

The Trout-Food Insects of Tasmania
Part II.—A Monograph of the Mayflies of
Tasmania

By

R. J. TILLYARD, M.A., Sc.D. (Cantab.), D.Sc. (Sydney),
F.R.S., F.R.S.N.Z., F.R.E.S., &c.

PLATE I

In Part I of this series of studies, (1934) I dealt with the problem of the genotype of the Mayfly genus *Atalophlebia* Eaton. Now that this problem is satisfactorily solved, and the characters of the genus firmly established, it is possible to make a survey of the whole Mayfly fauna of Tasmania. The interesting fact at once emerges that about two-thirds of this fauna consist of species of *Atalophlebia*, and that most of the species have a very close relationship with forms which occur on the highlands of Victoria and southern New South Wales. But in these parts of continental Australia the Mayfly fauna is far more varied than it is in Tasmania. In the family Siphonuridae, there is only a single species of *Tasmanophlebia* recorded from Tasmania, whereas from the Mount Kosciusko region alone (Tillyard, 1933) there are known, in this family, two species of *Tasmanophlebia*, one of *Ameletoides*, and two of *Coloburiscus*.

Of these, it is noteworthy that *Tasmanophlebia* possesses nymphs which live in still, or nearly still, water, whereas those of the other two genera require running water. In the family Leptophlebiidae again, the most striking development of species in Tasmania is a group of closely-related species of large size in which the structure of the gills appears to indicate that they have all been originally derived from one or two forms whose nymphs inhabited still or

slowly-running water. In the Mount Kosciusko region, on the other hand, the principal development of this same genus consists of a complex of forms whose nymphs live in fast-running water, and there is also present a related genus, as yet undescribed, whose larva burrows into the sandy beds of running streams.

Thus, in studying the Mayfly fauna of Tasmania, we are faced at once with the same problem as in the case of the Dragonflies: although the island is plentifully supplied with fast-running rivers, the aquatic fauna present appears to have been derived from a stock living in still or slowly-moving water. As I have pointed out previously, in my study of the Dragonflies in relation to the Bassian Isthmus [i.e., the original land-connexion between Tasmania and the mainland (Tillyard, 1914)], no less than 78.9 per cent. of the still-water species of Odonata are common to Tasmania and Victoria out of the species found in both States; whereas, in the case of the running-water forms, only 22.7 per cent. are common to both, and, of these, one is a species which occasionally breeds in still water, and the other two breed in slowly-running water.

The inevitable conclusion must be that, during the geological periods in which most of the Tasmanian Dragonfly and Mayfly fauna reached the island, the land-connexion with Australia proper was only a narrow, or possibly even a discontinuous, one, with sufficient still waters to allow of the free migration of forms inhabiting them, but with so little development of permanently-running streams that very few of the forms inhabiting such streams were able to get across. Further, it is clear that the great majority of species reached Tasmania from the north, and not from the south, though there is one important exception, viz., the rare Dragonfly *Archipetalia auriculata* Till. from the Cradle Mountain region, which had not been discovered when my 1914 paper was written.

Although, no doubt, further collecting, particularly in the western half of Tasmania, will bring to light a few more species, we know enough about the Tasmanian Mayflies to be able to give a fairly full account of them. It appears, for instance, highly improbable that the Siphonurid genus *Coloburiscus* occurs at all on the island, although it is common in all fast-running streams throughout New Zealand and on the highlands of Eastern Australia. This genus is taken as the 'indicator' for good trout-streams in New Zealand; for wherever its larva occurs, the water is found to be of first-class quality for trout and of exceptional purity. It is certain that, if any species of this genus had succeeded in getting into Tasmania, it would have spread rapidly through all the fast-running rivers, and would have made an excellent food for trout. But so far it has not been found, though the larvae are conspicuous objects of comparatively large size.

In the present paper the following Mayfly fauna is dealt with:—

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| Family SIPHLONURIDAE..... | 1. <i>Tasmanophlebia lacustris</i> Till. |
| Family LEPTOPHLEBIIDAE | 2. <i>Atalophlebia australis</i> (Walk.) |
| | 3. <i>Atalophlebia superba</i> , sp. nov. |
| | 4. <i>Atalophlebia hudsoni</i> , sp. nov. |
| | 5. <i>Atalophlebia albiterminata</i> , sp. |
| | 6. <i>Atalophlebia ida</i> , sp. nov. |
| | 7. <i>Atalophlebia fuscula</i> , sp. nov. |
| | 8. <i>Atalophlebia brunnea</i> , sp. nov. |
| | 9. <i>Atalophlebia delicatula</i> , sp. nov. |
| Family BAETIDAE..... | 10. <i>Baëtis frater</i> , sp. nov. |
| | 11. <i>Cloëon tasmaniae</i> , sp. nov. |
| Family CAENIDAE | 12. <i>Tasmanocoenis tonnoiri</i> Lestage |
| | 13. <i>Caenis scotti</i> , sp. nov. |

KEY TO FAMILIES

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| 1. Hindwings comparatively large, about half as long as the fore | Fam. Siphonuridae |
| Hindwings small or entirely absent | 2 |
| 2. Forewings with a plentiful supply of cross-veins, giving a reticulate appearance; hindwings small, but also reticulated | Fam. Leptophlebiidae |
| Forewings with few cross-veins and a generally open appearance | 3 |
| 3. Males with turban-eyes (Text-figs. 24, 25); marginal short veins (intercalary veins) developed between the ends of the main veins | Fam. Baëtidae |
| Males with small, button-like eyes placed wide apart; no marginal short veins developed between the ends of the main veins | Fam. Caenidae |

In defining the families and genera more fully, recourse must be had to the venational scheme, where the main differences relied upon for classification are to be found. Reference should therefore be made to the text-figures of the wings of the various genera, in which the Comstock-Needham terminology is used, as amended by myself for this particular order. Students should note, in particular, that there is, in the Mayfly wing, a complete alternation of convex and concave veins; this is indicated in the legend of text-fig. 1. It is usual to indicate convex veins by the sign +, and concave veins by the sign —.

To Lameere is due the recognition that the media in Mayfly wings is a composite vein, consisting of *anterior (convex) media*, MA, and *posterior (concave) media*, MP. In all existing Mayflies, MA is attached basally to the radial sector, Rs. In order to bring the notation of the cubitus as far as possible into line with that of the media, the *anterior (convex) cubitus* is here designated CuA, instead of the usual Cu₁, and the *posterior (concave) cubitus* CuP, instead of

the usual Cu₂. This course also enables us to avoid awkward suffixes for the branches of CuA. It should also be noted that the main stem of the radius is really the anterior convex portion of that vein, and might with advantage be termed RA, while the 'radial sector,' universally known as Rs, is in reality the posterior concave portion, and might be more logically termed RP.

Mayfly venation (text-fig. 1) differs essentially from that of any other order of insects, not only in the complete alternation of convex and concave veins, but also in the formation of *triads*. When a main vein branches distally into two, the alternation of convex and concave veins is kept intact by the development, between these two

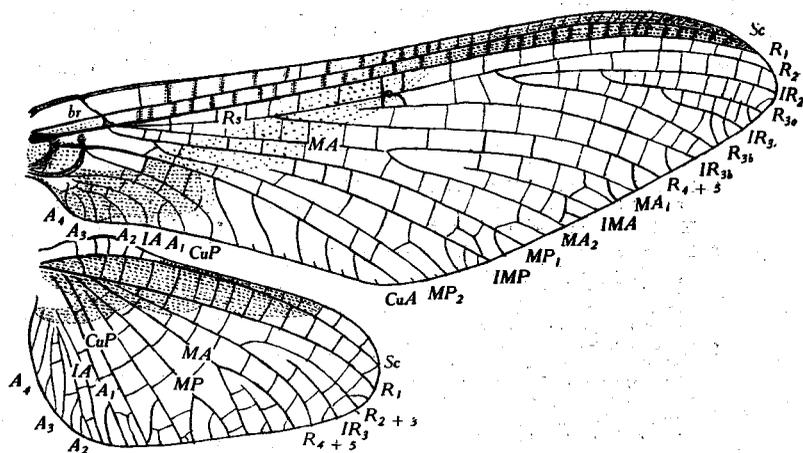


Fig. 1.—Venation of *Tasmanophlebia lacustris* Till. Male imago, from Great Lake, Tasmania.

A₁, A₂, A₃, anal veins (convex); br bridge vein; C, costa (convex); CuA, anterior cubitus (convex); CuP, posterior cubitus (concave); MA, anterior media (convex); MP, posterior media (concave); pt, pterostigma; R₁, radius (convex); R₂, R₃, R₄, R₅, branches of the radial sector, Rs, all concave; Sc, subcosta (concave); interpolated veins (middle members of triads) are distinguished by the prefix "I."

branches, of an extra, interpolated vein of opposite sign between the two branches. These middle veins of triads are distinguished by the addition of the prefix 'I'; e.g., the triad of MA consists of MA₁ (+) IMA (-), and MA₂ (+). Triads are normally developed on the branches of Rs, Ma, and MP only, i.e., on those branches which proceed to the distal or outer margin of the wing, from apex to tornus. As it is doubtful how far the formation of the distal part of CuA in the Leptophlebiidae is a true triad, it is left unlabelled in this paper. In the older family Siphonuridae there is no triad on CuA, but a pectinate series of descending veinlets. A short interpolated anal vein, IA, can also be recognized in this family.

Family SIPHLONURIDAE

Genus *Tasmanophlebia* Tillyard, 1921.

This genus, the only known Tasmanian representative of the family, can be at once recognized by the large size of the hindwings, which are about half as long as the fore and almost as wide, with the humeral angle well developed and obtuse. In the forewing the triad of MA is distally placed, that of MP very long, arising basally, and not attached to CuA. In correlation with the size of the hindwing, the tornus or posterior angle of the forewing is placed about half-way between base and apex, giving the wing the general shape of an obtuse-angled triangle.

In both sexes, except in the forelegs of the male, the tarsi are apparently only four-segmented, owing to the basal segment being more or less fused with the tibia; the forelegs of the male are greatly elongated. The tarsal claws are in all cases dissimilar, one being sharply hooked and one broad and blunt, with rounded apex. The abdomen is narrowly cylindrical, without any lateral dilations.

The larva or nymph is free-swimming, dorso-ventrally flattened, the thorax not humped; the abdominal segments have a median dorsal crest and lateral flanges with strongly projecting posterior angles. There are only four pairs of simple gills, carried dorsally upon the abdomen, one pair on each of segments 1-4; of these, the first pair are strongly chitinized lamellae forming gill-covers or opercula for the rest, which fit closely under them.

The genus is the Australian and Tasmanian representative of the well-known New Zealand genus *Oniscigaster* McLach. It differs from the latter in not possessing lateral flanges to any of the abdominal segments in the adult, and in the specialization and reduction of the nymphal gills.

Genotype.—*Tasmanophlebia lacustris* Till.

Habitat.—Lakes and still reaches of mountain streams in Tasmania and the uplands of South-Eastern Australia.

1. *Tasmanophlebia lacustris* Till.

(Plate I, figs. 1, 2; text-figs. 1, 2, 3)

Tillyard, 1921, *Proc. Linn. Soc. N.S.W.*, xlii., pp. 409-412, pl. xxxiv.

This species was originally described from Lake Lilla, Cradle Mountain, North-Western Tasmania. It is now known to occur also in the Great Lake, Lakes Echo and St. Clair, and more commonly in the Penstock and Shannon Lagoons, not far from the Great Lake.

