First Mesozoic representative of the subfamily Liparochrinae (Coleoptera: Hybosoridae) from the Lower Cretaceous Lebanese amber

Первый мезозойский представитель подсемейства Liparochrinae (Coleoptera: Hybosoridae) из нижнемелового ливанского янтаря

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One specimen among coleopterous inclusions recently recovered in Lebanese amber is described as *Libanochrus calvus* **gen.** et **sp. nov.** and assigned to the subfamily Liparochrinae of the Hybosoridae. This specimen is incomplete but a large part of its head with appendages, prothoracic segment with anterior legs, remains of the median part of the pterothoracic underside and the lateral base of the of the right elytron make possible the conclusion on the subfamily attribution and diagnose it among the rest of fossil and recent taxa of this family. At present it is the oldest representative of the subfamily.

Один экземпляр среди инклюзов жуков, недавно найденный в ливанском янтаре, описан как *Libanochrus calvus* **gen.** et **sp. nov.** и отнесен к подсемейству Liparochrinae из семейства Hybosoridae. Этот экземпляр неполный, но большая часть его головы с придатками, переднегрудной сегмент с передними ногами, остатки медиальной части низа птероторакса и основание бока правого надкрылья позволяют сделать вывод о его подсемейственной принадлежности и определить его среди представителей семейства. В настоящее время он является древнейшим представителем подсемейства.

Key words: Lower Cretaceous, fossil, Lebanese amber, Coleoptera, Hybosoridae, Leparochrinae, new genus, new species

Ключевые слова: нижний мел, ископаемые, ливанский янтарь, Coleoptera, Hybosoridae, Leparochrinae, новый род, новый вид

INTRODUCTION

The family Hybosoridae Erichson, 1847 is a worldwide distributed family within Scarabaeoidea, being most diverse in the areas with tropical climate and currently comprising more than 220 species belonging to 35 genera within five subfamilies (Ocampo, 2006). It is represented in the fossil record since the Middle or Upper Jurassic by members of the subfamily Hybosorinae (Bajan-Teg, Uver-Khangay ajmag, Mongolia – *Jurahybosorus mongolicus* Nikolajev, 2005 and Karatau, Kazakhstan – *Protohybosorus karatavicus* Nikolajev, 2010; *P. grandissimus* Nikolajev, 2010 and *P. mesasiaticus* Nikolajev, 2010). This subfamily is known also from the Lower Cretaceous of Baissa (Buryatskaya Autonomous Repu-

blic, Transbaikalia, Russia; Middle Neocomian: *Cretohybosorus buryaticus* Nikolajev, 1999 and *C. striatulus* Nikolajev, 1999; and also *Leptosorus zherikhini* Nikolajev, 2006), from the Lower Cretaceous of Chifeng (Inner Mongolia, China: *Leptophorus fortus* (Ren, Zhu & Lu, 1995) (*Geotrupoides*)), from the Oligocene of Kučlin [Kutschlin] (Czech Republic: *Phaeochrous tertiarum* (Deichmüller, 1881) (*Bolboceras*)), from the Lower Miocene Dominican amber (Dominican Republic: *Procoilodes adrastus* Ocampo, 2002 and *Tyrannasorus rex* Ratcliffe & Ocampo, 2001) and from the Upper Miocene of Oeningen (Baden-Württemberg, Germany: *Hybosorus lividus* Heer, 1862). Besides, from Baissa *Cretanaides trogopterus* Nikolajev, 1996 and *Protanaides sibiricus* Nikolajev, 2010 from the subfamily Anaidinae Nikolajev, 1996 and *Mimaphodius pusillus* Nikolajev, 2007 from the subfamily Mimaphodiinae Nikolajev, 2007 are known. Recently *Mesoceratocanthus tuberculifrons* Nikolajev, Wang, Liu & Ziiang, 2010 from the Yixian formation of the Upper Jurassic – Lower Cretaceus was described in the subfamily Ceratocanthinae. Finally, *Coprologus gracilis* Heer, 1847 with unclear subfamilian attribution was described from Oeningen. In spite of the fact that some mentioned indications could be regarded as somewhat doubtful, they give a preliminary imagination on the distribution of this family through time.

