

## Taxonomic notes on Tetracampidae (Hymenoptera: Chalcidoidea) with description of a new fossil species of *Dipriocampe* from Rovno amber

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E-mail: <sup>1</sup>gumovsky@izan.kiev.ua, o\_gumovsky@hotmail.com; <sup>2</sup>perkovsk@gmail.com, perkovsky@fromru.com

GUMOVSKY, A.V. & PERKOVSKY, E.E. 2005. Taxonomic notes on Tetracampidae (Hymenoptera: Chalcidoidea) with description of a new fossil species of *Dipriocampe* from Rovno amber. *Entomol. Probl.* 35(2): 123–130. – A new fossil species of the genus *Dipriocampe* is described from Late Eocene Rovno amber. The new species differs from *D. diprioni* in having distinctly petiolate transverse funicular segments and traceable median carina on the propodeum. It is also emphasized that the family Tetracampidae, in its current concept, is likely polyphyletic and a rather artificially composed group. Placement of many groups currently assigned to Tetracampidae was likely motivated by the conventional concept of this family as intermediate between Pteromalidae and Eulophidae, and thus serving as a “dumping ground” for species with a problematic status. It is recorded that one of the key characters defining Tetracampidae is the single short and nearly straight protibial spur (calcar). This character is peculiar to *Tetracampe* (the type genus) and allied genera (the subfamily Tetracampinae). However, the short straight calcar may support relationships in a large clade, i.e. Tetracampinae + Eulophidae + Trichogrammatidae. Platynocheilinae and Tetracampinae also share this type of calcar. However, this association may appear rather gradual branching than a monophyletic unit. Species of Mongolocampinae (including the fossil species *Electrocampe sugonjaevi* from Late Eocene Baltic amber) do not demonstrate any similarities with *Tetracampe* and other tetracampids, apart from some homoplastic characters (e.g. the expanded marginal vein of males); also they have two protibial spurs what is unique in Chalcidoidea. The fossil representatives from Cretaceous Canadian amber (species of Bouceklytinae, Baeomorphae and Distylopiniae) assigned to Tetracampidae by YOSHIMOTO (1975) hardly belong to this family, because their type species are characterized by the possession of the long and curved calcar. Discussions on all group currently classified in Tetracampidae are provided. It is concluded that care must be paid to any generalizations about this family as a whole “true” tetracampid species known from amber inclusions and to its paleontological history, in particular. Thus, the newly described *Dipriocampe bouceki* may be figured out as the only “true” fossil species of Tetracampidae, although many other species from fossil resins have been previously assigned to this family.

**Key words:** fossils, Late Eocene, Rovno Amber Tetracampidae, Eulophidae.

### Introduction

Tetracampidae comprise a small family with 50 described species classified in 15 genera (NOYES, 2003). BOUČEK (1958) reviewed the European species and divided the family into two subfamilies, Tetracampinae and Platynocheilinae. Another subfamily, Mongolocampinae, was established by SUGONJAJEV (1971) for the peculiar genera *Mongolocampe* SUGONJAJEV, *Eremocampe* SUGONJAJEV and *Platyneurus* SUGONJAJEV. Five extinct Cretaceous species in two new genera, *Bouceklytus* YOSHIMOTO and *Distylopus* YOSHIMOTO, were further described in Tetracampidae by YOSHIMOTO (1975), who also reassigned to the family another extinct Cretaceous taxon, *Baeomorpha* BRUES (1937), which originally had been classified in Scelionidae (Platygastroidea). The 3 fossil genera were assigned to separate extinct subfamilies, Bouceklytinae, Baeomorphae and Distylopiniae, by YOSHIMOTO (1975). Another extinct genus, *Electrocampe*, was newly described in Tetracampidae by TRIAPITZIN & MANUKYAN (1995) from

Late Eocene Baltic amber. As a result, Tetracampidae are considered to be one of the most represented chalcid families in fossil resins.

The biology of extant Tetracampidae in the current concept of this family is rather diverse. Tetracampinae are egg parasitoids of Hymenoptera and Coleoptera (BOUČEK, 1958; NIKLAS, 1956; BHUIYA et al., 2000) and larval parasitoids of Diptera (FRANCO & PANIS, 1991), Platynocheilinae (with the single genus *Platynocheilus* WESTWOOD) are larval parasitoids of Diptera, and Mongolocampinae are phytophagous (SUGONJAJEV & VOINOVICH, 2003).

