

Family Lasiosynidae n. fam., new palaeoendemic Mesozoic family from the infraorder Elateriformia (Coleoptera: Polyphaga)

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Abstract. Lasiosynidae n. fam. is proposed for the genera *Lasiosyne* Tan, Ren & Chih 2007 (transferred from Archostemata to Polyphaga), *Anacapitis* Yan 2009 *Tarsomegamerus* Zhang 2005 (proposed in the superfamily Chrysomeloidea) and *Bupredactyla* n. gen. The new family is regarded in composition of the infraorder Elateriformia without a more detailed attribution, because it demonstrates a mixture of characters of different families and superfamilies, i.e. somehow an intermediate position between the superfamilies Dascilloidea, Elateroidea, Buprestoidea and Byrrhoidea with most resemblance to Dascillidae, Schizopodidae, Eulichadidae, Ptilodactylidae and Callirrhpididae and probable more close relationship to the last three families. Four new fossil species of the genus *Lasiosyne*: *L. daohugouensis* n. sp., *L. fedorenkoi* n. sp., *L. gratiosa* n. sp., *L. quadricollis* n. sp., and also *Bupredactyla magna* n. sp. are described from the Middle Jurassic Jiulongshan Formation of eastern Inner Mongolia, China. A probable generic composition of the new family is considered. The synonymy of generic names *Anacapitis* Yan 2009 and *Brachysyne* Tan & Ren 2009, n. syn. as well as synonymy of species names *Lasiosyne euglyphea* Tan, Ren & Chih 2007, *Pappisyne eucallus* Tan & Ren 2009, n. syn. and *Pappisyne spathulata* Tan & Ren 2009, n. syn. are proposed.

Résumé. La nouvelle famille Lasiosynidae paléoendémique du Mésozoïque (Coleoptera : Polyphaga : Elateriformia). La nouvelle famille Lasiosynidae est proposée pour les genres *Lasiosyne* Tan, Ren & Chih 2007 (transféré des Archostemata vers les Polyphaga), *Anacapitis* Yan 2009 et *Tarsomegamerus* Zhang 2005 (antérieurement dans les Chrysomeloidea) and *Bupredactyla* n. gen. La nouvelle famille est considérée comme appartenant à l'infraordre Elateriformia sans plus de précision, car elle montre un mélange de caractères de différentes familles et superfamilles, c'est à dire «intermédiaire» entre les superfamilles Dascilloidea, Elateroidea, Buprestoidea et Byrrhoidea avec une plus forte ressemblance avec les Dascillidae, Schizopodidae, Eulichadidae, Ptilodactylidae et Callirrhpididae et une plus forte affinité probable avec les trois dernières familles. Quatre nouvelles espèces fossiles de *Lasiosyne* : *L. daohugouensis* n. sp., *L. fedorenkoi* n. sp., *L. gratiosa* n. sp., *L. quadricollis* n. sp., ainsi que *Bupredactyla magna* n. sp. sont décrites du Jurassique moyen de la formation Jiulongshan de la Mongolie intérieure, Chine. La composition générique de la nouvelle famille est discutée. Les mises en synonymie des genres *Anacapitis* Yan 2009 et *Brachysyne* Tan & Ren 2009 n. syn. ainsi que des espèces *Lasiosyne euglyphea* Tan, Ren & Chih 2007, *Pappisyne eucallus* Tan & Ren 2009 n. syn. et *Pappisyne spathulata* Tan & Ren 2009 n. syn. sont proposées.

Keywords: N. fam., New species, Fossils, Middle Jurassic, Inner Mongolia.

During the 20th century the knowledge on the fossils of Coleoptera has been essentially increased and it makes possible to propose some conclusions on history and phylogeny of the order (Ponomarenko 1969, 1977, 2001; Crowson 1975, 1981; Kirejtshuk 1991; etc.). The conclusions on available data in fossils frequently do not coincide with those on the recent fauna and sometimes both are in some contradictions. However, it is now difficult to foresee a proportion of the coleopterous families already described to the general number of groups of this level of taxonomical integration. Most systematic and phylogenetic

constructions are still based on a priori data from the recent fauna. In this paper an attempt to close only one of many gaps in the knowledge on history of the order well known to many palaeocoleopterists for long time is made. Representatives of this group seem to have been recovered in materials from many Mesozoic outcrops of Europe and Asia with compression fossils. Nevertheless, Daohugou is present a place from where very intensive materials of extremely perfect preservation have been obtained in the end of the last and beginning of current centuries. Therefore the authors chose some specimens of one genus only to start an investigation of this group rather abundant in Mesozoic faunas of Asia.

The group under here consideration belongs to the infraorder Elateriformia, including Dascilloidea,

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Accepté le 29 juin 2009

because of having the quite characteristic elytral sculpture, wing venation, well developed interlocking mechanism of thorax, structure of metaventrite and contiguous metacoxae with more or less well raised femoral plates etc. This infraorder was particularly many times re-interpreted by some authors and not infrequently one author crucially changed his own interpretation from one publication to another (f.i., Crowson 1955, 1971, 1975, 1982; Lawrence, 1987; Lawrence *et al.* 1995, 2007; etc.). New discoveries in Mesozoic fossils made evident that without a profound study of Jurassic and Cretaceous Elateriformia and description of palaeoendemic groups of this infraorder any serious progress in systematics and phylogenetics of it is scarcely possible. All specimens examined originated from the collection of Capital Normal University, Beijing and most of them are deposited in it, except one specimen of *Lasiosyne euglyphea* Tan, Ren & Chih 2007 and one paratype of each *L. fedorenkoi* n. sp., *L. gratiosa* n. sp. and *L. quadricollis* n. sp. are redeposited in the collection of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg), and one specimen *L. euglyphea* is redeposited in the collection of the Paleontological Institute of the Russian Academy of Sciences (Moscow).

The senior author studied specimens and prepared this paper with some assistance of the second author. Dong Ren was responsible for management of collection at CNU and supported the the study and publishing of color illustrations, and Shih Chung Kun provided the collection of CNU with some specimens.

Material and Methods

The specimens examined originated from the same outcrop and studied with LEICA MZ12.5 and MZ16.0 microscope and illustrated with the aid of a drawing tube attached to microscope and camera lucida, and then readjusted on the photographs using image-editing software (CorelDraw 12.0 and Adobe Photoshop CS). All pictures were taken with a Nikon Digital Camera DXM1200C. For comparison of specimens under study the collections of the Capital Normal University (Beijing), Palaeontological Institute of Russian Academy of Sciences (Moscow), Zoological Institute of the Russian Academy of Sciences (St. Petersburg), Museum National d'Histoire Naturelle (Paris) and Natural History Museum in London were used. Measurements were made in millimeters.

Type strata. Middle Jurassic, Jiulongshan Formation, circa - 165 Myr (Gao & Ren 2006).

Locality. Daohugou Village, Nengcheng County, Inner Mongolia.

Results

Family Lasiosynidae n. fam.

Type genus. *Lasiosyne* Tan, Ren & Shih 2007

Composition. This new family is proposed for four generic groups: *Lasiosyne* Tan, Ren & Shih 2007; *Tarsomegamerus* Zhang 2005; *Anacapitis* Yan 2009 and *Bupredactyla* n. gen.

Notes. The genera under consideration are certainly closely related to basal groups of the infraorder Elateriformia. *Sunocarabus brunneus* Hong 1988 seems to belong to the same family, however the description of this species is not sufficient for a proper generic diagnostics and now its type specimen is not accessible (at least this species differs from all species of *Lasiosyne* in its rather smaller body). The genus *Mesodascilla* Martynov 1926 seems also to be closely related or belongs to this family; however, further detailed studies are needed to make clear their relation. There are some other genera remain still undescribed and some generic taxa formerly proposed in composition of different families which could be also transferred into the family here described after proper re-testing of the materials used for their proposals. In most cases attribution of fossil species cannot be established with an equal certainty comparable with that which is possible for recent species because of lack of many characters important for diagnostics. For instance, *Mesodascilla* could belong to this family rather than to Dascillidae, where it was initially placed, because of the long radial cell in posterior wing quite characteristic of Buprestidoidea and the line Ptilodactylidae-Eulichadidae-Callirhipidae and the family under description. Perhaps, the same seems to concern the species described in the composition of *Artematopodites* Ponomarenko 1990 and *Ovivagina* Zhang 1997 and spread within the Middle Triassic and Lower Cretaceous (Ponomarenko & Kirejtshuk 2009), however, in contrast to *Mesodascilla*, there are no posterior wing remains are known from representatives of the last genera. Nevertheless, all mentioned groups should be regarded only as probable relatives of Lasiosynidae n. fam. till a further detailed re-examination of them. In collection of Paleontological Institute of the Russian Academy of Sciences (Moscow) and Capital Normal University (Beijing) there are some hundreds of specimens from Jurassic and Lower Cretaceous deposits with clear attribution to this family. They could be grouped into some genera which are waiting to be described. Finally, *Tersus crassicornis* Martynov 1926 known only after the holotype shares a considerable similarity in the outline of dorsal sclerites and elytral

striation with Lasiosynid genera, while the rest species proposed in the composition of *Tersus* Martynov 1926 belong to the suborder Archostemata.

In the course of this study there have been found some Jurassic specimens from Daohugou apparently belonging to the family under consideration with straighten posterior wings, but with missing many other organs and characters important for generic and species diagnostics. In the paper one fossil specimen with well exposed posterior wings, most similar to one new fossil species of the genus here considered (*Lasiosyne fedorenkoi* n. sp.), has the best preservation of elements of wing venation and folding and, therefore, it was taken for description to use its structure for the family characteristic. However, the posterior wing venation in available specimens demonstrates some level of variability which needs to be further considered in a more detail.

Anacapitis oblongus Yan 2009 (type species of the genus) and *Brachysyne plata* Tan & Ren 2009 (type species of the genus) are distinguished only due to some differences in their body size, pronotal shape and length of metacoxal femoral plates. Thus, it is advisable to consider these species in the composition of the same generic group and names *Anacapitis* Yan 2009 and *Brachysyne* Tan & Ren 2009 n. syn. should be respectively regarded as synonyms [the first name was published before June and the second – in June]. Two other species of the genus *Anacapitis* described by Yan (2009) seem to belong to other genera.

The genus *Tarsomegamerus* Zhang 2005 was proposed with the diagnosis which does not include proper diagnostic characters of Chrysomeloidea or some characters were misinterpreted. In contrast to members of the infraorder Cucujiformia, *Tarsomegamerus mesozoicus* has the elongate radial cell of posterior wing and distinctly raised femoral plates of metacoxae quite characteristic of many groups of the infraorder Elateriformia. It is also characterized by the narrowly separated or (sub) contiguous all pairs of coxae and distinctly striate elytra. In the original description of this genus it was written on nine elytral striae, however, the true number seems to be greater and comparable with other Lasiosynidae n. fam.

Diagnosis (taking into consideration some evident members of the family still remaining undescribed). Body on medium size (12.0–30.0 mm), elongate to elongate oval. Head prognathous or slightly deflecting, with large eyes, well developed mandibles, free labrum, large maxillary palpi, filiform to serrate or subpectinate antennae with comparatively small scape and very small antennomere 2. Prothorax with distinct lateral carina, anterior edges of prosternum and pronotum usually have a comparable level of vertical cross-section, posterior edge of pronotum crenulate or not crenulate, procoxal cavities strongly

transverse and open posteriorly. Trochantin exposed in all coxae. Procoxal cavities moderately narrowly separated; mesocoxal ones narrowly separated to subcontiguous, metacoxal ones contiguous. Elytra striate, with 11 subparallel striae forming by furrows, pairs of striae conjoining at base by an arcuate loop for each pair, striae 2 and 3 only slightly surpassing the elytral midlength, the rest striae nearly reaching the apex; lateral edge subparallel in basal 2/3 or somewhat emarginate at the middle. Posterior wing with comparatively short proximal part of the CuP, rather long AA 3a, AA 1+2 and CuP, very long rc; outline of 1a and 2a is similar to that in Dasciloidea and Buprestidae, although more distant from posterior edge of wing; Mr comparatively short. Mesoventrite with a more or less deep median fossa or excavation – promesothoracic interlocking mechanism apparently moderately developed, with transverse sutures on both sides of mesoventral rhombic cavity, mesepisterna and mesepimera subtriangular, mesocoxal cavities open to mesepimera but close to mesepisterna. Mesocoxae transversely oblong to subtriangular, somewhat conical. Metaventrite with distinct median and frequently at most with a small remains of transverse paracoxal sutures. Metepisterna rather wide, almost reaching the edge mesocoxal cavities and subparallel-sided or somewhat narrowing posteriorly. Distance between anterior inner angle of metepisternum and outer edge of mesocoxa rather small. Metacoxae strongly transverse, oblique and with more or less distinct femoral plate raised mostly at median part of coxae. Abdomen with 5 ventrites, segments 7 and following ones with sclerotization comparable with that of previous segments (more frequently in females). Legs comparatively narrow and rather long; tibiae with moderately large spurs; tarsi 5-segmented and with moderately to widely lobed or simple tarsomeres 1-4 or with strongly reduced tarsomere 4 (pseudotetramerous or tetramerous). Male genitalia of trilobate type. Female ovipositor comparatively short and with styli.

Description (taking into consideration some evident members of the family still remaining undescribed). Body elongate of medium size (12.0–30.0 mm); moderately convex dorsally and, perhaps, in most cases moderately convex ventrally; subglabrous or densely and uniformly covered with fine, dense and slightly conspicuous hairs; integument frequently rather rugosely sculptured, with very small and very dense punctures and very coarse microsculpture between them; elytra usually with 11 longitudinal subparallel striae forming by furrows, pairs of striae conjoining at base by an arcuate loop for each pair, 2d and 3d not or slightly extended behind the midlength, the rest striae usually reaching or disappearing only close to elytral apices.

Head not or only slightly deflected [(sub) prognathous], short and transverse or somewhat elongate behind usually constricted temples, with very large eyes; labrum free, well exposed from under frons, large mandibles more or less steeply curved at outer angle and pointed at apex, gular sutures very distinct and widely separated; antennal grooves more or less exposed along eye edges. Antennae subfiliform to subserrate or subpectinate; scape moderately short and rather swollen, comparable in length with most flagellomeres; antennomere 2 somewhat shorter than most antennomeres (not very small); antennomeres 3–10 usually comparable in shape and size. Pronotum transverse, with distinct lateral carina, usually subtruncate to slightly convex anteriorly or with anterior angles not projecting anteriorly, usually slightly wider than head; sides sometimes somewhat slightly subexplanate; posterior edge with rather variable crenellation

or without it; posterior angles forming acuminate process projecting lateroposteriorly and with a distinct sharp top, disc of pronotum more or less convex. Scutellum subtriangular. Elytra moderately to rather long (1.2–2.5 times as long as wide combined), gently convex along the middle, elytra widest at base, their lateral side at the middle usually with a shallow emargination, apices (sub) acuminate, in many cases leaving exposed at least apex of pygidium. Epipleura very narrow and more or less gradually narrowing posteriorly.

