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First fossil record of a nymph (Ephemeroptera, Teloganellidae) from the Indian subcontinent

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Abstract

A fossil of a mayfly nymph that shows similarities with the modern genus *Teloganella* Ulmer, 1939 of the family Teloganellidae is recorded for the first time from the Indian subcontinent. It is systematically described from the Gurha lignite mine of Bikaner, Rajasthan which belongs to the Palana Formation (late Paleocene-early Eocene). As assignment of the fossil to a modern species of *Teloganella* is difficult due to indistinguishable location of gills in the impression, a new species, *Teloganella gurhaensis* Agnihotri *et al*., **sp. nov.** is instituted to include this fossil naiad resembling the extant *Teloganella*.

Keywords: Western India, Gurha lignite mine, Paleocene-Eocene, *Teloganella*

Introduction

The systematic assignment of *Teloganella* Ulmer, 1939 within the superfamily Ephemerelloidea has been a subject of much debate. Many workers have placed it on its own monotypic family Teloganellidae (e.g., McCafferty & Wang 2000, Ogden *et al*. 2009) whereas others included it in other families like Ephemerellidae, Tricorythidae, Teloganodidae, Melanemerellidae (Ulmer 1939, Edmunds & Polhemus 1990, Peters & Peters 1993, Wang *et al*. 1995, Jacobus & McCafferty 2006).

This genus has been originally described from the Southeast Asia by Ulmer (1939) for the species *Teloganella umbrata* Ulmer, 1939. Recently, Selvakumar *et al.* (2014) described a new genus *Janohyphella* Selvakumar, Sivaramakrishnan & Jacobus for the species *Janohyphella indica* Selvakumar, Sivaramakrishnan & Jacobus. Shortly after, Kluge *et al.* (2015) considered *Janohyphella* as a subjective junior synonym of *Teloganella* and proposed the combination *Teloganella indica*. Here we systematically describe a fossil mayfly nymph from the Paleocene-Eocene succession of western India, Rajasthan; this becomes the first fossil record of *Teloganella* from the Indian subcontinent.

Material and methods

The fossil has been discovered from the Gurha lignite mine, located in the NW of Kolayat (27° 52′ N; 72° 50′ E), Bikaner, western India (Fig.1). The lignite of this mine belongs to the Palana Formation which is mined around the township of Palana (27° 51′ N; 73° 18′ E), Giral (26° 04′ N;71° 16′ E), and Barmer (28° N; 73° E) (La Touche 1897, Dutta 1971, Tripathi *et al*. 1999). On the basis of stratigraphic correlation (with the Ranikot beds in Sind,

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Pakistan), Khosla (1971) and Pareek (1984) have assigned Palana Formation to the Paleocene age. On the basis of palynomorph assemblage and fish fossils, Kulshreshtha *et. al*. (1989) and Kumar *et al*. (2005) have also favoured the Paleocene age (~ 60 My BP). An early Eocene age has been assigned for the Gurha lignite mine based on its palynoassemblage and its comparison with that of Vastan lignite mine (Shukla *et al*. 2014). The Paleocene age seems more appropriate for the formation because the overlying Marh/Kolayat Formation is considered to be late Paleocene–early Eocene on the basis of planktonic foraminifers (Singh 1971, Kalia & Sharma 1985) and lower vertebrates which are quite similar to those from the early–middle Eocene (~ 47 My BP) Subathu Formation of northwest Outer Himalaya (Jolly & Loyal 1985, Kumar & Loyal 1987). Detailed palynological studies being carried out on various lignite mines from Bikaner and Barmer areas also support an older age (for the lignite deposits, personal communication of Dr. Vandana Prasad).

The fossil insect investigated during the present study was collected from thin light yellow to medium grey clay layers of the Gurha lignite mine (Fig.1). It was chiseled out with the help of a hammer and photographed under Leica MZ 16 microscope with attached digital camera. Morphological terminology used for the insect fossil follows that of Kluge *et al.* (2015). The fossil type specimen is housed in the museum of the Birbal Sahni Institute of Palaeosciences, Lucknow.

