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FIRST RECORD OF FOSSIL SPECIES OF THE GENUS *TETRAMORIUM* (HYMENOPTERA, FORMICIDAE)

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First Record of Fossil Species of the Genus *Tetramorium* (Hymenoptera, Formicidae). Radchenko, A. G., Dlussky, G. M. — Two extinct species of the modern genus *Tetramorium* Mayr, *T. paraarmatum* sp. n. and *T. kulickae* sp. n., are described from the Baltic amber (Poland, ca. 37 Ma). This is the first record of the fossil species of this genus. Described species resemble recent Palaearctic species, and we preliminarily place them to the *inerme* and *caespitum* species groups, respectively. Findings of other, previously non-recorded and not described yet fossil *Tetramorium* species from the Middle (or possibly Early) Eocene and Miocene deposits of Europe and North America are discussed.

Key words: ants, taxonomy, palaeontology, Late Eocene, Baltic Amber, *Tetramorium paraarmatum* sp. n., *T. kulickae* sp. n.

Первая находка ископаемых видов из рода *Tetramorium* (Hymenoptera, Formicidae). Радченко А. Г., Длусский Г. М. — Два новых вымерших вида из современного рода *Tetramorium* Mayr, *T. paraarmatum* sp. n. и *T.kulickae* sp. n., описаны из Балтийского янтаря (Польша, около 37 млн лет назад). Это первое указание ископаемых видов из данного рода. Описанные виды соответственно сходны с современными палеарктическими представителями из групп видов *inerme* и *caespitum*. Приведены также находки прочих, ранее не указанных и еще не описанных видов ископаемых *Tetramorium* из отложений среднего (а, возможно, также и раннего) эоцена и миоцена Европы и Северной Америки.

Ключевые слова: муравьи, таксономия, палеонтология, поздний эоцен, Балтийский янтарь, *Tetramorium paraarmatum* sp. n., *T. kulickae* sp. n.

Introduction

Tetramorium Mayr, 1855 is one of the most speciose ant genera. It includes more than 450 described species (Bolton, 2014) distributed worldwide except for Antarctic and Arctic territories. Majority of them (> 200) are known from the Afrotropical Region, and about 60 — from the Palaearctic Region.

The genus *Tetramorium* is very complicated taxonomically. Workers of many species are quite variable in body sculpture and colour, those of different species resemble one another and hardly distinguishable, and queens and males are often required for correct identification of the majority of species. Withal, most of species and infraspecific forms have been described based only on workers, and in Museum collections sexual forms present only for a few samples. At last, besides ca. 450 described "good" species, about 250 valid infraspecific names are known in this genus. Moreover, as has been shown recently, even within one of the commonest and widespread Palaearctic species, usually identified as *T. caespitum* (Linnaeus, 1758), there are several morphologically and molecularly different cryptic species (Schlick-Steiner et al., 2006; Steiner et al., 2010; Csősz et al., 2014).

The latest taxonomic revisions of this genus were carried out for all zoogeographic regions, except for the Palaearctic (Bolton, 1976, 1977, 1979, 1980). Radchenko (1992 a, b) revised *Tetramorium* of the former USSR, but modern taxonomic revision of the Palaearctic *Tetramorium* is not yet completed, while several species groups have been revised (Csősz et al., 2007, 2014; Csősz, Schulz, 2010; Radchenko, Scupola, 2015).

Despite the great diversity of extant *Tetramorium*, no fossil species were recorded until now (see also Discussion, below). Nevertheless, in the course of our revision of the ants of the Late Eocene European ambers (ca. 37 Ma), in two pieces of Baltic Amber, we found two *Tetramorium* species, which described below.

Material and methods

We examined two specimens (dealate queen and worker) in two pieces of Baltic amber, belonging to two new species; both holotypes are preserved in the collection of Museum of Earth of Polish Academy of Sciences, Warsaw, Poland (Muzeum Ziemi Polskiej Akademii Nauk, MZ PAN).

The figures of *T. paraarmatum* are based on photographs made using an Olympus Camedia C-3030 digital camera fitted to an Olympus SZX9 microscope in conjunction with the computer program CorelDraw 8. Seeing that making photos of *T. kulickae* was technically impossible due to character of preserving of the specimen in amber, we made original drawings of the specimens by hand using the same microscope.

