DIAGNOSTICS OF THE FAMILIES OF THE AUCHENORRHYNCHA (HOMOPTERA) ON THE BASIS OF THE WINGS. I. FORE WING

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Imprints of wings usually constitute a major part of the fossil remains of insects, so that the wing structure of present-day forms is the key to the system of extinct forms. In the systematics of the Auchenorrhyncha, wing structure characters are of limited use, basically at the subfamily, tribe, and genus level, which is connected with the plasticity of the wing morphology, in particular that of the fore wings.

Works on the morphology of the wings of the Auchenorrhyncha are based on a comparison of individual representatives (Yemel'yanov, 1977) or deal only with parts of the suborder (Funkhauser, 1913; Metcalf, 1913a,b, 1917) and do not provide us with the possibility of identifying all the Auchenorrhyncha families from the fore or hind wing. The author has undertaken a comparative morphological study of the wings of Auchenorrhyncha on the basis of extensive material. Investigations were made of the collections of the Zoological Institute of the USSR Academy of Sciences, the Zoological Museum, and the Department of Entomology of Moscow State University, and also of collections placed at our disposal by Ye.E. Bekker-Migdisova and L.N. Medved, to whom the author expresses his thanks. The available material proved to be incomplete, especially as regards the Fulgoroidea. In view of this, the work presented can only be regarded as a preliminary account of the investigations and as new data come to hand, inevitably changes will be made in the diagnostic keys composed by us. The conclusions reached, however, may be used in studies of the phylogeny and systematics of the Auchenorrhyncha. The author is greatly obliged to A.P. Rasnitsyn (Palaeontological Institute of the USSR Academy of Sciences) and A.F. Yemel'yanov (Zoological Institute of the USSR Academy of Sciences) for extensive help in carrying out the present work and preparing it for the press.

The wings of the Auchenorrhyncha were studied with a binocular microscope both with incident and transmitted light. In preparing the illustrations, photographs were used that were taken with a stereophoto-adapter attached to the binocular microscope. From the large amount of material examined, the representatives of about 300 genera (see list below) were selected for more detailed study. Hind wings were only studied in a part of the genera (marked with an asterisk in the list). Where the collection material was inadequate or lacking for the individual families, use was made of the drawings of other authors (in this case the name of the genus is given in the list in brackets with an indication of the source). Because of lack of material, the families Achilixiidae, Kinnaridae, and Nicomiidae are not included in the key for diagnosis on the basis of the fore wing.

The system for the suborder at the superfamily level was according to Yemel' yanov (1977); the system of the Fulgoroidea was according to Muir (1930) with the addition of the fam. Gengidae (Fennah, 1949a) and change in the boundary between the families Dictyopharidae and Fulgoridae (Yemel'yanov, 1979), the system of the remaining superfamilies was according to Evans (Evans, 1946a,b, 1947, 1948;

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Woodward et al., 1970) with addition of the fam. Clastopteridae (Metcalf, 1951) and change in the compass of the fam. Aetalionidae (Hamilton, 1971).

LIST OF GENERA STUDIED

Fulgoroidea. Tettigometridae: *Hilda*, Tettigometra**; Cixiidae: *Bothriocera*, Cubana*, Brixia, Andes*, Pintalia*, Mnemosyne*, Cixius, Hyalesthes, Betacixius*, Myndus*, 1* gen. indet.; Delphacidae: *Asiraca, Tropidocephala, Kelisia*, Stenocranus, Terauchiana*, Dicranotropis, Euconomelus, Conomelus*, Chlorionidea*, 4 gen. indet. (3*); Kinnaridae: *Paramicrixia;* Meenoplidae: *Meenoplus*, Kermesia*, Eponisia*, Nisia;* Achilidae: (*Apateson, Ateson* - Metcalf, 1938), *Kosalya**, (*Achilus* - Woodward et al., 1970), (*Aneipo* - Fennah, 1949c), *Cixidia*, Catonidia*, Catonia*, Caristianus**, 2* gen. indet.; Achilixiidae: (*Muirilixius* - Metcalf, 1938); Derbidae: *Malenia**, (*Neocyclokara* - Muir, 1917), *Derbe*, Mysidia**, (*Rhotana** - Tillyard, 1926), *Pyrrhoneura*, Mysidioides*, Epotiocerus, Heronax, Zoraida*, Pamendanga, Nomuraida*, Diostrombus**, 3* gen. indet.; Dictyopharidae: *Dictyophara*, Orthopagus*, Igava*, Taosa*, Rhychomitra*, Saigona*, Thanatodictya*, Aselgeia, Pteroplegma, Hasta, Rhaphiophora, Scolops* (* - Metcalf, 1913b), *Phyllocelis;* Fulgoridae: *Aluntia, Dorysarthrus*, Dichoptera*, Phenax*, Pterodictya, Phrictus*, Hotinus*, Saiva*, Zanna*, Enchophora*, Cornelia*, Aphaena*, Lycorma*, Limois*, Lystra*, Polydictya*, Crypoptus*, Homalocephala, Benamatapa, Lyncides;* Tropiduchidae: *Numica, (Daradacella* - Fennah, 1949b*) Pelitropis*, Kallitaxila, (Neommatissus* - Baker, 1919), *Alcestis, Trypetimorpha*, Ammatissus*, Cixiopsis*, Duriopsis, Symplana*, 4 gen. indet. (3*); Gengidae: *(Gengis*, Microeurybrachys* - Fennah, 1949a); Eurybrachidae: *Eurybrachys*, Messena*, Thessitus*, Nicidus, Neoplatybrachys, Ancyra**, 3 gen. indet. (1*); Lophopidae: *Lophops, Corethrura, Pyrilla, Elasmoscelis*, Jugola**, 2 gen. indet. (1*); Ricaniidae: *Ricania*, Euricania*, Pochazia*, Deraulax*, 7 gen. indet. (4*); Nogodinidae: *Issidius*, Mindura, Siopaphora, Exphora, Biolleyana*, Neaethus*, 8 gen. indet. (1*); Flatidae: *Flata*, Cerynia*, Paratella*, Ormenis*, Salurnis*, Melormenis*, Cyarda*, Flatoides*, Mimophantia, Rhinophantia, Cyphopterum, Mistarnophantia*, 4 gen. indet. (1*); Acanaloniidae: *Acanalonia**, 1 gen. indet.; Issidae: *Ommatidiotus*, Caliscelis, Ahomocnemiella, (Bruchomorpha** - Metcalf, 1913b), (*Asarcopus* - Fennah, 1949c), *Prosonoma*, Gergithus*, Lollius, Hemitonga, Trienopa, Togoda, Colpoptera*, Issus*, Conosimus*, Latilica*, Mycterodus, Bootheca, Perissana, Alloscelis, Falcidiopsis, Scorlupella, Hysteropterum, Thionia* (* - Metcalf, 1913b), *Tetrica*, 7 gen. indet. (4*).

