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ON THE GENERIC POSITION OF *Cloeon papuanum* VAN BRUGGEN, 1957 (Ephemeroptera, Baetidae)

by

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Soon after I published the description of "*Cloeon papuanum*" (VAN BRUGGEN, 1957) I received a letter from my distinguished colleague Dr. G. DEMOULIN of the Brussels Museum pointing out that the species had been placed in the wrong genus. He suggested to reconsider the matter, which I have now done.

At first sight it could be assumed that "*Cloeon papuanum*", which has been described from the Wissel Lakes, West-central New Guinea, belongs to the genus *Pseudocloeon* KLAPÁLEK on account of the double marginal intercalaries in the wings. A closer examination, however, shows that the species possesses a rather remarkable combination of characters. Unfortunately no nymphs are yet available, so that study is restricted to the adult insects. Nowadays there is a rather marked tendency to classify Ephemeroptera mainly on the larval structures, in my opinion justifiable. Therefore this discussion is merely preliminary.

Six genera in the family Baetidae are known to have in common the following characters: hindwings completely reduced (thus absent) and intercalaries paired in the forewings¹). These genera are:

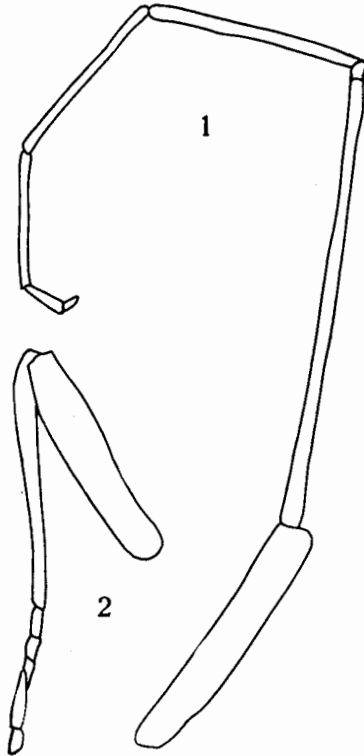
Apobaetis DAY, 1955 (U.S.A.), type species *A. indeprensus* DAY;
Baetiella UÉNO, 1931 (Japan), type species *Acentrella japonica* IMANISHI;
Bungona Harker, 1957 (Australia), type species *B. narilla* HARKER;
Cloeodes TRAVER, 1938 (Puerto Rico), type species *C. maculipes* TRAVER;
Paracloeodes DAY, 1955 (U.S.A., Puerto Rico), type species *P. abditus* DAY;
Pseudocloeon KLAPÁLEK, 1905 (U.S.A. and Canada, South America, Malaysia, West and South Africa), type species *P. kraepelini* KLAPÁLEK.

The first five genera are sufficiently well established, but *Pseudocloeon* seems to include some very different species. Very probably this genus will have to be

¹) The last-mentioned character applies particularly to male specimens, although usually the females show at least some paired intercalaries.

split into two or more units, since some groups of species in various parts of the world seem to form more or less natural taxa, e.g. those in Malaysia (*P. kraepelini* Klapálek, *P. boettgeri* Ulmer, and *P. obscurum* Ulmer). Further details are discussed at the end of this paper.

It appears that for the comparison of adult insects we must consider characters of the legs, of the genitalia, and of the wings; at the conclusion of the paper a synthesis will be presented. In Table I the proportions of the segments of the



Figs. 1-2. *Baetiella japonica* (IMAN.). First leg (1) and third leg (2) of male. After camera lucida drawings of Dr. M. UÉNO.

fore and of the hind legs are compared. In the tarsal formulae the tarsal segments are listed from the longest to the shortest. In the middle and hind legs the first segment of the tarsus is fused with the tibia, therefore number 1 has been omitted in the formula. Generally the middle legs are very similar to the hind legs. Most data were taken from the literature or measured from published camera lucida figures. Unfortunately a number of authors while describing new *Pseudocloeon* species mentioned the colour of the legs only (e.g. BARNARD, CRASS, DAGGY, McDUNNOUGH, etc.). Therefore the data on *Pseudocloeon* in

Table I are taken only from three Malaysian species discussed by ULMER (1924). Additional data on *Bungona* were supplied by Miss HARKER, while Prof. UÉNO kindly sent a camera lucida drawing of the legs of *Baetiella japonica* (IMANISHI). For the sake of completeness and in order to record his data the drawings are reproduced here (figs. 1-2).