This paper constitutes the sixth contribution to the knowledge on fauna of Coleoptera from Lebanese amber (Kuschel & Poinar, 1993; Lefebvre et al., 2005; Kirejtshuk & Azar, 2008; Kirejtshuk et al., 2009a, 2009b), which is devoted to the families, oldest representation of which in fossils is frequently put namely in Lebanese inclusions. The specimen described here is also the oldest representative of the hybosorid subfamily Liparochrinae Ocampo, 2006. A more detailed overlook on representation of the family Hybosoridae in the fossil record can be taken from the catalogue by Ponomarenko & Kirejtshuk (2011).

MATERIAL AND METHODS

Till present day the oldest amber with many arthropod inclusions is from Lebanon (Azar, 1997). The Lebanese amber ranges in age from the Late Jurassic to Cenomanian. The fossiliferous outcrops are all approximately of the same age and are mainly late Barremian to lowermost Aptian (Azar et al., 2003a). The precise dating of the Lebanese material was possible after the discovery of stratigraphical marker fossil pollen trapped in the amber (Dejax pers. com.). In the majority of amber outcrops in Lebanon, the amber is found in its primary deposits. The material studied herein comes from the Lower Cretaceous outcrops of Bouarij (Caza Zahleh, Beqaa, Central Lebanon) (for details see Azar et al., 2010). The material has been prepared (cut and polished), then included in Canada balsam medium between two glass cover slips as described by Azar et al. (2003b). Observations were made with usual optic equipment; in particular, the stereomicroscope Olympus SCX9 and inverted microscope Olympus CK 40 in Muséum National d'Histoire Naturelle, Paris, and also the stereomicroscope microscope Leica MZ 16.0 in Zoological Institute, St. Petersburg, were used.

The material under consideration is temporally deposited in the Laboratory of entomology, Muséum National d'Histoire Naturelle, Paris, until a national natural history museum in Lebanon is established.

RESULTS

Order **COLEOPTERA**

Suborder POLYPHAGA

Superfamily SCARABAEOIDEA

Family **HYBOSORIDAE** Erichson, 1847

Subfamily LIPAROCHRINAE Ocampo, 2006

***Libanochrus* gen. nov.**

Type species *Libanochrus calvus* **gen. et sp. nov.**

Diagnosis. Body of comparatively small size. Head and pronotum comparatively subflattened and without any horn or carina. Head feebly transverse, its outline evenly curved, including the short but wide eye canthus and clypeus; clypeo-frontal suture not visible; labrum transverse, short and rather wide, flat, prominent, exposed from above beyond apex of clypeus, located in an evenly curved excision of the latter, its anterior edge forming a gentle curved line, its side forming a discontinuity with the curve of clypeal side; eyes surrounded by fronto-clypeal folds; mandibles not exposed dorsally. Antenna short and with first club segment suboval cupular-shaped. Pronotum widest at the distinct posterior angles, with deeply excised anterior edge and widely explanate sides; lateral margins ciliate. All pairs of coxae narrowly separated or conjoined; mesocoxae feebly transverse and not very wide. Integument of dorsum smooth and unpunctured. Protibia tridentate on outer edge, with distinct crenulations from the base and between the main teeth, and bearing long setae between each pair of teeth in the crenulation. Femora and tibiae with brushes of long hair at apices.