Cicadelloidea. Aetalionidae: *Actalion*, Darthula*, (Endoiastus, Melizoderes, Mina, Tropidaspis, Lophyraspis** - Evans, 1948), *Microcentrus*, Stylocentrus*, Bocydium, Stegaspis;* Hylicidae: *Balala*, Hylica*, Nacolus*, (Kalasha* - Evans, 1946); Eurymelidae: *Anipo*, Katipo*, Bakeriola*, Eurymelops*, Eurymeloides*, Pogonoscopus*, Lasioscopus**; Cicadellidae: *Ulopa, Moonia, Megulopa, Bufonaria, Coloborrhis*, Megophthalmus, Ledra*, Petalocephala, Xerophloea, Macroceps*, (Stenocotis* - Evans, 1947), *Eupelix*, Paradorydium, Dryodurgades*, Symphypyga*, Adelungia, Macropsis*, Rhytidodus*, Idiocerus*, Austroagalloides*, Iassus*, Penthimia*, Aphrodes*, Gypona*, Tartessus*, Coelidia*, Glossocratus*, Selenocephalus, Paramesus*, Evacanthus*, Bathysmatophorus*, Cicadella*, Mileeva*, Empoasca*, Typhlocyba**, 6* gen. indet.; Nicomiidae: (*Nicoma* - Evans, 1948); Membracidae: *Xiphistes, Oxyrhachis, Centrotypus*, Otinotoides*, Monobelus*, Orthobelus*, Tricentrus*, Centrotus*, Gargara*, Sextius, Pyrgonota, Membracis*, Enchophyllum*, Enchenopa*, Bolbonota, Alchisme*, Potnia*, Hoplophorion*, Strictopelta*, Cymbomorpha*, Smiliorhachis*, Heteronotus*, Nessorhinus*, Ceresa*, Spissistilus, Tortistilus, Poppea, Cyphonia*, Vanduzeea, Actualis*, Micrutalis, Maturnaria*, Aphetea, Ennya*, Adippe, Horiola, Tragopa**, 4* gen. indet.

Cercopoidea. Machaerotidae: *Taihornia*, (Chaetophyes* - Evans, 1970), *Machaerota*;* Clastopteridae: *Clastoptera*;* Cercopidae: *Cercopis*, Phymatostetha*, Gynopygoplax*, Poeciloterpa*, Callitettix*, Tomaspis, Eoscartopsis*, Aufidus*,* 3* gen. indet.; Aphrophoridae: *Avernus*, Cephisus, Ptyelus*, Cnemidanomia*, Philagra*, Perinoia*, Clovia*, Aphrophora*, Sinophora*, Peuceptyelus*, Lepyronia*, Philaenus*, Neophilaenus*.*

Cicadoidea. Tettigarctidae: *Tettigarcta*;* Cicadidae: *Polyneura, (Mauricia** - Orian, 1949), *Huechis*, Tettigades*, Platypleura, Scieroptera*, Xosopsaltria*, Lembeja*, Platypedia*, (Frogattoides** - Woodward et al., 1970), *Moggania*.*

BRIEF SYNOPSIS OF WING MORPHOLOGY

The nomenclature of the veins is given according to Yemel'yanov (1977); unlike the widely used nomenclature, for the veins posterior to the cubital trunk the term "postcubitus" is employed. The basic regions and the plicae of the wing are cited after Wootton (1979).

The fore wings in the Auchenorrhyncha are reduced in area, folded on the body more or less roof-like, and cover the delicate hind wings, the anal region of which is enlarged and partly turned under when folded. Both in the fore and hind wings all the longitudinal veins are normally developed, except the subcosta which covers a large expanse or completely forms part of the radial trunk. The free base of the subcosta is well developed in the fore wing of the Cercopoidea and Cicadoidea (Fig. 32, 36); in some representatives of these superfamilies, the rudiments of the base of the subcosta can also be detected in the hind wing. In the remaining Auchenorrhyncha, the remains of the base of the subcosta are insignificant and inconspicuous.

In the text the main longitudinal veins are designated by the accepted abbreviations; the symbol Sc is only retained for the free base of this vein, while all the branches arising from the subcosto-radial trunk are termed branches of R, though some of them are hypothetically subcostal. The main branches of the longitudinal veins are indicated by indexes according to the dual system (R_1 is the anterior branch of R, while R_{1a} is the anterior branch of R_1). The posterior branch of R is designated by Rs and the branches of Cu almost separated from the base by CuA and CuP. One or several of the longitudinal branches, located between M and CuA and joined to both of these trunks, most probably have a mixed origin, but for the sake of simplicity they are placed with CuA; in the hind wing, these veins are located either in front of the medial fold (Fig. 2), or behind it, or between its two branches.

The fields, i.e. the spaces between the longitudinal veins, and the longitudinal plicae extending along them take their name from the vein delimiting the base of the field in front. If the costal vein is at a distance from the anterior wing margin, then the field between it and the margin is termed precostal (Fig. 9-13). If in the base of the hind wing Pcu and A_1 are coalescent, then the postcubital field is reckoned from the site of their disjunction. In Auchenorrhyncha, the claval plica along CuP is usually developed (corresponding to the antero- or postcubital plica - usually these two plicae are not developed simultaneously), dividing the fore wing into the remigium and clavus (Fig. 1) and the hind wing into the remigium and vannus. That part of the vannus behind A_1, the anal part, is separated by the vannal plica and turns under when folded. In the hind wing, the medial plica is usually developed, though for a short distance, sometimes with two branches, passing distally between M and CuA (Fig. 2).

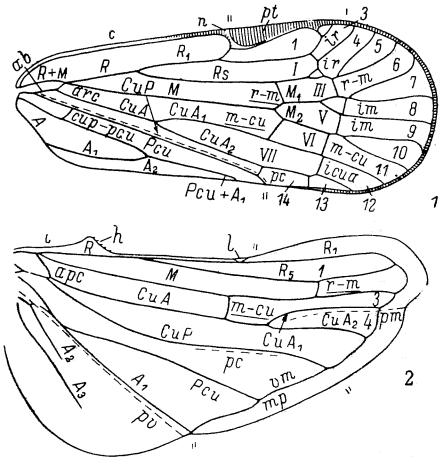

Fig. 1-2. Wing morphology in the Auchenorrhyncha.

1 - *Pintalia* (Cixiidae), fore wing; 2 - *Aphrophora* (Aphrophoridae), hind wing.

