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Ephemeroptera from Nyasaland, with descriptions of new species. By D. E. KIMMINS, Dept. of Entomology, British Museum (Natural History).

THIS paper is based upon material collected by Miss Rosemary H. Lowe, M.Sc., during the course of her fisheries research work on Lake Nyasa, 1946-7, and presented by her to the British Museum. Most of these Ephemeroptera were collected near Chipoka II, a village on the lake shore about twelve miles north of Fort Johnston, mainly at lights in the house. Collections were also made at Fort Maguire (70 miles north of Fort Johnston, on the east shore of the lake), Monkey Bay

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(40 miles north of Fort Johnston on the west shore) and on the R. Mlunguzu, Zomba Plateau, Nyasaland. Two species of Ephemeroptera collected by Miss Lowe in the Sudd region of the Nile, Anglo-Egyptian Sudan, during her return journey to this country, are also dealt with in this paper, since one of them has some bearing on the generic position of some of the Lake Nyasa species of *Cænis*.

Many of the specimens collected at light were subimagines, and in our present state of knowledge of the Bætidæ of Africa, it is not possible to identify such specimens with certainty. Two species of Ephemeroptera are here described as new, and additional descriptions are given of two species of *Cænis* described by Eaton in 1879, from L. Nyasa. In addition, a summary is given of what is known about the habits of an Ephemeropterous nymph which inhabits tunnels in submerged timber.

Family Polymitarceidæ.

Povilla adusta Navás—Fort Maguire, 30. iv. 1946, 2 ♂♂.

Polymitarceidæ nymphs—Lake Nyasa, Chipoka II, and Monkey Bay, viii.-x. 1946. Blantyre, Hynde Dam, 21. ix. 1946. (Although no specimens were received from Fort Maguire, Miss Lowe informs me that the nymphs were common in that locality also.)

On several occasions during the past ten years or so, Ephemeropterous nymphs have been sent to the British Museum or to the Imperial Institute of Entomology, with the report that they were causing damage to underwater wood or timber by tunnelling in it. The first report was from Ceylon, where nymphs were taken from tunnels in teak lock-gates. In 1939, damage was reported to an Imperial Airways launch on Lake Victoria, and during the second World War, nymphs from damaged wood were received from Nigeria.

In 1946, Miss Lowe sent me some nymphs from Lake Nyasa, 17. viii. 1946, where they were boring in Mlangecedar wood forming the bottom of a boat. She reports that wooden boats left in the shallow water parts of the lake suffered much from these borers, and that the nymphs apparently secreted a substance to make a case or lining to the tunnels. This lining is of a thin papery texture, mixed with wood fibres, and sometimes consists of two or three very thin layers. Nymphs have also been taken from blue-gum piles at Monkey Bay and from the

Hynde Dam, Blantyre. In the latter case, the nymphs were from the bottom mud, as well as from submerged sticks, which had been bored.

Much of the wood affected was fairly sound, and the nymphs apparently entered at cracks. In the case of the boats on Lake Nyasa, entry was effected around nails, particularly where any paint covering had come away. Examination of the stomach contents of some of the nymphs showed very finely divided vegetable matter, some diatoms, and considerable very fine mineral matter, particularly in the hind gut.

Most of the nymphs were mature, or nearly so, although some were much smaller, with rudimentary wing pads, suggesting that this species has a long period of emergence, or that more than one year is required for development. These nymphs were determined as Polymitarciæ, and a detailed study of the wing pads suggests that the nymphs may belong to the genus *Povilla* Navás. *Povilla adusta* Nav. has a recorded distribution in Africa from the Cameroons and Belgian Congo to British East Africa and the source of the Nile. There are examples in the British Museum collections from Congo Belge, Albertville; Nigeria, Lagos; Sudan, Lake No, White Nile; Uganda, Lake Bunyuni and Entebbe; and Nyasaland, Mt. Mlange. It has been recorded from L. Victoria Nyanza, but not hitherto from L. Nyasa.

Nymphs of this species have been recorded by Arndt (1938) as living in tunnels in the Freshwater Sponges, *Spongilla alba* Cart., from Kalondo, L. Ndalaga, Mokoto, and in *Ephydatia fluviatilis* (L.) from L. Mohasi, in Ruanda. The tunnels in the sponge also are lined with a thin brownish layer. I examined some specimens of a freshwater sponge from the Hynde Dam, but found no examples of Polymitarcid nymphs within. There were some smaller tunnels, with a brownish lining, but these contained only dipterous larvæ and pupæ (Chironomidæ, probably Chironominæ).

