smooth). *C. heteropholis* is reportedly most similar to *C. sisparensis*[8].

In addition, *C. sisparensis* and *C. heteropholis* are reported only from high rainfall areas (annually ~ 2000 mm), such as tropical evergreen forest compared to the record of the new species from mixed dry deciduous forest with scanty rainfall (600 mm). Similar to *C. anaikattiensis* and *C. heteropholis*, species with heterogeneous scalation might also be expected from other parts of the Western Ghats (A. M. Bauer, pers. commun.). Till mid 70s, 11 species of *Cnemaspis* have been reported from India[11,12]. Among them distribution data for *Cnemaspis boei* (Gray, 1842)[7] are lacking, and since then five new *Cnemaspis* species have been described from the Western Ghats[4,5,8]. The taxonomy of *Cnemaspis* geckoes is poorly understood[8], and further intensive surveys in the Western Ghats would result in more new species.

C. anaikattiensis is a fast-moving diurnal gecko, largely active during dawn and dusk. It inhabits rocky streambeds in the tropical dry deciduous forest. Fieldwork covering all seasons of the year yielded only four individuals, and it appears that this species is solitary. *Hemidactylus maculatus*, *H. frenatus*, *H. brookii*, *H. triedrus*, *Hemiphyllodactylus aurantiacus* and *Geckoella collegalensis* are common and sympatric with the new species in Anaikatti Hills.

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First record of an exceptionally diverse and well preserved amber-embedded biota from Lower Eocene (~ 52 Ma) lignites, Vastan, Gujarat

The only window to the diverse terrestrial biotic component comprising insects and spiders is through their preservation in amber nodules commonly found in coals and lignites, from the Permian onwards[1–4]. Although a few isolated insect remains have been reported from India[5–8], the present correspondence represents the first record of a diverse biota and provides insights into fossil insect and spider biodiversity, not available through other processes of fossilization. The present find has the potential of providing significant information on the migration and degree of isolation during the drift phase of the Indian Plate prior to the India–Asia collision. Palaeobiogeographical relationships of insects and spiders have been used in the context of geodynamic plate tectonic models to infer multiple migrational histories for the central Americas and Madagascar–Africa connection[9]. The excellent state of preservation of the Indian Eocene insects could help in DNA characterization and in understanding of the diversity and antiquity of modern-day South Asiatic insect and arachnid communities[10,11].

The age of the Vastan lignite has been established as Ypresian on the basis of foraminiferal biostratigraphy and more recently, by fossil shark assemblages[12–16]. Early Eocene coal and lignites represent a significant feature of the western margin of the Indian plate prior to the India–Asia collision both in India and Pakistan[17,18]. Vastan mine is situated about 30 km northeast of Surat between the Narmada and Tapti rivers (Figure 1). Amber occurs in most of the multiple lignite seams exposed in the quarry. Fossiliferous marine foraminiferal and molluscan shell-bearing grey and green shales and marls are intercalated with the lignite seams and are marked by the presence of *Nummulites burdigalensis*[12]. Sharks and rays have recently been described[13] and also suggests a lagoonal palaeoenvironment intermittently connected to the open sea.

The amber occurs as dispersed nodules in the brownish coloured lignites and is usually very brittle and fractured. Amber nodules were examined in a stereoscopic microscope and ground and polished to expose the embedded specimens. The specimens were coated in linseed oil and photographed digitally using Leitz model Lux 11 Pol S microscope. As some of the specimens were deeply embedded in amber and not exposed in one plane, focused photomicrography was not possible for all specimens.

The taxonomic diversity of the assemblage at Vastan is reflected by the compositionally different biotic components of the amber fragments as a result of taphonomic complexities related to the solidification and the contemporaneous entrapment of different elements. For example, the presence of the amoebae (Rhizopods) which are commonly found in soils, suggests that some of the amber solidified at ground level at the base of the tree, while other nodules with pollen and insects may have formed higher up in the branches. Resin-producing trees are particularly common in tropical, humid rainforests and this climatic reconstruction best fits the occurrence of biotic elements described here.

Expectedly because of their fragile nature, fossil amoebae are poorly represented in the fossil record[19]. However, exceptional occurrences have been reported in amber and the Indian occurrences (Figure 2 *i*, *j*) are noteworthy in this regard. Based on morphology, the taxon *Phryganella* can be easily recognized (Figure 2 *i*, *j*).

