

Ephemeroptera

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South African May-flies (*Ephemeroptera*).

By K. H. Barnard, D.Sc., F.L.S.

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CORRIGENDA.

Venation, pp. 203, 246, figs. 1, 2, 4, 5, 17, 19, 42. For $1R_2$, $1R_3$, $1MA$, $1M$, $1Cu$ (but not $1A$), read I (= intercalary) R_2 IR_3 etc. respectively.

Pp. 204, 208, and 244.132, for *westermanni* read *dislocans*. P.245. fig. 358. for *westermanni* read *dislocans*; fig. 35c for *dislocans* read *auriculata*.

P.220. Delete last sentence at bottom of page: "the nymph..... discovered."

P.230. l. 1. For "access" read "assess."

P.246. l. 12. For "long stalk of MA" read "long stalk of M."

P.252. Delete last sentence of first paragraph: "Other similar..... October 1931."

SOUTH AFRICAN MAY-FLIES (*EPHEMEROPTERA*).

By K. H. BARNARD, D.Sc., F.L.S.

(With forty-eight Text-figures.)

This paper forms the fourth report on the Fauna of the Mountain Ranges of the Cape Province, for the investigation of which I have received grants from the Royal Society of South Africa and the Research Grant Board. My thanks and acknowledgments are herewith tendered to these bodies.*

Very little work has been done on the South African May-flies. Eaton recorded 4 (described) species. Esben-Petersen, and later Lestage, working on dried material from the South African Museum, part of which was collected by the present author on various mountain expeditions, added 12 species (2 of Lestage's species are synonyms). Not a single nymph has been recorded south of the Zambezi, though Lestage has described some from the Belgian Congo. The present paper brings the total up to 38 species, more than double the number previously known, and contains diagnoses of 6 new genera and 22 new species, and descriptions of the nymphs of 22 species.

The breeding of nymphs in the course of mountain expeditions is almost impossible, and the results recorded in this paper would have been unattainable but for the very opportune and generous help offered by Mr. A. C. Harrison of Cape Town, a member of the Groot Drakenstein Angling Association and the Worcester Trout Anglers Association.

Mr. Harrison, knowing the English May-flies and being interested in the development of fly-fishing in South Africa, applied to me for information. On finding how little was known about South African May-flies he immediately began systematic observations and the breeding of nymphs. The success of his efforts is apparent from the following account, which, so far as the Cape species are concerned, is based almost entirely on the material obtained and bred by him.

A comparatively small amount of material from the South African Museum (adults *in sicco*),† and from my own collecting in the mountains

* Previous reports: 1. "A Study of the Freshwater Crustacea," *Trans. Roy. Soc. S. Afr.*, vol. xiv, 1927. 2. "A Study of the genus *Colophon*," *ibid.*, vol. xviii, 1929. 3. "The Cape Alder-flies," *ibid.*, vol. xix, 1931.

† Including specimens labelled by Esben-Petersen as types. Ulmer, however (1916, p. 2), says that Esben-Petersen sent him for comparison "die südafrikanischen Typen

(adults and nymphs), has helped in some cases to complete the descriptions of the species and add further localities. I have examined small collections of flies from the Natal and Albany Museums, thanks to the kindness of Dr. Warren and Mr. J. Hewitt.

I have also included the records of the few specimens collected in Ovamboland, South-West Africa, during the course of the Zoological Survey carried out by the South African Museum under the auspices of the South West Africa Administration.

It is difficult adequately to express my indebtedness to Mr. Harrison, but I herewith wish to tender him my best thanks for all the help he has rendered in the preparation of this paper.

Acknowledgments are also due to Mr. F. G. Chaplin of the Jonkershoek Trout Hatcheries, Mr. James Perkins, Hon. Secretary of the Worcester Trout Anglers Association, and Mr. A. T. Packham of Cape Town, for their interest in the investigations. Mr. Packham has frequently motored Mr. Harrison and myself to suitable collecting localities. To Mr. J. C. Dendy of Idas Valley, Stellenbosch, I am indebted for a small but very valuable sample of nymphs from the Transvaal.

As stated above, the works of Eaton, Esben-Peterson, and Lestage contain all that was hitherto known on South African May-flies. With a view to making the present paper a basis for the study of our May-flies, all the known species, including the extra-Cape species, are here incorporated, together with diagnoses of the families and genera.

It is hardly necessary to say how unsatisfactory is the examination of dried material, especially as regards the ♂ genitalia. It is not so much the dried specimen *per se* which has been responsible for several misconceptions in the past, but the omission to relax the specimen, spread out the wings, or mount up the genitalia. Dried specimens are always much darker than in life, and colours based on them are nearly always fallacious. But when moistened and plumped out again they frequently show, if not the true colours, at least the colour pattern. All the material used in this report has been preserved in alcohol, with the exception of that mentioned above; this dried material has been relaxed and examined in fluid in cases where no fresh material was available or where type material seemed to have been inadequately studied. In the field the flies are collected direct into alcohol, but it is always advisable to make a note of any special colours such as yellows or reds, or especially greens, which are often fleeting in alcohol (*cf.* p. 220).

seiner Sammlung." So it would seem that neither Esben-Petersen nor the South African Museum can claim "Holotypes." The types of Lestage's (1924) species have not been returned to the South African Museum, but there are topotypes of all except *Adenophlebia peringueyella* and *Ephemerellina barnardi*.

All the wing tracings have been executed by Mr. Harrison by means of a projector. The other drawings are by the author. Initials after a paragraph or sentence refer only to that paragraph or sentence. In general the majority of the field notes on habits, and all those on habits in captivity, are due to Mr. Harrison.

As regards the breeding of the nymphs, Mr. Harrison has found that even in the case of species inhabiting running water many of them flourish quite well in ordinary tanks, provided some vegetation is put in and the water is changed frequently. Some species, however, are intolerant of still water, e.g. *Tricorythus*, *Castanophlebia*, and Baetids in general. In these cases it is usually a simple procedure to collect fully-grown nymphs with the dark wing-cases, which indicate approaching metamorphosis, and breed these, as they will, as a rule, live a day or two in captivity.

Some of the Leptophlebiids have proved very hardy and easy to rear in captivity, e.g. *Aprionyx*, *Adenophlebia*, and *Choroterpes*. Two instances out of many may be cited: a nymph of *A. peterseni* collected on 27th July 1930 was reared to maturity on 12th November 1930. Several nymphs of *A. tabularis* obtained in midsummer (December–January 1930–31) are still alive at time of writing (31st May 1931) and are nearly mature.

These nymphs have been fed on a blackish or greenish ooze, taken from the lake at Lakeside (Cape Peninsula), which has been found to be a very suitable food supply.

Wing Venation.—The notation proposed by Tillyard (1926—Insects of Australia and New Zealand) is here adopted. In this system the anterior median vein (MA) is accepted as well as the posterior median (M), which has the effect of extending the median area and reducing the anal area as defined by previous authors.

As the Comstock-Needham notation is in use by other authors, it may be useful to quote from Tillyard the most important equivalents in the old and the new notations. The sign + indicates a convex vein and - a concave vein.

$$\begin{aligned}
 (\text{Comstock-Needham}) \quad M_1 &= MA_1 + \text{ (Tillyard).} \\
 M_2 &= 1 \text{ MA} - \\
 M_3 &= MA_2 + \\
 Cu_1 &= M_{1+2} - \\
 \text{---} &= 1 \text{ M} + \\
 Cu_2 &= M_{3+4} - \\
 1 \text{ A} &= Cu_1 + \\
 2 \text{ A} &= Cu_2 - \\
 3 \text{ A} &= 1 \text{ A} + \\
 3 \text{ A} &= 2 \text{ A} + \\
 3 \text{ A} &= 3 \text{ A} +
 \end{aligned}$$

Nomenclature.—As the nymphs of the majority of the Cape species have been discovered, it is not altogether surprising that in some cases the species will not fit in with the generic diagnoses based on material, frequently only adults, from Europe and other parts of the world. The Cape “Atalophlebias” are *Atalophlebia* as adults, but not as nymphs; and it seems not improbable that the South American “Atalophlebias” will be separated later from the true Australasian *Atalophlebia*.

The genus *Cloeon* has a number of species which agree in wing venation but whose nymphs are sharply divided into two series.

On the other hand, *Baetis bellus* and *Centroptilum excisum*, well differentiated by the wing venation of the flies, approach each other very closely in the character of the mouth-parts of the nymphs. *Adenophlebia peringueyella* and *westermanni* are not distinguishable with certainty as nymphs, but as adults are easily distinguished.

These differences have to be expressed taxonomically, and this explains the introduction of some new generic names.

Colloquial Names.—With a view to standardising the colloquial names of our commonest and most noticeable May-flies, the following list has been drawn up by Mr. Harrison for the benefit of South African Anglers. Spinner is the name given to the imago.

<i>Cloeon lacunosum</i>	Red Border-wing.
<i>Austrocloeon virgiliae</i>	Keurboom Yellow.
<i>Baetis harrisoni</i>	Yellow Dun.
„ <i>bellus</i>	Small Pink.
<i>Centroptilum sudafricanum</i>	Small Rusty.
„ <i>excisum</i>	Rusty Dun.
<i>Austrocaenis capensis</i>	Cape Cain-fly.
<i>Tricorythus discolor</i>	Worcester Dark Blue.
<i>Aprionyx tabularis</i>	April Dun.
„ <i>peterseni</i>	Pied Dun.
„ <i>intermedius</i>	Intermediate.
<i>Adenophlebia peringueyella</i>	September Brown.
„ <i>dislocans</i>	Summer Brown.
<i>Castanophlebia calida</i>	Chestnut Dun.
<i>Choroterpes nigrescens</i>	Darkening Dun (Bronze Spinner).
<i>Lithogloea harrisoni</i>	Blue-winged Orange (Sherry Spinner),
<i>Afronurus harrisoni</i> , f. <i>major</i>	Tawny Yellow.
„ „ f. <i>minor</i>	Dwarf Tawny Yellow.

Economics.—Tillyard (1920, Proc. Linn. Soc. N.S.W., vol. xlv, p. 207) and Phillips (1929) have reported on the value of May-fly nymphs and adults as food for the imported trout. In fact, in many localities in New

Zealand the indigenous May-fly fauna has been noticeably depleted in recent years; one of the reasons stated for this is the destruction by fire or otherwise of the natural vegetation clothing the banks of the rivers, thus reducing the amount of plankton (denuded river-banks increase scouring) and shelter for the flying stages. Consequently the Angling Associations in South Africa and the owners of properties with fishing rights will do well to consider this aspect of the evils of veld-burning, and add their weight in the scale against a practice which for many other reasons cannot be too strongly deprecated.

Phillips states that in New Zealand about 10 per cent. of the trout-food is composed of May-flies. For South Africa there are as yet no data. At certain seasons, however, May-flies and their nymphs must form very nearly the bulk of the trout's food. I have had trout stomachs submitted to me which were literally stuffed with nothing else but Baetid nymphs (*e.g.* from the Eerste River in October). Mr Harrison informs me that he has found the nymphs of the Tawny Yellow to be numerous in stomachs of trout caught at midsummer and in very low water; and under such conditions he has found that trout readily accept a wingless imitation "fly" tied to represent one of these nymphs.

This is a matter of special interest to anglers, most of whom look upon low-water conditions as hopeless. The remedy is to use artificial nymphs.

Characteristics of the South African May-fly Fauna.—It is obviously premature to discuss in detail the composition of the May-fly fauna of South Africa, as such a very small area has been systematically explored. With the exception of the south-west corner of the Cape Province, the records from other parts are, in truth, merely the results of casual collecting, often by persons not fully cognisant of these particular insects or their habits.

One or two general remarks, nevertheless, may be permitted, because, even with the meagre data at our disposal, there appears to be a very real and obvious difference in the May-fly fauna of the Cape and that of Natal.

Large and conspicuous forms like *Polymitarcys*, *Eatonica*, and *Elassoneuria* are not known from the South West Cape. It may be stated with fair certainty that they do not occur here. They represent a tropical element which extends from Central Africa south-eastwards to Natal and possibly to the Eastern Province. In the Transvaal also, at least in the eastern and northern parts, they will almost certainly be found to occur, as well as in Rhodesia.

Both these regions are an untouched field as regards May-flies. From the small collection of nymphs made by Mr. Dendy it is possible to state that the genera *Eatonica* (subimago), *Austroclleon*, *Centroptilum*, *Adeno-*

phlebia, *Castanophlebia*, and *Euthraulius* occur in the Transvaal. *Aprionyx*, *Adenophlebia*, *Centroptilum*, *Cloeon*, and *Afronurus* are known to extend to Natal (including Zululand). In Rhodesia only *Eatonica* and *Cloeon* are recorded. In Ovamboland the genera *Eatonica*, *Cloeon*, *Pseudocloeon*, *Centroptilum*, *Centroptiloides*, and *Afronurus* have been collected.

Tricorythus occurs from Egypt to South Africa; it is known from one locality in the Orange Free State, from Zululand, and probably occurs also in the Transvaal. It appears to be absent in the extreme South West Cape, *i.e.* west, south-west, and south of Tulbagh and Worcester in the valleys of the Little Berg and Breede Rivers respectively. Mr. Harrison has not found its peculiar and distinctive nymph in either the Berg River or Eerste River systems, or in the Holsloot (Louwshoek) and Smaalblaar (Du Toits Kloof), which are tributaries of the Breede River, but arising in the mountain massif (Wellington-Slanghoek-Goudini) to the south.

Physiographically the river at Tulbagh belongs to the Breede River system, as prior to its capture by the Little Berg River cutting through Tulbagh Poort (see map in the second of these reports: Trans. Roy. Soc. S.A., vol. xviii, pl. 1) it formed the head-waters of the Breede River. The presence of *Tricorythus*, therefore, at Tulbagh is not surprising. But its absence in the tributaries flowing into the Breede River *from the south* is surprising, and at present inexplicable. Perhaps, when we know more about its distribution and the factors governing its existence, it may prove to be an interesting if not important item of evidence in the history of the Cape mountains. At present it is the only one of the Cape May-flies which indicates possibilities in this direction.

Perhaps the chief feature of the May-fly fauna of the South West Cape is the abundance of Leptophlebiids and the presence of two representatives of the *Ephemerellidae*.

Apart from such low-lying localities as Lakeside and the pond in the Worcester Memorial Park, and also the actual ponds in the Jonkershoek Trout Hatcheries, in which the water is still or only feebly flowing, all the localities examined by Mr. Harrison and myself are typical swift-running mountain streams. In the case of Michell's Pass (Ceres to Wolseley), Hex River Poort, and Tradouw Pass, it would be more correct to say rivers. During the winter months (April or May to September and October) they are all liable to sudden and considerable spates.

To be correlated with this liability to severe floods is probably the fact that in these rivers and streams the large smooth-clawed Leptophlebiid (*A. tabularis*) nymphs are absent, whereas specially adapted forms like *Tricorythus*, *Afronurus*, *Lithogloea*, and even *Adenophlebia*, which is comparatively unspecialised but has denticulate claws, are abundant. In the

larger pools, however, *A. tabularis* grows very rapidly in late summer when the rivers are low and vegetable detritus tends to accumulate.

Characteristic of the smaller waterfalls and chutes in the smaller streams are Baetids (*B. harrisoni* and *Centroptilum sudafricanum*) and *Castanophlebia*.

Seasonal Occurrence.—As records are so few and so little intensive collecting has been done in any region except the South West Cape, it is no use discussing the seasonal appearance of the flies except in this region. The data derived from Mr. Jones's Zululand collecting, however, may be mentioned, as this was continued throughout the year over a number of years: *Polymitarcys*, February; *Eatonica*, December; *Elassoneuria*, February to April; *Austrocloeon africanum*, September and December; *Centroptiloides*, September, December, February, March, April; *Tricorythus discolor*, October; *Afronurus peringueyi*, September, October, December, February, March, April. All these records lie within the period of summer rainfall; and there appears to be a gap from April to September when Mr. Jones obtained no May-flies. These records are of the larger and more conspicuous species, and it is probable that the gap is a reality. On the other hand it is almost certain that with further collecting some species, especially the smaller inconspicuous species, will be found at all seasons of the year.

Experience has shown that in the South West Cape there is not a month in which May-flies of one species or another may not be found. At first it did seem that certain species appeared at definite seasons; but in the case of the more abundant species continued observations have proved the extension of what was considered the "season" by several weeks or a month or two. In certain cases it now seems that the flies emerge throughout the year in a succession of broods.

The emergence of some species may be continuous and their abundance nearly uniform (e.g. *Castanophlebia*), though there may be a "peak" or maximum (e.g. *Afronurus*). Other species (e.g. *Austrocaenis* and *Tricorythus*) emerge in large swarms at intervals.

The following chart indicates the seasonal occurrence of 30 Cape species. It is only a preliminary conspectus, and many of the gaps in it will be filled up by future observations. But it shows that there is a greater abundance of flies during the summer and especially the autumn months (October to April), a period which in the Cape coincides with the period of least rainfall. A noteworthy contrast with what appears to be the case in Natal. It must, however, be borne in mind that as a rule more collecting is done during the summer than the winter months. In the case of *Afronurus harrisoni* the times of maximum abundance of the two forms are shown, f. *major* at New Year, f. *minor* in February–March.

Months beginning June = VI.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	I.	II.	III.	IV.	V.
<i>Cloeon lacunosum</i>	—————								—————			
„ <i>delicatissimum</i>												
„ <i>aeneum</i>					—							
„ <i>chaplini</i>	—							—				
„ <i>perkinsi</i>												
<i>Austrocloeon africanum</i>												
„ <i>virgiliae</i>	—————							—				
<i>Pseudocloeon vinosum</i>					—							
„ <i>magae</i>												
<i>Baetis harrisoni</i>	—————											
„ <i>bellus</i>	—											
<i>Centroptilum sudafricanum</i>	—————											
„ <i>excisum</i>												
<i>Austrocaenis capensis</i>												
<i>Tricorythus discolor</i>												
„ <i>reticulatus</i>												
<i>Aprionyx tabularis</i>	—											
„ <i>peterseni</i>												
„ <i>intermedius</i>												
„ <i>rubicundus</i>												
„ <i>pellucidulus</i>												
<i>Adenophlebia peringueyella</i>	—————											
„ <i>westermanni</i>												
<i>Castanophlebia calida</i>	—————											
<i>Choroterpes nigrescens</i>												
<i>Euthraulus elegans</i>												
<i>Ephemerellina barnardi</i>												
<i>Lithogloea harrisoni</i>												
<i>Afronurus harrisoni</i>												
<i>Acentrella capensis</i>												
Total species 30	10	8	8	12	18	11	11	14	9	16	18	11

Key to the Suborders (Ulmer, 1920).

1. In fore-wing M_{1+2} and Cu_1 strongly divergent from base. Hind tarsus with only four (or fewer) freely movable joints (5th joint, if indicated, immovably fused with tibia) Ephemeroidea.
2. In fore-wing M_{1+2} and Cu_1 parallel at base, or only slightly divergent.
 - a. Hind tarsus with four freely movable joints (5th joint, if indicated, fused with tibia) Baetoidea.
 - b. Hind tarsus with five movable joints Heptagenioidea.

SUBORDER EPHEMEROIDEA.

Key to the South African Families (after Ulmer).

1. Wings milky. No disconnected intercalaries on hind margins. Legs weak, hind legs short and feeble Polymitarcidae.
2. Wings clear. Numerous short disconnected intercalaries on hind margins, especially in hind-wing. Legs strong Ephemeridae.

Family POLYMITARCIDAE.

Ulmer, 1920, p. 102.

Only one genus in South Africa.

Gen. *Polymitarcys* Eaton.

Eaton, 1883, p. 43, and pl. xxviii (nymph); Ulmer, 1920, p. 107; Lestage, 1921, p. 188, fig. 47 (nymph).

In fore-wing the fork of MA is distal to the fork of RS. Two or more intercalaries proximal to Cu_1 , connected by cross-veins, and converging basally. Genital styles in ♂ 4-jointed; penis bilobed. Cerci in ♂ 2, very long, in ♀ 3, shorter.

Nymph narrow, cylindrical. Eyes lateral; antennae longer than head; mandibles robust, elongate, projecting like forceps in front; labial and maxillary palps 2-jointed. Legs rather short, front pair stout. First gill minute, simple; 2nd-7th gills bifurcate, folded dorsally over abdomen, margins serrate. Cerci 3.

Habits.—The nymphs burrow in the mud of slowly running rivers and streams.

Polymitarcys savignyi (Pict.).

Eaton, 1883, p. 46, pl. vi, fig. 10b (a S. African sp.); Esben-Petersen, 1913, p. 178 (*capensis*); Navas, 1915, p. 172, fig. 1 (*temerata*); Lestage, 1918, p. 76, fig. 1 (egg-mass); Ulmer, 1920, p. 107; Lestage, 1924a, p. 319.

The nymph of this species has not yet been found in South Africa.

Localities (adult).—Zululand (S.A.Mus.); Pietermaritzburg, Natal (Warren. Nat. Mus.).

Distribution.—Egypt; Cameroons; Togo; Belgian Congo; Zambezi.

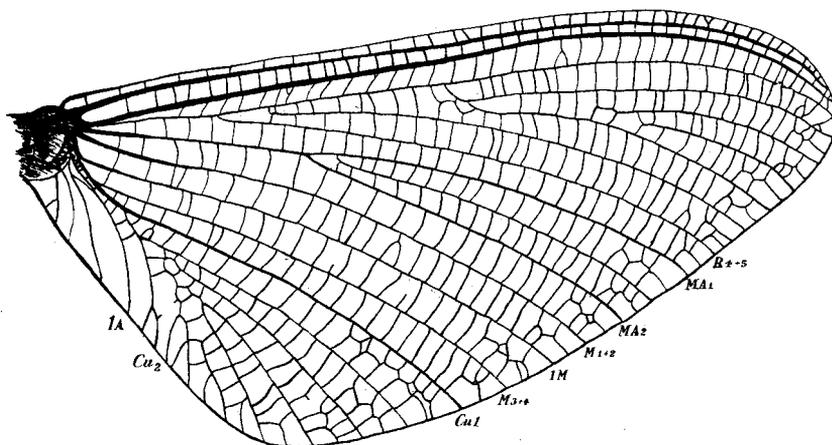


FIG. 1.—*Polymitarcys savignyi* (Pict.). Fore-wing ♀ imago.

Family EPHEMERIDAE.

Ulmer, 1920, p. 107.

Key to the South African Genera.

1. Cerci 3, well developed, subequal, in both sexes. Genital styles of ♂ 4-jointed. Prothorax of ♀ broader than long Ephemerica.
2. Cerci 2 in ♂, 3 in ♀. Genital styles of ♂ 3-jointed. Prothorax of ♀ longer than broad. Fatonica.

Gen. *Ephemera* Linn.

Eaton, 1883, p. 58; Ulmer, 1920, p. 109; Lestage, 1921, p. 182 (nymph).

Fore leg of ♂ about $\frac{3}{4}$ length of body, tarsus about $1\frac{1}{2}$ times as long as tibia and about 4 times as long as femur; in ♀ tarsus subequal to tibia. Genital styles of ♂ 4-jointed, the 2nd joint longest, 3rd and 4th short; penis bilobed. Cerci 3 in both sexes, well developed, subequal. Prothorax of ♀ broader than long.

Nymph burrowing in mud. Head with 2 more or less prominent projections in front. Mandibles with long subulate tusks. Legs strong. Cerci 3. Gills 7 pairs, all narrow, bilobed, the 1st pair small, simple, the others with the margins strongly fringed.

Remarks.—The occurrence of this genus in Africa rests on some fragmentary specimens recorded by Eaton (1913) from Nyasaland and Uganda. The species described below constitutes therefore the first definite record of this genus in Africa.

Ephemera natalensis n. sp.

Imago.—♂. 10th sternite in ♂ distally excised, the lateral portions forming bases for the styles; penis apically bilobed, the lobes narrow and widely divergent, a pair of sharply pointed processes (Eaton: stimuli) on ventral surface.

Eyes black (*in sicco*). Thorax and abdomen warm castaneous brown; the abdominal segments dorsally marked with a dark stripe near the lateral margins, more conspicuous on the posterior than the anterior segments. Legs

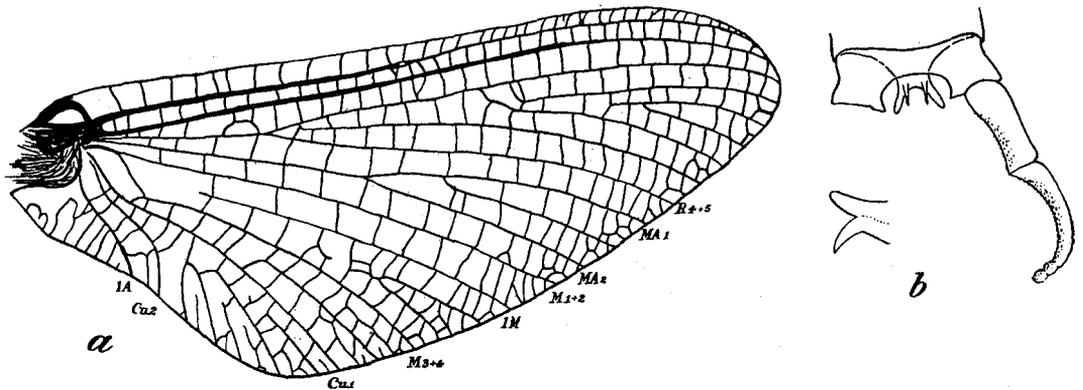


FIG. 2.—*Ephemera natalensis* n. sp. a, fore-wing ♂ imago; b, forceps and penis ♂, ventral view, and lateral view of penis.

fulvous. Cerci fulvous, narrowly annulated. Wings faintly tinged with brown, with an inconspicuous spot at the fork of MA, and the margin of hind-wing slightly darker; neuration fulvous brown, Sc and R dark brown, cross-veins slightly thickened with brown suffusion.

Body 13–14 mm., wing 12–12.5 mm., cerci about 20 mm.

Locality.—Pietermaritzburg, Natal (Akerman, 1916, Natal Mus.).

Remarks.—I am indebted to Dr. Warren, Director of the Natal Museum, for submitting the two ♂♂ on which this species is instituted. In coloration it resembles the European *vulgata*, as far as can be judged *in sicco*, but is distinguished by the penis.

Gen. *Eatonica* Navas.

Navas, 1912 (Tr. 2 Entom. Congr.), pp. 180, 181; Ulmer, 1920, p. 109; Lestage, 1923A, p. 304.

Fore leg of ♂ $\frac{3}{4}$ as long as body, tarsus about $1\frac{1}{2}$ as long as tibia, in ♀ subequal to tibia. Genital styles ♂ 3-jointed; penis bilobed. Cerci 2 in ♂, 3 in ♀; in the ♀ the median one is shorter and more slender than the lateral ones. Prothorax of ♀ longer than broad.

The nymph is unknown, but may be expected to resemble that of *Ephemera* (Eaton, 1884, pl. xxx; Lestage, 1921, fig. 45) in general; that is, it is a mud-burrower, with projecting tusk-like mandibles.

Eatonica schoutedeni (Navas).

Navas, 1911 (Ann. Soc. Sc. Bruxelles, 1910), p. 222, fig. 3; Esben-Petersen, 1913, p. 179 (*Hexagenia fulva*); Eaton, 1913, p. 276, fig. (*Hexagenia illustris*); Navas, 1915 (Mem. R. Ac. Ci. Barcel., xi.), p. 373 (*nimia*); Lestage, 1918, p. 82, figs. 2, 3; Needham, 1920, p. 38, pl. v, figs. 1, 2 (*Pentagenia s.*); Lestage, 1923A, p. 304, and 1924A, p. 320.

Imago.—A dark band on either side of pro- and meso-thorax, and characteristic dark marks dorso-laterally on the pale whitish abdominal segments.

Remarks.—The type of *H. fulva* E. P. ♀ has the stumps of 3 cerci clearly visible. The Wankie ♀ also has 3 stumps, and the Durban ♀ still retains the 3 cerci intact. A ♂ from South West Africa has a minute rudiment of the median cercus (*cf.* Eaton's figure), as has also the ♂ imago from Pietermaritzburg. The ♀ from Wankie is very small: body 12 mm., wing 14 mm., thus being even smaller than Navas' *nimia*.

Localities.—Zululand ; Durban (S.A. Mus.) ; Wankie, S. Rhodesia (S.A. Mus.) ; Sabi, Transvaal (S.A. Mus.) ; Andoni, Ovamboland, S.W.A. (Jan. 1921, K.H.B.) ; Pietermaritzburg (Natal Mus.).

Distribution.—Belgian Congo ; French Congo ; Cameroons ; Togo ; Uganda ; Tanganyika ; Abyssinia.

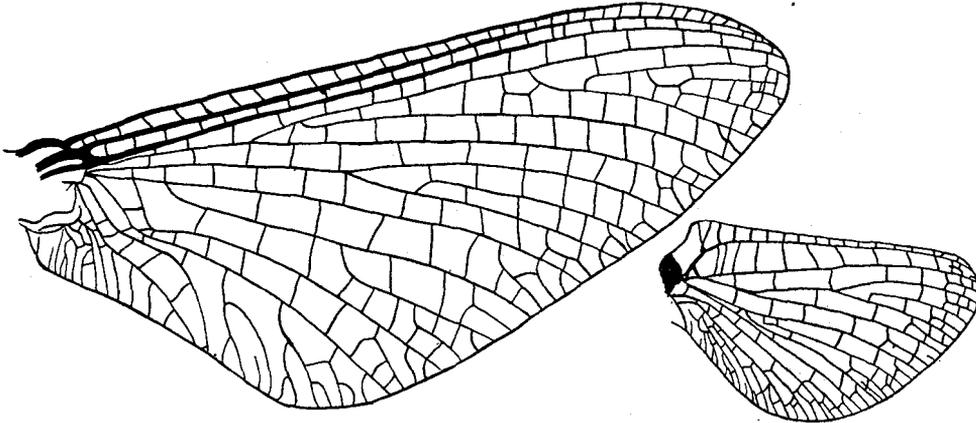


FIG. 3.—*Eatonica schoutedeni* (Navas). Fore- and hind-wings ♀ imago.

SUBORDER BAETOIDEA.

Key to the South African Families (after Ulmer).

- I. In fore-wing Sc united with R. Wings milky or cloudy, with very few veins *Oligoneuriidae*.
- II. In fore-wing Sc distinct from R.
 - A. In fore-wing MA not forked. Usually few cross-veins. Hind-wings very small or absent *Baetidae*.
 - B. In fore-wing MA forked.
 - 1. Fore-wings cloudy, ciliate on hind margin, no disconnected intercalaries, cross-veins few. Hind-wings absent *Brachycercidae*.
 - 2. Fore-wings clear, with numerous cross-veins. Hind-wings present.*
 - a. In fore-wing Cu_2 nearer to 1A than to Cu_1 at base. No disconnected intercalaries between M_{3+4} and Cu_1 . Genital styles of ♂ with 2 short terminal joints *Leptophlebiidae*.
 - b. In fore-wing Cu_2 nearer to Cu_1 than to 1A at base. Several, usually 2, disconnected intercalaries between M_{3+4} and Cu_1 . Genital styles ♂ with one short terminal joint *EphemereIIDae*.

Family OLIGONEURIIDAE.

Ulmer, 1920, p. 127.

Wings milky or cloudy. In fore-wing Sc united with R. Very few longitudinal veins (4-7). In hind-wing cross-veins absent, or a few in basal part.

Only one genus in South Africa.

Gen. *Elassoneuria* Eaton.

Eaton, 1883, p. 32 ; Ulmer, 1920, p. 129 ; Lestage, 1916, p. 314, figs. 1-5, and 1917, p. 122, fig. 1 (nymph).

