

REVISION OF THE AUSTRALIAN MAYFLIES (EPHEMEROPTERA)

I. SUBFAMILY SIPHLONURINAE

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Summary

The present paper deals with the systematics of the adults and nymphs of the Australian species of the subfamily Siphonurinae. Two new species of *Mirawara* are described.

INTRODUCTION

This is the first of a series of papers dealing with the systematics of the Australian mayfly fauna. As many of the imagos and subimagos have not been associated with their nymphs the descriptions, in the first place, will be limited to the winged stages. An exception is made of the subfamily Siphonurinae where the nymphs have been worked out. Subsequently it is hoped to record something of the biology and of the immature stages.

In this series of papers the order will be divided into subfamily groups. Part I deals with the subfamily Siphonurinae, the largest and most handsome of our mayflies.

This subfamily is more or less restricted to the highlands, particularly to the south-eastern corner, and to Tasmania. Tillyard has recorded the species known to occur in Tasmania and in the Kosciusko region of New South Wales. Most records actually are from these two areas but *Mirawara*, which occurs at Kosciusko, ranges as far north as central Queensland.

There is a single recorded species from Tasmania and six from the Kosciusko area. In this paper another two species are added to the fauna, one of them occurring in the highlands of New South Wales and one in the highlands of coastal Queensland.

Subfamily SIPHLONURINAE

Adult

Large species, wings with numerous crossveins; cubital area of forewing with a number of more or less sinuous veins extending from the 1st branch of the cubitus to the wing margin; hindwing small but with numerous veins; 2, or sometimes 3, caudal filaments; hind tarsi with 4 free segments in most species; forceps base usually very long, its apical margin, between the forceps limbs, more or less deeply emarginate; forceps more or less distinctly 4-segmented, basal segment short, usually rather ring-like, often more or less fused with the 2nd segment, which is often

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strongly bowed, 2, rarely 3, terminal segments, which together are not longer than the 2nd segment; penes variable; subanal plate of female variable.

Nymph

Body more or less cylindrical, head horizontal or nearly so; hind corners of the abdominal segments produced backwards to form tooth-like projections; lateral caudal filaments ciliated on the inner border only. The rather large nymphs are to be found on the surface of rock in swift flowing water but also in the quieter waters of stream pools and lakes. In some cases the nymphs can be observed under the spray of falls out of the water. Nymphs normally with 7 pairs of abdominal gills, quite conspicuous and usually standing away from the body. There are only 4 pairs in *Tasmanophlebia*.

KEY TO THE AUSTRALIAN GENERA OF THE SUBFAMILY SIPHLONURINAE

1. In the forewing MP_2 is attached basally to CuA ; in the hindwing triad on MP arises close to the base; tarsal claws alike, both sharp; 3 well-developed tail-filaments in each sex *Ameletoides* Tillyard
 In the forewing MP_2 is normal, not attached to CuA ; in the hindwing triad on MP varies; tarsal claws dissimilar, 1 sharp and 1 blunt; appendix dorsalis obsolescent or entirely absent 2
2. Hind tarsus appearing 5-segmented, the line of suture between metatarsus and tibia preserved; in the hindwing triad on MP small; in the forewing CuP and $1A$ at their bases converge before continuing parallel *Coloburiscoides* Lestage
 Hind tarsus only 4-segmented, metatarsus fused to tibia 3
3. In the hindwing MP forks close to the base but no distinct triad is developed; in the forewing CuP and $1A$ are more or less parallel for their whole length; male claspers 4-segmented *Mirawara* Harker
 In the hindwing triad on MP only over the apical half or less of the vein; in the forewing CuP and $1A$ at their bases converge before continuing parallel; male claspers 3-segmented *Tasmanophlebia* Tillyard

Genus AMELETOIDES Tillyard

Ameletoides Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 6.

Genotype *Ameletoides lacus-albinae* Tillyard, 1933, loc. cit. (original designation).

Adult

Forewing with tornus at about two-fifths of wing-length; MP_2 is secondarily attached to CuA ; bullae present; hindwing distinctly less than half as long as forewing, its costa only slightly angulated near base; fore legs on the male imago longer than the body, about as long as the forewing; those of the female imago shorter than the body; tarsal claws of all legs similar, both sharply pointed, smooth; tarsus with 1st segment shorter than that of the 2nd; the hind tarsus about equal in length to the hind tibia; 3 tail-filaments present, the appendix dorsalis almost as long as the cerci.

Nymph

Free-swimming, rather shrimp-like, somewhat laterally flattened, and with thorax slightly humped; head small, hypognathous, the eyes lateral, the antennae short; mandibles with a single large incisor; maxillary and labial palpi, 3-segmented; abdomen tapering posteriorly; 7 pairs of gills, 1 pair to each of segments 1-7; gills simple, lamellate, consisting of an oval portion, supported by a sclerotized rim and an unsupported dorsal flange; tail-filaments short, about half as long as body.

AMELETOIDES LACUS-ALBINAE Tillyard

Ameletoides lacus-albinae Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 6.

