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NEW UPPER JURASSIC AND LOWER CRETACEOUS LEPIDOPTERA (PAPILIONIDA)

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ABSTRACT: Lepidoptera are described: *Palaeolepidopterix aurea* (Eolepidopterigidae), *Aulicpterix mirabilis*, *A. minima* (Micropterigidae), *Protolepis cuprealata*, and *Karataunia lapidaria* (Papilionina *inc. sedis*); and a new Lower Cretaceous species *Daiopterix olgae* (Eolepidopterigidae).

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The ancient history of Lepidoptera (Papilionida = Lepidoptera) has been very incompletely studied. *Archaeolepis mane* Whalley and *Eolepidopterix jurassica* A. Rasn. have been described, and from the Lower Cretaceous, *Daiopterix rasnitsyni* Skalski, *Parasabatinca aftimacrai* Whalley, *Palaeosabatinca zherichini* Kozlov and *Undopterix sukatshevae* Skalski [2]. Study of the collection from the Paleontological Institute, USSR Academy of Sciences, has made it possible to describe four new genera and six new species of Lepidoptera, two of which, in our opinion, belong to the most productive suborder Papilionina (= Ditrysia). Lower Cretaceous members of this suborder have not been found; Upper Jurassic representatives are being established for the first time. Unfortunately, the absence of distinct diagnostic characters on the impression did not permit unequivocal assignment of the described species to a specific family of higher Lepidoptera. However, because it is extremely unlikely that recent genera will be found in the Upper Jurassic, these species are viewed as new genera of uncertain taxonomic position. All species are described on the basis of the holotype, and thus the categories "Distribution" and "Material" have been dropped.

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SUBORDER EOLEPIDOPTERIGINA RASNITSYN, 1983

FAMILY EOLEPIDOPTERIGIDAE RASNITSYN, 1983

Genus *Palaeolepidopterix* Kozlov, gen. nov.

Type species. *P. aurea* sp. nov.

Diagnosis. Labial palps long, protruding from under head at distance equal to diameter of eye. Ocelli located behind compound eyes. Pronotum somewhat smaller than head, 1.3 times longer than diameter of eye. Wings elongate and oval, ratio of width of forewing to its length 0.3; apex of forewing somewhat shifted forward from midline. Jugum well developed, bearing cluster of long hairs on inner margin. On forewings, forewings, R_1 forked, R_5 extending to apex of wing. On female genitalia, hind apophyses reaching to base of abdomen.

Species composition. Type species.

Comparison. Differs from *Eolepidopterix* A. Rasn. in having a larger pronotum and longer apophyses on the female genitalia; from *Daiopterix* Skalski by Sc and R_1 extending proximally to the wing margin, and also by the presence of a cluster of hairs on a well-developed jugum.

Remarks. Assignment of *Palaeolepidopterix* to Lepidoptera is confirmed by a relatively well-preserved monotone bronze, shiny metallic, scaly covering of the

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forewings, and also a well-developed jugum bearing a cluster of hairs. Among recent Lepidoptera, a similar jugum structure is observed in swifts. The large dimensions of the pronotum make it possible to assign the described genus to the family Eolepidopterigidae; the long labial palps bring it close to *Eolepidopterix* A. Rasn.

Palaeolepidopterix aurea Kozlov, sp. nov.

Name of species. From the Latin *aureus* ("golden").

Holotype. Paleontological Institute (PIN), No. 2239/607, direct impression; Kazakhstan, Chimkent Oblast, Chayan district, locality Aulye close to the village of Mikhaylovka; Upper Jurassic (Oxfordian-Kimmeridgian), Karabastau series.

Description (Fig. 1a). Female. Head is relatively short and wide; distance between eyes exceeds their diameter by 1.5 times. Pronotum has long dense clusters of hair-like scales along the margin. On forewings Sc (Sc_2?) extends to the costal margin at midpoint, R_{1b} at 3/5 the length of the wing from its base. The rear apophyses on the female genitalia are at least half as long as the forewing.

Size in mm: Length of forewing - 5.2.

Remarks. Dark monotone scaly covering of the forewings does not allow examination of the peculiar features of venation.

Genus *Daiopterix* Skalski, 1984

Type species. *D. rasnitsyni* Skalski, 1984; Lower Cretaceous, Glushkovskaya series; Transbaykal.

Diagnosis. Mouth apparatus with well-developed mandibles. Maxillary palps long, geniculate. Pronotum relatively large, its length equal to maximum diameter of eye. Forewings with a CuP stalk and two anal veins; CuP and A_1 connected by crossvein near base of wing, crossvein between A_1 and A_2 located somewhat more distally; A_2 extending into A_1 forming an anal loop.

