

A Preliminary Account of the East African Species of *Cloeon* Leach and *Rhithrocloeon* gen. n. (Ephemeroptera)

by

M. T. GILLIES

GILLIES, M. T.: A Preliminary Account of the East African Species of *Cloeon* Leach and *Rhithrocloeon* gen. n. (Ephemeroptera).
Aquatic Insects 7, 1985, No. 1, pp. 1-17.

Keys are given to males and females of 12 species of *Cloeon* known from Eastern Africa, including descriptions of *C. amaniensis* sp.n. and *C. tanzaniae* sp.n.. The new genus *Rhithrocloeon*, presumed to be a torrential form, is defined in terms of the character of the male forceps and the proportions of hind tarsal segments. Two species, *permirum* Kopelke and *insuetum* Kopelke from Eastern Zaire, formerly included in *Cloeon*, are transferred to *Rhithrocloeon*, and one new species, *R. indicator* sp.n. is described from Tanzania.

M. T. GILLIES, Whitfeld, Hamsey, Lewes, Sussex BN8 5TD, ENGLAND.

In an earlier paper I gave an introductory account of the genus *Cloeon* in West Africa, covering the 9 species known from the region at that time (Gillies, 1980). Keys were provided for males and females, together with descriptions of the nymphs of 6 species. The present paper deals with East Africa which, for these purposes, covers the eastern half of tropical Africa north of the Zambezi, including the High Shaba Province of Zaire. A record from south-west Arabia, which from a zoogeographical point of view is part of the Afrotropical Region, is also included.

This task has been made easier by the fact that the mayfly fauna of certain of the Great Lakes has been relatively well studied, while a number of species of *Cloeon* have been described from Zaire. These locally intensive studies have been supplemented by my own collections, made in spare moments and widely scattered localities, which together make it possible to give a preliminary account of the fauna. Small bodies of water in the cooler, highland areas have received relatively little attention although I have recently acquired a valuable series of reared adults from pools near Nairobi, collected by Dr. Alan Hildrew. It is here

that species originally described from South Africa might be expected to occur. The fact that up to now, apart from *C. virgiliæ* Barnard and the ubiquitous *C. perkinsi* Barnard, none of the southern forms have yet been established as occurring to the north may be connected with the paucity of collecting in the tropical highlands.

Kopelke (1980) described two species of *Cloeon*, *C. permirum* and *C. insuetum*, from eastern Zaire, the males of which possess forceps that are quite different from any other known species of *Cloeon* or, for that matter, from any other Baetid genus. A third species of this group occurs in Tanzania. For ecological as well as morphological reasons these 3 species are transferred to the new genus, *Rhithroclleon*.

This paper is intended to complement the study on West African *Cloeon* already published, and the descriptions and figures of species included there are not reproduced here. It is suggested that, when *Cloeon* species are being studied, it might be found useful to consult both.

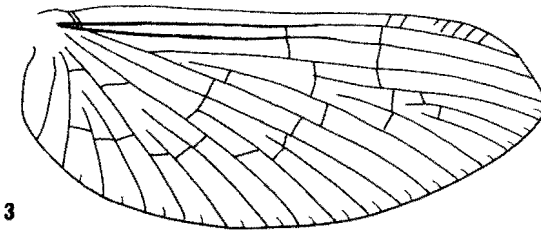
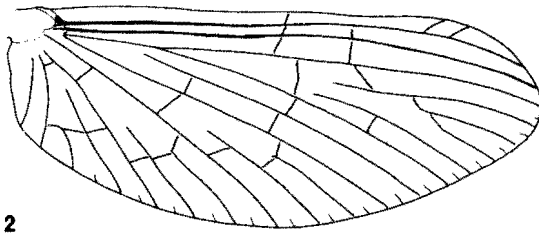
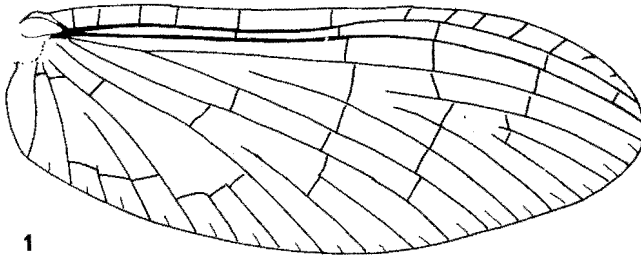
The adults of *Cloeon* are defined as possessing single marginal intercalaries and as lacking a hind wing. This definition also covers the problematical species *Centroptilium crassi* Demoulin from South Africa, whose generic position is still uncertain. It also covers certain species of *Afrobaetodes* Demoulin (see Gillies, 1979a) as well as the species now transferred to *Rhithroclleon*. Generic definitions in the Baetidae are strongly influenced by nymphal characters. But, since in only a minority of cases have the adults and nymphs of Afrotropical species been correlated, it is not possible at the present time to compile a reliable generic key to the family as a whole. The following key, however, should serve to separate the adults of *Cloeon* and *Rhithroclleon* from all other known forms.

PARTIAL KEY TO GENERA
OF EAST AFRICAN BAETIDAE (ADULTS)

1. Marginal intercalaries double *Baetis*, *Acentrella*, and *Pseudocloeon*
- Marginal intercalaries single 2
2. Hind wing present *Centroptiloides*, *Centroptilium*, and *Afrobaetodes* (in part)
- Hind wing absent 3
3. Wing 3 mm or less; body squat, abdomen about equal to length of head and thorax together
- *Afrobaetodes* (in part)
- Wing usually much longer than 3 mm; body elongate, abdomen much longer than head and thorax together 4
4. Second hind tarsal segment equal to 2-3 times length of third; male forceps with small or minute third segment *Cloeon**
- Second hind tarsal segment equal to 1.2 - 1.5 times length of third; male forceps with two segments only *Rhithroclleon*

The following table lists the known species of Afrotropical *Cloeon*, as recognised at the present time.