Ameletoides lacus-albinae Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Ameletoides lacus-albinae Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 266.

Tillyard described this species, the only one of the genus, in detail from male and female imagos and subimagos and nymphs.

Types.—Holotype ♂ imago, allotype ♀ imago, type ♂ subimago, type ♀ subimago all taken at Lake Albina, Mt. Kosciusko, 6350 ft. Type nymph and nymphal exuviae taken on rocks in the lake. Types in the Tillyard Collection, British Museum; types missing (see Harker 1954). Paratypes of both imagos and subimagos in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Lake Albina, Mt. Kosciusko, N.S.W., 6350 ft.

Distribution.—NEW SOUTH WALES: Kosciusko area: Lake Albina (Feb. 1929 and 1930, R. J. Tillyard); The Chalet, Mt. Kosciusko (9.ii.1946, E. F. Riek).

Genus TASMANOPHLEBIA Tillyard

Tasmanophlebia Tillyard, 1921, Proc. Linn. Soc. N.S.W. 46: 410.

Tasmanophlebia Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 350.

Tasmanophlebioides Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 350.

Genotype *Tasmanophlebia lacustris* Tillyard, 1921, loc. cit. (original designation).

Adult

Forewing with tornus at one-half the wing-length or even somewhat beyond; triad of *MP* normal, arising very close to the origin of that vein; bullae faintly indicated or absent; hindwing about half as long as forewing, or somewhat more, and very nearly as wide, the humeral angle well developed, obtuse; triad of *MP* very small, distally placed; fore legs of the male imago nearly as long as forewing; those of female imago only half as long as forewing, or less; tarsi of all legs, except fore legs of male, only 4-segmented, the basal segment being more or less fused with the tibia; this fused 1st segment about as long as the tibia, and longer than any of the other segments; tarsal claws of all legs strongly dissimilar, 1 sharply hooked and 1 broad and blunt, with rounded apex; abdomen narrowly cylindrical, tapering posteriorly, without lateral dilatations on any of the

segments; only 2 tail-filaments present, the cerci longer than the abdomen, the appendix dorsalis reduced to a minute remnant.

Nymph

Free-swimming, dorsoventrally flattened, the thorax not humped; abdominal segments with median dorsal crest and lateral flanges having strongly projecting posterior angles; head small, hypognathous, with laterally placed eyes and short antennae; mandibles with 2 sharp incisors; maxillary and labial palpi 3-segmented; hypopharynx bilobed; abdomen tapering posteriorly; only 4 pairs of gills, carried dorsally upon the abdomen, 1 pair on each of segments 1-4, the 1st a pair of strongly sclerotized lamellae forming an operculum to the other 3, which fit under it owing to the shortening of the 1st 4 abdominal segments; tail-filaments somewhat more than half as long as the abdomen, the appendix dorsalis somewhat shorter and much less strongly built than the cerci.

This genus appears to be well represented in the lakes and streams at high altitudes, both on the Australian mainland and in Tasmania. It is fairly closely related to the New Zealand genus *Oniscigaster* McLachlan, from which it can be distinguished in the adult by the narrow, cylindrical abdomen without any lateral dilatations of the segments, by the generally smaller size, and in the nymph by the peculiar specialization of the gills.

Lestage (1935) separated the two Australian species generically from the Tasmanian species. He based the division mainly on the forking of *MP* in the hindwing and on the structure of the male genital forceps. Lestage considered the forceps of *lacustris* to be 4-segmented whereas they are really only 3-segmented as in *lacus-coerulei* and *nigrescens*. The forking of *MP* in the hindwing varies with the individual specimen in all three species, in *lacustris* it may fork closer to the wing margin than figured by Tillyard, and in *lacus-coerulei* and *nigrescens* it may be more basad but it is always well after the middle of the vein.

KEY TO THE SPECIES OF THE GENUS TASMANOPHLEBIA

Imagos

1. Species of larger size, forewing 13-16 mm; wing membrane slightly clouded, darkened along the costal area, with brownish hues*lacus-coerulei* Tillyard
 Species of smaller size, forewing 10-12 mm; wing membrane clear in part, the costal area of forewing darker over the apical half, blackish2
2. In male, hindwing darkened over anterior third, forewing with the basal one-quarter darkened*lacustris* Tillyard
 In male, hindwing with the darkening more limited to the basal half of the costal area, forewing darkened only over the anal vein*nigrescens* Tillyard

Subimagos

1. Wings distinctly bicolorous; the costal area and apex widely of forewing, and margins of hindwing, dark grey, remainder of wing lighter grey
*lacus-coerulei* Tillyard
 Wings nearly unicolorous but with the same pattern as above
*lacustris* Tillyard and *nigrescens* Tillyard
 (*nigrescens* is a little smaller and darker than *lacustris*)

TASMANOPHLEBIA LACUSTRIS Tillyard

Tasmanophlebia lacustris Tillyard, 1921, Proc. Linn. Soc. N.S.W. 46: 410.

Tasmanophlebia lacustris Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 350.