Not all features of the examined specimens were properly visible and measurable, hence we measured only visible details (accurate to 0.01 mm), particularly:

HL — maximum length of the head in dorsal view, measured in a straight line from the most anterior point of clypeus to the mid-point of occipital margin;

HW — maximum width of the head in dorsal view behind (above) the eyes;

SL — maximum straight-line length of the scape from its apex to the articulation with condylar bulb;

ML — diagonal length of the mesosoma (seen in profile) from the anterior end of the neck shield to the posterior margin of the propodeal lobes (worker), or from the most anterodorsal point of mesosoma to the posterior margin of the propodeal lobes (queen);

MH — height of the mesosoma (seen in profile) from the upper level of the mesonotum perpendicularly to the level of lower margin of mesopleuron;

PL — maximum length of the petiole in dorsal view, measured from the posterodorsal margin of petiole to the articulation with propodeum (just below the posterior visible margin of propodeum); the petiole should be positioned so that measured points lay on the same plane;

PH — maximum height of the petiole in profile, measured from the uppermost point of the petiolar node perpendicularly to the imaginary line between the tip of subpetiolar process and posteroventral points of petiole;

PW — maximum width of the petiole from above;

PPL — maximum length of the postpetiole in dorsal view between its visible anterior and posterior margins;

PPW — maximum width of the postpetiole in dorsal view;

HTL — maximum length of the hind tibia;

ESL — maximum length of the propodeal spine in profile, measured along the spine from its tip to the deepest point of the propodeal constriction at the base of the spine;

ESD — distance between the tips of the propodeal spine in dorsal view;

ScW — maximum width of the scutum in dorsal view (queen);

ScL — maximum length of the scutum + scutellum in dorsal view (queen).

Tetramorium paraarmatum sp. n.

Tetramorium sp. n.: Kosmowska-Ceranowicz, 2001: 59. *Tetramorium* sp. A: Dlussky, Rasnitsyn, 2009: 1032.

Material examined: queen (dealate), holotype, No 15440, Muzeum Ziemi PAN, Baltic Amber, Gdansk-Stogi, Poland.

Etymology. From the Greek prefix "*para*" — beside, near, and the species name *Tetramorium armatum* Santschi, 1927, to what described species resembles.

Queen (fig. 1, 2). Head longer than broad (HL/HW 1.20), with subparallel sides, straight occipital margin and rounded occipital corners. Lateral portions of clypeus raised in both sides into a sharp shield-like ridge in front of antennal insertions, so that antennal sockets separated from the clypeal surface. Eyes well developed, of moderate size. Anterior clypeal margin convex, with shallow medial notch. Antenna 12-segmented, with 3-segmented apical club, scape short, far not reaching occipital margin (SL/HL 0.58, SL/HW 0.69).

Mesosoma quite long and narrow (SCL/SCW 3.23), flattened, pronotum does not overlapped by scutum, its anterior and lateral parts visible from above. Propodeum with relatively long, blunt, subparallel and directed backward spines (ESL/HW 0.17, ESD/ESL 1.27). Petiole relatively long and narrow (PL/PW 1.71), with not very long peduncle, its node apparently cuneiform. Postpetiole broader than length, but not strongly widened (PPL/PPW 0.67).

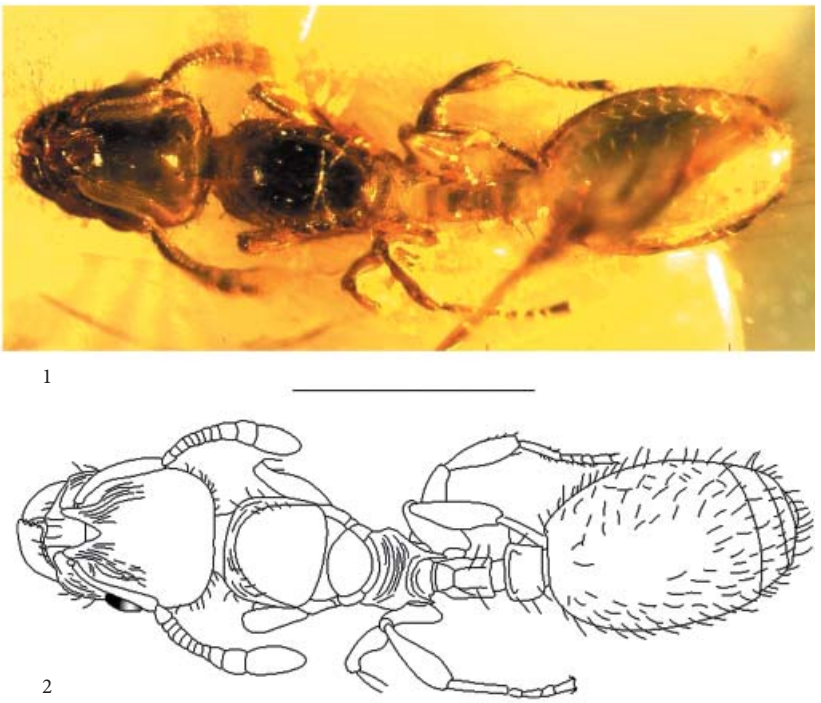

Fig. 1–2. *Tetramorium paraarmatum* sp. n., holotype queen, body in dorsal view: 1 — photo of holotype; 2 — line drawing, made based on photo. Scale bar 1 mm.