In fore-wing between R and Cu two strong longitudinal veins, of which the first arises at base of wing, the second from the first shortly before middle of wing. Between this second vein and Cu a long indistinct vein which arises from the first vein. Numerous very indistinct cross-veins. Cu forked. Genital styles of ♂ 3-jointed, 1st joint very long ; penis bilobed. Cerci 3.

Nymph in general resembling that of *Oligoneuria* (Eaton, pl. xxvi ; Lestage, 1921, fig. 54). Flattened, head more or less rounded, eyes dorsal. Antennae short. Mandibles short, not visible from above. Upper lip transverse, entire, setose. Maxilla with a bunch of branched gills at base. Femora stout, tibiae and tarsi rather slender ; femur and tibia of fore leg with long plumose hairs. Gills double, consisting of a lamella and a bunch of branched fibrillae ; 1st gill inserted ventrally, lamella very small ; 2nd-7th gills inserted dorsally, the lamella considerably larger than, and covering, the bunch of fibrillae. Cerci 3, not longer than abdomen.

By analogy with the European *Oligoneuria* this nymph should be sought for under stones in slowly flowing rivers.

The following brief explanation of the simplified neuration of the fore-wing may be given. The simplification is only apparent, and the key to the explanation is found in the position of Sc. Although the subcosta is stated to be united with R, it is not really so. It is a concave vein, and lies in the groove formed by the approximation of R to C by folding of the membrane. This fold is quite appreciable and it obliterates the pterostigmal area with its distinct cross-veins ; consequently in the dried wing C and R appear to run into one another. Eaton's figure (pl. iii, fig. 3) is evidently taken from a dried wing, and gives no hint of the true venation.

* Absent in *Hagenulodes* and *Hagenulopsis* (*Leptophlebiidae*).

When a wing is relaxed in hot water and examined in fluid the true relationships of the veins can be traced. The folding of the membrane, causing Sc to underlie R_1 , occurs also in connection with the other large veins. The concave vein R_2 lies close up against the posterior side of R_1 . The peculiar kinks in the cross-veins running apparently from R_1 , but in reality from R_2 , seem to indicate the course of the suppressed vein R_3 .

Examination of the big forked vein also shows folding of the membrane causing the concave veins R_{4+5} and M_{1+2} to underlie the convex MA. The intercalaries of Rs, MA, and M are entirely suppressed. M_{3+4} , however, is still traceable as a very faint vein arising proximally from M (not from the base of MA) and distally branching into an extremely fine reticulation.

The same approximation of veins occurs in connection with Cu and A. The fork of Cu is distinct, and close under Cu_1 lies I Cu. IA is approximate to Cu_2 .

Thus throughout the wing the membrane has been pleated near the convex veins, and the chief concave veins come to underlie the former, while the intercalaries (except I Cu) have been suppressed.

An examination of the wing-cases of the nymph would prove most interesting, and also the comparison of properly prepared wings of the other Oligoneuriid genera with that of *Elassoneuria*.

It is curious to see that an approximation of the concave veins to the convex veins, at least distally, has taken place in the genera *Anagenesia* and *Plethogenesia* belonging to the preceding suborder *Ephemeroidea*. This approximation leads to a division of the wing into broad areas in which the cross-veins tend to disappear, and a somewhat scalloped wing margin (Eaton, pls. i and ii, "Palingenia").

The whole anal-cubital margin of the fore-wing of *Elassoneuria* can be linked with the costal margin of the hind-wing, and the two together form a wing of considerable expanse.

Elassoneuria trimeniana (M'Lach.).

Eaton, 1883, p. 32, pl. iii, fig. 3; Navas, 1911 (Ann. Soc. Sci. Brux.), p. 221, fig. 2 (*congolana*); Eaton, 1913, p. 272, fig. 1 (*candida*); Esben-Petersen, 1913, p. 177; Lestage, *loc. cit. supra* (nymph); Lestage, 1924A, p. 346; Navas, 1926 (Broteria, xxiii), p. 102, and 1930 (*ibid.*, xxvi), p. 16.

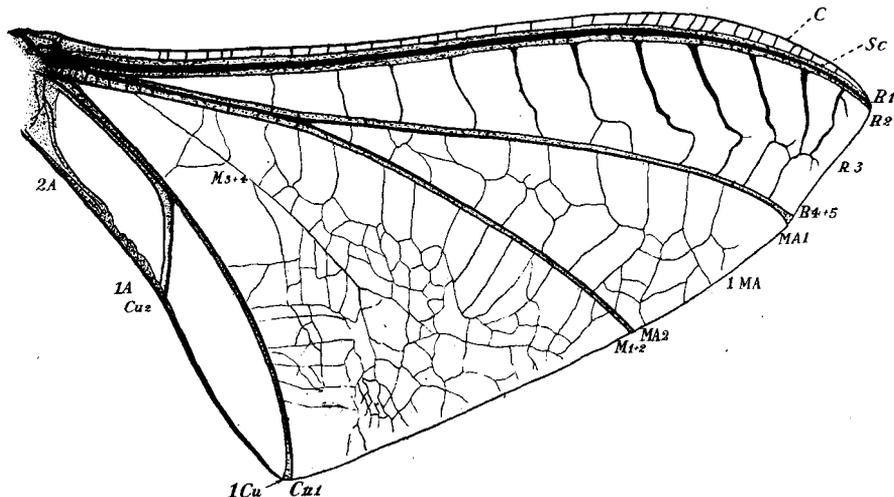


FIG. 4.—*Elassoneuria trimeniana* (M'Lach.). Fore-wing ♀ imago.

One of the Natal Museum specimens had a large irregular pale-green egg-mass attached to it. When placed in water the green colour faded to yellow, and the eggs separated. They are broadly oval or subrotund, 4–5 mm. long diameter, surface feebly reticulated, without attachment threads. A small mass of eggs attached to one of the South African Museum specimens is orange in colour.

Localities.—Umvoti, Natal (at light, March 1867); M'fongosi, Zululand (February, March, and April, S.A. Mus.); Pietermaritzburg (at light, April 1931, Natal Museum).

Distribution.—Belgian Congo; Cameroons; Southern Nigeria; Madagascar. The nymph has been recorded from the Belgian Congo.

Family BAETIDAE.

Ulmer, 1920, p. 123.

Imago.—Subcosta well developed, distinct. MA and M simple, MA_2 and M_{3+4} disconnected. Cross-veins usually few. Hind-wings absent, or if present very small and (usually) narrow, with 1–3 veins and a few cross-veins. Wings hyaline. Eyes turbinate in ♂.

Nymph.—Swimming type. Head more or less bent downwards. Labium with lobes longer than broad, palp 2–3 jointed. Maxillary palp 2–3 jointed. Cerci 2–3, strongly ciliate. Gills 7 pairs (occasionally only 6), lamellate, single or double.

In connection with this question, it may be mentioned that a ♀ of *A. virgiliae* from the Clovelly locality (p. 220) emerged from the nymph on 29th June (imago, 30 hours later) and lived until 7th August, i.e. 40 days. Three ♂♂ were put into her cage, one by one, but no mating was observed. The average life of each ♂ was 14 days. It is probable that mating occurs only during flight. The body of this ♀ was examined after death and found to contain a comparatively small number of eggs, all of which were unfertilised. The longevity of this ♀ seems to suggest ovoviviparity, as in the case of *C. dipterum*. Cf. literature quoted by Lestage, 1921, p. 250.

Eaton first recorded this genus from South Africa (Trans. Entom. Soc., 1871, p. 103, and Monograph, p. 186). Esben-Petersen has described a species from South Africa, and Lestage has added two from the neighbouring region of the Congo. Seven further species are here described together with the nymphs of three of them.

The adults of all these species show the typical venation of *Cloeon*, as opposed to that of *Procloeon*, in which latter genus the 1st cross-vein between R_1 and R_2 meets the latter opposite to or distal to the cross-vein between R_2 and $1R_2$.

The nymphs, on the other hand, diverge from the typical *Cloeon* nymph (cf. Eaton, 1885, pl. xlvii, and Lestage 1921, fig. 66) in the composition of the gills and the maxillary palp.

As regards the gills, typical *Cloeon* has the 1st-6th pairs double, the 7th single; *lacunosum* n. sp. has the 1st and 7th single, the others double; *africanum* and *virgiliae* n. sp. have the 1st-5th pairs double, the 6th and 7th single. There might be a possibility of splitting up the genus *Cloeon* on this character of the gills, but for the fact that in several European species a certain amount of variation occurs in the proportional size of the two lamellae composing each double gill (cf. Lestage, 1921, key to species, p. 252); and although the five European species agree in the typical gill formula (1st-6th double, 7th single) it is no great jump from the reduction of the inner lamella to its complete suppression.

There is, however, the character of the maxillary palp. This is typically 3-jointed, but in *praetextum* it is only 2-jointed (Lestage, 1921, p. 252). In the allied genus *Procloeon* it is also 2-jointed and slender, especially the long 2nd joint.

In the South African nymphs, while no great importance can be attached to the differences in the gill formula, we find that two species possess the slender 2-jointed maxillary palp of *Procloeon*. It may be noted that they possess also the marked clavate apex of the labial palp found in *Procloeon*. Associated with these features, however, the adult possesses the typical venation of *Cloeon*. Therefore either *Procloeon* is not justified, or the institution of another genus for the two South African species *africanum* and *virgiliae* is required.

The latter course is adopted, though at the present moment it leads to the inconvenience of assigning five species to *Cloeon*. The future discovery of their nymphs will show to which genus they should really be assigned.

Eaton's record of a species of *Cloeon* from Knysna may possibly refer to either *africanum* or *virgiliae*.

Key to the South African Species.

1. 4 cross-veins before bulla.
 - a. Marginal area in ♀ deep amber, with clear, window-like spots *lacunosum*.
 - b. Marginal area pale yellow, two dark spots in subcostal area below pterostigma *rhodesiae*.
2. No cross-veins before bulla.
 - a. Cross-veins faint or very faint.
 - i. 2-3 incomplete cross-veins in pterostigmal area. Wing ♀ 3.25 mm. *delicatissimum*.
 - ii. Several, some incomplete, cross-veins in pterostigmal area. Wing ♀ 5.5 mm. *aeneum*.
 - iii. 6-8 complete, some forked, cross-veins in pterostigmal area. Wing ♀ 9 mm. *chaplini*.
 - b. Cross-veins well marked, opaque, whitish or yellowish. 4 cross-veins in pterostigmal area *perkinsi*.

Cloeon lacunosum n. sp.

Imago.—In the costal area 4-6 extremely faint cross-veins before bulla, 6-8 beyond bulla, those in the pterostigmal area oblique, complete; in subcostal area 2-4 cross-veins. Cross-veins in distal part of wing connecting $Sc-R_1-R_2-1R_2$ present.

Body ♂ 5 mm., ♀ 6-7 mm.; wing ♂ 5 mm., ♀ 6-7.5 mm.; cerci ♀ 9 mm.

Head white, with two brown submedian longitudinal narrow streaks in ♀. Eyes pale French-grey, with two horizontal (in lateral view) dark stripes, in ♂ lower eyes as in ♀, turbinate eyes pinkish-orange. 1st, 3rd, and ventral part of 2nd joint of antenna white, dorsal part of 2nd joint brown, remaining joints brown. Prothorax white, with medio-dorsal and submedian brown longitudinal stripes. Meso- and meta-thorax straw or pale amber-coloured, the sutures mostly marked in brown, a medio-dorsal dark line flanked on either side by a white streak; laterally white, appearing in some cases almost silvery. Abdomen brown, darkest medio-dorsally, but somewhat mottled or speckled, dorso-laterally pale grey-brown, with a short dark streak on each segment; ventro-laterally pale grey or almost white, with a black speck on each segment; medio-ventrally pale brown, somewhat speckled. In ♂ thorax and abdomen as in ♀, but prothorax brown, meso-thorax darker, the lateral portions not so pale. Legs fulvous in ♀, pale straw in ♂, femora with faint darker longitudinal stripes. Cerci white, with narrow dark annulations. Genital styles of ♂ white. Wings hyaline, quite clear in ♂, but C, Sc, and R pale yellow; in ♀ costal and subcostal areas pale castaneous or fulvous, with a series (5-10) of hyaline, window-like, linear or narrow-oval spots, mostly extending between C and Sc, but sometimes developed only on C. Cross-veins faintly visible in these spots. Pterostigmal cross-veins and the 3 cross-veins in radial area (especially the 2 proximal ones of the latter) whitish.

Subimago.—Similar, with the castaneous marginal coloration in ♀, but the hyaline spots not, or very faintly, developed.

Nymph.—Abdominal segments 1-9 minutely denticulate dorsally and ventrally on posterior margins, the denticles confined to the median portion anteriorly, but extending to the lateral margins posteriorly, and on to the

lateral margins from the 5th or 6th segment onwards. Mouth-parts as figured. Legs moderately slender, femora with short simple spines, tibiae and tarsi with longer and more densely set simple spines; claws finely pectinate. First gill with only a single lamella, the outer margins of the 7th and of the lower lamellae of 2nd-6th gills with a few setae.

Up to 7.5 mm.; cerci 3 mm.

In life semitransparent, white, greenish or yellowish, the wing-cases of full-grown nymphs ready for edysis castaneous. Eyes black, ocelli greyish. Abdomen in full-grown nymphs showing the same colour pattern as the adult. Cerci pale, with dark annulations not corresponding with the segmentation.

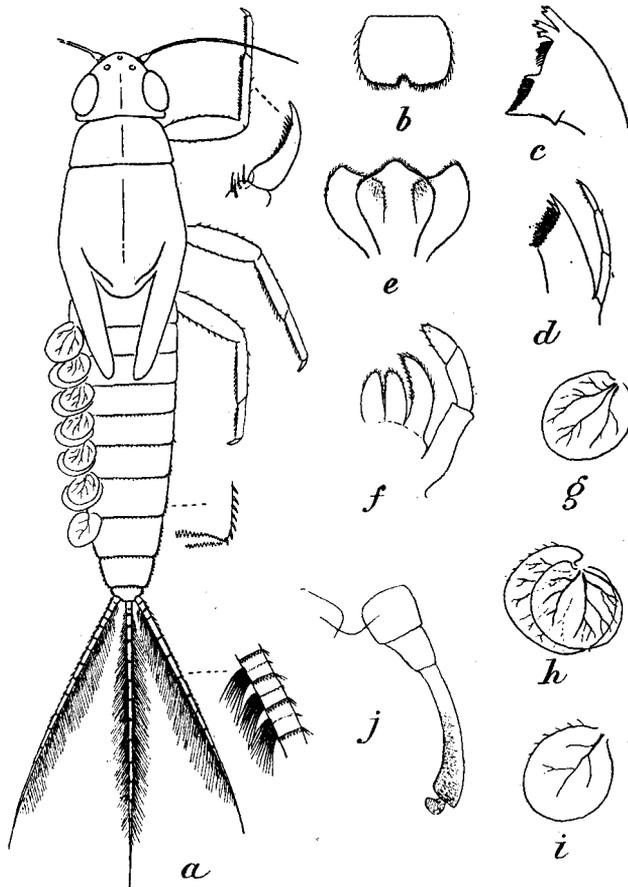


FIG. 6.—*Cloeon lacunosum* n. sp. a, nymph, with claw, abdominal segment, and portion of lateral cercus further enlarged; b, labrum; c, mandible; d, maxilla; e, hypopharynx; f, labium; g, h, i, 1st, 3rd, and 7th gills respectively; j, forceps of ♂ imago.

Localities.—Lakeside and Kalk Bay, Cape Peninsula (A. C. H.); Table Mt. (March 1920 and January 1928, K. H. B.); Rondebosch, Cape Peninsula (A. T. Packham); Jonkershoek, Stellenbosch (May 1931, A. C. H. and K. H. B.); Potteberg, Bradasdorp Div. (A. T. Packham).

Remarks.—Closely allied to *C. dipterum*, but differing in the coloration of imago and the castaneous costal margin of subimago and in the single first gill of nymph.

Habits.—This species inhabits still waters, or slowly flowing streams; it is abundant at Lakeside, and occurs also at Clovelly, Kalk Bay; and in the ponds at the Jonkershoek Trout Hatchery. Subimagos and imagos have been found in the months of January to March, May, June to August.

The nymphs in all stages can be found at nearly all seasons, and the species seems to go on throughout the year in a succession of hatches. The nymphs closely match the algae among which they live; the first 6 pairs of gills are in constant motion, but the 7th pair is held out rigidly at right angles to the body.

Cloeon rhodesiae n. sp.

Imago.—♀. 4 cross-veins before bulla, 6-7 in pterostigmal area, simple, oblique, thickened. 6-7 subcostal cross-veins. Cross-veins connecting Sc-R₁-R₂-1R₂ distally present.

Body 6 mm.; wing 6.5 mm.; cerci 14 mm.

Head, thorax, and abdomen pale ochraceous or yellow. Abdominal segments with a medio-dorsally raw-sienna stripe, which in some segments is triangular, narrow anteriorly, widening posteriorly; a triangular castaneous patch in postero-lateral corner of segments 3-6 dorsally, a castaneous streak near ventro-lateral margin on segments 1-7. Legs pale yellow. Cerci whitish, with narrow castaneous annulations. Wings clear, costal and subcostal areas pale yellow, leaving a clear white space around each of the indistinct cross-veins, except those in pterostigmal area, which are bright orange or burnt-sienna; a dark brown spot on either side of the cross-vein in costal area immediately before the bright pterostigmal cross-veins, and a more conspicuous dark spot, almost black, on either side of the cross-vein below the 1st bright pterostigmal cross-vein; apical cell in subcostal area, and the apical portion of apical cell in radial area suffused with dark brown.

Localities.—Salisbury, S. Rhodesia (May 1917, R. W. E. Tucker); near Erikson's Drift, Kunene River, Ovambo-land (March 1923, K. H. B.).

Remarks.—Both specimens agree in having the prettily marked wings and the conspicuous dark brown spots, but the Kunene River specimen shows no castaneous markings on the abdomen.

Cloeon delicatissimum n. sp.

Imago.—♀. No cross-veins before bulla, 2-3 very faint and incomplete cross-veins in pterostigmal area; cross-veins almost absent in MA, M, and Cu areas, the one or two that are present being extremely faint. No cross-veins distally connecting Sc-R₁-R₂-1R₂.

Body 3 mm.; wing 3.25 mm.

Pale fulvous-brown, almost uniform, some of the mesothoracic joinings slightly darker and also the posterior margins of the abdominal segments. Wings clear, pterostigmal area clear or very slightly suffused, neuration pale brown. Cerci lost.

Locality.—Wolvenhoek Kloof, French Hoek (April 1931, K. H. B.).

Remarks.—Only 4 ♀♀ imagos of this species have been taken. Its small size and venational characters render it distinct from the other species. The nymph is unknown, and the species is therefore included in *Cloeon*.

Cloeon aeneum n. sp.

Imago.—♀. No cross-veins before bulla, several slightly oblique simple cross-veins in pterostigmal area, some of them incomplete. No cross-veins distally connecting Sc-R₁-R₂-1R₂.

Body 5 mm.; wing 5-5.5 mm.

Head yellowish, slightly darker medianly between eyes. Pro-, meso-, and meta-thorax warm brown, rather bronzy in life, mesothorax with lighter markings, in particular a dark-bordered light horizontal streak in front of base of wings, scutellum pale yellowish, with dark brown on either side; thorax paler ventrally. Abdomen brown, uniform, paler ventrally. Legs pale straw, with faint longitudinal suffusion on femora. Cerci lost. Wings hyaline, venation faint grey, a dark suffusion at base of Sc and R.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (H. G. Wood); Lilyfontein, Kamiesberg (September 1931, K. H. B.); Grahamstown (Albany Mus.).

Remarks.—A considerably smaller species than *chaplini* and differing in the character of the fewer pterostigmal cross-veins. Differing in the same respect from *delicatissimum* as well as being larger. Only ♀ specimens have been found, in the months of March and April.

Cloeon chaplini n. sp.

Imago.—No cross-veins before bulla, 6-8 oblique, partly forked, but complete cross-veins in pterostigmal area occasionally one or two incomplete ones. No cross-veins distally connecting Sc-R₁-R₂-1R₂.

Body ♂ 7 mm., ♀ 9 mm.; wing ♂ 7 mm., ♀ 9.5 mm.; cerci ♂ 7.5 mm.

Head and prothorax brown. Mesothorax brown, with pale medio-dorsal line, and lighter marks laterally and ventrally. Metathorax brown. Abdomen raw-sienna dorsally, posterior margins of the segments slightly darker, burnt-sienna; ventrally pale creamy, a dark longitudinal stripe laterally immediately below the pleura on segment 9. Legs pale ochraceous. Cerci whitish, with faint narrow sienna annulations. Wings clear, costal area colourless but faintly opaque in pterostigmal area, neuration pale yellowish. ♀ like ♂ but paler.

Subimago.—Similar to imago, but abdomen paler, and the posterior margins of the segments brighter, orange-brown. Wings pale creamy, neuration very pale, cross-veins almost invisible.

Locality.—Jonkershoek, Stellenbosch (F. G. Chaplin, A. C. H., and K. H. B.).

Remarks.—This is the largest *Cloeon* yet found in South Africa. Specimens were taken in "Midsummer" and end of May by Mr. Chaplin, and in May by A. C. H. and K. H. B.

The absence of the distal cross-veins connecting Sc-R₁-R₂-1R₂ easily distinguishes the ♂ of this species from the clear-winged ♂ of *lacunosum*, and also from *perkinsi*.

Cloeon perkinsi n. sp.

Imago.—♀. No cross-veins before bulla, 4 (5) in pterostigmal area. Cross-veins connecting Sc-R₁-R₂-1R₂ distally present.

Body 5 mm.; wing 5.5 mm.; cerci 8 mm.

Head creamy-white, two orange-red or castaneous longitudinal stripes between eyes and ocelli, a narrow ring of the same colour around base of eye, basal joints of antennae with same colour dorsally. Prothorax white, with a broad medio-dorsal stripe of reddish-brown and a lateral stripe of the same colour on either side. Mesothorax creamy-white, the lateral prothoracic reddish stripe continued through base of wings, dorsum with two longitudinal pale drab stripes separated by a very narrow pale medio-dorsal line and continued as a single median stripe on scutellum, the sides of latter white. Metathorax with dorso-lateral reddish stripe continued, but broader. Pro-, meso-, and meta-thorax ventrally creamy-white. Abdomen creamy-white, a narrow medio-dorsal brick-red stripe, laterally a broad stripe of same colour, then a narrow white stripe followed on the pleurae by a narrow red line (*i.e.* there are dorsally five red stripes); ventrally creamy-white. Legs creamy, front femur suffused with orange. Cerci

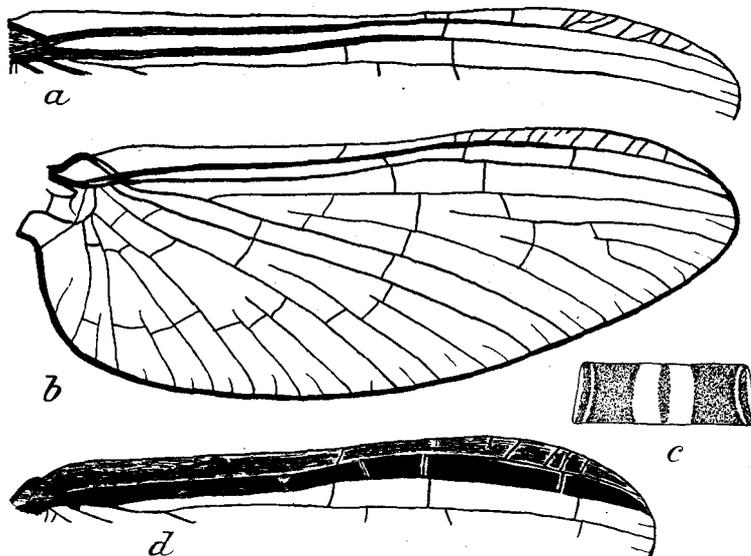


FIG. 7.—*Cloeon*. *a*, *chaplini* n. sp., marginal area of fore-wing ♀ subimago; *b*, *aeneum* n. sp., fore-wing ♀ imago; *c*, *d*, *perkensi* n. sp., abdominal segment and marginal area of fore-wing of ♀ imago.

white, with narrow red-brown annulations, which are much less numerous than the articulations. Wings clear, marginal area yellowish, subcostal area fulvous, both pellucid, cross-veins in marginal area opaque, pale yellow, the other cross-veins brownish like the longitudinal veins; by transmitted light the three submarginal cross-veins are dark, with very narrow hyaline borders.

Locality.—Worcester (town) (April 1931, A. C. H.).

Remarks.—A very pretty fly easily recognised by the five red stripes on the abdomen. Named after Mr. James Perkins of Worcester, who has been for very many years a keen angler.

Austroclaeon n. g.

Imago.—Like *Cloeon*. Cross-veins connecting Sc-R₁-R₂-1R₂ distally present or absent (as in *Cloeon*).

Nymph.—Like *Cloeon*, but labial palp apically clavate as in *Proclaeon*, maxillary palp 2-jointed, slender, as in *Proclaeon*, and 1st gill double, 6th and 7th single.

Remarks.—Lestage (1917, p. 131, fig. 6) has recorded nymphs from Lakes Tanganyika and Meru with the above-mentioned characters.

Austroclaeon africanum (E.-P.).

Esben-Petersen, 1913, p. 184, fig. 8 (♂ forceps); Esben-Petersen, 1920, p. 502; Lestage, 1924A, p. 343.

Imago.—No cross-veins before bulla, a single straight oblique cross-vein in pterostigmal area. No cross-veins distally connecting Sc-R₁-R₂-1R₂.

Body 4.5–5 mm.; wing 5.5–5.5 mm.; cerci 8–10 mm.

Head pale buff or biscuit, with orange longitudinal marks on occiput and along inner edge of eye, eyes black. Prothorax pale buff, with a small orange-brown spot on either side of median line, or each spot may be joined along the posterior margin to another smaller spot more laterally, forming a crescent-shaped mark. Mesothorax pale buff or biscuit, with orange and orange-brown markings and joinings, scutum with a median darker line, scutellum white, with brown on either side; laterally and ventrally whitish, with brown (clarety-brown) joinings. Metathorax with brown markings. Abdominal segments pale buff or biscuit, with orange-brown or clarety-brown markings as in figure, segments 2, 4, and 7 being the most conspicuously marked; pleurae whitish; ventrally whitish, with a round

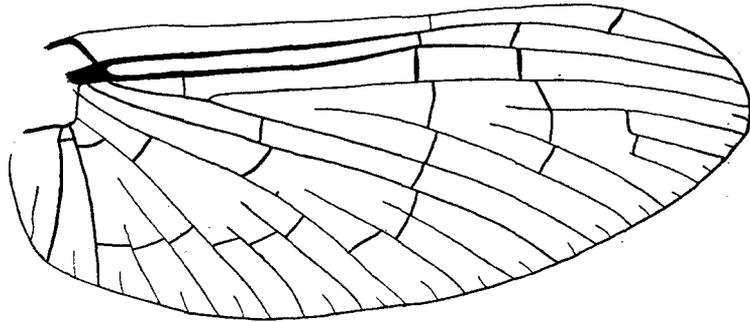


FIG. 8.—*Austroclleon africanum* (E. P.). Fore-wing of ♀ imago.

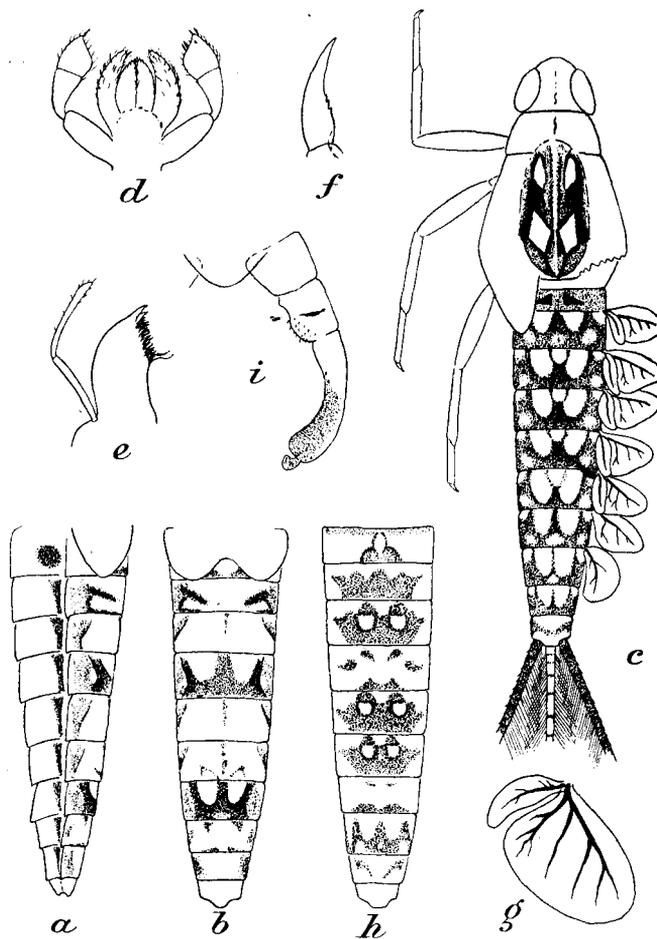


FIG. 9.—*Austroclleon africanum* (E. P.). *a*, *b*, lateral and dorsal view of abdomen of imago; *c*, nymph; *d*, labium; *e*, maxilla; *f*, claw; *g*, 2nd gill; *h*, abdomen of nymph, showing a second variety of colour pattern; *i*, forceps of ♂ imago.

clarety-brown spot laterally on segment 1, and lateral streaks of same colour on segments 2-8 or 9. Legs pale buff. Cerci white, narrowly annulate. Wings clear, marginal area faintly yellowish, cross-veins distinct, opaque whitish or pale yellow.

Nymph.—Labial and maxillary palps as figured. Claws very feebly denticulate. Gills 1-5 double, 6 and 7 single; sometimes a very small upper lamella on gill 6.

Body 5 mm., cerci 2.5 mm.

Brown, with two very distinct pale oval or lozenge-shaped marks, bordered with dark brown or black, on either side of median line of mesothorax in advanced nymphs. Abdomen brown, with pattern as figured (two varieties), ventrally pale, with a brown stripe near lateral margin on each segment except 10. Legs pale, femora and tibiae suffused near apices. Cerci, outer ones brown, median one white, all three annulate.

Localities.—Zululand (September and December, W. E. Jones); Kimberley (J. H. Power); Resolution, near Grahamstown (Miss Walton); Dunbrody and Uitenhage (July 1925, K. H. B.); Pilgrims Rest, Transvaal (Schunke); Ceres (April, R. M. Lightfoot (All S.A. Mus.)). Groot Drakenstein (A. C. H.); Du Toits Kloof, Rawsonville (A. C. H.); Worcester (town) (A. C. H.); Sabi, Transvaal (nymphs only, June, July 1930, J. C. Dendy); Winkle Spruit, Natal (Natal Mus.); Fort Brown (Albany Mus.).

Remarks.—The identification is confirmed by the comparison of relaxed and moistened topotypes from Zululand, which show the same colour-pattern as the fresh material. Apart from the colour-pattern, the single pterostigmal cross-vein is distinctive. Lestage (1924A) assigns to this species, with some doubt, subimagos from Salisbury (S. Rhodesia) and Incomati (Delagoa Bay); and also Ulmer's specimens from the French and Belgian Congo, Cameroons, and Sudan, which he attributed to *marginale*.

Habits.—In the Cape the flies of this species occur in March and April.

Austroclaeon virgiliae n. sp.

Imago.—No cross-veins before bulla, two well-marked cross-veins in pterostigmal area. Cross-veins distally connecting $Sc-R_1-R_2-1R_2$ present.

