

## DICTYOPHARIDAE FROM THE CRETACEOUS DEPOSITS ON THE TAYMYR PENINSULA (INSECTA, HOMOPTERA)

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**ABSTRACT:** This article describes the first Precenozoic species of the family Dictyopharidae and establishes it as a distinct tribe; a revision is made of the Dictyopharinae at the tribal level and all other paleontological data on the family are analyzed.

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Up to now fossil Dictyopharidae have been known only from Cenozoic deposits — the Eocene and Miocene of Europe and from the Oligocene of the USA [1, 5-8]. All the fossil Dictyopharidae that have been described belong to the genus *Dictyophara* Germ. (= *Pseudophana* Burm. = *Chanithus* Kol.), but their assignment to it has never had an adequate basis. The oldest finds thus far known, from the Upper Eocene amber of the Baltic region, described as *Pseudophana reticulata* [5], are limited to two specimens, identified as a larva and a pupa; the latter must evidently be interpreted as an adult nymph. The larva, judging by the illustration, more closely resembles representatives of the family Tropicodidae — this is indicated by the relatively weak development of the saltatorial hind legs, which is not typical of Dictyopharidae, and some details of distribution of the sensory pits. The "pupa" belongs to the family Achilidae, most probably to the genus *Cixidia* Fieb. Evidence for this is its general appearance, the smooth line of transition of the posterior edge of the metanotum into the rudimentary wings, the rounding of the abdomen, and the form and proportions of the head and pronotum. The habitat of the Achilidae larvae (on rotting, often fallen tree trunks, including conifers, inhabited by fungi) facilitates their burial in amber. At the present time the genus *Cixidia* has a holarctic distribution. *Pseudophana amatoria* Heer [6], from the Upper Miocene at Oeningen (Württemberg-Baden, West Germany) does not belong to the Dictyopharidae, nor apparently to the cicadas in general. *Dictyophara bouvei* Scudder (Lower Oligocene at Florissant, Colorado, USA) evidently belongs to the Cicadellidae; the illustration [8, Pl. 21, Fig. 16] shows a characteristically round cicadellid head; one wing is probably extraneous and does not belong to this insect. The insect described in the same publication and from the same locality as a representative of the family Cixidae, *Florissantia elegans* Scudder, definitely belongs to the Dictyopharidae. This is an indirect consequence even from what Scudder himself says, when he compares *Florissantia* with *Cladodiptera* Spinola, which is a Recent representative of Dictyopharidae. The similarity chosen to compare *Florissantia* to *Cladodiptera* is scarcely well founded: the wide pterostigma that is easily visible in the illustration is evidence against their close relationship. Out of all the published material, only Ye.E. Bekker-Migdisova's determination [1] of *Chanithus vishneviensis* B.-M., *Dictyophara* sp. from the Miocene at Stavropol' undoubtedly belongs to the family here considered. Thus the only reliably identified finds of Dictyopharidae are those from the Oligocene in Colorado and the Miocene in Ciscaucasia.

The fossil insect to be described below, *Netutela annunciator* gen. et sp. nov. (Fig. 1), from the Upper Cretaceous amber (retinite) in the Taymyr region, was initially identified as a member of the family Cixiidae [4], but there is no doubt that it properly belongs to the Dictyopharidae. The family Cixiidae (Fig. 2) is characterized by a pterostigma on the forewings that is formed by a widening of part of the peripheral membrane, which is embossed in the wing because the vein  $R_1$

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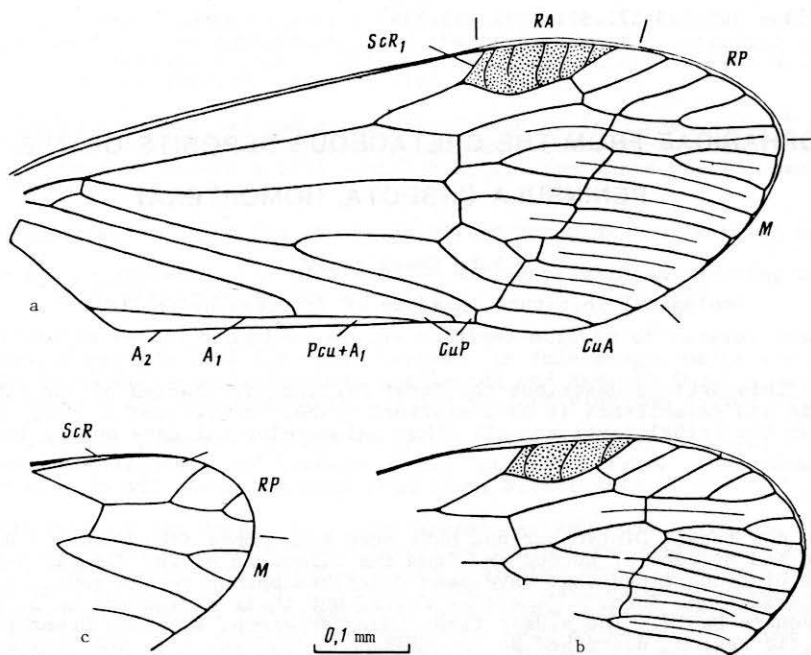