Hind tibia with one simple spur (second, smaller spur, is invisible).

Head dorsum smooth, only gena, frontal lobes and lower part of frons laterally with fine longitudinal striation. Scutum and scutellum smooth, pronotum and dorsal surface of propodeum with fine transversal striation.

Head margins with quite abundant, not too long suberect hairs; mesosoma with similar hairs, waist, and especially gaster, with more abundant, longer hairs. Legs with short subdecumbent hairs (only partly visible).

Total length ca 3.5 mm.

Measurements (in mm): HL 0.66, HW 0.55, SL 0.38, ML 0.85, PL 0.24, PW 0.14, PPL 0.14, PPW 0.21, HTL 0.35, ESL 0.11, ESD 0.14, ScW 0.13, ScL 0.42.

Workers and males unknown.

Tetramorium kulickae sp. n.

Leptothorax sp. C: Kosmowska-Ceranowicz, 2001: 59. *Tetramorium* sp. B: Dlussky, Rasnitsyn, 2009: 1032.

Material examined: worker, holotype, No. 20246, Muzeum Ziemi PAN, Baltic Amber, Gdansk-Stogi, Poland.

Etymology. The species is dedicated the memory of Polish palaeoentomologist, Dr. Róża Kulicka (1944–1999).

Worker (fig. 3–5). Head longer than broad, with subparallel sides, very feebly concave occipital margin and rounded occipital corners. Lateral portions of clypeus raised in both sides into a sharp shield-like ridge in front of antennal insertions, so that antennal sockets separated from clypeal surface. Eye well developed, of moderate size. Anterior clypeal margin convex. Antenna 12-segmented, with 3-segmented apical club, scape short, far not reaching occipital margin.

Mesosoma low (ML/MH 2.89), with distinct but shallow metanotal groove, promesonotum somewhat flattened. Propodeum with blunt denticles. Petiole with quite

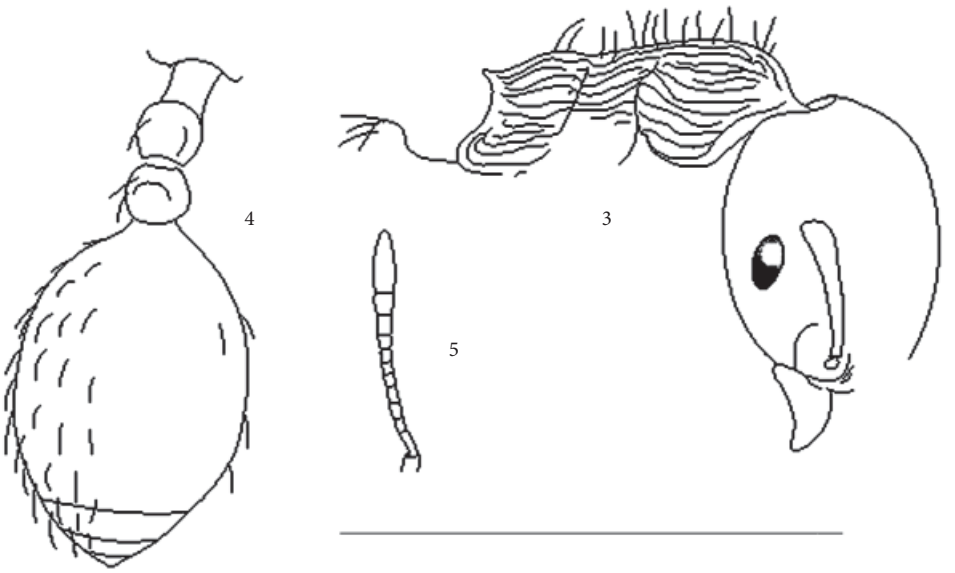

Fig. 3–5. Details of structure of *Tetramorium kulickae* sp. n., holotype, worker: 3 — mesosoma and head in profile; 4 — waist and gaster, dorsal view; 5 — antenna funiculus. Scale bar 1 mm.

long peduncle, strongly concave anterior surface, its node not high, with widely rounded dorsum (PL/PW 1.17, PL/PH 1.40) Postpetiole subglobular (PPL/PPW 1.00).

