Manual of Palaearctic Diptera 3, 1998

3.15. Family CARNIDAE

László PAPP

Very small (1.0–2.4 mm) black flies (Fig. 1); costal vein broken just proximally to conjointment with radial vein R_1 and broken or becoming very thin distally to humeral vein; 2 pairs of mesoclinate lower and 2 pairs of lateroclinate upper frontoorbitals; only 1 interfrontal pair in supralunular position (Fig. 2); female cerci fused (Figs 8–9).

Adult. Head: rounded, frons wide with large frontal triangle. Facial plate (praefrons) with deep antennal foveae and distinct facial keel (Fig. 2); facial carina is not very broad in the Palaearctic genera. Clypeus very thin and hidden. Palpi very small, labellae only exceptionally long. Cephalic bristles other than fronto-orbitals: strong *vte*, *vti* and ocellar pairs. Postocellars (postverti-

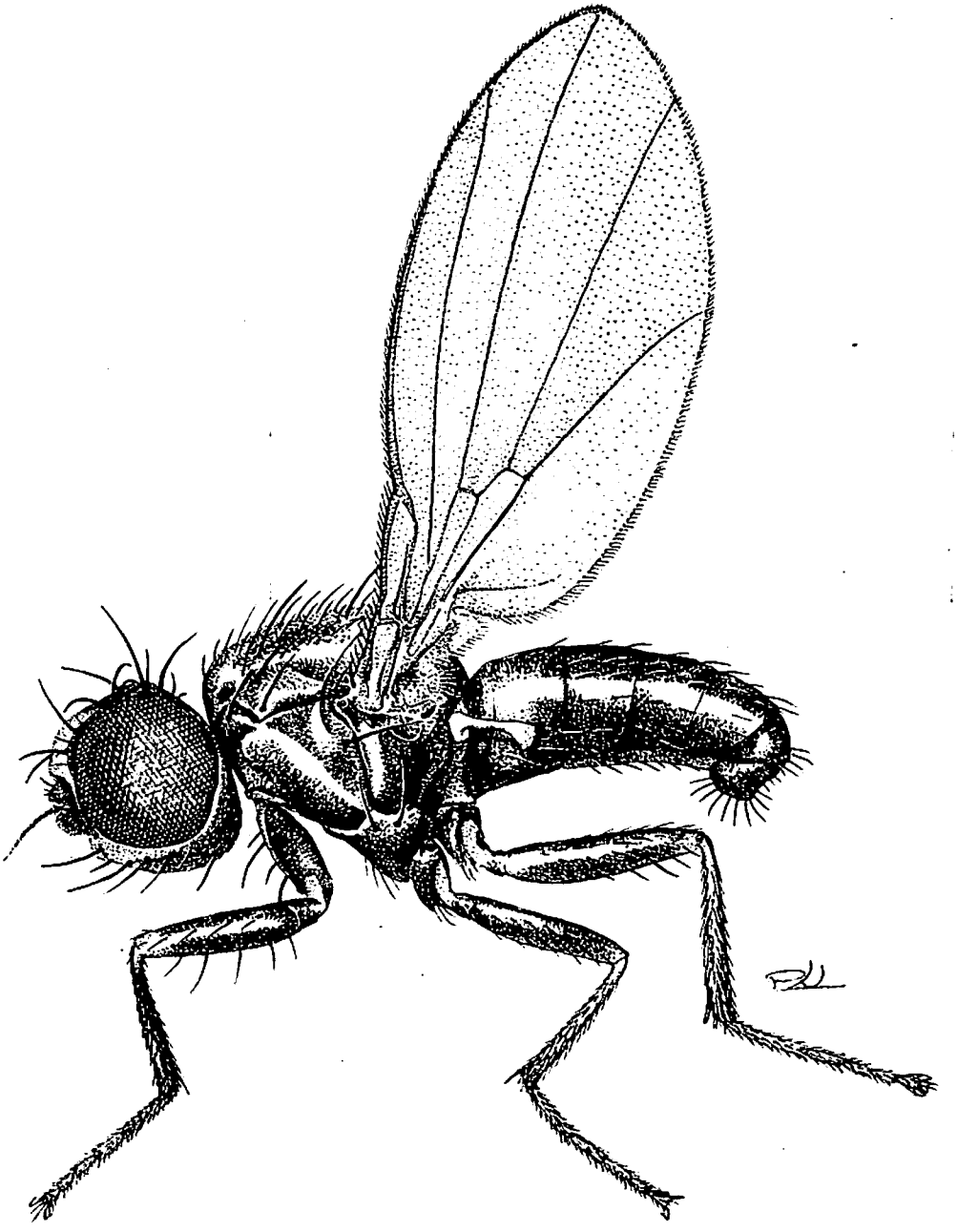
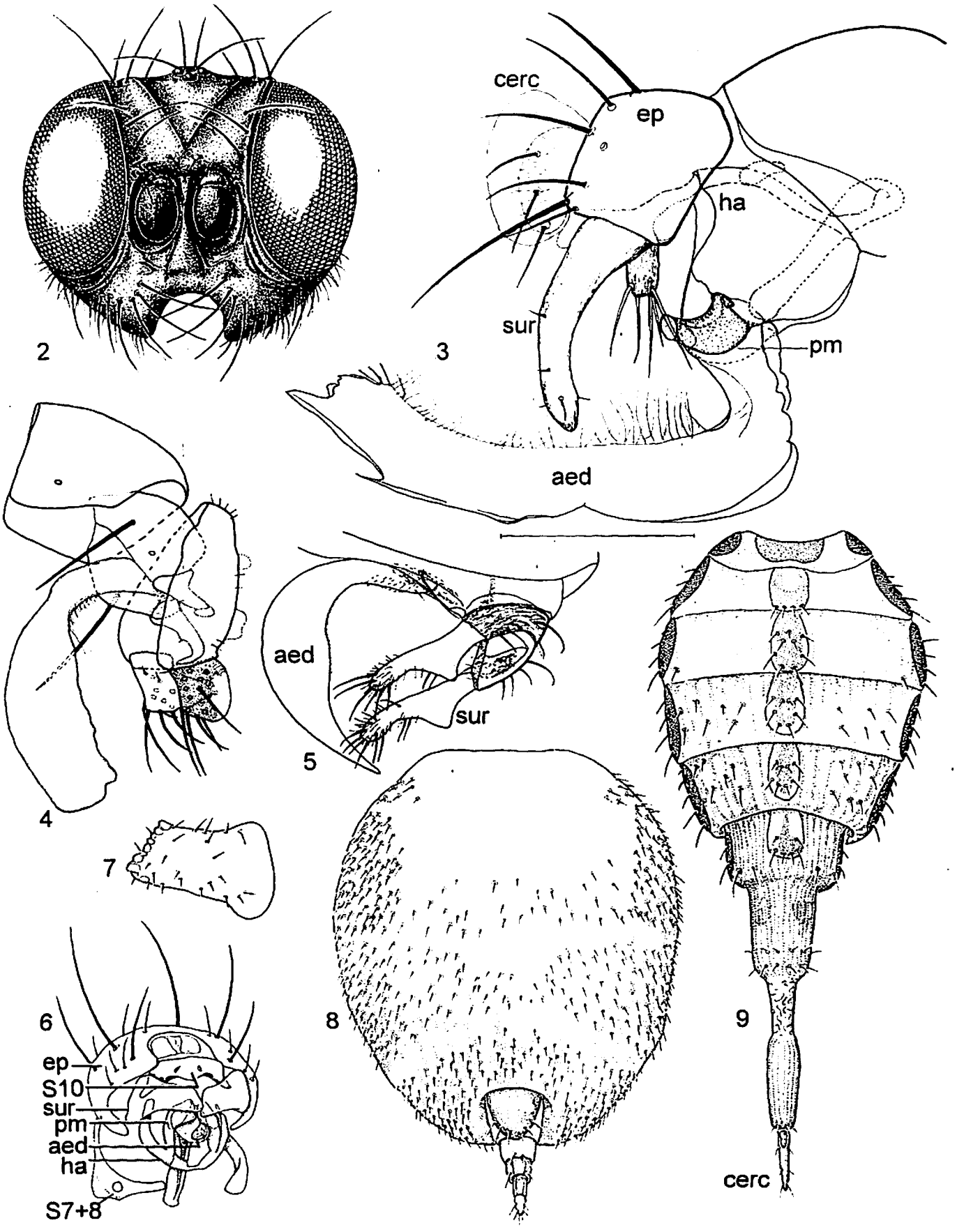