Body ♂ 5.5 mm., ♀ 7 mm.; wing ♂ 6 mm., ♀ 7-7.5 mm.; cerci ♀ 9 mm.

♀ Head white, with two dark castaneous or claret longitudinal submedian stripes. Eyes French-grey, with a narrow claret line around base, and two horizontal dark stripes laterally. Prothorax white, with two submedian dark

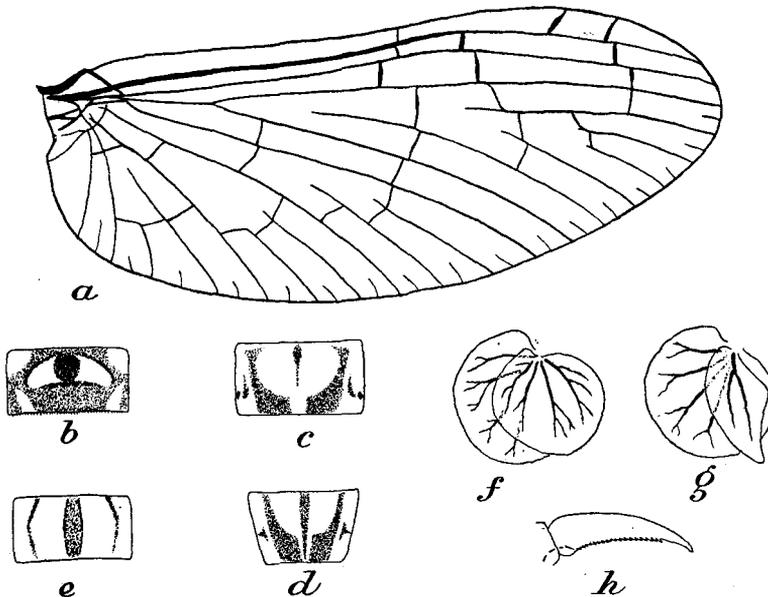


FIG. 10.—*Austroclaeon virgiliae* n. sp. a, fore-wing ♂ imago; b, dorsal abdominal pattern of nymph; c, d, dorsal pattern on abdominal segments 4 and 7 of subimago; e, ventral abdominal pattern of subimago; f, g, 3rd and 1st gills; h, claw of nymph.

claret stripes and a claret patch nearer the lateral margin. Mesothorax pale buff, with a medio-dorsal broad fawn stripe, narrowly bordered with white, scutellum white, bordered with dark claret; laterally and ventrally with orange-brown and claret speckling and joinings. Metathorax dorsally fawn, with a claret transverse bar anteriorly and posteriorly and a white patch laterally. Abdomen whitish, a medio-dorsal claret stripe on anterior segments, faint on posterior segments, a lateral claret patch on segments 1-3, and a smaller claret patch in postero-lateral corner of

segment 5; ventrally a medio-ventral claret stripe on segments 1-3 and 5, and a narrow claret stripe near the lateral margins on segments 1-3; segment 10 dorsally and ventrally suffused with claret. Legs whitish, femora suffused with orange-brown or claret. Cerci white, with narrow dark claret-brown annulations. Wings clear, costal and subcostal areas pale amber (♀) or pale yellow (♂), cross-veins conspicuous, those in marginal area opaque pale yellow, the others opaque milky-white.

Subimago.—Pale creamy-yellow. Head and prothorax with indications of the same marks as in imago. Mesothorax with some of the joinings marked with brown. Abdomen with pale claret-brown or reddish-brown medio-dorsal elongate spots or stripes and lateral patches, as figured, on segments 1-8, segment 9 with the lateral patches nearly or quite obsolete, segment 10 irregularly suffused; ventrally with the medio-ventral stripe and lateral marks as in imago and nymph. Cerci white, with orange or brownish annulations. Wings milky-white, especially the marginal area.

Nymph.—Similar to that of *africanum*, but with the inner (upper) lamellae of the gills broader, those of gills 2-5 being subcircular, and the claws much more strongly denticulate.

Body 5 mm.

Abdominal colour-pattern as figured (Groot Drakenstein). In the single Potteberg nymph-skin (from which the subimago was caught emerging) the two dorsal clear patches on either side of the median line are considerably contracted so as to form comma-shaped marks, with the tail of the comma pointing anteriorly.

Localities.—Keurbooms River, Plettenberg Bay District (side stream) (♂♂ January 1931, K. H. B.); Worcester (town) (♀ April 1931, A. C. H.); Jonkershoek, Stellenbosch (♀ May 1931, A. C. H. and K. H. B.); Potteberg, Bredasdorp District (May 1931, A. T. Packham); Groot Drakenstein (nymph, March 1931, A. C. H.); Clovelly, Kalk Bay, Cape Peninsula (May 1931, A. C. H.); Pietermaritzburg (May 1931, Natal Mus.).

Remarks.—Easily recognised by the two pterostigmal cross-veins and the coloration. Allied species with two pterostigmal cross-veins are *viridellum* Lest., 1923, from the Belgian Congo, and *Cloeon* sp. Ulmer, 1909 (Voeltzkow Reise, ii, p. 368, fig. 7), from Madagascar.

Variations occasionally occur; some specimens have 1 pterostigmal cross-vein on one wing and 3 on the other; one specimen had 2 on one side and 3 on the other. The presence of distal cross-veins below the pterostigmal area will easily separate aberrant or mutilated specimens of this species from *africanum*. The name is from *Virgilia capensis*, the Keurboom tree.

An olive-green nymph was found in watercress-beds at Clovelly, and the subimago emerged at 7 p.m., 31st May 1931. In this living subimago the ground-colour, under parts and legs were olive-green, but this colour faded to yellow after a few hours in alcohol.

Gen. *Pseudocloeon* Klap.

Ulmer, 1920, p. 125. (Non Bengtsson, 1914. = *Procloeon*.)

Imago.—Like *Cloeon*, but with the marginal intercalaries paired, at least in distal half of wing.

Remarks.—The position of the first cross-vein between R_1 and R_2 varies; cf. the figures of *jörgenseni* E. P. (Deutsch. Ent. Zeitsch., 1909, p. 551, fig. 2), and *obscurum* Ulmer (Notes, Leyden Mus., 35, 1913, p. 111, fig. 10). In the former it is oblique, meeting R_2 slightly distal to the origin of the cross-vein between R_2 and $1R_2$; in the latter it is its own length proximal to the cross-vein between R_2 and $1R_2$. In the species described below it varies in position. $1A$ not forked.

The nymph is known only for *vinosum* (*infra*).

The genus has been recorded hitherto from Java, Chile and Argentine, Canada, and Cameroons.

Some small specimens (wing 4 mm.) of a species of this genus were collected on the Kunene River, Ovamboland (March 1923, K. H. B. and R. F. Lawrence), but are in too poor a condition for description.

Pseudocloeon vinosum n. sp.

Imago.—Paired intercalaries extending only to one space beyond MA , or to Cu_1 , or to anal angle. First cross-vein between R_1 and R_2 slightly proximal, or opposite, or slightly distal to cross-vein between R_2 and $1R_2$.

Body ♂ 4.5-5 mm., ♀ 5-5.5 mm.; wing ♂ 5 mm., ♀ 5.5-6 mm.; cerci 7-8 mm.

Head pale ochre, medianly orange. Eyes black, ocelli white at tips. Prothorax brown, with orange transverse bar on anterior and posterior margins. Mesothorax dorsally castaneous brown, with pale yellow and darker brown markings, orange on humeral area, scutellum pale yellow, dark brown on either side; laterally and ventrally pale fulvous, with paler marks. Metathorax dorsally brown. Abdomen castaneous brown, with pale medio-dorsal stripe, on each segment a comma-shaped mark, the tail of the comma pointing posteriorly and followed by a pale spot on either side of median line, faint on segment 9 and absent on segment 10; ventrally paler fulvous, uniform. Legs pale ochre. Cerci whitish, uniform. Wings clear, faintly milky in pterostigmal area, neuration pale brown.

Nymph.—Of the Baetid type. Maxillary palp 3-jointed. Labial palp like that of *B. bellus* or *Centropitulum excisum*. Median cercus a little shorter than the others. Gills 6 pairs, none on 1st segment, broadly oval.

Up to 6 mm.

Brown, with the abdominal pattern of imago. Cerci sepia, apical third of all three whitish. Gills transparent, tracheae dark.

Localities.—Groot Drakenstein (October 1930, March 1931, A. C. H.); Silvermine Stream, Kalk Bay Mountains, Cape Peninsula (May 1931, A. C. H.); Schusters R., Simonstown (August 1931, A. C. H.).

Remarks.—Named from the wine-growing district in which the first specimens were found. The nymph has not yet been discovered.

Pseudocloeon magae n. sp.

Imago.—First cross-vein between R_1 and R_2 slightly proximal or slightly distal to cross-vein between R_2 and $1R_2$. Cross-veins in pterostigmal area as in *vinosum*, but faint.

Body ♂ 3.75–4 mm., ♀ 4 mm.; wing ♂ 3.75–4 mm., ♀ 4.25 mm.; cerci ♂ 7–8 mm.

♂. Eyes brown, turbinate eyes basally and on top orange or castaneous, with an intervening pale band. Pro-meso- and meta-thorax dorsally Vandyke brown, antero-laterally more or less suffused with orange, laterally and ventrally with pale marks and dark joinings. Abdomen brownish, with a fulvous or castaneous tinge, a faint medio-

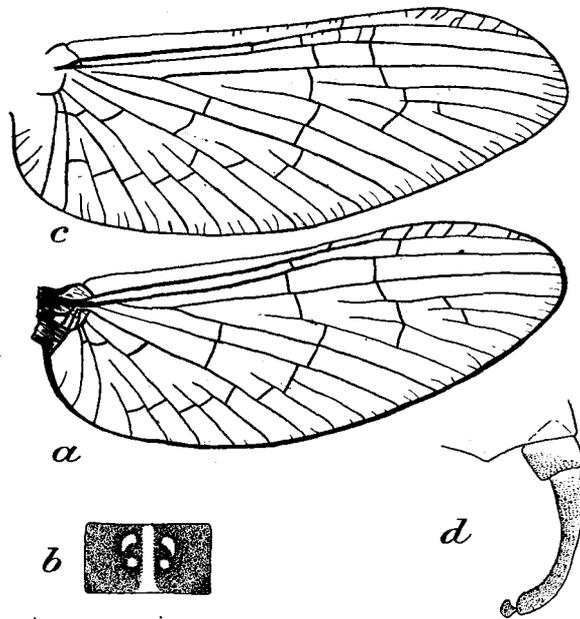


FIG. 11.—*Pseudocloeon vinosum* n. sp. a, b, fore-wing ♀ imago and abdominal pattern of imago. *P. magae* n. sp.; c, d, fore-wing of ♂ imago and forceps of ♂.

dorsal dark line, in some specimens forming a disconnected series of elongate spots, the most usual being a spot on each of segments 2, 6, and 8; ventrally pale greyish; a very narrow dark streak along the pleurae. Legs whitish. Cerci white, uniform. Wings clear, a faint milkiness in the pterostigmal area, and often the base of Sc and R at root of wing suffused with dark sepia. ♀ lighter, fulvous, mesothorax with pale marks and darker joinings.

Locality.—Hex River, Sandhills, Worcester District (April 1931, A. C. H.).

Remarks.—Distinguished from *vinosum* by its smaller size and coloration. (Maga, a witch, =Hex.)

In some of the ♂♂ some of the marginal intercalaries are single, not paired, and in both ♀♀ nearly all the intercalaries are single. This seems to show that the genus *Pseudocloeon* is somewhat insecurely based. The specimen figured is unusually heavily veined, showing paired intercalaries extending to the anal angle, and numerous very fine incomplete veinlets from C and a few also from Sc.

Gen. *Baetis* Leach.

Eaton, 1885, p. 156; Ulmer, 1920, p. 124; Lestage, 1921, p. 257 (nymph).

Imago.—Hind-wings small, elliptical or elongate-oval, usually with an acute process on front margin near base. with 2–3 veins, the 2nd sometimes forked, cross-veins very few or absent. Marginal intercalaries paired. 1A forked near margin. Cross-veins in fore-wing mostly in three dislocated series. Genital styles of ♂ 4-jointed, 3rd joint usually much the longest, 4th smallest. Front tarsus of ♂ subequal to tibia, slightly longer than femur. Claws dissimilar. Cerci 2, elongate in ♂. Eyes turbinate in ♂.

Nymph.—Eyes lateral. Antennae elongate. Mandibles with or without prostheca. Maxillary palp 2- or 3-jointed. Inner lobes of labium much narrower than outer lobes, palp 3-jointed, 3rd joint typically subcircular. Median lobe of hypopharynx without lateral processes, lateral lobes not curving outwards. Claws denticulate. Cerci 3, the median one shorter than the lateral ones. All gills single.

Remarks.—No flies of this genus have yet been recorded from Africa, but nymphs have been known (Ulmer, 1916) and described (Lestage, 1917, p. 123 *sqq.*). Lestage figures two species (figs. 2 and 3) with labial palps of the form found in the South African species *bellus*, described below.

Key to the South African Species.

1. Hind-wing oval, with costal process *harrisoni*.
 2. Hind-wing elongate, without costal process *bellus*.

Baetis harrisoni n. sp.

Imago.—Hind-wing oval, twice as long as broad, with two veins, the second simple, but indications of an incomplete fork at the margin. 8–10 cross-veins in pterostigmal area in fore-wing, some incomplete, and with T or Y-shaped longitudinal branchlets.

Body ♂ 5.5 mm., ♀ 6.5–8 mm.; wing ♂ 6 mm., ♀ 7.5–9 mm.; cerci ♂ 10–11 mm.

Head reddish-brown. Eyes and ocelli black, the latter with white tips. Turbinate eyes in ♂ fulvous orange. Pro-, meso-, and meta-thorax pale castaneous, the mesothorax dorsally, with darker and lighter longitudinal bands, scutellum pale, with dark brown below. Abdomen in ♀ pale, dorsally with faint greyish suffusion forming a pattern, as in figure, corresponding with that of nymph, posterior margins of segments pinkish (or sienna in alcohol); in ♂ very pale, semi-transparent, except posteriorly, where it is opaque white. Legs pale buff. Cerci pale straw, uniform or very faintly annulate in ♂. Wings clear, neuration pale brown, pterostigmal area faintly suffused. Genital styles of ♂ white.

Subimago.—Similar, but paler. Turbinate eyes pinkish. Cerci white, uniform.

Egg.—Roundish-oval, .14 mm. long diameter, surface smooth, no attachment threads, pale yellow.

Nymph.—Abdominal segments denticulate on posterior margin only on hinder segments, and only feebly if at all on ventral surface. Apex of mandible blunt, truncate, prostheca absent. Maxillary palp 2-jointed, the joints subequal. Labial palp typical. 3rd joint subcircular.

Femora with short spines on anterior margin, longer spines (especially basally) on hind margin, tibiae and tarsi with simple spines, claws strongly denticulate. Gills obovate, proximal margins sparsely setose, distal margin more or less densely setose, and minutely denticulate. Tracheae dark on all gills except 1st, where they are invisible or absent. Middle cercus about $\frac{2}{3}$ length of the lateral ones.

Up to 8–9 mm., cerci 4–5 mm.

Straw or pale brown. Abdominal segments dorsally greyish-brown, the colour bounded in front by a thin dark line separating it from the pale articular membrane; a lighter more or less oval patch on either side of the median line, which is also pale, often a small dark spot on either side of median line, postero-lateral angles where gills are attached, and also on segments 8 and 9, dark; ventral surface pale cream or white. Legs pale straw, knees and to a lesser degree also the apices of tibiae and tarsi, dark. Cerci pale whitish, with an ill-defined dark area about in middle of the lateral cerci, and, in the distal third of the median cercus, base of the latter also usually dark. Gills transparent with dark tracheae and margins.

The abdominal pattern varies in intensity, being very distinct and almost sharply defined in some nymphs, in others almost uniform.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H. and K. H. B.); Eerste River, Lynedoch (E. J. Steer); Hex River, Sandhills, Worcester Distr. (A. C. H.); Du Toits Kloof, Rawsonville (A. C. H.); French Hoek (K. H. B.); Table Mt. slopes, Cape Town (K. H. B.); Silvermine Stream, Kalk Bay (A. C. H.).

Habits.—Full-grown nymphs ready to hatch have been obtained in October and January to August; the species therefore in all probability goes on throughout the year. On the Eerste River trout have been caught with their stomachs packed exclusively with these nymphs.

The nymphs are very active swimmers and impatient of captivity.

Baetis bellus n. sp.

Imago.—♀. Hind-wing elongate-oval, without costal process, with two subparallel veins. 6–7 complete, simple unbranched cross-veins in pterostigmal area.

Body 5 mm.; wing 5.5–6 mm.; cerci 6 mm.

Nearly uniform castaneous or burnt sienna, mesothorax laterally and ventrally, with pale ochraceous marks and joinings. Abdomen castaneous, darker laterally and on posterior margins of segments, a medio-dorsal darker patch on each segment, with a pale median stripe, very faint indications on anterior segments of the pale dots seen in subimago; ventrally pale. Legs ochraceous, suffused with orange. Cerci pale, faintly annulate. Wings clear, milky in pterostigmal area, neuration fulvous.

Subimago.—♀. Head pale, with sienna markings, leaving a pale space medianly, widening posteriorly. Prothorax pale, with central sienna transverse patch, behind which are two pale dots outlined in dark brown. Mesothorax dorsally reddish or sienna, with a faint medio-dorsal line and horizontal pale streak, outlined in black, from base of wing, scutellum pale. Metathorax sienna. Thorax laterally and ventrally paler sienna or yellowish. Abdomen segment 1 sienna with a medio-dorsal pale spot on posterior margin; segments 2–9 sienna, with a faint medio-dorsal pale line, and two pairs of pale spots in anterior half, the anterior spots comma-shaped, with the tail of the comma pointing anteriorly, a short dorso-lateral pale streak in postero-lateral corner; segment 10 pale sienna; ventrally all segments whitish. Legs pale straw, margins of femora and tibiae, and all the tarsi, suffused with grey. Cerci whitish, faintly annulate.

Nymph.—Apex of mandible denticulate. Labial palp with 2nd joint apically expanded on inner margin, 3rd joint ovate. Maxillary palp 3-jointed. Claws strongly denticulate. Median cercus half length of the lateral ones. Gills as in *harrisoni*, but 1st gill with a simply branched trachea.

Body 5 mm.

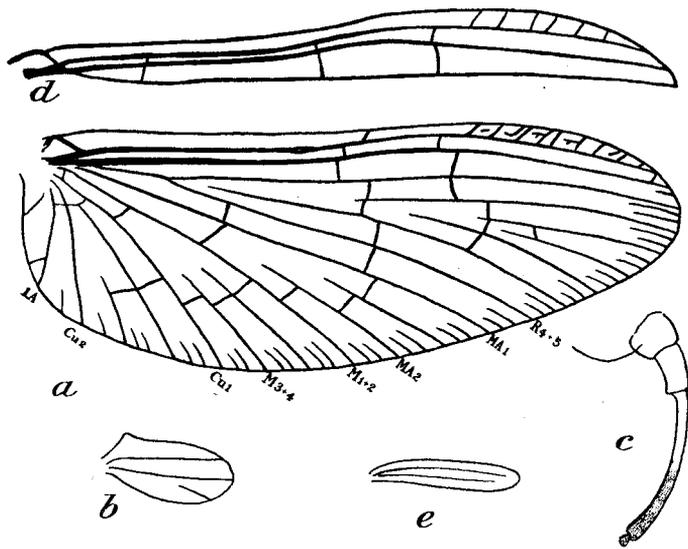


FIG. 12.—*Baetis harrisoni* n. sp. a, b, fore- and hind-wings ♀ imago; c, forceps of ♂. *Baetis bellus* n. sp. d, e, fore- and hind-wing ♀ imago.

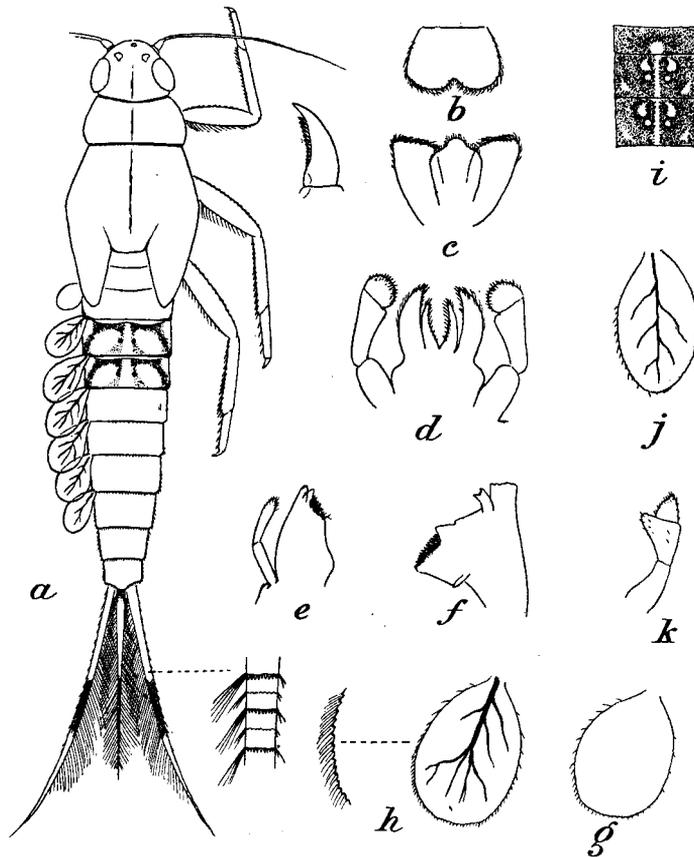


FIG. 13.—*Baetis harrisoni* n. sp. a, nymph, with claw and portion of lateral cercus further enlarged; b, labrum; c, hypopharynx; d, labium; e, maxilla; f, left mandible; g, h, 1st and 3rd gills. *Baetis bellus* n. sp. i, abdominal pattern of nymph; j, 2nd gill; k, labial palp.

In fully-grown nymph, coloration and colour-pattern as described for subimago, the pro- and meso-thoracic markings not so clearly defined. Femora and tibiae with a greyish suffused band across the middle.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Clovelly, Kalk Bay, Cape Peninsula (A. C. H.); Wellington Mts. (October 1931, K. H. B.).

Remarks.—Flies of this pretty species have been obtained in March, April, and May. At first sight the abdominal pattern appears very like that of *Pseudocloeon vinosum*, but on closer inspection the comma-shaped marks are seen to point in the opposite direction.

The species resembles the English species *atrebatinus* in the narrow hind-wings without costal process. This character easily distinguishes it from *harrisoni*, even in the subimago. The labial palp of the nymph does not conform to the typical *Baetis* character in the 2nd and 3rd joints.

Gen. *Centroptilum* Eaton.

Eaton, 1885, p. 174; Ulmer, 1920, p. 124; Lestage, 1921, p. 255 (nymph).

Imago.—Hind-wing small, narrow and elongate, with an acute spur-like process on costal margin basally, 1-2 simple longitudinal veins. Marginal intercalaries in fore-wing single. Cross-veins mostly in three dislocated series. Genital styles of ♂ 4-jointed (except in *tenellus*, where only 3-jointed). Front tarsus of ♂ rather longer than tibia, which is twice as long as femur. Claws dissimilar. Cerci 2. Eyes turbinate in ♂.

Nymph.—Similar to that of *Baetis*, except: gills more acutely ovate, especially the 1st (if present). Mandible with fine setae on molar. Labial palp with 3rd joint typically minute. Median cercus sometimes very short.

Key to the South African Species.

1. Hind-wing with bifid costal process in both sexes *sudafricanum*.
2. Hind-wing in ♂ with slender hook-like process, in ♀ hind-wing aborted *excisum*.

Remarks.—Only one species of this genus is known from South Africa, but other species are known from the Belgian Congo, Sudan, and Comoro Isles. Lestage (1917, p. 128, fig. 4) describes a nymph from Kitutu River, Belgian Congo, with 2-jointed maxillary palp, and a labial palp exactly like that of *sudafricanum*, but with 7 pairs of gills. The second species described below has 7 pairs of gills, but differs markedly in the labial palp. Its main feature, however, is the suppression of the hind-wing in the ♀, in the subimago almost completely, and completely in the imago.

A specimen of *Centroptilum* was collected on the Kunene River, Ovamboland (March 1923, K. H. B.), but is too damaged for description.

Centroptilum sudafricanum Lest.

Lestage, 1924a, p. 344.

Imago.—Hind-wing with two subparallel veins, costal process bifid, scabrous. In fore-wing no cross-veins before bulla, 3-4 in pterostigmal area, oblique, usually complete, with intervening short incomplete veinlets.

Body 4.5-5 mm.; wing 5 mm.; cerci 7.5-9 mm.

♀. Head pale brown, paler on occiput between eyes. Pro-, meso-, and meta-thorax brown, somewhat castaneous, pale ventrally; mesothorax dorsally uniform. Abdomen castaneous-brown, paler ventrally, uniform. Legs brown. Cerci pale brown, faintly annulate. ♂ darker. Turbinate eyes pale cream at base, reddish-castaneous on top.

Subimago.—Paler, with indications on the abdominal segments of the pale chevrons found in the nymph.

Nymph.—Labium and labial palp typical, though the inner lobes are rather slender. Mandible with prostheca. Claws strongly denticulate. Only 6 pairs of gills, the 1st pair completely aborted. Median cercus only half-length of the lateral ones.

Up to 5-6 mm.

Greyish-brown, thorax faintly mottled in young nymphs, uniform castaneous in full-grown nymphs. Abdomen greyish-brown, paler ventrally, an indistinct pale lateral border, and a pale V-shaped mark (apex posterior) on hind margins of the posterior segments, more strongly marked in young than in older nymphs, segment 10 pale. Legs pale biscuit, femora faintly suffused, with a dark band in distal third. Cerci pale. Gills semi-transparent, tracheae and margins black.

Localities.—Groot Drakenstein (A. C. H.); Hex River, Sandhills, Worcester Distr. (A. C. H.); Cedarbergen, Clanwilliam Distr. (K. H. B.); Table Mt. slopes, Cape Town (K. H. B.); Keurbooms River, Plettenberg Bay Distr. (K. H. B.); Zwartberg Pass, Prince Albert Distr. (K. H. B.); Jonkershoek, Stellenbosch (H. G. Wood); Krantzkop, Natal (November 1917, K. H. B.); Shefton Grange, Natal (Natal Mus.); Genadendal (K. H. B.).

Remarks.—The absence of the 1st pair of gills in the nymph is noteworthy. In the flies I can find no differences between the topotype material from Krantzkop and the Cape examples.

Some nymphs from Sabi, Transvaal (June, July 1930, J. C. Dendy), seem to belong to this species.

Habits.—In the Cape nymphs have been found in March, April, September, October, November, and January, and the flies also in January, March, April. The subimagos emerge from the nymph on the underside of stones (one stone leaning across or up against another) above the water-line.

Centroptilum excisum, n. sp.

Imago.—♂. Hind-wing with two subparallel veins, costal process hook-like, slender, scabrous apically. In ♀ hind-wing completely aborted. In fore-wing no cross-veins before bulla, 6-8 cross-veins in pterostigmal area, oblique, some occasionally incomplete or with intervening short incomplete veinlets.

Body ♂ 5-5.5 mm., ♀ 6-6.5 mm.; wing ♂ 5.5-6 mm., ♀ 7 mm.; cerci ♂ 8 mm., ♀ 6 mm.

♂. Eyes black. Turbinate eyes pale yellow below, castaneous above. Prothorax dark brown. Mesothorax Vandyke brown, dorsally shining, very dark, almost piceous, with light joinings on humeral region, scutellum dark;

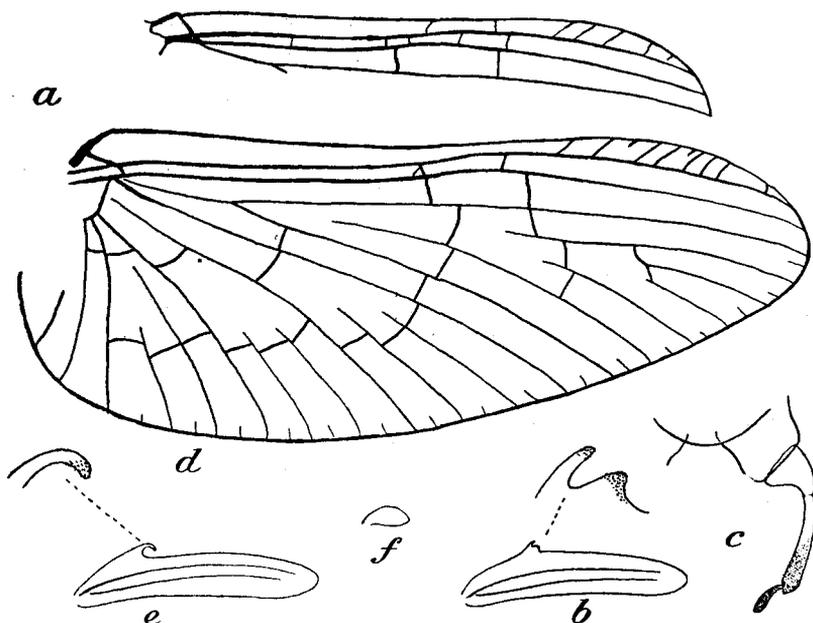


FIG. 14.—*Centroptilum sudafricanum* Lest. a, marginal area of fore-wing of imago; b, hind-wing; c, forceps of ♂. *C. excisum* n. sp. d, fore-wing ♂ imago; e, hind-wing ♂ imago; f, hind-wing ♀ subimago.

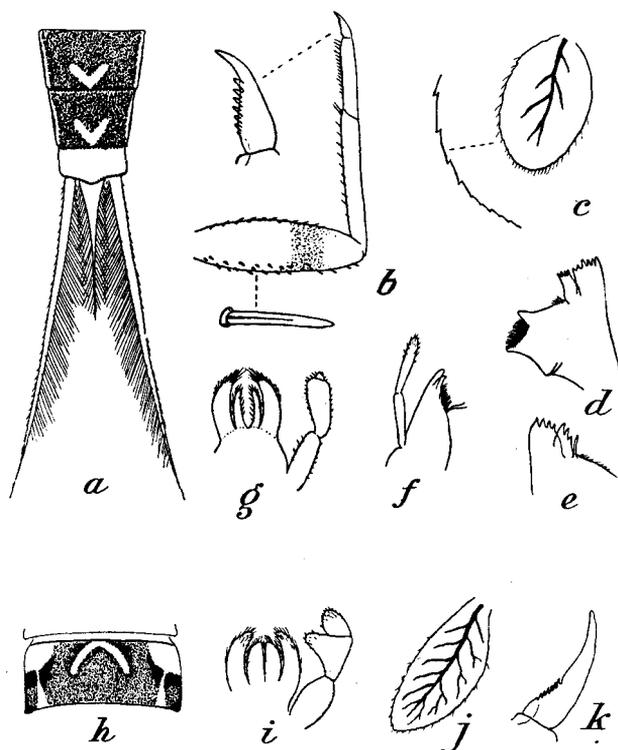


FIG. 15.—*Centroptilum sudafricanum* Lest. a, end of abdomen, and cerci, of nymph; b, front leg; c, gill; d, left mandible; e, apex of right mandible; f, maxilla; g, labium. *C. excisum* n. sp. h, abdominal pattern of nymph; i, labium; j, gill; k, claw.

laterally and ventrally with pale ochraceous or orange marks and joinings. Metathorax dark brown. Abdomen raw sienna, with reddish-orange or burnt sienna medio-dorsal and lateral stripes on all segments except 10; ventrally pale whitish. Legs suffused greyish. Genital styles of ♂ white. Cerci white, uniform. Wings clear, slightly milky in pterostigmal area, neuration pale yellowish-white. ♀ Lighter in colour. Head pale ochraceous, orange between ocelli. Eyes and ocelli black, tips of latter white. Prothorax brown, with lighter marks and joinings, scutellum ochraceous, brown on either side; laterally and ventrally paler. Abdomen brown, posterior margins slightly darker, medio-dorsal and lateral orange stripes as in subimago sometimes visible; ventrally pale whitish. Cerci white. Wings as in ♂.