An allied species, *P. corporaali*, has been recorded as boring in wooden aqueducts in Sumatra, and in underwater stems of rotten bamboo, although from Ulmer's account (1939) it would seem that this species does not line its burrow. Until Arndt recorded the fact, the production of silk, or of a similar secretion was unsuspected in the order Ephemeroptera, and even now the

claim rests upon somewhat circumstantial evidence, and requires confirmation. Such information can only be obtained by studying the living nymphs in captivity, and it is hoped that some biologist working on the African lakes will be able to clear up this point. One must not overlook the possibility that the material, of which the lining is made, may be a secretion of the malpighian tubules, as in the Neuroptera Planipennia, and not from modified salivary glands, as in the Lepidoptera. When examined microscopically, the material does not appear to have a filamentous structure.

The examples from Ceylon and from L. Victoria have been re-examined, and after comparing them with the Nyasa examples, I have revised my original determination of Palingeniidæ, and consider them to be Polymitarciidæ also. When making my original determination of the Ceylon examples, I was influenced by Eaton's description and figure of a Palingeniid from Ceylon (Eaton, 1883-8) and overlooked the presence of a vestigial filamentous gill on the first abdominal segment. Ulmer (1939) considers Eaton's description and figure of the Ceylon example to be incorrectly assigned to Palingeniidæ, and that it is really a Polymitarciid. It seems unlikely, however, that so observant a worker as Eaton would have missed the gill on the first abdominal segment, had it really been present, but it may have been accidentally detached.

The Nigerian nymphs unfortunately cannot now be traced, and were possibly lost during the transfer of the collections back to London after the cessation of hostilities. I think it likely that they also would prove to be Polymitarciidæ.

Family Ephemeridæ.

Ephemera natalensis Brnd. (1932)—Chipoka II, i., v., viii., x., xii. 1946, Imagines and subimagines.

Subimago, ♂ (in fluid).—Head and thorax brownish luteous, pronotum with a darker patch on disc. Legs whitish. Wings greyish white, subcostal area and cross-veins of anterior wing somewhat purplish, venation otherwise whitish. Abdomen dirty white, segments three to nine dorsally with a pair of widely separated purplish black marks, becoming longer and more evident on apical segments. Segments eight and nine also with a purplish grey cloud between the black marks, Sternites

whitish. Setæ white, finely annulated with purplish black. Forceps white.

♀ paler and more yellowish than the male. Abdominal pattern less conspicuous, setæ white, without annulations.

Eatonica schoutedeni Nav.—Chipoka II, i., vii., xii. 1946.
♂♀ subimagines.

Family Baëtidae.

Procloëon spp.—Chipoka II, 19. v., 3. vii., 21–22. viii., 27. x., 16. xii. 1946. Fort Maguire, 30. vi. 1946.

Many subimagines and a few female imagines of probably more than one species are present, but owing to the bleached condition of the material (which was preserved in alcohol) and the lack of male imagines, further determination is undesirable.

Baëtis sp.—Chipoka II, 27. x. 1946. 1 ♂ subimago.

Baëtidae nymphs—R. Mlunguza, Zomba, 16. vii. 1946.

These nymphs are rather shorter-legged than normal Baëtidae, head more flattened, abdominal tergites with the apical margins slightly elevated centrally. Seven pairs of single gills.

Centroptilum loweæ, sp. n (Figs. 1–4.)

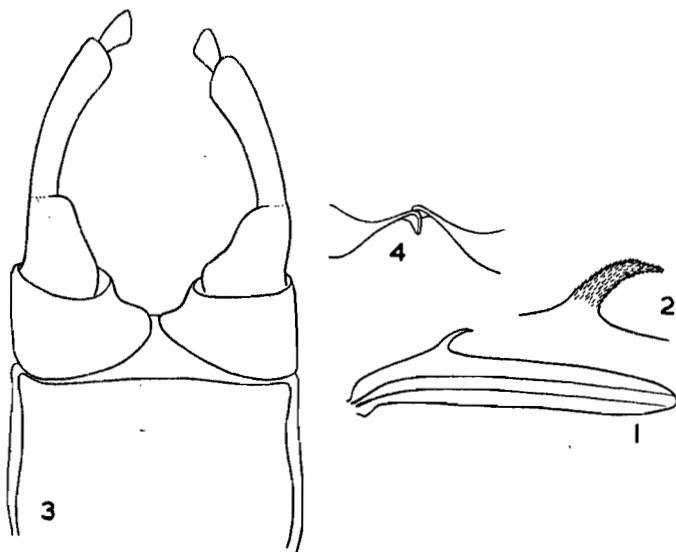
The specimens were preserved in alcohol, and it is presumed that the colours have been considerably bleached, particularly of the subimagines.