* In South Africa, *Centroptilium crassi* may key out here, since the proportions of the hind tarsal segments have not been described. The third segment of the male forceps is hooked, almost in the shape of a parrot's beak, and therefore quite unlike *Cloeon*.



Figs. 1-3. Wings of *Cloeon* and *Rhithroclaeon* spp., 1, *Cloeon amaniensis*; 2, *C. tanzaniae*; 3, *Rhithroclaeon indicator*.

The keys presented here cover the species known to occur in East Africa, north of the Zambezi, and also include the West African species *C. bellum* Navás not as yet recorded from this area. Those using the keys are warned that they may not always be reliable in specimens whose markings have faded through long preservation in fluid.

Table 1. Recorded distribution of Afrotropical *Cloeon* and *Rhithrocloeon*.

	Southern Africa south of		East Africa	West Africa	South-west Arabia
	Limpopo	Zambezi			
<i>Cloeon</i>					
<i>aeneum</i> Barnard	+	?			
<i>africanum</i> Esb. Petersen	+				
<i>agnewi</i> Hubbard	+				
<i>amaniensis</i> sp. n.			+		
<i>areolatum</i> Navas			+	+	
<i>bellum</i> Navas				+	
<i>chaplani</i> Barnard	+				
<i>crassi</i> Agnew	+				
<i>cylindroculum</i> (Kimmins)			+	+	
<i>dentatum</i> Kimmins			+	+	
<i>elevatum</i> Agnew	+				
<i>exiguum</i> (Crass)	+				
<i>gambiae</i> Gillies				+	
<i>lacunosum</i> Barnard	+				
<i>perkinsi</i> Barnard	+		+	+	
<i>rhodesiae</i> Barnard		+	+	+	
<i>scitulum</i> Kimmins			+	+	
<i>smaeleni</i> Lestage			+	+	
<i>tanzaniae</i> sp. n.			+		+
<i>virgiliae</i> (Barnard)	+	+	+		
<i>viridellum</i> Lestage			+		
<i>Rhithrocloeon</i>					
<i>indicator</i> sp. n.			+		
<i>insuetum</i> (Kopelke)			+		
<i>permirum</i> (Kopelke)			+		

KEYS TO EAST AFRICAN SPECIES OF CLOEON

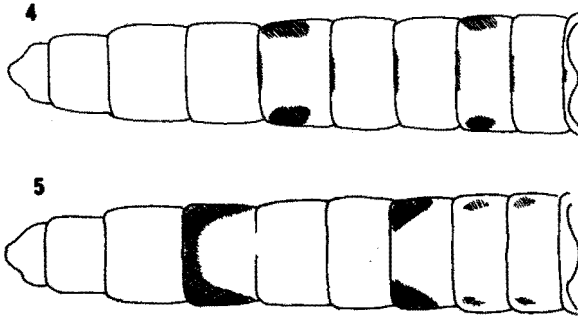
FEMALES

1. Costal and subcostal areas of wing unpigmented 2
- Costal and subcostal areas wholly or partly pigmented 6
2. Pterostigma with a single cross-vein; abdominal markings consisting of a continuous white, and an interrupted purple, lateral line *cylindroculum*
- Pterostigma with 2 or more cross-veins; abdominal markings otherwise 3
3. Pterostigma with 2 cross-veins 4
- Pterostigma with 4-6 cross-veins 5
4. Abdominal markings maximal on terga III and VI; all terga from II-IX with lateral markings, overlaid on III and VI with deep maroon, dorso-lateral patches; fore femur with a narrow, red, longitudinal line *scitulum*
- Abdominal markings maximal on IV and VII, these terga bearing large, burnt-umber, dorso-lateral triangles; fore femur uniformly red *tanzaniae*
5. Abdominal terga with strong markings, maximal on III and VI; vein MA2 not extending more than about 3/4 distance to cross-vein between MA1 and MP1 *amaniensis*
- Abdominal terga not so; vein MA2 extending up to or almost to cross-vein between MA1 and MP1 *dentatum*

6. Costal and subcostal areas faintly but uniformly amber; abdominal terga with medio-dorsal, claret stripe, faint posteriorly, and with lateral patches on terga I-III and V *virgiliae*
 — Costal and subcostal areas either strongly tinted brown, with clear windows round cross-veins, or with markings towards the apex of wing only; abdomen not so 7
7. Costal area yellowish brown, contrasting with deep chestnut brown of subcostal area; abdominal terga red with submedian yellow, and median red, lines *perkinsi*
 — Wings and abdomen not so 8
8. Both costal and subcostal areas brown throughout whole length 9
 — Costal area either unpigmented or with dark pigment limited to outer half 10
9. Outer half of wing with a number of oblique cross-veins near posterior margin; abdominal markings maximal on terga II, III and VI; hind tarsus 2 twice as long as tarsus 3 *bellum*
 — No oblique cross-veins near posterior margin of wing; abdomen evenly marked on most segments; hind tarsus 2 three times tarsus 3 *smaeleni*
10. Outer third of costal area and most of subcostal area lightly pigmented with clear windows round most cross-veins *areolatum*
 — Outer third of subcostal area very pale brown, preceded on the basal side by 2 conspicuous pitchbrown spots; pterostigmatic cross-veins strongly pigmented orange *rhodesiae*

