Bulletin de l'I.F.A.N.
T. 42, sér. A, n° 1, 1980.

An introduction to the study of *Cloeon* LEACH (Baetidae, Ephemeroptera) in West Africa

by M. T. GILLIES (1).

ABSTRACT

Nine species of *Cloeon* are recorded from West Africa, including *C. gambiae*, sp. n. *C. punctatum* NAVÁS is shown to be a synonym of *C. smaeleni* LESTAGE. Keys are given to the males and females, and the nymphs of six species are described.

RÉSUMÉ

L'auteur décrit neuf espèces de *Cloeon* d'Afrique Occidentale, dont une nouvelle espèce : *C. gambiae*. Il précise la position de *C. punctatum* NAVÁS qui est, en fait, synonyme de *C. smaeleni* LESTAGE. Il donne les clés d'identification des mâles et des femelles et décrit les larves de six espèces dont *C. gambiae*.

Apart from four species known only from Madagascar, 21 species of *Cloeon* were listed by DEMOULIN (1970) from the Afrotropical Region. Of these, 7 are not known for certain to occur outside South Africa. In East Africa, the fauna of certain of the Great Lakes has been well-studied, and a number of species have also been described and recorded from the Congo basin. There are very few published records of *Cloeon* from West Africa. From such as exist and from my own experience in both East and West Africa, particularly in the lower basin of the River Gambia, it appears that the African *Cloeon* comprise a limited number of very widely distributed species together with an unknown number of species with more specialised ecology, especially in the cooler waters of highland regions.

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This situation has encouraged me to put together what is known about the species of *Cloeon* occurring in West Africa and to provide keys and figures for their identification. While the list is bound to be incomplete, it is hoped that it may be of use to freshwater ecologists in the region, who may be concerned with the fauna of small bodies of water, as well as to mayfly specialists elsewhere. In this survey of the genus, West Africa is defined as that region west of, and including, the Republic of Cameroon.

In addition to describing one new species from the region, the diagnostic features of the nymphs of 5 other species are provided and, where possible, notes are given on the coloration of living adults. Unless otherwise stated, the collections were made by myself. The list for West Africa consists of the following 9 species :

C. areolatum Navás
C. bellum Navás
C. cylindroculum (Kimmins)
C. dentatum Kimmins
C. gambiae, sp. n.
C. perkinsi Barnard
C. rhodesiae Barnard
C. scitulum Kimmins
C. smaeleni Lestage

Navás gave inadequate descriptions of a number of species of *Cloeon*, and we owe a great debt of gratitude to Demoulin (1957, 1966) for redescribing or consigning to synonymy most of Navás, species. Evidence is given below to show that another of Navás species, *C. punctatum*, is also a synonym. As shown elsewhere, Gillies (1979 *a*), *C. pusillum* Navás is in fact a species of *Afrobaetodes* Demoulin. I have not included *C. viridellum* Lestage in this list. The male of this species was described from the High Shaba Province of Zaire. The abdominal terga are dark brown with paler markings and thus unlike any of the species known to occur in West Africa. The female is unknown.

The Palaearctic genus *Procloeon* Bengtsson has been regarded as separate from *Cloeon* on the basis of the proportion of the hind tarsus in the imago — tarsus 2 three times as long as tarsus 3 — and of the nymphal gills having a single lamella on all segments. This led Kimmins (1947, 1955) to assign a number of Oriental and African species of *Cloeon*, known only in the adult stage, to Bengtsson's genus. This overlooked the fact that Ulmer (1939) had shown that the nymph of the Oriental species *bimaculatum* Eaton, transferred by Kimmins to *Procloeon*, had bilamellate gills. Moreover, the nymphs of two African species, *cylindrocu-*

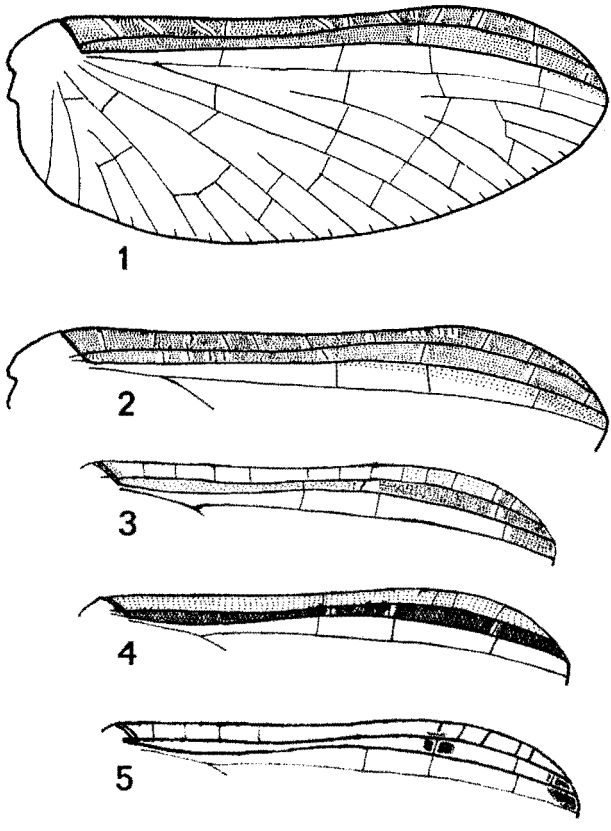
lum and *smaeleni*, assigned by KIMMINS to *Procloeon*, are also now known to have bilamellate gills. From this it seems clear that, as recognised by DEMOULIN (1970), the only valid character for distinguishing the two genera lies in the gills. While not going as far as BURKS (1953), who synonymised *Procloeon* with *Cloeon*, it could be suggested that *Procloeon* should be regarded as at most of subgeneric status. It is not known to occur outside the Palaearctic Region.

ADULTS.

Identification of adult *Cloeon* relies mainly on the abdominal markings, the proportions of the hind tarsal segments, wing venation and, in the female, on the presence or absence of pigmentation in the wings. Sexual dimorphism in coloration is well-marked, so that association of the sexes is sometimes difficult. In the past, this has sometimes led to the two sexes of the same species being described as different species. The male forceps are generally poorly differentiated between species and, with the exception of *C. dentatum*, are of little use in identification. Separate keys to the two sexes are given below. Since the markings may fade in preserved specimens, alternative characters are given in each couplet.

