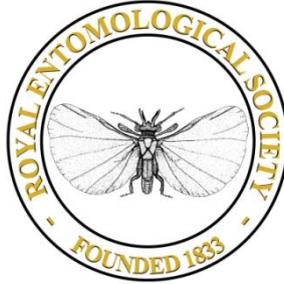


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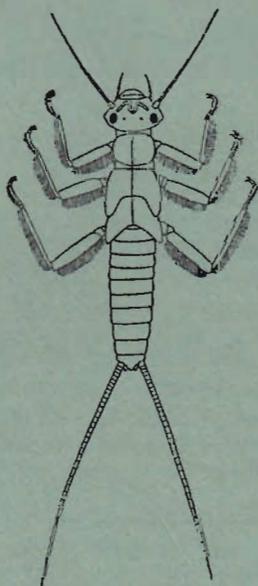
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HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS



PLECOPTERA

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. |
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- II. Hemiptera.
III. Lepidoptera.
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VI. Hymenoptera : Symphyta and Aculeata.
VII. Hymenoptera : Ichneumonoidea.
VIII. Hymenoptera : Cynipoidea, Chalcidoidea, and Serphoidea.
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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

PLECOPTERA

(Stone-flies)

BY D. E. KIMMINS.

RATHER weakly chitinized insects with two pairs of membranous wings often reduced in the male. Antennae filiform, long, mouth-parts of biting type. Legs with only three tarsal segments. Abdomen terminating in a pair of jointed cerci, which may be reduced to one or two segments. Male genitalia diverse in form, differing considerably in the different genera. In the female, the VII, VIII or IX sternite may be modified to form a sub-genital plate. In some families, vestiges of the nymphal gills persist in the imagines. Certain genera of LEUCTRIDAE and NEMOURIDAE show a decided tendency to brachyptery and reduced size in both sexes at altitudes over 1000 ft.

In the smaller species, especially in NEMOURIDAE and LEUCTRIDAE, the structure of the genitalia can rarely be made out clearly in dried or shrivelled specimens, and for accurate identification it is necessary to remove the abdomen, and to soften and clear it in caustic potash.

Stone-flies are generally terrestrial rather than aerial in habits, although many of the smaller species fly well in the warm sunshine near the lakes or streams in which they breed. They are more often, however, to be found hiding under stones, and they run actively when disturbed. Adults of the families TAENIOPTERYGIDAE, NEMOURIDAE, LEUCTRIDAE and CAPNIIDAE have been observed to feed on algae and lichens.

Eggs are laid in water and the nymphs are entirely aquatic. They feed mainly on vegetable matter, although the nymphs of the larger Plecoptera (PERLIDAE, PERLODIDAE) are more carnivorous than herbivorous. Almost any type of fresh-water habitat, if not polluted, will provide a home for some form of plecopterous nymph, from mountain stream to large lake, but the majority of British species prefer running water.

Nymphs of varying form, from moderately stout to long and slender. Antennae filiform, many-jointed. Mouth-parts of biting type. Compound eyes and ocelli present. Thorax primitive, with (except in apterous forms) wing-pads developing in later instars. Legs well developed, strong, often fairly long and sprawling, frequently fringed with hairs. Abdomen cylindrical, with ten segments, terminating in a pair of filamentous, many-jointed cerci. Tracheal gills are present in some forms and may be either on the pleurae of the thorax, or at the apex of the abdomen, arising from the tip of the sub-anal plates, or coxal, situated on the inner surface of the coxae, or prosternal, arising ventrally on each side of the neck, between the head and prothorax.

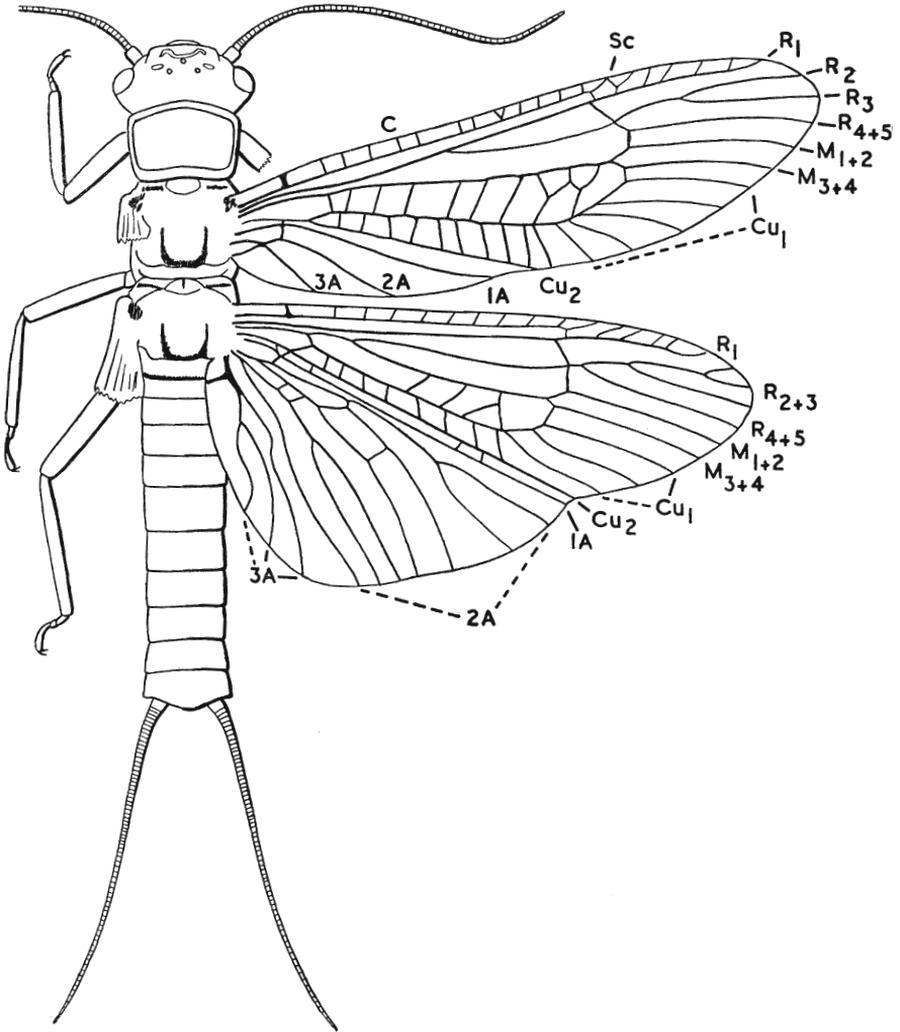


FIG 1.—*Perla cephalotes*, ♀.

These keys are based on those given by Hynes (1940, 1941) but have been considerably modified in arrangement to conform to the revised classification proposed by Frison (1942).

A key to the genera only of the nymphs has been given, since the nymphs of certain of our species are still unknown, or British examples have yet to be found. Of those which are known, the identification is a matter of greater detail than can be dealt with within the scope of these keys, and students are recommended to consult the excellent paper by Hynes (1941). Two genera, of which no British nymphs have yet been taken, have been omitted from the key (*Rhabdiopteryx* and *Isogenus*). Adults of the former have been taken on two streams in Yorkshire, and the second is included in the British list on the evidence of a few examples taken many years ago.