Mentum subquadrangular, transverse and moderately large. Maxillary and apparently labial palpi well developed, with ultimate and penultimate maxillary palpomeres comparable in length with most antennomeres. Prosternum moderately long, shallowly to rarely deeply excised at anterior edge; procoxal cavities rather transverse, shortening externally, narrowly separated and apparently not closed posteriorly; prosternal process somewhat extending behind posterior edge procoxae. Procoxae with exposed trochantin. Mesoventrite rather long, apparently not depressed (on the same plane as metaventrite) and with a median subrhombic fossa for reception of prosternal process; promesothoracic interlocking mechanism apparently moderately developed, with transverse sutures on both sides of mesoventral cavity, mesepisterna and mesepimera subtriangular, mesepimera more than two times as mesepisterna, mesocoxal cavities open to mesepimera but close to mesepisterna. Mesocoxae oblong to somewhat subtriangular (because of conical projection of mesocoxae), apparently with exposed trochantin and narrowly separated to subcontiguous. Metaventrite moderately long, with a distinct median suture (discrimen) and sometimes also with a comparatively very small transverse (paracoxal or katepisternal) suture. Metepisterna rather wide along the whole their length, their inner anterior angle close to outer edge of mesocoxal cavities, almost reaching the edge of the latter, subparallelsided or somewhat narrowing posteriorly. Metacoxae transverse, contiguous and externally reaching epipleura, more or less oblique and with distinct femoral plate well developed at inner side. Abdomen with five ventrites, three basal ventrites apparently connate, hypopygidium with arcuate posterior edge; females frequently with projecting and well sclerotized terminal segments (terminalia).

Legs comparatively narrow and rather long; trochanter of normal type to somewhat elongate; tibiae rather narrow and with moderately large spurs; tarsi five-segmented and with tarsomeres 1–4 moderately lobed or tarsomere 4 strongly reduced (pseudotetramerous or tetramerous), sometimes tarsomeres 1–4 simple; claws moderately thin, long and slightly curved.

Posterior wing with comparatively short proximal part of the *cubitus posterior* (CuP – here and further wing venation nomenclature used according to interpretation of Forbes (1922, 1926), Ponomarenko (1972), and mostly Fedorenko (2003, 2006), rather long anal veins and distal parts of the vein *cubitus posterior* (AA 3a, AA 1+2 and CuP) in the median field as well as very long radial cell (rc), about four times as long as wide; median recurrent vein (Mr) is comparatively short; 1st anal cell (1a) short and comparatively wide and 2a ('wedge cell') short and very narrow, narrowly ending distally and comparatively distant from posterior edge of wing. CuA rather long and joined with Mr at the level of the middle of rc. Distal part of wing (radial field) seemingly without clear sclerotization.

Male genitalia of typical trilobate type and usually heavily sclerotized; penis trunk acuminate at apex; tegmen with narrow 'parameres'. Proctiger distinct and angular at apex. Female

ovipositor very short and usually slightly sclerotized. Paraproct and valvifer moderately developed to rather short. Coxites very short and scarcely excised behind vulva. Styli well developed.

Notes. The specimens examined with clearly visible ventral surface of the head show a transverse depression before mentum, which should made possible some deflection of the head down. This feature is especially clear in *Lasiosyne daohugouensis* n. sp. and this species also has deeply excised anterior edge of prosternum more promoting deflection of the head.

Comparison. This new family is difficult to define in the current composition of Elateriformia, because it has characters, many of which are spread among different groups of the infraorder. The combination of the characters available in fossils makes possible to compare this new family with groups of the superfamilies Dascilloidea (Dascillidae Guérin-Mèneville 1843 and Rhipiceridae Latreille 1834), Buprestoidea (Buprestidae Leach 1815 and Schizopodidae Leconte 1861), Elateroidea (Artematopodidae Lacordaire 1857, Cerophytidae Latreille 1834, Eucnemidae Eschscholtz 1829 and Throscidae Laporte 1840) and Byrrhoidea (Cneoglossidae Champion 1897, Ptilodactylidae Laporte 1836, Eulichadidae Crowson 1973, and Callirhipidae Emden 1924). It can be scarcely approached with the superfamily Cantharoidea because of the not strongly projecting procoxae, well developed femoral plate of metacoxae, not clearly elongate trochanters, although representatives of Drilidae Lacordaire 1857 and Lampyridae Latreille, 1817: Otoretinae McDermott 1964 have an appearance somewhat similar to that in members of the new family. Nevertheless, most Cantharoidea have abdomen with more than five ventrites and frequently with secondarily more or less separated primary sternites 2 and 3. At the same time the characters which could give reason for an unambiguous decision on the attribution of the new family among taxa elaborated for the recent groups are mostly not present in fossils (many sclerites of mouthparts, type of ommatidia, metendosternite, spiracles, Malpighian tubules, details of structure of genitalia and so on). Besides, it is also impossible to use larval characters for analysis of similarities of only fossil groups and groups represented in both fossil and recent fauna.

The attribution of the new family to the infraorder Elateriformia and links with its different superfamilies are supported by the following similarities shared:

- with Dascilloidea (mainly Dascillidae) in the anterior part of slightly declined head with free labrum, moderately raised mandibles, oval eyes, type of antennal insertions, proportions in antennomeres 1 and 2, strongly transverse procoxal cavities (open posteriorly),

lateral carina of prothorax (reduced in Karumiinae Escalera 1913), conically projecting mesocoxae, rows of punctures or striae on elytra (Lawrence 2005), gentle lateral edge of elytra, longitudinal suture on metaventricle, wide metepisterna (sometimes rather narrow), contiguous metacoxae (sometimes narrowly separated); two anal cells, including 2a ('wedge cell') pointed distally and almost all veins reaching posterior edge on wing;

– with Buprestoidea in the posteriorly open procoxal cavities, lateral carina of prothorax, exposed pro- and mesotrochantins, elytral sculpture and type of striation (Polycestine type of striation with shortened striae 2 and 3), longitudinal suture of metaventricle, dense and very distinct puncturation as well as rugose sculpture of the integument, developed tibial spurs, wide metepisterna; similar posterior wing venation and folding, particularly very long radial cell (rc), presence of two anal cells (including pointed distal end of 2a 'wedge cell');

– with Ptilodactylidae and Eulichadidae (and partly Callirhipidae) in the anterior part of head and oval eyes, procoxal cavities apparently open posteriorly, lateral carina of prothorax, exposed pro- and mesotrochantins, conically projecting mesocoxae, oblique metacoxae, type of elytral striation, developed tibial spurs, wide metepisterna; long radial cell and five free veins in the medial field of the posterior wing; and with the first also in the longitudinal suture of metaventricle;

– with Armatopodidae in the anterior part of head and oval eyes, type of antennal incertions, proportions in antennomeres 1 and 2, short prosternal process, procoxal cavities transverse and apparently open posteriorly, exposed trochantin of pro- and mesocoxae, distinct lateral carina of prothoracic segment, longitudinal suture of metaventricle, tibial spurs, posterior wing with isolated 2a ('wedge cell') and without veins or sclerotizations in apical part;

– with Cneoglossidae by the free labrum, complete lateral carina of prothorax, short prosternal process, procoxal cavities transverse and apparently open posteriorly, exposed trochantin of pro- and mesocoxae, longitudinal suture of metaventricle, tibial spurs, elytra with two striae next to the adsutural one shorter), rather elongate radial cell of posterior wing;

– with Brachypsectridae LeConte & Horn 1883 by the free labrum, distinct lateral carina of prothoracic segment, evenly and moderately convex pronotum, short prosternal process, open posteriorly and transverse procoxal cavities, mesocoxae very narrowly separated, longitudinal suture of metaventricle, long radial cell, raised femoral plate of metacoxae, metacoxae meeting epipleura, simple tarsal claws, antennae with similar

proportions of scape and pedicelum.

The rather serious argumentation gives the venation of posterior wing studied in detail in one specimen apparently conspecific with the type specimens of *Lasiosyne fedorenkoi* n. sp. It gives a ground to approach of this group to different groups of the four mentioned superfamilies. However, the posterior wing venation in the new family, in contrast to all other groups of Elateriformia, seems to have the extremely short proximal part of the cubitus posterior, and very long anal veins. Besides, *cubitus anterior* of the Lasiosynidae n. fam. looks like that in Dascilloidea and some Dryopoid families related to Ptilodactylidae and Schizopodidae. Although in general it is similar to that in Dascilloidea and Buprestoidea rather than that in Elateroidea and Byrroidea because of the configuration of the cubital veins and narrow end of the second anal cell (a2) (at the same time it is unique in the level of proximal displacement the whole venation and distance of bases of free AA3a, AA1+2 and CuP from posterior edge of wing). Nevertheless, in contrast to that in Dascilloidea, the posterior wing venation in the new family is characterized by the long radial cell (rc) and, in contrast to Buprestoidea, the wing of the new family has the apical transverse fold, although this fold is present also in Schizopodidae. Taking into consideration the venation, folding and features of basal articulation of posterior wings in Dascilloidea and Buprestoidea, Fedorenko (2003, 2006) after Forbes (1922) inclines to regard both these groups in composition of one superfamily because of many cases of intermediate condition in characters, particularly in the characters of posterior wing of Schizopodidae. The recent Eulichadidae have the posterior wing venation (Hajek 2007) demonstrating apparently the most numbers of similarities to that in Lasiosynidae n. fam. and probably this feature could be interpreted as somehow an evidence of close relation.

The new family can be compared with some families of the superfamily Elateroidea and most families of Byrroidea, however, is distinct from families of the former and most members of the latter in the larger and strongly transverse procoxae and presence of remains of the transverse suture of metaventricle, although the new family and families close to Ptilodactylidae (see below) show a considerable similarity in the characters of the body outline, type of striation on elytra, posterior wing venation, structure of metaventricle, metacoxae and others. Lasiosynidae n. fam., in addition to the characters in the very coarse (rugose) sculpture of integument, peculiar CuP and long anal veins of the posterior wing venation, differs from Ptilodactylidae and allied byrrhoid groups as well as from some Elateroid

families in the longer prosternum and also from:

– Artematopodidae in the well developed femoral plate of metacoxae, much larger mesocoxal cavities, (sub) conically projecting mesocoxae: squarely truncate or obliquely truncate 2a (“wedge cell”) of posterior wing;

– Brachypsectridae in the head not inserted in prothorax and not declined, mouthparts oriented more or less anteriorly (not ventrally), moderately or strongly raised mandibles, mesocoxae markedly larger, distance between anteromedian angle of metepisternum and outer angle of mesocoxal cavity very small, wider metepisterna, presence of tibial spurs; Rr not continuing r4, 2a closed proximally, Mr much shorter;

– Cneoglossidae in the not strongly oblique metacoxae with rather developed femoral plates; presence of anal field and anal cells in posterior wings;

– Ptilodactylidae in the not declined head, pronotum with not more or less hanged over the head and longer prosternum; not very lobed tarsi; a2 narrowly ended;

– Eulichadidae in the usual lack of crenellation along pronotal base, 11 striae on elytra, presence of remains of transverse suture of metaventricle; a2 narrowly ended;

– Callirhipidae in the not declined head, pronotum with distinct lateral carina and its anterior angles not hanged over the head and longer prosternum, lack of crenellation along pronotal base, not very lobed tarsi; a2 narrowly ended;

– Cerophytidae in the not declined and not retracted head with mouthparts oriented more or less anteriorly (not ventrally), moderately widely separated antennal insertions, much shorter trochanters, lack of rows of large punctures on elytra;

– Eucnemidae and Throscidae in the not declined and not retracted head with mouthpart oriented more or less anteriorly (not ventrally), strongly transverse procoxae; slightly to moderately developed femoral plates only in medial parts of metacoxae.

The transverse suture of metaventricle is the more usual for the superfamilies Dascilloidea and Buprestoidea. Except of wing venation and almost lack of this suture on metaventricle, from Dascilloidea (mainly Dascillidae) the new family differs also in the coarser sculpture of integument, more or less projecting posterior angles of pronotum, much smaller and not strongly transverse procoxae, which seem to be not conically projecting, simple tibial spurs, usually a comparatively small difference between anterior edges of pronotum and prosternum relative to the cross-section, elytral striae 2 and 3 clearly shortened, very elongate radial cell, lack of vein PM 3+4 and lack of

clear pigmentation in distal part of wing (radial field). From Buprestoidea the new family differs also in the usually prognathous or nearly prognathous head, not vertical eyes, rather short scape, lack of scutellar striola (however, shortened elytral striae 2 and 3 reminiscent of some Polycestinae Lacordaire 1857), more gentle outer edge of elytra (with a very slight sinuation at the middle, but not before the middle), lack of crenellation along pronotal base, simple tarsal claws.

Particularly, it is necessary to mention that differences between the Lasiosynidae fam. n. and Ptilodactylidae-Eulichadidae visible in fossils are not so great and in any sense they could be reduced only to the coarseness of the sculpture of integument and a2 narrowly ended. Ivie (2002) supposed that the prothorax of *Anchytarsus* Guérin-Minéville 1843 could be regarded as one type of generalized one for Ptilodactylidae. The latter has anterior edges of prosternum and pronotum are close each to other in relation of the level of vertical cross-section, i.e. head in this case can be not strongly declined downwards. Besides, recent and Cenozoic fossil Ptilodactylidae as well as one Cretaceous member of this family from Lebanese amber (Kirejtshuk & Azar in preparation) have widely lobed tarsomeres 1-4, but tarsi of *Byrrhocryptus* Broun 1893; *Astrolichas* Lawrence & Stribling 1992 and some others very narrowly lobed. Probably the basal number of longitudinal rows of punctures in Ptilodactylidae is 11, while Eulichadidae frequently have more than 11 longitudinal rows of punctures. On the other hand, the very wide metepisterna, extremely coarse sculpture of integument, characteristic curve of lateral edge of elytra and some other peculiarities give some reminiscence of Buprestidae.

The inner anterior angle of metepisterna in species of *Lasiosyne* is closely approaching to the outer edge of mesocoxal cavities. This feature also demonstrates some similarity of Lasiosynidae n. fam. to Ptilodactylidae, Eulichadidae and Callirhipidae (although somewhat similar can be found also in other groups inside Dryopoidea and in families outside of this superfamily, like Dascillidae, Cneoglossidae, etc.). On the other hand, this feature is also partly reminiscent of the metathoracic structure of Archostemata, which could give a reason to consider it in the composition of the family Ademosynidae Ponomarenko 1969 (Tan, Ren & Shih 2007). Nevertheless, most characters used in the latter paper are not correctly drawn and described. Indeed the Lasiosynid species share some superficial similarity with species of *Dolichosyne* Ponomarenko 1969 (elongate body, metathoracic structure, striation of elytra, separated procoxae and so on), however, the group here considered, in contrast to the later, have the

transverse procoxal cavities and procoxae with exposed trochantins, metepisterna only approaching to the outer edge of mesocoxal cavities, not Archostematan metacoxae with femoral plate (like in many groups of Elateriformia), different type of elytral striation, not exposed propleura, characteristic Elateriformian genitalia in both sexes and other peculiarities clearly visible on compression fossils.

Aedeagus of species of *Lasiosyne* is of the trilobate type, quite characteristic of many groups of Elateriformia. The very short ovipositor of the mentioned genus is also quite frequent among many groups. However, the somewhat sclerotized other inverted parts of the female terminalia should be regarded as an archaic character of this group.