Tasmanophlebia lacustris Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Tasmanophlebia lacustris Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 267.

The species was described by Tillyard from male and female imagos and subimagos. The nymph is unknown.

Types.—Holotype ♂ imago and allotype ♀ imago reared from subimagos. Also ♂ and ♀ subimagos taken at the same time as the imaginal types. Types in the Tillyard Collection, British Museum. There is a long series of paratypes from Lake Echo in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Lake Lilla near Cradle Mt., north-west Tasmania, 3200 ft.

Distribution.—TASMANIA: Lake Lilla and Lake Echo (27.i.1933, R. J. Tillyard); Lake St. Clair (25.i.1949, E. F. Riek); Lake Dobson (22.i.1949, E. F. Riek).

There is some variation in the shape of the claspers in the males from the various localities but insufficient material is available to evaluate this character. The colouring at the base of the wing also varies considerably.

TASMANOPHLEBIA LACUS-COERULEI Tillyard

Tasmanophlebia lacus-coerulei Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 13.

Tasmanophlebioides lacus-coerulei Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 350.

Tasmanophlebia lacus-coerulei Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Tasmanophlebiodes lacus-coerulei Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 267.

Tillyard described the species in detail from all stages.

Types.—Holotype ♂ imago, allotype ♀ imago, type ♀ subimago, and type ♂ subimago taken at Blue Lake, Mt. Kosciusko, 6200 ft. Type nymph and nymphal exuviae taken on rocks in lake. Types in Tillyard Collection, British Museum. There is a long series of paratypes in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Blue Lake, Mt. Kosciusko, N.S.W., 6200 ft.

Distribution.—So far, this species has only been found in the Blue Lake, where the nymph may be seen resting on large rocks and boulders which occur in it, or sometimes on the pebbly bottom.

TASMANOPHLEBIA NIGRESCENS Tillyard

Tasmanophlebia nigrescens Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 18.

Tasmanophlebioides nigrescens Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 350.

Tasmanophlebia nigrescens Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Tasmanophlebiodes nigrescens Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 267.

Tillyard described the species in detail from all stages.

Types.—Holotype ♂ imago, allotype ♀ imago, type ♂ subimago, and type ♀ subimago taken at Spencer's Creek, Mt. Kosciusko, 5700 ft. Type

nymph and nymphal exuviae taken at the same locality. Types in the Tillyard Collection, British Museum. There is a long series of paratypes in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Spencer's Creek, Mt. Kosciusko, N.S.W., 5700 ft.

Distribution.—NEW SOUTH WALES: The species has also been taken at "The Lake", Mt. Kosciusko (31.xii.1932, R. J. Tillyard, 5000 ft, and at Rule's Point, upper Murrumbidgee River (20.xii.1934, R. J. Tillyard), 4450 ft.

This species comes fairly close to the genotype *lacustris* from Tasmania. It is about the same size or a little smaller. The male genitalia of the imagos differ very slightly as do the veins of the hindwings. The wings of the male imago in the type species are the more heavily pigmented. The form *nigrescens* may yet be considered a subspecies of *lacustris*.

COLOBURISCOIDES Lestage

Coloburiscus Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 29.

Coloburiscoides Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 354.

Genotype *Coloburiscus giganteus* Tillyard, 1933, loc. cit. (original designation).

Adult

Forewing with tornus at about two-fifths of wing-length from base; triad of *MP* arising close to the origin of that vein, with *MP*₂ much curved near its origin and approaching very close to *CuA* below it; hindwing less than half as long as forewing, the humeral angle strongly developed; triad of *MP* small, distally placed; fore legs of male imago from two-thirds to nearly as long as the forewing; those of the female much shorter; tarsi of all legs appearing 5-segmented, the line of suture between the metatarsus and tibia preserved, shorter than the tibiae; tarsal claws of each leg strongly dissimilar, 1 sharply hooked and 1 blunt; those of fore legs of male sometimes hypertrophied; abdomen tapering posteriorly, the 1st segment closely connected with the thorax; posterolateral angles of 9th tergite produced into spines; only 2 tail-filaments present, the cerci longer than the abdomen, the appendix dorsalis reduced to a mere remnant.

Nymph

Sedentary type, clinging to rocks in rapid waters; body somewhat S-shaped in lateral view, the thorax huge and strongly humped, the abdomen somewhat flattened dorsoventrally, but without a dorsal crest; head of medium size, hypognathous, with fairly large eyes, laterally placed, and antennae somewhat longer than the head; mandibles with 2 distinct incisors, strongly projecting molar area, and a large brush of long hairs on the upper surface; maxillary and labial palpi 2-segmented, large; labrum, maxillae, and labium very hairy, hypopharynx entire; legs rather short, spiny, the fore and middle femora also provided with long hairs; tarsal claws simple; gills carried upright dorsally upon the abdomen,

1 pair on each of segments 1-7 inclusive; each gill is deeply bifid and strongly spinose; tail-filaments 3, the cerci well developed, the appendix dorsalis variable.