Spiders are one of the most common components of Lower Eocene amber deposits worldwide[20] and are known by several thousand specimens. The Indian fossils are well preserved and represent at least two different arachnid morphostructural types based on the relative proportions of the cephalon, thorax and abdomen. Arachnid morphotype 1 (Figure 2 *b*) possesses a relatively small body length in comparison to that of its legs I–IV. The legs clearly show the femur, patella and tarsal segments with the presence of numerous bristles. Arachnid, morphotype 2 (Figure 2 *d*) represents the entire specimen in ventral view (Figure 2 *d*, C), showing a large thorax separated from the abdomen by a slight constriction. Anterior part of the mouth in dorsal view is shown (Figure 2 *d*, B). However, due to limited material, it is currently not possible to identify forms at the generic or familial levels. The preservation of fossil spider webs is a rare but not uncommon phenomenon and several spider web fragments, including beaded and thread-like structures occur in the Vastan ambers. The beaded web structures are comparable to those recently described from Cretaceous amber by Zschokke[21] and Selden *et al.*[22] (Figure 2 *e*, *f*).

Insects are well preserved in the Vastan amber, but the small size of the amber fragments precludes the possibility of finding large specimens. Two well-preserved insects are a fly (Figure 2 *a*) and an ant

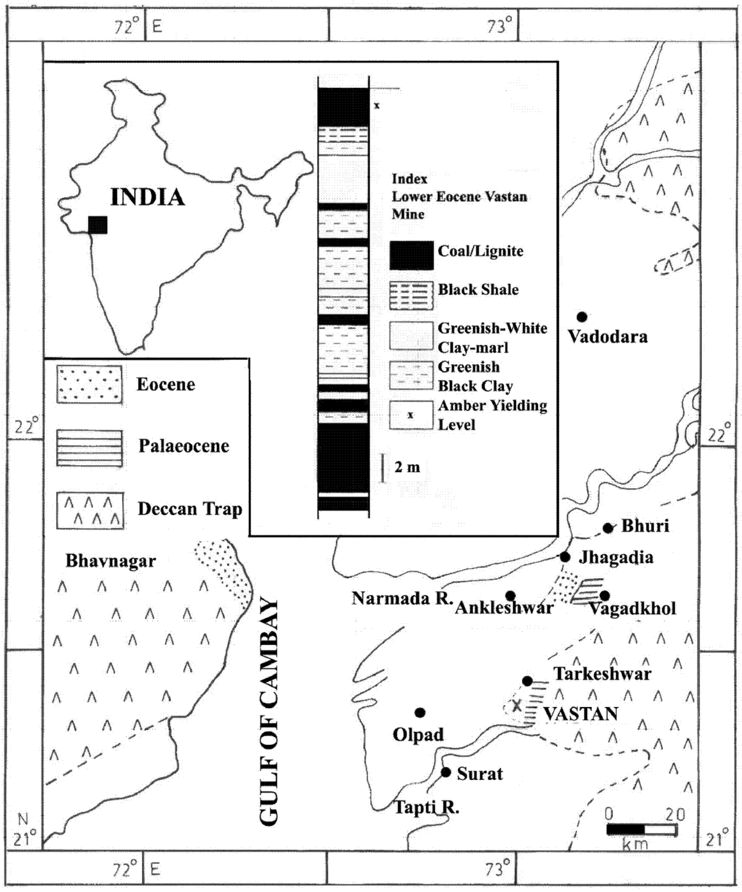

Figure 1. Location map of Vastan Mine with a lithocolumn showing position of amber-bearing horizon with reference to coal and lignite seams.

(Figure 2 *c*, A–C). At present, it is not possible to image the fossil fly from different angles and hence its taxonomic identity must await additional material. However, it is clearly a dipteran with well-developed forewings and a sharply differentiated head region, vertically oriented to the main body. The anterior part of the ant is well preserved, with the head, eyes and antennae intact. The posterior portion is cylindrical and much thinner than the first bulbous segment of the body. Figure 2 *c*, B clearly shows two large protruding eyes and a jaw apparatus. Figure 2 *c*, C shows antennae with beaded segments. The presence of a small insect larva with well-developed segments and an anterior end with developing limb elements is also observed (Figure 2 *g*). Figure 2 *h* is a small amber piece which contains several hairy bristles occurring in small bunches. The bristles are sheath-like and taper distally. Other amber fragments bear bristle and hair-like structures but in the absence of the complete insect it is not possible to speculate on the identity of the insect form.