The status of some of the world genera was clarified by BOUČEK (1988). The genus *Dipriocampe* was erected by BOUČEK (1958) for two species, *Tetracampe diprioni* FERRIERE, 1935, which was designated as type species of the genus, and *Foersterella elongata* ERDÖS, 1951. Females of the two extant species that are included in *Dipriocampe* differ rather poorly from each other and the male is known for *D. diprioni* only. The latter species is an egg parasitoid of sawfly *Neodiprion sertifer* (GEOFFROY) (NIKLAS, 1957).

This paper describes of a new species of *Dipriocampe* from Rovno amber and discusses some taxonomic problems in Tetracampidae.

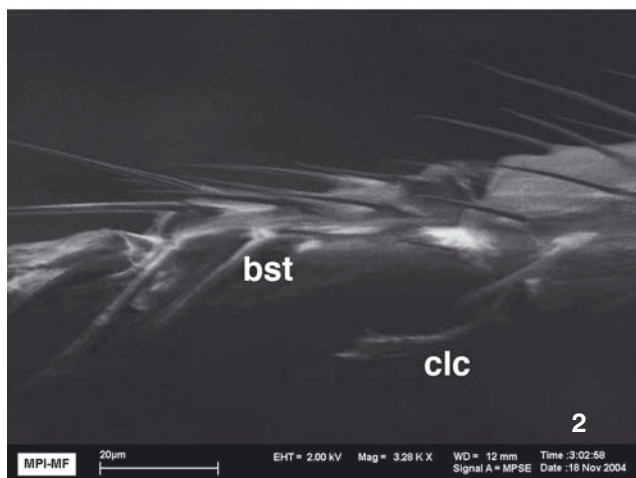
## Material

Rovno amber is of Late Eocene age; its geological background was discussed in detail by PERKOVSKY et al. (2003b). The amber sample containing the inclusion discussed below was obtained from the “Ukryantar” factory (Rovno) and originated from the Dubrovitsa deposit, being the largest one in the region between the Styr’ and Horyn’ rivers (PERKOVSKY et al., 2003a). Structurally, the region of the amber-bearing deposits is referred to the northwestern margin of the Ukrainian Crystalline Shield. The Palaeogene deposits in the most complete sections contain the Buchak (Lower and Middle Lutetian), Kiev (Upper Lutetian – Bartonian), Obukhov (Priabonian), Mezhygorje (Rupelian) and Berek (Chattian) suites. Amber occurs in almost all stratigraphic units of the sedimentary cover, but has not been found in the Buchak deposits and is extremely rare in the Kiev deposits. However, even in the part of the section where amber occurrences are abundant, its content in the rock is substantially different. The richest placers are asso-

ciated with the Obukhov (Upper Eocene) and Mezhygorje (Lower Oligocene) suites. The Obukhov and Mezhygorje suites seem to have been formed in shallow water zones of marine basins, with their deep water parts situated in the Pripjat and Dnieper-Donets depressions. The shorelines of these basins lay within the Ukrainian shield. The zone of littoral shallow waters in this shield was apparently the area where the formation of amber placers in the sea was simultaneous with the accumulation of primary sediment material of future suites.

The origin of Rovno amber from the North Ukraine is supported by comparison of the species compositions of its inclusions with species of the same groups recorded for Late Eocene Baltic amber (PERKOVSKY et al., 2003b). For example, 26% of the determined ants (Hymenoptera: Formicidae) belong to new species and respectively are not recorded from Baltic amber (DLUSSKY & PERKOVSKY, 2002; PERKOVSKY et al., 2003b). The number of new species is even higher for gall midges (Diptera: Cecidomyiidae) from Rovno amber, all of which are different from ones described from Baltic amber (PERKOVSKY & FEDOTOVA, 2004; FEDOTOVA & PERKOVSKY, 2004, 2005).

For the fossil assemblages of parasitic wasps from Dubrovitsa, the published information is available only for



Figs 1–4. 1) *Dipriocampe bouceki* male, holotype; 2–4) *Dipriocampe elongata elongata*, female: 2) fore basitarsus and calcar (the protibial spur); 3, 4) habitus: bst, fore basitarsus; clc, calcar.

Alysiinae indet. (Braconidae), Cryptinae indet. (Ichneumonidae), and for a new species of *Pherhombus* (Ichneumonidae: Pherhombinae) (TOLKANITZ et al., 2005).

Comparative material of Tetracampidae was studied by the first author in the collections of The Natural History Museum (London, BMNH) and Zoologisches Staatssammlung (München, ZSM).

## Methods

Relative measurements were made under x56 magnification, each ocular micrometer division was of 0.014 mm length.

