Two new mid-Cretaceous dictyopterans (Umenocoleidae: Vitisminae) from northern Myanmar exemplify taphonomic bias

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The genus *Perspicuus* Koubová, gen. n. with two species, *Perspicuus vrsanskyi* Mlynský, sp. n. (male) and *Perspicuus pilosus* Koubová, sp. n. (sex unknown) are described from Myanmar amber; their triangular head, hindwing structure and partially elytrised forewings categorise them within the family Umenocoleidae. Further, characteristic coloration allows their placement within subfamily Vitisminae. Vitisminae are already known from Cretaceous Laurasian sedimentary records of Mongolia, Russia and Spain. The new taxa are characterized by the following autapomorphies: wings and body covered by long, strong sensilla, differentiated legs, oral apparatus with indistinctly structured area above paraglossa and hairy anterior margin of forewing. The specimen of *Perspicuus pilosus* is deformed by preservation and a gas bubble affects >60% of its surface. It is an immature individual autapomorphic in having extremely long hair indicating autochtonous environments during burial. Syninclusions include a parasitic wasp (Gasteruptiidae: Aulacinae). This discovery indicates that burmite contains a mosaic of Gondwanan and Laurasian taxa owing to the species richness, with modern environmental adaptations.

fossil insect - Mesozoic – Dictyoptera - new genus - new species

Cockroaches represent an insect order including previously separated termites and mantodeans, split from its stem during Cretaceous (Inward et al. 2007, Vršanský et al. 2019d). Sometimes extinct species are called roaches or roachoids (Grimaldi 2003) to separate them from the crown group of living true cockroaches (Li 2019), but this “crown” clade has not been defined or delimited. Even hypothetically it cannot include (all) living cockroaches, as nocticolid cockroaches have different derivation (Sendi et al. 2020b). Cockroaches have about 110,000 fossils from the Mississippian, and numerous Mesozoic species have modern morphology (Zhang et al. 2013; Vršanský et al. 2009, 2017). Another 4,000 cockroaches are preserved in ambers (Vršanský & Wang 2017).

Mesozoic amber cockroaches are known from France, United States, Lebanon, Jordan, Syria, Russia, Spain and Canada. Cretaceous ambers provide a significant record of many insect groups and are the oldest window to the past of the cockroach evolution (Grimaldi 2000). Myanmar was first documented as a source of amber in 1836 (Cruickshank & Ko 2003).

Mesozoic cockroaches from Myanmar amber have been much studied (Bai et al. 2016, 2018; Gao et al. 2018; Grimaldi & Ross 2004; Guo et al. 2017; Hinkelman 2019, 2020; Kočárek 2018a, b; Li & Huang 2018a, b, 2020; Mlynský et al. 2019; Poinar 1999, 2009; Poinar & Brown 2006, 2017; Podstrelená & Sendi 2018; Qiu et al. 2019a, b, c; Ross 2019; Šmídová 2018, 2020; Vršanský et al. 2018; 2019a, b, c, d; Hinkelman & Vršanská 2020 and citations therein).

Taphonomy of insects preserved in amber can lead to serious systematic errors. The taphonomic processes that control insect preservation in fossil resins are discussed by Martínez-Delclós et al. (2004), Pike (1993), Schmidt & Dilcher (2007).

The aim of the present work was to photographically document, illustrate and morphologically describe two new, closely related, species from two clear samples of amber, introduce a new genus for them and discuss their ecological, systematic and palaeogeographic relevance (Figs. 1-5). We also aim to outline potential taphonomic changes during resin solidification.

Material and methods

We (T.M.) examined 570 cockroaches from the collection of NIGPAS (Nanjing) and the present genus is not represented by any other known species, except for those described here. The specimens were collected in a quarry in the Hukawng valley (26°15’N; 96°33’E; Fig. 1A – Cruickshank & Ko 2003) by Sieghardt Ellenberger and are deposited in the Slovak National Natural History Museum in Bratislava under SNM Z numbers 40037 and 40039. Rock matrix containing amber of the earliest Cenomanian age (Shi et al. 2012) is represented by a greyish to bluish-green volcanoclastic mudstone (Cruickshank & Ko 2003), located in the fine-grained facies of sedimentary rocks at Noije Bum. The host rock is poorly consolidated, such that it can be readily broken with bare hands and petrologically it varies between fine-grained sandstones and shales (Cruickshank & Ko 2003). The amber discs lie parallel to the bedding planes of finegrained sediment (see Shi et al. 2012 for petrological details). These sediments were deposited in a nearshore environment, with the amber resin being derived from a tropical forest with *Araucaria* trees (Poinar et al. 2007). Mesozoic locations of cockroaches were identified using the EDNA fossil insect database (active 2019-05-09). Specimens were studied with a Leica M80 stereo microscope. A map of locality was made in Corel Draw X3 and processed from a free online geological map of Myanmar (GS London 2017). Every distance used for species description based on morphology and comparative analysis was measured more than three times with negligible deviations. Values were measured precisely to 3 decimal points as observed, although this precision is not unequivocal due to nonlinearity of amber transparence.

Photographs were taken with a Leica DFC490 digital macro camera on a Leica Z16-Apo Macroscope and processed with COMBINE ZP for focus stacking. Photos were enhanced with Adobe Photoshop TM CS6 image processing software to merge photographs and to reveal the natural colour of the inclusions without the orange tint from amber, using allowed all-surface selective colour mode and white balance adjustment.

Drawings used a B2 0.5 mm pencil using the same stereo microscope Leica M80 (Fig. 1b). Their purpose was to capture all details of morphology, make all parts clearly visible with the utmost precision, but they do not show exact size ratios. Venation follows Comstock & Needham (1898) and by Li et al. (2018).

We use the name "dictyopterans" for all insects that belong to Dictyoptera and are similar in habitus to living cockroaches, even if they are basal stem group representatives including indirect relatives of Mantodea and/or Isoptera.

Results

Taxonomic palaeontology

Order Blattaria Latreille, 1810= Blattodea Brunner von Wattenwyl, 1882
Family Umenocoleidae Chen et Tian, 1973
Subfamily Vitisminae Vršanský et Ansorge, 2001

Composition: *Vitisma* and present genus.

Systematic remarks: Discriminating characters allowing categorisation of the present genus within this subfamily are plesiomorphic, linking the subfamily with the umenocoleoid main stem. This is supported by partial paranotalia and full leg carination similar to that of *Jantaropterix,* which is most basal within Umenocoleoidea (Vršanský 2003a). Position of *Vitisma* within Umenocoleidae was recently confirmed based on comparative phylogenetical analysis comprising 206 morphological characters (Sendi et al. 2020a).

Synapomorphies of the herein described species with Umenocoleidae are specialized head tending to triangulation, huge eyes, prolonged pronotum, elytrised forewings and hindwing venation scheme (Vršanský 2003a). The present specimens can be categorized within Umenocoleidae, Vitisminae on the basis of symplesiomorhically retained venation absent or reduced to certain extent in all other umenocoleoids, fully developed paranotalia and synapomorphies, including minute size (numerous amber cockroaches are miniaturised, but no Myanmar amber cockroach so small, except for Nocticolidae (Li and Huang 2019, Sendi et al. 2020b), has yet been described (see introduction for reference list of Myanmar amber cockroaches and Send and Azar (2017) and Vršanský (2003) for others from Lebanon amber); Alienopteridae of the Umenocoleoidea are also usually larger, and the more or less spotted coloration is absent in other Mesozoic cockroaches (Vršanský 2003b). Dense setation cover is plesiomorphic within Umenocoleoidea, also present in *Jantaropterix* (see Mlynský et al. 2019) and numerous liberiblattinid symplesiomorphies suggest a very basal split of the taxon and the whole subfamily within Umenocoleoidea (Umenocoleidae, Alienopteridae).