♂.—Turbinate eyes pale testaceous, lower eyes blackish, ocelli ringed with black. Thorax pale brownish, with lighter markings. Legs whitish, with very faint fuscous shading. Wings hyaline, subcosta, radius and base of costa faintly fuscous, remainder of venation colourless. No costal cross-veins before the bulla, five or six simple cross-veins in pterostigma. Posterior wing much as in *C. excisum* and *C. falcatum*, two longitudinal veins, costal process slender and hooked. Abdominal segments pale brownish above, mainly translucent, segments eight to ten opaque. Segs. two to nine tinged apically with purplish red, two to six also with a pair of narrow brownish lines, placed close together along the median line. Ventrally paler, without reddish tinge. Forceps whitish; terminal segment short, dilated apically and obliquely truncate. Within, at the base of the forceps can be seen (in a cleared example) a pair of sinuous titillators, whose apices are bent at right-angles and overlapping. Setæ broken off, probably whitish.

♂ subimago.—Creamy white, in some examples with traces of the imaginal colouring of the eyes and abdomen visible.

♀ subimago.—Creamy white, with black eyes, apical margins of some abdominal segments finely edged with reddish.

Figs. 1-4.



Centropitulum lowea, sp. n., ♂.

1. Posterior wing; 2. process of posterior wing, more enlarged;
3. forceps from beneath; 4. titillators.

Length of body, ♂ 4.5 mm.; ♀ (subim.), 5.5 mm.

Length of fore wing, ♂ 4 mm.; ♀ (subim.), 5 mm.

NYASALAND: L. Nyasa, Chipoka II, 19. v., 3. vii., 21-22. viii., 27, 29. x., 16. xii. 1946. Fort Maguire, 30. vi. 1946 (*R. H. Lowe*).

Type ♂ (in fluid), paratypes ♂♂ and ♂♀ subimagines in British Museum (N.H.).

In the form of the hind wing, this species resembles *C. excisum* Brnd. (1932) and *C. falcatum* Crass (1947). In the female, however, the posterior wing is normal (aborted in *excisum*) and the form of the terminal segment of the forceps is different.

Family *Cænidæ*.

Cænis cibaria Etn.—Chipoka II, 3. vii., 14. viii. 1946, 0700 hours.

This species was described by Eaton in 1879 from material collected on L. Nyasa. In 1924, Ulmer, when dealing with a collection of Ephemeroptera from the Anglo-Egyptian Sudan, erected for this species a new genus, *Cænodes*, the chief distinction from *Cænis* being that the male anterior legs were only about as long as the posterior legs. Of the two Eaton types in the B.M. collection, neither has a complete anterior leg, but in the better example the portion of the tibia still extant is as long as the tibia and tarsus of the posterior leg. It appears therefore that the anterior leg of *C. cibaria* is definitely longer than the posterior leg. In the collection made by Miss Lowe at Chipoka II, there is a good series of a *Cænis* which agrees well in other respects with Eaton's types, apart from a stronger pigmentation of the male abdomen. The anterior legs are moreover considerably longer than the posterior (fig. 5), as they are in the typical *Cænis*.

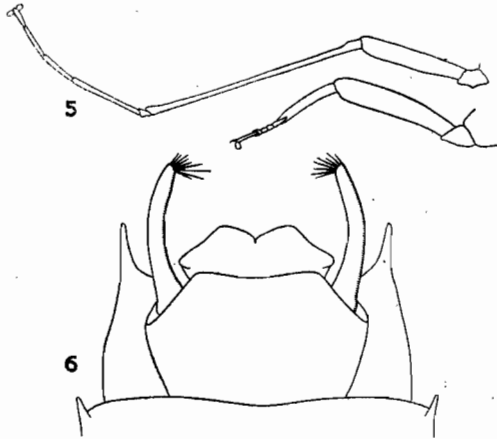
Dr. Ulmer had studied material from the Belgian Congo and from the A.-E. Sudan, but not, I believe, either Eaton's types or examples from the type-locality, Lake Nyasa. It appears therefore that the genus *Cænodes* Ulmer was erected on a mis-identified species and I propose that its genotype, *Cænis cibaria* Ulmer (*nec* Etn.) be re-named *Cænodes ulmeri*, *nom. nov.*

The fluid material from L. Nyasa enables Eaton's description of *cibaria* to be amplified and a figure of the male genitalia to be given.