Comparison. The genus *Libanochrus* **gen. nov.** showing explanate sides of pronotum, first antennal club segment cupular-shaped, position of coxa, clypeo-frontal suture not visible, shape of protibia (with setae between crenulations) coincides with the extant members of the family Hybosoridae. A particular evidence of the subfamily attribution of the new genus is the position of transverse labrum, exposed from above, at the same level as the dorsal surface of head, fitting an excavation of the clypeus (as observed in *Liparochrus* Erichson, 1848). *Libanochrus* **gen. nov.** differs from other genera in the anterior outline of its rather short head (evenly curved, not sinuate at front base of the eye canthus), markedly narrower mesocoxae and type of the armature of protibia, and also from *Antiochrus* Sharp, 1873, in the not so convex body, lack of hairs on dorsum, posterior angles of pronotum projecting posteriorly and armature of protibia (intermixed by more prominent and small teeth).

In contrast to most other members of the Hybosoridae, this genus is mostly characterised by the comparatively short head and mandibles not exposed dorsally. The members of the subfamily Anadiinae differ from the new species in their markedly longer head with frons not dilated laterally, projecting and not very wide procoxae, coarse sculpture of integument etc.; and *Cretanaides* Nikolajev, 1996 from Anaidinae cannot be compared with the new species, because it was described after one elytron. The shape of mesocoxae and very smooth integument of this specimen are similar to those of some Ceratocanthinae rather than to those of Hybosorinae and Liparochrinae, although other characters, including the outline of the anterior part of its head and an exposed labrum are very similar to those in some extant representatives of the last two subfamilies. *Libanochrus* **gen. nov.** is particularly distinguished from the members of Ceratocanthinae by the exposed labrum from under clypeus, much wider procoxae, shape of anterior legs and armature of protibiae. In particular, the Mesozoic Mesoceratocanthus Nikolajev, Wang, Liu & Ziiang, 2010 from this subfamily, in contrast to the new genus, has elongate and larger body (12 mm) with subquadrangular prothorax, oval labrum, exposed and far projecting mandibles, and also narrow protibiae without prominent teeth.

In fossils, the new genus differs from *Mimaphodius* Nikolajev, 2007 (Mimaphodiinae) in the not very convex body, exposed labrum, lack of clypeo-frontal suture, outline of head and pronotum, rather even dorsal surface of head and widely explanate pronotal sides. It is distinct also from the Mesozoic *Cretohybosorus* Nikolajev, 1999, *Leptosorus* Nikolajev, 2006 and *Protohypobosorus* Nikolajev, 2010 in the not exposed mandibles, laterally extended head sides making the head transverse, widely explanate pronotal sides, posterior angles of

pronotum slightly projecting backwards (posterior edge of pronotum subsinuate at sides) [although the pronotum of *Cretohybosorus* could be somewhat similar]; and also *Protanaides sibiricus* in the anterior part of head strongly extended laterally and surrounding the eyes, narrower head, pronotum more arcuately narrowing anteriorly and rounded anterior angles and also different armature of protibia. Since *Jurahybosorus* Nikolajev, 2005 (Hybosorinae) was described after the metathoracic ventral sclerites and posterior legs only, it cannot be compared with the new species. *Libanochrus* **gen. nov.** also differs from the Caenozoic *Procoilodes* Ocampo 2002 from Hybosorinae (probably with somewhat similar pronotum and small body size) in the flatly depressed to excavate (and not tuberculate) frons, not pointed labrum and smoothed surface of head and pronotum; and from *Tyrannasorus* Ratcliffe & Ocampo 2001 in the completely different structure of the transverse head (concealed mandibles, not projecting labrum, laterally extended anterior part of the head). Finally, the new genus is very distinct from *Coprologus gracilis* Heer, 1847 in the strongly dilated sides of the head, pronotum more narrowing anteriorly and concealed mandibles.