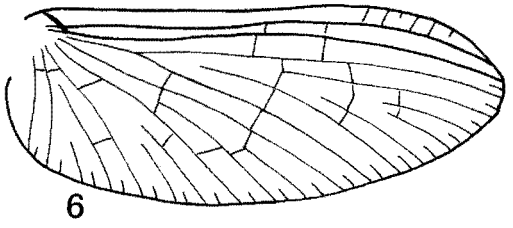
KEY TO FEMALES.

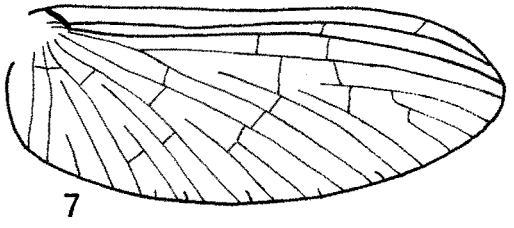
1. — Costal and subcostal areas of wing unpigmented..... 2
   — Costal and subcostal areas wholly or partly pigmented..... 4
2. — Pterostigma with a single veinlet ; abdominal markings consisting of a continuous white, and an interrupted purple, lateral line ; hind tarsus 2 three times as long as tarsus 3..... *cylindroculum*
   — Pterostigma with two or more veinlets ; abdominal markings otherwise ; hind tarsus 2 twice as long as tarsus 3..... 3
3. — Pterostigma with 2 veinlets ; abdomen strongly marked, terga III and VI with purple, lateral triangles ; fore femur with a narrow, red, longitudinal line..... *scitulum*
   — Pterostigma with 4-6 veinlets ; abdomen without solid markings ; fore femur pale..... *dentatum*
4. — Costal and subcostal areas lime green ; abdomen sometimes with faint median streaks on terga II and V..... *gambiae*
   — Costal and subcostal areas wholly or partly brown ; abdomen not so..... 5
5. — Costal area yellowish brown, contrasting with deep, chestnut brown of subcostal area ; abdominal terga red with submedian yellow, and median red, lines..... *perkinsi*

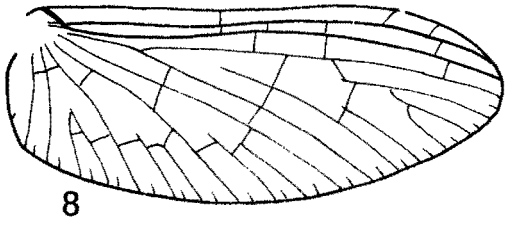


FIGS. 1-5. — Wings of female *Cloeon*.
1, *C. bellum*. 2, *C. smaeleni*. 3, *C. areolatum*. 4, *C. perkinsi*. 5, *C. rhodesiae*.

— Wings and abdomen not so..... 6
6. — Both costal and subcostal areas brown throughout whole length..... 7
— Costal area either unpigmented or with dark pigment limited to distal half..... 8
7. — Outer half of wing with a number of oblique crossveins near posterior margin ; abdominal markings maximal on terga II, III and VI , hind tarsus 2 twice as long as tarsus 3..... *bellum*
— No oblique crossveins near posterior margin of wing ; abdomen evenly marked on most segments ; hind tarsus 2 three times tarsus 3..... *smaeleni*
8. — Outer third of costal area and most of subcostal area lightly pigmented with clear windows round most crossveins..... *areolatum*
— Outer third of subcostal area very pale brown, preceded on the basal side by two conspicuous pitch brown spots ; pterostigmatic crossveins strongly pigmented orange..... *rhodesiae*





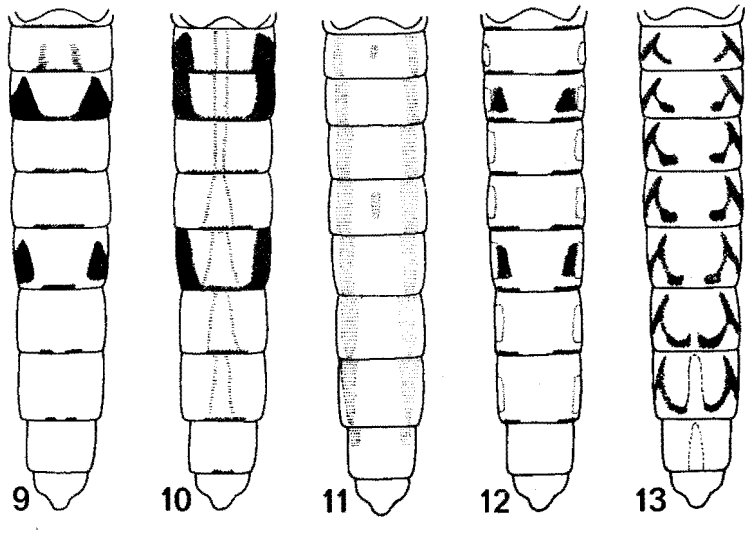


FIGS. 6-8. — Wings of female *Cloeon*.
6, *C. dentatum*. 7, *C. cylindroculum*. 8, *C. gambiae*.

