

With compliments
R. S. Crass

The May-Flies (*Ephemeroptera*) of Natal and the Eastern Cape.

By

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With 38 Text-figures.

CONTENTS.	PAGE
I. INTRODUCTION	39
II. GENERAL REMARKS ON THE FAUNA	40
1. Collecting and Breeding in Captivity	40
2. Characteristics and Ecology of the Natal Fauna	41
A Comparison of the Natal Fauna with that of the South-West Cape	41
The Zonal Distribution of the Natal May-flies	42
Habits	43
Seasonal Distribution	46
Importance as Trout Food	47
III. SYSTEMATIC DESCRIPTION OF THE FAUNA	48
Suborder EPHEMEROIDEA	48
Family POLYMITARCIDÆ	48
Gen. <i>Polymitarcys</i> Eaton	48
<i>P. savigni</i> (Pict.)	48
Gen. <i>Exeuthyplocia</i> Lest.	48
<i>E. sampsoni</i> Brnrd.	50
Family EPHEMERIDÆ	50
Gen. <i>Eatonica</i> Navas	50
<i>E. schoutedeni</i> (Navas)	50
Suborder BÆTOIDEA	52
Family OLIGONEURIIDÆ	52
Gen. <i>Oligoneuriopsis</i> n.g.	52
<i>O. lawrencei</i> n.sp.	53
Family BÆTIDÆ	56
Gen. <i>Clæon</i> Leach	56
<i>C. chaplini</i> Brnrd.	56
<i>C. rhodesiae</i> Brnrd.	57
Gen. <i>Austroclæon</i> Brnrd.	57
<i>A. africanum</i> Brnrd.	57
<i>A. paludinosum</i> n.sp.	57
<i>A. exiguum</i> n.sp.	59

CONTENTS— <i>cont.</i>		PAGE
Gen. <i>Pseudocloeon</i> Klap.	. . . . .	60
<i>P. inzingæ</i> n.sp.	. . . . .	60
<i>P. minutum</i> n.sp.	. . . . .	62
<i>P. maculosum</i> n.sp.	. . . . .	63
Gen. <i>Bætis</i> Leach	. . . . .	65
<i>B. harrisoni</i> Brnrd.	. . . . .	65
<i>B. bellus</i> Brnrd.	. . . . .	66
<i>B. cataractæ</i> n.sp.	. . . . .	66
<i>B. parvulus</i> n.sp.	. . . . .	70
<i>B. lawrencei</i> n.sp.	. . . . .	70
Gen. <i>Acentrella</i> Bgntsn.	. . . . .	72
<i>A. natalensis</i> n.sp.	. . . . .	72
<i>A. monticola</i> n.sp.	. . . . .	75
Gen. <i>Centroptilum</i> Eaton	. . . . .	76
<i>C. sudafricanum</i> Lest.	. . . . .	76
<i>C. excisum</i> Brnrd.	. . . . .	78
<i>C. flavum</i> n.sp.	. . . . .	78
<i>C. falcatum</i> n.sp.	. . . . .	80
<i>C. medium</i> n.sp.	. . . . .	81
<i>C. indusii</i> n.sp.	. . . . .	83
<i>C. parvum</i> n.sp.	. . . . .	84
<i>C. varium</i> n.sp.	. . . . .	85
<i>C. pulchrum</i> n.sp.	. . . . .	88
Gen. <i>Centroptiloides</i> Lest.	. . . . .	90
<i>C. bifasciatum</i> Lest.	. . . . .	91
Family BRACHYCERCIDÆ	. . . . .	93
Gen. <i>Austrocænis</i> Brnrd.	. . . . .	93
<i>A. capensis</i> Brnrd.	. . . . .	93
Gen. <i>Tricorythus</i> Eaton	. . . . .	93
<i>T. discolor</i> (Burm.)	. . . . .	93
<i>T. reticulatus</i> Brnrd.	. . . . .	94
Family LEPTOPHLEBIIDÆ	. . . . .	95
Gen. <i>Aprionyx</i> Brnrd.	. . . . .	95
<i>A. natalica</i> (Lest.)	. . . . .	96
<i>A. argus</i> Brnrd.	. . . . .	96
<i>A. tricuspidatus</i> n.sp.	. . . . .	97
Gen. <i>Adenophlebia</i> Eaton	. . . . .	100
<i>A. auriculata</i> Eaton	. . . . .	100
<i>A. sylvatica</i> n.sp.	. . . . .	102
Gen. <i>Euphlebia</i> n.g.	. . . . .	104
<i>E. bicolor</i> n.sp.	. . . . .	104
Gen. <i>Castanophlebia</i> Brnrd.	. . . . .	108
<i>C. calida</i> Brnrd.	. . . . .	108
Gen. <i>Choroerpes</i> Eaton	. . . . .	108
<i>C. nigrescens</i> Brnrd.	. . . . .	108
Gen. <i>Euthraululus</i> Brnrd.	. . . . .	108
<i>E. elegans</i> Brnrd.	. . . . .	108

CONTENTS— <i>cont.</i>		PAGE
Family EPHEMERELLIDÆ		109
Gen. <i>Lithogloea</i> Brnrd.		109
<i>L. harrisoni</i> Brnrd.		109
Suborder HEPTAGENIOIDEA		109
Family ECDYONURIDÆ		109
Gen. <i>Afronurus</i> Lest.		109
<i>A. peringueyi</i> (E.-P.)		109
<i>A. harrisoni</i> Brnrd.		109

I. INTRODUCTION.

THE present paper is based on material collected from Natal and parts of the Cape Eastern Province, and represents the first systematic investigation of the May-fly fauna of this region. Previously only 14 species were recorded from Natal and Zululand; the present study brings the total to 44. Intensive field-work has been carried out on the streams in the Curry's Post and Karkloof districts of the Natal Midlands, chiefly between 3500 and 4500 ft. alt., at all seasons of the year. This region contains mostly small streams, but the area investigated includes parts of the Lions and Karkloof rivers, besides the Yarrow stream. In addition, rivers and streams rising in the Drakensberg have been examined, including those in the Cathkin Peak area up to over 7000 ft. Collecting has been done on the following rivers and streams; some having been worked more systematically than others: Weza, Umgeni, Furth, Mooi, Little Mooi, Inzinga, Loteni and Umkomaas. Records from outside Natal are chiefly the result of earlier collecting in the Eastern Cape, around Grahamstown and in the Amatola Mountains, and at Kokstad, in East Griqualand. From Zululand I have only two species (one new); from Basutoland at 10,000 ft. three of the common Natal May-flies, which shows that some forms at least extend to high altitudes. The main fields that require further exploration are: Much of the Eastern Cape, Basutoland, the coastal area of Natal, the greater part of Zululand, and all Northern Natal.

Representatives of 43 species have been collected, 41 from Natal and 23 from the Eastern Cape. Of these 20 are new, bringing the total of known South African species to 62. Descriptions of these 20 new species are given, together with 22 new nymphs, and 2 new genera are instituted.

Acknowledgments.—I must express my deep indebtedness to Dr. K. H. Barnard, of the South African Museum, with whom I have had the pleasure of consultation on the problems that have arisen during the course of this work. He has made many helpful suggestions and devoted much time and trouble to answering my queries. He has also very kindly made accessible to me the relevant parts of various papers. His own publications¹ form the

¹ 'Trans. Roy. Soc. S. Afr.,' vol. xx, pt. 3, 1932; 'Annals Natal Mus.,' vol. viii, pt. 2, 1937; 'Ann. S. Afr. Mus.,' vol. xxxii, pt. 6, 1940; 'Annals Durban Mus.,' vol. iii, pt. 7, 1941.

chief contribution to a knowledge of South African May-flies, and are indispensable to anyone interested in the subject. The first paper contains descriptions and keys to all the previously known species, including his own new ones, and has references to all previous literature, so that it forms a convenient basis for the future study of our Ephemeroptera. I have modified his keys where the introduction of new genera and species has made this necessary, but I have not deemed it desirable to copy those that can remain unchanged.

From Dr. Lawrence, Director of the Natal Museum, I have received much encouragement, and also facilities for working in the Museum. To his kindness I am indebted for a number of specimens, and for the opportunity of exploring the Cathkin Peak area.

Mr. K. M. Pennington, of Michaelhouse, has taken keen interest in the work and has collected some useful specimens, including a sample from 10,000 ft. in Basutoland.

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II. GENERAL REMARKS ON THE FAUNA.

1. COLLECTING, AND BREEDING IN CAPTIVITY.

To obtain a thoroughly representative collection from any locality repeated visits must be made, since some species only hatch for a short period. However, even if adult flies are not obtained, nymphs usually can be taken throughout the year. Besides looking for imagos flying, particularly towards sunset, sweeping the banks of a stream is often a productive means of collecting. To obtain nymphs, except those that cling to rocks, a water-net is required, preferably a fairly large one. Both imagos and nymphs are most conveniently preserved in alcohol, although the latter should be killed in hot water first to avoid shrinkage. Preserved flies often fail to retain their full colour, and whenever possible I have used fresh material for descriptive purposes.

The breeding of flies from the nymph is an important part of any investigation such as the present, and numerous nymphs have been collected and kept in captivity. Of the 23 species that have been hatched out, 14 had not previously been bred in captivity. The differences in viability between various species are great. Bætidæ in general, with the notable exception of *Austroclæon paludinosum*, have proved delicate, and many will only live a few hours or at most a day or two in still water; particularly fatal are sudden changes in temperature, and overcrowding. To overcome the difficulty of rearing nymphs in still water, boxes with perforated zinc ends and covered with mosquito-netting have been used. They have proved successful, especially in the case of larger nymphs, when placed in the running water of a small stream. The chief disadvantage is that the empty shucks of Bætidæ which hatch from the surface film may be lost. However, if a loose piece of gauze is placed across the tank near the down-stream end, most of the shucks can be recovered. Most Leptophlebiidæ, especially *Aprionyx*, *Adenophlebia*, and *Euphlebia*, live for some time in still water if it is frequently changed, and apparently indefinitely in running-water "tanks." Specially adapted swift-water forms like *Tricorythus* and *Afronurus* are distinctly intolerant of still water, but not to the same extent as most Bætidæ. In this connection it may be noted that Bætidæ, with the exception of the *Clæon* group, have immobile gills, whereas most other nymphs are able to pulsate their gills. This enables them to create a respiratory current in still, poorly oxygenated water.

2. CHARACTERISTICS AND ECOLOGY OF THE NATAL FAUNA.

A Comparison of the Natal Fauna with that of the South-West Cape.—Although it seems certain that new species still await discovery, it is now possible to discuss the general nature of the Natal May-fly fauna and to compare it with that of the South-West Cape. No such comparison can be made with the Transvaal, and other territories to the north, since this is an almost unknown field; Basutoland, too, is scarcely explored. What little is known of the eastern Cape indicates that it has no distinctive fauna of its own, but merely forms a meeting-ground for that of Natal and the area to the south-west. Probably most of the sub-tropical May-flies of the genera *Polymitarcys*, *Exeuthyplocia*, *Ephemerella*, *Eatonica*, *Elassoneuria* and *Oligoneuriopsis* will be found to occur at least as far as East Griqualand and Pondoland, since there is no geographical break corresponding with the political border of Natal, although so far only *Polymitarcys* and *Oligoneuriopsis* have been taken south-west of Natal. However, as Barnard pointed out (*loc. cit.*, 1932, p. 205, these large Ephemeroidæ and Oligoneuridæ, which form a striking addition to the Natal fauna, are absent from the south-west Cape. Conversely, whereas there are two Cape genera of *Ephemerellidæ*, there is no record of either of these genera further north-east than the Amatola Mts., Kingwilliamstown

Division; the only known Ephemerellid from Natal is a nymph, apparently of a new genus, from Yarrow falls (25.ii.45, C. H. Crass), which has not yet been described. As might be expected, however, there are many points of resemblance between the May-flies of Natal and the Cape. Of the 32 species recorded from the south-western area, 13 are known to occur in Natal and a further 4 in the Eastern Province. An interesting point is that in three of these species slight morphological differences are apparent in the Natal forms, which might be sufficient to place them in separate subspecies, when such detailed taxonomy is desirable, and is justified by sufficiently wide and systematic collecting. In Natal the *Bætidæ* are even more dominant than in the Cape, both as regards species and individuals. The Leptophlebiids, while well represented and in several cases very abundant, come a poor second; while the Brachycercids are few in species, but prolific in individuals. Of 44 known species from Natal and Zululand, 25 belong to the *Bætidæ*, 8 to the *Leptophlebiidæ*, 3 to the *Brachycercidæ*, and 2 each to the *Ephemeridæ*, *Polymitarcidæ*, *Oligoneuriidæ* and *Ecdyonuridæ*. The most strongly represented genus in South Africa is *Centroptilum* with 9 species.

The Zonal Distribution of the Natal May-flies.—Most of the Natal rivers rise on the Drakensberg, and the streams which form the sources drop steeply for the first few miles, with numerous falls and rapids and rocky pools. The banks are usually clad with grass and bushes overhanging the stream, but cover other than stones is generally lacking in the water itself. The water is normally clear, and is in constant movement and well oxygenated. In these mountain streams May-fly nymphs are often extremely plentiful, but they are restricted to comparatively few types. The specialized *Acentrella*, *Tricorythus* and *Afronurus* are always to be found in the swift parts, while *Bætis harrisoni*, *Centroptilum sudafricanum*, *Adenophlebia* and *Castanophlebia* abound in less torrential situations. Besides these common species, *Oligoneuriopsis*, *Pseudoclaeon inzingæ*, *Bætis cataractæ*, *Centroptiloides*, *Austrocænis* and *Aprionyx* have been recorded from the Berg streams. The larger streams in the valleys have stiller pools, and more cover in the form of weed and herbage. Here the mountain species still occur, but are not so plentiful, and in addition numerous Bætids make their appearance, notably *Bætis bellus*, *Centroptilum excisum* and others of this genus, while *Euthraululus* tends to replace *Castanophlebia* as the commonest Leptophlebiid, along with *Adenophlebia auriculata* form *fasciata*, which continues to be plentiful well down the rivers wherever there are stones. Where the rivers pass out of the mountain region they become sluggish and discoloured, usually with mud banks and little cover. Such localities are unlikely to support a large May-fly fauna, but the lower parts of the rivers have not been investigated; there are records of some of the large mud-burrowing species, including *Ephemera natalensis*. The small tributary streams of the Natal midlands, which have short courses, often rise in swamps, in which *Austrocælon paludinosum* and *Adenophlebia auricu-*

lata (typical form) occur, and sometimes *Centroptilum pulchrum*, with *C. sudafricanum* in any running water. Further down there may be rocky sections where *Acentrella*, *Centroptilum excisum*, *Bætis harrisoni*, *Tricorythus* and *Afronurus* make their appearance. In the lower reaches, where pools with vegetation occur, most of the common Bætid and Leptophlebiids are to be found.

Of the larger streams, the Yarrow may be taken as an example. It can be divided roughly into six zones. The first is where it rises at about 5500 ft. in a large sponge on the top of the Karkloof range, and flows across a grassy plateau. In the second it enters a deepening trough, and goes over a number of falls and rapids, with pools among large boulders, the water-course passing through natural evergreen forest. The third section is fast-flowing over a stony bottom, in open country (except for artificial plantations). In the fourth zone running water alternates with open shallow pools, with scattered stones on the stream-bed, and some weed. The fifth stage in its course consists of short rapids, with long still stretches, the banks overgrown with long grass, while weed and trailing herbage form cover for nymphs in the water. The final zone extends from a small waterfall down a shallow rocky gorge to the Karkloof River at a little below 4000 ft.; this section has both swift rock situations and deep still water. The following species have been taken in the various zones: (1) *Centroptilum sudafricanum*, *Austroclæon paludinosum*, *Adenophlebia auriculata*. (2) *Bætis harrisoni*, *B. cataractæ*, *Acentrella natalensis*, *C. sudafricanum*, *C. excisum*, *Tricorythus discolor*, *Austrocænis*, *Aprionyx tricuspидatus*, *Adenophlebia auriculata*, *A. sylvatica*, *Castanophlebia*, *Afronurus harrisoni*, *A. peringueyi*. (3) The same as 2, except *Aprionyx* and *Adenophlebia sylvatica*, and with the addition of *Oligoneuriopsis* (this species probably also occurs in 2). (4) *Pseudoclæon minutum*, *P. maculosum*, *Bætis bellus*, *B. harrisoni*, *C. sudafricanum*, *C. excisum*, *C. indusii*, *Tricorythus*, *Austrocænis*, *A. auriculata*, *Castanophlebia*, *Euthraulius*, and the two *Afronurus* spp. (5) The same as 4 except the *Pseudoclæon* spp., and in addition *Polymitarcys*, *Exeuthyplocia*, *Austroclæon paludinosum*, *Bætis parvulus*, all the South African *Centroptilum* spp., and *Euphlebia*. (6) The same as 5 except the first three species and *Euphlebia*, and in addition *Pseudoclæon* sp. nymph, *Centroptiloides* and an *Ephemerellid* nymph.

The small torrential forest streams, which are plentiful in the Curry's Post and Karkloof districts, have a characteristic fauna restricted to a few types: *Bætis cataractæ*, *Centroptilum sudafricanum*, *Aprionyx tricuspидatus*, sometimes *A. natalica*, and *Adenophlebia sylvatica*, *Castanophlebia*; with *Bætis harrisoni*, *Afronurus* and *Tricorythus* in the less densely shaded parts.

Habits.—May-flies are to be found in almost every type of stream, since their nymphs occupy a great variety of habitats, and show a corresponding degree of adaptive variation, depending on whether they live in fast-running or still water, cling to stones or burrow in mud. Adaptation is both structural and

functional ; thus swift water forms are usually flattened, and have denticulate claws, to enable them to remain clinging to rocks in a strong current, while mud-burrowers have fossorial fore-legs. There are various modifications of gill structure related to habitat, and correlated physiological characters, particularly with regard to temperature tolerance, since both oxygen concentrations and variations in temperature will be very different in various environments. The experimental work of Wingfield on gill-function, and of Whitney on thermal resistance, in a few species of English May-flies ('J. Exp. Biol.,' xvi, p. 363, 1939) is of importance in this respect. Whitney found that the thermal resistance of swift-water nymphs was lower than that of similar species from ponds and other localities with great variations in temperature. Wingfield's results indicate that the gills of at least some swift-water forms have no respiratory function. It would be of great interest to extend these investigations to include a much larger number of species. It appears that in *Betis* the gills are not used in respiration, since the water in which the nymphs live is always well oxygenated, and evidently gaseous exchange can take place through the integument. In the still-water *Cloëon* the gills are used to create a current to aid respiration in low oxygen concentrations, although their loss does not affect oxygen uptake in an artificial current, and they do not seem to be true respiratory organs. The experiments led to the conclusion that the gills of *Ephemera* are true respiratory organs. In the majority of nymphs (except most Bætids) the gills can be used to create a current, and in poorly oxygenated water these organs are in constant movement.

The degree of restriction to any particular type of habitat varies greatly in different species. Whereas the burrowing Ephemeroid nymphs are confined to localities with slowly flowing water and suitable banks, such generalized forms as *Adenophlebia* are to be found in a wide range of situations. The following points may be noted with regard to the habits of South African May-fly nymphs: Ephemeroids are burrowers. *Oligoneuriopsis* differs from the European *Oligoneuria* in being chiefly an inhabitant of swift mountain streams, whereas the latter lives in sluggish rivers. Bætids in general have active, free-swimming nymphs, but some (*Acentrella*, *Betis cataractæ* and *Centroptilum varium*) are of the crawling type adapted for clinging to rocks. Those forms, such as *Betis harrisoni* and *Centroptilum sudafricanum*, which favour mountain streams, are to be found on rocks from which they swim actively if disturbed. Most Bætids, however, prefer the stiller pools where there is cover, other than rocks, in the form of weed, trailing herbage or grass roots. Of the *Brachycercidae*, *Tricorythus* is typically an inhabitant of swift water, while *Austrocœnis* is adapted to life in deeper pools among vegetable debris on the bottom. Most Leptophlebiids are primarily swift-water nymphs, but they extend to slow-flowing rivers, and even swamps, and the smooth-clawed *Aprionyx* species favour still pools and backwaters in mountain streams.

The peculiar *Euphlebia* nymph is the only South African Leptophlebiid which is specially adapted to life in sluggish water. In general, swift-water types can survive in slow-flowing stretches and commonly extend into such localities, whereas those nymphs which normally inhabit still water are unable to resist a strong current. Thus the mud-burrowing *Polymitarcys*, *Exeuthyplocia* and *Eatonica* are confined to localities where floods will not scour the banks and wash them out. Even the free-living *Austroclæon* and *Euphlebia* have not been taken in any but still stretches. Some species, such as *Bætis bellus* and *Austrocænis*, while commonest in still water, are also to be found in fast-flowing streams, where there are small pools with adequate cover.

The duration of the nymphal stage of most May-flies is uncertain, but of the South African species, it is probable that *Eatonica* lives for two years; this agrees with the data for similar European forms. The nymphs of *Adenophlebia auriculata* at times complete their development in about four months. This was proved by the following observation at Curry's Post: A small stream which had dried up completely during the winter began to run again after the first rain of the season on September 16, 1944. On October 3 some very young nymphs were observed in the stream. They were visited at frequent intervals, and by mid-January the nymphs were mature. On January 17 an empty shuck was found, proving that a subimago had emerged.

The habits of adult May-flies are very diverse, both in their time and method of emergence, and with regard to the nuptial dance and oviposition. The duration of life of the imago varies from a few hours to a number of days, or even weeks; a *Clæon* is recorded by Barnard that lived for 54 days, and an *Adenophlebia* was kept in captivity for 31 days by the present author. The subimaginal stage is very brief in short-lived species, such as *Polymitarcys*, *Exeuthyplocia*, *Tricorythus* and *Austrocænis*; the pellicle may be shed during the first flight after emergence. Bætidæ bred in captivity have usually remained in the subimaginal stage 12-24 hours, but in cold weather *Bætis* and *Centroptilum* have taken from 2 to 5 days. It has been found that most Leptophlebiidæ remain about 2 days as subimagos, but in the case of *Adenophlebia* this may be extended to 5 days. Bætidæ, except *Acentrella*, have been observed to hatch from the surface film, the nymphal skin splitting as the insect reaches the surface, and the fly emerging rapidly. *Acentrella*, like *Leptophlebiidæ*, crawls at least partially out of the water before emerging. *Exeuthyplocia* and *Afronurus* both hatch from the surface.

Most of the species investigated hatch from the nymph during the day, although *Austroclæon* and *Euthraulius* usually emerge in the night, and some specimens of other species have been found to do so as well. The nuptial dance and oviposition generally takes place during daylight, although many Bætidæ fly towards sunset. *Polymitarcys*, *Exeuthyplocia* and *Eatonica* are crepuscular insects, while *Tricorythus* flies from sunset until dusk. May-flies are not infrequently attracted by light, and it is evident that these species

are active at night ; on one occasion at Kokstad a ♀ *Polymitarcys* imago, and subimagos of *Euthraululus* and *Bætis bellus*, came to electric light, which was fully half a mile from the nearest water. The nuptial flight of May-flies is often characteristic. *Polymitarcys* and *Oligoneuriopsis* both fly rapidly to and fro close to the surface of the water, usually over the middle of the river, the latter about midday, the former after sunset. *Exeuthyplocia* has been observed hatching from the water and flying up and away. It is not known how mating takes place, but it probably occurs shortly after the shedding of the subimaginal pellicle, which happens within a few minutes of emergence. Most Bætids dance in clouds like gnats, their wings shining in the sunshine. When a female appears one of the competing males quickly mates with her, and the copulating pair drops out of the swarm. Later females may be seen ovipositing, flying down stream and "dapping" on the water every here and there. In the case of many species this occurs about sunset, but *Centroptiloides* and *Centroptilum sudafricanum* have been observed doing so about midday. Some Bætids, e.g. *Bætis* spp. and *Acentrella*, crawl under water and lay their eggs on submerged objects. *Austrocœnis* forms dense masses of individuals whirling together, which present a smoky appearance from a little distance as they drift with the wind. *Tricorythus* appears in vast numbers, the males flying erratically through the air and dancing over the water, while a comparatively few females are to be seen flying steadily along apparently weighted down by their large egg-masses. Leptophlebiids dance together in considerable numbers at times. *Adenophlebia* males are active in bright sunlight, the individuals apparently taking it in turns to perform, some sitting on grass or herbage while others dance in the air. *Euphlebia* is a strong flyer, small groups of individuals dashing backwards and forwards in the air together, often at a considerable height above the ground. The *Aprionyx* species, on the other hand, are rather feeble on the wing, and congregate in sheltered places under banks or behind bushes to perform their communal flight. The males flutter upwards and drift down repeatedly, while an occasional female flies slowly among them until a male succeeds in mating with her. If *Afronurus* performs a nuptial dance this would appear to be nocturnal, since only solitary individuals have been seen flying and settling on grass. More detailed descriptions of habits will be found under the headings of the individual species.