♂.—Head light yellowish brown, eyes and ocelli black; two transverse blackish spots on vertex, a narrow black line linking the lateral to the median ocelli, and a pair of black spots on frons near antennal bases. Antennæ pale. Pronotum light yellowish brown, mottled with purplish black on disc and lateral margins; meso- and metonota light yellowish brown, sutures finely picked out in blackish. Legs whitish, anterior femur much clouded with purplish black, median and posterior femora each with a small blackish patch apically. Wings hyaline, in anterior third faintly shaded with purplish; costa, subcosta, radius and radial sector purplish, remainder of venation colourless. Abdomen whitish, shaded dorsally with

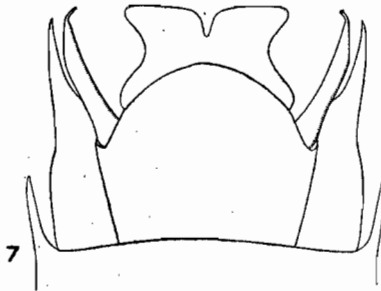
purplish black, which is sometimes absent on tergites three to six, sternites white, sometimes clouded with blackish laterally. Cerci white. Forceps light yellowish,

Figs. 5, 6.

*Cænis cibaria*, Etn., ♂.

5. Anterior and posterior legs; 6. genitalia from beneath.

Fig. 7.

*Cænis kungu* Etn., ♂.
Genitalia from beneath.

slender, slightly curved and armed apically with a tuft of acute bristles. Penis broad, forming two rounded lobes with an excision between them (fig. 6).

♀.—Resembling male, but less heavily marked with blackish. Abdomen more yellowish in gravid specimens.

Eaton's type material of this species in the British Museum consists of two males and two females, each

mounted dry between cover-glasses. From this series I have selected as *type* the male having the more complete anterior leg and without adherent subimaginal skin, and as *allotype* the female without adherent subimaginal skin.

Cænis kungu Etn.—Chipoka II, 14. viii. 1946, 0700 hours; 3 ♂♂.

The male type of *kungu* also lacks its anterior legs. Three examples collected by Miss Lowe are undoubtedly of this species, and have the anterior legs much longer than the posterior. Thus Eaton's *kungu* is a true *Cænis* and not a *Cænodes* as suggested by Ulmer. It is rather larger than *C. cibaria*. The head and thorax pale yellowish brown, unmarked except for a darker brown patch on each anterior angle of mesonotum. Anterior legs greyish, the femora marked distally with blackish, and coxæ striped externally with brown. Median and posterior legs creamy white. Wings hyaline, venation pale purplish grey, anterior veins darker, Sc. and R. bordered with purplish grey. Abdomen, cerci and forceps whitish. Forceps short, tapering, extreme apex acute and angled inwards. Forceps-base produced, but margin obscure owing to lack of pigmentation. Penis large, projecting almost to apex of forceps, broad, with a constriction about midway, and with a narrow median excision (fig. 7).

Cænis sp. ? *kungu* Ern.—Chipoka II, 14. viii. 1946, 0700 hours.

These specimens are possibly distinct from *C. kungu* Etn. There is greyish on the abdomen, the forceps are yellowish brown, and the penis lobes are more divergent. More material of both *C. kungu* and this form is desirable to ascertain the limits of variation.

Cænodes ulmeri, nom. nov.

Cænis cibaria Ulmer, 1924 (*nee* Eaton, 1879), Denks. Akad. Wiss. Wien, Math.-Naturwiss. xcix. p. 5.

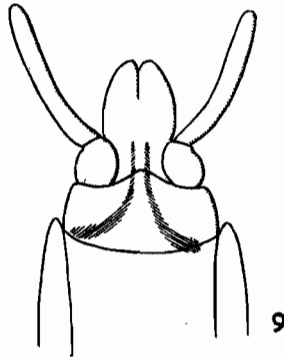
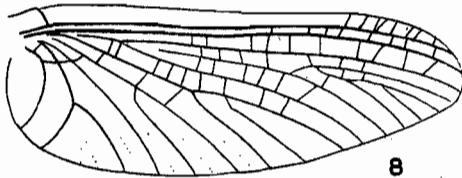
Cænodes cibaria Ulmer, 1924, *loc. cit.* p. 7.

The reasons for the above changes of name have already been set out when dealing with *Cænis cibaria* Etn. Miss Lowe collected a series of this species in the Sudd region of the Nile, Anglo-Egyptian Sudan, on 12. v. 1947, during her journey back to England. The anterior legs of the male are noticeably shorter than in *Cænis* and are only slightly longer than the posteriors, the shortening being in the tibia and tarsus.

