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Key to Diptera families (adults)

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See last page for book title page.

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J. Richard Vockeroth, Verner Michelsen, and Stephen A. Marshall

Introduction

The present key is the first of its kind that deals with the families of Diptera of Central America. Previously, one had to rely on keys to the world Diptera fauna (Hendel, 1936–1938; Brues et al., 1954; Hennig, 1973) for the identification of flies from this area. Apart from the unavoidable shortcomings due to their global approach, these keys are long outdated and do not reflect recent progress in Diptera systematics. The present key is also the first regional treatment dealing with the New World tropics. The only existing regional Neotropical keys are partial and deal with the highly aberrant fauna of temperate South America (Malloch, 1948; Peña, 1987). At present there is still no key that covers the whole Neotropical Region. Although the geographic scope of the present key consists of Central America and the Neotropical part of Mexico (Fig. 1.1), it was designed also to work for specimens from the Caribbean and South America, excluding temperate faunas of Argentina and Chile.

The Central American fauna includes 105 of a total of 113 Neotropical Diptera families. Among the eight Neotropical families not known from Central America, five have a disjunct Nearctic–temperate South American distribution in the New World (Tanyderidae, Thaumaleidae, Pelecorhynchidae, Pallopteridae, Dryomyzidae). The other three families are restricted to South America (Evocidae) or South America and the Australasian Region (Helosciomyzidae, Teratomyzidae). The number of families recorded from the Neotropical Region is approximately the same as the number of Nearctic families (116). The following 12 Nearctic families do not occur in (or have not yet been recorded from) the Neotropical Region: Deuterophlebiidae, Nymphomyiidae, Axymyiidae, Pachyneuridae, Bolitophilidae, Canthyliscelidae, Oreoleptidae, Apsilocephalidae, Hilarimorphidae, Diopsidae, Acartophthalmidae, and Opomyzidae (Apsilocephalidae has been included in the present key because it occurs near the Neotropical–Nearctic boundary and might be found in the Neotropical part of Mexico in the future). Only six Central American families do not occur (or have not yet been found) in the Nearctic Region: Pantophthalmidae, Ctenostylidae, Somatiidae, Syringogastridae, Inbiomyiidae, and Nannodastiidae. Most of these families are restricted to the Neotropical Region; the exceptions are Ctenostylidae, which also occurs in the Afrotropical and Oriental Regions, and Nannodastiidae, which occurs in the Palearctic, Oriental, and Australasian–Pacific Regions. The family Xenasteiidae, which is known from the Pacific Region, has not yet been

recorded from the New World but might well be found in coastal areas of Central or South America in the future.

In most cases the present approach to keying out certain families or groups of families is similar to that of keys for other biogeographical regions, especially the key for Nearctic Diptera provided by McAlpine (1981). This includes, for example, the traditional breakdown of “Acalyptratae” families according to the degree of development of the subcosta and costal breaks. The construction of a completely novel key was beyond the scope of this project, as this would have required a more extended period of research followed by extensive testing of the generated key. The advantages of following a more established approach are that existing problems were well known and could be addressed specifically, thereby leading to a more reliable end product. The novel approaches presented in this key include the early separation of most Tephritoidea families from the rest of acalypterate flies and a new method for keying out the problematic Oestroidea family complex.

When using the key the reader should be aware that the Neotropical fauna (including the Central American one) still remains poorly studied. A great number of taxa await description, and surprising discoveries are made on a regular basis. Because of the high number of undescribed taxa and the overwhelming diversity in certain groups, it is almost impossible to appreciate the full range of morphological variation exhibited by the families in this key. Future research will undoubtedly uncover unusual taxa that will not key properly. Most couplets in this key provide several diagnostic characters that will facilitate identification even in case of aberrant specimens or species or misinterpretation of one character. It is recommended, especially for the less experienced user, that all the characters provided in one couplet be evaluated before proceeding to the next couplet.

The present key tries to strike a balance between providing a product that satisfies the scientific user while being easy to use for a Diptera novice. This was, in part, accomplished by referring to numerous illustrations of diagnostic characters and by also incorporating habitus photographs of live exemplar specimens of almost every family. However, some characters that are indispensable for family identification can still be difficult to interpret in certain specimens. This is especially true for certain wing venational characters (e.g., the degree of development of the subcosta and the presence or absence of costal breaks) in acalypterate Diptera. To facilitate identification, one should use transmitted light against a white background (rather than reflected light) and view the wing from different angles when studying these characters. The probability of error was minimized by keying taxa with

equivocal or easily misinterpreted characters through both leads of problematic couplets (see notes following the couplets in question).

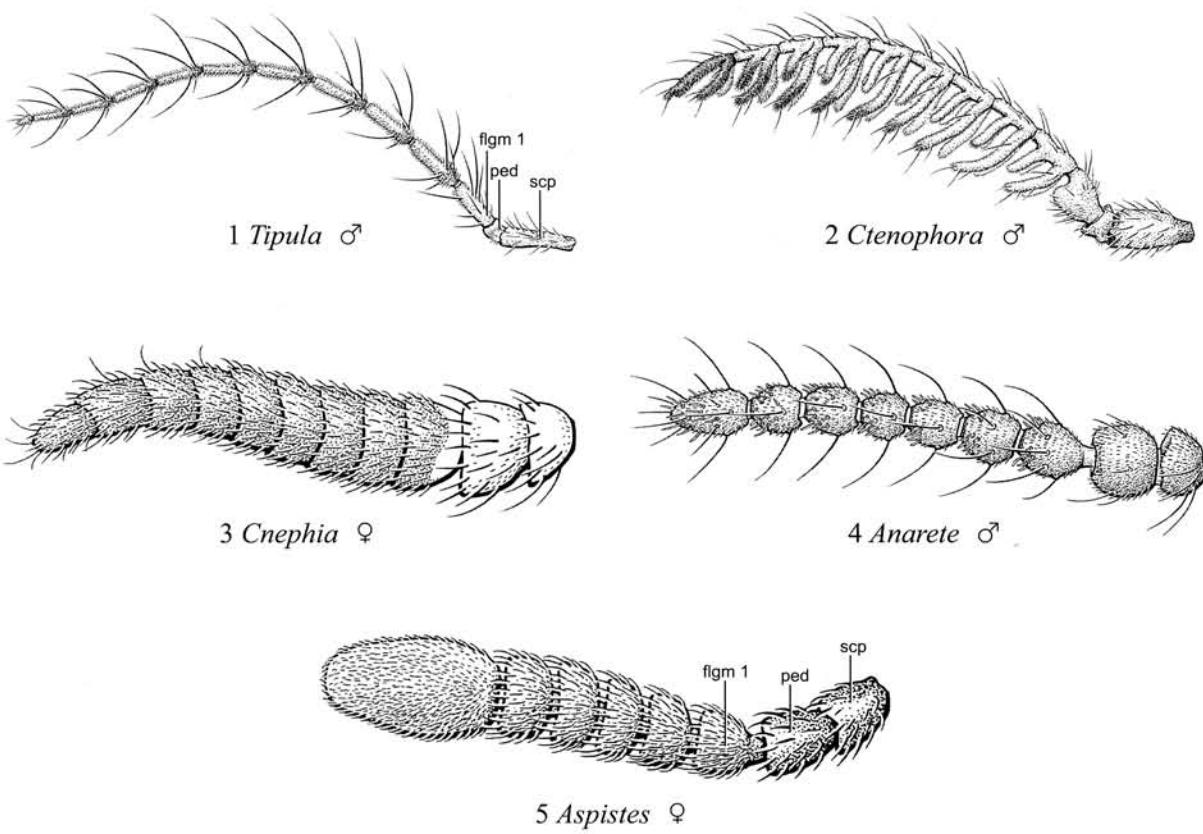
The treatments of the various subgroups of Diptera within the key were prepared by the following authors: A. Borkent and D.M. Wood (nematocerous families, excluding Sciaroidea), J.R. Vockeroth and D.M. Wood (Sciaroidea), N.E. Wood-

ley (lower Brachycera), T. Pape (Oestroidea), V. Michelsen (Muscoidae), M. Buck (separation of major groups, Cyclorrhapha, excluding Calyptratae), and S.A. Marshall (miscellaneous contributions). Various other authors of this book provided invaluable help in the construction of couplets dealing with particular families.

Key to the families of Diptera of Central America

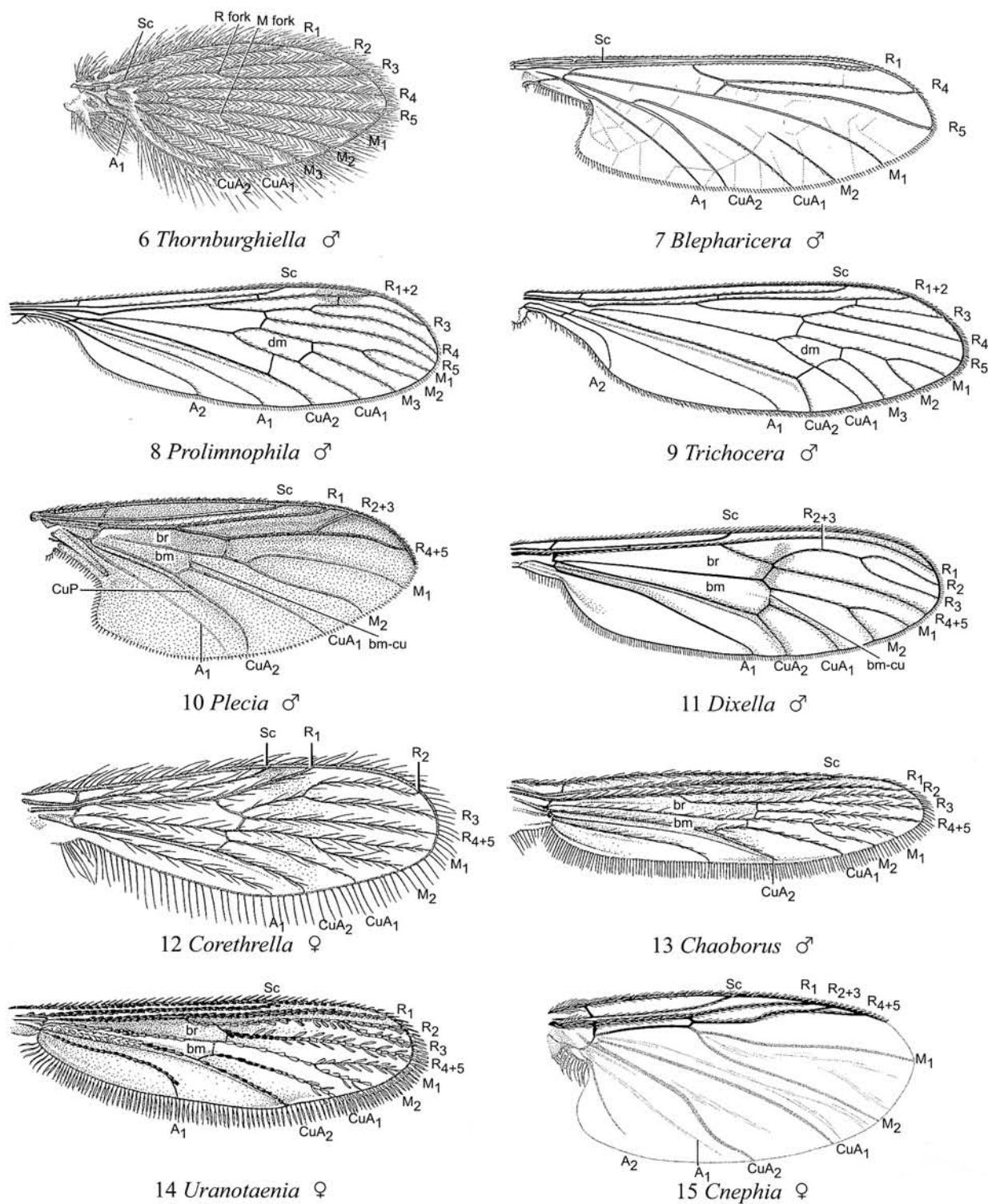
1. Macropterous; wings developed and apparently functional, longer than thorax 2
- Apterous or brachypterous; wing rudiment or remnant, if present, usually not longer than thorax, if longer then wing extremely narrow (strap-shaped or linear) with more or less obliterated venation 157
Note: Doubtful cases will key either ways.
2. Antennal flagellum with at least four (usually more than eight) articulating flagellomeres, with distal segments not consolidated into stylus or arista (Figs. 1–5; 2.10–2.12); wing lacking closed cell cup (Figs. 6–32); palpus with one to five segments (Figs. 34–39); nematocerous families . . . 4
- Antennal flagellum usually more compact, with eight flagellomeres at most (except *Rachicerus* Walker, Xylophagidae: Fig. 55), apical flagellomeres usually differentiated into stylus or arista (Figs. 2.23–2.28), if flagellum with four or more flagellomeres and arista or stylus not developed then cell cup closed (Fig. 58); palpus with one or two segments (Figs. 57, 177, 185), rarely vestigial or absent; BRACHYCERA. 3
3. Ptilinal fissure absent (Figs. 49–53); lower BRACHYCERA and lower CYCLORRHAPHA*. 32
- Ptilinal fissure present (Figs. 2.4; 133, 134, 138–143, 175–187); CYCLORRHAPHA SCHIZOPHORA** 58
***Note:** Includes some unusual Sciomyzidae with ptilinal fissure reduced or absent.
****Note:** Includes some unusual Syrphidae with frontal sulcus that strongly resembles a ptilinal fissure.
4. Wing with two strong anal veins, A_1 and A_2 , both reaching wing margin (Figs. 8, 9); legs long and slender 5
- Wing with at least A_2 fading out before margin, or absent (Figs. 10–32); legs various. 6
5. Scutum with complete V-shaped transverse suture (Fig. 8.2); ocelli absent or rudimentary (Fig. 2.64); widespread Tipulidae, in part
- Scutum with V-shaped suture incompletely developed medially; ocelli present (Fig. 20.1); Mexico Trichoceridae
6. Wing with many nearly parallel veins, seven to eight branches of R and M reaching wing margin (four to five branches of R and three of M); each vein covered with short to long hairs; crossveins absent or with r-m proximal and inconspicuous (Fig. 6); in subfamily Psychodinae all parts of head and body covered with long hairs (Fig. 19.1) Psychodidae, in part
- Wing with fewer veins, together no more than six branches of R and M reaching wing margin (one to four branches of R and zero to three branches of M); veins with short hairs, scales, or bare; crossvein r-m more conspicuous, or if absent with venation much reduced (Figs. 10–32); body without dense covering of long hairs 7
7. Thorax with prehalter (elongate, setose lobe arising from anterior margin of halter) (Fig. 41) Ptychopteridae
- Thorax without prehalter 8

8. Wing with four branches of R reaching wing margin (Figs. 11–14) 9
 – Wing with one to three branches of R reaching wing margin (Figs. 15–32) 13
9. Proboscis long and slender, at least twice as long as head capsule and covered with scales (Fig. 27.2); legs more or less covered with appressed scales Culicidae
 – Proboscis stout, less than twice as long as head capsule and lacking scales (Figs. 34–39); legs with or without scales 10
10. R_{2+3} strongly convex anteriorly (Fig. 11) Dixidae
 – R_{2+3} straighter, parallel with R_1 (Figs. 12, 13) 11
11. Eyes broadly separated medially, with ommatidia restricted to outer margin of head capsule (as in Fig. 35); wing with apex of Sc nearly transverse and terminating at less than 0.30 of wing length, with crossvein sc-r well developed; hind margin of wing with row of simple setae Psychodidae, in part (Sycoracinae)
 – Eyes narrowly separated, with ommatidia extending medially, in some nearly meeting (Fig. 39); wing with apex of Sc nearly parallel to anterior wing margin and terminating at more than 0.45 of wing length, without crossvein sc-r; hind margin of wing with row of broad scales 12



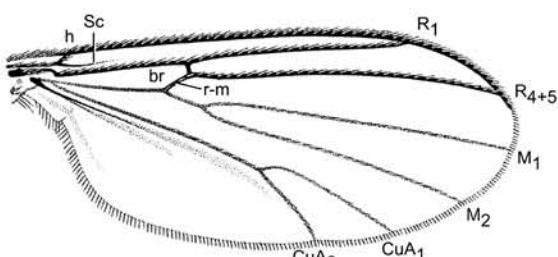
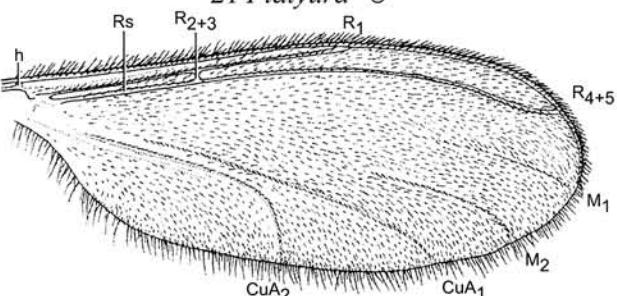
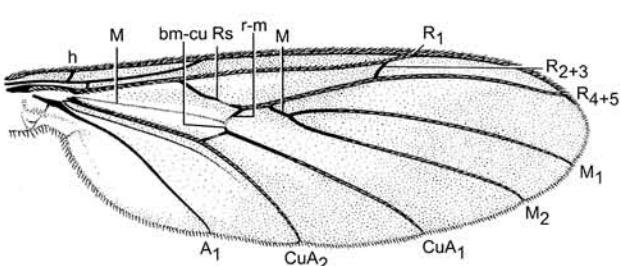
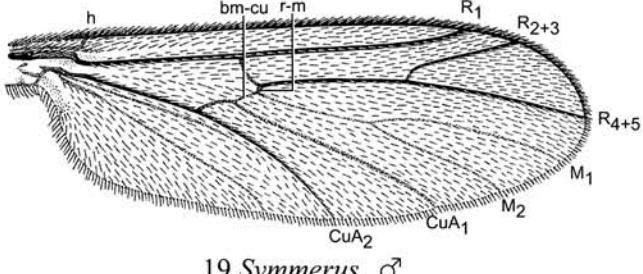
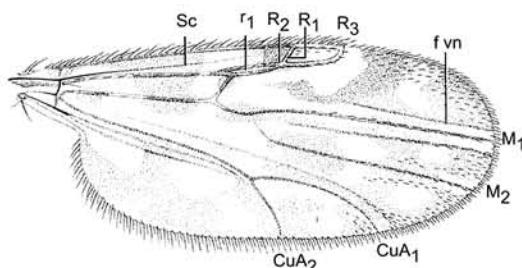
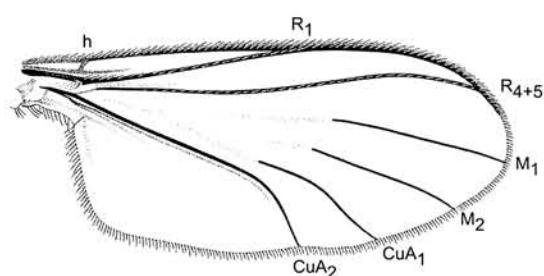
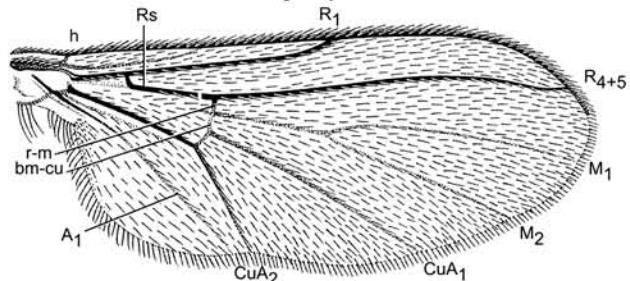
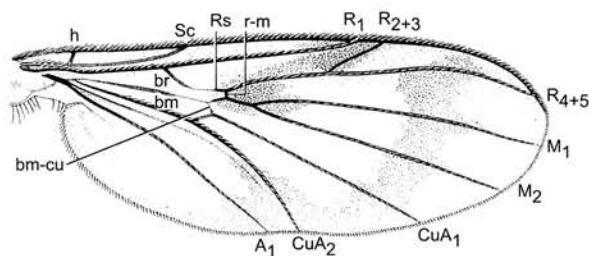
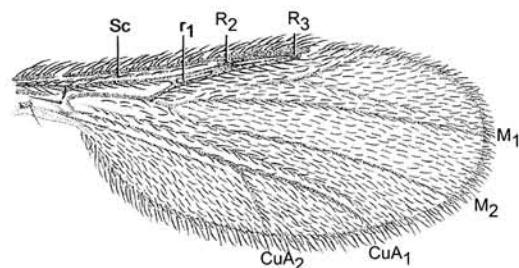
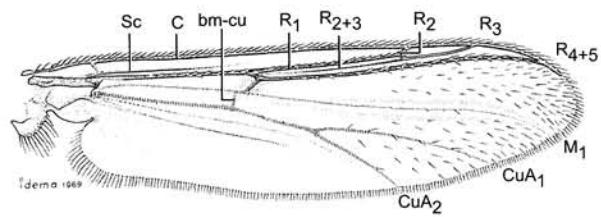
Figs. 6.1–5. Antennae of nemácerous Diptera: lateral view of (1) *Tipula triplex* Walker, (Tipulidae), (Nearctic, MND, figs. 2.15, 7.13); (2) *Ctenophora apicata* Osten Sacken, (Tipulidae), (Nearctic, MND, figs. 2.17, 7.8); (3) *Cnephia dacotensis* (Dyar & Shannon), (Simuliidae), (Nearctic, MND, fig. 2.18); (4) *Anarete anepsia* Pritchard, (Cecidomyiidae), (Nearctic, MND, fig. 16.37); and (5) *Aspistes hartii* Malloch, (Scatopsidae), (Nearctic, MND, figs. 2.21, 20.12).

Abbreviations: flgm 1, first flagellomere; ped, pedicel; scp, scape.



Figs. 6.6–15. Wings of nematocerous Diptera: dorsal view of (6) *Thornburghiella marginalis* (Banks), (Psychodidae), (Nearctic, MND, figs. 4.2, 17.11, as *Pericomia*); (7) *Blepharicera tenuipes* (Walker), (Blephariceridae), (Nearctic, MND, fig. 4.3); (8) *Prolimnophila areolata* (Osten Sacken), (Tipulidae), (MND, figs. 4.6, 7.47); (9) *Trichocera garretti* Alexander, (Trichoceridae), (Nearctic, MND, fig. 18.3); (10) *Plecia americana* Hardy, (Bibionidae), (Nearctic, MND, figs. 4.10, 13.6); (11) *Dixella nova* (Walker), (Dixidae), (Nearctic, MND, figs. 4.11, 23.4); (12) *Corethrella* sp., (Corethrellidae), (MND, fig. 24.3, as Chaoboridae); (13) *Chaoborus americanus* (Johannsen), (Chaoboridae), (Nearctic, MND, figs. 4.12, 24.2); (14) *Uranotaenia sapphirina* (Osten Sacken), (Culicidae), (Nearctic, MND, figs. 4.14, 25.5); and (15) *Cnephia dacotensis* (Dyar & Shannon), (Simuliidae), (Nearctic, MND, figs. 4.18, 27.27).

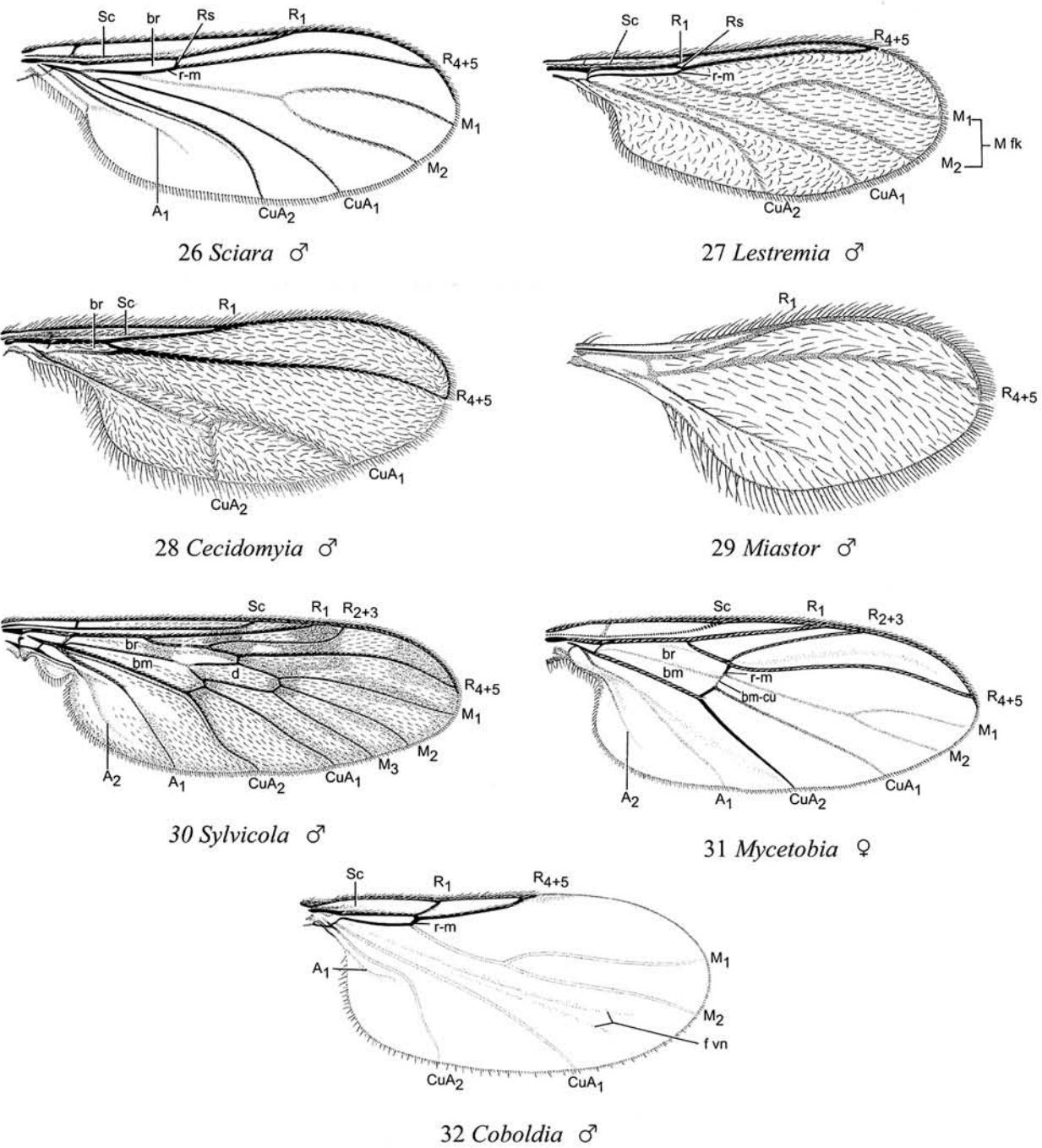
12. R_1 ending in wing margin nearer to apex of Sc than to apex of R_2 (Fig. 12); midfemur thicker than hind femur Corethrellidae
- R_1 ending near wing apex, nearer to apex of R_2 than to apex of Sc (Fig. 13); mid and hind femur of similar diameter Chaoboridae
13. Wing membrane with network of foldlike lines between true veins (Fig. 7) Blephariceridae
- Wing membrane without network of folds or creases (Figs. 15–32) 14
14. Tarsomere 1 much shorter than tarsomere 2 (Fig. 44) or, if approximately equal, with four or fewer tarsomeres and at most two veins posterior to R_s (Fig. 29); tibiae without apical spurs Cecidomyiidae, in part (Porricondylinea, Cecidomyiinae)
- Tarsomere 1 longer than or equal to tarsomere 2, tarsus with five tarsomeres; with at least three veins posterior to R_s ; fore- and hind tibia each with zero to two apical spurs 15
15. First abdominal tergite with long setae laterally, remaining tergites with only short setae (Fig. 48) Simuliidae
- First abdominal tergite either without setae or with short to moderately elongate setae subequal to those of subsequent tergites 16
16. Antenna with 4–11 flagellomeres, each small and compact (except apical one), not spherical (Figs. 5, 33) 17
- Antenna with five to more than 11 flagellomeres, but if 11 or fewer, these spherical to elongate (as in Figs. 2.11, 2.12; 4, 34) 20
17. Ocelli absent; M unbranched (Fig. 16) Chironomidae, in part
- Ocelli present; M with two branches (Figs. 10, 25, 32), base of M_1 sometimes obsolete 18
18. Crossvein bm-cu present; Sc well developed, as wide or nearly as wide at midlength as width of R (Fig. 10) Bibionidae
- Crossvein bm-cu absent; Sc absent or extremely shortened (Figs. 25, 32) 19
19. Tibial spurs absent; eyes usually holoptic, three ocelli present; palpus with one segment (Fig. 22.1); CuA forked at base of wing, without stem (Fig. 32) Scatopsidae
- Tibial spurs long (as in Fig. 15.1); eyes broadly dichoptic, only two ocelli present; palpus with three apparent segments, basal one strongly swollen (Fig. 35); CuA forked near middle of wing, with long stem (as in Fig. 25). Mycetophilidae, in part (*Cordyla* Meigen)
20. Wing with discal cell; M with three branches (Fig. 30) Anisopodidae, in part (Anisopodinae)
- Wing without discal cell; M at most with two branches (Figs. 16–26) 21
21. Ocelli absent (Figs. 36, 38); antenna with short, flattened scape and enlarged, globular pedicel, especially in males (Figs. 2.11, 2.12; 38) 22
- Usually with two to three ocelli (some Mycetophilidae with median ocellus absent, and lateral ocelli located next to eyes) (Figs. 34, 35), if ocelli absent then scape and pedicel of similar size 24
22. M unbranched (Fig. 16); postnotum usually with longitudinal groove (Fig. 45), if absent (Podonominae) then crossvein m-cu present (as in Fig. 16); eyes dichoptic Chironomidae, in part
- M usually with two branches (sometimes difficult to see); crossvein m-cu absent (Figs. 17, 18, 27); postnotum without longitudinal groove; eyes holoptic or dichoptic 23