Seasonal Distribution.—In Natal, as in the Cape, May-flies are to be found throughout the year, but only a few species occur in winter. However, some forms are actually more plentiful in the cold weather, notably *Bætis harrisoni* and *Centroptilum excisum* ; and on dry sunny days, even during heavy frosts, a number of Bætids and also *Adenophlebia* hatch in mid-winter. Most of the Natal Leptophlebiids, such as *Aprionyx*, *Adenophlebia*, *Castanophlebia* and *Euthraululus*, appear in numbers with the first warm weather in spring, and reach their peak in early summer. Bætids generally have successive hatches throughout the season, reaching their period of greatest abundance in autumn, at

which season *Oligoneuriopsis* appears, and *Tricorythus* is most plentiful. *Austrocænis* appears in swarms at short intervals in all months of the year, except the coldest; *Afronurus* is also apparent at most times, chiefly from October to February. In contrast to these forms, which have a long period of emergence, are some of the larger species, notably *Exeuthyplocia*, which only hatches during 10 to 20 days each year. *Polymitarcys* and *Eatonica* also seem to have a short season, about midsummer. The occurrence and relative numbers of the various species change from year to year. Thus, in the spring and summer of 1944-45 there have been fewer May-flies in general than in the previous year, apparently due to the effect of a very dry autumn, winter, and spring. Some species have been little affected, whereas others, e.g. *Adenophlebia* and *Acentrella*, have been very noticeably scarcer.

Importance as Trout Food.—Although no adequate investigation has been made, it is certain that in Natal, as in most regions where trout flourish, May-flies, especially in the nymphal stage, form an important part of the food of these fish. This applies particularly to clear mountain streams, and it is noticeable that trout from waters where nymphs are plentiful are in better condition than those from rivers where May-flies are scarce. This fact may be observed sometimes on adjacent stretches of the same river; thus, on the Mooi River trout caught in a rocky section had been feeding on nymphs, and were in excellent condition, whereas those from the open water further down, where nymphs are scarce, were definitely lighter for their length. I have examined the throats and stomachs of 159 trout from 8 Natal streams, and of these 100 contained the remains of at least some May-fly nymphs and/or adults. In low-water conditions, especially in rivers such as the Loteni and Inzinga, Bætid nymphs and those of *Afronurus* undoubtedly form the bulk of the food of the trout; over 100 nymphs have been taken from a single fish. The following species are the most important in Natal: *Bætis harrisoni*, *B. bellus*, *Acentrella natalensis*, *Centroptilum sudafricanum*, *Tricorythus discolor*, *Adenophlebia auriculata* form *fasciata*, *A. sylvatica*, *Afronurus peringueyi* and *A. harrisoni*. In addition, nymphs of the following species have been taken from trout's stomachs: *Polymitarcys savigni*, *Eatonica schoutedeni* (in large numbers at Dalcrue, on the Mooi River), *Oligoneuriopsis lawrencei* (some trout from the upper Inzinga had been feeding largely on these nymphs), a number of Bætid species, *Austrocænis capensis*, *Aprionyx tricuspoidatus*, *Castanophlebia calida*, and *Euthraululus elegans*. Each evening that *Exeuthyplocia* emerges on the Yarrow a great rise of trout is to be observed, the fish apparently feeding voraciously on the nymphs as they come up to hatch, and later on the adult flies. The immense swarms of *Tricorythus discolor* that appear on fine autumn evenings always cause trout to come on the feed, although they are often difficult to tempt under these conditions with an artificial fly, unless it be a floating imitation of the natural insect. Indeed, this often applies when other species of May-fly are on the water, and there seems to be scope for the

extension of dry-fly fishing in South Africa, using imitations of the various duns and spinners.

III. SYSTEMATIC DESCRIPTION OF THE FAUNA.

Suborder EPHEMEROIDEA.

Family POLYMITARCIDÆ.

Genus *Polymitarcys* Eaton.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 46, 1883.

Polymitarcys savigni (Pict.).

Barnard, 1932, *loc. cit.* (references).

Localities.—Kokstad, East Griqualand, 17 and 30.xii.40. One at light ; other imagos taken at dusk (7–7.20 p.m.) flying rapidly over the surface of the river. Lions River, Natal, 22.ii.44. One disintegrated specimen.

Nymph assigned to *Polymitarcys savigni*. Text-fig. 1.

A nymph taken in Yarrow stream (J. A. Crass, 19.i.44), among vegetable detritus and grass roots, seems closely to resemble the nymph of *P. virgo*, and probably represents the nymph of *P. savigni*. I have not had access to Eaton's paper, but Dr. Barnard has kindly sent me a tracing of Eaton's figures of the head and mandible, and there seems to be no essential difference, although the mandibular tusk of the new specimen appears to be somewhat stouter and more curved distally. However, this appearance may be due chiefly to a difference in the angle from which it was viewed. The general characters agree with the generic diagnosis for *Polymitarcys*.

During life the gills are held arched over the back, not as shown for convenience in fig. 1.

Body 16 mm. ; outer cerci 6 mm.

Colour almost uniform, pale yellowish. The thoracic segments have faint brownish marks, and the abdomen shows indications of a fuscous pattern, which is obscured by a deposit of sediment in the Yarrow specimen. Setae on legs somewhat fulvous, cerci pale, uniform.

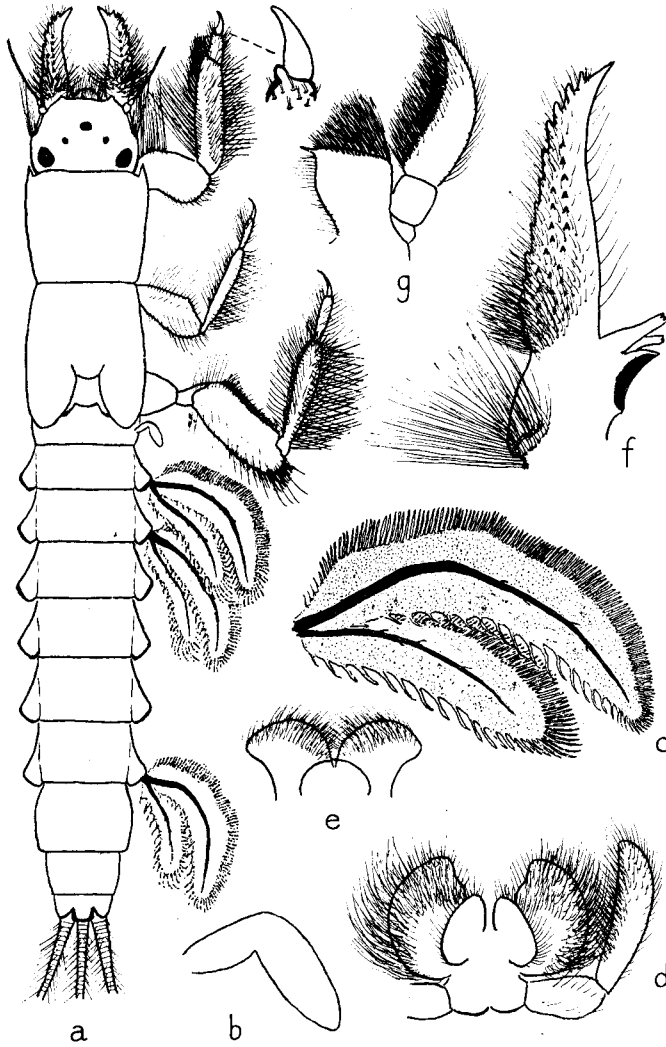
On the Mooi River, near Rosetta, 5.x.44, the remains of another specimen were taken from a trout's stomach ; and the same day three empty shucks were found floating in the water. The shucks are about 17–18 mm. body-length, and have mouth-parts and other structures identical with the Yarrow nymph.

Genus *Exeuthyplocia* Lest.

Lestage, Rev. Zool. Afr., vol. vi, p. 74, 1918.

Barnard, Ann. S. Afr. Mus., vol. xxxii, p. 617, 1940.

TEXT-FIG. 1.



Nymph assigned to *Polymitarcys savigni* (Pict.). *a*, whole animal, gills 4-6 omitted; *b*, 1st gill; *c*, 4th gill; *d*, labium; *e*, hypopharynx; *f*, left mandible; *g*, maxilla.

Exeuthyplocia sampsoni Brnrd.

Barnard, Ann. Natal Mus., vol. viii, p. 276, 1937 (imago, fig.); 1940, *loc. cit.*, p. 617 (nymph, fig.).

Localities.—Yarrow stream, 23 and 24. x. 44, 5 adults and 3 empty nymphal shucks. Hemyock, Mooi river, 30. iii. 46.

Remarks.—The presence of the shucks while the flies were actually hatching correlates the nymph with fair certainty. Furthermore, the specimens are identical with that already assigned to *E. sampsoni* by Dr. Barnard.

The flies emerged in the twilight between 6.20 and 6.45 p.m. Specimens in captivity shed their subimaginal pellicle within an hour, and were dead the following morning. This indicates that the fly only lives a few hours after emerging from the nymph.

Mr. R. B. Fyfe tells me that the flies usually appear about October 18 on the Yarrow, and continue to hatch until the end of the month. In the past immense swarms are said to have appeared, but both in 1943 and 1944 their emergence was sporadic and their numbers small.

A nymph was taken from the throat of a trout captured in a rocky section of river, where mud or clay is absent, although sand and vegetable detritus is present in which the nymph might find cover. This indicates that the species is not restricted to slow-flowing reaches with muddy banks. The nymph was 15 mm. long.

Family EPHEMERIDÆ.

Genus *Eatonica* Navas.

Navas, Trans. 2nd Intern. Ent. Congr., p. 180, 1913.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 210, 1932 (references).

Eatonica schoutedeni (Navas). Text-fig. 2.

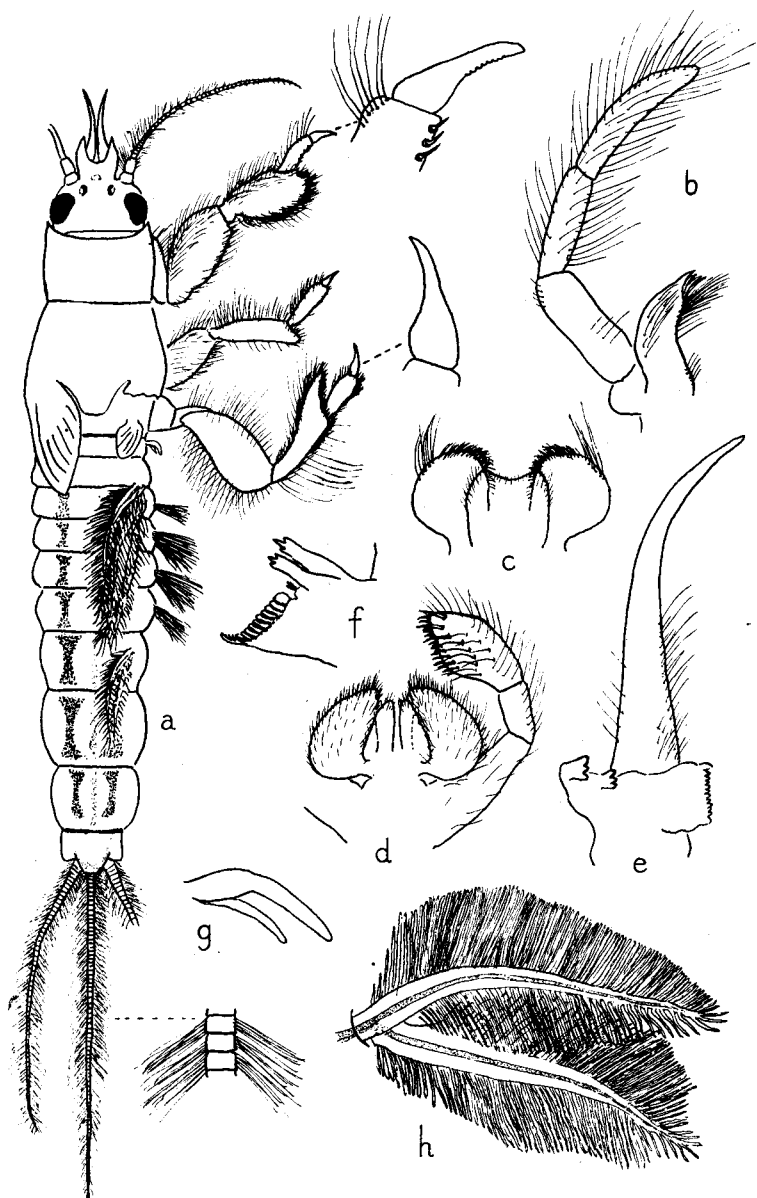
Navas, Ann. Soc. Sci. Bruxelles, vol. xxxv, p. 222, 1911.

Nymph.—Similar to *Ephemera* in structure and habits. Mandible triquetral, tusk smooth elongate, curved in vertical plane, setose proximally. Maxillary palp 3-jointed, elongate. Labium with inner lobes somewhat broad, and palp with bulbous terminal segment. Median lobe of hypopharynx apically emarginate.

Body up to 29 mm. from front of clypeus to end of abdomen; cerci 9 mm. (lateral) and 11 mm. (median).

Colour pale yellowish. Head uniform; eyes dark olive brown; labrum and apices of mandibles burnt sienna. Prothorax almost uniform with faint brown lateral and median marks. Mesothorax with anterior and posterior dorsolateral dark reddish-brown marks and faint median marks. Metathorax similar but marks less distinct. Abdomen with dorso-lateral reddish-brown markings as in imago; on anterior segments marks less strong than posteriorly, where they form broad longitudinal bands. Segments VII and VIII with slight orange suffusion. Abdomen ventrally pale greenish yellow.

TEXT-FIG. 2.



Eatonica schoutedeni (Navas). *a*, whole nymph, with details of cercus, and 1st and 3rd claws, gills 4-6 omitted and the right wing-case cut away; *b*, maxilla; *c*, hypopharynx; *d*, labium; *e*, internal lateral view of left mandible ($\frac{2}{3}$ scale of other mouth-parts); *f*, dorsal view of part of left mandible; *g*, 1st gill; *h*, 3rd gill.

Gill filaments rich tawny. Legs pale yellowish; setæ tawny or burnt sienna, more deeply coloured distally.

Localities.—Dalcruie, Mooi River (4500 ft.); Karkloof River (4000 ft.); Dec., 1944. Subimagos and nymphs.

Habits.—The nymphs are mud-burrowers, and in suitable localities are to be found in large numbers in the banks of slow-flowing rivers. The nymphs were taken near the bases of rushes in soft mud overlying a clayey substratum. The nymphs live for some time in captivity, even in jars, and have been bred in tanks containing mud. The subimagos apparently hatch during the day, and shed their pellicle the same or the following night. The main flight of the flies is said to take place at dusk in the evening. It would appear that the nymphs live for two years, since half-grown specimens (12–15 mm.) were taken along with mature nymphs. The normal duration of life of the imago is not known, but a ♂ bred in captivity lived 5 days.

Suborder BÆTOIDEA.

Family OLIGONEURIIDÆ.

KEY TO THE SOUTH AFRICAN GENERA.

- | | | | |
|-------------------------------------|-------------------------------|-------|-----------------------------|
| 4 strong convex veins in fore-wing. | Genital styles of ♂ 3-jointed | . . . | <i>Elassoneuria</i> Eaton. |
| 5 strong convex veins in fore-wing. | Genital styles of ♂ 4-jointed | . . . | <i>Oligoneuriopsis</i> n.g. |

Genus *Oligoneuriopsis* n.g.

Barnard, Ann. S. Afr. Mus., vol. xxxii, p. 620, 1940. (Fig. and description of nymph assigned to *Elassoneuria*.)

Imago.—In fore-wing between R_1 and Cu_1 , 3 strong convex longitudinal veins, IR_{3a} , MA_1 and MA_2 , the two latter separating near their base; the concave veins, R_{3a} , R_{3b} , R_{4+5} , M_{1+2} and M_{3+4} , all well marked; R_2 and IR_2 almost suppressed; R_{3a} and R_{3b} approximate to IR_{3a} ; R_{4+5} approximate to MA_1 ; M_{1+2} and M_{3+4} approximate respectively to MA_2 and Cu_1 ; $1A$ approximates to Cu_2 ; faint intercalaries present in radial and medial areas. Cross-veins much reduced except in anterior part of the wing. In hind wing radial area reduced, cross-veins almost absent.

Genital styles of ♂ 4-jointed. Penis broad, deeply cleft, lobes approximate. 1st leg considerably shorter and weaker than 2nd and 3rd.

Claws somewhat obtuse, outer one with an acute process. Cerci 3, median shorter and weaker than lateral ones; in ♂ strongly setose, in ♀ setae almost absent.

Nymph.—Similar to *Oligoneuria* (see Barnard, *loc. cit.*, 1932, p. 211). Differing from *Elassoneuria* in not having a carinate and pointed head, and from *Oligoneuriella* in the absence of lamellar cover to 1st gill, which consists only of a bunch of fibrillæ. A nymph from Surinam assigned to *Oligoneuria* closely resembles *Oligoneuriopsis*, except that it has a greatly expanded and

flattened fronto-clypeal region (see Spieth, 'Amer. Mus. Novit.,' no. 1244, Nov., 1943).

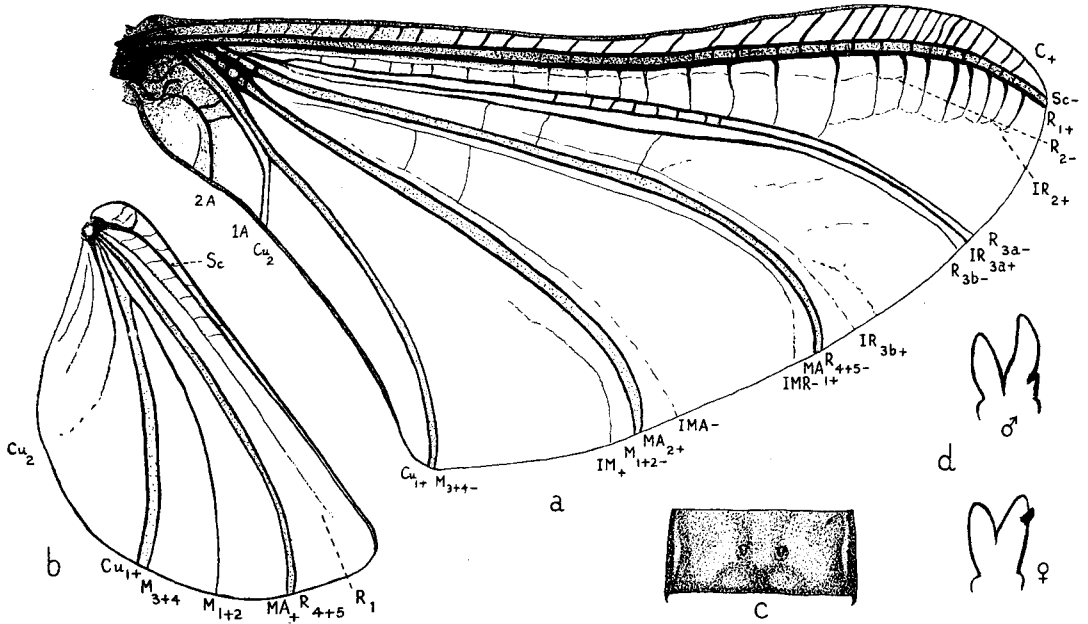
Oligoneuriopsis lawrencei n. sp. Text-figs. 3 and 4.

Imago.—Fore-wing broad, subtriangular, rounded apically. Sc strong, R_1 very strong; R_2 extremely weak, only apparent in its proximal part; IR_2 apparently represented by an indistinct line of abutment of the distal cross-veins from R_1 ; R_{3a} stronger than R_{3b} , which forms the lowest branch of R_3 , and is approximate to the strong convex IR_{3a} ; IR_{3b} weak, only apparent distally; faint intercalaries approximate to MA_1 , MA_2 , and M_{1+2} ; IM indistinct, and ICu suppressed. Cross-veins in costal area strong, and numbering 32–34; about 20 connecting Sc and R_1 distally. Cross-veins in the radial area appear to arise distally from R_1 , but as the proximal ones arise from the vestigial R_2 this connection may be the result of the partial suppression of R_2 . Only the proximal cross-veins reach R_{3a} , the others ending in an irregular line that probably represents the remains of IR_2 . Cross-veins show progressive reduction towards the posterior part of the wing. Hind wing with C reflexed over Sc, forming a ridge by means of which the wings can be linked to form a continuous surface for flight. R_1 not well marked; Rs distinct, unbranched; MA strong, also simple; M forked proximally; Cu_1 strong; Cu_2 and anals present. Intercalaries suppressed, and cross-veins only present proximally in costal and subcostal areas.

In ♂ tibia slightly longer than femur; tarsus short. 2nd and 3rd legs subequal, about twice as long as 1st. In both ♂ and ♀ median cercus half length of lateral. Outer claw of ♀ with an acute distal process; in ♂ a more obtuse projection near base. Sternite X of ♂ apically entire. Ventral plate of ♀ with elongate processes laterally (see text-fig. 4b). Genital styles of ♂ slender, curved, 1st joint very long, 2nd and 3rd short, terminal joint small and slender; penis broad, apically truncate, flattened dorso-ventrally, and divided into two approximate lobes, each lobe with an outer chitinized portion, supporting the softer inner tissue through which the vas deferens passes.

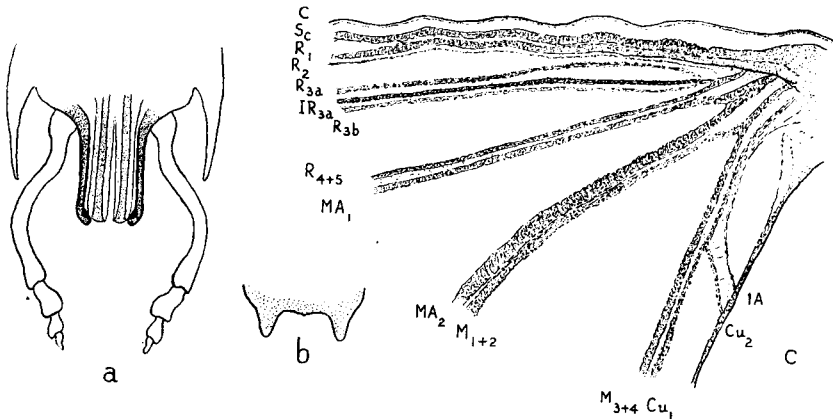
Head dark, almost black; eyes, and turbinate eyes of ♂ grey; ocelli white. Prothorax dorsally uniform, dark brownish grey; ventrally with pale areas laterally and anteriorly. Meso- and metathorax dorsally piceous, laterally and ventro-laterally with pale fuscous to almost white marks and joinings; sternites dark. Scutellum dark. Abdominal segments with pattern shown in text-fig. 3, c; a yellowish median stripe fades posteriorly into a brown suffusion, which extends forwards on each side of the yellow, and is concentrated into paired dark "eyespot." A bluish-grey area extends laterally to a dark brown longitudinal stripe, which is divided by a whitish streak. Abdomen ventrally pale bluish grey, paler along median line; each segment with an anterior median white spot, thin paired stripes of bright yellow, and a posterior yellow suffusion. Wings opaque, bluish grey; strong veins fulvous,

TEXT-FIG. 3.



Oligoneuriopsis lawrencei n. gen. et sp. *a*, *b*, fore- and hind-wings of ♂ imago¹; *c*, pattern of III abdominal segment; *d*, claws of ♂ and ♀ imago.

TEXT-FIG. 4.



Oligoneuriopsis lawrencei n. gen. et sp. *a*, forceps and penis of ♂; *b*, ventral plate of ♀; *c*, proximal part of fore-wing dissected out of mature nymph.

¹ In text-figure 3a, for IMR- read IMA-.

weak ones grey. Legs pale grey, 1st suffused with sepia, especially tibia and end of femur; 2nd and 3rd with only a small dark streak at base of femur, and dark knees and claws. Genital styles and cerci of ♂ pale yellow; ♀ cerci grey.

Body, ♂ 14.5 mm. (one specimen 12 mm.), ♀ 15-17 mm.; wing, ♂ 15 mm. (one specimen 11 mm.), ♀ 17-19 mm.; hind wing, ♂ 7 mm. (and 6.5 mm.), ♀ 7-8 mm.; cerci, ♂ 29 and 14 mm.; ♀ 12 and 6 mm.

Nymph.—A mature nymph from Kokstad (19 mm. excl. cerci) has been correlated with *O. lawrencei* by dissecting out the wing and examining the venation, which shows all the chief features of the imago (see text-fig. 4, c). Since this nymph appears to be identical with those from the Cathkin Peak area assigned by Dr. Barnard to *Elassoneuria* (*loc. cit.*, 1940), these latter presumably also belong to the new species. Further specimens of nymphs have been taken from tributaries of the Inzinga and Loteni rivers (January, 1945) and from the Cathkin Peak area (Feb., 1945) in considerable numbers, and from the Hogsback (Feb., 1944; S. Perks), and they all appear to belong to the same species. Some of these additional specimens are sufficiently mature to give a hint of the imaginal venation, which is apparently that of *Oligoneuriopsis*. None have yet been bred in captivity, however.