ABBREVIATIONS USED IN LEGENDS.

Sc, Subcosta; C, Costa; R1-R5, Branches of Radius; M1-M4, Branches of Media; Cu1, Cu2, Branches of Cubitus; 1A, 2A, 3A, Anal veins; c.c., Cubital cell; t.c., Transverse cord; s.g.p., Subgenital plate; I-IX, First to ninth segments of abdomen; g, Gills of nymph; gl., Glossae of nymphal labium; p, Palpus of nymphal maxilla.

FIGS. 2, 9, 12-20 after Kimmins (1940); 3-8, 10, 11, 21-25, 26(♀)-28, 31-37 after Hynes (1940); 38-49 after Hynes (1941); 30 after Klapálek (1912).

Measurements in millimetres refer to the expanse of the wings.

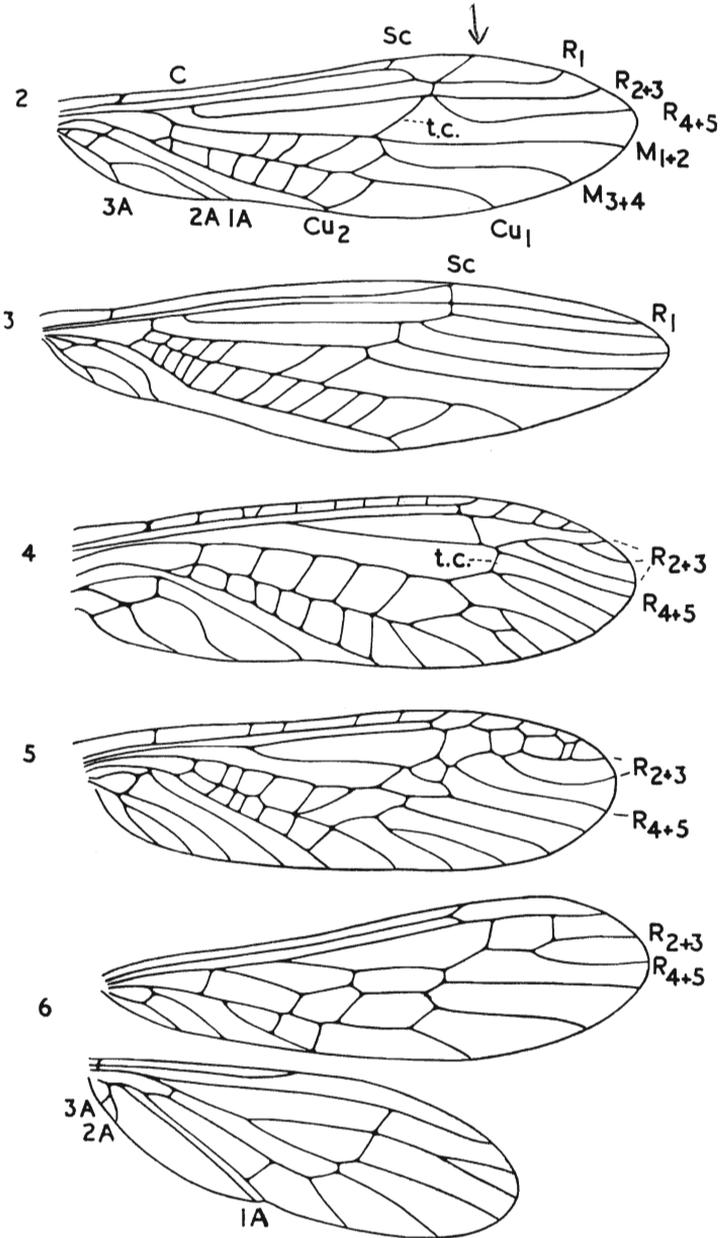
KEY TO FAMILIES.

- 1 (6) Cerci short, not longer than the greatest width of pronotum.
- 2 (3) Second tarsal segment about as long as other segments. TAENIOPTERYGIDAE (p. 3).
- 3 (2) Second tarsal segment shorter than first or third.
- 4 (5) Apical marginal space beyond tip of subcosta with an oblique cross-vein (fig. 2) NEMOURIDAE (p. 5).
- 5 (4) Apical marginal space beyond tip of subcosta without an oblique cross-vein (fig. 3) LEUCTRIDAE (p. 9).
- 6 (1) Cerci long, longer than greatest width of pronotum.
- 7 (8) Basal tarsal segment about as long as third CAPNIDAE (p. 9).
- 8 (7) Basal tarsal segment shorter than third.
- 9 (12) In fore wing R_{2+3} branched (fig. 4); males short-winged (except in *Isogenus*).
- 10 (11) R_{4+5} arises at the transverse cord (fig. 4) PERLIDAE (p. 9).
- 11 (10) R_{4+5} arises distal to the transverse cord (fig. 5) PERLOIDAE (p. 13).
- 12 (9) In the fore wing R_{2+3} simple (fig. 6), males fully winged.
- 13 (14) Anal area of hind wing small, all anal veins simple (fig. 6). CHLOROPERLIDAE (p. 13).
- 14 (13) Anal area of hind wing large, 2A and 3A forked (fig. 7) ISOPERLIDAE (p. 14).

Family TAENIOPTERYGIDAE.

KEY TO GENERA AND SPECIES.

- 1 (4) Fore wing with two branches to Cu_1 (fig. 8).
- 2 (3) Fore wing with no cross-veins between C and Sc near apex of Sc (fig. 8). 22-35 mm. *Taeniopteryx nebulosa* (L.).
Slow rivers with considerable aquatic vegetation. Locally common. 2-4.
- 3 (2) Fore wing with one cross-vein between C and Sc near apex of Sc (fig. 9). 22-24 mm. *Small, fairly rapid streams. Local (Yorkshire). 3-4.*
Rhabdiopteryx anglica Kimmins.
- 4 (1) Fore wing with three or more branches to Cu_1 (fig. 10) .. *Brachyptera* Newport.
- 5 (6) Male short-winged, antennae moniliform; female with four or more branches to Cu_1 in fore wing; wing banded, apex darkened (fig. 11). 14-25 mm.
Recorded only from Scotland. Rare. 4. *B. putata* (Newman).



FIGS. 2-6.—Figs. 2-5. Fore wing: 2, *Nemoura*; 3, *Leuctra*; 4, *Perla*; 5, *Perlodes*.
6. Wings of *Chloroperla*.

- 6 (5) Male full-winged, antennae filiform, female with three or four branches to Cu₁ in fore wing; wing banded but apex not darkened (fig. 10). 22-27 mm. *Small stony streams. Locally common.* 2-7. **B. risi** (Morton).

Family NEMOURIDAE.

