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The male of the pentatomoid bug genus *Chinchekoala* from the Ypresian of Patagonia, Argentina

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Abstract

A new specimen attributable to the genus *Chinchekoala* Petrulevičius, 2016 was recovered from the Laguna del Hunco locality, corresponding to the Ypresian stage of Patagonia, Argentina. This male specimen is assigned to *C. qunita* Petrulevičius, 2016, the sole described species within the genus. All specimens of *Chinchekoala* exhibit a consistent taphonomic signature, characterized by a fully articulated body and the absence of most appendages and their derivatives, with the exception of genital structures; notably missing are the antennae, wings (absent?), and legs.

Key words: Heteroptera, Pentatomoidea, male, taphonomic signature

Introduction

Fossil pentatomoids are far more common than previously assumed, as evidenced by the fact that only approximately 150 fossil species have been formally described in the literature (Mitchell 2013; Popov & Pinto 2000; Yao *et al*. 2012, 2013; Petrulevičius & Popov 2014; Petrulevičius 2016; Wedmann *et al*. 2021), compared with some 7,000 extant species (Cassis & Gross 2002; Rider 2006, 2011; Schuh & Slater 1995). This is true at least for the Paleogene of France (A. Nel, pers. comm.) and Mo-Clay, with hundreds of undescribed specimens; and in less number from Green River Formation in USA and Ekfeld in Germany (Wedmann *et al*. 2021). This scarcity can be attributed to the challenges associated with studying most of these taxa, stemming from two key factors: the lack of diagnostic characters in fossil specimens and the inherent difficulties in researching the group as a whole, even for its extant representatives, given that some subfamilies and tribes within the Pentatomidae remain poorly circumscribed (Grazia *et al*. 2008; Wedmann *et al*. 2021).

The study of the genus *Chinchekoala* from the early Eocene of Patagonia is possible because of the presence of several characters that clearly differentiate it from all other genera of the superfamily (Petrulevičius 2016). The assignment of the genus to a familial status awaits the finding of new characters to clearly establish its familial relationships.

The discovered specimen of *Chinchekoala* comes from the Patagonian locality of Laguna del Hunco (52.2 Ma), Chubut province, Patagonia, Argentina. Eocene insect localities in Patagonia became more and more interesting regarding the different ages from the early Eocene Nahuel Huapi Este (54 Ma), Laguna del Hunco (52 Ma) to the middle Eocene Río Pichileufú (48 Ma) (Petrulevičius 2013). Additionally, ongoing efforts dedicated to the collection and formal description of fossil specimens have yielded a notable expansion in the known diversity of insects and plants over the past several years (Wilf *et al*. 2003, 2005; Wilf 2011; Petrulevičius & Nel, 2003, 2005, 2013; Petrulevičius *et al*. 2010; Petrulevičius 2005, 2009, 2013).

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Material and methods

The material was recovered from the caldera lake bed locality Laguna del Hunco, province of Chubut, Patagonia, Argentina (Wilf *et al*. 2003). It consists of one specimen collected from pyroclastic debris of the layer LH-25, same as for the holotype of *Chinchekoala qunita*, paleolatitude ca. 47°S (Wilf 2012; Wilf *et al*. 2003, 2005, 2009). The outcrop was dated using $^{40}Ar/^{39}Ar$ by Wilf *et al*. (2005) and recalculated by Wilf (2012), giving an age of 52.22 ± 0.22 (analytical 2 σ), ± 0.29 (full 2 σ) Ma. The specimen was photographed with a Nikon SMZ800 with a DS-Vi1 camera.

Systematic palaeontology

Heteroptera Latreille, 1810

Pentatomomorpha Leston, Pendergrast & Southwood, 1954

Pentatomoidea Leach, 1815

Chinchekoala qunita Petrulevičius, 2016

Figs 1–4

Material. MPEF-PI 985a-b, dorsal and ventral sides of a male.

Diagnosis (revised)**.** Female characters in Petrulevičius (2016). The male (submature nymph (?)) of *C. qunita* has a pygophore reaching the half of the conexivum; in the dorsal view the pygophore is subquadrate with free lateral sides; the ventral intersegmental suture VI–VII has a small medial notch.

Type locality and horizon. LH-25, Laguna del Hunco, province of Chubut, Patagonia, Argentina; Ypresian (52 Ma), Lower Eocene.

Description. Male. This description is based on a single specimen presenting a dorsal (Figs 1B, 2A–C) and a ventral view (Figs 1A, 3A–C) of a mainly complete body lacking appendages (namely antennae, legs, and wings).