The type series, consisting of one imago of each sex and also one subimago of each sex, is now seen to be somewhat below the average size of the species; the average expanse is about an inch, the males

being slightly smaller than the females, and much less numerous. Some additions to the original description may suitably be made here, as follows:—

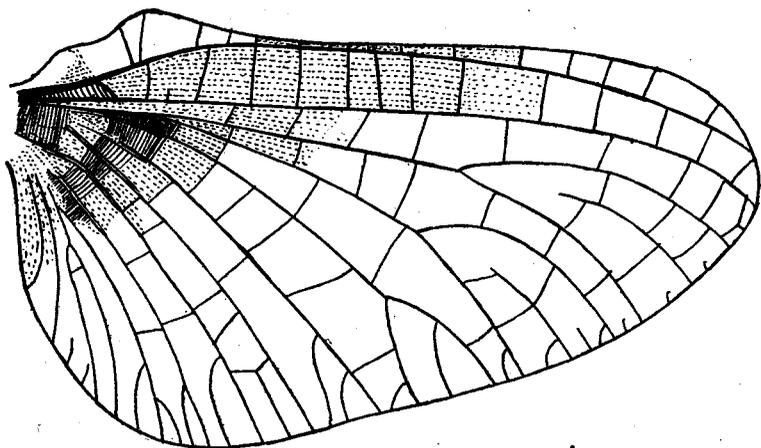


Fig. 2.—*Tasmanophlebia lacustris* Till. Hindwing. Length 5.5 mm.

In the IMAGO, the male can be at once distinguished from the female by a rich brown longitudinal mark on the forewing (Plate I, figs. 1, 2), extending outwards from the base posteriorly to CuP. There is a similar but longer mark, about 3 mm. long, covering the basal sixth of the hindwing and also extending outwards along the subcostal space to about two-thirds (text-fig. 2). Further, the brown markings along the costa of the forewing are much stronger in the male, particularly in the region of the pterostigma.

The *hindwing* (text-fig. 2) differs from those of the mainland species in having the humeral projection of the costal margin irregular and rounded at its apex instead of being a simple obtuse angle. The definition of the genus therefore needs to be amended, and should properly read 'hindwing with humeral angle prominent, either obtuse-angled or irregularly humped and rounded.'

In the SUBIMAGO, the general colour of the wings in both sexes is a medium fuscous, with a slightly paler lunule passing from about the middle of the costa of the forewing to the tornus; the part of the wing situated basally from the lunule is slightly paler than the distal part; in the hindwing, the wing is darkest around the distal portion.

The NYMPH (text-fig. 3), previously unknown, may be described as follows:—Total length of body (average) 16 mm., tail filaments 6 mm. *Head* narrow, eyes wide apart in female but touching in male; antennae short, subulicorn. *Thorax* fairly stout; the legs short, rather slender, tibio-tarsus divided obliquely and end-

ing in a single claw. *Abdomen* with short, backwardly projecting dorsal spines only on segs. 1-5; lateral spines present on segs. 1-9. Gill-covers or opercula large, extending to the end of seg. 5, slightly irregular in shape, the inner margin subangulate not far from base, but otherwise oval in form. Caudal filaments short, strongly fringed, the middle one on both sides, the outer ones on the inner margin only. General coloration sandy, with mottled brownish markings; eyes and wing-sheaths dark, tail filaments with darker annulations.

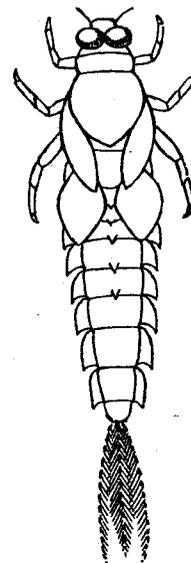


Fig. 3.—*Tasmanophlebia lacustris* Till. Full-grown nymph (male). Length, excluding tail-filaments, 16 mm.

In general appearance, this nymph comes close to that of *T. nigrescens* Till. from Mount Kosciusko (Tillyard, 1934, p. 19); it also agrees with it in having the dorsal spines confined to segs. 1-5; these, however, are much smaller and less nodding than in *T. nigrescens*, that of seg. 1 particularly being small.

Types.—Holotype male imago, allotype female imago, type male and female subimagos, from Lake Lilla, Cradle Mountain, North-Western Tasmania (R. J. Tillyard, 21st January, 1917); type nymph (male) and series of paratypes (in spirit), from Todd's Corner, Great Lake (R. J. Tillyard, 28th January, 1933).

Family LEPTOPHLEBIIDAE

In this family the hindwings are small, from less than 1 mm. to about 3 mm. in length, but always more or less reticulated. The

forewings have a complete system of cross-veins, though the series of costal veinlets may be incomplete in some of the smaller species. The nymphs are of the crawling type, and may be found under stones, rocks, logs, &c., in either still or running water. Their tail-filaments are long and filiform, not fringed as in the Siphonuridae and Baëtidae, but only very lightly hairy.

All the Tasmanian species so far discovered belong to the genus *Atalophlebia*, which has its headquarters in Australia and New Zealand. In New Zealand the larger species of the family Leptophlebiidae belong to the genus *Atalophlebia*, the smaller to the genus *Deleatidium*; the only valid difference between them appears to be that the nymphs of the former have double gills, while those of the latter have single gills. I have shown that the supposed difference in the tarsal claws of the adult does not hold (Tillyard, 1934, pp. 4, 7), as the genotype, *A. australis* (Walk.), has the claws similar in shape, each provided with a transparent flange. All the Tasmanian species of which the nymphs are known possess double gills, and must therefore be placed in *Atalophlebia*. The nymphs also all possess denticulate tarsal claws, thus distinguishing them from the nymphs of the South African genus *Aprionyx* Barnard, which is otherwise closely allied to *Atalophlebia*.

The most striking character of the genus *Atalophlebia* is the form of the hindwing (text-figs. 4-9), in which the costal border is always peculiarly humped, the costal space becoming narrowed beyond the hump, and the subcostal space being very broad.

Having previously defined the genus very fully (Tillyard, 1934), and having also given a full description of the genotype, *A. australis* (Walk.), it now only remains to describe the other known Tasmanian species, and to give keys for the separation of the imagos, subimagos, and nymphs, as far as these are known. In order to shorten the descriptions as far as possible, reference will be made to those parts of *A. australis* which have already been fully described and figured in such cases as the corresponding parts of other species only differ slightly from those of the genotype.

It should be noted that the Tasmanian species of *Atalophlebia* can be arranged in two quite distinct groups, one consisting of comparatively large species in which the nymphal gills are digitate, and the other consisting of much smaller species in which the gills are narrowly lanceolate. This distinction will be made use of in the keys.

KEYS TO THE TASMANIAN SPECIES OF THE GENUS ATALOPHLEBIA

I. IMAGOS

1. Larger species, expanding about an inch (forewing from 10 to 13 mm. long) 2
- Smaller species, expanding from one-half to three-quarters of an inch (forewing from 5 to 8 mm. long) 6

2. Forewings with two large black spots (each 1 to 1.5 mm. in diameter) near middle, one on costa and one below it, also many smaller spots along and below costa 3
 - Forewings not spotted 8
 3. Forewings with black venation and costal veinlets widely darkened; body black; males with two extremely long tail-filaments, black tipped with white 4
 - Colour of wings and body brown, orange, or red 4
 4. Abdomen distinctly red; tail-filaments usually three, rarely two 5
 - Abdomen brown or orange-brown; tail-filaments two only, stout 5
 5. Thorax brown with a mid-longitudinal dorsal orange stripe; abdomen fulvous 6
 - Thorax dark brown without any orange stripe; abdomen brown 6
 6. General colour a medium brown; wings with brown veins 7
 - General colour grey or fuscous 7
 7. Forewing about 7 mm., rather broad, veins black; general body colouring dark fuscous, the whole insect appearing blackish in life when at rest 7
 - Forewing about 5 mm., long and narrow, veins thin, fuscous; general body colouring medium fuscous 7
- A. ida*, sp. nov.
A. albiterminata, sp. nov.
A. australis (Walk.)
A. hudsoni, sp. nov.
A. superba, sp. nov.
A. brunnea, sp. nov.
A. fuscula, sp. nov.
A. inconspicua Eat.

II. SUBIMAGOS

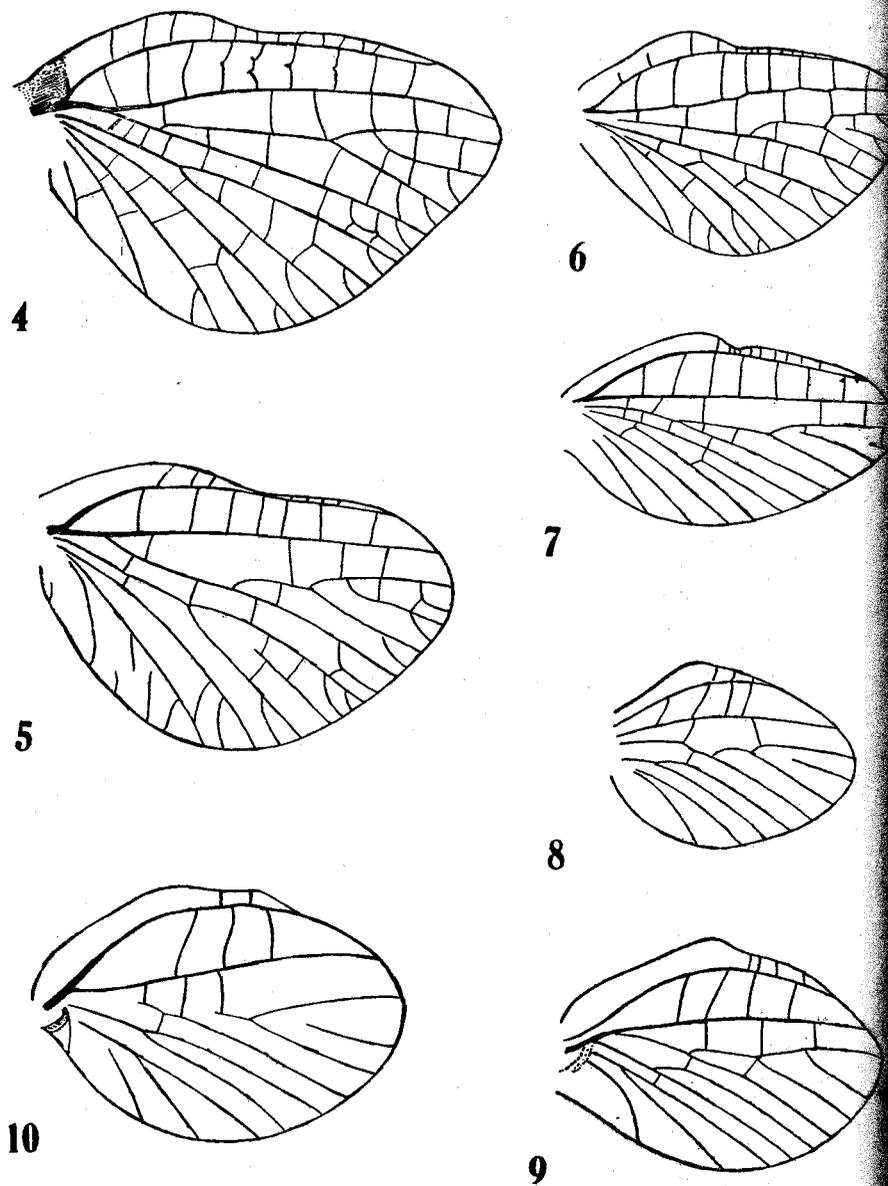
1. Larger species, expanding about an inch (forewing from 10 to 13 mm. long) 2
 - Smaller species, expanding from one-half to three-quarters of an inch (forewing from 5 to 8 mm. long) 6
 2. Forewings pale greyish, marked with two large dark spots near middle and numerous smaller spots along and below costa 3
 - Forewings dark, with paler areas 3
 3. Lambda-mark complete or almost complete (Plate I, fig. 3) very clearly visible in living insect when at rest; abdomen reddish 4
 - Lambda-mark incomplete, broken up into three or four fragments; abdomen brown or black 4
 4. General colour a rich dark brown 5
 - General colour black 5
 5. Forewings pale brownish, slightly mottled 6
 - Forewings grey or fuscous 6
 6. Forewing about 7 mm., dark fuscous, appearing almost black in the living insect at rest 7
 - Forewing about 5 mm., much narrower than above, pale greyish, slightly mottled 7
- A. ida*, sp. nov.
A. australis (Walk.)
A. superba, sp. nov.
A. albiterminata, sp. nov.
A. brunnea, sp. nov.
A. fuscula, sp. nov.
A. inconspicua Eat.