Figs. 6.16–25. Wings of nematocerous Diptera (continued): dorsal view of (16) *Procladius freemani* Sublette, (Chironomidae), (Holarctic, MND, figs. 4.13, 29.2); (17) *Culicoides insignis* Lutz, (Ceratopogonidae), (MND, figs. 4.15, 28.21); (18) *Forcipomyia fairfaxensis* Wirth, (Ceratopogonidae), (Nearctic, MND, figs. 4.16, 28.17); (19) *Symmerus vockerothi* Munroe, (Ditomyiidae), (Nearctic, MND, fig. 14.12, as Mycetophilidae); (20) *Paleoplatyura johnsoni* Johannsen, (Keroplatidae), (Nearctic, MND, figs. 4.19, 14.19, as Mycetophilidae); (21) *Platyura nigriventris* (Johannsen), (Keroplatidae), (Nearctic, MND, fig. 14.18, as Mycetophilidae); (22) *Diadocidia ferruginosa* (Meigen), (Diadocidiidae), (Holarctic, MND, fig. 14.14, as Mycetophilidae); (23) *Colonomyia albicaulis* Colless, (*Ohakunea* group, unassigned to family), (Australasian, Hippa & Jaschhof, 2004, fig. 3); (24) *Lygistorrhina sanctaecathariniae* Thompson, (Lygistorrhinidae), (Nearctic, MND, fig. 14.21, as Mycetophilidae); and (25) *Phronia cordata* Lundström, (Mycetophilidae), (Holarctic, MND, fig. 14.70).

Abbreviation: f vn, false vein.

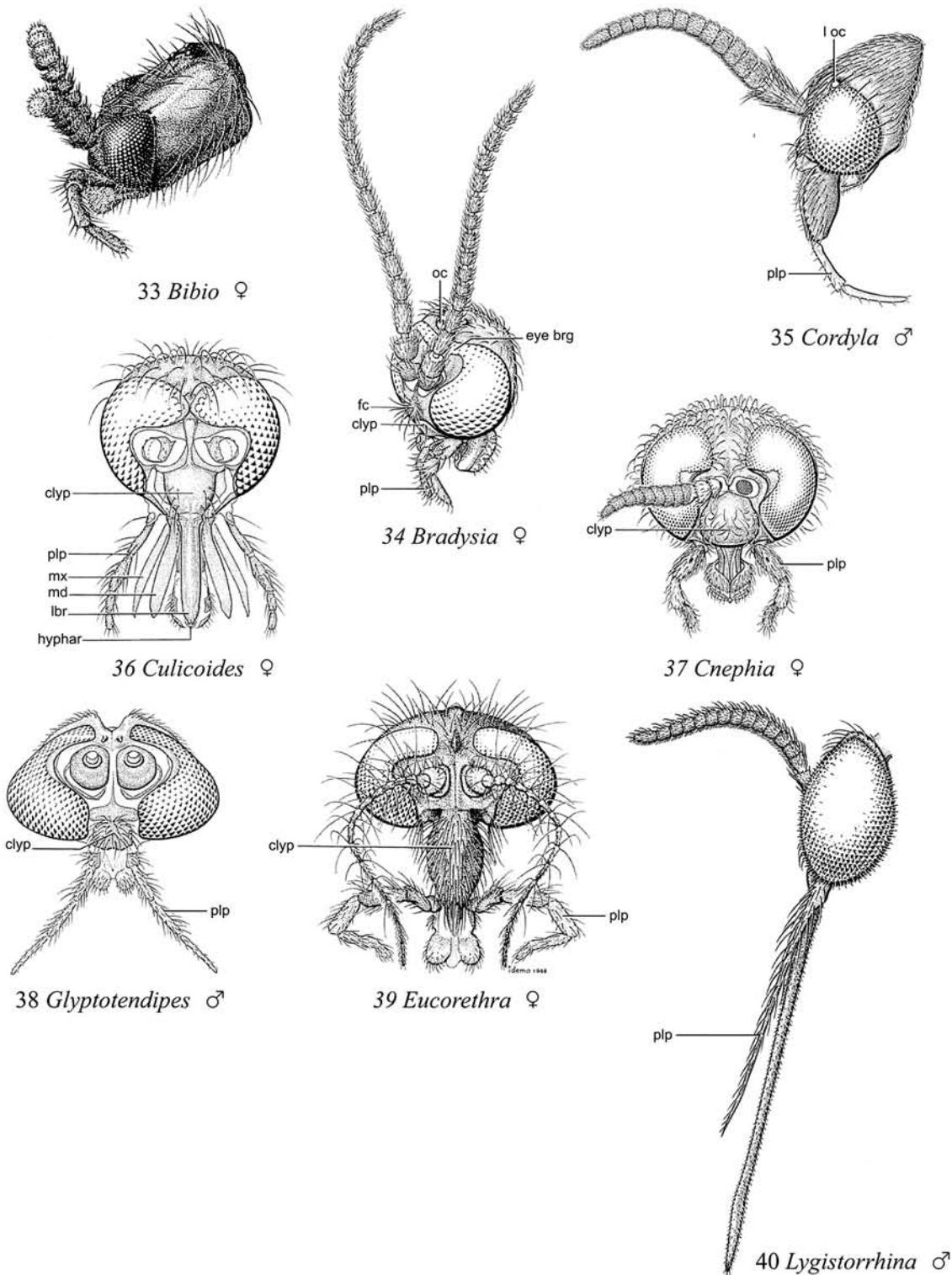
23. CuA either forked near base of wing, without stem, or CuA₁ obsolescent at base, disconnected from CuA₂; vein R₂₊₃ absent and cell r₁ not closed (as in Fig. 27); antenna with 10 or fewer flagellomeres; tibial spurs absent; female mouthparts not piercing, adapted for lapping and sucking, mandibles vestigial (as in Fig. 34) Cecidomyiidae, in part (*Conarete* Pritchard)
- CuA forked near middle of wing, with long stem; CuA₁ complete, joined at base with CuA₂; cell r₁ usually closed before wing margin by short, crossvein-like R₂ or brief fusion of R₁ and Rs (Figs. 17, 18); antenna with 6–13 flagellomeres, rarely with 10 or fewer; tibial spur present at least on hindleg, sometimes small and difficult to see; female mouthparts generally adapted for bloodsucking or predatory feeding habits, most with mandibles well developed and bladelike (Fig. 36) Ceratopogonidae
24. R₂₊₃, R₄₊₅, and crossvein r-m originating at same point (as in Fig. 31) Anisopodidae, in part (*Neomesochria* Amorim & Tozoni)
- R₂₊₃ and/or r-m absent or, if both present, R₂₊₃, R₄₊₅, and crossvein r-m not originating at same point (Figs. 19–27) 25
25. Legs without tibial spurs Cecidomyiidae, in part (Lestremiinae, in part)
- Legs with tibial spurs (Fig. 16.1) 26
26. Crossvein bm-cu present, connecting M and CuA₁ well beyond level of crossvein h (Figs. 19–22) 27
- Crossvein bm-cu absent, M and CuA₁ connected at or near level of crossvein h (Figs. 25, 26) or M and CuA evanescent towards base, with apical portions of M₁, M₂, and CuA₁ detached (Figs. 23, 24) 29
27. R₂₊₃ present and at least one-third as long as R₄₊₅; Sc distinctly sclerotized for only short distance, continuing as weak fold that ends freely (Fig. 19); wing membrane with macrotrichia; postpronotum with one or more long, fine setae Ditomyiidae
- R₂₊₃ absent or present and at most one-fourth as long as R₄₊₅; Sc ending in C or in R or ending freely (Figs. 20–22); wing membrane with or without macrotrichia; postpronotum bare or with short setae 28
28. R₂₊₃ present; crossvein r-m present or absent because of contact or partial fusion of R and M (Figs. 20, 21) Keroplatidae
- R₂₊₃ absent; crossvein r-m present (Fig. 22) Diadocidiidae
29. Eyes separated dorsally, their dorsomedial corners more widely separated than ocelli, which are usually present (Figs. 35; 14.1); veins CuA₁ and CuA₂, when both present, usually forking nearer middle of wing than wing base (Fig. 25) 30
- Dorsal corners of eyes extending medially toward each other between ocelli and antennal bases, forming eye bridge, usually meeting each other at midline (Figs. 34; 16.3); veins CuA₁ and CuA₂, when both present, forking almost at base of wing (Figs. 23, 26; 18.3, 18.4; rarely basal half of CuA₁ absent, Fig. 24) 31
30. Proboscis and palpus both long and slender, proboscis longer than combined length of head and thorax and palpus longer than half length of proboscis (Fig. 40); basal portions of veins M₁, M₂, and CuA₁ absent, only their apices reaching wing margin (Fig. 24) Lygistorrhinidae
- Proboscis shorter than height of head, and palpus longer than proboscis; base of vein M usually present, if weak or absent (Figs. 15.4, 15.17, 15.18), then CuA present from wing base to margin, usually forking to CuA₁ and CuA₂ (Figs. 15.4–15.7) Mycetophilidae, in part



Figs. 6.26–32. Wings of nematocerous Diptera (concluded): dorsal view of (26) *Sciara* sp., (Sciaridae), (MND, figs. 4.21, 15.15); (27) *Lestremia cinerea* Macquart, (Cecidomyiidae), (Holarctic, South America, MND, fig. 16.12); (28) *Cecidomyia resinicola* (Osten Sacken), (Cecidomyiidae), (Nearctic, MND, figs. 4.22, 16.32); (29) *Miastor metraloas* Meinert, (Cecidomyiidae), (Holarctic, MND, fig. 16.21, as *Miastor americana* Felt); (30) *Sylvicola fenestralis* (Scopoli), (Anisopodidae), (Holarctic, MND, figs. 4.23, 19.4); (31) *Mycetobia divergens* Walker, (Anisopodidae), (Nearctic, MND, figs. 4.24, 19.2); and (32) *Coboldia fuscipes* (Meigen), (Scatopsidae), (MND, figs. 4.26, 20.3).

Abbreviations: f vn, false vein; M fk, fork of vein M.

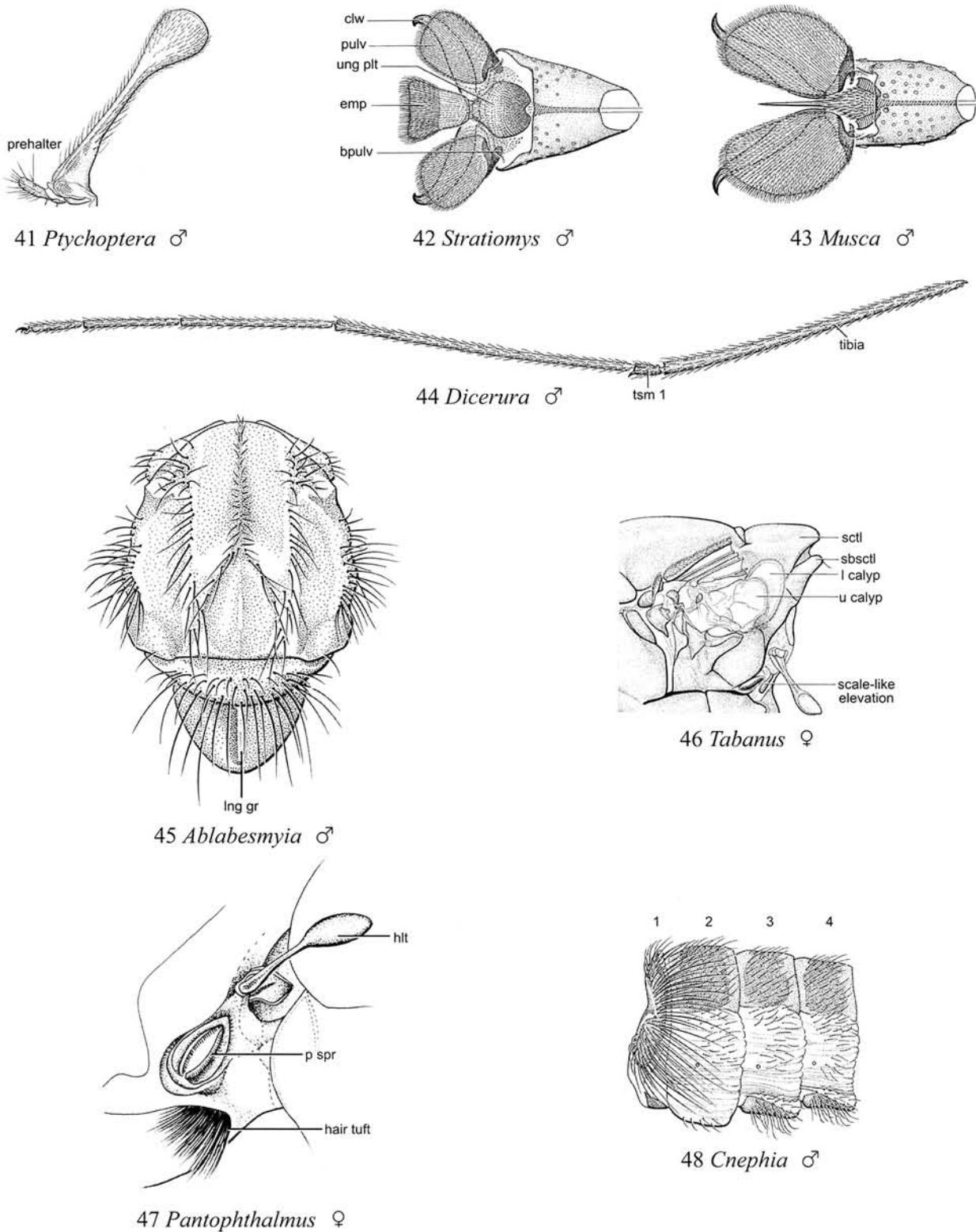
31. R_1 and R_{4+5} interconnected, usually near middle of R_1 , with stout crossvein (Rs) but not connected to one another at base (Fig. 26); basal stem of vein M usually well developed; ocelli present. Sciaridae, in part
- R_1 and R_{4+5} interconnected only at base by weak, often transparent Rs (Figs. 18.3, 18.4) and ocelli absent, or R_1 and R_{4+5} connected at base by Rs and also more distally by R_{2+3} (Fig. 23) and ocelli present; basal stem of vein M weak or absent (Figs. 23; 18.3, 18.4). Ohakunea group (unassigned to family)
32. Empodium pulvilliform, each acropod with three similar flattened pads below tarsal claws (Fig. 42); CuA₂ free or meeting A₁ in acute angle near wing margin (Figs. 58–63) 33
- Empodium setiform or absent, each acropod with only two flattened pads below tarsal claws (Fig. 43); if acropod with three pads then empodium much narrower and more tapered than pulvilli; rarely empodium somewhat pulvilliform (some water-striding Empididae and Dolichopodidae), but in these taxa CuA₂ joining A₁ at obtuse angle far from wing margin (Fig. 84) 42
33. Head unusually small in proportion to the body, rarely more than half as wide as thorax (Fig. 39.1); eyes holoptic or nearly so in both sexes; lower lobe of calypter extremely large, wider than head (Fig. 39.1). Acroceridae
- Head more than half as wide as thorax; eyes not holoptic in female; lower lobe of calypter smaller, not as wide as head. 34
34. Branches of R and M more or less converging to apex of wing (Fig. 59); branches of M curving forward and ending before or scarcely behind apex of wing; composite “diagonal vein” running from distal end of cell br to posterior margin of wing (Fig. 59) Nemestrinidae
- Branches of R and M diverging to wing apex; branches of M ending behind apex of wing; no composite “diagonal vein”. 35
35. Posterior thoracic spiracle with scalelike elevation immediately posterior to it (Fig. 46). 36
- Posterior thoracic spiracle without scalelike elevation immediately posterior to it. 37
36. Antennal flagellum appearing composed of two flagellomeres (Fig. 49); small basal flagellomere only slightly larger than pedicel, and apical flagellomere in form of long, arista-like stylus; R_{2+3} ending in R_1 or near R_1 at C (Fig. 60); R_4 and R_5 only gradually divergent beyond fork; fork originating at distal margin of cell d or proximal to it. Athericidae
- Antennal flagellum composed of two to eight flagellomeres (usually four or more), forming complex much larger than pedicel, and without arista-like stylus; R_{2+3} ending well beyond R_1 at C (Fig. 61); R_4 and R_5 strongly divergent beyond fork; fork originating well beyond distal margin of cell d. Tabanidae
37. Foretibia with apical spur. 38
- Foretibia without apical spur. 39
38. Antennal flagellum with seven or eight more or less unmodified flagellomeres (Fig. 52), or with 15–30 slightly to strongly ventrally pectinate flagellomeres (Fig. 55); disc of scutellum at least slightly convex, with obvious erect hairs. Xylophagidae
- Antennal flagellum with first flagellomere ovoid, tapering apically, remaining flagellomeres forming slender elongate stylus (Fig. 31.1); disc of scutellum flat, without erect hairs. Vermileonidae
39. Antennal flagellum with basal flagellomere small, at most slightly larger than pedicel, remaining flagellomeres modified into extremely slender, arista-like stylus (Fig. 71); clypeus bulbous (as in Fig. 50), evenly convex, delimited laterally from parafacials and usually dorsally by deep sutures; wing cell m₃ open (as in Fig. 60); mostly slender flies with long, delicate legs. Rhagionidae



Figs. 6.33–40. Heads of nematocerous Diptera: dorsolateral view of (33) *Bibio* sp., (Bibionidae), (MND, fig. 13.3); anterolateral view of (34) *Bradysia impatiens* (Johannsen), (Sciaridae), (Nearctic, MND, figs. 4.77, 15.4); lateral view of (35) *Cordyla* sp., (Mycetophilidae), (MND, figs. 4.78, 14.9); anterior view with mouthparts spread laterally of (36) *Culicoides yukonensis* Hoffman, (Ceratopogonidae), (Nearctic, MND, figs. 4.80, 28.46); anterior view of (37) *Cnephia dacotensis* (Dyar & Shannon), (Simuliidae), (Nearctic, MND, figs. 4.81, 27.5); (38) *Glyptotendipes barbipes* (Staeger), (Chironomidae), (Holarctic, Oriental, MND, figs. 4.83, 29.22); and (39) *Eucorethra underwoodi* Underwood, (Chaoboridae), (Nearctic, MND, figs. 4.84, 24.4); lateral view of (40) *Lygistorrhina sanctaecatharinae* Thompson, (Lygistorrhinidae), (Nearctic, MND, fig. 14.6, as Mycetophilidae).

Abbreviations: clyp, clypeus; eye brg, eye bridge; fc, face; hyphar, hypopharynx; lbr, labrum; l oc, lateral ocellus; md, mandible; mx, maxilla; oc, ocellus; plp, palpus.

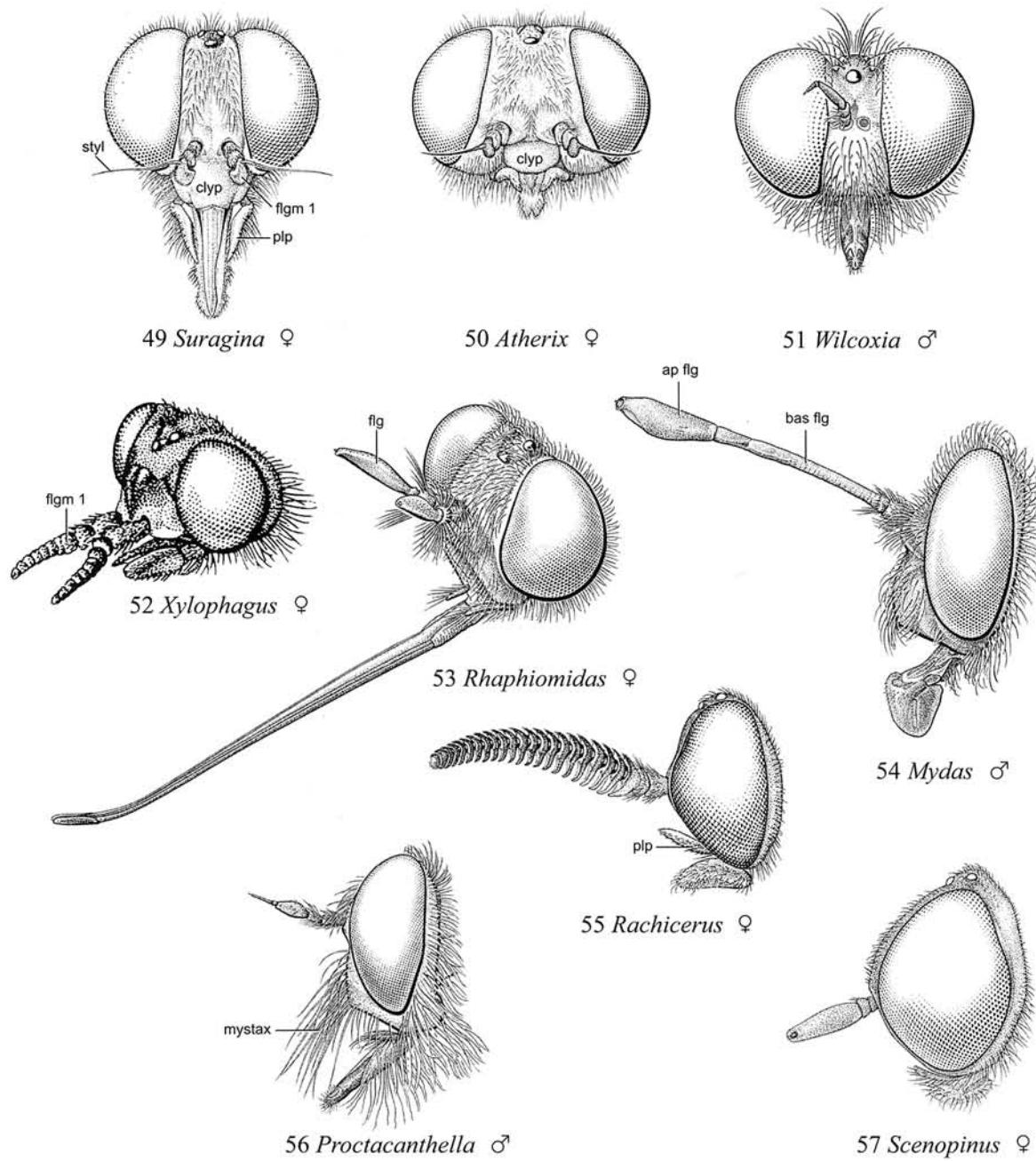
- Antennal flagellum highly varied, but not with single basal flagellomere followed by arista-like stylus (some Stratiomyidae with arista-like stylus have basal flagellar complex formed from several flagellomeres); clypeus usually flat or concave, but if convex not evenly so, not bulbous; wing cell m_3 open or closed before wing margin; body form highly varied, but without long, delicate legs 40
- 40. R_4 and R_5 strongly divergent beyond fork (similar to Fig. 61); R_5 ending well posterior to wing apex; distinct tuft of elongate hairs present just below posterior thoracic spiracle (Fig. 47); large to extremely large, heavy-bodied brownish to blackish flies Pantophthalmidae
- R_{4+5} not forked or R_4 and R_5 gradually diverging from fork, R_{4+5} or R_5 ending at to well anterior to wing apex; no obvious hair tuft just below posterior thoracic spiracle; body form and color highly varied, but not extremely large in size 41
- 41. Cell m_3 closed before wing margin (as in Fig. 58); radial veins not strongly crowded anteriorly; R_5 ending at apex of wing; discal cell usually elongate, usually two to three times longer than wide (as in Fig. 58); mid and hind tibiae with apical spurs (can be small and difficult to see in *Solva* Walker, which has hind femur swollen and armed with blunt tubercles on ventral surface). Xylomyidae
- Cell m_3 open (Fig. 63) or vein M_3 absent (Fig. 62); radial veins strongly crowded anteriorly; R_5 ending well anterior to apex of wing; discal cell usually small, about as long as wide; midtibia rarely with tiny apical spur, hind tibia without apical spurs Stratiomyidae
- 42. Basal part of wing modified, narrowed to almost linear, thus veins CuA_1 and A_1 and cell cup absent; hind femur slender with bulbously enlarged apex; abdomen strongly clavate, with first four segments slender, those beyond segment 4 larger Asilidae, in part (*Eurhabdus* Aldrich, *Leptopteromyia* Williston)
- Basal part of wing sometimes slender, but with veins CuA_1 and A_1 and cell cup usually present (if absent hind femur and abdomen different); hind femur and abdomen various 43
- 43. CuA_2 reaching wing margin near A_1 (Fig. 64) or joining it near wing margin (i.e., cell cup open or closed near wing margin) (Fig. 65); if joining A_1 then CuA_2 at least 1.5 times as long as A_1+CuA_2 44
- CuA_2 absent, vestigial, or joining A_1 far from wing margin (Figs. 66, 84); if joining A_1 then CuA_2 not or scarcely longer than A_1+CuA_2 (except rarely in Platypezidae, Fig. 87) 52
- 44. Branches of M peculiarly curved forward, more or less parallel to posterior wing margin, apical portions of veins R_5 and M_1 parallel to each other, M_1 ending well before wing apex (Fig. 68); R_5 separate from R_4 ; large, asilid-like flies 45
- Branches of M not configured as above, but if curved anteriorly, then not ending freely in wing margin and apical portions of veins R_5 and M_1 not parallel to each other; M_1 usually ending at or well behind wing apex; R_5 frequently fused with R_4 to form R_{4+5} ; size and form various. 46
- 45. M_2 ending in M_1 or CuA_1 before wing margin, or ending freely in wing margin anterior to wing tip (Figs. 67, 68); antennal flagellum long in most species, with slender stalklike base and strongly clubbed apex, stalk at least twice as long as combined length of scape and pedicel (Fig. 54), but shorter than head, without stalklike base, and spindle shaped in *Rhaphiomidas* Osten Sacken (Fig. 53); vertex almost always with ocellar triangle highly modified, only anterior ocellus obviously present (excluding *Rhaphiomidas*, which has three unmodified ocelli). Mydidae
- M_2 ending in wing margin well posterior to wing tip (Fig. 69); flagellum shorter than head, without stalklike base; entire flagellum not much longer than combined length of scape and pedicel; vertex with ocellar triangle unmodified, with three distinct ocelli. Apioceridae



Figs. 6.41–48. Special characters of Diptera: dorsal view of right halter of (41) *Ptychoptera quadrifasciata* Say, (Ptychopteridae), (Nearctic, MND, fig. 2.71); ventral view of fifth tarsomere of (42) *Stratiomys badia* Walker, (Stratiomyidae), (Nearctic, MND, fig. 2.75); and (43) *Musca autumnalis* DeGeer, (Muscidae), (Holarctic, MND, fig. 2.78); tibia and tarsus of left foreleg of (44) *Dicerura furcata* (Felt), (Cecidomyiidae), (Nearctic, MND, fig. 16.81, as *Neosynepedosis*); dorsal view of thorax of (45) *Ablabesmyia* sp., (Chironomidae), (MND, fig. 29.26); lateral view of posterior half of thorax of (46) *Tabanus sulcifrons* Macquart, (Tabanidae), (Nearctic, MND, fig. 4.168); lateral view of posterior thoracic spiracle and halter of (47) *Pantophthalmus* sp., (Pantophthalmidae), (illustrated by A. Brenes); lateral view of first four abdominal segments of (48) *Cnephia dacotensis* (Dyar & Shannon), (Simuliidae), (Nearctic, MND, fig. 27.34).

