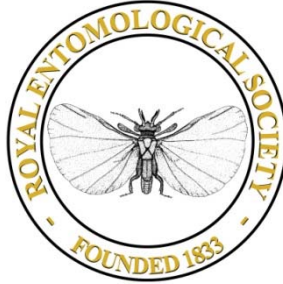


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HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS

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HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS



EPHEMEROPTERA

By
D. E. KIMMINS

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HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS

The aim of this series of publications is to provide illustrated keys to the whole of the British Insects (in so far as this is possible), in ten volumes, as follows :

- | | |
|------------------------------------|------------------------|
| I. Part 1. General Introduction. | Part 9. Ephemeroptera. |
| „ 2. Thysanura. | „ 10. Odonata. |
| „ 3. Protura. | „ 11. Thysanoptera. |
| „ 4. Collembola. | „ 12. Neuroptera. |
| „ 5. Dermaptera and
Orthoptera. | „ 13. Mecoptera. |
| „ 6. Plecoptera. | „ 14. Trichoptera. |
| „ 7. Psocoptera. | „ 15. Strepsiptera. |
| „ 8. Anoplura. | „ 16. Siphonaptera. |
- II. Hemiptera.
III. Lepidoptera.
IV. and V. Coleoptera.
VI. Hymenoptera : Symphyta and Aculeata.
VII. Hymenoptera : Ichneumonoidea.
VIII. Hymenoptera : Cynipoidea, Chalcidoidea, and Serphoidea.
IX. Diptera : Nematocera and Brachycera.
X. Diptera : Cyclorrhapha.

Volumes II to X will be divided into parts of convenient size, but it is not possible to specify in advance the taxonomic content of each part.

Conciseness and cheapness are main objectives in this new series, and each part will be the work of a specialist, or of a group of specialists. Although much of the work will be based on existing published keys, suitably adapted, it is expected that it will also include much new and original matter.

Parts will be issued, separately paged and priced, as they become available.

Orders for the Series or for separate parts may be placed with the Registrar at the Society's rooms now, but prices can only be quoted for those parts already in the press.

The Society is indebted to the Royal Society for a grant towards the cost of initiating this series of *Handbooks*.

A list of parts now available appears on the back cover

EPHEMEROPTERA

(Mayflies or Dayflies.)

By D. E. KIMMINS.

NORMALLY two pairs of wings; anterior pair much larger than the posterior which in some genera are much reduced in size or even entirely absent. Venation is of considerable importance in classification, and the principal veins are marked in fig. 2. The areas between the veins take the name of the main vein preceding them. Small additional veins between the main veins are termed intercalary veins. Three pairs of legs, the anterior pair in the male often very long. The abdomen terminates in two or three long, many-jointed setae, the median one in certain genera being atrophied, and the male carries a pair of jointed claspers or forceps arising from a plate on the ninth sternite. Mouth-parts completely atrophied. Compound eyes of male larger than of the female, sometimes divided, and the upper part elevated turret-like (turbinate eye).

LIFE HISTORY.

Eggs are laid in water, in small numbers at a time, or in one cluster, being washed off or dropped from the tip of the abdomen, or, as in certain species of *Baëtis*, the female crawls beneath the surface of the water and deposits her eggs on underwater objects. The nymphs are entirely aquatic, and are of very diverse forms. Needham has divided them into two main groups, each with three subdivisions :

I. Still water forms :

- a. Climbers among vegetation, agile, streamlined forms.
Siphonurus, *Cloeon*, etc.
- b. Sprawlers upon the bottom, silt-dwellers.
Caenis.
- c. Burrowers.
Ephemera.

II. Running water forms :

- d. Agile, free-ranging, swimming forms.
Baëtis, *Ameletus*.
- e. Close-clinging, flattened forms found under stones.
Rhithrogena, *Ecdyonurus*, etc.
- f. Stiff-legged, trash, moss and silt-inhabiting forms.
Ephemerella.

The food of ephemeropterous nymphs consists mainly of vegetable matter—filamentous algae, diatoms and fragments of higher plants—although some species are thought to be partly carnivorous. Gills are