Genus *Lasiosyne* Tan, Ren & Shih 2007

Type species. *Lasiosyne euglyphea* Tan, Ren & Shih 2007

= *Pappisyne* Tan & Ren 2009, **n. syn.**

Type species. *Pappisyne eucallus* Tan & Ren 2009.

Composition. Except the type species, *L. daohugouensis* **n. sp.**, *L. fedorenkoi* **n. sp.**, *L. gratiosa* **n. sp.** and *L. quadricollis* **n. sp.** This genus is represented in the collection of Capital Normal University (Beijing) at least by about 150 specimens from Jurassic Daohugou and Liaoning, which could be belong to more than 10 species.

Diagnosis. Body subparallel-sided to subcylindrical; integument with subuniform and very coarse sculpture, extremely densely punctured; pubescence fine and short or not visible; head (sub) prognathous, antennal grooves usually expressed on head underside; mandibles large and with acute apex; eyes large; labrum moderately short and transverse; cervical constriction distinct; antennae rather long and with 11 segments, antennomere 2 short and frequently transverse, rest antennomeres elongate subcylindrical or subconical and usually rather long, sometimes widened apically; pronotum much narrower than elytral base, subquadrate to slightly transverse, not crenulate along base, anterior angles rounded and not projecting, anterior margin nearly as wide as head, posterior angles sharp, extending lateroposteriorly; metepisterna 2.5-3.0 times as long as wide; elytra with subacute apices and 11 striae (2 and 3 not complete); ultimate labial palpomere widened apically; mentum moderately large and subquadrangular; gular sutures distinct and rather widely separated, slightly curved and following behind posterior angles of mentum; prosternal process moderately narrow; mesocoxae narrowly separated to subcontiguous; metacoxal femoral plates slightly to moderately developed only in median part of coxae; tarsi five-segmented with moderately lobed tarsomeres 1-4.

Comparison. This genus is similar to *Anacapitis* differing from it only in the more slender body and longer prothoracic segment. Besides, the antennae of *A. plata* (Tan & Ren 2009), **n. comb.** (type species of the genus *Brachysyne*) are shorter than in members of *Lasiosyne*, and metacoxae of *A. oblongus* Yan 2009 (type species of

the genus *Anacapitis*) are considerably shorter than in the species of the genus under consideration. *Lasiosyne* differs from *Tarsomegamerus* in the somewhat more slender body, particularly in the narrower pronotum, shorter and narrower frons, and pentamerous tarsi and also from *Buprestodactyla* n. gen. mostly in the pentamerous tarsi and not so wide metepisterna. Besides, the genus under consideration is characterized by comparatively large eyes.

Note. The proposed synonymy of generic names *Lasiosyne* and *Pappisyne* is evident because the holotypes of the type species of both 'genera' should be regarded as conspecific (see below). The species of this genus here considered are rather similar in body size and shape, appendages, character of puncturation and sculpture of integuments and other characters. Therefore it is thought that the descriptions of new species could be shortened due to omitting of the characters which they share with the type species. However the type species is re-described in a more details because it was first described with many deficiencies.

Lasiosyne euglyphea Tan, Ren & Shih 2007 (Figs. 1-13, 18)

= *Pappisyne eucallus* Tan & Ren 2009, **n. syn.**

= *Pappisyne lasiospatha* Tan & Ren 2009, **n. syn.**

Material. Holotype of *Lasiosyne euglyphea*: CNU-COL-NN2006013, probably female; positive imprint of dorsum with exposed details of underside, part of both antennae, anterior and intermediate legs with tarsi and right posterior legs. Holotype of *Pappisyne eucallus* and *Pappisyne lasiospatha*: CNU-COL-NN2006023, female; positive imprint of dorsum with exposed details of underside, with left antenna and exposed outline of parts of anterior legs, right intermediate and both posterior ones. Additional specimens: CNU-COL-NN2009120, female; positive imprint of dorsum, with both antennae and exposed outline of parts of anterior legs; CNU-COL-NN2009123 (part and counterpart – further PC), female; part and counterpart with exposed part details of ovipositor; CNU-C-NN2009126, female; positive imprint of dorsum with exposed details of underside, with right antenna and detailed outline of left hind legs; CNU-COL-NN2009870, sex unknown; positive print of dorsum with part of right antenna and legs; CNU-COL-NN2010357, female; positive imprint of dorsum, with exposed outline of parts of sclerites of legs and without antennae; CNU-COL-NN2010358, probable male; positive imprint of dorsum, with left antenna and exposed some sclerites and outline of legs.

Diagnosis. Antennomeres 3-10 more or less homonomous and narrow; eyes rather large; anterior edge of pronotum slightly emarginate to slightly convex and markedly narrower than posterior ones, its lateral sides strongly arcuate, anterior angles arcuate; anterior edge prosternum rather concave disposed markedly behind anterior edge of pronotum; femoral plates of metacoxae moderately raised.

This species differs from:

- *L. daohugouensis* **n. sp.** in the arcuate anterior angles and shallowly emarginated sides of base of pronotum and not strongly excised anterior edge of prosternum; more arcuate pronotal sides, not so deeply bisinuate pronotal base and much shorter femoral plate of metacoxae;

- *L. fedorenkoi* **n. sp.** in the antennomeres 3-10 not widened apically, larger eyes; more arcuate pronotal sides; other proportions of tarsomeres; other proportions of length of last two segments of abdomen;

- *L. gratiosa* **n. sp.** in the pronotum somewhat longer and clearly widened anteriorly from posterior angles, lack of median longitudinal ridge on pronotum and much shorter femoral plate of metacoxae;

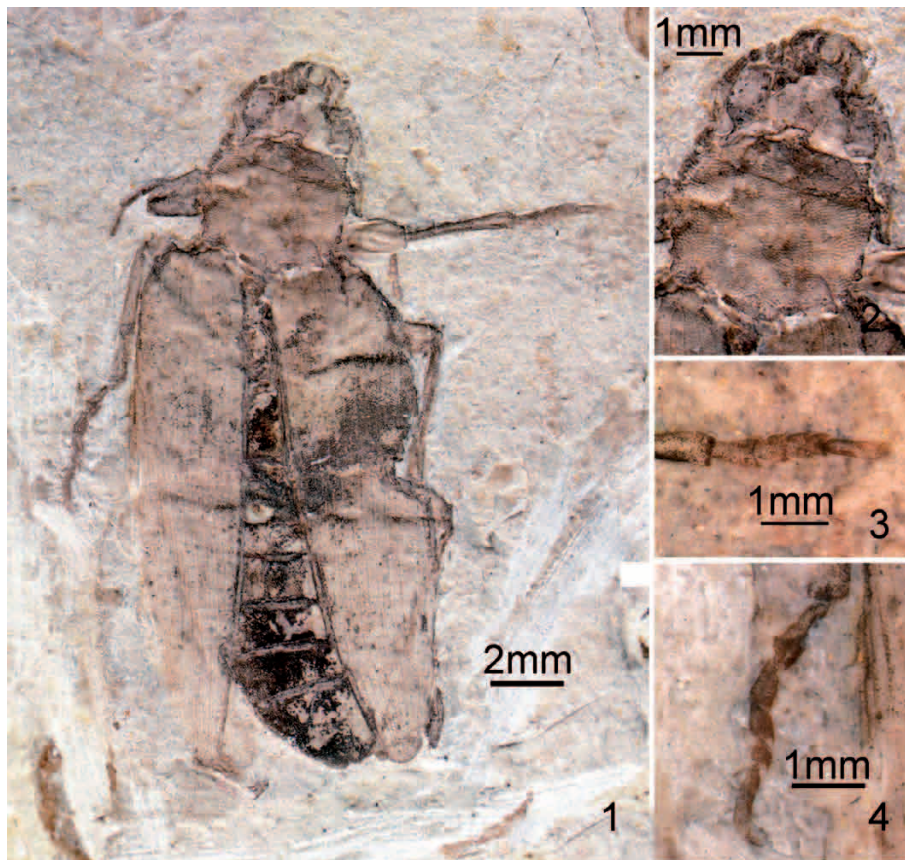
- *L. quadricollis* **n. sp.** in the not subquadrangular pronotum; other proportions of length and shape of apical and subapical abdominal segments, and also in the much shorter femoral plate of metacoxae.

Redescription. Body 20.0–23.0 mm long, 6.9–8.3 mm wide; elongate, moderately convex dorsally and, perhaps, ventrally, dorsum and legs with very short and very thin hairs about as long as distance between punctures on elytra or somewhat longer; antennae with particularly dense hairs.

Head, pronotum and thoracic sclerites with rather deep, dense

and medium punctures (about as large as eye facets in diameter on head and nearly twice larger on pronotum), extremely narrow interspaces between them densely microreticulated (punctures on pronotum forming an irregular transrugosity). Elytra with more or less clear 11 longitudinal striae on whole elytral surface and with extremely fine diffuse punctures between them. Underside of abdomen with similar punctures as large as on thoracic ones but much shallower and microsculpture between them somewhat smoothed.

Head transversely subtriangular, 1.5–1.6 mm long, 2.4–2.5 mm wide, eyes rather large and suboval, somewhat less than 1/2 as long as width of head, mandibles large and rather long, more or less sharply curved at outer angle, labrum moderately short and widely transverse. Antennae subfiliform, somewhat less than 1/2 as long as entire body, antennal scape moderately short and moderately swollen, about twice as long as pedicel, shorter than other antennomeres, pedicel subcylindrical, antennomeres 3–10 more or less subequal in length, subcylindrical to subconical, 3–4 times as long as thick at apex, antennomere 11 longest and somewhat narrowing at apex. Pronotum transverse, about 3.0 mm long, about 1.2 times as long as wide, anterior margin nearly straight, anterior angles round, lateral edges gently convex, posterior edge shallowly emarginated at each posterior angle and strongly convex at the middle; posterior angles forming



Figures 1–4

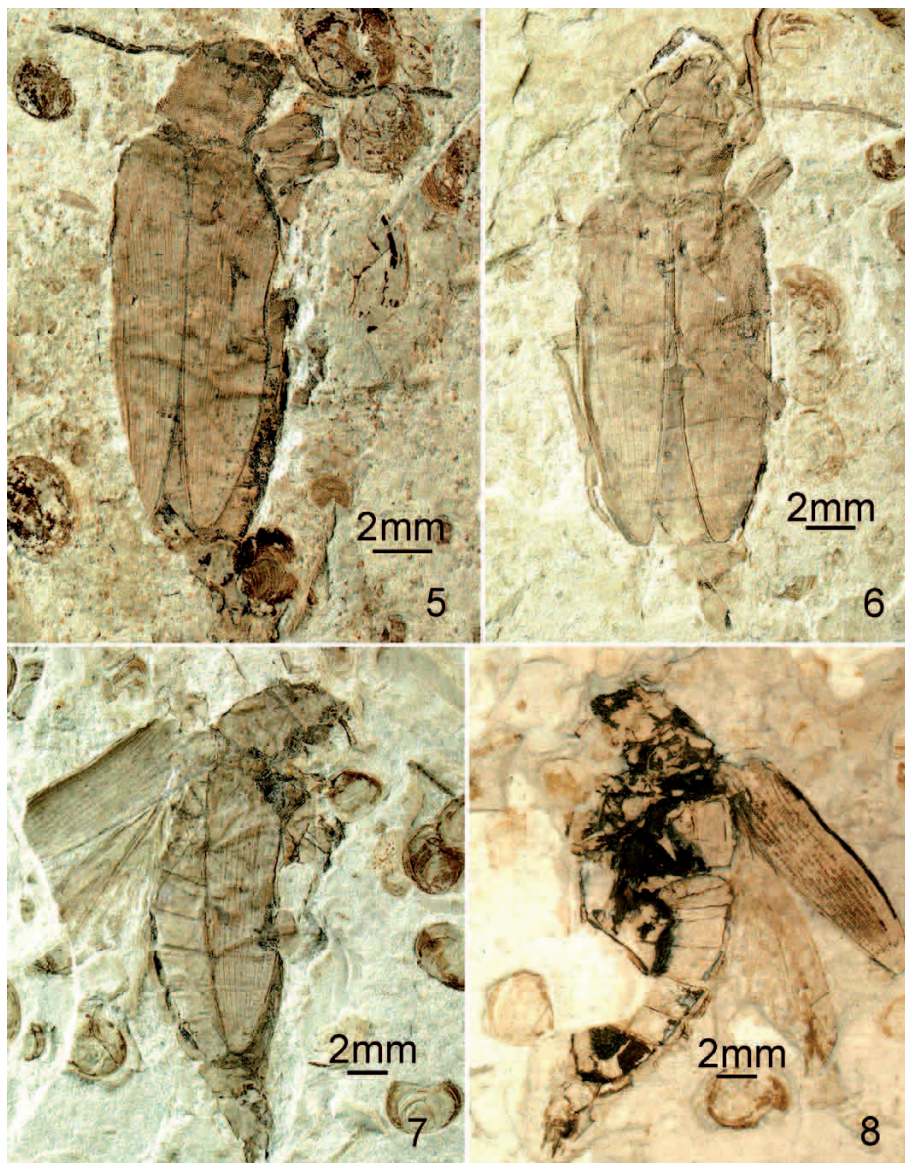
Laiosyne euglyphea. **1**, body of holotype (CNU-COL-NN2006013), dorsally (body length 20.0 mm); **2**, head and pronotum of this specimen, dorsally; **3**, protarsus of this specimen, dorsally; **4**, metatarsus of this specimen, dorsally.

acuminate lateroposterior projections and with a distinct top, disc moderately convex. Scutellum subtriangular and rounded at apex. Elytra 15.0–15.5 mm long, 6.0–8.0 mm wide; remaining uncovered only the pygidial apex, about 1.3 times as wide as prothorax, somewhat more than twice as long as wide combined, widest near base, narrowed in distal 1/3; striae 1 and 2, 3 and 4, 5 and 6 conjoined at the base; striae 2 and 3 only slightly surpassing the middle, the rest striae converging and becoming obsolete only at apex; epipleura rather narrow. Pygidium widely rounded to subtruncate at apex and somewhat longer than ventrite 1.

Mentum subquadrangular and transverse. Labial palpi apparently three-segmented, ultimate palpomere apparently

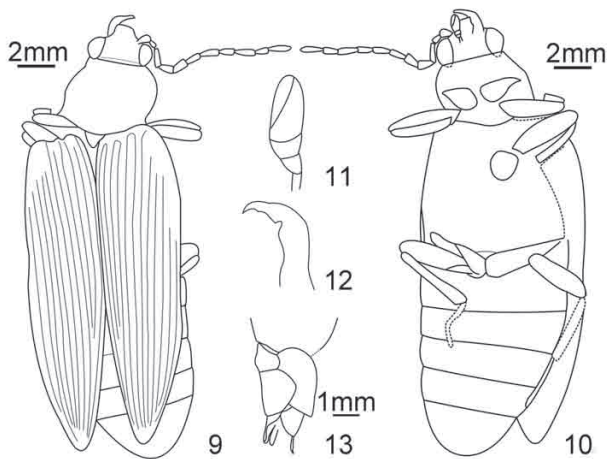
subsecuriform and oblique apex. Procoxal cavities transverse, and moderately narrowly separated, mesocoxal cavity subtriangular and apparently narrowly separated; metacoxal cavities broadly conjoining; metepisterna rather wide and 2.0–2.5 times as long as wide. Metacoxae with femoral plates of arcuate shape in the median part and becoming obsolete at outer edge. Abdominal ventrites 2–4 subequal in length, hypopygidium 1.4 times as long as the previous one and rounded at apex.