Genus *Perspicuus* Koubová, gen. n.
Genus Zoobank Code: urn:lsid:zoobank.org:act:1CBE55EF-B0FA-4BF9-BF55-76168EE4C606

Type species: *Perspicuus vrsanskyi* Mlynský, sp. n. described below.
Composition: *Perspicuus vrsanskyi* Mlynský, sp. n. and *Perspicuus pilosus* Koubová, sp. n.
Differential diagnosis: *Perspicuus* differs from the slightly smaller relative *Vitisma* in having more sophisticated color patterns contrasting with simple macula and simple stripes and more elongated forewings and body. Long hairs are autapomorphic. *Vitisma* is uniform and extremely conservative genus (without morphological variability) known from Barremian of Mongolia and Russia, Aptian of Spain, so erection of a morphologically different, separate genus is fully validated for the present taxa.
Description: as for *Perspicuus vrsanskyi* Mlynský, sp. n. and *Perspicuus pilosus* Koubová, sp. n., described in the latter "description" paragraph. Differences among these two species are listed in "differential diagnosis" paragraph of *P. pilosus*.
Derivation of name: From Latin *perspicuous*. Gender masculine.

***Perspicuus vrsanskyi* Mlynský, sp. n.** (Figs.1a, b; 3)

Species Zoobank Code : urn:lsid:zoobank.org:act:59CC4636-D79A-4DAD-BF76-1217B94A9024

Holotype: SNM Z 40037. A complete male.
Type horizon and locality: Hukawng valley, Kachin Province, Myanmar. The lowermost Cenomanian (98.79 ± 0.62 Ma), mid-Cretaceous.
Description: Distance from head to the end of forewings is 6.85 mm. Exoskeleton is light honey coloured visible from ventral view mainly and contrasting black marks are observable mostly on the legs. Stronger shades of brown are visible from the dorsal view on the wings, but with distinct pale spots. Significant pubescence covers wings, pronotum and head. Small head is angled downwards with compound eyes protruding to the sides. Antenna is filiform, long. Oval, drop shaped pronotum is fully developed, transversal with paranotalia, very thin and transparent. Wings are folded. Forewings are shorter, slightly exceeding over subgenital plate, hardened, covered by strong sensilla. Hindwings with distinct venation are longer, narrow and both are slightly wide. Between front, middle and hind legs is diversification with trend of protraction from front to hind legs, which are armed by longest spines and spurs. Abdomen is a little bent towards the ventral side and its thickness extends to the central axis. Multisegmented cerci are very long covered by sparse but long sensillae. Styli present.
Detailed description as for *Perspicuus pilosus* Koubová, sp.n. below, with differences of states in differential diagnosis and differences in measurements designated in square brackets.
Derivation of name: After Dr. Peter Vršanský, advisor of Tomáš Mlynský.
Character of preservation: One complete adult male. Individual is preserved very well and is complete with head, nota and abdomen in subplanar position with antennae leading down pointing along the abdominal axis and legs folded downwards the body. Head, pronotum and wings are not wrinkled and unaffected by drying (measurements used for taphonomic comparison), compound eyes are irregular shaped, apparently naturally asymmetrical, *excrescentia nasus* (if present) is covered by antennae.

***Perspicuus pilosus* Koubová, sp. n.** (Fig. 2)
Species Zoobank Code: urn:lsid:zoobank.org:act:3EA3D3BF-C6C4-4807-886D-715F84E72806

Holotype: SNM Z 40039. A complete individual of unknown sex
Type horizon and locality: Hukawng valley, Kachin Province, Myanmar. Lowermost Cenomanian (98.79 ± 0.62 Ma), mid-Cretaceous.
Differential diagnosis: Slightly different forewing coloration patterns from *Perspicuus vrsanskyi* Mlynský, sp. n., with less numerous and less extensive pale areas, different coloration of legs and without crossveins observable on hindwings (Figs. 1, 3). It is significantly smaller than *Perspicuus vrsanskyi* (the exact length of the body 4.864 mm), from head to the end of hindwings is by 1.986 mm shorter. Ratio of head height to this dimension differs by 1.2 in favour of *P. vrsanskyi* higher head and using an individual length coefficient 1.408, will be height of its head smaller by 0.03 mm. Without compound eyes will be head wider by 0.262 mm, difference between ratios to-body-length is 2.953. Including compound eyes it is 0.726 and under the same individual length will be its head by 0.239 mm larger. The averaged measurements of compound eyes reveal less regular shape and compared with body size is ratio smaller by 2.9, which means larger dimensions. The same as pronotum length, ratio to body is smaller by 0.676 (smaller pronotum) and if both will be of the same length *P. vrsanskyi* would have a shorter pronotum by 0.214 mm. The averaged measurements of wings showed ratio body size/wings is smaller by 0.274 (shorter wings) and difference between wings length, assuming the same body size, should be even 0.917 mm. Width will not be markedly larger.

Fig. 1. a1 – *Perspicuus vrsanskyi* Mlynský, sp. n. head (**holotype** SNM Z 40037); a2 – dorsal view (orig. by T. M.); b - *Perspicuus pilosus* Koubová, sp. n. (**holotype** SNM Z 40039) (orig. by I.K.)

Size of legs is comparable. In addition to the coloration and proportional differences, there is variation in eye shape. *Perspicuus vrsanskyi* Mlynský, sp. n. does not have full and rounded eyes like *Perspicuus pilosus* Koubová, sp. n. , but rather stretched sideways to downward. The head of *Perspicuus vrsanskyi* Mlynský, sp. n. is horizontally flatter also. On the contrary its wings are oval, wider than the long and narrow wings of *Perspicuus pilosus* Koubová, sp. n., bigger legs spines differ in the angle at which they protrude from legs while in *Perspicuus pilosus* Koubová, sp. n. spines stand almost at right angles.

Remarks: The shape of the head resembles that of mantids and some blattulid heads, including oral apparatus, large bulging compound eyes (Fig. 2c), the both antennae measurements have the same trend but different values, which may result from different preservation, it was not possible to do whole antennae measurements, on the left antennae from 23. to 26. segments and 34., 35. segments at right antennae, many lengths of oral apparatus parts have been measured as sin functions; because of its extension to the front, abdomen and cerci are present.

Character of preservation of the holotype [measurements of *Perspicuus vrsanskyi* in square brackets]. Polished amber is oval-shaped but flat, wedge-shaped in cross-section, 31.5 mm long, ca. 28.5 mm wide, maximal thickness is 7.3 mm and minimal around 1 mm on the other side. Weight is 3.16 g. Its colour is honey brown. Transparency is very good in thinner part where the cca 7.6 mm long individual is located (longest measurable distance from head to end of hind leg) [7.66 mm from maxillary palp to end of cercus]. Thicker half part is darker, full of small particles, faeces and plant debris. Behind the specimen is a complete undescribed parasitic wasp (Fig. 5a, b). The thinnest edge of the amber, on the remote side from the individual placement, was chipped off for IR analysis (see Kotulová et al. 2019).

Distance from head to the end of forewings is 4.864 mm [6.85 mm], nearly complete, but due to taphonomic processes protruding hindwings have cracked and crumpled. The end of the right hind tarsus remained. The whole specimen was affected by drying. The head parts, except the compound eyes which are affected only slightly at their base by connection to head are considerably wrinkled. Pronotum and wings are also shrivelled too. Most of the head parts are hard to measure because of drying and the angle at which they are presented. Genae, stipes, mandibular teeth, some of maxillary palps and labial palps segments are not recognizable. Segments of the oral part are flattened, as are some spines and larger fuzz. In this way, the most affected are pronotum spines and transparent margin side spines which are frequently cracked in several places.