Localities.—Hogsback, Amatolas, Kingwilliamstown Div., 31.iii.40 (2 ♀♀); Kokstad, East Griqualand, Jan., 1941 (nymph); Weza River, Natal, 15.iv.41 (1 ♂); Karkloof, Natal, 5.iv.44 (5 ♂♂ and 1 ♀). All these localities, and the additional localities for nymphs given above, are between 4000 and 6000 ft. alt.

Habits.—The chief period of emergence is evidently during the autumn, since this is the time when imagos have been taken, and the majority of nymphs found in January and February were approaching maturity. The flies have been seen at midday, flying rapidly close to the surface of the water. The nymphs occur under stones, chiefly in mountain streams, where their denticulate claws enable them to remain even in a strong current. Up to 20 individuals have been found under a single stone.

Remarks.—For the above interpretation of the wing-venation of this interesting insect I am much indebted to the assistance of Dr. Barnard. As in Dr. Barnard's interpretation of the wing of *Elassoneuria* the notation used is that proposed by Tillyard. This modern notation has not been applied to any other Oligoneurid, and a fact which makes a comparison between the South African species and other members of the family still more difficult is that the figures given by Eaton and others were apparently taken from dried wings, which often give no hint of the true venation (see Barnard, *loc. cit.*, 1932, p. 211). As Dr. Barnard pointed out to me, allowing for this fact, the wings of *Oligoneuriella* and *Oligoneuriopsis* are probably very similar, although according to Eaton's figure ('Trans. Linn. Soc. Lond.,' 2nd ser., zool., III, 1883, pl. 3) the former is more simplified. However, he shows five veins in

the fore wing, which probably represent not only the convex R_1 , IR_{3a} , MA_1 , MA_2 and Cu_1 , but also their adjacent concave veins, which, in dried specimens, are largely hidden in folds of the membrane, and come to lie under the convex veins. On comparing *Oligoneuriopsis* with *Elassoneuria* it will be seen that the former shows more primitive features in both fore and hind wings. The fore wing still has the primitive triad system of Rs well developed in *Oligoneuriopsis*, whereas R_3 has been almost totally suppressed in *Elassoneuria*, and MA moved forward to support the anterior region of the wing membrane, while M is also vestigial. On the other hand, R_2 is stronger in *Elassoneuria*, and the reticulated cross-veins of the latter are absent in *Oligoneuriopsis*. In the hind wing of the new genus Sc is strong instead of very delicate and subsidiary to R_1 , which is weak in *Oligoneuriopsis*, but strong in *Elassoneuria*. Rs is represented by a single vein in the former, but is entirely suppressed in the latter. In the simple MA, forked M, and presence of Cu_1 and Cu_2 , the two genera are similar.

I have much pleasure in naming this species after Dr. R. F. Lawrence, who discovered the original specimens of the nymph in the Cathkin Peak area.

Family BÆTIDÆ.

Remarks.—Of the 15 new species described below, 14 fit without difficulty into already existing genera, while the remaining species, *C. pulchrum*, has been placed tentatively in the genus *Centroptilum*, chiefly on the nymphal characters, although the imago lacks hind-wings. With this exception Barnard's key to the imagos of the genera (*loc. cit.*, 1932, p. 213) still applies. However, the discovery of a number of new nymphs of *Pseudoclaeon*, *Bætis* and *Centroptilum* has shown that the nymphs of these genera are not easily separable on structural characters and no synoptic key seems possible. Of course a hind-wing bud is present in *Centroptilum* (except *pulchrum* and *excisum* ♀) and in *Bætis*, whereas it is absent in *Pseudoclaeon*, and if a nymph is examined which was on the point of hatching, the character of the future imaginal venation can be determined. The nymph of *Centroptiloides* is now known and is easily recognized by its large size when mature, and by the structure of its gills and mouth-parts (see p. 92).

Genus *Claeon* Leach.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 32, 1885.
Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 213, 1932.

Claeon chaplini Brnrd.

Barnard, *loc. cit.*, 1932, p. 216.

Localities.—Fenfield, Amatola Mts., Feb., 1942. Cathkin Peak area, Natal, Feb., 1945.

Remarks.—The specimens from the above localities appear to belong to the Cape species, but in the absence of the nymph the assignment can only be regarded as provisional. The same applies in the case of other species.

Clæon rhodesiæ Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 216, 1932.

Localities.—Mtubatuba, Zululand, Aug., 1944 (J. A. Crass). One ♀.

Genus *Austroclæon* Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 217, 1932.

Austroclæon africanum (E.-P.).

Esben-Petersen, Ann. S. Afr. Mus., vol. x, p. 184, 1913.

Localities.—Grahamstown, May and June, 1941 (J. Omer-Cooper); Cradock and Nelspoort, Oct. and Nov., 1941; Fenfield, Amatolas, Feb., 1942; Curry's Post, Natal, Jan., 1945.

Austroclæon paludinosum n.sp. Text-figs. 5 and 6.

Imago.—No cross-veins before bulla, two well-marked cross-veins, and sometimes a 3rd incomplete one, in pterostigmal area. Cross-veins distally connecting Sc-R₁-R₂-IR₂ present.

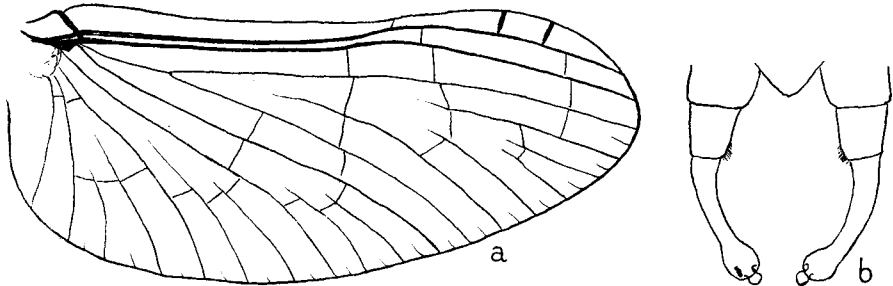
♂. Head light castaneous, eyes pale greenish with one black and two sienna stripes; turbinate eyes dull yellow. Prothorax light olive with paired raw sienna stripes and paired dorso-lateral piceous markings. Mesothorax dorsally olive-brown, laterally and ventrally yellowish green, with burnt sienna marks and pale joinings. Scutellum pale, bordered with brown. Metathorax with paired dorsal sienna markings; ventrally similar to mesothorax. Abdomen dorsally pale green, with a small anterior median light sienna and lateral dark burnt sienna areas. Behind the anterior marking the green is rather brighter than laterally. Ventrally pale, with a median stripe of sienna, more distinct on posterior segments, and fine lateral stripes. Cerci whitish, proximally banded with sienna. Legs and genital styles also whitish, the former with faint sienna bands on the femora. Wings clear except for slight suffusion in costal and subcostal areas, neuration pale yellowish. ♀. Abdomen with smaller burnt sienna areas, and a bright green dorsal marking on segments 4-8. Border of wing more deeply coloured than in ♂; distinct yellow to purplish.

Body, ♂ 6-7 mm., ♀ 6-7 mm.; wing, ♂ 5.5-6.5 mm., ♀ 6.5-7.5 mm.; cerci, ♂ 13 mm., ♀ 10 mm.

Subimago.—Similar, but paler and duller. Turbinate eyes of ♂ dull biscuit.

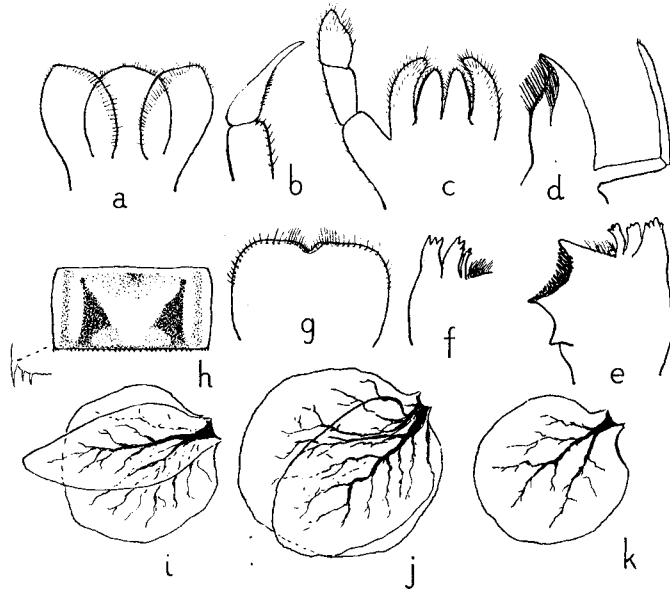
Nymph.—Labial palp clavate. Maxillary palp 2-jointed, elongate. Posterior margins of abdominal segments denticulate. Claws with numerous

TEXT-FIG. 5.



Austroclæon paludinosum n.sp. a, fore-wing of ♀ imago; b, forceps of ♂.

TEXT-FIG. 6.



Austroclæon paludinosum n.sp. Nymph: a, hypopharynx; b, claw; c, labium; d, maxilla; e, left mandible; f, apex of right mandible; g, labrum; h, pattern of III abdominal segment; i, j, k, 1st, 3rd and 7th gills.

small denticulations. Gills 1-6 double, 7th single; lower lamella of all gills subcircular; upper (inner) lamella of 1st gill somewhat pointed, those of 2-6 ovate.

Colour approaching that of the adult in mature nymphs, but more olive. Young nymphs are very green and transparent-looking. Later the body-pattern shown in text-fig. 6, *h*, becomes apparent on segments 2-5; on the remaining segments the triangular sienna patches tend to become separated into anterior and posterior areas, and the anterior median mark becomes larger. Cerci olive with proximal sienna annulations; towards end of median, and near middle of lateral cerci, a dark band; setæ strong, pale proximally, and black on dark part of cerci.

Body up to 9 mm.; cerci 7 mm. (lateral) and 4 mm. (median).

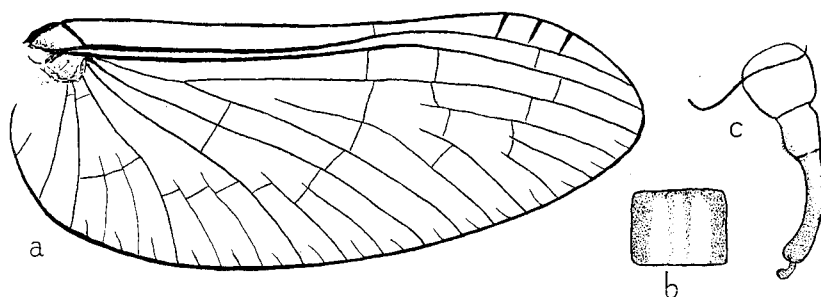
Localities.—Curry's Post, Karkloof, and Cathkin Peak area, all in Natal.

Habits.—The nymphs are to be found in still ponds, dams, and slow-flowing streams. They usually occur amongst weed, in which the green colour of the young stages makes them very inconspicuous. Unlike most Bætidæ, the nymphs live well in captivity. They usually hatch in the evenings after dark, and the subimago sheds its pellicle about noon the following day—15-18 hours. The imagos come out in successive hatches from August to April, but are very elusive. Most of the specimens were obtained by breeding, although ♂♂ have been taken dancing at sunset. The nymphs differ from other genera studied in that during life the body is arched, the cerci pointing upwards at an acute angle. As Barnard records in the case of *Clæon lacunosum*, the first six pairs of gills are in constant motion, while the last pair is held rigid.

Austroclæon exiguum n.sp. Text-fig. 7.

Imago.—3-4 strong pterostigmal cross-veins. Cross-veins distally connecting Sc-R₁-R₂-IR₂ present.

TEXT-FIG. 7.



Austroclæon exiguum n.sp. a, fore-wing of ♂ imago; b, pattern of abdominal segment III; c, forceps of ♂.

Head straw, almost white below; eyes mottled green with a longitudinal sienna stripe, ocelli white with dark bases, turbinate eyes buffy orange. Prothorax dorsally raw umber. Mesothorax olive, streaked with umber, and deep umber areas posteriorly. Scutellum pale. Metathorax dorsally uniform

umber with a posterior dark border. Thorax laterally and ventrally pale olive. Abdominal segments II–VII very pale, slightly greenish, with a bright sienna pattern consisting of dorso-lateral areas and submedian stripes, the sienna areas decreasing in size posteriorly, and not apparent on terminal segments. Segment VIII uniform dark olive; segments IX and X tinged pink, IX with paired purplish streaks. Abdomen ventrally pale caesious olive, terminal segments slightly pinkish. Legs, cerci, and genital styles whitish, uniform. Wings clear; costal and subcostal areas milky; neuration pale greyish, stronger veins slightly fulvous.

Body 5–5.5 mm., wing 5–5.5 mm., cerci 8 mm.

Localities.—Mtubatuba, Zululand, Aug., 1944 (J. A. Crass). 4 ♂♂.

Remarks.—The discovery of the nymph will confirm, or prove incorrect, the assignment of this species to *Austroclæon*.

Genus *Pseudoclaeon* Klap.¹

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 220, 1932.

Pseudoclaeon inzingæ n.sp. Text-figs. 8 and 9.

Imago.—Paired intercalaries extending to Cu₂. Pterostigmal cross-veins 4–6, oblique, some incomplete. Terminal joint of ♂ genital styles elongate.

♂. Head piceous; eyes olive, ocelli white-tipped, turbinate eyes of ♂ deep brownish pink. Pro-, meso- and metathorax piceous, almost uniform, with small pale markings laterally; scutellum dark. Ventrally junctions between head and prothorax, and between pro- and mesothorax bright orange (fading in alcohol). First abdominal segment sepia, with pale convergent stripes; segments II–V sepia, with conspicuous pale spots and a pale median streak, the size of the pale areas varying considerably in different individuals. Segments VI and VII similar, but without a median streak; VII like IV, the dark somewhat reduced. Segments VIII and IX bright green, with sepia lateral and posterior borders. Segment V brownish, green dorso-laterally. Ventrally, anterior abdominal segments pale caesious, posterior segments greenish with caesious stripes. Legs olive. Cerci pink, pale distally, with crimson annulations proximally. Genital styles slightly pink. Wings clear with fulvous neuration.

♀ rather more fuscous. Head and prothorax castaneous brown, with dark markings. Meso- and metathorax dorsally sepia, laterally castaneous with pale markings and joinings. Scutellum pale with dark border. Abdomen similar to ♂, but sepia less dark, and occupying a smaller area except that the median pale stripe is obliterated.

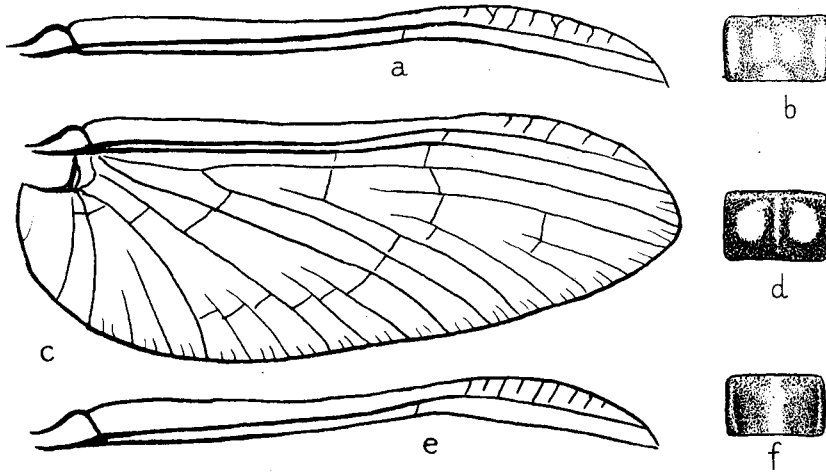
Body.—♂ 4.5–5.5 mm., ♀ 5.5–6 mm.; wing, ♂ 4.5–5.5 mm., ♀ 6–6.5 mm.; cerci c. 8 mm.

Subimago.—Duller than imago, but with same body-pattern. Pro- and

¹ The nymphs of all South African representatives of this genus have a median caudal filament, whereas the typical nymphs have only 2 cerci.

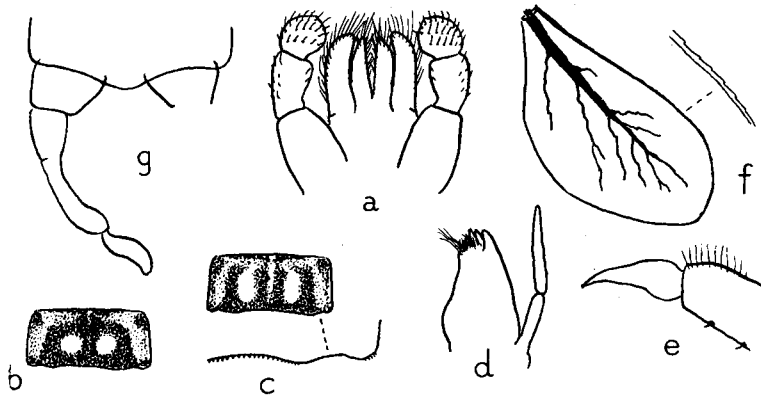
mesothorax with pale median stripe. Wings dark, opaque bluish grey, with pale grey neurulation.

TEXT-FIG. 8.



Pseudocloeon maculosum n.sp. a, b, margin of fore-wing and abdominal pattern of ♂ imago. *P. inzingae* n.sp. c, d, fore-wing and abdominal pattern of ♂ imago. *P. minutum* n.sp. e, f, margin of fore-wing and abdominal pattern of ♂ imago.

TEXT-FIG. 9.



Pseudocloeon inzingae n.sp. Nymph: a, labium; b, c, two forms of abdominal pattern; d, maxilla; e, claw; f, gill. Imago: g, forceps of ♂.

Nymph.—Gills 7 pairs, ovate. Abdominal segments feebly denticulate posteriorly. Maxillary palp 2-jointed. Labial palp resembling *Baetis harisoni*; 2nd joint not expanded, 3rd well developed, bulbous. Inner lobes of labium almost as long as outer. Claw without denticulations.

Colouring similar to subimago. Cerci dark olive proximally, with white tips. Gills clear, tracheæ well-marked, dark.

Body up to 6 mm. ; cerci 3 mm. (lateral), and 2 mm. (median).

Habits.—The nymphs inhabit fairly deep, slow-flowing water, and soon die in captivity. They have been bred, however, by catching specimens on the point of hatching. Subimagos have been taken emerging during the afternoon, and the nuptial dance of the imagos occurs about midday.

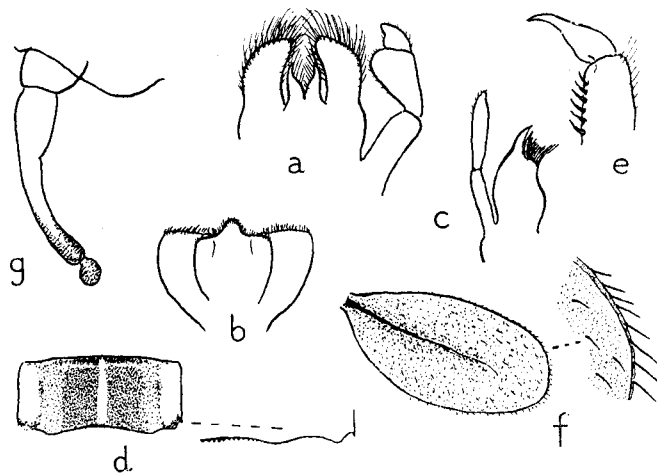
Localities.—Inzinga River, 28.iv.44. Furth stream, Dargle, Dec., 1944 ; Geekie's stream, Karkloof, Feb., 1945.

Pseudoclaeon minutum n.sp. Text-figs. 8 and 10.

Imago.—Intercalaries extending to Cu_2 ; last space often with only a single intercalary. 7-9 oblique, incomplete, pterostigmal cross-veins. Terminal joint of ♂ genital styles minute.

♂. Head sepia, eyes light greyish brown, ocelli white-tipped. Turbinate

TEXT-FIG. 10.



Pseudoclaeon minutum n.sp. Nymph : a, labium ; b, hypopharynx ; c, maxilla ; d, abdominal pattern ; e, claw ; f, gill. Imago : g, forceps of ♂.

eyes laterally and dorsally dull castaneous, with a pale band separating the sides from the top. Prothorax sepia, with pale, orange-tinged borders. Meso- and metathorax very dark, almost piceous above, with orange markings and pale joinings laterally ; scutellum pale. Ventrally amber with sepia markings. Abdominal segments I-VI medio-dorsally pale caesious olive ; II-VI with rusty olive on each side, becoming darker laterally, where it is divided by a pale narrow longitudinal streak. Segments pale brownish antero-

laterally. Segments VI-X more uniform olive, all but the last with three fine brown submedian stripes. Ventrally pale olive, with small purplish paired markings on each segment. Legs pale greenish. Cerci almost white, uniform except for a slight pink tinge proximally. Wings clear; costal and subcostal areas slightly milky; neuration pale fulvous.

♀. Head fulvous brown, eyes dark green. Thorax similar to ♂, but less dark, with more orange laterally. Abdominal segments dorsally very pale olive, bordered with fulvous brown.

Body.—♂ 4.5-5 mm., ♀ 4.5-5 mm.; wing, ♂ 4.5-5 mm., ♀ 5-6 mm.; cerci, ♂ 9 mm., ♀ 7 mm.

Subimago.—Similar to imago, but thorax not so dark, more mottled brown above. Abdomen showing pattern of imago, but less distinctly and colours not so bright. Wings opaque greyish, neuration fulvous olive.

Nymph.—Gills 6 pairs, elongate ovate; 1st gill suppressed. Mandible without prosthema, apically denticulate. Maxillary palp 2-jointed. Labial palp with inwardly expanded 2nd joint, like *P. vinosum*, *B. bellus*, and some *Centroptilum* spp. Inner lobes of labium small. Claw without denticulations.

Colouring similar to subimago. Gills opaque, with a single trachea. Cerci proximally pale brownish, with a dark band and a white tip.

Body up to 5 mm.; cerci 4 mm. (lateral) and 3 mm. (median).

Habits.—The nymphs are free-swimming, and occur in patches of weed in moderately-flowing stretches. They are intolerant of captivity, and have only been bred by catching mature nymphs. Imagos have been taken at midday.

Localities.—Mooi River, near Rosetta, 9.ix.44; Yarrow stream, 11.xi.44; Little Mooi River, 19.xi.44.

Pseudoclaeon maculosum n.sp. Text-fig. 8.

Imago.—Paired intercalaries extending to ICu. Pterostigmal cross-veins about 8, incomplete, tending to branch. Terminal joint of ♂ genital styles minute.

Head fulvous; eyes black, ocelli white-tipped. Turbinate eyes castaneous. Thorax resembling that of *P. minutum*, but rather more olive and not so dark. Abdominal segments II-VII pale olive, with an ochraceous pattern dividing the olive into three large spots; each segment with a sepia border. On the terminal segments the ochraceous becomes brownish, and occupies all the dorsal area of each segment except narrow streaks of olive. Ventrally very pale greenish. Legs, cerci, and genital styles all whitish. Wings clear, neuration pale fulvous.

Body, 5.5 mm.; wing, 5 mm.; cerci incomplete.

Locality.—Yarrow stream, 21.x.44.

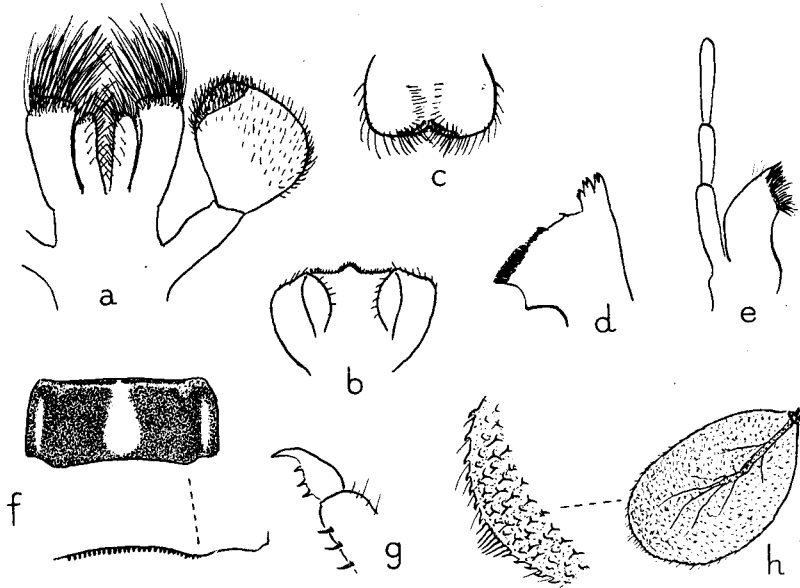
Remarks.—This species is at present based on a single ♂, and is only

separable from the previous species on the body- and eye-colour. However, if the nymph described below should prove to belong to *maculosum* the species would be well characterized.