Femora comparable in shape and size, moderately narrow and long. Tibiae narrow (about 2/5 as wide as femora) and somewhat longer than femora; slightly dilating apically. Tarsi almost as wide as tibiae; metatarsi at least 2/3 as long as metatibiae.



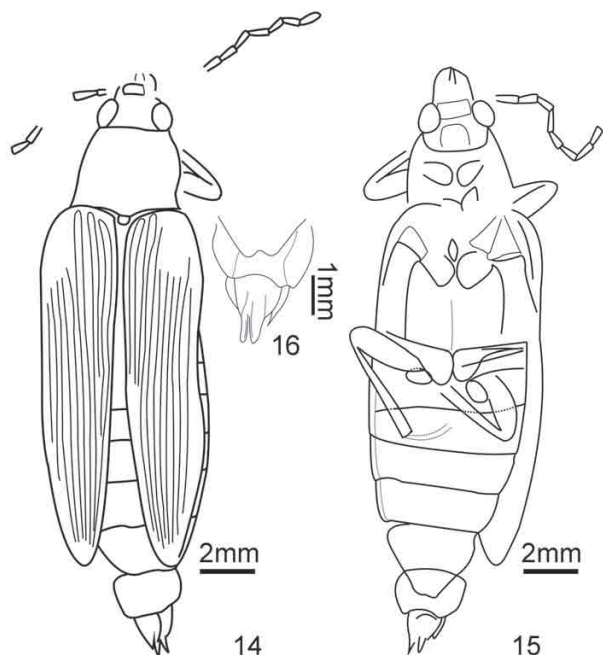
Figures 5–8

Lasiosyme euglyphea. **5**, body of CNU-COL-NN2009120, dorsally (body length 17.1 mm); **6**, body of CNU-COL-NN2009126, dorsally (body length 19.5 mm); **7**, body of CNU-COL-NN2009123-1 (part), dorsally (body length 20.0 mm); **8**, body of CNU-COL-NN2009123-2 (counterpart), dorsally (body length 20.0 mm);

**Figures 9–13**

Laiosyne euglyphea. **9**, body of CNU-COL-NN2006023, dorsally (body length 23.0 mm); **10**, idem, ventrally; **11**, maxillary palp of this specimen, ventrally; **12**, right mandible of this specimen, ventrally; **13**, ovipositor of CNU-COL-NN2009123, laterally.

Variability. Certain variability is observed in the shape of tarsomeres: specimen CNU-COL-NN2009126 has tarsomere 4 subquadrate, but CNU-COL-NN2006013 has tarsomere 4 somewhat subcordate. Besides, the CNU-COL-NN2009870

**Figures 14–16**

Laiosyne daobugouensis n. sp. **14**, body of holotype (CNU-COL-NN2009121), dorsally (body length 19.5 mm); **15**, idem, ventrally; **16**, ovipositor of this specimen, ventrally.

has, in contrast to other representatives of this species, deeply excised sides of base and not so prominent posterior angles of pronotum.

Notes. The proposed synonymy is based on absence of differences between both holotypes examined. The names *Pappisyne eucallus* n. syn. and *Pappisyne lasiospatha* n. syn. were given for the same specimen (the first in its Chinese description and the second in the English one).

***Laiosyne daobugouensis* n. sp.**
(Figs. 14–17, 19–20)

Material. Holotype: CNU-COL-NN2009121 (PC), female; perfectly preserved part and counterpart with both dorsum and underside, almost complete right antennae, details of ovipositor, but without most parts of tarsi. Additional specimen: CNU-COL-NN2006014, male, positive imprint of dorsum and exposed details of the inner surface, partly destroyed at the middle of lateral edge of the right elytron and in posterior part along the posterior half of the left elytron, with missing antennae and most sclerites of legs.

Diagnosis. Antennomeres 3–10 more or less homonomous and narrow; eyes rather large; anterior edge of pronotum almost straight to slightly emarginated and markedly narrower than posterior ones, its lateral sides strongly arcuate, anterior angles with clear top; anterior edge prosternum rather concave disposed markedly behind anterior edge of pronotum; femoral plate of metacoxae rather strongly raised.

This species differs from all congeners in the strongly excised anterior edge of prosternum, and also from:

- *L. euglyphea* in the distinct top of anterior angles and somewhat more deeply excised sides of posterior edge of pronotum; wider abdominal apex and much longer femoral plate of metacoxae;

- *L. fedorenkoi* n. sp. in the antennomeres 3–10 not widened apically; larger eyes; more arcuate pronotal sides; other proportions of last abdominal segments of abdomen and much longer femoral plate of metacoxae;

- *L. gratiosa* n. sp. in the pronotum slightly widened anteriorly from posterior angles, arcuate posterior edges of female pygidium and hypopygidium and larger mandibles; and lack of median longitudinal ridge on pronotum;

- *L. quadricollis* n. sp. in the not subquadrate pronotum and larger mandibles; other proportions of length and shape of apical and subapical abdominal segments.

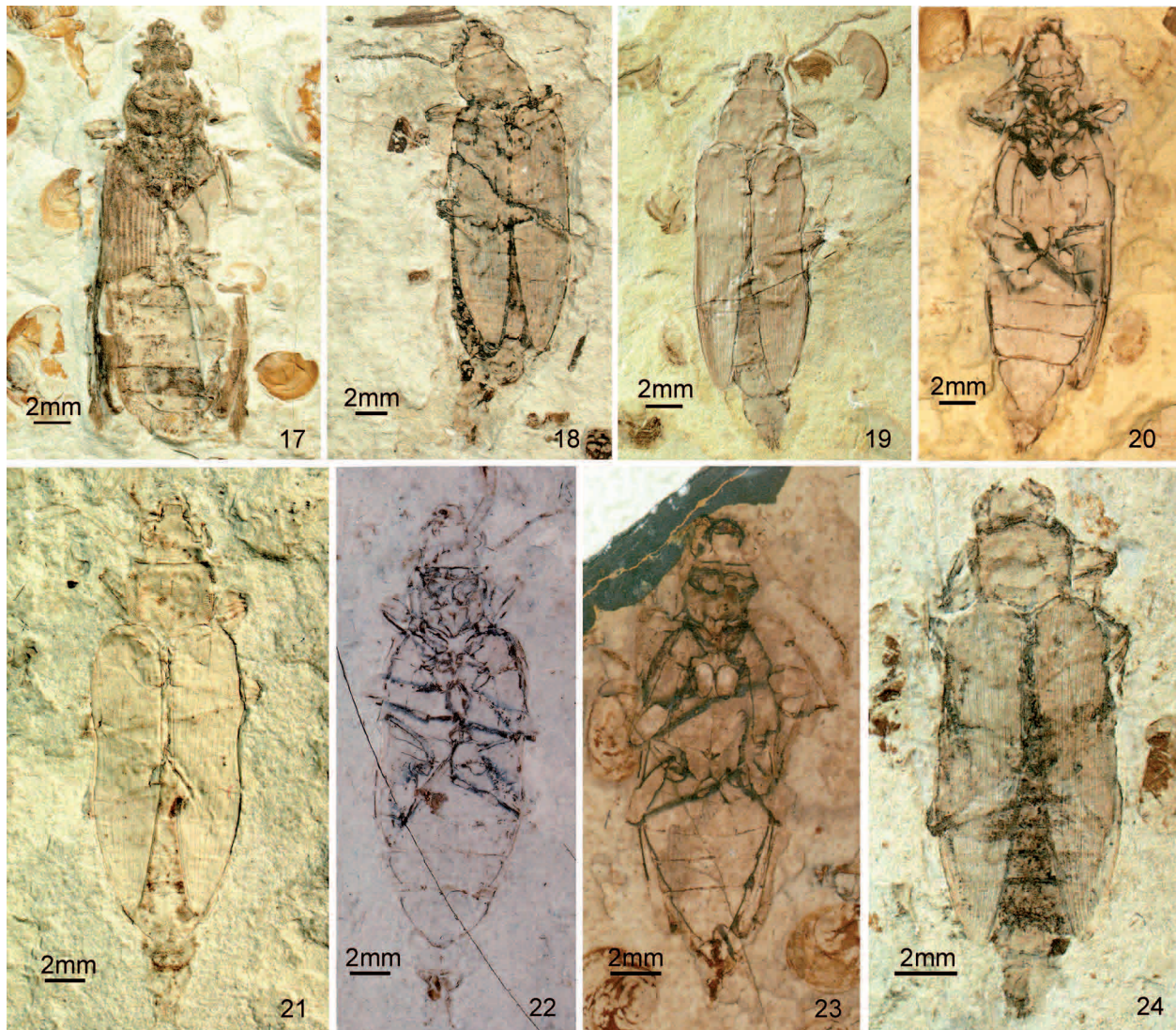
Description of holotype. Body 21.5 mm long, 6.0 mm wide; elongate, moderately convex dorsally and, perhaps, ventrally; apparently glabrous. Head, pronotum and thoracic sclerites with rather deep, dense and medium punctures (about as large as eye facets in diameter), extremely narrow interspaces between them densely microreticulated (punctures on pronotum deeper and forming an irregular rugosity). Elytra with clear 11 longitudinal striae on whole elytral surface and with extremely fine diffuse punctures between them. Underside of head as punctured and sculptured as dorsum; metaventrite and abdominal sclerites with punctures much shallower and microsculpture between them somewhat smoothed.

Head transverse, 2.0 mm long, 3.0 mm wide, dorsally about 1.5 times as wide as long, eyes rather large and oval, nearly 1/3

as long as width of head, mandibles moderately large and long, more or less gently curved at outer angle, labrum moderately short and widely transverse. Antennae subfiliform, somewhat less than 1/2 as long as entire body, antennal scape scarcely visible and apparently shorter than antennomeres 3–11, antennomeres 3–11 more or less equal in length and about 3.0–3.5 times as long as wide. Pronotum 3.43 mm long, slightly transverse, about 1.1 times as long as wide, anterior margin straight, nearly as long as base of head, anterior angles with clear top, not projecting anteriorly, lateral edges gently convex, posterior edge rather excised at each posterior angle and strongly convex at the middle; posterior angles forming acuminate lateroposte-

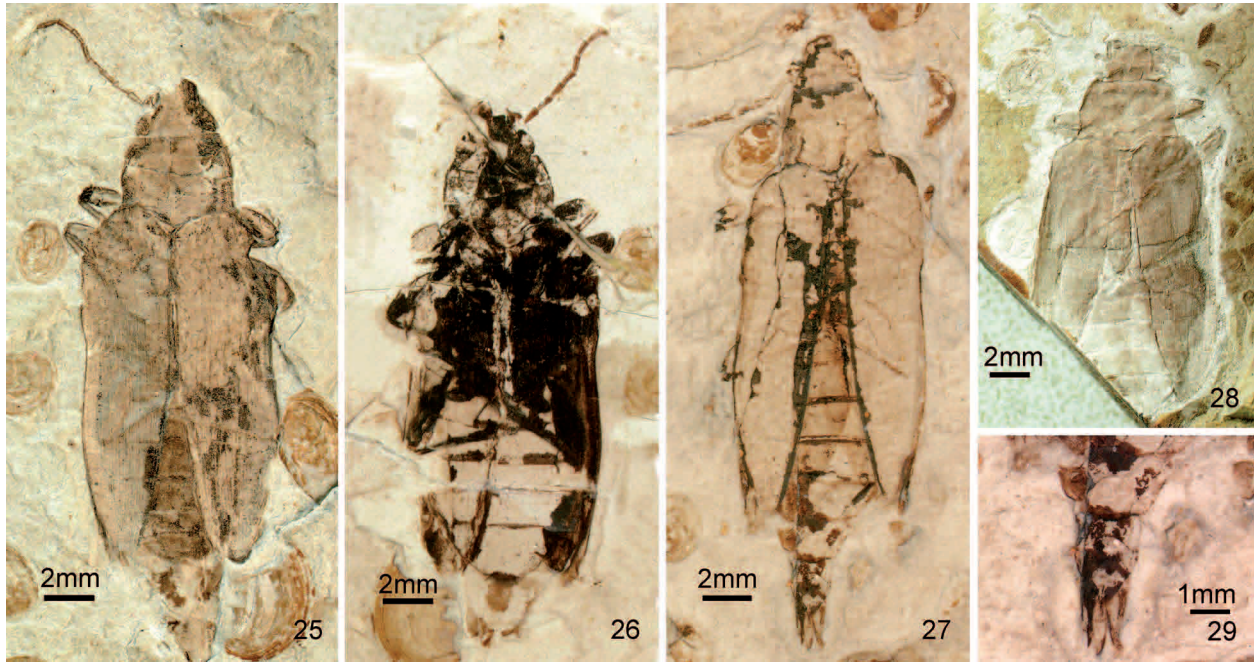
rior projection and with a distinct top, disk moderately convex. Scutellum subtriangular to subsemi-circular. Elytra 13.3 mm long, 6.12 mm wide; remaining uncovered only the pygidial apex, about 1.3 times as wide as prothorax, somewhat more than twice as long as wide combined, widest near basal part, narrowed in distal 1/3; Pygidium widely rounded to subtruncate at apex and markedly shorter than ventrite 1.

Mentum subquadrangular and very transverse (about 3.5 times as wide as long). Procoxal cavities strongly transverse, and moderately narrowly separated, mesocoxal cavity subtriangular and apparently narrowly separated; metepisterna not narrowing posteriorly, rather wide and about 3.5 times as long as wide.



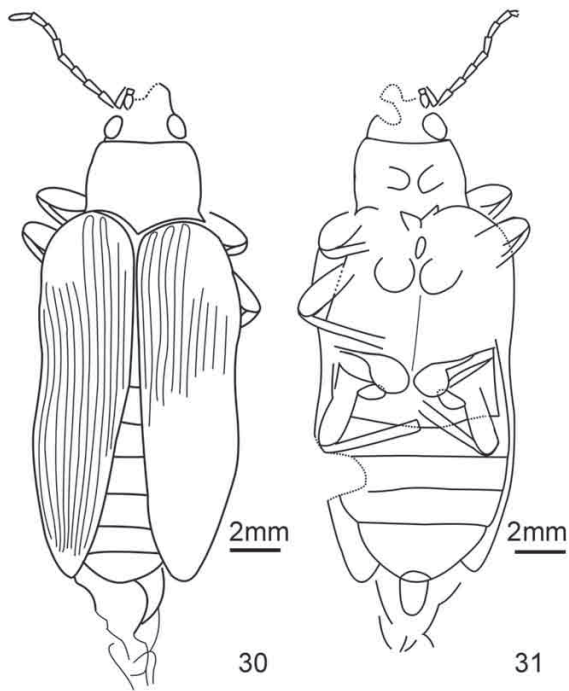
Figures 17–24

Laiosyne spp. **17**, body of *L. daohugouensis* n. sp. (CNU-COL-NN2006014), dorsally (body length 22.5 mm); **18**, body of *L. euglyphea* (CNU-COL-NN2006023), dorsally (body length 23.0 mm); **19**, body of holotype *L. daohugouensis* n. sp. (CNU-COL-NN2009121-1, part), dorsally (body length 21.5 mm); **20**, idem (CNU-COL-NN2009121-2, counterpart), ventrally (body length 21.5 mm); **21**, body of holotype *L. quadricollis* n. sp. (CNU-COL-NN2006019-1, part), dorsally (body length 21.5 mm); **22**, idem (CNU-COL-NN2006019-2, counterpart), ventrally (body length 21.5 mm); **23**, body of paratype *L. quadricollis* n. sp. (CNU-COL-NN2009131), dorsally (body length 13.2 mm); **24**, body of paratype *L. quadricollis* n. sp. (CNU-COL-NN2009124), dorsally (body length 15.2 mm).