Fig. 15.1. *Meoneura flavifacies* Collin, male.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cals) weak, lateroclinate, mesoclinate, parallel or absent; 3–4 pairs of strong vibrissae (pseudovibrissa), usually a row of genal bristles. Antenna with rounded first flagellomere and comparatively short micropilose arista.

Thorax: Thoracic chaetotaxy: 1 *h* (postpronotal; occasionally some additional short *h*), 2 *np*, 1 *prst*, 1 *sa*, 1 *pa*, 1 posterior *ia*, 0–1+1–3 *dc*, 0–1 *prsc*, 2 *sc*. Anepisternum and katepisternum setulose, usually with at least 1 characteristic seta each.

Legs: No dorsal preapicals on tibiae, fore femora with 1 or more long and thick bristles posteroventrally.

Wing (Fig. 1). In the majority of species there is no anal cell or anal vein on wings (except for *Hemeromyia* Coquillett). Crossveins rather basal in position, hind crossvein (dM-Cu) absent in *Carnus* Nitzsch).

Abdomen: with 5 preabdominal segments in both sexes, abdominal spiracles in membrane. Sclerites of male segments 6–8 weakly sclerotized and more or less fused.

Male terminalia (Figs 3–7). In most species two pairs of epandrial processes (anterior one named "lamella", posterior one "surstylus"). Aedeagus (penis) long, curved on coiled with numerous spinules. Male hypandrium (9th sternite, "forked plate") distinct, gonopods fused to hypandrium, this complex usually of characterictic shape and armature. Parameres ("postgonites", paraphyses) always present. Decasternum (or subepandrial sclerite) distinct (e.g., Fig. 6)

Female terminalia (Figs 8–9). Female 6th tergite and sternite usually small, even if sometimes large, withdrawn in 5th segment, segments 7–10 telescoping, weakly sclerotized. 8th segment completely membraneous, cerci fused (Figs 8–9). No sclerotized spermathecae.

Egg. Undescribed (cf. Ferrar 1987).

Larvae. Larvae (Figs 10–13) comparatively simple, slender, slightly S-shaped, but cephalic and prothoracic segment ventrally curve; last segment with characteristic protuberances; cephalopharyngeal skeleton similar to that of other saprophagous fly families but weakly sclerotized (except for mouth hooks and hypostomal ("intermediate") sclerite); mandible with large sharp ventral process (probably dental sclerite fused to mandible) and with comparatively large dorsal and ventral processes caudally; parastomal bar distinct; dorsal and ventral cornua without "windows"; pharyngeal (tentopharyngeal) part robust; pharynx ventrally with several longitudinal ridges; anterior spiracles with 5–7 (*Carnus*) or 3 (*Meoneura*) short digitiform protuberances, posterior spiracles always with 3 protuberances each.