Abbreviations: bpulv, basipulvillus; clw, claw; emp, empodium; hlt, halter; l calyp, lower calypter; lng gr, longitudinal groove; p spr, posterior thoracic spiracle; pulv, pulvillus; sbsctl, subscutellum; sctl, scutellum; tsm 1, first tarsomere; u calyp, upper calypter; ung plt, unguirtractor plate.

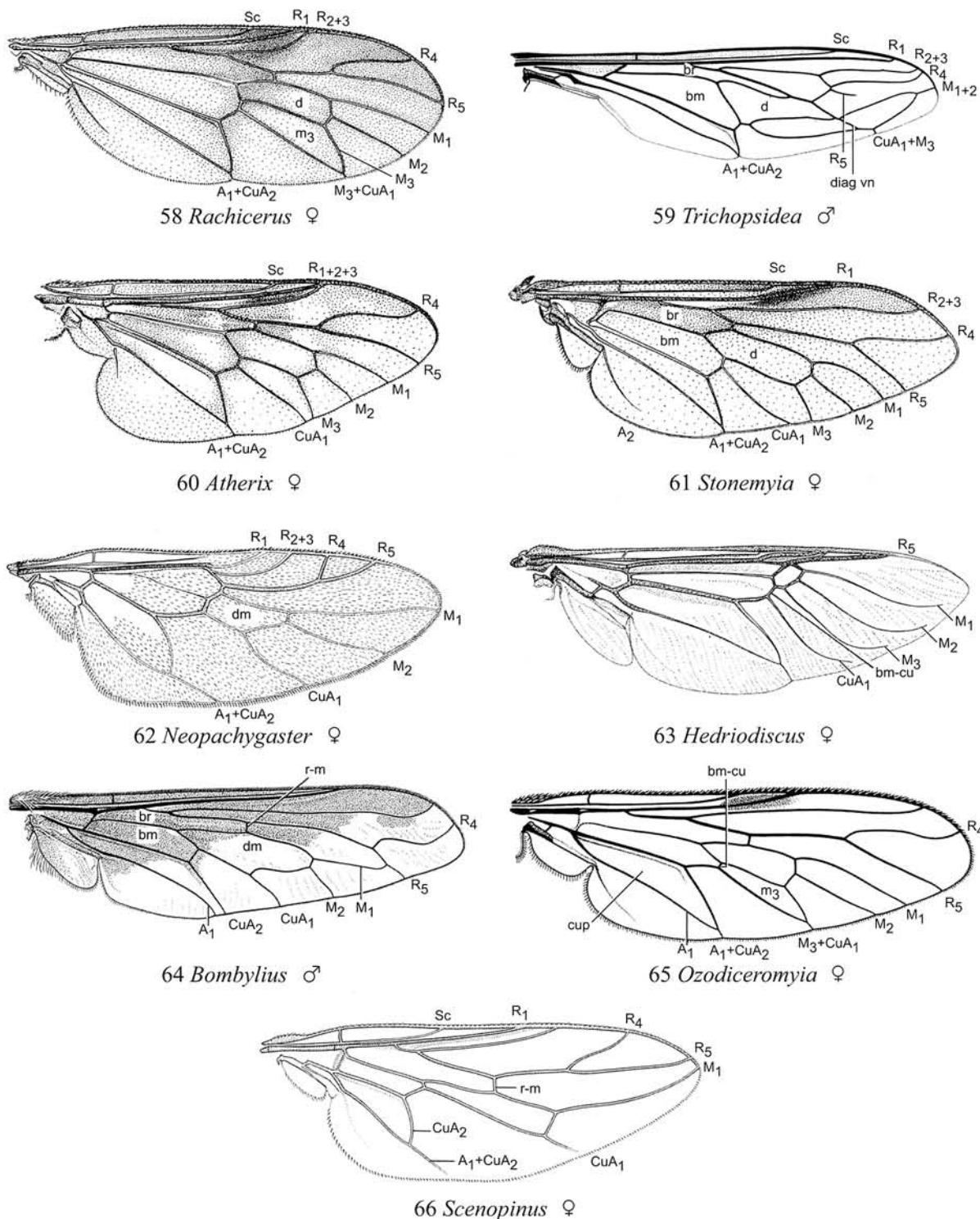
46. Spurious vein usually evident as veinlike fold between R_s and M ; M_1 curved forward more or less in line with crossvein $dm-cu$ and joining unbranched R_{4+5} near or anterior to the wing apex (Figs. 89, 90) Syrphidae, in part
- Spurious vein undeveloped; M_1 not curved forward, usually ending freely in wing margin, but if not (some Asilidae, Bombyliidae) then joining R_5 beyond fork of R_{4+5} or rarely at the point of bifurcation, near posterior margin of wing 47
47. Head strongly hemispherical, with eyes unusually large and almost meeting on midline both above and below antennae; flagellum with dorsal arista; R_{4+5} unbranched; C ending at wing apex (Fig. 91) Pipunculidae
- Head usually not hemispherical, but if so (some Bombyliidae), then flagellum without dorsal arista; R_{4+5} usually forked; C usually continuing around wing apex 48
48. Vertex usually distinctly excavated between eyes (Fig. 51), ocellar tubercle below dorsal level of eyes; eyes not holoptic; face relatively long, with cluster or row of long bristles (mystax) (Fig. 56); proboscis stout and polished; labella reduced and inconspicuous; hypopharynx protrusible, strongly developed for piercing Asilidae, in part
- Vertex not or only slightly concave, ocellar tubercle usually elevated above dorsal level of eyes; eyes usually holoptic in male; face relatively short, sometimes hairy, but without mystax; proboscis short and stout to long and slender, usually dull pruinose; labella usually well developed and conspicuous; hypopharynx not protrusible, not developed for piercing 49
49. Crossvein $m-cu$ present; cell bm truncate distally and with four corners from which arise four separate veins (M_{1+2} , M_3 , CuA_1 , and CuA_2) (e.g., Fig. 65); M_3 present; base of cell m_3 truncate 50
- Crossvein $m-cu$ absent; cell bm , when present, pointed distally and with three corners from which arise three separate veins (M_{1+2} , CuA_1 , and CuA_2) (Figs. 64, 70); M_3 absent or present, when present base of cell m_3 pointed 51
50. Five or more pairs of dorsocentral setae; male aedeagus elongate, coiled; male with articulated surstyli; Nearctic Mexico and southwestern United States [Apsilocephalidae]
- Four or fewer pairs of dorsocentral setae; male aedeagus short, not coiled; male lacking epandrial surstyli Therevidae
51. R_5 absent, i.e., R_{4+5} unbranched (Fig. 70); palpi absent or minute; abdominal spiracles located in terga; small flies, 1–5 mm in length Mythicomyiidae
- R_5 present, i.e., R_{4+5} branched (Fig. 64); palpi present, usually large; abdominal spiracles located in pleural membrane; mostly larger flies, greater than 5 mm in length Bombyliidae
52. Flagellum with minute stylus concealed in subapical pit (Fig. 57); crossvein $r-m$ at or beyond middle of wing; R_4 separate from R_5 ; M unbranched and curved forward, joining R_5 or closely approaching it at wing margin (Fig. 66); head devoid of bristles Scenopinidae
- Flagellum usually with elongate, fully exposed stylus or arista (Figs. 2.23–2.25); crossvein $r-m$ almost always well before middle of wing (Figs. 79–87) or absent (Fig. 88), if beyond middle of wing (some Sciomyzidae) then R_4 and R_5 fused (Fig. 155); M branched (Figs. 79, 81, 83, 85–87) or unbranched (Figs. 80, 82, 84), sometimes curved forward but not as above; head usually with well-developed bristles 53
53. Wing pointed at apex, and with peculiar parallel venation; upper surface of veins with black setulae except Sc and R_{2+3} (Fig. 86); flagellum rounded, with terminal arista; slender brownish or yellowish flies Lonchopteridae
- Wing rounded at apex, with radiating venation; veins at least in posterior half of wing not setose; flagellum, body size, and color various 54



Figs. 6.49–57. Heads of orthorrhaphous Brachycera: anterior view of (49) *Suragina concinna* (Williston), (Athericidae), (MND, fig. 32.2); (50) *Atherix variegata* Walker, (Athericidae), (Nearctic, MND, fig. 32.3); and (51) *Wilcoxia martinorum* Wilcox, (Asilidae), (Nearctic, MND, fig. 42.32); anterolateral view of (52) *Xylophagus cinctus* (De Geer), (Xylophagidae), (Holarctic, MND, fig. 34.1, modified, as *Xylophagus abdominalis* Loew); and (53) *Rhaphiomidas acton* Coquillett, (Mydidae), (Nearctic, MND, fig. 41.4, as Apioceridae); lateral view of (54) *Mydas clavatus* (Drury), (Mydidae), (Nearctic, MND, fig. 40.3); (55) *Rachicerus obscuripennis* Loew, (Xylophagidae), (Nearctic, MND, fig. 34.5); (56) *Proctacanthella cacopiloga* (Hine), (Asilidae), (Nearctic, MND, fig. 42.36); and (57) *Scenopinus fenestralis* (Linnaeus), (Scenopinidae), (MND, fig. 38.7).

Abbreviations: ap flg, apical portion of flagellum; bas flg, basal portion of flagellum; clyp, clypeus; flg, flagellum; flgm 1, first flagellomere; plp, palpus; styl, stylus.

54. Branches of R strongly thickened and abbreviated, crowded anteriorly; remainder of wing blade with four other weak and peculiarly aligned veins; C ending far from wing apex, often near or before middle of wing (Fig. 88).....Phoridae, in part
- Branches of R not strongly thickened and crowded anteriorly; other veins normal; C extending to at least wing apex.....55
55. Arista three segmented, dorsobasally situated (Fig. 76); posteroapical corner of cell cup rectangular or forming wide angle; crossvein r-m located about halfway between bm-cu and dm-cu; Sc reaching C, neither R_{4+5} nor M forked (Fig. 155).....Sciomyzidae, in part (*Sepedon* group)
- Arista or stylus usually two segmented, terminally or dorsally situated (Figs. 2.23, 2.24), if three segmented (Platypezidae) then cell cup with acute posteroapical corner (Fig. 87); wing venation not as above: often either bm-cu (Figs. 81, 84, 85) or dm-cu absent (Fig. 82), if both present then crossvein r-m much closer to bm-cu than to dm-cu (Figs. 79, 80, 83, 87); Sc often apically fused with R_1 (Figs. 84, 85) or incomplete and fading away before reaching C (Figs. 81, 82); R_{4+5} and/or M often forked (Figs. 79, 81, 83, 85, 87).....56
56. Wing with both A_1+CuA_2 and Sc reaching wing margin; cell cup with acute posteroapical corner (Fig. 87); arista three segmented, terminally situatedPlatypezidae
- A_1+CuA_2 rarely reaching wing margin (some Empididae), but if so Sc incomplete (Fig. 80) and/or cell cup obtuse or rounded at posterior apex (Fig. 83); arista or stylus two segmented (Figs. 2.23, 2.24).....57
57. Rs originating at or near level of crossvein h (Figs. 84, 85), or distal to crossvein h by, at most, length of crossvein h; R_{4+5} not forked, M sometimes forked; bifurcation of M, if present, beyond level of dm-cu and M_2 not reaching wing margin (Fig. 85); crossvein r-m in basal fourth of wing; cells bm and dm confluent (crossvein bm-cu absent or incomplete); Sc usually fused with R_1 distally (except in Hydrophorinae) (Figs. 84, 85)Dolichopodidae, in part
- Rs originating well distal to level of crossvein h (usually by more than length of crossvein h) (Figs. 79–83); R_{4+5} and/or M frequently forked; bifurcation of M often near level of crossvein dm-cu and M_2 always reaching wing margin (Figs. 79, 81, 83); crossvein r-m distal to basal fourth of wing; cell bm usually separated from cell dm by crossvein bm-cu (if cell dm present) (Figs. 79, 80, 83); Sc joining C (Figs. 79, 83) or ending freely, not joining R_1 Empididae, in part
58. Body dorsoventrally flattened (Figs. 119, 120); hind coxae widely separated (Fig. 103); tarsal claws large, curved, often toothed (Fig. 106); ectoparasitic on birds or mammals; CALYPTRATAE (Hippoboscoidea).....59
- Body not strikingly dorsoventrally flattened; hind coxae contiguous or almost contiguous; claws not strongly recurved and toothed; not ectoparasitic on birds or mammals (except *Carnus* Nitzsch (Carnidae)).....60
59. Eye greatly reduced, not more than half the height of the head (Fig. 120); ectoparasitic on bats ..Streblidae, in part
- Eye large, at least three-quarters the height of the head (Fig. 119); ectoparasitic on birds and on mammals other than batsHippoboscidae, in part
60. (1) Greater ampulla present as bulbous swelling below wing base (Figs. 93; 2.42); (2) antennal pedicel with complete dorsolateral seam (Fig. 2.28); (3) vibrissa present (absent in Oestridae and some unusual Tachinidae); and/or (4) lower calypter moderately to strongly developed, with convex outer margin (absent only in Scathophagidae) (Figs. 99, 100). Auxiliary characters: scutum with complete or medially interrupted transverse suture (suture extending at least slightly beyond dorsocentral lines medially); postalar callus developed (Fig. 2.41); mid and hind tibia almost always with at least one bristle besides apical and preapical ones, if not (Rhinophoridae, Oestridae, possibly some Tachinidae) then lower calypter enlarged and prominent; CALYPTRATAE....61

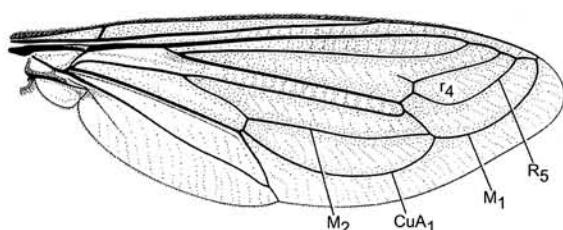
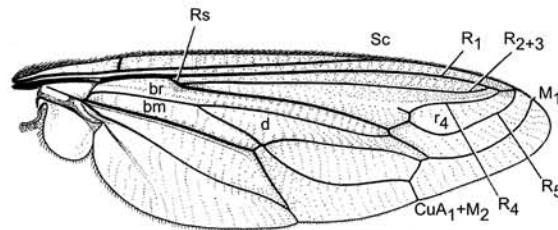
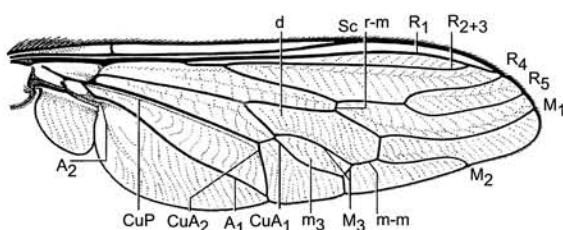
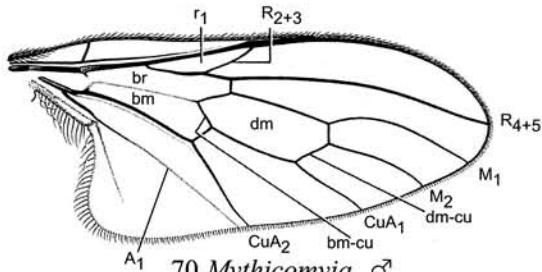


Figs. 6.58–66. Wings of lower Brachycera: dorsal view of (58) *Rachicerus obscuripennis* Loew, (Xylophagidae), (Nearctic, MND, fig. 34.2); (59) *Trichopsidea clausa* (Osten Sacken), (Nemestrinidae), (Nearctic, MND, fig. 44.3); (60) *Atherix variegata* Walker, (Athericidae), (Nearctic, MND, figs. 4.28, 32.4); (61) *Stonemyia tranquilla* (Osten Sacken), (Tabanidae), (Nearctic, MND, fig. 31.30); (62) *Neopachygaster maculicornis* (Hine), (Stratiomyidae), (Nearctic, MND, fig. 36.28); (63) *Hedriodiscus binotatus* (Loew), (Stratiomyidae), (Nearctic, MND, fig. 36.36); (64) *Bombylius major* Linnaeus, (Bombyliidae), (Holarctic, MND, figs. 4.37, 45.20); (65) *Ozodiceromyia signatipennis* (Cole), (Therevidae), (Nearctic, MND, fig. 37.14); and (66) *Scenopinus fenestralis* (Linnaeus), (Scenopinidae), (MND, fig. 38.2).

Abbreviation: diag vn, diagonal vein.

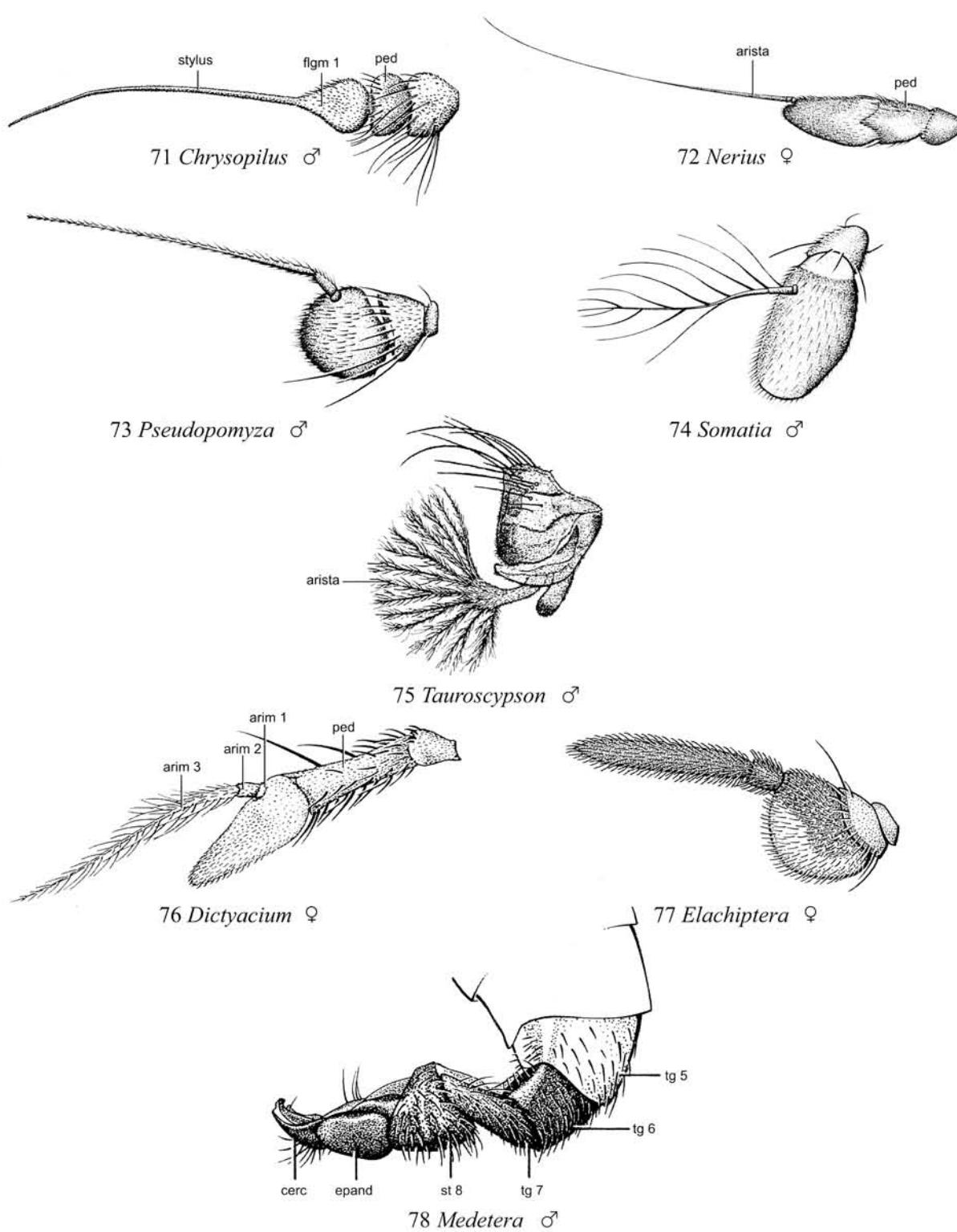
- At most two of characters 1–4 above present: greater ampulla sometimes present, developed to varied degree; pedicel sometimes with dorsal seam; vibrissa present or absent; lower calypter absent or linear, its margin rarely weakly convex. Auxiliary characters: transverse suture less developed in most families, usually not extending beyond level of dorsocentral lines medially, rarely complete (e.g., Somatiidae, some Micropezidae); postalar callus rarely more or less differentiated; tibiae frequently without bristles besides apical or preapical ones, if additional bristles present then lower calypter not developed or small and linear; acalyprate families 77
61. Hairing of body uniform and dense, scutum without differentiated bristles (Fig. 121); proboscis absent or unusually small, subcranial cavity greatly reduced; gena high, antennae usually small and in deep cavities (Fig. 188); meron usually with cluster of long hairs or hairlike bristles; large, heavy-bodied flies, sometimes resembling bees (Fig. 121) Oestridae
- Hairing of body not uniform and less dense, scutum with at least some differentiated bristles; proboscis present and well developed (rarely palpi absent), subcranial cavity almost always well developed; meron usually bare or with row of normal bristles (Fig. 93), sometimes with short setulae or hairlike bristles *in addition to* row of bristles (Figs. 92, 98), rarely meron with few setulae only..... 62
62. Meron with row of at least three bristles (Figs. 92, 93, 98)..... 63
- Meron without row of bristles, usually bare, rarely with few scattered setulae. 73
63. Subscutellum strongly developed, prominently and evenly convex in profile (Fig. 2.42)..... 64
- Subscutellum absent (Fig. 92) or weakly developed; if weakly developed (Rhinophoridae, Calliphoridae: Mesembrinellinae, and Melanomyinae, and a few Sarcophaginae) upper half more or less membranous and usually concave in profile (Fig. 102)..... 65
- Note:** Doubtful cases (some Calliphoridae: Mesembrinellinae) will key both ways.
64. Metathoracic spiracle large, distinctly longer than high, and with one large, ventrally continuous feltlike fringe (Fig. 94); lower and/or posterior margin of spiracle in addition to this fringe with few to many outstanding hairs projecting over spiracular opening (often inserted within fringe); ventral surface of scutellum short haired, including area below apex (as in Fig. 101), rarely with narrow bare median strip; arista plumose; vein M gently curved forward (Fig. 113) Calliphoridae, in part (Mesembrinellinae, in part)
- Metathoracic spiracle of various sizes, at most slightly longer than high, with fringe usually more or less divided into two separate lappets (division often indistinct in species with small spiracle), lower and posterior margin of spiracle without outstanding hairs in addition to feltlike fringe (as in Figs. 92, 93, 98); ventral surface of scutellum bare or with lateral patches of fine hair that are separated by broad bare median area (rarely only narrowly separated); arista bare, pubescent, or plumose; vein M often more strongly or angulately curved (Fig. 117) Tachinidae, in part
65. At least one of following characters or character combinations present: (1) stem vein with setulae on posterior surface (Fig. 114); (2) supra-squamal ridge posteriorly with setose sclerite (Fig. 100); (3) lower calypter with black setae dorsally *and* body metallic; (4) metathoracic spiracle large, distinctly longer than high and with either two distinct lappets (Fig. 95) or one large, continuous fringe (Fig. 94) Calliphoridae, in part
- Not with the above characters or character combinations: stem vein and supra-squamal ridge bare; lower calypter bare dorsally, if setose (some Sarcophaginae) then species not metallic; metathoracic spiracle not particularly large, with fringe divided into two lappets, one or both lappets sometimes small (Figs. 92, 93, 96, 97) 66
66. Lower calypter oval or tongue shaped, diverging from scutellum (as in Fig. 99)..... 67
- Lower calypter broad, median (inner) margin following scutellum for some distance (Fig. 100) ... 71

67. Wing vein CuA₁ setose (Fig. 115) Sarcophagidae, in part (*Lepidodexia (Johnsonia)* Coquillett, in part)
 – Wing vein CuA₁ bare 68
68. Wing cell r₄₊₅ closed, M ending in R₄₊₅ (Fig. 116) 69
 – Wing cell r₄₊₅ open, M reaching C or fading away beyond crossvein dm-cu 70
69. Abdomen strongly constricted near base, wasplike; scutellum with single pair of divergent apical bristles; palpus and vibrissa absent Tachinidae, in part (*Ichneumonops* Townsend)
 – Abdomen neither strongly constricted near base nor wasplike; scutellum with strong pair of lateral bristles and smaller pair of cruciate apical bristles; palpus and vibrissa present; Caribbean, South America [Rhinophoridae, in part (*Melanophora* Meigen)]
70. Metathoracic spiracle small, triangular, shorter than diameter of knob of halter; fringes small, variously developed but not strong and dense (Fig. 97) Rhinophoridae, in part
 – Metathoracic spiracle medium sized or elongate oval, not particularly small, longer than diameter of knob of halter; anterior lappet strong and dense, posterior lappet small and difficult to see (Fig. 96) Calliphoridae, in part (Melanomyinae, in part)
71. Coxopleural streak present (Fig. 93); arista bare or pubescent, trichia shorter than largest diameter of arista Sarcophagidae, in part (Miltogramminae)
 – Coxopleural streak absent (Fig. 92); arista usually plumose (bare in some high altitude species of Sarcophaginae: *Microcerella* Macquart) 72

67 *Nemomydas* ♂68 *Opomydas* ♂69 *Apiocera* ♂70 *Mythicomyia* ♂

Figs. 6.67–70. Wings of lower Brachycera (concluded): (67) *Nemomydas pantherinus* (Gerstaeker), (Mydidae), (Nearctic, MND, fig. 40.13); (68) *Opomydas townsendi* (Williston), (Mydidae), (Nearctic, MND, fig. 40.11); (69) *Apiocera haruspex* Osten Sacken, (Apioceridae), (Nearctic, MND, fig. 41.2); and (70) *Mythicomyia rileyi* Coquillett, (Mythicomyiidae), (Nearctic, MND, fig. 45.27, as Bombyliidae).