Antennal segments are flatter, some preserved disconnected. Leg spines and spurs are not markedly flattened, but cracks are observable. Two right leg spurs are oddly deformed, one has small circular bump close to the end and second has two in a row and seems to end in an arrow-head shape.

Complications during processing were caused by air bubbles. Nearly the whole specimen is wrapped from dorsal side, and air also passed to the ventral side, and was captured under the legs, now mostly covering the middle and hind coxae and the biggest bubbles stayed close to the body on the left above the front tibia and abdomen (Fig 2a, b). This suggests the position of the specimen while the amber was hardening (dorsal - right down). For this reason the neck, abdomen and body area until middle, hind coxae are not clearly observable from the ventral view. The distal parts of the left front and middle legs are also covered by bubble. Very unusual is the extension of the upper side body margin and clavus on the left in the direction of the most distinctive air bubble.

From the dorsal view, just above the right hind pale macula, is a strange, distinct but obscure structure, with regular rectangular cracks inside the amber (Fig. 4d, e). Because of transparency of the individual layers, and the regular shape of its surfaces it is only visible in certain angles of light. In the amber it is also possible to see feather-like formations in which light breaks to spectrum of colours (Fig. 4c). This may suggest some stress conditions and higher viscosity during and after amber hardening.

Position: Head, nota and abdomen are in subplanar position. Head is twisted slightly to the right. Right maxillary palp is stretched directly to the right side. Both antennae lead down and slightly left. Left antenna nearly parallel to the body, but diverted below 25º and leads over front, middle distal parts of legs. Right antenna is bent sigmoidally halfway, between middle legs, to the right side and subsequently parallel close to the body. Front legs diverging to the sides. Right front tibia bent below right angle, after parallels close to the body. Left one is more open, front tibia is diverging from the body below 135 º. Middle left leg is nearly in the same position, just tarsus is more bent to the side. Right middle leg is pushed to the central body axis. Hind legs are stretched nearly directly down along the abdomen and to the left a little. Therefore, from the dorsal view just hind and left part of legs are visible. All wings are folded. A little distal part of transparency hindwings protrude from below forewings end. Maximal length from compound eye to hind leg is 7.656 mm and maximal width from the left middle leg to the right side margin is 3.567 mm.

Exoskeleton and colour: Strong shades of brown from the dorsal view cause of dark wings mostly. Significant are just two front and two hind pale maculae on forewings (Fig. 1b; Fig. 3b). Surface of all wings, pronotum and head noticeably hairy. More transparent thinner exoskeleton of leg segments is light honey coloured, visible mainly in ventral view, darkening distally. Spines can be brown-black toward the ends of the femora. Pronotum is honey coloured but very transparent, as is lateral fuzz. Fuzz on sides of body is even brighter. The antennae and head are darker brown. Only compound eyes and antennal pits are brighter coloured.

Measurements: for detailed measurements see SI1.

Description. Holotype. Head is small with large protruding compound eyes (Fig. 2c). The most of acquired data were converted from measurements below angles and calculated using sin function. The length is 0.686 mm from epicranium to paraglossa. Maximal width is 1.157 mm including both compound eyes, width of epicranium is 0.636 mm and frons is wide 0.255 mm. Clypeus is 0.25 mm high and width is 0.246 mm. It´s distinctively convex to compare with face surface but very shrivelled. Labrum is 0.081 mm high and width is 0.183 mm. Lower distance between genae and its height is difficult to measure due to unclear borders. Spacing between clypeus and paraglossa is 0.24 mm. From the dorsal view, head without eyes distinctive by horizontal wrinkles and is 0.655 mm wide [0.66 mm] and 0.29 mm high [0.44 mm].

Antenna is nearly as long as body, rather thin, filiform. Antennal pits are large (height of right is 0.123 mm, width is 0.148 mm and left is 0.124 mm with no measurable width), convex and circle shaped. Distance between them is 0.25 mm. Right antenna is 1.681 mm long and left is 1.459 mm. Both consist of 49 segments. The first three segments are longer than others and flattened cause of drying. First few segments have been calculated due to antennae growing up from the head and tilted position of flat segments. The right scape seems even 0.31 mm long, while the left one is 0.22 mm. Pedicels are 0.13 to 0.146 mm long. Then third segments are less than 0.1 mm long. Width of this all segments is around 0.1 mm, just right third segment looks markedly thicker, ca. 0.3 mm. Subsequently the lengths of following square segments are decreasing to sixth and seventh

segment (0.037 mm) and after slowly increasing to a little more than 0.1 mm from seventeenth segments with continuous extension to the little more than 0.12 mm in the middle part. Middle and terminal extended segments are cylindrical or rectangular shaped but flattened. End segments are slightly shorter, 0.098 mm. Due to preservation probably, gaps of 0.014 mm on average formed between each segment. Most of the right antennae segments width constantly varies around 0.026 mm, except the first segments. To compare with the left antennae segments seems wider and unstable, varying between 0.02 to 0.06 mm and its possible to recognize decreasing trend to terminal segments. Sensillar cover is very thin 0.003 to 0.004 mm and of length 0.051 mm on the biggest segments.

The compound eyes are lentiform, circular kidney shaped, drawn down, protruding beyond the head outline, situated on the sides behind the base of antennae. Size is large, nearly the same on both sides, ca. 0.45 mm [ca. 0.5 mm] in height and 0.3 mm [0.39 mm right, 0.34 mm left] in width. They are clearly bordered. Three small ocelli are deployed in a line on the epicranium, close above antennal pits, between upper parts of compound eyes. They are circular, distributed at nearly regular distances, ca. 0.12 mm. After left one remained just a dimple. Their size is ca. 0.05 mm.

Visible part of left mandible is 0.282 mm long, width 0.033 mm. Right one is not visible. The right first maxillary palp segment is 0.061 mm high, width is 0.044 mm. Second seems short too, 0.071 mm of nearly the same width. Next two right maxillary palp segments are roughly of the same length ca. 0.29 mm but width of the third is 0.034 mm and fourth 0.06 mm. The last segment is the widest, 0.063 mm, but no the longest, 0.231 mm. Left first three palpomeres were not observable. Fourth palpomere is 0.17 mm long and 0.056 mm wide. The last palpomere seems 0.27 mm long and 0.068 mm wide. Labial palps were hard to recognize and measured were just right second and last segment. Second is of length 0.116 mm and third one is a little longer, 0.16 mm. Width is nearly the same, 0.044 mm but longer segment looks slightly thinner, 0.043 mm. Paraglossa is 0.096 mm of height and is 0.124 mm wide. Above the paraglossa is an extraordinary shape, here named *excrescentia nasus* (Fig. 2d). Its function is unknown, it consist of two short, irregular, diverging, dorsoventrally flattened stems, connected at the end while creating elongate slot between and on the top of each stem are two small spherical shapes. Both the side beads stand higher and are bigger than middle ones but all seem to be covered by tight air bubble. Whole formation reminds a mushroom in shape and its 0.115 mm high, 0.086 mm wide. Stipes, mandibular teeth and genae are indistinct.

Sensillar cover of oral apparatus is thin, short, sparse, looks covering all segments. On the protruding head front part is fuzzy, not very recognizable. Most of the epicranium and back side of the head is very dense and rich in sensilla, fuzz is even, long, 0.133 mm and ca. 0.005 mm wide.

Neck is not observable but does not seem too short [1.08 mm in height, 0.91 mm in width].