Spurs on the mid and hind tibia are obscure.

Whole mesosoma with quite coarse longitudinal, slightly sinuous rugosity. Sculpture on head barely visible, but head seems to be longitudinally rugose; petiolar and postpetiolar nodes seem to be coarsely punctated. Mesosomal dorsum with long, thin erect hairs.

Total length ca 2.5–2.7 mm.

Measurements (in mm): ML 0.81, MH 0.28, PL 0.21, PH 0.15, PW 0.18, PPL 0.15, PPW 0.15.

Queen and male unknown.

Taxonomic notes

Kosmowska-Ceranowicz (2001) recorded two species from the Baltic Amber collected near Gdansk (Stogi) in the Catalogue of amber collection of Tadeusz Giecewicz, deposited in the Museum of the Earth. Their collecting numbers fully correspond with those of *T. paparamatum* and *T. kulickae*, and determined by her as *Tetramorium* sp. n. and *Leptothorax* sp., respectively.

Dlussky, Rasnitsyn (2009) recorded three undescribed species of this genus from the Baltic and Rovno ambers. Two of them from Baltic amber we described above, but record from the Rovno amber was based on misidentification, and we identify now this specimen as *Fallomyrma transversa* Dlussky et Radchenko, 2006.

Radchenko (1992 a, b) established six species groups for *Tetramorium* of the former USSR. One of them, *inerme* group, is characterized by the relatively small queens with flattened scutum and scutellum, scutum is narrowed anteriorly so that anterio-lateral angles of pronotum are visible from above. Additionally, body sculpture in queens and workers reduced, head dorsum and mesosoma mostly smooth or at most with the fine striation. We placed *T. paraarmatum* sp. n. to this group.

The species of *caespitum* group have much bigger queens, their scutum distinctly convex, not narrowed anteriorly, so that anterio-lateral angles of pronotum covered by scutum and invisible or very barely visible from above. Body sculpture of queens and workers well

developed, head dorsum and mesosoma longitudinally rugulose, while this sculpture in not very coarse. Since we described *T. kulickae* sp. n. based on workers, we tentatively place it to this group.

Based on the main diagnostic features, e. g., the body size, the shape of mesosoma, the reduced body sculpture, presence of distinct propodeal teeth, *T. paraarmatum* sp. n. resembles modern species *T. armatum*. At the same time, *T. kulickae* sp. n. is similar to modern species of *Tetramorium caespitum* group, e. g., *T. caespitum* s. l., *T. impurum* (Foerster, 1850) or *T. hungaricum* Röszler, 1935. Nevertheless, we do not think that modern ant species might exist in the Late Eocene, what is supported by the all existing data. For example, several fossil Late Eocene amber ant species are very similar to modern ones, e. g. extinct *Formica flori* Mayr, 1868 to extant *F. fusca* Linnaeus, 1758, *Lasius schiefferdeckeri* Mayr, 1868 to *L. niger* Linnaeus, 1758, etc., but no one doubts their heterospecifity.

Discussion

Rarity of the fossil *Tetramorium* may be explained, on the one hand, by the lifestyle of the majority of species, which nesting predominately in soil, often under stones, and rarely — in wood remnants. Workers forage on a ground surface and are not arboreal dwellers. As a result, workers might be very rarely trapped to resin and later fossilized in amber. One may suppose that well flying *Tetramorium* gynes and males might trapped to resin similar to sexual forms of many other non-arboreal ant species. However, *Tetramorium* gynes and males are much bigger than those of majority of known species from the Late Eocene ambers, what may explain its lack in amber. On the other hand, *Tetramorium* gynes and males should be easily fallen down to water (as is often observed in modern species) and then fossilized in sediments.

As was mentioned above, no any fossil *Tetramorium* species has been described until now. Nevertheless, we found several, not described yet, *Tetramorium* species from imprints of Messel (Germany, Middle Eocene, two gynes, probably two species) and from Miocene deposits of Radoboj (Croatia, one gyne) and Rott (Germany, one gyne). Moreover, Poinar et al. (1999) recorded undescribed species of the genus *Leptothorax* Mayr from the early Eocene ambers of Canada (British Columbia, Hat Creek), but judging from the photo in that paper, we cannot exclude that this specimen belongs to *Tetramorium*.

Thus, existing data show that the genus *Tetramorium* is known from at least Middle or even Early Eocene, and it is one of the oldest known extant genera of the subfamily Myrmicinae. At the same time, it seems that *Tetramorium* was quite rare at that time even compared to other myrmicine genera (e. g. *Monomorium* Mayr, 1855 or *Fallomyrma* Dlussky et Radchenko, 2006).

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