KEY TO MALES

1. — Pterostigma with a single veinlet ; lateral margins of abdominal terga with a broad, opaque white line extending along whole length of abdomen ..... *cylindroculum*
— Pterostigma with 2 or more veinlets ; 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. — Hind tarsus 2 three times as long as tarsus 3..... 5
— Hind tarsus 2 twice as long as tarsus 3..... 6

5. — Fore femur deep reddish-brown, other femora pale ; abdominal terga II to VII with broad, lateral reddish markings, tending to meet in the middle..... *smaeleni*
— All femora pale with preapical spots ; abdominal terga mainly whitish with broad, purplish triangles on III and VI... *rhodesiae*
6. — Thorax blackish-brown ; abdominal terga II-VII white with faint red triangles on III and VI ; pterostigma with 2 veinlets... *scitulum*
— Thorax pale or medium brown ; abdomen otherwise ; pterostigmatic veinlets variable in number..... 7
7. — Abdominal terga II-VIII generally pink with a central cream band and often with a median pink line..... *perkinsi*
— Abdominal markings otherwise..... 8
8. — Posterior margins of abdominal terga II-VII narrowly dark red, terga II, III and VI with reddish lateral triangles ; tails ringed purplish..... *bellum*
— Abdominal terga II-VII colourless, sometimes with faint, reddish submedian bands ; tails white..... *gambiae*



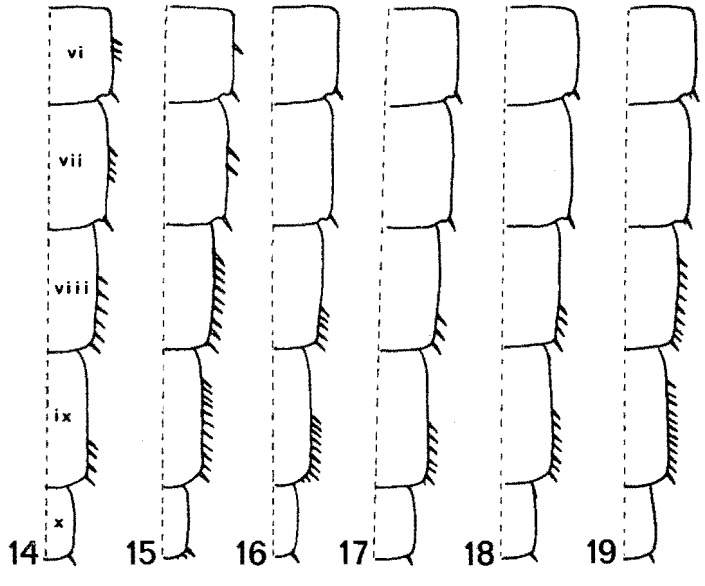
FIGS. 9-13. — Abdomens of female *Cloeon*.
9, *C. areolatum*. 10, *C. bellum*. 11, *C. gambiae*. 12, *C. scitulum*. 13, *C. smaeleni*.

NYMPHS.

Since the nymphs of only six of the West African species are known, it is not possible to construct a reliable key for the fauna as a whole. However, the most important diagnostic characters are given in the Table below. Taken in conjunction with the descriptions in the text, this should permit positive identification of

most specimens or, alternatively, indicate that they belong to one of the species, the nymphs of which are unknown.

A useful diagnostic character is the presence and number of sharp spines along the lateral margins of the abdominal segments. These are normally present on segments VIII and IX, where they occupy a variable proportion of the margin of each segment (Figs. 14-19). On the other segments there is usually only a single spine at the posterior angle at the insertion of the gill. In two species, however, as well as in the South African species, *C. lacunosum* BARN. and *C. africanum* ESB. PET., there are in addition a number of spines on segments IV-VII, which are situated near the centre of the lateral margin and are separated from the posterior angle. In counting the spines for identification, I include the spine on the posterior angle of segments VIII and IX since it forms part of a continuous line of spines down the margin. On the other segments it is convenient to ignore the spine at the posterior angle, since it is present in all species, and one then notes the number of spines, or their absence, in the central part only of the lateral margin. This method of counting is indicated in the Table 1.



FIGS. 14-19. — Abdominal margins of *Cloeon* nymphs. 14, *C. cylindroculum*. 15, *C. bellum*. 16, *C. perkinsi*. 17, *C. gambiae*. 18, *C. scitulum*. 19, *C. smaeleni*.

TABLE 1.

Diagnostic characters of nymphs of *Cloeon*.

SPECIES	NUMBER OF SEGMENTS ON MAXILLARY PALPS	LABIAL PALP	NUMBER OF LATERAL SPINES ON ABDOMINAL SEGMENTS					
			IV*	V*	VI*	VII*	VIII°	IX°
bellum	2	clavate			0–3	1–4	7–10	9–12
cylindroculum	2	clavate	0–2	0–3	1–5	3–6	4–7	4–6
gambiae	3	tapered					1–6	4–7
perkinsi	3	tapered					4–7	7–11
scitulum	3	clavate					3–5	5–9
smaeleni	3	clavate					6–11	7–15

* Number excludes spine at posterior angle.
° Number includes spine at posterior angle.

Cloeon areolatum NAVÁS

Cloeon areolatum NAVÁS, 1930, *Rev. Zool. Bot.*, **19** : 320.
Procloeon areolatum : DEMOULIN, 1957, *Bull. Ann. Soc. roy. Ent. Belge*, **93** : 274.
Procloeon areolatum : KIMMINS, 1960, *Bull. Brit. Mus. (Nat. Hist.) Entom.*, **9** : 341.
Cloeon areolatum : DEMOULIN, 1970, S. Afr. Animal Life, **14** : 54.

Costal and subcostal areas in outer third of female wing tinted brown with paler windows round crossveins, pterostigma with 3-4 veinlets (Fig. 3) ; eyes in male tall and cylindrical ; abdominal terga with markings maximal on segments III and VI ; hind tarsus 2 three times as long as 3.

I have a long series of specimens from Kinshasa, which enable me to describe the male and to supplement the account of the female given by DEMOULIN.

Male imago (in spirit). Eyes pale orange, cylindrical, fully 1.5 times as tall as broad with a distinct waist in upper half. Thorax chestnut brown. Abdominal terga translucent white : posterior margins reddish-brown, this being complete on II and III, on IV to VII confined to central area ; on III and VI with conspicuous lateral, reddish-brown triangles, their apices directed forwards : VIII pinkish-brown, IX and X chestnut ; abdominal sterna unmarked except for a very small dark median spot on the posterior border of III or IV to VII. Forceps typical of the genus with minute, globular terminal segment.

