PARC NATIONAL DE L'UPEMBA
I. MISSION G. F. DE WITTE
en collaboration avec
W. ADAM, A. JANSSENS, L. VAN MEEL
et R. VERHEYEN (1946-1949).
Fascicule 8 (1)

NATIONAAL UPEMBA PARK
I. ZENDING G. F. DE WITTE
met medewerking van
W. ADAM, A. JANSSENS, L. VAN MEEL
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Aflevering 8 (1)

PERLIDÆ
(PLECOPTERA)

BY

H. B. N. HYNES (Liverpool)

One hundred and twenty seven adult stoneflies and one nymph collected by the Mission G. F. DE WITTE were made available to me for study by the President of the « Institut des Parcs Nationaux du Congo Belge », to whom I am very grateful for giving me the opportunity of examining this material.

Just before I was asked to study this material I had completed a paper (HYNES, 1952) based on an examination of a large number of stoneflies from many parts of Africa, in which it was suggested that there were strong grounds for supposing that all the specimens of the family *Perlidæ* so far recorded from Africa south of the Sahara belong to a single very variable species of the sub-family *Neoperlinæ*, which should bear the name *Neoperla spio* (NEWMAN, 1839). It was further suggested that this species is the only member of the order *Plecoptera* which occurs in tropical Africa. The present collection has been studied with these suggestions in mind, and it appears to support them.

LIST OF LOCALITIES.

Kaswabilenga, rive dr. Lufira, alt. 700 m, 13.IX-8.XI.1947, 48 ♂♂, 38 ♀♀.
Riv. Lupiala, affl. dr. Lufira, alt. 700 m, 6-9.X.1947, 1 ♂, 7 ♀♀; alt. 850 m, 24.X.1947, 2 ♂♂.
Kilwezi, affl. dr. Lufira, alt. 750 m, 2-21.VIII.1948, 1 ♂, 1 ♀.
Lukawe, affl. dr. Lufira, alt. 700 m, 30.IX-9.X.1947, 3 ♂♂, 12 ♀♀.
Kankunda, affl. g. Lupiala, alt. 1.300 m, 13-28.XI.1947, 4 ♂♂, 3 ♀♀; 15-26.II.1948, 1 ♂.

Kaziba, affl. g. Senze, sous-affl. dr. Lufira, alt. 1.140 m, 4-12.II.1948, 1 ♀.
Lusinga, alt. 1.760 m, 12-17.XII.1947, 2 ♀♀.
Kiamakoto-Kiwakishi, alt. 1.070 m, 4-16.X.1948, 2 ♂♂, 1 ♀.
Gorges de la Pelenge, alt. 1.150 m, 18-20.VI.1947, 1 nymph.

All these localities are in the watershed of the Lufira River, a tributary of the Lualaba River.

SPECIES PREVIOUSLY RECORDED FROM THE BELGIAN CONGO.

At least twenty-nine species of *Neoperla* NEEDHAM (= *Ochthopetina* ENDERLEIN) have been recorded from Africa, and of these the following have been recorded or described from the Belgian Congo.

Neoperla dubia KLAPÁLEK (1909) recorded by NEEDHAM (1920) from Faradje.
Ochthopetina haugi NAVÁS (1916) recorded by NAVÁS (1931) from Sankuru, Komi, Stanleyville and Ubangi Burubu.
Neoperla needhami LESTAGE (1921) (= *N. excisa* NEEDHAM nec KLAPÁLEK) described by NEEDHAM (1920) from Faradje.
Neoperla burgeoni NAVÁS (1926) described from Kindu, distr. Maniema.
Neoperla lujana NAVÁS (1931) described from Kivu, Buserengenye, Rutshuru.
Neoperla luluana NAVÁS (1931) described from Lulua, riv. Luele.
Neoperla leopoldina NAVÁS (1932) described from Bomokandi.
Neoperla bredoana NAVÁS (1932) described from Waika, Prov. or.