Cells numbered (apical - Arabic numerals, subapical - Roman numerals). Symbols for nodal transverse veins underlined. ab - basal cell; arc - arculus; h - coupling hamuli; l - coupling lobe; mp - peripheral membrane; n - nodus; pc - claval plica; pm - medial plica; pt - pterostigma; pv - vannal plica; vm - marginal vein. Along wing margin double lines indicate nodus, anterior borders of clavus (vannus), and anal lobe; ordinate lines indicate boundaries between regions of R_1, Rs, M, and CuA.

The perimeter of the fore wing is divided provisionally into anterior, apical, and posterior margins. If the apical margin is slightly convex, then at the sites of its passage into the anterior and posterior margins there are areas of maximum perimeter curvature - the anterior and posteroapical angles (Fig. 11); sometimes one of the angles is much more markedly defined than the other (Fig. 27); rarely the posteroapical angle assumes the form of a true geometrical angle (Fig. 13). The anterior margin may also be distinguished in the perimeter of the hind wing. The wing apex is the point most distant from its base. We say of two structures equally distant from the wing base that they are at the same level.

The clavus is said to be open if CuP over some distance is parallel to the posterior wing margin or even diverges from it; then the claval plica disappears from the wing membrane, not passing into the posterior margin (Fig. 14-16), more rarely curved at an angle before the apex and intersecting CuP, Pcu, and A_1, passing into the posterior wing margin (Fig. 17). Usually the clavus is closed, CuP up to the apex converges with the posterior wing margin and enters it at an acute angle, then the claval plica passes into the posterior margin immediately behind CuP (Fig. 1,20). The apex of the closed clavus is the point of junction of CuP with A_2, while the apex of the open clavus is the site where CuP assumes a direction parallel to the posterior margin (at this site, CuP or the margin are curved).

Sometimes a nodal plica is developed on the fore wing, which extends from the apex of the clavus to the nodus and separates the distal part of the remigium—the membranule (Fig. 21). Where the nodal plica is absent in the fore wing, the membranule may be separated by the flexure of the wing membrane, changing its consistence, and the simultaneous branching of the longitudinal veins (Fig. 3) or by

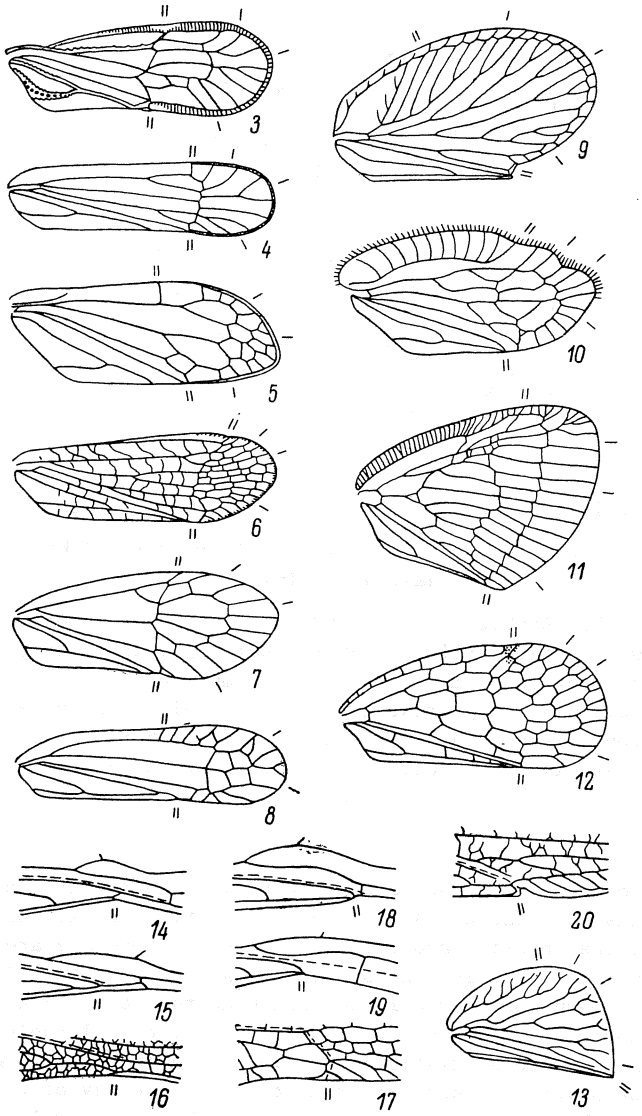

Fig. 3-20. Fulgoroidea. Fore wing.

3 - *Meenoplus* (Meenoplidae); 4 - *Terauchiana* (Delphacidae); 5 - *Tettigometra* (Tettigometridae); 6 - *Pelitropis* (Tropiduchidae); 7 - *Neommatissus* (Tropiduchidae, accord. to Baker, 1919); 8 - *Ommatidiotus* (Issidae); 9 - *Togoda* (Issidae, schematic); 10 - *Microeurybrachys* (Gengidae, accord. to Fennah, 1949a); 11 - *Euricania* (Ricaniidae); 12 - *Siopaphora* (Nogodinidae); 13 - *Hemitonga* (Issidae, schematic); 14-20 - area of apex of clavus: 14 - *Muirilixius* (Achilixiidae, accord. to Metcalf, 1938), 15 - *Pyrrhoneura* (Derbidae), 16 - *Cyrpoptus* (Fulgoridae), 17 - *Nicidus* (Eurybrahcidae), 18 - *Derbe* (Derbidae), 19 - *Kosalya* (Achilidae), 20 - *Ancyra* (Eurybrachidae). Symbols as in Fig. 1-2.

the nodal series of transverse veins (Fig. 6,7). Provisionally the remigium beyond the level of the nodus and the apex of the clavus may be considered the membranule. The nodus is approximately at the level of the apex of the clavus (vannus) and was evidently the site of the passage of the first of the primary branches of R_1 into the wing margin. It is frequently identified by change in the

structure or flexure of the wing margin (Fig. 3,12,21). In some cases, the position of the nodus is masked by the secondary branches of R and R_1, which are possibly of subcostal origin. In the fore wing in the region of the nodus, the pterostigma is sometimes developed (dilation of the marginal vein or flattened area of the membrane - Fig. 1,12) and in the hind wing usually the coupling lobe (wing area turned upwards - Fig. 2). Besides this lobe, hamuli on the posterior wing margin serve for wing coupling, sometimes concentrated on the marginal process and the undercurved posterior margin of the clavus. The coupling hamuli diverge from the base of the hind wing and project upwards; sometimes besides these, hamuli are developed on the actual base of the anterior margin, not serving for coupling with the fore wing and directed downwards.