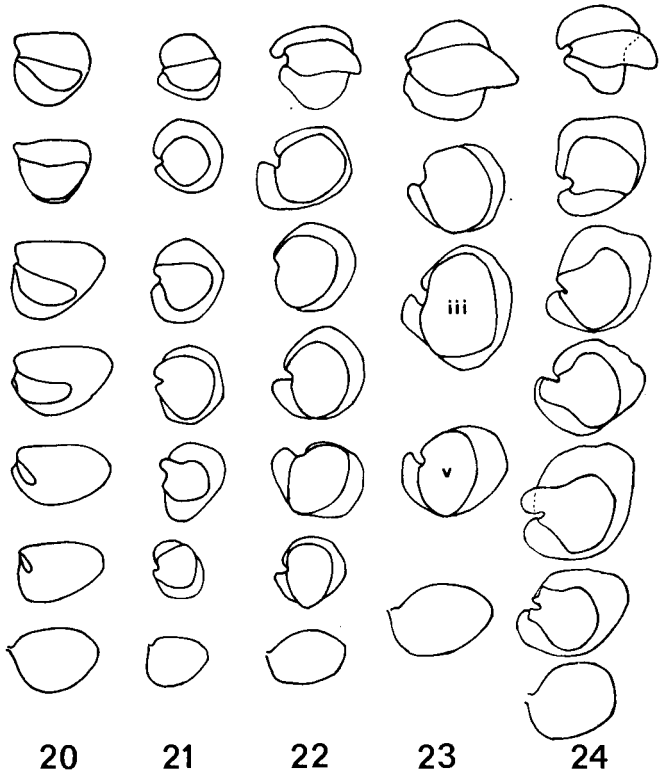
Tails ringed with reddish-brown. Pterostigma with 2-3 veinl ts. Fore femur reddish in distal half with a subapical pale interrupti n.

Female imago (in spirit). Abdominal tergal markings as in male (Fig. 9) ; sterna IV to VIII with lateral, longitudinal reddish stripes, on VII curling round and meeting in the mid line posteriorly, on II to VII with a median fine red spot. Tails ringed with reddish brown. Pterostigma with 3-4 veinlets ; wing differing from DEMOULIN's description in that there are only 1-2 cross veins in the basal half of the costal area, and the pigment in the basal half of the subcostal area is absent (or faded).

Nymph. Not known.

DISTRIBUTION IN WEST AFRICA. **Cameroon** : Ayosi, by R. Nyong.

This appears to be a species of slow-moving rivers and large



FIGS. 20-24. — Outlines of gill lamellae of *Cloeon* nymphs. 20, *C. cylindroculum*. 21, *C. perkinsi*. 22, *C. smaeleni*. 23, *C. scitulum*. 24, *C. bellum*.

bodies of water. I have seen enormous numbers at lights in Kinshasa, Zaire, presumably coming from the lacustrine reaches of the River Congo above the town.

Cloeon bellum NAVÁS.

Cloeon bellum NAVÁS, 1931, *Rev. Zool. Bot. Afr.*, **20** : 274.
Cloeon rimosum NAVÁS, 1936, *Rev. Zool. Bot. Afr.*, **28** : 368.
Cloeon bellum : DEMOULIN, 1957, *Bull. Ann. Soc. roy. Ent. Belge*, **93** : 264.

Costal and subcostal areas of female wing brown with hyaline windows round cross veins ; outer part of wing in both sexes a series of oblique cross veins just anterior to marginal inter-

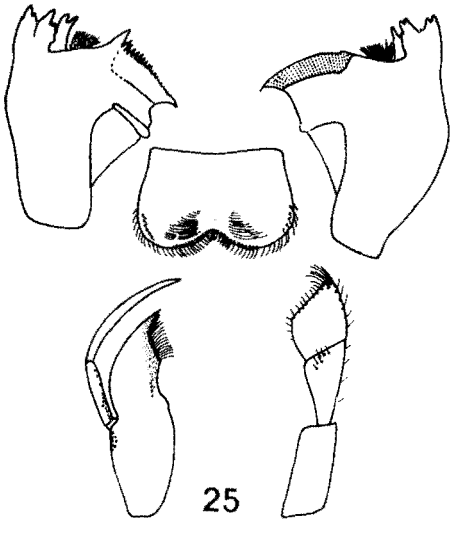


FIG. 25. — Nymphal mouthparts. *C. bellum*.

calaries (Fig. 1) ; female abdomen with prominent dark red lateral markings on terga II, III and VI (fig. 10) ; hind tarsus 2 twice as long as tarsus 3.

Nymph. Labial palps clavate, maxillary palps with 2 segments (Fig. 25) ; tarsal claws long and fine, comb extending less than halfway to tip. Gill lamellae double on I to VI, single on VII (Fig. 24), upper lamellae on II to VI in outline somewhat bell-shaped, lower lamellae on III to VI with irregular outer margin ;

lateral abdominal spines on segments VI (0-3), VII (1-4), VIII (7-10), IX (9-12), (Fig. 15). Tails heavily banded, distal one quarter of paracercus unfeathered.

DISTRIBUTION IN WEST AFRICA. **Gambia** : R. Prufu, Basse. **Upper Volta** : Banfora (*M. Cornet*). **Nigeria** : Lagos (*J. D. Thomas*).

Described from Zaire, this species appears to be quite widely distributed in West Africa. In The Gambia, despite the ubiquity and abundance of permanent and seasonal swamps, *bellum* has only been found in one of the few permanent streams in that low-lying country.

Cloeon cylindroculum (KIMMINS).

Procloeon cylindroculum KIMMINS, 1955, *Ann. Mag. nat. Hist.* (12) **8** : 865.
Procloeon cylindroculum : KIMMINS, 1960, *Bull. Brit. Mus. (Nat. Hist.) Entom.*, **9** : 341.
Procloeon sp. DEMOULIN : 1969, Mém. IFAN, no. 84 : 82.
Cloeon cylindroculum : DEMOULIN, 1970, S. Afr. Animal Life, **14** : 55.

A distinctive species, the wings clear in both sexes with a single veinlet in the pterostigma and the marginal intercalaries much reduced in number (fig. 7) ; hind tarsus 2 three times tarsus 3. Upper lamella of nymphal gills much smaller than lower lamella, lateral spines present on abdominal segments VI (sometimes IV) to IX.

Male imago (in life). Eyes tall and cylindrical (but see below), reddish-orange. Thorax dark brown, with a broad, lateral white line. Abdominal terga II to VI translucent whitish, laterally with a broad, opaque, white line extending the whole length of abdomen, VIII to X reddidh-brown. Tails white, grey basally. Legs unmarked.