Subimago.—Hind-wings in ♀ minute. Pale ochraceous. Turbinate eyes pinkish on top. Abdomen with the orange or sienna medio-dorsal and lateral stripes more conspicuous on the paler ground colour than in the imago, the white chevron-marks of the nymph also showing.

Nymph.—Apices of mandibles denticulate. Maxillary palp 2-jointed. Inner lobes of labium not so narrow as in *sudafricanum*, 2nd joint of palp strongly expanded inwards at apex, 3rd joint well developed, ovoid. Claws denticulate at base only. Gills 7 pairs, ovate-lanceolate.

Up to 6-7 mm.; cerci 3 mm.

Head and thorax brown, with lighter mottling and markings. Eyes black. Abdominal segments brown, segments 7, 8, and 10 usually paler than the others, a medio-dorsal chevron-like pale mark near anterior margin, and a pale lateral longitudinal stripe, antero-lateral angles of each segment pale, semipellucid, postero-lateral angle with dark border; the chevron marks are usually broken up into two pairs of dots on segment 9, and not visible at all on segment 10; ventrally paler, uniform, sometimes suffused with orange on anterior segments. Legs whitish, more or less suffused, knees dark. Cerci pale.

Localities.—Groot Drakenstein (April, May, June 1930, 1931, A. C. H.); Clovelly, Kalk Bay, Cape Peninsula (May 1931, A. C. H.); Table Mt. slopes, Camps Bay, Cape Peninsula (May 1931, K. H. B. and H. G. Wood); Glencairn, Cape Peninsula (June 1931, A. C. H.); Lilyfontein, Kamiesberg (September 1931, K. H. B.).

Remarks.—The partial reduction of the hind-wing in the ♀ subimago and its complete abortion in the ♀ imago is noteworthy. The labium of the nymph is different from that of *sudafricanum*, and resembles very closely that of *Baetis bellus*. For the present the species may be left in *Centroptilum*.

Habits.—Flies have been found in April, May, and June. At Clovelly, Kalk Bay, the nymphs were found in great numbers in the watercress bordering the sandy bed of the Silvermine stream in May and June. Many were seen to rise to the surface and disclose the subimago. Spinner flights were observed in this locality on bright, windless days (A. C. H.).

Gen. *Centroptiloides* Lest.

Lestage, 1918, p. 107, and 1924A, p. 340; Ulmer, 1920, p. 125, and 1920A, p. 52.

Imago.—Hind-wings comparatively broad, with a small acute costal process followed by a more obtuse process, three longitudinal veins, the middle one more or less clearly forked, and one or two marginal intercalaries, cross-veins few and very faint. In fore-wing marginal intercalaries single; 1A simple; cross-veins in three dislocated series. Front tarsus of ♂ subequal to or slightly shorter than tibia, but longer than femur, tibia 1-1½ times length of femur; claws dissimilar. Genital forceps of ♂ 4-jointed, 3rd joint elongate, 4th slender, pyriform. Cerci 2. Eyes turbinate in ♂.

Nymph.—Unknown.

Centroptiloides bifasciatum (E.-P.).

Esben-Petersen, 1913, p. 182, figs. 4-7; Lestage, 1918, p. 108, and 1924A, p. 341; Lestage, 1924A, p. 341 (*marginatum*).

Remarks.—From a study of the material in the South African Museum it is clear that *marginatum* is merely a synonym of *bifasciatum*. One or other of the branches of the middle vein in hind-wing is often actually disconnected

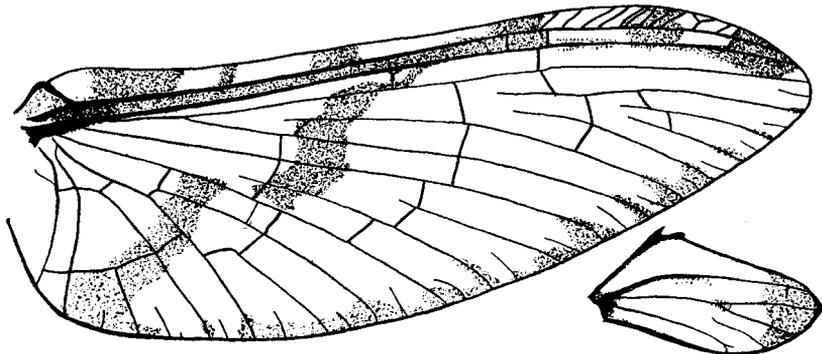


FIG. 16.—*Centroptiloides bifasciatum* (E. P.). Fore- and hind-wings ♂ imago.

from the stem, or so faintly connected as to appear disconnected; this character therefore is too inconstant to be used as a specific character. Even from a glance at the labels on the specimens it seemed strange that Mr. Jones's

assiduous collecting in one locality should produce one species in the years 1914 and 1924, and another species in the previous and intervening years.

The cross-veins and the two costal processes in the hind-wing are better defined in the subimago than in the imago.

In addition to the Zululand locality, a subimago ♀ was taken on the Kunene River, Ovamboland (March 1923, K. H. B.).

Ulmer (1920a, p. 53) mentions having seen a specimen from the Cameroons.

Gen. *Acentrella* Bgtsn.

See addendum, p. 259.

Family BRACHYCERCIDAE.

Ulmer, 1920, p. 120 (*Caenidae*); Campion, 1923 (Ann. Mag. Nat. Hist. (9), xi), p. 515.

Imago.—Wings milky or smoky, margin setose (in imago as well as in subimago). Sc well developed, separate from R. MA forked. No short marginal intercalaries. Hind-wings absent. Cerci 3, very long in ♂. Tarsal claws in front leg of ♂ either alike or dissimilar.

Nymph.—Crawling type, living in muddy situations or in rapid streams. Antennae moderately long. Mandible with prostheca. Maxillary palp 3-jointed. Labial palp 3-jointed. Cerci 3. Gills 5 or 6 pairs of varying character.

Remarks.—The discovery of the nymph of the true *Tricorythus* (as distinct from the American *Tricorythodes*) raises the interesting question of the rightful inclusion of this genus in the family *Brachycercidae*, which is discussed below.

In 1920 Needham described a Brachycercid and its nymph from the Belgian Congo, for which he instituted the genus *Caenopsis* (*C. fugitans*). Lestage (1925, Ann. Biol. Lac., vol. xiii, pp. 254, 259, 264) claims this as a synonym of *Tricorythus*, and speaks of the nymph as that of a true *Tricorythus*. But the wing venation alone shows that it is not a *Tricorythus*, and *a fortiori* if the nymph described below for *Tricorythus discolor* proves to be typical for the other species, *Caenopsis* cannot possibly be a synonym. *Caenopsis* would seem to be a perfectly valid genus, allied more closely to the "Caenid" series than the *Tricorythus* series, though the ♂ genitalia are certainly Tricorythoid in character.

Key to the South African Genera.

Imagos.

1. The two intercalaries between Cu_1 and Cu_2 forming a long narrow fork. Cross-veins few, in a single series. *Austrocaenis*.
2. The two intercalaries forming a short broad fork. Cross-veins numerous, more or less in three series. *Tricorythus*.

Nymphs.

1. 1st gill rudimentary, filiform; 2nd gill elyptoid, covering the following 3rd–6th pairs. *Austrocaenis*.
2. 1st gill obsolete; gills on 2nd–6th segments double, outer lamella oval, elyptoid, inner composed of several imbricate lamellae. *Tricorythus*.

Austrocaenis n. g.

Imago.—Prothorax broader than long, front coxae well separated. Wings broadest in cubital region. The two intercalaries between Cu_1 and Cu_2 arising near base, forming a long narrow fork. Cu_2 and 1A subparallel, convergent at base. Cross-veins uniserial. Front tibia of ♂ much longer than femur. Genital styles of ♂ 1-jointed; penis broadly lamellar, undivided. Tarsal claws of front legs of ♂ alike, of mid and hind legs, and of all legs of ♀ dissimilar.

Nymph.—Prothorax broader than long. Abdominal segments 3–9 shortly produced postero-laterally. Maxillary palp with 2nd and 3rd joints subequal. Lobes of labium distinct, inner lobes longer than broad, palp with 3rd joint much the shortest. Femora stout; front claws smooth, mid and hind claws minutely setulose. 1st gill rudimentary, filiform; 2nd gill forming a subquadrangular elyptoid cover, nearly completely concealing the 3rd–6th gills, without tracheate tuft on under surface; 3rd–6th gills oval, with long fimbriate marginal processes, no tracheate tufts on under surface. Lateral ocelli near inner margin of eyes.

Egg.—Ovoid, sculptured, with attachment threads arising from both poles.

Remarks.—Resembling *Brachycercus* Curtis (= *Eurycia* Bgtsn.) in the broad prothorax, both in imago and nymph, but otherwise with the characters of *Ordella* Camp. (= *Caenis*).

Austrocaenis capensis n. sp.

Eaton, 1884, p. 142 (*Caenis* sp. undescrib.).

Imago.—Prothorax in ♂ slightly wider than long, narrowing in front, hind margin concave, lateral margin angular; in ♀ twice as wide as long. All abdominal segments except 1 and 10 in both sexes produced laterally in acute points, which are slender on the anterior segments, becoming stronger posteriorly. Genital styles of ♂ slender, gently curved, minutely setulose apically, extending slightly beyond penis, whose lateral and distal margins are concave. Ventral plate in ♀ transverse, distal margin gently convex. Cerci setose in ♀, naked in ♂.

Body ♂ 5 mm., ♀ 4–6 mm.; wing ♂ 4–5 mm., ♀ 5–6.5 mm.; cerci ♂ 15–17 mm., ♀ 4–6 mm.

Head, prothorax and abdomen creamy-white, the abdominal segments more or less suffused dorsally with grey, the terminal segment in ♂ often orange. Mesothorax and metathorax dorsally and laterally more or less bright

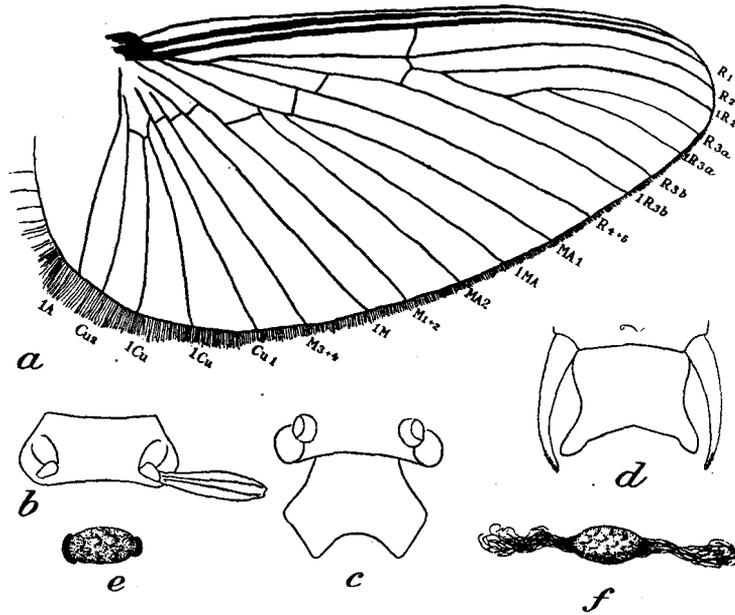


FIG. 17.—*Austrocaenis capensis* n. g., n. sp. *a*, forewing ♀ subimago; *b*, ventral view of prothorax ♀; *c*, dorsal view of prothorax ♂ imago; *d*, forceps and penis of ♂; *e*, *f*, egg, before and after uncoiling of the attachment threads.

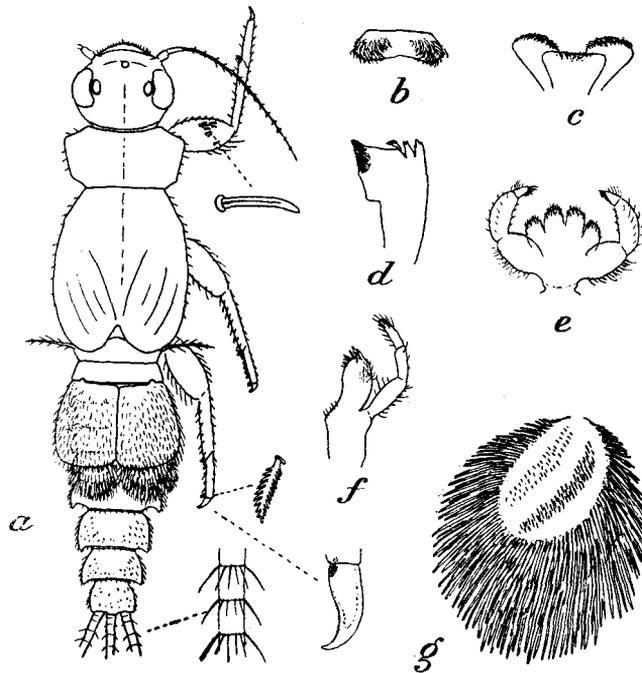


FIG. 18.—*Austrocaenis capensis* n. g., n. sp. *a*, nymph, with claw, spines, and portion of cercus further enlarged; *b*, labrum; *c*, hypopharynx; *d*, mandible; *e*, labium; *f*, maxilla; *g*, gill.

orange (pale buff in alcohol), ventrally white. Legs white, front coxa and trochanter suffused with grey, front femur with two longitudinal grey streaks on upper edge and two on lower edge, front tibia streaked with grey on outer edge. Bases of antennae white. Eyes and ocelli black, apices of lateral ocelli white. Cerci uniform white. Wings hyaline, C, Sc, and R with an orange tinge (grey in alcohol).

Subimago.—Similar, but cerci in ♂ setose, and wings milky.

Egg.—Oval, shallowly sculptured, with attachment threads at each pole. Before the eggs are laid these threads form a compact knob at the pole; when the eggs touch the water the threads uncoil and become entangled with other eggs and vegetation in the water (cf. Ulmer, Notes Leyden Mus., vol. xxxv, p. 107, fig. 7, 1913). The eggs are at first pale yellow, later orange, and when ready for deposition, depending from the abdomen of the ♀, black.

Nymph.—Abdominal segments 3-9 produced postero-laterally in short acute points. Ocelli distinct, the lateral ones close to the inner margins of eyes. Femora stout, oval, front femur with an irregular transverse series of stout flattened spines; mid and hind tibiae and tarsi more strongly spinose than front tibia and tarsus, the tarsi with 2-3 pectinate spines on inner apex; claws smooth in front leg, minutely setulose in mid and hind legs. Median cercus slightly longer than lateral ones; all with setae on both margins at intervals. Elytroid gill covers of the 2nd gills setose on margin and upper surface; 3rd-6th gills with two bands of outwardly directed spine-setae on upper surface; marginal fringes simple near base, mostly bifid apically.

Up to 8 mm.; cerci 5 mm.

Uniform pale brown.

Localities.—Lakeside, Cape Peninsula (A. C. H. and K. H. B.); Jonkershoek, Stellenbosch (A. C. H. and K. H. B.); Groot Drakenstein (A. C. H.); Du Toits Kloof, Rawsonville (A. C. H.); Worcester (town) (A. C. H.); Keurbooms River, Plettenberg Bay Distr. (side stream) (January 1931, K. H. B.); Potteberg, Bredasdorp Div. (A. T. Packham).

Remarks.—Eaton, in 1874, found a single drowned ♀ at Cape Town, which he did not describe. The species has remained unknown until the present time, although it is exceedingly abundant at Lakeside. It probably occurs in all the lakes on the Cape Flats. The life-history has been worked out by Mr. Harrison on Lakeside material.

Habits.—The species inhabits ponds and pools, with still or slowly flowing water, and an abundance of weed and algae. The nymphs are found amongst the weed, but to large extent burrow in or crawl over the mud and ooze on the bottom, and it is difficult to get specimens which are not covered with particles of foreign matter.

The flies hatch in swarms in July, August, November, December, February, March, April, May. Emergence takes place by night, or sometimes by day in dull weather, and the flies are dead by morning. Swarming was observed on one occasion at 7 a.m. on a dull, rainy morning (March).

Austrocaenis ? sp.

A minute ♂ imago was collected in the Schuurftebergen, east of Citrusdal (February 1928, K. H. B.), and may represent a second species of this genus.

Body 2 mm.; wing 2.25 mm.; cerci 6 mm.

Eyes black. Pro- and meso-thorax fulvous brown. Abdomen pale sepia. Legs, femora pale grey, tibiae and tarsi whitish. Cerci pale grey. Wings almost clear, marginal area faintly milky.

Gen. *Tricorythus* Eaton.

Eaton, 1884, p. 138; Lestage, 1918, p. 95; Ulmer, 1920, p. 122; Navas, 1926 (Broteria, vol. xxiii), p. 100.

Imago.—Wings almost hyaline or milky or smoky, broadest in cubital region. The two intercubitalies between Cu_1 and Cu_2 not arising at base, forming a short broad fork. Cu_2 and 1A subparallel, divergent at base. Cross-veins multiserial. Legs short, half length of body; front tibia of ♂ not longer than femur. Genital styles of ♂ 2- or 3-jointed; penis narrow. Cerci 3. Abdominal segments not produced postero-laterally. Tarsal claws all dissimilar in both sexes.

Nymph.—Flattened ventrally, dorsally convex. Antennae moderately long. Labrum not or scarcely incised. Mandible very strong, projecting and forming the lateral margin of head, with thick fringe of long setae on outer margin, protheca distinct. Maxilla oblong, with apical and ventral brushes of setae, palp slender, 3-jointed, 3rd joint minute, unguiform. Hypopharynx with median lobe incised, outer lobes subtriangular, not curving outwards. Labium with outer and inner lobes completely fused into a subtriangular plate, palp moderate, 2nd joint long, ensiform, with marginal fringe of long setae, 3rd joint minute, unguiform. Femora stout, claws with only two denticles. Cerci 3. Gills consisting of five pairs situate on segments 2-6, each double, the outer lamella oval, elytroid, the inner lamella bifid, each branch carrying two series of imbricate lamellae; no gill on segment 1.

Remarks.—The genus comprises five African and one Javanese species.

The discovery of the nymph of this genus (the nymph described by Cockerell and Gill, Univ. Colorado Stud., 3, 1906, belongs to *Tricorythodes* Ulmer) raises some interesting questions.

The retention of the fringe of setae on the wings of the imago, albeit not so prominent as in typical Brachycercids, and the venation seem to indicate that *Tricorythus* is a Brachycercid, though the abdominal segments are not laterally acuminate, and the front tibia in ♂ is not very long.

Ulmer (1920, p. 120) has suggested the division of the family into two groups, one containing *Brachycercus* and *Ordella*, the other containing *Tricorythus* and three other genera, which appear to be closely related to the *Ephemerellidae*. At least the nymph of *Tricorythodes*, according to Ulmer, seems to denote this affinity (*loc. cit.*, p. 123). This last statement is based on Morgan's description of the larva of a North American "*Tricorythus*" (Ann. Amer. Ent. Soc., vol. iv, 1911. This paper is not accessible to me, but a figure of the labium occurs in Murphy, 1922, Bull. Lloyd. Libr., No. 22; Entom. Ser., 2, pl. v, fig. 64).

Two features of the adult *Tricorythus discolor* bear analogy with some of the Ephemerellids. The South African *E. barnardi* and *T. discolor* have the same peculiar armature of the genital styles of the ♂. This may be only a minor

point; its value is difficult to access because such minutiae are seldom figured. But the armature is totally different from that of the other South African forms here studied.

The penis of *T. discolor* seems to resemble very closely that of *Ephemerella invaria* figured by Eaton (pl. xiv, fig. 24c). This feature again probably has little or no significance because the penis of *E. ignita* is broad (pl. xiv, fig. 24a), more like that of *E. barnardi*.

When the nymph of *Tricorythus* is examined, although at first sight it looks very like the nymph of *Ephemerellina*, it is found that there is no character which is really Ephemerellid except the gills. These are of the same imbricate type as those of *Ephemerella* and other genera, though the double series of lamellae on each rachis is unique; in fact, they are far more Ephemerellid in character than those of *Ephemerellina*, where the outer lamella of 1st gill becomes definitely elytrid and covers all the other gills, as in typical Brachycercids. The gills, therefore, are not conclusive as to affinities.

Of the other features: a similar fringe of setae on the mandible is found in the burrowing nymph of *Palingenia*, the femora with their arrangement of clavate spines are paralleled by those of *E. barnardi*, the labium is nearest to that of *Tricorythodes*, with the glossae and paraglossae completely fused, and the maxilla seems to be *sui generis*, though with some resemblance to the Leptophlebiid maxilla.

The femora are clearly adaptations to a habitat in rapidly flowing water, and the modifications of the mouth-parts would seem to form a wide-spreading net or basket for the capture of particles of food brought down by the current.

One other feature may be mentioned, namely, the fusion of the wing-cases. This seems to be carried further than in any of the described forms of Ephemerellid nymphs, and indicates the course of evolution of the remarkable *Prosopistoma* which, it may be noted, is also an inhabitant of swift currents (cf. Lestage, 1921, p. 179).

Apparently, therefore, the criteria for deciding on the systematic position of *Tricorythus* must be taken from the adult. Possibly the discovery of the nymphs of *Leptohyphes* and *Leptohyphodes* will provide a way out of the difficulty, even to the extent of instituting a separate family for *Tricorythus* and its allies, between the *Ephemerellidae* and the *Brachycercidae*.

A second very remarkable species of this genus has been discovered in the Cape.

Tricorythus discolor (Burm.).

Eaton, 1884, p. 139; Esben-Petersen, 1913, p. 181, figs. 2, 3; Lestage, 1924A, p. 338.

Imago.—Longitudinal and cross-veins all more or less equally well developed, the radial veins nearly straight (not wavy). 1-3 faint cross-veins before bulla, 4-6 (7) beyond bulla. Ventral plate of ♀ ovate, feebly notched at apex. Genital styles of ♂ 2-jointed, 2nd joint with minute papillose armature along inner margin. Penis with a

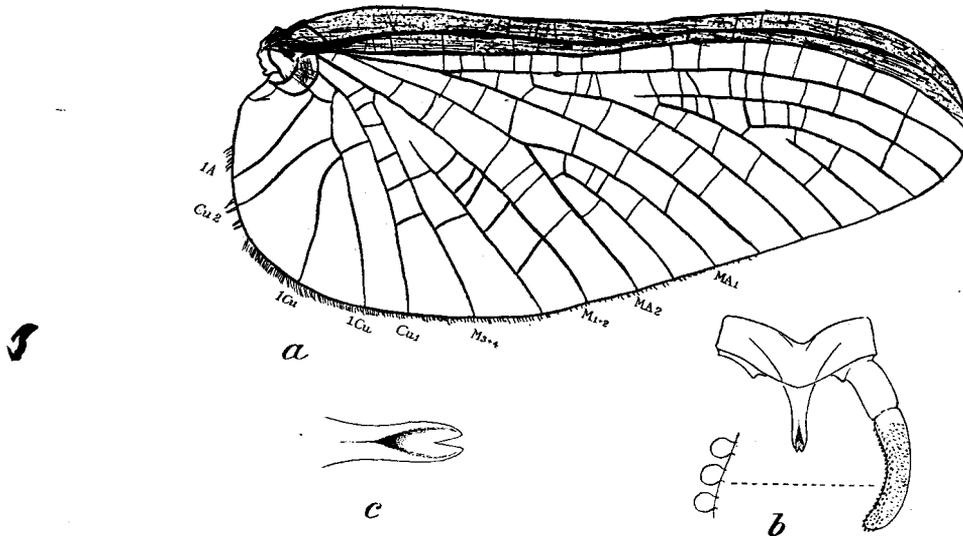


FIG. 19.—*Tricorythus discolor* (Burm.). a, fore-wing ♂ imago; b, forceps and penis of ♂, with armature of forceps further enlarged; c, ventral view of apex of penis further enlarged.

short apical cleft dorsally, ventrally with a shallow excavation into which apparently the vasa deferentia open. Cerci of both sexes setose.

Body ♂ 6.5-7 mm., ♀ 7-7.5 mm.; wing ♂ 6 mm., ♀ 10-11 mm.; cerci ♂ 12-15 mm., ♀ 10-12 mm.; fore-leg and hind-leg ♂ 3.5 mm., ♀ 5 mm.

Head black, a pale whitish patch between lateral ocelli and eyes. Eyes black, ocelli black with white apices. Antennae pale. Prothorax black or sooty dorsally and ventrally. Mesothorax pale fulvous (chiefly due to the inter-

nal tissues), with sooty suffusions, ventrally fulvous on either side of the sternite, which is sooty. Metathorax pale fulvous with sooty margin, ventrally sooty. Abdomen dark grey, sooty, with posterior margins of the segments narrowly black, ventrally paler. Legs sooty, longitudinally striped with darker and paler lines. Cerci grey, articulations of the joints slightly darker but less noticeable in fresh material than in dry. Genital styles and penis whitish. Wings sooty-grey, marginal area more suffused than rest of membrane.

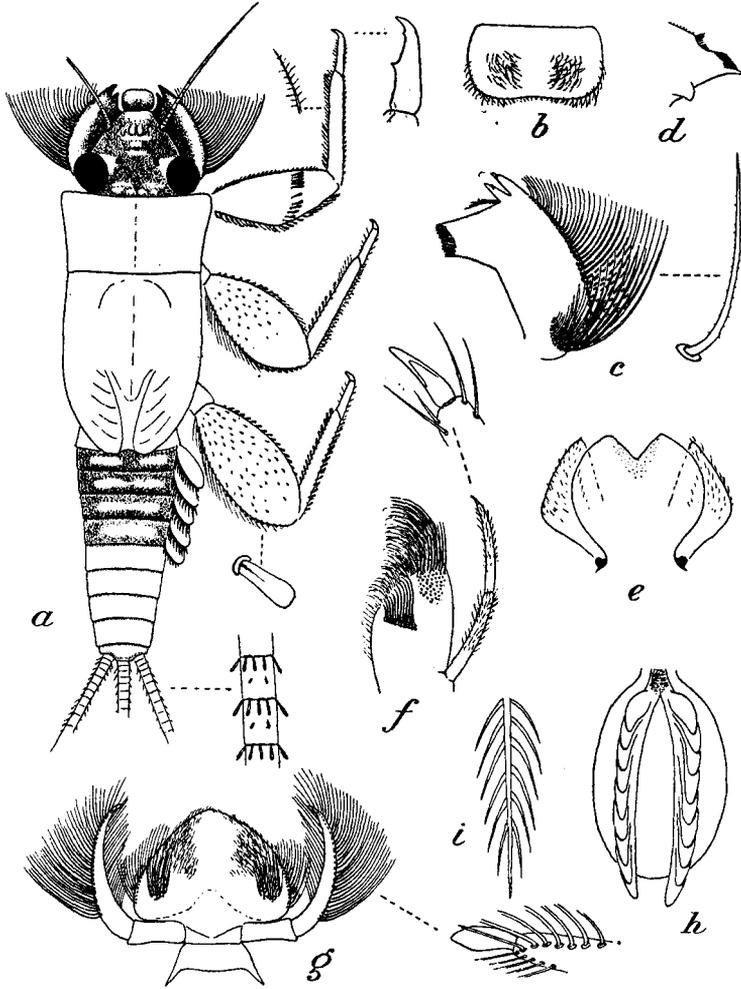


FIG. 20.—*Tricorythus discolor* (Burm.). *a*, nymph, with claw, femoral spine, and portion of cercus further enlarged; *b*, labrum; *c*, ventral view of left mandible; *d*, apex of right mandible; *e*, hypo-pharynx; *f*, maxilla, with apex of palp further enlarged; *g*, labium, with apex of palp further enlarged; *h*, inner view of gill; *i*, diagram of one rachis of inner lamella of gill.

Subimago.—Similar but body paler, femora white, with conspicuous black edges, cerci whitish, uniform; wings, on the other hand, more darkly suffused.

Egg.—Bluntly oval, surface reticulate, attachment threads from one pole only (apparently), pale yellow in body, orange when ready for deposition.

Nymph.—Body quite flat ventrally. Head not really very large, but appearing so on account of the projecting mandibles. Ocelli small, the lateral ones some little distance from the antero-internal border of eyes. Labrum transverse, scarcely if at all emarginate. Mandibles very large and strong, projecting laterally and forming the whole of the lateral margins of the head, prostheca distinct, outer margin with a series of close set long spine-setae, which proximally curves round on to the lower surface, each seta bears minute setules on both margins, but can scarcely be called plumose. Maxilla oblong, apex obliquely truncate, with a brush of long setae, lower surface also with a

patch of long setae near outer margin and an oblique row of long curved spine-setae, palp slender, long, 1st and 2nd joints subequal, setose, 3rd minute, unguiform. Hypopharynx with median lobe widely excised at apex, outer lobes subtriangular, a dark chitinous knob basally at junctions of outer lobes and median lobe. Labium with outer and inner lobes completely fused, without any traces of sutures, palp moderately stout, 2nd joint long, ensiform, with long spine-setae (of same type as those on mandibles) on both inner and outer margins, 3rd joint minute, unguiform. Legs stout, femora with clavate spines forming a transverse series on upper surface in front femur, and marginal series on mid and hind femora, with scattered ones on upper surfaces, front tibia with plumose setae, clavate spines on inner margin of mid tibia, and on both margins in hind tibia, claws with one denticle in middle of inner margin and another near apex. Wing-cases fused almost to their apices. Abdominal segments without dorsal projections, and not imbricate, posterior margins of all segments dorsally denticulate, ventrally smooth, postero-lateral angles not acuminate. No trace of gills on segment 1. Gills on segments 2-6 double, slightly decreasing in size posteriorly, the outer lamella oval, margins not setose, inner lamella bifid, each half consisting of a central rachis bearing two series of delicate imbricate lamellae. Cerci verticillate, with stout clavate spines and very fine setules.

Up to ♂ 6-7 mm., ♀ 9-10 mm. Cerci about as long as body.

Dark sepia-brown, mottled. A white spot between each lateral ocellus and eye. Eyes black. Mandibles and other mouth-parts bright ochraceous or fulvous. Abdomen dark sepia, the margins of the anterior segments darker than the slightly lighter central portions, posterior segments uniform. Legs pale ochraceous, more or less suffused, the spines dark brown, tarsi apically pale. Cerci warm brown, with a few paler annulations proximally. Outer lamellae of gills pale whitish, inner lamellae blackish-grey.

Young nymphs (2 mm., excl. cerci) are pale, with sepia suffusion dorsally, legs and cerci pale whitish.

Localities.—Tulbagh (April 1892, L. Peringuey); Michell's Pass, Wolseley (April 1931, A. C. H.); Hex River, Sandhills, Worcester Distr. (April and December 1930, A. T. Packham; April and October 1931, A. C. H.); Zululand (October 1911, W. E. Jones); Smithfield, O.F.S. (Dr. Kannemeyer).

Remarks.—Two of the ♂ and one of the ♀ specimens examined by Esben-Petersen are now in the South African Museum, and prove to be subimagos, not imagos. This accounts for the darker colour of the wings given in Esben-Petersen's description. It also accounts for Esben-Petersen thinking that the Smithfield specimen, which is also in the S.A. Museum, was a different species. It is in fact a ♀ imago, and is indistinguishable from Cape and Zululand specimens (*cf.* Lestage, 1924a, p. 340).

