlength (Fig. 10), gently tapering along length to acutely rounded apex, with sparse very long, stiff setae in middle third, without tubercles, dentition, or serrations, broadly separated at base; pygidium short and broad, apical margin broadly rounded, downcurved and therefore horizontal between cerci (Fig. 10).

ETYMOLOGY: The new genus-group name is a combination of the Greek words *toxon* (meaning, "bow") and *labis* (meaning, "forceps"), serving as a reference to the arched or bowed cercal forceps. The name is feminine.

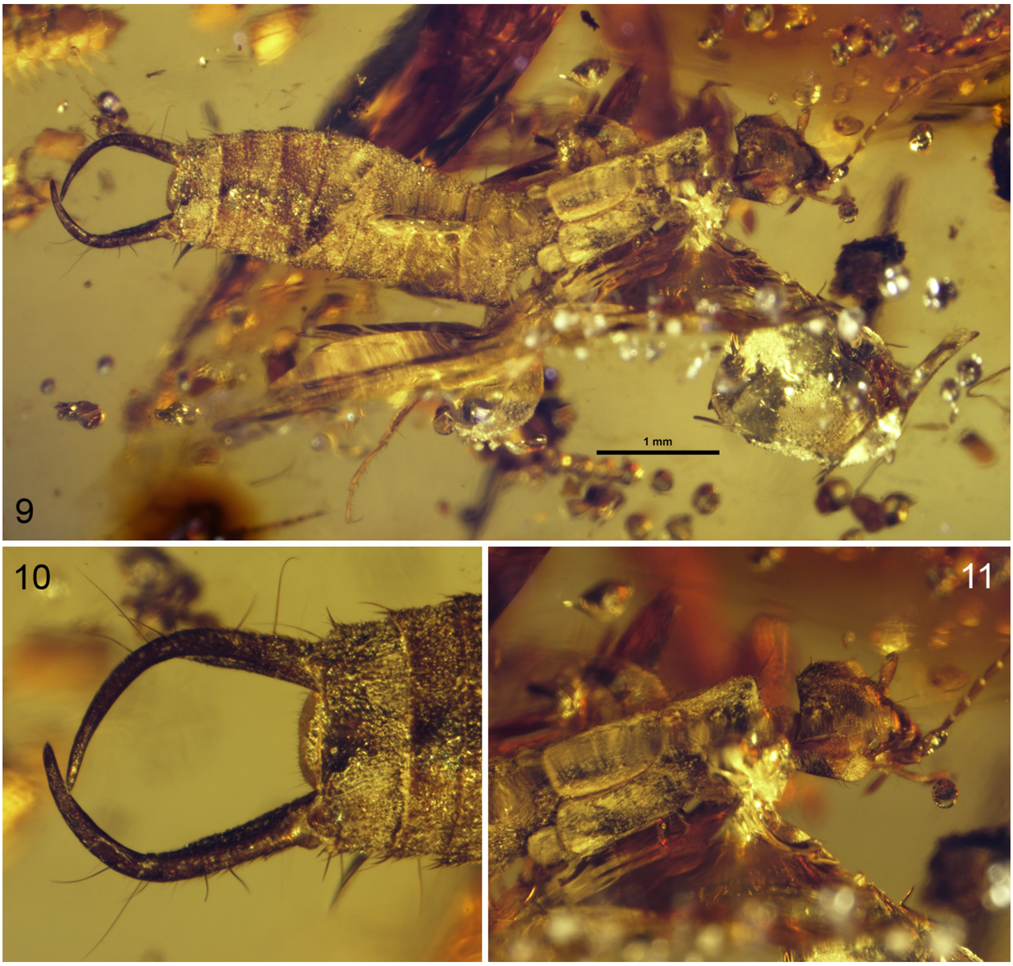
Toxolabis zigrasi Engel & Grimaldi, new species
ZooBank: urn:lsid:zoobank.org:act:8A0D1FDA-2A2B-4948-ABCE-962B6E05FCD1
(Figs. 9–11)

DIAGNOSIS: As for the genus (*vide supra*).