MALES

1. Pterostigma with a single cross-vein; lateral margins of abdominal terga with a broad, opaque, white line extending along whole length of abdomen *cylindrocolum*
 — Pterostigma with 2 or more cross-veins; abdominal markings not so 2
2. Turbinate eyes cylindrical and waisted, 1.5 times as tall as broad *areolatum*
 — Eyes not cylindrical, as broad as or broader than tall 3
3. Terminal segment of forceps about as broad as second segment, which has a prominent tooth at the extreme base *dentatum*
 — Terminal segment of forceps minute, much narrower than second segment which lacks an internal tooth 4
4. Second hind tarsal segment three times as long as third 5
 — Second hind tarsal segment twice to 2.5 times as long as third 7
5. Fore femur deep reddish-brown, other femora pale; abdominal terga II-VII with broad, lateral, reddish markings, tending to meet in the middle *smaeleni*
 — All femora orange or pale with preapical spots; abdominal terga not so 6
6. Tails with dark red annulations; abdominal terga with broad, purplish triangles on III and VI *rhodesiae*
 — Tails white, without dark annulations; terga with dark, dorso-lateral markings on II, III and VII *tanzaniae*
7. Thorax blackish-brown; abdominal terga II-VII white with faint red triangles on III and VI; pterostigma with 2 cross-veins *scitulum*
 — Thorax pale or medium brown; abdomen otherwise; pterostigma cross-veins variable in number 8
8. Fore femur with subapical, median and subbasal dark spots; abdominal terga dark brown with paired, pale, submedian markings on terga II-VII and a pale spot in the mid line on the posterior border of II-VI *viridellum*
 — Fore femur without dark spots; abdominal terga not so 9
- Abdominal terga II-VIII generally pink with a central cream band and often with a median pink line *perkinsi*
 — Abdominal markings otherwise 10
10. Outer half of wing with a series of oblique cross-veins near posterior margin *bellum*
 — No oblique cross-veins near posterior margin 11
11. Costal and subcostal areas faintly tinted yellow; anterior abdominal terga with medio-dorsal, dark stripe and diffuse lateral patches not especially concentrated on III and VI *virgiliae*
 — Costal and subcostal areas clear; abdominal terga III and VI with dark red, postero-lateral triangles *amaniensis*



Figs. 4-5. Female abdominal markings of *Cloeon* spp., 4, *C. amaniensis*; 5 *C. tanzaniae*.

NYMPHS

The diagnostic characters of the nymphs of East African species of *Cloeon* are given below. Those of *areolatum*, *dentatum*, *rhodesiae* and *viridellum* are not known, while the description of *virgilliae*, although precise, omits details of the diagnostically important spines on the abdominal margins. Apart from the characters listed in the table, it may be noted that in *cylindroculum* the upper gill lamella is much reduced and on segments V and VI (not V and VII as, due to a printer's error, the description in Gillies, 1980, had it) is rudimentary. In this it resembles the South African species, *C. africanum*, except that in the latter species the upper gill lamella on segment VI is absent. In counting the lateral spines for identification, the spine on the posterior angle of segments VIII and IX is included in the count since it forms part of a continuous line of spines down the margin. Only in the case of *tanzaniae* is this spine the only one present on segment VIII. On the other segments it is convenient to ignore the spine at the posterior angle, since it is present in all species, and one simply notes the number of spines, or their absence, in the central part of the lateral margin.

An account of the status of the East African *Cloeon* follows, including descriptions of two new species. For synoptic descriptions and figures of the other species, the reader is referred to Gillies (1980) or to other sources where indicated.

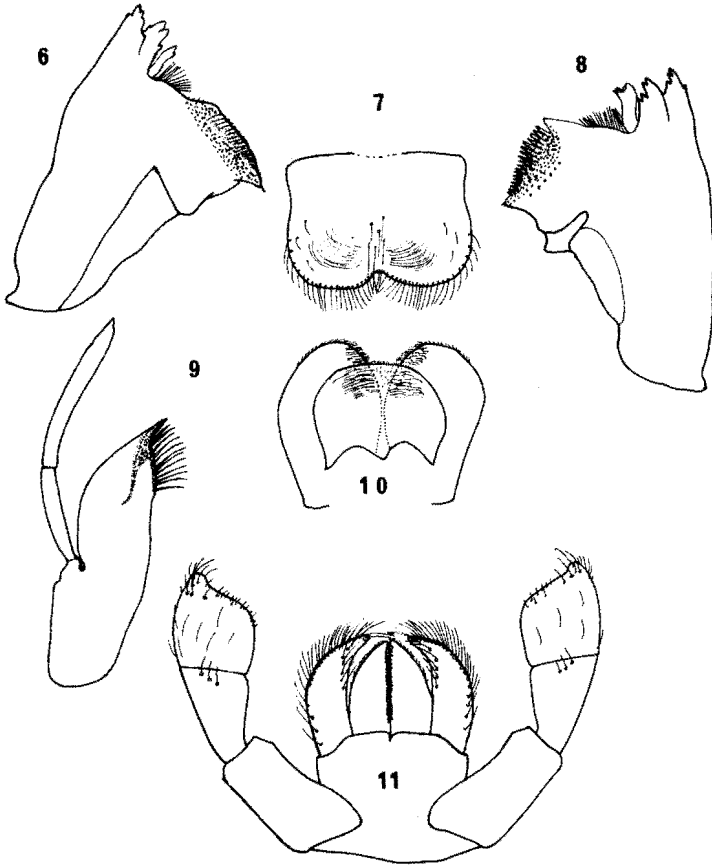
Cloeon africanum Esb. Pet.

As previously, I am treating all the older records of *africanum* from tropical Africa as being due to confusion with some other species, possibly in some cases with *cylindroculum*. The description given by Ulmer (1924) of '*africanum*' from the Algerian Sahara and Kinchasa, as well as those referred to by him as '*C. marginale* Hag. (?)' from Kinshasa and the Sudan (Ulmer, 1916), clearly refer to *C. perkinsi*. On this interpretation, *C. africanum* is at present to be regarded as a purely southern species.

Cloeon amaniensis sp. n.

A large species, the female with clear wings, the abdomen in both sexes with markings maximal on terga III and VI; maxillary palps of nymph with 2 segments.

Male imago (in spirit). Turbinate eyes, head and thorax pale orange; femora pale orange, tibiae and tarsi colourless, hind tarsal segment 2 equal to almost 2.5 times segment 3; wing veins clear except for dark red base of costal brace, no cross-veins before bulla, pterostigma with 2-4 cross-veins. Abdominal segments II-VI translucent, dark red postero-lateral triangles on terga III and VI, forceps typical of the genus with minute, globular terminal segment, tails ringed.