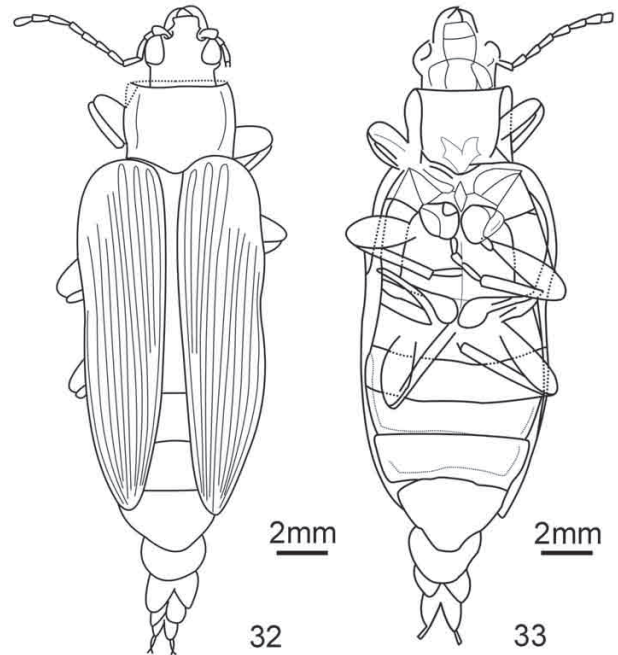
Figures 25–29

Laiosyne gratiosa n. sp. **25**, body of holotype (CNU-COL-NN2006016-2, part), dorsally (body length 24.2 mm); **26**, idem (CNU-COL-NN2006016-1, counterpart), ventrally; **27**, body of paratype (CNU-COL-NN2009119), dorsally (body length 21.5 mm); **28**, body of additional specimen (CNU-COL-NN2009127), dorsally (body length 21.0 mm); **29**, aedeagus of paratype (CNU-COL-NN2009119), dorsally.



Figures 30–31

Laiosyne gratiosa n. sp. **30**, body of holotype (CNU-COL-NN2006016), dorsally; **31**, idem, ventrally.



Figures 32–33

Laiosyne quadricollis n. sp. **32**, body of holotype (CNU-COL-NN2006019), dorsally (body length 19.5 mm); **33**, idem, ventrally.

Metacoxae with femoral plates of arcuate shape in the median part and becoming obsolete at outer edge. Abdominal ventrite 1 longest, ventrites 2–4 subequal in length, hypopygidium about 1.4 times as long as the previous one and rounded at apex.

Femora comparable in shape and size, moderately narrow and long. Tibiae narrow (about 1/3 as wide as femora) and somewhat longer than femora; slightly dilating apically, tarsi slightly narrower than tibiae.

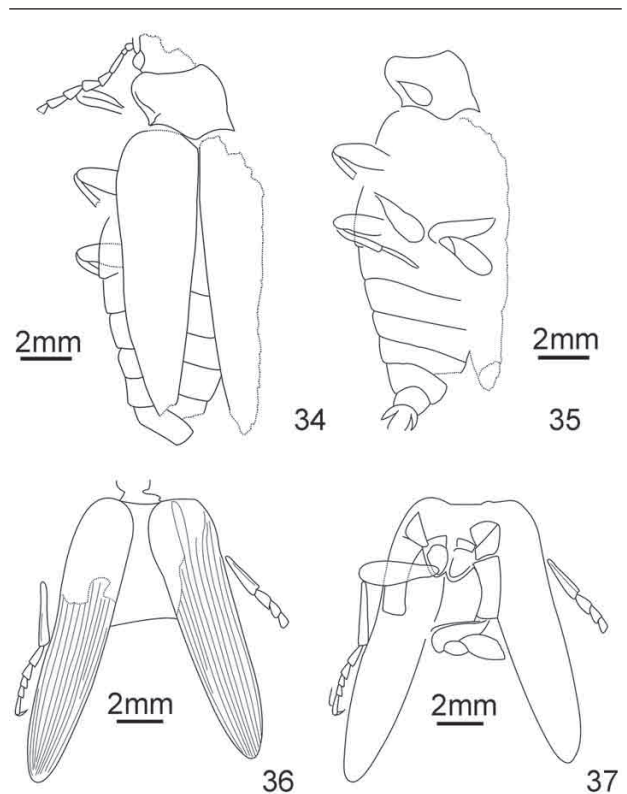
Ovipositor slightly sclerotized and very short, with clear styli.

Additional specimen. CNU-COL-NN2006014 differs from the holotype particularly in the much larger eyes, sharply curved outer edge of mandible, sculpture of integument on elytra. Body 23.0 mm long, 6.95 mm wide; (head 1.6 mm long, pronotum 3.0 mm long, elytra 15.5 mm long); elongate, moderately convex dorsally and, perhaps, ventrally; integument with rather small and dense punctures, uniformly spread through all observed sclerites, with weakly traced longitudinal striae on whole elytral surface.

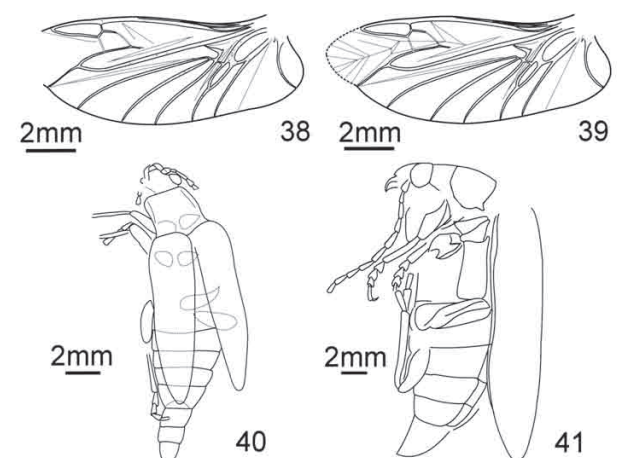
Head nearly longer than wide; eyes large in size and oval, nearly 2/5 as long as width of head; mandibles large, more or less steeply curved at outer angle, pointed at apex; labrum well exposed from under frons, subquadrangular and almost three times as wide as long. Antennal scape moderately short and rather swollen. Mentum subquadrangular, more than twice as wide as long and about a third as wide as head. Antennal grooves more or less distinct and divergent proximally. Pronotum transverse, about 1.4 times as long as wide, subsemi-circular anteriorly, a little wider than head; anterior edge gently convex; posterior edge shallowly emarginate at each posterior angle; posterior angles forming acuminate processes projecting lateroposteriorly. Scutellum subtriangular and narrowly rounded at apex. Elytra gently convex along, remaining uncovered the pygidial apex, widest at base and about 1.5 times as wide as prothorax, about 2.2 times as long as wide combined, narrowed in distal 1/3. Remains of both posterior wings demonstrating clear and long radial cell. Prosternum comparatively long, with deeply excised anterior edge. Metaventrite with a transverse suture visible just before the joining of metacoxae. Abdominal ventrite 1 somewhat shorter than hypopygidium, ventrite 4 shortest, hypopygidium more than twice as long as the previous one and rounded at apex. Femora comparable in size and shape, moderately narrow and long. Protibiae narrow (about 2/5 as wide as profemur).

***Lasiosyne gratiosa* n. sp.**
(Figs. 25–31)

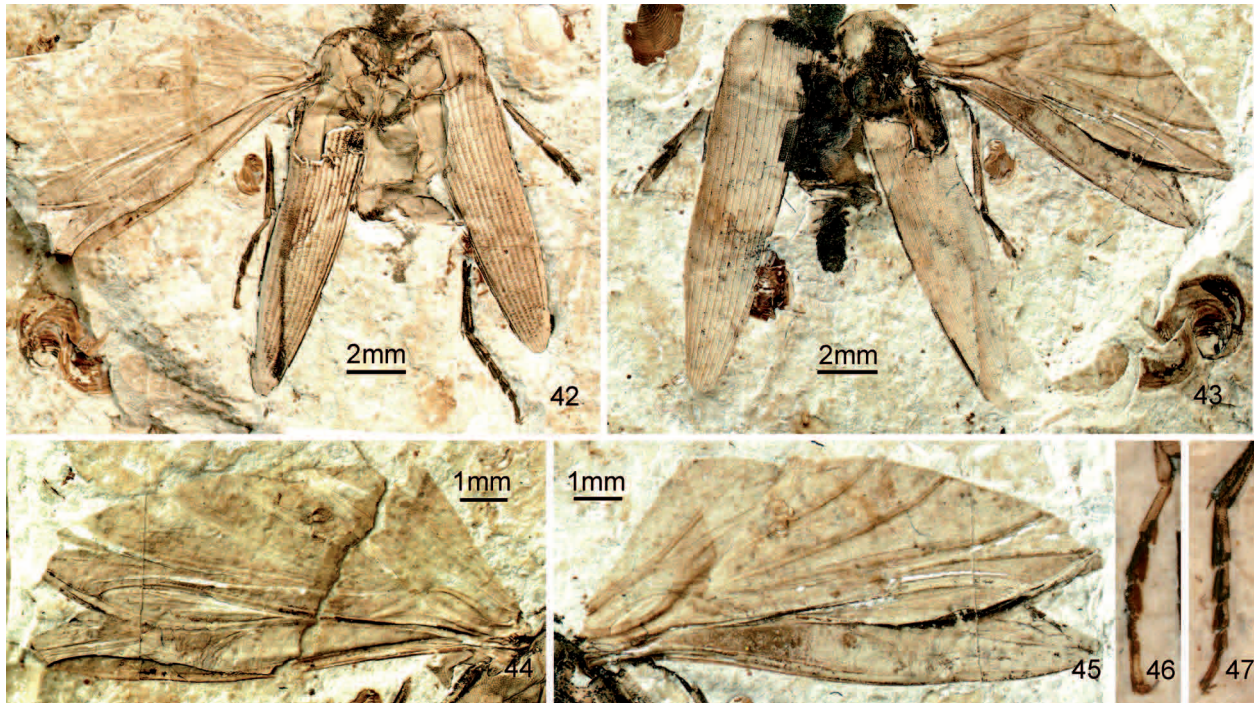
Material. Holotype: CNU-C-NN2006016 (PC), female, part and counterpart represented the dorsal and ventral sides with left antenna and all legs. Paratypes: CNU-C-NN2009119, male, positive imprint of dorsum and exposed details of underside, partly destroyed at the middle of lateral edge of right elytron and in posterior part along the posterior half of left elytron, with missing antennae and most sclerites of legs; CNU-C-NN2009128, sex unknown, positive imprint of dorsum and exposed details of underside, destroyed left part of abdominal apex and side of apex of left elytron and also with missing most antennomeres (except 3 left antennomeres). Additional specimen: CNU-C-NN2009127, sex unknown; partly positive imprint of dorsum and exposed details of underside, with left antenna, some right antennomeres legs, but with missing apex of left elytron and left part of abdominal apex.



Figures 34–37
Lasiosyne fedorenkoi n. sp. **34**, body of paratype (CNU-COL-NN2007862), dorsally; **35**, idem, ventrally; **36**, pterothorax, elytra, intermediate and posterior legs of additional specimen (CNU-COL-NN2006015), dorsally; **37**, idem, ventrally.



Figures 38–41
Lasiosynidae: *Lasiosyne fedorenkoi* n. sp. **38**, posterior wing (CNU-COL-NN2006015); **39**, idem with reconstruction of complete folding (made by D.N. Fedorenko); **40**, body of holotype (CNU-COL-NN2009853); *Bupredactyla magna* n. gen. et sp., body of holotype (CNU-COL-NN2009881), laterally; **41**, idem, ventrally.



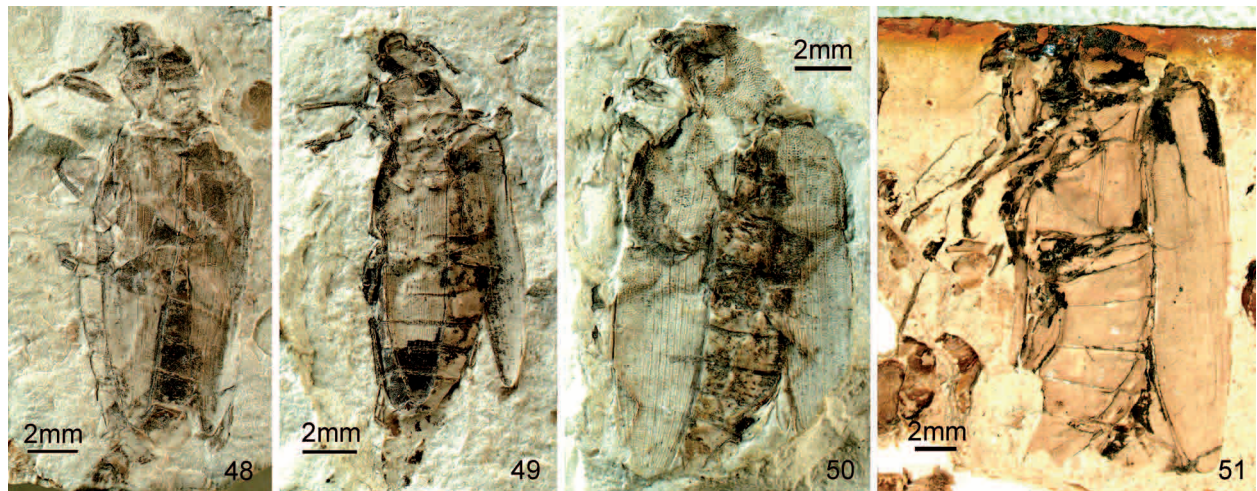
Figures 42–47

Lasiosyne fedorenkoi n. sp. (CNU-COL-NN2006015). 42, pterothorax, elytra, posterior wing, intermediate and posterior legs of additional specimen (CNU-COL-NN2006015-1, part), dorsally (length of elytra 12.0 mm); 43, idem (CNU-COL-NN2006015-2, counterpart), dorsally; 44, posterior wing (CNU-COL-NN2006015-1, part); 45, idem (CNU-COL-NN2006015-2, counterpart); 46, mesotarsus; 47, metatarsus.