Pronotum: Fully developed, transverse, vertically oblong, with paranotalia. The shape looks like oval drop expanding towards the body and head. Its very transparent and surface is longitudinally wrinkled and covered with distinctive fuzz, which is marked on the sides especially (0.191 mm long, 0.006 mm wide) (Fig. 1b). Maximal measurements are of height 1.125 mm [1.37 mm] and of width 1.07 mm [1.47 mm]. Its plane, mostly in horizontal position relative to the body, edges are slightly bent inside and to the sides after. It is covering ca. 1/4 of head from dorsal view. Disc of pronotum is absent.

Wings: Hardened forewings are folded, slightly vaulted, heavily sclerotised into tegmen, covered hindwings are narrow, flat and long. They are covered by strong dense sensillae (ca. 0.1 – 0.18 mm long, width to 0.01 mm). The whole left wing is of the length 3.774 mm [4.28 mm] and the widest proximal part, clavus is 0.965 mm [1.22 mm]. The right one is 3.715 mm [4.43 mm] long and widest part is 0.804 mm [1.22 mm]. Clavi are well bounded, distinct, long, upturn drop shaped and both connected heart shaped. The left is 1.524 mm long, right 1.529 mm. Small triangular scutellum present, of length 0.28 mm and 0.228 mm wide. The main wing-case on the left is of length 2.985 mm while proximal width, close to the clavus, is 0.988 mm and tapered section after hind pale macula is 0.736 mm wide. The right forewing is 2.988 mm long, wide part is of 0.833 mm and narrower part is of width 0.761 mm. Front, clavus, pale maculae are horizontally oblong, situated nearly in the centre of the border lines with main wings. The left is 0.298 mm long, wide 0.547 mm. The right is 0.274 mm long, 0.548 mm wide. On contact with clavi is on the main forewings ca 0.175 mm wide pale strip, flanking anal area. Hind, more regular pale maculae are located on main wing-cases, at the beginning of its second half and pushed to the sides to R area. Left one is of the same width and height, 0.44 mm. The right is 0.413 mm high and 0.494 mm wide. All wing-cases have undulate surface furrowed by mostly straight veins (seen under the certain angle of light). Part of the membranous net–veined hindwings, protruding from under the wing-case is (combined) 1.018 mm long and 1.408 mm wide.

Big clavus anal veins are not clearly visible, especially on the left, distortion of the surface by the bubble in a left direction has made transverse wrinkles. These veins appear sparse on the right, but suggest a large anal lobe on the hindwings. Anal furrow (ab) is 1.37 mm long. Cubitus anterior (CuA) straight, branched, long ca. 1 mm. Media (M) veins 4 at distal part, looks of two main veins on both sides while outer one, closer to R+M, is branched to three. On the left wing are radius (RS) veins of the maximal observable length 2.25 mm, 1.75 mm on the right and appear as one main R vein branched to the sides three times. On the left, the more shrivelled wing looks more branched. On the R veins is an observable deformation on the right wing, at the end of the main R vein, on the left on R+M vein, upper, close to the lower base of the pale macula, but it should be caused by drying during preservation. R+M is straight on the right, long 2.3 mm. Base of RS veins is not recognizable or is missing. Costal margin seems short, to 1.5 mm. Veins are not clearly recognizable, Subcosta (Sc) on the right, if it is not wrinkled, is around 1 mm long. Crossveins are not observable and apex is wrinkled because of drying and terminal parts of veins are distorted.

Legs: Diversification between front, middle and hind legs is marked. Visible is trend of protraction from front to hind legs. Legs are armed by very long and thick spines and spurs (Fig. 2e). One from the most significant difference except the length and shape of segments between legs is in the sensillar cover of the femora. From the bottom, long, distinctive bright fuzz is visible, spread in line and regular distances. By the biggest ones are armed middle legs. Also on the inner sides of femora in the line are shorter but stronger, denser fuzz, even darker on the front legs but softening to the hind legs. Femora are also armed with three long spines. The most distinctive is one spine protruding from above directly (Fig. 2a). Two smaller are situated beneath but directed inwards. The longest spines are visible on the hind legs as well as spurs. Tarsi seem stronger and shorter on the front and middle legs while the fourth segment is very short to compare with others. Each segment is armed from below with posterior ventral spines associated with pulvilli, also longest on the fourth segment (segment length was measured including spines) (Fig. 2f) but hind legs seem to have just two short hooked spines instead of spurs. Also the claws look different at the end on the front legs, are stronger, shorter and without arolium.

Fore legs cursorial, shorter and more compact than other legs. Left coxa is 0.6 mm long, right length was not measurable, nearly of the same width, 0.259 mm. Left procoxal processes appear longer, 0.397 mm but thinner, 0.107 mm. Right is 0.134 long and 0.148 mm wide. Trochanters are similar nearly, on the average

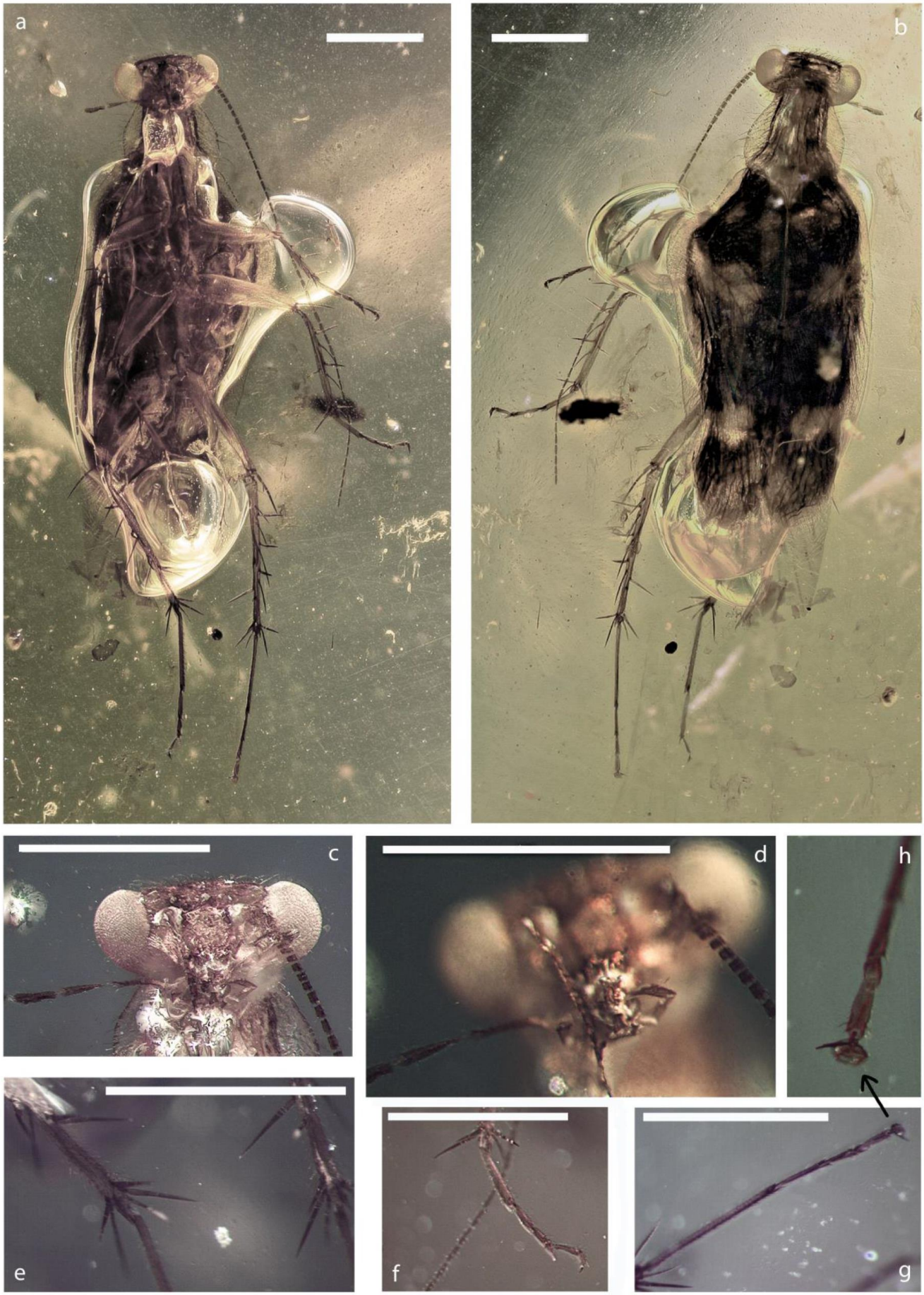

Fig. 2. *Perspicuus pilosus* Koubová, sp. n. (**holotype** SNM Z 40039) a – ventral view; b – dorsal view; c – head detail; d - excrescentia nasus; e – right tibia spurs ; f – left middle tarsus; g – left hind tarsus; h – left hind tarsus, arolium detail (scales – 1mm)