Habits.—The flies appear throughout the spring, summer, and autumn months in successive swarms. The subimagos emerge towards evening (5 p.m. in April) and take a short flight to the nearest stone (or angler) where they rest with wings outspread horizontally and pressed against the rock like a Geometrid moth. The imago appears in about an hour's time. The life of the imago is very fleeting, lasting only about an hour (A. C. H.).

The unique resting position of the subimago suggests that the rapid change to the imago may be correlated; the outspread position against the sun-warmed rocks helping to dry up and loosen the subimaginal pellicle.

The nymphs are very abundant, and all stages are found together. They cling to stones and rocks in swiftly running streams, and their remarkable structure is evidently adapted to withstand torrential currents. They are far more difficult to dislodge from a stone than are the nymphs of *Afronurus* or *Ephemerellina* (A. C. H.). The flat ventral surface appears to be pressed closely to the substratum, and is most probably made to function as a vacuum by retraction of the central portions; the flattened femora also aid in adhesion. When the front femora are moved forwards, the head fits into the slightly concave basal portion, proximal to the transverse rows of clavate spines, as in *Ephemerellina*. The clavate spines on the mid and hind femora and tibiae, and on the cerci, probably abut against irregularities of the surface of the stone, and help to stem the animal against the push of the water from in front or from the side.

In still water in captivity they live only a short while (14 days).

When several nymphs are placed in a glass jar without objects to which to cling, they cling to one another in a tight mass (*cf.* *Prospistoma*, Lestage, 1921, p. 179).

Tricorythus reticulatus n. sp.

Imago.—♀. Wing more uniformly broad than in *discolor*. Longitudinal veins from Sc to M very distinctly curved distally for a short distance before meeting the margin of wing. All veins in Rs field between R₂ and R₄₊₅

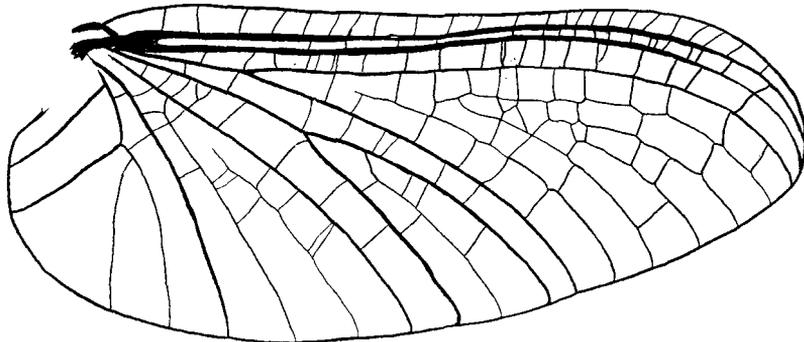


FIG. 21.—*Tricorythus reticulatus* n. sp. Fore-wing ♀ imago, marginal setae omitted.

feebly developed, and tending to form a more or less irregular network, the longitudinal veins wavy. 1MA, 1M, M_{3+4} and both 1Cu also less distinct than the other longitudinal veins.

Body 4-5 mm.; wing 8 mm.

Head blackish. Mesothorax fulvous. Abdomen light sooty-grey, the posterior margins of the segments darker. Legs grey. Cerci pale. Wing pale greyish.

Locality.—Tradouw Pass, Langeberg Range, east of Swellendam (October 1925, K. H. B.).

Remarks.—This species is not only smaller than *discolor*, but is easily distinguished by the reticulate veining in the Rs field. The ♂ is as yet unknown.

Family LEPTOPHLEBIDAE.

Ulmer, 1920, p. 112.

Imago.—Wings hyaline, with numerous cross-veins. Fore-wing with distinct, well-developed subcosta; MA forked; M_{3+4} and Cu_1 parallel, not separated by disconnected intercalaries; Cu_2 at base nearer to 1A than to Cu_1 (often only slightly so); Cu_2 and 1A curving sharply back, abutting on margin near base. Hind-wing well developed. Genital styles of ♂ 3-jointed, 2nd and 3rd joints very short; sometimes with only one short terminal joint clearly demarcated from the long basal joint; sometimes a short annular joint at base of long joint, making four joints. Penis entire or bilobed. Eyes in ♂ turbinate. Cerci 3.

Nymph.—Of the crawling type, more or less flattened. Head oblong, more or less bent downwards, eyes lateral, lateral ocelli at level of anterior margin of eyes. Antennae moderate or rather long. Labrum more or less apically excavate. Mandibles stout, outer margin more or less strongly convex, forming the antero-lateral margin of head, protheca distinct. Maxillae oblong, apically truncate with a thick brush of setae, and a row of pectinate spines, palp 3-jointed. Hypopharynx with median lobe apically incised, with or without lateral forwardly curving processes, outer lobes (paragnaths) more or less curving outwards. Labium with inner lobes much smaller than outer, palp 3-jointed. Legs moderately stout, claws denticulate or smooth. Gills seven pairs, each consisting of a double or single lamella, of various shapes. Cerci 3.

Key to the South African Genera.

Imagos.

1. Claws all alike, narrow, hooked.
 - a. Hind-wing without angular costal process, costal area narrow, long *Aprionyx*.
 - b. Hind-wing with angular costal process, costal area broad, short *Adenophlebia*.
2. Claws unlike, one hook-like, the other obtuse.
 - a. Stalk of MA long, forking broad, considerably distal to origin of R_{4+5} from Rs *Castanophlebia*.
 - b. Stalk of MA shorter, forking narrow, a short distance distal to origin of R_{4+5} from Rs.
 - i. Genital styles ♂ 4-jointed, 1st joint annular. Hind-wing broadly oval *Choroterpes*.
 - ii. Genital styles ♂ 3-jointed. Hind-wing narrowly oval *Euthraulius*.

Nymphs.

1. Claws smooth. Abdominal segments 8 and 9 laterally biacuminate *Aprionyx*.
2. Claws denticulate. Abdominal segments 8 and 9 laterally uniacuminate.
 - a. Gill on segment 1 not reduced.
 - i. Gills ovate-lanceolate *Adenophlebia*.
 - ii. Gills narrow-lanceolate *Castanophlebia*.
 - b. Gill on segment 1 reduced to a single filiform process.
 - i. Each lamella of gills 2-7 ending in three digitiform filaments *Euthraulius*.
 - ii. Each lamella of gills 2-7 indented in middle, distal half abruptly narrower than basal half. *Choroterpes*.

Aprionyx n. g.

Eaton, 1884, p. 83 (*Atalophlebia* part); Ulmer, 1920, p. 115 (*Atalophlebia* part).

Imago.—Like *Atalophlebia*, i.e. claws of all legs alike, apically hooked. Hind-wing with costal margin convex, without strongly projecting process, the summit of the arch before middle of wing; Sc long; costal area long and narrow, subcostal area broader than costal area. 10th sternite of ♂ undivided. Genital styles of ♂ with two distinct terminal short joints, basal joint more or less abruptly narrowed in its distal half. Penis single, broad basally, more or less rapidly tapering, with a recurved flap near each orifice, sometimes apically cleft, but the lobes not deliscent.

Egg.—Ovoid, sculptured with large pits, no projecting bosses, no attachment threads.

Nymph.—Claws quite smooth. Antennae long. Labrum shallowly emarginate, with denticles in the emargination. Hypopharynx with forwardly curving lateral processes on median lobe. Labium with inner lobes ovate, set in a vertical plane at right angles to the outer lobes, palp stout, terminal joint very short, broader than long, triangular, with short stout spines. Shoulder of prothorax with a patch of long slender spines. Abdominal segments 8 and 9 with two spines at each postero-lateral angle. Gills double, more or less obovate, with fine apical filamentous point.

Remarks.—This genus is closely allied to *Atalophlebia* Eaton and *Atalonella* Needh. and Murphy, 1924, but is distinguished by the smooth nymphal claws ($\alpha\text{-}\pi\text{ρι}\omega\text{ν}\text{-}\delta\text{ν}\nu\zeta$). The nymph of the genotype of *Atalophlebia*, viz. *australis*, is unknown; but in all probability it has toothed claws like the New Zealand species described by Phillips (1930). Nymphs attributed to the Chilean species of *Atalophlebia* and the closely allied *Atalonella* are described by Needham and Murphy (1924) as having toothed claws.

The labial palp is quite different from that figured for a Chilean *Atalophlebia*, but resembles in its stoutness and

very short 3rd joint that of the New Zealand species *cruentata* (Phillips, 1930, p. 347, fig. 15), though not that of *versicolor* (*ibid.*, fig. 1).

The egg is quite different from those described by Phillips.

Referring to Needham and Murphy's (1924, p. 36) tabulation of the venational differences between Chilean *Atalophlebia* and *Atalonella*, it may be noted that *Aprionyx* resembles *Atalonella* in having oblique pterostigmal cross-veins, M_{3+4} nearer to Cu_1 than to M_{1+2} at base, Cu_2 curved throughout its length; but agrees with *Atalophlebia* in having cross-veins before the bulla in subcostal area, and in the hind-wings. The penis in both genera is represented as divided into two lobes from the base, whereas in *Aprionyx* it is entire or with only a slight apical cleft.

Needham and Murphy (1924, p. 36) also state that the inner lobes of labium in *Atalophlebia* are conical, widened in *Atalonella*. This may perhaps be a misconception. In the South African nymphs the two inner lobes lie not in the same horizontal plane as the outer lobes, but side by side vertically; consequently if the appendage be viewed without compression these lobes appear narrow and more or less conical, but under a cover-slip ovate (in fig. 24 they are represented as flattened).

As the fore-wings and abdominal patterns of all the Cape species are here figured, a key or synopsis is unnecessary.

Aprionyx tabularis (Eaton).

Eaton, 1884, p. 91, pl. x, fig. 16h. Esben-Petersen, 1920, p. 500, figs. 3, 4. Lestage, 1924A, p. 325 (*phoecocera*).

Imago.—Ten fine cross-veins before bulla, 12–14 in pterostigmal area, very oblique, sigmoid, and nearly all anastomosing, some cases so much so as to form almost a longitudinal vein between C and Sc. Hind-wing with Sc extending to $\frac{3}{4}$ length of wing; 12–13 cross-veins in subcostal area. Genitalia σ as figured, penis not angular ventrally when viewed laterally, rather abruptly narrowed towards apex, which is shallowly cleft.

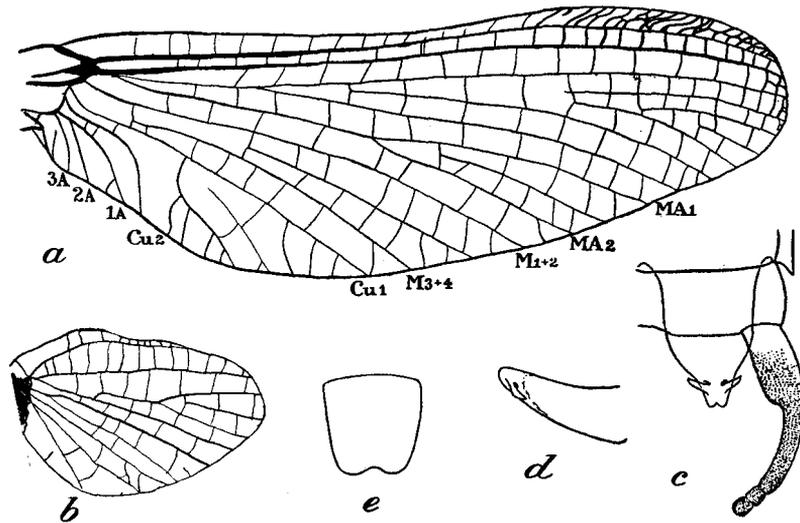


FIG. 22.—*Aprionyx tabularis* (Eaton). *a, b*, fore- and hind-wings σ imago (from Ceres. Determined by E.-P.); *c*, ventral view of forceps and penis of σ ; *d*, lateral view of penis; *e*, ventral plate of ρ .

Body σ 9 mm., ρ 12 mm.; wing σ 10 mm., ρ 13 mm.; cerci.

σ . Head and thorax dark Vandyke brown, junctions of sclerites on mesothorax laterally paler. Turbinate eyes dark basally, light pinkish (in alc.) on top, ocelli with white apices. Legs dark fuscous, femora suffused at apices and broadly across middle. Abdomen sepia-brown, segments 1, 9, and 10 uniform or nearly so, segments 2–7 or 8 with a medio-dorsal pale narrow stripe, with a pale round or oval spot on either side anteriorly and a fainter spot more posteriorly and laterally (*cf.* nymph), pleurae pale with dark margins; ventrally pale grey, segments 2–6 or 7 with two very faint darker specks near anterior margin. Neuration dark fuscous-brown, the costal and subcostal areas in the pterostigmal region slightly milky. Cerci ochraceous, the articulations of the joints slightly darker. Genital styles σ brown, the inner margin of the curved portion whitish, penis apically pale.

Subimago.—Similar, but darker, the scutum of mesothorax with a lateral dark border enclosing two dark longitudinal stripes, scutellum pale. Wing membrane greyish. When freshly emerged, with a slaty bloom; fades to a much paler tint in alcohol.

Egg.—Oval, twice as long as broad, .25 mm. long diameter, sculptured with coarse shallow pits, no attachment threads.

Nymph.—Posterior margins of abdominal segments 9 and 10 with strong denticles, of the other segments with very minute and obscure, more or less bifid denticles, quite obsolete on the anterior segments. Segments 4–7 laterally acuminate, segments 8 and 9 with two acute points at postero-lateral angles; a minute second denticle occurs also

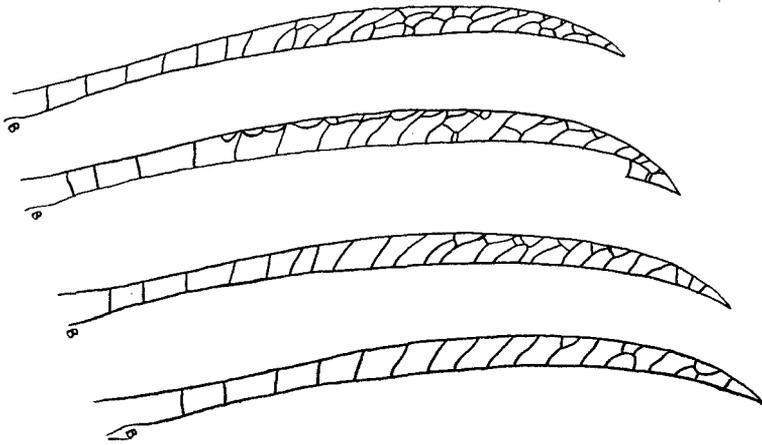


FIG. 23.—*Aprionyx tabularis* (Eaton). Varying degrees of anastomosis of the pterostigmal veins in four ♀ subimagos. Compare the same area in *A. intermedius*, fig. 27.

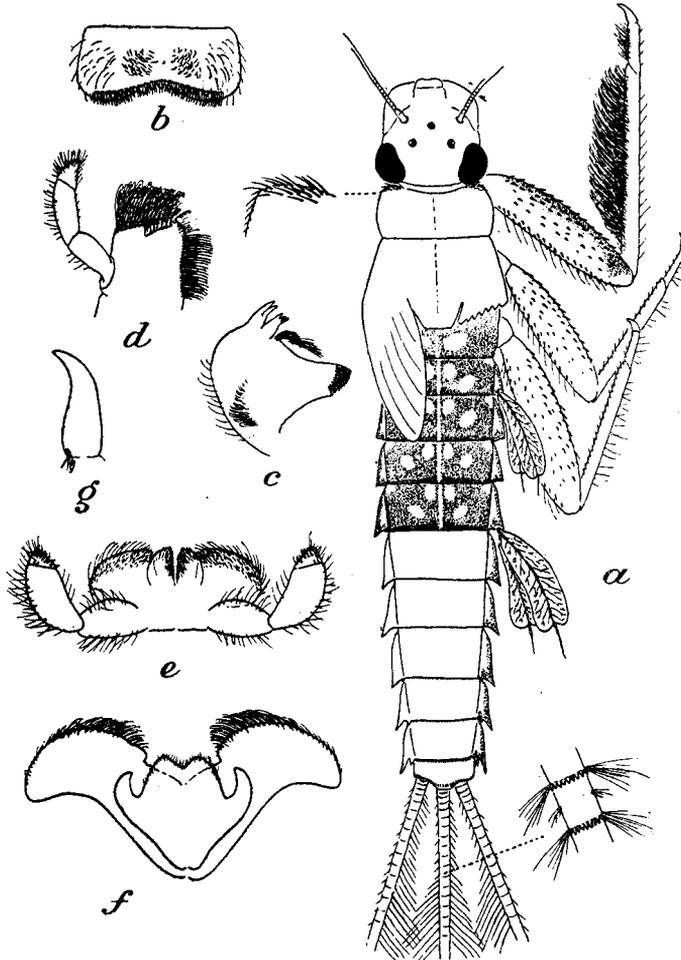


FIG. 24.—*Aprionyx tabularis* (Eaton). *a*, nymph with right wingcase cut away and some of the gills omitted, antennae and cerci cut short, colour pattern indicated on anterior abdominal segments only, prothoracic shoulder spines and portion of middle cercus further enlarged; *b*, labrum; *c*, left mandible; *d*, maxilla; *e*, labium (inner lobes flattened); *f*, ventral view of hypopharynx; *g*, claw.

sometimes within the lateral point on segments 6 and 7. Femora, especially front femur, rather stout. Front tibia and tarsus stronger than the others, with thick fringe of hairs on inner margin. Claws smooth. Gills slightly obovate, apically truncate, with a shallow notch from which arises the slender terminal filamentous point; 1st gill narrower than the others. Cerci elongate, verticillate, both margins of the median cercus and the inner margin of the lateral cerci rather thickly clothed with long setae, some plumose.

Mottled brown. Femora suffused at apices and along front margin, but no distinct bands. Metathorax brown with a faint median paler stripe with an oval pale spot on either side. Abdominal segments 1-9 with pale median stripe, with a round spot on either side anteriorly and a slightly larger obliquely ovate one posterior to it, pleurae pale with darker margins. Cerci brown, uniform, only the articulations of the joints slightly darker. Gills greyish-white, semi-opaque, tracheae black.

Up to 16 mm., antennae 9 mm., cerci 20 mm.

Localities.—Table Mt., Cape Town (1874, A. E. Eaton); Ceres (village) (April 1913, R. M. Lightfoot); Groot Drakenstein (A. C. H.); French Hoek (K. H. B.); Jonkershoek, Stellenbosch (A. C. H. and K. H. B.); Du Toits Kloof and Louws Hoek, Rawsonville (A. C. H.).

Remarks.—There is considerable variation in the pterostigmal cross-veins, and fig. 23 shows four varieties. The smaller specimens show the least amount of anastomosis. Such specimens remind one very forcibly of Eaton's description of *tabularis*, and the numbers of cross-veins before and after the bulla also agree.

Esben-Petersen's figure 3a (1920) of the penis closely resembles in outline Eaton's figure 16h, and it is to be noted that Lestage in his key (1924, p. 331) uses the same simile to describe Esben-Petersen's figure ("en forme de plume à écrire") as does Eaton ("the nib of a pen"). Yet Lestage declines to admit the correctness of Esben-Petersen's identification because the latter states that the cerci are uniform and the femora are dark only at the knees.

In fact, both in the specimens seen by Esben-Petersen and in fresh material, the cerci are annulate, albeit not strongly, and the femora are banded in the middle and dark at the knee.

There are only two reasons against designating this form as *tabularis*: the shape of the penis and the negative evidence that up to the present no specimen, fly or nymph, of an *Aprionyx* has been found in the Platteklip stream, Table Mt., where Eaton caught his original specimen.

As regards the penis, Esben-Petersen's figure was made from a dry specimen. If one examines the specimen under a low power in the dry condition his figure is accurate. But the figure is valueless, as he does not describe the penis or state whether it is bilobed or not.

Eaton's figure, from a specimen in alcohol, may be assumed to be more reliable. But it shows the penis deeply cleft into two lobes. This condition is found in *Choroterpes* and *Euthraulius*; but a still better likeness is found in the subimago (not the imago) of *Castanophlebia* (which latter *does* occur in the Platteklip stream). But apart from other considerations, the hind-wings and the venation of the fore-wings of all these genera are so different from those of *tabularis* as to preclude any confusion.

It therefore seems reasonable to use Eaton's name for this species, which agrees exactly in the number of costal cross-veins.

Lestage's name, *phoecocera*, was based not on actual specimens but on Esben-Petersen's description, which has been shown to be inaccurate, and therefore falls into synonymy.

Whether *tabularis* has become extinct or very rare in the Table Mt. streams is a matter for further investigation.

Habits.—The eggs are dropped in clusters as the female dips to the surface of the water. The larger open pools seem to be favoured, and the act was observed in the forenoon in warm sunny weather in April. A captured ♀ laid egg-masses in a tube of water; the eggs separated as they sank to the bottom. They hatched after 22-23 days. The first instar measures 5.5 mm. plus cerci, and is hyaline yellow, no sign of gills (A. C. H.).

Nymphs of 7 mm. length are easily recognisable as belonging to this species by the characteristic "stance," the fringed front tibiae being held forwards aggressively. In captivity nymphs have been seen to pass the mouth-parts over the fringe on the front legs (A. C. H.).

Nymphs occur under stones in running water, and swim fairly well, using legs and body undulations.

The flies occur in March to June.

Aprionyx petersemi (Lest.).

Lestage, 1924A, p. 328.

Imago.—Five strong cross-veins before bulla; 8-9 strong ones in pterostigmal area, all simple, slightly oblique. Hind-wing with Sc extending about $\frac{3}{4}$ length of wing, seven cross-veins in subcostal area. Penis ventrally angular, apically entire. Ventral plate of ♀ sharply incised.

Body ♂ 9.5-10 mm., ♀ 10-5 mm.; wing ♂ 9-11 mm., ♀ 10-11 mm.; cerci ♂ 15-20 mm., ♀ 13-15 mm.

Head white with a dark brown or black median stripe, and a disconnected transverse stripe between its posterior end and the eye; a castaneous patch between the median stripe and the lateral ocelli, around which is also a castaneous ring. Eyes and ocelli black. Prothorax white with black crescentic marks and castaneous suffusion medio-dorsally, and a black margin. Mesothorax dorsally black, scutellum white, laterally white with blackish and brown marks. A black bar across the "chest" in front of bases of middle legs, followed by two suffused spots on the sternite. Metathorax dorsally brown with a median pale mark. Abdominal segment 1 brown with a median conical pale spot and an oval pale spot on either side. Segments 2-7 white, pellucid, with a conical dark patch, containing an oval white spot on either side of median line, and a dark line on posterior margin; pleurae with a black mark anteriorly and posteriorly; ventrally with a very faint H-shaped mark. Segment 8 more suffused; segment 9 brown; segment 10 pale whitish. Femora pale with basal, middle and apical bands; tibiae and tarsi pale. Cerci white with dark annulations, the white and brown sections about equal in length. Neuration dark brown or blackish. Turbinate eyes in ♂ black basally, deep yellow (pinkish in alc.) distally.

Subimago.—Similar, but thorax with less brown mottling, mesothorax medio-dorsally white in centre, wings cloudy and neuration not so dark.

Egg.—Resembling that of *tabularis*.

Nymph.—In general like that of *tabularis*, but pleurae not so prominent, front tibia and tarsus without long fringe of hairs, cerci not so strongly setose.

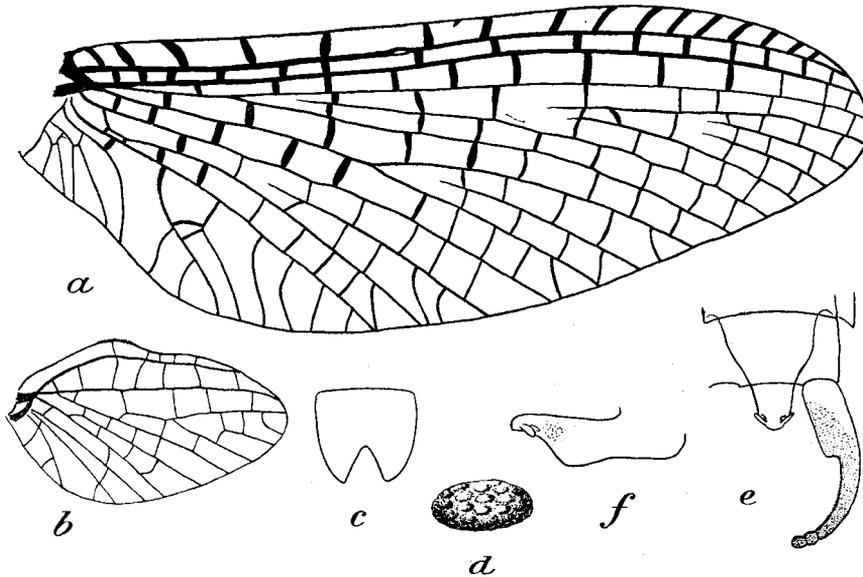


FIG. 25.—*Aprionyx peterseni* (Lest.). a, b, fore- and hind-wings ♀; c, ventral plate of ♀; d, egg; e, ventral view of forceps and penis of ♂; f, lateral view of penis.

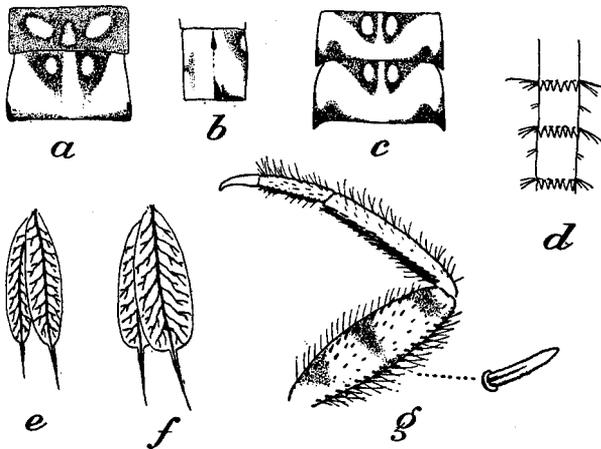


FIG. 26.—*Aprionyx peterseni* (Lest.). a, dorsal view of 1st and 2nd abdominal segments of imago; b, lateral view of segment 2 of imago (dorsum to right); c, dorsal view of 2nd and 3rd abdominal segments of nymph; d, portion of middle cercus of nymph; e, f, 1st and 2nd gills; g, front leg of nymph.

Brownish, mottled. Abdomen pale, with the same style of pattern as in the imago; in half-grown nymphs this seems to show only on the posterior segments; ventrally pale with a minute short black line on posterior margin on either side. Cerci annulate. Lamellae of gills not apically indented.

Up to 12 mm., antennae 4 mm., cerci 12–15 mm.

Localities.—Paarl (Rev. G. Hawke); Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.);

French Hoek (April 1931, K. H. B.); Montagu (October 1919, K. H. B.); Witte River, Wellington Mts. (November 1922, K. H. B.); River Zonder End Mts. (November 1928, K. H. B.); Bosch Kloof, Keeromberg, Worcester (January 1930, K. H. B.); Cedarbergen, Clanwilliam Distr. (January 1930, K. H. B.).

Habits.—The nymph crawls out, or partly out, of the water before emergence of the subimago. The emergence of both subimago and imago is crepuscular or nocturnal, the latter about 22–24 hours after the former. The flies appear in spring (October) and go through the summer to April in successive hatchings. The species is common, but not so common as *tabularis* or the "September" and "Summer Browns."

Aprionyx intermedius n. sp.

Subimago.—8–9 cross-veins before bulla; 12–14 in pterostigmal area, slightly oblique, and often slightly sigmoid, but rarely anastomosing. Hind-wing with Sc extending about $\frac{1}{4}$ length of wing, seven cross-veins in subcostal area. Ventral plate ♀ shallowly incised.

Imago.—♀. Penis much broader and flatter (dorso-ventrally depressed) than in any of the other species.

Body 9–10 mm., wing 9.5–10 mm., cerci 10–11 mm.

♀. Head brown with darker markings. Eyes black, ocelli black with whitish apices. Prothorax fulvous brown, anterior margin with a thin dark line and a faint dark patch on either side of median line. Mesothorax pale brown

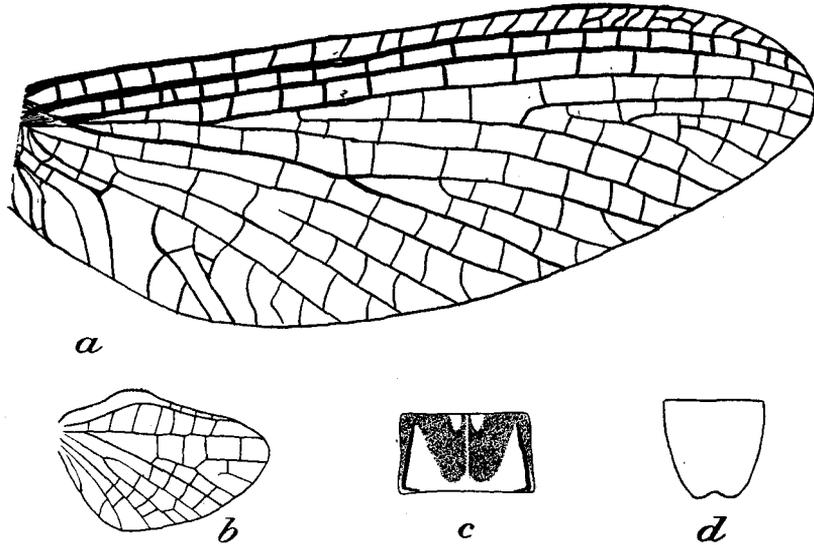


FIG. 27.—*Aprionyx intermedius* n. sp. a, b, fore- and hind-wings of ♀ subimago; c, dorsal view of abdominal segment of subimago; d, ventral plate of ♀.

with darker markings, a dark brown horizontal stripe on lateral margin of scutum. Metathorax brown. Abdomen castaneous-brown, segments 1 and 10 dorsally uniform, segments 2–8 each with a pale spot on anterior margin on either side of the narrow medio-dorsal line, a subtriangular pale patch towards the postero-lateral corner connected along posterior margin by a pale bar on the posterior segments, and bounded laterally by a blackish streak; ventrally paler, each segment with a faint darker spot in middle of anterior margin. Legs ochraceous, femora with dark basal, middle, and apical bands. Wings greyish, longitudinal veins light red-brown, cross-veins jet black. Cerci whitish or pale grey, with narrow dark annulations. Venation of ♂ imago paler.

Egg.—Similar to that of *tabularis*, .33 mm. long diameter.

Nymph.—Resembling the nymph of *peterseni* very closely, but the posterior margins of all the abdominal segments are denticulate, the denticles strong and closely set, with many minute submarginal accessory denticles; and the cerci are only sparsely setose.

Coloration in general like that of *peterseni*, but the abdominal pattern as figured for the subimago, with the brown colour more extensive and separating the two postero-lateral pale patches except on the posterior segments where they are connected by a pale bar across the posterior margin.

Locality.—Groot Drakenstein (A. C. H.).

Remarks.—Only one ♂ imago and three subimagos of this species have been obtained. It is probably not rare, but the nymphs very closely resemble those of *peterseni* and can only be discriminated by close scrutiny of the cerci and the colour pattern on abdomen. It is probably a winter and early spring fly, as those obtained were caught or bred in October. One ♂ nymph was obtained in December, and is ready to disclose the subimago.

The subimago fly is distinguished from *peterseni* by the more numerous cross-veins in the costal area, both before and after the bulla, and the tendency of the pterostigmal veins to branch and anastomose, though this is not nearly so pronounced as in *tabularis*; the abdominal pattern, and the shallowly incised ventral plate of the ♀.

Aprionyx rubicundus n. sp.

? Lestage, 1924A, p. 330 (*Atalophlebia* sp. subimago Paarl).

