

# ***Prototeleia* Talamas, Popovici, Shih & Ren: A new genus of Platygasteridae from Burmese amber**

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## **Abstract**

A new genus and species of parasitoid wasp is described from Burmese amber: *Prototeleia kleio* **gen. nov., sp. nov.** (Platygasteroidea, Platygasteridae). *Prototeleia kleio* exhibits multiple characters that we consider to be plesiomorphic for Platygasteridae. These characters are analyzed and discussed in the context of extant and fossil taxa.

## **Keywords**

Fossil, morphology, Platygasteroidea

## **Introduction**

The systematics of Cretaceous Platygasteroidea has undergone significant advancement in recent years, facilitated by an abundance of well-preserved specimens in Burmese amber. These advances include the documentation of four platygasteroid families from Burmese amber, of which the latter three are extant: Proteroscelpiopsidae (Talamas et al. 2019), Platygasteridae (Talamas et al. 2019), Sparasionidae (Talamas et al. 2017) and

Geoscelionidae (Engel et al. 2017; Chen et al. 2021). Simultaneously, the concept of Platygastriidae has stabilized, primarily by a return to its historical definition, with the inclusion of *Orwellium enigmaticum* Johnson, Masner & Musetti, which was retrieved as a basal taxon (Chen et al. 2021). The new genus and species that we here describe from Burmese amber expands the limits of Platygastriidae, yet it remains identifiable by nearly all family-level diagnostic characters presented in Talamas et al. (2019) and Chen et al. (2021). In this regard, *Prototeleia kleio* Talamas, Popovici, Shih & Ren is highly valuable for expanding our knowledge about morphological evolution in Platygastriidae. The age of this specimen, combined with characters shared between *P. kleio*, *O. enigmaticum* and other platygastroid lineages, form the basis for our hypotheses on plesiomorphies in Platygastriidae.

## Materials and methods

### Informatics

The numbers prefixed with acronyms, e.g. “USNMENT” or “OSUC”, are unique identifiers for the individual specimens (note the blank space after some acronyms). Details on the data associated with these specimens may be accessed at <https://mbd-db.osu.edu/>. The species description was generated from a morphological character matrix in the online program vSysLab (<https://vsyslab.osu.edu>) in the format of character: state.

### Imaging and microscopy

Amber pieces were cut and polished to optimize viewing and photography of the inclusions. Direct examinations were made with a Zeiss V8 stereomicroscope and an Olympus BX51 compound microscope. Photography was performed with an Olympus BX51 compound microscope with a Canon EOS 70D digital SLR camera and a Leica DM2500 compound microscope with a Leica DFC425 camera. Illumination was achieved either with a lighting dome or with LED gooseneck lamps and mylar light dispersers. Images were rendered from z-stacks with Helicon Focus. In some cases, multiple rendered images were stitched together in Photoshop to produce larger images at high resolution and magnification.

Dissections for scanning electron microscopy were performed with a minuten probe and forceps. Body parts were mounted to a 12 mm slotted aluminum mounting stub (EMS Cat. #75220) using a carbon adhesive tab (EMS Cat. #77825-12) and sputter coated with approximately 70 nm of gold/palladium. Micrographs were captured using a Hitachi TM3000 Tabletop Microscope or a Phenom XL G2 Desktop SEM.

### Collections

The amber specimens were collected from Kachin (Hukawng Valley) of northern Myanmar, a site that has been dated to  $98.79 \pm 0.62$  Ma (Cruickshank and Ko 2003; Shi

et al. 2012), equivalent to the earliest Cenomanian and approximately 1 Myr within the boundary between the Early and Late Cretaceous (Walker et al. 2012). This locality has been the source of many notable insect fossils (Lin et al. 2019; Zhao et al. 2020).

Specimens on which this work is based are deposited in the following repositories with abbreviations used in the text:

<b>CNCI</b>	Canadian National Collection of Insects, Ottawa, Canada
<b>CNU</b>	Key Lab of Insect Evolution and Environmental Changes, Capital Normal University, Beijing, China
<b>FSCA</b>	Florida State Collection of Arthropods, Gainesville, Florida, USA
<b>OPPC</b>	Ovidiu Popovici, personal collection, “A.I. Cuza” University, Faculty of Biology, Iasi, Romania
<b>OSUC</b>	C.A. Triplehorn Insect Collection, The Ohio State University, Columbus, Ohio, USA
<b>USNM</b>	National Museum of Natural History, Washington, District of Columbia, USA
<b>UCRC</b>	Entomology Research Museum, University of California, Riverside California, USA

## Morphology

Terminology follows Mikó et al. (2007). The number of clavomeres in platygastroid females is best determined by the presence of papillary sensilla (Bin 1981). However, these structures were not visible in the female specimen examined; thus, the clavomeres were determined by size alone.