Pseudocloeon sp. Text-fig. 11.

Nymph.—Some nymphs from Yarrow stream (25. ii. 45) apparently belong to *Pseudocloeon*, since one was on the point of hatching, and the wing when dissected out showed double intercalaries. In addition, no hind-wing was present.

TEXT-FIG. 11.



Pseudocloeon sp. Nymph from Yarrow: *a*, labium; *b*, hypopharynx; *c*, labrum; *d*, right mandible; *e*, maxilla; *f*, abdominal pattern; *g*, claw; *h*, gill.

Gills 7 pairs, ovate. Abdominal segments medio-posteriorly denticulate. Mandible with feebly developed prostheca. Maxillary palp 3-jointed, elongate. Labium as figured (text-fig. 11, *a*); 2nd joint of palp much enlarged; 3rd joint small, not clearly separated from 2nd. Claw with 3 large denticulations.

Head, thorax, and abdomen, vandyke brown, with a whitish pattern. Eyes black, ocelli white-tipped with dark bases; a whitish band extending from the eyes forwards, round the ocelli. A conspicuous broad pale streak from the occiput down the centre of the thorax, with lateral expansions at the base of the wing-cases. Abdominal pattern as figured (text-fig. 11, *f*).

Legs pale, femora suffused brownish. Cerci brown proximally, whitish distally. Gills opaque, tracheæ indistinct.

Body up to 6.5 mm. ; cerci 4 mm. (lateral) and 2 mm. (median).

Remarks.—The form of the labium is very remarkable, and the spinous, “plated” appearance of the gill surface (see text-fig. 11) is also unusual. The maxilla is of the *Claeon* type ; it resembles *Pseudoclaeon vinosum* Brnrd. in having a 3-jointed palp, and differs in this respect from *inzingæ* and *minutum*. No name is attached to this form, since it is possible that it may prove to be the nymph of *maculosum* (*supra*).

Genus *Bætis* Leach.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 156, 1885.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 221, 1932.

KEY TO THE SOUTH AFRICAN SPECIES (adapted from Barnard).

Hind-wing broad, with pointed costal process	<i>harrisoni</i> and <i>parvulus</i> .
Hind-wing without costal process	<i>bellus</i> , <i>cataractæ</i> , and <i>lawrencei</i> .

Bætis harrisoni Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 222, 1932.

Localities.—Hogsback, and Fenfield, Amatolas, Kingwilliamstown Division. Kokstad, East Griqualand. Curry's Post, Karkloof, Dargle, and Cathkin Peak area. Mooi, Little Mooi, Inzinga, Loteni, Umkomaas, Umgeni, Lions and Yarrow rivers.

Habits.—This species has been found to be one of the most plentiful of Natal May-flies, and imagos have been taken at all times of the year. However, the period of greatest abundance in Natal is late autumn and throughout the winter. Even in the coldest weather, on still, sunny afternoons, ♂♂ can be found performing their characteristic dance, often in the neighbourhood of rapids or small waterfalls. Sometimes they perform singly, but more often in small groups, each individual making a rapid vertical ascent of a few feet, followed by a slow descent with motionless wings, body slightly inclined, and cerci pointing steeply upwards. After falling a short distance, the rapid flight is repeated. The method of oviposition is similar to that of *Acentrella capensis* as observed by Harrison (see Barnard, *loc. cit.*, p. 259). On a number of occasions ♀♀ have been found clinging to the undersides of rocks projecting from the water ; their wings folded along the abdomen, with air bubbles attached. On removal from the water their wings re-expand, and the insects are again capable of flight. On one occasion a ♀ was seen to settle on a projecting rock, and crawl under water. Subimagos appear during the daytime, and one that hatched in captivity (9.viii.43) shed its pellicle approximately 72 hours after emergence ; another (25.v.44) took 84 hours.

Remarks.—Natal specimens appear to be identical with the Cape form except that the 1st nymphal gill in the former has a dark trachea similar to those in the following gills, instead of being atracheate.

Bætis bellus Brnrd. Text-fig. 14.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 222, 1932.

Localities.—Hogsback, Amatolas. Kokstad (captured at light). Mtubatuba, Zululand (J. A. Crass). All the localities in Natal listed for the previous species except the Loteni River.

Habits.—The nymphs are extremely plentiful in all rivers and streams in the area examined wherever the current is not too strong and where there is adequate cover, usually in the form of trailing grass or herbage. In swift mountain streams, or fast-flowing rocky rivers like the Loteni, they are absent or at least very scarce. The nymphs live better in captivity than many Bætids, and the sub-imaginal stage has been found to last 12–30 hours. The imagos fly chiefly about sunset, and have been taken throughout the spring, summer and autumn. There is little emergence during the coldest winter months. Oviposition evidently takes place under water, since a ♀ has been observed coming up to the surface from the depths of a still pool, floating for a few seconds, and then flying to the bank.

Remarks.—It has been found that Natal specimens show considerable variation in the shape of the hind-wing. The extreme variant is shown in text-fig. 12, *d*, and at first sight would seem almost to justify specific separation (*cf.* Barnard, text-fig. 12, *e*). However, further investigation has shown that a continuous series can be obtained from the typical narrow form to the broad ovate type. Another variable character (not correlated with the type of hind-wing) is the size, which has been found to range from 5.5 to 9 mm. The colour of the thorax, too, is often darker than that described for the type. Such variability is unusual, and it seems possible that Natal might be the meeting-place of relatively constant forms from the Cape and from the territories to the North respectively. However, there is at present no evidence whatever that such is the case.

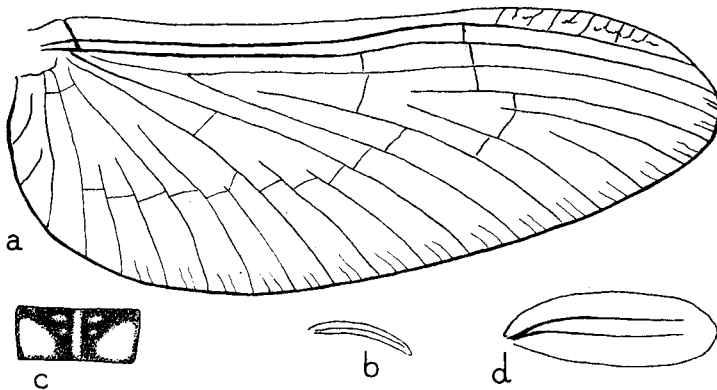
Bætis cataractæ n.sp. Text-figs. 12, 13 and 14.

Imago.—Hind-wing minute, narrow, slightly curved, with a single longitudinal vein. Fore-wing with 8–10 branching and anastomosing cross-veins. Genital styles of ♂ with terminal joint more elongate than other South African species of the genus, and resembling *Acentrella natalensis*.

♂. Head dark castaneous above; ventrally olive, with orange-yellow posteriorly; eyes black, ocelli black with white tips; turbinate eyes deep pink on top, laterally whitish. Pro-, meso- and metathorax dorsally piceous; prothorax with median and lateral fulvous markings above, and reddish

orange below, with anterior and posterior sepia areas and a pale V-shaped marking between the legs. Mesothorax with a fine dorsal bright yellow streak extending forwards from near each wing-base, laterally with orange and pale yellow markings and reticulations; ventrally olive and olive-brown with pale reticulations, and a broad piceous V-shaped area pointing forwards with pale stripes arising from the apex and meeting an anterior piceous area. Scutellum dark. Metathorax ventrally olive to olive-brown. First abdominal segment dark olive-brown; II and III with pattern shown in text-fig. 12, *c*, a pale yellowish-olive median streak, and dots and dorso-lateral areas of the same colour contrasting with purplish-brown on the rest of the segment.

TEXT-FIG. 12.



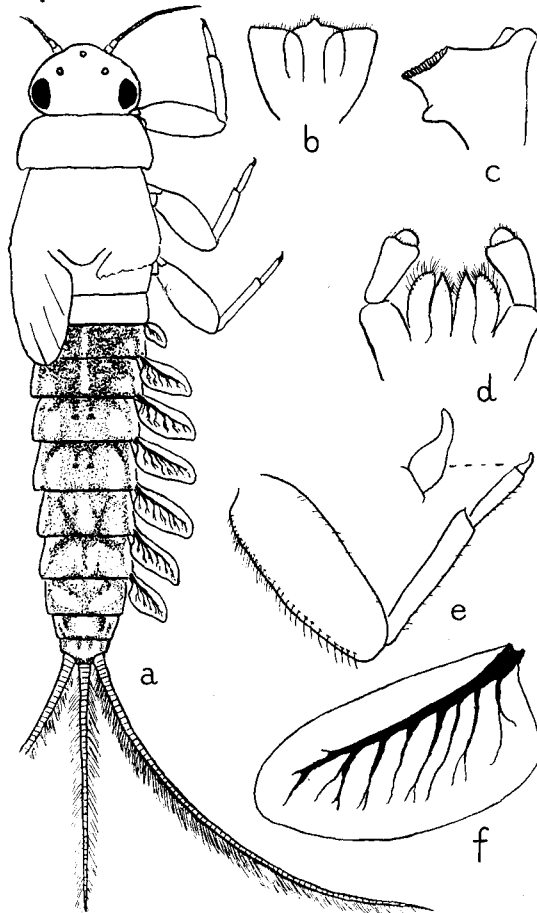
Baëtis cataractæ n.sp. *a, b*, fore- and hind-wings of ♂ imago; *c*, pattern of III abdominal segment. *B. bellus* Brnrd. *d*, broad form of hind-wing.

On segments IV and V the dark area is restricted to an anterior border with small submedian posterior extensions, and a posterior border with lateral anterior extensions; VI is similar, but with dark submedian posterior marks. Segments VII, VIII and IX suffused umber with dark borders, and a pale median area divided by a narrow longitudinal dark streak; X similar, but without median pattern. Abdomen ventrally pale ochraceous with faint darker pattern, and dark segmental borders. Fore-legs dark olive, femur suffused castaneous; 2nd and 3rd legs much paler, with a dark castaneous area on the femur. Cerci pale, tinged with castaneous proximally. Genital styles pale olive. Wings clear, with slight opacity in costal and subcostal areas; neuration olive-brown. ♀ similar, but thorax less dark than in ♂, and more uniform. Abdomen with body-pattern of ♂, but dark less intense.

Body, ♂ 5-6 mm., ♀ 6-6.5 mm.; wing, ♂ 5-6 mm., ♀ 5.5-6 mm.; hind-wing *c*. 0.4 mm.; cerci, ♂ 14 mm., ♀ 11 mm.

Subimago.—Much duller coloured, and more greyish. Head olive tinged with castaneous; eyes black, turbinate eyes paler pink than in imago. Prothorax greyish olive; mesothorax with pale castaneous median stripe, brown

TEXT-FIG. 13.



Nymph assigned to *Batis cataractae* n.sp. a, whole animal; b, hypopharynx; c, mandible; d, labium; e, 1st leg; f, gill.

borders, and dark brown dorso-lateral areas; ventrally olive grey, with pale yellowish marks and reticulations laterally. Metathorax more castaneous dorsally, similar to mesothorax ventrally. Abdomen with pattern of imago, but less well-marked, and ground-colour more greyish. Legs similar to imago. Wings opaque grey, neuration bluish grey.

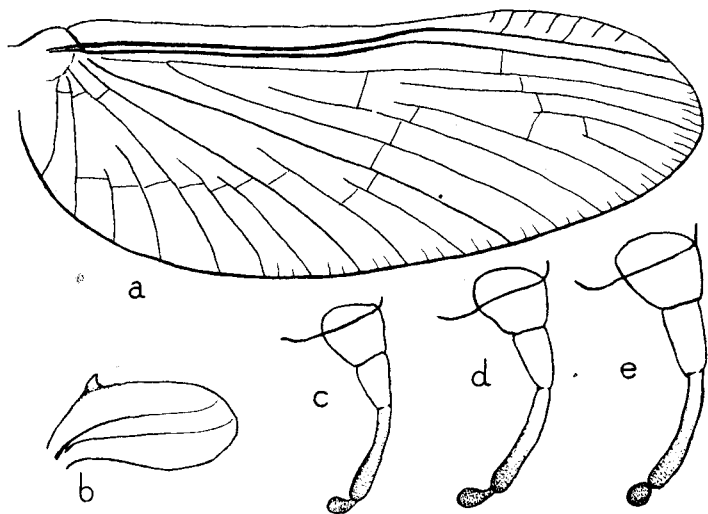
Nymph.—Of the crawling type, body dorso-ventrally flattened. Gills 7 pairs, 1st somewhat reduced. Mandible without prostheca, apically rounded. Maxillary palp 2-jointed. Labial palp with semicircular terminal joint. Claw smooth.

Thorax olive-brown, with darker mottlings. Abdomen resembling sub-imago; pale olive with an olive-brown to sepia pattern as shown in text-fig. 13, *a*. Legs and cerci pale olive, uniform. Gills clear, with well-marked dark tracheæ.

Body up to 7 mm.; cerci 5 mm. (lateral) and 3 mm. (median).

Localities.—Kokstad, East Griqualand. Curry's Post and Karkloof districts. Mooi and Loteni rivers.

TEXT-FIG. 14.



Bætis parvulus n.sp. *a*, *b*, fore- and hind-wings, and *c*, forceps of ♂ imago. *Bætis cataracte* n.sp. *d*, forceps of ♂. *Bætis bellus* Brnd. *e*, forceps of ♂.

Habits.—Imagos have been taken from August to March, mostly in the neighbourhood of waterfalls, where the ♂♂ perform their dance at midday and during the afternoon. Nymphs occur under stones in swift water and, unlike other Bætidæ except *Acentrella* and *Centroptilum varium*, are not free-swimming, but usually remain clinging to a rock when it is overturned. The ♀♀ apparently oviposit in the same way as *B. harrisoni*, since they have been found on the lower sides of submerged stones.

Remarks.—The degree of reduction of the hind-wing is noteworthy as indicative of the possible course of evolution of *Pseudoclaeon* from an original *Bætis* type. The nymph is only assigned, since none have hatched in captivity;

the assignment is, however, lent support by the fact that minute elongate wing-buds are present in the nymph.

Bætis parvulus n.sp. Text-fig. 14.

Imago.—Hind-wing similar to *harrisoni*, but slightly more elongate oval, with well-marked costal process, and 2 simple veins. Fore-wing with 8-10 pterostigmal cross-veins, some incomplete and tending to anastomose. Genital styles of ♂ with well-developed terminal joint (text-fig. 14, c).

♂. Head brown, eyes and ocelli black. Turbinate eyes fulvous orange. Pro-, meso- and metathorax sepia above and below, with pale buff lateral and ventral markings and reticulations; a dark patch at the base of each wing. Scutellum dark. Abdomen cæsius, tinged with fulvous dorsally, and a faint pale median pattern of three fine stripes, on each segment. Posterior borders of segments dark. Ventrally whitish green with faint brown marks laterally. Legs greenish, uniform. Cerci pale, with faint brown proximal annulations. Wings clear, faintly suffused in pterostigmal area; neuration brown.

Body, ♂ 3.75-4.25 mm., ♀ 4-4.5 mm.; wing, ♂ 3.5-4 mm., ♀ 4.5-5 mm.; hind-wing c. 0.7 mm.; cerci, ♂ 8 mm., ♀ 6 mm.

Subimago.—Similar, but thorax duller brown, and abdomen more ochraceous. Wings greyish.

Localities.—Curry's Post, 13.xi.43. Yarrow stream, 2.iv.44. Mooi River, 11.ix.44. Lions River, 1.xii.44. Furth stream, Dargle, 4.xii.44. Loteni River, 22.i.45.

Remarks.—The nymph is at present unknown. The imago is to be distinguished from *harrisoni* by the larger terminal joint of the clasper, and by the difference in size.

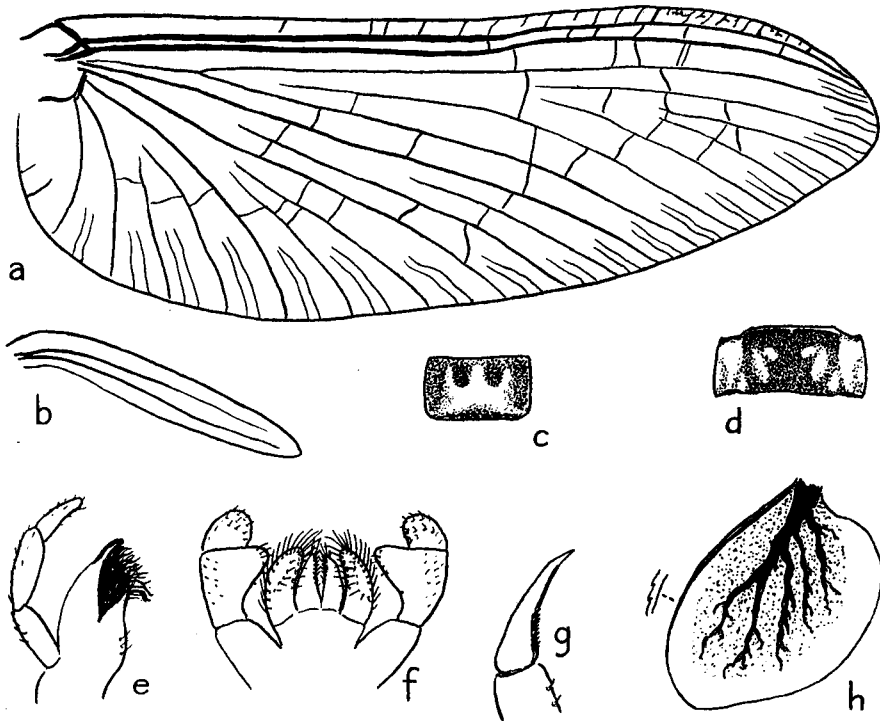
Bætis lawrencei n.sp. Text-fig. 15.

Imago.—♀. In fore-wing 6 sub-costal cross-veins before bulla, and about 14 complete ones in the pterostigmal area, with some incomplete anastomosing veinlets in addition. Paired intercalaries well-marked and unusually long. Narrow elongate hind-wing, without costal process.

Head pinkish buff, with a brown pattern on the occiput. Eyes purplish brown, ocelli white-tipped. Thorax chiefly raw umber, with straw-coloured or pale fulvous areas and pale joinings between the sclerites. Prothorax pale laterally, with well-marked dark pattern medio-dorsally. Mesothorax mostly dark dorsally, except a pale anterior streak on each side, and pale laterally with pinkish anterior dorso-lateral areas. Scutellum pale, dark bordered. Metathorax almost uniformly dark. Abdominal colouring similar to thoracic, but ground-colour more fulvous. Segment I almost uniformly pale, segments II-V with pattern figured, consisting of two dark areas extending back from the anterior edge on each side of the median line, the outer larger and more

diffuse; posterior border of each segment dark. Segments VI–X more uniform, with ill-defined brownish reticulations. Ventral surface pale with pinkish borders to the abdominal segments. Legs pale fulvous, with darker areas, especially on 1st leg. Cerci pale proximally, becoming darker distally.

TEXT-FIG. 15.



Baetis lawrencei n.sp. a, fore-wing; b, hind-wing; c, abdominal segment III of imago; d, abdominal segment III of nymph; e, maxilla; f, labium; g, claw; h, 2nd gill.

Wings suffused, especially proximally with pale gold; neuration fulvous to castaneous; costal and sub-costal areas amber-coloured.

Body 10 mm.; fore-wing 11 mm.; hind-wing 1.35 mm.; cerci 23 mm.

Nymph.—Apex of mandible denticulate, prosthema present. Labial palp with 2nd joint strongly produced inwards. Maxillary palp three-jointed. Claw distally smooth, with fine denticles proximally. Gills 7 pairs, broadly ovate.

Head fulvous brown with darker reticulations. Eyes black, ocelli white-tipped. Thorax warm fulvous brown with darker markings and reticulations.

Abdomen pale fulvous with a dark umber-coloured pattern. Segment I mostly dark, segments II–IV as figured, segments V and VI chiefly dark, segment VII with three broad dark stripes, VIII mostly pale with a dark median streak, IX and X dark. Legs olive, with dark markings. Cerci olive, becoming darker distally.

Body up to 9.5 mm. ; lateral cerci 5 mm., median 4 mm.

Locality.—Mont-aux-Sources summit, 10,500 ft., March, 1946 (R. F. Lawrence, E. Bursell and W. D. Oliff). One ♀ imago, and 4 nymphs.

Remarks.—The nymph is assigned to the imago on the fact that one of the specimens of the former was on the point of disclosing the sub-imago. On dissecting out the wing it was found to show venational characters similar to the imago. Hind wing-buds were present, and the nymph is characteristic of *Betis*, although it differs from other South African species in possessing a 3-jointed maxillary palp.

I have pleasure in naming this species after one of its discoverers, Dr. R. F. Lawrence.

Genus *Acentrella* Bngtsn.

Bengtsson, Ent. Tidskr., vol. xxxiii, p. 110, 1912.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 259, 1932. Ann. S. Afr. Mus., vol. xxxii, p. 625, 1940.

KEY TO THE SOUTH AFRICAN SPECIES.

- | | |
|---------------------------------------------------------|---------------------|
| 1. Hind wing broad, with acute costal process | <i>capensis</i> . |
| Hind wing narrow, without costal process. | 2 |
| 2. Hind wing present in both sexes | <i>monticola</i> . |
| – Hind wing absent in ♂ | <i>natalensis</i> . |

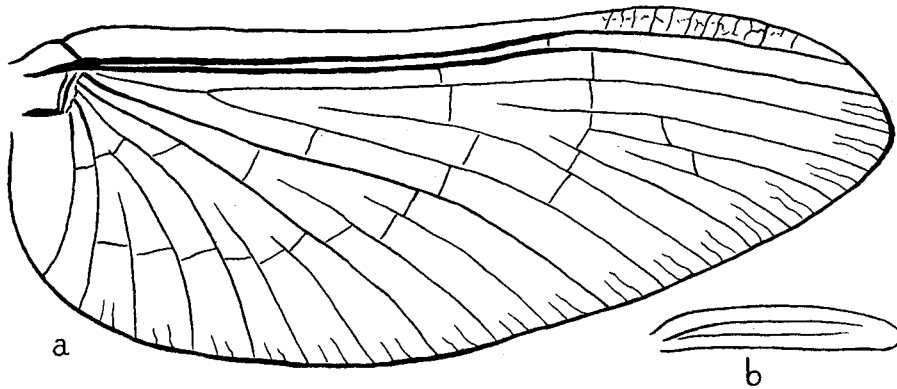
Acentrella natalensis n.sp. Text-figs. 16 and 17.

Imago.—Hind-wing absent in ♂ ; in ♀ narrow, elongate. Pterostigmal cross-veins 7–12, some incomplete and tending to anastomose. Genital styles of ♂ with well-developed terminal joint.

♂. Head pale brown mottled with dark, eyes black, ocelli white-tipped with dark bases. Turbinate eyes dull pink. Pro-, meso- and metathorax dorsally sepia ; laterally and ventrally more castaneous, with pale joinings tinged orange. Abdomen dorsally ochraceous olive with a deep burnt sienna pattern, and each segment posteriorly bordered with sepia. Segments 2 and 3 mostly dark, with a pale median streak and small lateral pale areas ; on 4 and 5 the dark reduced to submedian areas, and lateral and posterior borders ;

6 and 7 similar to 2 and 3, but with larger pale areas dorso-laterally; terminal segments pale with dark dots. Ventrally pale olive, with small brown markings. Legs castaneous, pale distally. Cerci pale castaneous, uniform. Wings clear, costal and subcostal areas suffused; neuration pale fulvous. ♀ Paler. Head biscuit coloured, with two brown spots between the eyes, which are sepia. Prothorax castaneous-brown; mesothorax with a brown median stripe, dorso-lateral castaneous areas, and pale orange-tinged marks and joinings. Metathorax light castaneous, with a transverse brownish-purple marking on each side. Abdominal segments with pattern remaining almost uniform, on segments II-VIII; the dark areas more purplish than in

TEXT-FIG. 16.



Acentrella natalensis n.sp. a, b, fore- and hind-wings of ♀ imago.

♂, and ochraceous olive occupying dorso-lateral and median areas. Wings similar to ♂.

Body, ♂ 5-6 mm.; ♀ 6-7 mm.; wing, ♂ 5-6 mm., ♀ 6.5-7.5 mm.; hind-wing, 0.8-0.9 mm.; cerci, ♂ 14 mm., ♀ 12 mm.

Subimago.—Similar, but duller. Wings opaque greyish.