Imago.—♂. 8–9 cross-veins before bulla, 8–10 simple, mostly straight, oblique cross-veins in pterostigmal area. Hind-wing with Sc extending nearly $\frac{1}{4}$ length of wing, five cross-veins in subcostal area, other cross-veins considerably reduced. Penis with short apical cleft, the lobes adnate.

Body 7 mm., wing (6.75) 7–8 mm., cerci broken.

Turbinate eyes black basally, yellow or fulvous on top. Prothorax brown, darker in centre, with black lateral margin. Mesothorax deep red-castaneous or maroon, uniform, laterally brown with whitish oblique marks from base of hind-wing, and a horizontal white mark extending from base of fore-wing forwards; ventrally brown. Metathorax brown. Abdomen mottled pale and sepia-brown, segment 1 nearly uniform, segments 2–8 as figured, segment 9 nearly and segment 10 completely uniform brown. Legs ochraceous, femora with basal, middle, and apical bands.

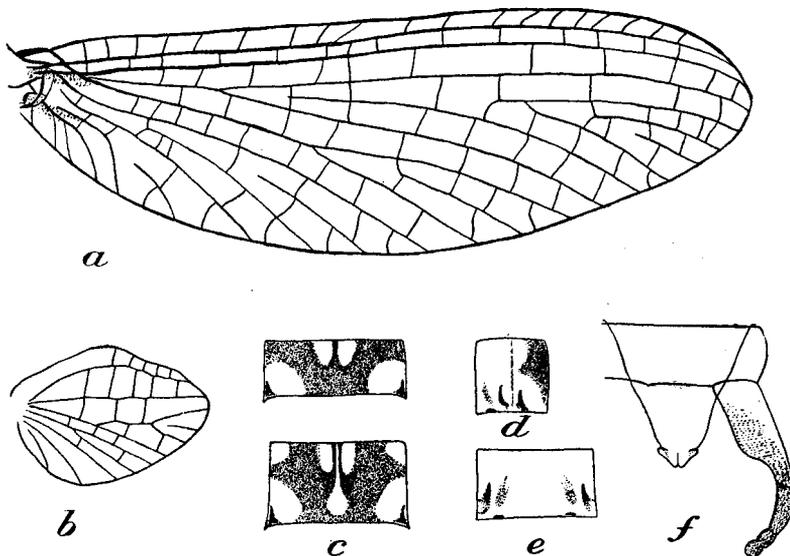


FIG. 28.—*Aprionyx rubicundus* n. sp. a, b, fore- and hind-wings of ♂ imago; c, dorsal view of abdominal segments 2 and 6; d, lateral view of abdominal segment (dorsum to right); e, ventral view of abdominal segment; f, ventral view of forceps and penis of ♂.

Cerci ochraceous with narrow dark annulations. Wings clear, a little cloudy in costal and subcostal areas, neuration bright ochraceous-brown, both longitudinal and cross-veins equally coloured.

Localities.—Montagu (October 1919, K. H. B.); River Zonder End Mts. (December 1920, K. H. B.); Banhoek, Stellenbosch (October 1929, K. H. B.); Nonna Kloof, Keeromberg, Worcester (September 1930, K. H. B.).

Remarks.—Only the fly of this very pretty species is known. It is a small species with distinctive maroon mesothorax and bright brown neuration.

Aprionyx pellucidulus (E.-P.).

Esben-Petersen, 1920, p. 499, figs. 1, 2; Lestage, 1924A, p. 330.

Imago.—6–8 fine cross-veins before bulla, 10–12 fine oblique, slightly curved, not anastomosing cross-veins in pterostigmal area. Hind wing with Sc extending about $\frac{1}{4}$ length of wing, 6–7 cross-veins in subcostal area. Penis ventrally angular as in *peterseni*, but broader and blunter when viewed from below. 10th sternite with very shallow median emargination.

Body ♂ 10–12 mm., ♀ 12–13 mm.; wing ♂ 11–13 mm., ♀ 13–14 mm.; cerci 23–29 mm.

♂. Head dark brown. Turbinate eyes dark at base, paler on top, ocelli with pale apices. Pro- and mesothorax fulvous or pale castaneous, the latter with paler streaks laterally, scutellum pale. Metathorax pale brown. Abdomen pale, pellucid, segments 9 and 10 grey, segments 1–8 with dark brown transverse bar on posterior margin, some segments also show an indistinct transverse suffusion near the anterior margin, ventrally pale. Legs pale grey, femora with dark middle and apical bands, and often an indistinct suffusion near base. Cerci pale grey, the articulations slightly and indistinctly darker. Wings clear, very faintly yellowish in pterostigmal area, neuration dark brown or castaneous. Subimago similar but duller, wing membrane grey.

Egg.—(Extracted from dried subimago) similar to that of *tabularis*, .4 mm. long diameter.

Localities.—Gt. Winterhoek Mts., Tulbagh Distr. (November 1916, R. M. Lightfoot and K. H. B.); North slopes of Matroosberg, Ceres Div. (November 1917, R. M. Lightfoot).

Remarks.—This fly has only been found in two localities, both at an altitude of about 4000 feet, and would seem to be a strictly mountain form.

The nymph is unknown, but the abdominal colour pattern of the nymph described below from the Zwartberg Pass is not very inconsistent with the adult pattern. If this be the nymph of *pellucidulus*, then the species is rightly included in the genus *Aprionyx*.

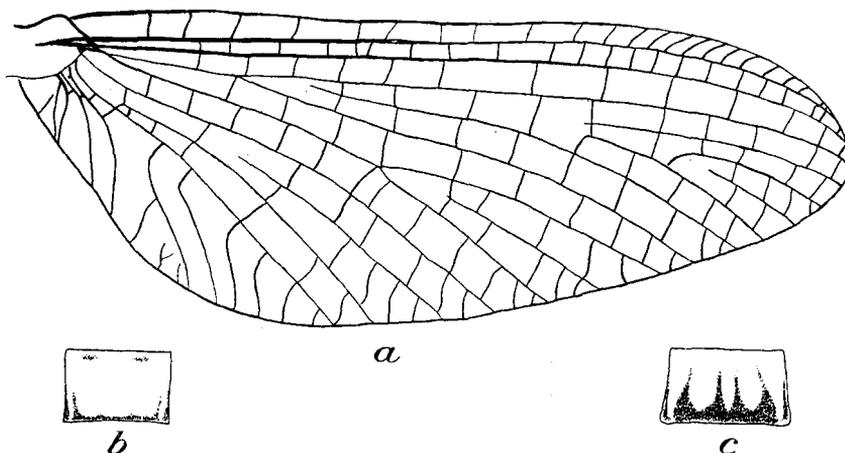


FIG. 29.—*Aprionyx pellucidulus* (E.-P.). *a*, fore-wing of topotype ♂ imago; *b*, dorsal view of abdominal segment; *c*, dorsal view of abdominal segment of nymph from Zwartberg Pass for comparison, but not definitely assigned to *pellucidulus*.

In Esben-Petersen's description (1920, p. 500) the statement that the pterostigmal cross-veins anastomose is apparently due to a transposition either in the MSS. or in the printing thereof. None of the type specimens or several others in the S.A. Museum have anastomosing cross-veins. The three ♂♂ from Ceres (*Ceres village*. Leg. Lightfoot, April 1913) are in fact the three described lower down on the same page by Esben-Petersen as *tabularis*, and later named *phoocera* by Lestage.

Aprionyx natalica (Lestage).

? Esben-Petersen, 1913, p. 179 (*tabularis* non Eaton); Lestage, 1924A, p. 325.

Imago.—6-7 fine cross-veins before bulla, 9-10 oblique, curved not anastomosing cross-veins in pterostigmal area. Hind-wing with Sc extending almost to apex of wing, 5-6 cross-veins in subcostal area.

Body 11-12 mm.; wing ♂ 11-12 mm., ♀ 13-14 mm.

♂. Blackish (in sicco), abdomen lost. Legs fulvous, front femur blackish, mid and hind femora with blackish apices. Neuration fulvous brown, pterostigmal area suffused yellowish.

Locality.—Krantzkop, Natal (November 1917, K. H. B.); Katberg and Hogsback (Albany Mus.).

Remarks.—The nymph being unknown, it can only be assumed that this is a species of *Aprionyx*. For further description of the fly see Lestage.

The Zululand specimen referred to by Esben-Petersen in 1913 is not in the South African Museum collection.

Aprionyx sp. Nymph.

Some nymphs collected on the Zwartberg Pass (November 1929, K. H. B.) are 8-9 mm. in length. The head and thorax are greyish-brown mottled, the abdomen pale yellowish, with dark transverse bars on the posterior margins of the segments (fig. 29, *c*) with four narrow streaks or lines extending forwards; a dark spot on the pleurum; segment 9 nearly uniform; segment 10 pale. Femora with three dark bands. Cerci pale, uniform. Gills resembling those of *peterseni* in shape.

As remarked above, this may possibly prove to be the nymph of *pellucidulus*, and therefore no name is attached to this form.

Gen. *Adenophlebia* Eaton.

Eaton, 1884, p. 111; Ulmer, 1920, p. 115; Lestage, 1924A, p. 332, and p. 336 (*Esbenophlebia*).

Imago.—Like *Aprionyx* as regards tarsal claws, fore-wings, and 10th sternite of ♂. Hind-wing with costal margin strongly and angularly convex, Sc short, costal area short and broad, subcostal area narrower than costal area. Genital styles of ♂ obscurely 3-jointed, *i.e.* there is only one clearly demarcated terminal short joint, basal joint more or less abruptly narrowed in distal half; penis single, broad basally, rapidly tapering, apically cleft for a short distance, the lobes slightly dehiscent, each with a recurved spiniform process ventrally. Ventral plate of ♀ apically truncate.

Egg.—Ovoid, sculptured with small pits, no attachment threads.

Nymph.—Antennae long. Labrum shallowly emarginate, with 4-5 denticles. Hypopharynx with forwardly

curved lateral processes on median lobe. Labium with inner lobes horizontal, *i.e.* on the same plane as outer lobes, with fine setae only, palp rather slender, 3rd joint conical, longer than broad. Shoulder of prothorax with a patch of short stout spines. Tarsal claws denticulate, the denticles increasing regularly in size distally. Abdominal segments 8 and 9 with only one acute point at postero-lateral corner. Gills double, ovate-lanceolate, tapering to a fine point.

Remarks.—Besides the three South African species herein mentioned, Navas (1929) has described *A. burgeoni* from the Belgian Congo. *A. ornata* Ulmer, 1916, from the Cameroons, has been placed in a separate genus: *Adenophlebioides* Ulmer, 1924, as it differs in venation, though it has the tarsal claws alike.

In explanation of the sinking of *Esbenophlebia* as a synonym it may be noted: firstly, that Eaton's figure of *dislocans* shows a very asymmetrical fork of MA, which is surely not normal, even if correctly drawn; secondly, Esben-Petersen's statement (1913) that the neuration of *westermanni* agrees with that of the type species is, from the figure he gives, obviously incorrect, as pointed out by Lestage, 1917.

Lestage therefore (1924), without, however, seeing any actual specimens, instituted the genus *Esbenophlebia* for *westermanni*, defining it from Esben-Petersen's figure as follows: $1R_2$ arising separately from R_s , $1R_{2b}$ connected with R_s , junction of R_{4+5} with R_s nearer to junction of R_s and MA than to fork of MA, only a single cross-vein on either side of 1MA, connecting this vein with MA_1 and MA_2 , cross-veins between MA (and MA_2) and M_{1+2} few (4-5).

Of the numerous examples examined by me not one has been found showing these peculiarities, though reduction of the cross-veins in MA to two or occasionally to one on one side or the other may occur. Moreover, not one of three specimens in the S.A. Museum labelled by Esben-Petersen himself as *westermanni* shows the very narrow wing form or the peculiar neuration.

Both Eaton's and Esben-Petersen's figures are therefore to be regarded as representing abnormal wings, and Lestage's genus falls as a synonym of *Adenophlebia*.

The three species *auriculata*, *peringueyella*, and *dislocans* are very closely allied, and it is difficult to find constant differential characters. In the fore-wing the best criteria seem to be the number of cross-veins on either side of MA, *i.e.* between R_{4+5} and MA_1 and between MA_2 and M_{1+2} , and the cross-veins between Cu_1 and the first cubital intercalary. The ♂ genitalia do not differ. The partial or complete demarcation of two small apical joints in the forceps is so inconstant as to be valueless for specific differentiation.

In order to try and obtain as true a picture as possible of the species, Mr. Harrison and I have analysed all the specimens in hand, counting both wings of each specimen, and taking the average. The extreme figures are given in brackets on either side of the average number in the following table, but in the descriptions only the averages are given.

	<i>auriculata.</i>	<i>peringueyella.</i>		<i>dislocans.</i>	
	Barberton and Natal.	♂.	♀.	♂.	♀.
a. C. v. in costal area before bulla . . .	6-7	6-7	(6) 7 (8)	(5) 6 (8)	(6) 7 (9)
b. " " " after " . . .	11-12	(11) 14 (17)	(12) 14 (17)	(10) 11 (14)	(14) 15 (16)
c. " subcostal area . . .	15-16	(15) 16 (18)	(16) 17 (19)	(12) 14 (17)	(14) 16 (20)
d. " subradial area . . .	11 (16)	(11) 12 (14)	(12) 13 (14)	(8) 9 (12)	(9) 10 (11)
e. C. v. between R_{4+5} and MA_1 . . .	9-11	(9) 12 (13)	(11) 12 (14)	(5) 7 (8)	(7) 8 (10)
f. " " MA_2 and M_{1+2} . . .	10-11	(9) 10 (12)	(8) 11 (13)	(4) 6 (8)	(6) 8 (10)
g. " " M_{3+4} and Cu_1 . . .	3-4	(3) 4 (5)	(4) 5 (7)	(2) 3 (4)	(3) 5 (6)
h. " " Cu_1 and 1st $1Cu_1$. . .	2-3	(2) 3 (5)	(3) 4 (5)	(0) 2 (3)	(2) 3 (3)

Thus it will be seen that taking characters *d*, *e*, *f*, *h*, together with the extent of the wing markings, the species are well characterised, especially *dislocans*; though in the case of some individual specimens it might be difficult to identify them satisfactorily on venational characters alone.

The differences in numbers of cross-veins are not always due to variation in size, in particular those in *d*, *e*, *f*, and, moreover, they are greater between species than between the two sexes or between large and small specimens of the same species. This is particularly noticeable between the two markedly spotted species *peringueyella* and *dislocans*, and between the latter and *auriculata*. Between *peringueyella* and *auriculata* the difference is not so noticeable, but our conception of the latter species is as yet based on only four specimens (excluding Eaton's material).

The ♀♀ appear always to have the wings more heavily spotted than the ♂♂, though there is not such a marked difference as Eaton recorded between the ♀ and ♂ of *dislocans*. For this reason I had doubts whether Eaton was correct in regarding his *auriculata* ♂ as conspecific with Walker's *dislocans* ♀. This was confirmed by a tracing of Walker's type ♀, for which I thank Mr. D. E. Kimmins of the British Museum. There is no difference between *westermanni* and *dislocans*.

It is impossible to institute any comparison of *burgeoni* Navas with the South African species, as it was founded on a single subimago, sex not stated, inadequately described, and only the portion of the fore-wing proximal to MA figured.

Adenophlebia auriculata Eaton.

Eaton, 1884, p. 112, pl. xiii, fig. 21; Esben-Petersen, 1913, p. 180 (*dislocans* non Wlkr.).

One ♂ imago and 1 ♂ subimago (Barberton, March 1911), seen and recorded by Esben-Petersen, have been removed from their mounts and examined. Both show a perfectly symmetrical fork of MA. In the area between MA and R_5-R_{4+5} there are 9 (imago) and 11 (subimago) cross-veins; in the area between MA and M_{1+2} there are 10 and 11 respectively. Costal cross-veins before bulla 6-7, beyond bulla 11-12; subcostal 15-16; subradial 11; between Cu_1 and first $1Cu_1$ 2. Thus corresponding closely with Eaton's figure, which represents the ♂ originally described as *auriculata* from Grahamstown, in which the numbers are respectively: 11, 11, 6, 12, 17 (18), 16,* 3.

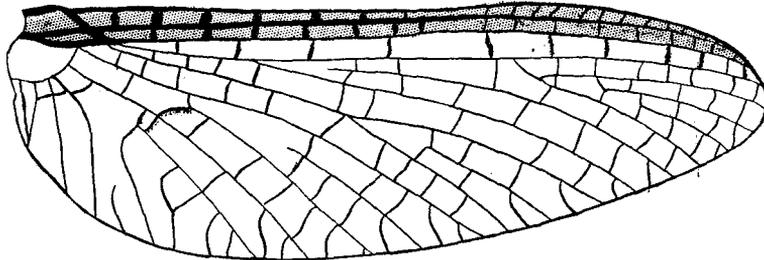


FIG. 30.—*Adenophlebia auriculata* Eaton. Fore-wing of ♂ imago (Barberton).

Walker's type ♀ was from the Cape but without definite locality. From the similarity of the *hind-wings* Eaton considered his ♂ conspecific with Walker's ♀. According to Eaton the ♂ has clear wings, but the ♀ has various dark spots on the cross-veins, and a dark spot at base of costa (between root of wing and cross-vein immediately beyond the humeral brace vein).

The Barberton ♂ imago has small reddish-brown spots around the cross-veins in costal and subcostal areas (before the bulla), and slight thickenings of the cross-veins between R_1 and R_5 ; in fact all the cross-veins in base of wing are feebly thickened with reddish-brown colour.

A ♂ from Natal (S. G. Rich, Natal Mus.) is similar, but has sixteen cross-veins in the subradial area, as in Eaton's specimen. I have seen another specimen from Grahamstown (Albany Mus.), which is the type locality for Eaton's species.

Adenophlebia sp. Nymph.

Some nymphs collected on the Zwartberg Pass (Prince Albert) in November 1929 (K. H. B.) resemble structurally the nymphs described below except that the inner lamellae of the gills are only half the length of the outer lamellae.

The coloration, however, is notably different. The whole body is pale uniform (or almost so) ochraceous or straw-colour. The small black spot at base of wing-cases (representing the humeral brace vein of the imago) is

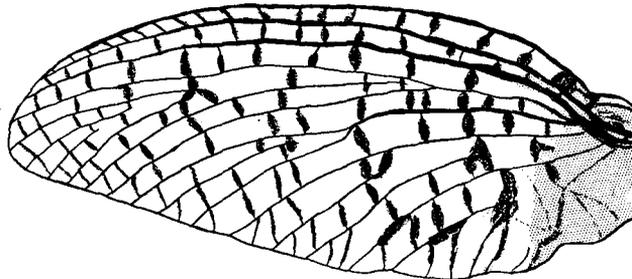


FIG. 31.—*Adenophlebia* ?*auriculata* Eaton. Fore-wing dissected out of nymph ready to disclose subimago (Zwartberg Pass).

consequently more conspicuous. Femora faintly banded. Abdominal segments with dark brown narrow border on posterior margins, except segment 10, which is uniformly pale.

Size 9-13 mm. The largest nymph was ready to disclose the subimago, and one wing was dissected out. As the number of cross-veins in the critical areas seems to coincide best with that of *auriculata*, these specimens are provisionally assigned to this species.

Adenophlebia peringueyella Lest.

Lestage, 1924A, p. 333 (incl. *dislocans* non Walker).

Imago.—Front tibia slightly longer than femur, tarsus subequal to tibia, its joints decreasing in length distally. Ventral plate of ♀ apically truncate or very feebly excavate. Genital styles of ♂ and penis as in Eaton's figure of

* Sixteen cross-veins in the subradial seems abnormally high, but it occurs in the Natal specimen.

dislocans, penis apically bifid, each lobe with a recurved spiniform process ventrally. Cross-veins before bulla 6-8, beyond bulla 12-14, subcostal 16-18, subradial 11-13, between R_{4+5} and MA_1 10-12, between MA_2 and M_{1+2} 10-13, between Cu_1 and 1st $1Cu_1$ 4 (not counting proximal connecting vein or oblique vein to margin).

Body ♂ 10 mm., ♀ 11-12 mm.; wing ♂ 10 mm., ♀ 11-13 mm.; cerci 15-18 mm.

♀. Head pale ochraceous, a dark brown bar between ocelli, a dark spot on either side of median line near posterior margin. Eyes black, ocelli dark, apices paler. Prothorax pale ochraceous medianly, more sepia laterally. Meso-

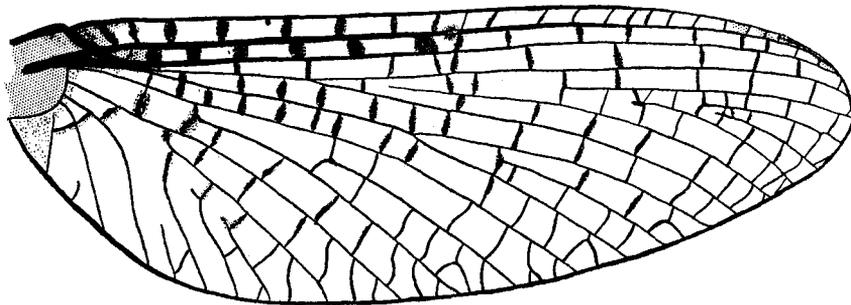


FIG. 32.—*Adenophlebia peringueyella* Lest. Fore-wing of ♀ imago.

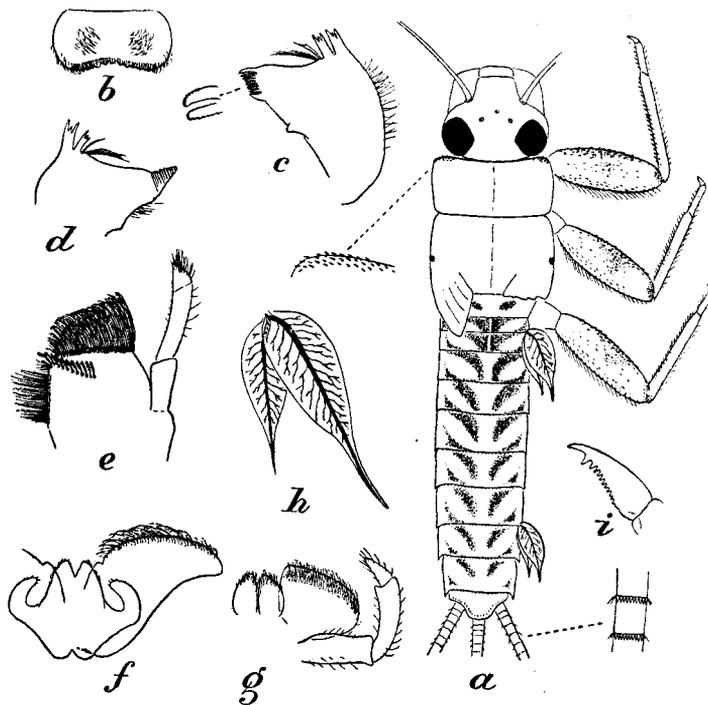


FIG. 33.—*Adenophlebia peringueyella* Lest. *a*, nymph, with shoulder of prothorax and portion of cercus further enlarged, right wingcase cut away, and gills 2-6 omitted; *b*, labrum; *c*, *d*, left and right mandibles; *e*, maxilla; *f*, hypopharynx; *g*, labium; *h*, gill; *i*, claw.

thorax dorsally warm brown, including scutellum, scutum antero-laterally with pale border, laterally with darker and lighter brown, the area occupied by the decurrent portion of the membrane of fore-wing white. Metathorax brown with paler transverse bar on either side of median line. Abdominal segments 1 and 2 brown with narrow pale medio-dorsal line and a transverse pale bar or oval patch dorso-laterally; segments 3-9 pale brown, each with a dark brown oblique bar running from near middle line posteriorly to the antero-lateral corner, the lateral margin also dark (the difference between the coloration of the first two segments and the others is more verbal than real; in

the former the dark colour occupies the greater area, in the latter the pale colour. Cf. also Eaton's description of *dislocans* ♀. Segment 10 pale brown. Abdomen ventrally pale greyish. Legs ochraceous or fulvous, femora with dark median bands, knees also slightly darker. Cerci brown, uniform. Neuration dark sepia-brown, pterostigmal area somewhat milky (direct light) or ochraceous (transmitted light), the ante-humeral costal area and its decurrent membrane white, the humeral brace vein, however, suffused, spots dark sepia, usually oval, confined to the immediate vicinity of the cross-veins, never diffuse or forming fasciae. Hind-wing clear, except for a large blotch at base.

♂ similar but darker, mesothorax dorsally Vandyke brown; turbinate eyes pinkish (in alc.). There is very little difference in the number or size of the spots or enlargements of the cross-veins.

Subimago.—Similar but paler, especially dorsum of mesothorax, wing membrane grey.

Egg.—Bluntly oval, .2 mm. long diameter, closely pitted, no attachment threads.

Nymph.—Legs moderately slender, femora with short pointed spines on front and hind margins and on upper surface, hind margin with setae as well, tibiae and tarsi spinose on inner margin, sparsely setose on outer margin; claws slender, denticulate, about 12–16 denticles, increasing regularly in size distally.

Up to 13–14 mm., cerci about as long as body.

Mottled brown, usually an oblong dark patch between the lateral ocelli, eyes black. Metathorax pale with two transverse oval dark spots. A small dark spot at base of wing-case near outer margin, corresponding with the dark humeral brace vein in imago. Legs pale ochraceous, femora with suffused patch on front margin expanding into a median band on both upper and lower surfaces, with a roundish sepia spot in the band on lower hind margin, knees dark. Abdomen pale ochraceous with dark markings as figured, segment 10 uniform, ventrally pale, uniform. Cerci ochraceous, uniform.

Localities.—Paarl (Rev. G. Hawke); Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Table Mt. slopes (K. H. B.).

Habits.—The "September Brown" is a very notable winter and spring May-fly, occurring from mid-June to early October. Emergence of the subimago takes place by day, after the nymph has crawled out of water on to a stone; but emergence can take place from the surface film of the water. The subimagos are very sluggish and can easily be caught with the hand. The subimaginal stage lasts 1½–2½ days, and the imago has been kept in captivity for 10–11 days (A. C. H.).

Half-grown nymphs begin to be conspicuous in running streams in March. Early attempts to breed them in captivity were not too successful, but later they were found to thrive on Lakeside ooze (see p. 203). A batch of nymphs observed during April and May (½–¾ grown) moulted regularly every fortnight (A. C. H.).

Nymphs with similar coloration from between Graskop and Sabi. Transvaal, were obtained by J. C. Dendy in July 1930, but whether they belong to this species or to *westermanni* is impossible to tell.

Adenophlebia dislocans (Wlkr.).

Esben-Petersen, 1913, p. 180, fig. 1 (*westermanni*, abnormal wing); Lestage, 1917, p. 91, and 1924a, p. 338 (*Esenophlebia w.*).

Imago.—Like *peringueyella*, but with the following numbers of cross-veins: before bulla 5–6, beyond bulla 11–13, subcostal 16, subradial (7) 8, 9, 10–12, between R_{4+5} and MA_1 6–7 (8), between MA_2 and M_{1+2} (5) 6–7 (8), between Cu_1 and 1st $1Cu_1$ 1 or 0. That is to say, there are noticeably fewer cross-veins in the MA, M, and Cu areas. Summit of costal projection nearer middle of wing than in *peringueyella*.

Smaller than *peringueyella*: body ♂ 6–8.5 mm., ♀ 10 mm.; wing ♂ 6.5–9 mm., ♀ 10.5 mm.; cerci 16–20 mm.

Colour as in *peringueyella*, but the wings marked with heavier and warmer brown blotches and spots, which are diffuse and tend to form fasciae. Hind-wing spotted.

Egg.—As in *peringueyella*.

Nymph.—Not distinguishable from that of *peringueyella*, except that there are usually only four denticles in the labral emargination, and the size is smaller: 10–11 mm.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); North slopes of Matroosberg, Ceres Div. (November 1917, R. M. Lightfoot); Montagu (October 1919, K. H. B.); Langeberg Mts., at Riversdale (October 1926, K. H. B.); Schuurfteberg Mts., east of Citrusdal (February 1928, K. H. B.); River Zonder End Mts. (November–December 1928, K. H. B.); Table Mt. slopes (March 1931, K. H. B.); Keurbooms River, Knysna Distr. (December 1930, January 1931, K. H. B.).

Habits.—The "Summer Brown" is also a notable fly in the Cape, emerging in October or November after the disappearance of the "September Brown," and continuing throughout the summer until March. It is a smaller fly and more heavily blotched and spotted.

There is some variation in the blotching, but the blotches at base of the median and cubital intercalaries, and at the cross-vein connecting M_{3+4} with M_{1+2} and Cu_1 are always large and well marked. The ♀ is, as a rule, more heavily spotted than the ♂.

The subimago emerges by day, the nymph crawling up a stone, either half out or completely out of the water. The imago follows in about 24 hours, and specimens have been kept in captivity 6½ days (A. C. H.).

The ♂ is remarkably active in hot sunshine; when pursued it takes short quick flights from stone to stone, and when it settles it faces the pursuer; when it settles on bushes it has the habit of many grasshoppers of sidling round the stem to keep out of sight (K. H. B.).

The nymphs are indistinguishable from those of the "September Brown" in structure and coloration.

Castanophlebia n. g.

Imago.—Claws dissimilar, one hook-like, the other obtuse. Fore-wing long and narrow; fork of MA rather broad but symmetrical or almost so; M symmetrically and narrowly forked; Cu_2 and 1A at base separate, sub-

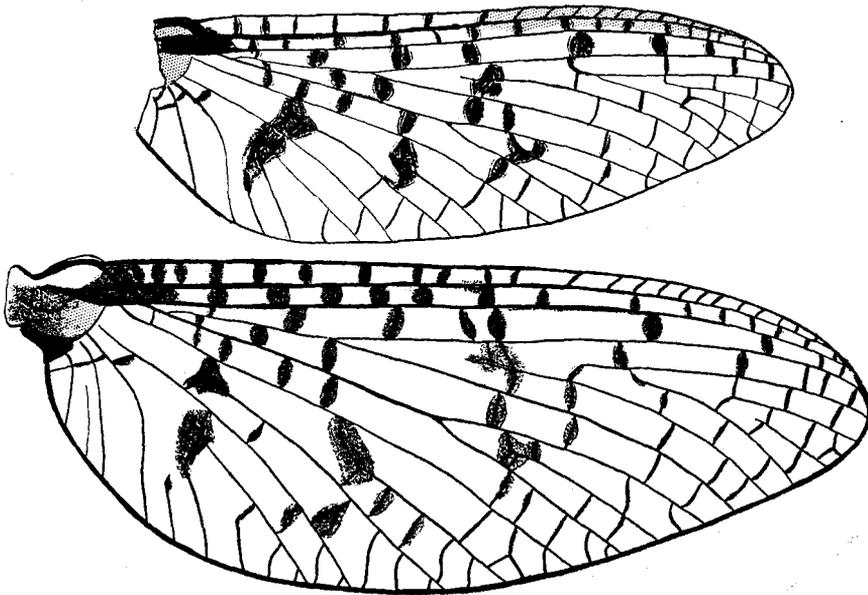


FIG. 34.—*Adenophlebia dislocans* (Wlkr.). Fore-wing of ♂ above and of ♀ below, imagos.