The scanning electron microscopy (SEM) photography was carried out in the Max-Planck Institute for Metal Research (Stuttgart, Germany) using an LEO 1530VP microscope, and in the Mineralogy Department of the Natural History Museum (London) using an LEO 14S5VP microscope, which allows imaging of uncoated specimens (under the program LEO-32 V04.00.01).

The color photo of the amber specimen was done in the Staatliches Museum für Naturkunde (Stuttgart, NKMS) using Automontage Program.

## *Dipriocampe bouceki* GUMOVSKY ET PERKOVSKY, sp.nov.

**Type material. Holotype** ♂, D-2349, Dubrovitsa, Rovno amber, Late Eocene (in the collection of the Schmalhausen Institute of Zoology, Kiev, SIZK), Fig. 1.

**Diagnosis.** Funicular segments petiolate, marginal vein thin; propodeum with weakly traceable median carina.

**Colour.** Hardly traceable.

Length of body. 1.02 mm.

**Head.** Clypeus with anterior margin concave. Eye height about 3.6 times as long as malar space. Antennae attached at level of lower ocular line; scape 4.5 times as long as broad, slightly longer than first funicular segment; flagellum with 6 separate funicular segments and three-segmented relatively acute clava; funicular segments all subequal in length, somewhat wider than long, and separated by distinct peduncles; clava about 3 times as long as broad. Pronotum elongate, its collar not delimited from neck by a carina, but with distinct setae, 0.2 times as long as mesosoma. Notauli sulcate; mesoscutum and scutellum weakly reticulate; dorsellum smooth. Propodeum smooth except for weakly traceable median carina; spiracle round and separated from anterior margin of propodeum by distance slightly shorter than its own diameter. Mesopleuron with transepimeral sulcus traceable as weakly curved suture.

**Wings.** Fore wing about 1.7 times as long as broad and 4.3 times as long as marginal vein. Length of apical fringe : submarginal vein in widest part = 4 : 0.7. Relative length of marginal : postmarginal : stigmal veins = 11 : 3.5 : 14. Costal cell narrow. Speculum closed below by the basal and cubital lines of setae.

**Legs.** Fore femur 4 times as long as broad, fore tibia

7.3 times as long as broad. Fore tarsus slightly shorter than its tibia, consisting of four segments. Protibial spur short and straight, as long as width of fore tibia. Mid femur 4.5 times as long as broad. Mid tarsus slightly shorter than its tibia, consisting of four segments. Mid tibial spur short and straight, about twice as long as width of fore tibia. Hind coxa 2.5 times as long as broad. Hind femur 4 times as long as broad, hind tibia 7.5 times as long as broad. Hind tarsus 0.7 times as long as tibia, consisting of four segments. Hind spur short and straight, about 1/3 of length of its tibia.

**Metasoma.** Petiole short, but details are hardly apparent; metasoma slightly shorter than mesosoma.

**Female** unknown.

**Etymology.** The species is named after famous chalcidologist Z. Bouček, who, in particular, was the first reviser of Tetracampidae.

**Family and generic placement.** The inclusion specimen may be identified as a tetracampid male because of the combination of the short protibial spur (Fig. 2), the 4-segmented tarsi, the 6-segmented funicle, and fore wing with rather long postmarginal and comparatively short stigmal veins. The habitual peculiarities discussed below easily figures it out as a member of the subfamily Tetracampinae. The described species is assigned to *Dipriocampe* (Figs 3, 4) through the possession of the acute antennal clava (the clava is abruptly truncate in *Tetracampe* FÖRSTER, Fig. 5, and oblique truncate in *Niticampe* BOUČEK), the evenly concave anterior margin of clypeus (the anterior margin of clypeus produced in *Cassidocida* CRAWFORD), the rounded propodeal spiracles and equiangular scutellar setae (the propodeal spiracles elongate and posterior setae on scutellum are longer than anterior ones, in *Diplesiostigma* GIRAULT), the narrow antennal scape (the scape is widened in *Foersterella* DALLA TORRE), the short petiole and the lack of the frenal area (the petiole robust elongate and the frenal area generally delimited in *Epiclerus* Haliday, Fig. 10).

**Comparative notes.** The new species differs from *D. diprioni* in having distinctly petiolate transverse funicular segments (the peduncles between the segments are rather short and the segments are quadrate to slightly longer than broad in *D. diprioni*), and traceable median carina on the propodeum (the median area of propodeum is smooth in *D. diprioni*).