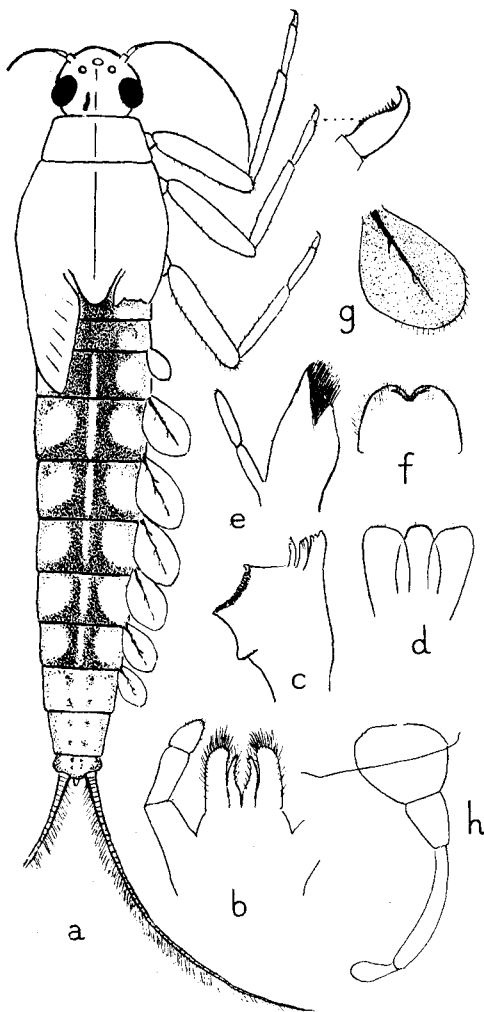
Nymph.—Of the crawling type. Median cercus reduced to a minute conical projection (text-fig. 26, f). Gills, 7 pairs, 1st somewhat reduced. Maxillary palp 2-jointed. Labial palp with somewhat elongate terminal joint, and 2nd joint not expanded (text-fig. 17, b). Claw finely denticulate, the teeth becoming smaller proximally.

Colouring of mature nymphs similar to subimago. Imaginal pattern apparent on abdomen. Legs and cerci pale castaneous, the former with a dark suffusion on the femora. Gills opaque, with a simple unbranched trachea apparent in all but the 1st.

Body up to 8 mm.; cerci 4 mm.

Localities.—Curry's Post and Karkloof districts. Mooi, Inzinga, Loteni and Umkomaas rivers. Cathkin Peak area. Giant's Castle, 10,000 ft. Montaux-Sources summit, March, 1946 (R. F. Lawrence).

TEXT-FIG. 17.



Acentrella natalensis n.sp. a, whole nymph; b, labium; c, left mandible; d, hypopharynx; e, maxilla; f, labrum; g, gill; h, forceps of ♂ imago.

Habits.—Imagos have been taken at various times of the year, but chiefly in August and September. The nymph is adapted to a swift-water existence and specimens are to be found on rocks, to which they remain clinging tenaciously.

Nymphs soon die in captivity in still jars, but one was observed to hatch shortly after capture; the nymph crawled partly out of the water before emerging. Females have been found under water, presumably for the purpose of oviposition.

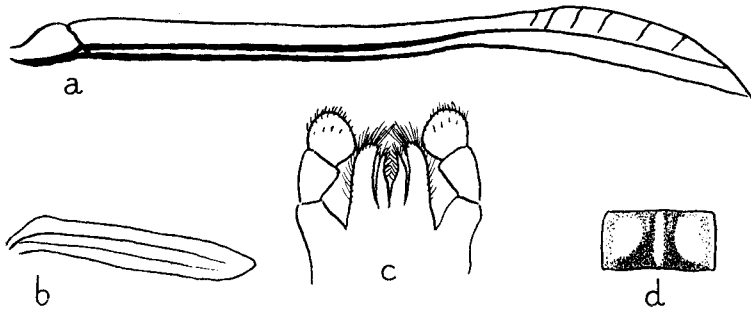
Remarks.—The absence of a hind-wing in the ♂ is noteworthy. Unlike *Centroptilum excisum* ♀, the wing is suppressed in the nymphal stage.

Acentrella monticola n.sp. Text-fig. 18.

Imago.—Hind-wing present in both sexes, narrow, elongate, with two veins. Pterostigmal cross-veins 5–8, some incomplete. Genital styles of ♂ similar to *natalensis*.

Colouring very similar to *natalensis*, but light occupying a slightly larger area of the abdominal body-pattern.

TEXT-FIG. 18.



Acentrella monticola n.sp. Imago: *a, b*, fore- and hind-wings of ♂. Nymph: *c, d*, labium, and abdominal pattern of segment III.

Subimago.—Unknown.

Nymph.—Closely resembling *natalensis* except in the character of the labial palp, the terminal joint of which is bulbous, and the 2nd joint slightly inwardly expanded (text-fig. 18, *c*).

♂. Body, 4.5–5 mm.; wing, 4.5–5.5 mm.; cerci, 11 mm.

Localities.—Cathkin Peak area, Feb., 1945. Loteni River, March, 1945.

Remarks.—The nymph is only assigned, but the assignment seems to be tolerably certain in view of the fact that mature nymphs, both males and females, with hind-wing buds were taken in the same locality as the imagos. This species and the last are evidently closely related, but the presence of a hind-wing in *monticola*, ♂, and the difference in the labial palp of the nymphs, readily distinguish the two species. An interesting point is that the nymphs of the two forms have been found together in the same locality at Loteni.

Genus *Centroptilum* Eaton.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 174, 1885.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 224, 1932.

Remarks.—Seven new species are described below, of which all have venational characters of the fore-wing in accordance with the generic diagnosis. However, one species, *pulchrum*, has no hind-wings and is only tentatively assigned to the genus, while others have hind-wings with three longitudinal veins, and even cross-veins (text-fig. 19, *d*). If these species are to remain in *Centroptilum*, an alteration in the generic diagnosis will be required. At present this seems to be the only course, since there is no sharp line of demarcation between the species with additional veins and those with typical hind-wings. Indeed, in the single species *sudafricanum*, specimens are known showing all variations from a narrow wing with two veins to a broader one with three longitudinal veins and cross-veins in addition (text-fig. 19). The nymphs differ with respect to the form of the labial palp, and *varium* shows a remarkable reduction in the median cercus, but there appears to be no justification for generic separation on these nymphal characters. The only species about whose true systematic position some doubt remains is *pulchrum* (*infra*). It is at present placed in *Centroptilum*, since it appears to have no close relatives, and this is the only genus to which it is assignable without creating a new, monotypic genus, which would be of doubtful validity.

KEY TO THE SOUTH AFRICAN SPECIES.

(Based on the characters of the hind wing.)

- | | |
|-----------------------------------------------------------------------------|---------------------------------------------------------|
| 1. Hind wing absent in both sexes | <i>pulchrum</i> . |
| Hind wing always present in ♂ | 2 |
| 2. A. Costal process bifid. | |
| i. Distal projection of costal process short, rounded. | 3 longitudinal veins (usually)
<i>sudafricanum</i> . |
| ii. Distal projection of costal process acute. | Only 2 longitudinal veins . <i>parvum</i> . |
| B. Costal process single. | |
| i. 2 longitudinal veins. | |
| a. Hind wing aborted in ♀. In ♂ costal process slender, hook-like | <i>excisum</i> . |
| b. Costal process large, upright. Hind wing relatively large | <i>flavum</i> . |
| c. Costal process slender, curved. Hind wing small | <i>falcatum</i> . |
| ii. 3 longitudinal veins. | |
| a. Costal process basally broad, apically curved | <i>medium</i> . |
| b. Costal process upright, acute | <i>indusii</i> and <i>varium</i> . |

Centroptilum sudafricanum Lest. Text-fig. 19.

Lestage, Ann. Soc. Ent. Belg., vol. lxiv, 1924.

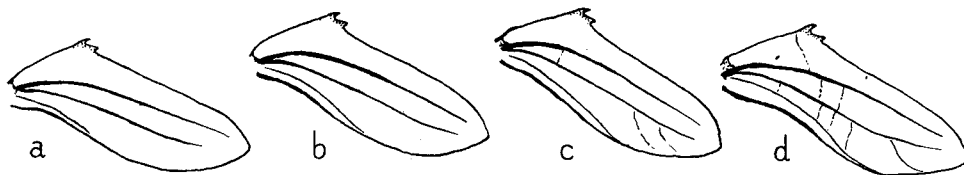
Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 224, 1932.

Localities.—Hogsback, and Fenfield, Amatola Mts. (A. Perks); Kokstad, East Griqualand; Curry's Post, Karkloof, Dargle, and Cathkin Peak area; Mooi, Little Mooi, Inzinga, Loteni, Umgeni, Lions, and Yarrow rivers.

Habits.—This species has been found to be most abundant and widespread all over the region investigated. The nymphs occur in swift-running rivers and streams, chiefly under stones along the edge of the current. They are of the swimming type, and are not adapted to living in torrential situations. Imagos have been taken throughout the year, but the chief time of hatching is spring and early summer. Nymphs live better in captivity than most Bætidæ. Subimagos have been found to shed their pellicle after 36–72 hours, depending on the temperature conditions.

Remarks.—Lestage described the species from specimens collected at Krantzkop, and he stated that the hind-wing had two subparallel longitudinal veins. Barnard's figure (Fig. 14, *b*) also shows a narrow wing with two veins. However, all the specimens examined by me from Natal and the Eastern Province of the Cape have somewhat broader hind-wings, and besides the two typical veins they all have at least the basal portion of a third. There is

TEXT-FIG. 19.



Centropilum sudafricanum Lest. *a, b, c, d*, variations in the form of the hind-wing of ♀♀ imagos.

considerable variation, and whereas some specimens have only a trace of the 3rd vein, in others it is well marked, and occasionally cross-veins are even apparent. Specimens with the extreme form shown in text-fig. 19, *d*, at first sight seem to be fully worthy of specific separation from the typical *sudafricanum*, but it would appear that forms occur which make a complete intergrading series, so that no such separation is possible. Dr. Barnard kindly examined some topotype material from Krantzkop in the South African Museum, with reference to the hind-wing, and he states (*in lit.*, 8.viii.44) that he found traces of a 3rd vein in some of the wings; also in some of his Cape material at least the basal portion of the extra vein is present. Thus it would appear that the specific diagnosis should be emended; however, since the type material is apparently no longer in existence, and as no fresh topotypes are available, it is at present scarcely justifiable to take this step. It is possible that Lestage's original specimens had only two veins, but in my opinion it is more probable that his observation was an error due to the fact that his material was dried up and defective. All the material obtained from other Natal localities, besides the dried Krantzkop specimens (so far as Dr. Barnard could investigate them), differ to some extent from the original descrip-

tion. I understand that in the majority of Cape specimens the hind-wing is of the typical form. Another variable character in Natal specimens is size—wing-length being from 5 to 7.5 mm.

Centroptilum excisum Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 224, 1932.

Localities.—Curry's Post, Karkloof and Dargle districts; Mooi, Loteni and Umgeni rivers.

Habits.—Another species that makes its chief appearance in Natal during the winter months. It is a very abundant species, and the nymphs favour still backwaters in rocky streams and rivers. It has been found to live and hatch fairly well in captivity.

Centroptilum flavum n.sp. Text-figs. 20 and 21.

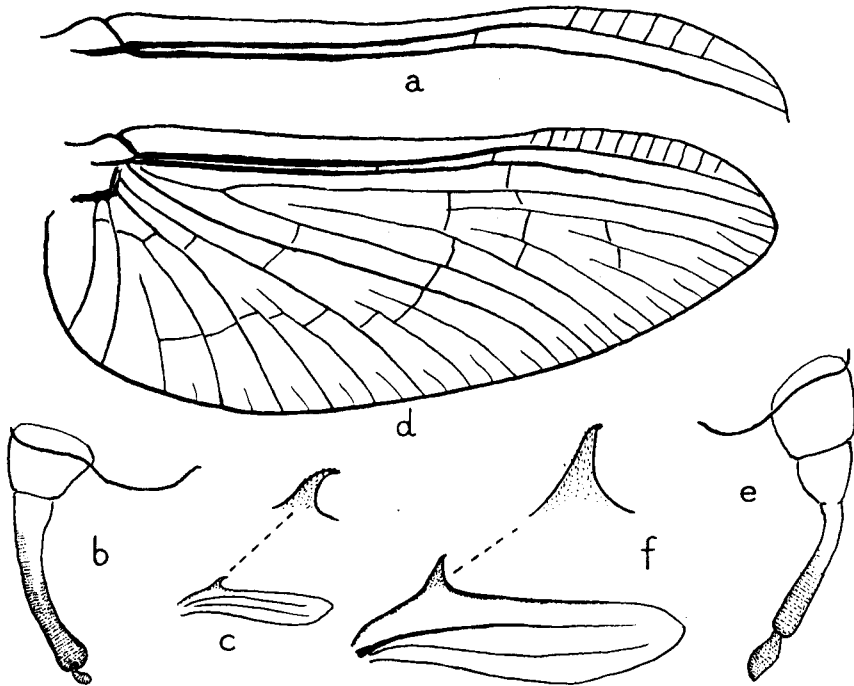
Imago.—Hind-wing elongate, narrow, with a large upright costal process and two longitudinal veins. Fore-wing with 10–12 simple, some incomplete, pterostigmal cross-veins. Terminal joint of ♂ genital styles rather short, ovate.

♀. Head buff, ventrally orange. Eyes sepia, mottled with dark green; ocelli black, with white tips. Prothorax almost uniform, buff. Meso- and metathorax dorsally biscuit, laterally more orange, ventrally pale; mesothorax with a brown marking extending forwards and inwards from each wing-base. Abdomen dorsally dull orange, each segment with median and posterior darker areas; ventrally pale buff yellow, with small purple sigmoid markings on each segment, laterally. Femora orange blotched with castaneous; tibia and tarsus pale yellowish. Cerci distally pale yellow, proximally tinged with crimson. Wings clear, slightly milky in pterostigmal area; neuration pale, stronger veins yellowish. ♂. Turbinate eyes bright orange. Thorax similar to ♀, but with dark pencillings, and pale greyish markings and joinings laterally on meso- and metathorax. Abdomen dorsally dull orange, with dorso-lateral and posterior deep castaneous suffusions on each segment, and a median pattern formed by two longitudinal stripes of deep castaneous and two fine pale stripes arising medio-anteriorly and curving outwards and backwards.

Body, ♂ 7.5–8.5 mm., ♀ 7.5–9.5 mm.; wing, ♂ 7.5–8.5 mm., ♀ 8–10 mm.; hind-wing c. 1.6 mm.; cerci, ♂ c. 16 mm., ♀ c. 13 mm.

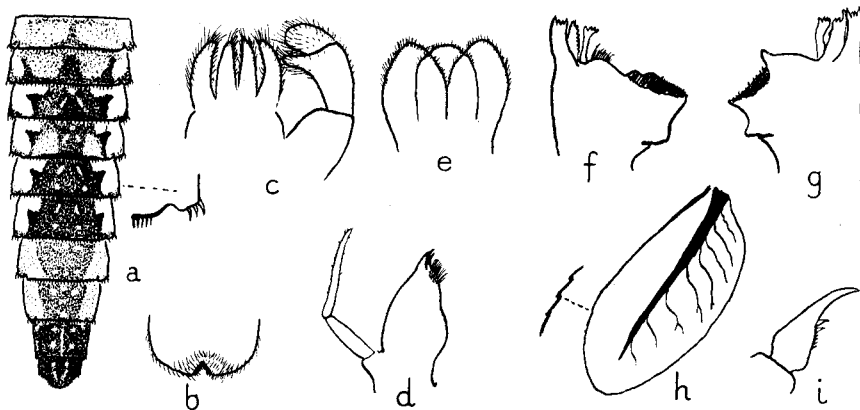
Subimago.—Colour greyish. Thorax with dull yellow and orange markings laterally; meso- and metathorax each with latero-dorsal triangular markings of purplish brown. Abdominal segments each with lateral and medio-dorsal castaneous areas. Legs and cerci whitish grey. Wings opaque, neuration greyish.

TEXT-FIG. 20.



Centroptilum falcatum n.sp. a, margin of fore-wing; b, forceps of ♂; c, hind-wing.
C. flavum n.sp. d, fore-wing; e, forceps of ♂; f, hind-wing.

TEXT-FIG. 21.



Centroptilum flavum n.sp. Nymph: a, abdomen; b, labrum; c, labium; d, maxilla; e, hypopharynx; f, right mandible; g, left mandible; h, gill; i, claw.

Nymph assigned to C. flavum.—Gills 7 pairs, elongate ovate, anterior margin serrate. All the abdominal segments denticulate on posterior margin. Claw elongate with two large and about four small denticulations. Labrum apically excised; mandible with prostheca, and apically denticulate; maxillary palp 2-jointed; labial palp with 2nd joint strongly produced inwards, and 3rd joint ovate.

Head olive, with pale dots and streaks. Thorax olive, with whitish areas, especially laterally; and darker, almost sepia, submedian areas. Abdomen with pattern shown in text-fig. 21, *a*, of olive to olive-brown and sepia on a whitish ground-colour. Ventral surface whitish with faint pencillings on abdominal segments. Legs pale, with faint olive suffusion on the femora and darkened knees. Gills clear, with dark tracheæ branching on posterior side. Cerci white in proximal and distal thirds; middle part sepia.

Body up to 9.5 mm.; cerci, 5 mm. (lateral) and 4 mm. (median).

Localities.—Mooi, Lions and Umgeni Rivers; Yarrow and Furth streams; Jackson's spruit, Curry's Post.

Habits.—Imagos have been taken throughout the year, but the chief emergence occurs from March to May. The time of the nuptial dance of this species is unknown; the only ♂♂ taken were spent specimens floating on water. At sunset, and just after, ♀♀ may be observed flying downstream and dipping on the surface of the water, apparently ovipositing.

Remarks.—The above nymph is assigned to the imago on its structural characters, especially the hind-wing bud, on its size, and on the fact that it has been taken in the same localities as the imago. The hind-wing bud in mature specimens is comparatively large, elongate, and shows the developing costal process of the imago. The nymphs have proved very intolerant of captivity.

Centroptilum falcatum n.sp. Text-fig. 21.

Imago.—Hind-wing small, narrow, elongate, with an acute curved costal process, and two longitudinal veins. Fore-wing with 5–8 usually complete cross-veins. Terminal segment of ♂ genital styles minute, elongate.

♂. Head ochraceous, eyes and ocelli black; turbinate eyes buff yellow. Pro-, meso- and metathorax dorsally buff; laterally brownish, and ventrally pale ochraceous. Scutellum pale. Abdominal segment I ochraceous, with sienna posteriorly. Segments II–X bright pinkish sienna; II–IV with a pale median streak, and the pale area forming an inverted horseshoe-shaped mark; VII with three fine pale streaks; VIII and IX almost uniform, with a burnt sienna median stripe; terminal segment uniform, somewhat brownish. Abdomen ventrally pale yellowish. Legs suffused ochraceous. Cerci and genital styles white. Wings clear, slightly suffused in costal and subcostal areas; neuration whitish. ♀ similar, but with sienna marks on the head,

and abdomen more yellowish, with dull crimson markings dorso-laterally on each segment.

Body, ♂ 6 mm., ♀ 7-8 mm.; wing, ♂ 6 mm., ♀ 7.5-8.5 mm.; hind-wing, c. 0.8 mm.; cerci, 12-14 mm.

Subimago and *nymph* unknown.

Localities.—Yarrow stream, 19.iii.44 and 25.ii.45; Dalcrue, Mooi River, 14.xii.44.

Centroptilum medium n.sp. Text-figs. 22 and 23.

Imago.—Hind-wing rather broad, with three veins; costal process broad basally, apically curved. Pterostigmal cross-veins 6-8, weak, some incomplete. Terminal joint of ♂ genital styles elongate.

♂. Head light yellow, eyes dark mottled green, ocelli white-tipped; turbinate eyes bright chrome yellow. Prothorax yellowish with anterior and posterior transverse burnt sienna bands. Meso- and metathorax pale yellowish dorsally, with sienna markings dorso-laterally and laterally. Scutellum pale, with a small sienna marking on each side anteriorly. Abdominal segment I ochraceous with sienna posteriorly; segments II-VII dorso-laterally burnt sienna, medio-dorsally pale ochraceous with three fine whitish stripes converging anteriorly on each segment. Segments VIII and IX pale, suffused with sienna, dorso-laterally; and a median sienna area with faint pale streaks. Segment X pale, uniform. Ventral surface pale buffy yellow. Legs almost uniform pale yellow; 1st femur slightly suffused with sienna. Cerci and genital styles whitish. Wings clear, slightly opaque in pterostigmal area; neuration ochraceous. ♀. Head pale yellow, with submedian sienna stripes; eyes light green with dark brown mottling. Prothorax similar to ♂; meso- and metathorax deeper yellow. Abdomen bright chrome yellow dorsally, with lateral longitudinal castaneous bands; segments 2-4 each with a posterior-lateral dark sienna band.

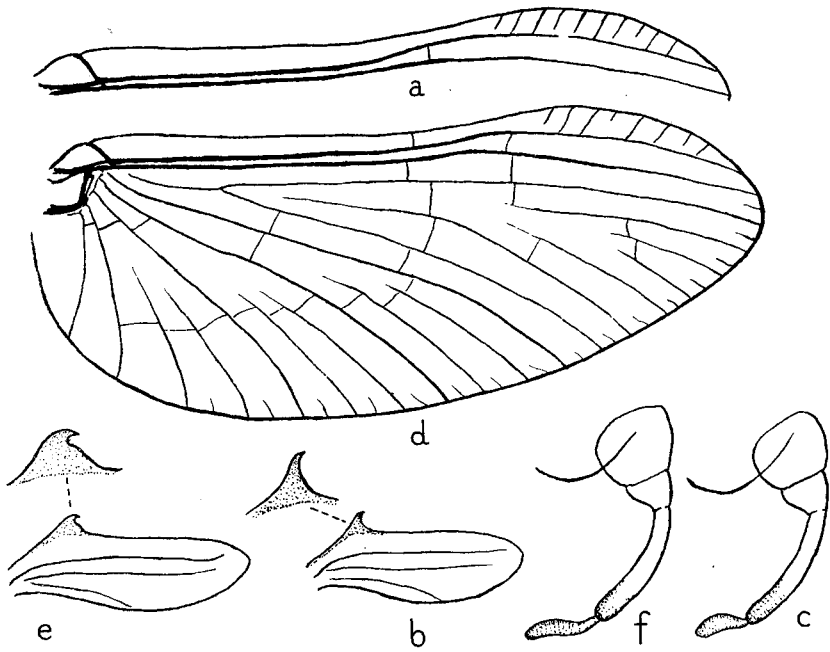
Body, ♂ 6 mm., ♀ 6-6.5 mm.; wing, ♂ 5.5 mm., ♀ 6.5-7 mm.; hind-wing, c. 1.1-1.2 mm.; cerci, ♂ 12 mm., ♀ 10 mm.

Subimago.—Similar, but paler and duller. Wings opaque yellowish grey.

Nymph.—Gills 7 pairs, broadly ovate. Abdominal segments posteriorly denticulate. Claw with about six denticulations. Mandible with prostheca. 2nd joint of labial palp slightly inwardly expanded, terminal joint bulbous.

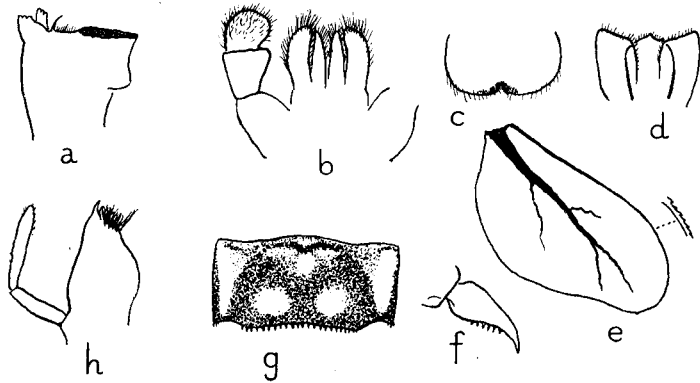
Head whitish, with olive-brown markings; two broad bands between the eyes, and an area round the ocelli. Eyes black, ocelli white-tipped. Thorax olive-brown, with conspicuous whitish areas. Abdomen with a pattern of the same two colours; on segments I, IV, VII and VIII, the pale occupying more of the dorsal surface than the dark; segments II, III, V and VI with pattern shown in text-fig. 23, *g*; terminal segments mostly dark. Ventral surface very pale olive; thorax with faint yellow marks; abdominal segments with

TEXT-FIG. 22.



Centroptilum indusii n.sp. a, b, c, margin of fore-wing, hind-wing, and forceps of ♂ imago.
C. medium n.sp. d, e, f, fore- and hind-wings, and forceps of ♂ imago.

TEXT-FIG. 23.