Species composition. *D. rasnitsyni* Skalski and *D. olgae* sp. nov.

Comparison. Differs from *Eolepidopterix* A. Rasn. in Sc_2 extending to the costal margin of forewing proximally of the branching of the radial stalk. Distinctions from *Palaeolepidopterix* gen. nov. presented above.

Remarks. In the diagnosis only those characters are indicated which clarify the original description [5]. The enlarged dimensions of the pronotum make it possible to include *Daiopterix* Skalski in the Eolepidopterigidae.

Daiopterix olgae Kozlov, sp. nov.

Holotype. PIN, No. 3063/741, direct and reverse impressions; Chitinsk Oblast, Shelopugino district, left bank of Daya River, 2 km above the mouth of the Shiviya River valley; Lower Cretaceous, Glushkovskaya series.

Description (Fig. 1b). Female. Eyes oval, ratio of width of eye to height is 0.6. Antennae filiform, length of segments in basal part equal to their diameter, distally, the length exceeds diameter 1.5-1.7 times. In forewings, R_1 is forked somewhat distally of R_2 and R_3 fork; M_1 fuses with M_2 somewhat proximally of the R_{2+3} and R_{4+5} fork, connected with R_{4+5} stalk by a crossvein close to this fork. The medial cell is closed. The CuP stalk fuses with the posterior margin at its own half length. On the hind wings the R_1 fork is located significantly distally of the R_{2+3} and R_{4+5} forks. Tibiae of the hindlegs have numerous bristles; both pair of spurs are long, approximately 1.5-2 times longer than the diameter of the tibia. Sternal structures not found. Precise establishment of the length of apophyses not possible; apparently, the tips of the anterior apophyses reach the distal margin of segment VII, whereas the posterior reach abdominal segment III.

Dimensions in mm: Length of forewing - 5.

Comparison. Differs from *D. rasnitsyni* Skalski in M_1 fusing with M_2 considerably more proximally and having a closed medial cell in the forewings, and also a more distally located R_1 fork in the hindwings.

Remarks. Scaly covering of wings virtually unpreserved; however, the well-

pronounced wing fringe of piliform scales confirms assignment of the species to Lepidoptera.

Age of rocks, variously assigned between Late Jurassic and the end of Early Cretaceous, is here considered Cretaceous, after Zherikhin [1].

SUBORDER MICROPTERIGINA HERRICH-SCHAEFFER, 1855

FAMILY MICROPTERIGIDAE HERRICH-SCHAEFFER, 1855

Genus *Auliepterix* Kozlov, gen. nov.

Name of genus. From locality found, Aulye, and from the Greek *pteryx* ("wing").

Type species. *A. mirabilis* sp. nov.