72. Thorax without stripes or with four stripes indicated anteriorly; notopleuron with two bristles and with or without additional setulae (as in Fig. 93); male sternites 2–4 slightly overlapped by margins of corresponding tergites; female with telescopic, narrow, and partly protruding terminalia of about same color as remaining abdomen (Fig. 107) *Calliphoridae*, in part (*Melanomyinae*, in part)
- Thorax usually with three distinct black stripes; notopleuron usually with two large and two smaller bristles; male sternites 2–4 exposed and overlapping margins of corresponding tergites (Fig. 118); female with short, broad, and non-telescopic terminalia (Fig. 108), but tergite 6 sometimes slightly elongated and shining yellow or orange *Sarcophagidae*, in part (*Sarcophaginae*)
73. Distal half of Sc straight (Fig. 111); frontal vitta without pair of interfrontal setae or setulae; hind tarsomere 1 without outstanding ventrobasal seta; hind tibia with true dorsal seta near middle, aligned with dorsal preapical seta (Fig. 105) *Fanniidae*
- Distal half of Sc usually curved towards C (Figs. 109, 110, 112), if almost straight (*Anthomyiidae*: *Calythea* Schnabl & Dziedzicki) then frontal vitta with pair of interfrontal setae or setulae (Fig. 2.4), and tarsomere 1 with outstanding ventrobasal seta (Fig. 104); hind tibia usually with setae in anterodorsal and posterodorsal position, but without true dorsal seta near middle (Fig. 104) 74
74. Lower calypter linear; postgena with whitish or golden hairing; frons wide in both sexes, frontal vitta bare except for occasional microscopic setulae *Scathophagidae*
- Lower calypter convex at hind margin, distinctly shorter to much longer than upper calypter (Fig. 99), but if linear (*Anthomyiidae*: *Fucellia* Robineau-Desvoidy, *Myopinella* nom. nov.) then postgenal hairing all black and frontal vitta with pair of interfrontal setae or setulae (Fig. 2.8) 75
75. Apex of scutellum with fine hairs ventrally (Fig. 101) and/or A_1+CuA_2 reaching wing margin at least as faint fold (Fig. 109) *Anthomyiidae*, in part
- Apex of scutellum bare ventrally (but scutellum sometimes with ventrolateral setulae); A_1+CuA_2 not reaching wing margin, not even as fold (Fig. 112) 76
76. A_1+CuA_2 short, not reaching midpoint between its base and wing margin (Fig. 110); hind tarsomere 1 with outstanding ventrobasal seta (as in Fig. 104); frons with pair of interfrontal setae (as in Fig. 2.4) *Anthomyiidae*, in part (*Coenosopsia* Malloch)
- A_1+CuA_2 usually longer, fading out beyond midpoint between its base and wing margin (Fig. 112), if fading out before reaching midpoint between its base and wing margin then hind tarsomere 1 without outstanding ventrobasal seta and/or frons without pair of interfrontal setae or setulae ...
..... *Muscidae*
77. R_1 setulose dorsally from apex to base (fork of stem vein) or almost to base (Figs. 124–127); anepimeron setulose, with or without outstanding bristle(s) 78
- Either R_1 bare (Figs. 122, 123, 130, 131, 153–162, 189–197) or less extensively setulose (either apical or basal portion bare; Figs. 128, 129), or anepimeron bare, or both 83
Note: Doubtful cases (some *Ulidiidae*) will key both ways.
78. Ocelli absent (Fig. 132) 79
- Ocelli present 80
79. Proboscis small to completely absent (but palpus sometimes well developed) (Fig. 134); female arista with dendritic branching, lacking single main axis (Fig. 75); face with pair of large membranous windows in female (Fig. 134); wing with cells *bm* and *br* usually confluent (Fig. 127) ..
..... *Ctenostylidae*
- Proboscis well developed; arista not branched; face without large membranous areas (Fig. 132); wing with *bm* and *br* separate (Fig. 126) *Pyrgotidae*

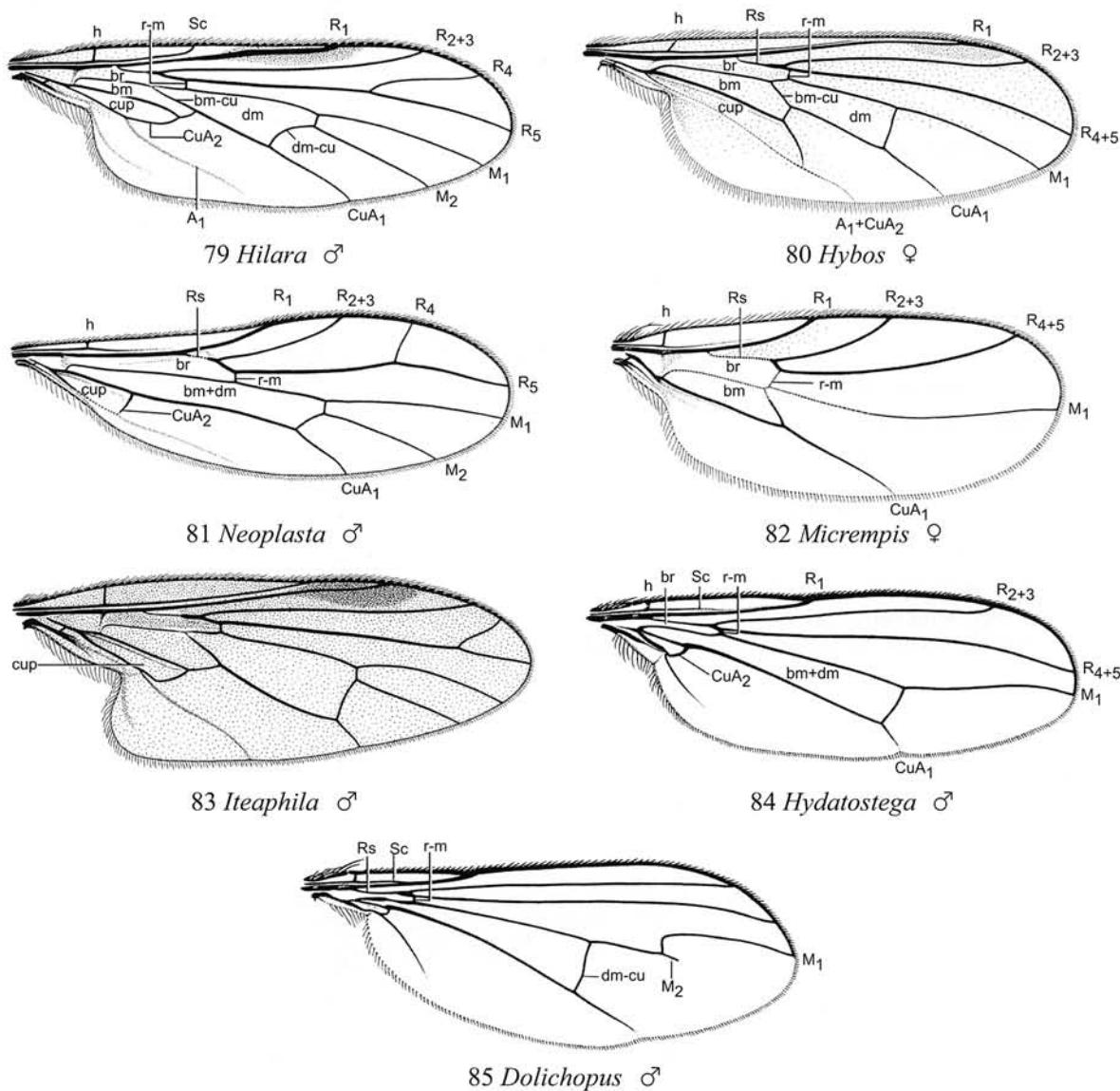


Figs. 6.71–78. Antennae and male terminalia of Brachycera: lateral view of antenna of (71) *Chrysopilus ornatus* (Say), (Rhagionidae), (Nearctic, MND, fig. 33.6); medial view of antenna of (72) *Nerius plurivittatus* Bigot, (Neriidae); lateral view of antenna of (73) *Pseudopomyza* (*Rhinopomyzella*) sp., (Pseudopomyzidae); and (74) *Somatia* sp., (Somatiidae); medial view of antenna of (75) *Tauroscyphson andina* Aczél, (Ctenostylidae), (South America, Aczél, 1956, fig. 96); lateral view of antenna of (76) *Dictyacium ambiguum* (Loew), (Sciomyzidae), (Nearctic, MND, figs. 2.39, 84.7); and (77) *Elachiptera costata* (Loew), (Chloropidae), (Nearctic, MND, fig. 99.20); lateral view of male terminalia of (78) *Medetera aldrichii* Wheeler, (Dolichopodidae), (Nearctic, MND, fig. 48.38). Figs. 72–74 illustrated by A. Brenes.

Abbreviations: arim, aristomere; cerc, cercus; epand, epandrium; flgm 1, first flagellomere; ped, pedicel; st, sternite; tg, tergite.

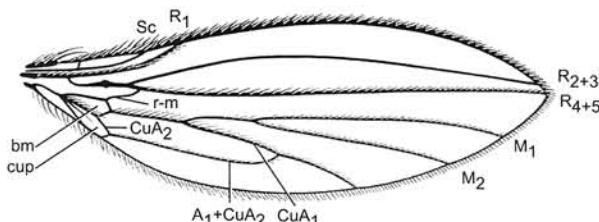
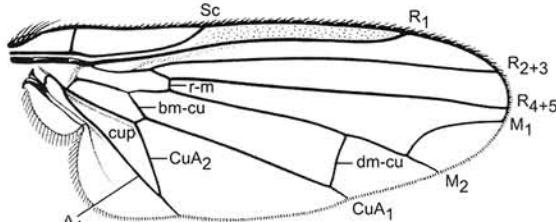
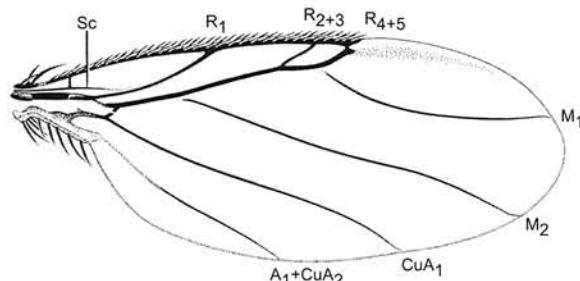
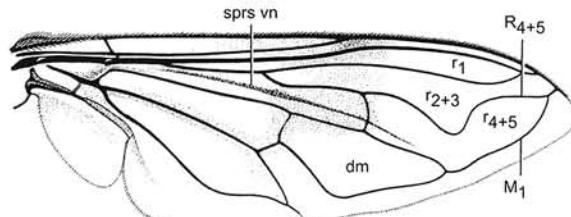
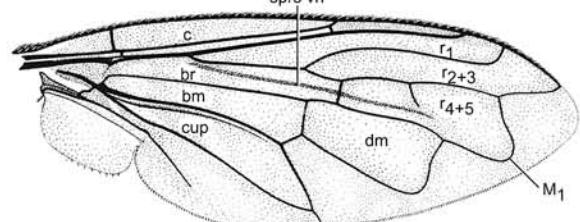
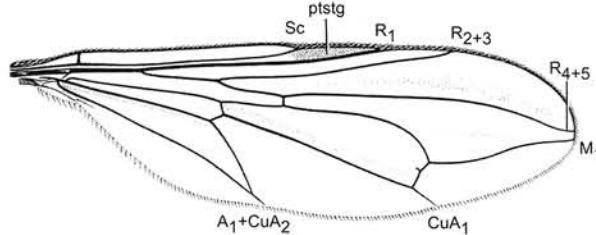
80. Frons almost always with one to many inclinate frontal bristles and one to three reclinate orbital bristles (occasionally posterior one inclinate) (Fig. 133), if fronto-orbital bristles reduced or absent then habitus usually wasplike with petiolate abdomen and either R_{2+3} with three bends (often with spur veins) and scutum with weak median longitudinal depression (*Toxotrypana* Gerstaecker), or vein CuA and usually CuA₁ setulose dorsally and abdominal syntergite 1+2 with one to several outstanding lateral setae (*Pseudophorellia* Lima); Sc usually abruptly bent forward, frequently at angle of almost 90° (Fig. 125) Tephritidae
- Frons with zero to three orbital bristles, frontal bristles absent; other characters not as above; Sc not abruptly bent forward. 81
81. R_{4+5} and M strongly convergent towards wing margin; hind tarsomere 1 with ventrobasal projection (Fig. 172); katepisternum and anepimeron setulose but without outstanding bristles Tanypezidae
- R_{4+5} and M more or less parallel near wing margin; hind tarsomere 1 simple; usually either katepisternum or anepimeron with outstanding bristle 82
82. Katepisternum setulose but without outstanding bristle; anepimeron with numerous setulae and sometimes outstanding bristle Platystomatidae
- Katepisternum with outstanding bristle; anepimeron with ca. one to five subequal setulae, without outstanding bristle Ulidiidae, in part
83. R_{4+5} and M strongly convergent towards wing margin (Figs. 130, 148, 162), sometimes confluent distally (Figs. 129, 131); maximum width of cell r_{4+5} at least 2.7 times its width at apex. 84
- R_{4+5} and M divergent, parallel or slightly convergent (rarely last sector of M evanescent or absent); maximum width of cell r_{4+5} less than 2.7 times its width at apex 90
- Note:** It is not necessary to take exact measurements of cell r_{4+5} ; if in doubt proceed to couplet 84.
84. Proboscis long, geniculate (Fig. 135) and/or antenna with stylus (Fig. 2.26) or arista that is at most as long as first flagellomere; C without breaks; crossvein sc-r often present (Fig. 131); ocelli sometimes absent Conopidae
- Proboscis usually moderate sized and not geniculate, if long and geniculate (some Milichiidae) then C with subcostal and humeral break; arista distinctly longer than first flagellomere, antenna without stylus; Sc and R₁ sometimes closely approximated or apically fused but without connecting crossvein; ocelli present. 85
85. Wing with spurious vein; cell r_{4+5} closed before wing margin; cell cup long (apex separated from wing margin by less than length of CuA₂) and closed by straight to slightly convex vein CuA₂ (Figs. 89, 90); katepisternum without vertical series of long bristles Syrphidae, in part (unusual species)
- Wing without spurious vein; cell r_{4+5} rarely closed before wing margin; in this case cell cup short or CuA₂ with distinct inward kink or katepisternum with vertical series of long bristles (Fig. 163) 86
86. Posterior thoracic spiracle with one or more conspicuous bristlelike setae on posterodorsal margin (Fig. 167); M with distinct angle at dm-cu, its last section more or less in line with dm-cu; cell cup without posteroapical extension (Fig. 148); anepimeron with hairs or bristles or both; femora (especially hind femur) conspicuously thickened; hind tibia often laterally flattened (Fig. 148); katepisternum without vertical series of long bristles Ropalomeridae
- Posterior spiracle bare or sometimes with enlarged fine hairs posterodorsally, but these not bristlelike; M straight to somewhat angled at dm-cu, its last section rarely more or less in line with dm-cu (some Ulidiidae) but then cell cup with distinct posteroapical extension; femora usually not thickened; anepimeron bare and hind tibia simple, if anepimeron setulose dorsally and/or hind tibia flattened (some Micropezidae) then katepisternum with vertical series of long bristles (Fig. 163) 87

87. C with anterior (and usually dorsal) row of outstanding spinules in addition to usual setulae; tibiae with preapical dorsal bristle; anepisternum bare; head with two reclinate fronto-orbital bristles, slightly divergent postocellar bristles and no vibrissa; arista micropubescent; South America [Helosciomyzidae]
- C without anterior or dorsal spinules (but sometimes with inconspicuous ventral denticles in third sector); tibiae usually without preapical dorsal bristle, if present then either anepisternum with hairs and/or bristles or vibrissa present; frons rarely with two reclinate fronto-orbital bristles; other characters various 88



Figs. 6.79–85. Wings of Empidoidea: dorsal view of (79) *Hilara femorata* Loew, (Empididae), (Nearctic, MND, figs. 4.41, 47.32); (80) *Hybos reversus* Walker, (Empididae), (Nearctic, MND, figs. 4.42, 47.20); (81) *Neoplasta scapularis* (Loew), (Empididae), (Nearctic, MND, figs. 4.43, 47.15); (82) *Micrempis testacea* Melander, (Empididae), (Nearctic, MND, figs. 4.44, 47.4); (83) *Iteaphila macquarti* Zetterstedt, (Empididae), (Holarctic, MND, fig. 47.33); (84) *Hydatostega viridiflos* (Walker), (Dolichopodidae), (Nearctic, MND, figs. 4.45, 48.32, as *Hydrophorus intentus* Aldrich); and (85) *Dolichopus cuprinus* Wiedemann, (Dolichopodidae), (Nearctic, MND, figs. 4.46, 48.23).

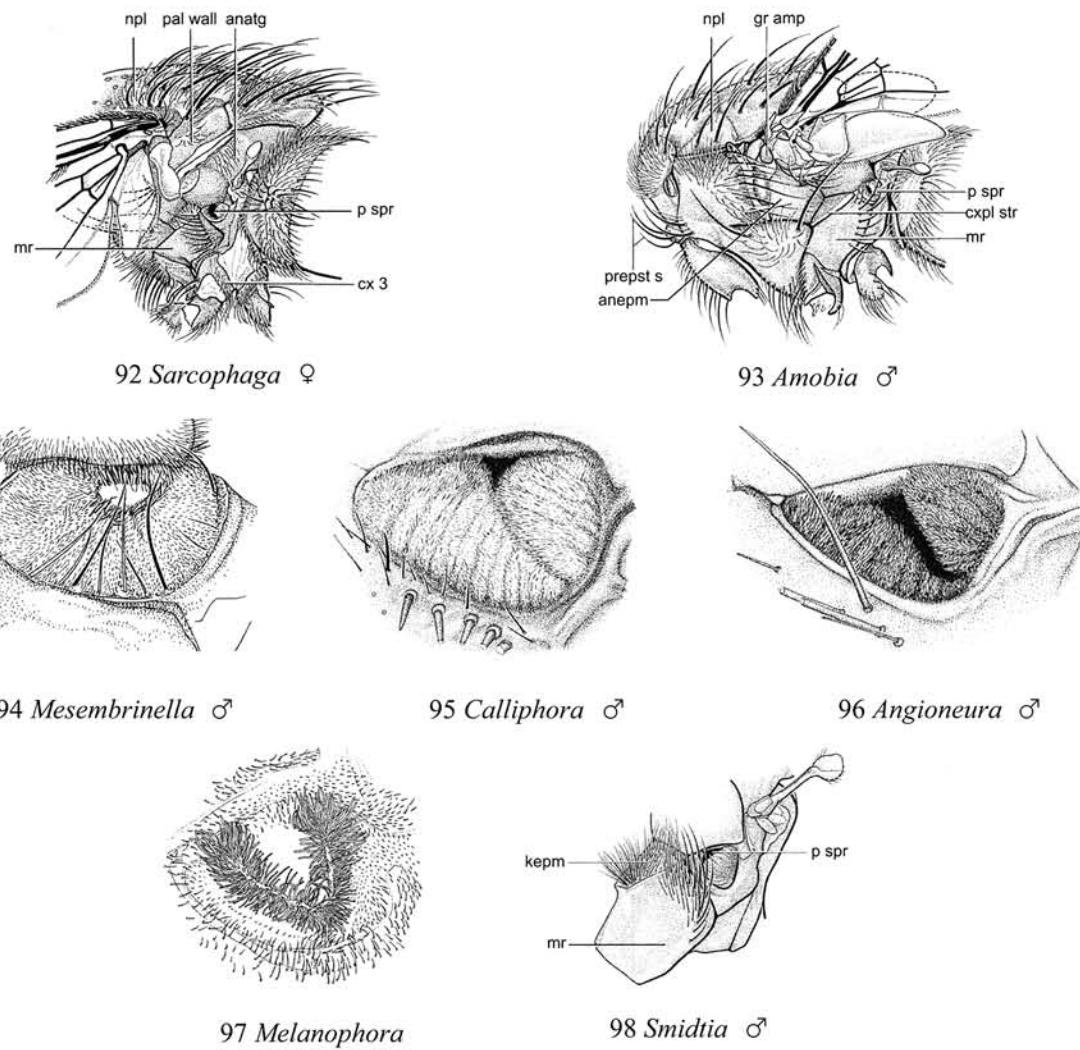
88. Large, slender flies (length usually at least 7 mm, rarely as small as 5 mm), with long legs (Fig. 144); ocellar bristles absent (Fig. 136) 89
- Usually smaller and/or stouter flies (length less than 5 mm) with shorter legs, if not (some Richardiidae) then ocellar bristles present. 92
89. Pedicel with triangular to elongate apical projection on inner side; arista subapical to apical (Fig. 72); lunule long and exposed, deeply grooved medially, its halves forming peculiar antennal bases (Fig. 136); katepisternum setulose, at most with one bristle; hind tibia without antero- and posterodorsal rows of bristles; femora usually with stout, spinelike bristles ventrally (Fig. 144) . Neriidae
- Inner side of pedicel without apical projection; arista dorsobasal; lunule rarely enlarged and medially grooved (some *Micropeza* Meigen); katepisternum with three to many long bristles arranged in vertical series (Fig. 163) and/or hind tibia with antero- and posterodorsal rows of bristles; femora without stout bristles ventrally. Micropezidae

86 *Lonchoptera* ♀87 *Polyporivora* ♀88 *Lecanocerus* ♂89 *Eristalis* ♂90 *Microdon* ♂91 *Pipunculus* ♂

Figs. 6.86–91. Wings of lower Cyclorrhapha (“Aschiza”): dorsal view of (86) *Lonchoptera bifurcata* (Fallén), (Lonchopteridae), (MND, figs. 4.47, 49.2, as *Lonchoptera furcata* Fallén); (87) *Polyporivora polyopori* (Willard), (Platypezidae), (Nearctic, MND, fig. 50.10); (88) *Lecanocerus compressiceps* Borgmeier, (Phoridae), (MND, figs. 4.49, 51.49); (89) *Eristalis tenax* (Linnaeus), (Syrphidae), (Holarctic, MND, figs. 4.51, 52.60); (90) *Microdon cothurnatus* Bigot, (Syrphidae), (Nearctic, MND, fig. 52.47); and (91) *Pipunculus fuscus* Loew, (Pipunculidae), (Nearctic, MND, figs. 4.50, 53.6).

Abbreviations: ptstg, pterostigma; sprs vn, spurious vein.

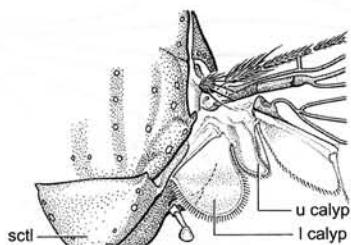
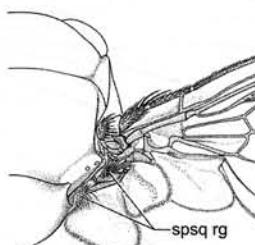
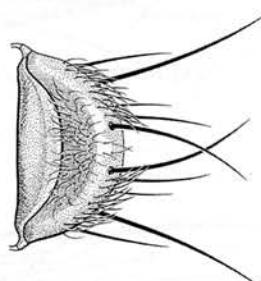
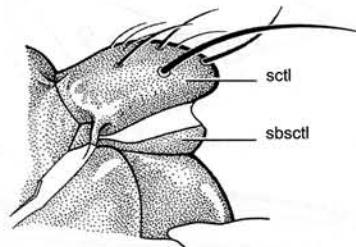
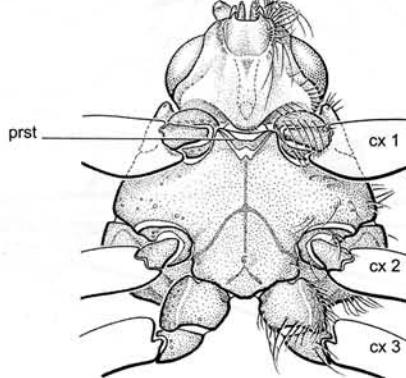
90. Pronotum enlarged, holding head capsule well clear of mesoscutum (Figs. 145, 146); metathorax with high postmetacoxal bridge (as in Fig. 169); arista bipectinate, with spaced dorsal and ventral rays (Fig. 74); orbital bristles absent (but sometimes with small anterior inclinate frontal bristle); tibiae without preapical bristle; alula and anal lobe of wing not developed (Figs. 145, 146) 91
- Pronotum short and inconspicuous, head capsule held close to mesoscutum; otherwise without above combination of characters 92
91. Fine vibrissa and convergent postocellar bristles present; anepisternum with outstanding bristle at hind margin; abdomen broadly oval, distinctly wider than thorax; femora subequal, unarmed Somatiidae



Figs. 6.92–98. Thoracic characters of Calypratae: posterolateral view of thorax of (92) *Sarcophaga aldrichi* Parker, (Sarcophagidae), (Nearctic, MND, fig. 108.23, as *Arachnidomyia*); lateral view of thorax of (93) *Amobia floridensis* (Townsend), (Sarcophagidae), (MND, fig. 108.98); left metathoracic spiracle of (94) *Mesembrinella bicolor* Giglio-Tos, (Calliphoridae); (95) *Calliphora vicina* Robineau-Desvoidy, (Calliphoridae), (Holarctic, South America); (96) *Angioneura* sp., (Calliphoridae); (97) *Melanophora roralis* (Linnaeus), (Rhinophoridae), (Holarctic, Caribbean, South America, Crosskey, 1977, fig. 44); and (98) *Smidtia fumiferanae* (Tothill), (Tachinidae), (Nearctic, MND, fig. 110.170, as *Winthemia*). Figs. 94–96 illustrated by B. Rubæk.