Figs. 6-11. Mouthparts of *Cloeon amaniensis*. 6 right mandible; 7 labrum; 8 left mandible; 9 maxilla; 10 hypopharynx; 11 labium.

Female imago (in spirit). Body generally pale orange; femora pale orange, tibiae and tarsi colourless, hind tarsal ratio as in male; wing membrane colourless, basal half of costal brace at junction with R1 dark red, a similar dark spot at junction of R4-5 and MA; venation strongly developed (fig. 1), 4-5 cross-veins before bulla, stigma with 4-6 cross-veins; abdominal terga III and VI with postero-lateral dark red patches, median third of posterior margins of segments II-VI with narrow, transverse, dark red bands (fig. 4), lateral margins of sterna IV-VI each with a small longitudinal red streak, tails with alternating broad and narrow, red rings at joints.

Body, male 6.5-7.0 mm, female 8.0 mm; wing, male 6.5 mm, female 8.0 mm.

Nymph. Labial palps stout, clavate, maxillary palps with 2 segments (fig. 9); tarsal claws long with a double row of long teeth (fig. 14); upper gill lamellae well developed, present on gills I-VI; lateral abdominal spines present on segment VII (0-1), VIII (5-8), IX (8-10), (fig. 12).

Holotype female imago, TANZANIA: Amani lake, 900 m, 25.vii.61, in British Museum (Natural History). Paratypes, 2 male imagines, 1 male subimago, 2 female subimagines, all with associated nymphal skins, same provenance, vi.61.

The female differs from all other African *Cloeon* by the combination of unpigmented wings, maximal abdominal markings on terga III and VI and stigma with more than 2 cross-veins. The male imago resembles *rhodesiae*, but differs in the proportions of the hind tarsal segments and in the absence of dark rings before the apices of the femora; the nymph is distinguished from other known species by the maxillary palps having 2 segments and by the absent or single lateral abdominal spine on segment VII; the denticles on the tarsal claws are also more prominent than in other described species.

Cloeon areolatum Navás

DISTRIBUTION IN EAST AFRICA. Uganda: Entebbe, Kampala (Kimmins, 1960).

The only other records of this species come from the Congo basin and West Africa, suggesting that it may primarily be a species of the West African zoogeographical zone.

Studies on West African material have shown that the abdominal pattern of females of *C. bellum*, as figured by Gillies (1980), are more variable than was thought and that confusion may arise with *C. areolatum*. In such cases, the absence of pigment in the basal half of the costal region in *areolatum*, and the presence of oblique, marginal cross-veins in *bellum* serve to separate them.

Cloeon cylindroculum (Kimmins)

DISTRIBUTION IN EAST AFRICA. Malawi: Tengadzi (Kimmins, 1955). Uganda: Entebbe, Jinja, Kaazi (Kimmins, 1960). Tanzania: Amani, Muheza, Korogwe, Pangani Falls, Gonja, Ifakara, Mwanza.

In recording emergence cycles on Lake Victoria, Tjønneland (1960) noted that *cylindroculum* could be "easily confused with some other species". It is interesting

to speculate as to whether he was referring to broad-eyed males of *cylindroculum* (see Gillies, 1979b, 1980) or possibly to *areolatum*, whose males are now known to have cylindrical eyes.

Cloeon dentatum Kimmins

DISTRIBUTION IN EAST AFRICA. Uganda: Jinja (Kimmins, 1956), Entebbe (Gillies, 1980).

Tjønneland (1960) recorded males swarming after sunrise at Jinja.

Cloeon perkinsi Barnard

DISTRIBUTION IN EAST AFRICA. Malawi: numerous localities (Kimmins, 1955). Uganda: Jinja, Entebbe, Kampala, Pakwach (Kimmins, 1960). Kenya: Naivasha (P. C. Barnard; also Demoulin, 1965, as *Cloeon* sp. no. 1), Rwiroti (A. Hildrew). Tanzania: Kigoma, Mwanza (Kimmins, 1960), Amani, Muheza, Gonja, Shinyanga; also Nyumba ya Mungu Reservoir, Korogwe (R. G. Bailey).

Probably the commonest and most widespread *Cloeon* in Africa. I have seen vast swarms of males, along with those of *scitulum*, swarming in the early morning sun in September, in the vicinity of Lake Kalimawe, near Gonja in Tanzania.

Cloeon rhodesiae Barnard

DISTRIBUTION IN EAST AFRICA. Uganda: Jinja, Entebbe, Kampala. Kenya: Kisumu. Tanzania: R. Malagarasi, Katara (all preceding records from Kimmins, 1960), also Amani, Muheza, Korogwe.

A widespread but apparently not an abundant species. The nymph is unknown.

Cloeon scitulum Kimmins

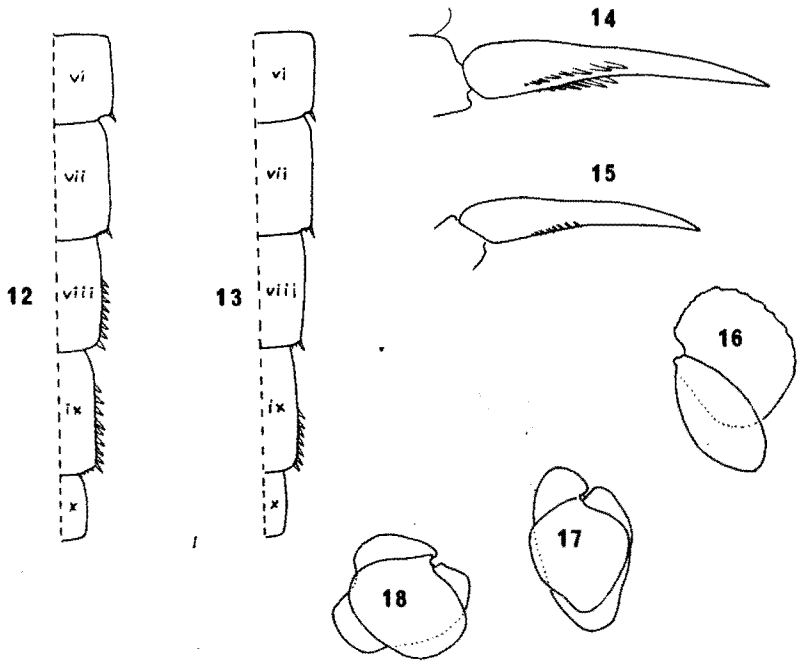
DISTRIBUTION IN EAST AFRICA. Malawi: Chiromo, Ntundu, Port Herald (Kimmins, 1955). Uganda: Jinja (Kimmins, 1960), Bugiri (Demoulin, 1965). Kenya: Kisumu, Rwiroti (A. Hildrew). Tanzania: Muheza, Gonja.