The table shows that the group under discussion is rather heterogeneous in the composition of the legs. Apparently *Bungona* has a unique position on account of the short tibia and the fusion of first and second segments in the tarsus of the first pair of legs, and the long tarsus in the hind legs. On the whole there is a remarkable resemblance in the tarsal formulae of the fore legs, while on the other hand the tarsal formulae of the hind legs show more differences. The position of "*Cloeon*" *papuanum* is not at all clear. It shows affinities with most of the genera except, of course, *Bungona*; however, it does not agree with the general aspect of these taxa.

Next the male genitalia have to be considered, viz. the segments of the forceps or genostyles, in the various genera. Table II shows the results of a comparison of the shape of the joints. The data on *Pseudocloeon* are derived from African species [*inzingae* CRASS, *magae* BARNARD, *minutum* CRASS nec DAGGY = *vinosum* BARNARD¹)] (top) and from Asiatic species (*boettgeri* ULMER, *kraepelini* KLAPÁLEK, *obscurum* ULMER) (bottom). Unfortunately many authors either do not figure the male genitalia or describe them inadequately.

It is extremely difficult to comment upon Table II. It appears that *Bungona* agrees well with what is seen in the other genera; this is certainly contradictory to what has been found in studying the legs. The last segment of the forceps may be very different, either it may be broadly attached to the third joint (*Baetiella*, some species of *Pseudocloeon*, and "*Cloeon*" *papuanum*) or only have a narrow point of attachment to the third segment (*Apobaetis*, *Bungona*, *Cloeodes*, *Paracloeodes* and some species of *Pseudocloeon*). However, it does not seem to be of any taxonomic importance. A more interesting point of discussion is offered by the fusion of the second and third joints as is observed in the genera *Apobaetis*, *Paracloeodes* and in some species of *Pseudocloeon*. It may be suggested that the genera that do not possess this phenomenon are older than the others; "*Cloeon*" *papuanum*, which very probably is endemic to the island of New Guinea, belongs to the latter group. Many of the faunal elements of New Guinea have relict characters; on the strength of the male genitalia "*Cloeon*" *papuanum* might well belong to these faunal elements.

Finally we have to compare the wings of the six genera under consideration and of "*Cloeon*" *papuanum*. It is impossible to tabulate differences; therefore certain characters must be considered point by point. The wings of *Cloeodes* have not been figured, but fortunately at least sketchy descriptions are available (TRAVER, 1938). Of *Pseudocloeon* only figures of four South African and one Malaysian species were available; the wings of some Canadian species are inadequately

1) Fide CRASS, in litt.

TABLE I
 Comparison of the first and third pairs of legs of the genera under discussion and "*Cloeon*" *papuamum*.
 Abbreviations: fe = femur, ti = tibia, ta = tarsus, I = fore legs, III = hind legs.

Genus	fe I	ti I	tarsal formula fore legs	fe III	ti III	tarsal formula hind legs
<i>Apobaetis</i>	fe = $\frac{2}{3}$ ti	ti = $\frac{15}{13}$ ta	2, 3, 4, 5, I	fe = ti	ti = 2 ta	2, 3 = 5, 4
<i>Baetiella</i>	fe = $\frac{1}{2}$ ti	ti = $\frac{3}{4}$ ta	2, 3, 4, 5, I	fe = $\frac{5}{6}$ ti	ti = 2 ta	5, 2, 3, 4
<i>Bungona</i>	fe = 2 ti	ti = $\frac{1}{2}$ ta	I + 2 = 5, 4, 3	fe = $\frac{4}{3}$ ti	ti = ta	2, 3, 5, 4
<i>Cloeodes</i>	fe = $\frac{1}{2}$ ti	ti = ta	2, 3, 4, 5, I	fe = ti	ti = $\frac{9}{5}$ ta	2, 3, 5, 4
<i>Paracloeodes</i>	fe = $\frac{1}{2}$ ti	ti = ta	2, 3, 4, 5, I	fe = ti	ti = 2 ta	5, 2, 3, 4
<i>Pseudocloeon</i>	fe = $\frac{2}{3}$ or $\frac{3}{5}$ ti	ti = ta or $\frac{3}{2}$ ta	2, 3, 4, 5, I	fe = $\frac{2}{3}$ or $\frac{5}{6}$ ti	ti = 3 ta	2, 3 = 5, 4 or 2, 3, 5, 4
" <i>Cloeon</i> " <i>papuamum</i>	fe = ti	ti = ta	2 = 3, 5, 4, I	fe = ti	ti = 3 ta	2 = 5, 3, 4

described, while those of some U.S. species are only slightly better known (e.g. DAGGY, 1945).