As stated above, it is highly probable that all these names refer to one species only.

CHARACTERS PREVIOUSLY USED TO SEPARATE SPECIES.

The various authors describing species have used the following characters on which to separate them : coloration, size, distance apart of ocelli, ratio of width to length of pronotum, eggs, the sub-genital plate (8th sternum) of the female and male genitalia. HYNES (1952) has shown that there is a complete overlap of all these characters in the specimens studied by him, and that none is satisfactory for specific distinction. Some of these characters have been studied in detail on the present collection and some points of interest have emerged.

Coloration.

The females were found to be almost all pale specimens with a yellowish body. The dark spots round the ocelli were separate in some and fused in others. The legs were pale yellowish except that in a few specimens the

proximal ends of the tibiæ were slightly darkened. The cerci were pale and the antennæ darkened towards the tip. The wings were pale and yellowish.

The males, except for five or six specimens which were pale and may have been teneral, were slightly darker in general colour than the females, being more orange yellow, but the extent of darkening was similar to that of the females. Noticeably, however, most of them had darkened, smoky wings. This sex-difference in coloration was not noticed in collections previously examined and may have been overlooked. It was not, however, an absolute difference, because apart from the few pale, possibly teneral, males the female from Kiamakoto-Kiwakishi had smoky wings, like the males, and the female from Kilwezi was intermediate in this respect.

Size.

The lengths of the fore wings ranged in the males from 10-13 mm and in the females from 12 ½-19 mm. There appeared to be no correlation between size and locality, but as shown by most authors the males are generally smaller than the females.

Wing Venation.

Table 1 shows details of the venation of the fore wings of 20 males and 20 females from Kaswabilenga. It can be seen that, as shown previously (HYNES, 1952) this is extremely variable, and thus unsatisfactory for specific distinction.

The sub-genital plate (8th sternum) of the female.

Most of the specimens had a straight posterior edge to the 8th sternum (fig. 1 A), but in some it was to a variable extent drawn out in the middle (figs. 1 B and C). The female from Kiamakoto-Kiwakishi, had however, a distinct sub-genital plate (fig. 1 D). More or less intermediate specimens occurred in the Kaswabilenga series (fig. 1 C) indicating that, as previously postulated (HYNES, 1952), variation in this character is continuous. Figs. 1 C and D illustrate the form of the spermatheca and vagina as seen through the cuticle of cleared specimens and the extent of the heavier chitinisation just inside the vagina. This last character varied considerably from specimen to specimen. The peculiar spiral spermatheca has been previously commented upon (HYNES, 1952). It was most obvious in specimens with few or no well-developed eggs and became more transparent as the number of eggs in the oviducts increased. Possibly this is because the content of spermatozoa is reduced, or because the chitin of its walls is resorbed for use in the chorions of the eggs.

The Eggs.

Three specimens from Kaswabilenga had one or two eggs still adhering to the abdomen. These were of two distinct types although the three females were very similar in general appearence. On one female the two eggs were deeply grooved longitudinally with about 10 striæ, and resembled the eggs of *N. traansvaalensis* ENDERLEIN as described by BARNARD (1934). In the other two females the single eggs had a much larger number of shallow striæ. The same two types of egg were found in the oviducts of specimens which were cleared, and in one specimen both types occurred