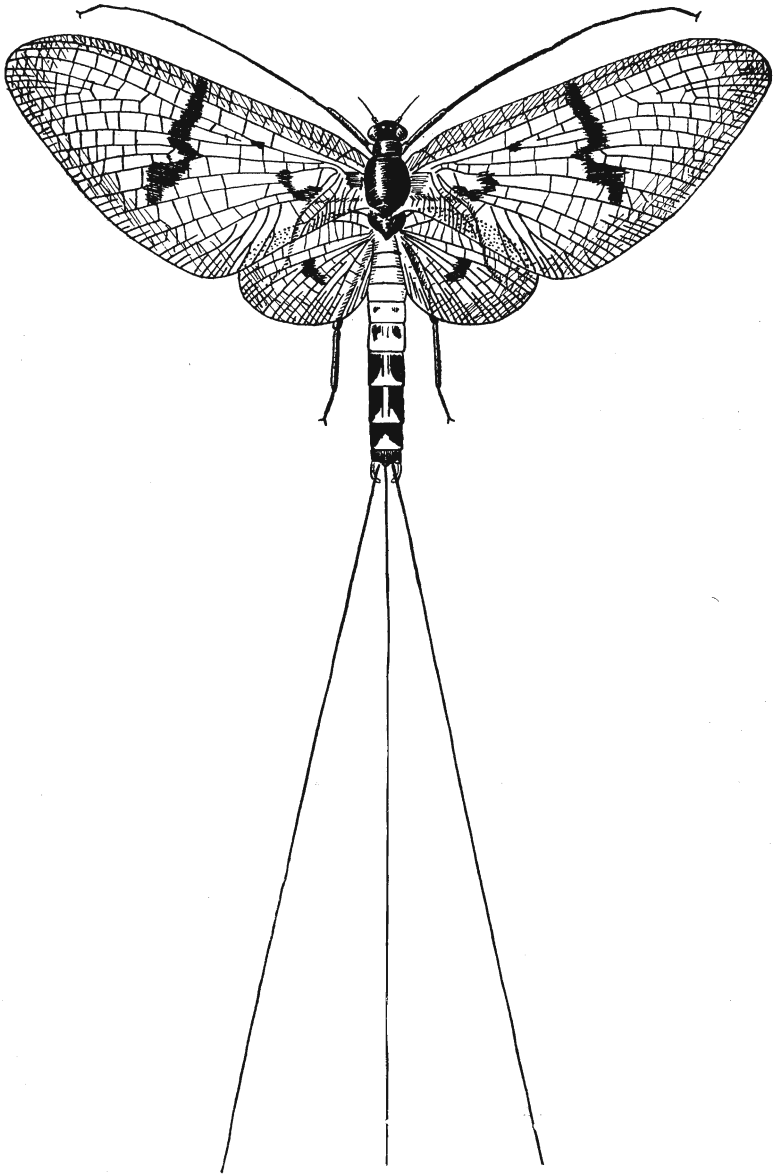
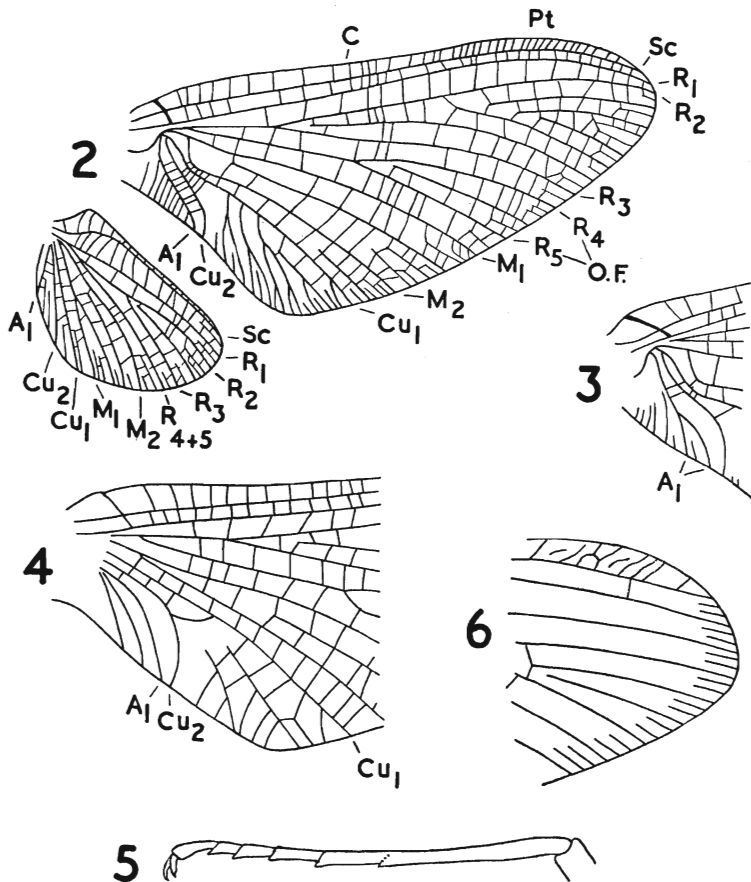


FIG. 1.—*Ephemera danica* Müller. ♂ imago.

present on some or all of the first seven abdominal segments. These gills are of varying type and may be either filamentous or platelike, the latter being sometimes accompanied by tufted gills. Frequent moults accompany the growth of the nymph; rudiments of wings appear when the nymph is

about half grown, and increase in size at each moult. The Ephemeroptera are unique in Insecta in that the full-grown nymph gives rise, not to an imago, but to a subimago. In this stage it is fully winged, but the wings are dull and opaque, with a fringe of minute hairs, and the legs and setae are not of the full length. Transformation from the nymph takes place on the surface of the water, on some object at the water's edge or even beneath the surface. The subimago flies away from the water to shelter amongst vegetation, and there, after a period of rest, it moults again, to disclose the imago. The males of many species indulge in a dancing flight in swarms at certain times of the day, and mating takes place in the air. The life-cycle of many of our Ephemeroptera takes one year, although *Ephemera* certainly takes at least two years, and some other species accomplish two generations a year.



Figs. 2-6.—2. *Ephemera danica* Müll. Wings. C = costa, Pt = pterostigma Sc = subcosta, R₁ = radius, R₂, R₃, R₄, R₅ = branches of radial sector (Rs, OF = outer fork of radial sector, M₁ and M₂ = branches of media, Cu₁ and Cu₂ = branches of cubitus, A₁ = anal vein. 3. *Potamanthus luteus* (L.). Base of anterior wing. 4. *Leptophlebia marginata* (L.). Base of anterior wing. 5. *Siphonurus lacustris* Etn. Hind tibia and tarsus. 6. *Baëtis scambus* Etn. Apex of anterior wing, showing paired intercalary veins.

- 9 (10) In fore wing Cu_2 either nearer to A_1 at base or midway between Cu_1 and A_1 (fig. 4) LEPTOPHLEBIIDAE (p. 5).
 10 (9) In fore wing Cu_2 nearer to Cu_1 at base (fig. 8) EPHEMERELLIDAE (p. 7).
 11 (6) Hind wing absent, wings milky, fringed with minute hairs in both imago and subimago, outer fork (OF) of Rs very deep (fig. 9) ... CAENIDAE (p. 7).
 12 (7) R_5 detached basally from R_4 in fore wing (fig. 20) BAETIDAE (p. 8).
 13 (8) R_4 and R_5 in hind wing separate at wing margin (fig. 10) SIPHLONURIDAE (p. 9).
 14 (5) Hind tarsus with five free segments (fig. 11) ECDYONURIDAE (p. 11).

Family EPHEMERIDAE.

One genus, *Ephemera* L.

KEY TO SPECIES.