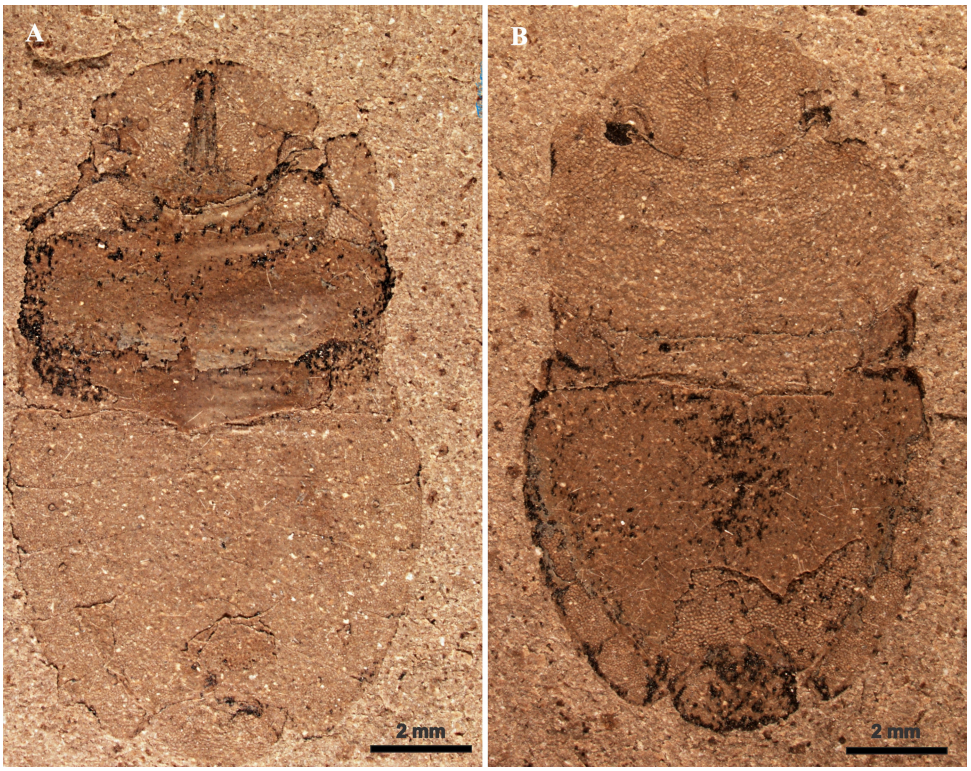

FIGURE 1. Habitus of male of *Chichekoala qunita* MPEF-PI 985a/b from Laguna del Hunco (Chubut, Argentina); Ypresian. **A**, Ventral view. **B**, Dorsal view.