Fig. 1. *Netutela annunciator* sp. nov.; Holotype PIN 3130/168: a) left fore wing; b) fragment of right hind wing, mirror image; c) fragment of left hind wing; Taymyr region, Upper Cretaceous.

(ScR)<sup>1</sup> stops short of the wing margin and the costal vein turns into the interior of the wing. Veins C and ScR<sub>1</sub> are seemingly joined by a cross vein, distal to which is the pterostigma. In the Dictyopharidae the pterostigma is formed by the terminal branches of ScR<sub>1</sub> and is therefore bordered anteriorly by the peripheral vein, the continuation of the costa, and along the surface is intersected by the branches of R<sub>2</sub>. In addition, the family Cixiidae is characterized, on the veins of the fore wing, by ciliated granules, whereas in the Dictyopharidae the veins are smooth and lack bristles or macrotrichia.

Only the distal part of the hind wings of *Netutela annunciator* was preserved; it has the characteristic feature of the Dictyopharidae and some other families that is not peculiar to the Cixiidae: an R<sub>2</sub> with three terminations in the Dictyopharidae R<sub>2</sub> sometimes has two branches, as in the Cixiidae, but in this case the anterior branch of R<sub>2</sub> is obliquely transverse and not obliquely longitudinal. In the Cixiidae R<sub>2</sub> is often not branched at all. Unfortunately, the anjugal part of the hind wing of *Netutela* was not preserved. A feature highly characteristic of the family Dictyopharidae is the additional turning under of the doubled wing along the vein A<sub>1</sub>; thus in the Dictyopharidae the A<sub>2</sub> vein does not reach the edge of the wing, but stops short at the line of the secondary fold. In the Cixiidae, A<sub>2</sub> extends to the edge of the wing.

Members of the family Dictyopharidae may, in their wing structure (especially if it is not fully preserved), also be confused with some representatives of the families Tropicuchidae and Fulgoridae. From the generally similar Tropicuchidae without a precostal area, such as the Tambiniini, the new genus differs, apart from the presence of a pterostigma, in the fact that A<sub>1</sub> + Pcu abuts on A<sub>2</sub> and not the vertex of the clavus, and in the structure of the apex of the scutellum, which lacks a suture separating the scutum from the scutellum. It differs from the small deviant Fulgoridae with impoverished venation, such as *Aluntia* and *Dorysarthrus*,<sup>2</sup> in its

<sup>1</sup>Nomenclature of venation follows that in [2].

<sup>2</sup>I have cited the evidence for the assignment of these genera to the Fulgoridae in an earlier publication [3].

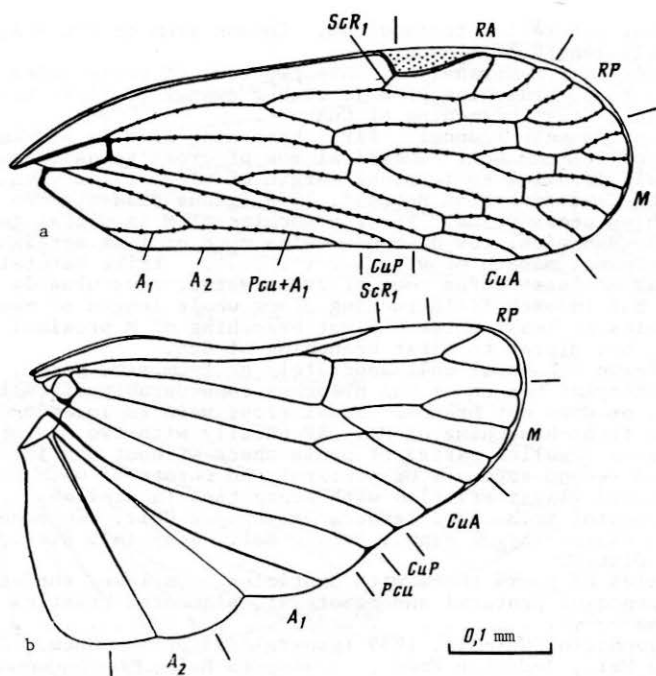


Fig. 2. *Pentastiridius leporinus* L. (Cixiidae): a) fore wing, b) hind wing; Kazakhstan; Recent.