- 1 (2) Abdomen ivory white or light grey above, with brown markings as in fig. 12a. Exp. 32-46 mm. *E. danica* Müller.
Lakes and moderately fast rivers and streams, with a sandy or silted bottom. Generally common. 5-9.
 2 (1) Abdomen yellowish to reddish brown, markings not as above.
 3 (4) Abdominal tergites V or VI-IX with pair of broad triangular brown marks (fig. 12b). Exp. 30-51 mm. *E. vulgata* L.
Sluggish rivers with a muddy bottom and a rather higher average temperature than for the previous species. Generally common (Midlands, Southern and Eastern England, and in Ireland). 5-8.
 4 (3) Abdominal tergites V or VI-IX with three pairs of brownish longitudinal lines (fig. 12c). Exp. 30-44 mm. *E. lineata* Eaton.
Large rivers such as the Thames. Local. 7.

The subimagines of these species may be distinguished by body markings similar to those of the imagines.

Family POTAMANTHIDAE.

There is only one species recorded from Britain, *Potamanthus luteus* (L.).
 Exp. 25-32 mm.
Large rivers such as the Thames. Imagines nocturnal and have been taken at light. Rare or local. 7.

Family LEPTOPHLEBIIDAE.

KEY TO GENERA.

- 1 (4) Costal margin of hind wing smoothly rounded, costal area narrow (fig. 7).
 2 (3) Cu_2 in fore wing at base midway between Cu_1 and A_1 (fig. 4) *Leptophlebia* Westwood.
 3 (2) Cu_2 in fore wing at base nearer A_1 than Cu_1 (fig. 13) .. *Paraleptophlebia* Lestage.
 4 (1) Costal margin of hind wing with a strong projection about midway, costal area at base broad (fig. 14) *Habrophlebia* Eaton.

Genus *Leptophlebia* Westwood.

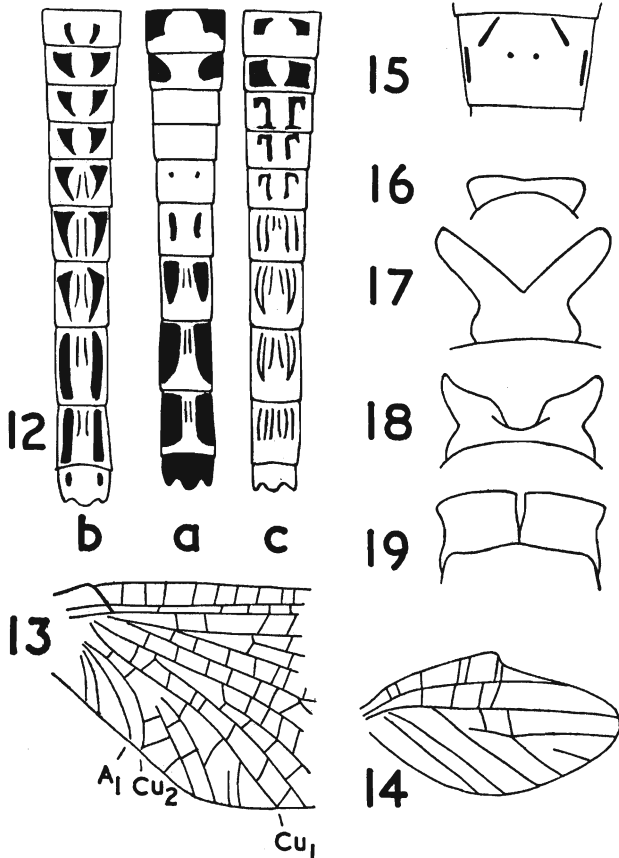
KEY TO SPECIES.

- 1 (4) Imagines.
 2 (3) Fore wing smoky brown, particularly towards apex. Exp. 13-23 mm. *L. marginata* (L.).
Lakes and slow streams, up to height of at least 2500 ft. Generally common. 4-6.
 3 (2) Fore wing entirely hyaline. Exp. 15-21 mm. *L. vespertina* (L.).
Lakes and small streams. Generally common. 5-8.
 4 (1) Subimagines.
 5 (6) Both wings brownish grey, cross-veins margined with brownish *L. marginata* (L.).
 6 (5) Fore wing mouse- or blue-grey, hind wing pale creamy grey, cross-veins not noticeably margined *L. vespertina* (L.).

Genus *Paraleptophlebia* Lestage.

KEY TO SPECIES.

- 1 (6) Imagines.
 2 (5) Setae yellowish brown or brown.
 3 (4) Male with abdominal tergites III–VI dark brown; longitudinal veins (except C, Sc and R₁ in fore wings) usually white; wings of female hyaline. Exp. 19–27 mm. *P. submarginata* (Stephens).
Small, moderately fast streams. Generally common. 5–7.
 4 (3) Male with abdominal tergites III–VI yellowish brown, translucent; longitudinal veins yellowish brown; wings of female pale smoky brown. Exp. 16–20 mm. *P. tumida* Bengtsson.
Small streams with much aquatic vegetation. Local. 5.



FIGS. 12–15.—12. Diagram of body markings: a, *Ephemera danica* Müll.; b, *E. vulgata* L.; c, *E. lineata* Etn. 13. *Paraleptophlebia submarginata* (Steph.). Base of anterior wing. 14. *Habrophlebia fusca* (Curt.). Hind wing. 15. *Ephemerella notata* Etn. Pattern of abdominal sternites.
 FIGS. 16–19.—Penis-lobes, ventral. 16. *Caenis horaria* (L.). 17. *Caenis rivulorum* Etn. 18. *Caenis moesta* Bengtss. 19. *Caenis macrura* Steph.

- 5 (2) Setae white in male, pale yellowish in female; abdominal tergites II-VII in male whitish, translucent, VIII-IX piceous. Exp. 17-19 mm. **P. cincta** (Brauer).
Rivers and large streams. Generally common. 5-8.
- 6 (1) Subimagines.
- 7 (8) Wings pale fawn, cross-veins bordered with blackish. **P. submarginata** (Stephens).
- 8 (7) Wings greyish, cross-veins not margined.
- 9 (10) Wings mouse-grey **P. tumida** Bengtsson.
- 10 (9) Wings blackish grey **P. cincta** (Brauer).

Genus **Habrophlebia** Eaton.

One species, **Habrophlebia fusca** (Curt.) has been recorded from Britain.
Exp. 13-15 mm.
Slow streams with much aquatic vegetation. Generally common in England. 5-9.

Family EPHEMERELLIDAE.