DESCRIPTION: ♂: As for the genus, with the following additions: Total length as preserved (including cerci) 6.2 mm. Integument brown to dark brown throughout except lighter on legs and mouthparts; not densely setose, setae relatively sparse and short except for some prominent stiff setae as noted, not chaetulose; integument apparently imbricate, more coarsely so on abdomen, and largely impunctate except shallow, faint, punctures on abdomen. Head length 0.74 mm, width 0.69 mm; compound eye length 0.15 mm, temple length 0.31 mm; first flagellomere length 0.20 mm, width 0.05 mm; second and third flagellomeres individual lengths 0.10 mm, individual widths 0.05 mm. Head with few prominent, short setae on temples near posterior corner of head, with a more elongate, stiff, erect seta posterior to antenna and near inner border of compound eye, and a similar seta on face near lateral border with clypeus; clypeus and labrum with scattered, very short, subappressed, fine setae. Legs with scattered, fine, short, appressed to subappressed setae; femora with 2–3 elongate, stiff, setae, but without stiff spines. Pronotum length 0.61 mm, width 0.69 mm, with elongate, prominent, stiff setae at anterolateral corners and directed forward, with much shorter, stiff setae on anterior margins slightly inward from apicolateral corner seta, with 1–2 short, stiff prominent setae near or at posterolateral angles. Tegmina length 0.77 mm, width 0.36 mm, with scattered short, fine, appressed to suberect setae, with 2–3 more prominent, erect, stiff setae on disc and situated along length in tangent near longitudinal midline, with a couple similarly prominent setae along outer border. Abdominal length 3.5 mm, maximal width 1.1 mm (at segment VI), with scattered very short largely appressed to suberect posteriorly-directed setae, although more prominent setae present at apicoloateral corners of terga, some of those more erect and sometimes perpendicular to long axis of abdomen; posterior margins of abdominal terga relatively straight; ultimate tergum longer than penultimate tergum, ultimate tergum length 0.33 m, width 0.82 mm; cerci long, length 1.0 mm, basal width 0.15 mm, basal separation 0.38 mm.

♀: Unknown.

HOLOTYPE: ♂ (Fig. 9), JZC-Bu231, in amber from the earliest Cenomanian/latest Albian of Kachin Province, northern Myanmar (Grimaldi *et al.*, 2002; Shi *et al.*, 2012); specimen in collection of Mr. James Zigras, available for study through the Division of Invertebrate Zoology, American Museum of Natural History, New York.



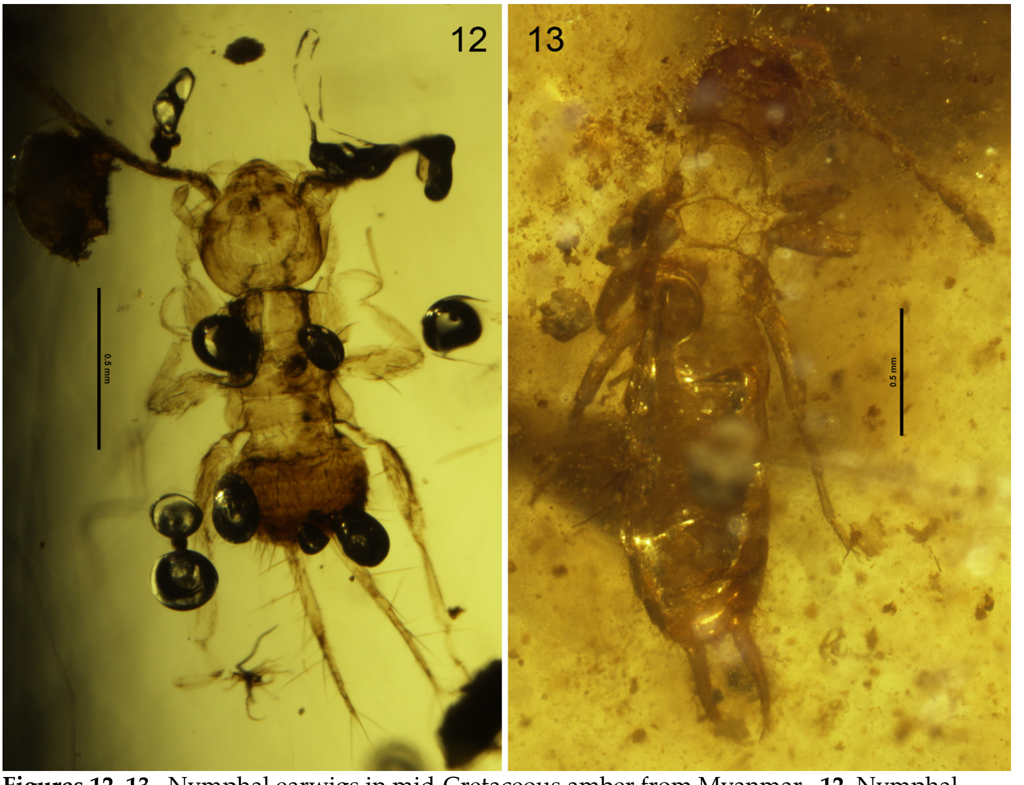
Figures 9–11. Photographs of male holotype (JZC-Bu231) of *Toxolabis zigrasi*, new genus and species, in mid-Cretaceous amber from Myanmar. **9.** Dorsal habitus. **10.** Detail of cercal forceps and apicalmost abdominal terga. **11.** Detail of thoracic dorsum and head.