Beginning from the apex of the clavus (in the hind wing from the anal lobe), the peripheral membrane is developed along the marginal vein in the form of a fringe free of veins, extending at the most to the nodus (Fig. 2,28) and sometimes over a short distance also passing into the posterior margin of the clavus (anal lobe; Fig. 28, 30). If the peripheral membrane is broad, then it will be crimped (radially undulating). Sometimes in the fore wing a continuation of the claval plica separates a part of the peripheral membrane as appendages (Fig. 22,23).

The longitudinal veins are connected to one another by transverse veins (these do not include the transversely oriented branches of the longitudinal veins that pass into the wing margin). In the text the generally accepted abbreviations are used for the transverse veins. Most constant are transverse m-cu in the wing base (arculus) and the two transverse veins usually located approximately at the level of the nodus (nodal r-m and m-cu; Fig. 1,2). The other transverse veins on the remigium are termed supplementary and frequently form a row along the margin of the membranule (apical row; Fig. 1). In the fore wing, sometimes one or several supplementary veins are located at the same level as the nodal veins, forming with them the nodal row (Fig. 4,6,7). The arculas, or coalescence of M and CuA, delimits the basal cell distally (Fig. 32,35,37). Transverse veins and the ramifications of the longitudinal veins separate other cells on the remigium, among which are distinguished the apical ones, bordering the margin of the membrane and the subapical ones bordering the apical ones (Fig. 1). The apical cells are read from the nodus to the clavus. The apical cell is called pedunculate if the apical adjacent to it interlock more basally than its base (Fig. 1,27). If the longitudinal veins bend at the sites where the transverse ones pass into them, they are then said to be flexuose (Fig. 12). Sometimes some ramifications of the veins terminate blindly in the membrane, not passing into the other vein (Fig. 23).

The wing surface, especially along the veins, may bear articulated outgrowths (hairs, setae). Frequently the bases of the hairs are raised or depressed (in the fore wing); if in this case the hairs themselves are reduced or appressed and short, then one may speak of grains (Fig. 3) or depressed dots (Fig. 25). Frequently the wing surface is covered by microsculpture - usually consisting of capilliform unarticulated outgrowths of the cuticle (chaetoids), visible as small dots on the membrane.

On the fore wing at the base of R_1 and Rs, a small but very pronounced convexity is sometimes developed. This is the geniculate tubercle, under which is found the apex of the femur of the folded hind leg.

Among the Auchenorrhyncha are to be found short-winged forms, in which the fore wings do not cover the apex of the abdomen, usually very short (some of the Delphacidae, Tropiduchidae, Issidae, Caliscelinae, Cicadelliadae, and all the Dictyopharidae, Orgeriinae, and Hypochthonellidae), while the hind wings are

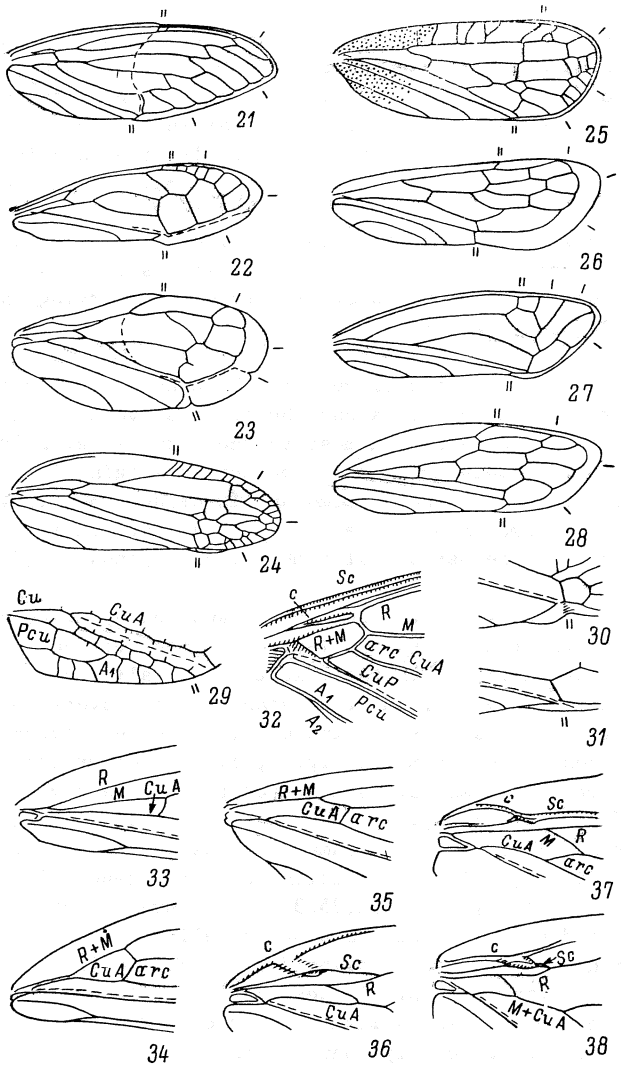

Fig. 21-38. Cicadoidea (21,32), Cercopoidea (22-24,30,31,36-38) and Cicadelloidea (25-29,33-35). Fore wing.

21 - *Tettigarcta* (Tettigarctidae); 22 - *Machaerota* (Machaerotidae); 23 - *Clastoptera* (Clastopteridae); 24 - *Ptyelus* (Aphrophoridae); 25 - *Aetalion* (Aetalionidae); 26 - *Balala* (Hylicidae); 27 - *Stylocentrus* (Aetalionidae); 28 - *Xiphistes* (Membracidae); 29 - clavus of *Bufonaria* (Cicadellidae); 30-31 - area of apex of clavus: 30 - *Phymatostetha* (Cercopidae), 31 - *Aphrophora* (Aphrophoridae); 32-35 - wing base from above: 32 - *Platypedia* (Cicadidae), 33 - *Alchisme* (Membracidae), 34 - *Tortistilus* (Membracidae), 35 - *Tartessus* (Cicadellidae); 36-38 - wing base from below: 36 - *Aphrophora* (Aphrophoridae), 37 - *Phymatostetha* (Cercopidae), 38 - *Eoscartopsis* (Cercopidae). Symbols as in Fig. 1-2.

reduced. Among the Fulgoroidea, besides short-winged forms, one can fairly reliably distinguish full- and partial-winged forms (macropterous and subbrachypterous forms). In the latter, the fore wings only extend slightly beyond the apex of the abdomen, are highly sclerotized, and usually markedly convex and

broad ("beetle-like" forms; Fig. 9), while the hind wings are often shortened, with a secondarily reduced anal region. Among the Cicadoidea there are no partial-winged forms and in the two remaining superfamilies it was not possible to make such a distinction. In the keys composed by us, short-winged forms are not included and for the hind wing neither are those of the partial-winged forms in which the hind wings are half as long as the fore wings or less.