One genus, **Ephemerella** Walsh.

KEY TO SPECIES.

- 1 (4) Imagines.
- 2 (3) Abdominal sternites I-VII or VIII with black markings (fig. 15). General colour yellowish to yellowish brown. Exp. 17-23 mm... **E. notata** Eaton.
Moderately fast rivers, generally of an alkaline character. Locally common. 5-6.
- 3 (2) Sternites without such markings, general colour reddish brown. Exp. 15-23 mm.....**E. ignita** (Poda).
Fast streams and rivers, up to at least 1500 ft. Generally common. 4-9.
- 4 (1) Subimagines.
- 5 (6) Wings pale greyish with yellowish venation, body yellowish **E. notata** Eaton.
- 6 (5) Wings dark greyish- or bluish-black, body olive-brown in male, apple-green in female **E. ignita** (Poda).

Family CAENIDAE.

KEY TO GENERA.

- 1 (2) Prosternum very narrow, fore coxae closely approximated.. **Caenis** Stephens'
- 2 (1) Prosternum very broad, fore coxae widely separated... **Brachyercus** Curtis.

Genus **Caenis** Stephens.

KEY TO SPECIES.

- 1 (8) Imagines.
- 2 (5) Setae whitish or yellowish white. A small, slender, median process on apical margin of second abdominal tergite.
- 3 (4) First five or six tergites with blackish grey markings. Penis-lobes of male truncate (fig. 16). Exp. 8.5-11 mm. **C. horaria** (L.).
Large rivers, canals, lakes, where there is a silted bottom with much vegetable detritus. Imagines late evening and nocturnal in flight. Generally common. 6-9.
- 4 (3) Only first three tergites with greyish markings. Penis-lobes of male with a wide excision between them (fig. 17). Exp. 6.5 mm. ... **C. rivulorum** Eaton.
Small stony streams. Imagines fly in late evening and at night. Locally common. 5-6, 9.
- 5 (2) Setae sepia-grey or greyish white. No slender, median process on second tergite.
- 6 (7) Base of terminal antennal bristle conically dilated. Penis-lobes with a broad sinuous excision between them (fig. 18). Exp. 7-9 mm. **C. moesta** Bengtsson.
Lakes, rivers and streams, with sandy or silted bottom. Imagines fly at night and in early morning. Generally common. 6-9.

- 7 (6) Base of antennal bristle not conically dilated. Penis-lobes truncate with a narrow excision between them (fig. 19) Exp. 8·5–15 mm.
C. macrura Stephens.
Large rivers, nocturnal or early morning in flight. Locally common. 6–8.
- 8 (1) Subimagines.
- 9 (12) Setae greyish.
- 10 (11) Setae dark grey **C. macrura** Stephens.
- 11 (10) Setae pale grey **C. moesta** Bengtsson.
- 12 (9) Setae white.
- 13 (14) Size larger, wing exp. 8·5–11 mm..... **C. horaria** (L.).
- 14 (13) Size smaller, wing exp. 6·5 mm. **C. rivulorum** Eaton.

Genus **Brachycercus** Curtis.

There is only one species recorded from Britain, **Brachycercus harrisella** Curtis.
 Exp. 10·5–13 mm.
The imago is probably nocturnal. Rare. 6.

Family BAETIDAE.

KEY TO GENERA.

- 1 (4) Hind wing present, though sometimes very small.
- 2 (3) Marginal intercalary veins paired (fig. 6) **Baëtis** Leach.
- 3 (2) Marginal intercalary veins single (fig. 20)..... **Centroptilum** Eaton.
- 4 (1) Hind wing absent.
- 5 (6) Hind tarsus with the fused basal segment twice as long as the second (fig. 21)
Cloëon Leach.
- 6 (5) Hind tarsus with the fused basal segment three times as long as the second
 (fig. 22) **Procloëon** Bengtsson.

Genus **Baëtis** Leach.

The separation of species in this genus offers considerable difficulty even in the case of males (for which this key is intended), as the characters used are not infrequently subject to variation in individuals. The production of a satisfactory key to females and subimagines must await further study.

KEY TO SPECIES.

- 1 (14) Second longitudinal vein in hind wing not forked (fig. 23) (exceptionally so in
B. buceratus Eaton).
- 2 (13) Hind wing with a costal process near base (fig. 23).
- 3 (4) Forceps arched downwards in side view. Exp. 17–19 mm.
Rivers. Rare. 6, 9. **B. buceratus** Eaton.
- 4 (3) Forceps not arched downwards.
- 5 (6) Setae grey, with reddish-brown annulations from base to apex. Exp. 12–25
 mm. **B. rhodani** (Pictet).
Rivers and small streams. Generally common, occurring throughout most of year.
- 6 (5) Setae whitish or greyish (if annulated, only near base).
- 7 (10) Basal segment of forceps with a large callosity at inner apical angle (fig. 24).
- 8 (9) Forceps stout; junction of second and third segments only slightly constricted
 (fig. 24). Exp. 11–19 mm..... **B. vernus** Eaton.
Rivers, possibly with a preference for alkaline waters. Generally common. 5–9.
- 9 (8) Forceps slender, junction of second and third segment noticeably constricted
 (fig. 25). Exp. 12–17 mm. **B. tenax** Eaton.
Rivers and small streams up to at least 1700 ft. Generally common. 4–9.
- 10 (7) Basal segment of forceps with a small tooth at inner apical angle (fig. 26).

- 11 (12) Forceps stout, noticeably constricted at junction of second and third segments. third somewhat inflated (fig. 26). Turbinate eyes lemon-yellow. Exp. 13-17 mm. **B. bioculatus** (L.).
Rivers, possibly with a preference for alkaline waters. Generally common. 5-9.
- 12 (11) Forceps slender, scarcely constricted at junction of second and third segments. Turbinate eyes warm sepia-brown. Exp. 10-15 mm. **B. scambus** Eaton.
Rivers. Generally common. 2-11.
- 13 (2) Hind wing without a basal costal process (fig. 27). Exp. 12-16 mm.
Rivers. Rare or local. 6, 9. **B. atrebatinus** Eaton.
- 14 (1) Second longitudinal vein in hind wing forked (fig. 28).
- 15 (16) Hind wing with three longitudinal veins, membrane somewhat milky hyaline (fig. 28) Exp. 9-17 mm. **B. pumilus** (Burmeister).
Rivers and small streams up to at least 1500 ft. Generally common. 4-9.
- 16 (15) Hind wing with two longitudinal veins, membrane vitreous. Exp. 13-17 mm.
B. niger (L.).
Rivers and small streams with much aquatic vegetation. Locally common. 5-9.