Etymology. Epithet of this new species is formed from the Latin “*gratia*” (grace or graceful) and “*-osus*” (having the quality of).

Diagnosis. Antennomeres 3–10 more or less homonomous

and narrow; eyes rather large; anterior edge of pronotum almost straight to slightly emarginated and markedly narrower than posterior ones, its lateral sides strongly arcuate and not narrowed posteriorly, anterior angles more or less rounded; anterior edge prosternum slightly emarginated and disposed at



Figures 48–51

Lasiosynidae: *Lasiosyne fedorenkoi* n. sp. 48, body of paratype (CNU-COL-NN2009862), dorsally (body length 19.5 mm); 49, body of holotype (CNU-COL-NN2009853), dorsally (body length 14.0 mm); 50, body of paratype (CNU-COL-NN2009869), dorsally (body length 16 mm); *Bupredactyla magna* n. gen. et sp.: 51, body of holotype (CNU-COL-NN2009881), laterally.

the same level with anterior edge of pronotum; femoral plates of metacoxae rather strongly raised.

This species differs from the rest congeners in the longitudinal ridge on pronotum and also from:

– *L. daohugouensis* n. sp. in the pronotum not widened anteriorly from posterior angles, arcuate posterior edges of female pygidium and hypopygidium; more transverse pronotum;

– *L. euglyphea* in the pronotum not widened anteriorly from posterior angles and more deeply excised sides of posterior edge of pronotum; more transverse pronotum and much longer femoral plate of metacoxae;

– *L. fedorenkoi* n. sp. in the pronotum not widened anteriorly from posterior angles, antennomeres 3-10 not widened apically, larger eyes and much longer femoral plate of metacoxae;

– *L. quadricollis* n. sp. in the not subquadrangular pronotum and somewhat longer femoral plate of metacoxae.

Description of holotype. Body 24.2 mm long, 7.0 mm wide; (head 3.2 mm long, pronotum 4.1 mm long, elytra 14.0 mm long); elongate, moderately convex dorsally and, perhaps, ventrally; integument with rather small and dense punctures (coarser and denser on pronotum), uniformly spread through all observed sclerites, with weakly traced longitudinal striae on whole elytral surface; apparently glabrous.

Head subtriangular, with moderately large eyes. Antenna 11-segmented (about as that in *L. euglyphea*). Pronotum with nearly straight anterior edge; its sides arcuately narrowing anteriorly; posterior edge comparatively deeply sinuate at each posterior angle; posterior angles forming acuminate processes projecting lateroposteriorly; there is a longitudinal ridge along the middle of pronotum. Elytra remaining uncovered pygidial apex, about 1.75 times as wide as prothorax, 1.78 times as long as wide combined, narrowed in distal 2/3, epipleura very narrow. Pygidium comparatively narrow and widely rounded at apex. Prosternum comparatively long, with almost straight anterior edge; procoxal cavities transverse, narrowing externally. Mesocoxal cavities somewhat rounded and apparently narrowly separated. Metacoxae with comparatively long femoral plates. Hypopygidium about 1.45 times as long as the previous one and rounded at apex. Femora comparable in size and shape, moderately narrow and long. Metatibiae narrow (about 1/3 as wide as profemur) and short.

Paratypes. CNU-C-NN2009119, male: differs from the holotype in the structure of antennae and somewhat narrower pronotum. Its body 21.5 mm long, head 3.6 mm wide, pronotum 3.9 mm long, elytra 15.5 mm long. Antennomere 3 about 1.3 times as long as antennomere 4. Abdomen with sternite 8 rather narrow and with subtruncate apex. Aedeagus moderately long and heavily sclerotized. CNU-C-NN2009119, male: differs from the holotype in the more robust body and pronotum somewhat more narrowing anteriorly than that in the holotype. Its body 21.5 mm long, head 3.6 mm wide, pronotum 3.9 mm long, anterior edge of pronotum as great as 3.3 mm, posterior edge of pronotum as great as 5.0 mm, elytra 14.0 mm long.

Additional specimen. CNU-C-NN2009127, sex unknown: differs from the holotype in the much wider pronotum. Its body 21 mm long, 7.8 mm wide, head 3.5 mm wide and 2.0 mm wide; pronotum 5 mm long, anterior edge of pronotum as great as 3.5 mm, posterior edge of pronotum as great as 6.0 mm, elytra 15.0 mm long.

Lasiosyne quadricollis n. sp. (Figs. 21–24, 32–33)

Material. Holotype: CNU-COL-NN2006019-1, CNU-COL-NN2006019-2, female; positive imprint of dorsum and negative imprint of underside, with contour of ventral sclerites, with left antenna, all legs and exposed terminatia. Paratypes: CNU-COL-NN2009124, female, positive imprint of dorsum, with projecting contour of ventral sclerites, with part of right antenna and partly exposed terminatia; CNU-COL-NN-2010224, male; mixture of positive and negative print of underside, with part of left antenna, left legs and right posterior leg. Additional specimen: CNU-COL-NN2009131, male, imprints of ventral side, with almost completely well preserved antennae, and the contour of hind claws.

Etymology. Epithet of this new species refers to its rectangular pronotum.

Diagnosis. Antennomeres 3–10 more or less homonomous and narrow; eyes rather large; anterior edge and sides of pronotum almost straight; anterior angles with clear top; anterior edge prosternum slightly emarginated and disposed at the same level with anterior edge of pronotum; femoral plates of metacoxae well raised.

This species differs from the rest congeners in the subquadrangular pronotum and also from:

– *L. daohugouensis* n. sp. in the not deeply excised anterior edge of the prosternum, smaller mandibles and somewhat shorter femoral plate of metacoxae;

– *L. euglyphea* in the shorter pronotum; another proportion of length and shape of apical and subapical abdominal segments and somewhat longer femoral plate of metacoxae;

– *L. fedorenkoi* n. sp. in the antennomeres 3-10 not widened apically, larger eyes; other proportion of length and shape of apical and subapical abdominal segments and somewhat longer femoral plate of metacoxae;

– *L. gratiosa* n. sp. in the arcuate posterior edges of female pygidium and hypopygidium, and somewhat shorter femoral plate of metacoxae.

The femoral plate of metacoxae of this new species demonstrates somewhat an intermediate level of development in size between those in *L. daohugouensis* and *L. gratiosa* with rather large femoral plate, on one hand, and those in *L. euglyphea* and *L. fedorenkoi* with short femoral plate, on the other.

Description. Body 22.5 mm long, 6.8 mm wide, elongate, moderately convex dorsally and, perhaps, ventrally; integument without clear trace of pubescence. All dorsal sclerites with more or less uniform and moderately deep, dense and medium punctures (apparently about as large as eye facets in diameter or somewhat smaller), extremely narrow interspaces between them apparently smoothly microreticulated. Pronotum with somewhat larger and deeper punctures forming an irregular or partly transverse rugosity. Elytra also with weakly traced 11 longitudinal striae on whole elytral surface.

Head 2.8 mm long, 3.2 mm wide; about as long as wide; eyes large, nearly 2/5 as long as width of head; mandibles large, more or less steeply curved at outer angle, pointed at apex. Antennal scape moderately short and rather swollen. Antennal grooves apparently developed and following eye edges. Antennae shorter than half of body length, scape moderately swollen, antennomere 2 shortest, antennomeres 3-10 subequal in size

and shape, slightly thickening apically, antennomere 11 longest and apically subacute. Pronotum 3.1 mm long; transverse, about 1.3 times as long as wide, subquadrangular, a little wider than head; anterior edge almost straight; sides somewhat subexplanate; posterior edge sinuate at each posterior angle and rather convex in the middle; posterior angles forming acuminate processes projecting lateroposteriorly and with distinct top, disc of pronotum moderately convex. Elytra 15.0 mm long; remaining uncovered the pygidial apex, widest at base and about 1.8 times as wide as prothorax, about twice as long as wide combined, narrowed in distal 1/3; lateral edges subsinuate at the middle. Pygidium subtriangular.

Prosternum comparatively long, with shallowly emarginate anterior edge; procoxal cavities transverse and narrowly separated. Mesoventricle small, with transverse sutures on both sides of mesoventral cavity, mesoventral cavity rhombic, mesepisterna and mesepimera subtriangular, mesepimera more than two times as mesepisterna, mesocoxae open to mesepimera but close to mesepisterna. Mesocoxal cavities oblong to somewhat subtriangular and apparently narrowly separated. Metepisterna rather wide and about 2.5 times as long as wide. Metacoxae with moderately developed femoral plates arcuately outlined in median part. Abdominal ventrite 1 somewhat longer than hypopygium, hypopygium more than twice as long as the previous one and rounded at apex.

Femora comparable in size and shape, moderately narrow and long. Protibiae narrow (about 2/5 as wide as profemur). Mesocoxae apparently conically projecting. Metacoxae subtriangular becoming longer medially and with median apices rounded.

Exposed genital capsule and ovipositor well sclerotized.

Variability. Paratype CNU-COL-NN2009124, female differs from the holotype only in the wider head and subtruncate pygidial apex. Its body 15.2 mm long, head 2.9 mm wide, pronotum 3.0 mm long, elytra 10.8 mm long. Head looking rather wide from the base. Pygidium and hypopygium subtruncate at apex. Ovipositor well sclerotized. Paratype CNU-COL-NN2010224, male, with body 15.6 mm long, head 2.7 mm wide, pronotum 3.1 mm long, elytra 10.8 mm long. Temples very long behind eyes. Pygidium and hypopygium narrowly subtruncate at apex. Aedeagus heavily sclerotized and wide. Additional specimen CNU-COL-NN2009131, male, differs from the holotype only in the wider head and subtruncate pygidial apex. Its body 13.2 mm long, head 2.4 mm wide, pronotum 2.8 mm long, elytra 10.0 mm long. Aedeagus heavily sclerotized and wide.

***Lasiosyne fedorenkoi* n. sp.**
(Figs 34–40, 42–50)

Material. Holotype: CNU-COL-NN2009853, female, positive imprint of dorsal surface of body and exposed details of the underside, and also with part of left antenna, parts of all legs, and remains of exposed terminalia. Paratypes: CNU-COL-NN2009862, male, positive imprint of dorsal surface of body and exposed details of the underside, and also with part of left antenna, parts of all left legs and right posterior leg, and exposed aedeagus; CNU-COL-NN2009869, sex unknown, positive imprint of dorsal surface of body and exposed details of the underside, and also with part of left antenna, parts of all left legs and right posterior leg. Additional specimen: CNU-COL-NN2006015-1, CNU-COL-NN2006015-2, positive

imprint of pterothorax with preserved elytra, perfectly preserved posterior wing in unfolded condition exposing all veins and trace of many folds.

Note. The specimen with exposed posterior wing was put in this species, mostly because its comparable body size, which could be supposed after estimation of the proportions and size of elytra.

Etymology. The name of the new species is devoted to D.N. Fedorenko (Institute of Problems of Evolution and Morphology of Animals of the Russian Academy of Sciences, Moscow), who helped to the author in correct reconstruction of venation and folding of posterior wing of *Lasiosyne*.

Diagnosis. Antennomeres 3–10 more or less homonomous, subtriangular and somewhat widened apically; eyes rather large; anterior edge of pronotum subtruncate to slightly convex and somewhat narrower than posterior ones, its lateral sides slightly arcuate, anterior edge prosternum rather concave disposed markedly behind anterior edge of pronotum; femoral plates of metacoxae moderately raised.

This species differs from all congeners in the antennomeres 3–10 not widened apically and also from:

– *L. daohugouensis* n. sp. in the smaller eyes; not strongly excised anterior edge of prosternum; less arcuate pronotal sides; other proportions of the last abdominal segments of abdomen and markedly shorter femoral plate of metacoxae;

– *L. euglyphea* in the smaller eyes; less arcuate pronotal sides; other proportions of tarsomeres; other proportions of length of last two segments of abdomen;

– *L. gratiosa* n. sp. in the pronotum not widened anteriorly from posterior angles, smaller eyes; shorter metacoxal plates; lack of longitudinal ridged on pronotum; markedly shorter femoral plate of metacoxae;

– *L. quadricollis* n. sp. in the not subquadrangular pronotum; other proportion of length and shape of apical and subapical abdominal segments and somewhat shorter femoral plate of metacoxae.

Description of holotype. Body 14.0 mm long, 5.0 mm wide; elongate, moderately convex dorsally and, perhaps, ventrally; integument without clear hairs.

Head and pronotum with more or less uniform puncturation and coarse microsculpture with somewhat transverse and very dense punctures (apparently much larger than eye facets), forming short and irregular transverse rows on pronotum. Elytra with more or less clear striae. Underside with puncturation and sculpture somewhat similar to that on head and pronotum, but punctures almost regularly round and somewhat sparser.

Head transversely subtriangular, 1.7 mm long, 2.4 mm wide, eyes comparably small, somewhat less than 1/2 as long as width of head, mandibles comparatively small, more or less gently curved at outer angle, labrum moderately short and widely transverse (about 1 and 1/3 as wide as long). Antennae apparently about 1/2 as long as entire body, antennal scape moderately short and moderately swollen, about twice as long as pedicel, shorter than other antennomeres, pedicel subcylindrical, antennomeres 3–10 more or less subequal in length and triangularly dilated apically, 2.0–2.5 times as long as thick at apex. Pronotum scarcely transverse, 2.6 mm long, anterior margin nearly straight to slightly convex, anterior angles rather distinct, lateral edges slightly convex, posterior edge shallowly emarginated at each posterior angle and strongly convex at the middle; posterior

angles forming rather weak projections acuminate orienting lateroposteriorly and with a distinct top. Scutellum small and subtriangular. Elytra 10.1 mm long, 4.8 mm wide; remaining uncovered only the pygidial apex, about 1.3 times as wide as prothorax, almost 2.5 times as long as wide combined, widest near basal part, narrowed in distal 1/3. Pygidium widely rounded to subtruncate at apex.

Procoxal cavities transverse, and moderately narrowly separated, mesocoxal cavity transversely subtriangular and apparently narrowly separated; metacoxae with rather weak femoral plates (markedly shorter than metacoxae) becoming obsolete at outer edge. Abdominal ventrites 2–4 subequal in length, hypopygidium 1.2 times as long as the previous one and subtruncate at apex.

Femora comparable in shape and size, moderately narrow and long. Tibiae moderately narrow and somewhat longer than femora; slightly dilating apically. Tarsi almost as wide as tibiae.

Variability. Paratypes: CNU-COL-NN2009862, male differs from the holotype in the arcuate sides of pronotum (probably as a sequence of fossilization); body (with heavily sclerotized aedeagus) 19.2 mm long, head 1.8 mm long, head 2.0 mm wide; elytra 13.0 mm long 6.8 mm wide. CNU-COL-NN2009869 differs from the holotype in the longer and narrower pronotum (probably as a sequence of fossilization); body length 16.0 mm, width 7.8 mm; head invisible; pronotum length 3.20 mm, width of anterior margin of pronotum 2.6 mm, width of posterior margin of pronotum 4.5 mm, elytral length 13.0 mm, elytral width with 7.8 mm. Additional specimen: CNU-COL-NN2009862: elytra 12.1 mm long and 6.0 mm wide; metaventricle with longitudinal and small paracoxal sutures; tarsi with five segments, tarsomere 1 longest, 4 shortest, terminal with two claws.