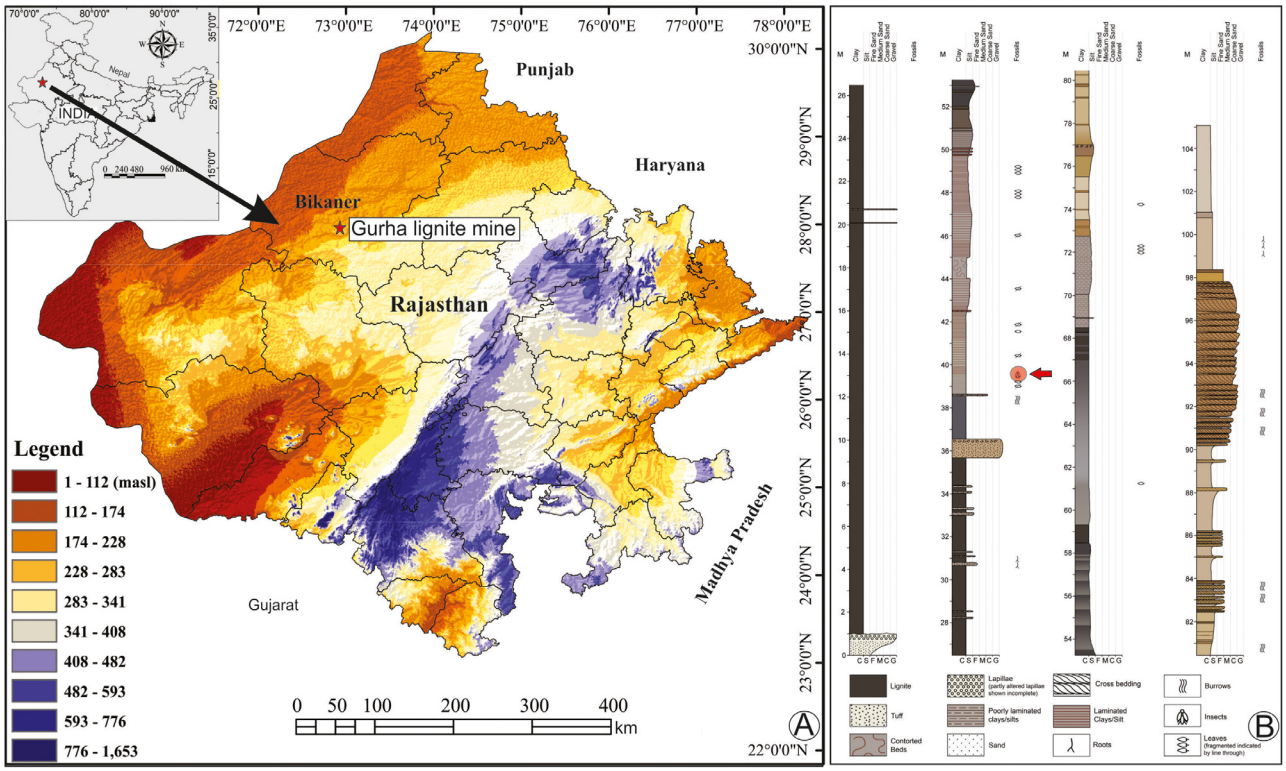

FIGURE 1. A. Shuttle Radar Topographic Mission (SRTM) digital elevation model (DEM) of Rajasthan (red star showing the location of Gurha lignite mine (fossil locality). **B.** Litholog of the Gurha lignite mine (after Shukla *et al*. 2014) showing the location of the fossil insect (red arrow).

Results

***Teloganella gurhaensis* sp. nov.**
(Figs 2, 3)

Diagnosis. Body with defined proportions**,** flattened pronotum and mesonotum, eyes widely separated, fore-femora greatly expanded, claws without denticles, fore-femora margined with bristle-like setae, elongated abdomen, three caudal filaments well-developed.

Holotype. BSIP specimen no. 41813, Late Paleocene-early Eocene, Palana Formation, Gurha lignite mine, Bikaner district, Rajasthan.