NOTE.—The subimago of *A. hudsoni* sp. nov. is not known.

III. NYMPHS

1. Large nymphs, length of body when full-grown 12 to 16 mm.; gills digitate (Text-figs. 17, 18) 2
 - Smaller nymph, length of body 7 to 8 mm. when full-grown; gills entire, lanceolate (Text-fig. 19) 2
 2. General colour very dark brown to blackish; gills wide, multidigitate (Text-fig. 18); three tail-filaments 3
 - General colour rich brown or reddish-brown 3
 3. General colour reddish-brown; tail-filaments three, approximately equal 4
 - General colour rich chocolate-brown; two very stout cerci and a slender, very short appendix dorsalis 4
- A. fuscula*, sp. nov.
A. albiterminata, sp. nov.
A. australis (Walk.)
A. superba, sp. nov.

NOTE.—Of the three smaller species *A. fuscula*, sp. nov., *A. brunnea*, sp. nov., and *A. inconspicua* Eat., only the nymph of *A. fuscula*, sp. nov., has been determined.

Figs. 4-10.—Hindwings of the genus *Atalophlebia*:

4. *A. superba* n. sp. (length 4 mm.).
 5. *A. hudsoni* n. sp. (length 3.5 mm.).
 6. *A. albiterninata* n. sp. (length 3 mm.).
 7. *A. ida* n. sp. (length 2 mm.).
 8. *A. brunnea* n. sp. (length 1.1 mm.).
 9. *A. fuscata* n. sp. (length 1.6 mm.).
 10. *A. delicatula* n. sp. (length 1.2 mm.).

Genus *Atalophlebia* Eaton2. *Atalophlebia australis* (Walk.)

This species, the genotype, has been fully dealt with by me in Part I. of this series of studies (Tillyard, 1934).

3. *Atalophlebia superba*, sp. nov.

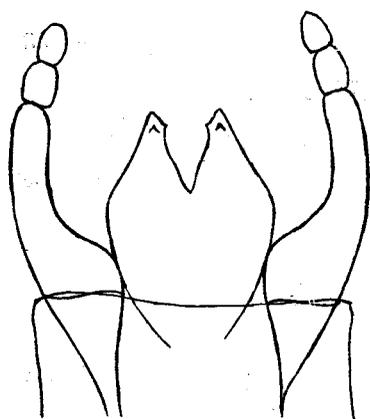
(Plate I, figs. 5, 6; text-figs. 4, 11, 17)

MALE IMAGO: Total length of body (dried) 10-12 mm.; abdomen 6-7 mm.; forewing 11-12 mm.

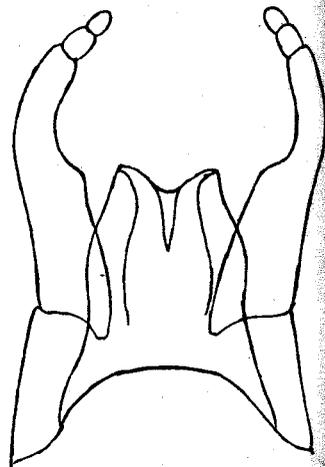
Head: General colour dark chocolate brown, drying almost to black; eyes black; antennae very dark brown.

Thorax shiny, dark chocolate brown, drying almost to black; a pale short stripe on either side of prothorax, brownish or ochreous; underside very dark brown. Legs rich dark brown, the femora blackish apically; forelegs 10 mm. long, the femur and tarsus about equal, the tibia slightly longer; tarsal segments, in descending order of length, 2 = 3, 4, 5, 1 (partly fused with tibia); middle and hind legs much shorter, with order of tarsal segments 5, 2 = 3 = 4, 1 (almost completely fused with tibia); tarsal claws both sharp, with narrow lateral flanges, much as in *A. australis* (Tillyard, 1934, pl. ii, fig. 6).

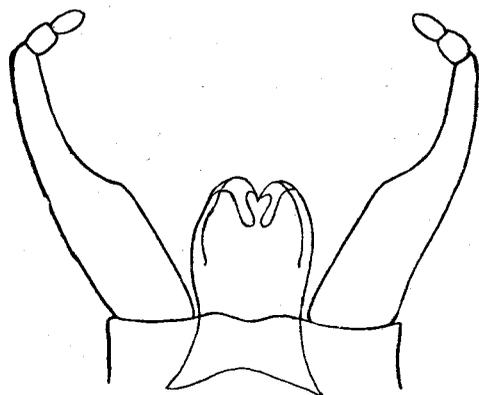
Wings with strong hyaline membrane, shiny, the veins from dark to medium brown, MA of forewing being the darkest. Bases of both wings clouded with dark brown, the forewing for 2 mm., the hind for less than 1 mm.; costal space of forewing heavily blotched with dark brown as far as the bulla, then more lightly tinted with brown around the pterostigmatic veinlets; basal portions of R_1 and Sc heavily blackened. **Forewing** (Pl. I, fig. 6) more stoutly built than that of *A. australis* (Pl. I, fig. 4), slightly broader, and the veins distinctly thicker, especially MA, the basal portion of CuA , the whole of CuP , and the anal veins. The general venational scheme of the forewing is closely similar to that of *A. australis*, but the posterior branches of CuA are more nearly parallel, and LMP extends further in towards the base than the fork of MA. Further, the wide gaps between the cross-veins shown in *A. australis* below R_1 and MP_1 are not present, and this, being the same in the subimago, causes the breaking-up of the complete lambda-pattern, owing to the development of pigment around the extra cross-veins. **Hindwing** (text-fig. 4) 4 mm. long, 2.5 mm. wide, with the costal hump more pronounced than in *A. australis*, the narrowed portion of the costal space much longer, reaching not



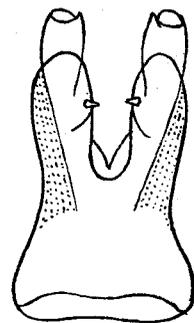
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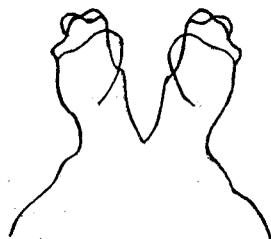
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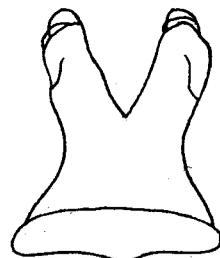
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far from apex, with a dozen or more costal veinlets present, two-thirds of them belonging to the narrowed portion; subcostal series of cross-veins complete, with a tendency to the formation of cross-struts between its middle members; Rs arising much closer to base than in *A. australis*; generally a fuller development of cross-veins everywhere in the wing; posterior margin less rounded than in *A. australis*, and with a faint embayment at end of MA.

Abdomen stout basally, dark chocolate brown, ringed with rich medium brown at ends of segments 2-9; spiracles surrounded with circlets of pale brown. *Genitalia* (text-fig. 11) brown, with three-segmented forceps, the first segment long and greatly narrowed for its distal half, the two distal segments nearly equal, short, subglobular; penis large and prominent, broadest near middle, deeply bifid, the two forks each carrying a small inner angle not far from apex, which is fairly sharply pointed also; just below each apex there is also a small denticle. *Cerci* long, 10-12 mm., brown, ringed narrowly with blackish at end of each segment; appendix dorsalis aborted.

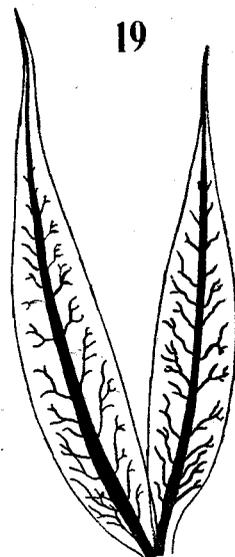
FEMALE IMAGO generally resembling the male, but with much smaller eyes and shorter forelegs; general colour dark brown, the wings not quite as heavily shaded as in the male; prothoracic lateral stripes larger; abdomen generally stouter. A small remnant of the appendix dorsalis usually present, about 0.5 mm. long and very slender; cerci as long as in male. Subgenital plate entire; subanal plate with a median triangular incision.

SUBIMAGO (both sexes) with the general body colouration dark fuscous, distinctly duller than in imago and not shiny; abdomen with pale segmental rings, clearer in male than in female. *Forewings* (Pl. I, fig. 5) heavily shaded with dark fuscous, so as to isolate an incomplete lambda-pattern; the presence of extra cross-veins with shading is the cause of the incompleteness of the lambda-mark. *Hindwings* shaded heavily with fuscous on all the cross-veins.

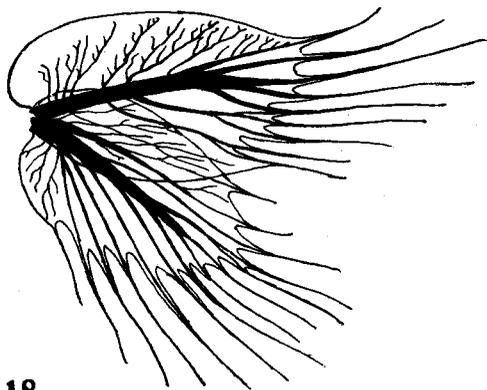
NYPH.—Total length of body 13-15 mm., cerci stout, 8-10 mm.; appendix dorsalis vestigial in male, 0.5 mm., slender, 7-9 mm., long in female but much paler than cerci. General colour dark brown, head and thorax almost black above, the latter with a more or less marked, mid-longitudinal stripe of brown or fulvous on mesonotum. Legs stout, femora dark brown, tibiae and tarsi medium dull fulvous above, all parts dull fulvous below; femur and tibia of equal length, tarsus less than half as long; tarsal claws somewhat stouter and less curved than in *A. australis*, denticulations very



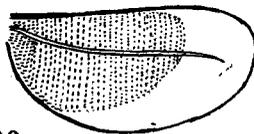
17



19



18



20

Figs. 17-20.—Fourth gill-pair in nymphs of the genera *Atalophlebia* and *Baëtis*:

17. *A. superba* n. sp. ($\times 20$).
 18. *A. albiterminata* n. sp. ($\times 20$).
 19. *A. fuscata* n. sp. ($\times 67$).
 20. *B. frater* n. sp. ($\times 100$). (Single gill.)

fine. *Gills* (text-fig. 17) seven pairs on segs. 1-7, all double, large and feathery, grey with blackish tracheae; in shape each gill is a broad, rather irregular, oval lamella with the apex trifurcate, each of the three forks being drawn out into a slender filament and provided with a stout trachea; main tracheal trunk stout, subdividing near halfway into three, one branch going into each fork; the main trachea gives off numerous branching tracheae on each side; the narrower of the two gills in each pair has the longest filaments. By comparison with the gills of *A. australis*, these gills are much larger and stouter, with more abundant lateral tracheae, and the apical filaments slenderer.

