INTRODUCTION

The Nemestrinidae or tangle-veined flies are a small group of brachycerous flies with about 300 extant and fossil species (Evenhuis, 1994). Many of them are large to medium-sized flies with a densely pilose body. They have a unique wing venation with a compound diagonal vein which is an apomorphic character for Nemestrinidae (Yeates, 1994). The diagonal vein comprises elements of veins R, M, and Cu and it crosses the wing obliquely. Adult nemestrinids often occur in open areas and many feed on the nectar of flowers (Richter, 1997). Nemestrinid larvae appear to be internal parasitoids of Orthoptera (grasshoppers) and can even control the population numbers of Acridoidea (Orthoptera: Caelifera); however, the species of Hirmoneura Meigen, 1820 develop in larvae of scarabaeid beetles (Richter, 1997). As far as is known, the female places the eggs in the host’s habitat and the first-instar larvae actively search out their host. Larval development takes about 40 days, but there may be a long diapause (inactive period) before 20 to 30 days of pupation take place. Adults live for about 25 to 45 days (Richter, 1997).

Extant Nemestrinidae occur worldwide, but some subgroups show a very disjunct distribution (Bernardi, 1973). Centers of their diversity are in the Palaearctic, Australian, Neotropical, and Afrotropical regions (Bernardi, 1973). Particularly in southern Africa, long-proboscid nemestrinid flies are well known for their spectacular pollination associations with a wide range of plant species with tubular flowers (e.g., Goldblatt and Manning, 2000). These plants have mostly odorless flowers with a long floral tube that is typically 35 to 60 cm long, and many species are pollinated solely by specially adapted long-proboscid flies (Goldblatt and Manning, 2000).

The fossil record of Nemestrinidae is quite extensive. An up-to-date list is given in Ansorge and Mostovski (2000). The oldest nemestrinoids were already in existence in the late Early Jurassic. They probably originated in the Late Triassic/Early Jurassic (Ansorge and Mostovski, 2000). About 24 Mesozoic nemestrinoid species were recorded from the Upper Jurassic and from the Cretaceous of several Eurasian localities (Ansorge and Mostovski, 2000). Hitherto, the only known fossil Cenozoic Nemestrinidae were five species from the upper Eocene of Florissant, Colorado, USA (Bequaert and Carpenter, 1936). No Nemestrinidae are known from Baltic Amber (Hoffeins, personal commun. 2005) or from any other amber deposit. The specimen described in this paper is the sixth Paleogene species, and was found in the Messel Pit fossil site in Germany.

SYSTEMATIC PALEONTOLOGY

The systematic classification of Nemestrinidae follows Bernardi (1973), the nomenclature of wing cells is from the discussion provided by Bequaert and Carpenter (1936), and the wing venation nomenclature follows Bernardi (1973).

Order Diptera Linnaeus, 1758
Family Nemestrinidae Macquart, 1834
Genus cf. Hirmoneura Meigen, 1820

DESCRIPTION

The fossil shows the following diagnostic features, which according to Bernardi (1973) allow the exclusion of all nemestrinid genera except for Hirmoneura and Prosoeca Schiner, 1867: eyes bare, without hairs. First segment of hind tarsus longer than or as long as the last four combined. Wing venation: Vein R3 absent, so that first and second submarginal cells are fused; crossvein r-m absent; longitudinal veins R4 + 5 and M1 + 2 meet only at one point. Many characters of the wing venation can be quite variable in nemestrinid taxa (e.g., Bequaert, 1957; Timon-David and Léonide, 1968).

Unfortunately, none of the apomorphic characters of both Hirmoneura and Prosoeca are preserved in the fossil described here. But if one considers that the fossil is embedded in a ventrolateral position with large parts of the head preserved, one can assume that a long proboscis (which is characteristic for species of Prosoeca) most likely would be visible. Because no trace of a proboscis is visible in the fossil specimen, the proboscis probably was short or vestigial. In extant species of Hirmoneura the proboscis is reduced and always much shorter than the head (Bernardi, 1973). Thus, this fossil is provisionally identified as belonging to Hirmoneura.

cf. Hirmoneura sp.

GEOLOGICAL SETTING AND LOCALITY INFORMATION

The Messel Pit fossil site is located within the Sprendlingen Horst in the state of Hesse, Germany, situated between the towns Frankfurt-am-Main and Darmstadt on the northeastern shoulder of the Upper Rhine Valley. The Messel Pit is an isolated former lake with sedimentary infill, interpreted as a Maar lake created by explosive volcanic activity (e.g., Schulz et al., 2002; Felder and Harms, 2004).

The Messel Formation is biostratigraphically dated as lower Middle Eocene (Geiseltal, MP 11; Franzen, 2005), and recent absolute dating shows that the deposits have an age of about 47 million years (Mertz et al., 2004; Mertz and Renne, 2005).

The Messel Pit currently has yielded approximately 15,000 fossil insects that are deposited mainly in the collections of the Forschungsinstitut Senckenberg and the Hessisches Landesmuseum Darmstadt. The insects from Messel comprise a diverse fauna (e.g., Lutz, 1990; Wedmann, 2005). Interestingly, flies are exceptionally rare among the Messel fossils. Lutz (1990) recorded only five specimens of flies (0.5%) among roughly 1,200 insect fossils. An initial estimate for dipteran abundance among the entire current collections is under 1%. This rarity definitely is attributable to taphonomic reasons and not from a scarcity of Diptera in the surrounding habitats of former Lake Messel. For example, analyses of small fish coprolites showed that the former Lake Messel was populated by large midge larva populations that comprised a major part of the food for small fish (e.g., Richter and Wedmann, 2005; Wedmann and Richter, 2007). The contents of these coprolites are chaoborid midges, which are absent in all collections of insect body fossils. Thus, it is relevant that, although there are few dipteran species known from Messel, a representative of a parasitoidic and therefore comparatively rare group such as the Nemestrinidae has been found.

A NEMESTRINID FLY
(INSECTA: DIPTERA: NEMESTRINIDAE: CF. HIRMONEURA)
FROM THE EOCENE MESSEL PIT (GERMANY)

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