Species of this genus occur in south-eastern Australia, mainly in the highlands but also in the coastal streams around Melbourne. There are three species, the two from Mt. Kosciusko being very large. They occur only where the flow of water is permanent and where there are rocky rapids suitable for the nymphs. The third species prefers the lower country and is known from near Melbourne and close to Canberra. The genus is closely allied to the New Zealand *Coloburiscus*.

KEY TO THE SPECIES OF THE GENUS COLOBURISCOIDES

Imagos

1. Costal and subcostal spaces of the forewing entirely light reddish brown
.....*giganteus* (Tillyard)
- Costal and subcostal spaces of the forewing in the pterostigmatic region greenish grey, otherwise clear*munionga* (Tillyard)
- Costal and subcostal spaces of the forewing in the pterostigmatic region pale brown, otherwise clear*haleuticus* (Eaton)

Subimagos

1. Forewing, except for costal and subcostal spaces uniformly coloured2
Forewing patterned in grey and water white with a large transverse area at the furcation of *MA**munionga* (Tillyard)
2. Wings uniformly very pale grey*haleuticus* (Eaton)
Forewing dark grey, tending to black, hindwing lighter in colour, costal and subcostal spaces semiopaque black*giganteus* (Tillyard)

The species *haleuticus*, which combines many of the characters of the other two species, is generally considerably smaller than them. The subimago has the more or less uniform pigmentation of *giganteus* but the imago has the major portions of the costal and subcostal spaces clear as in *munionga*.

COLOBURISCOIDES MUNIONGA (Tillyard)

Coloburiscus munionga Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 29.

Coloburiscoides munionga Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 354.

Coloburiscus munionga Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Coloburiscoides munionga Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 266.

The species was described fully from all stages by Tillyard.

Types.—In the Tillyard Collection, British Museum. Types missing (see Harker 1954). Paratypes in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Mt. Kosciusko, N.S.W.

Distribution.—NEW SOUTH WALES: Digger's Creek, Spencer's Creek, and Perisher Creek, Mt. Kosciusko (Jan. 1929 and Dec. 1931, R. J. Tillyard).

The species can be distinguished readily from *giganteus* by its smaller size, by lack of the darkened costal and subcostal spaces of the forewing in the imago, and more especially by the strongly mottled wings of the subimago.

COLOBURISCOIDES GIGANTEUS (Tillyard)

Coloburiscus giganteus Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 22.

Coloburiscoides giganteus Lestage, 1935, Bull. (Ann.) Soc. Ent. Belg. 75: 354.

Coloburiscus giganticus Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Coloburiscoides giganteus Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 266.

This species was described fully from all stages by Tillyard.

Types.—Holotype ♂ imago, allotype ♀ imago, and type ♂ and ♀ subimagos all taken on Digger's Creek, Mt. Kosciusko, 5000 ft. Type nymph and nymphal exuviae taken under rocks in the same locality. Types in the Tillyard Collection, British Museum; types missing (see Harker 1954). A series of paratypes in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Digger's Creek, Mt. Kosciusko, N.S.W., 5000 ft.

Distribution.—This mayfly has only been taken towards the end of January or beginning of February on Digger's Creek and other similar, rapid, rocky creeks on Mt. Kosciusko. The nymphs cluster in small colonies under rocks in the swiftest parts of the stream.

COLOBURISCOIDES HALEUTICUS (Eaton)

Coloburus haleuticus Eaton, 1871, Trans. Ent. Soc. Lond. 1871: 133.

Coloburiscus haleuticus Tillyard, 1933, Proc. Linn. Soc. N.S.W. 58: 22.

Coloburiscus haleuticus Harker, 1950, Proc. Linn. Soc. N.S.W. 75: 29.

Coloburiscus haleuticus Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 266.

Male Imago

Dried. Forewing 15.5 mm; length of body 15 mm; cerci 18 mm; appendix dorsalis 0.5 mm.

Colouring much as in *munionga* except that all parts are paler. Differs in the colour of the claspers, which are dark except for the basal half of the 1st segment; cerci dark to base, 1st segment not paler; forewing hyaline except at extreme base and for the pale brown costal and subcostal spaces particularly in the pterostigmatic region; terminalia as in *munionga* but the ventral of the 3 processes of the penis shorter and more rapidly tapered to the strongly incurved apex (in *munionga* the apex is directed ventrally and is evenly tapered to a point); posterolateral margin of the 9th abdominal segment rather bluntly produced, not half as long as the 10th segment, 8th segment virtually not produced.

Type.—Holotype ♂ in the National Museum, Melbourne.

Type locality.—Unknown.

Distribution.—In the National Museum there are another 2 specimens, 1 ♂ from near Melbourne and 1 ♀ subimago from Heidelberg, Vic. 1 ♀

from Jeeralong, Vic. (8.xi.1949, A. N. Burns), in the Burns Collection. The species occurs also near Canberra and on the upper reaches of the Murrumbidgee. AUSTRALIAN CAPITAL TERRITORY: Coree Creek (28.xi.1930, A. L. Tonnoir), 1 ♂, bred from nymph. Upper Cotter River (above dam) (13.xi.1948, E. F. Riek), 1 ♂ subimago; same locality (7.iii.1948, E. F. Riek), 1 ♀ subimago. NEW SOUTH WALES: Bolairo (11.iii.1951, E. F. Riek), 1 ♀ subimago.