All genera of Hybosorinae with laterally expanded clypeus have more or less expressed sinuation at the base eye canthus, while *Libanochrus calvus* **gen.** et **sp. nov.** is characterised by the even outline of the lateral edges of its head. Besides, the head of all recent Hybosorinae is markedly longer than that in new species and the dorsum of the recent Hybosorinae is clearly punctured (not infrequently rather coarsely), but the head and pronotum of the new species are smooth and nearly unpunctured. *Hypsoloderes* Fairmaire, 1893 has an appearance dorsally somewhat similar to *Libanochrus* **gen. nov.**, because its rather long labrum and mandibles are turned ventrally. Some species of *Phaeochrous* Laporte, 1840 demonstrate comparatively short exposed labrum (as in the new species) and mandibles with the outer anterior edge somewhat shortly elevated and their elevated edge is closely clasped to the anterior edge of the labrum. However most species of the latter genus have the mandibles far projecting anteriorly and pronotal sides only subexplanate or narrowly explanate. Besides, the new species has a short labrum similar to members of *Seleucosorus* Kuijten, 1983 (the later have the mandibles also short, but distinctly projecting anteriorly). Finally, the specimen examined is comparatively small, however many groups of the generic rank include the members with small body size. *Libanochrus calvus* **gen.** et **sp. nov.** shows the most similarity to some species of *Phaeochrous* and *Kuijtenous* Paulian, 1981, but in addition to the mandibles which are not exposed from under labrum, a comparatively short head and gently outlined head sides (not subsinuate at the base of eye canthus), the new species has no trace of border along edges of its pronotum.

Etymology. The name of the new genus is formed from Greek '*Libanos*' (Lebanon) and a usual root of generic names in Hybosoridae descended from the Greek '*chros*' (skin, surface of body; skin colour). Gender masculine.

Libanochrus calvus sp. nov.
(Figs 1–7)

Material examined. Holotype. 'TAR 39', sex unknown; flat piece of amber, the inclusion badly preserved but with characters that allow the description and placement of the fossil, such as the head and most of its appendages, most of the prothoracic segment with anterior legs and most of the ventral median surface of pterothorax, left meso- and metafemora, a trace of the dorsal surface of right meso- and metafemora is located in the epoxy between round microscope glasses. Pieces of yellowish to very dark organic matter and very small gas vesicles surround the inclusion. The remains of the body seemed to be somewhat pressed before entombing in the fresh resin. Most parts of integument are masked by very small pieces of organic matter and gas vesicles. The specimen examined seemed to be rather soft when it became stuck to the resin but still alive

Fig. 1. *Libanochrus calvus* **gen.** et **sp. nov.**, holotype. Head and pronotum, dorsal view. Head width 2.6 mm.

Fig. 2. *Libanochrus calvus* **gen.** et **sp. nov.**, holotype. Head and thorax, ventral view. Head width 2.6 mm.

(being evidence of the traces of moving in the amber), then it was destroyed and decayed before fossilization (as a result its remains including appendages became additionally depressed).

Description of the holotype. Length of head 1.4, width of head 2.6, width of available part of pronotum 3.4 mm (complete body length of this specimen before its destruction could be about 5.0 mm). Head and pronotum without hairs; pronotal and elytral sides, and legs with moderately long and fine hairs (particularly dense on entire surface of femora and they are arranged in a long row along the anterior edge and two shorter ones located along posterior edge of meso- and metafemora; with brushes of long setae at apices of all femora and very distinct brush of very long setae along anterior edge of profemur; besides longitudinal rows of setae are visible on protibiae). Dorsum of head and pronotum as well as prohypomera apparently without puncturation. Along lateral edges of frons there are dense transverse strips looking like strengthening and lightening of sclerotization.

Head transverse, somewhat depressed medially and widely explanate along frons, much narrower than pronotum; median part of frons apparently partly isolated by fine and oblique swellings at each side. Eyes not clearly outlined (because the layer of small pieces of organic matter and very small gas bubbles covers them) apparently finely faceted eyes (although facets scarcely visible and eyes seeming translucent) and with lateral edge surrounded by fold of frons. Ultimate maxillary palpomere narrowest and as long as two previous ones combined. Apices of maxillary lobes (narrow galea and rather wide lacinia) exposed from under labrum and bearing extremely dense setae. First antennal club segment somewhat dorsoventrally compressed. Pronotum widest at base and compressed at right posterior angle, however it was apparently not very convex, its anterior edge strongly trapezium-likely excised, its sides narrowly explanate