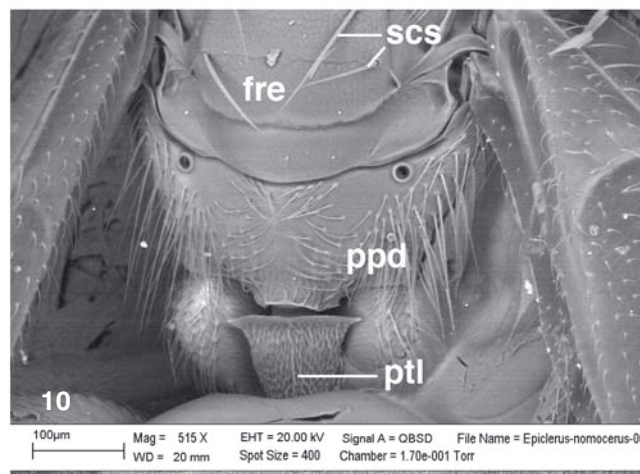
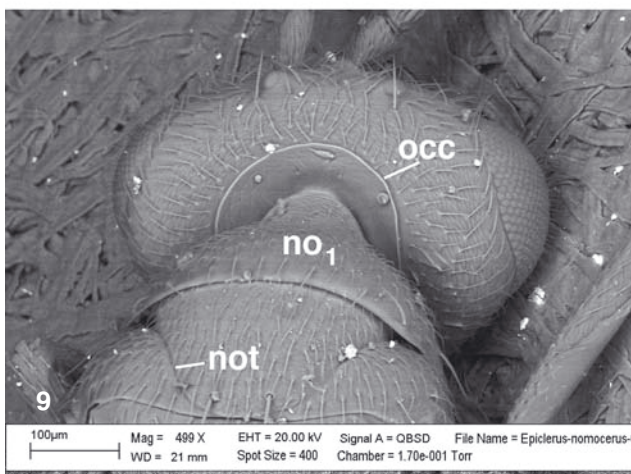
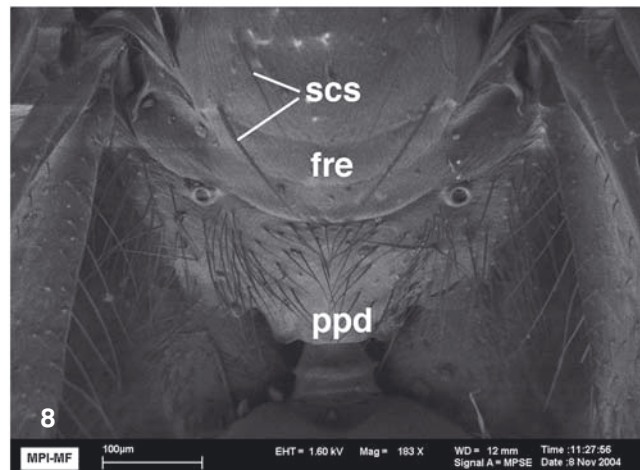
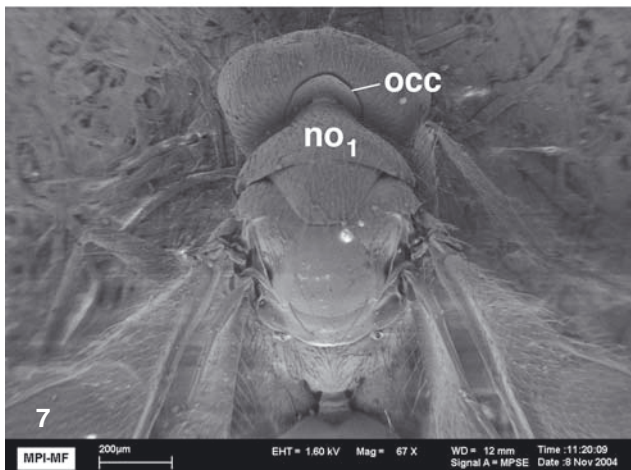
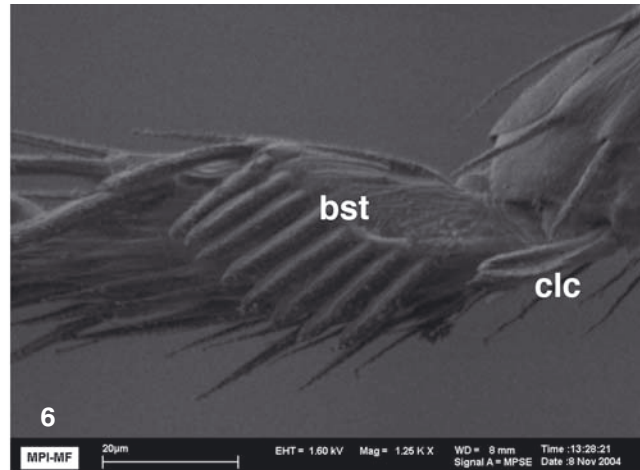
## Discussion