A widespread and frequently abundant species. The nymphs are found in permanent or semipermanent waters, occasionally in temporary pools.

Cloeon smaeleni Lestage

DISTRIBUTION IN EAST AFRICA. Malawi: numerous localities (Kimmins, 1955). Zaire: Lubumbushi, Shaba Province (Lestage, 1924). Uganda: Kampala (Kimmins, 1960). Kenya: Rwiroti (A. Hildrew). Tanzania: Amani, Muheza, Herkulu, Gonja, Ifakara. South Yemen: Sa'id, Wadi Yeshbum.

An ubiquitous species throughout tropical Africa. I have 4 females collected in South Yemen, which appear typical. They evidently represent the Afrotropical element in the fauna of south-west Arabia.



Figs. 12-13. Abdominal margins of *Cloeon* nymphs. 12, *C. amaniensis*; 13, *C. tanzaniae*.
 Figs. 14-15. Tarsal claws of *Cloeon* nymphs. 14, *C. amaniensis*; 15, *C. tanzaniae*.
 Figs. 16-18. Gill lamellae of *Cloeon tanzaniae*. 16, Gill I; 17, Gill III; 18, Gill VI.

Cloeon tanzaniae sp. n.

A clear-winged species in both sexes; in life, the female pale green with burnt caramel markings on terga IV and VII, in the male the same markings on II, III and VII; hind tarsus 2 three times as long as 3; maxillary palp of nymphs with 3 segments.

Male imago (in spirit). Turbinate eyes orange brown; body generally dark orange; femora orange, tibiae and tarsi clear; wings with 2 stigmatic cross-veins; abdominal terga I-III orange laterally, IV-VI clear, VII clear but in life with dark lateral markings, VIII-X dark orange; tails clear; forceps typical of the genus.

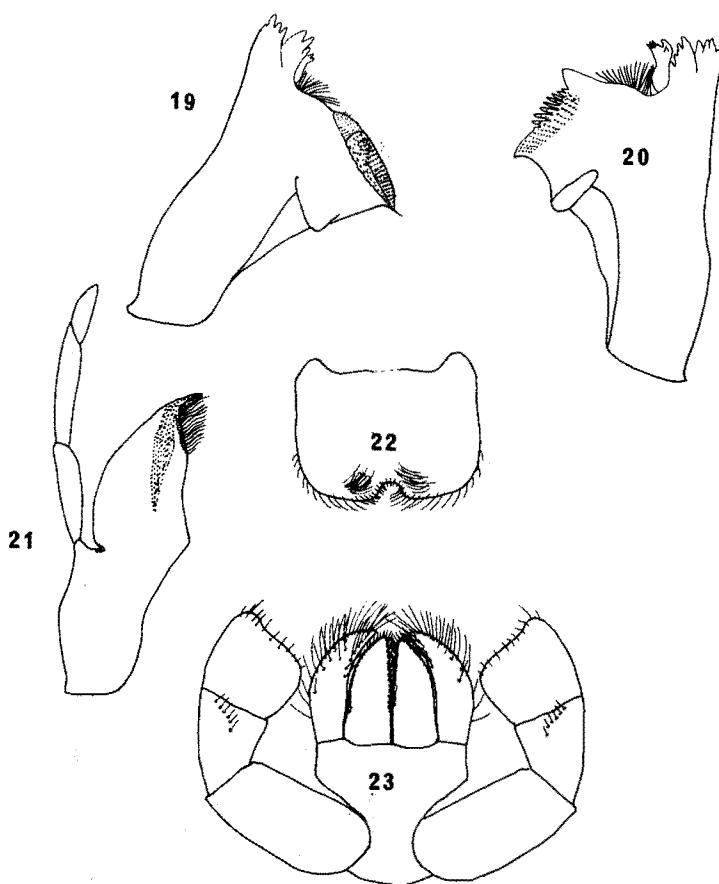
Female imago (in life). Generally pale green; pedicel of antenna brown at apex, base of filament likewise; thorax green, pronotum with median dark brown band, postero-lateral corners of mesonotum with discrete dark brown spots; fore femur and tibia reddish throughout, mid and hind femora faintly green with a red dot at extreme apex on inner side, tarsi clear; wings colourless (fig. 2) except for posterior half of costal brace and small portion of wing membrane together marked with a conspicuous umber spot (faded in preserved specimen); no cross-veins before bulla, 2 stigmatic cross-veins; abdomen pale green (fig. 5) with very small dashes of orange on lateral portions of terga II-VII, terga IV and VII with large, burnt

caramel triangles, that on VII forming a continuous bar across the middle, VIII colourless, IX and X white, orange posteriorly; tails with narrow, umber rings; venter unmarked.

Body, male 4.0-4.5 mm, female 5.0-6.0 mm; wings, male 4.0-4.5 mm, female 6.0 mm.

Nymph. Labial palps stout, clavate, maxillary palps with 3 segments (figs. 23, 21); tarsal claws with minute denticles (fig. 15); upper gill lamellae well developed on gills I-VI (figs. 16-18); lateral abdominal spines on segment IX (7-8) only.