## Character annotations

<b>mas</b>	malar sulcus (Figures 7, 8)
<b>mees</b>	mesepimeral sulcus (Figure 9)
<b>mns</b>	metanotal trough (Figures 10, 14–16, 18–20)
<b>msct</b>	metascutellum (Figure 19)
<b>pcxs</b>	paracoxal sulcus (Figures 11, 16)
<b>pssu</b>	prespecular sulcus (Figures 11, 15–16)
<b>T1–6</b>	metasomal tergites 1–6 (Figures 21, 25–26)
<b>tel</b>	transepisternal line (Figures 10, 14, 16)
<b>S2–5</b>	metasomal sternites 2–5 (Figures 21–23)

## Results

***Prototeleia* Talamas, Popovici, Shih & Ren, gen. nov.**

<http://zoobank.org/00950E60-AFF3-40D2-8007-328AD99A3866>

**Type species.** *Prototeleia kleio* Talamas, Popovici, Shih & Ren, sp. nov.

***Prototeleia kleio* Talamas, Popovici, Shih & Ren, sp. nov.**

<http://zoobank.org/49ACB05A-3EFA-40D6-9563-2D98387939DA>

**Family placement.** We place *Prototeleia* in Platygasteridae based on the combination of the following characters, which are consistent with the diagnosis of the family provided in Talamas et al. (2019) and Chen et al. (2021): antenna with 8 flagellomeres; pronotal cervical sulcus setose; mesopleuron with transepisternal line (broadly defined); mesepimeral sulcus absent; T2/S2 the longest metasomal segment.

**Diagnosis.** *Prototeleia* can be separated from all other genera of Platygasteridae by the combination of the following characters: bulla of fore wing present; fore wing with marginal, postmarginal, and stigmal veins; anterior margins of T2 and S2–S4 with transverse lines of foveae; paracoxal sulcus present along anterior margin of metapleuron; malar sulcus present; malar and facial striae absent.

**Description.** Body length of female: 1.73 mm. Body length of male: 1.82 mm.

**Head.** Number of antennomeres in female: 10. Number of clavomeres (based on size) in female: 5. Male antenna: filiform. Number of antennomeres in male: 10. Number of mandibular teeth: 2. Malar sulcus: present. Malar striae: absent. Facial striae: absent. Orbital carina: absent. Submedian carina on frons: absent. Setation of compound eye: present, very short. Interantennal process: present. Torulus: opening laterally. Frontal ledge: absent. Ocular-ocellar length: lateral ocellus separated from compound eye by less than one diameter of lateral ocellus. Sculpture of dorsal head: finely reticulate. Hyperoccipital carina: absent. Occipital carina: present, continuous dorsally and ventrally extending below occipital foramen.

**Mesosoma.** Pronotal cervical sulcus: present as a setose furrow. Epomial carina: absent. Transverse pronotal carina: absent. Posterior margin of pronotum in dorsal view: evenly arched, slightly overlapping mesoscutum. Netrion: present. Skaphion: absent. Antero-admedian lines: absent. Sculpture of mesoscutum: finely reticulate. Notaulus: percurrent, converging posteriorly and sharply bending laterally at anterior end. Parapsidal lines: absent. Scutoscutellar sulcus: present as a smooth furrow between notauli, striate in dorsal axillar area. Sculpture of mesoscutellum: finely reticulate. Posterior mesoscutellar sulcus: foveate. Sculpture of metanotal trough: foveate. Metascutellum: absent. Acetabular carina: absent. Postacetabular sulcus: absent. Episternal foveae: absent. Mesopleural carina: absent. Anterior mesepisternal area: absent. Mesopleural pit: absent. Prespecular sulcus: indicated by rugae. Transepisternal line: present as a chevron-shaped depression. Mesepimeral sulcus: absent. Mesopleural epicoxal sulcus: indicated by weakly impressed foveae on lateral surface of mesopleuron, not visible ventrally. Paracoxal sulcus: indicated by foveae along anterior margin of metapleuron. Metapleural pit: present. Metapleural sulcus: present as a transverse furrow. Sculpture of dorsal metapleural area: very fine microsculpture. Sculpture of ventral metapleural area: very fine microsculpture. Number of spurs on mesotibia: 1. Number of spurs on metatibia: 2.