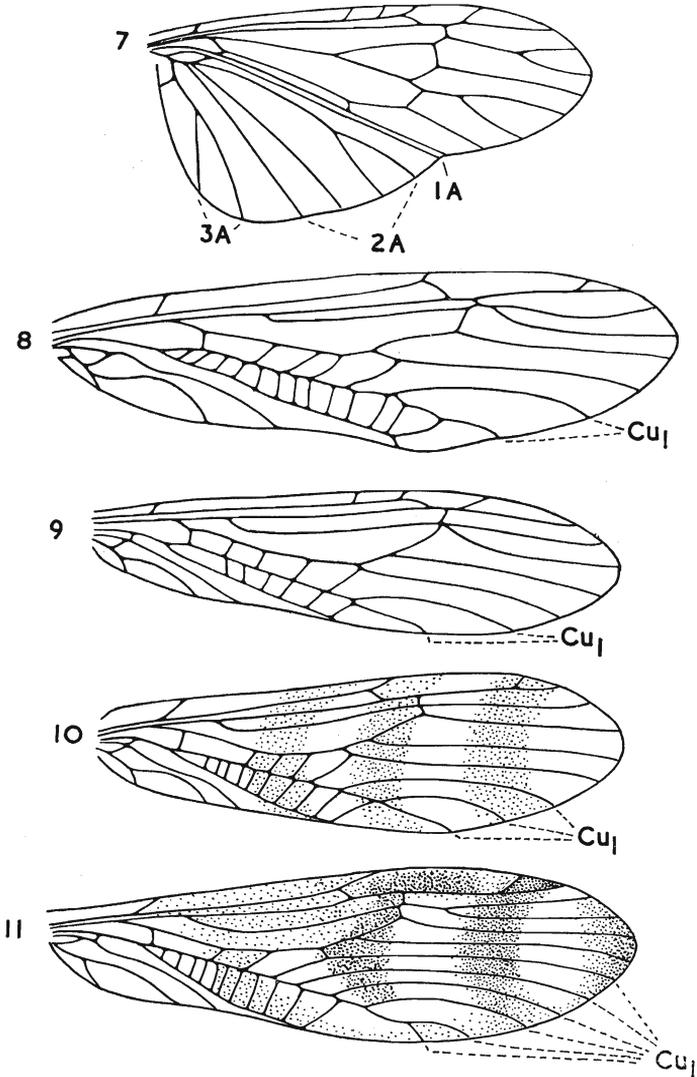
KEY TO GENERA AND SPECIES.

- 1 (10) Vestiges of prosternal gills present. *fig. 41, 42*
- 2 (7) Prosternal gills arranged in two groups of three fingers (fig. 41) **Protonemura** Kempny.
- 3 (6) Male, sub-anal plate with long, slender, apical spine. Female, margin of subgenital plate sinuous or excised (fig. 12).
- 4 (5) Vertex of head behind ocelli with yellowish brown, transverse band. 16-26 mm. **P. meyeri** (Pictet).
Streams with mossy stones. Generally common. 2-6, 8-9.
- 5 (4) Head uniformly dark brown. 15-19 mm. **P. montana** Kimmins.
Small stony streams, 1700-2000 ft. Local (Lake District and Ben Nevis). 9.
- 6 (3) Male, sub-anal plate with very short apical spine. Female, margin of subgenital plate convex (fig. 13) **P. praecox** (Morton).
Small streams. Locally common. 2-6.
- 7 (2) Prosternal gills arranged in two tufts of filaments (fig. 42) . . **Amphinemura** Ris.
- 8 (9) Male, outer lobe of sub-anal plate bent upwards in a blackened finger, not set with spines. Female, subgenital plate with a median notch (fig. 14) 13-18 mm. **A. sulcicollis** Steph. (= *A. cinerea* (Olivier))¹.
Rivers with stony bottom. Generally common. 5-9.
- 9 (8) Male, outer lobe of sub-anal plate bent upwards and set with spines. Female, subgenital plate with a median and a pair of lateral excisions (fig. 15) 12-17 mm. **A. standfussi** Ris.
Small streams with plenty of vegetable matter, up to at least 2000 ft. Local. 6-7.
- 10 (1) No prosternal gill vestiges.
- 11 (20) Male, cerci modified, generally hooked at apices (except *N. dubitans*). Female, basal margin of ninth sternite triangularly produced **Nemoura** Pictet.
- 12 (13) Pronotum dull, coarsely punctate. 15-28 mm. **N. cinerea** Retz (= *N. variegata* (Olivier))².
Ponds, slow streams. Generally common. 3-7.
- 13 (12) Pronotum shiny, not coarsely punctate.
- 14 (15) Male, cerci not hooked at apices. Female, margin of seventh sternite produced in broad quadrate plate (fig. 16). 16-20 mm. **N. dubitans** Morton.
Swampy places. Local (Suffolk, Hants, Berks, Isle of Wight). 4.
- 15 (14) Male, cerci hooked at apices. Female, margin of seventh sternite otherwise formed.
- 16 (17) Male, inner margin of sub-anal plate pronounced angular excision about mid-way. Female, production of seventh sternite narrow and trapezoidal (fig. 17). 15-20 mm. **N. erratica** Claassen.
Small stony streams with much dead vegetable matter, up to at least 1800 ft. Locally common. 2-9.
- 17 (16) Male, inner margin of sub-anal plate sinuous. Female, production of seventh sternite not trapezoidal.
- 18 (19) Male, vesicle short, truncate. Female, produced margin of seventh sternite broadly convex (fig. 18). 14-19 mm. **N. cambrica** Stephens
Small stony streams with much dead vegetable matter. Generally common. 4-6.