Genus *Bupredactyla* n. gen.

Type species. *Bupredactyla magna* n. sp.

Composition. For now only the type species is described, however it includes some species which could be recognized among available specimens from Daohugou.

Etymology. The name of this new genus is formed from the generic name “*Buprestis*” and “*Ptilodactyla*” referring to a similarity of Lasiosynids to some Buprestidae and close relationship to Byrthoid group of families related to Ptilodactylidae (see above).

Diagnosis. Body apparently elongate oval; integument with subuniform and very coarse sculpture, extremely densely punctured; pubescence fine and short; mandibles moderately developed and with acute apex; eyes moderately large; antennae rather long and apparently with 11 segments, most antennomeres elongate subcylindrical or subconical (thickened apically); pronotum with most width comparable with that of elytral base, transverse and subarcuate at sides, anterior angles rounded and not projecting, posterior angles sharp, extending lateroposteriorly; metepisterna a little more than twice as long as wide; elytra with blunt apices and 11 striae (2 and 3 not complete); mesocoxae apparently narrowly separated to subcontiguous; metacoxal femoral plates slightly to moderately developed only in median part of coxae; tarsi four-segmented with moderately lobed tarsomeres 1–3 (indeed tarsi pseudotetramerous with a very small tarsomere 4 and very long tarsomere 5).

Comparison. This new genus is most similar to *Lasio-*

syne differing from it only in the tetramerous (or pseudotetramerous) tarsi, wider metepisterna, wider pronotum and less slender body. Besides, this new genus differs from *Tarsomegamerus* at least after the specimens available in the larger body, narrower posterior femora and particularly in the much wider and subparallel-sided metepisterna. Besides, the genus under consideration is characterized by comparatively large eyes.

Bupredactyla magna n. sp. (Figs 41, 51)

Material. Holotype: CNU-COL-NN2009881, probably male, positive imprint of lateral view with well preserved appendages. The beetle is with strongly declined pronotum and head.

Etymology. The epithet of this new species means ‘large’, ‘great’, ‘important’.

Description of holotype. Maximum length of imprint is 19 mm. Probable length of specimen could be at least 24 mm. Body elongate oval, rather convex dorsally and ventrally, dorsum and legs with very short and very thin hairs about as long as distance between punctures; antennae with particularly dense hairs.

Head, pronotum and thoracic sclerites with rather deep, dense and medium punctures or somewhat dislodged by microtuberculation, extremely narrow interspaces between them densely microreticulated. Elytra with 11 longitudinal striae on whole elytral surface and with extremely fine diffuse punctures between them. Underside of abdomen with similar puncturation and sculpture as those on thoracic ones but punctures shallower and finer, and microsculpture somewhat smoothed.

Head apparently transversely subtriangular, eyes moderately large and suboval, mandibles large and rather long, more or less sharply curved at outer angle. Antennae subfiliform, somewhat more than 1/2 as long as entire body, antennomeres 2–10 comparable in length, subcylindrical to subconical, 3–4 times as long as thick at apex. Pronotum transverse, apparently at least twice as wide as long, anterior margin convex, anterior angles round, lateral edges gently convex, posterior edge shallowly emarginated at each posterior angle and somewhat convex at the middle; posterior angles forming acuminate lateroposterior projections and with a distinct top, disc moderately convex. Elytra 18 mm long, apparently somewhat more than 8.0 mm wide; apparently remaining uncovered only the pygidial apex, widest near base, narrowed in distal 1/3; striae 1 and 2, 3 and 4 conjoined at the base; striae 2 and 3 almost reaching the distal 1/3, the rest striae converging and becoming obsolete only at apex; epipleura rather narrow.

Procoxal cavities apparently transverse, mesocoxal cavity transversely oval to subtriangular and apparently narrowly separated; metacoxal cavities broadly conjoining; metepisterna rather wide and only slightly more than twice as long as wide. Metacoxae with femoral plates of arcuate shape in the median part (only slightly shorter than coxae) and becoming obsolete at outer edge. Abdominal ventrites 2–4 subequal in length, hypopygidium nearly twice as long as the previous one and rounded at apex.

Pro- and metafemora comparable in shape and size, moderately narrow and long. Tibiae narrow (about 2/5 as wide as femora) and somewhat longer than femora (metatibiae longest); slightly dilating apically. Tarsi almost as wide as tibiae; tarsomeres 1–3 somewhat wider than tibiae; claws simple and rather long.

Discussion

Five superfamilies of Elateriformia (Dascilloidea, Elateroidea, Buprestoidea, Byrrhoidea, and Cantharoidea) have been used in this paper mostly because of the currently recognized tradition rather than these groups can be clearly distinguished. This infraorder is here tentatively considered without the superfamily Scirtoidea. The latter seems to maintain a rather archaic (plesiotypic) character in imaginal structures which frequently were traditionally treated as a base to join members of this superfamily with both Dascilloidea and other Elateriformia. Nevertheless, some facts in the structure of posterior wing (Fedorenko 2003, 2006) and ventral thoracic sclerites (Freiedrich & Beutel 2007) make possible to suppose that Scirtoidea could be a more archaic and primitive group of the suborder than the rest superfamilies. Some structural parallels can be also traced between this superfamily and subordera Adephaga and Archostemata in the posterior wing venation (Fedorenko & Kirejtshuk in preparation). Finally, the surprising confirmation of this came also from sequencing data (Hunt *et al.* 2007) which allow the computer software to put the Scirtoidea out of both infraordera Elateriformia and Staphyliniformia (including Scarabaeoidea).

Supposition on a close relation between Dascilloidea and Scarabaeoidea was grounded on larval morphology (Böving & Craighead 1929) and later Crowson (1971) linked them by the probable common ancestor inhabited in soil. However, making such a conclusion it is necessary to take into consideration, that larvae having come in soil should acquired some adaptations to live there. Crowson (1971) pointed out that imaginal structures are “more strikingly distinct” in these superfamilies, although he found some traces of similarities in structure of the male genitalia and mandible. He mentioned a considerable similarity of imagines of Dascilloidea to those of Byrrhoidea and other Elateriformia. In particular, Crowson (1955) inclined to place Ptilodactylidae between Dascilloidea, on one hand, and Dryopidae Billberg 1820 + Elmidae Curtis 1830, on the others, and the posterior wing venation of *Dascillus* was regarded by him as most primitive among Polyphaga. At the same time, Crowson (1971) tried to ground this situation by adaptations of adults of Scarabaeoidea for burrowing habits. In the meanwhile it would be more reasonable to view adults (more flexible and less dependable on ecological circumstances) maintain more traces of common ancestry than larvae. The origin and many evolutionary events in history of the order happened in association with history of forests, inhabitation of many groups of the order in subcortical space and wood, and also with changes of this adherence un-

der different ecological circumstances (Ponomarenko 1969; Crowson 1981; Kirejtshuk 1991, etc.). Larvae leaving trees for inhabitation in soil should acquire some specific adaptations which could be similar in different lineages. Therefore, the return to the idea of Kolbe (1908) on the link Staphyliniformia and Scarabaeoidea on base of the priority of imaginal similarities proposed by Hansen (1995) seemed to be rather advisable. This hypothesis has been getting more and more additional support (Lawrence 1987; Kukulová-Peck & Lawrence 1993; Lawrence *et al.* 1995, etc.) and it is thought to have a more correspondence with fossil records. The most cladograms in Lawrence *et al.* (1995) show similarity in distribution of apomorphies of Schizopodidae and Dascillidae. Finally, Lawrence *et al.* (2007) found even a reason to include Dascillidae in the ‘ingroup’ of the lineage Brachypsectridae-Cerophytidae-Throscidae-Eucnemidae.

The features of the new family examined in fossils give more doubts in the proposed reason for the current structure of the infraorder Elateriformia. All superfamilies of the infraorder are thought to be defined by ambiguous argumentation which cannot bring a clear understanding of the rational composition and phyletic relation between families included. This circumstance makes possible to explain very frequent changes in placement of some families within different superfamilies (see publications by Crowson and Lawrence referred above and so on). Nevertheless, the discovery of this new family seems to make evident a close relation between Dascilloidea and the rest Elateriformia and allows to admit also some close relationship between Dascilloidea, Buprestoidea and Byrrhoid lineage Ptilodactylidae-Eulichadidae-Callirrhidae, which could be much less differentiated during the Jurassic than these groups in the Recent epoch. The true recognizable Buprestidae were already quite distinct during this period and Cretaceous (Alexeev 1996, 1999 etc.) and also distinct Byrrhidae, Cerophytidae and Elateridae Leach 1815 have been recorded from the Jurassic as well (Dolin 1973, 1980; Ponomarenko 1990; Kirejtshuk & Azar 2008; Chang *et al.* in press etc.). The most of rest Elateriformian families appear in fossil record during Cretaceous and later (see Ponomarenko & Kirejtshuk 2009). Many Jurassic fossils remaining still undescribed manifest the characters similar to those in Lasiosynidae n. fam. (Ponomarenko, personal communication and unpublished data of the authors), however, their taxonomic interpretation is difficult because of lack of evident and clear diagnostic features of fossils.

An affinity of Buprestoidea (particularly Schizopodidae) and Byrrhoidea (particularly Dryopoidea sensu stricto) was grounded by Crowson (1955, 1982),

although he mentioned that this idea was suggested by Obenberger in personal communication in 1948. This hypothesis is supported by the internal abdominal structures and ventral nerve cord (Kasap & Crowson 1975), and also by the presence of longitudinal and transverse suture of metaventrite, strongly deflected head with short rather dorsally inserted antennae and some other (mostly inner) features of adults and larvae (Crowson, 1982), which are not observable in fossils. Moreover, Crowson (1982) pointed out that 'modern Byrrhidae Latreille 1804 would seem to be ruled out as Buprestid ancestors'. Thus, he thought that ancestor of Buprestoidea and those of Elmidae; Lutrochidae Kasap & Crowson 1975; Dryopidae; Limnichidae Erichson 1846 and Heteroceridae MacLeay 1825 could origin from the same phyletic roots. The most cladograms elaborated on base of analysis of Lawrence (1987) also mainly coincide with this opinion of Crowson. At the same time, Crowson (1982) is far to admit a close relationship between Buprestoidea and Ptilodactylidae-Eulichadidae, and he also mentioned that the distribution of the spiracular closing apparatus of larvae in Buprestidae, Throscidae-Eucnemidae and Brachypsectridae contradicts this phylogenetic scheme. The new fossil family here proposed gives also some argumentation partly controversial to this opinion, because at least the imaginal characters accessible in fossils are similar namely in Lasiosynidae n. fam. and Buprestoidea-Ptilodactylidae-Eulichadidae rather than those in Lasiosynidae fam. n. and Elmidae-Lutrochidae-Dryopidae-Limnichidae-Heteroceridae. This is somewhat more correspondent with another phylogenetic dendrogram proposed by Kasap & Crowson (1975). However, Frantzevich & Shumakova (1987) found that the arcellary apparatus of the femoral chordotondal organ of many Buprestidae and *Glyptoscelimorpha* Horn 1893 (Schizopodidae) shows a great similarity in the structure of arcellus, while the latter is absent in the Byrrhoid taxa studied by them. At the same time, Crowson found such arcellus in *Lutrochus* Erichson 1847 (Lutrochidae) (Nelson & Bellamy 1991).

According to the comparison with different groups externally similar to Lasiosynidae n. fam., it could be supposed that it seemed to be closely related, on one hand, to Ptilodactylidae and Eulichadidae, differing from them only in the lack of very prominent crenellation along pronotal base, 11 striae on elytra and outline of the vein a2 in posterior wing narrowly ended. On the other hand, it could be related to Buprestoidea, taking into consideration, the similarity in the sculpture of integument, outline of elytra, peculiarities of the wing venation etc. It is more probable that the family under consideration should be placed into the basal diversifi-

cations of the infraorder Elateriformia, perhaps, at the level when the currently recognized superfamilies in the recent fauna were still not so strongly secluded and included some groups with a mixture of the characters of different superfamilies ('archaic diversity' sensu Mamkayev 1987).

The outstanding peculiarity of the new family (or at least species of *Lasiosyne*) is the heavy sclerotization of female terminalia, which could be interpreted as predisposition for sexual dimorphism in number of abdominal segments in "Cantharoidea" (Cantharid lineage). The number of exposed abdominal segments which is more than seven, is usually regarded as a secondary feature appeared as a sequence of pedomorphic transformation of imaginal abdominal structure (Crowson 1955; Tikhomirova 1991; etc.). The 'Malacoderm' adults are usually regarded as characteristic of more 'advanced' 'Cantharoidea' (or cantharid lineage) rather than of other Elateriformia showing a rather great stability in maintenance of the abdomen with five ventrites. Though it is not infrequently thought that most groups of the Elateroidea, including cantharid lineage, could have a rather deep root of divergence (Crowson 1972 etc.), the fossil record showed that all 'cantharoid' groups are represented in the Caenozoic (Ponomarenko & Kirejtshuk 2009). The discovery of this new family shows that a tendency to larvalization of females, at least in structure of abdomen could be somehow traced in some cases in the Jurassic, particularly taking into consideration appearance of Micromalthidae not later than the Upper Jurassic (Kirejtshuk & Azar 2008). However, other structural peculiarities of Lasiosynidae n. fam. cannot be certainly used for linking in a closer relationship of this new family and Cantharid lineage. Among not cantharid lineages of the infraorder there is one group with the sexual dimorphism in number of ventrites. This is the buprestoid family Schizopodidae, however it has more number in males, while females of it have five exposed ventrites (Nelson & Bellamy 1991).

The Bayesian analysis based on maximum congruence of data on ribosomal 18S r RNA and mitochondrial 16 r RNA (Hunt *et al.* 2007) shows a rather peculiar distribution of the families of the Elateriformia, although they, in contrast to other infraordera, are concentrated in one place. Different members of Elateroidea are intermixed with different members of Cantharoidea (cantharid lineage), while the members of Dascilloidea and Buprestoidea are compactly put in the base of the infraorder with some additions to both groups from the Byrrhoidea.

This new family represents the third groups after Elateridae and Cerophytidae (Chang *et al.* in press)

which seemed to be most usual at least in the Asian sedimentary deposits of the second half of the Jurassic and Cretaceous. If the rest two groups could be linked as more or less close relatives, the new family can be for now regarded only as a group rather isolated from all known members of the infraorder, characters of which spread within different superfamilies. It could be also supposed that this new family has not any evident descendants in the recent fauna. At the same time, a numerous part of still unstudied imprints from the late Mesozoic looking like close relatives of the genera here included in the new family could be put into other families after a more detailed study of them. On the other hand, the attribution of Jurassic forms with 'tetramerous' tarsi could rather different, although some of them are certainly belong to this new family (fig. 51), but others are evident members of Chrysomeloidea (Medvedev 1968; unpublished data from Upper Jurassic-Lower Cretaceous site of the Yixian Formation: Beipiao, Liaoning Province, China). Finally, other Elateriformian groups (except the mentioned three families) are represented in fossils from the Mesozoic outcrops in much less number of specimens (unpublished data of the authors).