**Wing venation.** 1Rs+1M (basal vein): nebulous. Bulla in fore wing: present. Marginal vein: present, approximately as long as stigmal vein. Postmarginal vein: present,



**Figure 1.** *Prototeleia kleio*, holotype female (CNU-HYM-MA-2017056), lateral view of right side.

shorter than stigmal vein. 3Rs in fore wing: indicated distal to stigmal vein. Medial vein in fore wing: nebulous in distal half. Cubital vein in fore wing: nebulous. Submarginal vein in hind wing: sclerotized, extending to anterior margin.

**Metasoma.** T1 in female: without horn. Sculpture of T1: longitudinally striate. Sculpture of T2 in female: with transverse line of large foveae at anterior margin, otherwise with fine reticulate microsculpture. Sculpture of T2 in male: with transverse line of large foveae at anterior margin and striate in anterior half, otherwise with fine reticulate microsculpture. Sculpture of T4–T6 in male: with fine microsculpture. Shape of S2 in lateral view: distinctly expanded in posterior half. Sculpture of S3–S5: anterior margin with row of deep foveae, otherwise smooth. Sculpture of S2: foveate along anterior margin with short costae, otherwise with fine microsculpture. Sculpture of S3–S4 in female: foveate along anterior margin with short costae, otherwise with fine microsculpture. Sculpture of S3–S4 in male: foveate along anterior margin, medial costae extending nearly to posterior margin, otherwise with fine microsculpture. Sculpture of S5–S6: fine microsculpture.

**Material examined.** Holotype female: **Myanmar**: CNU-HYM-MA- 2017056 (deposited in CNU); paratype male: **Myanmar**: OPPC-BUR-1719 (deposited in OPPC).





**Figures 2, 3.** *Prototeleia kleio*, holotype female (CNU-HYM-MA-2017056) **2** habitus, dorsal view **3** head, mesosoma, metasoma, dorsolateral view of right side.

**Etymology.** *Prototeleia* derives from Greek, meaning “primitive end”. This name refers to plesiomorphies retained on the metasoma: the transverse lines of foveae along the anterior margins of T2 and S2–S4, and the small degree by which the second metasomal segment is the longest. The species epithet, *kleio*, is the name of the Greek muse of history and refers to the piece of platygastrid history provided by this species.

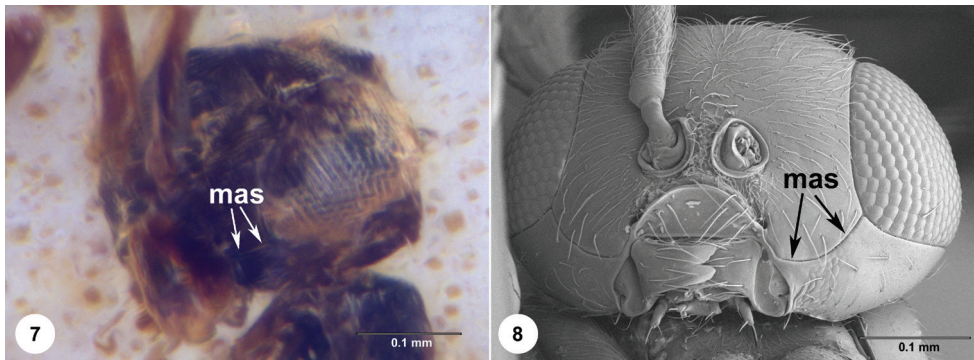
## Character discussion

### Malar sulcus

A malar sulcus is found in very few extant platygastrids: *Orwellium* Johnson, Masner & Musetti, *Aleyroctonus* Masner & Huggert, *Alfredella* Masner & Huggert, *Metaclisis* Förster and *Oligomerella* Masner & Huggert. In all but *Orwellium* and *Prototeleia*, the malar sulcus is bordered by malar and facial striae. The malar area is obscured in the holotype female of *P. kleio*, but the malar sulcus can be seen in the paratype male (Figure 7).