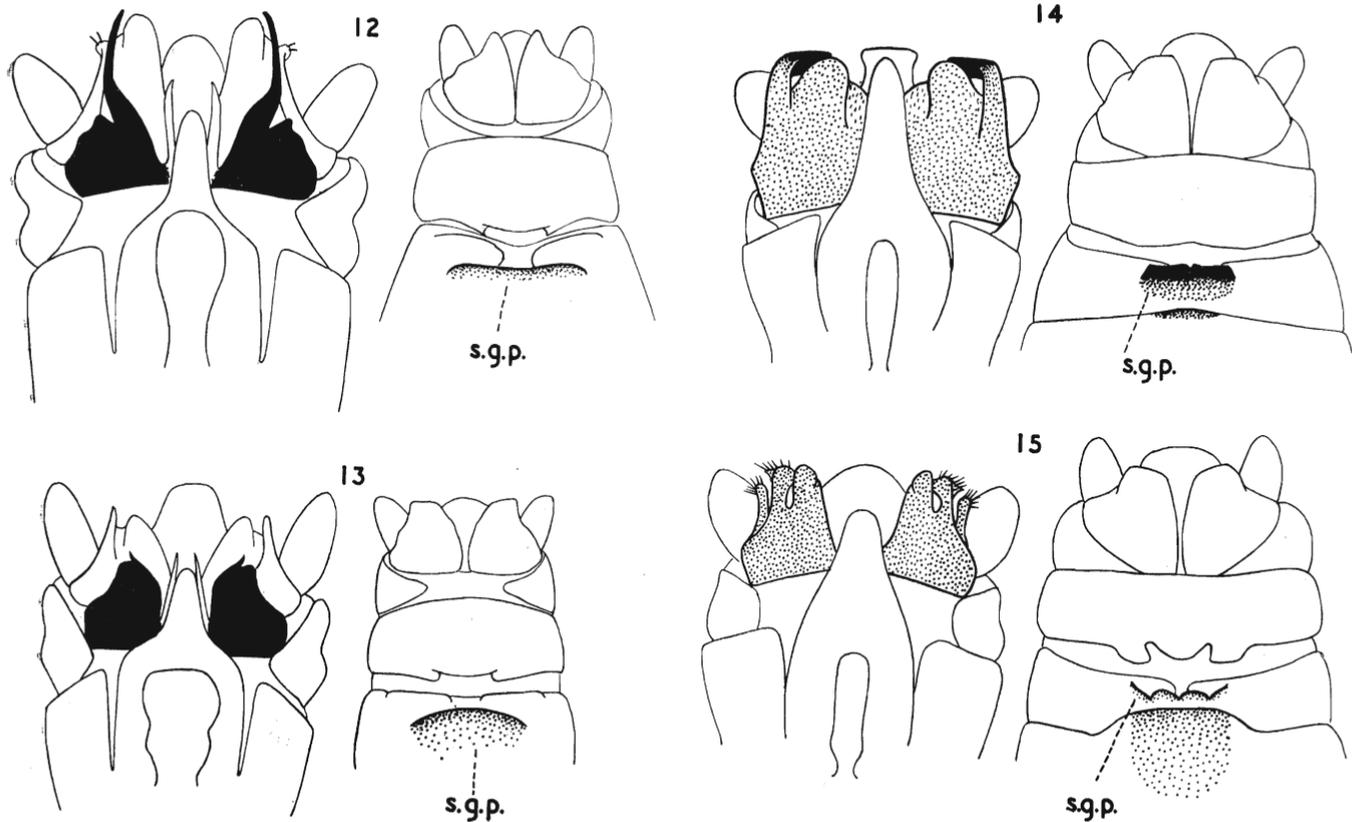
¹ Dr. Per Brinck (1949), has drawn attention to the fact that *Nemoura cinerea* Olivier, 1811, is a homonym of *Nemoura cinerea* (Retzius, 1783). The former species, therefore, should be known by its first available synonym, *Nemoura sulcicollis* Stephens, 1835.

² Dr. Per Brinck (1949), has examined the type of *Perla cinerea* Retzius, 1783 (in the De Geer collection, Stockholm), and finds it to be conspecific with *Nemoura variegata* Olivier, 1811. The latter name must therefore give place to *Nemoura cinerea* (Retzius, 1783).

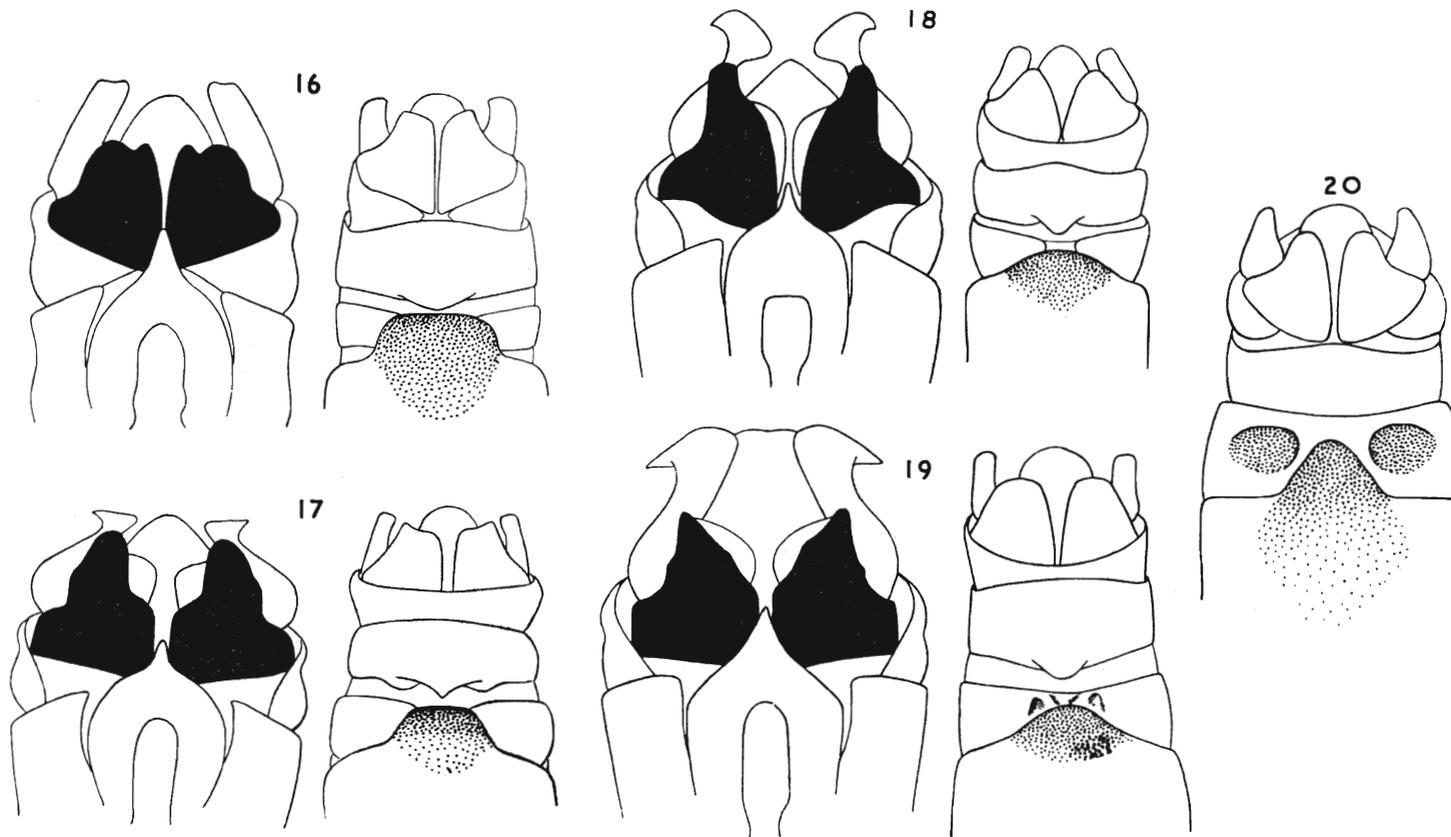
- 19 (18) Male, vesicle slender, rounded at apex. Female, margin of seventh sternite broadly convex (fig. 19). 18–25 mm. *N. avicularis* Morton.
Rivers and stony shores of lakes. Locally common. 3–8.
- 20 (11) Male, cerci long, not hooked at apices. Female, margin of seventh sternite with a triangular projection, a pair of chitinized plates on eighth sternite (fig. 20). 13–27 mm. *Nemurella inconspicua* (Pictet). ✓
Slow streams, lakes. Generally common. 3–9.