Genus **Centroptilum** Eaton.

KEY TO SPECIES.

- 1 (4) Imagines.
- 2 (3) Hind wing acute at apex (fig. 29). Exp. 13-16 mm. **C. luteolum** (Müller).
Rivers, streams and stony shores of large lakes. Generally common. 4-9.
- 3 (2) Hind wing rounded at apex. Exp. 16-19 mm. **C. pennulatum** Eaton.
Streams, possibly with a preference for alkaline waters. Local. 5-10.
- 4 (1) Subimagines.
- 5 (6) Wings ashy grey **C. luteolum** (Müller).
- 6 (5) Wings blue-grey. **C. pennulatum** Eaton.

Genus **Cloëon** Leach.

KEY TO SPECIES.

- 1 (4) Imagines.
- 2 (3) Pterostigma with three to five cross-veins; anterior margin of wing yellowish-brown in female. Exp. 13-25 mm. **C. dipterum** (L.).
Ponds with a rather high summer temperature. Bred freely in static water-tanks in London 1941-45. Generally common. 5-9.
- 3 (2) Pterostigma with nine to eleven cross-veins; anterior margin of wing colourless in female. Exp. 17-23 mm. **C. simile** Eaton.
Lakes and slow streams. Generally common. 5-9.
- 4 (1) Subimagines.
- 5 (6) Wings light blackish grey. **C. dipterum** (L.).
- 6 (5) Wings mouse-grey with slight yellowish-green tinge at base. **C. simile** Eaton.

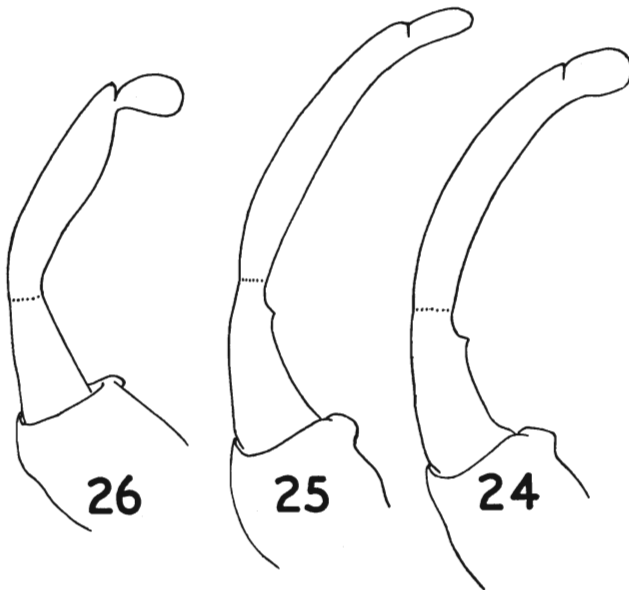
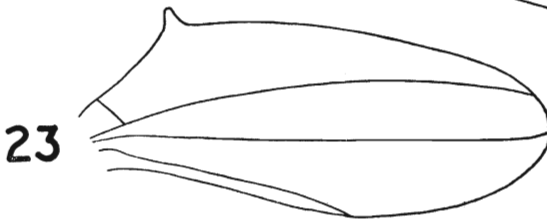
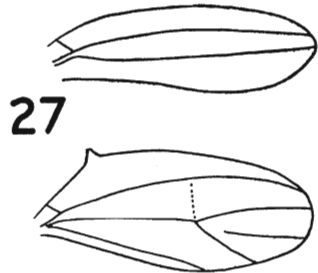
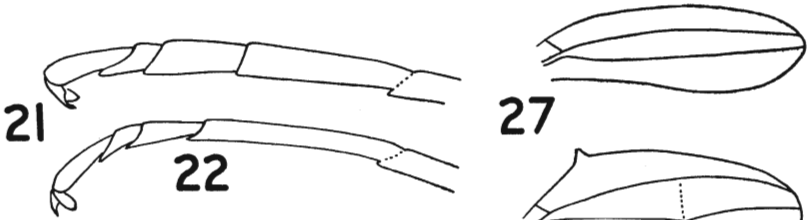
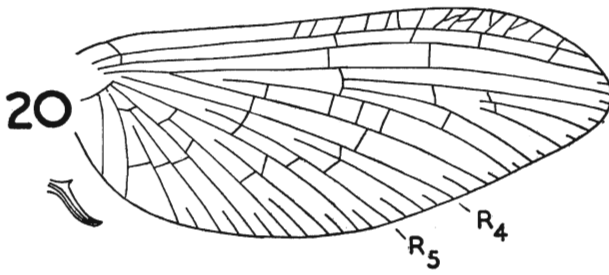
Genus **Procloëon** Bengtsson.

One species, **P. rufulum** (Müller), recorded from Britain. Exp. 12-21 mm.
Lakes and slow streams. Locally common. 5-10.

Family SIPHLONURIDAE.

KEY TO GENERA.

- 1 (2) Hind tarsus about one and a half times as long as tibia; claws similar (fig. 5)
Siphonurus Eaton.
- 2 (1) Hind tarsus slightly shorter than tibia (fig. 31); claws dissimilar
Ameletus Eaton.



Genus *Siphonurus* Eaton.

KEY TO SPECIES.