Centroptilum medium n.sp. Nymph: a, right mandible; b, labium; c, labrum
d, hypopharynx; e, gill; f, claw; g, abdominal segment III; h, maxilla.

a dark border, and segments III-VI each with a median triangular area of yellow, with a narrow dark border. Legs pale olive with dark femoral areas. Gills clear, tracheæ dark. Cerci brownish olive, becoming darker distally, but with pale whitish tips.

Body up to 7.5 mm.; cerci 4 mm. (lateral) and 2.5 mm. (median).

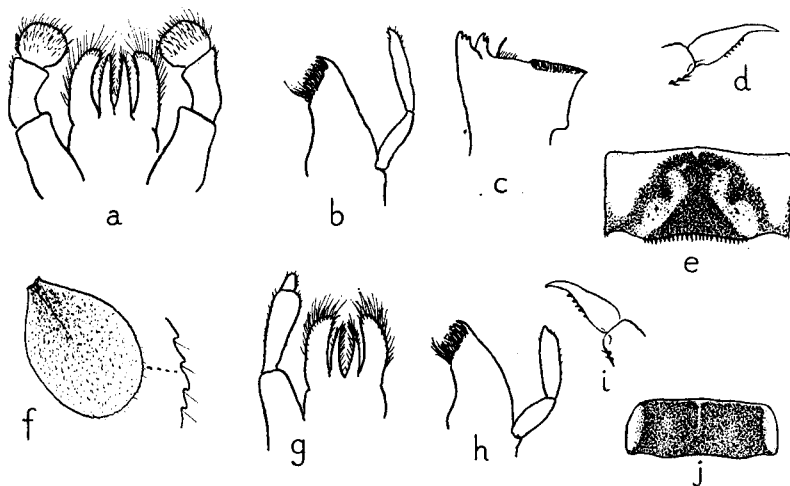
Localities.—Curry's Post and Karkloof districts, Dec.-April; Kokstad, Dec., 1940.

Remarks.—The nymphs are delicate, but specimens have been bred in captivity.

Centroptilum indusii n.sp. Text-figs. 22 and 24.

Imago.—Hind-wing somewhat broad, with three veins; costal process acute, upright. Fore-wing with 7-10, some incomplete, pterostigmal cross-veins. Terminal joint of ♂ genital styles moderate.

TEXT-FIG. 24.



Centroptilum indusii n.sp. Nymph: a, labium; b, maxilla; c, mandible; d, claw; e, abdominal segment III. *C. parvum* n. sp. Nymph: f, gill; g, labium; h, maxilla; i, claw; j, abdominal segment III.

♂. Head pale straw, eyes and ocelli black; turbinate eyes bright buff, with paler sides and orange bases. Prothorax deep burnt sienna, with pale median stripe. Mesothorax dorsally straw, with two submedian light brown stripes, and dorso-lateral dark purplish markings, almost meeting posteriorly and enclosing two white spots; laterally dark markings and pale areas between the sclerites; ventrally paler, tinged with green. Scutellum pale. Metathorax

dorsally marked with vandyke brown on a pale background and with paired white spots; ventrally same as mesothorax. Abdominal segments I–VII whitish dorsally, with a posterior transverse band of burnt sienna, each segment suffused dorso-laterally with deep pink and bordered by a dark band. Terminal segments more uniform, suffused castaneous or burnt sienna. Abdomen ventrally pale greenish, with faint lateral comma-shaped marks on each segment. Legs, genital styles and cerci whitish. ♀ similar, but thorax more uniform and abdomen with median whitish area smaller on each segment and pink suffusion brighter, almost crimson. Wings in both ♂ and ♀ similar to *medium* (*supra*).

Body, ♂ 5·5–5 mm., ♀ 5·5–6 mm.; wing, ♂ 4·5–5 mm., ♀ 6–6·5 mm.; hind-wing, c. 1·0 mm.; cerci, ♂ 10 mm., ♀ 8 mm.

Subimago.—More greenish yellow than imago. Abdomen mediodorsally yellowish olive; dorso-lateral areas dull orange-castaneous.

Nymph.—Gills 7 pairs, similar to *medium* (*supra*). Abdominal segments posteriorly denticulate. Claw with about six denticulations. Mandible with prostheca. 2nd joint of labial palp scarcely at all expanded, terminal joint bulbous.

Colouring similar to *medium*, but with different body-pattern, as shown in text-fig. 24, e.

Body up to 7 mm.; cerci, 3·5 mm. (lateral) and 2·5 mm. (median).

Localities.—Curry's Post; Yarrow stream; Karkloof, Umgeni, Mooi and Loteni Rivers. Various dates from Dec. to May.

Remarks.—This species is evidently closely related to *medium*. The two species are separable, however, on the form of the costal process of the hind-wing, and on the body-pattern of both imago and nymph. The only nymph taken was a mature specimen that hatched in captivity.

Centroptilum parvum n.sp. Text-figs. 23 and 25.

Imago.—Hind-wing apically rounded; costal process double, both projections acute, one upright and the other curved; two simple longitudinal veins. 7–10 mostly incomplete pterostigmal cross-veins. Terminal segment of ♂ genital styles elongate.

♂. Head light castaneous, eyes and ocelli black, turbinate eyes bright yellow. Prothorax dark castaneous; meso- and metathorax ochraceous, with castaneous markings and pale joinings laterally. Scutellum pale. Abdominal segments I–VI pale ochraceous, with castaneous margins, and a light median stripe and submedian markings; terminal segments suffused castaneous, VII with submedian pale stripes. Ventrally pale yellowish. Legs ochraceous. Cerci and genital styles whitish, the former faintly annulated. Wings clear, with slight suffusion in pterostigmal area; neuration whitish. ♀ similar, but more orange-yellow than ♂, and with smaller castaneous markings on the abdomen.

Body, ♂ 4.5–5 mm. ; ♀ 4.5–5 mm. ; wing, ♂ 4.5–5 mm., ♀ 5–5.5 mm. ; hind-wing *c.* 0.9 mm. ; cerci, 8 mm.

Subimago.—Similar, but duller. Wings greyish yellow.

Nymph.—Gills 7 pairs, small and rounded. Abdominal segments not denticulate. Claw with five small denticles. Mandible with prostheca ; 2nd joint of labial palp elongate ; terminal joint very small.

Head brownish-green, with a pale streak between the eyes, which are black. Thorax deep olive-brown with pale streaks and markings, especially laterally ; ventrally whitish. Abdominal segments, except V and VI, as shown in text-fig. 24, *j* ; mostly olive-brown, with pale dorso-lateral areas and an anterior median pale streak ; V and VI mostly pale with anterior and dorso-lateral dark areas. Abdomen ventrally whitish with faint brown lateral bands. Legs pale, with dark knees. Gills opaque, tracheæ not distinct. Cerci uniform, pale brownish.

Body up to 5.5 mm. ; cerci, 2.5 (lateral) and 1.25 (median).

Localities.—Kokstad, Dec., 1940 ; Curry's Post, Yarrow stream, Lions and Loteni Rivers, March to May.

Remarks.—It is noteworthy that while the imagos of this species and *sud-africanum* both have hind-wings with bifid costal processes, the nymphs also resemble each other, especially in the form of the labial palp, although the 3rd joint is somewhat larger in *parvum*. This species has not been bred in captivity, but the nymph has been correlated with the imago from a specimen which died when on the point of hatching and in which the adult characters could be distinguished.

Centroptilum sp.

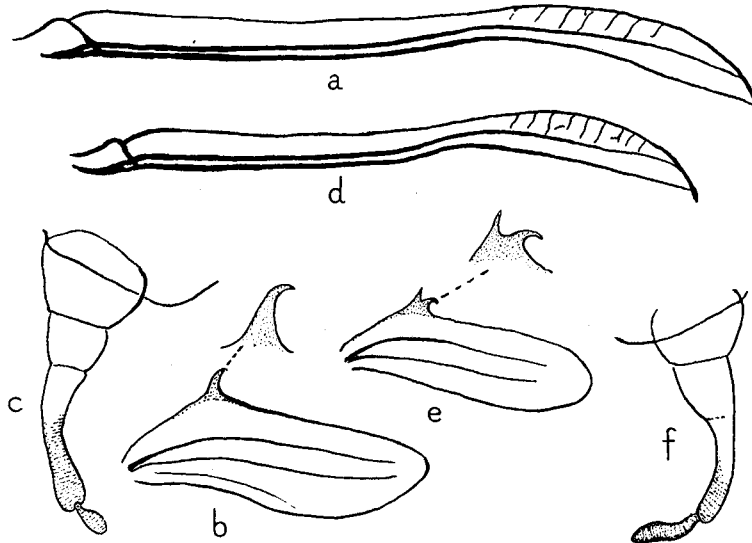
Some ♂ specimens of a small *Centroptilum* (4.5 mm. wing) taken on the Yarrow stream (19.iii.44) have the same structural characters as *parvum*, but differ in colour. The turbinate eyes are deep pink ; the thorax raw umber, with pale olive lateral marks and joinings ; and the abdomen pale olive on segments 1–6, with darker dorso-lateral marks corresponding to the castaneous marks on *parvum*, while the terminal segments are suffused pinkish olive. Whether this is merely a colour form of *parvum*, or a separate species, cannot at present be determined, but in view of the close structural similarity it is not justifiable to give these specimens a separate name.

Centroptilum varium n.sp. Text-figs. 25 and 26.

Imago.—Hind-wing somewhat broad, with three veins ; costal process upright, apically curved. Pterostigmal cross-veins 6–10, mostly incomplete, and occasionally branching. Genital styles of ♂ with small terminal joint.

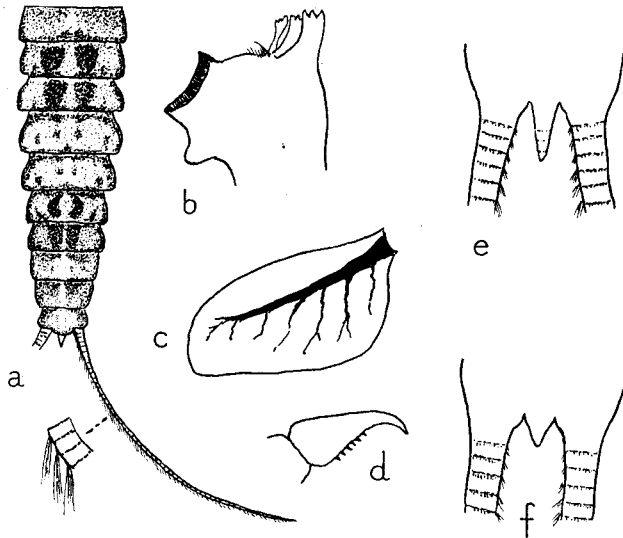
♂. Head dull castaneous, eyes black, ocelli white-tipped ; turbinate eyes pinkish-orange. Prothorax sepia anteriorly, paler behind ; mesothorax dor-

TEXT-FIG. 25.



Centroptilum varium n.sp. a, b, c, margin of fore-wing, hind-wing and forceps of ♂ imago.
C. parvum n.sp. d, e, f, margin of fore-wing, hind-wing, and forceps of ♂ imago.

TEXT-FIG. 26.



Centroptilum varium n.sp. Nymph: a, abdomen; b, left mandible; c, gill; d, claw; e, apex of abdomen showing much reduced median cercus. *Acentrella natalensis* n.sp. f, apex of abdomen for comparison.

sally raw umber, dorso-laterally and anteriorly piceous, laterally with orange areas between the sclerites (fading to grey in alcohol); scutellum pale; metathorax dorsally piceous. Thorax ventrally umber, with pale areas. Abdomen varying shades of olive, with dark purplish-brown markings on each segment; segments I-VI light coloured, each with a narrow dorso-lateral dark stripe; II and III with submedian dark blotches, each curved outwards; in addition, IV and V each with small dark markings, and VI with larger ones. Segments VII-X olive-brown, VII with conspicuous purplish-brown submedian markings, VIII and IX with submedian sienna streaks. Abdomen ventrally pale whitish anteriorly, suffused light brown posteriorly. Legs, cerci and genital styles all whitish. Wings clear, pterostigmal area slightly suffused; neuration pale fulvous. ♀ similar, but thorax more uniform umber, and abdomen more castaneous.

Subimago.—Duller coloured, with the thorax more mottled, and the dark occupying a greater area on the abdomen, which is similar to that of the nymph. Wings opaque, bluish-grey.

Nymph.—Median cercus very greatly reduced (text-fig. 26, *e*), approaching the form of *Acentrella*. Gills 7 pairs, ovate, margin not serrate. Claw apically curved, with a series of small denticles. Mandible with protheca, apically denticulate. Maxillary palp 2-jointed. Labial palp with small semi-circular terminal joint, closely resembling that of *Bætis cataractæ* (text-fig. 13, *d*).

Head light olive-brown, darker on occiput, eyes black, ocelli white-tipped. Thorax olive, with dark brown mottlings. Abdominal pattern resembling that of imago, and as shown in text-fig. 26, *a*; the dark areas brown to almost piceous on an olive background. Legs mottled whitish and olive-brown, with dark streaks on the femora. Gills clear, with dark tracheæ. Cerci uniform, light olive-brown.

Body up to 7 mm.; lateral cerci 4 mm.

Localities.—Yarrow stream, 19.iii.44 and 25.ii.45; Cathkin Peak area, 18.ii.45; Loteni River, 22.iii.45.

Habits.—Imagos have been taken flying at sunset. The nymphs are inhabitants of swift water, where they cling to the lower sides of stones, in the same way as *Acentrella* and *Bætis cataractæ*; they soon die in captivity in still water, but by catching mature nymphs the subimago has been bred.

Remarks.—The imago shows no unusual characters, and its hind-wing closely resembles that of *indusii*. However, the nymph differs notably from other members of the genus in that it is of the crawling type, with minute median cercus. Apart from this latter character, in which it approaches *Acentrella*, the nymph bears a striking resemblance to *Bætis cataractæ*; the general form of the body is the same, which is not very surprising, since they both occur in the same type of habitat, and also there is a remarkable similarity in the mouthparts (except the mandibles), particularly in the form of the labium. The gills are also very similar, and lack the serrate margin of most

of the other members of the genus which occur in South Africa. While the general form of the two nymphs may be similar owing to adaptive modification, the structural resemblances are harder to understand, since the venational characters of the two imagos are so different. If the two species were known only by their nymphs, they would probably be regarded as related forms, whereas on imaginal characters they belong to separate genera.

venustum

Centroptilum pulchrum n.sp. Text-figs. 27 and 28.

Imago.—Hind-wings entirely suppressed in both ♂ and ♀. About 8 pterostigmal cross-veins, some incomplete and tending to anastomose. Terminal joint of ♂ genital styles minute, hook-like. Fore-tibia and femurs subequal.

♂. Head light brown above, with sepia marks below; eyes dark brown, ocelli shining piceous; turbinate eyes purplish-brown. Prothorax light brown with sepia anteriorly. Mesothorax with submedian olive-brown bands divided by a pale median streak, and with pale olive areas on each side; latero-dorsally and posteriorly sepia, with pale streaks; laterally and ventrally pale ochraceous, with sepia areas; scutellum pale with a dark border. Metathorax dorsally sepia, ventrally similar to mesothorax. Abdominal segment I anteriorly brown, posteriorly ochraceous; segments II–V ochraceous, slight olive anteriorly, with submedian burnt sienna streaks, a curved brown marking on each side, and a posterior and dorso-lateral suffusion extending laterally to narrow sepia stripes (see text-fig. 28, *b*). Segment VI similar, but sienna less distinct, and forming only a slight median suffusion. Segments VII–IX deeper ochraceous, lacking the sienna, the curved brown marks becoming smaller, and dorso-lateral dark dots appearing. Segment X almost uniform brownish. Abdomen ventrally pale ochraceous, with paired brown submedian dots. Legs ochraceous, streaked with brown on the femora. Cerci whitish, with faint sienna annulations. Genital styles pale. Wings clear, very faintly suffused with sherry-colour, and a bright orange suffusion at the base of the wing; the costal and subcostal areas somewhat opaque; neuration bright fulvous.

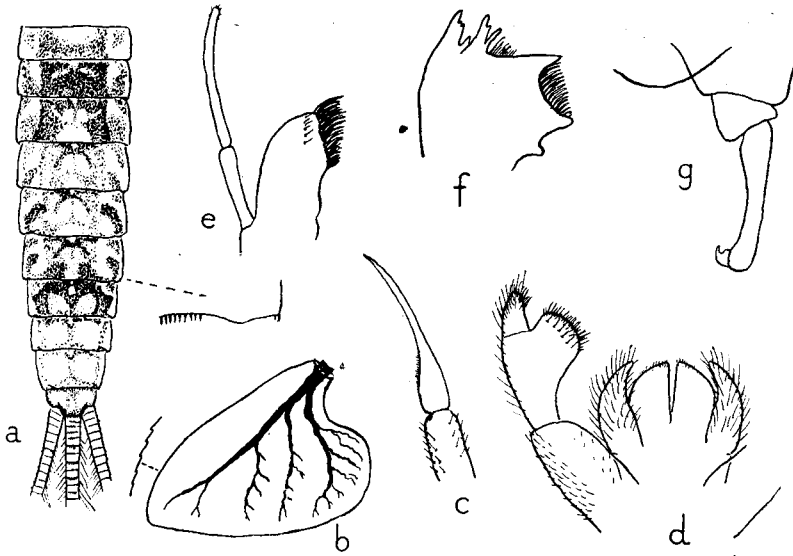
Body, ♂ 7–7.5 mm., ♀ (subimago) 7.5 mm.; wing, ♂ 6.5–7 mm., ♀ 8 mm.; cerci, ♂ 12 mm.

Subimago.—Similar, but thorax rather darker, and abdomen light castaneous instead of ochraceous, but showing pattern of imago, although more faintly. Wings opaque green, with a creamy-white longitudinal patch extending down the centre of the wing, the whole suffused with sherry-colour. Neuration paler than in imago.

Nymph.—Gills 7 pairs, broad, palette-shaped, rather pointed. Claw very elongate, narrow, finely pectinate proximally. Maxillary palp elongate, 2-jointed. Labium with large inner lobes, and the 2nd joint of the palp forming a bulge inwards.

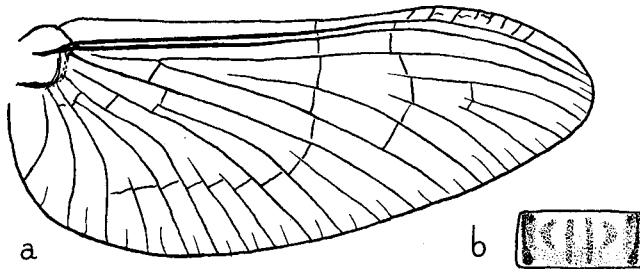
Head pale ochraceous, eyes dark brown. Thorax ochraceous to olive-brown, with sepia streaks. Abdomen with pattern shown in text-fig. 28, *a*,

TEXT-FIG. 27.



Centroptilum pulchrum n.sp. Nymph: *a*, abdomen; *b*, gill; *c*, claw; *d*, labium; *e*, maxilla; *f*, left mandible. Imago: *g*, forceps of ♂.

TEXT-FIG. 28.



Centroptilum pulchrum n.sp. *a*, fore-wing, and *b*, pattern of abdominal segment III of ♂ imago.

of sepia and light brown on a pale yellowish background. Legs pale ochraceous, with dark streaks. Gills clear, with dark tracheæ. Cerci whitish; distally long brown setæ with white tips.

Body up to 8 mm.; cerci 4 mm. (lateral) and 3.5 mm. (median).

Localities.—Little Mooi River, 12.ix.43 and 22.iv.44; Mooi River, 5.ix.44; Yarrow stream, 6.xi.44 and 11.ii.45.

Remarks.—The nymphs occur in still deep stretches of river, and a specimen which died in the act of hatching in captivity was correlated with the imago by removing the shuck and comparing the wings and body-pattern with those of other subimagos. Both subimagos and imagos were taken along the same stretches of river as were inhabited by the nymphs.

The systematic position of this species presents an interesting problem. The imago is of the *Clæon* type in having no hind-wing and single intercalaries in the fore-wing; the terminal joint of the genital styles resembles *Clæon* and *Austroclæon* (and also *Centroptilum falcatum*) in being minute, but its hook-like form seems to be *sui generis*. On the other hand, the nymph is, on the whole, of the *Centroptilum-Bætis* type. The gills are, however, remarkably broad; the mandible is like that of *Clæon*; and the maxilla resembles that of *Austroclæon*, especially in the long slender 2-jointed palp. The long narrow pectinate claw differs from that of other South African nymphs, but is nearer the form of *Clæon* or *Austroclæon* than *Centroptilum*. At first sight the only way out of the difficulty would seem to be the institution of a new genus, and this course may eventually be adopted. Dr. Barnard has, however, suggested to me that *pulchrum* might be included in *Centroptilum*, since that genus already has a form (*excisum*) in which the ♀ imago lacks a hind-wing. Although the hind-wing has been so completely suppressed in *pulchrum* that it has disappeared in both adult and nymph, it seems reasonable to regard this species as being still sufficiently close to the other species of *Centroptilum* to be included in that genus. I am therefore doing so tentatively, since monotypic genera are admittedly unsatisfactory, unless they possess very distinctive characters, and in the present case the anomalous features do not seem to be conclusive enough to make a new genus perfectly valid. Stress, then, is laid on the general form of the nymph, on its single gills and on its labial palp, all of which point to affinities with *Centroptilum*, also the fore-wing of the imago, while the various peculiarities of the insect are, for the present, regarded as of less account. It is possible that when the May-fly fauna of South Africa is fully known, species will be found that show characters intermediate between *pulchrum* and other members of the genus *Centroptilum*, in which case separation would be difficult. Alternatively forms might be discovered very similar to *pulchrum*, which would justify the creation of a new generic name.

Genus *Centroptiloides* Lest.

Lestage, Rev. Zool. Afric., vol. vi, p. 65, 1918.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 226, 1932.

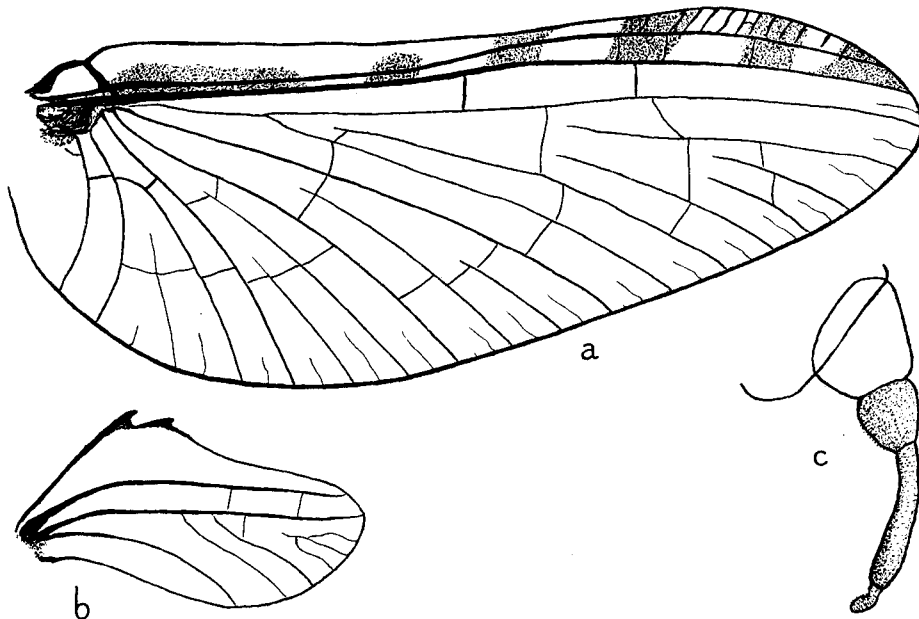
Nymph.—Gills 7 pairs, single. Mandible with protheca. Maxillary palp 3-jointed. Labial palp with short basal joint, and elongate terminal joint. Outer lobe of hypopharynx produced laterally.

Centroptiloides bifasciatum (E.-P.). Text-figs. 29 and 30.

Esbén-Petersen, Ann. S. Afr. Mus., vol. x, p. 182, 1913.
 Barnard, *loc. cit.*, 1932, p. 226.

Nymph.—Gills palette-shaped, 1st and 7th short and broad, 2nd–6th more elongate. A posterior basal flap forming a partly separate extension of the lamella is well-marked on the anterior gills. The anterior margin of the gills, especially the posterior ones, is considerably thickened and serrate. Labrum excavate. Mandible apically denticulate, with very small molar region;

TEXT-FIG. 29.



Centroptiloides bifasciatum (E.-P.). *a*, hyaline form of fore-wing; *b*, hind-wing with additional intercalary; *c*, forceps of ♂ imago.