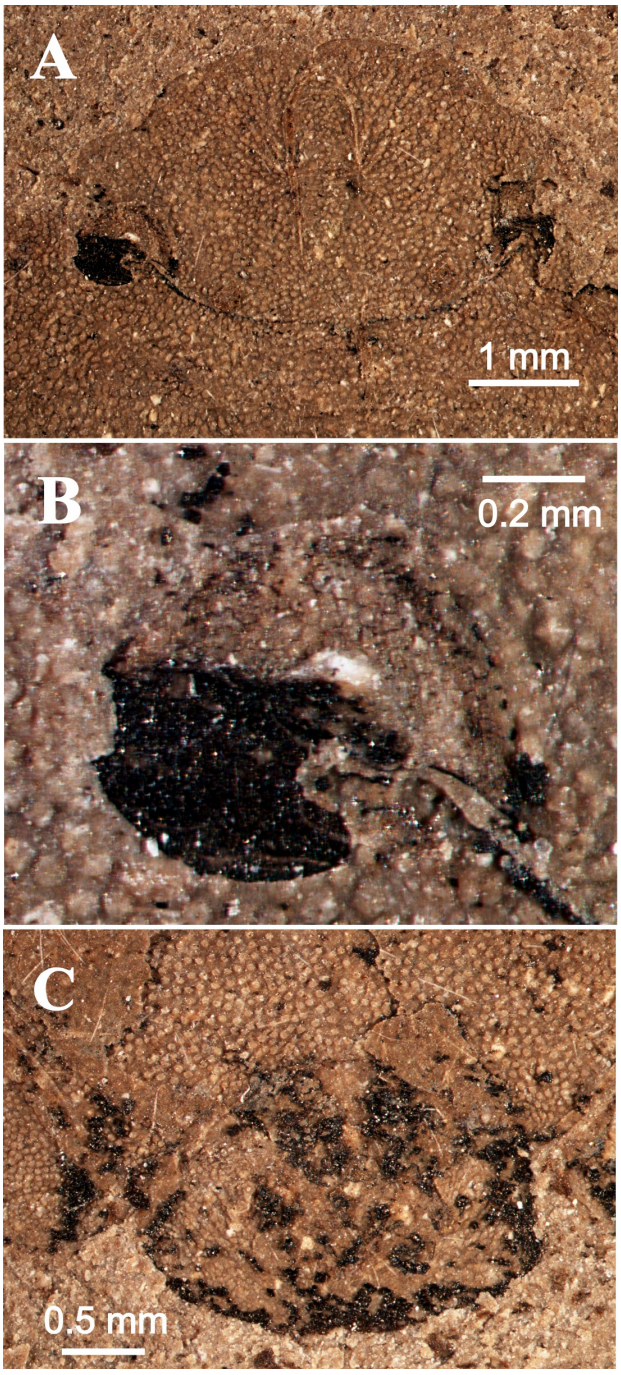

FIGURE 2. Details of dorsal habitus of male of *Chichekoala qunita* MPEF-PI 985a/b from Laguna del Hunco (Chubut, Argentina). **A**, Head. **B**, Compound eye. C, Pygophore.

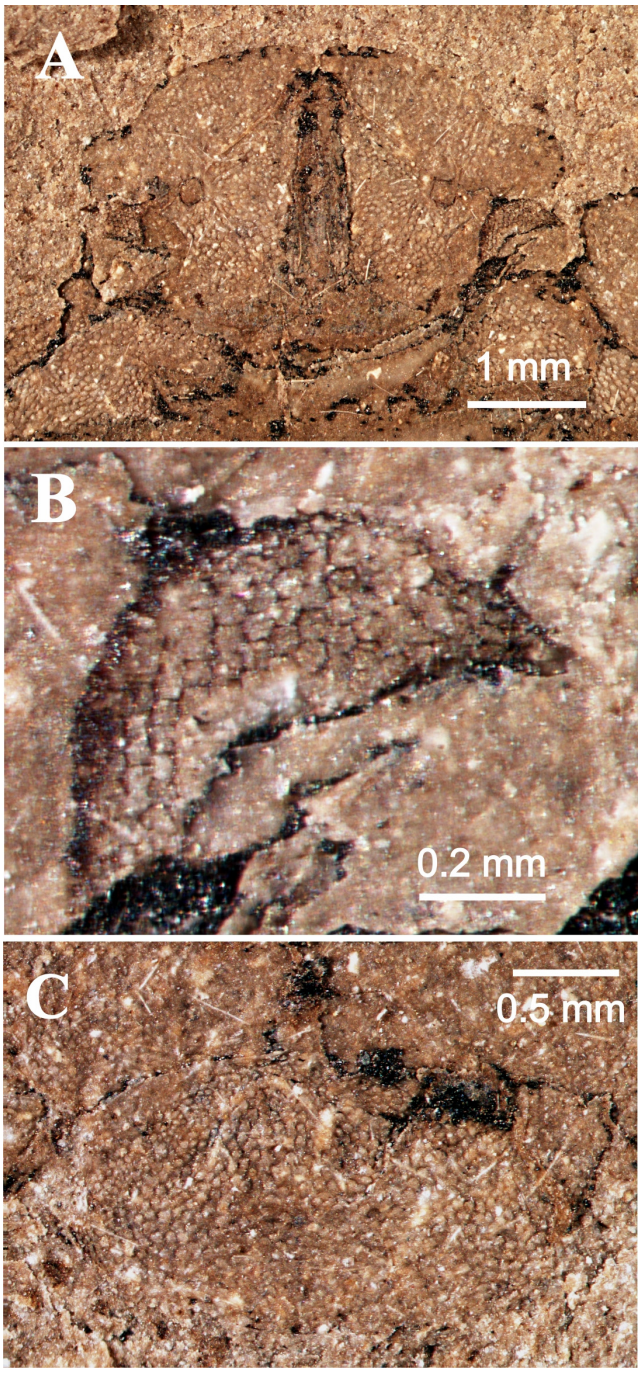

FIGURE 3. Details of ventral habitus of male of *Chichekoala qunita* MPEF-PI 985a/b from Laguna del Hunco (Chubut, Argentina). **A**, Head. **B**, Compound eye. **C**, Pygophore.