Like most chalcidoid families, the monophyly of Tetracampidae is not established and diagnoses of the family represent rather a number of characters, none of which is uniquely derived, and just their combination is considered diagnostic (BOUČEK, 1958; BOUČEK, 1988; GIBSON et al., 1997). As to Tetracampidae among these are: the 5-segmented tarsi of females, the short and just weakly curved protibial spur (Figs 2, 6), the antenna with fewer than 13 segments but with at least 5 funicular segments (Fig. 5), the head with complete horseshoe-like occipital carina (Figs 7, 9, occ), the mesoscutum with complete notauli (Fig. 9, not) (GIBSON et al., 1997). The 4-segmented

tarsi of males, the depressed first gastral (second metasomal) tergite and the scutellum with two pairs of setae, are peculiar to some but not all species assigned to the family. None of the listed characters is peculiar predominantly or exclusively to entire family. Tetracampidae were proposed to be an intermediate group between Pteromalidae and Eulophidae (BOUČEK, 1958; SUGONJAEV, 1971; BOUČEK,

1988). The molecular data has neither yet supported, nor disproved this proposition (GAUTHIER, 2000), probably because of small number of included taxa.

This uncertainty in diagnostic characters has eventually resulted in the current composition of the family on the genus- and subfamily-level. Some taxonomic problems of the composition of Tetracampidae are discussed below.