Female imago (in life). A beautiful, pale green or yellowish-green insect with a broad, opaque white line as if painted along the whole lateral aspect of the body from the base of antenna to Xth tergum, interrupted only on the posterior margin of tergum IV and on VII where it is scarcely discernible. Immediately below it — and on the head and thorax, above it as well — runs a thin brownish-red line, becoming thicker on the abdomen and, on the posterior part of tergum IV, becoming broader still and extending onto the dorsum thus interrupting the main white line. On the mesothorax, another white line, bordered above with

red, runs forward from the wing-root to the anterior thoracic suture ; terga VIII and IX mainly white above, X overlaid with red. Tails white, basal segment mostly dark red, alternate annulations banded with red. Femora lime green, tibiae and tarsi colourless.

Nymph. Labial palps stout, clavate, maxillary palps with 2 segments (Fig. 26) ; tarsal claws moderately long, teeth extending from a third to one half distance from base. Upper gill lamella much reduced in size on all segments, on V and VII rudimentary (Fig. 20) ; lateral abdominal spines on segment IV (0-2), V (0-3), VI (1-5), VII (3-6), VIII (4-7), IX (4-6), (Fig. 14). Tails unbanded, subequal, paracercus feathered almost to tip.

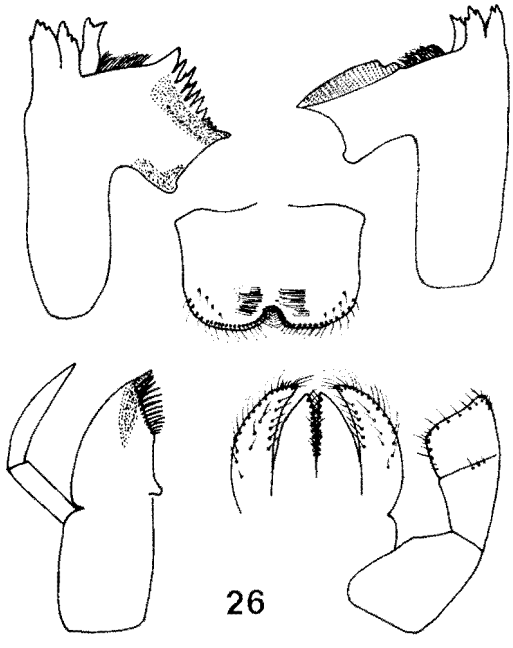


FIG. 26. — Nymphal mouthparts. *C. cylindroculum*.

DISTRIBUTION IN WEST AFRICA. **Gambia** : R. Gambia, Wali Kunda. **Senegal** : Niokolo-Koba (DEMOULIN, 1969). **Ivory Coast** : R. Bagoé (*J.-M. Elouard*). **Nigeria** : Lagos (*J. D. Thomas*). **Cameroon** : R. Nyong.

C. cylindroculum is primarily a mayfly of large bodies of water and slowly moving streams and rivers. It does not normally

occur in ponds or swamps but, curiously, I have one record of it breeding in a rock pool beside a torrential river in Tanzania.

This very distinctive species was described by KIMMINS from specimens from Malawi and the Ugandan shores of Lake Victoria. I have material from a number of widely separated localities in Tanzania as well as West Africa. All these specimens agree well with KIMMINS' description. However, in every specimen the marginal intercalaries, within the area of the wing in which they occur, are present in alternate spaces and not in every space as figured by KIMMINS. Re-examination of the type and paratype shows that, in this minor point, his figure was incorrect and that the marginal intercalaries are much as in Fig. 7.

The cylindrical eyes of the male are highly characteristic with the ratio of height : width being 1.5 : 1. But, as recorded by GILLIES (1979 *b*), the species shows well-marked dimorphism in this character. Thus, occasional specimens from East Africa have eyes that, although tall, are broader at the apex than the base, and the overall ratio of height to width is about 1 : 1. The only males seen from West Africa (The Gambia) are of the broader type.

Freshly caught females occur in two colour forms, those with the typical dark red markings, and those in which red thoracic and abdominal lines are largely or completely absent. The nymphs of both forms are indistinguishable, and they occur together in both Tanzania and The Gambia.

C. cylindroculum is rather closely related to the South African species, *C. africanum* ESB. PET., both in wing venation and in nymphal characters. Apart from its smaller size, the nymph differs from *africanum* in the relatively larger upper lamellae of gills I-IV and in the presence of a rudimentary upper lamella on segment VI. It appears possible that some of the records of *africanum* from tropical Africa cited by older authors and listed by DEMOULIN (1970), should be referred to *cylindroculum*. In view of the absence of any new records in the past 50 years, I am omitting *africanum* from this review of West African species. SOLDAN (1977) recorded *africanum* from the Sudan, but the author kindly informs me (*in litt.*) that, owing to the state of the material, this record would be better cited as *Cloeon* sp.

Cloeon dentatum KIMMINS.

Cloeon dentatum KIMMINS, 1956, *Bull. Brit. Mus. (Nat. Hist.), Entom.*, **4** : 76.

Wings clear in both sexes ; vein MA2 rather long, extending up to or almost to crossvein between MA1 and MP1 (Fig. 6) ; second (long) segment of male forceps swollen and with a prominent tooth on its inner border, terminal segment dilated ; hind tarsus 2 about twice as long as tarsus 3.

Female imago (in spirit). Head cream, thorax very pale brown with a darker median stripe, the posterior folds of the mesonotum of the same colour. Abdomen yellowish brown (probably from the contained eggs) overlain with a number of faint red, very fine lines on terga II-V, these scarcely constituting a regular pattern but with a tendancy to form two submedian lines and to radiate towards the dorso-lateral border of the terga ; tails white. Legs white. Wings hyaline with 5-6 pterostimatic veinlets ; wing length 5 mm.

DISTRIBUTION IN WEST AFRICA. **Ivory Coast** : Bouaflé (*J.-M. Elouard*).