Abbreviations: anatg, anatergite; anepm, anepimeron; cx 3, hind coxa; cxpl str, coxopleural streak; gr amp, greater ampulla; kep m, katepimeron; mr, meron; npl, notopleuron; pal wall, postalar wall; prepst s, proepisternal seta; p spr, posterior thoracic spiracle.

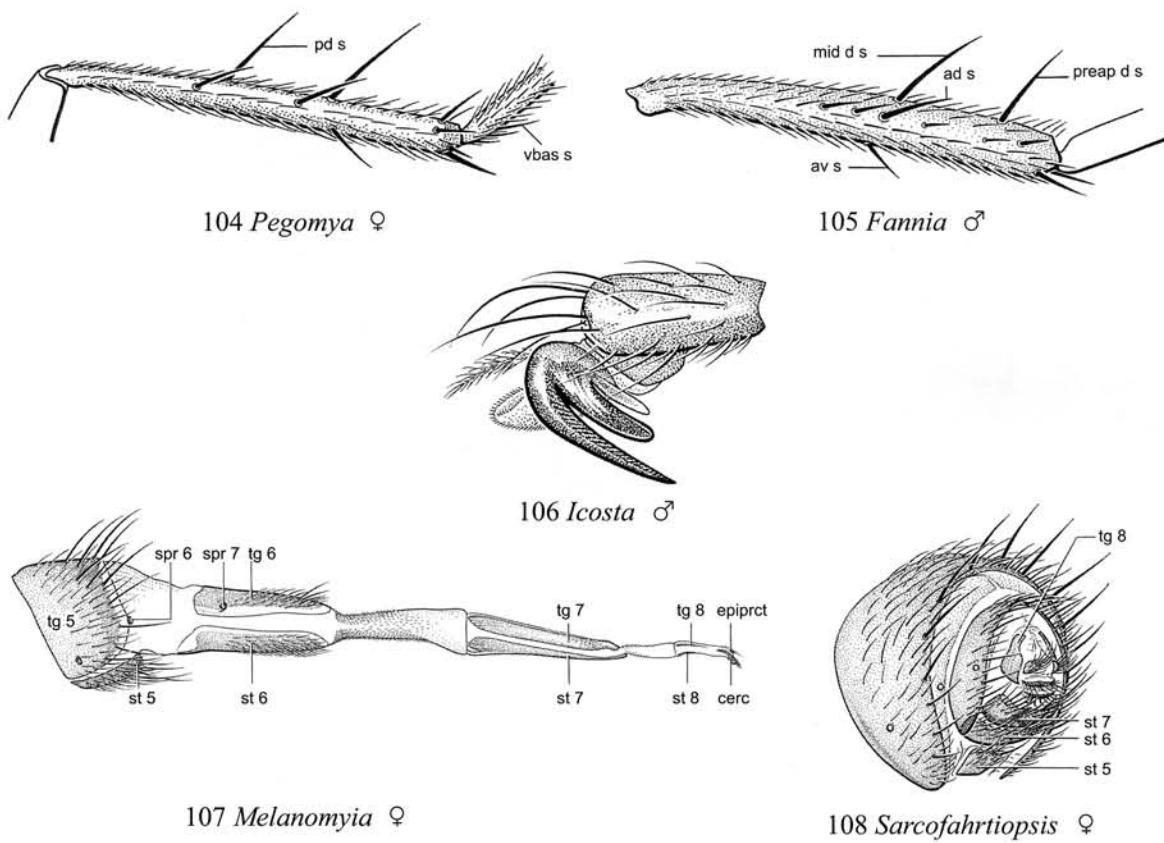
- Vibrissa and postocellar bristles absent; anepisternum without outstanding bristle at hind margin; abdomen slender, clavate, not broader than thorax; hind femur greatly thickened, with two rows of stout, spinelike ventral bristles (Fig. 146) Syringogastridae
 - 92. Sc complete or nearly so, ending in C or just short of it and free from R_1 distally (Figs. 122–124, 126–131, 153–155, 193–195) 93
 - Sc incomplete, not reaching C or reaching it merely as linear fold, often fusing with R_1 distally (Figs. 156–162, 189–192, 196, 197) 118
- Note:** Doubtful cases — some Agromyzidae, Canacidae, Carnidae, Chyromyidae, Milichiidae, Trixoscelidini (Heleomyzidae), Tethinidae — will key both ways.

99 *Neomuscina* ♂100 *Lucilia* ♀101 *Alliopsis* ♀102 *Melanophora* ♂103 *Ornithomya* ♀

Figs. 6.99–103. Thoracic characters of Calypratae (*concluded*): wing base and right side of thorax of (99) *Neomuscina tripunctata* (Wulp), (Muscidae), (MND, fig. 105.15); and (100) *Lucilia sericata* (Meigen), (Calliphoridae), (MND, fig. 106.14, as *Phaenicia*); posteroventral view of scutellum and subscutellum of (101) *Alliopsis silvestris* (Fallén), (Anthomyiidae), (Holarctic, MND, fig. 104.26, as *Paraprosalpia*); lateral view of scutellum, subscutellum, and adjacent thorax of (102) *Melanophora roralis* (Linnaeus), (Rhinophoridae), (Holarctic, Caribbean, South America, MND, fig. 109.2); ventral view of head and thorax of (103) *Ornithomya anchineuria* Speiser, (Hippoboscidae), (Nearctic, MND, figs. 4.171, 111.35).

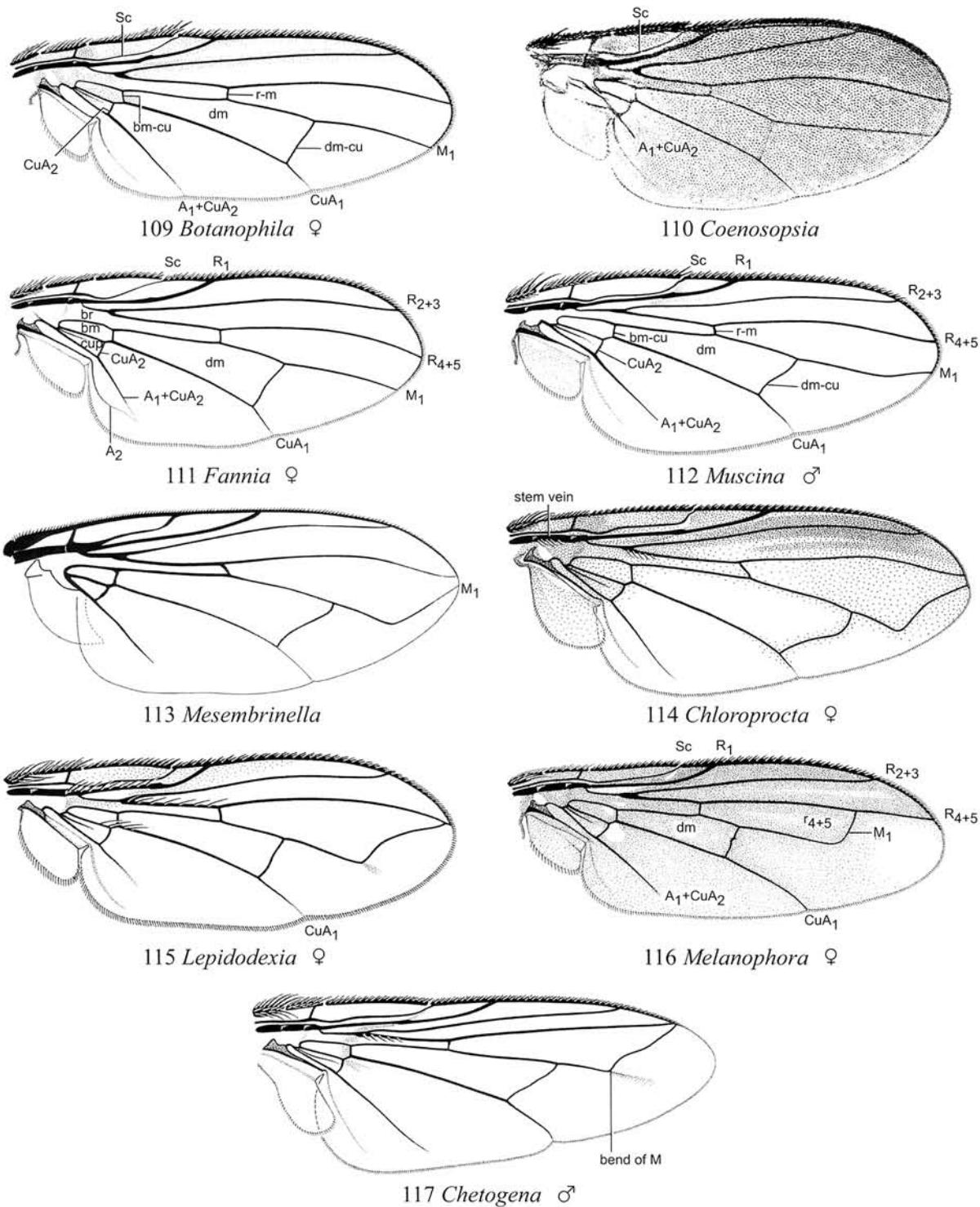
Abbreviations: cx 1, 2, 3, fore-, mid-, and hind coxa; l calyp, lower calypter; prst, prosternum; sbsctl, subscutellum; sctl, scutellum; spsq rg, suprasquamal ridge; u calyp, upper calypter.

93. C without subcostal break (Figs. 124, 126, 129, 131, 153–155) 94
 – C with subcostal break (Figs. 122, 128, 130, 193–195). 103
Note: Doubtful cases — some Clusiidae and Ulidiidae — will key both ways.
94. Form antlike, with elongate and basally constricted abdomen (Fig. 149); posterior thoracic spiracle with one or more fine bristles on lower margin (Fig. 168); head subspherical with large eyes (Fig. 149); palpus vestigial; male forefemur and/or foretibia often with tubercles or emarginations (Fig. 149) Sepsidae
 – Form almost never antlike but if so posterior thoracic spiracle without bristles or outstanding hairs; head not subspherical; palpus almost always well developed; male forefemur and foretibia simple 95

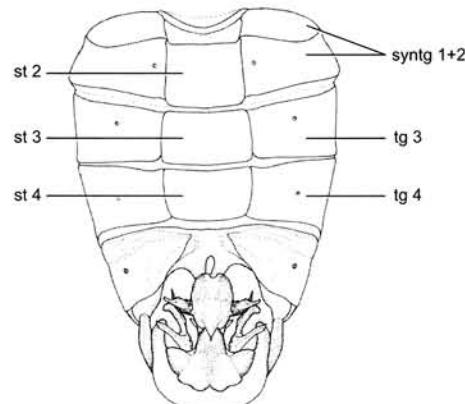
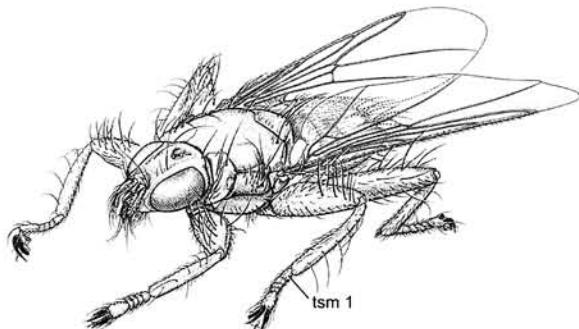
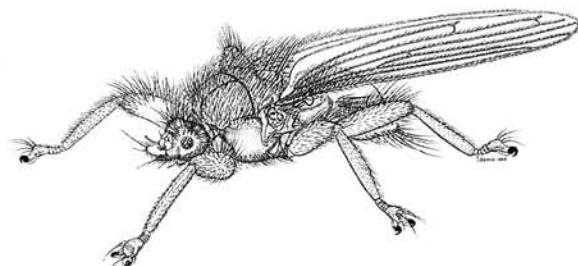
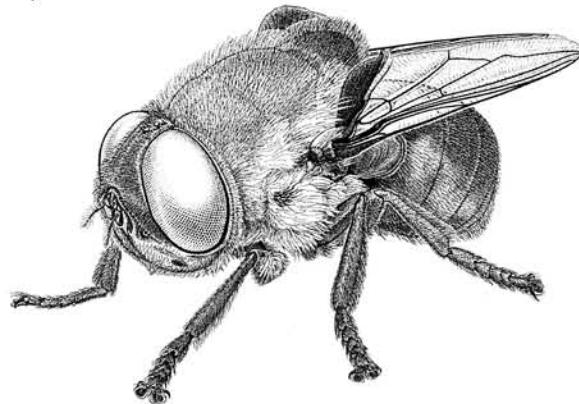


Figs. 6.104–108. Leg and abdominal structures of Calyptratae: tibia and basal portion of first tarsomere of left hind leg of (104) *Pegomya notabilis* (Zetterstedt), (Anthomyiidae), (Holarctic, MND, fig. 104.33, as *Pegomya zonata* (Zetterstedt)); left hind tibia of (105) *Fannia canicularis* (Linnaeus), (Fanniidae), (MND, fig. 4.177, as Muscidae); fifth tarsomere of right foreleg of (106) *Icosta americana* (Leach), (Hippoboscidae), (MND, figs. 4.179, 111.26); lateral view of extended female terminalia of (107) *Melanomyia serva* (Walker), (Calliphoridae), (Nearctic, MND, fig. 106.37); posterolateral view of female terminalia of (108) *Sarcofahrtiopsis jamaicensis* Dodge, (Sarcophagidae), (Caribbean, MND, fig. 108.69).

Abbreviations: ad s, anterodorsal seta; av s, anteroventral seta; cerc, cercus; epiprct, epiproct; mid d s, middorsal seta; pd s, posteroventral seta; preap d s, preapical dorsal seta; spr, spiracle; st, sternite; tg, tergite; vbas s, ventrobasal seta.



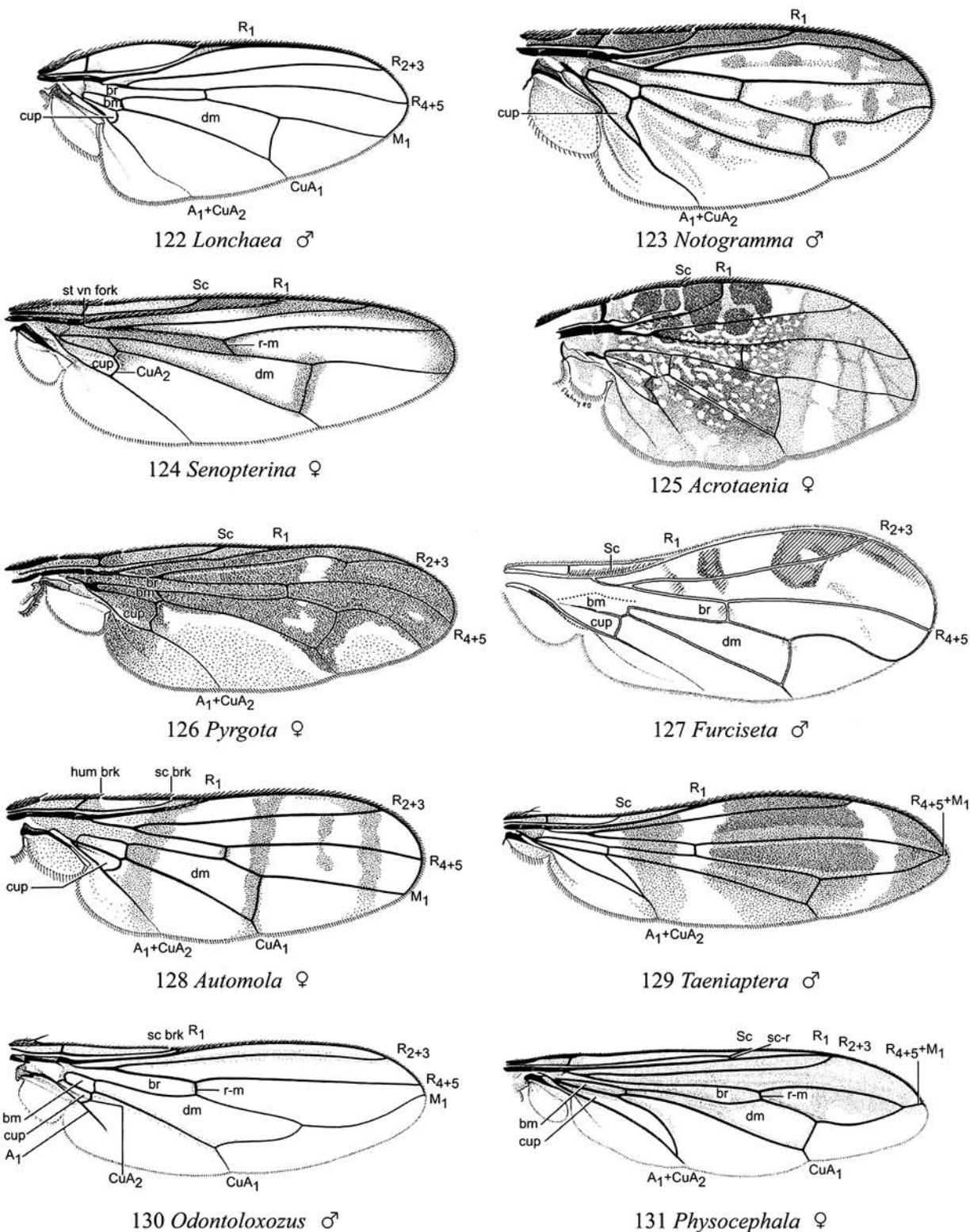
Figs. 6.109–117. Wings of Calyptratae: dorsal view of (109) *Botanophila spinidens* (Malloch), (Anthomyiidae), (Nearctic, MND, figs. 4.70, 104.29); (110) *Coenosopsia prima* Malloch, (Anthomyiidae), (photograph by V. Michelsen); (111) *Fannia canicularis* (Linnaeus), (Fanniidae), (MND, fig. 4.73, as Muscidae); (112) *Muscina levida* (Harris), (Muscidae), (MND, figs. 4.72, as *Muscina assimilis* (Fallén), 105.29); (113) *Mesembrinella* sp., (Calliphoridae), (illustrated by B. Rubæk); (114) *Chloroprocata fuscanipennis* (Macquart); (115) *Lepidodexia elegans* (Coquillett), (Sarcophagidae), (MND, fig. 108.30, as Johnsonia); (116) *Melanophora roralis* (Linnaeus), (Rhinophoridae), (Holarctic, Caribbean, South America, MND, figs. 4.75, 109.4); and (117) *Chetogena gelida* (Coquillett), (Tachinidae), (Nearctic, MND, fig. 110.197).

118 *Oxysarcodexia* ♂119 *Ornithomya* ♀120 *Trichobius* ♀121 *Cuterebra* ♂

Figs. 6.118–121. Adults, and abdomen, of Calypratae: ventral view of abdomen (male terminalia retracted) of (118) *Oxysarcodexia timida* (Aldrich), (Sarcophagidae), (illustrated by E. Binkiewicz); anterolateral view of adult of (119) *Ornithomya anchineuria* Speiser, (Hippoboscidae), (Nearctic, MND, fig. 111.1); (120) *Trichobius corynorhini* Cockerell, (Streblidae), (Nearctic, MND, fig. 113.1); and (121) *Cuterebra emasculator* Fitch, (Oestridae), (Nearctic, MND, fig. 107.2).

Abbreviations: st, sternite; syntg, syntergite; tg, tergite; tsm 1, first tarsomere.

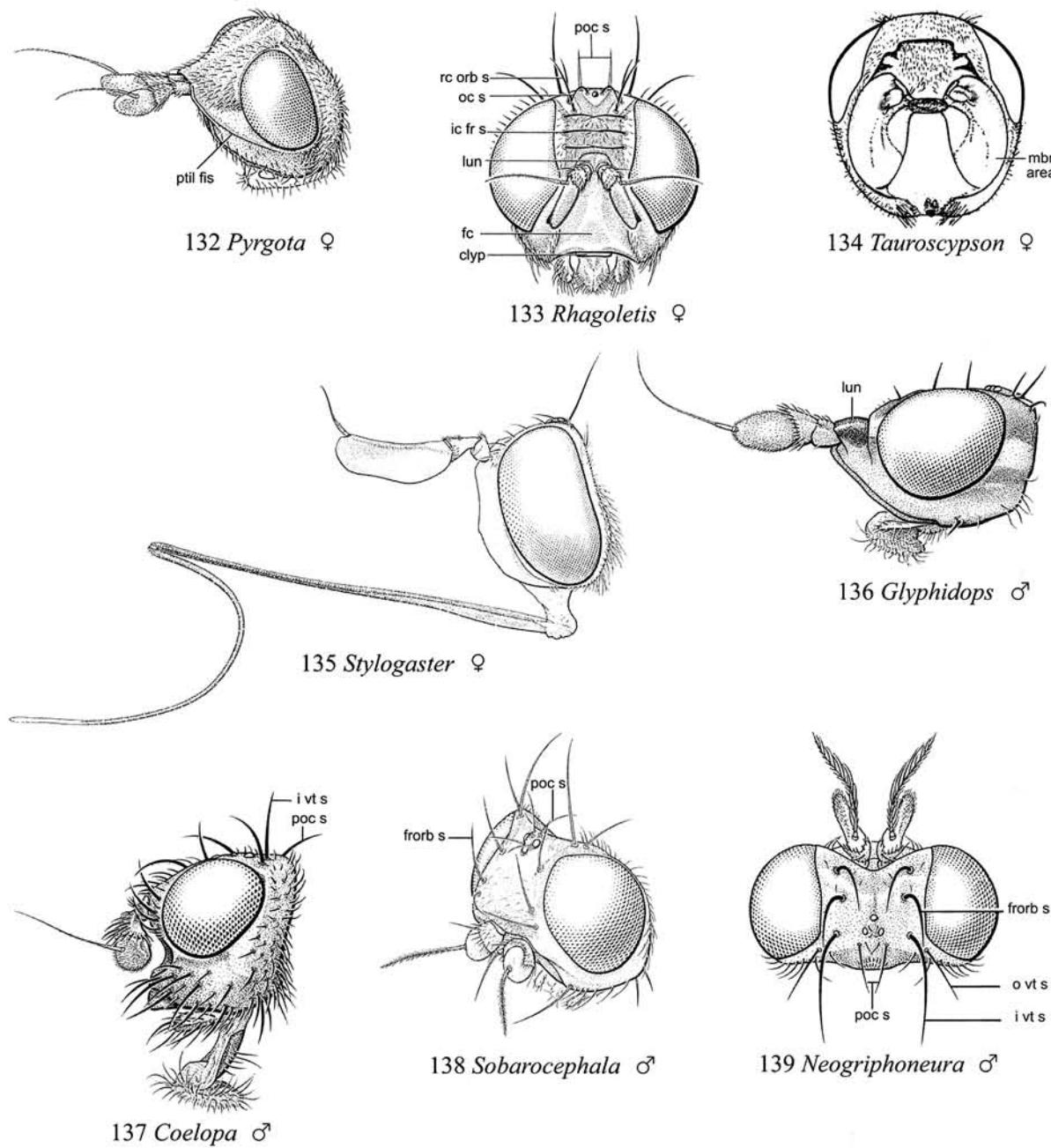
95. Main bristles of head and thorax absent or greatly reduced; scape longer than pedicel; abdomen broad and dorsoventrally flattened, with white, triangular appressed scales; metepisternum with one or more fine hairs near posteroventral margin of spiracle; tibiae without preapical dorsal bristles, hind tibia expanded and flattened; South America.....
..... [Lauxaniidae, in part (*Eurychoromyia* Hendel)]
- At least some bristles of head and thorax well developed; otherwise not with the above combination of characters: scape usually shorter than pedicel, if not then tibiae with preapical dorsal bristles; abdomen not covered in scales; metepisternum usually without hairs; hind tibia not expanded or flattened..... 96
96. Katepisternal bristle (posterior one if two are present) gently curved anteriorly; metepisternum setulose; face concave, vibrissal angle prominent; antenna decumbent (Fig. 137); A_1+CuA_2 reaching hind margin of wing as desclerotized fold; postocellar bristles convergent or parallel; found near sea shores Coelopidae
- Katepisternal bristle (posterior one if two are present) pointing upwards and often slightly posteriorly, rarely absent; metepisternum usually bare, if setulose then face convex and/or antenna porrect; A_1+CuA_2 various, fully developed to completely reduced; postocellar bristles various; various habitats..... 97
97. Vibrissa present; pedicel with angular though sometimes weak projection on outer distal margin (Fig. 138); frons with first or second pair of fronto-orbitals inclinate, if all reclinate then with single pair of enlarged interfrontal bristles anteriorly; postocellar bristles divergent if present (Fig. 138) Clusiidae, in part
- Vibrissa absent (but peristomal or lower parafacial bristles vibrissa-like in some unusual Lauxaniidae and Ulidiidae); pedicel without angular projection; frontal chaetotaxy usually different: inclinate fronto-orbitals frequently absent, sometimes more than one inclinate pair present; if all fronto-orbitals reclinate then without single pair of enlarged interfrontals; postocellar bristles various 98
98. At least one pair of tibiae with preapical dorsal bristle and/or postocellar bristles convergent... 99
- Tibiae without preapical dorsal bristle and postocellar bristles divergent or absent 102
99. Prescutellum present (sometimes difficult to observe in dry specimens) (Fig. 165); tibiae without preapical dorsal bristle; anepisternum bare or with single bristle or with one to several setulae near hind margin (but not setulose with outstanding bristle); arista bare to short pubescent; A_1+CuA_2 ending far from hind margin of wing, not even reaching it as fold (Fig. 154). Chamaemyiidae, in part (Chamaemyiini)
- Prescutellum absent; tibiae almost always with preapical dorsal bristle, if without (some Lauxaniidae) then anepisternum setulose and with outstanding bristle near hind margin; arista bare to long plumose; A_1+CuA_2 abbreviated or reaching hind margin of wing. 100
100. Postocellar bristles convergent or cruciate (Fig. 139), if exceptionally vestigial to absent then scutellum with two pairs of bristles and katepisternum with well-developed dorsal bristle; anepisternum setulose and with outstanding bristle near posterior margin; A_1+CuA_2 ending before hind margin of wing (not even reaching it as fold) (Fig. 153). Lauxaniidae, in part
- Postocellar bristles divergent to almost parallel, if absent (some Sciomyzidae) then scutellum with only one pair of bristles and both anepisternum and katepisternum with setulae but no bristles; anepisternum otherwise setulose or bare, with or without outstanding bristle at posterior margin; A_1+CuA_2 usually extending to hind margin of wing (apically often desclerotized and foldlike) (Fig. 155) 101



Figs. 6.122–131. Wings of acalyprate Schizophora: dorsal view of (122) *Lonchaea polita* Say, (Lonchaeidae), (Nearctic, MND, fig. 62.22); (123) *Notogramma cimiciformis* Loew, (Ulidiidae), (MND, fig. 63.18, as *Notogramma cimiciforme* in Otidae); (124) *Senopterina caerulescens* Loew, (Platystomatidae), (Nearctic, MND, fig. 64.3); (125) *Acrotaenia testudinea* (Loew), (Tephritidae), (Nearctic, Caribbean, MND, fig. 66.37); (126) *Pyrgota undata* Wiedemann, (Pyrgotidae), (Nearctic, MND, fig. 65.4); (127) *Furcisetamplumanni* (Hennig), (Ctenostylidae), (South America, illustrated by V. Korneyev); (128) *Automola rufa* Cresson, (Richardiidae), (Nearctic, MND, fig. 67.2); (129) *Taeniaptera trivittata* Macquart, (Micropezidae), (Nearctic, MND, fig. 56.12); (130) *Odontoloxozus longicornis* (Coquillett), (Neriidae), (MND, figs. 4.54, 57.4); and (131) *Physocephala texana* (Williston), (Conopidae), (Nearctic, MND, figs. 4.53, 54.8).