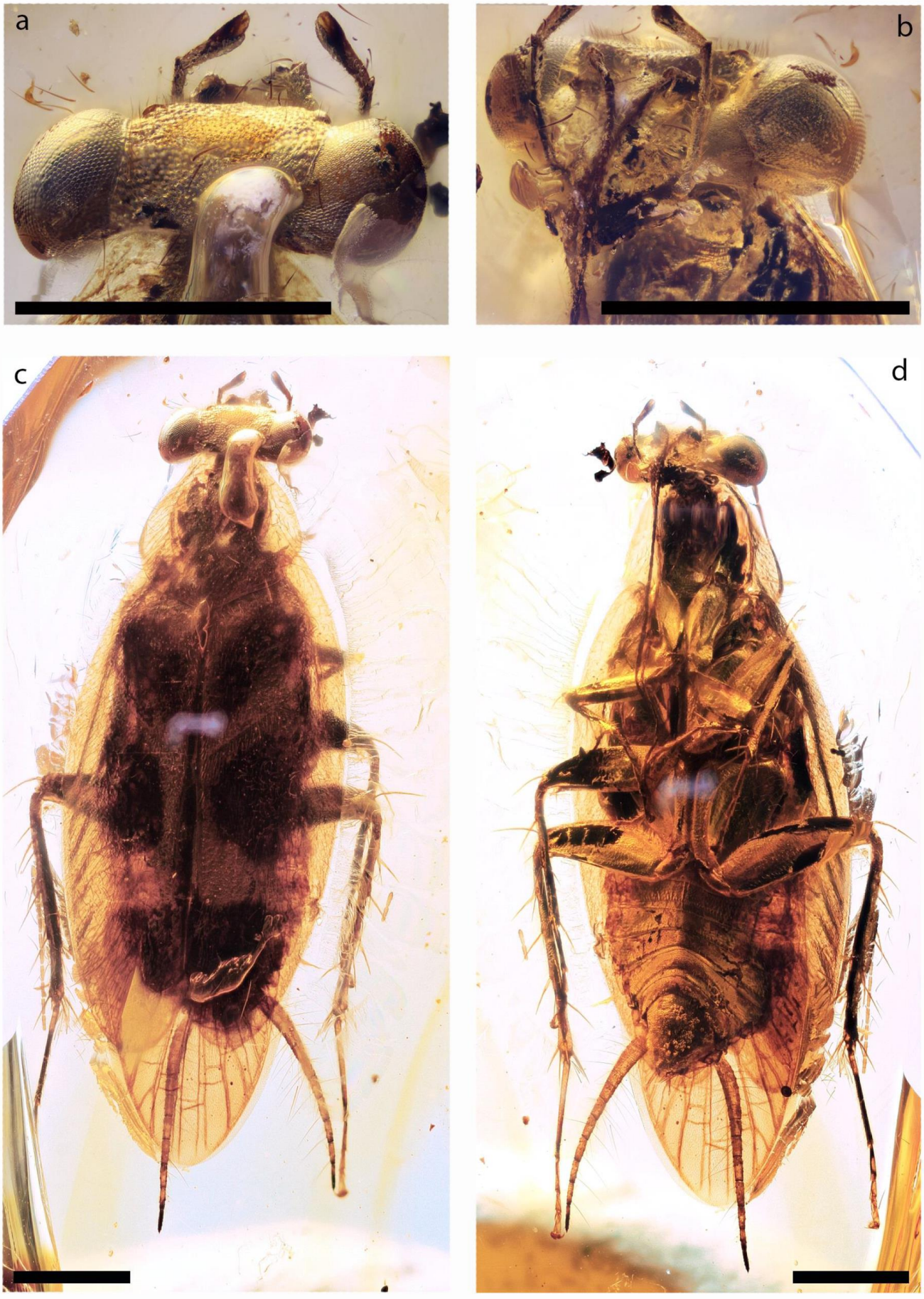

Fig. 3. *Perspicuus vrsanskyi* Mlynský, sp. n. (**holotype** SNM Z 40037) a , b – dorsal, ventral head detail; c - dorsal view; d - ventral view (scales – 1mm)

0.28 mm long and 0.1 mm wide. The right femur is 0.891 mm long and 0.26 mm wide, the left is slightly smaller. Right tibia is 0.721 mm long (width not measurable), left 0.612 mm and 0.07 mm wide. Spines here are not as long as others. The longest, 0.233 mm, front leg spine is localized on the left leg and is 0.028 mm wide. Spurs are shortest here but on the right leg is one very long, 0.371 mm, 0.013 mm wide. They are growing in a rosette and as appear in five numbers at the end of the tibia (Fig. 2e). They are characterized by sawtoothed edge and sparse longitudinally helical ridges (<8), mostly visible from the middle legs. Spurs bases can be thinned followed by distinct hump regularly tapering even to a sharp end. This is characteristic for the middle and hind legs too. Tarsi are shorter, 5-segmented. Tarsomeres are unspecialized. Left is longer (better visibility) than right one, 0.693 mm and maximal width (ca. 0.075 mm) is measured on the first segment (all tarsomeres). Also first segment is longest (ca. 0.35 mm) and massive but on hind legs is very long to compare and thinner. Whole tarsi measured without claws part for all. The maximal width measured on left fourth segment with longest posterior ventral spines associated with pulvilli is 0.126 mm and minimum width is 0.034 mm measured on the thinnest part of the fifth segment. Tarsal spines are growing in pairs from the dorsal side probably and are symmetrical diverging to the sides but visible clearly just on the hind left tarsus. Part with claws is around 0.1 mm long and width is not too provable. Arolium is missing. Claws seems bigger at right leg, may be caused by position, of length 0.09 mm and width 0.018 mm.

Middle legs are longer. The coxae were not measurable. Procoxal process here is ca. 0.55 mm long (right leg), 0.15 mm wide. Trochanters are around 0.3 mm long, the width is 0.15 mm. Femora are 1.15 mm long and 0.3 mm wide, right seems a little bit bigger. The left tibia is longer 1.267 mm (right is 1.176 mm) but thinner, 0.101 mm wide (right is 0.164 mm). The longest spine was measured on left tibia, it is 0.378 mm long and 0.035 mm wide. On the right it is long 0.318 mm and 0.036 mm wide. The longest left leg spur is 0.322 mm long and 0.036 mm wide. Left tarsus is longer, 0.886 mm and wide 0.062 mm, 0.038 mm (thinnest part). Spine on tarsus was measurable on the right leg, is long 0.097 mm and wide 0.062 mm. Area holding claws is around 0.1 mm long and wide 0.14 mm (visible on the right leg and bigger width should be caused by spread position and location in bubble). The claws seem more massive on the right leg, 0.098 mm and 0.016 mm wide. Here we observe arolium, 0.032 mm long, 0.055 mm wide.