The male of *dentatum* was described by KIMMINS from Jinja, Uganda. I have three females collected at Entebbe, 2.iii.1953, which appear to be the females of KIMMINS' species. The markings are much faded, but the veinlets in the pterostigma are exactly as in his specimens and vein MA2 is as long as in male specimens. The forceps are quite unlike any other African *Cloeon*.

Cloeon gambiae, sp. nov.

Costal and subcostal areas in the female a delicate pale green ; pterostigma with 2-4 veinlets ; abdomen faintly marked ; hind tarsus 2 twice as long as tarsus 3. Nymph much as in *C. perkinsi*.

Male imago (in life). Eyes orange, tips of scape and pedicel touched with chestnut. Thorax pale buff. Abdominal terga II to VII usually colourless, sometimes with a median reddish streak on II and V (as in female) and, rarely, with broad, reddish submedian bands ; VIII and IX orange, X white ; tails white ; forceps typical of the genus. Pterostigma with 2-3 veinlets.

Female imago (in life). A delicate pale green insect. Antenna as in male ; vertex with fine, paired, submedian red lines, conti-

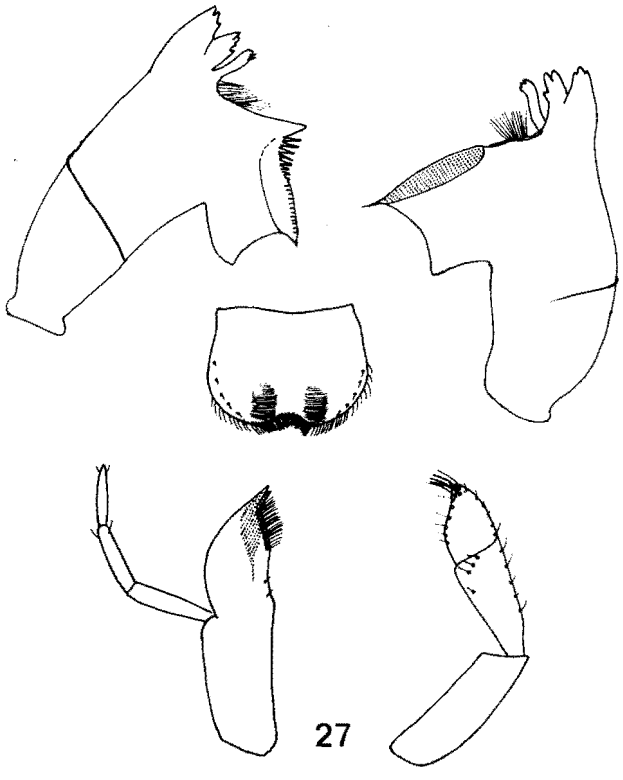


FIG. 27. — Nymphal mouthparts. *C. gambiae*.

nuing onto pronotum ; lateral lobes of pronotum reddish. Thorax and abdomen lime green (fading in spirit to cream) ; terga II to IX with faint but broad rufous bands, extending anteriorly across thorax ; on terga II and V a reddish median streak (Fig. 11) ; venter unmarked ; tails white, basal segments very narrowly ringed with dark red. Fore femur lime green with a faint subapical red spot, tibia and tarsus colourless ; mid and hind legs colourless. Costa, subcosta and radius 1 tinted green, all other veins dusky ; costal and subcostal areas a delicate lime green ; pterostigma with 2-4 veinlets (fig. 8).

Wing 4-5 mm.

Nymph. Closely resembles *C. perkinsi.* Apex of labial palps tapered ; maxillary palps with 3 segments (Fig. 27). Tarsal claws stout, teeth extending about halfway to three-fifths distance to

apex. Gill lamellae double on I to VI, single on VII ; lateral abdominal spines on segments VIII (1-6) and IX (4-7) only ; tails unbanded, distal third of paracercus unfeathered.

Holotype female, Gambia : Wali Kunda ; in British Museum (Natural History). Paratypes, males, females and nymphal pelts, the same locality.

DISTRIBUTION. **Gambia** : Wali Kunda, Sapu, R. Prufu at Basse.

The pale green tinting of the costal and subcostal areas of the female wing distinguishes this species from all other African *Cloeon*, although it shares this character with the Oriental species *C. kimminsi* HUBBARD. The male is separable from *C. viridellum* Lest. by the lack of background colour and markings on abdominal segments II to VII (apart from the median streaks on II and V). In occasional specimens the tinting of the costal and subcostal areas of the female wing may be so faint after preservation as to be scarcely detectable. In such individuals the abdominal markings are diagnostic. Curiously enough, these markings are sometimes more distinct in preserved than in fresh specimens.

The nymph of *C. gambiae* has been found in association with *C. smaeleni* and *C. perkinsi* in marshy backwaters of the River Gambia, in a seasonal pond and in a slowly moving permanent stream. Adults are not uncommon at light in the type locality.

Cloeon perkinsi BARNARD.

Cloeon perkinsi BARNARD, 1932, *Trans. r. Soc. S. Afr.*, **20** : 216.

Female readily distinguishable from all other African species by the contrasting yellow and brown tinting of costal and subcostal areas of wing respectively (Fig. 4) ; the dorsal red and cream stripes of abdomen in both sexes also distinctive ; hind tarsus 2 twice as long as tarsus 3.

Nymph. Apex of labial palps tapered, maxillary palps with three segments (Fig. 28); tarsal claws stout, teeth extending more than halfway to tip. Gill lamellae double on I to VI, single on VII (Fig. 21) ; lateral abdominal spines on segment VIII (4-7) and IX (7-11) (Fig. 16) ; tails unbanded, distal third of paracercus unfeathered.