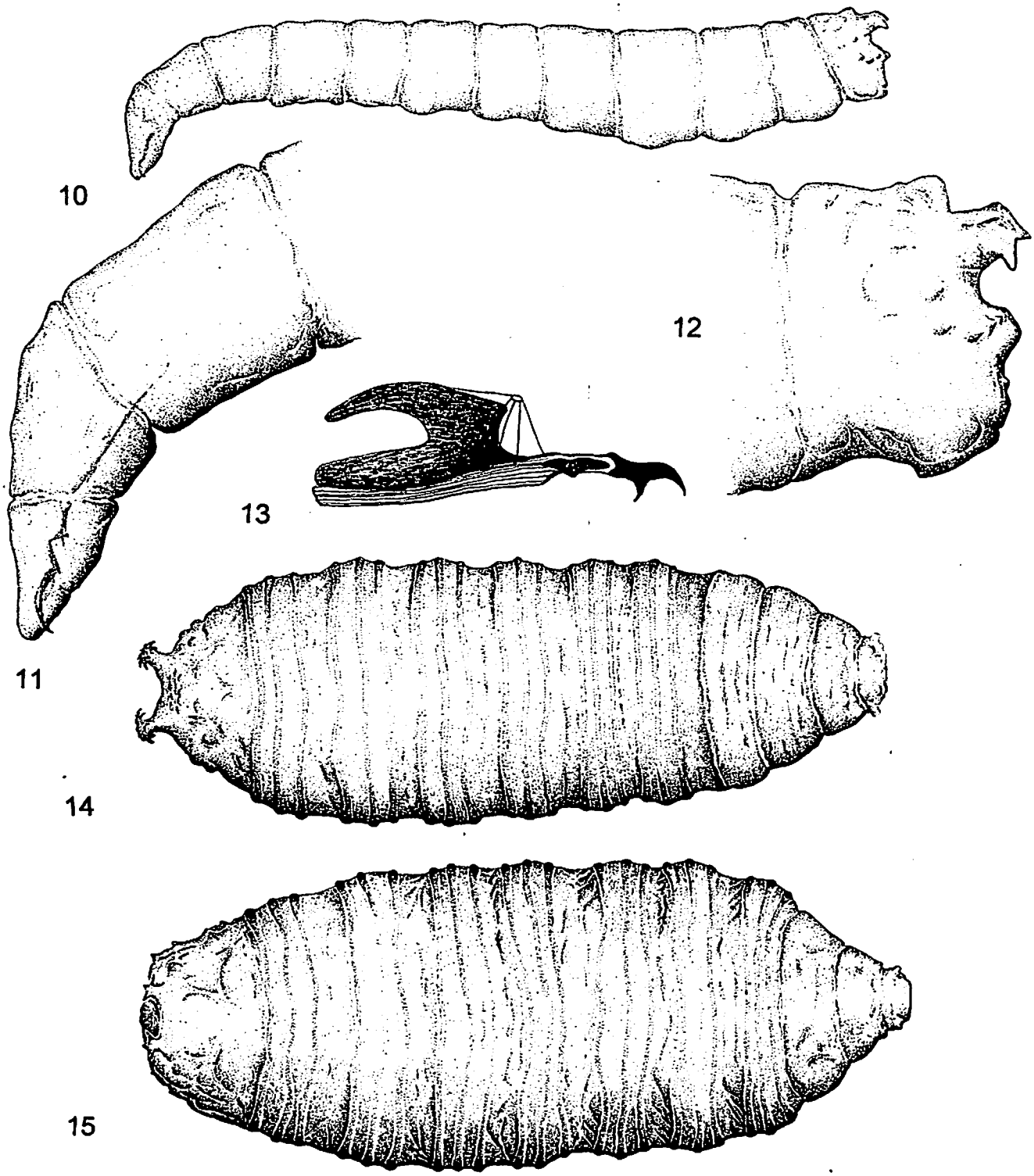
Puparium. Puparia cylindrical or barrel shaped (Figs 14–15), black, short, abdominal segments with annulation, posterior spiracles at caudal end (*Carnus*, Fig. 14) or in dorsal position (*Meoneura*, Fig. 15).