DETERMINATION OF THE SUPERFAMILIES ACCORDING TO THE FORE WING

1. A_1 passing into Pcu, before entry not connected by vein with A_2; Pcu at site of entry of A_1 bent at angle (Fig. 1); sometimes Pcu and A_1 extending to apex of open clavus, not coalescent (Fig. 17). If Pcu and A_1 lost in network of transverse veins or not developed, then claval plica absent. Peripheral membrane not developed or rudimentary . . . . . Fulgoroidea.

-- A_1 passing into A_2, sometimes before entry connected by vein with Pcu (Fig. 29); very occasionally A_1 passing into Pcu, then latter straight at site of entry. Clavus closed. A_1 sometimes coalescent with Pcu or not developed (Fig. 22). If Pcu and A_1 indistinct or lacking, then claval plica well developed . . . . . 2.

2. Nodal plica strong, longitudinal veins at sites of intersection with it interrupted (Fig. 21). Sc (wings viewed from above) convex, passing into R immediately after separation of trunk of R+M, usually very strong (Fig. 32). Basal cell not longer than twice its breadth. Peripheral membrane equally broad to wing apex . . . . . Cicadoidea.

-- Nodal plica undeveloped or rudimentary, longitudinal veins continuous. If Sc visible from above as vague convex vein, then passing into R appreciably more distally than site of separation of trunk of R+M (Fig. 36). Basal cell more elongated (Fig. 35) or trunk of R+M not developed (Fig. 27). . . . . 3.

3. Sc very long, distant from R+M and passing into R after separation of M, visible on upper side of wing (Fig. 24) and at least for a small section cariniform below; cariniform sector of Sc frequently a unit with the costal carina, arising from anterior margin of wing (Fig. 37-38). Remigium irregularly convex; costal field broad, at base concave or base of anterior wing margin concave. Wing between veins, including apical cells, evenly covered with hairs or depressed dots; hairs not squamiform. Sc sometimes indistinct, and wing with depressed dots only at base, in this case peripheral membrane broad, crimped, with appendage (Fig. 22) . . . . . Cercopoidea.

-- Sc short, situated immediately adjacent to R, not visible on upper side of wing, on lower side vague, inconspicuous; costal carina on anterior wing margin. Remigium uniformly slightly convex or almost flat; costal field not dilated and not concave, anterior margin at base not concave. At least some parts of wing in apical cells without depressed dots and hairs or hairs locally squamiform; sometimes whole wing, including wing surface, with chaetoids or alveolate microsculpture. If peripheral membrane broad and crimped, then without appendage . . . . . Cicadelloidea.

Superfam. FULGOROIDEA

1.. Not full-winged, without reduced claval plica . . . . . 2.

-- If not full-winged, then claval plica well developed . . . . . 4.

2. Wing markedly convex, length less than twice breadth. Longitudinal veins flexuose or very slight, venation often indistinguishable . . . . . Issidae (Hemisphaeriinae and some Issinae).

-- Wing moderately convex and more elongated. Longitudinal veins, even and strong . . . . . 3.

3. All transverse veins gathered in nodal row. CuP undeveloped or slight. R branching up to level of coalescence of Pcu and A_1, or veins granular . . . . . some Delphacidae.

-- Transverse veins not gathered in nodal row. CuP in distal part strong. R branching beyond level of coalescence of Pcu and A_1. Veins without granules . . . . . Fulgoridae (Lyncidinae).

4(1). Clavus open (Fig. 14-17), sometimes reduced, occupying about a third of length of wing or less, and its structure not evident; in this case nodal r-m much more distal than nodal m-cu, while nodal row of transverse veins not developed or not including icua . . . . . 5.

-- Clavus closed (Fig. 1,18-20), condition clearly visible also in forms with reduced clavus, with nodal veins transverse, approximately at one leval and including icua) . . . . . 9.

5. Supplementary transverse veins few, all gathered in apical row (sometimes, except 1-2 transverse veins, included in nodal row). Clavus without transverse veins . . . . . 6.

-- Supplementary transverse veins numerous; if apical and also nodal row developed, then its (their) composition by no means including all supplementary transverse veins. Clavus with numerous transverse veins. . . . . 7.

6. Nodal r-m not more distal than nodal m-cu. $Pcu+A_1$ before entry into CuP connected by vein with A_2, latter at point of entry bent at angle (Fig. 14). Pterostigma formed by dilation of marginal vein . . . . . Achlixiidae.

-- Nodal r-m appreciably more distal than nodal m-cu. $Pcu+A_2$ not connected by vein with A_2, passing into CuP; A_2 to apex of clavus not curved (Fig. 15). Pterostigma lacking or rarely formed by flattening of wing membrane . . . . . Derbidae (Zoraidini, Otiocernini, part of the Rhotanini).

7(5). Rs separating from R_1 more distally than level of branching of CuA. Precostal field undeveloped, more rarely very narrow, not intersected by branches of C (as in Fig. 6). Clavus narrowly open, claval plica not passing into posterior wing margin (Fig. 16) . . . . . Fulgoridae (part).

-- Rs separating from R_1 appreciably more basally than level of branching of CuA. Precostal field usually developed . . . . . 8.

8. Precostal field, if developed, not reaching midlength of wing. R_1 with many long branches, passing into basal half of anterior wing margin. Clavus usually wide open, Pcu and A_1 before its apex constricted by transverse vein or coalescent, then again divergent and intersected by claval plica (Fig. 17) . . . . . Eurybrachidae (part).

-- Precostal field reaching midlength of wing, broad, evenly filled by branches of C (Fig. 11). Branches of R_1 not entering basal half of anterior wing margin. Clavus narrowly open, Pcu and A_1 coalescent or markedly approximated to its apex, not intersected by claval plica (Some Flatidae and Ricaniidae) . . . . . 25.

9 (4). Pcu+A_1 passing into A_2, usually at considerable distance from apex of clavus (Fig. 1). Precostal field lacking or rarely very narrow, not intersected by branches of C (as in Fig. 6). If nodal row of transverse veins developed, then apical row uniting only part of supplementary transverse veins (as in Fig. 6) or undeveloped (Fig. 4), or longitudinal veins equipped with setae and wing narrow (as in Fig. 4). . . . . 10.

-- Pcu+A_1 passing into apex of clavus (Fig. 19) or into CuP (Fig. 8), rarely into A_2 together with apex of clavus, then broadly developed and precostal field intersected by branches of C (Fig. 11), or all supplementary transverse veins part of apical and nodal rows (in latter case if with one supplementary transverse vein), veins without setae and wing broader (Fig. 7). . . . . 17.