**Figures 4–6.** *Prototeleia kleio*, holotype female (CNU-HYM-MA-2017056) **4** head, anterodorsal view **5** wings, anterodorsal view **6** head, mesosoma, metasoma, lateral view of left side.

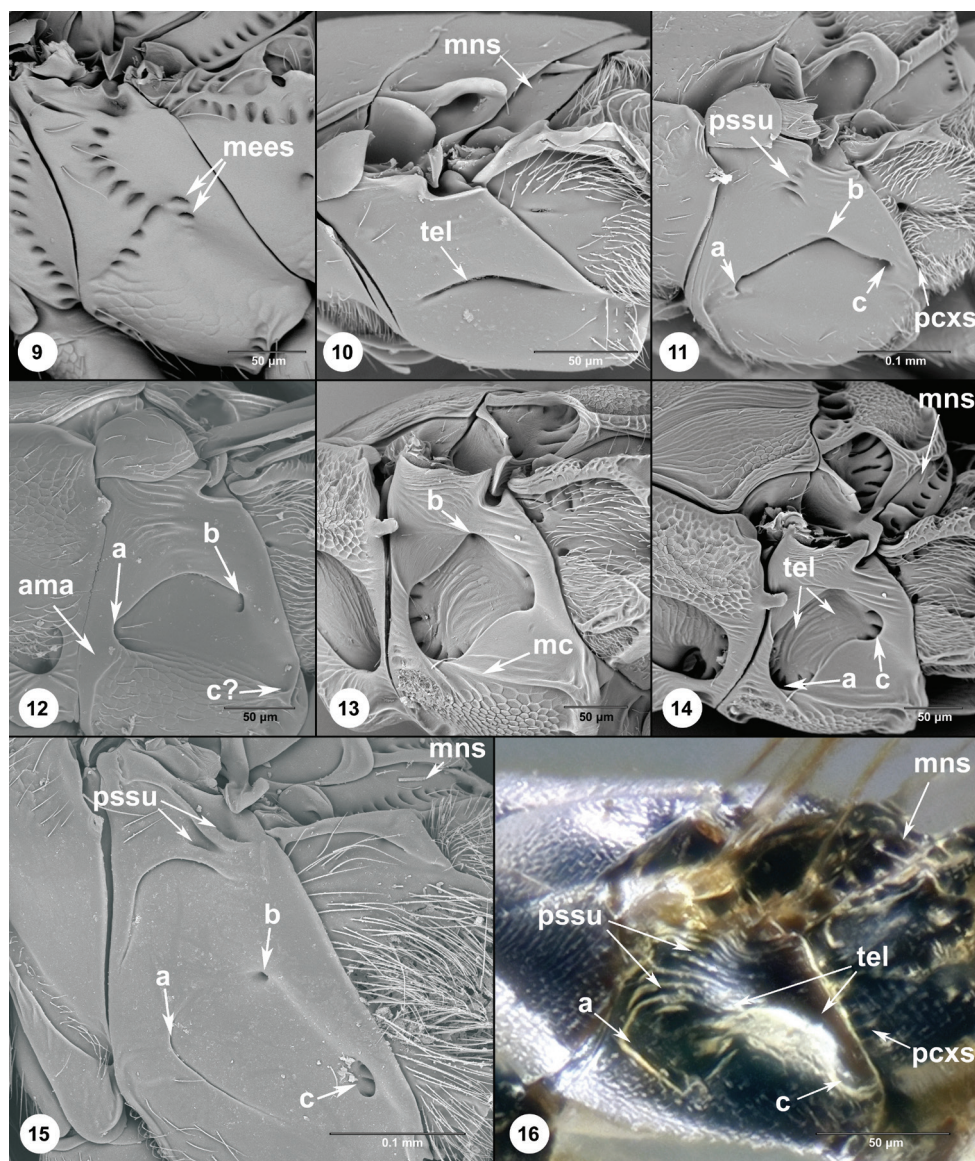


**Figures 7, 8.** **7** *Prototeleia kleio*, paratype male (OPPC-BUR-1719), head, ventrolateral view **8** *Orwellium enigmaticum* (OSUC 226542), head, anteroventral view.