Etymology: The specific epithet is a patronym honoring James S. Zigras, the collector of this and many excellent inclusions in Burmese amber.

Nymph sp. 1 (*T. zigrasi*?)

Material: Two, largely-cleared first-instar nymphs (Fig. 12), in same piece as holotype of *T. zigrasi*, JZC-Bu231; specimen in collection of Mr. James Zigras, available for study through the Division of Invertebrate Zoology, American Museum of Natural History, New York.

Descriptive notes: Total length as preserved (excluding cerci) 1.8 mm; submentum particularly large and circular; pronotum narrower than head; tarsi trimerous, second tarsomere shortest and simple; pretarsal ungues simple, short; arolium absent; pygidium distinct, broadly rounded apically with minute medioapical point or spine; cerci long and thin, length 0.64 mm, longer than abdomen, straight throughout length, with long setae similar to those of abdomen.



Figures 12–13. Nymphal earwigs in mid-Cretaceous amber from Myanmar. **12.** Nymphal form #1 (JZC-Bu231), possible first-instar nymph of *Toxolabis zigrasi*, new genus and species. **13.** Nymphal form #2 (JZC-Bu59).

COMMENTS: These nymphs have structures virtually identical to that of the adults in the same piece (*e.g.*, large, characteristically-circular submentum: Fig. 12), as well as tarsal structure and absence of an arolium. They do differ in the form of the pygidium, which might indicate that they belong to a different species, but this structure may change slightly during development and so this may not be sufficient evidence to exclude the possibility of conspecifity. The form of the cerci is obviously dramatically different but in early-instar nymphs these typically begin as long and thin (Fig. 12) and only gradually develop into more complicated and forcipate form later, so presumably the early nymphs of *T. zigrasi* would not have the greatly arched forceps of their associated adults. Naturally, it is not possible to determine conclusively whether they represent immatures of *T. zigrasi* but the circumstantial evidence is intriguing.

Nymph sp. 2

MATERIAL: One early nymph (not possible to stage to particular instar) with dorsum missing from pronotum to penultimate tergum (possibly an exuvium) (Fig. 13), JZC-Bu59; specimen in collection of Mr. James Zigras, available for study through the Division of Invertebrate Zoology, American Museum of Natural History, New York.

DESCRIPTIVE NOTES: Total length as preserved (including cerci) 2.7 mm. Integument light brown throughout but entirely cleared so true coloration not discernible; not densely setose, setae relatively sparse, not chaetulose; integument apparently faintly imbricate to smooth, impunctate. Head without ecdysial lines evident, slightly wider than long, length 0.43 mm, width 0.47 mm, compound eyes well developed, not greatly prominent, shorter than postorbital length of head, compound eye length 0.13 mm, temple length 0.15 mm, distance between compound eyes 0.30 mm; apicolateral angles of head acutely rounded, posterior border weakly concave; antenna 8-segmented as preserved, first flagellomere longest, slightly longer than scape; scape length 0.13 mm, width 0.07 mm; pedicel length 0.04 mm, width 0.05 mm; first flagellomere length 0.17 mm, width 0.05 mm; second and third flagellomere each with length 0.10 mm, width 0.05 mm; fourth flagellomere length 0.11 mm, width 0.05 mm. Pronotum narrower than head (as evidenced by minute outline of where apical margin was preserved). Prosternum with anterior border largely straight, length only slightly greater than anterior width, length 0.28 mm, width 0.39 mm, lateral borders straight and weakly converging posteriorly, posterior border faintly convex, procoxae positioned at tangent just anteriad of posterior border; mesosternum broad, widest just posterior to anterior margin, medioapically meeting posterior margin of prosternum, narrower than prosternum at that point, margins slanting outward to widest point, then converging posteriorly alongside mesocoxa to broad, straight posterior border; metasternum broad, about as broad as widest point of mesoternum, anterior and posterior borders straight, lateral borders slightly converging posteriorly, with metacoxae bordering sternum posterolaterally. Femora not keeled or carinate, without stout setae or spines; tarsi trimerous, second tarsomere shortest and simple (blunt apically); pretarsal ungues simple; arolium absent. Abdominal maximal width 0.53 mm; ultimate tergum strongly transverse, without modifications (*e.g.*, no tubercles, carinae); pygidium prominent, broadly rounded apically with minute medioapical point or spine, length 0.06 mm, basal width 0.06 mm; cerci long, length 0.43 mm, basal width 0.07 mm, basally separated by 0.12 mm, straight except weakly incurved apically, apex acutely pointed, without dentition or tubercles.