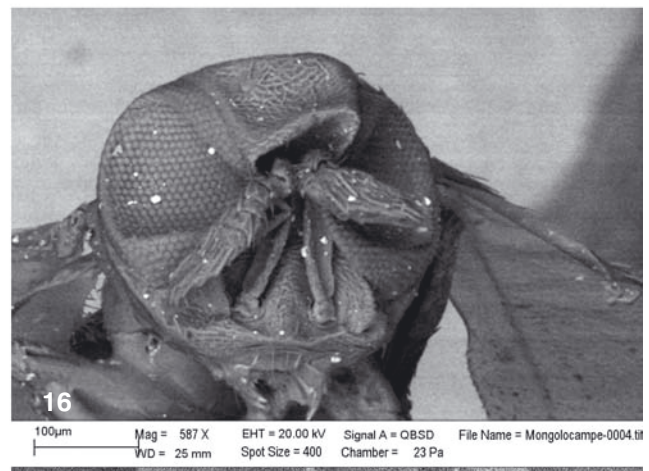
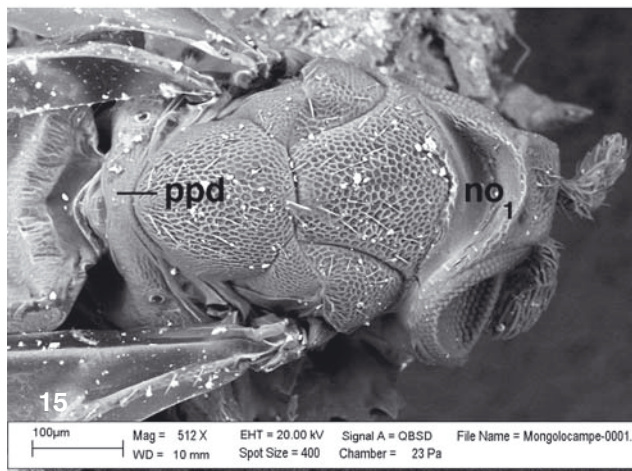
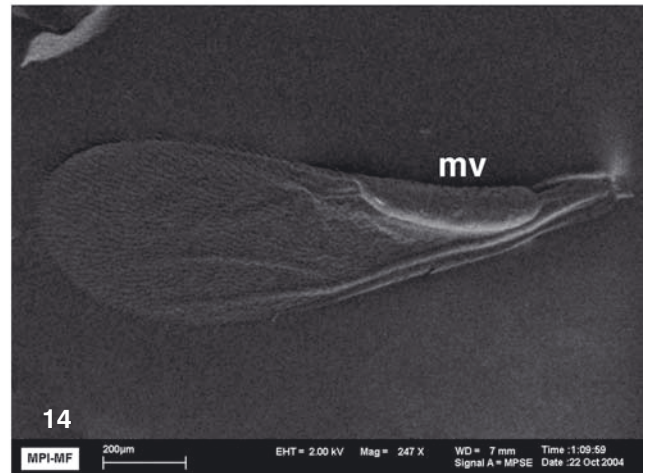
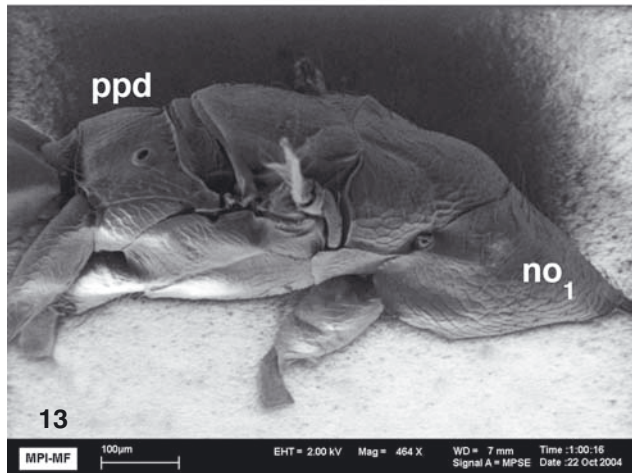
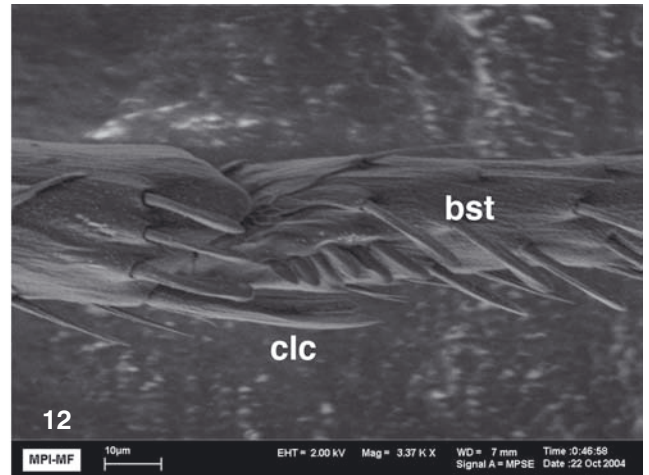
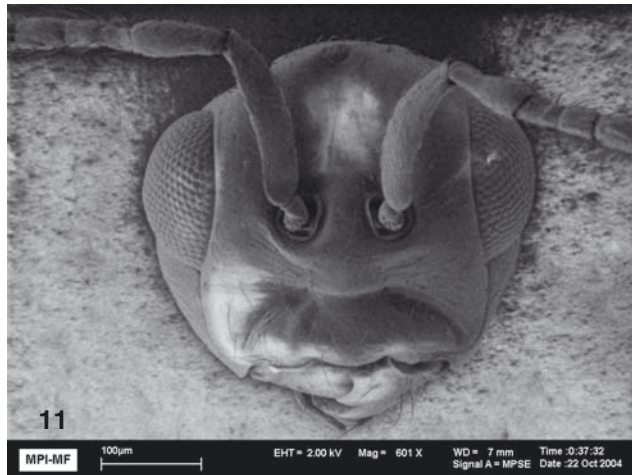
Figs 5–10. 5–8 *Tetracampe impressa* FÖRSTER: 5) head and anterior part of mesosoma; 6) fore basitarsus and calcar (the protibial spur); 7) head and mesosoma in dorsal view; 8) posterior part of scutellum, metanotum, propodeum and petiole; 9, 10 *Epiclerus nomoceris* (MASI): 9) head and anterior part of mesosoma; 10) posterior part of scutellum, metanotum, propodeum and petiole; bst, fore basitarsus; clc, calcar; fre, frenum; no<sub>1</sub>, pronotum; occ, occipital carina; ppd, propodeum; ptl, petiole; scs, setae on scutellum.

## Tetracampinae

This group comprises the genera (*Tetracampe*, *Foersterella*, *Dipriocampe*, *Niticampe*, *Diplesiostigma*, *Cassidocida*, *Epiclerus*) displaying some common characters, which can bear evidence of their common ancestry. These are: the face with sutured scrobal and frontal grooves, the conical pronotum with densely pubescent collum (Fig.

7, 9, no1), the scutellum with 2 pairs of setae (Figs 8, 10, scs), the 4-segmented tarsi of males, the postmarginal vein much longer than stigmal, the latter short or sessile.