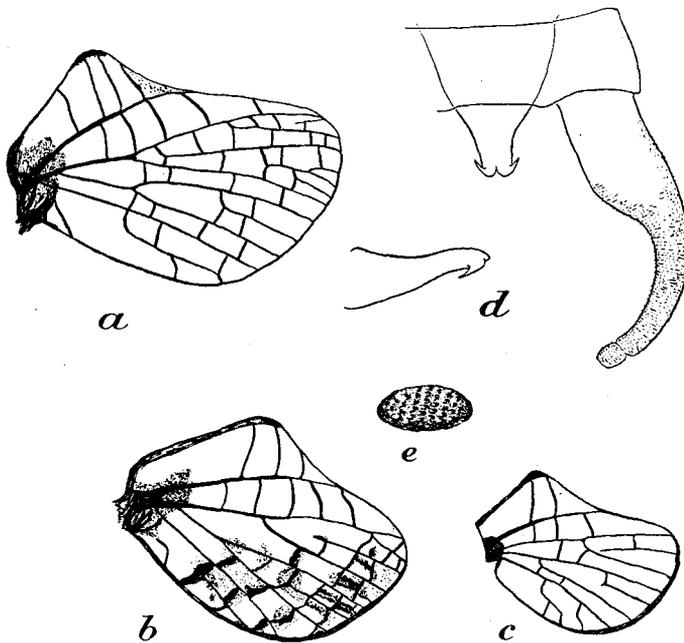


FIG. 35.—Hind-wings of: *a*, *Adenophlebia peringueyella*; *b*, *westermanni*; *c*, *dislocans*; *d*, forceps and penis of ♂, with lateral view of penis (all three species); *e*, egg of *peringueyella*.

parallel. Hind-wing with angular process on costal margin, summit of the arch beyond middle of wing; Sc rather long, costal area narrow, subcostal area broader than costal; MA simple. Genital styles of ♂ 3-jointed; penis broad, deeply cleft, lobes divergent, with pointed outwardly directed processes in middle of ventral surface. 10th sternite of ♂ undivided. Ventral plate of ♀ sharply incised.

Nymph.—Legs slender. Claws denticulate, a large tooth in middle of inner margin preceded and followed by smaller denticles. Shoulder of prothorax with a single row of a few setae. Antennae long. Labrum incised. Hypopharynx without lateral processes on median lobe. Mandibles as in *Aprionyx*, protheca distinct but slender. Maxilla with a row of pectinate spines arising from very large sockets. Inner lobes of labium ovate, in same plane as outer, palp rather slender, 3rd joint narrow cylindrical. Abdominal segments 8 and 9 postero-laterally uniaxiate. Gills seven pairs, double, slender and very narrowly lanceolate, tracheae unbranched.

Remarks.—Allied to *Deleatidium* and still more closely to *Atalophlebioides*, but differing in the broad, characteristic forking of MA and the long stalk of MA in the fore-wing of adult, and the very narrow, almost thread-like gills of the nymph.

Castanophlebia calida n. sp.

Imago.—4-6 cross-veins before bulla, 9-11 in pterostigmal area, the latter oblique, straight or slightly sigmoid, rarely anastomosing; subcostal 12-14; between R_{4+5} and MA_1 7-8; between MA_2 and M_{1+2} 6-7; 1-3 cross-veins between IMA and MA_1 and MA_2 (not counting proximal connecting veins); $1R_{5b}$ usually not connected with Rs. Ventral plate of ♀ sharply incised. Genital styles of ♂ with distal two joints very short; penis broad, bilobed, lobes

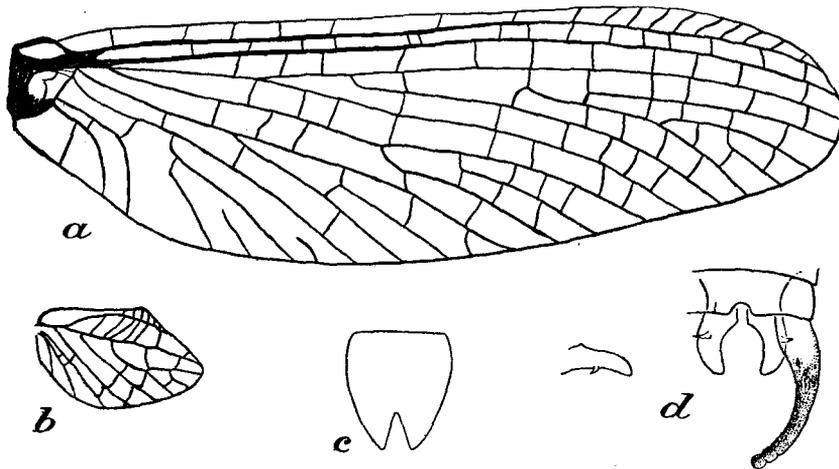


FIG. 36.—*Castanophlebia calida* n. g., n. sp. a, b, fore- and hind-wings of imago; c, ventral plate of ♀; d, ventral view of forceps and penis of ♂, with lateral view of penis.

divergent, each lobe apically blunt, with a small acute process ventrally in the middle. 10th sternite of ♂ with a median semi-circular excision. Median cercus slightly longer than the lateral ones.

Body: ♂ 6.5 mm., ♀ 6-9 mm.; wing ♂ 7 mm., ♀ 6.5-9 mm.; cerci 8-10 mm.

Castaneous, nearly uniform, occiput paler; a dark brown horizontal bar on lateral margin of scutum from above insertion of fore-wing; abdomen paler ventrally. Eyes black, apices of ocelli whitish. Legs fulvous. Cerci fulvous, uniform. Neuration fulvous, castaneous, costal and subcostal areas in the pterostigmal region semi-opaque (♂ and ♀).

Subimago.—Similar but paler, more fulvous, mesothorax dorsally with a darker median patch in front and longitudinal dark stripe laterally. Legs pale fulvous, knees darker. Cerci pale greyish, uniform.

Egg.—Oblong-oval, twice as long as broad, .25 mm. long diameter, pale yellow, surface not sculptured, no attachment threads.

Nymph.—Abdominal segments postero-laterally quadrate, or only slightly acuminate. Denticles on posterior margins very minute except on segment 10. Mouth-parts as figured; outer margin of mandible strongly convex, very sparsely setose; inner lobes of labium with fine setae only. Legs slender, femora with scattered short blunt spines on both margins and upper surface, setae on hind margin, tibiae and tarsi with setae on outer margin and acute spines on inner margin. Claws with a strong tooth in middle, with four (usually) strong outstanding denticles distal to it, and four smaller, forwardly directed denticles proximal to it. Cerci elongate, the median slightly the longer. Gills 1-6 bifurcate, 7th gill with a much smaller inner branch, which is often only a rudiment or even absent.

Up to 8 mm., antennae 3-4 mm., cerci 8-10 mm.

Fulvous, rufous, or castaneous, slightly mottled on pro- and meso-thorax dorsally. Abdomen with a faint darker, slightly oblique stripe on either side of each segment, though usually obsolete on the posterior segments. Ventrally paler, usually with three round median spots, one between bases of front legs, one between bases of middle legs, and one immediately behind the latter. Legs ochraceous, knees and tarsi darker. Cerci fulvous, uniform.

Gills whitish, tracheae black. Young nymphs are paler brown and the hind margins of the posterior abdominal segments are pale. Only mature nymphs show the characteristic rufous or deep castaneous coloration.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Banhoek, Stellenbosch (K. H. B.); River Zonder End Mts. (January 1919 and November–December 1928, K. H. B.); Witte River, Wellington Mts. (November 1922, K. H. B.); Table Mt. slopes (October 1913 and March–April 1931, K. H. B.); French Hoek (April 1931, K. H. B.); Zwartberg Pass, Prince Albert (November 1929, K. H. B.); Hex River, Worcester (A. C. H.); Genadendal (K. H. B.); Elgin (K. H. B.).

I have also seen some nymphs from Sabi, Transvaal (July 1930, J. C. Dendy), which are indistinguishable from Cape specimens, but the locality should be quoted with a query until the adults are obtained.

Habits.—The "Chestnut Dun" is notably a *day fly*. The subimagos emerge by day on protruding stones, often in great numbers, from early October onwards throughout the summer; but the numbers decrease towards February and March. The imago emerges about 24 hours later.

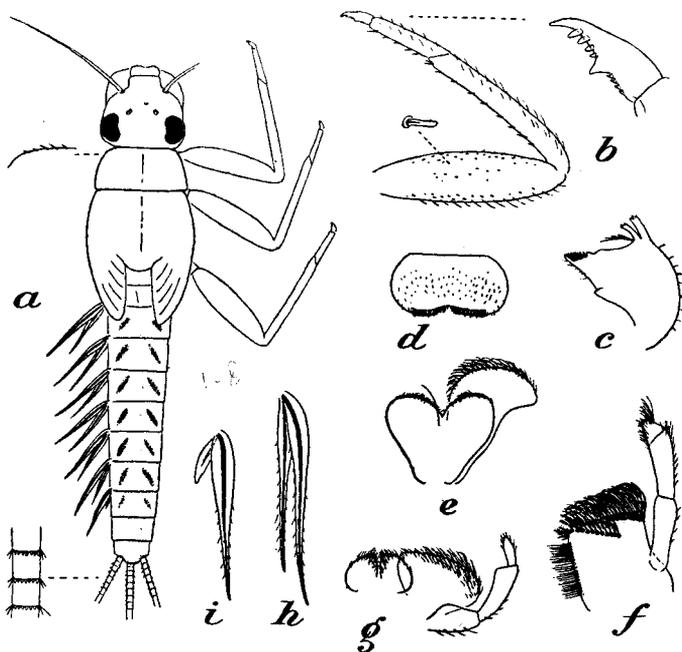


FIG. 37.—*Castanophlebia calida* n. g., n. sp. a, nymph, with shoulder of prothorax and portion of cercus further enlarged; b, leg, with claw further enlarged; c, mandible; d, labrum; e, hypopharynx; f, maxilla; g, labium; h, i, 2nd and 7th gills.

Females have been observed ovipositing in October (A. C. H.) and early April (K. H. B.). They do not dip and rise at once like the "April Dun," but rest on the surface for a second or two.

Small half-grown nymphs are found in June, and in large numbers up to December, after which they become less plentiful. The nymphs frequent swift-running streams, and are evidently able to hold their own in torrential waters. They are often found crawling on the rock at the very lip of the small waterfalls found in mountain streams (K. H. B.).

In a tank of still water they thrive for a time on "Lakeside ooze" (p. 203), but are difficult to rear to the subimago stage unless captured when almost full-grown (A. C. H.).

Gen. *Choroterpes* Eaton.

Eaton, 1884, p. 104; Ulmer, 1920, p. 116; Lestage, 1921, p. 228 (nymph.)

Imago.—Tarsal claws dissimilar, one acute, hook-like, the other obtuse. Fore-wing with the costal margin slightly but distinctly concave in the middle; Cu_2 and 1A at base separate, subparallel. Hind-wing with costal margin strongly and obtusely angulate, with a slight concavity at end of Sc, which is short; costal and subcostal areas subequal in width; MA simple. 10th sternite of ♂ undivided. Ventral plate of ♀ shallowly incised apically. Genital styles of ♂ 4-jointed, 1st joint ring-shaped, short, sometimes obscurely demarcated, 2nd long, 3rd and 4th short. Penis rather narrow, divided into two long adnate lobes, without appendices. Cerci 3.

Nymph.—Eyes lateral. Antennae short. Labrum deeply incised. Mandibles with prostheca. Labium with inner lobes narrow, with stout spinules, palp slender, 3rd joint cylindrical, nearly as long as 2nd. Hypopharynx with forwardly curving lateral processes on median lobe. Shoulder of prothorax with a single row of slender spines.

Legs moderately stout, claws denticulate, the denticles increasing in size distally. Abdominal segments 8 and 9 postero-laterally uniauculate. Cerci 3, elongate. Gills 7; 1st single, narrow-lanceolate, 2nd-7th double, foliaceous, the distal half considerably narrower than the basal half and arising from an indentation, tracheae branched.

Remarks.—This genus has been known hitherto from Europe, North and Central America, and Lower Burma. The discovery of an African representative is due to Mr. A. C. Harrison.

Choroterpes nigrescens n. sp.

Imago.—In fore-wing 1-3 cross-veins before the bulla, usually faint; numerous simple, straight or sometimes slightly sigmoid cross-veins in pterostigmal area; subcostal 16-19, subradial 10-12, of which only 1-2 are proximal

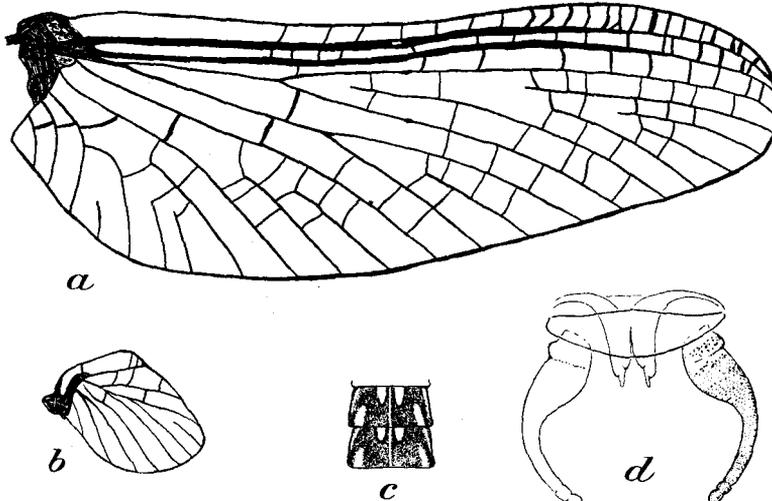


FIG. 38.—*Choroterpes nigrescens* n. sp. a, b, fore- and hind-wings of imago; c, abdominal pattern of nymph; d, forceps and penis of σ .

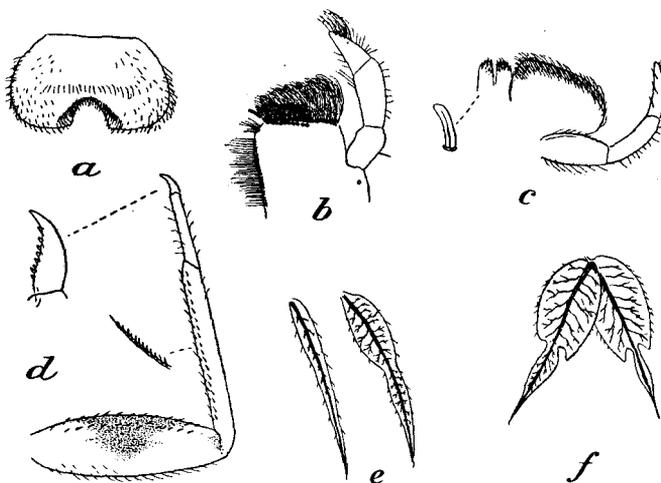


FIG. 39.—*Choroterpes nigrescens* n. sp. nymph. a, labrum; b, maxilla; c, labium; d, leg, with claw further enlarged; e, two forms of 1st gill; f, one of the following gills.

to bulla. Hind-wing with few cross-veins; 3-4 in subcostal area, 1-2 in subradial. Genital styles of σ with basal ring-like joint obscurely demarcated from 2nd, but visible by the convexity on outer margin; penis lobes as figured. Distal margin of 10th sternite of σ evenly convex.

Body σ 7-8 mm., ♀ 7-10 mm.; wing σ 7-8 mm., ♀ 7.5-10.5 mm.; cerci σ 8-9 mm., ♀ 7-10 mm.

♀. Head raw umber with darker mottling, eyes black, ocelli black at base, then with a castaneous ring, apically white. Prothorax brown with blackish margins and markings. Mesothorax dark brown dorsally, uniform, scutellum blackish; laterally with rufescent markings at the joinings. Metathorax dark brown. Abdomen dark brown, posterior margin of each segment black, a medio-dorsal pale streak bordered with black, on either side of which is a pale oval or conical spot in anterior half of segment. Posterior segments also show a faint pale streak just dorsal to the lateral margin. Sternites of thorax and abdomen pale, more or less rufescent, the contrast between dorsal and ventral surfaces of abdomen very marked. Femora with broad dark suffusion in middle and dark knees, tibiae grey, tarsi paler. Cerci brown, with narrow blackish annulations. Neuration dark brown, a gamboge patch on the pterostigmal portion of the costal and subcostal areas in the ♀ only.

♂ similar but darker, almost black on the mesothorax dorsally, turbinate eyes castaneous on top, genitalia grey or blackish.

Nymph.—Abdomen segments 4 (or 5)–9 laterally acuminate, more strongly so than in the nymph of *Euthraulus*. Labrum more deeply incised, and mandible more setose on outer margin than in *Euthraulus*.

Up to 10 mm., cerci $1\frac{1}{4}$ – $1\frac{1}{2}$ as long as body.

Mottled greyish or brownish or olivaceous. Eyes black. Abdominal segments with a pale lateral stripe, a pale dorso-lateral stripe, a pale medio-dorsal stripe with a pale conical spot on either side of it anteriorly; 10th segment mottled. Femora pale whitish, suffused with grey in middle and at apices. Cerci pale. Gills grey, tracheae dark brown.

Localities.—Groot Drakenstein (A. C. H.); Du Toit's Kloof, Rawsonville (A. C. H.); Potteberg, Bredasdorp Division (nymphs and imagos, A. T. Packham).

Habits.—Emergence of the subimago takes place from the surface film of the water, after dark, and the transformation to the imago occurs during the same night (under 12 hours). In the wild state swarms can be seen "dancing" in the hot sunshine in the forenoon, but judging from specimens in captivity the imagos live only one day (A. C. H.).

The season lasts from January to about end of April.

The nymphs seem to adapt themselves well to still water, and in captivity are very hardy and easy to breed (A. C. H.).

Euthraulus n. g.

Imago.—Resembling *Thraulius*, i.e. tarsal claws dissimilar, Cu_1 and 1A at base separate, subparallel; genital styles of ♂ 3-jointed, basal joint abruptly narrower in its distal two-thirds; penis narrow, divided into two long adnate tapering lobes. But differing in the more delicate neuration, with fewer cross-veins, especially subradially and in the branches of Rs in fore-wing and in hind-wing; and the much narrower, ovate shape of the hind-wings.

Nymph.—In general like that of *Thraulius*, but 1st gill filiform, and 2nd–7th gills with only three long processes on each lamella. Abdominal segments 8 and 9 postero-laterally uniauculate. Shoulder of prothorax with a single row of slender spines. Antennae moderate. Labrum incised. Hypopharynx with curved lateral processes on median lobe. Labium with inner lobes narrow, cylindrical, with stout spinules, palp moderately slender, 3rd joint cylindrical, shorter than 2nd. Cerci elongate.

Euthraulus elegans n. sp.

Imago.—♀. Fore-wing with one or no cross-vein before the bulla, beyond bulla 8–12, subcostal 1–2 before bulla, beyond 6–7. Costal process of hind-wing noticeably scabrous. Genital styles and penis of ♂ as figured.

Body ♀ 6 mm.; wing 6.5 mm.; cerci 5–6 mm.

Head brown-castaneous, with darker markings, lighter on occiput. Eyes black, ocelli black, castaneous and white as in *Choroterpes*. Prothorax castaneous, with two dark brown stripes dorsally and blackish lateral margins. Mesothorax dorsally dark Vandyke brown, scutellum blackish, with a paler patch in front of it; laterally and ventrally brown-castaneous. Metathorax brown. Abdomen dorsally brown, with pale medio-dorsal streak on each segment, with faint indications of a light patch anteriorly on either side (cf. *Choroterpes*), lateral margins blackish, with a light faint mark dorso-laterally; ventrally pale yellowish. Femora pale, with dark median and apical bands, tibiae and tarsi pale. Cerci pale, narrowly annulate proximally. C, Sc, and R in fore-wing pale yellowish, other veins very pale and delicate.

Subimago.—♂ and ♀ similar.

Nymph.—Abdomen segments 6–9 shortly acuminate postero-laterally. Legs slender, inner margins of front tibiae rather thickly set with short spines, mid and hind tibiae only sparsely spinose; claws strongly dentate. 1st gill very slender, filiform; 2nd–6th gills ovate, each lamella with three elongate slender processes, the outer lamella slightly larger than the inner, with longer processes; 7th gill similar but smaller.

Up to 7 mm.; cerci 8–10 mm.

Brownish, mottled. Prothorax with two dark marks on either side of medio-dorsal line (sometimes coalesced) and dark lateral margins. Abdominal markings dorsally like those of *Choroterpes*. Legs pale whitish, femora with a grey patch in middle and another at apex. Cerci pale rufous, very faintly annulate.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Hex River, Sandhills, Worcester Distr. (April, A. C. H.); Cedarbergen, Clanwilliam Distr. (January 1930, K. H. B.).

Habits.—This species occurs in October to January, and less abundantly up to early March or April.

Subimagos in captivity emerged mostly from the surface film, usually at night. On one occasion the imago emerged the same night (A. C. H.).

The nymphs tolerate still-water conditions well, but are not so hardy as those of *Choroterpes* (A. C. H.).

Remarks.—Some nymphs from Schuurmans Kloof and Olifants River near Satara, Transvaal (June 1930, J. C. Dendy), and also a subimago from Upington, Cape Province, in all probability belong to this species.

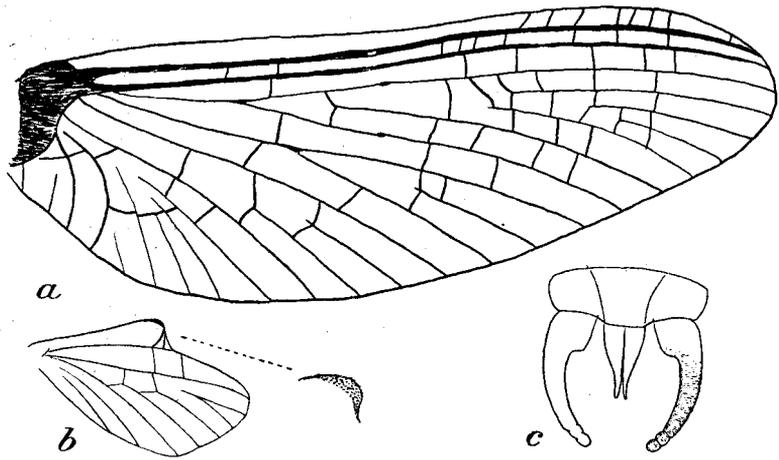


FIG. 40.—*Euthraulus elegans* n. g., n. sp. *a, b*, fore- and hind-wings of ♀ imago, with costal process of latter further enlarged; *c*, forceps and penis of ♂.

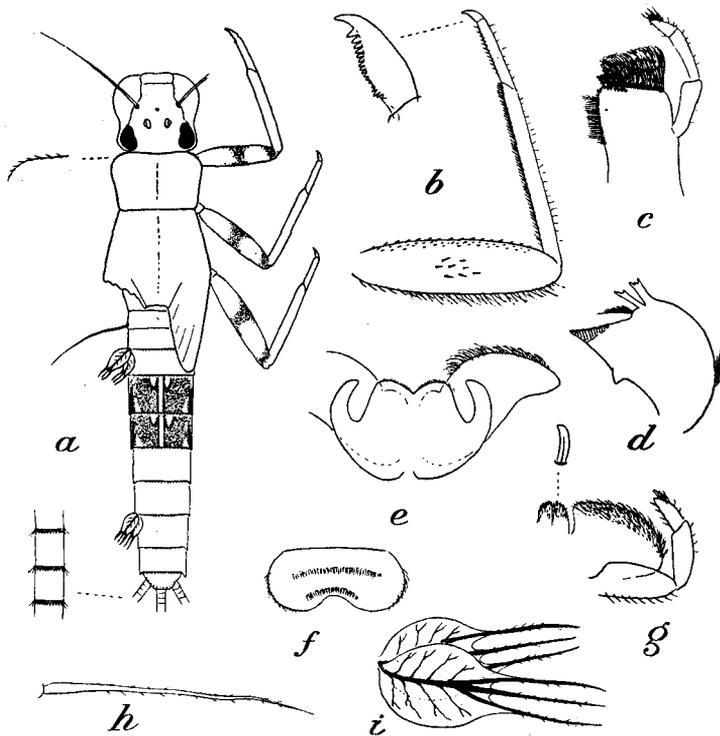


FIG. 41.—*Euthraulus elegans* n. g., n. sp. *a*, nymph, with shoulder of prothorax and portion of cercus further enlarged, left wingcase cut away, and 3rd–6th gills omitted; *b*, leg, with claw further enlarged; *c*, maxilla; *d*, mandible; *e*, hypopharynx; *f*, labrum; *g*, labium; *h*, 1st gill; *i*, one of the following gills.

Family EPHEMERELLIDAE.

Ulmer, 1920, p. 118.

Imago.—Wings hyaline, with numerous cross-veins. Fore-wing with distinct well-developed subcosta; MA forked; Cu_2 at base nearer to Cu_1 than to 1A; M_{3+4} and Cu_1 divergent, with several, usually two, large disconnected intercalaries between them; Cu_2 and 1A sharply curving back, abutting on margin near base. Hind-wing well developed, costal margin angular, costal area very narrow, subcostal area broad. Genital styles in ♂ 3-jointed, the terminal joint short; penis entire or more or less bilobed, stout or slender. Eyes in ♂ turbinate. Cerci 3.

Nymph.—Crawling, flattened type. Abdominal segments usually dorsally imbricate or with spinous processes. Antennae moderate. Upper lip feebly excavate. Mandibles rather narrowly subtriangular, protheca distinct. Maxilla narrow, tapering apically, palp small or absent. Hypopharynx, median lobe entire, outer lobes oblong. Labium, inner lobes smaller than outer, palp 3-jointed. Femora stout, claws denticulate. Cerci 3. Gills consisting of five pairs situate on segments 3-7, or of six pairs situate on segments 1-6, inserted dorsally, lamellate, imbricate, the outer lamella of first lamellate gill elyroid, each lamella bearing on its inner surface two series of delicate imbricate tracheate lamellae; gill on the 1st segment, when present, reduced to a small 2-jointed appendage.

Remarks.—Hitherto only one genus has been recorded from Africa. A second closely allied genus is described below.

The nymph of this second genus has been discovered, and also another nymph which is considered to be that of the first-recorded genus. These nymphs necessitate an alteration in the family diagnosis. All the nymphs so far known belonging to this family have five pairs of gills situate on segments 3-7. In the South African nymphs there are five or six pairs situate on segments 2-6 or 1-6 respectively. The 7th pair has gone in all cases, but the South African nymphs seem to be less specialised than other recorded nymphs in that the 1st and 2nd pairs, or at least the 2nd pair, are still retained; the 2nd pair is well developed, but the 1st pair when present is reduced. On the other hand, the maxillary palp has completely disappeared (cf. *Ephemerella deficiens* Morg.).

Gen. *Ephemerellina* Lest.

Lestage, 1924a, p. 347.

Imago.—Fore tibia of ♂ twice as long as femur; tarsus and claws? Mid and hind tarsi $\frac{1}{2}$ length of tibiae, which are subequal to femora; 5th tarsal joint longest, then 2nd, 3rd=4th, 1st shortest, claws dissimilar. In ♀ all legs with tibiae subequal to femora, tarsi about $\frac{1}{2}$ length of tibiae, joints decreasing thus: 5, 2, 3, 4, 1, claws dissimilar. Forceps of ♂ 3-jointed, 3rd joint much smaller than 1st or 2nd, inner margin armed with minute papillose processes. Penis moderately slender, apically bifid. Wings as figured below for *Lithogloea*.

Nymph.—Not correlated with certainty. If nymph described below proves to be correctly assigned, its characters are similar to those of nymph of *Lithogloea*, but without any gill on 1st segment, and the prothoracic sternite is raised into two spinulose or scabrous knobs.

Remarks.—It is unfortunate that the character of the tarsal claws of the foreleg in ♂ remains unknown; in Lestage's specimen they were missing, and in the Wellington ♂ examined by me both forelegs are completely missing.

As regards the ♂ genitalia I am at a loss to understand Lestage's description of these parts. I have examined only one ♂ of *barnardi*, the genitalia of which (removed and cleared in potash in the usual manner) are here figured and are in such close agreement with those of the following closely allied genus and species that one mutually confirms the correctness of the other. There are three clearly defined joints, of which the 3rd is much the shortest, the 1st and 2nd being nearly equal to one another. The discrepancy in Lestage's description of the penis, on the other hand, is perhaps merely verbal. I would describe the penis as "single, apically bifid" in preference to "lobes du pénis . . . séparés par un sillon étroit . . ."

Ephemerellina barnardi Lest.

Lestage, 1924a, p. 348.

Imago.—With the above characters. In fore-wing between M_{3+4} and Cu_1 two short marginal intercalaries and one longer one, which, however, is not disconnected but joined to M_{3+4} . Similarly, the longer of the marginal intercalaries between Cu_1 and Cu_2 is joined to Cu_1 .

Body ♂ 8-8.5 mm., ♀ 9.5 mm.; wing ♂ 10 mm., ♀ 12 mm.; cerci ♂ 27-30 mm., ♀ 18 mm.

Castaneous, darker in ♂ than in ♀, nearly uniform, but with lighter and brighter marks laterally on mesothorax; abdomen nearly uniform, but with slightly darker bands in ♂, without the conspicuous dark spots on segment 2 found in *L. harrisoni*. Legs fulvous, knees darker, but femora not banded. Cerci rufous, the articulations slightly deeper in colour.

Localities.—Hottentots Holland Mts. (east side, i.e. Caledon side) (1 ♂, 1 ♀, January 1916, K. H. B.); Gt. Winterhoek Mts., Tulbagh Div. (♀, November 1916, K. H. B.); Witte River, Wellington Mts. (♂, November 1922, K. H. B.).

Remarks.—The small amount of material available confirms Lestage's description except as regards the ♂ genitalia mentioned above.

This seems to be a mountain form living at higher altitudes than the next species. The original pair was taken in the Hottentots Holland Mts. at about 4000 feet (not 4900 as given by Lestage). The Winterhoek and Wellington specimens were caught at about 3000-4000 feet.

The rarity of the flies seems to indicate nocturnal habits as in the case of *L. harrisoni*.

Ephemerellina nymph.

A nymph collected in the Cedarbergen, Clanwilliam District, in January 1930 (K. H. B.), is clearly allied to the following species, but nevertheless shows such obvious differences as to deserve specific, if not generic, separation. There is every likelihood of its being the nymph of *E. barnardi*. Other similar nymphs were found at Groot Drakenstein by Mr. Harrison in December 1930, and Eerste River in October 1931.

Prothorax longer in proportion to width than in *L. harrisoni*. Prothoracic sternite raised into two rounded knobs separated by a shallow median channel, closely covered with short spinules. Abdominal segments 6-9 shortly acuminate laterally, but not expanded into projecting pleurae as in *harrisoni*; segments 1-8 raised medio-dorsally into projecting, imbricate spinous knobs, especially segments 2-6. Dorsal surface with short blunt spines, especially on posterior margins of segments; lateral margins with short spines; ventral surface of segments 1, 2, and 6-9 (not 3-5) with short spines or minute denticulation. Mouth-parts as in *harrisoni*. Femora less strongly expanded than in *harrisoni*, front margin with densely set, stout clavate spines, like palisades, in more than a single series, giving place distally to more widely spaced spines; hind margin with stout clavate spines and setae; upper surface with very short, scale-like spines; tibiae and tarsi with very fine and dense short fur on inner margins, outer margins with sparse setae. Claws denticulate, the denticles more or less uniform in size, a series of very fine setules distally. Five pairs of gills, the gill on the 1st segment completely obsolete; the gills resembling those of *harrisoni*, but the single lamella on segment 6 relatively smaller. Cerci at least as long as whole body, setose and spinose, but both setae and spines shorter than in *harrisoni*.

Body 8 mm.; cerci 9 mm.

Uniform ochraceous, with faint dark marks dorso-laterally on the posterior abdominal segment; the anterior segments also show faint dark marks nearer the median line; gills greyish, the elyroid gill lamella on segment 2 with a pale oblong transverse spot on either side; cerci with one or two narrow dark annuli at base; eyes black.

The specimen is a ♂, and the 9th sternite is only feebly trifold apically, but might at the next moult approximate to the definitely trifold form found in *harrisoni*.