- 1 (6) Imagines.
 2 (3) Femora with a reddish-brown band externally before apex. Exp. 25–32 mm.
Lakes and rivers. Local. 5–8.
S. linnaeanus (Eaton).
 3 (2) Femora not banded.
 4 (5) Posterior angles of ninth tergite strongly produced in broad flat spines.
 Exp. 28–38 mm. **S. armatus** Eaton.
Lakes and ponds. Rare. 5, 6, 8.
 5 (4) Posterior angles of ninth tergite only slightly produced. Exp. 24–32 mm.
Lakes and slow streams in mountainous districts up to at least 2500 ft.
Generally common. 5–9.
S. lacustris Eaton.
 6 (1) Subimagines.
 7 (8) Hind wings greyish with a pale border on posterior margin
S. linnaeanus (Eaton).
 8 (7) Hind wings without pale border.
 9 (10) Wings brownish grey **S. armatus** Eaton.
 10 (9) Wings greenish grey **S. lacustris** Eaton.

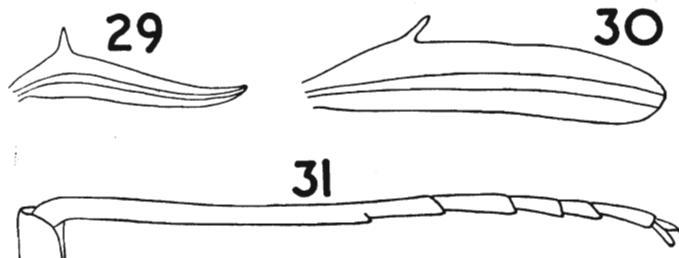
Genus *Ameletus* Eaton.

One species recorded from Britain, **A. inopinatus** Eaton. Exp. 20 mm.
Mountain and hill streams, English Lake District and Scotland. Local. 6–7.

Family ECDYONURIDAE.

KEY TO GENERA.

- 1 (2) R_4 and R_5 in hind wing fused (fig. 32) **Arthroplea** Bengtsson
 2 (1) R_4 and R_5 in hind wing separate at the margin (fig. 33).
 3 (4) In male, penis-lobes outspread and boot-shaped (fig. 38) .. **Ecdyonurus** Eaton.
 4 (3) In male, penis-lobes not outspread and boot-shaped.
 5 (6) Penis-lobes contiguous, slightly dilated or egg-shaped (figs. 34–35)
Heptagenia Walsh.
 6 (5) Penis-lobes separated by a wide U-shaped excision, cylindrical (figs. 41–42)
Rhithrogena Eaton.



FIGS. 20–23.—20. *Centroptilum luteolum* (Müll.). Wings. 21. *Cloëon dipterum* (L.). Hind tarsus. 22. *Procloëon rufulum* (Müll.). Hind tarsus. 23. *Baëtis rhodani* (Pict.). Hind wing.
 FIGS. 24–26.—24. *Baëtis vernus* (Curt.). 25. *B. tenax* Etn. 26. *B. bioculatus* (L.).
 FIGS. 27–31.—27. *B. atrebatinus* Etn. Hind wing. 28. *B. pumilus* (Burm.). Hind wing. 29. *Centroptilum luteolum* (Müll.). Hind wing. 30. *C. pennulatum* Etn. Hind wing. 31. *Ameletus inopinatus* Etn. Hind tibia and tarsus.

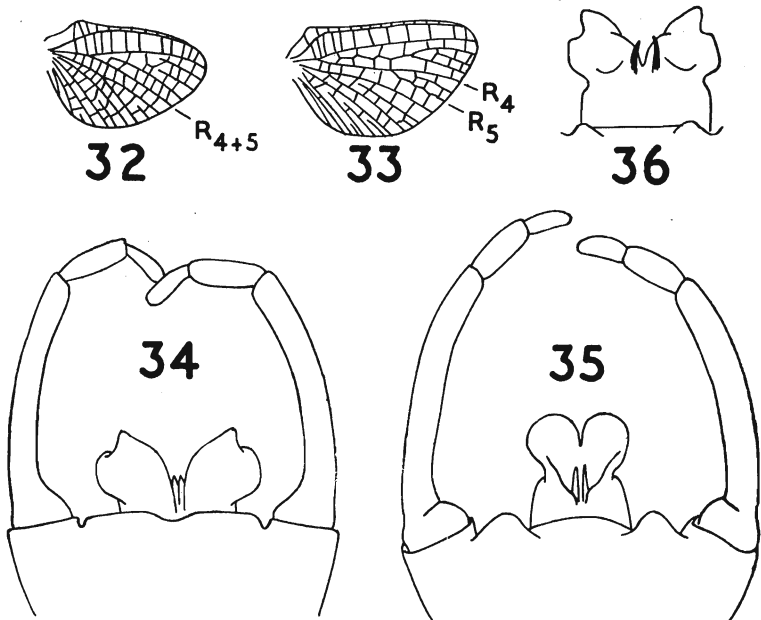
Genus *Arthroplea* Bengtsson.

One species, *A. congener* Bengtsson, recorded from Britain. Exp. 24 mm.
Only one British specimen known, taken at Stanmore, Middlesex, June, 1926.

Genus *Heptagenia* Walsh.

KEY TO SPECIES.

- 1 (8) Imagines.
- 2 (5) Hind tarsus with basal segment shorter than second, forceps base simple (fig. 34).
- 3 (4) Anterior femur with two flesh-coloured rings; a small black spot on thorax above hind coxa. Exp. 25–36 mm. *H. longicauda* (Stephens).
Rivers; imago possibly nocturnal. Rare. 6–7.
- 4 (3) Anterior femur without flesh-coloured rings; a short black line on thorax behind anterior coxa and one to three black dots above mid coxa. Exp. 17–27 mm. *H. sulphurea* (Müller).
Fast rivers. Generally common. 5–8.
- 5 (2) Hind tarsus with basal segment longer than second, forceps base toothed (fig. 35).
- 6 (7) A bright yellow thoracic streak directed forwards from the wing base; penis-lobes ovate (fig. 35.) Exp. 13–32 mm. *H. lateralis* (Curtis.).
Rapid streams and stony shores of large lakes. Generally common. 5–9.
- 7 (6) No bright yellow thoracic streak; penis-lobes with an excision on outer margin near apex (fig. 36) Exp. 21–28 mm. *H. fuscogrisea* (Retzius).
Large rivers and lakes. Local. 5.
- 8 (1) Subimagines.
- 9 (12) Wings yellow or greenish yellow.