### Prespecular sulcus

Each of the platygastriid genera that have a malar sulcus also have a prespecular sulcus on the dorsal mesopleuron. This sulcus may exist as a line of foveae, as in *Aleyroctonus* and *Metaclisis* (Figure 11), or a line of rugae (Figures 15, 16). Given that the trend in Platygastriidae is toward reduction of sulci, we consider the presence of the prespecular sulcus to be plesiomorphic.





**Figures 9–16.** **9** *Nirupama* (UCRC ENT 516877), mesosoma, lateral view **10** *Fidiobia* Ashmead (USNMENT01197212\_2), mesosoma, lateral view **11** *Metaclisis* (USNMENT01109609), mesosoma, lateral view **12** *Inostemma* Haliday (USNMENT00872720), mesosoma, lateral view **13** *Sacespalus* (USNMENT01197981\_1), mesosoma, lateral view **14** *Sacespalus* (USNMENT01197981\_1), mesosoma, dorsolateral view **15** *Orwellium enigmaticum* (OSUC 226542), mesosoma, lateral view **16** *Prototeleia kleio* (CNU-HYM-MA-2017056), mesosoma, lateral view.

### Transepisternal line

We here propose a hypothesis that the transepisternal line in Platygastriidae originates from three landmarks surrounding an ancestral femoral depression. Figures 11–16 il-



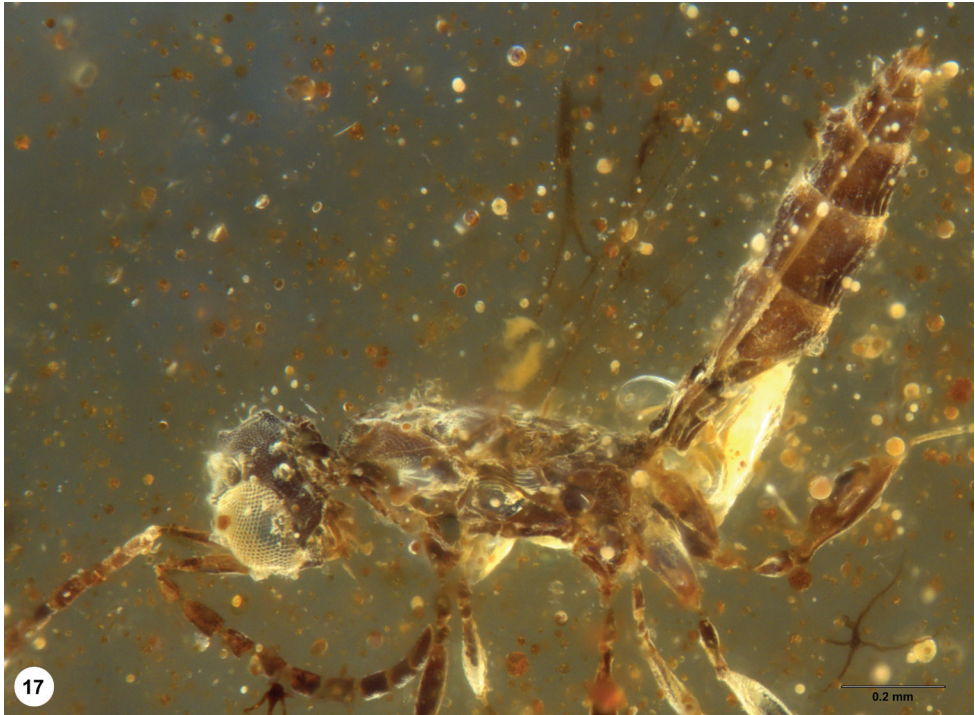
illustrate these landmarks (a–c) in a transformation series from the putatively derived (Figure 10) to ancestral (Figures 15, 16) states. The first landmark (a) is a depression or ridge on the anteroventral mesopleuron. In *O. enigmaticum*, *P. kleio* and *Inostemma* Haliday it is a simple ridge, whereas in *Sacespalus* Kieffer it is a curved line of foveae (Figures 13, 14). The foveae in *Sacespalus* are dorsal to the mesopleural carina and posterior to a raised area at the anterior margin, making them positionally homologous to the subacropleural sulcus in *Archaeoteleia* Masner (see Figures 7, 8 in Talamas et al. (2017)). The second landmark (b) was interpreted by Johnson et al. (2009) to be the mesopleural pit in *O. enigmaticum*. We consider that it may be a fovea of the mesepimeral sulcus, which is consistent with its location at the margin of an elevated posterior mesepimeral area (Figure 15). Supporting this idea, Figure 9 illustrates a species of the scelionid genus *Nirupama* Nixon in which the mesepimeral sulcus is reduced to two foveae. The location of these foveae in *Nirupama* corresponds to that of the single fovea in both *O. enigmaticum* (Figure 15) and *Inostemma* (Figure 12). The third landmark (c) is indicated in *O. enigmaticum* by a short line of foveae in the posteroventral portion of the mesopleuron, and we hypothesize that these are homologous to the more dorsally located line of foveae in *Sacespalus* (Figures 13, 14) and the single fovea in *Metaclisis* (Figure 11). The location of this landmark in *Inostemma* (Figure 12) and *P. kleio* (Figure 16) is speculative because no foveae are indicated. The angled form of the transepisternal line in *Metaclisis*, also found in *Alfredella* (Lahey et al. 2021), can thus be interpreted as a furrow connecting these three landmarks. In cases where the landmarks are either colinear or further reduced, the transepisternal line becomes a simple furrow as in *Fidiobia* Ashmead (Figure 10). Implicit in this explanation is the assertion that the dorsomedial fovea (b) in *Sacespalus* is associated with the mesepimeral ridge. The transepisternal line is found only in Platygastriidae and Proterosceliopsidae, and in the latter it terminates posteriorly at the mesepimeral sulcus (see Figure 16 and fig. 53 in Talamas et al. 2019) but is otherwise a rather simple and smooth arc. Analysis of internal anatomy is clearly needed in these taxa to determine if the transepisternal lines are homologous and test our hypothesis about the evolution of this structure.