Lasiosynidae n. fam. seemed to origin at the beginning of diversification of the infraorder in general and, therefore, it demonstrates a more or less great similarity to the families of different superfamilies (probably mostly in plesiotypic features). Members of this new family could be in some sense to maintain during the Jurassic as the recent Cneoglossidae (partly similar to the members of Lasiosynidae n. fam.) the mode of life close to the initial one for the infraorder in general. Recent species of *Cneoglossa* Guérin-Ménéville 1843 are characterized by inhabitation inside submerged brush-wood, which made possible habit changes in different directions: mode of life of Dascillidae (soil), that of Buprestidae (terrestrial wood) and that of most Byrrhoidea (different places in fresh water basins). It can also explain a rather wide distribution of the spiracular closing apparatus in larvae of wood-living groups (see above). Crowson (1995) regarded the origin of Buprestidae among Dryopoid ancestors and that 'larvae of some Elmidae (Larinae) and Lutrochidae may come to live on water-logged wood rather than pebbles and may come to ingest the woody material itself rather than only algae growing on it'. Besides, he considered as an evidence for an aquatic ancestry for the Buprestidae also 'the absence in the family of digitiform pegs on the apical segment of the adult maxillary palpi' (absent in Larinae, Lutrochidae and many other groups, but not in all). The considerable similarity of Buprestidae and Lasiosynidae fam. n. seems to support this viewpoint on origin of Buprestidae and the concept here proposed on some links the family under consideration with wet

or submerged wood.

Acknowledgements. This research is supported by the Programme of the Presidium of the Russian Academy of Sciences 'Origin and Evolution of Biosphere' and Russian Foundation of Basic Research (grants 07-04-92105-GFEN_a and 09-04-00789-a), and also by the National Natural Science Foundation of China (No.30430100, 40872022, 30811120038), the Nature Science Foundation of Beijing (No.5082002) and Scientific Research Key Program KZ200910028005 and PHR Project of Beijing Municipal Commission of Education D.N. Fedorenko (Institute of Problems of Evolution and Morphology of Animals of the Russian Academy of Sciences, Moscow) did a serious contribution to this study when he reconstructed the venation and folding of posterior wing here described. A.G. Ponomarenko (Palaeontological Institute of the Russian Academy of Sciences, Moscow) encouraged this study and made a considerable and various and very valuable assistance to it. The discussions on phylogenetic relation of Elateriformia with M.G. Volkovitsh (Zoological Institute of the Russian Academy of Sciences), J. Hájek (Národní Muzeum in Praha), V.V. Gratshev (Palaeontological Institute of Russian Academy of Sciences) and other colleagues were very fruitful and useful for the authors. The senior author greatly appreciate to Andre Nel (Museum National d'Histoire Naturelle, Paris) for a possibility to make research in Paris museum, and also to him and Antoine Mantilleri (Paris Museum) for their assistance in comparison the fossils here described with other fossil and recent representatives of the Elateriformia. He is also greatly thankful to Maxwell Barclay (Natural History Museum in London) for opportunity to make important comparisons in London museum.

References

- Alexeev A.V. 1996. Buprestid beetles from the Mesozoic and Cenozoic of C.I.S. *Paleontological Journal* **30** (5): 559-565.
- Alexeev A.V. 1999. A survey of Mesozoic buprestids (Coleoptera) from Eurasian deposits. *AMBA Projects Publications n°. AMBA/AM/PFCIM98/1.99: Proceedings of the First Palaeontological Conference at Moscow, Bratislava, 1998: 5-9.*
- Boving A. G., Craighead F. C. 1930 (1931). An illustrated synopsis of the principal larval forms of the order Coleoptera. *Entomologica Americana* **11**: 1-351.
- Chang H., Kirejtshuk A. G., Ren D. 2010. On taxonomy and distribution of fossil Cerophytidae (Coleoptera, Elateriformia) with description of a new Mesozoic species of *Necromera* Martynov, 1926. *Annales de la Société Entomologique de France* (N. S.) **46**(1): 000-000. (XXX to be completed)
- Crowson R. A. 1955. *The natural classification of the families of Coleoptera.* Nathaniel Lloyd, London, 187 p.
- Crowson R. A. 1971. Observations on the superfamily Dascilloidea (Coleoptera: Polyphaga), with the inclusion of Karumiidae and Rhipiceridae. *Zoological Journal of the Linnean Society* **50**: 11-19.
- Crowson R. A. 1972. A review of the classification of Cantharoidea (Coleoptera) with the definition of two new families Cneoglossidae and Omethidae. *Revista de la Universidad Complutense de Madrid* **21**: 35-77.
- Crowson R. A. 1975. The evolutionary history of Coleoptera, as documented by fossil and comparative evidence. *Atti X Congresso Nazionale Italiano di Entomologia*, Sassari: 47-90.
- Crowson R. A. 1981. *The biology of Coleoptera.* Academic Press, London, xii + 802 p.
- Crowson R. A. 1982. On the dryopoid affinities of Buprestidae. *The Coleopterists' Bulletin* **36**: 22-25.
- Crowson R. A. 1995. Some interesting evolutionary parallels in Coleoptera, p. 63-85 in: Pakaluk J., Slipinski S.A. (eds.). *Biology, phylogeny*

- and classification of Coleoptera. Papers celebrating the 80th birthday of Roy A. Crowson. Muzeum i Instytut Zoologii PAN Warszawa, 2 volumes, 1-558 + 559-1092.
- Dolin V. G. 1973.** Iskopayemye stchelkuny (Elateridae Coleoptera) iz nizhney yury Sredney Azii [Fossil forms of click-beetles (Elateridae, Coleoptera) from the Lower Jurassic of Middle Asia.], p. 71-82 in: **Yaroshenko M. F. et al. (eds).** *Fauna i biologiya nasekomykh Moldavii [Fauna and biology of Insects of Moldavia.]* Akademiya nauk Moldavskoj SSR, Institut Zoologii, Shtuntza, Kishinev, 186 p. [in Russian.]
- Dolin V. G. 1980.** Stchelkuny (Elateridae) iz verkhney yury Karatau [Elaterid beetles (Elateridae) from Upper Jurassic of Karatau.], p. 17-81 in: **Dolin V. G., Panfilov D. V., Ponomarenko A. G., Pritykina L. N. (eds).** *Iskopajemye nasekomyje mezozoya. [Fossil insects of the Mesozoic.]* Akademiya nauk Ukrainskoj SSR, Institut Zoologii, Naukova Dumka, Kiev, 135 p. [in Russian.]
- Fedorenko D. N. 2003.** Coleopteroid wing: effect of the system of folds on the genesis of the remigium venation. *Entomological Review* **83**: 1137-1151.
- Fedorenko D. N. 2006.** The clavus and jugum venation in the wings of beetles (Coleoptera) and its genesis. *Entomological Review* **86**: 973-986.
- Forbes W. T. M. 1922.** The wing-venation of the Coleoptera. *Annals of the Entomological Society of America* **15**: 328-352.
- Forbes W. T. M. 1926.** The wing folding patterns of the Coleoptera. *Annals of the Entomological Society of America* **34**: 42-68, 91-139.
- Frantzevich L. I., Shumakova I. D. 1987.** Evolyutzia struktury I funkczii artzellyarnogo apparata u Zhukov (Coleoptera) [Evolution of structure and function of the arcellate apparatus in Coleoptera]. *Entomologicheskoye obozrenie* **66**: 735-745 [in Russian].
- Friedrich F., Beutel R. G. 2007.** The pterothoracic skeletomuscular system of Scirtoidea (Coleoptera: Polyphaga) and its implications for the high-level phylogeny of beetles. *Journal of Zoological Systematics and Evolutionary Research* **44**: 290-315.
- Gao K. Q., Ren D. 2006.** Radiometric dating of Ignimbrite from Inner Mongolia provides no indication of a Post-Middle Jurassic age for the Daohugou bed. *Acta Geologica Sinica* **80**: 41-45.
- Hájek J. 2007.** Revision of the genus *Eulichas* Jacobson, 1913 (Coleoptera: Eulichadidae) I. Introduction, morphology of adults, key to subgenera and species groups, and taxonomy of *E. funebris* species group. *Zootaxa* **1620**: 1-35.
- Hansen M. 1995.** Evolution and classification of the Hydrophiloidea – a systematic review, p. 321-353 in: **Pakaluk J., Slipinski S. A. (eds).** *Biology, phylogeny and classification of Coleoptera.* Papers celebrating the 80th birthday of Roy A. Crowson. Muzeum i Instytut Zoologii PAN Warszawa, 2 volumes, 1-558 + 559-1092.
- Hunt T., Bergsten J., Levkanikova Z., Papadopoulou A., John O. S., Wild R., Hammond P. M., Ahrens D., Balke M., Caterino M. S., Gómez-Zurita J., Ribero J., Barraclough F. G., Bokakova M., Bokak L., Vogler A. P. 2007.** A comprehensive phylogeny of beetles reveals the evolutionary origins of a superradiation. *Science* **318**: 1913-1916.
- Ivie M. A. 2002.** Family 49. Ptilodactylidae Laporte 1836, p. 135-138 in: **Arnett R. H., Jr., Thomas M. C., Skelley P. E., Frank J. H. (eds).** *American Beetles, vol. 2: Polyphaga: Scarabaeoidea through Curculionoidea.* CRC Press LLC, Boca Raton, FL, i-xiv + 1-861 p.
- Kasap H., Crowson R. A. 1975.** A comparative anatomical study of Elateriformia and Dascilloidea (Coleoptera). *Transactions of the Royal Entomological Society* **126**: 441-495.
- Kirejtshuk A. G. 1991.** Evolution of mode of life as the basis for division of the beetles into groups of high taxonomic rank, p. 249-261 in: **Zunino M., Belles X., Blas M. (eds).** *Advances in Coleopterology.* Ass. Europ. Coleopt., Barcelona.
- Kirejtshuk A. G., Azar D. 2008.** New taxa of beetles (Insecta, Coleoptera) from Lebanese amber with evolutionary and systematic comments. *Alavesia* **2**: 15-46.
- Kolbe H. 1908.** Mein System der Coleopteren. *Zeitschrift für Wissenschaftliche Insektenbiologie* **4**: 116-213, 153-162, 219-226, 246-251, 286-294, 389-400.
- Lawrence J. F. 1987 (1988).** Rhinorhipidae, a new beetle family from Australia, with comments on the phylogeny of the Elateriformia. *Invertebrate Taxonomy* **2**: 1-53.
- Lawrence J. F., Nikitsky N. B., Kirejtshuk A. G. 1995.** Phylogenetic position of Decliniidae (Coleoptera: Scirtoidea) and comments on the classification of Elateriformia (*sensu lato*), p. 375-410 in: **Pakaluk J., Slipinski S. A. (eds).** *Biology, phylogeny and classification of Coleoptera.* Papers celebrating the 80th birthday of Roy A. Crowson. Muzeum i Instytut Zoologii PAN Warszawa, 2 volumes: 1-558 + 559-1092.
- Lawrence J. F. 2005.** 16. Dascillidae Guérin-Mèneville, 1843. In: **Beutel R. G., Leschen R. A. B. Coleoptera, beetles. Volume 1: Morphology and systematics (Archostemata, Adephaga, Myxophaga, Polyphaga partim).** Handbuch der Zoologie/Handbook of Zoology. Band/Volume IV, Arthropoda: Insecta. Teilband/Part 38, Walter de Gruyter, Berlin-New York, i-xii + 1-578 p.
- Lawrence J. F., Muona J., Teräväinen M., Stahls G., Vahtera V. 2007.** *Anischa, Perothops* and the phylogeny of Elateroidea (Coleoptera: Elateriformia). *Insect Systematics & Evolution* **38**: 205-239.
- Medvedev L. N. 1968.** [Polyphagous beetles from the Jurassic of Karatau (Coleoptera: Chrysomelidae).], p. 155-165 in: **Rohdendorf B. B. (ed.).** *Yurskie nasekomye karatau [Jurassic insects of Karatau.]* Akademiya nauk SSSR Otdelenie Obshchey Biologii, Moscow. [In Russian]
- Mamkaev Yu. V. 1987.** Resnichnye chervil I metodologicheskie printzipy evolyuzionnoy morfologii. [Ciliated worms and methodological principles of evolutionary morphology]. In: *Morfologia resnichnykh chervey, pogonofor i astzidiy [Morphology of Ciliated Worms, Pogonophorans and Ascidians].* *Trudy Zoologicheskogo Instituta Akad. Nauk SSSR* **167**: 4-33. [In Russian].
- Nelson G. H., Belamy C. L. 1991.** A revision and phylogenetic re-evaluation on the family Schizopodidae (Coleoptera, Buprestoidea). *Journal of Natural History* **25**: 985-1026.
- Ponomarenko A. G. 1969.** Istoricheskoe razvitiye zhestkokrylykh-arkhostemat [Historical development of the Coleoptera - Archostemata.] *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR* **125**: 1-240. [In Russian]
- Ponomarenko A. G. 1972.** On nomenclature of wing venation in beetles (Coleoptera). *Entomological Review* **51**: 768-775.
- Ponomarenko A. G. 1977.** [Suborder Adephaga], p. 17-104 in: **Ponomarenko A. G., Nikritin L. M., Zherichin V. V., Arnoldi L. V. (eds).** [Mesozoic Coleoptera.] *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR* **161**: 1-203.
- Ponomarenko A. G. 1990.** [Coleoptera.], p. 39-52 + 66-88 in: **Rasnitsyn A. P. (ed.).** *Pozdnemezozoykskie nasekomye Vostochnogo Zabaykal'ya [Late Mesozoic insects of Eastern Transbaikalia.]* *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR, Moscow* **239**: 1-223. [in Russian.]
- Ponomarenko A. G. 2001.** 2.2.1.3.2. Superorder Scarabaeoidea Laicharting, 1781. Order Coleoptera Linne, 1758, The beetles, p. 164-180 in: **Rasnitsyn A. P., Quicke D. L. J. (eds.)** *History of insects.* Kluwer Academic Publishers, Dordrecht, Boston, London.
- Ponomarenko A. G., Kirejtshuk A. G. 2009.** *Catalogue of fossil Coleoptera* <http://www.zin.ru/Animalia/Coleoptera/rus/paleosys> & [htm http://www.zin.ru/Animalia/Coleoptera/eng/paleosys.htm](http://www.zin.ru/Animalia/Coleoptera/eng/paleosys.htm) (April 2009)
- Tikhomirova A. L. 1991.** *Ontogeneticheskie perestrojki kak mekhanizm evolyuzii nasekomykh [Ontogeny transformation as a mechanism of the insect evolution].* Nauka SSSR, Moscow, 168 p. [in Russian]
- Tan J., Ren D., Chih C. 2007.** New beetles (Insecta: Coleoptera: Archostemata) from the Late Mesozoic of North China. *Annales Zoologici* **57**: 231-247.
- Tan J., Ren D. 2009.** *Mesozoic Archostematan fauna from China.* Science press, Beijing, 347 p. [in Chinese and English].
- Yan E. V. 2009.** A new genus of elateriform beetles (Coleoptera, Polyphaga) from the Middle-Late Jurassic Karatau. *Paleontological Journal* **43**: 78-82.