Holotype female imago with associated nymphal skin, TANZANIA: Amani lake, Amani, 900 m, 22.vi.61; paratypes, 1 male imago, 3 female subimagines, 2 nymphal skins, same provenance, vi.61. Type in British Museum (Natural History).



Figs. 19-23. Mouthparts of *Cloeon tanzaniae*. 19, right mandible; 20, left mandible; 21, maxilla; 22, labrum; 23, labium.

The female differs from all other African *Cloeon* by the combination of unpigmented wings and maximal abdominal markings on segments IV and VII; the nymph is distinguished from all other described species by the absence of lateral abdominal spines on all except the IXth segment.

Cloeon virgiliae Barnard

DISTRIBUTION IN EAST AFRICA. Zambia: Livingstone (Demoulin, 1970). Tanzania: Amani, Kihurio.

Although the abdominal markings have faded, the 2 female specimens from Tanzania have the costal and subcostal areas uniformly tinted very pale brown and the pterostigma with 2-3 cross-veins. Hind tarsus 2 is 2-2.5 times as long as tarsus 3. In East Africa, this South African species is evidently scarce in most districts.

Cloeon viridellum Lestage

Only known as a single male from Lubumbashi, Shaba Province, Zaire. The markings are somewhat unusual for *Cloeon*, the abdominal terga being dark brown with medial clear areas. The pterostigma has 2 cross-veins (Demoulin, 1957).

BIOLOGY OF *CLOEON* ADULTS

Cloeon adults are often seen at light at night-time, resting on walls or screened windows. Kimmins (1955) reproduced a figure of the resting posture of *C. smaeleni*, as observed by Prof. Lewis Berner. The abdomen is curved upwards, so that the tip is pointing vertically while the tails are held at right angles and drooping a little so as to be almost parallel with the ground. This is a commonly seen posture for *smaeleni* and also for *rhodesiae*, but I have seen it in no other African *Cloeon*. It is also typical for *C. dipterum* in Europe. Berner also described *perkinsi* as having a quite different posture, the tip of the abdomen being curved upwards and forwards and with the tails extending over the head. This appears to have been an exceptional finding since, although *perkinsi* is such a common species, I have never seen it resting in any except the normal posture for mayflies with the abdomen more or less parallel with the substrate.

Gillies (1975) commented on the fact that in tropical countries swarming of male *Cloeon* has only been noted in the cool season. This is particularly well marked in East Africa, where swarming at low altitudes was only observed in the months from May to October. On the other hand, in highland areas above, say, 1200-1500 m such records of swarming as I have refer to both cooler and warmer periods of the year. No explanation of this phenomenon has been put forward. On the Ugandan shores of Lake Victoria at Jinja (c. 1200 m above sea level) Tjønneland (1960) recorded *C. dentatum* swarming in the early morning. Seasonal data were not presented, but light-trap catches of male imagoes showed a bimodal

peak, catches being mainly confined to the first hour after sunset and the last hour before sunrise.

Ovoviviparity has been reported in the Palearctic *C. dipterum* and in several Oriental species, Gillies (1949). I have likewise observed it in 4 African species, *smaeleni*, *gambiae*, *perkinsi* and *cylindroculum*.

Rhithroclaeon gen. n.

Separable from *Cloeon* Leach by the male forceps and the proportions of the hind and mid tarsal segments. The forceps are characterised by loss of the terminal segment, the remaining 2 segments being fused and variously shaped. On the mid and hind legs, tarsal segment two equals 1.25 - 1.5 times segment three. Vein MA2 well developed, tending to reach as far as the cross-vein between MA1 and MP1.

The nymph is not known but, judging from the provenance of all known adults, it must be an inhabitant of torrents and therefore most unlikely to resemble *Cloeon*.

Type species. *R. permirum* (Kopelke), in *Cloeon*.

Cloeon differs from *Rhithroclaeon* by the male forceps having a small, usually globular, third segment and, on the mid and hind legs, by tarsal segment two equalling 2-3 times segment three. Vein MA2 usually short, only in one known species, *C. dentatum*, reaching up to the cross-vein between MA1 and MP1.

Cloeon dentatum is to a certain extent an intermediate between typical *Cloeon* and *Rhithroclaeon*. The ratio of hind tarsal segments II : III is 2 : 1, while the male forceps retain the terminal third segment, thus clearly remaining in *Cloeon*. But the shape of the forceps is otherwise quite different from other species in the genus. Exact definition of the position of this species, like its relationship to *Rhithroclaeon*, must await the discovery of their nymphs.

There is also the question of the status of *Centroptilum crassi* Demoulin. In possessing single marginal intercalaries in the fore wing and in lacking a hind wing it approaches *Cloeon*, although the hooked third segment of the forceps is anomalous. The proportions of the hind tarsal segments have not been described. The nymphal gills resemble those of the Palearctic genus *Proclaeon*, the mandibles *Cloeon*, while the labial palps resemble those of *Baetis*. If hind tarsal segment II was found to be shorter than in *Cloeon*, and given the fact that MA2 reaches up to the cross-vein between MA1 and MP1, its grouping with the species for which *Rhithroclaeon* has been erected might have to be considered. It would follow from this that the unknown nymph of *Rhithroclaeon* should be of the same type as *crassi*, even though the latter inhabits "still, deep stretches of river" (Crass, 1974) similar to those favoured by *Proclaeon* in Europe. At the present time the question remains unresolved.

Rhithroclaeon permirum (Kopelke), comb. n.

DISTRIBUTION IN EAST AFRICA. Zaire: Kalengo, Lake Kivu (Kopelke, 1980). Tanzania: by R. Sigi, 700 m below Amani, 7 males, 2 male subimagines, iv.61, x.61, xi.61 ii.63.