more distal first branching of the medial stem, whereas in the lantern flies it branches far more proximally. Finally, the presence of longitudinal folds in the distal part of the fore wings differentiates the winged Dictyopharidae from all the other cicadas, including the closely similar Fulgoridae family. It should be kept in mind that the most important, the key, differences between the families of the Fulgoroidea appear in the structure of the ovipositor, the legs, and other parts of the body that cannot be reconstructed on the basis of the wings alone. The systematic position of *Netutela* therefore must remain largely tentative.

The family Dictyopharidae is subdivided into two subfamilies — the Dictyopharinae Spinola, 1839 and Orgeriinae Fieber, 1872. The second of these, no fossil representatives of which are known, is characterized by extreme shortening of the wings. Their fore wings lack tegula and are transformed into elytra, which cover only the thorax and base of the abdomen; and the hind wings are almost completely reduced. The Dictyopharinae include almost exclusively normal-winged forms, and cases of wing shortening are rare, but the tegula are retained and the wings always cover the entire abdomen.

The Recent Dictyopharinae can be subdivided into a number of tribes that differ from the artificial tribe of Dictyopharini. Most of these tribes are characterized by characteristic structures of their fore wings, which are most often preserved in fossil state, but some similar tribes that are segregated on the basis of genitalic structure in the males or females cannot be reliably diagnosed from their wings alone. The characteristics of the oldest Dictyopharidae described below are at least at the tribal level. A key for distinguishing ten tribes, of which eight are new, is given below. The key contains diagnoses and comparisons, and was drawn up with the requirements of paleontology in mind, primarily in regard to the features of the fore wings, which are supplemented when necessary by other features. The key shows the isolation of the Netutelini and their resemblance in some respects to the Cladodipterini, but in the characteristic of the free departure of ScR and M from the basal cell, the Netutelini resemble the Recent Palaeogaean tribes Dictyopharini s. str. and Orthopagini.

#### Key to the Tribes of Subfamily Dictyopharinae

- 1(16) Wings fully developed, membranous, and flat. Stem divides into anterior and posterior branches (ScRA and RP) before pterostigma, and posterior branch in