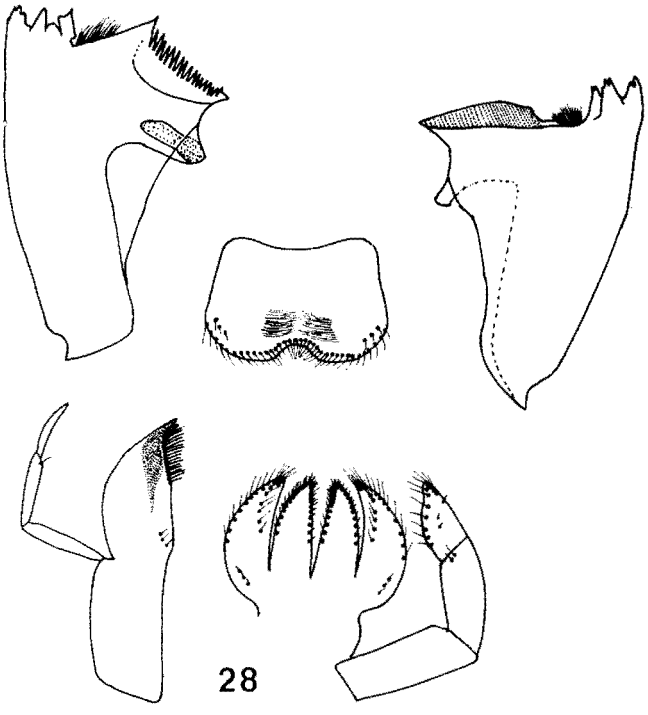


FIG. 28. — Nymphal mouthparts. *C. perkinsi*.

DISTRIBUTION IN WEST AFRICA. **Gambia** : Abuko, Keneba, Wali Kunda, Bansang, Fatoto. **Ghana** : Accra plain (THOMAS, 1966). **Nigeria** : Kaduna ; Lagos (*J. D. Thomas*).

As pointed out by KIMMINS (1960), the abdominal markings are somewhat variable and the median dark stripe on the abdomen may be entirely lacking. I have seen a gynandromorph in which one wing was of the male and the other of the female type. The nymph figured by DEMOULIN (1965, 1970) from Kenya and recorded from numerous localities in Southern Africa is probably that of *perkinsi*.

C. perkinsi is the most widespread and abundant of the African *Cloeon*, often exceeding *smaeleni* in numbers and, unlike that species, extending into temperate South Africa whence it was originally described. The nymphs occur in many types of still or slowly moving water, from temporary ponds to the margins of large lakes.

Cloeon rhodesiae Barnard.

Cloeon rhodesiae Barnard, 1932, *Trans. r. Soc. S. Afr.*, **20** : 216.
Cloeon carneum Navás, 1936, *Rev. Zool. Bot. Afr.*, **28** : 366.
Cloeon stigmale Navás, 1936, *Rev. Zool. Bot. Afr.*, **28** : 367.
Cloeon rhodesiae : Demoulin, 1957, *Bull. Ann. Soc. roy. Ent. Belge*, **93** : 266.
Procloeon rhodesiae : Kimmins, 1960, *Bull. Brit. Mus.* (*Nat. Hist.*), *Entom.*, **9** : 342.

Apical third of subcostal area of female wing pale brown with a separate blackish-brown spot on the proximal side of this area, pterostigma with 5-6 strongly marked orange-brown veinlets (Fig. 5) ; abdomen in both sexes with lateral reddish-brown patches on terga III and VI ; hind tarsus 2 three times as long as tarsus 3. Nymph not known.

Distribution in West Africa. **Liberia** : Narnoda, St. Paul River.

Although widespread in East Africa and eastern Zaire, the only West African record I have is of two spent females found on the surface of a pool in Liberia.

Cloeon scitulum Kimmins.

Cloeon scitulum Kimmins, 1955, *Ann. Mag. nat. Hist.* (12) **8** : 863.
Cloeon scitulum : Demoulin, 1965, Ann. Mus. Roy. Afr. Cent. (8°), Zool., **138** : 104.

Wings clear in both sexes, pterostigma constantly with 2 veinlets ; abdomen with purple markings maximal on terga III and VI, often much reduced in the male (Fig. 12) : fore femur of female with a longitudinal dark red line ; hind tarsus 2 about twice as long as tarsus 3.

Male imago (in life). Eyes chocolate brown. Thorax shining blackish-brown ; abdominal terga II-VII white, VIII to X dark red, faint dark red lateral triangles on terga III and VI ; tails white. Legs colourless.

Female imago (in life). Thorax pale brown, submedian folds of mesonotum outlined in white. Abdomen cream with a complex pattern of markings comprising an incomplete orange, median streak on terga II-V, paired orange-brown, dorsolateral, trapezoidal markings on terga II-IX, which are overlaid on III and VI with deep maroon, and lateral oval markings on II-IX outlined in maroon ; venter cream with an indefinite median streak down

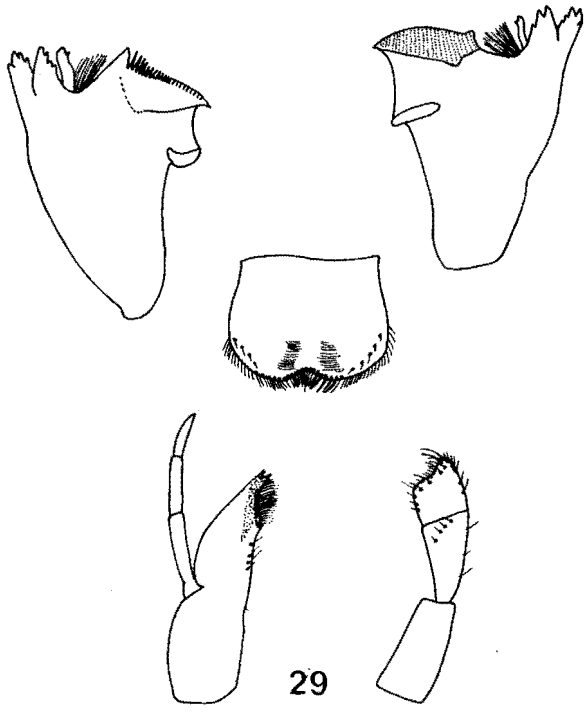


FIG. 29. — Nymphal mouthparts. *C. scitulum*.

the last 3-4 segments ; tails ringed with chocolate-brown. Fore legs translucent yellowish, the outer femoral surface with a broad, longitudinal red line extending the whole length ; outer surface of mid and hind femora with a similar but narrow dark red line, interrupted subapically.