DISCUSSION

Both of the new species described herein, like *Myrrholabia electrina* (Cockerell), can be excluded from the Protodermaptera based on the form of the ventral cervical sclerites in which the posterior ventral sclerite is enlarged and abutting, or nearly so, the anterior border of the prosternum (the so-called "forficuloid neck"). Similarly, both can be excluded from the Eudermaptera (which should exclude some spongiphorines as they may be related to anisolabidids: *e.g.*, Jarvis *et al.*, 2004) owing to the absence of the extreme elongation and/or dilation of the second tarsomere under the third and, for those subfamilies with a simple second tarsomere (Spongiphoridae), by the absence of a lateral ridge on the tegmina. The families Hemimeridae and Arixeniidae can be excluded as they are generally pedomorphic and have several apomorphic traits associated with epizoic life histories. Similarly, Apachyidae may be excluded owing to their bizarrely modified tenth abdominal tergum, which is broadly expanded and possesses a massive, semi-circular projection (the "anal process") medially between the cercal bases and has a distinctively broadened head with large, prominent compound eyes.

The slightly angled second tarsomere of *Z. speciosa* is similar to that of the Labiduridae (a condition whereby the dorsal length is slightly shorter than the ventral length, but not projecting as a ventral extension or lobe as in Forficuloidea) and the subparallel prosternum, obscured pygidium (bent ventrad in many labidurids), and broadly separated forceps (frequently so in labidurids) are also consistent with placement in this family. The outer margins of the tegmina lack a distinct ridge, so, accordingly, assignment to Labidurinae seems confident for the moment. *Zigrasolabis* differs from *Myrrholabia* Engel & Grimaldi, the only other putative labidurine in Burmese amber, in its larger size (8 mm vs. 5 mm), the postorbital length of the head less than that of the compound eye length (postorbital length greater than compound eye length in *Myrrholabia*), the pronotum broader than the head (narrower than the head in *Myrrholabia*), and the presence of large arolia (absent in *Myrrholabia*).

The placement of *T. zigrasi* is a bit more challenging given the poor preservation of the venter of the thorax, rendering information on the arrangement of the sterna impossible to discern. The simplified second tarsomere, which is blunt apically, and the clearly downcurved pygidium are indicative of the Anisolabididae, a family otherwise largely comprised of wingless species, although there are numerous exceptions (*e.g.*, several Anisolabidinae). *Toxolabis* clearly has well developed tegmina and hind wings, a primitive feature of the family and other Dermaptera in general. Among the subfamilies therein, *Toxolabis* best fits among the Anisolabidinae (or the Carcinophorinae of earlier authors), easily one of the most confused and challenging of earwig groups and one which may not be monophyletic as presently conceived (*e.g.*, Jarvis *et al.*, 2004). Accordingly, it is not possible to make more refined statements about affinities of the genus until such time as the systematics of anisolabidids is greatly clarified.

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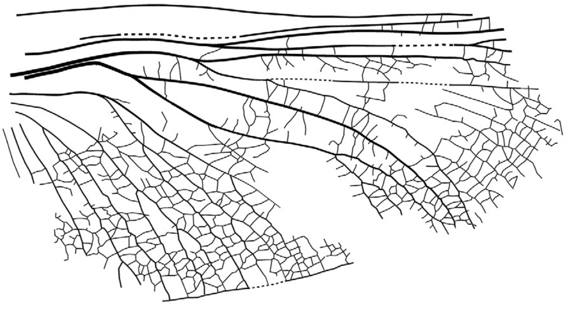

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