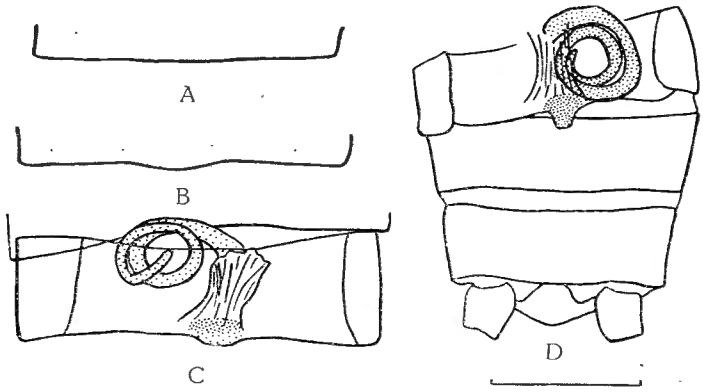

FIG. 1. — Female subgenital plates in ventral view.
A-C : Specimens from Kaswabilenga. — D : A specimen from Kiamakoto-Kiwakishi showing the entire tip of the abdomen. — C and D : Show the vagina and spermatheca as seen by transparency. — The line represents 1 mm. — Drawn from cleared specimens with a projector.

together. No eggs with spiral striæ as described in *N. dubia* KLAPÁLEK by NEEDHAM (1920) were seen in the few specimens examined. As stated previously (HYNES, 1952) the pattern of the egg-chorion appears to be very variable.

The Male genitalia.

The abdomens of all the male specimens were cleared in caustic potash and examined. They were found to vary considerably.

It has been shown previously (HYNES, 1952) that the male genitalia of African specimens of *Neoperla* can be placed in seven somewhat overlapping groups as follows, which seem to represent stages in a continuous variation.

A. — Specimens with a wide lappet, bearing denticles ventrally, on the seventh tergum, and with only denticles on the eighth tergum.

B. — Specimens with a narrow lappet, bearing denticles ventrally and sometimes with spines round the edge, on the seventh tergum, and with only denticles on the eighth tergum (e.g. *N. kunenensis* BARNARD, 1934).

C. — Specimens with a backwardly directed conical process, ending in two to a few points and bearing denticles at the base, on the seventh tergum, and with only denticles, or a very small hump bearing denticles on the eighth tergum [e.g. *N. dubia* KLAPÁLEK (1909), *N. lacroixi* LESTAGE (1921) and *N. nigricauda* KLAPÁLEK (1909)].

D. — Specimens with a more or less backwardly directed simple process, ending in a simple point and bearing denticles at the base, on the seventh tergum, and with only denticles, or a very small hump bearing denticles, on the eighth tergum (e.g. *N. africana* KLAPÁLEK, 1910).

E. — Specimens with an upwardly directed conical process, usually ending in a simple point but occasionally with a few points, and bearing denticles at the base, on the seventh tergum, and with a medium sized hump or process, bearing denticles anteriorly, on the eighth tergum.

F. — Specimens with a more or less small upwardly directed process, usually ending in a simple point but occasionally with a few points and bearing denticles at the base, on the seventh tergum, and with a fairly large process bearing denticles or points anteriorly on the eighth tergum (e.g. *N. sjöstedti* KLAPÁLEK, 1910).

G. — Specimens with no process, but only denticles, and sometimes with a transverse ridge, on the seventh tergum, and with a large process, bearing points anteriorly, on the eighth tergum [e.g. *N. lerioana* KLAPÁLEK (1911), *N. bottegoana* NAVÁS (1933), *N. excisa* KLAPÁLEK (1909), *N. needhami* LESTAGE (1921), *N. arambourgana* NAVÁS (1936), and *N. transvaalensis* (ENDERLEIN, 1909)].

It has also been shown that specimens with genitalia types A, B, C and G have been recorded from the Belgian Congo.

In the present collection only types B, C, D and G were found, and most specimens were of type C. One or two specimens however approached type E fairly closely (fig. 2 C and D) and type D, which is a special case of type C, was represented by one specimen (fig. 2 E).

Some long series from other parts of Africa have been found to show a greater range and continuity of the various genitalia types than this. This is discussed more fully below.