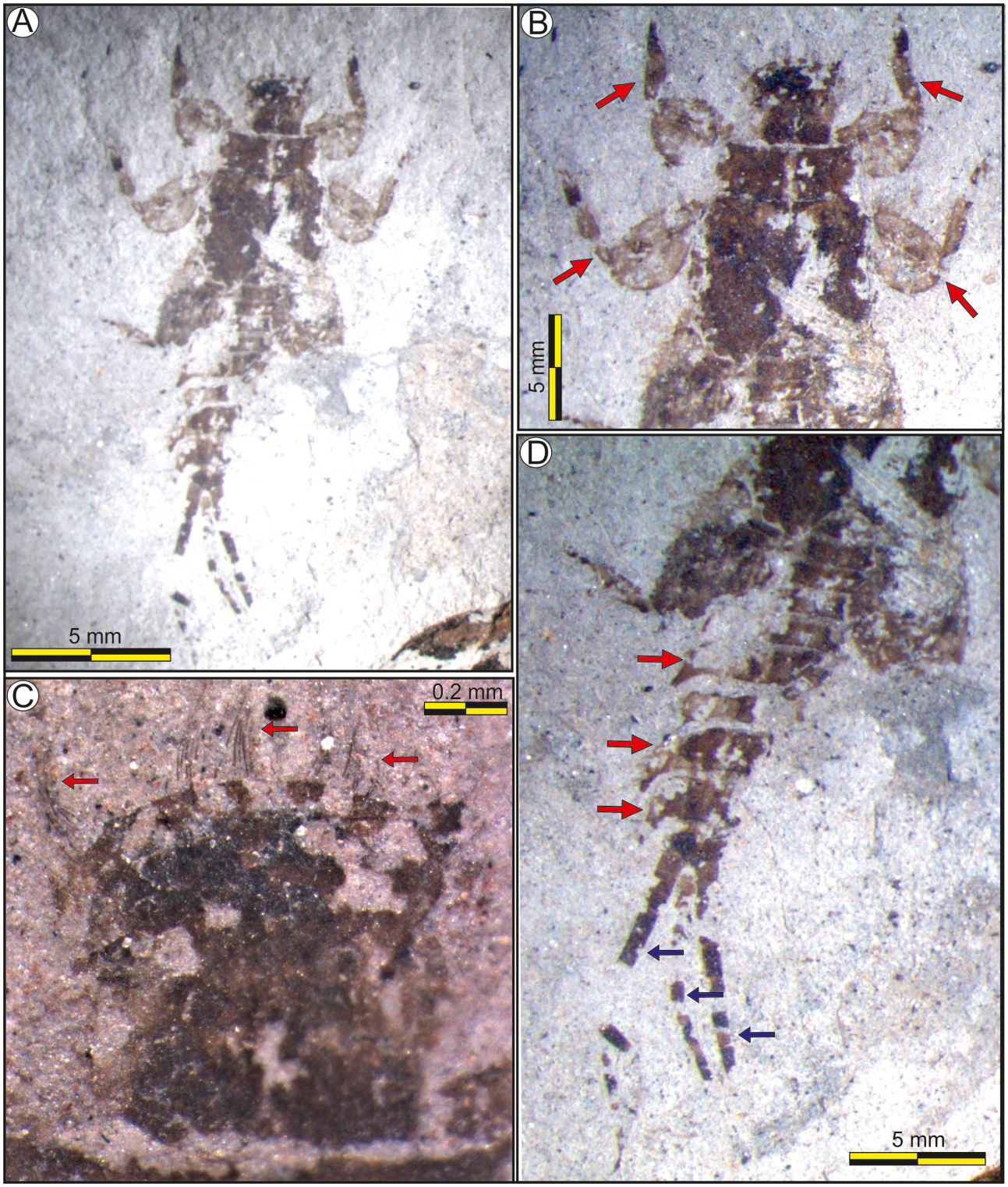

FIGURE 2. A–D. *Teloganella gurhaensis* Agnihotri *et al.,* **sp. nov. A.** Fossil insect in reflected light. **B.** Enlarged view of the upper half showing fore-femora, mid-femora and mid-tibia. **C.** Enlarged head portion with setae (red arrows). **D.** Enlarged lower half with abdominal segments (red arrows) and terminal filaments (black arrows).

Etymology. The specific name is given after the locality Gurha, where the fossil was discovered.

Description. Nymph impression in dorsal position; satisfactory preservation quality of the specimen; body 8.4 mm in length; head 1 mm long with lateral location of eyes and fringe of setae over the head capsule, antennae visible; prothorax 0.6 mm divided into two lobes, hard sclerite impression over the dorsal surface; fore-femora wider than long (FF_L- 0.92 mm; FF_R- 0.8 mm), setae on the inner and outer margins of femur and tibia, single tarsal claw

without denticles; mesothorax 1.4 mm, forewing pads slightly visible, left and right mid-tibia margined with setae; abdomen 3.4 mm, segments I to X visible, Xth segment bearing 3 caudal filaments (cerci- 2 mm), filaments 1/4th of the body length, median filament visible, slender with no spines; location of gills not discernible.

FIGURE 3. Numbered abdominal segments of *Teloganella gurhaensis* Agnihotri *et al.*, **sp. nov.**

Affinities. The fossil exhibits morphological similarities with modern *Teloganella* studied from India and Malaysia. Expanded fore-femora are considered a convergence trait that has evolved through diverse taxa of Pannota (McCafferty & Wang 2000) and also justifies its convergence with Teloganodidae**.** Row of well-developed broad setae on the larval fore-femora distinguishes the Teloganellidae from the other families of Ephemeroptera (Kluge 2004). This trait also suggests co-relation with the Tricorythidae and is also considered as a homophyly (resemblance due to common ancestry) both in Pannota and other mayflies under similar environmental conditions. Teloganellidae belongs to the superfamily Ephemerelloidea which also encloses Ephemerellidae, Melanemerellidae, Teloganodidae and Tricorythidae; however, the affinities and the position of *Teloganella* are still unsolved (Sites *et al.* 2001, Soldan 2001, Sartori *et al.* 2003, Kluge 2004, Ogden *et al.* 2009).

A number of fossil insects from the early Eocene amber belonging to different families have been described from the Indian subcontinent (Grimaldi & Singh 2012, Stebner *et al.* 2017, Zakrzewska *et al.* 2017, Kania *et al.* 2018, and reference therein). The present fossil is the first record of a mayfly from the Indian subcontinent, and is described as *Teloganella gurhaensis* Agnihotri *et al.,* **sp. nov.**

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