FIGS. 7–11.—7. Hind wing of *Isoperla*. Figs. 8–11. Fore wing: 8, *Taeniopteryx nebulosa*; 9, *Rhabdiopteryx anglica*; 10, *Brachyptera risi*; 11, *Brachyptera pulata*.



FIGS. 12-15.—Genitalia, ♂♀, ventral: 12, *Protonemura meyeri*; 13, *P. praecox*; 14, *Amphinemura sulcicollis*; 15, *A. standfussi*.



FIGS. 16-20.—Genitalia, ♂♀, ventral, ♀ subgenital plate shaded: 16, *Nemoura dubitans*; 17, *N. erratica*; 18, *N. cambrica*; 19, *N. avicularis*; 20, *Nemurella inconspicua* ♀ (♂ not figured).

Family LEUCTRIDAE.

Genus *Leuctra* Stephens.

- 1 (2) A whorl of outstanding hairs around the apex of each antennal segment. 19–28 mm. **L. geniculata** Stephens.
Stony streams and rivers. Generally common. 8–11.
- 2 (1) No whorl of outstanding hairs at apex of each antennal segment.
- 3 (4) Male, no processes on any abdominal tergite. Female, posterior margin of lobes of subgenital plate sinuous (fig. 21). 11–16 mm. . . **L. inermis** Kempny.
Stony rivers and streams. Generally common. 4–9.
- 4 (3) Paired processes to at least one abdominal tergite in male. Female, posterior margin of lobes of subgenital plate not sinuous.
- 5 (6) Male, paired processes present only on eighth tergite. Female, each lobe of subgenital plate produced tailward and inward (fig. 22). 13–17 mm.
L. hippopus Kempny.
Stony streams and rivers, shores of lakes. Generally common. 2–6.
- 6 (5) Male, paired processes on more than one abdominal tergite. Female, lobes of subgenital plate not so produced.
- 7 (8) Male, paired processes on sixth and eighth tergites. Female, subgenital plate with a small central lobe between the main lobes, and with a heavily chitinized plate in the centre (fig. 23). 10–18 mm. **L. nigra** (Olivier).
Streams. Generally common. 4–6.
- 8 (7) Male, paired processes on sixth and seventh tergites. Female, subgenital plate without central lobe or strongly chitinized plate as above.
- 9 (10) Male, processes of sixth tergite set close together and directed tailward. Female, lobes of subgenital plate with a quadrate excision between them (fig. 24). 14–19 mm. ***L. fusca** L. (= *fusciventris* Stephens).
Stony streams and shores of lakes. Generally common. 6–11.
- 10 (9) Male, processes of sixth tergite set farther apart and directed somewhat inward. Female, lobes of subgenital plate with a shallow triangular excision between them (fig. 25). 12–15 mm. **L. moselyi** Morton.
Streams. Rare. 7–8.

Family CAPNIIDAE.

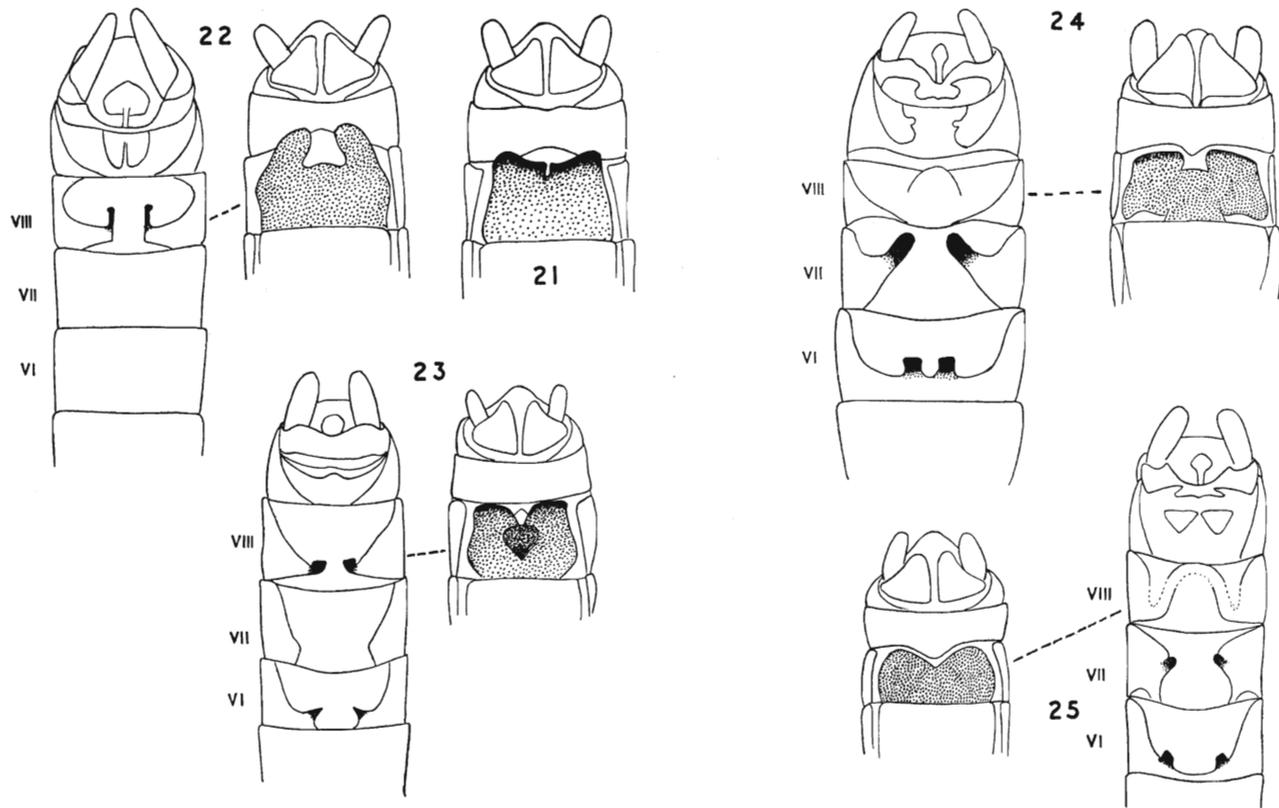
Genus *Capnia* Pictet.

- 1 (2) Male, ninth tergite produced in an upwardly directed cone; short-winged. Female, subgenital plate not produced apically, and without lateral plates (fig. 26). Female, 16–19 mm. **C. bifrons** Newman (= *C. nigra* Morton).
Stony shores of lakes, also in rivers. Locally common. 2–5.
- 2 (1) Male, eighth tergite upwardly produced. Female, subgenital plate either produced or with small lateral plates.
- 3 (4) Male fully-winged, supra-anal lobe in side view with a deep rounded excision below the apex. Female, subgenital plate not produced apically, but with a small lateral plate on each side (fig. 27). 12–17 mm. . . . **C. atra** Morton.
Lake shores. Rare (Scotland, Ireland). 4–5.
- 4 (3) Male short-winged, supra-anal lobe very slightly emarginate at tip in side view. Female, subgenital plate triangularly produced (fig. 28). Female, 12–14 mm. **C. vidua** Klapálek.
Small stony streams. Rare. 3–4.