The Tanzanian specimens agree well with the description and figures given by Kopelke (1980). The forceps differ, however, in a number of minor points, notably in the basal segment, which is divided in the sagittal plane into a medio-lateral portion and an inner portion which, viewed from the ventral aspect, is at a much deeper level (fig. 25). The internal projection at the base of the basal segment is also longer and appears to arise from a broader base. The apex of the IXth segment, while similar in outline, appears to lack the internal structure depicted by Kopelke. It seems preferable for the moment to regard these differences as within the limits of variation of the species. The specimens were caught in a light-trap beside the River Sigi, at a point where the river plunges down the mountainside in a series of cascades.

Rhithroclaeon indicator sp. n.

Male imago (in life). Turbinate eyes brick red, thorax chestnut brown. Femora lemon yellow, fainter in mid and hind legs, tibiae and tarsi colourless; fore femur: tibia:tarsus 31:49:49, fore tarsal segments 2:17:18:10:3, mid and hind tarsal segments II:III 1.2-1.5:1. Wing, see fig. 3; abdominal terga II-VII translucent, tinted lemon yellow, VIII-X brick red, tails white; forceps dark brown except at apex (fig. 26).

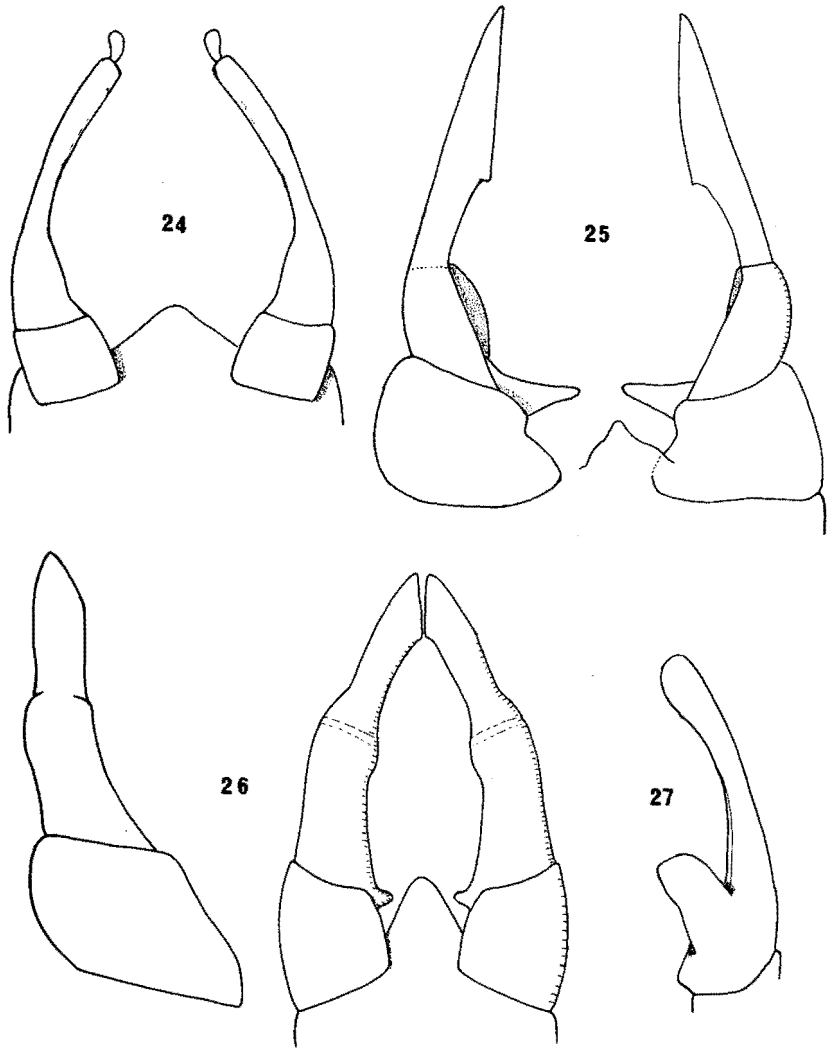
Female imago (in spirit). Head and thorax orange brown; legs colourless, hind tarsus II:tarsus III 1.4:1; wings vitreous, MA2 reaching to cross-vein, no cross veins before bulla, stigma with 5 cross-veins; abdominal terga II-VII with posterior margins broadly banded reddish pink, posterior half of IX and tergum X pink, tails white. A single, dark orange, apparently unembryonated egg mass is present in the tube.

Body, Male 6.0-7.0 mm; wing, male 6.0-7.0 mm, female 5.5-6.0 mm.

Holotype male imago, TANZANIA: Gonja, South Pare District, 600 m, 2.viii.55, in British Museum (Natural History). Paratypes, 4 males, 1 female, same provenance; Shume, West Usambara Mountains, c. 1800 m, 1 male, below Amani, 700 m, 2 males.

This species differs from *R. permirum* by the finger-like aspect of the forceps, the distal segment being subequal to the basal segment, while the terminal, blade-like portion is stouter and much shorter; the apex of the IXth sternum, posterior to the forceps base, is more evenly tapered than in *permirum*. The third species in the genus, *R. insuetum* (Kop.) has quite distinct forceps.

The specimens were mainly collected at rest on vegetation over small mountain streams near the base of the South Pare Mountains at Gonja and in a similar site high up in the Western Usambaras in montane forest. The specimens from near Amani came from light-trap collections beside the River Sigi. It is evidently widely distributed in northern Tanzania. A female of *Rhithroclaeon* was caught at Amani, but since the female of *permirum* is not known, the identity of this specimen cannot be established.



Figs. 24-27. Genital forceps of *Cloeon* and *Rhithrocleon* spp.; 24, *Cloeon amaniensis*; 25, *Rhithrocleon permirum*, the two sides shown from different angles; 26, *R. indicator*, on the left lateral view, on the right ventral view; 27, *R. insuetum* (redrawn from Kopelke, 1980).

***Rhithrocleon insuetum* (Kopelke), comb. n**

The forceps in this species are swollen towards the tip and have a thumbshaped projection towards the base on the inner side (fig. 27).