Tricorythus maculatus, sp. n. (Figs. 8-10.)

♂ imago (in fluid).—Head pale brownish, eyes black. Thorax brownish, with pale sutures. Legs missing in type, apart from one posterior, which is pale testaceous. Wings hyaline, with pale testaceous venation (fig. 8). Abdomen pale translucent fuscous, marked dorsally with blackish as follows: segments one to two with a pair of median triangles, seven with a pair of small apical spots,

Figs. 8, 9.

*Tricorythus maculatus*, sp. n., ♂.

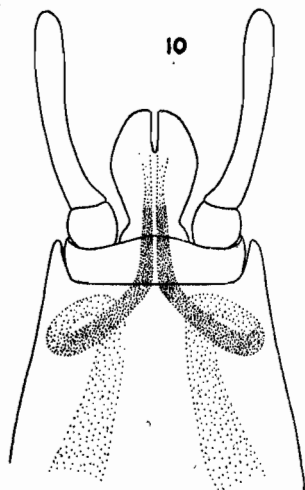
8. Wing; 9. genitalia from beneath.

eight to nine with a pair of small basal triangles. Forceps two-segmented, basal segment short and globular, terminal long, slender and out-spread. Penis stout, about half as long as forceps, slightly divergent beyond the middle and tapering to an excised apex. Within can be seen the blackish seminal ducts (fig. 9). Cerci whitish, basal segments annulated with blackish.

♂ subimago (in fluid).—Head very light brownish, turbinate eyes purplish black, ocelli bordered with black. Thorax pale creamy white, faintly marked with brownish, and with a pair of elongate purplish triangular spots on

anterior margin of mesonotum. Legs whitish, posterior (and sometimes median) femora with a small blackish spot on upper surface towards apex. Wings rather narrow, greyish white. Venation strong, with few cross-veins in cubital and anal areas. Abdomen whitish, segments one to six broader than long, seven to nine as long as, or longer than broad. Tergite one unmarked or with indefinite blackish marks, two with a pair of black spots, about half as long as segment, one on each side of median line, seven with a pair of curved faint blackish marks in apical half, eight to nine each with a pair of

Fig. 10.



Tricorythus maculatus, sp. n., ♂.
Genitalia of subimago from beneath.

narrow blackish triangles basally. Ventrally with a suggestion of a blackish spot in centre of basal margin of sternites two to seven. The paired genital ducts can be seen within segments eight and nine as an inverted Y-shaped blackish mark (fig. 10). Forceps two-segmented, basal segment short, terminal about five times as long. Penis about as long as forceps, moderately dilated beyond midway, tapering to a narrowly-excised apex. Cerci whitish, with faint indications of blackish annulations basally.

♀ subimago with markings similar to male, but without black spots on femora or black genital ducts.

Length of body, ♂ 7 mm.; ♀ 7.5 mm.

Length of wing, ♂ 6 mm.; ♀ 6.5 mm.

NYASALAND: L. Nyasa, Chipoka II, 19. v., 3. vii., 21-22. viii., 27. x., 16. xii. 1946. Fort Maguire, 30. v. 1946 (*R. H. Lowe*).

Type male imago, allotype female subimago and paratypes in fluid in British Museum (Nat. Hist.). The form of the genital appendages, the pattern of the abdomen and the black genital ducts should render this species easily recognizable in both imaginal and subimaginal stages.

Tricorythus ? *varicauda* Pict.—A.—E. Sudan, Sudd region of R. Nile, 12. v. 1947.

A series which may belong to this species, but the penis in ventral view is much wider than as figured by Ulmer (1916), which is presumably drawn from the dried Pictet type.

? *Tricorythus* sp. nymphs.—R. Mlunguzu, Zomba, 26. vii. 1946.

One mature nymph, one young example. These specimens lack the manibular fringe and differ in the form of the pronotum from that figured by Barnard.

Family Leptophlebiidæ.

? *Euthraululus* sp. nymphs.—Zomba Plateau, 28. vii. 1946.

? *Adenophlebiodes* sp. nymph.—Zomba Plateau, 28. vii. 1946.

Leptophlebiidæ nymphs.—R. Mlunguzu, Zomba, 23, 26. vii. 1946.

Specimens lacking gills and legs, not further determinable.

Family Ecdyonuridæ.

Ecdyonuridæ nymphs.—R. Mlunguzu, Zomba, 23, 26. vii. 1946, Zomba Plateau, 28. vii. 1946.

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