This species differs from *munionga* in the colour of the wings of both subimago and imago, in the colour of the claspers and cerci of the male, and also in the shape of the 8th and 9th abdominal segments and in the male terminalia.

Genus MIRAWARA Harker

Mirawara Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 261.

Genotype *Mirawara aapta* Harker, loc. cit. (original designation).

Adult

Forewing with tornus at about two-fifths of wing-length; triad of *MP* arising close to the origin of that vein; bullae reduced; hindwing distinctly less than half as long as fore, its costa only slightly angulated near base; *MP* forked close to its base but no triad developed till near the wing margin; fore legs of male imago nearly as long as the forewing; those of the female much shorter; tarsi of all legs only 4-segmented, the basal segment more or less fused with the tibia; this fused 1st segment shorter than the tibia, but as long as or longer than any of the other tarsal segments; tarsal claws of all legs strongly dissimilar, 1 sharply hooked and 1 broad, obliquely truncate at apex; abdomen tapering posteriorly, the 1st segment closely connected with the thorax; posterolateral angles of 9th tergite produced into spines; only 2 tail-filaments, the cerci, which are longer than the abdomen; tergite of the 10th somite produced posteriorly over the minute appendix dorsalis; male claspers distinctly 4-segmented, with 1 large basal segment and 3 small apical segments.

Nymph

Shrimp-like, actively swimming type, resting on rocks in quiet water or clinging to the under surface in more rapidly flowing water; body somewhat S-shaped in lateral view; thorax large and strongly humped, not exceptionally broad; abdomen almost round, very slightly dorso-ventrally compressed; head of medium size, hypognathous, with fairly large eyes placed dorsolaterally; abdomen tapering posteriorly, gills conspicuous, carried laterally away from the body, situated on segments 1-7, 1st 2 pairs relatively small, gills strongly lamellate with entire margins, anteroventral margin thickened and with spines towards the outer margin except for the 1st, gills with a large tuft of fibrils, posteriorly at base; 3 equal tail-filaments, the cerci plumed only on the inner side; tarsal claws simple, swollen at base, only slightly curved at apex; all legs rounded and without tufts or brushes of long setae; mouthparts abnormal, mandible

with very reduced molar process, maxillary and labial palps multi-segmented, maxilla with a number of apical, extremely long, curved spines.

This genus comes close to *Ameletopsis* Phillips from New Zealand but in the adult it differs in lacking a distinct triad on the deeply forked *MP* of the hindwing and in the distinctly 4-segmented claspers of the male. The nymph differs in having long setae only on the inner margins of the cerci and in minor details of segmentation of the maxillary and labial palps. The genus is known to occur from near Mackay in Queensland to the Kosciusko region of New South Wales.

Harker (1954) compares this genus with *Coloburiscoides* to which it bears a superficial resemblance.

KEY TO THE SPECIES OF THE GENUS MIRAWARA

Imagos

1. Wings pale brown with a purplish tinge; darker yellow-brown over costal and subcostal spaces; yellowish at base *megaloprepia*, sp. nov.
Wings pale purple; yellow brown over costal and subcostal spaces; slightly yellowish at base *purpurea*, sp. nov.
- Wing hyaline; dark yellow brown, with almost black spots, over the costal and subcostal spaces; slightly yellowish at base *aapta* Harker

MIRAWARA MEGALOPREPIA, sp. nov.

Plate 1; Plate 2, Figs. 1-3

Female Imago

Head moderate, as wide as prothorax, reddish brown with some black markings; eye large, dark; ocelli pale, set in black; antenna very short, reddish; thorax reddish brown, mesoprescutum and postscutellar margins darker; mesopostscutellum projecting over the metanotum; legs reddish brown, dorsal surface of tarsi somewhat darker; tarsal segments decreasing regularly in length except in that the apical is longer than the preceding; 1st tarsal segment fused with the tibia; tarsus, including this fused segment, considerably longer than the tibia; tarsal claws small, markedly dissimilar, the sharp claw with a pronounced bulge on the inner side and strongly incurved apex; 2nd claw stout, dark, and with an obliquely truncate, apical margin.

Wings brilliant, the membrane completely coloured a rich pale brown with purplish hues except for the costal area which is a deep yellowish brown with 4 or 5 darker zones. The colouring is a little lighter towards the base and somewhat yellowish. Forewing with tornus beyond two-fifths of the wing-length from base; *MP*₂ arising close to the base and curving so as to run closer to *CuA* than to *1MP*; faint bullae about half-way along *R*₄₊₅ and *MP*₁; hindwing triangular, apex rounded, caudal margin with a slight reentrant angle; humeral angle not strongly produced, rounded; costal crossveins numerous; *Rs* and *MA* forking before the middle of the wing; *MP* forking close to its base, without a distinctly developed triad.