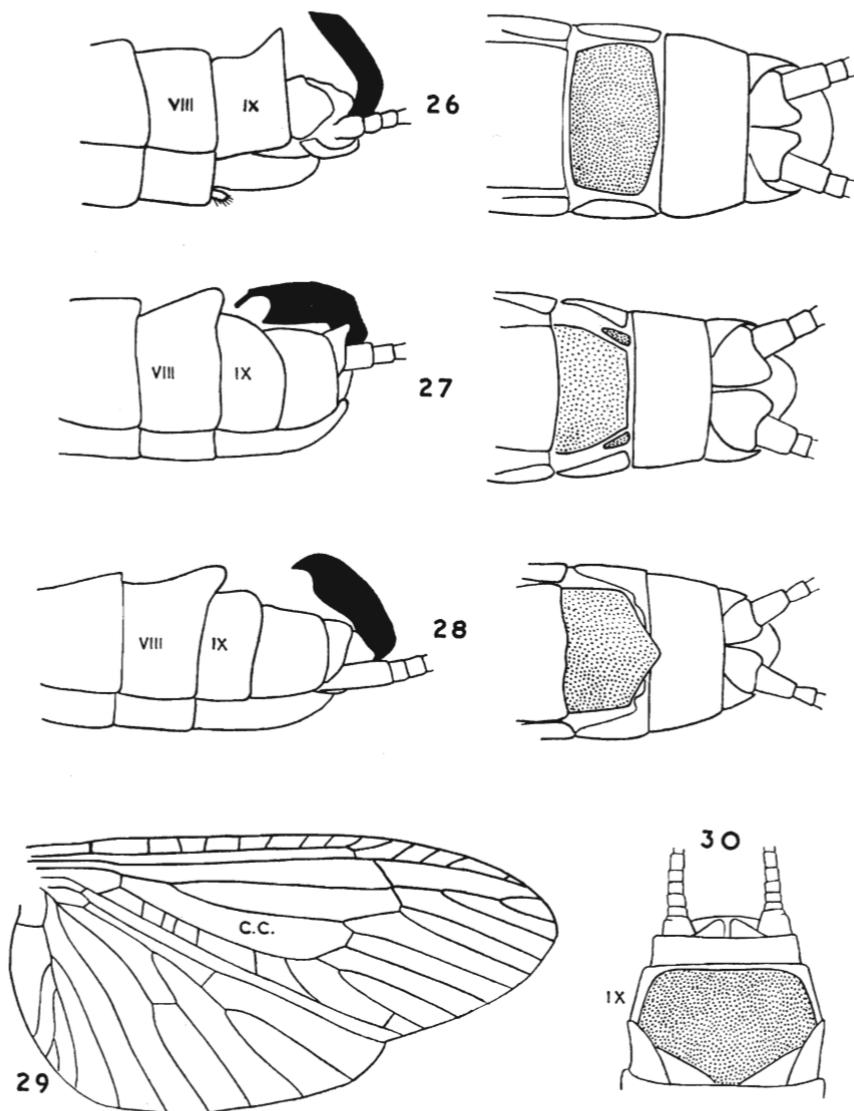
Family PERLIDAE.

Genus *Perla* Pictet.

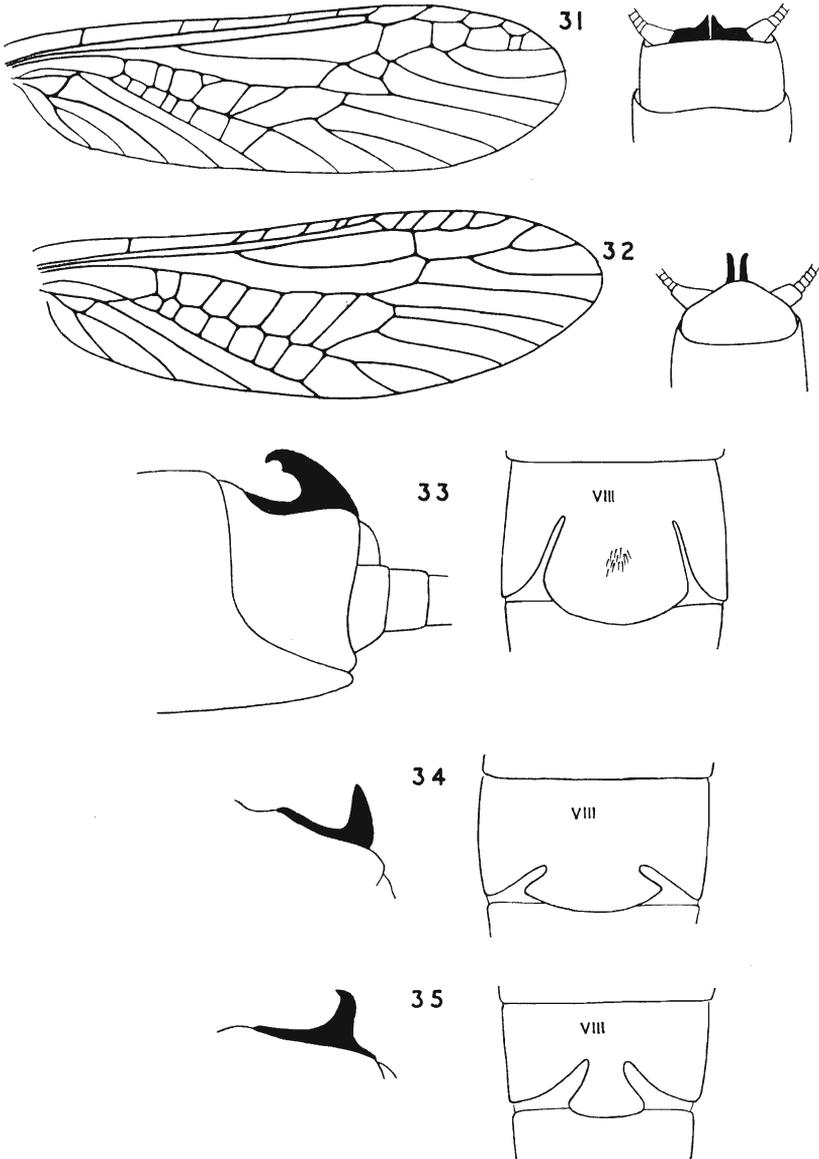
- 1 (2) Pronotum black. One to three cross-veins in cubital cell of hind wing (fig. 1). Female, 43–54 mm. **P. cephalotes** Curtis.
Stony rivers. Generally common. 5–6.
- 2 (1) Pronotum pale yellow, margined with black and with a black median line. No cross-veins in cubital cell of hind wing (fig. 29). Female, 30–45 mm.
Stony rivers. Generally common. 5–6. **P. carlukiana** Klapálek, ✓



Figs. 21-25.—Genitalia, ♂ dorsal, ♀ ventral, ♀ subgenital plate shaded: 21, *Leuctra inermis*, ♀; 22, *I. hippopus* ♂ ♀; 23, *L. nigra* ♂ ♀; 24, *L. fusca* ♂ ♀; 25, *L. moselyi* ♀ ♂.