Abbreviations: hum brk, humeral break; sc brk, subcostal break; st vn fork, fork of stem vein.

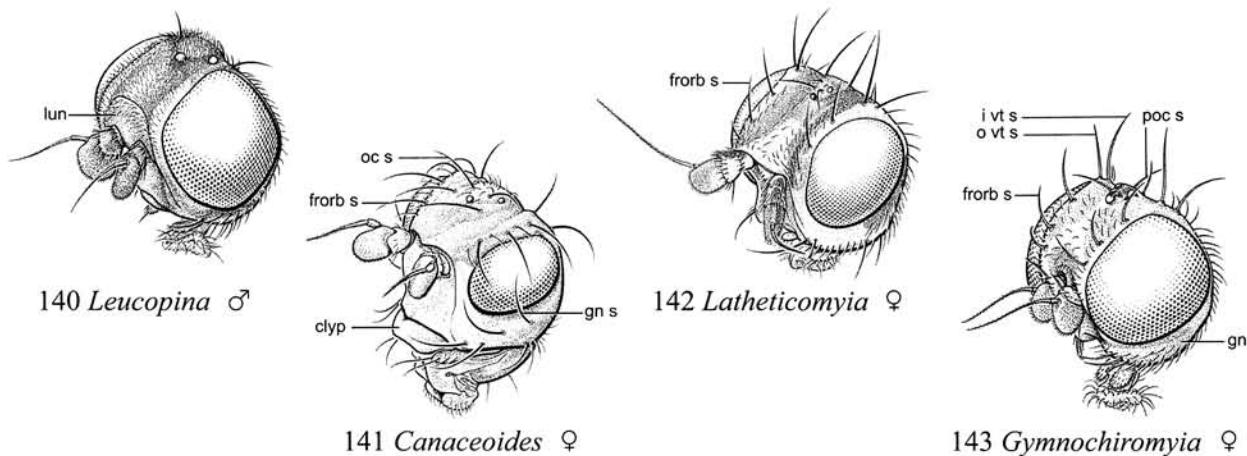
101. At least one of the following characters present: R_1 setulose dorsally; cell cup with posteroapical extension (Fig. 123); female abdominal segment 7 developed as dorsoventrally flattened, non-retractile oviscape (Fig. 199); male aedeagus extremely long and coiled, often in part visible ventrolaterally between last preabdominal segment and hypopygium (Fig. 198). Auxiliary characters: antenna not porrect; pedicel not distinctly elongate. *Ulidiidae*, in part (unusual species)
- R_1 bare dorsally; cell cup without posteroapical extension (Fig. 155); female segment 7 short and inconspicuous, not developed as heavily sclerotized oviscape; male aedeagus small, not coiled, not visible externally; antenna often porrect; pedicel sometimes elongate (Fig. 76). *Sciomyzidae*, in part
102. Lunule setulose or bare, exposed, and often unusually large (Fig. 140); prescutellum present (Fig. 165); prosternum and propleuron bare, anepisternum usually bare; postocellar bristles absent (Fig. 140); R_1 bare; cell cup simple; wing unmarked except occasional darkening of crossveins; female without oviscape; small (1–4 mm), grey pruinose or (rarely) shining black flies *Chamaemyiidae*, in part (Leucopini)
- Lunule not setulose or unusually large or exposed; prescutellum not developed; prosternum and propleuron frequently setulose; anepisternum setulose (number of setulae may be small), almost always with outstanding bristle(s); postocellar bristles almost always present; R_1 often setulose dorsally; cell cup frequently with posteroapical angular extension (Figs. 123, 126); wing usually marked; female abdominal segment 7 modified as non-retractile oviscape (Fig. 199); larger flies (usually greater than 4 mm, rarely as small as 3 mm) *Ulidiidae*, in part
103. Gena with one to several strong upcurved bristles below eye; frons with three to five pairs of laterooclinate fronto-orbital bristles (Fig. 141); female cercus large, fused with epiproct and bearing short, stout apical bristle (Fig. 201); coastal *Canacidae*, in part
- Gena without strong upcurved bristles below eye; if frons with more than two fronto-orbital bristles then rarely (some Tethinidae) all of them laterooclinate; female cercus different; various habitats 104
104. Frons with two well-developed fronto-orbital bristles, one proclinate and one reclinate (Fig. 151) 105
- Frontal chaetotaxy various, but frons rarely with proclinate fronto-orbital bristle; if present then with total of at least four fronto-orbital bristles (one of which may be reclinate) 106
105. Ocellar bristles strong (Fig. 151); palpus well developed, much longer than broad; tibiae with strong preapical dorsal bristle; C with row of outstanding spines in addition to usual setulae; humeral break present (Fig. 151); thoracic scutum strongly arched, with numerous rows of acrostichal hairs (Fig. 151) *Curtonotidae*
- Ocellar bristles absent (Fig. 150); palpus small and short, at most twice as long as broad; tibiae without preapical dorsal bristle; C without outstanding spines, humeral break absent; thoracic scutum flattened or weakly arched, with one to two rows of acrostichal hairs (Fig. 150) *Aulacigastridae*, in part (unusual species)
106. Vibrissa present (Figs. 176–180, 183–186), in rare cases represented by fascicle of fused bristles 107
- Vibrissa absent (e.g., Figs. 132–137, 140), but subvibrissal bristles sometimes vibrissa-like (e.g., Lonchaeidae, Chyromyidae, as in Figs. 141, 143, 187) 114
107. C with distinct humeral break (Figs. 190, 191) 108
- C without humeral break (Figs. 122, 189, 193–195) 109



Figs. 6.132–139. Heads of acalyprate Schizophora: anterolateral view of (132) *Pyrgota undata* Wiedemann, (Pyrgotidae), (Nearctic, MND, figs. 4.138, 65.1, modified); anterior view of (133) *Rhagoletis pomonella* (Walsh), (Tephritidae), (MND, figs. 4.99, 66.2); and (134) *Tauroscyphson andina* Aczél, (Ctenostylidae), (South America, Aczél, 1956, fig. 94); lateral view of (135) *Stylogaster neglecta* Williston, (Conopidae), (MND, fig. 54.3); (136) *Glyphidops flavifrons* (Bigot), (Neriidae), (MND, fig. 57.2); and (137) *Coelopa frigida* (Fabricius), (Coelopidae), (Holarctic, MND, fig. 82.3); anterolateral view of (138) *Sobaroccephala flaviseta* (Johnson), (Clusiidae), (Nearctic, MND, fig. 70.3); dorsal view of (139) *Neogriphoneura sordida* (Wiedemann), (Lauxaniidae), (MND, fig. 87.14).

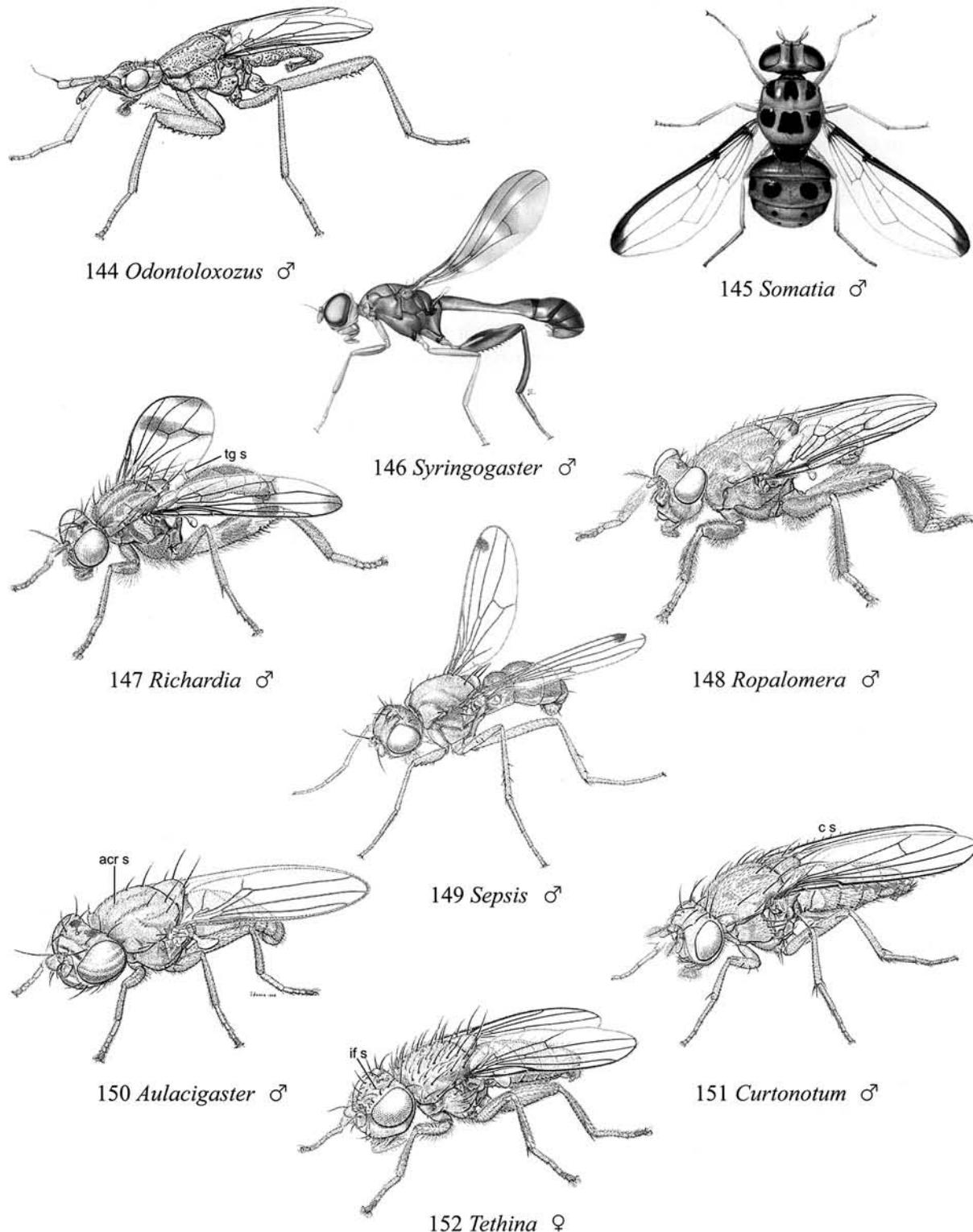
Abbreviations: clyp, clypeus; fc, face; frorb s, fronto-orbital seta; ic fr s, inclinate frontal seta; i vt s, inner vertical seta; lun, lunule; mbr area, membranous area of face; oc s, ocellar seta; o vt s, outer vertical seta; poc s, postocellar seta; ptil fis, ptilinal fissure; rc orb s, reclinate orbital seta.

108. Proboscis small, not geniculate, with stout bulbous prementum, apex of labella pointing anteriorly; frons with four fronto-orbital bristles (Fig. 177); anepisternum with hairs and/or bristles*; vibrissa below level of lower eye margin (Fig. 177); C not notched and without prominent costal lappet (Fig. 190)..... Carnidae, in part
- Proboscis geniculate (Fig. 178) and often long (Fig. 179), usually with slender prementum, apex of labella pointing posteriorly in resting position; if proboscis small then anepisternum bare and/or vibrissa well above lower margin of eye; frons sometimes with more than four fronto-orbital bristles (Fig. 178); C sometimes deeply notched at subcostal break and with prominent costal lappet (Fig. 191) Milichiidae, in part
- *Note: The southern South American genus *Neomeoneurites* Hennig has a long (not bulbous) prementum and a bare anepisternum.
109. C moderately to strongly spinose (Fig. 193); at most two fronto-orbital bristles in Neotropical species; all tibiae with preapical dorsal bristle; postocellar bristles strong and convergent Heleomyzidae, in part (Trixoscelidini, Heleomyzini, Suilliini)
- C usually not spinose, if weakly spinose (some Heleomyzidae, Gephyromyzini) then with three fronto-orbital bristles; preapical dorsal bristle of tibia present or absent; postocellar bristles various 110
110. Arista subapical to (rarely) apical; pedicel with more or less developed angular projection on outer distal margin (Fig. 138); frons either with one inclinate fronto-orbital bristle (sometimes with reclinate bristle in front of it) or strong single pair of inclinate interfrontal bristles; female terminalia telescoping, segment 7 not developed as heavily sclerotized oviscape; postocellar bristles divergent (Fig. 138) or absent; anepisternum setulose and with outstanding bristle at posterior margin Clusiidae, in part
- Arista dorsobasal; pedicel without external angular projection; frons usually without inclinate fronto-orbital bristle; if inclinate bristle(s) present (Agromyzidae) then often more than one pair and without reclinate bristle in front of it (them) (Fig. 176), and female segment 7 forming conical, non-retractile oviscape (Fig. 202); interfrontal bristles absent or at least two pairs present (e.g., Fig. 152); postocellar bristles various; anepisternum setulose or bare, with or without outstanding bristle(s) 111



Figs. 6.140–143. Heads of acalyptate Schizophora (concluded): anterolateral view of (140) *Leucopina ocellaris* (Malloch), (Chamaemyiidae), (Nearctic, MND, fig. 88.8, as *Leucopis*); (141) *Canaceoides nudatus* (Cresson), (Canacidae), (Nearctic, MND, figs. 4.116, 102.2); (142) *Latheticomyia tricolor* Wheeler, (Pseudopomyzidae), (MND, fig. 55.2, as *Cypselosomatidae*); and (143) *Gymnochiromyia concolor* (Malloch), (Chyromyidae), (Nearctic, MND, fig. 91.2).

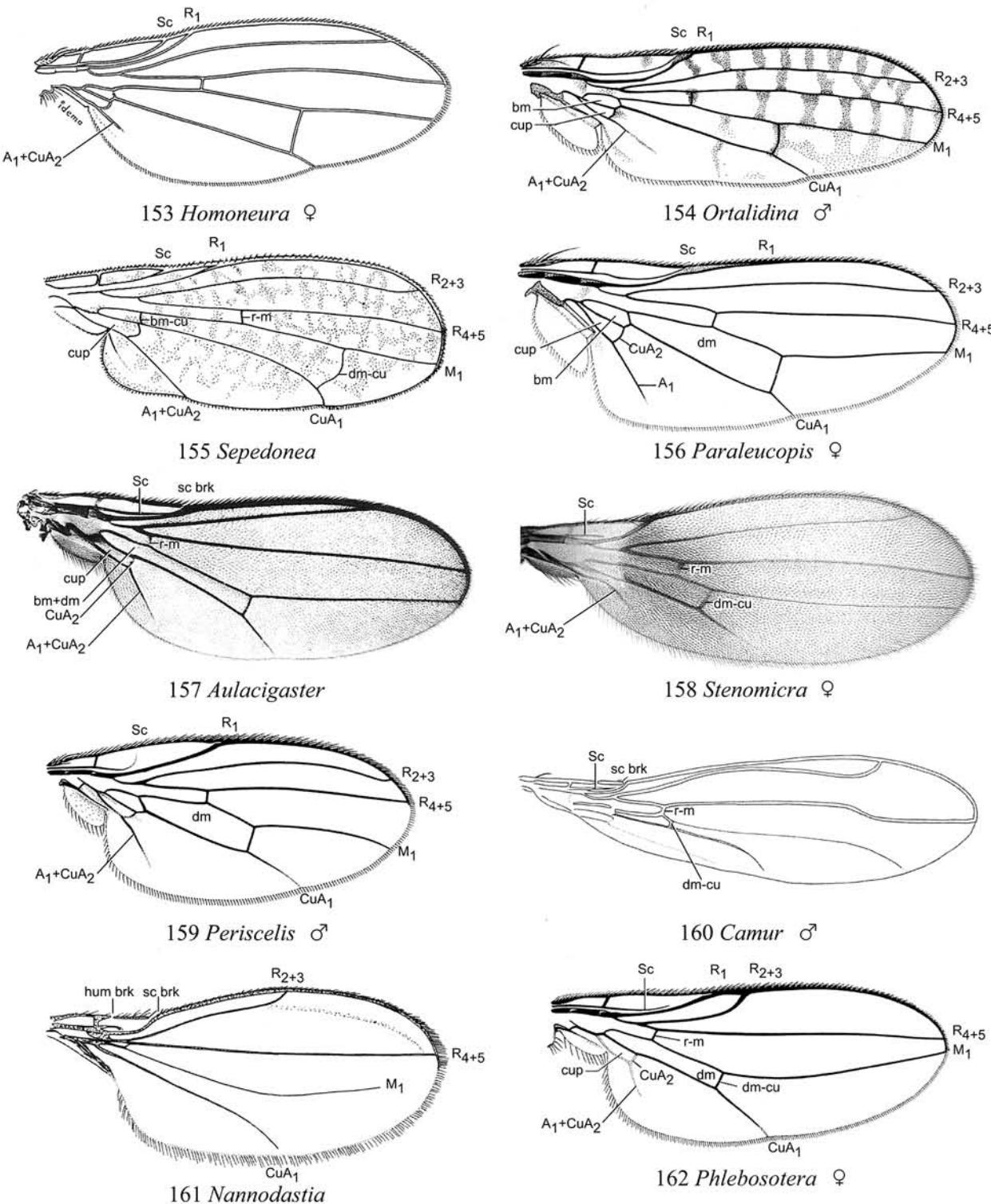
Abbreviations: clyp, clypeus; frorb s, fronto-orbital seta; gn, gena; gn s, genal seta; i vt s, inner vertical seta; lun, lunule; oc s, ocellar seta; o vt s, outer vertical seta; poc s, postocellar seta.



Figs. 6.144–152. Adults of acalyprate Schizophora: anterolateral view of (144) *Odontoloxozus longicornis* (Coquillett), (Neriidae), (MND, figs. 4.131, 57.1); dorsal view of (145) *Somatia* sp., (Somatiidae), (Zumbado, 2006: 137, modified); lateral view of (146) *Syringogaster brunnea* Cresson, (Syringogastridae), (Zumbado, 2006: 139); anterolateral view of (147) *Richardia eburneosignata* Hennig, (Richardiidae), (MND, fig. 67.1); (148) *Ropalomera femorata* (Fabricius), (Ropalomeridae), (MND, figs. 4.146, 85.1); (149) *Sepsis punctum* (Fabricius), (Sepsidae), (Holarctic, MND, figs. 4.145, 86.1, as *Sepsis punctum* (Linnaeus)); (150) *Aulacigaster neoleuceopeza* Mathis & Freidberg, (Aulacigastridae), (Nearctic, MND, figs. 4.141, 76.1, as *Aulacigaster leuceopeza* (Meigen)); (151) *Curtonotum helvum* (Loew), (Curtonotidae), (Nearctic, MND, figs. 4.150, 94.1); and (152) *Tethina parvula* (Loew), (Tethinidae), (Nearctic, MND, figs. 4.156, 101.1).

Abbreviations: acr s, acrostichal setula; c s, spinelike costal seta; if s, interfrontal setula; tg s, erect setae of syntergite 1+2.

111. Postocellar bristles divergent (Fig. 176) 112
 – Postocellar bristles convergent (Fig. 184), parallel, or absent 113
112. Frons with three or more fronto-orbital bristles, at least lowest one inclinate (Fig. 176); anepisternum setulose, with outstanding bristle(s) at hind margin; anepimeron bare; female tergite and sternite 7 fused, forming conical oviscape (Fig. 202) Agromyzidae, in part
 – Frons with two to zero lateroclinate to reclinate fronto-orbital bristles; anepisternum bare or setulose, usually without outstanding bristles, if with outstanding bristle(s) near hind margin (*Bocainamyia* Albuquerque, South America) then anepimeron setulose; female tergite and sternite 7 more or less elongate but free from each other Piophilidae
113. A_1+CuA_2 desclerotized and foldlike beyond cell cup; A_2 extending well beyond alula as desclerotized crease (Fig. 189); anepisternum setulose, with one or more outstanding bristles near hind margin; wing without supernumerary crossveins; usually coastal Tethinidae, in part
 – A_1+CuA_2 well sclerotized beyond cell cup; A_2 much reduced, disappearing without trace beyond alula (Fig. 194); anepisternum bare or setulose, without outstanding bristle(s) near hind margin; wing often (most Rhinotorini) with one to many supernumerary crossveins between C and R_{2+3} (Fig. 194); not coastal Heleomyzidae, in part (Rhinotorini, Gephyromyzini, Diaciini)
114. Halter black; anepisternum with row of distinct bristles posteriorly; frons, face, thorax, abdomen, and legs (exclusive of tarsi) black, usually with metallic reflections; frons with only one reclinate fronto-orbital bristle; wing membrane usually clear or evenly infuscated, rarely infuscation restricted to anterior wing margin and crossveins; cell cup without angular extension posteroapically; R_1 bare (Fig. 122) Lonchaeidae
 – Halter usually whitish, but if blackish, then anepisternum without row of enlarged bristles posteriorly, and/or head, thorax, abdomen, and legs not as extensively black; frons frequently with more than one fronto-orbital bristle; wing frequently marked; cell cup various; R_1 setulose or bare 115
115. Postocellar bristles convergent or cruciate (Fig. 143); A_1+CuA_2 well sclerotized beyond cell cup (Fig. 195) Chyromyidae, in part
 – Postocellar bristles divergent, parallel, or absent; A_1+CuA_2 sclerotized or desclerotized and foldlike beyond cell cup (Fig. 189) 116
116. A_1+CuA_2 desclerotized and foldlike beyond cell cup (Fig. 189); wing unmarked; small flies, less than 3 mm; mainly coastal Tethinidae, in part
 – A_1+CuA_2 well sclerotized beyond cell cup (Figs. 123, 126, 128) or rarely A_1+CuA_2 reduced and cell cup absent; wing usually marked; larger flies, usually greater than 3 mm 117
117. Usually abdominal syntergite 1+2 with one or more pairs of outstanding lateral bristles on disc and/or at least hind femur with one to several pairs of stout antero- and posteroventral setae (Fig. 147), if neither present then presutural supra-alar bristle developed (as in Fig. 164) or postmetacoxal bridge present (Fig. 169); cell cup without posteroapical angular extension (Fig. 128); frons with single orbital bristle in Neotropical species (Fig. 147) *Richardiidae, in part
 – Abdominal syntergite 1+2 without outstanding lateral bristles on disc; femora without stout ventral setae; presutural supra-alar bristle absent; postmetacoxal bridge not developed; cell cup usually with angular extension at posterior apex (Fig. 123), but if this extension lacking, then frons almost always with two orbital bristles Ulidiidae, in part
***Note:** Some species of *Omomyia* Coquillett (Nearctic Mexico) will not key properly to Richardiidae. In this genus the wing is unmarked except for an apical spot of R_{2+3} and C bears small, spinelike bristles.
118. C without subcostal or humeral break or weakening (Figs. 156, 159, 162) 119

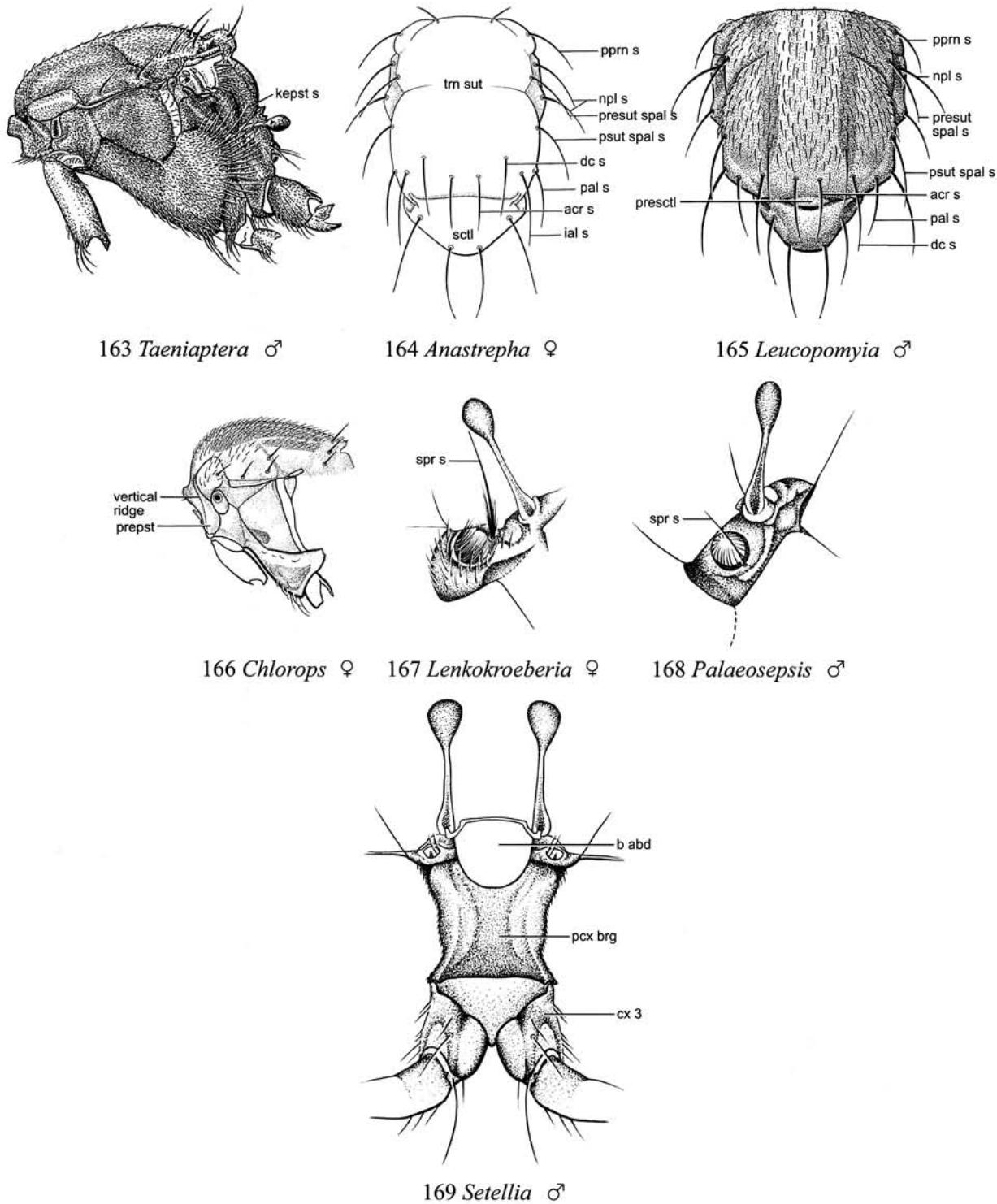


Figs. 6.153–162. Wings of acalyprate Schizophora: (153) *Homoneura bispina* (Loew), (Lauxaniidae), (Nearctic, MND, fig. 87.20, modified); (154) *Ortalidina punctata* (Coquillett), (Chamaemyiidae), (Nearctic, MND, fig. 88.9, as *Toropamecia*); (155) *Sepedonea lagoa* (Steyskal), (Sciomyzidae), (illustrated by L. Marinoni); (156) *Paraleucopis corvina* Malloch, (Paraleucopidae), (Nearctic, MND, figs. 4.62, 88.10, as Chamaemyiidae); (157) *Aulacigaster* sp., (Aulacigastridae), (photograph by W. Mathis); (158) *Stenomicra* sp., (Periscelididae), (photograph by M. Buck); (159) *Periscelis flini* (Malloch), (Periscelididae), (Nearctic, MND, fig. 77.3, as *Periscelis annulata* Fallén); (160) *Camur willii* McAlpine & de Keyzer, (Teratomyzidae), (South America, McAlpine & de Keyzer, 1994, fig. 25); (161) *Nannodastia horni* Hendel, (Nannodastiidae), (Australasian–Pacific, Oriental, Papp & Mathis, 2001, fig. 17); (162) *Phlebosotera setipalpis* Sabrosky, (Asteiidae), (Nearctic, MND, fig. 78.6).