Plant remains are represented by a variety of elements. Based on morphology and size alone, the presence of fungal bodies and hyphae is inferred for specimen shown in Figure 2 *l*. Fungal bodies commonly occur in fossil amber and have been previously reported from amber of Schliersee, Southern Germany[19]. Cuticular structures occur along with degraded leaf material showing the presence of veins and veinlets (Figure 2 *k*). A flower with projecting stamen-like structures (Figure 2 *m*) is found with a stem axis and degraded plant tissue. Several grains of *Proxapertites* (Figure 2 *n*) are observed in the amber and this taxon has also been recorded from other Indian Lower Eocene lignites[14,23]. The association of leaves, flowers and pollen in lignites with fossil vertebrate assemblages is also reported from the Lower Eocene lignites of France of Le Quesnoy[24], where elasmobranches (sharks) and other land vertebrates have also been recorded.

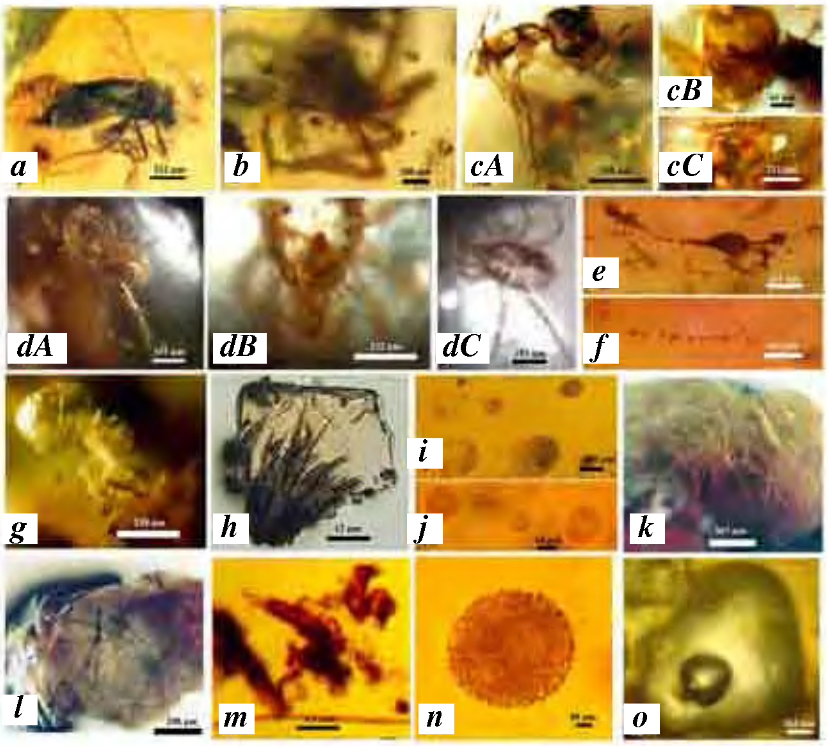

Figure 2. Bar length as specified. Catalogue numbers in parenthesis. ***a***, Fly in lateral view (H.A./VPL/103). ***b***, Arachnid, spider morphotype 1 (H.A./VPL/101). ***c***, A, Ant in lateral view (anteriorly to right); B, Anterior facial view showing eyes and jaw apparatus; C, Left antenna with beaded segments (H.A./VPL/117). ***d***, Arachnid, morphotype 2. A, Surface ornamentation showing bristles on body and legs in ventral view; B, Dorsal view of anterior part; C, Ventral view (H.A./VPL/100). ***e***, Fossil spider web with globular glandular secretions similar to structures reported from the Cretaceous sequences by Selden[20] and Zschokke[21] (H.A./VPL/112). ***f***, Web structure (H.A./VPL/112). ***g***, Insect larval stage (H.A./VPL/117). ***h***, Bristle structures in amber (unidentified; H.A./VPL/102). ***i***, Testate amoebae similar to the forms recently described from Germany[19] (H.A./VPL/106). ***j***, Additional rhizopod material (H.A./VPL/106). ***k***, Degraded leaf structures showing veins and cuticles (H.A./VPL/113). ***l***, Fungal bodies with hyphal structures (H.A./VPL/113). ***m***, Twig with tubular flower-like structure and stamens (H.A./VPL/106). ***n***, *Proxapertites* pollen grain (H.A./VPL/106). ***o***, Fluid inclusion in air vesicle (H.A./VPL/104).

The present assemblage represents a coastal lagoonal facies with swampy marshes enclosing small freshwater bodies in a subtropical rainforest setting. Several fluid inclusions along with numerous air vesicles are also present in the amber (Figure 2 *o*) and these fluid and gaseous phases have the potential for providing data on Lower Eocene palaeoatmospheric composition using stable carbon and oxygen isotopes in the Indian Lower Eocene.

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