Types.—Holotype male, allotype female, type male and female subimagos, and type nymph all taken at the Penstock Lagoon, near Great Lake, Tasmania, on 29th January, 1933, by myself. Imagoes both bred from subimagoes; actual date of emergence, 31st January, 1933. All adult types pinned and set; nymph in spirit.

Habitat.—Great Lake, Shannon Lagoon, and Penstock Lagoon, Tasmania.

The nymphs were found in abundance under every piece of rotting wood in the lagoon, and were also dredged up in water-weed and detritus from the bottom. They are rather sluggish, and generally remain quiescent when removed from water; after a while they attempt to run away, and can travel quite fast; they are also quite good swimmers.

The subimago, locally known as the 'Penstock Brown,' emerges in hundreds on the Penstock Lagoon, and in smaller numbers on the Shannon Lagoon and Great Lake. The nymph rises far out in deep water, and the subimago emerges almost as soon as the nymph touches the surface of the water. The wings expand immediately, and the subimago floats on the water like a miniature, brown-sailed yacht. It makes no attempt to fly, but is drifted by the wind towards the shore. If the trout are feeding at the time, many fall easy victims to them; but many more reach the shores of the lagoon, where they at once seek shelter under the bark of near-by trees, under logs and rocks, and down near the roots of clumps of sedge or grasses. The time taken for the imago to emerge is from two to two and a half days.

A good way of ensuring emergence of the imago is to put a layer of soft moss, not too moist, in a tin billy, and stand upright in the moss a number of stiff stems of sedges. The subimagoes can be picked up by their wings and dropped into the billy, when they will at once take up positions on the sedge stems and will remain there until the imago emerges. If the lid is kept on, the humidity of the air inside will be just right to ensure the emergence without deformation.

A large number of paratype imagos, subimagos, and nymphs were secured at the same time as the types.

Var. pallida.—A very distinct variety of the subimago was found occasionally at Penstock Lagoon and, later on, more commonly on the Shannon Lagoon. In this the dark parts of the wings are replaced by an almost uniform pale greyish brown, so that the pale portions forming the broken lambda-mark are almost obliterated, and the wings appear very nearly unicolorous. Types of this variety were also taken on 27th January, 1933.

4. *Atalophlebia hudsoni*, sp. nov.

(Plate I, fig. 9; text-figs. 5, 12)

MALE IMAGO: Closely allied to *A. superba*, which it resembles in general size, form, and coloration. Only the male imago is known; it may be distinguished by the presence of a mid-longitudinal fulvous stripe on the mesonotum, by the different shading of the wings, the different shape of the hindwing, and by the colour of the abdomen.

Forewing (Pl. I, fig. 9) intermediate in colouring, and shading between that of *A. superba* and that of *A. australis*; the base is only moderately tinged with fulvous and the bulla only lightly indicated. The venational scheme comes closer to that of *A. australis* than that of *A. superba*. *Hindwing* (text-fig. 5), 3.5 mm. long, similar to that of *A. australis*, but somewhat larger and broader.

Abdomen a medium fulvous with darker markings on the spiracles, two interrupted and rather indistinct dorso-lateral darker bands separating a mid-longitudinal paler area, and paler rings around the ends of the segments.

Genitalia (text-fig. 12) rather closely similar to those of *A. australis*, but the forceps is more markedly narrowed after half-way, with a marked bulge on the inner margin; penis broader, more approaching the shape of that of *A. superba*, but with the lobes more like those of *A. australis*, though without the wide pockets seen in that species; instead, there is a deep cleft running backwards from the incision, very narrow. Cerci very long, 20 mm. or more, medium fulvous in colour; appendix dorsalis completely aborted.

Types.—Holotype male imago and three paratype male imagos, taken at Lake Leake, 26th February, 1933, by Mr. Eric Hudson, of Launceston, to whom this species is dedicated. Holotype and two paratypes in spirit; the third paratype dissected and mounted on slides in Canada Balsam.

I saw no sign of this interesting species when I visited Lake Leake on 9th February, so it is evidently late in emerging. As neither the female imago, nor the subimago nor the nymph, is known, we have to rely for the definition of the species purely on the male imago, which appears to me to be in many ways intermediate between *A. australis* and *A. superba*. In view of the fact that nymphs of *A. superba* have been transferred by anglers from the Penstock Lagoon to Lake Leake, with a view to improving the fishing, there seems to me to be a possibility that this form might be a natural hybrid between the two species, which would not otherwise intermingle, as far as is known, anywhere in Tasmania, *A. australis* being apparently confined to the Macquarie River watershed, and *A. superba* to that of the Great Lake and streams connected with it. But unless proof of this is forthcoming, it is better to consider *A. hudsoni* as a valid species.

5. *Atalophlebia albiterminata*, sp. nov.

(Plate I, figs. 7, 8; text-figs. 6, 13, 18)

MALE IMAGO: Total length of body 9-10 mm.; forewing 10-12 mm. General colour black, the thorax shiny above, with two fine whitish lines running forward on the mesonotum in front of the insertions of the forewings. Forelegs 8-10 mm. long, slender, blackish, the femora touched with brown in two places; tarsal segments in descending order 2, 3, 4, 5, (partly fused with tibia); middle and hind legs mostly medium brown, the femora strongly marked with black just before middle and for the apical one-fourth, the black and brown areas about equal; tibia blackish basally, brown distally; tarsus dark brown, the segments in descending order 5, 4, 3, 2, 1 (fused with tibia).

Wings hyaline, the *forewing* (Plate I, fig. 8) with black venation, the extreme base faintly yellowish, all the cross-veins in costal and subcostal spaces broadly shaded with black, the bulla carrying a large semi-circular blotch covering about two cellules, with a minute black spot forming a second bulla on R_2 ; the posterior margin of the forewing is more curved from MA to CuA than in the previous species and the cross-vein system considerably denser; the costa is narrowly basally and the brace-vein comparatively small. *Hindwing* (text-fig. 6) only 2.5 to 3 mm. in length, more triangular than in the previous species; R_1 tends to become slightly bent or broken, MP is very straight, not dichotomously forked; the cross-vein system fairly complete.

Abdomen black, usually with more or less distinct but very narrow pale transverse rings at end of each segment. *Genitalia* (text-fig. 13) of the general shape of *A. australis*, but with the lobes of the penis much more rounded, the incision between the lobes

short, triangular, the pockets quite separate, deep, and divided by a heart-shaped process on a short stalk. Cerci extremely long, 20-30 mm., stout, black, tipped for 3-5 mm. with white; in dried specimens, the ends of the cerci are usually pale buff or brownish; appendix dorsalis absent.

FEMALE IMAGO generally resembling the male, but with smaller eyes and shorter legs, the body stouter and sometimes very dark brown instead of black, the size usually somewhat larger, forewing 11-13 mm. (A female specimen in my collection from Mount Kosciusko expands 28 mm., and is the largest specimen of the genus *Atalophlebia* known to me.) Tail-filaments three, approximately equal, 12-15 mm., the appendix dorsalis slenderer than the cerci.

SUBIMAGO with the general coloration dark fuscous (dull grey in many dried specimens); forewing (Plate I, fig. 7) pale greyish, with a more finely mottled pattern than in that of any of the previous species, there being a large number of shaded cross-veins, and the terminal veinlets being more numerous and more heavily shaded; very little of the lambda-pattern can be made out, owing to its being broken up by shaded cross-veins; hindwing with all cross-veins shaded, the subcostal series heavily so.

NYMPH: Total length of body 10-13 mm., tail filaments 12-15 mm. General colour either dark brown, dark fuscous, dark grey, or black, according to the colour of the débris in which it is living. Head with two very pale, squarish patches between eyes and lateral ocelli and a pale triangular patch on median ocellus; eyes black; antennae 3 mm., slender, filiform, multi-articulate, pale greyish brown. Mouth-parts closely resembling those of *A. australis* (Tillyard, 1933, pl. ii, figs. 13-18), but with the following slight differences:—labrum with shallow median incision carrying five distinct, flatly rounded processes; mandibles not quite as broad as in *A. australis*, the incisors longer and more pointed, three in the outer group in each mandible, two in the right inner, one large, sharp one in the left inner; tufts of the prostheca somewhat thicker; maxillae with first and second segments of palp subequal; labium with larger laciniae and with second and third segments of palp equal. Thorax almost uniformly dark all over; legs semi-transparent brownish, very strongly particoloured, there being two large dark patches on each femur, one near middle and one occupying the apical fourth, together with an extra basal patch on hind femur; tibia darkened at base and beyond middle, apex pale; tarsus dark from one-fifth to three-fifths from base; tarsal claw with finely denticulate inner margin. Abdomen dark, the segments marked with a variable pattern of pale greyish or brownish, which may best be described by stating that the anterior and posterior margins of each segment are pale, and the dark colour appears to be partially

divided up into three contiguous blocks whose projecting posterior ends are more or less squarish or sometimes rounded off; tail-filaments medium brownish or fuscous, the principal segments marked off by black rings, but each segment is again subdivided into two, three, or four annulations or subsegments, each very short and only indicated by slightly darkened rings; the more basal segments are short, the more distal much longer. Gills (text-fig. 18) pale, greyish, with black tracheae; large, wide, and multi-digitate, with from 7 to 15 slender filaments; the shorter gill is the broader of the two.

Types.—Holotype male imago, allotype female imago, male and female type subimagos and type nymph, all taken on Lake Echo, Tasmania, on 5th February, 1933, by myself, together with a long series of paratypes of both adults and nymphs. Type adults pinned and set, nymphs in spirit; two adult paratypes and two nymphal paratypes dissected and mounted on slides in Canada Balsam.

Habitat.—All over Tasmania and the eastern highlands of Australia, in stagnant or still waters or in backwaters of rivers.

This species is geminate to *A. costalis* Burm., found along the coastline of Eastern Australia (Queensland and N.S.W.), and has closely similar habits. These are the only two species known to me whose nymphs can exist in absolutely stagnant water and appear to prefer it to any other location. The nymphs are usually dredged up with the bottom mud or débris, but are sometimes found in masses of tangled water-weed, or under logs, stones, or rocks in stagnant backwaters; they do not occur where the current is moving at all. The mottled coloration of the legs appears to be 'camouflage'; the multiplication of gill-filaments appears to be correlated with the added difficulty of breathing in stagnant water.

It should be here noted, in passing, that the figure given by me as that of the nymph of *A. costalis* Burm. (Tillyard, 1926, p. 60, fig. E3) is not that of this species, but belongs to a large, undescribed species; the larva of *A. costalis* resembles that of *A. albitrminata* fairly closely and has somewhat similar gills.