10. All supplementary transverse veins forming part of apical and/or nodal rows (Fig. 1,3,4). In partial-winged individuals, R branching not more distally than CuA, and wing surface between strong veins smooth and without setae . . . . . 11.

-- If apical and/or nodal rows developed, then not all supplementary transverse veins forming part of them. In partial-winged individuals, R branching more distally than CuA, or veins weak and wing surface between them covered by setae or depressed dots . . . . . 15.

11. R and CuA branching immediately before nodal transverse veins, approximately at level of apex of clavus (short, 4-6 angled cell present between CuA_1 and CuA_2; Fig. 3). Costal field in wing base not developed (Fig. 3) or very wide from base (in almost whole length twice as broad as radial field) . . . . 12.

-- R and CuA branching far before nodal transverse veins at level of apex of clavus (cell between CuA_1 and CuA_2 very long or triangular: Fig. 1,4). Costal field developed from wing base, not so broad . . . . . 13.

12. Costal field at base not developed (Fig. 3). R, Pcu, and partly also A_1 cariniform, with granules (even if on Pcu and A_1 strong granules present). M_2 and Cua_1 coalescent at level of nodus. Pcu+A_1 virtually straight . . . . . Meenoplidae.

-- Costal field broad from base. Longitudinal veins not cariniform, without strong granules. M_2 and CuA_1 united by nodal m-cu. Pcu+A_1 before apex convex to CuP . . . . . .Kinnaridae.

13 (11). All transverse veins gathered in nodal row (Fig. 4); apical row rarely developed (in this case nodal row may be preserved), and basal cell not developed, transverse cup-pcu arising from distal half of free Pcu, clavus longer then 2/3 of wing, wing to level of apex of clavus almost parallel-sided, not constricting distally. Pterostigma lacking . . . . Delphacidae.

-- Nodal row of transverse veins undeveloped, all supplementary transverse veins gathered in apical row (Fig. 1). Basal cell developed. Transverse cup-pcu located more basally or undeveloped. Clavus shorter. Wing dilating at level

of apex of clavus and not constricted immediately behind it, and/or pterostigma present . . . . . 14.

14. Pterostigma formed by dilation of marginal vein, with distinct border of its own (Fig. 1), if inconspicuous, then covered with setae. Nodal r-m not distal to nodal m-cu and/or all longitudinal veins equipped with numerous setae. Transverse cup-pcu usually developed . . . . . Cixiidae.

-- Pterostigma undeveloped or formed by flattening of wing membrane and delimited by vein R_{1b}, without setae. Nodal r-m markedly distal to nodal m-cu. Sometimes some veins in base granulose, without developed setae. Transverse cup-pcu lacking . . . . . Derbidae (Cenchreini).

15 (10). Partial-winged individuals. Veins weak, sometimes unconspicuous, wing surface between them up to apex covered by setae or depressed dots. Basal cell not visible. Anterior wing margin concave basally (Fig. 5). Sc a deep groove along R+M (wing viewed from above) . . . . . Tettigometridae.

-- Usually full-winged. Veins strong, wing surface between them without depressed dots and at least at apex without setae. Basal cell well developed. Anterior wing margin basally convex or almost straight. Sc, if visible from above, a slight groove, arising from R+M . . . . . 16.

16. If transverse veins on clavus numerous, then CuA branching much more distally then M, and claval plica not extending to wing margin. If only 1-2 transverse veins on clavus (between CuP and Pcu), then Rs diverging from R_1 not more distally than level of branching of CuA, or part of transverse veins forming nodal row (as in Fig. 6) . . . . . Fulgoridae (Dorysarthrinae, Dichopterinae, and some others).

-- Clavus without transverse veins, rarely with numerous ones, then CuA branching only slightly more distally than M. Claval plica extending to wing margin. Rs diverging from R_1 more distally than level of branching of CuA. Nodal Nodal row of transverse veing lacking. . . . Dictyopharidae (Dictyopharinae).

17 (9). CuP at very apex curved and passing into A_2 at almost right angle, (apex of clavus obtuse; Fig. 18,19), claval plica as if continuing slightly beyond apex of clavus. Precostal field not developed or very narrow, not intersected by branches of C . . . . . 18.

-- CuP at apex straight, passing into A_2 at acute angle (Fig. 6), claval plica not continued beyond apex of clavus; apex of clavus rarely obtuse, and then broad precostal field developed intersected by branches of C . . . . . 20.

18. Clavus with many transverse veins, most with numerous arborescent blind appendages. R, M, and CuA branching approximately at same level . . . . . Fulgoridae (Aluntiinae).

-- Clavus at most with one transverse vein. Transverse veins without many blind appendages. R, M, and CuA branch at different levels . . . . . 19.

19. Nodal r-m much more distal than nodal m-cu. Supplementary transverse veins all gathered in apical row or also even forming part of nodal row. Claval plica entering wing margin not far from apex of clavus, antecubital field intersected by vein before apex of clavus or immediately after it (Fig. 18). Clavus much shorter than half wing length . . . . . Derbidae (Derbini, part of the Rhotanini).

-- If nodal r-m much more distal than nodal m-cu, then not all supplementary transverse veins gathered in apical and nodal rows. Claval plica extending beyond apex of clavus along wing margin, disappearing in membrane; antecubital field intersected by vein far from apex of clavus, usually markedly dilated beyond apex of clavus (Fig. 19). Clavus longer than half wing length, rarely slightly shorter . . . . . Achilidae.

20 (17). Rs diverging from R_1 at level of branching of CuA, about at level of apex of clavus (Fig. 6,8); if more basally, then all transverse veins gathered in apical and nodal rows (latter of at least 3 veins; Fig. 7), or R_1 (and R) with many long branches, passing into basal half of anterior wing margin, while M branches more distally than CuA, at base not forming common trunk with Rs . . . . . 21.

-- Rs diverging from R_1 up to level of branching fo CuA, usually up to level of middle of clavus. All transverse veins not gathered in apical and nodal rows, usually numerous. If R_1 (and R) with many long branches, passing into basal half of anterior wing margin, then M branching more distally than CuA, and/or forming at base short common trunk with Rs (Fig. 9) . . . . . 22.

21. $Pcu+A_1$ passing into apex of clavus, more rarely into A_2 (Fig. 6,7). Anterior wing margin evenly convex, or straight almost from base, or concave at base. If CuA not branching before level of apex of clavus, then supplementary transverse veins not developed or collected into apical row, or all transverse veins in nodal and apical rows. If wing narrow and flat, then wing membrane beyond apical row of transverse veins with flexure. Precostal field developed, although very narrow . . . . . Tropiduchidae.