Within type C many different shapes of process on the seventh tergum were found, some of which are illustrated in figs. 2 B, C and D. Similarly within type G considerable variation was observed in the form of the process on the eighth tergum (figs. 2 F, G and H) and in the shape of the

seventh tergum. In two specimens (fig. 2 H) the posterior edge of the tergum was cleft, and in another (fig. 2 G) the posterior edge of the segment was drawn up in such a way as to be almost intermediate between type F

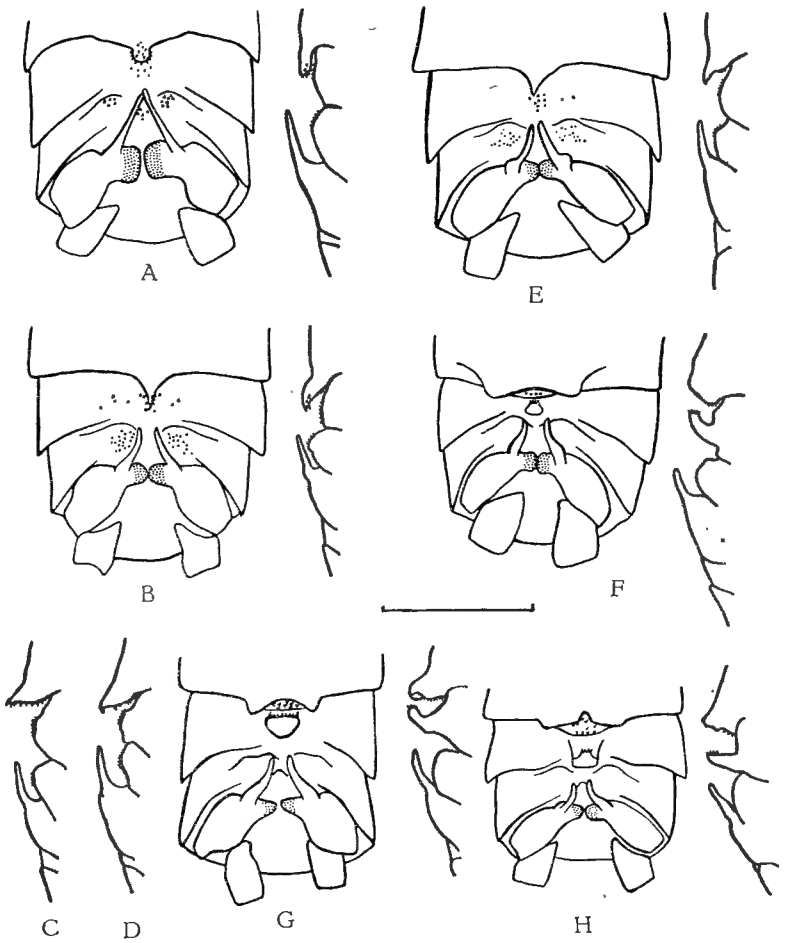

FIG. 2. — Male genitalia in dorsal and profile views.
A-F : Specimens from Kaswabilenga. — G : A specimen from Kankunda.
H : A specimen from Kiamakoto-Kiwakishi. — The line represents 1 mm.
Drawn from cleared specimens with a projector.

and type G. As had previously been noted (HYNES, 1952) there was much variation in the shape of the patch of denticles on the eighth tergum, the forwardly directed horns of the tenth tergum, the inner lobes of the tergites of the tenth segment, and the width of the ædeagus.

DISCUSSION.

If the conclusion previously arrived at (HYNES, 1952), that there is but one species of *Neoperla* in Africa, is correct, there are three facts about the present collection which need clarification. These are :

1° The complete absence of the intermediate male genitalia types E and F. This may well be due to chance, or perhaps to a real absence or scarcity of these forms in this particular watershed, as they are known to occur together with other types in other areas. Also, at least some specimens were very near these types (figs. 2 D and G).

2° The fact that the one dark-winged female was also the smallest (12 ½ mm fore wing-length as opposed to 13-19 for the rest) and the one with the best developed sub-genital plate. This is almost certainly due to chance, and does not indicate any specific difference, because as has been shown above the collection contains intermediate forms in all these characters, and the female which was intermediate in wing colour had a very poorly developed sub-genital plate. Also specimens from the Belgian Congo which were previously described as having similar well developed sub-genital plates (HYNES, 1952) had fore wings 14 or more mm long.