- turn branches before its termination. Common stem of Pcu + A<sub>1</sub> long, occupying at least half length of clavus.
- 2(5) Remigium (corium + membrane) has only two rows of cross veins — nodal and subapical. First branching of M is either distal to first branching of ScR or proximal to first branching of CuA.
- 3(4) Clavus has cross vein (cupcu). First branching of M is proximal to first branchings of ScR and CuA. Subapical row of cross veins forms stepped arc approximately parallel to terminal margin of wing . . . . . tribe Cladodipterini Metcalf, 1938 (genus *Cladodiptera* Spinola, 1839)
- 4(3) Clavus with no cross veins. First branching of M is distal to first branching of ScR. Subapical row of cross veins more or less straight and not parallel to terminal margin of wing . . . . . tribe Netutelini trib. nov.
- 5(2) Remigium has at least three rows of cross veins, rows usually being out of alignment, but in each field running along whole length of membrane; number of cross veins at least three. First branching of M proximal to first branching of ScR, but distal to first branching of CuA.
- 6(9) ScR and M leave the basal cell separately or from same point, but immediately diverge. Anterior branch of CuA branches considerably distally to nodal cross vein, or does not branch. Nodal cross vein rm located considerably proximal to first branching of MA. RP usually with two or three branches.
- 7(8) Lower vesicles (swollen parts) of penis theca without denticles. Vertices of first and second segments of protarsi and mesotarsi with not more than two specialized glassy bristles with acute tips (acutellae) . . . . . tribe Orthopagini trib. nov. (genera *Orthopagus* Uhl., *Centromeria* Stål, *Saigona* Mats., *Phaeodictyon* Fenn., *Putala* Mel., *Neoputala* Dist., and perhaps also *Miasa* Dist.).
- 8(7) Lower vesicles of penis theca with denticles. On lower surfaces of first and second segments of protarsi and mesotarsi, pigmented bristles usually replaced by acutellae . . . . . tribe Dictyopharini Spinola, 1839 (genera *Dictyophara* Germ., *Raivuna* Fenn., *Philotheria* Mel., *Zedochir* Fenn., *Paranagnia* Mel., *Pseudophanella* Fenn., *Aselgeia* Walk., *Afronesia* Fenn., *Paradictya* Mel., *Neodictya* Syn., *Dictyopharina* Mel., and evidently also *Rhaba* Dist., *Engela* Dist.)
- 9(6) ScR and M extend from basal cell in common stem, which is longer (usually considerably longer) than the arculus. Anterior branch of CuA branches proximally to nodal cross vein mcu. Nodal cross vein rm located distally to first branching of MA, or on it, or only slightly proximally to it; RP usually has four or five branches.
- 10(11) Pterostigma wide; its posterior margin forms sharp S-curve . . . . . tribe Lappidini trib. nov. (genus *Lappida* A. S.).
- 11(10) Pterostigma narrow, no wider than costal field; its posterior margin gently arcuate and does not project rearward.
- 12(15) Ovipositor (?) "zegrebayushchy-mesyashchy" type; lower parts of third valves of ovipositor sclerotized to usual degree, and for the most part relatively wide and short.
- 13(14) Lower parts of third valves of ovipositor at top have no bent membranaceous margin. Anal tube of female without specialized bristles . . . . . tribe Nersiini trib. nov. (genera *Nersia* Stål, *Pteroplegma* Mel., *Hyalodictyon* Fenn., *Retiala* Fenn., *Pharodictyon* Fenn., *Digitorista* Fenn., *Trimedia* Fenn., *Toropa* Mel., and also, apparently, *Paralappida* Mel.).
- 14(13) Lower parts of third valves of ovipositor at top have outward-bent membranaceous margin. Anal tube of female at bottom has bristles, one on each papilla . . . . . tribe Hastini trib. nov. (genera *Hasta* Kirk., *Thanatodictya* Kirk.).
- 15(12) Ovipositor of secondary prickly-sawtoothed type, narrow, attenuate; lower parts of its third valves strongly sclerotized, very narrow, and envelop first and second segments like jacket . . . . . tribe Taosini trib. nov. (genera *Taosa* Dist., *Rhynchomitra* Fenn., and also evidently *Protachilus* Fenn., *Mitrops* Fenn.).
- 16(1) Wings flat, strongly sclerotized, shortened and clearly convex; venation varies strongly from one individual to another. Stem ScR does not branch, and only weak cross veins may extend from it. Common stem of Pcu + A<sub>1</sub> short.
- 17(18) Wings with sharply carinate longitudinal veins, of which vein CuP, running along suture of clavus, is markedly less distinct . . . . . tribe Scoloptini trib. nov. (genus *Scolops* Schaum).
- 18(17) Wings with distinct convexity, but not carinate longitudinal veins; vein CuP developed like other veins . . . . . tribe Phylloscelini trib. nov. (genus *Phylloscelis* Germ.)

Tribe Netutelini Emeljanov, trib. nov.

Diagnosis. Only two rows of cross veins in membranous area (nodal and subapical). First branching of M considerably distal to first branchings of R(ScR) and CuA. Membrane between terminal longitudinal veins has five or six folds in all

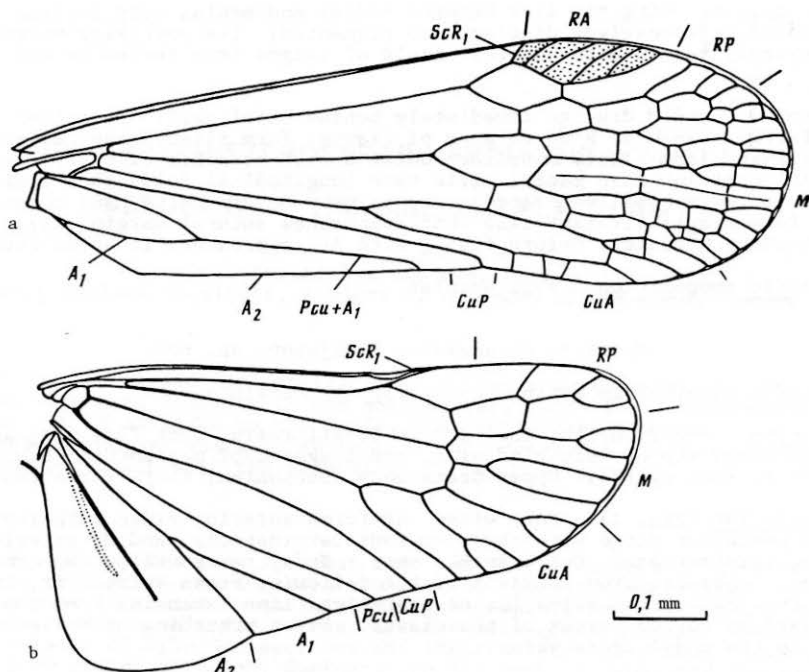


Fig. 3. *Raivuna striata* Oshanin (Dictyopharidae): a) fore wing, b) hind wing; Central Asia; Recent.

intervals. On clavus vein  $A_1$  and common stem of  $A_1 + Pcu$  approach  $A_2$ ;  $Pcu$  merges into  $A_1$  at obtuse angle, curving arcuately.

