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High-resolution X-ray computed tomography of an extant new *Donuea* (Araneae: Liocranidae) species in Madagascan copal

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Abstract

A new extant *Donuea* (Liocranidae) species is described from Madagascar, from both alcohol preserved fresh material and also as a subfossil in copal from the Sambava area. X-ray micro computed tomography was used to visualise minute details of the male palp of the copal specimen in order to confirm conspecificity. This is the first time a new spider species discovered in Madagascan copal can immediately be demonstrated as belonging to an extant species.

Key words: subfossil resin, Dionycha, palp structure, *collustrata*, *decorsei*, extant, extinct, fauna, palaeontology

Introduction

Arthropod inclusions in fossilised resins, first described by Sendelius (1742), offer a unique opportunity to study past life forms in unmatched detail (Bachofen-Echt 1949; Poinar 1992). Insects and spiders enclosed in Tertiary Baltic and Dominican ambers are well known (Petrunkevitch 1942, 1958; Bachofen-Echt 1949; Wunderlich 1986, 1988, 2004, 2008; Poinar 1992; Penney 2001, 2008). Data obtained from such specimens can be an invaluable resource for improving our insight into the phylogeny of groups (Wunderlich 1986, 2004; Kathirithamby & Grimaldi 1993; Grimaldi *et al.* 1997; Kotrba 2004).

However, interesting spider inclusions have also been found in the more recent copal (Wunderlich 1986, 1988). Dunlop *et al.* (2010) list 24 species from copal, 15 of these from Madagascar. Copal is a somewhat ill-defined (Nagel & Körnchen 1934; Vandenabeele *et al*. 2003; Stacey *et al*. 2006; Penney 2008) term for a hardened, polymerised, subfossil diterpenoid resin (Lambert & Poinar 2002; Scalarone *et al.* 2003) which, contrary to amber, has not yet lost most of its volatile terpenes (Poinar 1992; Scalarone *et al.* 2003). On the North-East coast of Madagascar, substantial amounts of copal with inclusions are found, originating from resin of *Hymenaea* (= *Trachylobium*) *verrucosa* Gaertner (Langenheim 1969; Schlüter & von Gnielinski 1987; Poinar 1992; Poinar & Brown 2002). While amber is generally considered to be fossilized resin older than two million years (Wunderlich 1986, 1988; Poinar 1992; Ross 1998), copal is estimated by different authors to be a few hundred to four million years old, depending on its origin, i.e. of Holocene, Pleistocene or Pliocene age (Maia e Vale & Fernandes Costa 1962; Schlee & Glöckner 1978; Schlee 1984; Wunderlich 1986; Poinar 1992; Anderson 1997; Dubois 1998; Stankiewicz *et al.* 1998; Dubois & LaPolla 1999). Madagascar copal, reported as more immature than Dominican copal (Moreno *et al.* 2001), is considered by some authors to be only a few decades old (Poinar 1999; Wunderlich 2004; Penney *et al.* 2005).

It has been stated that most, or all, of the inclusions in copal are Recent species (Poinar 1992: 63, 1999), but some inclusions have been reported as representing extinct species (Hills 1957). Lourenço (2000) described the spider species *Archaea copalensis* (Archaeidae) from Madagascan copal, but it was later synonymised with the extant *Eriauchenius gracilicollis* (Millot 1948) by Wunderlich (2004: 794). Bosselaers

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