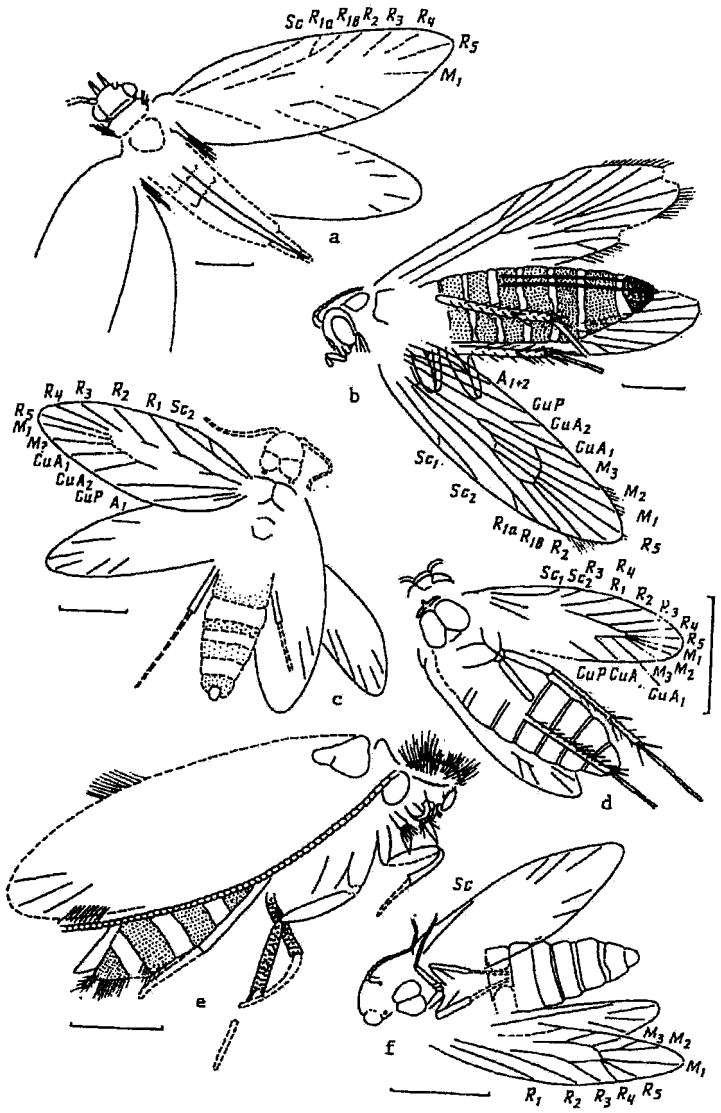

Fig. 1. New Upper Jurassic and Lower Cretaceous Lepidoptera: a) *Palaeolepidopterix aurea* sp. nov., holotype PIN, No. 2239/607; b) *Daiopterix olgae* sp. nov., holotype PIN, No. 3063/741; c) *Auliepterix mirabilis* sp. nov., holotype PIN, No. 2997/891; d) *A. minima* sp. nov., holotype PIN No. 4307/39; e) *Protolepis cuprealata* sp. nov., holotype PIN, No. 2066/3564; f) *Karataunia lapidaria* sp. nov., holotype PIN, No. 2066/3461. Scale line = 1 mm.

Diagnosis. Antennae filiform, short, 2/5 length of forewing. Pronotum, apparently, typical of Micropterigidae. Mesonotum with median suture, mesoscutellum half length of mesonotum. Wings elliptical, tips rounded, and lying on midlines in both wings. Ratio of maximum width to length for forewing 0.31-0.36, for hind wing around 0.3. On forewings, Sc forked; Sc_2 extending to costal margin of wing at point 2/5 length of wing from base. Radio-cubital cell narrow, 1/4 width of wing. R_1 not forked, R_5 fusing with costal margin of wing immediately before tip.

Species composition. *A. mirabilis* sp. nov., *A. minima* sp. nov.

Comparison. The described genus differs from *Micropterix* Hon. in having a reduced medial stalk and a narrow radio-cubital cell in the forewing. These characters also distinguish *Auliepterix* from Cretaceous *Parasabatinca* Whalley and Recent genera of the *Sabatinca* group [4]. The new species differs from Cretaceous *Palaeosabatinca* Kozlov in having a considerably more proximal location of the point where Sc fuses with the costal margin of the wing.

Remarks. Reduction of the medial stalk and convergence of the radial and precubital trunk to form a narrow radio-cubital cell are not characteristic of recent primitive moths: In *Auliepterix* these transformations are related, apparently, to the reduced size of the body. Based on the sum of the characters (size of pronotum, wing shape, absence of apophyses on the female genitalia) the described genus is being preliminarily assigned to Micropterigidae, previously known from the beginning of Lower Cretaceous.

Auliepterix mirabilis Kozlov, sp. nov.

Name of species. From the Latin *mirabilis* ("surprising").

Holotype. PIN, No. 2997/858, 891, direct and reverse impressions; Kazakhstan, Chimkent Oblast, Chayan district, locality Aulye, close to Mikhaylovka village; Upper Jurassic (Oxfordian-Kimmeridgian), Karabastau series.

Description (Fig. 1c). Immediately in front of the anterior margin of the mesonotum, small rounded structures are symmetrically arranged, which might be homologous to ocelli. All veins in the forewings extend independently away from the cell.

Dimensions in mm. Length of the forewing - 3.4.

Remarks. Impression is poorly preserved; head capsule, apparently, is deformed, the veins are very indistinctly seen, particularly at the center of the wing. Despite the coarse grainy structure of the rock in which the impression is encased, margin scales and the base of the fringe on the costal margin of the forewing, were preserved, which confirms assignment of *A. mirabilis* to Lepidoptera. The sex of the moth cannot be determined reliably. A sclerite close to the tip of the abdomen might be a tegumen on the male genitalia.

Auliepterix minima Kozlov, sp. nov.

Name of species. From the Latin *minimum* ("very small").

Holotype. PIN, No. 4307/39, direct and reverse impressions; Mongolian Peoples' Republic, Ara-Khangayskiy Aymak, 6 km west of Khotont Somon, the northern part of Ukha; Upper Jurassic-Lower Cretaceous.

Description (Fig. 1d). Female. Pronotum narrow; mesonotum with distinct medial suture; length of mesoscutellum is 2/5 the length of the mesonotum. Forewings are oval, with a full set of veins; R_5 runs into the tip of the wing. Hind tibiae are twice as long as the femora, and densely covered with long bristles; preapical spurs are 3/5 the length of the tibia away from its base. The tarsus is 3/4 as long as the tibia. Apophyses are not developed on the genitalia.