-- $Pcu+A_1$ passing into CuP (Fig. 8). Anterior wing margin at base markedly convex, in middle part almost straight or slightly concave. CuA not branching up to level of apex of clavus. Numerous supplementary transverse veins arranged without any specific order, more rarely all transverse veins in nodal row. Wing narrow, flat, without flexure of membrane and precostal field . . . . . Issidae (Caliscelinae).

22 (20). Precostal field reaching middle of anterior wing margin and completely filled by numerous branches of C, and/or smoothly passing into flat area of apical cells corresponding to it in breadth (Fig. 9-13), usually broad, more rarely narrow or gradually dilating towards apex . . . . . 23.

-- Precostal field not developed or not reaching middle of anterior wing margin, rarely reaching it and then with sharp dilation, not continued by area of apical cells, while branches of C in it developed only at apex or individually . . . . . 29.

23. Posteroapical wing angle coincidental with apex of clavus, often geometrically regular or attenuated (Fig. 9,13). R_1 with many long branches in basal half of wing, or longitudinal veins flexuous and wing without large regular cells. Clavus without granules . . . . . Issidae (Tonginae, Trienopinae).

-- Posteroapical angle at distance from apex of clavus (Fig. 11) or slight. R_1 without long branches in basal half of wing. If longitudinal veins flexuous, then wing with large regular cells (Fig. 12) or clavus with granules . . 24.

24. Venation reduced, transverse veins strong and few in number, partly in apical row; about 10 apical and 5 subapical cells, some of latter with 2-4 apical

cells each (Fig. 10). Wing margin about apex of Rs with incision, anterior wing margin with setae . . . . . Gengidae (Microeurybrachys).

-- If venation reduced and transverse veins few, then apical cell corresponds to each subapical cell. Wing margin at apex of Rs convex, anterior wing margin without strong setae . . . . . 25.

25. Trunk of A_1+A_2 not longer than maximum breadth of postcubital field or not developed, Pcu coalescent with A_1 in distal third of clavus. Wing surface with very strong granules concentrated in bases of costal field and clavus and at base of Rs. Genal tubercle present on base of R_1, rarely together with R_1 but not on Rs . . . . . Flatidae.

-- Trunk of A_1+A_2 longer than maximal breadth of postcubital field, Pcu coalescent with A_1 in middle third of clavus (Fig. 11,12). Wing surface without granules, rarely with weak granules in costal field or over whole basal half of wing. Genal tubercle absent, rarely present on base of Rs . . . . . 26.

26. Posterior branches of R_1 passing into anteapical angle of wing (Fig. 11). Posteroapical angle immediately beyond apex of clavus. Wing broadly triangular, more rarely of some other form, then apical cells 5-6 times longer than wide . . . . . Ricaniidae.

-- Posterior branches of R_1 passing into anterior wing margin (Fig. 12). Posteroapical angle more or less distant from apex of clavus. Wing not broadly triangular, apical cells less elongated . . . . . 27.

27. Remigium up to level of middle of clavus with some weak veins or even one strong transverse vein, or breadth of intervals between branches of C exceeding length of actual branches (Fig. 12). Trunk of R_1+Rs shorter than trunk of R+M or not developed, either pterostigma (in full-winged individuals) and large 5-7-angled cells present on remigium or branches of C united by numerous transverse veins . . . . . Nogodinidae.

-- Transverse veins lacking on remigium up to level of middle of clavus. At least in apex of precostal field length of branches of C exceeding breadth of intervals between them. Trunk of R_1+Rs not shorter than trunk of R+M. Without Pterostigma, large 5-7-angled cells, or transverse veins between branches of C . . . . . 28.

28. M branching much more distally than CuA, beyond level of apex of clavus; not more than 3 branches of Rs and usually not more than 5 branches of M (if more, then these are short branchlets). Nodal transverse veins far beyond middle of length of wing. Clavus without transverse veins, tapering finely towards apex . . . . . some Tropiduchidae.

-- M branching at most somewhat more distally than CuA, up to level of apex of clavus; not less than 6 branches of Rs, not less than 8 long branches of M. Nodal transverse veins about middle of length of wing. Clavus even with weak transverse veins in postcubital field, towards apex obtuse because of flexure of CuP . . . . . Lophopidae.

29 (22). CuA branching more basally and/or more copiously than M. M and CuA at base forming common trunk, and/or Pcu intersecting claval plica and continuing on remigium along marginal vein and branches (Fig. 20). Partial-winged individuals: First anal field before apex not narrower than before coalescence of A_1 with Pcu . . . . . 30.

-- CuA not branching more basally nor more copiously than M. M and CuA at base not forming common trunk. Pcu not passing onto remigium except in composition of marginal vein. In partial-winged individuals 1st anal field before apex at least somewhat narrower than before coalescence of A_1 with Pcu . .33.

30. Clavus shorter than 2/3 length of wing. Pcu with branches on remigium. Transverse veins weak, ramose, numerous, covering whole wing, not forming definite apical row . . . . . 31.

-- Clavus longer. Pcu not continued on remigium. Transverse veins strong, unbranched, few in number, concentrated on membranule, even part of them in apical row . . . . . 32.

31. Anterior wing margin concave in basal third. Clavus shorter than half length of wing. Postcubital at level of coalescence of A_1 with Pcu field much broader than 1st anal field. Wing covered with scarcely discernible setae . . . . . Issidae (Prosonoma).

-- Anterior wing margin slightly concave in middle third. Clavus longer. Postcubital field at level of coalescence of A_1 with Pcu not broader than 1st anal field (Fig. 20). Wing covered with long setae . . some Eurybrachidae.

32 (30). Trunk of M+CuA long (approximately 1/3 length of clavus), as also trunk of R_1+Rs. Not all transverse veins in apical row. Basal cell not developed. Anterior wing margin convex . . . . . Gengidae (Gengis).

-- Trunk of M+CuA very short, trunk R_1+Rs not developed. All transverse veins gathered in apical row. Basal cell developed. Anterior wing margin concave in middle part . . . . . some Lophopidae.

33 (29). Full-winged individuals. R_1 with many long branches towards anterior wing margin. R branching more copiously than M. Longitudinal veins numerous, smooth. Posteroapical angle of wing well defined, at distance from apex of clavus . . . . . Eurybranchidae (part).

-- Usually partial-winged individuals, sometimes in this case with a few branches. In full-winged individuals R_1 without long branches and M branching more copiously than R. Longitudinal veins few and/or flexuous. Posteroapical angle slightly defined or approximated with apex of clavus . . . . . 34.

34. Basal cell large, not narrower than postcubital field (as in Fig. 11,12). Genal tubercle behind Rs. R_1 and Rs without strong branches, R_1 at actual base almost perpendicular to CuP. Posteroapical angle more markedly defined than anteroapical one . . . . . Acanaloniidae.