Hind procoxal processes are around 0.3 mm long, wide 0.1 mm. The right leg trochanter is 0.34 mm long (left is 0.285 mm) and of width 0.123 mm (left is 0.116 mm). Both femora are nearly of the same length, 1.3 mm, but right seems wider, 0.439 mm. The right tibia is 1.787 mm long and 0.142 mm wide, the left one is 1.807 mm long and width is 0.099 mm. Overall, the longest 0.42 mm spine, wide 0.018 mm, was found on the left leg. On the right 0.4 mm and 0.031 mm. Spurs are nearly the same on both sides, 0.38 mm long, 0.02 mm wide. Tarsus looks bigger on the left leg while is long 1.556 mm, width is 0.054 (max), 0.037 mm (min) (Fig. 2g) and the right tarsus is 1.536 mm long, width is 0.055 mm (max) and 0.044 mm (min), from which the first proximal visible segment has even 0.879 mm on the average on the both sides and the second segment is around 0.32 mm long and 0.051 mm on the right. Spine from the one of right segments is of length 0.074 mm and width 0.049 mm, on the left is 0.07 mm long and 0.024 mm wide. Claws were measurable on the left leg, 0.057 mm long and of width 0.01 mm. Rounded arolium is of length 0.076 mm and is 0.037 mm wide (Fig. 2h). [**Abdomen**: S9 – height 0.79 mm and width 0.75 mm; S8 – 0.18 mm, 1.05 mm; S7 – 0.26 mm, 1.36 mm; S6 – 0.26 mm, 1.5 mm; S5 – 0.29 mm, 1.56 mm; S4 – 0.31 mm, 1.72 mm. **Cerci**: **right cercus (cercomeres from proximal segment):** 1. – 0.22 mm long, 0.12 mm wide; 2. – 0.12 mm, 0.12 mm; 3. – 0.09 mm, 0.12 mm; 4. – 0.09 mm, 0.09 mm; 5. – 0.17 mm, 0.09 mm; 6. – 0.17 mm, 0.07 mm; 7. – 0.19 mm, 0.07 mm; 8. – 0.19 mm, 0.07 mm; 9. – 0.19 mm, 0.05 mm; 10. – 0.22 mm, 0.05 mm; 11. – 0.24 mm, 0.03 mm; **left cercal cercomeres:** 1. – 0.24 mm, 0.12 mm; 2. – 0.12 mm, 0.12 mm; 3. – 0.12 mm, 0.12 mm; 4. – 0.09 mm, 0.09 mm; 5. – 0.09 mm, 0.09 mm; 6. – 0.19 mm, 0.09 mm; 7. – 0.19 mm, 0.07 mm; 8. – 0.19 mm, 0.07 mm; 9. – 0.22 mm, 0.06 mm; 10. – 0.17 mm, 0.06 mm; 11. – 0.22 mm, 0.05 mm; 12. – 0.22 mm, 0.03mm. Cerci fuzz: 0.34 mm long.]

Derivation of name: after *pilosus* (Latin for hairy).

Systematic remarks. Visual separation of the two present species reveals much more extensive coloration in *P. pilosus* than in *P. vrsanskyi*. This single-specimen study elaborated in detail here is also supported by abundant observations of the species in extensive collections (Nanjing Institute for Geology and Paleontology, NIGPAS collection: 10 uncatalogued specimens; Earth Science Institute Slovak Academy of Sciences, ESISAS temporary collection: 7 uncatalogued specimens). All these specimens visually correspond to the coloration of *P. pilosus* with very little coloration variability, and at the same time they represent both sexes. *P. vrsanskyi* is significantly different, so sexual dimorphism can be excluded. *P. vrsanskyi* as a different life stage can also be excluded due to different proportions eliminating possible burial deformations (see *P. pilosus* description) and lack of excrescentia nasus. Basically, besides coloration, the two species also differ distinctly in shape of head and in size (total forewing length 3.72-3.77 mm in *P. pilosus* vs. 4.28-4.43 mm in *P. vrsanskyi*).

Phylogenetically annotated character list

130 characters of Umenocoleoidea are after Vršanský et al. (2018; 1-58 are modified after Bai et al. 2016); characters 131-193 are from Hinkelman (2020); 194-206 by Sendi (in preparation); here characters numbers 207-211 are listed.

207 Forewing anterior transparent hem - autapomorphy
208 Extension of oral apparatus – synapomorphy with Eadiidae
209 *Excrescentia nasus* - autapomorphy
210 Dorsal strong and dense hairy surface – autapomorphy
211 Antenna consisting of 49 segments - autapomorphy

Syninclusions
Superfamily Evanioidea Latreille, 1802
Family Gasteruptiidae Ashmead, 1900
Subfamily Aulacinae Hedicke, 1939

Longest dimension from the end of antennae to the hind leg claws is of 4.404 mm (Fig. 4a). Biggest width is between most distal part of legs and it is of 2.137 mm. Head is 0.269 mm high and wide 0.548 mm with big lentiform compound eyes, of height 0.215 mm and 0.326 mm of length. Filiform antennae are around 1.6 mm long. Neck is 0.312 mm long, width of proximal part is 0.304 while it is rapidly thinning forward to head. Wings length was measurable only, 2.052 mm (Fig. 4b). Abdomen remains just a base and end is damaged but 0.722 mm long. Longest hind leg is of the length 2.163 mm with very thin tarsus (0.028 mm) and claws part presents 0.122 mm from its length and is 0.029 mm wide.

Subfamily Aulacidae are endoparasitoids of wood-boring wasps and bees (Engel & Wang 2016; Carlson 1979; Gauld & Bolton 1996; Smith 2001, Jennings & Austin 2004). They are characterized by an elongate metasoma, clavate metatibiae, long neck and elongation of the propleura (Engel & Wang 2016). Although at various times Aulacinae has been treated as a group within Evaniidae, or a distinct family (Naumann 1991; Hanson & Gauld 1995; Jennings & Austin 2000; Smith 2001; Jennings et al. 2004a,b,c), we treat them as a subfamily within

Fig. 4. a – Syninclusion Aulacinae (SNM Z 40039); b - wing detail; c - feather-like formation inside amber; d,e - regular rectangular cracks inside the amber (scales – 1mm)

Gasteruptiidae (Hymenoptera: Evanioidea) (Jennings et al. 2004). *Hyptiogastrites electrinus* Cockerell, 1917 is known from the locality.

Discussion and conclusion

It must be noted that genus *Vitisma* is extremely conservative within its subfamily and nearly without variability of wing form, venation and coloration within the whole genus (Vršanský 1999, 2005; Vršanský and Ansorge 2001). Lack of variability is not restricted to the type locality in Siberia (*V. rasnitsyni*), but also characteristic of other conservative species from Spain (*V. occidentalis*) and two Mongolian sites (*V. diffusa, V. orientalis;* Vršanský & Ansorge 2001), which can hardly be distinguished from each other. *Vitisma* seems to represent more basal offshoot in spite of its occurrence in both earlier and later sediments based on the plesiomorphies lost in the present genus due to elongation and enlargement of the body and with further coloration specialization.

Dense hairy wings, head and pronotum surface is known within extant Corydiidae species, such as *Eremoblatta* Rehn, 1903 from North American desert environments (Copeland 2003), but desert cockroaches have different body characters. Myanmar amber does not contain desert taxa (Sendi et al. 2020b). Some myrmecophilous and termitophilous cockroaches are characterized by strongly developed hairy surface structures, and are also known from Cretaceous amber (Vršanský et al. 2019b).