The interpretation of the veins is extremely difficult in the Ephemeroptera. The whole group discussed here shows marginal cross-veins; they vary somewhat in number and shape but they do not give any clues as to relationships. There is also nothing particularly remarkable in the marginal intercalaries, except perhaps in *Apobaetis* where they do not reach much further than the middle of the wing. However, there are considerable differences in the position of the cross-veins; in this respect "*Cloeon*" *papuanum* comes nearest to *Bungona* and *Baetiella* because most cross-veins, especially in the cubital and medial regions, form a rather irregular pattern. In other genera, e.g. in *Paracloeodes* and many species of *Pseudocloeon*, these cross-veins are more or less arranged in a continuous line which runs partly parallel to the hind margin of the wing. The wing of "*Cloeon*" *papuanum* shows more peculiarities, viz., the comparatively narrow field of MA (MA¹-IMA-MA² or the veins nos. 8, 9 and 10, counted from the anal region), the joining of IMP and MP² (the fifth and sixth veins counted as before), and the presence of only one ICuA. The last-mentioned character is also found in the genus *Bungona*. It has been said before that homologizing and therefore comparison of veins in wings of Ephemeroptera is very difficult, especially since usually there is some variation, interspecific as well as intraspecific.

The general shape of the wings as a rule is rather uniform, except for *Baetiella*; as far as can be judged from IMANISHI's figure (in UÉNO, 1931, fig. 30) the wing in this genus is long and narrow. It should be noted that in the figure of "*Cloeon*" *papuanum* (VAN BRUGGEN, 1957, fig. 3) the anal angle of the wing has been drawn a bit too angulate.

Summarizing the evidence of the wings we can say that those of "*Cloeon*" *papuanum* do not agree completely with those of any of the genera discussed, but that the species comes near to *Bungona* and to a much lesser degree to *Baetiella*. This is more or less in accordance with the distribution of the species: *Bungona narilla* — Australia, "*Cloeon*" *papuanum* — New Guinea, *Baetiella japonica* — Japan.

From the genera and species under discussion only the nymph of "*Cloeon*" *papuanum* is so far unknown; it is thus not possible to make comparisons with described nymphs. Interesting discussions on the comparison of nymphs in some of the genera are presented by TRAVER (1938) and DAY (1955). Moreover there is at present no agreement on the genus *Pseudocloeon*; it appears for instance that nymphs of the Nearctic and of the Oriental Regions have two tails only, while South African species are known to possess three caudal filaments. A reconsideration of the genus is therefore necessary.

The results of the foregoing comparative studies are as follows: "*Cloeon*" *papuanum* has been compared with six genera in the family Baetidae which apparently are its closest relatives. It has been shown that in the composition of the legs it does not fit in with any of these genera; it shows affinities with most of them, except *Bungona*. A study of the segments of the forceps (male

TABLE II
 Comparison of the joints of the genostyles of the males of the six genera under discussion and
 "Cloeon" papuanum.

A brace indicates that the connected joints are fused.

Genus	first	second	third	fourth joint
<i>Apobaetis</i>	long and thick	very short	long and slender	slender, small, not broadly attached to 3rd
<i>Baetiella</i>	large and thick			elongate and incurved
<i>Bungoma</i>	short and stout	broad and short, arched on inner surface	rather long and bowed or arched	narrow and short, not broadly attached to 3rd
<i>Cloeodes</i>	short and stout	short, not too slender	slender, long, arched on inner surface	small, roundish, not broadly attached to 3rd
<i>Paracloeodes</i>	long, thick, almost cylindrical	short and (rather) stout	long and slender	slender, not broadly attached to 3rd
<i>Pseudocloeon</i>	short and (rather) stout		long and slender (incurved)	long and slender or shorter and rounded, not broadly attached to 3rd
"Cloeon" papuanum	short and wide	short to medium-sized	OR elongate and incurved	OR oval, broadly attached to 3rd
	short and wide	short and wide	long and narrow, almost cylindrical	rounded, base broadly attached to 3rd

genitalia) revealed that "*Cloeon*" *papuanum* can not be assigned to any one of the genera, but that it shows weak affinities to *Bungona*. Finally, an examination of the wings showed that the New Guinea species is perhaps nearer to *Bungona* than to the other genera. Summarizing we can conclude that "*Cloeon*" *papuanum* certainly merits a genus to itself on the strength of morphological characters of the adult insect; this is in accordance with the isolated geographic position on the island of New Guinea. The new genus would have to be classified next to the Australian genus *Bungona*, although showing considerable differences in the composition of the legs. However, the author prefers to refrain from naming the new genus and proposes to leave it in abeyance until nymphs of the New Guinea species become available, for there is always a possibility that it might be assigned to one of the known genera on the strength of larval characters. The student is referred to the discussions on the value of larval characters by VERRIER (1956).

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