As regards the adults, the males may be seen commonly in quiet backwaters, particularly in dull weather or late in the afternoon, performing their graceful evolutions over the water. The flight of the male consists of a long, swinging pendulum motion, usually performed quite close to the water, with the long tail-filaments held out fairly wide apart behind, their white tips being plainly visible. It is seldom that one sees more than six or seven of these insects flying together, often only one or two. They are easily alarmed, and disappear with startling suddenness, apparently becoming suddenly invisible when they swerve away from their swinging flight. The subimagoes may often be seen sitting on the stems of reeds, especially during dull or stormy weather, and can then be

easily collected by picking them off with the hand; if the same is attempted with the imago, it usually drops from the reed-stem with a quick motion. The subimagos of this species in Tasmania have the wings more definitely and beautifully mottled than those of the mainland, but there do not appear to be any other differences.

6. *Atalophlebia ida*, sp. nov.

(Plate I, fig. 10; text-fig. 7.)

FEMALE IMAGO: Total length of body 8-10 mm., forewing 12 mm., cerci about 12 mm. *General coloration* strongly mottled in brown and black. Head (shrivelled) black with bright brown markings. Thorax rich brown shading to black; legs medium brown, with femora black just beyond halfway and also at apex; tarsal segments in descending order, 2 = 3, 4 = 5 (1 fused with tibia).

Forewing (Pl. I, fig. 10) with rather delicate hyaline membrane, dark brown veins, heavily spotted with black; all the costal veinlets and cross-veins in the subcostal space are surrounded by wide oval or rounded black patches, as are also the fewer cross-veins just below R_1 , most of those between R_s and MA basally and also between MA and MP. Around the bulla there is a large irregular black patch covering the width of two cellules, and a somewhat similar large patch covers the cross-veins around the fork of MA. Cross-vein system, on the whole, rather open; the wing distinctly narrower than in the preceding four species, with less prominent tornus. *Hindwing* (text-fig. 7) small, barely 2 mm. long, veins delicate, brownish; shape rather elongate oval, the costal hump very pronounced, and followed by a minute notch; costal space comparatively narrow basally and devoid of veinlets; about nine costal veinlets placed distally, three being close together below the notch; subcostal space wide, with complete series of cross-veins, about seven in number; very few cross-veins in posterior portion of wing.

Abdomen mottled in brown and black; in lateral view, the abdomen appears at first sight as if ringed with black on each segment; but, seen more closely, each segment carries a black mark shaped somewhat like a capital R, the loop being small and the lower stroke lengthened. *Tail-filaments* three, subequal, blackish, narrowly ringed with pale brown at end of each segment. Subgenital plate entire, projecting slightly in middle. Subanal plate prominent, projecting beyond end of abdomen, deeply bifid, the two projecting halves pointed, curving inwards distally, and separated by a deep oval cleft.

MALE SUBIMAGO closely resembling the imago, but with the wings pale opaque greyish; forewing with the spots along the costal and subcostal spaces blackish, but the rest of the mottling only medium grey; tail-filaments three, about 15 mm. long, greyish.

NYMPH unknown.

Types.—Holotype female imago, taken at Dee Bridge, between Lakes Echo and St. Clair, Tasmania, on 7th February, 1933, by myself, together with five paratype female imagoes. Type male subimago taken by myself on Lake St. Clair, 6th February, 1933. All pinned and set except one paratype, which was dissected and mounted on slides in Canada Balsam.

The specific name is taken from Mount Ida, near Lake St. Clair.

Habitat.—Upper reaches of River Dee; also Lake St. Clair, Lakes Lilla and Dove (Cradle Mountain, N.W. Tasmania). The insect was first seen by me on 6th February, drifting far out over Lake St. Clair; several were captured from a boat by striking them down into the water with a net; these were all subimagos, and were mostly badly damaged. The following day the type series was secured by beating bushes overhanging the stream at Dee Bridge; but no male imagos could be found. The specimens from Cradle Mount are considerably smaller (forewing 10 mm.) and less spotted,

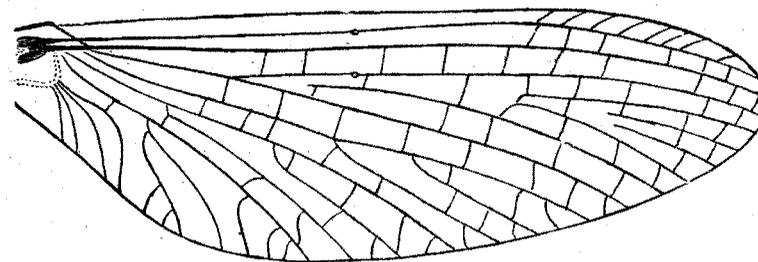


Fig. 21.—*Atalophlebia brunnea* n. sp. Forewing. Length 6 mm.

the patch covering the fork of MA being reduced to a very small size or even to a point, while the rest of the spots on the forewing more closely resemble those of the male subimago described above. The Cradle Mountain series consists of four male and one female imago taken by me in January, 1917; but I prefer to await the discovery of a male imago from the type locality before describing it.

7. *Atalophlebia brunnea*, sp. nov.

(Text-figs. 8, 14, 21)

MALE IMAGO: Total length of body 6 mm.; forewing 6 mm.; cerci 10-11 mm. General colour brown.

Head dark brown; eyes subdivided into two portions, the larger and upper being pinkish brown, the smaller and lower dark grey; antennae pale; ocelli transparent, whitish, the lateral ones swollen, hemispherical globes on dark brown bases.

Thorax dark brown above, a faint indication of a pair of darker longitudinal stripes on mesonotum. Legs medium brown, knee-joints and ends of tibiae slightly darkened; forelegs 5 mm. long, tarsal segments in descending order of size 2, 3, 4, 5, 1 (partly fused with tibia); middle and hind legs much shorter, tarsal segments in descending order 5, 2, 3 = 4 (1 fused with tibia).

Forewing (text-fig. 21) hyaline with semi-transparent brownish venation, C, Sc, and R₁ darker than the other veins, especially in region of the pterostigma, which is also faintly tinted with brown on the membrane; costal veinlets absent except for a series of about eight in the pterostigma; subcostal cross-veins also absent from base to beyond halfway; rest of venation moderately open; basal portion of anal area with very faint veins; posterior margin before tornus very slightly concave. *Hindwing* (text-fig. 8) very small, 1.1 mm., costa stout, meeting Sc at about three-fifths; costal space without veinlets except for three short ones beyond the hump; four subcostal cross-veins, of which the last two continue the lines of the last two costal veinlets downwards; two cross-veins below R₁ and one below MA, but no other cross-veins in the wing.

Abdomen pale, semi-transparent brown from base to end of seg. 7; seg. 8 medium brown, 9-10 darker brown; sutures between most of the segments pale, a black spot on each stigma. Genitalia (text-fig. 14) pale buff, with three-segmented forceps, the first segment long, the other two small and globular; penis with slightly diverging lobes separated by a deep semi-circular embayment; each lobe irregularly truncated. Tail-filaments three, equal, pale buff, slightly darker at bases.

FEMALE IMAGO, SUBIMAGO, and NYMPH unknown.

Types.—Holotype male imago and two paratype male imagines, all taken at Clarendon, Northern Tasmania, on the South Esk River, by Mr. Eric Scott, of Launceston, on 9th March, 1933. Holotype and all except tip of abdomen of one paratype in spirit; the other paratype and the cut-off tip of abdomen dissected and mounted on slides in Canada Balsam.

A similar but considerably larger insect was bred by me from a nymph taken in the Shannon River, near the Great Lake, in February, 1933. I also have two specimens rather closely similar to the holotype, taken at Hobart and Mount Wellington respectively in 1917, but these have a faint series of costal veinlets before the pterostigma. Pending the discovery of more abundant material, it seems wise to leave these undescribed.

8. *Atalophlebia fuscula*, sp. nov.

(Text-figs. 9, 15, 19, 22)

MALE IMAGO: Total length of body 7.8 mm.; forewing 7.8 mm.; tail-filaments 10 mm. General colour black.

Head black.

Thorax black: Legs chiefly black, but hind femora mostly dark brown, tending to black at apex; forelegs 6.5 mm., tarsal segments in descending order 2 = 3 = 4 (all fairly long), 5, 1 (partly fused with tibia); middle and hind legs rather long, tarsal segments in descending order 5, 1 = 2 = 3 = 4 (1 fused with tibia).

Wings hyaline, with dark brown venation, rich russet brown at bases of C, Sc, and R of forewing together with brace-vein. *Forewing* (text-fig. 22) with slight fuscous tinting of membrane at pterostigma; costal series of veinlets complete, but very weakly chitinized and widely spaced before pterostigma, there being only about six such veinlets, with about ten much more strongly chitinized and closely spaced in pterostigma; subcostal cross-veins slightly more numerous in basal half, but fewer beneath pterostigma. There are three bullae, in the form of minute circular clear areas in slight swellings of the main veins, as follows: anterior bulla on Sc at about three-sevenths

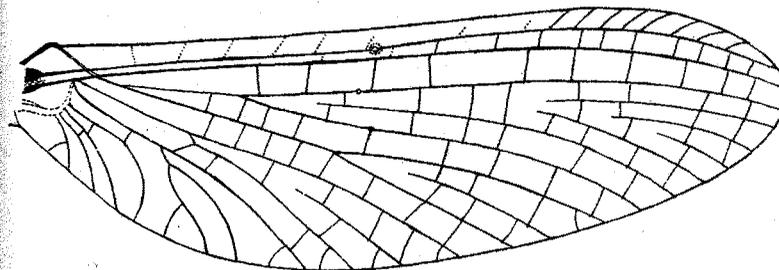


Fig. 22.—*Atalophlebia fuscula* n. sp. Forewing. Length 8 mm.

from base; middle bulla on R₁, slightly basad from level of anterior bulla; posterior bulla on R₁ . . . at junction of cross-vein descending on to fork of MA or close to it, i.e., either at level of anterior bulla or of middle bulla. The anterior bulla usually has slight clouding around it, but the others resemble tiny knots in the veins, with clear holes (membrane) in the middle. Anal veins pale. *Hindwing* (text-fig. 9) 1.6 mm., somewhat larger than that of *A. brunnea*, the apex more pointed, the hump somewhat more prominent, the narrow distal portion of the costal space longer, with four veinlets; no veinlets in basal portion of costal space; four long cross-veins in the wide subcostal space, three in the radial, one connecting fork of R₁ with MA and one below MA.

Abdomen black, marked with a pattern of dark brown, of which the areas decrease in size from seg. 2 to end of abdomen; segs. 2-4 with approximately the basal half dark brown, then the amount of brown decreases until on seg. 8 it is only a narrow basal ring;

segs. 9-10 black, 10 rather large; underside brown. Genitalia (text-fig. 15) with the forceps three-segmented, the first segment very long, narrowed about halfway by a marked inbending of the inner margin; the second segment distinctly longer than the third, sub-cylindrical, the third globular. Penis turned upwards, its lobes separate, cylindrical, irregularly truncated at apex, which is divided into two blunt lobes, with a third lobe arising on the inner side and not reaching the level of the apex; this inner lobe carries a small, blunt triangular tooth. Tail-filaments three, subequal, about 10 mm long, dark fuscous; very easily broken off.

FEMALE IMAGO closely similar to male, but usually somewhat larger and with stouter abdomen; legs rather long, but forelegs not quite as long as in male. *Forewing* 8 mm.; *hindwing* somewhat larger than in male, with more numerous cross-veins in the posterior portion, there being usually three or four below MA.

SUBIMAGO generally similar to imago, except that the black coloration is much duller; *wings* a medium opaque slate-grey in the pinned specimen, but appearing almost black in the living insect at rest.