The holotype of *Perspicuus pilosus* is taphonomically remarkable. A range of deformities developed due to the preservation conditions outlined above (results part). There are many characteristics of amber preservation that can affect individual body proportions, coloration and measurements.

Firstly, in high viscosity amber, at a particular stage after death, some tensions can stretch part of the exoskeleton without visible cracks on the surface (Figs. 1b; 2a, b). In such cases, viscosity and air bubbles played main roles. Ratio length/width of the wing-case on *Perspicuus pilosus* is 3.912 on the left and 4.621 on the right. Enough air surrounding the specimen caused subsequent drying of certain body parts, accompanied by wrinkles, cracks and flattenings. Comparative measurements of the most affected surfaces, head, pronotum, wings, on *Perspicuus pilosus* and *P. vrsanskyi* have shown that measured dimensions ratio confirms size reduction perpendicular to the direction of wrinkles on the affected holotype *P. pilosus* [*P. vrsanskyi*]: head width/height – 0.655/0.29= 2.29 [1.5]; pronotum height/width– 1.125/1.07= 1.051 [0.932]; forewings length/width – 3.715/0.804= 4.62 [3.63]; 3.774/0.965= 3.9 [3.51]). The syninclusion is not in the air bubble and does not bear bursting marks, just secessions of abdomen. In simple words, the postburial deformity reaches 60% of holotype *P. pilosus* surface connected with air bubble and affects nearly the whole left forewing, head and pronotum mostly. Deformations do not affect the present taxonomic categorization, since the sample is considered in its entirety, both sides, disregarding local or simple deformations.

It is possible to recognize stress conditions by structures within amber (Figs. 2a, b; 4c-e) and caution is needed while using measurements to prevent wrong species identification. Therefore, the careful attention must be paid to taphonomy and measurements while studying amber. The present specimens were carefully examined to exclude asymmetrical deformity that might influence their systematic placement. The taphonomy cannot cause taxonomic error in the present case (because of the diagnostic coloration and details of proportions, as well as fact the taphonomic distortion has not affected the whole specimen), but it must be taken into consideration by future workers evaluating representatives of the genus. It is notable that highly asymmetrical specimens also occur in the Chiapas amber (Barna et al. 2019).

Palaeogeographically, Vitisminae unequivocally link Myanmar amber with Laurasia, with species known from Spain, Russia and Mongolia. They are absent only in the Laurasian Yixian Lagerstatte and in both Gondwanan Lagerstätten, Orapa and Crato (Lee 2016). The genus *Spinaeblattina* Hinkelman, 2019 is shared between Yixian and Myanmar amber (Hinkelman 2019) also links Myanmar with Laurasia. However, the whole family Alienopteridae is restricted to Gondwana, while they are common in Myanmar amber (Poinar 2018; Hinkelman 2020; Rasnitsyn 2013). Juvenile stages of individuals of the genus *Perspicuus,* synapomorphic with extremely long hair found at the locality, 4.152 mm long from the head to end of abdomen, with autochtonous burial suggest from dimensions and fully developed wing pads, pre- or directly preimaginal stage of this immature individual (Fig. 5). It cannot be subordinated within a species due to absence of characteristic adult coloration and morphological ratio changes throughout development. Characteristic adult structures such as *excrescentia nasus* are undeveloped, which nevertheless, they may be onthogenetically supressed. Regarding the syninclusion, Aulacinae are cosmopolitan, but do not contradict the tropical forest environment.

Ecologically, *P. vrsanskyi* is present as a single individual among 1,000 cockroaches surveyed (T.M.) in NIGPAS and ESISAS collections and thus was apparently rare. On the other hand, the same collections contain at least 17 complete adult specimens of *P. pilosus* (these could not be studied in the course of present research) suggesting this was a very common species at least in the nearest vicinity of source trees.

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Fig. 5. Immature individual (private collection) of *Perspicuus* Koubová, gen.n., sp. incertae sedis (scales – 1mm)

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Table 1.

Antennae				
fuzz	length (average)	width		
	0.044	0.004		
first segments	0.051	0.003		
distance between segments (on average)	0.014			
	left antennae		**right antennae**	
segment (from prox.)	length	width	length	width
scapes	0.224	0.115	0.311	0.108
pedicels	0.13	0.12	0.146	0.13
3	0.07	0.094	0.097	0.3
4	0.039	0.08	0.069	0.09
5	0.035	0.065	0.051	0.08
6	0.037	0.065	0.042	0.045
7	0.047	0.056	0.037	0.08
8	0.054	0.055	0.048	0.075
9	0.073	0.051	0.052	N
10	0.07	0.048	0.07	N
11	0.082	0.049	0.095	0.033
12	0.079	0.053	0.096	0.022
13	0.089	0.051	0.098	0.022
14	0.088	0.045	0.098	0.025
15	0.092	0.038	0.099	0.028
16	0.106	0.037	0.106	0.026
17	0.105	0.033	0.115	0.026
18	0.117	0.036	0.12	0.023
19	0.117	0.038	0.114	0.024
20	0.117	0.037	0.107	0.024
21	0.115	0.03	0.109	0.024
22	0.124	0.037	0.115	0.023
23	N	0.046	0.103	0.027
24	N	N	0.115	0.031
25	N	N	0.108	0.027
26	N	N	0.109	0.027
27	0.107	0.032	0.109	0.029
28	0.107	0.035	0.101	0.036
29	0.115	0.035	0.111	0.03
30	0.116	0.04	0.108	0.024
31	0.115	0.044	0.109	0.025
32	0.123	0.045	0.1	0.024
33	0.12	0.045	0.105	0.025
34	0.122	0.036	N	0.029
35	0.125	0.038	0.113	N
36	0.128	0.026	0.116	0.031
37	0.127	0.028	0.126	0.032
38	0.126	0.021	0.124	0.026
39	0.122	0.029	0.119	0.02
40	0.117	0.032	0.121	0.024
41	0.119	0.035	0.118	0.024
42	0.113	0.03	0.115	0.026
43	0.122	0.023	0.112	0.027
44	0.115	0.026	0.118	0.025
45	0.119	0.027	0.118	0.027
46	0.11	0.029	0.114	0.027
47	0.107	0.026	0.103	0.027
48	0.098	0.023	0.098	0.028
49	0.109	0.027	0.098	0.027
total length	1.459		1.681	

Table 2.

Head	(mm)					
height (as appearing)	0.686					
width	1.157					
width of epicranium	0.636					
width of frons	0.255					
Measured part of head	height (mm)		width (mm)			
clypeus	0.25		0.246			
labrum	0.081		0.183			
lowermost distance between genae	N					
from clypeus to bottom part of paraglossa (as appearing)	0.24					
genae	N		N			
antennal pits distance			0.25			
eyes distance			0.636			
from mandible to mandible	0.25					
paraglossa	0.096		0.124			
excrescentia nasus	0.115		0.086			
Measured part of head	Left side (right parts)		Right side (left parts)		Middle	
	height (mm)	width (mm)	height (mm)	width (mm)	height (mm)	width (mm)
mandibles	N	N	0.282	0.033		
compound eyes, (circular kidney shaped)	0.46	0.271	0.439	0.314		
lateral ocelli, (circle shaped)	0.048	0.048	0.043	0.043	0.05	0.05
antennal pit	0.123	0.148	0.124	N		
galea	0.269	0.053	0.26	0.053		
maxillary palps, segments from prox.	height (mm)	width (mm)	height (mm)	width (mm)		
1. segment (as appearing)	0.061	0.044	N	N		
2. segment (as appearing)	0.071	0.041	N	N		
3. segment	0.282	0.034	N	N		
4. segment	0.298	0.06	0.17	0.056		
5. segment	0.231	0.063	0.27	0.068		
labial palps, segments from prox.(calculated)						
1. segment	N	N	N	N		
2. segment	0.116	0.044	N	N		
3. segment	0.16	0.043	N	N		
stipes, mandibular teeth	N					

Table 3.