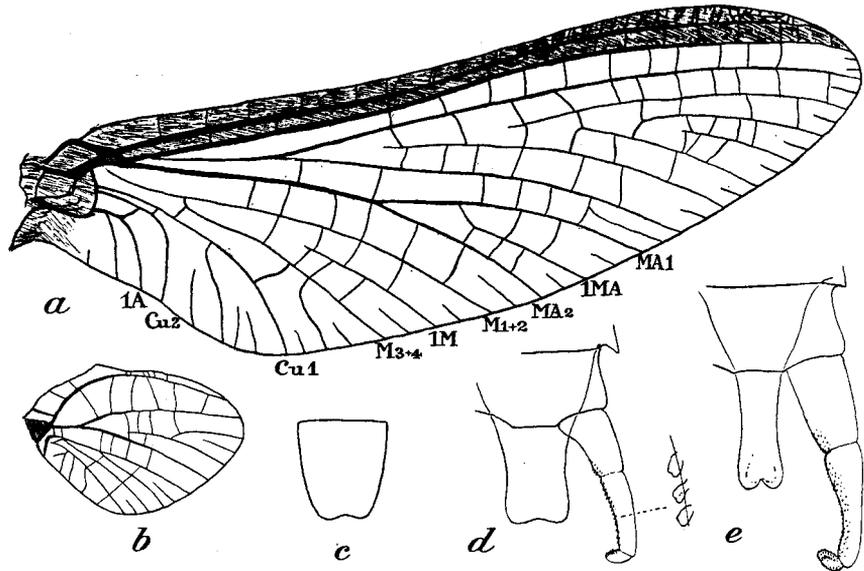


FIG. 42.—*Lithogloea harrisoni* n. g., n. sp. a, fore-wing ♀ subimago (ciliation omitted); b, hind-wing ♂ subimago; c, ventral plate of ♀; d, forceps and penis of ♂; e, forceps and penis of ♂ of *Ephemerellina barnardi* Lest.

Lithogloea n. g.

Imago.—Like *Ephemerellina* but: fore tarsus of ♂ nearly as long ($\frac{8}{9}$) as tibia, which is $1\frac{1}{2}$ times the length of femur, 1st tarsal joint very short, 2nd longest, 3rd, 4th, 5th decreasing, claws alike. Mid and hind tibiae half length of femora, tarsi half length of tibia, 1st-4th joints subequal, 5th equal to 1st-4th joints together. In ♀ as in *Ephemerellina*. Genital forceps of ♂ as in *Ephemerellina*, but penis broader.

Nymph.—Like that of *Ephemerellina* (assuming the latter is correctly correlated), but with a 2-jointed rudimentary gill on 1st segment, and the prothoracic sternite flat. Closely resembling the nymph of *Torleya*, but with gills on segments 1-6, those on segment 2 more strongly elyroid and covering all the following pairs. Maxillary palpi obsolete.

Remarks.—The ♂ imago agrees well with that of *Torleya* (see Lestage, 1924A, p. 347) as regards the forelegs and the penis; but the ♂ forceps, like those of *Ephemerellina*, differ from those of other Ephemerellids.

Lithogloea harrisoni n. sp.

Imago.—♂. Fore tibia $1\frac{1}{2}$ times length of femur, tarsus slightly longer than femur, joints decreasing in length from 1st, claws alike, lamellate, obovate. Tarsal claws of mid and hind tarsi dissimilar. Genital styles, 2nd joint longer than 1st, which is longer than 3rd, inner margin with numerous minute scale-like processes; penis broad, feebly excavate apically.

♀. Tarsal claws of all legs dissimilar. Ventral plate very shallowly excavate distally.

Body ♂ 6 mm., ♀ 6.5 mm.; wing ♂ 6.5 mm., ♀ 7 mm.; cerci ♂ 8 mm., ♀ 9 mm.

♀. Head pale yellowish with bright deep-orange marks on occiput between eyes and between ocelli. Eyes dull greyish orange; ocelli with basal black ring, then an orange ring, apices white. Prothorax with orange or orange-

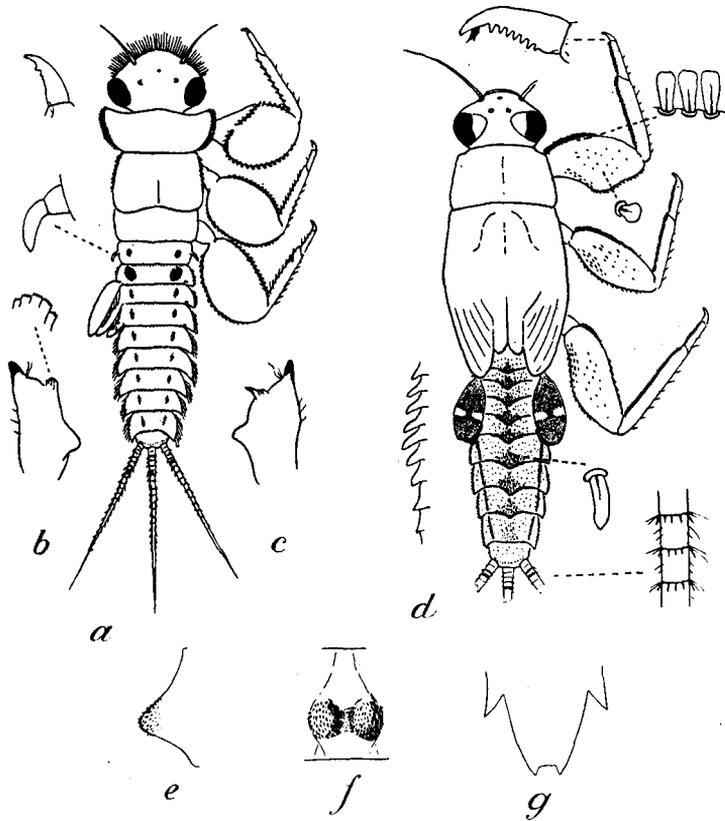


FIG. 43.—*Lithogloea harrisoni* n. g., n. sp. a, young nymph, 2 mm. long, with claw and gill on 1st segment further enlarged; b, c, left and right mandibles. *Ephemerellina* (Cedarberg). d, ♂ nymph with profile of abdomen, claw, portion of cercus, and spines further enlarged; e, f, lateral and ventral views of prothoracic sternite; g, 9th sternite of ♂.

brown marks, lateral margin brown. Mesothorax ochraceous or fulvous, laterally with orange and brown patches, scutellum apically more or less orange, laterally dark brown. Metathorax fulvous brown, lighter medio-dorsally and ventrally. Abdomen orange-ochraceous, each segment (except 10) with a short transverse darker bar on posterior margin on either side of median line, which is pale or whitish; and another darker spot or patch antero-laterally; a conspicuous dark-brown spot on pleura of segment 2, and sometimes a less conspicuous one on segment 1; ventrally paler, uniform. Some specimens have a deeper ground-colour than others, with the dark bars and patches more conspicuous, the medio-dorsal line consequently more conspicuously pale. Legs orange-ochraceous, femora with more or less conspicuous dark basal, middle and apical bands, tibiae also suffused in basal third. Cerci pale grey, with narrow orange-brown annulations. Wings clear, fore-wing somewhat milky in pterostigmal area, neuration pale, whitish, C, Sc, and RS greyish distally, a conspicuous dark spot right at base of Sc.

♂ considerably darker, brown, pro-, meso-, and meta-thorax almost Vandyke brown, mesothorax laterally with lighter joinings. Turbinate eyes dark basally; pinkish (in alc.) on top.

Subimago.—Paler, mesothorax medio-dorsally quite pale.

Egg.—Bluntly oval, .2 mm. long diameter, surface indistinctly pitted, no attachment threads.

Nymph.—Head transversely ovoid, antennae not much longer than transverse width of head. Mouth-parts as figured. A mere chitinous knob indicates the base of the obsolete maxillary palp. Apex of 3rd joint of labial palp minutely scabrous, but not setose. Prothoracic sternite flat. Abdomen triquetral in cross-section, flattened ventrally, convex dorsally; segments 2-8 produced and raised into blunt projecting points medio-dorsally, especially segments 2-5; segments 3-9 laterally acuminate, the points increasing in size posteriorly. Anterior segments

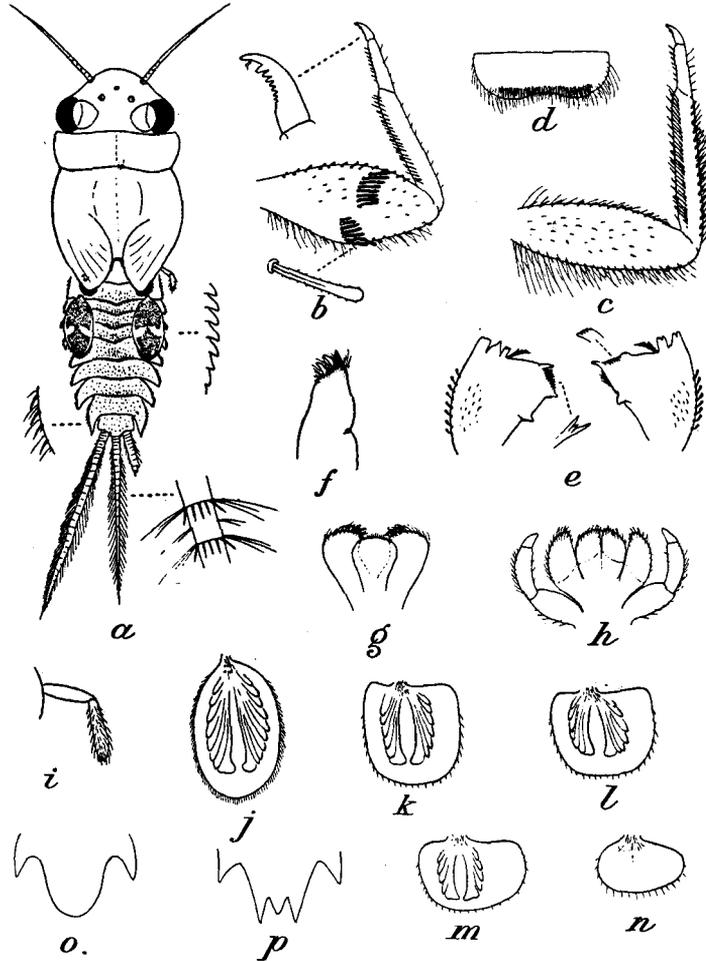


FIG. 44.—*Lithogloea harrisoni* n. g., n. sp. a, ♂ nymph, with profile of abdomen, lateral margin of an abdominal segment, and portion of middle cercus further enlarged; b, front leg, with claw further enlarged; c, hind leg; d, labrum; e, mandibles; f, maxilla; g, hypopharynx; h, labium; i, gill on 1st segment; j-n, gills on 2nd-6th segments respectively; o, p, 9th sternite of ♀ and ♂ respectively.

dorsally, especially on the projecting knobs, with numerous short clavate spines; lateral margins with pointed spines and a few setae; ventrally with minute spines, chiefly on the posterior segments. Femora broadly ovate; front femur broadest, with short clavate spines on front margin, longer clavate or blunt spines forming an interrupted series across middle of upper surface, hind margin with setae and a few spines; tibia with setae on outer margin, spines on inner margin, and a row of stronger spines on upper surface near inner margin; tarsus with spines on inner margin. Middle and hind femora with spines and setae on front margin, and long plumose setae on hind margin; tibiae and tarsi as in front leg, but hind tibia has, in addition, spines and setae on outer margin. All claws denticulate, the distal denticle largest, the others decreasing proximally, 2-3 fine setules distally. Cerci with long spines at articulations of the joints, and long setae, feebly plumose, beginning from about the middle third, decreasing in length distally. Gill on segment 1 rudimentary, curving upwards, 2-jointed, 2nd joint longer than 1st, and setose. Second

gill double, outer lamella ovoid, margin setose, elytrid and concealing almost completely the following gills, inner lamella bilobed, each lobe consisting of a number of delicate imbricate lamellae. Third, fourth, and fifth gills also double, the outer lamella becoming subquadrangular or ovoid, margins setose. Sixth gill a single, delicate, transversely oval lamella, with setose margin.

Younger nymphs appeared at first sight to belong to a different species, but breeding experiments and further collecting refuted this. At about 2 mm. length (cerci excluded) the young nymph or larva has the margins of the head strongly setose, the lateral margin of prothorax, and to a lesser degree also of the mesothorax, with short close-set clavate spines, and the posterior abdominal segments strongly setose laterally. The posterior margins of the abdominal segments are minutely denticulate. None of the segments are dorsally raised or imbricate. The femora are enormously dilated, and the outstanding spines on the front femur form an almost complete hemiwhorl (on upper surface); both front and hind margins of middle and hind femora are strongly spinulose; claws feebly denticulate. Cerci feebly spinose. Mandibles more cylindrical, less triangular. First gill with shorter basal joint. Only three pairs of lamellate gills; those on segments 2 and 3 double as in mature nymph, that on segment 4 single.

At about 4 mm. length the femora are less broadly expanded. The mature features (dorsally imbricate abdominal segments, six pairs of gills, colour, etc.) would appear to be developed suddenly in one moult, but this point has not been definitely proved by breeding.

Up to about 8-9 mm., cerci 3-4 mm.

Very young (2 mm.) and half-grown (4 mm.) nymphs are pale straw colour, yellowish or ochraceous, eyes black, a series of dorso-lateral dark spots on abdomen, one on each segment, that on segment 2 being the largest and most conspicuous.

Larger and fully-grown nymphs are speckled and mottled with various shades of brown, 9th abdominal segment darker than the others, the spot on segment 2 still remaining conspicuous (as in the imago); femora mottled and banded, tibiae more or less dark proximally, pale distally, tarsi dark. Cerci irregularly annulate; in pale-coloured examples there is usually a single dark narrow annulus near base of each cercus. Outer elytrid lamella of 2nd gill suffused, usually with an ovate oblique pale spot on either side.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Banhoek, Stellenbosch (K. H. B.); Table Mt. slopes (K. H. B.); Witte River, Wellington Mts. (2 imagos, November 1922, K. H. B.).

Habits.—Half-grown and fully-grown nymphs are extremely common during spring and summer, October to February or March, in rapidly flowing mountain streams. They live on the undersides of stones, and do not accumulate particles of mud or detritus as camouflage (as do some of the European species of this family) or not to any great extent. They swim clumsily by dorso-ventral flexions of the body.

Emergence of the subimago takes place either after the nymph has crawled up a stone above the water-line, or from the surface film of the water, and occupies only a second or two. Emergence occurs either late in the afternoon or by night. The subimagos are extremely active immediately after emergence. The subimaginal stage may last more than 24 hours in cool weather, but usually less, especially in hot weather.

Their nocturnal habits evidently explain why the flies have only once been taken in a wild state (Witte River).

SUBORDER HEPTAGENIOIDEA.

Family ECDYONURIDAE.

Eaton, 1885, p. 237 *sqq.**; Ulmer, 1920, p. 136.

Imago.—Prothorax well developed. In fore-wing Cu_2 and 1A subparallel, divergent from Cu_1 ; two pairs of straight intercalaries between Cu_1 and Cu_2 , the longer pair always proximal to the shorter pair, *i.e.* nearer to Cu_2 . Hind-wing ovoid.

Nymph.—Of the crawling type, strongly flattened. Head usually large. Eyes dorsal. Labial and maxillary palps 2-jointed. Legs strong, claws usually dentate. Cerci 2 or 3, elongate. Gills 7.

The nymphs of this family are characteristic of swiftly running streams, to which their structure is well adapted.

Only one genus is known for certain from Africa. Eaton (1913, p. 277) records some fragmentary specimens from British East Africa which appear to have affinities with *Epeorus*.

Gen. *Afronurus* Lest.

Lestage, 1924A, p. 349.

Imago.—Cross-veins in fore-wing numerous, forming a close network. Hind-wing broadly ovoid, neuration well developed, MA forked. Hind tarsus much shorter than femur, 1st joint slightly longer than 2nd. Fore tarsus of ♂ with 1st joint shorter than 2nd and 3rd, but longer than 5th joint. All claws in both sexes dissimilar. Penis broad, apically incised.

Nymph.—In general like that of *Ecdyonurus* (see Lestage, 1921, p. 203, fig. 52).

Afronurus peringueyi (E.-P.).

Esben-Petersen, 1913, p. 185, figs. 9-12; Navas, 1915, p. 173; Lestage, 1918, p. 109; Lestage, 1924A, p. 351.

The following notes on material in the South African Museum are supplementary to Esben-Petersen's description.

Imago.—The outer apex of the femora is produced in a rounded lobe or flange, especially in the mid and hind legs, which has the appearance of a spine in dorsal view. In Esben-Petersen's figure 10 the small size of the hind

* Eaton's original spelling of the name of the genus, from which this family takes its name, must stand.

leg of ♀ is evidently due to a draftsman's error. A better figure of the penis is here given, taken from a preparation in liquid. The ventral plate of ♀ is sharply and rather deeply excised on distal margin.

Major and Minor Forms.—The small amount of material sent to Esben-Petersen was insufficient to give a hint that two forms are present. In fact the whole of the S.A. Museum material would not do that except by analogy with the Cape species described below. The details of the material are as follows:—

Forma Major.—♀ October 1911 (Type, not in S.A. Mus.), February 1912, March 1917; subimago ♀, October 1911 (not in S.A. Mus.), December 1914, February 1912, March 1917.

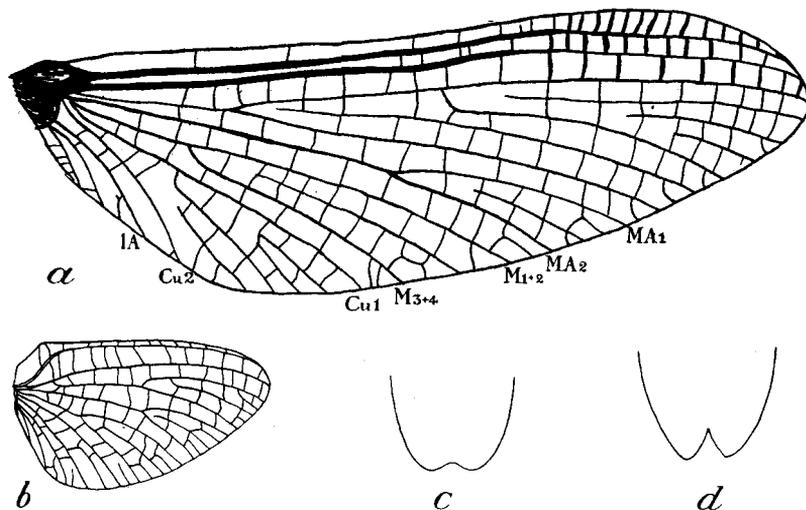


FIG. 45.—*Afronurus harrisoni* n. sp. *a, b*, fore- and hind-wings of imago; *c, d*, ventral plate of ♀ of *harrisoni* and *peringueyi* respectively.

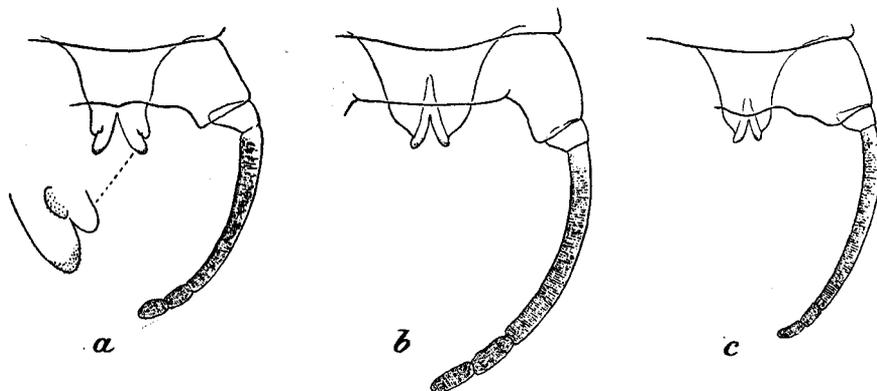


FIG. 46.—*Afronurus*. Forceps and penis of ♂ of: *a*, *peringueyi* (E.-P.); *b, c*, *harrisoni* n. sp. *forma major* and *forma minor* respectively.

Forma Minor.—♂, September 1911, December 1914, April 1916 and 1917; subimago ♂, December 1914, April 1917; subimago ♀, December 1914, April 1916.

All the ♂♂ are *forma minor*, and most of the ♀♀ are *forma major*.

Localities.—Besides the one locality in Zululand, this species has been recorded from the Belgian Congo (Navas, 1915, and Lestage, 1918) though with some doubt.

The capture of a ♀ specimen (*forma minor*: body 7.5 mm., wing 9 mm.) on the Kunene River, near Erikson's Drift, Ovamboland (March 1923, K. H. B.) bridges to some extent the gap in the distribution. The species will probably be found in the Transvaal, and the presence in Natal of nymphs, which are almost certainly this species, indicates that it occurs in Natal also.

Nymph assigned to *Afronurus peringueyi*.

Head regularly oval. Antennae short. Abdominal segments finely spinulose dorsally on posterior margins; segments 3-8 with the postero-lateral angle acuminate, the points becoming stronger posteriorly. Femora broadly lamellate, anterior margin with spines especially in mid and hind legs, dorsal surface with spines which are blunt on front femur, pointed on mid and hind femora; hind margins with long plumose setae, and with short spines also on mid and hind femora. Fore tibia sparsely setose, mid and hind tibiae densely setose and with a few spines; claws stout, inner margin with 5 denticles. Gills: lamella of 1st gill elongate oval, of 2nd-6th gills subtriangular, of 7th gill long-oval, the branchial filaments of the latter much shorter than in the other gills; margin of 7th lamella setulose, all the others smooth.

Size of specimens, which do not appear to be fully grown: 10 mm.

Colour as preserved: dark brown, eyes black, ocelli apically pale; thorax, abdomen, and femora mottled, abdomen, with two pale subdorsal spots on each segment except the 10th; tibiae and tarsi pale, the former with a fuscous band in middle; cerci annulate.

Natal (no exact locality); collected by Mr. L. A. Day, Provincial Inland Fisheries Officer of Natal.

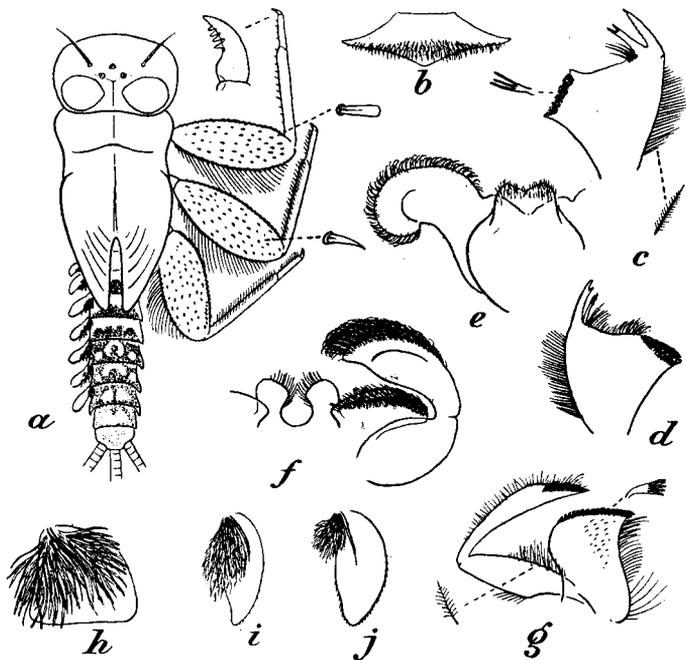


FIG. 47.—*Afronurus peringueyi* (E.-P.). a, nymph with claw and femoral spines further enlarged; b, labrum; c, d, left and right mandibles; e, hypopharynx; f, labium; g, maxilla; h, i, j, inner view of 2nd, 1st, and 7th gills respectively.

Afronurus harrisoni n. sp.

Eaton, 1887, p. 309 (*Ecdyurus* sp. ♀ from Paarl).

Imago.—Venation as in *peringueyi*. ♂ styles as in *peringueyi*. Penis apically bifid, the lateral margins sinuous, the apical lobes grooved on the underside and the tips curved downwards. Ventral plate of ♀ shallowly excised on distal margin.

Two forms occur, which are distinguished as *forma major* and *forma minor*. *Forma major*: body ♂ 11.5 mm., ♀ 12 mm.; wing ♂ 12 mm., ♀ 13 mm.; cerci ♂ 24 mm., ♀ 25 mm. *Forma minor*: body ♂ 8-9 mm., ♀ 9.5 mm.; wing ♂ 8.75-9 mm., ♀ 10.5 mm.; cerci ♂ 13-19 mm., ♀ 18 mm.

Turbinate eyes of ♂ at first caesious, turning reddish orange or flavous, with two burnt sienna bands laterally; ocelli shining piceous. General colour varying from light yellow to orange, darkening with age, with a dorsal stripe of burnt sienna or reddish orange. Abdomen laterally with a dark comma-shaped mark on each segment, and ventrally a median sienna stripe. Legs brownish. Genital styles light sienna. Cerci light reddish brown with sepia annulations. ♀ similar to ♂ but often with a deeper red or purplish shade on abdomen.

Egg.—One ♀ lived in captivity for six days and then extruded an egg-mass (unfertilised). The portion of the egg-mass external to the body is connected with the remainder still inside the body. It is a hard mass, as preserved, and the eggs are connected with one another by fine, tough, elastic threads. These threads do not appear to arise from any particular part of the egg. The eggs are pale yellow, ovoid, shallowly sculptured.

Nymph.—As in *peringueyi*, with the following differences: head larger, broader, the lateral margins not parallel but converging posteriorly; femora relatively not quite so broadly lamellate, spines on upper surface of fore femur pointed like those on the other femora. 7th gill more broadly ovate, without any filaments.

Colour: see *infra*.

Localities.—Groot Drakenstein (A. C. H.); Jonkershoek, Stellenbosch (A. C. H.); Hex River, Sandhills, Worcester Distr. (A. C. H.); River Zonder End Mts. (November, December, 1928, K. H. B.); French Hoek (K. H. B.).

Remarks.—This species is clearly distinct from the Zululand species in the ♂ genitalia (penis), ventral plate of ♀, and even more strikingly in the nymph. I have much pleasure in naming this fine Cape May-fly after Mr. Harrison, who has worked out the life-history.

Habits.—The flies occur from late October to mid-March, being most abundant about Christmas and New Year.

The nymphs live in running water; young instars can be found throughout the year, but full-grown nymphs are conspicuous only in late spring and early summer. The nymphs live on the undersides of stones, either deeply submerged or at the margin of the stream; they are very agile and dodge round from one surface to another when the stone is lifted out of the water. They are difficult to dislodge from the stone. Their swimming is laboured, the legs aiding the flexions of the body (A. C. H.).

The coloration is variable, but there are two main types of coloration: the commoner variety is the "tawny-yellow" with predominating yellowish ground-colour and broad reddish-brown markings on head, thorax, abdomen, and legs, ventral surface and cerci pale yellowish; the other variety is the "partridge-mottled," in which the whole upper surface and the cerci are brown-mottled.

Emergence of the subimago takes place by night, either from the surface film or subaqueously. In the latter case the nymph skin remains firmly attached to a stone or piece of weed not less than 1 inch from the surface (in aquarium). The subimago from a subaqueous emergence slips out of the nymph-skin, shoots up to the surface with wings folded plicately along the abdomen, and, bursting through the surface film, rests on the surface for an instant on its legs before taking flight to a neighbouring object (A. C. H.).

Nymphs ready to disclose the subimago are sensitive to light. If the electric light be switched on during the usual restlessness just prior to emergence, the insect is distressed and ecdysis interrupted, often resulting in death. If, however, ecdysis has actually begun, and the nymph-skin split along the back, light has little or no effect (A. C. H.).

Transformation to the imago follows about 24–36 hours later, the shortest times being during hot weather. Imago has been kept alive for six days (A. C. H.).

In the subimago variations in the shade of the prevailing body colours, yellowish brown and reddish brown, are found. The following are the three varieties of wing coloration, in order of frequency:—

1. Membrane dull hyaline yellow, neuration shaded with brownish.
2. Membrane shaded with brownish, except the marginal area, which is yellowish, neuration bright hyaline yellow.
3. As in 2, but neuration shaded with deeper brownish.

All three varieties of subimago can emerge from either the "tawny-yellow" or the "partridge-mottled" type of nymph (A. C. H.).

The above remarks apply to both *forma major* and *forma minor*, except that all the bred subimagos of the "Dwarf Tawny-Yellow" belong to variety 2; there were none of variety 1, which is the commonest in *forma major*.

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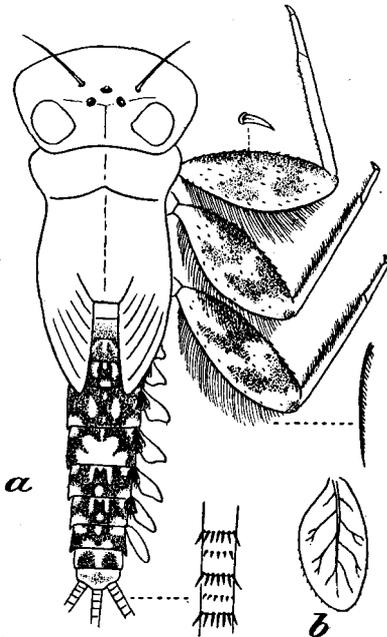


FIG. 48.—*Afronurus harrisoni* n. sp. a, nymph, with portion of cercus and spines further enlarged; b, 7th gill.

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ADDENDUM.

Gen. *Acentrella* Bgntsn.

See Lestage, 1921, p. 257.

Acentrella capensis n. sp.

Imago.—Venation resembling that of *Baetis harrisoni* (cf. fig. 12A), including the incomplete longitudinal branchlets in the pterostigmal area, and 1A distally forked, but the short branch disconnected. Hind-wing as in *B. harrisoni*, but costal process more sharply acute.

Body 5-6 mm.; wing 6.5-7.5 mm..

Colour as in *B. harrisoni*, but without colour-pattern on abdomen, except the darker hind border to each segment, cerci annulate.

Egg.—Broadly oval, .12 mm.

Nymph.—Resembling that of *B. harrisoni* (cf. fig. 13), but with inconspicuous light-coloured tracheae in gills. The median cercus is represented by a minute conical point.

7 mm. Ochraceous, abdomen with a series of medio-dorsal dark marks on each segment, forming a discontinuous dark longitudinal stripe on either side of the median line; knees dark; cerci brownish, uniform.

Localities.—Hex River, Worcester Distr. (October 1931, A. C. H.); Lilyfontein, Kamiesberg (September 1931, K. H. B.); Wellington Mts. (October 1931, K. H. B.); Eerste River, Stellenbosch (October 1931, A. C. H.); Groot Drakenstein (October-November, A. C. H.).

Habits.—The method of oviposition was observed in the Hex River (A. C. H.). The ♀♀ settle on large stones protruding from the water; they crawl down the sides beneath the surface, with wings folded along the abdomen, and lay masses of eggs on the under surface of the stones. After oviposition the ♀♀ crawl out of the water, the wings soon dry, and they are again capable of flight.

Some eggs collected on 5th October (actual date of oviposition not known) hatched on 19th-20th October (i.e. not less than 14 days). The newly hatched larvule, like most other 1st stage larvules, has only 2 cerci.

Unlike other Baetids, the nymphs are stone-clingers and runners rather than swimmers. When a stone is disturbed the ordinary Baetid nymphs dart away with great rapidity, but the *Acentrella* nymphs remain clinging. Thus in habits they closely resemble a Leptophlebiid, e.g. *Castanophlebia*.

A fuller description, with figures, of this interesting May-fly, which was discovered too late for inclusion in the body of this paper, will be given elsewhere.