**Composition.** *Netutela* gen. nov. from Upper Cretaceous of the Taymyr Peninsula.

**Remarks.** Among the distinctive features of venation in the Netutelini that indicate their considerable primitiveness as compared to that in any Recent representatives of Dictyopharidae are the distally shifted first branching of  $M$  and the slight but abundant folding in the terminal part of the fore wing. In Recent Dictyopharidae (Fig. 3), the folds are usually represented by only one vein, between vein systems  $R$  and  $M$ , and more rarely two (*Taosa* Dist.) or three (*Pteroplegma* Mel.) adjacent veins. The number of cross veins in each field in Recent Dictyopharidae, except for the Cladodipterini, is more than two and they are not arranged in rows but more-or-less additionally (like ashlar masonry). The increased number of cross veins in Dictyopharidae is related to the general condensation of the fore wings. Only two rows of cross veins or, more precisely, only two veins in each membranous field are characteristic of isolated, not very progressive families of Fulgoroidea—Cixiidae and Tropiduchidae.

The venation of the clavus in *Netutela* differs from that of Recent Dictyopharidae in characters that are usually typical of forms with steeper, tent-like arrangement of the wings at rest: convergence of  $A_1$  and  $A_2$ , and arcuate curvature of  $Pcu$  before it fuses with  $A_1$ . Such disposition of the wings at rest may be due to their considerable width and slanted terminal margin.

It may be that *Netutela* represents some primitive side branch of the family Dictyopharidae with relatively weak sclerotized fore wings that are more steeply tent-like when folded than those in Recent representatives.

Genus *Netutela* Emeljanov, gen. nov.

**Generic name.** From an arbitrary combination of letters.

**Type species.** *N. annunciator* sp. nov.; Santonian; Taymyr region.

**Diagnosis.** Fore wing relatively broad and widens slightly toward tip; costal and anal edges diverge slightly. Terminal margin of wing slightly sloping toward

posterior margin; wing tip lies between radial and medial vein systems or just barely behind. Pterostigma distinct and pigmented; its posterior margin ( $R_2$ ) projected strongly rearward in an arc; field of stigma intersected by two to four cross veins.

Branches R and M diverge immediately behind basal cell. Subapical cross veins, from posterior branch of R up to apex of clavus, form slight steps aligned almost in one straight line. Only anterior medial branch branches distally to cross veins. Radiomedial cell and five medial cells have longitudinal folds that indistinctly penetrate the more basally located cross veins. On clavus,  $A_1$  and common branch  $PCu + A_1$  form single straight line that approaches sutural margin ( $A_2$ ). Postcubital branch, bending arcuately before fusing with  $A_1$ , approaches it at an obtuse angle.

Specific composition. Type species.

*Netutela annunciator* Emeljanov, sp. nov.

Specific name. From Latin *annunciator* (= "herald").

Holotype. PIN 3130/168, enclosed in fossil resin, left fore wing and incomplete right hind wing, tip of left hind wing, and fragment of mesonotum; Eastern Taymyr region, Yantardakh cliffs; Upper Cretaceous, Santonian, Kheta Formation.

Description (Fig. 1). Fore wing. RP forms anterior ridge with four terminations, MA posterior ridge with three or four terminations, and MP anterior ridge with three terminations. CuA branches once. Nodal row contains two cross veins rm and mcu; subapical row consists of the following cross veins: ir, rm, four im, mcu, and two icu. Nodal veins lie on a straight line extending from the base of the pterostigma to the vertex of the clavus. First branching of M lies directly anterior to the nodal cross veins.

Hind wing (Fig. 1, c). Radial cell with two oblique cross veins. Only one vein rm. Medial system with three terminations, in the form of posterior ridges.

Scutum (notum of mesothorax) between steps of wing with three distinct keels, the middle of which disappears at the boundary between the scutum and scutellum.

Distribution. Upper Cretaceous; Taymyr region.

Material. Holotype.

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