Biology and behaviour. Adults are usually found on carrion (e.g., *Meoneura neottiophila* Collin), on various kinds of dung, on human feces, on inflorescence of Umbelliferae (sometimes also on other flowers), in bird's nests, some species in feathers of birds. Habits of the majority of the species have not been determined yet, this is why collecting them is still problematic. The larvae are saprophagous and develop in various kinds of dead organic materials, in dung (droppings), in birds' nests, less abundantly in carrion. For instance, in Central Europe *Meoneura flavifacies* Collin and *M. neglecta* Collin are common though not abundant on cow pats, *M. minutissima* (Zetterstedt) is rare but occurs in the same situation. Adults of species living in birds' nests

Figs 15.2–9. 2: *Hemeromyia* sp., head. 3–5: terminalia of *Meoneura* species: 3: *M. falcata* L. Papp, 4: *M. minuscula* L. Papp; 5: *M. longifurca* L. Papp. 6–7: *Carnus hemapterus* Nitzsch, male: 6: male terminalia, 7: surstylus. 8–9: female abdomen, ventral view: 8: *Carnus hemapterus* Nitzsch; 9: *Meoneura* sp. (abbreviations: aed: aedeagus, ep: epandrium, ha: hypandrium, pm: paramere or paraphysis, S7+8 synsternite, S10: decasternum) (3, 5 after Papp 1997, 4 after Papp 1977, 6–9 after Grimaldi 1997)

are semiparasitic-saprophagous (*Carnus*) or saprophagous (*Meoneura*).

The habits of *Carnus hemapterus* are rather well-known. It has been found not only in Europe but also in Egypt, Canada and in the USA (Grimaldi 1997). Its larvae and imagoes live in birds' nests, thus the imagoes are very seldom collected in the open. In nests on soil, in marshes or on water surfaces it has not been found but one can find it in almost all bird species breeding



Figs 15.10–15. Developmental stages of Carnidae. 10–14: *Carnus hemapterus* Nitzsch, third instar larva, lateral view: 10: habitus, 11: cephalic part of body, 12: caudal part, 13: cephalopharyngeal skeleton. 14–15: puparia, dorsal view: 14: *Carnus hemapterus* Nitzsch; 15: *Meoneura neottiophila* Collin.

in hollows of trees or in cavities. It is rather common also in nests built on trees or on bushes. Thus it has been collected in nests of birds of prey, owls, woodpeckers, bee-eaters, species of pigeons and in nests of numerous species of song-birds (Papp 1978); Grimaldi (1997) added several new records from North America and summarised the host records. The larvae are humidophilous and they feed upon dead organic matter in nests. The height of their activity occurs between 26 and 27 °C but they can also feed at temperatures below 15 °C. They overwinter usually as pupae in the nests. The adults possess wings after their eclosion till they can find a new bird's nest, then they break down their wings themselves. The adults can always be found on birds brooding in nest or mainly on their young, or in the close vicinity; the height of their activity is at 36–37 °C but they do not move below 15 °C. The flies cling to barrels of quills and they also feed on blood, but they live mainly on derivative particles of skin and on discharges of living feathers. Its flight period and the number of generations per year are dependent on the actual temperature in the nests and on other ecological parameters of the environment.

Classification and distribution. The systematic position of this small family has been long debated. Formerly they were treated as a subfamily of Milichiidae (Hennig 1937). Hennig (1972) and Griffiths (1972) – although from different points of view – separated them as a family, which was followed by most of the modern researchers (e.g., Papp 1984, Sabrosky 1987). The genus *Australimyza* Harrison (Australian islands) was included in Carnidae ~~by McAlpine (1989) and~~ Colless and McAlpine (1991), which the present author thinks questionable. Griffiths (1972) regarded *Australimyza* as quite distant from Carnidae, creating for it a new family, Australimyzidae, and placing it in a separate prefamily, Australimyzoinea. In any case, *Australimyza* was completely left out of consideration when characterizing Palaearctic Carnidae.