### Paracoxal sulcus

The presence of a paracoxal sulcus in the ventral portion of the metapleuron is a rarity in Platygastriidae. Lahey et al. (2019) reported it to occur only in *Calixomeria* Lahey & Masner, but it can also be found in some *Metaclisis* (Figure 11). In these two genera it is a smooth furrow, whereas in *Prototeleia* it is a line of foveae (Figure 16).

### Metanotal trough

We consider a foveate metanotal trough to be plesiomorphic for Platygastroidea because it occurs in all families and all Cretaceous fossils that we have examined. Secondary modification occurs in some Scelionidae where the metanotal trough is largely smooth (some *Telenomus* Haliday) or contains a transverse furrow (e.g. *Dvivarnus mikuki* Talamas & Miko) and in Janzenellidae where the metanotal trough is irregularly rugulose in addition

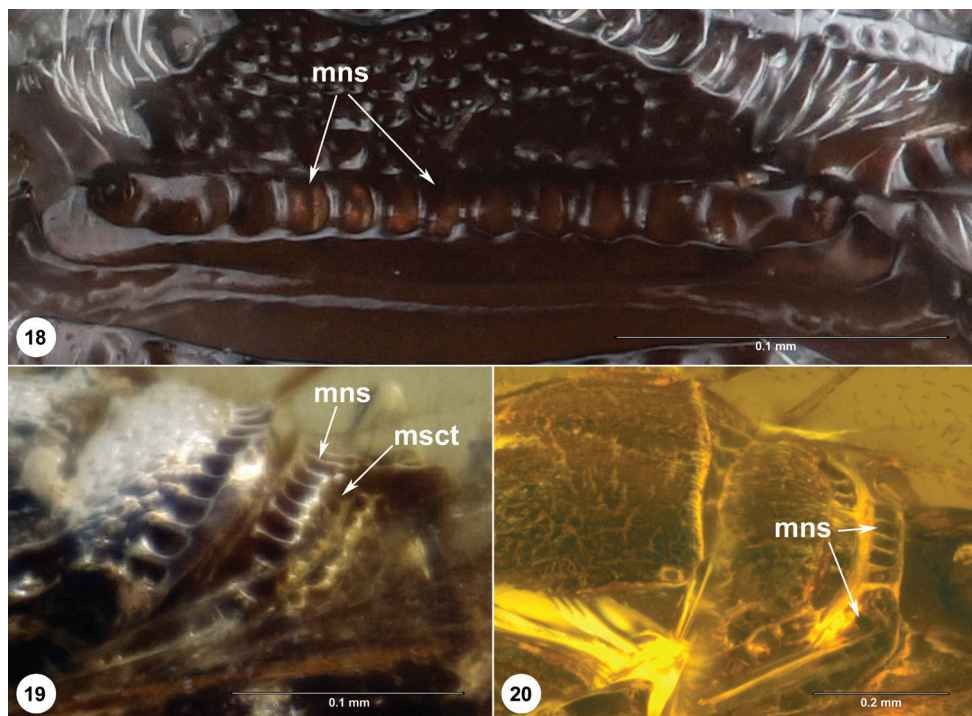


**Figure 17.** *Prototeleia kleio*, paratype male (OPPC-BUR-1719), lateral view of right side.

to having foveae present (Bremer et al. 2021). *Prototeleia* has a foveate metanotal trough (Figures 3, 16), which is also found in number of extant platygastriid genera. The scanning electron micrographs and illustrations in Masner and Huggert (1989), and our own observations indicate that the foveate metanotal trough is found in *Allostemma* Masner & Huggert, *Aphanomerus* Perkins, *Calomerella* Masner & Huggert, *Errolium* Masner & Huggert, *Metaclisis* (variable within the genus, Figure 11), *Nanomerus* Masner & Huggert, *Orseta* Masner & Huggert, *Orwellium* (Figure 15), *Pseudaphanomerus* Szélenyi, *Proplatygaster* Kieffer, *Sacespalus* (Figure 14) and *Zelostemma* Masner & Huggert. However, the majority of platygastriid genera have a smooth metanotal trough (Figure 10). The distribution of this character suggests that it may eventually be useful for dividing the family at the tribal or subfamily levels.

### Metascutellum

The metascutellum, a median, elevated, and often smooth area of the metanotum, is absent in *P. kleio*. In this species the entire metanotum is uniformly foveate (Figure 16), contrasting with the rest of Platygastriidae in which a metascutellum is clearly differentiated, when visible. It should be noted that in some derived platygastriine genera the posterior margin of the mesoscutellum overlaps the metanotum and articulates directly with the lateral propodeal carinae, thus obscuring the metascutellum. The phylogenetic



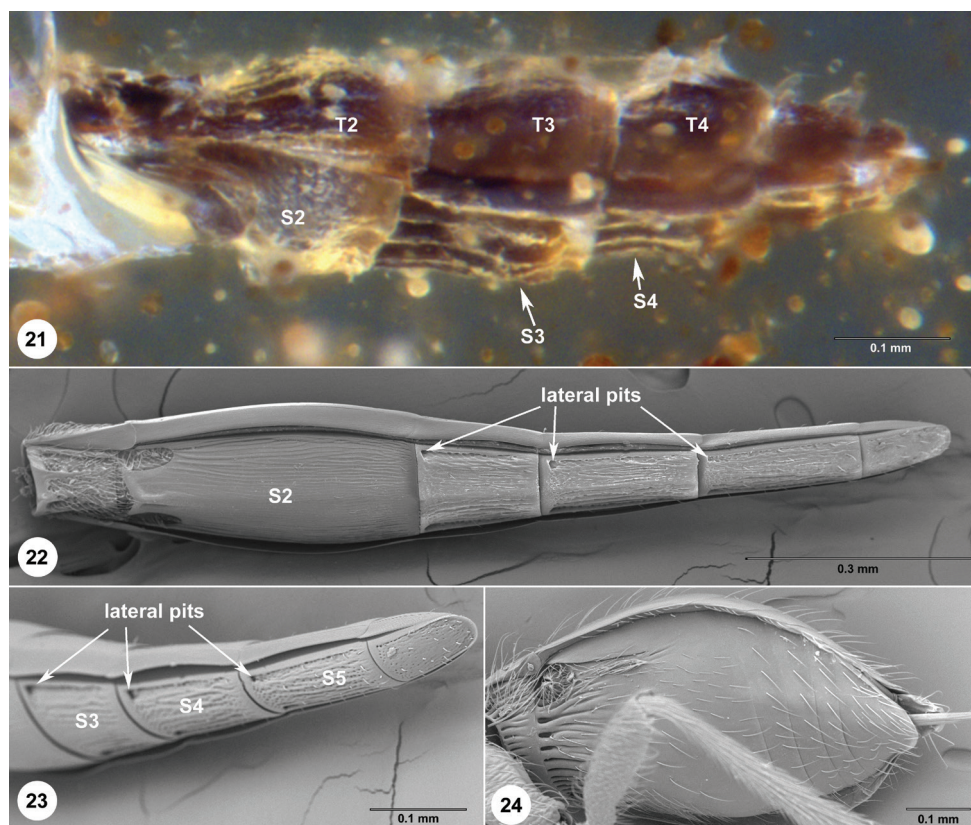
**Figures 18–20.** 18 *Huddlestonium exu* (OSUC 232305), mesosoma, posterior view 19 *Platygastroidea* sp., Burmese amber (CNU-HYM-MA-2017068), mesosoma, dorsolateral view 20 *Sparasionidae* sp., Burmese amber (CNU-HYM-MA-2016104), mesosoma, dorsolateral view.