Abdomen with segments rather short and broad, yellowish brown, the lateral and caudal margins with a wide dark border; medianly with a longitudinal brownish stripe and lateral to that an irregular darker longitudinal stripe, narrowing and straightening to the caudal segments; segment 9 with its posterolateral angles carrying a sharp, backwardly projecting spine extending almost as far as the caudal margin of segment 10; segment 10 much narrower than 9, small, a caudal lobe almost as long as the base of the segment and half its width extending over the very reduced appendix dorsalis; under surface of abdomen much paler, each segment with a pair of oblique, slightly curved dark lines and a pair of dark spots caudal to the lines; 2 tail-filaments, the appendix dorsalis very reduced, the cerci very long, about twice as long as the body, the basal portion dark, the apex white, slightly darkened at the joints; subanal plate excavated semicircularly on its distal margin, strongly bifid, with pointed lobes.

Length of body 17 mm; length of forewing 20 mm; length of cerci 36 mm.

Male Imago

Not known.

Subimago

The coloration of the two sexes differs markedly. Further, the male is only about two-thirds the size of the female.

Male Subimago

The body colour of the adult male, which is similar to that of the adult female, shows through the thin subimaginal skin.

Wings opaque, greyish, with numerous small, more or less rectangular, darker areas bordered by the main veins and the crossveins. This darkening is more pronounced towards the caudal margin of the hindwing and the apical margin of the forewing, where it forms more or less distinct transverse bands. There is also a complete band at the middle of the wing and other incomplete ones along the costal area. Costal space darker than the rest of the wing particularly so at the base of the wing.

Fore legs of the male only a little over half the length of the forewing; 2 tail-filaments, the cerci, which are much shorter than the body; eyes large, meeting in the midline.

Female Subimago

Considerably larger than the male. The adult coloration of the body shows below the thin subimaginal skin except over the abdomen where the subimago is uniformly dark grey.

Wings opaque, with a grey pattern similar to that of the male overlying the pale brown colouring of the imago and so obscured to some extent. (In the male the imago would have clear wings except for a slight darkening along the costal border.)

Fore legs relatively much shorter than in the male; the 2 tail-filaments relatively longer but not as long as the body.

Nymph

Shrimp-like, head slightly dorsoventrally flattened, thorax humped, abdomen rounded; legs rounded and without tufts of setae, gills on segments 1-7, held laterally away from the body, consisting of a greatly expanded lamella and a posterior, basal tuft of fibrils; eyes large, placed dorsally on the flattened head, labrum large, protruding; antenna longer than the head.

Mouth parts abnormal; mandible with extremely well-developed canines and very reduced molar process; molar process a slight obtusely pointed projection at the inner basal margin; canines in 2 groups, an apical very strong, gently curved, 3-pronged projection, the median prong somewhat longer than the subequal upper and lower prong; a second group, directed mesally, consisting of an anterior, stronger, almost straight, sharply pointed projection bearing a smaller prong on its ventral face; below these canines a much shorter, blunter projection bearing an apical tooth and a series of very much smaller teeth and setae on its posterior margin, decreasing in size away from the apex; maxilla very large, cardo and stipes quite distinct, a small, more heavily sclerotized area on the mesal border of the stipes, and demarcated from it, may represent a lacinia; galea as stout and long as the stipes, terminating in 5 very long, fine, gently curved and tapered, sharply pointed, articulated spines; these spines form two series, 4 form an outer vertical series, the most ventral being a little longer and more finely tapered than the others which are subequal and have the apex slightly hooked, the 5th is placed mesad to the outer series and is considerably shorter and finer; on the inner apical margin a small tuft of very short hairs; maxillary palp about as long as the galea and 14-segmented, the 2nd segment being considerably stouter and longer than the others which taper to a very fine apex; the labium with abnormally long and multisegmented palps, palps 15-segmented, the 1st segment very long and stout, the remaining segments forming a thin whip-like flagellum, not quite twice as long as the basal segment; mentum produced to acute points at the anterolateral corners, ligula with convex lateral margins, glossa and paraglossa quite distinct, longer than the ligula, the paraglossa constricted about its middle and appearing 2-segmented; paraglossa with a few setae on the outer margin of the apical half; hypopharynx with heavily sclerotized anterior margin, truncate, with rounded lateral margins, bearing dense fine setae over the sclerotized portion; superlinguae emarginate mesally before the rounded apex.

Colour varying from yellowish brown to dark brown, with darker markings, tips of caudal setae whitish, gills grey with fibrils black; face mostly dark and wing-sheath dark in fully grown nymphs.

Types.—Holotype ♀ imago and type ♀ subimago, Lamington National Park, Qld. (Jan. 1943, E. F. Riek); type ♂ subimago, same locality (Jan.

1944, E. F. Riek). Type nymph taken under rocks at the same locality (Jan. 1943, E. F. Riek). Types and a series of ♀ imago paratypes and numerous nymphs in the Division of Entomology Museum, C.S.I.R.O., Canberra. 1 ♀ paratype in George F. Edmunds Collection, Salt Lake City, Utah.