Dimensions in mm. Length of forewing - 1.9.

Comparison. Differs from *A. mirabilis* sp. nov. by being almost half the size.

Remarks. Assignment to Lepidoptera is confirmed by impressions of fragments of the scaly wing covering.

SUBORDER PAPILIONINA LAICHARTING, 1781

FAMILIAE INCERTAE

Genus *Protolepis* Kozlov, gen. nov.

Name of genus. From the Greek *protos* ("earliest") and *lepis* ("scale").

Type species. *P. cuprealata* sp. nov.

Diagnosis. Head with thick covering of piliform scales. Proboscis short, spirally twisted. Maxillary palps rudimentary, two- and three-segmented. Labial palps large, apparently three-segmented; apical segment 1.5 times smaller than maximum diameter of eye. Antennae long, at least 7/8 as long as forewing. Female genitalia with elongate anal papillae, without long apophyses.

Species composition. Type species.

Comparison. Differs from all Jurassic and Cretaceous fossil genera in having a proboscis and very long antennae; from Eocene *Electromeessia* Kozlov, which has long antennae, in reduced maxillary palps. Comparison with recent genera is difficult.

Remarks. Assignment of the described genus to Lepidoptera is unequivocally determined by the presence on the wings of thick scaly covering. Presence of a proboscis, rudimentary nature of the maxillary palps, development in the female of a short secondary ovipositor with distinctly pronounced anal papillae make it possible to assign *P. cuprealata* preliminarily to ditrysian Lepidoptera (suborder Papilionina), after approximating it on the basis of indirect characters to archaic representatives of the tineoids. The impossibility of observing important diagnostic characters does not allow assignment of this genus to any specific family; however, finding a ditrysian Lepidoptera in Upper Jurassic deposits is of considerable interest. It confirms the hypothesis, validated by comparative morphological data, of the great age of the suborder Papilionina [3].

Protolepis cuprealata Kozlov, sp. nov.

Name of species. From the Latin *cupreus* ("copper") and *alatus* ("winged").

Holotype. PIN, No. 2066/3564, direct impression; Kazakhstan, Chimkent Oblast, Chayan district, locality Aulye, close to Mikhaylovka village; Upper Jurassic (Oxfordian-Kimmeridgian), Karabastau series.

Description (Fig. 1e). Female. Head is wide, length of antennal segments approximately equal to their diameter. Apical segments of the labial palps are tapered toward the tip; the preceding segments are expanded toward the tip, with clusters of piliform scales. Front tibiae are 1/4 as long as the femora; epiphysis is apparently lacking. Forewings are elongate-oval, the hind wings have a tapered apex; the venation is not known.

Dimensions in mm. Length of forewing - 4.6.

Remarks. Shape of wings can be established only approximately, since their impressions are on top of one another.

Genus *Karataunia* Kozlov, gen. nov.

Name of genus. From the Karatau Range.

Type species: *K. lapidaria* sp. nov.

Diagnosis. Very small moths with elongate oval wings. In the forewings, medial trunk reduced; radio-cubital cell very narrow, its tip almost reaching 3/4 length of forewing; M_2 and M_3 stalked, R_1 extending to middle of costal margin.

Species composition. Type species.

Comparison. Differs from all Jurassic and Cretaceous Lepidoptera genera in high specialization of the venation on the narrow forewings, primarily, the arrangement of M_2 and M_3 on a common stalk. Similar arrangement of the veins is observed in representatives of Elachistidae, Gracillariidae, Tischeriidae, and others.

Remarks. Assignment of *Karataunia* to Lepidoptera is determined on the basis of the forewing venation; as far as we know, this type of venation is not found in

caddis flies. Homologization of the clearly examined oval structures on the second abdominal segment is not clear.

Karataunia lapidaria Kozlov, sp. nov.

Name of species. From the Latin *lapidarius* ("cut on stone").

Holotype. PIN, No. 2066/3461, 3453, direct and reverse impressions, Kazakhstan, Chimkent Oblast, Chayan district, locality Aulye, close to Mikhaylovka village; Upper Jurassic (Oxfordian-Kimmeridgian), Karabastau series.

Description (Fig. 1f). Ocelli are developed behind the rounded compound eyes. Antennae are at least half as long as the forewings. On the forewings R_1 extends to the costal margin immediately past its middle; CuP reaches almost 2/3 the length of the posterior margin. In the hind wings, the veins extending to the wing tip are free.

Dimensions in mm. Length of the forewing - 2.8.

Remarks. The symmetrical structure observed on the border of the head and thorax, is, possibly, the coxae of the thoracic legs.

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