DISTRIBUTION IN EAST AFRICA. Zaire: Kalengo stream, by Lake Kivu (Kopelke).

ACKNOWLEDGEMENTS

I am indebted to Dr. R. Bailey of Chelsea College, University of London, for a collection of nymphs from the Nyumba ya Mungu Reservoir in Tanzania, and to Dr. Alan Hildrew of Queen Mary College, University of London, for a valuable series of reared specimens from temporary pools in Kenya.

LOCATION OF COLLECTING SITES

Amani	5° 9'S, 38°36'E	Korogwe	5°10'S, 38°30'E
Bugiri	0°34'N, 33°46'E	Livingstone	17°50'S, 25°53'E
Chiromo	16°33'S, 35°10'E	Lubumbashi	11°41'S, 27°29'E
Entebbe	0° 5'N, 32°29'E	Muheza	5°11'S, 38°50'E
Gonja	4°20'S, 38° 3'E	Mwanza	2°30'S, 32°54'E
Herkulu (Lushoto)	4°48'S, 38°15'E	Ntundu (Fort Johnston)	14°29'S, 35°14'E
Ifakara	8°10'S, 36°38'E	Pakwach	2°17'N, 31°28'E
Jinja	0°27'N, 33°14'E	Pangani Falls	5°20'S, 38°40'E
Kaazi (nr. Kampala)		Port Herald	16°55'S, 35°12'E
Kampala	0°19'N, 32°55'E	Rwiro	1° 9'S, 36°57'E
Katara, Malagarasi	5° 7'S, 30°51'E	Shinyanga	3°40'S, 33°20'E
Kigoma	4°52'S, 29°36'E	Shume	4°42'S, 38°12'E
Kihurio	4°28'S, 38° 4'E	Tengadzi (nr. Chiromo)	
Kisumu	0° 3'S, 34°47'E	Wadi Yeshbum	14°19'N, 46°53'E
Kivu, L.	1°50'S, 29°10'E		

Table 2. Diagnostic characters of nymphs of East African species of *Cleone*.

	No. of segments on maxillary palps	Labial palps	Number of lateral spines on abdominal segments					
			IV*	V*	VI*	VII*	VIII°	IX°
<i>amaniensis</i>	2	clavate				0-1	5-8	8-10
<i>bellum</i>	2	clavate			0-3	1-4	7-10	9-12
<i>cylindroculum</i>	2	clavate	0-2	0-3	1-5	3-6	4-7	4-6
<i>perkinsi</i>	3	tapered					4-7	7-11
<i>scitulum</i>	3	clavate					3-5	5-9
<i>maeleni</i>	3	clavate					6-11	7-15
<i>tanzaniae</i>	3	clavate					1	7-8
<i>virgiliae</i>	2	tapered	?			?		?

* Number excludes spine at posterior angle.

° Number includes spine at posterior angle.

REFERENCES

- CRASS, R. S. (1947): The may-flies of Natal and the eastern Cape. - Ann. Natal Mus. 11, 37-110.
- DEMOULIN, G. (1957): Revision de quelques Ephéméroptères décrits du Congo Belge par L. Navas. III. - Bull. Ann. Soc. roy. Ent. Belgique 93, 257-275.
- (1965): Mission zoologique de l'I.R.S.A.C. en Afrique orientale. (P. Basilewsky et N. Leleup, 1957). LXXXVIII. - Ephemeroptera. - Ann. Mus. roy. Afr. centr. (8°) Zool. 138, 91-114.
- (1970): Ephemeroptera des faunes éthiopiennes et malgaches. - S. Afr. Animal Life 14, 24-170.
- GILLIES, M. T. (1949): Notes on some Ephemeroptera Baetidae from India and South-East Asia. - Trans. R. ent. Soc. Lond. 100: 161-177.
- (1975): Winter swarming of *Cloeon* in the tropics. - Eatonia No. 20, 10-11.
- (1979a): *Cloeon pusillum* Navás, a species of *Afrobaetodes* Demoulin. - Ent. mon. Mag. 114: 153-154.
- (1979b): Polymorphism in the turbinate eyes of an African *Cloeon*. - Ent. mon. Mag. 114, 155.
- (1980): An introduction to the study of *Cloeon* Leach (Baetidae, Ephemeroptera) in West Africa. - Bull. I.F.A.N. 42A, 135-156.
- KIMMINS, D. E. (1955): Ephemeroptera from Nyasaland, with descriptions of three new species and some interesting nymphal forms. - Ann. Mag. nat. Hist. (12) 8, 859-880.
- (1956): New species of Ephemeroptera from Uganda. - Bull. Brit. Mus. (Nat. Hist.) Entom. 4, 71-87.
- (1960): Notes on East African Ephemeroptera, with descriptions of new species. - Bull. Brit. Mus. (Nat. Hist.) Entom. 9, 337-355.
- KOPELKE, J.-P. (1980): Ephemeroptera aus der Emergenz des Zentralafrikanischen Bergbaches Kalengo (Zaire). I. Baetidae. - Entom. Abh. Mus. Tierk. Dresden 43, 99-129.
- LESTAGE, J. A. (1924): Etudes sur les Ephémères du Congo Belge. II. Un nouveau *Cloeon* du Katanga (*Cloeon smaeleni* nov. sp.). - Rev. Zool. Afr. 12, 426-428.
- TJØNNELAND, Au. (1960): The flight activity of Mayflies as expressed in some East African species. - Arbok Univ. Bergen, Mat. - Naturv. ser. 1960, 3-88.
- ULMER, G. (1916): Ephemeropteren von Aequatorial-Afrika. - Arch. Naturgesch., 81 (A), 7, 1-19.
- (1924): F. Werner's Zoologischer Expedition nach dem Anglo-Aegyptischen Sudan (Kordofan) 1914. XII. Trichopteren und Ephemeropteren. - Denkschr. Akad. Wissenschaft, Wien IC, 1, 1-9.