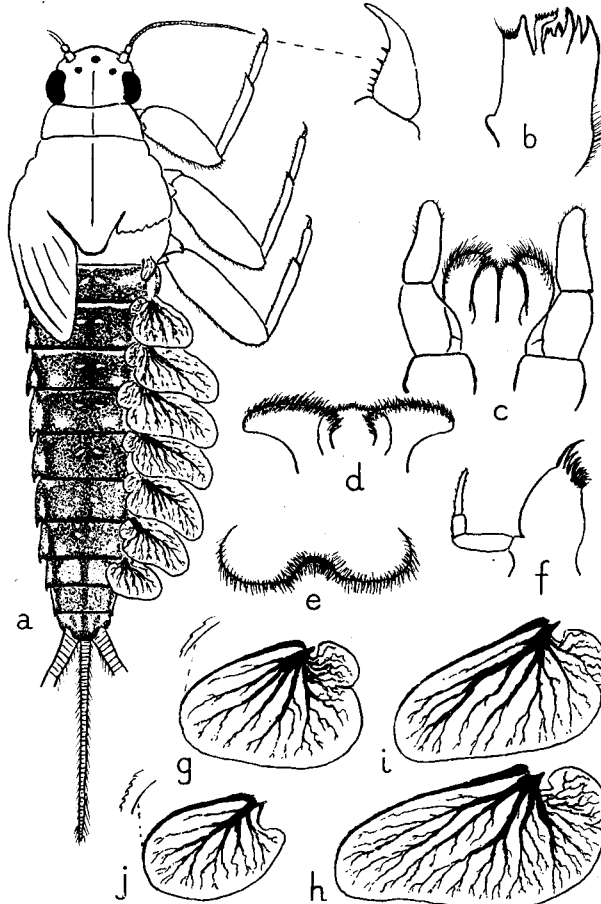
prostheca present. Maxillary palp with short thickened 2nd joint, and slender 3rd joint. Labium with broad inner lobes; palp stout, 3rd joint elongate. Outer lobes of hypopharynx strongly produced laterally. Claw with six large denticles.

Colour, varying shades of olive and, in addition, pale whitish and sepia areas. Head mottled dark and light, eyes black. Prothorax dark with subtriangular and circular pale spots. Meso- and metathorax largely sepia, with pale and intermediate streaks and dots. Abdomen with pattern shown in text-fig. 30, *a*. Ventral surface of thorax whitish; abdomen more olive, with

dark intersegmental bands. Legs mottled sepia olive and whitish. Gills clear, tracheæ dark. Cerci uniform olive-brown.

Body up to 14 mm. ; cerci, 10.5 mm. (lateral) and 4.5 mm. (median).

TEXT-FIG. 30.



Centroptiloides bifasciatum (E.-P.). Assigned nymph: *a*, whole animal; *b*, mandible; *c*, labium; *d*, hypopharynx; *e*, labrum; *f*, maxilla; *g*, *h*, *i*, *j*, 1st, 3rd, 5th and 7th gills.

Localities.—Mooi River, 22.xii.42 and 6.iii.44; Little Mooi River, 25.iv.43; Lions River, 15.iv.44; Umgeni River, Dec., 1944 (H. Evans); one adult at each locality. Nymphs from Furth stream; Collins' stream, Karkloof; and Cathkin Peak area, 5000 ft. alt. (R. F. Lawrence).

Remarks.—The nymph has been correlated with the imago on its size and the nature of the hind-wing bud; the character of the gills and mouth-parts

also differs from that of any other genus. Nymphs soon die in captivity.¹ Two forms of imago occur—the typical one, and another with clear wings except a coloured and blotched costal margin. The three imagos recorded from Natal (the two Mooi River records and that from the Yarrow, mentioned by Barnard, *loc. cit.*, 1940) are all hyaline specimens. Further, Dr. Barnard tells me that both forms are represented in the Zululand material of the South African Museum. Another variable character is the venation of the hind-wing, in which there may be an additional triple-branched intercalary as shown in text-fig. 29, *b*. There are, however, intergrading stages in which indications of the intercalary appear, so that it is evident that no specific separation can be effected on the basis of this character, which varies from one individual to another. I follow Barnard in regarding the presence or absence of pigmented "fascia" in the fore-wing as insufficient evidence of the occurrence of two species. Lestage's description of *marginatum* ('Rev. Zool. Afric.,' vol. xii, 1924) was based on a hyaline type, the hind-wing with three single veins and a disconnected intercalary; this species is synonymous with *bifasciatum*, and in its place a "form *hyalinum*" might be recognized.

Family BRACHYCERCIDÆ.

Genus *Austrocænis* Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 227, 1932.

Austrocænis capensis Brnrd.

Barnard, *loc. cit.*, p. 227, 1932.

Localities.—Kasouga River mouth, near Grahamstown, Sept., 1944 (G. B. Hudson); Fenfield, Amatolas, 10.i.42; Kokstad, East Griqualand, Dec., 1940; Curry's Post, Karkloof, Dargle, and Cathkin Peak area; Mooi, Little Mooi, Inzinga, Loteni, Umkomaas, Lions, Umgeni and Karkloof rivers; various dates.

Remarks.—This has been found to be an exceedingly plentiful species, occurring all over the area examined. There is considerable variation in colour, some specimens being much darker than the typical form. Size also varies, and ♂♂ have been taken with wings under 3 mm.

Genus *Tricorythus* Eaton.

Eaton, Trans. Linn. Soc. Lond. Zool., vol. iii, p. 138, 1884.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, pt. 3, p. 229, 1932.

Tricorythus discolor (Burm.).

Barnard, *loc. cit.*, p. 230, 1932.

Localities.—Hogsback and Fenfield, Amatolas; Kokstad and Matatiele, East Griqualand; all the Natal localities listed above for *Austrocænis*.

¹ A mature nymph emerged in captivity (27.ii.46) thus confirming the assignment.

Remarks.—Another extremely abundant May-fly that occurs in all perennial streams and rivers examined. The nymphs favour rocky situations in fast water, and are particularly common in swift-flowing rivers, such as the Loteni. However, they have also been taken in slow deep stretches with a muddy bottom.

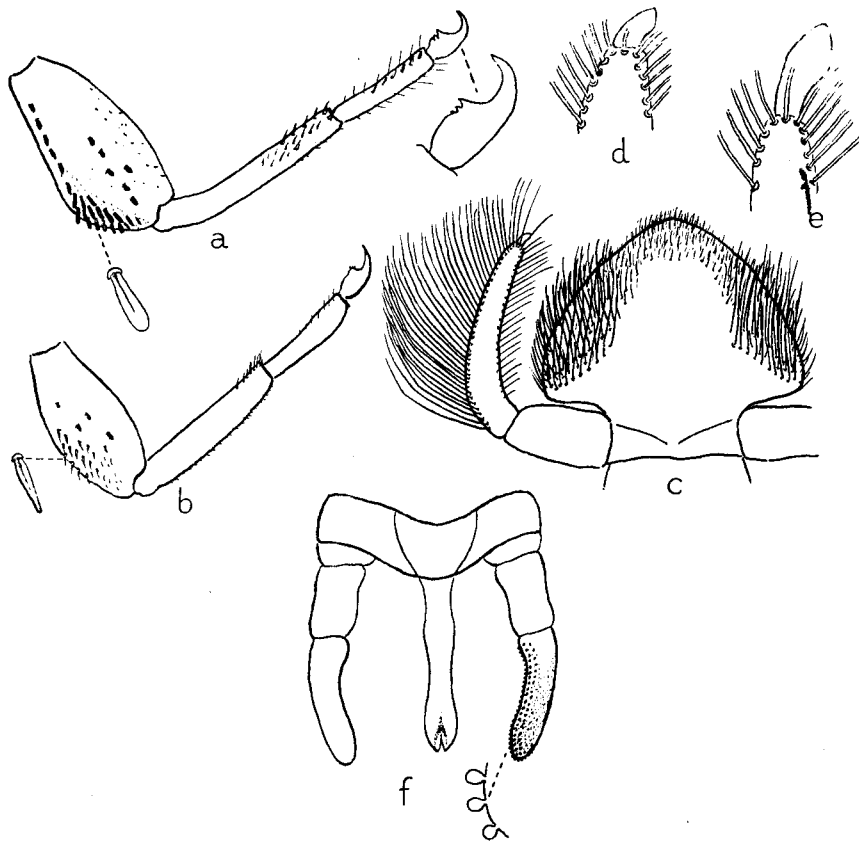
Tricorythus reticulatus Brnrd. Text-fig. 31.

Barnard, *loc. cit.*, p. 232, 1932.

Locality.—Lions River, Natal, 11.iv.44. 2 ♂♂ and 3 ♀♀.

Remarks.—The ♂ of this species was previously unknown. The wing is similar to that of the ♀, but the reticulated appearance is less noticeable. The ♂ genitalia are of the same type as *T. discolor* and the clasper has similar armature, but the penis is more elongate in *reticulatus* (see text-fig. 31, *f*).

TEXT-FIG. 31.



Tricorythus reticulatus Brnrd. Assigned nymph: *a*, *b*, 1st and 2nd legs; *c*, labium; *d*, end of labial palp further enlarged with *e*, that of *T. discolor* (Burm.) for comparison. Imago: *f*, forceps and penis of ♂.

Nymph.—A shuck found in the Lions River (25 . x . 43) resembles the nymph of *discolor*, but shows certain differences, and probably represents the nymph of *reticulatus*. The shuck is about 6 mm. body-length, and almost colourless. Structurally it is very similar to *discolor*, but the terminal joint of the labial palp is even smaller (text-fig. 31), and the 2nd joint rather more stout. The other mouth-parts and the gills seem to be indistinguishable in the two nymphs, but the claws are more hooked in *reticulatus*, and the arrangement of the spines on the legs is different.

Family LEPTOPHLEBIIDÆ.

KEY TO THE SOUTH AFRICAN GENERA (modified from Barnard).

Imagos.

1. Claws all alike, narrow, hooked.
 - a. Penis of ♂ deeply divided, with a long, inwardly directed, acute process at the apex of each lobe *Euphlebia*.
 - b. Penis of ♂ not deeply divided, and processes, if present, outwardly or downwardly directed.
 - i. Hind wing without angular costal process, costal area narrow, long . . . *Aprionyx*.
 - ii. 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 R_s *Castanophlebia*.
 - b. Stalk of MA shorter, forking narrow, a short distance distal to origin of R_{4+5} from R_s .
 - i. Genital styles of ♂ 4-jointed, 1st joint annular. Hind wing broadly oval *Choroterpes*.
 - ii. Genital styles of ♂ 3-jointed. Hind wing narrowly oval *Euthraulius*.

Nymphs.

- A. 6 pairs of gills, 1st pair single, operculiform *Euphlebia*.
- B. 7 pairs of gills, 1st pair not operculiform.
 1. Claws smooth. Abdominal segments VIII and IX laterally biacuminate . . . *Aprionyx*.
 2. Claws denticulate. Abdominal segments VIII and IX laterally uniauculate.
 - a. Gill on segment I not reduced.
 - i. Gills ovate-lanceolate *Adenophlebia*.
 - ii. Gills narrow-lanceolate *Castanophlebia*.
 - b. Gill on segment I 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*.

Genus *Aprionyx* Brnrd.

Barnard, Ann. S. Afr. Mus., vol. xxxii, p. 627, 1940; Trans. Roy. Soc. S. Afr., vol. xx, p. 233, 1932.

A third Natal species is described below which is allied to the other two (*natalica* and *argus*) from this region. All three differ from the western Cape

species in the form of the penis, which is broad, dorso-ventrally flattened and without recurved flaps. The nymphal gills of *tricuspidatus* and *natalica* are notably different from those of the typical species in being trifid; however, two *Aprionyx* nymphs from Cathkin Peak (the type locality for *argus*) have gills which approach the form of *tabularis* Brnrd. It would thus seem that *argus* may form a connecting link between the Natal species and those from the Cape.

Aprionyx natalica (Lest.). Text-fig. 34.

Lestage, Rev. Zool. Afric., vol. xii, p. 325, 1924.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 240, 1932.

Localities.—Fenfield, Amatolas, 13.ii.42; Curry's Post, Nov.–Dec., 1944; Furth stream, Dargle, 5.xii.44; Maylands, Inzinga, 25.i.45.

Nymph.—A nymph that hatched in captivity at Curry's Post is very similar to *tricuspidatus* (*infra*), but the points of the gills are rather more irregular, few of the lamellæ being symmetrically trifid, and several merely "shouldered" (*cf.* text-fig. 34, *e*). The only definite structural difference seems to be the slightly greater relative length of the 2nd joint of the maxillary palp (text-fig. 34, *j*).

Habits.—The nymphs inhabit mountain streams and seem to favour those with large boulders, under which they find adequate cover. The imagos fly in the afternoon towards sunset.

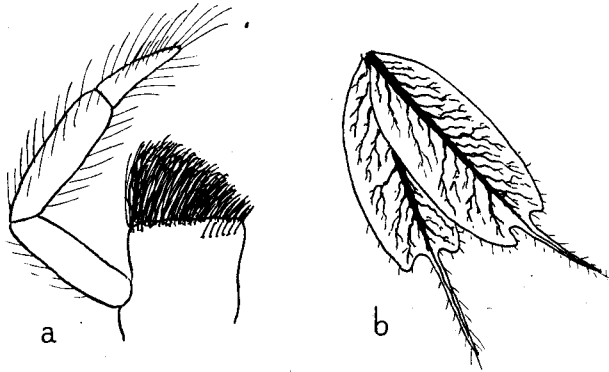
Remarks.—In all the specimens examined by me the inner margin of the 1st joint of the ♂ clasper is sharply curved inwards proximally, as in *argus* and *tricuspidatus*, whereas in Barnard's figure (*loc. cit.*, 1940) the clasper tapers gradually.

Aprionyx argus Brnrd. Text-fig. 32.

Barnard, Ann. S. Afr. Mus., vol. xxxii, p. 628, 1940.

Nymph.—Two specimens collected at Cathkin Peak, 7500 ft. alt. (18.ii.45), probably belong to this species. They bear a close resemblance to *tricuspidatus*, but there is a slight difference in the relative lengths of the joints of the maxillary palp, and, more interesting, the gills are not trifid. In all the gills the lateral filaments are represented by mere bulges, as is the case in some variant gills of *tricuspidatus*. This form is thus intermediate between the other Natal species, and the typical Cape members of the genus, with single-pointed gills. A complication is introduced by the fact that another small *Aprionyx* nymph was taken in a different stream at Cathkin Peak with trifid gills. Whether this specimen is *tricuspidatus* or *natalica*, or represents another form of *argus*, cannot be determined.

TEXT-FIG. 32.

Nymph assigned to *Aprionyx argus* Brnrd. a, maxilla; b, gill.*Aprionyx tricuspидatus* n.sp. Text-figs. 33 and 34.

Imago.—Fore-wing with 8–10 strong cross-veins before bulla and 12–14 thickened, slightly sigmoid, oblique veins in pterostigmal area. Hind-wing with Sc extending nearly to end of wing; 5–6 subcostal cross-veins. Penis broad and flattened dorso-ventrally, with an obovate apical excision; the vasa deferentia opening on curled processes on each side of the excision. Genital styles with the inner margin forming an angular bend nearly half-way along the 1st joint.

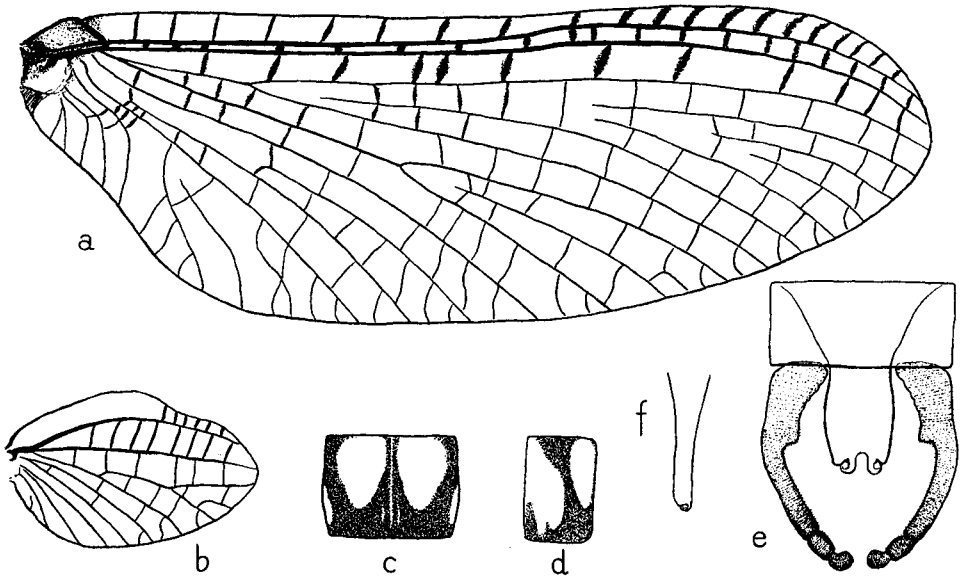
♂. Head piceous with ochraceous touches anteriorly, eyes black, ocelli pale, translucent; turbinate eyes deep raw umber. Prothorax olive-brown with piceous marks. Mesothorax dorsally piceous, more umber laterally, with pale wing-bases, and fulvous marks with pale joinings; scutellum dark. Metathorax dorsally umber, with dorso-lateral and posterior piceous areas. Ventral surface of thorax raw umber, with slight russet tinges, and sepia areas, with pale joinings. Abdominal segments II–VIII with pattern shown in text-fig. 32, of sooty black on a pale, slightly yellowish background; segments I, IX and X dark, almost uniform. Abdomen ventrally pale olive, each segment posteriorly dark, with a sepia mark extending forwards on each side and a similar median mark, which is small on the anterior segments but increases in size posteriorly. Legs pale, slightly ochraceous, femora with conspicuous dark ends; 1st femur also with an elongate dark area in the middle. Genital styles umber. Cerci clear, neuration dark brown; proximal cross-veins and also distal ones in costal, subcostal and subradial areas thickened with light reddish-brown. ♀ similar, but more fulvous-brown, and pattern on abdomen sepia and ochraceous olive. Wings with more spotted appearance, owing to a greater thickening of the cross-veins.

Body, ♂ 9.5–12.5 mm.; ♀ 11–14 mm.; wing, ♂ 10–13 mm., ♀ 12–15 mm.; hind-wing, *c.* 2 mm.; cerci, ♂ 23–30 mm., ♀ 20–25 mm.

Subimago.—Slightly duller; mesothorax dorsally pale, with dark borders, and submedian dark streaks; metathorax with dorso-lateral pale areas surrounded by piceous. Wings greyish, in fresh specimens with a slaty bloom; neuration light brown.

Egg.—Normal *Aprionyx* type; twice as long as broad, long diameter 0.27 mm.

TEXT-FIG. 33.



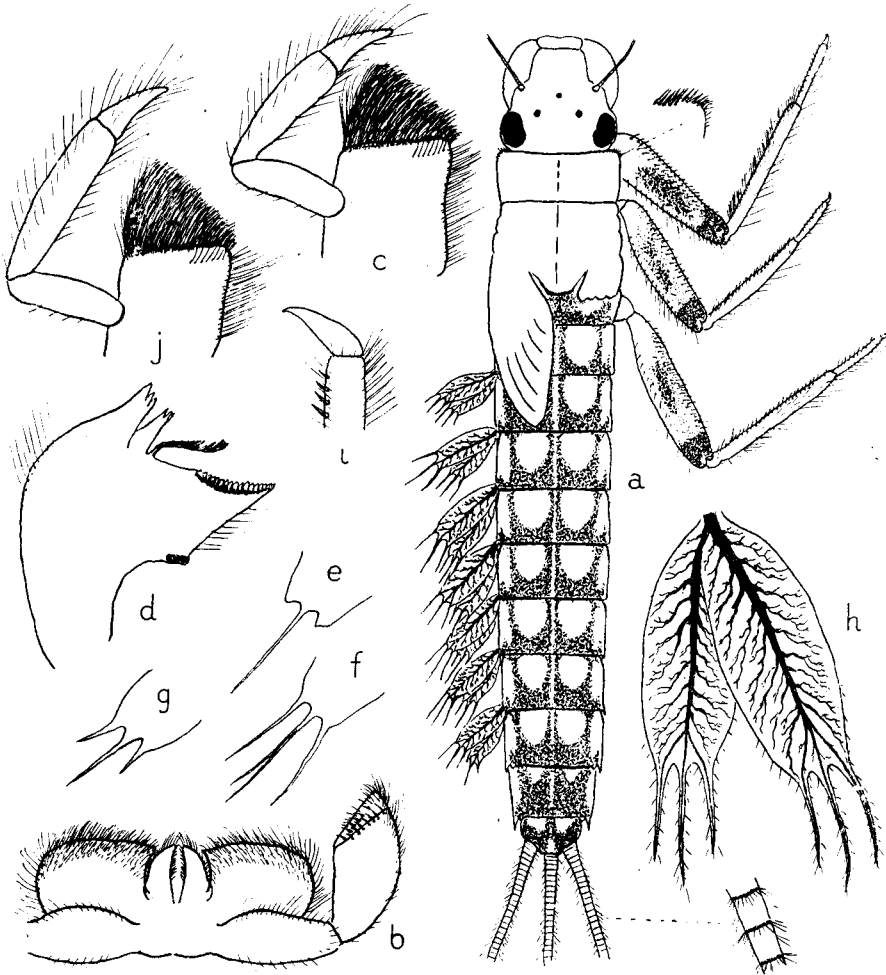
Aprionyx tricuspoidatus n. sp. ♂ Imago: *a, b*, fore- and hind-wings; *c, d*, dorsal and lateral pattern of abdominal segment III; *e*, penis and forceps; *f*, lateral view of penis.

Nymph.—Abdominal segments VIII and IX laterally biacuminate, the inner projection small and blunt. Femora rather stout, especially 1st, which tapers distally. Legs spinous and with short setæ, densest on 1st tibia. Claws smooth. Gills somewhat obovate, with a median and two lateral terminal filamentous points; some of the lamellæ usually with irregular points, the lateral filaments (one or both) being represented by mere bulges. Cerci elongate, setæ short and rather sparse.

Head ochraceous, with dark brown marks, eyes black. Thorax pale yellowish with extensive light brown to sepia mottled areas; prothorax with a fine reticulated pattern; mesothorax with larger, darker marks; meta-thorax more uniform brownish. Abdomen pale yellowish with dark pattern similar to that of imago, U-shaped markings on each side separated by a pale

narrow median streak, the markings tending to coalesce on posterior segments. In adult ♀ nymphs the colouring is more fulvous. Legs ochraceous, fulvous

TEXT-FIG. 34.



Aprionyx tricuspidatus n.sp. a, nymph; b, labium; c, maxilla; d, mandible; e, f, g, variations in the apices of gill lamellae; h, normal gill; i, claw. *A. natalica* (Lest.). j, maxilla.

distally, femora with dark distal bands and median streaks. Cerci olive-brown almost uniform, articulations of the segments pale. Gills opaque slaty grey, tracheae dark.

Body up to 17 mm.; cerci, 24 mm. (lateral) and 17 mm. (median).

Localities.—Hogsback, Amatolas, 2.xii.40 (1 subimago); Kilmore, Kamberg district, Natal, 9.iv.43 (nymph); Curry's Post and Karkloof districts, abundant material in a number of forest streams.

Habits.—The nymphs occur in mountain streams that are well shaded by natural forest, and in a few others in open localities that apparently used to be forest-covered. They do not occur in torrential situations, since they are not adapted to this type of habitat, but are to be found under stones in the stiller pools and backwaters. Imagos hatch throughout the spring and summer from August to April, but the peak season is about October. Their flight is slow and irregular, and they are to be seen dancing in the later afternoon, chiefly in the shade, in the neighbourhood of waterfalls and small chutes. The nymphs live well in captivity, especially in gauze-ended tanks in running water; the subimaginal stage has been found to last about two days. The nymph crawls at least partially out of the water before hatching.

Remarks.—This species is evidently closely related to *natalica* and *argus*, but is easily distinguished by the form of the ♂ penis.

Genus *Adenophlebia* Eaton.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 111, 1884.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 240, 1932.

A fourth South African species of this genus is described below. All four species are closely related and only separable with certainty by the comparison of numbers of individuals, since their characters are variable and often require statistical analysis. The new species, *sylvatica*, is not easily separable from *auriculata* unless adequate material is available, since the differences in size, number of cross-veins, and pigmentation are not always conclusive in individual cases. The nymphal gills form a useful criterion, but even in this character there is considerable variation within each species. However, the morphological differences, although largely of a statistical nature, seem to be sufficient to justify the specific separation of *sylvatica*.

Adenophlebia auriculata Eaton. Text-figs. 35 and 36.