FIGS. 26-30.—Figs. 26-28. Genitalia, ♂ lateral, ♀ ventral: 26, *Capnia bifrons*, ♀ subgenital plate shaded; 27, *C. atra*, ♀ subgenital plate shaded; 28, *C. vidua*, ♀ subgenital plate shaded. 29. Hind wing of *Perla carlukiana*, ♀. 30. Genitalia, ventral, ♀, of *Isogenus nubecula*.



FIGS. 31-35.—Figs. 31, 32. Fore wing ♀, genitalia ♂: 31, *Perlodes mortoni*; 32, *Diura bicaudata*. Figs. 33-35. Supra-anal hook ♂, subgenital plate ♀, ventral: 33, *Chloroperla torrentium*; 34, *C. tripunctata*; 35, *C. apicalis*.

Family PERLODIDAE.

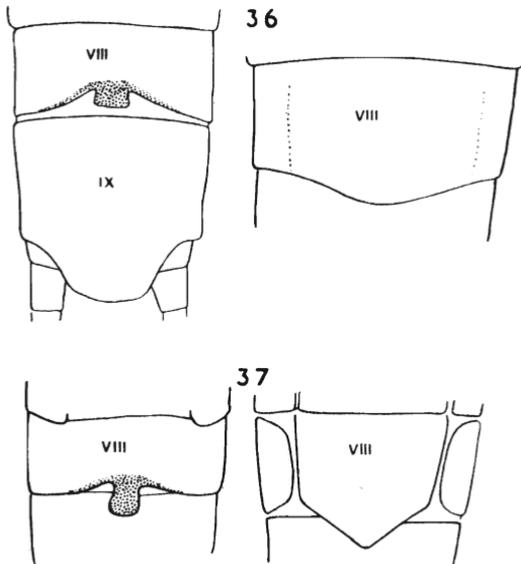
KEY TO GENERA AND SPECIES.

- 1 (2) Male fully winged. Female, subgenital plate occupying nearly entire width of ninth sternite (fig. 30). 30–38 mm. **Isogenus nubecula** Newman.
Very few British specimens.
- 2 (1) Male short-winged. Female, subgenital plate occupying two-thirds or three-quarters of the width of ninth sternite.
- 3 (4) Wing tip with an irregular network of cross-veins. Male, sub-anal plates short, triangular (fig. 31). Female, 32–39 mm. **Perlodes mortoni** Klapalek.
Stony streams and rivers. Generally common. 3–7.
- 4 (3) Wing tip without an irregular network of cross-veins. Male, sub-anal plates longer, more slender (fig. 32). Female, 14–20 mm.
***Diura** (= *Dictyopterygella*) **bicaudata** (L).
Stony shores of lakes, small streams above 1000 ft. Locally common. 4–8.

Family CHLOROPERLIDAE.

Genus **Chloroperla** Newman.

- 1 (2) Male, supra-anal hook strongly chitinized and emarginate at tip in side view. Female, subgenital plate as in fig. 33. 12–17 mm. . . **C. torrentium** (Pictet).
Stony streams, rivers and lake shores. Generally common. 4–8.
- 2 (1) Male, supra-anal hook not emarginate at tip. Female, subgenital plate as in figs. 34 or 35.
- 3 (4) Male, anterior margin of supra-anal hook in side view straight. Female, subgenital plate as in fig. 34. 16–20 mm. **C. tripunctata** (Scopoli).
Streams and rivers with gravelly bottom. Locally common. 5–7.
- 4 (3) Male, anterior margin of supra-anal hook in side view, emarginate. Female, subgenital plate as in fig. 35. 12–15 mm. **C. apicalis** Newman.
Doubtfully British.

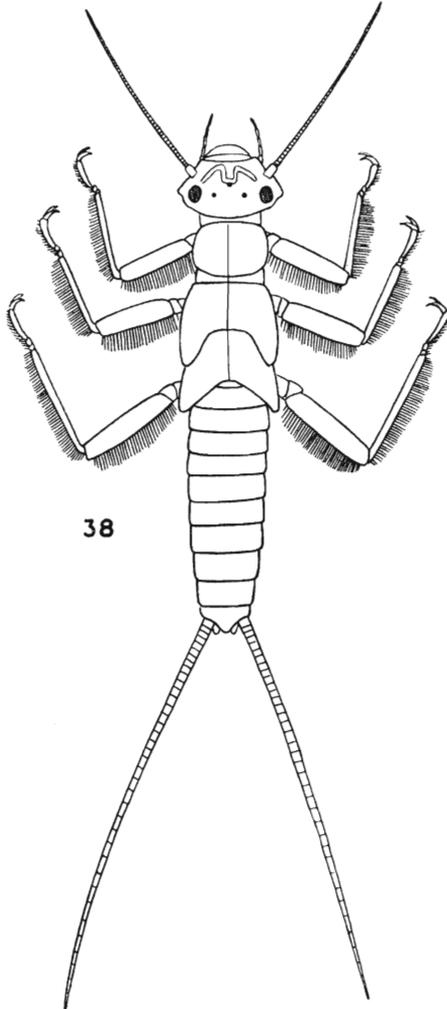


FIGS. 36, 37.—Genitalia, ♂, subgenital plate, ♀, ventral: 36, *Isoperla grammatica*; 37, *I. obscura*.