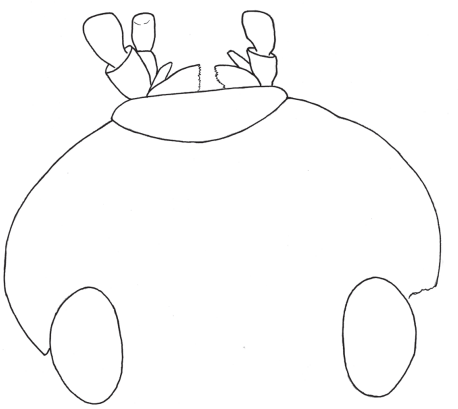

Fig. 3. *Libanochrus calvus* **gen.** et **sp. nov.**, holotype. Head with exposed maxillary lobes (narrow galea and rather wide lacinia) and palpi, dorsal view. Head width 2.6 mm.

and with undulate edges, posterior angles with distinct top, posterior edge apparently widely and evenly convex and with a slight sinuation at posterior angles. All coxae apparently (sub)contiguous; procoxae apparently suboval to subquadrangular, mesocoxae suboval and metacoxae transverse.

Protibia comparatively short (slightly longer than head) and rather compressed, its outer edge with clear not quite regular and oblique crenulations from the base and between three more prominent teeth disposed with subequal distances between them, the proximal tooth rather small. Spur of anterior legs very long (about as long as protarsomeres 1 and 2 combined) and slightly curved. Profemora gently curved along posterior edge and strongly subangularly curved along the anterior one, about twice as wide as probibia. Left meso- and metafemora are visible only from posterior side and they look like strongly compressed. Protarsus rather thin and apparently about three quarters as long as protibia; protarsomere 1 apparently longer than each of protarsomeres 2–4 and protarsomere 5 longest (about as long as protarsomeres 1–4 combined; one claw available apparently about two fifths as long as protarsomere 5.

Antennal club of the specimen examined represented by the basal wall of the first segment, but remains seem to be moved away.

Etymology. The epithet of the new species refers to the mostly smooth and hairless integument of dorsum of the specimen.

DISCUSSION

The composition and placement of the family Hybosoridae are in great discussion during the last decade. The most generalised viewpoint, which is close to the traditional one, was formulated by Browne and Scholtz (1999) and Howden and Gill (2000) according to which Hybosoridae, Ceratocanthidae, Ochodaeidae Mulsant & Rey, 1871 and Geotrupidae Latreille, 1802 can be treated as most relatives putting the latter as closer to their common ancestor. Krell (2006) after a review of the fossil records also regards the Hybosoridae and Ceratocanthidae as sister groups with the closest link also to Ochodaeidae and joining all three families with Geotrupidae. Ocampo (2006) and Ocampo and Hawks (2006) on molecular and morphological comparison put Hybosoridae (including Ceratocanthidae) as a sister group of Ochodaeidae, both of which are linked with Glaphyridae MacLeay, 1819. Nikolajev (2007) having analysed some fossil families considers as sister groups the Hybosoridae (including Belohinidae Paulian, 1959) and Trogidae MacLeay, 1819 and approaching both to Geotrupidae and some subfamilies of Scarabaeidae Latreille, 1802. The new species demonstrates that the subfamily Liparochrinae has a Mesozoic root in addition to the Middle Jurassic – Cretaceous Anaidinae Hybosorinae and Ceratocanthidae (Krell, 2007; Ponomarenko & Kirejtshuk, 2011; Nikolajev et al., 2010). On the other hand, the comparatively great representation of this family in fossils from the Asian outcrops could be evidence that this family was rather diverse on this continent during the late Mesozoic, compared with diversity of Geotrupidae, Ochodaeidae and Glaphy-

ridae beginning from the Cretaceous (Krell, 2007; Kirejtshuk et al., 2010; Ponomarenko & Kirejtshuk, 2011).

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