NYPH: Total length of body 7-8 mm.; tail-filaments 10 mm. General colour blackish above, yellowish buff beneath. *Head* blackish tending to dark brown on occiput; eyes grey-black; antennae pale greyish; three pale yellowish or whitish spots cover the ocelli. Mouth-parts differ from those of *A. australis* as follows:—labrum very slightly incised in the middle of the outer margin; mandibles with the incisors much slenderer, ending in two to three teeth in each group, the right mandible with the projecting area far separated from the molar area and ending in a hardened black tubercle; maxillae comparatively short and broad, the inner lobe very wide and not as square in shape as in *A. australis*, the palp comparatively short, the first segment rather broad and almost as long as the second and third taken together, the second cylindrical, the third slightly longer, pointed, with a brush of apical hairs; labium with galea less broad than in *A. australis*, laciniae very small and rounded, palps with the first segment longest and broadest, the other two subequal. *Thorax* dark brown above, mesonotum with two pale yellowish-brown marks above apex, apex itself tipped with blackish; wing-sheaths dark brown (black before emergence); legs somewhat hairy, medium brown, semi-transparent, femora with a dark line along dorsal ridge, longer than tibia, apex fuscous; tibia slender, three-fourths the length of femur; tarsus one-third as long as tibia; tarsal claw small, very strongly denticulate. *Abdomen* rather elongate, tapering from base to anal end, black above, with a mid-longitudinal row of pale yellowish-brown markings, triangular on the more basal segments, but becoming broader and more distinct posteriorly, until on seg. 10 the brown colour covers all but the

posterior margin of the segment; seg. 10 with three posterior angles, one at its apex and two postero-lateral; there are also faint indications of a smaller series of brown spots along the sides, one pair on each segment, increasing in size posteriorly; lateral flanges small, hooked posteriorly, semi-transparent yellowish-brown, touched with black at the gill-insertions; underside dull yellowish. *Gills* (text-fig. 19) double, seven pairs, on segs. 1-7, increasing in size from 1 to 4, then decreasing to 7; each lamella is narrowly lanceolate and ends in a long, slender filament; colour pale, semi-transparent brownish, with stout blackish tracheal trunk and short, stumpy lateral tracheal twigs.

Types.—Holotype male imago, allotype female imago, type male and female subimagos and type nymph, also long series of paratypes of both adults and nymphs, taken by myself on the River Shannon, Tasmania, near the bridge on the road leading from the Great Lake to the Penstock Lagoon, on 27th January, 1933.

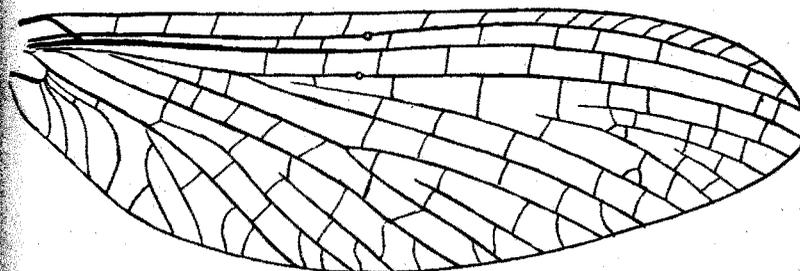


Fig. 23.—*Atalophlebia delicatula* n. sp. Forewing. Length 6 mm.

Habitat.—Fast-running streams in many parts of Tasmania and the highlands of Eastern Australia, including Mount Kosciuszko up to about 5000 feet. The imagos may be seen flying in the air in considerable numbers with a typical 'spinning' flight; the subimagos sit about on bushes, reed-stems, &c., and are very conspicuous; they can also be found in numbers hiding on the undersides of large rocks, &c. The nymphs are very active, and cling to the undersurface of rocks in a fast current; when disturbed, they run with great agility.

9. *Atalophlebia delicatula*, sp. nov.

(Text-figs. 10, 16, 23)

MALE IMAGO: Total length of body 5 mm.; forewing 6 mm.; tail-filaments 9 mm. *General colour* blackish.

Head black; eyes large, globular, black; antennae very short, dark brown.

Thorax black; legs long, dark brown, the apices of femora and tibiae blackish; forelegs 5 mm., tibia slightly longer than femur, very slender; tarsal segments in descending order 2, 3, 4, 5, 1 (partly fused with tibia); middle and hind legs fairly long, tarsal segments in descending order 5, 1 (fused with tibia), 2, 3, 4.

Wings hyaline, with delicate, dark brown to blackish venation. *Forewing* (text-fig. 23) 6 mm., brace-vein and bases of C, Sc, and R₁ russet brown; at first sight there are apparently no veinlets in the costal or subcostal spaces until the region of the pterostigma, but, under careful lighting, a few pale, semi-transparent veinlets can be made out (more easily in the female), some of which may be incomplete; about six well-developed slanting veinlets in the pterostigma, with four or five more widely spaced in the subcostal space beneath; there are only two bullae, the anterior just short of midway along Sc, and a second, slightly basad from this level, on R₂; each bulla is a small circular hollow in the vein, with hyaline centre; anal veins pale, anal margin slightly thickened. *Hindwing* (text-fig. 10) 1.2 mm., costal hump rather inconspicuous, not very wide basally, with only two veinlets, both in the short, narrowed distal end of costal space; subcostal space wide, with three cross-veins; bases of R_s and MA missing; one supporting cross-vein above R_s, two above MA, and one below; no cross-veins in posterior half; general shape well rounded.

Abdomen grey-black, with a pattern of greyish markings, only clear on the middle segments, each of which has a pair of pale longitudinal curved lines separating a median dark stripe. Genitalia (text-fig. 16) with the forceps three-segmented, the first segment long, stout basally, tapering strongly distally, the other two segments short, subequal, oval; penis small, its lobes separated by a deep cleft, each lobe stout, irregularly truncated, with three terminal rounded embossments and a larger rounded process projecting slightly inwards not far from apex. Tail-filaments three, subequal, grey, the segments ringed apically with black.

FEMALE IMAGO closely resembling the male, but generally slightly larger, body stouter, forelegs somewhat shorter; forewings usually with a few more pterostigmatic veinlets; subgenital plate entire, subanal plate apparently strongly projecting, slightly truncate at tip and hollowed out.

SUBIMAGOS resemble the imagos, except that the body coloration is a dull greyish black and the wings are slightly opaque pale fuscous, with the cross-veins narrowly shaded in darker fuscous, so as to produce an appearance of mottling, most noticeable in the living insect when at rest.

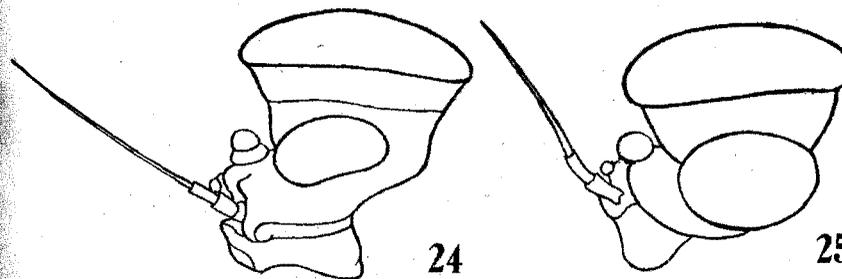
NYPH unknown.

Types.—Holotype male imago, allotype female imago, type male and female subimagos, also two male paratype imagos and three paratype subimagos, all taken by myself on the North Esk River, near Perth, Tasmania, on 21st January, 1933. All pinned and set.

Habitat.—Northern Tasmania, in moderately flowing rivers. North Esk and Macquarie Rivers. Probably common if searched for.

Family BAETIDAE

In this family the species are all of rather small size, the forewings being from 4 to at most 12 mm. in length. The hindwings are either absent or excessively small, with very little venation. The most outstanding character in the family is the development of the compound eyes in the males; these are divided into two quite distinct parts, a lower and outer normally oval or rounded part, usually darkly pigmented, and a huge upper and inner portion, raised on a broad pedestal, and known as a 'turban eye' from its marked resemblance to a turban; this part of the eye is usually pale in colour. (See text-figs. 24, 25.)



Figs. 24-25.—Turban-eyes in the males of Baëtidae:
24. Lateral view of head of *Baëtis frater* n. sp. (× 50).
25. Lateral view of head of *Cloëon tasmaniae* n. sp. (× 50).

In the forewing, the cross-vein system is usually (but not always) greatly reduced; the anal system of veins is reduced in correlation with the great reduction or total loss of the hindwing, while, at the same time, the anal area is somewhat broadened and the anal border more or less well rounded. The middle branches of all triads (interpolated veins) are disconnected at their inner ends, except, in some cases, IR_m and ICuA; MA₁ and MP₁ are also usually similarly disconnected. Along the whole of the posterior margin, from CuP to apex, there is developed a complete series of short, marginal veinlets, in between the branches of the main veins; these may be single (*Cloëon*), or in sets of two or three.

Of the three caudal setae, the middle one (appendix dorsalis) is aborted; the other two (cerci) are usually much longer than the body.

Two cosmopolitan genera are represented in Tasmania, and may be distinguished as follows:—

Hindwing present, exceedingly small; forewing with the marginal veinlets in sets of two or more	Genus <i>Baëtis</i> Leach.
Hindwing absent; forewing with the marginal veinlets single	Genus <i>Cloëon</i> Leach.

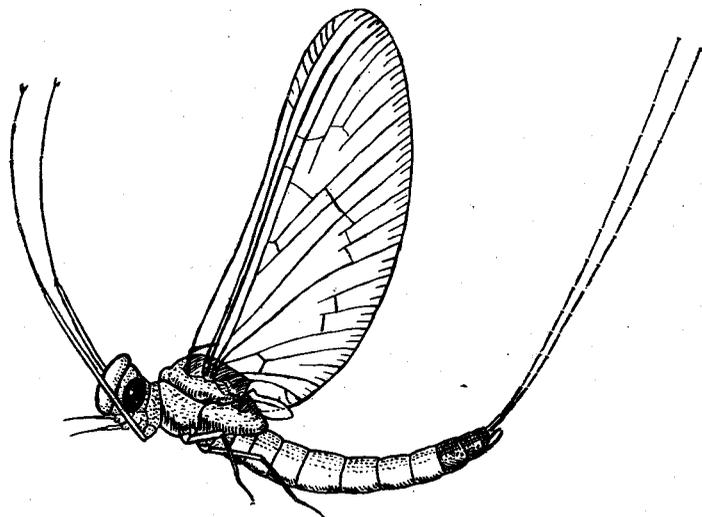


Fig. 26.—*Baëtis frater* n. sp. Male. Complete insect, lateral view, with tail-filaments cut short. ($\times 11$.)

Genus **Baëtis** Leach.

10. *Baëtis frater*, sp. nov.

(Text-figs. 20, 24, 26-28)

MALE IMAGO, Subimago, and Female Imago unknown: Length of body, 4.5 mm.; forewing 4.5 mm.; hindwing 0.6 mm.

Head dark brown; antennae brown; compound eyes dark fuscous, the turban-eyes pale buff; ocelli transparent.

Thorax dark brown. Legs whitish; forelegs 4 mm. long, very slender, tibia twice as long as femur, tarsus one and a half times as long as tibia; segments of tarsus, in descending order of length, 2, 3, 4 = 5, 1; middle and hind legs short, the tarsus only four-segmented, the segments in descending order of length being 1, 2 = 4, 3.