FIGS. 32–36.—32. *Arthroplea congener* Bengtss. Hind wing 33. *Heptagenia sulphurea* (Müll.). Hind wing. 34. *H. sulphurea* (Müll.). Genitalia from beneath. 35. *H. lateralis* (Curt.). Genitalia from beneath. 36. *H. fuscogrisea* (Retz.). Penis lobes from beneath.

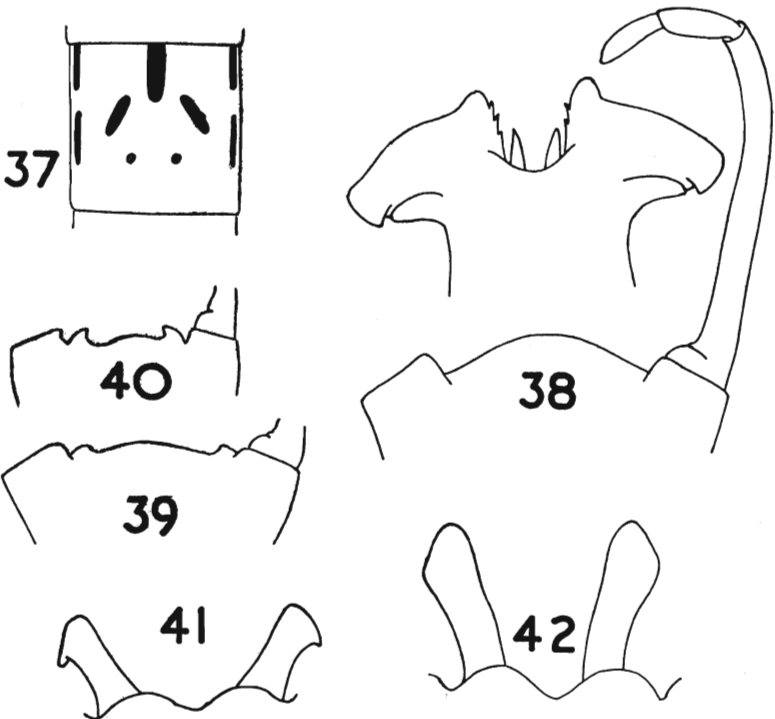
- 10 (11) Femora with flesh-coloured bands and a black dot on side of thorax as in imago **H. longicauda** (Stephens).
- 11 (10) Femora without flesh-coloured bands; sides of thorax marked with black as in imago **H. sulphurea** (Müller).
- 12 (9) Wings grey or greyish yellow.
- 13 (14) Wings grey, sometimes with faint transverse bands **H. lateralis** (Curtis).
- 14 (13) Wings greyish yellow, veins and cross-veins darker . . **H. fuscogrisea** (Retzius).

Genus **Ecdyonurus** Eaton.

KEY TO SPECIES.

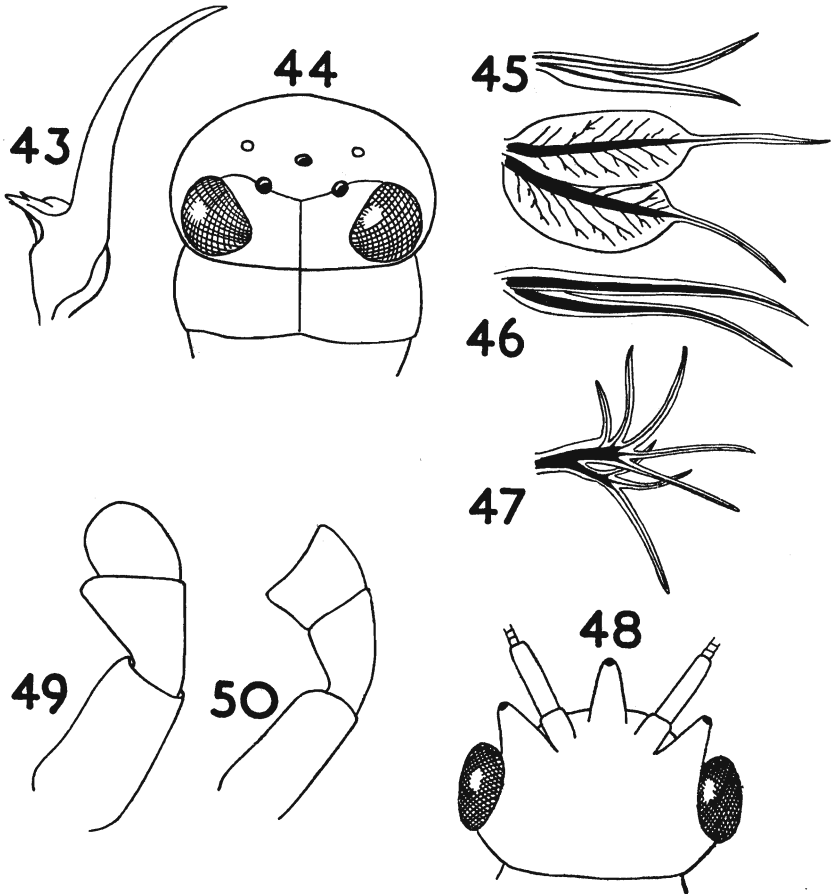
(Imagines—males only.)

- 1 (8) Imagines.
- 2 (3) Abdominal sternites II-VIII yellow, marked with black as in fig. 37. Exp. 21-31 mm. **E. insignis** (Eaton.).
Large fast streams and rivers, with a preference for alkaline waters. Locally common. 6-8.
- 3 (2) Sternites red or brown, not marked with black as in fig. 37.
- 4 (5) Forceps base untoothed (fig. 38); proportions of fore tibia to tarsus 1 : 1.5 approx. Exp. 24-35 mm. **E. venosus** (F.).
Rapid stony rivers. Generally common. 5-9.



FIGS. 37-42.—37. *Ecdyonurus insignis* (Etn.). Sternal pattern of abdomen. 38. *E. venosus* (F.). Forceps base, right forceps and penis-lobes (more enlarged) from beneath. 39. *E. torrentis* Kim. Forceps base from beneath. 40. *E. dispar* (Curt.). Forceps base from beneath. 41. *Rhithrogena semicolorata* (Curt.). Penis-lobes, ventral. 42. *R. haarupi* Esb.-P. Penis-lobes, ventral.