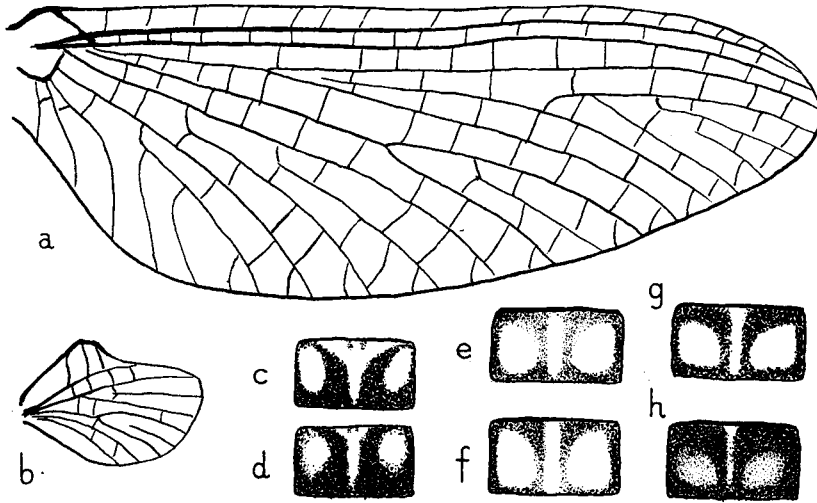
Barnard, *loc. cit.*, p. 242, 1932.

Localities.—Woest Hill, Grahamstown; Pirie Forest, near Kingwilliamstown; Fenfield, Amatolas; Ford Donald, Pondoland; Kokstad, East Griqualand; Curry's Post, and Karkloof districts; Cathkin Peak area; all the rivers examined in Natal; Basutoland, 10,000 ft. (K. M. Pennington); Mont-aux-Sources summit, March, 1946 (R. F. Lawrence).

Remarks.—This has been found to be among the commonest and most widespread of Natal and Eastern Cape May-flies. It is also extremely variable, especially in pigmentation; moreover, such characters as the numbers of cross-veins and the form of the nymphal gills are far from constant. The typical form of imago from Grahamstown and from parts of Natal is a "sherry

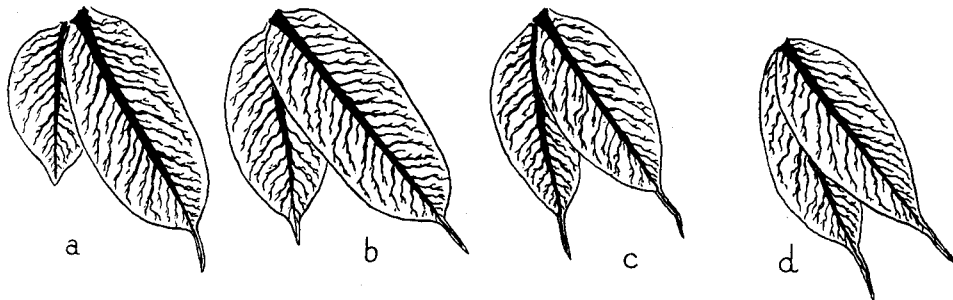
spinner"; the thorax is dark, with fulvous and light brown areas and sherry-coloured suffusion, especially at the wing-bases, and all along the costal margin of the wing, the neuration of which is a light warm brown, with the anterior

TEXT-FIG. 35.



Adenophlebia sylvatica n.sp. ♂ Imago: *a, b*, fore- and hind-wings; *c* and *d*, two types of abdominal pattern. *A. auriculata* Eaton. *e, f, g, h*, variations in abdominal pattern.

TEXT-FIG. 36.



Adenophlebia nymphal gills. *a, b*, *auriculata* Eaton; *c, d*, *sylvatica* n. sp.

and proximal cross-veins thickened. The abdomen is fulvous, with sherry-brown submedian marks, extending to a darker segmental border. This form seems to be confined to small, moderately shaded streams. Another type of coloration occurs in specimens from the larger streams and rivers, particularly in the foot-hills of the Drakensberg; it is much darker than typical *auriculata*, the thorax almost uniform piceous, with small fulvous areas laterally; abdo-

men dark with a pale median streak and more or less suffused pale areas dorso-laterally on each segment and narrow intersegmental whitish bands. These latter give a fasciated appearance to the abdomen, and this form might be known as *fasciata*. There can be no question of specific separation from *auriculata*, however, since there is no structural difference, and the opaque costal and subcostal areas and the thickened cross-veins (although the neuration is dark vandyke brown in *fasciata*) are still present. Further, all intergrading stages between the two forms occur, sometimes even in the same stream.

Nymph.—Indistinguishable structurally from *peringueyella*, except that the gills usually have the inner lamella without a filamentous point and only half the length of the outer lamella (as in the nymphs described by Barnard from Zwartberg, *loc. cit.*, p. 242, 1932). The colour varies from almost uniform pale with light brown marks, in the typical form, to the dark nymphs of *fasciata*, with the same body-pattern as the imago.

Adenophlebia sylvatica n.sp. Text-figs. 35 and 36.

Imago.—Cross-veins in fore-wing (averages): (a) In costal area before bulla, 6-7. (b) In costal area after bulla, 10-11. (c) In subcostal area, 16. (d) In subradial area, 11. (e) Between R_{4+5} and MA_1 , 11. (f) Between MA_1 and M_{1+2} , 9. (g) Between M_{3+4} and Cu_1 , 3-4. (h) Between Cu_1 and 1st ICu_1 , 2-3. Penis and genital styles of ♂ as in other species of *Adenophlebia*.

♂. Head umber, eyes black, ocelli white with dark bases; turbinate eyes deep raw sienna. Prothorax umber, with piceous posterior and lateral borders. Meso- and metathorax piceous above and below, with small fulvous markings and pale joinings laterally. Scutellum dark. Abdominal segments with medio-dorsal pale ochraceous or whitish areas narrowing posteriorly, and dorsolateral areas of the same colour, separated by forwardly curving extensions of the deep brown or black that occupies the posterior part of the segment; two small submedian dark dots anteriorly. Ventrally ochraceous, suffused with brownish, indistinct raw umber bands curving forwards from each side to meet a similar median band, with small white submedian spots. Legs whitish femora suffused with bright fulvous, and with median and terminal dark bands. Cerci and genital styles olive-brown, the former uniform. Wings clear, no suffusion in pterostigmal area; neuration brown, bases of strong veins often somewhat fulvous, especially where humeral brace vein joins Sc and R_1 . ♀ not so dark and more fulvous.

Body, ♂ 7.5-10.5 mm., ♀ 8-12 mm.; wing, ♂ 7-10 mm., ♀ 8-10 mm.; cerci, 15-20 mm.

Subimago.—Similar, but paler and duller. Scutum of mesothorax pale, with dark borders, and submedian dark streaks. Abdominal pattern less distinct than in imago, and the dark less extreme, but occupying a slightly greater area. Wings greyish, neuration dull brown.

Nymph.—Gills with inner and outer lamellæ subequal, both with filamentous points. Other characters as in *peringueyella* and *auriculata*.

Head mottled brown, eyes black. Prothorax light brown, with dark patches and streaks, and dark lateral and posterior borders. Mesothorax slightly darker, with a black dot corresponding to the humeral brace vein of the imago. Metathorax similar to prothorax. Abdomen showing pattern of imago, but less distinctly, the pale dorsolateral areas tending to disappear in a brownish suffusion extending from the blackish posterior part of each segment. The pale median streak always remains, and the terminal segment is entirely whitish. Ventrally ochraceous olive, with small median amber areas increasing on the posterior segments, absent on last. Legs pale ochraceous, femora with a large dark blotch in the middle and a small one terminally. Cerci olive-brown, uniform. Gills opaque greyish, tracheæ dark.

Body up to 13 mm.

Localities.—Hogsback, 1.xii.40, and Fenfield, April, 1944 (A. Perks), Amatola Mts.; Furth stream, Dargle; Reekie Lynn, Kamberg; all the small forest streams examined in the Curry's Post and Karkloof districts.

Habits.—The nymphs are plentiful in the forest streams inhabited by *Aprionyx tricuspoidatus*, but are less restricted in the type of situation they occupy, being found under stones both in rapid water and in pools. Like other *Adenophlebia* nymphs they live well in captivity, and hatch successfully if provided with some object on which they can crawl out of the water. Subimagos of this species and the last have been found to shed their pellicle from two to five days after emergence. Imagos appear, like *auriculata*, throughout the year, but most abundantly in early summer. Both these species are active during the hot part of the day, and are to be seen dancing in swarms, and sitting on grass or other vegetation. Both imagos and subimagos are active runners and, the former particularly, are often slow to take wing when disturbed.

Remarks.—The following table, which is based on numerous individuals, summarizes the relevant characters of the two Natal species. The body-

	<i>auriculata</i>	<i>sylvatica.</i>		<i>auriculata.</i>	<i>sylvatica.</i>
a .	(5)7(8)	(5)6-7	} Length of wing (mm.)	♂ 10±1.5	♂ 8.5±1.5
b .	(11)15(17)	(9)10-11		♀ 12.5±1.5	♀ 10±2
c .	(13)18(22)	(13)16(20)	} Colour of wing	Costal margin coloured. Cross-veins thickened	Costal margin clear. Cross-veins not thickened
d .	(10)13(16)	(9)11(13)			
e .	(11)12(13)	(9)11(13)	} Nymphal gills	Inner lamella shorter than outer, and without filamentous point	Inner lamella subequal to outer, and with a filamentous point
f .	(9)11(12)	(6)9(10)			
g .	(4)5(6)	3-4			
h .	(3)4(5)	2-3			

pattern of the imago is an additional character that is useful for separating the two species (see text-fig. 34), but it is very variable and therefore cannot be relied upon alone.

The letters a, b, c, etc., refer to the numbers of cross-veins in the various areas of the fore-wing referred to in the specific diagnosis of *sylvatica*. In each case the average number is given, with the extreme figures in brackets on each side.

Genus *Euphlebia* n. genus.

Imago.—Tarsal claws both alike, apically hooked. Venation of wings similar to that of *Adenophlebia*, but costal margin of hind-wing less strongly convex, approaching the form of *Aprionyx*; costal area broader than subcostal. Ventral plate of ♀ apically truncated, entire, 10th sternite of ♂ undivided. Genital styles 3-jointed, basal joint elongate, its inner margin forming an angular bend; terminal joints short. Penis broad, flattened dorso-ventrally, deeply cleft; lobes divergent, slightly tapering, each with an apical inwardly-directed acute elongate process, through which the vas deferens passes.

Nymph.—Legs elongate; claws narrow, finely denticulate. Shoulder of prothorax with a small patch of spines. Antennæ long. Labrum apically incised, without denticulations. Mandible with prostheca, and resembling *Adenophlebia*. Maxilla of the usual type, but without pectinate spines. Median lobe of hypopharynx with small narrow apical incision; outer lobes with lateral upward-curving processes. Labium with much elongated inner lobes that are freely movable, and can be folded back against their bases. Gills, 6 pairs; 1st single, operculiform; 2nd–6th bilamellate, each lamella broad apically incised, with much-branched tracheation.

Egg.—Oval, the ends somewhat pointed. Smooth, without pits or projections; but with numerous attachment threads arising irregularly over the surface.

Remarks.—This genus shows a number of very remarkable characters. Thus the nymph has only six pairs of gills, instead of seven, as in other Leptophlebiids; while the operculiform nature of the 1st gill is reminiscent of the *Brachycercidæ* and *Ephemerellidæ*. It also differs in the absence of pectinate spines on the maxilla, which are possessed by other members of the family. The long, articulated, inner lobes of the labium seem to be *sui generis*. The egg, with its attachment threads, is also aberrant. These peculiar features would almost seem to be of sub-family rank; however, except in the ♂ penis, which differs rather markedly from that of other genera, the imago is a fairly typical Leptophlebiid, resembling *Adenophlebia* in venational characters.

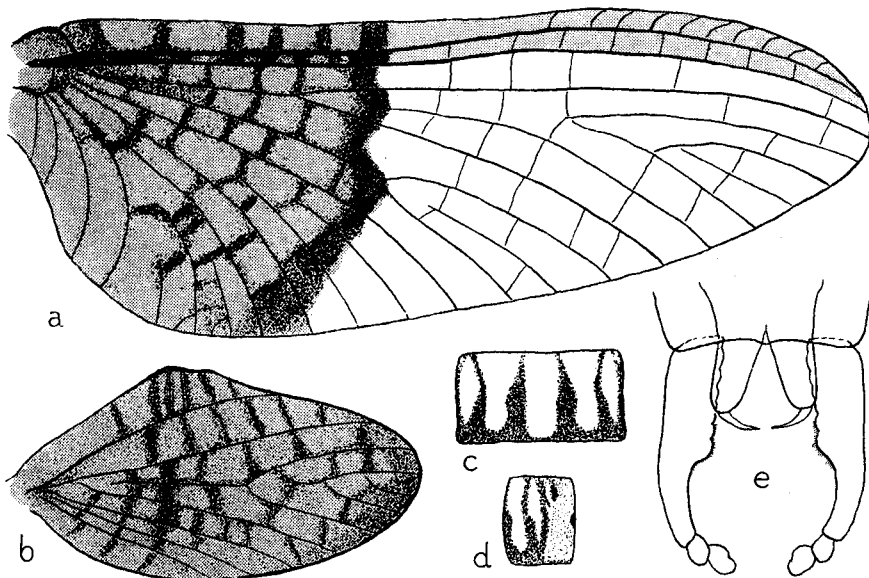
Euphlebia bicolor n.sp. Text-figs. 37 and 38.

Imago.—Five to seven thickened subcostal cross-veins before bulla, and 7–10 fine curved ones in pterostigmal area. In hind-wing summit of costal

margin slightly before middle of wing ; costa thickened in this region. Inner margin of basal joint of genital styles proximally irregular and sharply curved outwards slightly beyond half-way.

♂. Head castaneous, mottled with sepia ; eyes brown, ocelli white-tipped with dark bases ; turbinate eyes dull castaneous. Prothorax castaneous, with sepia areas and pale markings laterally ; meso- and metathorax dark, almost piceous, above and below, with lateral castaneous areas and pale areas between the sclerites. Scutellum pale, with dark border. Abdominal segment I

TEXT-FIG. 37.

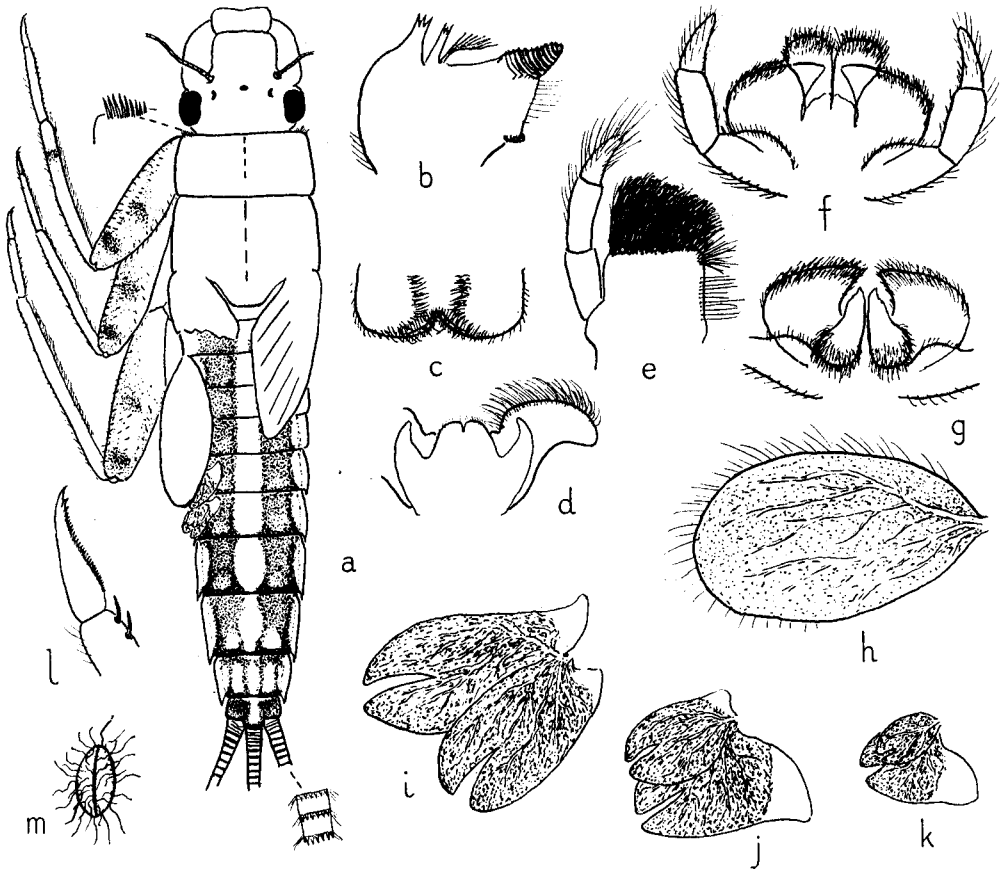


Euphlebia bicolor n. gen. et sp. ♂ Imago : *a, b*, fore- and hind-wings ; *c, d*, dorsal and lateral pattern of abdominal segment V ; *e*, penis and forceps of ♂.

dark anteriorly, with a castaneous posterior area ; segments II–VIII dorsally pale castaneous, with sepia lateral and posterior borders, and two sepia markings extending forwards on each side from the posterior border ; on anterior segments both markings broad, and occupying the greater part of the dorsal surface ; on posterior segments becoming narrower, especially the outer, forming dark bands on the pale ground-colour, which becomes tinged with fulvous. Segments IX and X mostly dark brown, with paler areas, the whole suffused with fulvous. Abdomen ventrally umber, with a median and an antero-lateral dark dot on each of segments I–VIII ; pleuræ whitish. Legs pale brownish, femora with median and terminal sepia blotches. Cerci whitish with conspicuous dark, non-segmental annulations. Fore-wing proximally

suffused with bright pale brown up to an irregular chocolate band, which extends across the wing; within the coloured area cross-veins are strongly thickened with chocolate markings. Distal part of wing clear except costal

TEXT-FIG. 38.



Euphlebia bicolor n. gen. et sp. *a*, nymph; *b*, mandible; *c*, labrum; *d*, hypopharynx; *e*, maxilla; *f*, labium, with inner lobes extended; *g*, labium, with inner lobes folded down; *h*, *i*, *j*, *k*, 1st, 3rd, 5th and 6th gills; *l*, claw; *m*, egg.

and subcostal areas, which are suffused opaque white, with a bright chrome yellow patch at the end (disappears in alcohol); neuration bright fulvous brown. Hind-wing coloured like proximal region of fore-wing. Genital styles dark, 2nd and 3rd joints and end of 1st pale whitish.

Subimago.—♀. Head grey, ocelli shining piceous, eyes light brown with dark marks. Prothorax brownish-grey, with dark markings; mesothorax

pale castaneous, merging into grey and vandyke brown areas; metathorax grey, with dark areas. Abdomen pale grey, with brown pattern similar to nymph, and posterior dorso-lateral white spots on each segment. Legs and cerci similar to imago. Wing-membrane opaque, washed with brown, and blotched with sepia; in pterostigmal area three blotches of sepia alternating with bright ochraceous areas extending down to R_1 . Irregular dark band across wing as in imago, but region proximal to this not so highly pigmented; distal part almost equally coloured; both proximal and distal cross-veins heavily thickened with brown, dark proximally, and light greyish brown beyond the band.

Egg.—(Removed from ♀ subimago.) Nearly twice as long as broad, long diameter 0.25 mm. Numerous attachment threads arising from the smooth surface, while in the body wrapped round the egg, but uncurling when placed in liquid. Pale yellow, with four longitudinal dark bands.

Body, ♂ 7–7.5 mm., ♀ (subimago) 8–9 mm.; wing, ♂ 7–7.5 mm., ♀ 9–10 mm.; hind-wing, *c.* 2 mm.; cerci, ♂ 16 mm.

Nymph.—1st gill single, operculiform, fringed with setæ, and covering all but the last pair of succeeding gills, which are bilamellate, progressively reduced in size posteriorly. The upper (inner) lamella is the smaller, especially in the last pairs, the lower lamellæ becoming shorter and broader with a marked posterior extension, which is transparent in contrast to the opaque, granular appearance of the rest of the gill-surface. Both lamellæ are deeply incised apically. Abdominal segments VI–IX laterally acuminate. Cerci feebly setose.

Head ochraceous, with brown markings and mottlings; eyes black. Thorax castaneous brown, with darker mottlings and pale ochraceous marks, chiefly laterally; in moderately mature specimens the proximal part of the wing-case is spotted and blotched with dark brown, indicating the future imaginal wing colour. Abdomen ochraceous to fulvous medio-dorsally and latero-dorsally; on segments I–V almost uniform broad submedian bands of deep castaneous with brown edges; on segments VI–IX the lateral and posterior borders of these bands become darker, almost black, and the castaneous brighter, while posterior pale areas within each band increase in distinctness and size with each segment. Segment pale along median line, otherwise deep castaneous brown. Ventrally fulvous-olive, with faint brownish marks on each segment. Legs ochraceous, with two dark marks on the femora and one on the 1st tibia. Gills opaque greyish, tracheæ pale. Cerci pale ochraceous with brownish annulations proximally.

Body up to 9–10 mm.; cerci, *c.* 15 mm.

Localities.—Fort Donald, Pondoland, 10.ii.41 (J. A. Crass); Reekie Lynn, Kamberg, 19.i.44; Yarrow stream, Jan. and Feb., 1944 (nymphs).

Habits.—The nymphs live in still deep stretches of water, where there is little current, and cover in the form of trailing herbage and vegetable detritus.

There would be quantities of foreign matter in such a situation that might interfere with the gills, unless they were specially adapted, as would seem to be the case. The only nymph kept in captivity lived for nine days, and then emerged successfully. Imagos have been taken dancing at midday, and are swift and powerful fliers.

Remarks.—Imagos of this very interesting species can readily be recognized by the distinctive appearance of the wings. It is apparently a fairly widespread May-fly, but it is far from common.

Genus *Castanophlebia* Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 244, 1932.

Castanophlebia calida Brnrd.

Barnard, *loc. cit.*, p. 246, 1932.

Localities.—Hogsback, Amatolas; Kokstad, East Griqualand; Curry's Post, Karkloof, and Cathkin Peak districts; Mooi, Little Mooi, Yarrow and Umgeni rivers.

Habits.—This has been found to be a plentiful Natal and eastern Cape species. It is chiefly an inhabitant of swift mountain streams, and is especially common in those that are shaded by forest. The nymphs are not as hardy in captivity as most Leptophlebiids, but they live more readily than Bætidæ from similar localities. The subimaginal stage has been found to last up to two days.

Remarks.—Natal specimens are identical with the type in every respect except the inner branch of the 7th gill. In western Cape nymphs this structure is much reduced, whereas in the specimens I have examined it is nearly as long as the outer branch, and the 7th gill resembles the 1st–6th.

Genus *Choroerpes* Eaton.

Eaton, Trans. Linn. Soc. Lond., zool., vol. iii, p. 104, 1884.

Choroerpes nigrescens Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 248, 1932.

Locality.—A single ♀ imago from Fenfield, Amatolas, Feb., 1942, seems to belong to this species.

Genus *Euthraulius* Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 249, 1932.

Euthraulius elegans Brnrd.

Barnard, *loc. cit.*, p. 249, 1932.

Localities.—Kokstad, East Griqualand, 4.xii.40 and 11.xii.40 (subimagos captured at light); Curry's Post and Karkloof districts; lower Sterk

Spruit, Cathkin Peak area ; Mooi, Little Mooi, Yarrow, Umgeni and Lions rivers.

Remarks.—A fairly common species in the less torrential parts of rivers and streams. A noteworthy feature is the variation in size ; specimens from 5 to 8 mm. wing-length have been taken.

Family EPHEMERELLIDÆ.

Genus *Lithoglæa* Brnrd.

Lithoglæa harrisoni Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 253, 1932.

Locality.—Two small nymphs (c. 4 mm.) from Hogsback, Amatolas, July, 1941, are structurally indistinguishable from that figured by Barnard.

Suborder HEPTAGENIOIDEA.

Family ECDYONURIDÆ.

Genus *Afronurus* Lest.

Lestage, Rev. Zool. Afric., vol. xii, p. 349, 1924.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 255, 1932.

Afronurus peringueyi (E.-P.).

Esben-Petersen, Ann. S. Afr. Mus., vol. x, p. 185, 1913.

Localities.—Amatola Mts. ; Kokstad, East Griqualand ; Curry's Post, Karkloof, Dargle, and Cathkin Peak areas ; Umzimkulu, Loteni, Mooi, Little Mooi, Umgeni, Lions, Yarrow and Karkloof rivers.

Remarks.—This is an abundant Natal species, but not so common as *harrisoni*. The nymph assigned to this species has now been bred in captivity, and the assignment confirmed.

Afronurus harrisoni Brnrd.

Barnard, Trans. Roy. Soc. S. Afr., vol. xx, p. 257, 1932.

Localities.—All the above localities, and in addition a few small streams in which *peringueyi* has not been found. The nymphs are extremely plentiful and have been taken in all the perennial streams examined, except forest streams that are densely shaded. They are commonest in swift water, where there are rocks to which they can cling, but also extend to still deep stretches of river. Imago hatch throughout the summer, most abundantly about December–February.

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