About 65 species of 4 genera have been described thus far, but there must be numerous species undescribed. Two species of a Neotropical genus (*Neomeoneurites* Hennig), which is a close relative of one fossil species (*Meoneurites enigmatica* Hennig, 1965; Eocene) from Baltic amber – representing a living fossil itself – and which is different in some characteristics (mainly their broad facial carina) from all the other carnids, was also left out of consideration when making the family diagnosis above.

Three genera are considered in the Palaearctic region: *Hemeromyia* Coquillett, 1902 (incl. also 2 Nearctic and 1 Afrotropical species), *Carnus* Nitzsch, 1818 (1 Palaearctic species) and *Meoneura* Rondani, 1856, where most of the species belong.

The majority of the species are of Palaearctic or Nearctic distribution, some of them showing a Holarctic distribution, very few species occurring in other regions (see e.g., Grimaldi 1997). Numerous species are still undescribed in museum collections.

Meoneurites enigmatica Hennig, 1965 (Eocene; from Baltic amber) and *Meoneura vieja* Grimaldi, 1997 (Dominican amber; Miocene) are the known fossil records (Evenhuis 1994, Grimaldi 1997).

KEYS TO GENERA

Adults

1. Costal vein longer, extended to M. Terminal section of vein M and anal vein (A_1+CuA_2) strong, anal (cup) cell present. Crossveins distant from wing base and from each other. Frontal triangle not emerging from the plane of frons. Postocellars (postverticals) comparatively long (Fig. 2), facial carina comparatively broad Hemeromyia Coquillett

   7 spp. in Palaearctic, 2 Nearctic and 1 Afrotropical species (Carles-Tolrá 1992, Barraclough 1994, Freidberg, Papp and Ozerov 199x).

- Costal vein shorter, extended only to R_{4+5}. Terminal section of vein M and anal vein weak, mostly only some shadow of a vein discernible, no anal (cup) cell. Crossveins close to wing base and to each other, or crossvein dM-Cu lost 2

2. Crossvein dM-Cu lost. Frontal triangle elevated from plane of frons and extended to lunule. No postocellars. Facial carina comparatively broad. Abdominal tergites and sternites rudimentary, weakly sclerotized, female sternite 6 enlarged Carnus Nitzsch
   1 sp. in Palaearctic, *C. hemapterus* Nitzsch, 1818, 1 Oriental, 1 Afrotropical and 3 known species in the Nearctic region; Grimaldi 1997.

- Crossvein dM-Cu present. Frontal triangle not emerging from plane of frons. Postocellars present though short. Facial carina narrow. Abdominal tergites and sternites normal, female sternite 6 small Meoneura Rondani
   Over 50 spp. in the Palaearctic (Papp 1976, 1977, 1984, 1997, etc.); at least 5 spp. in the Afrotropical region (Deeming 1976, Barraclough 1994).

Larvae and puparia
(developmental stages of *Hemeromyia* are unknown)

1. Anterior larval spiracles with 5–7, posterior spiracles with 3 short processes. Posterior spiracles of puparia situated caudally (Fig. 14) Carnus Nitzsch

- Anterior larval spiracles with 3, posterior spiracles with 3 short processes. Posterior spiracles of puparia situated dorsally (Fig. 15) Meoneura Rondani

Species of economic importance. Only *Carnus hemapterus* may have some economic or rather nature conservancy importance, being parasitic also on rare birds (see above). The other species are insignificant from this point of view.

REFERENCES

Barraclough, D. A. 1994. Hemeromyia australis sp.n. and Meoneura prima (Becker, 1903) from Namibia ans South Africa, the first Carnidae (Diptra: Schizophora) recorded from subequatorial Africa. *Ann. Natal Mus.* 35: 15–24.

Carles-Tolrá, M. 1992. New species of Carnidae and Lauxaniidae (Diptera) from Spain. *Entomologist's mon. Mag.* 128: 63–67.