- 5 (4) Forceps base more or less toothed; proportions of fore tibia to tarsus 1: 1.85 approx.
- 6 (7) Forceps base moderately toothed; teeth not incurved (fig. 39); penis-lobes boot-shaped. Exp. 28-32 mm. *E. torrentis* Kimmins.
Small stony streams. Generally common. 5-6.
- 7 (6) Forceps base with strong incurved teeth (fig. 40), penis-lobes subtriangular. Exp. 22-32 mm. *E. dispar* (Curtis).
Stony rivers and stony shores of large lakes. Generally common. 5-9.
- 8 (1) Subimagines.
- 9 (10) Sternites marked with black as in imago (fig. 37) *E. insignis* (Eaton).
- 10 (9) Sternites not so marked.
- 11 (12) Wings uniformly greyish yellow; cross-veins only very finely bordered with blackish *E. dispar* (Curtis).
- 12 (11) Cross-veins strongly bordered with blackish, giving a mottled or banded appearance to the wing.



FIGS. 43-50.—43. *Ephemerella* nymph, right mandible. 44. *Heptagenia* nymph, head and thorax from above. 45. *Leptophlebia*, first and second pair of nymphal gills. 46. *Paraleptophlebia*, nymphal gill. 47. *Habrophlebia*, nymphal gill. 48. *Brachycercus harrisella* Curt. Head from above. 49. *Baëtis*, labial palp of nymph. 50. *Centroptilum*, labial palp of nymph.

Family ECDYONURIDAE.

- | | | | |
|---|-----|--|---------------------|
| 1 | (2) | No tufted gills beneath lamellae..... | Arthroplea. |
| 2 | (1) | Tufted gills beneath some or all lamellae. | |
| 3 | (4) | Hind angles of pronotum produced backward..... | Ecdyonurus. |
| 4 | (3) | Hind angles of pronotum more or less rectangular. | |
| 5 | (6) | First pair of lamellae widely separated, not touching each other ventrally | Heptagenia. |
| 6 | (5) | First pair of lamellae large, touching each other ventrally | Rhithrogena. |

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ILLUSTRATIONS.

All illustrations after, or adapted from, Kimmins, 1942.

INDEX TO FAMILIES, GENERA AND SPECIES OF EPHEMEROPTERA.

Numerals in heavy type indicate pages on which illustrations occur.

- Ameletus, 9, **16**, 17
 armatus (Siphonurus), 11
 Arthroplea, 11, **12**, 17
 atrebatinus (Baëtis), 9, **10**
- BAËTIDAE, 8, **16**, 17
 Baëtis, 8, **14**, 17
 bioculatus (Baëtis), 9, **10**
 Brachycercus, 7, 8, **16**
 buceratus (Baëtis), 8
- CAENIDAE, 7, **16**
 Caenis, **6**, 7, **16**
 Centroptilum, 8, 9, **14**, **16**
 cincta (Paraleptophlebia), 7
 Cloëon, 8, 9, 17
 congener (Arthroplea), **12**
- danica (Ephemera), **2**, **3**, **5**, **6**
 dipterum (Cloëon), 9, **10**
 dispar (Ecdyonurus), **13**, **14**
- EDYONURIDAE, 11
 Ecdyonurus, 11, **13**, **16**, 17
 Ephemera, 5, **14**, 15
 Ephemerella, 7, 16
 EPHEMERELLIDAE, 7, 16
 EPHEMERIDAE, 5, 15
- fusca (Habrophlebia), 6
 fuscogrisea (Heptagenia), **12**, **13**
- haarupi (Rhithrogena), **13**, 15
 Habrophlebia, 5, 7, **14**, 16
 harrisella (Brachycercus), 8, **14**
 Heptagenia, 11, **12**, 17
 horaria (Caenis), **6**, 7, 8
- ignita (Ephemerella), **4**, 7
 inopinatus (Ameletus), **11**
 insignis (Ecdyonurus), **13**
- Key to Families (Imagines), 4
 Key to Families (Nymphs), 15
- lacustris (Siphonurus), **3**, **4**, 11
 lateralis (Heptagenia), **4**, **12**, **13**, **14**
 Leptophlebia, 5, **14**, 16
 LEPTOPHLEBIDAE, 5, 16
 lineata (Ephemera), 5, **6**
 linnaeanus (Siphonurus), 11
 longicauda (Heptagenia), 12, 13
 luteolum (Centroptilum), 9, **10**, **11**, 17
 luteus (Potamanthus), **3**, 5
- macrura (Caenis), **4**, **6**, 8
 marginata (Leptophlebia), **3**, **4**, 5
 moesta (Caenis), **6**, 7, 8
- niger (Baëtis), 9
 notata (Ephemerella), **6**, 7
- Paraleptophlebia, 5, 6, **14**, 16
 pennulatum (Centroptilum), 9, **11**, 17
 POTAMANTHIDAE, 5, 15
 Potamanthus, 5, 15
 Procloëon, 8, 9, **16**, 17
 pumilus (Baëtis), 9, **10**
- rhodani (Baëtis), 8, **10**
 Rhithrogena, 11, **15**, 17
 rivulorum (Caenis), **6**, 7, 8
 rufulum (Procloëon), 9, **10**
- scambus (Baëtis), **3**, 9
 semicolorata (Rhithrogena), **13**, 15
 simile (Cloëon), 9
- SIPHONURIDAE, 9, 11
 Siphonurus, 9, **16**, 17
 submarginata (Paraleptophlebia), **6**, 7
 sulphurea (Heptagenia), **12**, 13
- tenax (Baëtis), 8, **10**
 torrentis (Ecdyonurus), **13**, **14**, 15
 tumida (Paraleptophlebia), 6, 7
- venosus (Ecdyonurus), **13**, 15
 vernus (Baëtis), 8, **10**
 vespertina (Leptophlebia), 5
 vulgata (Ephemera), 5, 6

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