Body: 13.9 mm long and 7.25 mm wide at pronotum. Head broader than long with numerous punctures; anterior margin of head somewhat convex; head 4.75 mm wide, 2.6 mm long (dorsal view); eyes reaching both dorsal and ventral surface of head; eyes well developed with ≈ 80 visible ommatidia in dorsal and ≈ 80 in ventral side; eyes, 0.4 mm wide in dorsal view, 0.35 mm wide in ventral view, 0.87 mm long in dorsal view, 0.77 mm long in ventral view; ommatidia showing juxtaposed crystalline cones hexagonally packed in the anterior portion of the eye; postgenae (= temples) well surpassing the eye laterally; anteocular length 1.46 mm; inter-ocular width 2.92 mm; inter-ocular width / head length ratio 1.12; ocelli situated posteromedially to eyes near anterior pronotal margin; distance between ocelli 1.66 mm; distance between eyes and ocellus 0.42 mm; mandibular plates superimposed (left

one under right one) before clypeus for a short distance in dorsal view, separated in ventral view; apex of mandibular plates contiguous in dorsal view about 0.25 mm; lateral margins of mandibular plates deeply concave; clypeus bullet shaped; anteocular process completely embracing the anterior margin of the eye and perpendicular to the sagittal plane, round shaped, 0.58 mm long, with its anterior and posterior margins symmetrical; eyes almost enclosed anteriorly by the anteocular processes and posterolaterally by the expanded anterolateral angles of pronotum; labrum narrow; origin of the labium at the same height than anterior side of anteocular process, distinctly anterior to antennal sockets and anterior margins of eyes.

Pronotum: transverse with numerous punctures, 7.25 mm wide, 3.46 mm long; anteriorly strongly concave to receive head; anterolateral angles broad and triangular, parallel to the sagittal plane and produced anteriad, reaching the anterior margin of eyes; humeral angles rounded.

Thoracic venter: punctated, with grooved and punctated mesosternum narrowing anteriad and posteriad; surface of pleura uneven; evaporatorium large with preserved dark oval area covering the mesepimeron and metepimeron; spiracle developed, wide and long and slightly curved (posteriorly); peritreme long, spout-shaped, slightly falcate, apically curved anteriad, with peritremal surface oriented posteroventrally.

Abdomen in dorsal view: Tergites II to VII visible, 8 mm wide at segment IV, 7.7 mm long; most part of the abdomen apparently covered by a fine layer of sediment that makes the scutellum not visible (?); abdomen laterally arcuate, lateral margins of segments ca. straight, without projections; genital capsule subquadrangular, anteriorly and posteriorly rounded, lateral sides straight, 1.7 mm long and 2.46 mm wide, with posterolateral projections subquadrangular and not prominent.

Abdomen in ventral view: with pregenital segments II to VII visible; spiracles placed on flat tubercles from segment III to segment VII; genital capsule suboval, anteriorly rounded, 1.42 mm long and 3.04 mm wide, with posterolateral projections subtriangular and not prominent.

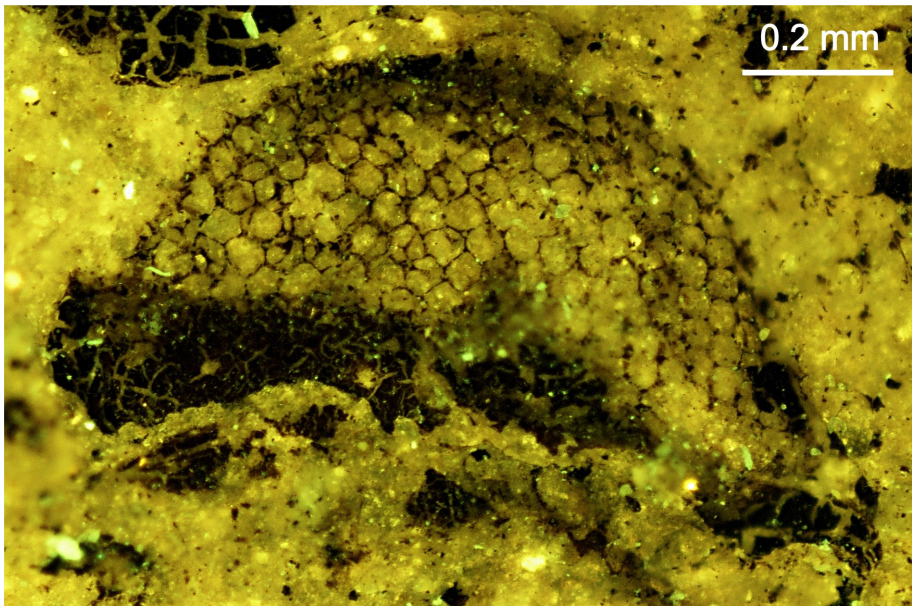

FIGURE 4. Compound eye of *Chichekoala qunita*, holotype MPEF-PI 944b from Laguna del Hunco (Chubut, Argentina).