Forewing (text-fig. 26) 4.5 mm. long by 1.6 mm. wide, hyaline with white veins and slightly opaque, cream-coloured pterostigma. Venation as in text-fig. 26; from seven to nine pterostigmatic veinlets, irregularly placed, the first two or three very faint; two

cross-veins between R_1 and R_2 ; and two below R_2 basal ends of R_{5a} and IR_{3a} connected with main veins above and below; a cross-vein joining IR_{3a} to MA_1 across R_1 ; faint cross-veins below basal ends of IMA , MA_2 , IMP and MP_2 ; $ICuA$ connected basally with CuA and CuP . Marginal veinlets in sets of two. **Hindwing** (text-fig. 27) excessively reduced, 0.6 mm. long, with a strong costal knob or hump, one fairly strong vein (R_1) and four very weak veins.

Abdomen slender, segments 1-6 lightly chitinized, pale, whitish, a tinge of pale brown on tergites; segments 7-10 much more heavily chitinized, dark brown. Genitalia with the limbs of the forceps four-segmented; the basal segment short and broad, the second and third not very clearly separated, slender and much longer, the fourth small, narrow pyriform. Penis retracted, its lobes broad, flattened, rather bluntly pointed. **Cerci** 3 to 4 mm. very slender, with about 50 cylindrical segments, mostly 5 to 6 times as long as wide.

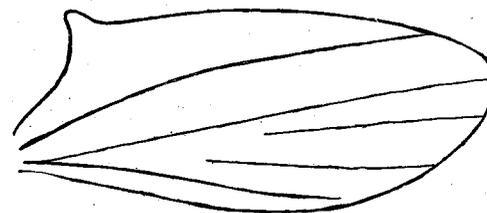


Fig. 27.—*Baëtis frater* n. sp. Hindwing. ($\times 100$.)

NYMPH (text-fig. 28): Length of body 6 to 7 mm.; cerci 3 to 4 mm., antennae 3 mm., pale buff, with more than 30 segments; appendix dorsalis slightly shorter. General colour a medium brown, the head somewhat darker, the eyes dark-grey; mouth-parts and legs pale buff; last segment of abdomen and tail-filaments pale buff; gills semi-transparent tinged with buff. There is a slight pattern dorsally on the thorax, consisting of a pale mid-longitudinal line, bordered on each side by a narrow stripe of dark brown, which is joined posteriorly by a more laterally placed, oblique, broader dark stripe on each side. The extreme base of each abdominal segment is narrowly ringed in pale buff. The mouth-parts, femora, tibiae, and tarsi are touched distally with fuscous. Viewed laterally, the abdominal tergites are dark brown, the sternites pale buff. Legs short, with rather stout femora, slender tibiae somewhat shorter than femora, tarsi about same width as tibiae but shorter. Gills (text-fig. 20) seven pairs, on abdominal segments 1-7, the first pair very small, the third and fourth pairs largest, those of segs. 6 and 7 much smaller than 5; each consists of a single oval lamina, of which the outer (anterior) margin is fairly straight, the inner well rounded; each carries a single tracheal trunk, situated

somewhat closer to the anterior than to the posterior margin; the anterior and basal parts of the lamella are of tougher consistency than the inner and distal, and are darkened with a fine brownish granulation; both anterior and inner margins are somewhat thickened, especially the former. The cerci are narrowly fringed on the inner side only, the appendix dorsalis is similarly fringed on both sides.

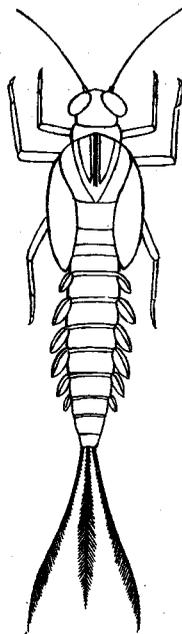


Fig. 28.—*Baëtis frater* n. sp. Full-grown nymph (male). Length, excluding tail-filaments, 6 mm.

Types.—Holotype male imago and type nymph, both taken together by myself on a small creek near Weldborough, North-Eastern Tasmania, together with numerous paratypes of male imagos and nymphs. All in spirit. The adults were flying in small groups a yard or two above the water; the nymphs rested on the sandy or gravelly bed of a fairly fast-running creek.

This species appears to be rather closely related to *B. soror* Ulm, from Western Australia, but can be at once distinguished from it by its smaller size, pale abdominal segments 1-7, and pale costa and subcosta without any darkening of the costal and subcostal spaces. In the venation, *B. soror* has a much more extensive series of costal veinlets occupying the whole of the distal half of the costal space, and the marginal veinlets are single along the basal half or

more of the posterior margin, then double to apex. The hindwing in *B. soror* has the costal projection ending in a sharp angle, not in a rounded hump as in the new species. Also the cerci in *B. soror* are faintly ringed with dark at the end of each segment.

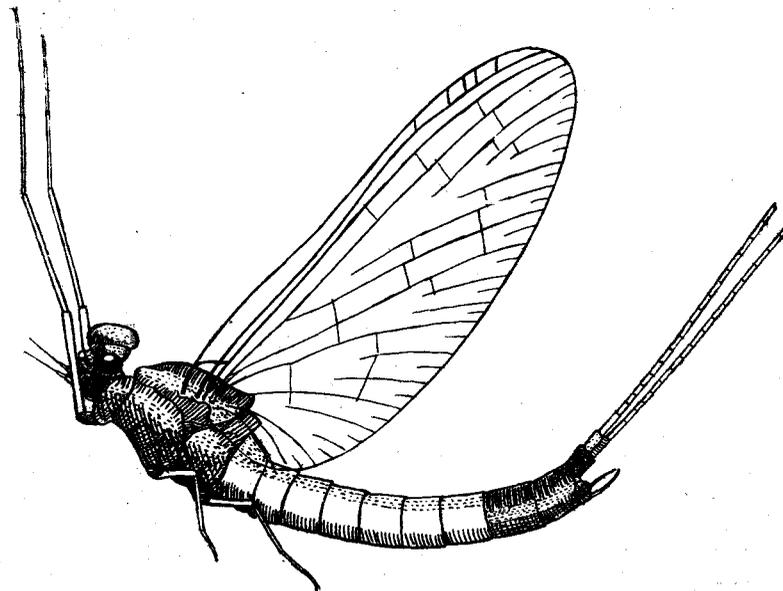


Fig. 29.—*Cloëon tasmaniae* n. sp. Male. Complete insect, lateral view, with tail-filaments cut short. ($\times 11$.)

Genus *Cloëon* Leach.

11. *Cloëon tasmaniae*, sp. nov.

(Text-figs. 29, 30)

MALE IMAGO (text-fig. 29): Length of body 7 mm., forewing 6 mm., cerci 12 mm., foreleg 5.2 mm.

Head pale brown; antennae whitish; compound eyes dark fuscous, the turban-eyes pale buff tinged with pink.

Thorax medium brown, paler beneath. Legs whitish; foreleg with femur about 1.2 mm. long, not very stout, tibia 1.6 mm., slender, tarsus 2.2 mm., the segments in descending order of length being 2, 3, 4, 5, 1; middle and hind legs short, segs. 1 and 2 fused together; in descending order the lengths of the segments are 1 + 2, 3 = 5, 4.

Forewing (text-fig. 29) 6 mm. long by 2.4 mm. wide, hyaline (except for the costal and subcostal areas, which are opaque) pale cream-coloured, deepest on pterostigma; veins very pale buff, except R_1 , which is whitish except at its distal end. Pterostigma with about five veinlets well spaced apart. Branches of main veins all disconnected basally, but supported by a number of cross-veins arranged as shown in text-fig. 29. Marginal veinlets single. *Hind-wing* absent.

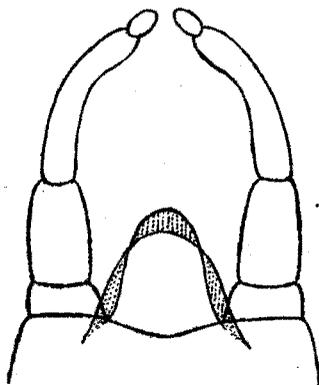


Fig. 30.—*Cloëon tasmaniae* n. sp. Male genitalia, dorsal view. ($\times 100$.)

Abdomen pale yellowish brown darkening to medium brown on segs. 7-10; no definite pattern. Genitalia (text-fig. 30) whitish, the limbs of the forceps four-segmented, the first segment short and stout, the second somewhat longer, fairly stout, the third slenderer, thrice as long as the first, the fourth a minute knob; penis a pair of minute projecting lobes, barely visible. Cerci extremely long and slender, 12.5 mm., with more than forty segments, whitish, the joints slightly darkened; appendix dorsalis vestigial.

FEMALE IMAGO generally of same size as male, but differing in its slightly darker coloration, the head and thorax being somewhat darker brown; no turban eyes present; cerci and forelegs shorter.

SUBIMAGO (both sexes) similar to imago in general form and size, but with general body-colouring pale creamy buff; compound eyes fuscous, ringed with creamy white; turban-eyes of male smaller than in imago, cream-coloured. Wings with the membrane slightly opaque, milky white, the veins whitish.

NYPH unknown.

Types.—Holotype male imago and allotype female imago from the Macquarie River, Stewarton, Tasmania, 8th February, 1933, taken by Mr. Eric Scott; type subimagos, male and female, from

same locality, 5th March, 1933, taken by Mr. B. Plomley. Also a series of paratypes, three male imagoes, and eight subimagoes.

This interesting species of a cosmopolitan genus is the first purely Australian species of the genus *Cloëon* to be described, the other being *C. viridis* Klap., found in Java, Sumatra, and North-Western Australia. A species closely allied to *C. tasmaniae* n. sp. is known to occur also in the mountains of Eastern Australia, but has not yet been described. *C. tasmaniae* n. sp. agrees with all the Indo-Malayan species in having the costal and subcostal areas of the forewing distinguished from the rest of the wing by special coloration, but not so markedly, for instance, as in *C. viridis* Klap. or in *C. samoëense* Till. The creamy-buff subimagoes are very striking.

Family CAENIDAE

(*Brachycercidae* Lestage)

It should be noted that Lestage has changed the spelling of *Caenis* Leach to *Coenis*, and, later, has suppressed this name as a synonym of *Brachycercus* Curtis, at the same time changing the well-established family name to *Brachycercidae*. As no other authors have followed him in these alterations, I propose to keep to the name *Caenis*, pending a full investigation of the problems of nomenclature involved.

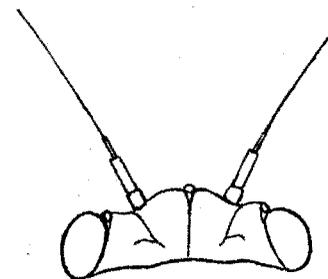


Fig. 31.—*Caenis scotti* n. sp. Head, dorsal view. ($\times 67$.)

In this family the species are all of small to very small size, some being the smallest known Mayflies, the forewing of one species being only 2 mm. long. The hindwings are absent in almost all cases. The family can be at once distinguished from the Baëtidae by the form of the compound eyes (text-fig. 31), which are button-like and placed wide apart in both sexes. The anal area of the forewing is expanded and well rounded, usually even more so than in the Baëtidae, and there is usually only a single

anal vein, more rarely two. The branches of the main veins, including the middle members of triads, are either all or mostly complete basally; the cross-vein system is greatly reduced (almost entirely absent in *Caenis* itself). The nymphs (not yet discovered in Tasmania) have shorter and somewhat stouter bodies than the nymphs of Baëtidae, and can be distinguished at once by the fact that the gills of the second segment of the abdomen form a pair of stiff gill-covers or opercula, completely protecting the succeeding pairs of gills on segments 3 to 6. The caudal filaments are stiff, filiform, hairy, but not fringed as in Baëtidae.