Colless, D. and McAlpine, D. K. 1991. Diptera. *In: The Insects of Australia.* Melbourne University Press.

Deeming, J. C. 1976. Three new species of Meoneura Rondani (Diptera: Milichiidae) from Northern Nigeria. *Nigerian J. Ent.* 2(1–2): 29–34.

Evenhuis, N. L. 1994. *Catalogue of the fossil flies of the world (Insecta: Diptera).* Backhuys Publishers, Leiden, 600 pp.

Ferrar, P. 1987. *A guide to the breeding habits and immature stages of Diptera Cyclorrhapha.* E. J. Brill, Leiden, I: 1–478, II: i-iv+479–907 pp.

Freidberg, A., Ozerov, A. and Papp, L. 199x. Revision of the Palearctic species of Hemeromyia Coquillett. A manuscript.

Griffiths, G. C. D. 1972. *The phylogenetic classification of Diptera Cyclorrhapha with special reference to the structure of the male postabdomen.* Series Entomologica, Vol. 8. Dr. W. Junk N. V., The Hague, 340 pp.

Grimaldi, D. 1997. The bird lifes, genus Carnus species revision, generic relationships, and a fossil Meoneura in amber (Diptera: Carnidae). *Am. Mus. Novitat.* No. 3190: 1–30.

Hennig, W. 1937. 60a. Milichiidae et Carnidae. Vol. 6/1, pages 1–91, *in* Lindner, E. (ed.): *Die Fliegen der palaearktischen Region*. Schweizerbart, Stuttgart.

Hennig, W. 1965. Die Acalyptratae des baltischen Bernsteins und ihre Bedeutung für die Erforschung der phylogenetischen Entwicklung dieser Dipteren-Gruppe. *Stuttg. Beitr. Naturk.* 145: 1–215.

Hennig, W. 1972. Beitrage zur Kenntnis der rezenten und fossilen Carnidae, mit besonderer Berücksichtigung einer neuen Gattung aus Chile (Diptera: Cyclorrhapha). *Stuttg. Beitr. Naturk.* No. 240: 1–20.

McAlpine, J. F. 1989. Phylogeny and classification of the Muscomorpha. Vol. 3, pages 1397–1518, *in* McAlpine, J. F. et al. (eds): *Manual of Nearctic Diptera*. Research Branch, Agriculture Canada, Ottawa. Agric. Can. Monograph No. 32, vi+1333–1581 pp.

Papp, L. 1976. Milichiidae and Carnidae (Diptera) from Mongolia. *Acta zool. hung.* 22: 369–387.

Papp, L. 1977. New species and records of Hungarian Odiniidae, Milichiidae and Carnidae (Diptera). *Acta zool. hung.* 23: 171–181.

Papp, L. 1978. 72a. család: Carnidae. Vol. 15/9, pages 32–50, *in*: *Magyarország Állatvilága (Fauna Hungariae)*. Akadémiai Kiadó, Budapest, 202 pp. [In Hungarian]

Papp, L. 1984. Family Carnidae. Vol. 10, pages 118–124, *in* Soós, Á. and Papp, L. (eds): *Catalogue of Palaearctic Diptera*. Akadémiai Kiadó, Budapest, 402 pp.

Papp, L. 1997. Three new species and a new subspecies of Meoneura from the Alps (Diptera, Carnidae). *Annls hist.-nat. Mus. natn hung.* 89: 151–156.

Sabrosky, C. W. 1959. The Nearctic species of the filth fly genus Meoneura (Diptera, Milichiidae). *Ann. ent. Soc. Am.* 52: 17–26.

Sabrosky, C. W. 1987. Chapter 80. Carnidae. Vol. 2, pages 909–912, *in* McAlpine, J. F. et al. (eds): *Manual of Nearctic Diptera*. Research Branch, Agriculture Canada, Ottawa. Agric. Can. Monograph No. 28, vi+675–1332 pp.