Abbreviations: hum brk, humeral break; sc brk, subcostal break.

- C with subcostal and/or humeral break or weakening (e.g., Figs. 157, 158, 160, 161, 189–192, 196, 197) 123

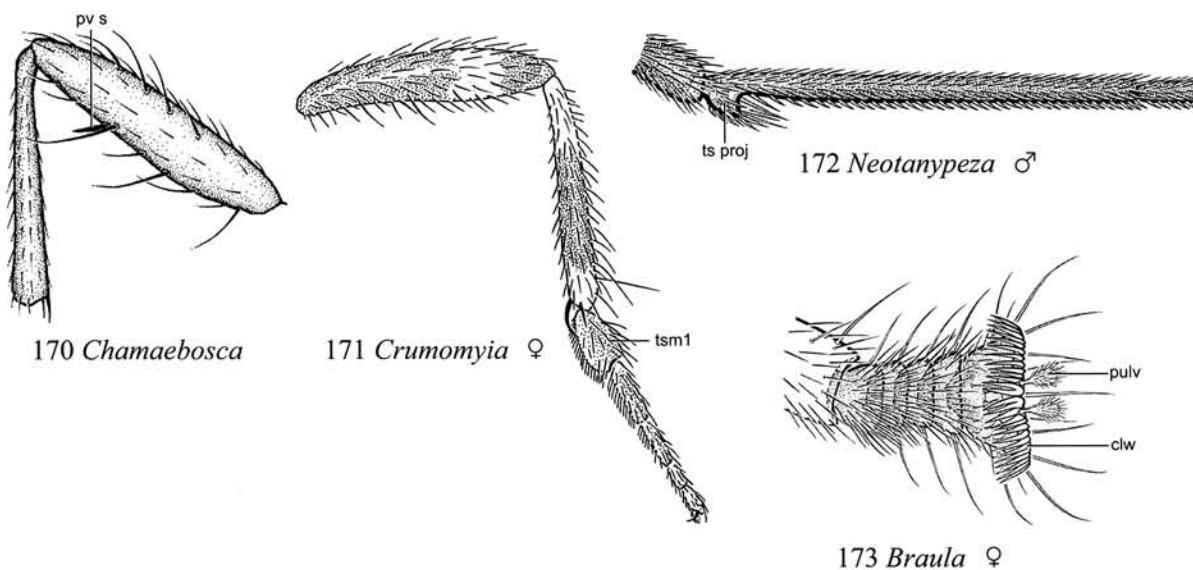
Note: Doubtful cases — some Periscelididae: Stenomicrinae — will key both ways.
- 119. R_{2+3} short, joining C at or slightly beyond R_1 ; R_{4+5} and M slightly to distinctly convergent distally (Fig. 162); crossvein bm-cu and sometimes dm-cu absent; cell cup absent, sometimes marked by faint folds (Fig. 162) Asteiidae, in part
- R_{2+3} long, joining C far beyond R_1 (but R_{2+3} running parallel and contiguous to C in second costal sector in some Periscelidinae); R_{4+5} and M not convergent (Fig. 159); crossveins and cell cup various 120
- 120. Anepisternum setulose and with outstanding bristle near hind margin; eye bare; inner vertical bristle reclinate to inclinate; postocellar bristles convergent but often small, more or less hairlike; cell cup present; bm and dm separate Lauxaniidae, in part (unusual species)
- Anepisternum setulose or bare, without outstanding bristle near hind margin, if with one or more enlarged hairs at hind margin then eye microsetulose and inner vertical bristle proclinate; postocellar bristles usually divergent or absent, if convergent or cruciate then cell cup absent and cells bm and dm confluent 121
- 121. Arista bipectinate with long, spaced dorsal and ventral rays (Fig. 182); either ocellar bristles completely absent (Stenomicrinae) (Fig. 182) or C abruptly ending at R_{4+5} (Periscelidinae) (Fig. 159); postocellar bristles divergent or absent Periscelididae, in part
- Arista bare to pubescent; ocellar bristles present, sometimes small; C extending to M (but sometimes weaker in last sector); postocellar bristles not divergent 122
- 122. Cells bm and dm confluent; cell cup absent (Fig. 192) (the only presently known genus that keys here, *Pseudogaurax* Malloch, is furthermore characterized by haired eyes, long and well-defined ocellar triangle (similar to Fig. 181), and cruciate postocellar bristles) Chloropidae, in part (unusual species)
- Cells bm and dm separate; cell cup present (Fig. 156); eye bare; frons without long, well-defined ocellar triangle; postocellar bristles absent Paraleucopidae
- 123. Hind tarsomere 1 almost always distinctly swollen and/or at most as long as tarsomere 2 (Fig. 171), which is sometimes swollen as well; if neither swollen nor shorter (Homalomitrinae, extremely rare) then ocelli absent (Fig. 174); anepisternum bare or setulose, without outstanding bristles; arista pubescent or bare Sphaeroceridae, in part
- Hind tarsomere 1 longer than tarsomere 2, rarely swollen but if so anepisternum with outstanding bristle near hind margin and arista pectinate (as in Fig. 187); ocelli present 124
- 124. Arista much shorter than large first flagellomere, either minute and peglike, or rodlike and inserted in deep apical emargination of first flagellomere; small flies, body length 1.5 mm or less 125
- Arista elongate, usually longer than first flagellomere, if not (a few Ephydriidae) first flagellomere small; body size often larger 126
- 125. First flagellomere elongate and decumbent, not emarginate apically; R_{2+3} long, terminating beyond middle of wing; dm-cu present; scutellum densely setulose, with thin and sharp-edged posterior margin; katepisternum bare (Fig. 203) Cryptochetidae
- First flagellomere wider than long, with deep apical emargination that is somewhat obscured by long hairs along apical margin; R_{2+3} short, terminating at or near apex of R_1 (similar to Fig. 162); dm-cu absent; scutellum bare except marginal bristles, with thick, rounded posterior margin; katepisternal bristle present Asteiidae, in part (*Loewimyia* Sabrosky)



Figs. 6.163–169. Thoracic characters of acalyprate Schizophora: lateral view of thorax of (163) *Taeniasptera trivittata* Macquart, (Micropezidae), (Nearctic, MND, fig. 56.7, modified); dorsal view of thorax showing chaetotaxy of (164) *Anastrepha ludens* (Loew), (Tephritidae), (MND, fig. 66.8); and (165) *Leucopomyia pulvinariae* (Malloch), (Chamaemyiidae), (Nearctic, MND, fig. 88.13, as *Leucopis*); lateral view of anterior part of thorax of (166) *Chlorops certimus* Adams, (Chloropidae), (Nearctic, MND, fig. 4.166); left metathoracic spiracle and halter of (167) *Lenkokroeberia* sp., (Ropalomeridae); and (168) *Palaeosepsis* sp., (Sepsidae); posteroventral view of metathorax of (169) *Setellia* sp., (Richardiidae). Figs. 167–169 illustrated by A. Brenes.

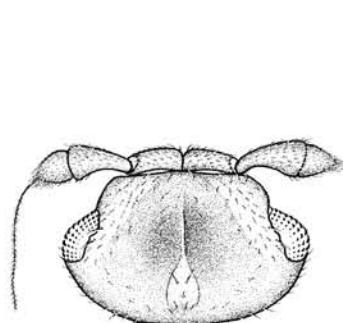
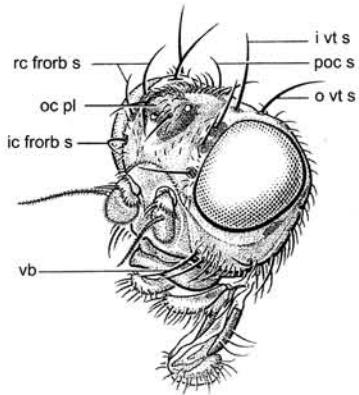
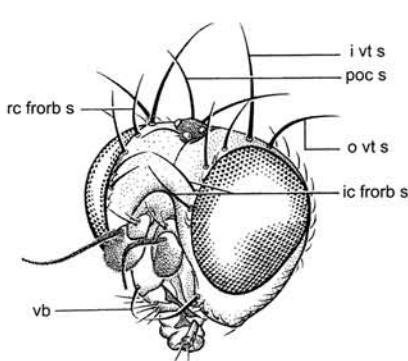
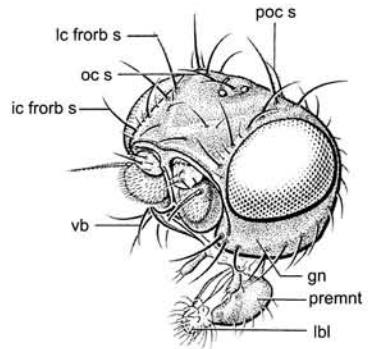
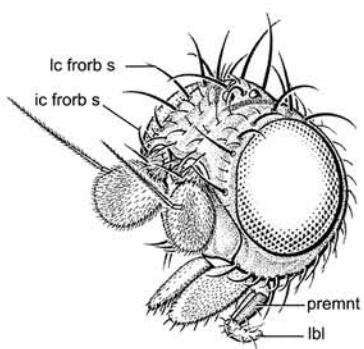
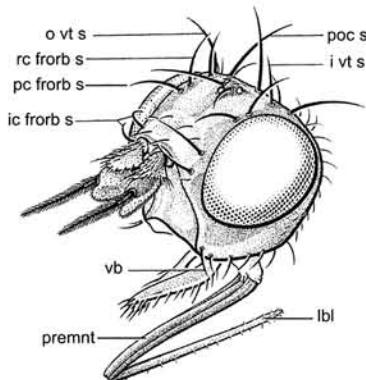
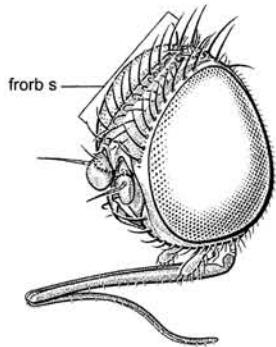
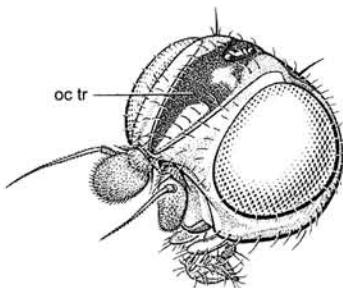
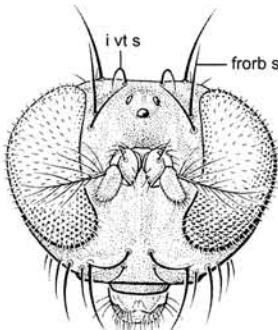
Abbreviations: acr s, acrostichal seta; b abd, base of abdomen; cx 3, hind coxa; dc s, dorsocentral seta; ial s, intra-alar seta; kepst s, katepisternal seta; npl s, notopleural seta; pal s, postalar seta; pcx brg, postmetacoxal bridge; ppm s, postpronotal seta; prepst, proepisternum; presctl, prescutellum; presut spal s, presutural supra-alar seta; psut spal s, postsutural supra-alar seta; sctl, scutellum; spr s, enlarged seta at margin of posterior thoracic spiracle; trn sut, transverse suture.

126. Cell cup absent or incomplete, CuA₂ absent or vestigial, A₁ absent or present (Figs. 158, 161, 190, 192, 197) 127
- Cell cup closed, CuA₂ and A₁ present (Figs. 157, 189, 191, 195, 196) 139
Note: Doubtful cases — some Anthomyzidae, Drosophilidae, Milichiidae, and Periscelididae; Stenomicriinae — will key both ways.
127. Frons with four or more fronto-orbital bristles, anterior two to three pairs inclinate (Figs. 177, 178); face not convex, often with deep antennal foveae; arista bare to pubescent; C with humeral break (Figs. 190, 191) 128
- Fronto-orbital bristles varied in number and orientation (rarely reduced altogether), but usually none of them inclinate, if, rarely (some Drosophilidae), one of them inclinate then arista bipectinate and fronto-orbitals in three pairs (Fig. 185) 129
128. Anepisternum with hairs and/or bristles; proboscis small, not geniculate, with stout bulbous prementum, apex of labella pointing anteriorly; frons with two inclinate and two lateroclinate fronto-orbital bristles (Fig. 177); vein M faint, distinctly weaker than R₄₊₅; dm-cu present or absent (Fig. 190) Carnidae, in part (*Carnus* Nitzsch, *Meoneura* Rondani)
- Anepisternum bare and/or proboscis geniculate, with slender prementum and apex of labella pointing posteriorly in resting position (Figs. 178, 179); number of fronto-orbital bristles sometimes greater (Fig. 178) or fewer than four, posterior fronto-orbital bristles sometimes reclinate or proclinate (Fig. 179); vein M strong or faint, if faint then dm-cu absent Milichiidae, in part
129. Crossveins r-m and dm-cu closely approximated (Fig. 160); head with one well-developed pair of fronto-orbital bristles; dm-cu and usually bm-cu developed, if bm-cu absent then anepimeron with small bristle and anepisternum bare; forefemur without short, spinelike posteroventral bristle; South America [Teratomyzidae]



Figs. 6.170–173. Legs of acalyptate Schizophora: femur and tibia of left foreleg of (170) *Chamaebosca microptera* Speiser, (Anthomyzidae), (South America, Roháček, 1998, fig. 13); left hind leg of (171) *Crumomyia annulus* (Walker), (Sphaeroceridae), (Nearctic, MND, fig. 93.22); posterior view of first tarsomere of hind leg of (172) *Neotanypeza elegans* (Wiedemann), (Tanypezidae), (MND, fig. 58.3); ventral view of midtarsus of (173) *Braula coeca* Nitzsch, (Braulidae), (MND, figs. 4.178, 81.2).

Abbreviations: clw, claw; pulv, pulvilli; pv s, spinelike posteroventral seta; tsm 1, first tarsomere; ts proj, ventrobasal projection of first hind tarsomere.

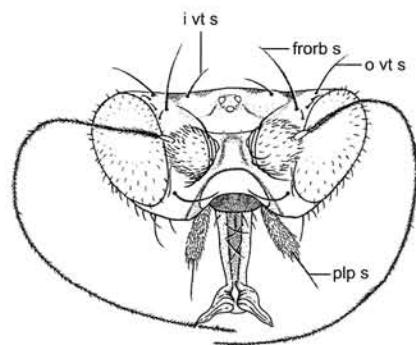
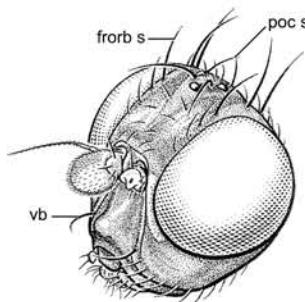
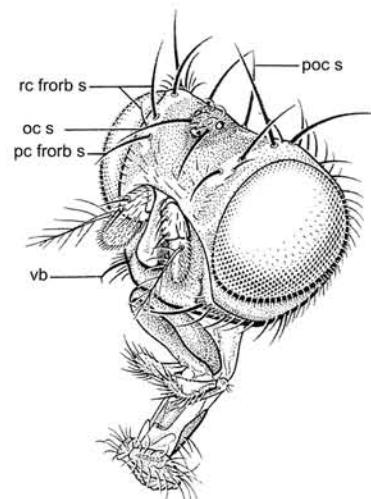
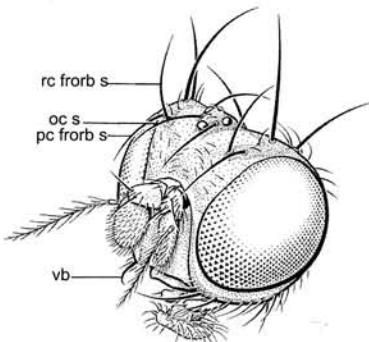
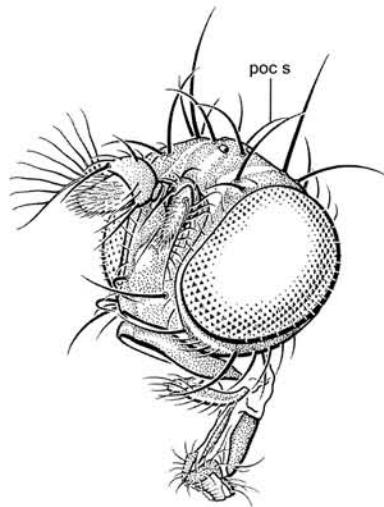
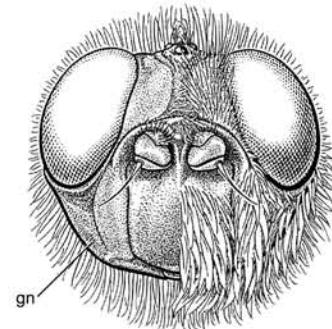
174 *Homalomitra* ♂175 *Traginops* ♂176 *Liriomyza* ♀177 *Carnus* ♀178 *Phyllomyza* ♂179 *Aldrichiomyza* ♀180 *Eusiphona* ♀181 *Thaumatomyia* ♂182 *Stenomicra* ♀

Figs. 6.174–182. Heads of acalyprate Schizophora: dorsal view of (174) *Homalomitra antiqua* Roháček & Marshall, (Sphaeroceridae), (Roháček & Marshall, 1998, fig. 2, modified); anterolateral view of (175) *Traginops irroratus* Coquillett, (Odiniidae), (Nearctic, MND, fig. 72.2, as *Traginops irrorata*); (176) *Liriomyza septentrionalis* Sehgal, (Agromyzidae), (Nearctic, MND, fig. 73.2); (177) *Carnus hemapterus* Nitzsch, (Carnidae), (Holarctic, MND, figs. 4.118, 80.4); (178) *Phyllomyza securicornis* Fallén, (Milichiidae), (Holarctic, MND, fig. 79.3); (179) *Aldrichiomyza agromyzina* (Hendel), (Milichiidae), (Nearctic, MND, fig. 79.2); (180) *Eusiphona mira* Coquillett, (Milichiidae), (MND, fig. 79.6); and (181) *Thaumatomyia glabra* (Meigen), (Chloropidae), (Holarctic, MND, fig. 99.9); anterior view of (182) *Stenomicra* sp., (Periscelididae), (MND, figs. 4.101, 76.3, as *Stenomicra angustata* Coquillett in Aulacigastridae).

Abbreviations: frorb s, fronto-orbital seta; gn, gena; ic frorb s, inclinate fronto-orbital seta; i vt s, inner vertical seta; lbl, labella; lc frorb s, laterooclinate fronto-orbital seta; oc pl, ocellar plate; oc s, ocellar seta; oc tr, ocellar triangle; o vt s, outer vertical seta; pc frorb s, proclinate fronto-orbital seta; poc s, postocellar seta; premnt, prementum; rc frorb s, reclinate fronto-orbital seta; vb, vibrissa.

- Crossveins r-m and dm-cu (if present) usually well separated (Figs. 192, 197), if not then head with more than one fronto-orbital bristle or fronto-orbitals altogether reduced and hairlike; almost always either bm-cu (Figs. 192, 197) and/or (rarely) dm-cu missing, if both present then forefemur with short, spinelike posteroventral bristle (Fig. 170) and anepisternum bare; anepimeron bare..... 130
- 130. C without humeral break (Figs. 158, 192) 131
- C with humeral break or distinct humeral weakening (Figs. 161, 197) 133
- 131. Arista bare to long pubescent or rarely plumose (usually micropubescent), sometimes flattened and ensiform (Fig. 77), not bipectinate with spaced dorsal and ventral rays; wing vein bm-cu absent (Fig. 192); propleuron with sharp vertical carina anteriorly (Fig. 166)*; fronto-orbital bristles usually all small and hairlike (Fig. 181), if well developed then usually proclinate or lateroclinate, rarely with one to three well-developed, reclinate bristles Chloropidae, in part
- Arista bipectinate, with spaced dorsal and ventral rays (Fig. 182) and/or vein bm-cu present; propleuron not carinate; frons with one to three well-developed, reclinate fronto-orbital bristles 132
- *Note: This character is sometimes difficult to see. In certain cases the carina only becomes visible after the head is removed.
- 132. Ocellar bristles absent; inner vertical bristle proclinate (Fig. 182); forefemur without short, spinelike posteroventral bristle; wing vein bm-cu usually absent, dm-cu present (Fig. 158) Periscelididae, in part (*Stenomicra* Coquillett, in part)
- Ocellar bristles present; inner vertical bristle inclinate; forefemur with short, spinelike posteroventral bristle (Fig. 170); bm-cu present, dm-cu present or absent Anthomyzidae, in part
- 133. Anepisternum bare; vibrissa present (Figs. 142, 185) 134
- Anepisternum with hairs and/or bristles; vibrissa present or absent 136
- 134. Long axis of antenna straight, first flagellomere porrect (Fig. 73); frons with three pairs of reclinate fronto-orbital bristles, anterior one at least half as long as posterior one (as in Fig. 142); scutum with well-developed presutural pair of dorsocentral bristles, median row of acrostichal setulae unpaired (except in prescutellar area), usually two of them in front of and behind transverse suture enlarged and bristlelike; arista short pubescent..... Pseudopomyzidae, in part (*Pseudopomyza* Strobl)
- Long axis of antenna distinctly elbowed, first flagellomere decumbent (Fig. 185); frons with two reclinate fronto-orbital bristles at most (tiny third one may be present anteriorly), and usually with proclinate fronto-orbital (Fig. 185); scutum without distinct presutural dorsocentral bristles, acrostichal rows of setulae paired throughout; arista usually bipectinate (Fig. 185) 135
- 135. Frons almost always with distinct proclinate fronto-orbital bristle (Fig. 185), rarely all fronto-orbitals reduced; forefemur rarely with one or more short, spinelike posteroventral bristles Drosophilidae, in part
- Frons with reclinate fronto-orbital bristle(s) only; forefemur with single short, spinelike posteroventral bristle (Fig. 170) Anthomyzidae, in part (unusual species)
- 136. All fronto-orbital bristles reclinate, in three pairs (anterior pair small); wing vein M faint, distinctly weaker than R_{4+5} , gently curved forward and often fading away before wing margin; dm-cu absent; C ending at R_{4+5} or slightly beyond it; alula absent (Fig. 161); arista short pubescent to bare; coastal Nannodastiidae
- Usually at least one fronto-orbital bristle proclinate or all fronto-orbitals lateroclinate, if all reclinate then only one pair present; rarely fronto-orbitals altogether reduced and hairlike; wing vein M as strong as R_{4+5} , reaching wing margin; dm-cu present; C usually reaching M; alula present (Fig. 197); arista various; various habitats. 137

137. Postocellar bristles divergent (Fig. 187) or absent; vibrissa absent (but sometimes with vibrissa-like parafacial bristles as in Fig. 187); arista pectinate (with dorsal rays only, Fig. 187), pubescent, or bare; number and orientation of fronto-orbital bristles various, sometimes all lateroclinate; common Ephydriidae, in part
- Postocellar bristles convergent (Fig. 185) or cruciate; vibrissa present, sometimes duplicated (Fig. 185); arista bipectinate (with dorsal and ventral rays) (Fig. 185), but ventral rays often and dorsal rays sometimes very short, giving arista almost pectinate or sparsely pubescent appearance; frons with one proclinate and one to two reclinate fronto-orbital bristles (Fig. 185); rare 138
138. Anepisternum with outstanding bristle near hind margin; abdominal syntergite 1+2 with pair of large, marginal paramedian bristles (Fig. 200); preabdomen with three (♂) or four (♀) apparent large tergites only*; frons with one proclinate and one reclinate fronto-orbital bristle. Camillidae

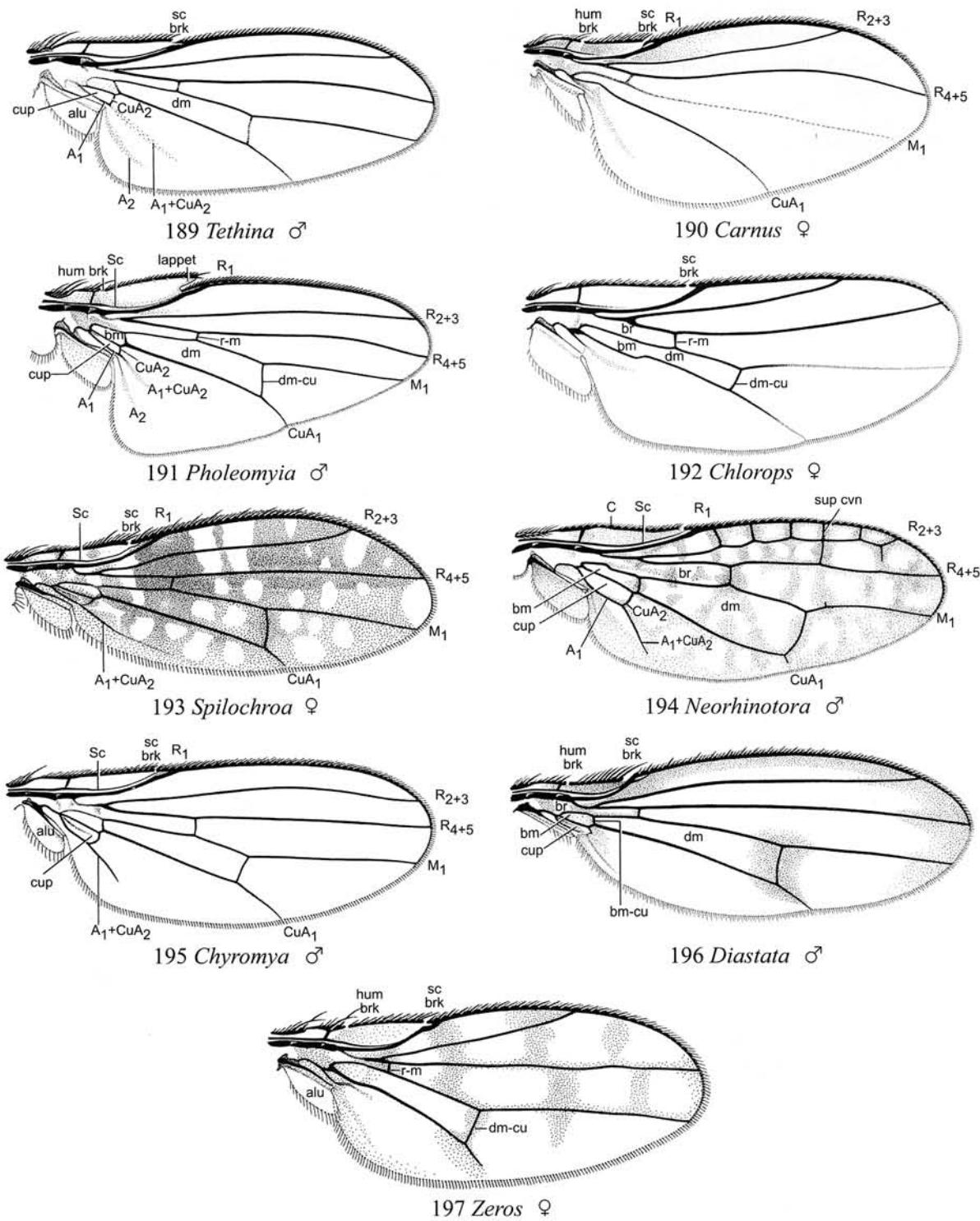
183 *Inbiomyia* ♀184 *Cinderella* ♀185 *Drosophila* ♀186 *Diastata* ♀187 *Clasiopella* ♀188 *Hypoderma* ♂

Figs. 6.183–188. Heads of Cyclorrhapha: anterior view of (183) *Inbiomyia mcalpineorum* Buck, (Inbiomyiidae), (Buck, 2006, fig. 3A); anterolateral view of (184) *Cinderella lampra* Steyskal, (Heleomyzidae), (Nearctic, MND, fig. 4.112); (185) *Drosophila colorata* Walker, (Drosophilidae), (Nearctic, MND, figs. 4.120, 95.2); (186) *Diastata vagans* Loew, (Diastatidae), (Holarctic, MND, figs. 4.119, 96.2); and (187) *Clasiopella uncinata* Hendel, (Ephydriidae), (MND, fig. 98.14); anterior view of (188) *Hypoderma bovis* (Linnaeus), (Oestridae), (Holarctic, MND, fig. 107.4).