analyses of Chen et al. (2021) retrieved Platygastriidae in a clade with Janzenellidae and Neuroscelionidae, both of which have a metascutellum, suggesting that its absence in *P. kleio* is not a plesiomorphy. Similar to *P. kleio*, the uniformly foveate metanotum without a metascutellum occurs in Proterosceliopsidae and *Huddlestonium exu* Polaszek & Johnson (Geoscelionidae, Figure 18). Among other Cretaceous platygastroids, some of which require further study for family-level placement, the metascutellum is apparently absent or minimally differentiated from the metanotal trough (Figures 19, 20). It currently remains unclear at what level in the superfamily this character can be considered derived or ancestral, and the degree to which it is homoplastic.

## Wing venation

The wing venation of *Prototeleia*, in which the stigmal vein is perpendicular to the marginal vein, is similar to that of the fossil platygastrid illustrated in figures 65, 66 in Talamas et al. (2019), and *O. enigmaticum*, which is the only extant platygastrid with these veins (see figure 6 in Johnson et al. (2016)). A bulla in the fore wing is found in both platygastrid specimens known from the Cretaceous and is not found in extant members of the family.





**Figures 21–24.** **21** *Prototeleia kleio*, paratype male (OPPC-BUR-1719), lateral view of left side **22** *Sacespalus* [USNMENT01197981\\_1](#), metasoma, ventrolateral view **23** *Sacespalus* [USNMENT01197981\\_1](#), posterior metasoma, ventrolateral view **24** *Orwellium enigmaticum*, ([OSUC 226542](#)), metasoma, ventrolateral view.

## Metasomal foveae

The transverse line of foveae along anterior T2 (Figures 1–3, 21) is found in only a few platygastriids, including *Orwellium*, *Metaclisis* and *Prototeleia*, but is ubiquitous in Sparasionidae and nearly so in Scelionidae. *Prototeleia kleio* is unique among platygastriids by having lines of foveae on anterior S3–S4 (Figures 6, 17, 21), which are deeply impressed and costate, especially in the male specimen. In all other platygastriids, except *Sacespalus*, S3–S6 (or the terminal segment) are simple. In *Sacespalus*, pits are present in the anterolateral corners of S3–S5 (Figures 22, 23). We consider anterior, transverse lines of foveae on metasomal segments 1–5 to be the ancestral condition in Platygastroidea based on its prevalence in the Cretaceous fossils that we have examined (Burmese and Lebanese amber). We thus interpret *Prototeleia kleio* to be a transitional form, one that clearly belongs in Platygastriidae while exhibiting a plesiomorphy not present in the extant fauna.



**Figures 25, 26.** **25** *Synopeas idarniforme* (Dodd) (SAMA No. 32-032767), habitus, lateral view  
**26** *Platygaster prolata* MacGown ([USNMMENT01059214](#)), habitus, dorsal view.

### Length of metasomal segments

The relative length of the second metasomal segment is a useful character for Platygastridae because essentially all members of the family have this as the longest segment. The rare exceptions are species with an extremely elongated metasoma, as is known to occur in some species of *Synopeas* Forster and *Platygaster* Latreille (Figures 25, 26). Metasomal segments of roughly equal length can be found in Scelionidae, but this is not typical, whereas in Sparasionidae, Nixonidae, Proterosceliopsidae, and the unplaced *Proteroscelio* Brues, the segments are generally equal in length. We thus consider T2/S2 as the longest segment to be a derived character for Platygastridae. The metasoma of *Prototeleia* appears to be an intermediate form: T2/S2 is the longest, but only slightly so in comparison to the extant fauna.

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