3° The fact that the six males in the collection having genitalia of type G were also the smallest (fore wing-length 10-11 ½ mm as opposed to 11 ½-13 for the rest). This is a point of some interest, which remains unexplained. These six specimens included both very pale winged and very dark winged specimens, and, apart from their genitalia and their size, did not appear to differ from the rest of the collection. Were it not for the existence of intermediate genitalia types in other collections this might be taken to indicate a specific difference. Also specimens with genitalia types B-F are known from Sierra Leone with fore wing-lengths of 7-9 ½ mm (HYNES, 1952). It may be that in any given locality there is some correlation between the size of the individual and the genitalia type which it develops, that type A specimens tend to be the largest and type C the smallest, the rest being intermediate. There is some support for this suggestion in the fact that the fore wing-lengths of six males from Bugarama in the Belgian Congo which had genitalia of types A and B were 13-14 mm, the range of fore wing-lengths of the type C specimens in the present collection is 11 ½-13 mm and of type G specimens 10-11 ½. The four type B specimens in this collection have, however, fore wing lengths of 12-12 ½ mm. It is obvious that to test this suggestion a very much longer series of specimens from one small area than any that has yet been available would be needed.

There would appear therefore to be nothing in the present collection to modify the suggestion that only one species of the family *Perlidæ* occurs in the Ethiopian region.

Finally a point of interest is that all the adult specimens were collected between August and December, except for one collected in February. According to information kindly supplied by the Institut des Parcs Nationaux du Congo Belge « la saison des pluies au Parc National de l'Upemba se situe de la mi-septembre ou du début d'octobre jusqu'au début du mois de mai. Le mois d'août est caractérisé par de violents orages accompagnés de grêles ». They also state that *Plecoptera* were searched for throughout the year by the Mission G. F. DE WITTE. It would seem therefore that the main season of eclosion of these insects is the first half of the rainy season.

University of Liverpool, July, 1951.

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TABEL 1. — **Some details of the variation in the venation of the fore wings of twenty males and twenty females from Kaswabilenga.**

Males :																				
Number of sub-costal cross-veins	11	11	10	10	13	11	9	12	11	10	11	9	10	7	9	10	10	9	9	7
Number of costal cross-veins	5	2	3	2	3	4	5	3	3	3	3	3	3	5	4	3	2	3	5	4
Number of medio-cubital cross-veins.	6	8	5	5	7	6	6	7	7	7	7	6	7	5	6	6	6	7	6	7
Number of cubital cross-veins	4	5	4	4	5	5	4	5	4	5	5	5	5	3	4	4	4	4	5	5
Number of branches of first cubital vein	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2
Number of branches of radial sector	3	3	3	4	3	4	3	4	3	3	3	3	3	4	4	5	3	3	4	3
Radial sector branching at (+) or beyond (—) the anastomosis	+	—	+	+	+	+	—	—	—	—	—	+	—	—	+	+	—	—	+	+
Females :																				
Number of sub-costal cross-veins	10	9	9	7	8	11	11	10	11	10	6	9	11	8	9	9	9	11	12	9
Number of costal cross-veins	3	3	4	5	6	5	2	4	6	5	4	6	5	5	6	5	5	4	3	6
Number of medio-cubital cross-veins.	7	6	6	6	7	6	8	7	8	7	6	7	7	6	8	6	7	8	7	8
Number of cubital cross-veins	5	6	6	5	4	5	6	4	5	4	4	5	6	5	6	5	5	6	6	6
Number of branches of first cubital vein	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2
Number of branches of radial sector ...	3	4	4	4	4	4	4	4	4	4	3	4	4	3	4	4	3	4	4	3
Radial sector branching at (+) or beyond (—) the anastomosis	+	—	—	+	—	+	+	+	+	+	—	+	+	+	—	—	—	+	+	—