Nymph. Labial palps clavate ; maxillary palps with 3 segments (Fig. 29). Teeth on tarsal claws extending halfway to three-fifths distance to apex. Lateral abdominal spines on segments VIII (3-5) and IX (5-9) only ; gills (Fig. 23), on I upper lamella longer and narrower than lower, on II-VI upper lamella slightly smaller than lower, on VII single. Tails unbanded, distal third of paracercus unfeathered.

DISTRIBUTION IN WEST AFRICA. **Gambia** : Wali Kunda. **Nigeria** : Lagos, Ibadan.

C. scitulum appears to be less universally distributed than

smaeleni or *perkinsi*, but often occurs in great abundance. The nymphs have been found in permanent swamps, irrigation channels and the margins of large ponds and lakes.

Cloeon smaeleni LESTAGE.

Cloeon smaeleni LESTAGE, 1924, *Rev. Zool. Afr.*, **12** : 426.
Cloeon affine NAVÁS, 1930, *Rev. Zool. Bot. Afr.*, **19** : 322.
Cloeon punctatum NAVÁS, 1931, *Brot., Zocl.*, **27** : 122 (SYN. NOV.).
Cloeon incertum DEMOULIN, 1957, *Bull. Ann. Soc. roy. Ent. Belge*, **93** : 268.
Procloeon fraudulentum DEMOULIN, 1957, *Bull. Ann. Soc. roy. Ent. Belge*, 93 : 272.
Procloeon smaeleni : KIMMINS, 1960, *Bull. Brit. Mus. (Nat. Hist.) Entom.*, **9** : 344.
Cloeon smaeleni : DEMOULIN, 1966, *Bull. IFAN*, **28** (A) : 1415.

A moderately large species, female wing with costal and subcostal area uniformly tinted brown with small, clear windows round crossveins, the colour spreading distally into the first radial interspace ; hind tarsus 2 three times as long as tarsus 3.

Male imago (in life). Turbinate eyes brownish-amber, tip of antennal pedicel and base of filament brown. Thorax mahogany-brown. Abdomen generally orange-brown, terga II to VII pale medially with lateral orange brown markings, becoming broader posteriorly and tending to meet in the middle ; VIII to X orange brown ; sterna pale with lateral brown streaks on II to IX, becoming longer on posterior segments, a median brown line on VIII and IX and a brown patch on outer aspect of basal segment of forceps ; tails white with every second or fourth annulation brown. Wings colourless except for two red spots on costal brace ; pterostigma with 2-4 crossveins. Fore femur deep reddish-brown, tibia and tarsus pale ; other femora pale with apical and subapical reddish-brown spots.

Female imago (in life). Thorax greyish-brown, medial scutal folds reddish-brown. Abdomen with extensive reddish-brown markings (Fig. 13) ; sterna cream with a dark red median streak on the anterior part of each segment and dark red lateral patches ; tails as in male. Wings (Fig. 2). Legs as in male.

Nymph. Labial palps stout, clavate ; maxillary palps with three segments (Fig. 30). Tarsal claws long, teeth extending less than halfway to apex. Lateral abdominal spines on segments VIII (6-11) and IX (7-15) only (Fig. 19) ; gills (Fig. 22). Tails with a broad dark band subapically ; distal quarter of paracercus unfeathered.

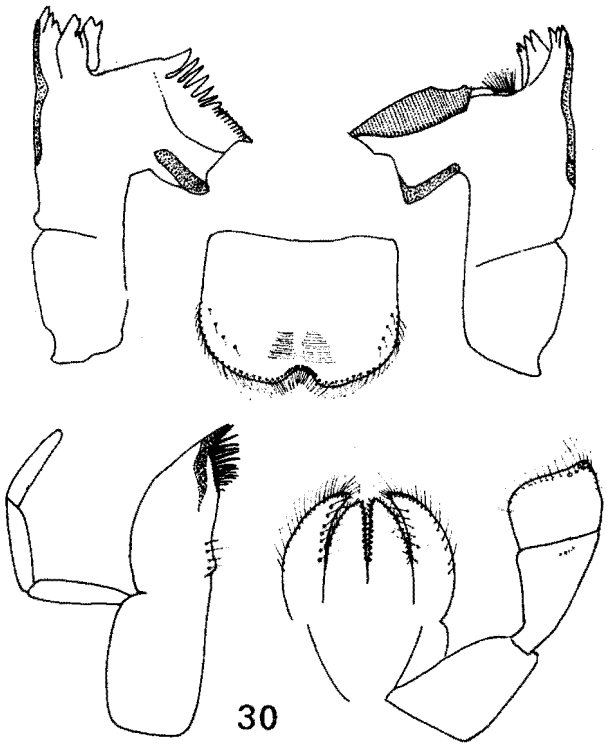


FIG. 30. — Nymphal mouthparts. *C. smaeleni.*

DISTRIBUTION IN WEST AFRICA. **Gambia** : Abuko, Keneba, Wali Kunda, Basse. **Ivory Coast** : Bouaké (DEMOULIN, 1966). **Ghana** : Accra plain (THOMAS, 1966). **Nigeria** : Lagos (*J. D. Thomas*). **Upper Volta** : Bare (*L.-O. Brun*). **Chad** : (NAVÁS, 1931).

With *C. perkinsi*, *smaeleni* is one of the most widespread and common species of *Cloeon* in tropical Africa. It abounds in temporary ponds, rice fields, dams, swamps, slow-moving streams and the margins of lakes, and is a characteristic member of the insect fauna of such bodies of water.

Although the description of *C. punctatum* from Chad is rather brief, NAVÁS' figure of the base of the wing, with two pigmented spots on the costal brace, closely resembles the male of *smaeleni*. The figure also shows a small spot near the base of radius sector, which is absent in *smaeleni*. However, the number of

pterostigmatic crossveins, the size, preapical spot on the hind femur and dark ring near the base of the tails all agree with the latter species, and I am accordingly treating *punctatum* as a synonym of *smaeleni*.

ACKNOWLEDGEMENTS

I wish to express my thanks to Mr. J.-M. Elouard for specimens of *C. dentatum* from the Ivory Coast and to Dr. J. D. Thomas for a series of nymphs from Lagos.

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