*Diplesiostigma* and *Cassidocida* may be distinguished by most characters provided by BOUČEK (1988), in particular, the shape of the propodeal spiracles (*Diplesiostigma*), the shape of the anterior margin of clypeus, lengths of posterior scutellar setae and ovipositor (*Cassidocida*).



Figs 11–16. 11–14 *Platynocheilus cuprifrons* (NEES): 11) head in frontal view; 12) fore basitarsus and calcar (the protibial spur); 13) mesosoma; 14) fore wing; 15–16) *Mongolocampe bouceki* SUGONJAEV; 15) head and mesosoma; 16) head in frontal view: bst, fore basitarsus; clc, calcar; mv, marginal vein; no1, pronotum; ppd, propodeum.

However, differences between the rest of the genera appear less distinct. *Tetracampe*, *Foersterella*, *Dipriocampe*, *Epiclerus* and *Niticampe* share a notable depression on the first gastral tergite, but differ in characters supposed to be of specific rank in many other groups of Chalcidoidea. *Tetracampe*, *Foersterella* and *Niticampe* differ mainly by the shape of the antennal clava: it is abruptly truncate in *Tetracampe* (Fig. 5), obliquely cut in *Niticampe*, and acute in *Foersterella*. *Epiclerus* is characterized by robust metasomatic petiole (Fig. 10, ptl), whereas the petiole is short conical in *Tetracampe* (Fig. 8, ptl), and transversely reduced in *Foersterella* and *Dipriocampe*. Two last genera differ mainly in the width of antennal scape of males (wide in *Foersterella* and slender in *Dipriocampe*).

### Platynocheilinae

Representatives of this subfamily, containing only the type-genus *Platynocheilus* WESTWOOD, share the short straight protibial spur (Fig. 12, clc) with *Tetracampe*. Species of *Platynocheilus* also possess the elongate pronotum (Fig. 13, no1) and the 6-segmented antennal funicle. In other groups, the funicle has either more (most chalcid groups) or less (Eulophidae, Trichogrammatidae) segments. Otherwise, *Platynocheilus* demonstrates no similarity with Tetracampinae, and the listed above characters appear rather homoplastic, so that their presence is not sufficient to establish close relationships with Tetracampinae.

### Mongolocampinae

Association of this group with other Tetracampidae is doubtful. SUGONJAJEV (1971) provided no justification why Mongolocampinae should be placed in Tetracampidae in the original description apart from the personal communication of E. Riek, which contained unsupported suggestion of such placement.

*Mongolocampe* and the other two extant genera assigned to the subfamily, *Eremocampe* and *Platyneurus*, are characterized by their peculiar habitus (Figs 15, 16) and two short protibial spurs. Other Chalcidoidea have only one protibial spur and two spurs are unique for Mongolocampinae, though two spurs are possessed also by Ceraphronoidea within parasitic Hymenoptera. However, additional attention must be paid to the number of the protibial spurs in this group: one of us (AG) has an impression that they have one simple spur, which is neighbored by robust setae being superficially reminiscent of additional spurs. The possession of two protibial spurs (if correct!) may indicate Mongolocampinae is not closely related to other chalcidoid groups with short protibial spurs (i.e. Platynocheilinae, Tetracampinae, Eulophidae, Rotoitidae, Trichogrammatidae). Another peculiarity that probably was taken into consideration when Mongolocampinae was assigned to Tetracampidae is the swollen marginal vein of their males, which is reminiscent of the condition of male *Platynocheilus* (Fig. 14, mv). However, an affinity of *Platynocheilus* with Tetracampinae is not properly supported. Furthermore, the expanded marginal vein of the

fore wing occurs in males of some other, rather distantly related, groups of chalcids such as *Pterandrophysalis levantina* NOWICKI and *Oligosita krygeri* GIRAULT (Trichogrammatidae) and some Pteromalidae (e.g. *Mesopolobus morys* (WALKER, 1848)).

Mongolocampinae and Tetracampinae differ in several characters. In Mongolocampinae the propodeum is narrow and bare (Fig. 15, ppd) and the pronotum is short, strongly reduced (Fig. 15, no1), whereas in Tetracampinae the propodeum is wide, mostly setose, and the pronotum is elongate and conical. Also, Mongolocampinae have the head without either scrobal or frontal sutures, and the fore wing has an elongate stigmal vein subequal in length to the postmarginal vein. The latter combination of characters is peculiar to Platynocheilinae (i.e. *Platynocheilus*), not to Tetracampinae, but the position of the former group within Tetracampidae is not clear (see above), and Mongolocampinae are rather different from Platynocheilinae in most other characters. Also, elongate stigmal and postmarginal veins are quite common within other groups of Chalcidoidea, especially in Pteromalidae.