Body ventral							
	length (mm)						
maximal length from head to left hind leg	7.656						
from head to end of wings	N						
head with chest and abdomen	N						
maximal width (left middle leg to right side hem)	3.567						
overhang of wing on the left (right wing)	N						
overhang of wing on the ride (left wing)	N						
abdomen	N						
abdomen segments (sternum)	height (mm), (axis)	width (mm)					
(from the bottom up)							
abdomen axis	N	N					
two juts of ovipositor	N	N					
ovipositor (stilus)	N	N					
1. subgenital plate	N	N					
2. sternum	N	N					
3. sternum (holotype-bubble on left-standard)	N	N					
4. sternum (holotype-bubble on left-standard)	N	N					
5. sternum (holotype-bubble on left-standard)	N	N					
Legs area		**right legs**			**left legs**		
Front legs:		length (mm)	width (mm)		length (mm)	width (mm)	
coxa		N	0.258		0.6	0.259	
procoxal processus		0.34	0.148		0.397	0.107	
trochanter		0.27	0.103		0.284	0.091	
femur		0.891	0.26		0.841	0.243	
tibia		0.721	N		0.612	0.07	
tarsus:	1. segment (from prox.)	0.293	0.078		0.349	0.071	

;

	2. segment	0.135	0.068		0.184	0.056	
	3. segment	0.084	0.061		0.124	0.061	
	4. segment (with spine)	0.045	0.043		0.122	0.126	
	5. segment	N	N		0.176	0.047	
	claws area	0.109	N		0.101	0.057	
		length (mm)	(min)	(max)	length (mm)	(min)	(max)
	total (without claws area)	0.563	0.034	0.078	0.693	0.042	0.071
Middle legs:		length (mm)	width (mm)		length (mm)	width (mm)	
coxa		N	N		N	N	
procoxal processus		0.547	0.154		N	0.151	
trochanter		0.304	0.157		0.32	0.152	
femur		1.158	0.365		1.154	0.3	
tibia		1.176	0.164		1.267	0.101	
tarsus:	1. segment (from prox.)	0.391	0.037		0.384	0.062	
	2. segment	0.141	0.034		0.175	0.06	
	3. segment	0.108	0.041		0.127	0.057	
	4. segment (with spine)	0.083	0.059		0.103	0.062	
	5. segment	0.145	0.043		0.18	0.043	
	claws area (as appearing)	0.099	0.141		0.119	N	
		length (mm)	(min)	(max)	length (mm)	(min)	(max)
	total (without claws area)	0.856	0.032	0.059	0.886	0.038	0.062
Hind legs:		length (mm)	width (mm)		length (mm)	width (mm)	
coxa		N	N		N	N	
procoxal processus		0.287	0.12		0.306	0.102	
trochanter		0.34	0.123		0.285	0.116	
femur		1.302	0.439		1.29	0.378	
tibia		1.787	0.142		1.807	0.099	
tarsus:	1. segment (from prox.)	0.879	0.048		0.864	0.054	
	2. segment	0.314	0.051		0.335	0.037	
	3. segment	0.158	0.055		0.15	0.045	
	4. segment (with spine)	0.101	0.088		0.086	0.049	
	5. segment	0.183	0.029		0.21	0.044	
	claws area	N	N		0.074	0.134	
		length (mm)	(min)	(max)	length (mm)	(min)	(max)
	total (without claws area)	1.536	0.044	0.055	1.556	0.037	0.054

Table 4.

Legs area – sensillas (fuzz 0,06 - 0,153mm, width to 0,010)		**right legs**			**left legs**	
Front legs:		length (mm)	width (mm)		length (mm)	width (mm)
femur - spine at the end		N	N		0.2	0.018
femur - spine at the end from the bottom		N	N		0.112	0.012
femur - fuzz on the bottom		0.135	0.006		0.145	0.01
femur - fuzz in the side line		0.048	0.009		0.054	0.005
tibia – spine (max)		0.193	0.026		0.233	0.028
spurs (max)		0.371	0.013		0.184	0.029
tarsus (spine from the fourth segments)		0.113	0.048		N	N
tarsus - fuzz		0.043	0.004		0.059	0.005
claws at the end of tarsus		0.09	0.018		0.052	0.008
arolium rudiment		N	N		N	N
Middle legs:						
femur - spine at the end		0.352	0.035		0.422	0.032
femur - spine at the end from the bottom		0.136	0.014		0.127	0.016
femur - fuzz on the bottom		0.202	0.012		0.214	0.006
femur - fuzz in the side line		0.052	0.009		N	N
tibia – spine (max)		0.318	0.036		0.378	0.035
spurs (max)		0.262	0.024		0.322	0.036
tarsus (spine from the fourth segments)		0.097	0.062		N	N
claws at the end of tarsus		0.098	0.016		0.054	0.011
arolium rudiment		0.032	0.055		N	N
Hind legs:						
femur - spine at the end		0.522	0.038		0.555	0.04
femur - spine at the end from the bottom		0.123	0.015		0.184	0.011
femur - fuzz on the bottom		0.139	0.009		0.126	0.01
femur - fuzz in the side line		N	N		N	N
tibia – spine (max)		0.4	0.031		0.42	0.018
spurs (max)		0.381	0.022		0.38	0.019
tarsus (spine from the fourth segments)		0.074	0.049		0.07	0.024
claws at the end of tarsus		N	N		0.057	0.01
arolium					0.076	0.037
cercuses	length (mm)	width base (mm)	width distal (mm)			
left side (right cercus)	N	N	N			
right side (left cercus)	N	N	N			

sensillas (width standard min. 0,010 mm)	length (mm)					
right cercus	N					
left cercus	N					
subgenital plate	N					
ovipositor	N					

Table 5.

Body dorsal	length (mm)	width (mm)		
from head to the end of hind leg	7.54			
from head to end of wing	4.864			
biggiest width (from leg to side hem)		3.508		
biggiest width of wing (with side hems)		2.128		
biggiest width of wings		1.769		
	heigh (mm)	width (mm)		
head (overhang)	0.29	0.655		
shield comming from below pronotum to head	N	N		
pronotum	1.125	1.07		
light side hem on the edges of the body (left side)		0.245		
disc of pronotum	N	N		
furrow in the center (disc of pronotum)	N	N		
clavus	N	1.739		
chest (where the front wings are growing from)	N	N		
chest (where the hind wings where detached)	N	N		
exosceleton (where the hind wings where detached)	N	N		
overhang of hind wings	1.018	1.408		
wings	**Left side**		**Right side**	
	length (mm)	width (mm)	length (mm)	width (mm)
all wings (wing-case)	3.774	0.965	3.715	0.804
clavus	1.524	0.965	1.529	0.804
main wing-case	2.985	0.988	2.988	0.833
width of main wing-case after hind white spots		0.736		0.761
front pale maculae (chest wing-case)	0.298	0.547	0.274	0.548
hind pale maculae	0.44	0.44	0.413	0.494
front wings – veins				
RS	2.25		1.75	
M as appearing	2.2		2	
anal furrow	1.37		1.37	
tergi	heigh (mm)	width (mm)		
(from the bottom up)				
ovipositor	N	N		
T8 (subgenital plate)	N	N		
T7	N	N		
T6	N	N		
T5	N	N		
T4	N	N		
T3	N	N		
T2	N	N		
T1	N	N		

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