-- Basal cell much smaller (as in Fig. 13). Genal tubercle, if developed, then forwards of Rs. If R_1 without strong branches, then at actual base it oriented towards CuP at acute angle. If wing margin with 2 angles, then the stronger defined continuously . . . . . Issidae (Issinae).

Superfam. CICADOIDEA

1. Sc before passing into R (wing viewed from above; Fig. 21) weak, R(+Sc) continuing direction of base of R. Rs separating from R_1 immediately after separation of M. Clavus broad, Pcu and A_1 not approximated markedly with its

margins. Wing in basal half covered with numerous hairs, in costal field and on clavus, bases of hairs depressed . . . . . Tettigarctidae.

-- Sc before passage into R above very strong R(+Sc) continuing direction of Sc (Fig. 32). Rs diverging from R_1 before nodal plica. Clavus narrow, Pcu and A_1 shifted towards its margins. Wing usually not covered with hairs, if rarely covered, then bases of hairs not depressed . . . . . Cicadidae.

Superfam. CERCOPOIDEA

1. Claval plica beyond apex of clavus dividing into 2 branches, anterior one extending right up to marginal vein and intersecting appendage of peripheral membrane, remaining part sometimes slightly developed (Fig. 22,23). Radial field at level of branching of R much broader than costal field. M and CuA with no more than 2 branches . . . . . 2.

-- Claval plica not branching, sometimes only dilated beyond apex of clavus (Fig. 30), peripheral membrane without appendage or not developed. Radial field at level of branching of R not broader than costal field (Fig. 24), and/or M and CuA with many branches . . . . . 3.

2. No fewer than 4 apical cells (anterior ones often small). Pcu and A_1 united by 1-2 transverse veins or coalescent (sometimes throughout whole distance). Appendage of peripheral membrane narrow, cut off by straight plica (Fig. 22) . . . . . Machaerotidae.

-- 3 apical cells, last subdivided by blind process of vein. Pcu and A_1 not united by transverse vein and not coalescent. Appendage broad, cut off by plica curved at angle (Fig. 23) . . . . . Clastopteridae.

3 (1). Costal carina and cariniform area of Sc forming unit wing base viewed from below; Fig. 37,38), Sc up to approximation with costal carina weak, then rising sharply. A_2 before apex of clavus even slightly curved anteriorly (clavus usually rounded towards apex; Fig. 30). Apical wing margin usually broadly rounded. Venation of membranule more often copious . . . Cercopidae.

-- Costal carina and gradually rising cariniform Sc disconnected, at most united by smooth ridge (Fig. 36). A_2 before apex of clavus straight or slightly curved rearwards (clavus towards apex thinly tapering or attenuated; Fig. 31). Apical wing margin usually narrowly rounded. Venation of membranule usually scanty . . . . . Aphrophoridae.

Superfam. CICADELLOIDEA

1. Trunk of R+M developed from base of wing, distant from CuA; M not coalescent with CuA (Fig. 34). Arculus joining M (sometimes Rs+M) with CuA after separation of trunk of R+M, closing basal cell; if arculus weak, then no fewer than 3 apical cells present. If veins in wing base indistinct, then wing at apex without peripheral membrane and clavus tapering towards apex . . . . 2.

-- Trunk of M+CuA (sometimes R+M+CuA; Fig. 27-28), from base of wing, more rarely base of M markedly approximated to CuA (Fig. 33); sometimes after separation of trunk of R+M+CuA trunk of R+M developed (Fig. 34). More often without arculus and basal cell. Rarely trunk of R+M developed from base, distant

from CuA and then arculus absent and only 1 subapical cell present. If veins in wing base indistinct, then wing at apex with broad peripheral membrane and clavus rounded towards apex (Fig. 28) . . . . . 5.

2. Supplementary transverse veins not all gathered in apical row, usually numerous (Fig. 25). Rs diverging from R_1 by common trunk with M, R_1 with many branches towards anterior wing margin. Peripheral membrane colorless, in whole length very narrow (but clearly distinguishable), reaching area of nodus. Depressed dots developed only in bases of costal field and clavus (not extending beyond border of basal half of wing) . . . . . Aetalionidae (Aetalioninae, Darthulinae).

-- If supplementary transverse veins not all gathered in apical row, then numerous and Rs not forming common trunk with M, and/or peripheral membrane not colorless, broadest beyond apex of clavus, not reaching nodus. Depressed dots lacking, if rarely present, then distributed more widely over wing. . 3.

3. Anterior wing margin about middle concave, costal field here constricted (Fig. 26). R up to separation of Rs split along plica by narrow groove. Nodal m-cu oriented almost longitudinally (resembles M_2), passing into CuA_1. Whole wing between veins, including peripheral membrane, covered with hairs in places squamiform, bases of hairs in basal part of wing slightly depressed. Peripheral membrane broad to wing apex, crimped . . . . Hylicidae.

-- Anterior wing margin in middle part not concave, costal field in distal part not constricted. If plica along R developed, then not far from separation of M. Nodal m-cu, if developed, oriented transversely and passing into CuA. If wing covered with hairs, they do not extend to peripheral membrane, not squamiform, but with bases markedly depressed. Usually peripheral membrane at wing apex not broad and not crimped . . . . . 4.

4. Rs separating from R_1 by common trunk with M. R_1 as a rule with several branches towards wing margin. Peripheral membrane entering clavus appreciably, separating from its continuation of the claval plica a more or less broad appendage along margin of last apical cell, remainder of peripheral membrane rudimentary . . . . . Eurymelidae.

-- Rs separates from R_1 much more distally than M. R_1 usually with 2 branches. Peripheral membrane not appreciably entering clavus, sometimes not developed, is more or less broad, then not only along margin of last apical cell, appendage lacking. . . . . Cicadellidae.

5 (1). Clavus markedly constricted and tapering towards apex, A_2 before apex of clavus almost straight (Fig. 27). Peripheral membrane narrow, not crimped. 1 subapical cell or apical cells covered with short appressed hairs . . . . . Aetalionidae (Bitturitiinae, Stelocantrinae).

-- Clavus towards base at most slightly constricted and rounded as result of flexure of A_2 (Fig. 28). Peripheral membrane usually broad, crimped, if virtually not crimped, then more than one subapical cell present and apical cells not covered by hairs . . . . . 6.

6. R, M, and CuA in wing base forming common trunk dividing at once into 3 veins. Basal cell not developed. 4 transverse veins, 7 apical cells . . . . . Nicomiidae.

-- If trunk of R+M+CuA developed, then dividing into 2 veins: either R+M and CuA (in this case basal cell developed: Fig. 34), or R and M+CuA. If transverse veins few (not more than 6), then 5 apical cells present. .Membracidae.

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