The two Tasmanian genera may be distinguished as follows:--

Wings not exceptionally broad; ratio of length to breadth approximately 3 : 1	Genus <i>Tasmanocoenis</i> Lestage
Wings exceptionally broad near base; ratio of length to breadth 2 : 1 or even less	Genus <i>Caenis</i> Leach

Genus *Tasmanocoenis* Lestage

This genus has the wings only slightly dilated in the anal region; A_1 stands well apart from CuP basally, but the latter vein curves distally towards it again; A_1 itself is slightly sigmoid. Lestage gives no figures, so it is difficult to picture what the insect is like.

Genotype.—*Tasmanocoenis tonnoiri* Lestage.

12. *Tasmanocoenis tonnoiri* Lestage

This small Mayfly, with a forewing 5 mm. long, was described from a single male imago taken by Mr. A. L. Tonnoir at Geeveston, Tasmania, on 7th December, 1922. The type is in Brussels.

Genus *Caenis* Leach.

13. *Caenis scotti*, sp. nov.

(Text-figs. 31-33.)

MALE IMAGO: Length of body 3.4 mm.; forewing 3.4 mm.; foreleg 2.6 mm.; caudal filaments about 9 mm.

Head short, wide, more than thrice as wide as long; compound eyes black, placed laterally, almost as long as the head itself; median ocellus small, on a slight median prominence in front; lateral ocelli also small and contiguous with the inner margin of the compound eyes; antennae pale brownish, about as long as the head is wide, the scape short and stout, the pedicel about twice as long, fairly stout, the first distale stiff, slender, about half as long as the pedicel, the remainder of the antenna consisting of an extremely delicate, transparent filament.

Thorax extremely large and stout, heavily chitinized, dark brown to blackish. Prothorax short, not quite as wide as head; ventrally it carries an inverted V-shaped mark, edged posteriorly with a black line. Mesothorax immense, occupying almost the whole of the thorax; metathorax very short, attached closely to mesothorax behind; sternites pale. Legs pale brownish; forelegs 2.6 mm., femur rather short, tibia and tarsus each about thrice as long as femur; lengths of tarsal segments in descending order 2, 3, 4, 5, 1; middle and hind legs much shorter, tarsal segments in descending order of length 1, 5, 2, 3 = 4; tarsal claws alike in foreleg, both globular, unlike in middle and hind legs, one blunt and one sharp.

Forewing (text-fig. 32) 3.4 mm. long by 1.8 mm. wide; completely hyaline, except for pterostigma, which is milky; veins white, except

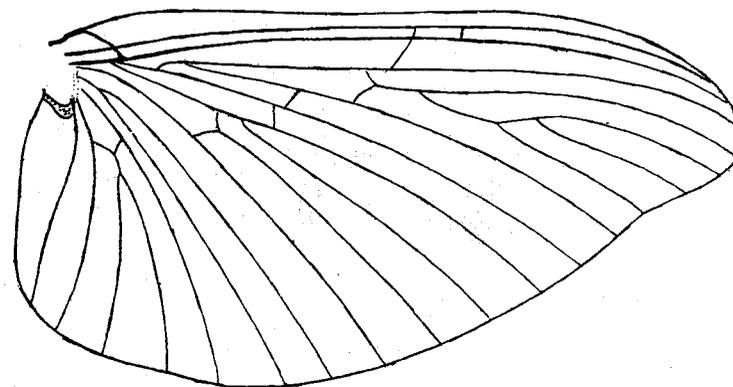


Fig. 32.—*Caenis scotti* n. sp. Forewing. Length 3.9 mm.

Sc and R_1 , which are dark purplish to pterostigma. Venation typical for the genus (text-fig. 32); all the branches of the main veins complete basally; IR_2 attached basally both above and below; R_2 arising from IR_2 ; IMA arising from MA_1 , IMP from MP_2 . Two short subcostal cross-veins are present near middle of Sc; the first of these is continued obliquely backwards and downwards to R_3 ; about one-third from base, there is a cross-vein between IR_2 and R_{4+5} , and another joining MA_2 near its origin to MP_1 ; still closer to base, the posterior fork of CuA is joined by a cross-vein to CuP. CuP and A_1 between them isolate a narrow, bottle-shaped area with bent neck. *Hindwings* absent.

Abdomen short, stout basally, tapering from segment 1 to 4, then cylindrical to 9; 10 narrower, closely attached to 9. Colour pale to medium brown, segs. 8-10 much darker. Genitalia as in

text-fig. 33, the limbs of the forceps with only a single segment, curved, sharply pointed, calliper-like; the penis with its two lobes fused to form a projecting, broadly rounded organ, flattened dorso-ventrally, dark brown basally, transparent distally and along both sides. Caudal filaments three, about equal, 9 mm. long, with about 40 long, slender cylindrical segments, followed at the extreme tips by a few very short, partly fused segments carrying long hairs.

FEMALE IMAGO, SUBIMAGO (both sexes), and NYMPH unknown.

Types.—Holotype male imago and series of six paratype male imagoes taken on the South Esk River at Clarendon, Tasmania, on 9th March, 1933, by Mr. Eric Scott, to whom the species is dedicated. Holotype mounted whole on slide in Canada Balsam; one paratype dissected and similarly mounted, the other five in spirit.

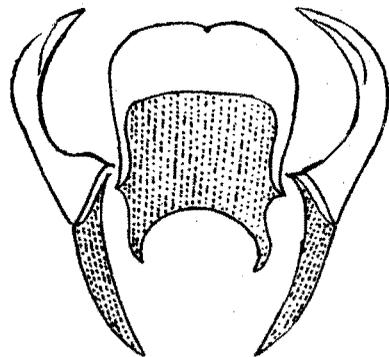


Fig. 33.—*Caenis scotti* n. sp. Male genitalia. ($\times 100$.)

A very striking and distinctive species, easily recognized by the purple coloration of Sc and R_1 in forewing combined with the milk-white pterostigma, and by the tuft of long hairs at the end of each caudal filament. There is a similarly coloured, but much smaller, species in the mountains of Eastern Australia, not yet described.

SUMMARY

The paper forms Part II. of the 'Trout-food Insects of Tasmania,' and is intended to be read with Part I., in which *Atalophlebia australis* (Walker), the long-lost genotype of the genus *Atalophlebia*, was fully discussed and described. Part II. is a Monograph of the Mayflies of Tasmania, as far as at present known. A total of thirteen species is listed, of which no less than eight belong to the genus *Atalophlebia*. There are only four families represented, as follows:—Siphonuridae (*Tasmanophlebia*, one species, previously

known); Leptophlebiidae (eight species, all belonging to *Atalophlebia*, one known previously, seven new); Baëtidae *Baëtis*, one species, and *Cloëon*, one species, both new); Caenidae (*Tasmanocoenis*, one species, previously known, and *Caenis*, one species, new). The nymphs of seven of the species are known. The paper is illustrated with a plate showing ten forewings (imagoes and subimagoes), together with thirty-three text-figures.

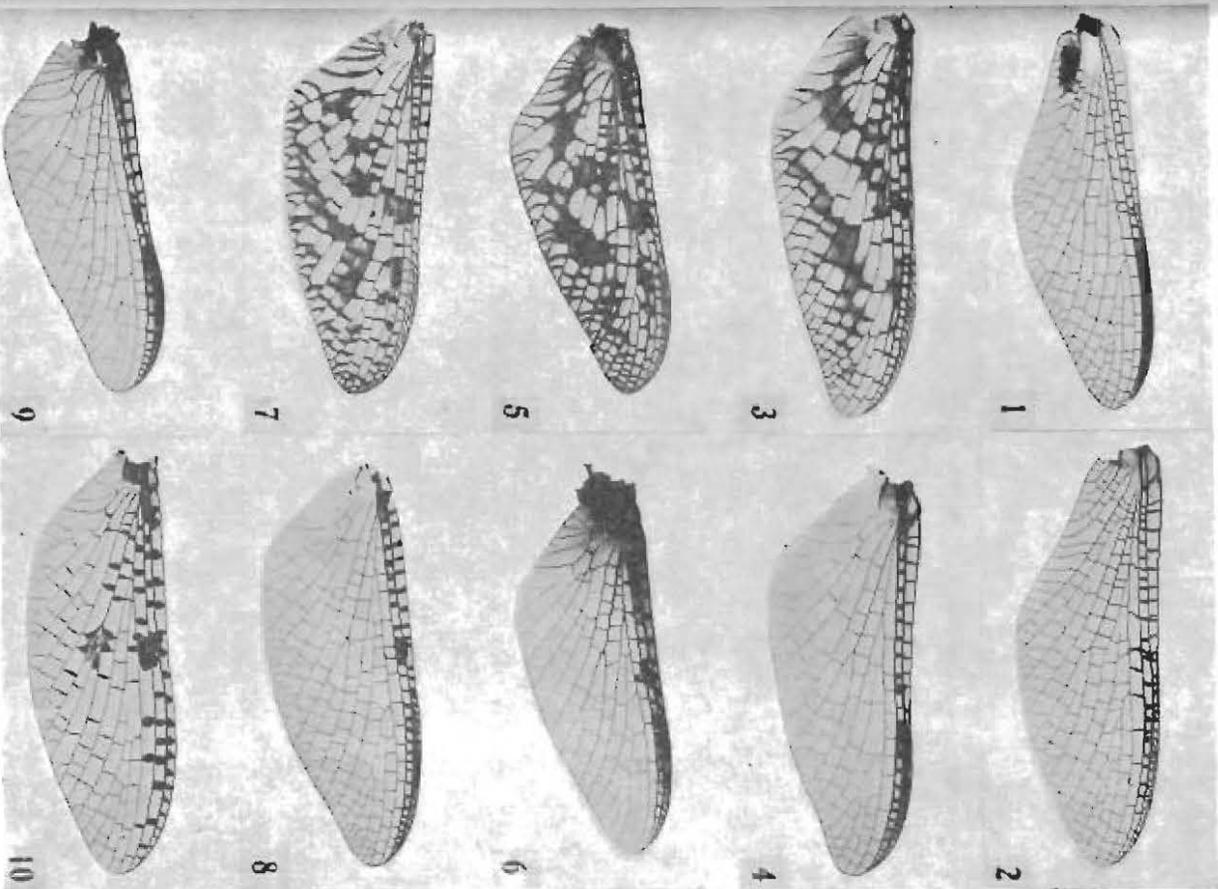
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EXPLANATION OF PLATE

PLATE I.—Photographic Enlargements of the Forewings in the Genera *Tasmanophlebia* (figs. 1, 2) and *Atalophlebia* (figs. 3-10):

- Fig. 1. *Tasmanophlebia lacustris* Till. Male Imago.
 Fig. 2. *Tasmanophlebia lacustris* Till. Female Imago.
 Fig. 3. *Atalophlebia australis* (Walker). Subimago.
 Fig. 4. *Atalophlebia australis* (Walker). Imago.
 Fig. 5. *Atalophlebia superba* n. sp. Subimago.
 Fig. 6. *Atalophlebia superba* n. sp. Imago.
 Fig. 7. *Atalophlebia albiterminata* n. sp. Subimago.
 Fig. 8. *Atalophlebia albiterminata* n. sp. Imago.
 Fig. 9. *Atalophlebia hudsoni* n. sp. Imago.
 Fig. 10. *Atalophlebia ida* n. sp. Imago.



Photographic Enlargements of the Forewings of the Genera *Tarsanotophlebia* (Figs. 1, 2) and *Alasophlebia* (Figs. 8-10).