The extinct genus *Electrocampe* is rather similar to *Mongolocampe* and their association, as well as monophyly of Mongolocampinae, seems reasonable. However, as was stated above, the placement of Mongolocampinae in Tetracampidae is not well supported. This supposition is also supported by the discussions provided by BOUČEK (1988) and LASALLE et al. (1997).

Another peculiarity of Mongolocampinae is their biology: all extant genera are recorded as being phytophagous on *Nitraria* plants (SUGONJAJEV & VOINOVICH, 2003), whereas available host records for other Tetracampidae indicate the species are either egg or larval parasitoids.

### Bouceklytinae, Baeomorphae, Distylopinae

These groups are known only from fossils, the Canadian amber inclusions. YOSHIMOTO (1975) has not provided an appropriate background for the placement of the species described from amber inclusions in Tetracampidae. The diagnosis provided by the author has not demonstrated any distinguishable characters of the family, and Tetracampidae were mentioned as having the “characters ... intermediate between the families Eulophidae and Pteromalidae”. Placement of *Distylopus* in Tetracampidae was based mainly on rather homoplastic characters such as elongate veins of fore wing (similar to *Mongolocampe*), petiolate gaster and undifferentiated antennal clava and flagellum (similar to *Epiclerus*). Placement of *Bouceklytus* in Tetracampidae was based on that some of the characters found in its type species, which appeared “intermediate between the families Pteromalidae and Eulophidae”. These characters (occipital triangle delimited by sutures, shape of mandibles and veins), however, are rather uncertain and not peculiar to Tetracampinae. The most sound support for the placement in Tetracampidae was reported for *Baeomorpha*: the 5-segmented fore tarsi of female and 4-segmented tarsi of male.

YOSHIMOTO (1975) provided illustrations of the de-

scribed species, displaying, in particular, the long and curved protibial spur (calcar) (e.g. on Figs 28, 30, 31 of his paper). The long curved calcar was also mentioned in the original descriptions of all these taxa. However, *Tetracampe* and its allies (i.e. Tetracampinae) have the short, nearly straight protibial spur, what may bear evidence of relationships between Eulophidae and Tetracampidae. The long curved protibial spur is similesiomorphy in Hymenoptera, being part of the so-called strigil, the antennal cleaning organ (BASIBUYUK & QUICKE, 1995). The short straight protibial spur is peculiar to Tetracampinae, Eulophidae and Trichogrammatidae. The association of the taxa with long curved and short straight protibial spurs in one and the same family rather suggests its artificial composition and the necessity of its phylogenetic re-assessment.

We suppose that there is no strong evidence to presume that the association of *Bouceklytus*, *Baeomorpha*, *Distylopus* with *Tetracampe* (and respectively with Tetracampidae s. str.) is natural.

## Conclusions

Tetracampidae in their current composition represent a rather diverse, and likely artificially composed group.

The fossil representatives of Tetracampidae from Canadian Amber (species of *Bouceklytus*, *Baeomorpha* and *Distylopus*) hardly belong to Tetracampidae s. str., because of the lack of any obvious synapomorphies with *Tetracampe*, the type genus of the family. The placement of these extinct genera in Tetracampidae likely renders the latter polyphyletic. Species of Mongolocampinae (including the fossil species *Electrocampe sugonjaevi* TRJAPITZIN & MANUKYAN) do not demonstrate any similarities with *Tetracampe*. The only character which is shared by both, *Platynocheilus* and *Tetracampe* is the single short protibial spur. However, this character may support relationships of larger clade (e.g. *Platynocheilus* + *Tetracampe* + Eulophidae + Trichogrammatidae), and thus the association of *Platynocheilus* and *Tetracampe* may appear a rather gradual branching than a monophyletic unit.

Placement of these groups in Tetracampidae was likely motivated by the conventional concept of this family as intermediate between Pteromalidae and Eulophidae, and thus serving as a “dumping ground” for the species with problematic status (likewise Pteromalidae and Aphelinidae).

Further studies, preferably cladistic-based, are needed to establish true relationships of the discussed groups with each other, and with other groups of Chalcidoidea. Now, we can conclude that only Tetracampinae may be expected to appear monophyletic and figure as “true Tetracampidae”. Thus, care must be paid to any generalizations about this family as a whole, and to its paleontological history, in particular.

It is remarkable that *Dipriocampe bouceki* described here is the only “true” tetracampid species known from amber inclusions, despite many other species from fossil resins have been assigned to this family in past.

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