Type locality.—Upper Coomera River, Lamington National Park, Qld.

Distribution.—QUEENSLAND: Streams of the Lamington National Park; Netherdale, 35 miles W. of Mackay (A. N. Burns), 2000 ft. Possibly also Conondale (25.iv.1945, E. F. Riek) where nymphs only were collected.

The female subimago was reared from fully grown nymphs which require running or well-aerated water for their survival. The male subimago was taken clinging to the under surface of an overhanging log on an overcast day.

The species occurs in any of the fast-flowing streams in the area above about the 2000 ft level. The adult females fly in the middle of the day, only over the quiet, sheltered pools, and are rarely seen over the broken water. The shrimp-like nymphs are found both in the more slowly moving waters of the deep pools where they often rest on the upper surface of submerged rocks and in the swiftly flowing broken water where they cling to the under surface of boulders, preferably along the margins.

MIRAWARA PURPUREA, sp. nov.

Female Imago

Differs from *megaloprepia* only in coloration; head and thorax dark brownish rather than reddish brown; the abdomen reddish brown, the dark banding at the caudal and lateral margins of each segment narrow; segments with a pattern similar to that of *megaloprepia*; ventral surface of abdomen much lighter in colour than the dorsal.

Wings pale purple, costal area dark yellowish brown, slightly yellowish at bases of wings; cerci long but not twice as long as body, apex white.

Length of body 16.5 mm; length of forewing 18 mm; length of cerci 31 mm.

Male Imago

Not known.

Subimago

Not known.

Nymph

Not known definitely as two species of adult have been collected from the type locality of this species.

Type.—Holotype ♀ imago in the Division of Entomology Museum, C.S.I.R.O., Canberra.

Type locality.—Upper Cotter River, A.C.T. (8.ii.1947, E. F. Riek).

Distribution.—AUSTRALIAN CAPITAL TERRITORY: Cotter River. NEW SOUTH WALES: Styx River (1.iv.1950, E. F. Riek); Wee Jasper, Goodradigby River (7.xii.1950, E. F. Riek).

This species is very similar in general coloration and habits to *megaloprepia* but the pigmentation is less intense and of a slightly different colour.

MIRAWARA AAPTA Harker

Plate 1, Figs. 7 and 8; Plate 2, Figs. 4-6

Mirawara aapta Harker, 1954, Trans. R. Ent. Soc. Lond. 105: 261.

Female Imago

Wings hyaline except for the yellow-brown costal and subcostal spaces and for a slight yellowing at the bases; body colouring much as in *megaloprepia* but the head and thorax more brown with blackish markings; cerci black at base, becoming lighter in middle (and there only darkened at apex of segments) and white over almost the apical half.

Male Imago

Similar colouring to female but dorsal thorax mostly or all black; fore leg mostly dark except for coxa and base of femur, other legs yellowish brown; claspers darkened on external face except for basal half of 1st segment.

Cerci relatively longer than in female; clasper 4-segmented, 1st very long, 2nd to 4th very short, decreasing regularly in size; penis with a pair of simple lobes, apex pointed and incurved, upper surface near apex with a slight thickening.

Female Subimago

Wings opaque, brownish, with numerous small, more or less rectangular, darker areas bordered by the main veins and the crossveins. This darkening is more pronounced at the tornus and forms faintly darker transverse bands in the apical half of the forewing; also darker at caudal margin of hindwing. Costal space darker than the rest of the wing due to the underlying pigment of the imaginal wing. Tail-filaments about as long as the body, the apical half mostly pale.

Types.—Holotype ♂ imago, allotype ♀ imago, type subimago in the British Museum (ex Tillyard Collection).

Type locality.—Upper Murrumbidgee River, Adaminaby, N.S.W. (11.xii.1936, R. J. Tillyard).

Distribution.—NEW SOUTH WALES: Bolairo, upper Murrumbidgee River (11.iii.1951, E. F. Riek); Styx River (1.iv.1950, E. F. Riek); Mt. Garrick, Snowy River (Feb. 1909). AUSTRALIAN CAPITAL TERRITORY: Upper Cotter River (7.iii.1948, 28.ii.1948, E. F. Riek).

This species is distinguished readily by the hyaline wings of both sexes. At the Styx River and the upper Cotter River it is associated with *purpurea*. The males collected at Bolairo were taken swarming around a

limited number of females settled on shrubs and long grass bordering deep open pools on the stream. Although flying at midday and slightly later, the males were caught fairly readily by hand. The nymphs form a significant part of the food of the introduced trout.