Abbreviations: frorb s, fronto-orbital seta; gn, gena; i vt s, inner vertical seta; oc s, ocellar seta; o vt s, outer vertical seta; pc frorb s, proclinate fronto-orbital seta; plp s, palpal seta; poc s, postocellar seta; rc frorb s, reclinate orbital seta; vb, vibrissa.

- Anepisternum and abdominal syntergite 1+2 without outstanding bristle(s) on hind margin; preabdomen with five apparent large tergites* in both sexes; frons (possibly in all specimens) with one proclinate and two reclinate fronto-orbital bristles. *Drosophilidae*, in part (unusual species)

*Note: Syntergite 1+2 counted as one tergite. The fourth apparent tergite in *Camillidae* females is often small.
- 139. Katepisternum and anepisternum setulose but without outstanding bristles; notopleuron with one bristle only (posterior one); vibrissa absent; postocellar bristles present, divergent; C with subcostal break only. *Psilidae*
- Katepisternum with one or more outstanding bristles; anepisternum bare or setulose, with or without outstanding bristle(s); notopleuron usually with two bristles; other characters various ... 140
- 140. Ocellar bristles absent or minute (Fig. 183); forefemur without short, spinelike posteroventral bristle 141
- Ocellar bristles present and usually well developed (in *Trixoscelidini* (*Heleomyzidae*), inserted at level or slightly in front of level of anterior ocellus), if reduced (some unusual *Anthomyzidae*) then forefemur with short, spinelike posteroventral bristle (Fig. 170) 143
- 141. Frons with one inclinate fronto-orbital bristle; palpus well developed and with long, preapical ventral bristle (Fig. 183); midtibia without ventroapical bristle; anepisternum bare *Inbiomyiidae*
- Frons with two or rarely one fronto-orbital bristle(s), one reclinate; palpus often small, without long bristles; midtibia with at least small ventroapical bristle; anepisternum setulose or bare. 142
- 142. Crossvein r-m at or basal to level of subcostal break; cells bm and dm confluent (Fig. 157); eye bare; frons without interfrontal bristles; face bare and not unusually broad (Fig. 150); midtibia without preapical dorsal bristle; arista usually with short dorsal and ventral rays *Aulacigastridae*, in part
- Crossvein r-m distal to level of junction of R₁ and C (Fig. 158); cells bm and dm almost always separate; eye usually microsetulose (sometimes sparsely so) (Fig. 182), if bare (*Planinasus* Cresson) then frons with pair of interfrontal bristles, face broad with several strong bristles on disc, and midtibia with preapical dorsal bristle; arista bipectinate with long rays (Fig. 182) *Periscelididae*, in part (*Stenomicrinae*, in part)
- 143. Scutellum with three (rarely four) pairs of marginal setae; exposed portion of face with setulae medially between and below level of antennae; frons with three to four reclinate to more or less lateroclinate fronto-orbital bristles (Fig. 142); postocellar bristles cruciate; cells bm and dm fused *Pseudopomyzidae*, in part
- Scutellum with one to two pairs of marginal setae; exposed portion of face bare between or below level of antennae (but lunule sometimes with two or more setulae); if with more than two fronto-orbital bristles then at least one of them usually inclinate or proclinate or all fronto-orbitals plainly lateroclinate; postocellar bristles various; cells bm and dm separate or fused 144
- 144. Sc abruptly bent up to C, strong before bend, foldlike beyond (as in Fig. 125); wing strongly patterned; frons with one to two reclinate orbital bristles; postocellar bristles divergent; vibrissa absent; anepisternum setulose and with outstanding bristle; tibiae without preapical dorsal bristle. 145
- Sc not abruptly bent up to C; otherwise not with above combination of characters 146
- 145. Scutellum with one pair of marginal bristles; scutum with presutural supra-alar bristle (as in Fig. 164) and/or abdominal syntergite 1+2 with outstanding lateral bristles on disc (as in Fig. 147) *Richardiidae*, in part (*Schnusimyia* Hendel)
- Scutellum with two pairs of marginal bristles; scutum without presutural supra-alar bristle; syntergite 1+2 without outstanding bristles on disc *Ulidiidae*, in part (unusual species)



Figs. 6.189–197. Wings of acalyprate Schizophora: dorsal view of (189) *Tethina horripilans* (Melander), (Tethinidae), (Nearctic, MND, figs. 4.69, 101.10); (190) *Carnus hemapterus* Nitzsch (Carnidae), (Holarctic, MND, figs. 4.60, 80.3); (191) *Pholeomyia indecora* (Loew), (Milichiidae), (Nearctic, MND, fig. 79.16); (192) *Chlorops certimus* Adams, (Chloropidae), (Nearctic, MND, figs. 4.68, 99.40); (193) *Spilocroa ornata* (Johnson), (Heleomyzidae), (Nearctic, MND, fig. 90.3, as Trixoscelidae); (194) *Neorhinotora diversa* (Giglio-Tos), (Heleomyzidae), (Nearctic, MND, figs. 4.64, 92.3, as Rhinotoridae); (195) *Chyromya flava* (Linnaeus), (Chyromyidae), (Holarctic, MND, fig. 91.5); (196) *Diastata vagans* Loew, (Diastatidae), (Holarctic, MND, figs. 4.66, 96.3); (197) *Zeros flavipes* (Willistion), (Ephydriidae), (MND, fig. 98.52).

Abbreviations: alu, alula; hum brk, humeral break; sc brk, subcostal break; sup cvn, supernumerary crossvein.

146. C with humeral break or distinct and abrupt humeral weakening (Figs. 190, 191, 196). 147
- C without humeral break (Figs. 189, 193, 195), at most with slight, ill-defined, and gradual weakening sometimes emphasized by interruption of series of costal spinules. 151
147. Frons almost always with at least four fronto-orbital bristles, anterior ones usually inclinate (Figs. 177, 178) or else fronto-orbitals numerous and all more or less reclinate (Fig. 180); if rarely with only three fronto-orbitals then two most anterior ones inclinate; arista bare or short pubescent (Figs. 177, 178), rarely densely plumose (Fig. 179) 148
- Frons with one to three fronto-orbital bristles of varied orientation but usually not inclinate, if rarely one of them more or less inclinate (some Drosophilidae) then arista bipectinate, with spaced dorsal and ventral rays (as in Fig. 185) 149
148. Anepisternum with hairs and/or bristles; proboscis small, not geniculate, with stout, bulbous prementum and porrect labella (Fig. 177); frons with two inclinate and two lateroclinate fronto-orbital bristles (Fig. 177); C simple, not deeply notched (as in Fig. 190) Carnidae, in part
- Anepisternum bare and/or proboscis geniculate, with slender prementum and labella folded back against prementum (Figs. 178, 179); number of fronto-orbital bristles sometimes higher (Fig. 178), exceptionally lower than four, one or more bristles may be reclinate or proclinate (Fig. 179); C sometimes deeply notched at subcostal break and with prominent costal lappet (Fig. 191) Milichiidae, in part
149. Frons with one or two reclinate or lateroclinate fronto-orbital bristles and sometimes several smaller, reclinate hairlike setae in front of it (them) (Fig. 184); long axis of antenna nearly straight, with flagellum more or less porrect (Fig. 184); pedicel without dorsal seam Heleomyzidae, in part (Cinderellini, Cnemospinthidini)
- Frons with reclinate and proclinate (or rarely inclinate) fronto-orbital bristles (Fig. 185); long axis of antenna strongly bowed, with flagellum distinctly decumbent (Fig. 185); pedicel almost always with dorsal seam (Fig. 2.27) 150
150. C with small, evenly spaced, erect spinules between apices of R_1 and R_{2+3} (Fig. 196); proclinate fronto-orbital bristle arising posterolaterally to reclinate fronto-orbital bristle (Fig. 186), or posterolaterally to anterior reclinate bristle if two present; anepisternum setulose or bare . . . Diastatidae
- C without erect spinules (but sometimes with low tuberculate spinules ventrally between apices of R_{2+3} and R_{4+5}); position of proclinate bristle various (sometimes this bristle more or less inclinate) but not arising posterolaterally to reclinate (anterior reclinate) bristle (Fig. 185); anepisternum bare Drosophilidae, in part
151. Anepisternum bare 152
- Anepisternum with hairs and/or bristles 153
152. All tibiae with preapical dorsal bristle; frons with (two)three to seven fronto-orbital bristles, anterior one to five inclinate (Fig. 175); ocellar plate sometimes raised and unusually prominent (Fig. 175); forefemur without short, spinelike posteroventral bristle Odiniidae
- Tibiae without preapical dorsal bristle; frons with one to two(three) fronto-orbital bristles, all reclinate; ocellar plate not raised; forefemur usually with short, spinelike posteroventral bristle (Fig. 170) Anthomyzidae, in part
153. Gena with one to several strong upcurved bristles below eye (often arranged in oblique series); frons with three to five pairs of lateroclinate fronto-orbital bristles; clypeus large and exposed (Fig. 141); female cercus large, fused with epiproct and bearing short, stout apical bristle (Fig. 201); coastal Canacidae, in part

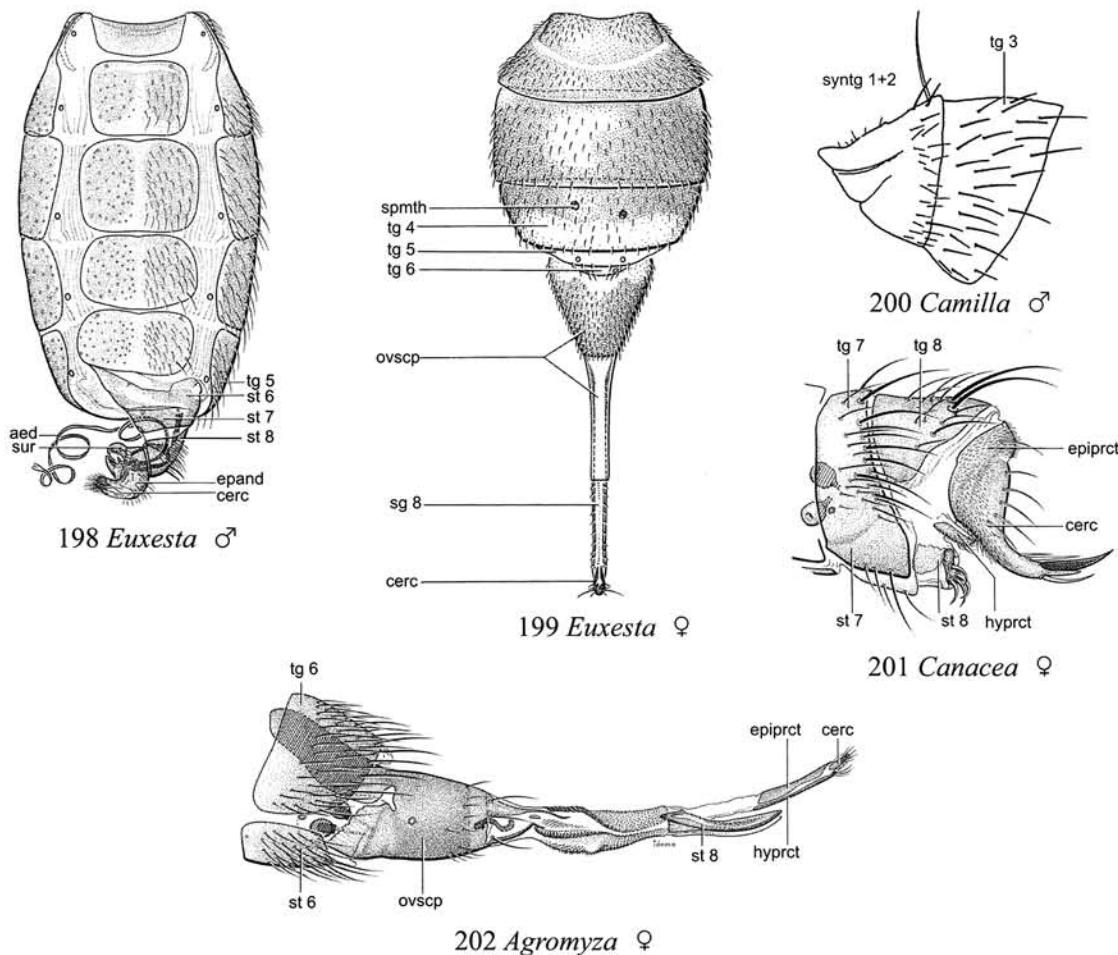
— Gena without strong upcurved bristles below eye (but sometimes with relatively strong bristles at lower margin); frons rarely (some Tethinidae) with three to five pairs of lateroclyinate fronto-orbital bristles; clypeus not unusually large, usually more or less withdrawn; female cercus otherwise; various habitats..... 154

154. Frons with three or more inclinate and reclinate fronto-orbital bristles*; frontal vitta bare or rarely with few setulae anteriorly; postocellar bristles divergent, always present (Fig. 176); female segment 7 modified as conical, non-retractile oviscape (Fig. 202) Agromyzidae, in part

— Usually at most three fronto-orbital bristles present, or otherwise fronto-orbitals more or less lateroclyinate; frontal vitta often setulose or with two rows of interfrontal bristles; postocellar bristles various**; female terminalia telescoping, segment 7 unmodified. 155

*Note: Males of one unusual Nearctic species of *Ophiomyia* Braschnikow (probably present in Mexico) have only one to two inclinate fronto-orbital bristles.

**Note: Though postocellar bristles are not divergent in families keyed here, some Tethininae (Tethinidae) possess well-developed divergent pseudopostocellar bristles, which can easily be confused with postocellar bristles.

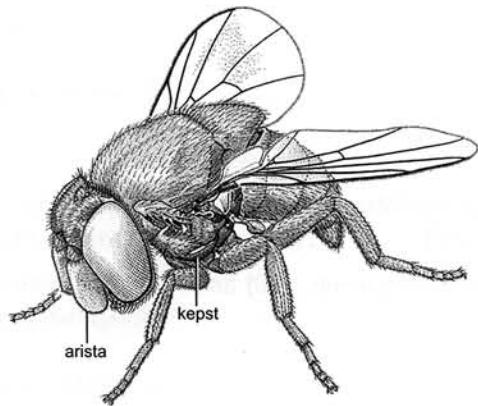
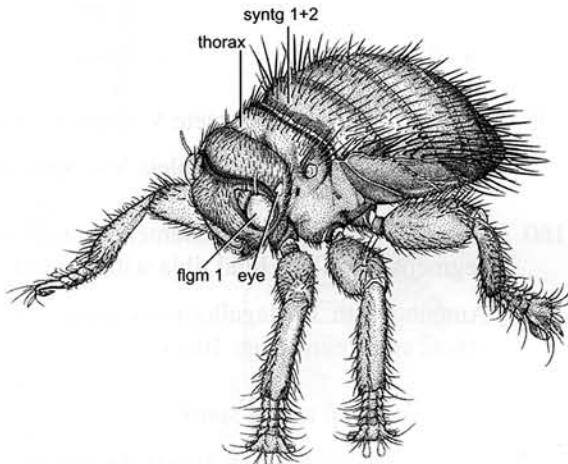
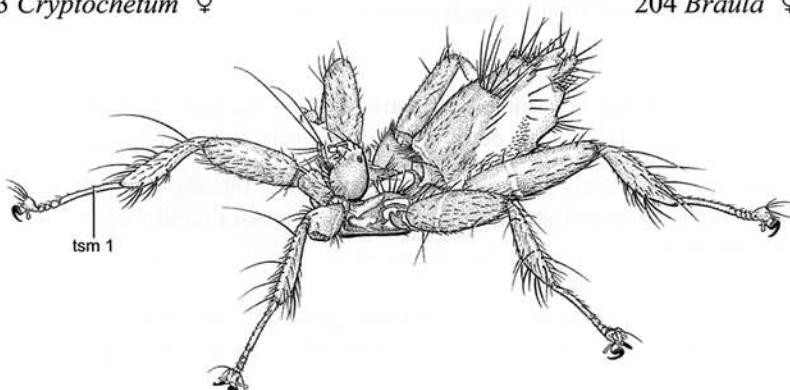


Figs. 6.198–202. Abdominal characters of acalyprate Schizophora: ventral view of (198) male abdomen, and dorsal view of (199) female abdomen of *Euxesta notata* (Wiedemann), (Ulidiidae), (Nearctic, MND, male: fig. 63.23; female: fig. 63.28, as Otitidae); lateral view of abdominal tergites 1–3 of (200) *Camilla arnaudi* Barraclough & Wheeler, (Camillidae), (Nearctic, Barraclough & Wheeler, 1995, fig. 5); lateral view of female terminalia of (201) *Canacea macatee* Malloch, (Canacidae), (MND, fig. 102.5); lateral view of female terminalia with ovipositor extended of (202) *Agromyza pseudoreptans* Nowakowski, (Agromyzidae), (Nearctic, MND, fig. 73.22).

Abbreviations: aed, aedeagus; cerc, cercus; epand, epandrium; epiprt, epiproct; hypprt, hypoproct; ovscp, oviscape; sg, segment; spmth, spermatheca; st, sternite; sur, surstyli; syntg, syntergite; tg, tergite.

155. Ocellar bristles shifted anteriorly, at or slightly before level of median ocellus; tibiae with preapical dorsal bristle; C with small spinelike bristles on first and second sector; wing usually marked (Fig. 193) *Heleomyzidae*, in part (*Trixoscelidini*)
- Ocellar bristles not shifted anteriorly, behind level of median ocellus (sometimes also with more or less enlarged interfrontal bristles in front of median ocellus); tibiae without preapical bristle; C not spinose; wing unmarked; frequently coastal 156
156. $A_1 + CuA_2$ desclerotized and foldlike beyond cell cup; A_2 extending well beyond alula as desclerotized crease (Fig. 189); face sometimes concave but not carinate; either gena bare with only one row of peristomal setae along lower margin (*Tethininae*, Fig. 152) or acrostichals absent or minute and scattered (*Pelomyiinae*) *Tethinidae*, in part
- $A_1 + CuA_2$ well sclerotized beyond cell cup; A_2 much reduced, disappearing without trace beyond alula (Fig. 195); face with deep antennal foveae, often carinate; gena setulose (Fig. 143); acrostichals well developed, arranged in at least two (usually more) rows *Chyromyidae*, in part
157. Flagellum with two or more flagellomeres, stylus or arista not developed (Figs. 2.10–2.12; 1–5); nematocerous families 158
- Flagellum with one flagellomere and stylus or arista (antenna excluding arista sometimes appearing two segmented because of concealed pedicel or fused scape) (Figs. 2.23–2.28); BRACHYCERA 162
158. Ocelli absent 159
- Ocelli present 161
159. Mesoscutum with complete V-shaped suture (Fig. 8.2) *Tipulidae*, in part
- Mesoscutum without complete V-shaped suture 160
160. Antenna with 4–14 flagellomeres, rarely with 12 (*Parapsectra* Reiss) but then palpus with five segments; mid and hind tibia with at most one spur each *Chironomidae*, in part
- Antenna with 12 flagellomeres; palpus with one to two segments; mid and hind tibia with two apical spurs each (Fig. 16.1) *Sciaridae*, in part
161. Tibiae without apical spurs *Cecidomyiidae*, in part
- Tibiae with (sometimes short) apical spurs (Fig. 16.1) *Sciaridae*, in part
- Note:** Flightless Sciaridae and Cecidomyiidae have not yet been recorded from Central America but their presence is likely.
162. Mid and hind coxae widely separated ventromedially (Fig. 103); tarsal claws stout, strongly recurved, sometimes bifid (Fig. 106); ectoparasites of birds, bats, and mammals 163
- Mid and hind coxae not widely separated ventromedially; tarsal claws not unusually stout and recurved, simple, rarely absent; usually free living, rarely associated with nestling birds (*Carnidae*) or honeybees (*Braulidae*) 165
163. Head vertically oriented, folded back into groove on mesoscutum (Fig. 205); tarsomere 1 of each leg elongate, at least as long as remainder of tarsus (Fig. 205); ectoparasites of bats *Nycteribiidae*
- Head horizontally oriented, not folded back (Figs. 119, 120); tarsomere 1 of each leg short, subequal to second tarsomere (Figs. 119, 120); ectoparasites of bats, other mammals, or birds 164
164. Eye relatively large, vertically oval, at least three-fourths the height of the head, with at least 100 small facets (Fig. 119); ectoparasites of birds and mammals (excluding bats) *Hippoboscidae*, in part

- Eye small and round, sometimes absent, at most half the height of the head and with fewer than 40 relatively large, beadlike facets (Fig. 120); ectoparasites of bats *Streblidae*, in part
 - 165. Ptilinal fissure absent (Figs. 49–53) 166
 - Ptilinal fissure present (Figs. 2.4; 133, 134, 138–143, 175–187) 168
 - 166. Preabdominal venter largely desclerotized, at most with one sternite; pedicel concealed within excavated first flagellomere, usually not visible (Fig. 2.25) *Phoridae*, in part
 - Preabdominal venter with at least four sternites, some of which may be longitudinally divided or partly desclerotized; pedicel exposed and well visible (but scape sometimes small) (Figs. 2.23, 2.24) 167
 - 167. Proboscis elongate and pointed (Fig. 48.9); hypopygium not flexed downward and forward (Fig. 48.1) *Empididae*, in part
 - Proboscis short and retracted, not pointed (Fig. 49.4); hypopygium flexed downward and forward in resting position (Fig. 78) *Dolichopodidae*, in part*
- *Note: Brachypterous species are known from South America but not yet recorded from Central America.

203 *Cryptochetum* ♀204 *Braula* ♀205 *Basilia* ♀

Figs. 6.203–205. Adults of Cyclorrhapha: anterolateral view of (203) *Cryptochetum iceryae* (Williston), (Cryptochetidae), (Australasian, Nearctic, MND, figs. 4.157, 100.1); (204) *Braula coeca* Nitzsch, (Braulidae), (MND, figs. 4.184, 81.1); and (205) *Basilia forcipata* Ferris, (Nycteriidae), (MND, fig. 112.1).

Abbreviations: *kepst*, katepisternum; *syntg*, synergidite; *tsm 1*, first tarsomere.

168. Thorax shortened and without scutellum, less than half as long as head as seen from above, closely adjoined by abdominal syntergite 1+2 (Fig. 204); eye extremely reduced, without differentiated ommatidia (Fig. 204); tarsi without claws, but bearing broad inflexed comb of numerous microscopic teeth (Fig. 173); associated with honey bees *Braulidae*
- Thorax at least as long as head and clearly separated from abdominal syntergite 1+2; scutellum present; eye almost always well developed and with numerous ommatidia (excluding some Sphaeroceridae associated with mammal burrows); tarsi with claws, not as above; not associated with honey bees 169
169. Meron with two bristles; anepimeron with one to two long bristles; notopleuron with one anterior bristle only; fronto-orbital bristles all cruciate, in ca. five pairs; antennal pedicel with complete dorsolateral seam (as in Fig. 2.28); scutum with transverse suture (Fig. 2.41); large flies, body length greater than 5 mm *Rhinophoridae*, in part
- Meron and anepimeron bare; notopleuron with anterior and posterior bristle; fronto-orbital bristles reclinate, lateroclinate, and/or proclinate, rarely with two pairs of inclinate, non-cruciate lower fronto-orbitals; antennal pedicel simple; scutum without transverse suture; smaller flies, body length usually less than 5 mm 170
170. Hind tarsomere 1 swollen, at most as long tarsomere 2 (Fig. 171); frons with zero to two lateroclinate fronto-orbital bristles; anepisternum bare *Sphaeroceridae*, in part
- Hind tarsomere 1 not swollen, longer than tarsomere 2; frontal chaetotaxy various, if lateroclinate fronto-orbital bristles present then anepisternum setulose 171
171. Propleuron with sharp vertical ridge (similar to Fig. 166); frons with fronto-orbital bristles small and hairlike (Fig. 181); face flat to concave *Chloropidae*, in part*
- *Note: Brachypterous species known from South America but not yet recorded from Central America.
- Propleuron without ridge; frons usually with at least one well-developed pair of fronto-orbital bristles, if fronto-orbitals small and hairlike then face convex 172
172. Anepisternum bare; frons with reclinate and sometimes proclinate fronto-orbital bristles 173
- Anepisternum setulose; frons with lateroclinate and sometimes inclinate fronto-orbital bristles or fronto-orbital bristles altogether reduced and hairlike 174
173. Frons with one proclinate and one or two reclinate fronto-orbital bristles; arista bipectinate with dorsal and ventral rays (Fig. 185); tibiae with preapical bristles; forefemur without short, spinelike posteroventral bristle *Drosophilidae*, in part (mutant specimens)
- Frons with reclinate fronto-orbital bristles only; arista pubescent in known species; tibiae without preapical bristles; forefemur usually with short, spinelike posteroventral bristle (Fig. 170) *Anthomyzidae*, in part*
- *Note: Brachypterous species known from South America but not yet recorded from Central America.
174. Face deeply excavated to accommodate antennae, with prominent median carina; frons with two inclinate and two lateroclinate fronto-orbital bristles (Fig. 177); associated with nestling birds *Carnidae*, in part
- Face convex, not carinate; frons with lateroclinate fronto-orbital bristles only or fronto-orbital bristles inconspicuous and hairlike; not associated with nestling birds *Ephydriidae*, in part

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