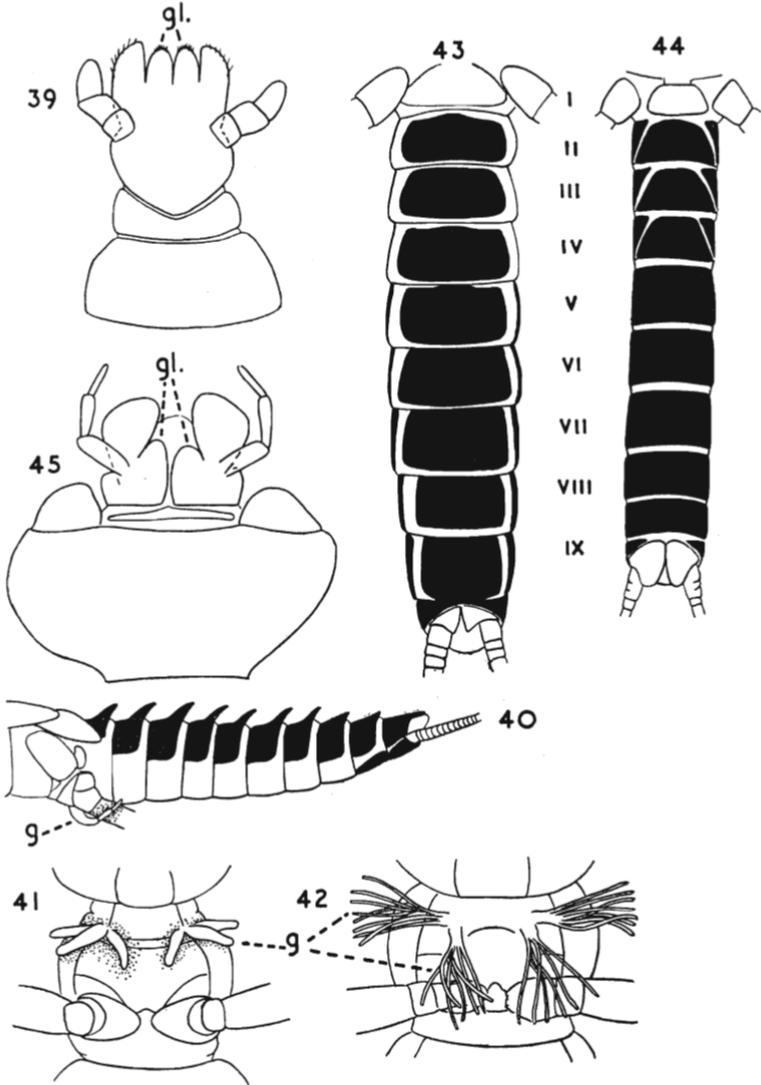
Family ISOPERLIDAE.

Genus *Isoperla* Banks.

- 1 (2) Male, chitinized lobe on hind margin of VIII sternite broader than long, rectangular. Female, subgenital plate wide and rounded. 22-27 mm. (fig. 36.) *I. grammatica* (Poda).
Stony or gravelly rivers and streams. Generally common. 4-8.
- 2 (1) Male, chitinized lobe on VIII sternite longer than broad, rounded at tip. Female, subgenital plate triangular. 16-22 mm. (Fig. 37.)
*I. *obscura* (Zetterstedt) (= *griseipennis* (Pictet)).
Rivers. Very local (R. Trent, near Nottingham). 5-6.

FIG. 38.—Nymph of *Diura bicaudata*.

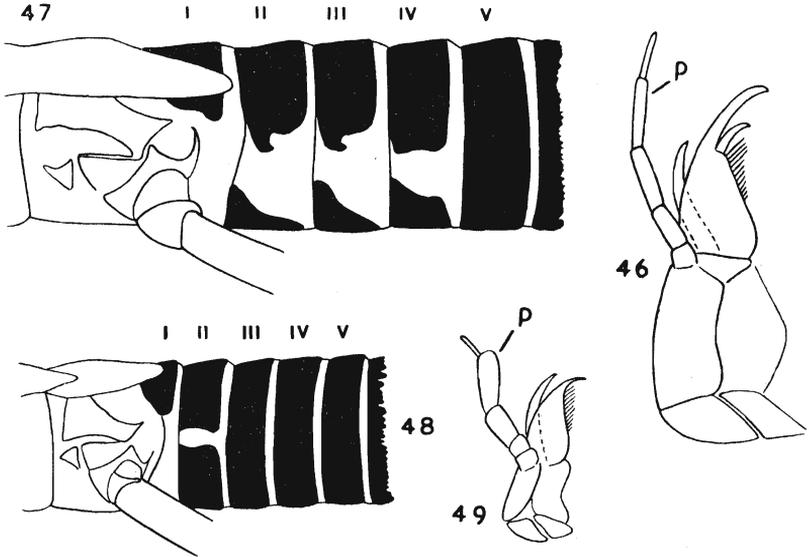
* Brinck (1949).



FIGS. 39-45.—39. Labium of nymph of *Capnia*. 40. Abdomen of nymph of *Taeniopteryx nebulosa*, lateral. 41. Prosternal gills of nymph of *Protonemura*, ventral. 42. Prosternal gill of nymph of *Amphinemura*, ventral. 43. Abdomen of nymph of *Capnia*, ventral. 44. Abdomen of nymph of *Leuctra*, ventral. 45. Labium of nymph of *Perla*.

KEY TO FAMILIES AND GENERA OF NYMPHS.

- 1 (16) Glossae of labium as long as paraglossae (fig. 39). Labrum less than twice as wide as long.
- 2 (5) Each tarsus with the segments becoming progressively longer from base to apex. TAENIOPTERYGIDAE.
- 3 (4) Spiniform projections on hind margins of abdominal tergites (fig. 40). A three-segmented retractile gill on inner surface of each coxa. **Taeniopteryx.**
- 4 (3) Abdominal tergites without projections. No coxal gills. **Brachyptera.**
- 5 (2) Second segment of tarsus shorter than first.
- 6 (13) Small robust nymphs, wing pads set obliquely to the body. Hind leg definitely longer than the abdomen. NEMOURIDAE.
- 7 (10) Prosternal gills present.



FIGS. 46-49.—46. Maxilla of nymph of *Isoperla*. 47. Abdominal segments of nymph of *Perlodes*, lateral. 48. Abdominal segments of nymph of *Diura*, lateral. 49. Maxilla of nymph of *Chloroperla*.

- 8 (9) Gills composed of three sausage-shaped structures on each side (fig. 41)
Protonemura.
- 9 (8) Gills composed of two groups of five to eight filaments on each side (fig. 42)
Amphinemura.
- 10 (7) Prosternal gills absent.
- 11 (12) Basal segment of hind tarsus much shorter than third segment **Nemoura.**
- 12 (11) Basal segment of hind tarsus about as long as third segment **Nemurella.**
- 13 (6) Small slender nymphs, wing pads sub-parallel to the body. Hind legs generally a little shorter than abdomen.
- 14 (15) Abdominal segments 1-9 divided into tergite and sternite (fig. 43)
CAPNIIDAE (**Capnia**).
- 15 (14) Abdominal segments 1-4 only divided into tergite and sternite (fig. 44)
LEUCTRIDAE (**Leuctra**).
- 16 (1) Glossae of labium much shorter than paraglossae (fig. 45). Labrum more than twice as wide as long.

- 17 (18) Branched filamentous gills present on sides and venter of thorax
PERLIDAE (*Perla*).
- 18 (17) No such gills present.
- 19 (24) Apical segment of maxillary palpus normal, more than one-quarter the width of the preceding segment (fig. 46).
- 20 (23) Body lacking clothing hairs, only scattered bristles present. . . . PERLODIDAE.
- 21 (22) Abdominal segments 1-4 divided into tergite and sternite (fig. 47) . . . *Perlodes*.
- 22 (21) Abdominal segments 1-2 only divided into tergite and sternite (fig. 48)
Diura (= *Dictyopterygella*).
- 23 (20) Body thickly clothed with short black clothing hairs
ISOPERLIDAE (*Isoperla*).
- 24 (19) Apical segment of maxillary palpus reduced, only about one-quarter as wide as preceding segment (fig. 49) CHLOROPERLIDAE (*Chloroperla*).

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