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EXPLANATION OF PLATES 1 AND 2

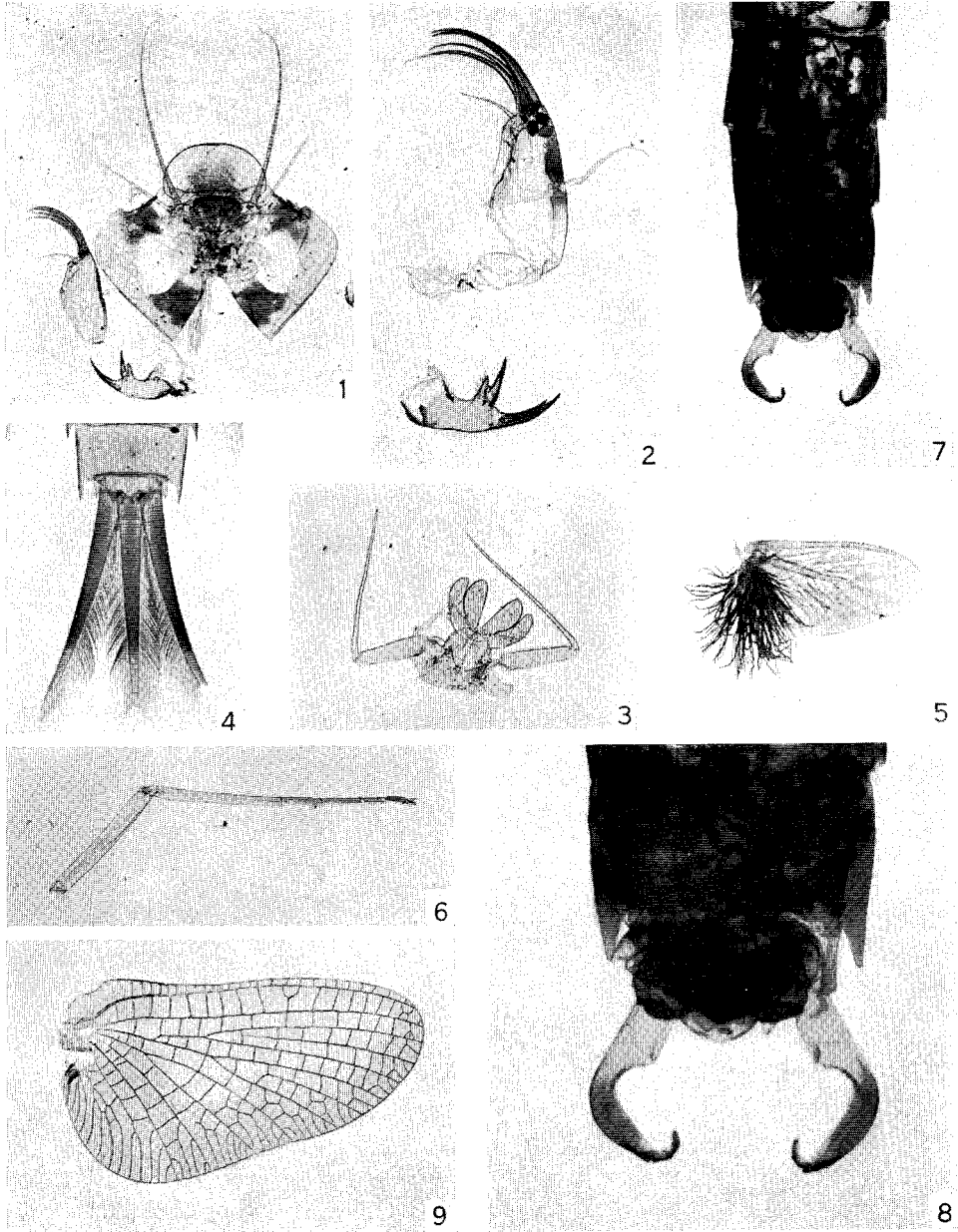
PLATE 1

- Figs. 1-5.—*Mirawara megaloprepia*, sp. nov., mature nymph.
- Fig. 1.—Flattened head split at dorsal suture; also displaced mandible and maxilla. $\times c. 5$.
- Fig. 2.—Mandible and maxilla enlarged. $\times c. 9$.
- Fig. 3.—Labium. $\times c. 9$.
- Fig. 4.—Tail-filaments. $\times c. 5$.
- Fig. 5.—Abdominal gill. $\times c. 9$.
- Fig. 6.—*Mirawara megaloprepia*, hind leg of adult female showing tarsal segmentation. $\times c. 5$.
- Figs. 7-8.—*Mirawara aapta* Harker, caudal portion of abdomen. $\times c. 9$. (Fig. 7.) Apical portion. $\times c. 18$. (Fig. 8.)
- Fig. 9.—*Mirawara megaloprepia*, hindwing of adult female. $\times c. 5$.

PLATE 2

- Figs. 1-3.—*Mirawara megaloprepia*, sp. nov.
- Fig. 1.—Holotype female, natural size.
- Fig. 2.—Type female subimago, natural size.
- Fig. 3.—Type male subimago, natural size.
- Figs. 4-6.—*Mirawara aapta* Harker.
- Fig. 4.—Male, natural size.
- Fig. 5.—Female, natural size.
- Fig. 6.—Female subimago, natural size.

AUSTRALIAN MAYFLIES (EPHEMEROPTERA). I



AUSTRALIAN MAYFLIES (EPHEMEROPTERA). I