Discussion

Is noteworthy the presence of the same taphonomic signature in the specimens of Pentatomoidea from the Eocene of Argentina, Germany and USA. This signature is considered very frequent in fossil heteropterans (A. Nel, rev. comm.). Anyhow, I point it out in three age related outcrops with Pentatomidae. In the genera *Eospinosus* Wedmann *et al*. 2021, *Acanthocephalonotum* Petrulevičius and Popov, 2014 and *Chinchekoala*. *Eospinosus* comes from the lower mid-Eocene, Lutetian, ca 47.5 Ma of Germany (Messel Formation; Wedmann *et al.*, 2021) and from the Early Eocene, Late Ypresian of USA (Green River Formation; Wedmann *et al*. 2021). Coincidently, *Acanthocephalonotum* comes from 47.8 Ma from Patagonian Río Pichileufú locality and *Chinchekoala* from the Ypresian. Specimens from the three genera are preserved in dorsal and ventral views in each side of the part and counterpart and without main

appendages, *i.e*. antenna and legs. *Acanthocephalonotum* and *Eospinosus* have wings. Only in the latter and in *Chinchekoala* male genitalia is present.

The new species is considered to belong to the genus *Chinchekoala* because of the presence of a head dorso-ventrally flattened and laterally carinate; mandibular plates (= juga) well developed, surpassing the clypeus and touching each other in dorsal view; head wider than long, anterior margin of head slightly convex; eyes reniform reaching both dorsal and ventral surface of head; interocular width greater than head length (1.7×); well-rounded and broad anteocular process completely embracing the anterior margin of the eye and perpendicular to the sagittal plane; postgenae (= temples) well surpassing the eye laterally; pronotum with broad and triangularly produced anterolateral angles parallel to the sagittal plane and reaching the anterior eye margin; slightly concave mesosternum; evaporatorium large and oval; spiracle long and slightly curved; peritreme long, spout-shaped and slightly falcate. The specimen is considered belonging to the unique species of the genus *C. qunita* because of the general habitus, same size; and same shape, size and number of facets in the eyes. The absence of a visible scutellum may indicate that the specimen is possibly a submature nymph (A. Nel, rev. comm.).

The specimen could be differentiated from the other fossil genus of Pentatomidae present in the Eocene of Patagonia, *Acanthocephalonotum*, by the presence in this latter of pointed and triangular anteocular processes and the pronotum with a broad spine-like anterolateral process, stout and sharp, among several other characters (Petrulevičius & Popov 2014).

Conclusion

The presence of both male and female diagnostic characters justifies its inclusion within Pentatomoidea, pending the discovery of additional material to resolve its definitive familial affinities. The hypothesis that the specimen represents a nymph does not alter the species' taxonomic status. Notably, the description of new species based on immature specimens is feasible, at the very least, within fossil Heteroptera. A case in point is the Cretaceous backswimmer *Notonecta mazzoniae*, which was described not only from a fifth-instar nymph but also from an exuvia (Petrulevičius *et al*. 2010).

The most surprising characters are related to the eyes (Figs 2A, 3A), which are surrounded antero-lateral and posteriorly by the anteocular processes and the pronotum, as well as they extend medially more than usual in the Pentatomoidea (Petrulevičius, 2016). The nice preservation of crystalline cones in *Chinchekoala* allows counting the number of facets, concluding a similar number in both dorsal and ventral surfaces (Figs 2B, 3B, 4). *Chinchekoala* also seems to have lateral vision.

The discovery of a second specimen of *Chinchekoala* from the Eocene deposits of Patagonia represents a noteworthy advance in our understanding of this species. The fossil diversity of Pentatomoidea from the Patagonian Eocene, encompassing *Acanthocephalonotum* and *Chinchekoala*, merits particular emphasis, especially given that only 26 extant species belonging to 21 genera of Pentatomidae and Acanthosomatidae are currently documented in modern Patagonia (Grazia *et al*. 2008). This incipient fossil diversity of pentatomoid bugs is, in any case, unsurprising, as the fossil locality has yielded records of over one hundred plant species, a pattern consistent with the warm, humid palaeoclimate conditions reconstructed for the region (Wilf 2011).

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