Odonatologica 16(4): 335-346 *December 1, 1987*

TAXONOMIC STUDIES ON AFRICAN GOMPHIDAE (ANISOPTERA) 1. *MALGASSOGOMPHUS ROBINSONI* GEN. NOV., SPEC. NOV. FROM MADAGASCAR*

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Received March 13, 1986 / Revised and Accepted June 22, 1987

Malgassogomphus robinsoni gen. n., sp. n. is described and figured from a single ♂ (Sainte Marie Island, Madagascar, March, 1960), deposited in the MNHN, Paris. Its relationships are discussed and the new taxon is tentatively placed in the Phyllogomphinae Carle, 1986.

INTRODUCTION

This paper is the first in a series aiming to improve our knowledge of the diversity of the African Gomphidae.

Since many species are difficult to catch or the adults occur only during a short season, much of the available information is inevitably based on incidental captures. In addition to these somewhat fortuitous samplings, there are intensive collections, of which the most noteworthy were made by E. Pinhey (in southern, and south-central and eastern Africa), R.M. Gambles (mainly in Nigeria) and R. Lindley (in Ivory Coast and Central African Republic). Working in a limited area of eastern Gabon, J. Legrand carried the collection of data a step further. He succeeded in discovering probably all the existing species by netting them during all seasons and by systematically rearing the larvae found in the different biotopes.

Many original results to be published in this series are due to the above mentioned and other workers, who generously provided the material. Without

* A tribute to the memory of the late M.A. Lieftinck

their invaluable help and the access to museum collections the present work could not be completed.

Nevertheless, our knowledge of the African Gomphidae remains on the whole unsatisfactory. Interesting discoveries are expected especially in Madagascar and between the 10° N and S latitudes and the variability of many species needs to be ascertained. This is the reason I consider this series of papers, some of which may be published jointly with colleagues, solely a preliminary contribution to the alpha-level taxonomy of African Gomphidae.

For reasons concerning the descriptive nature of this work, morphological nomenclature based upon theoretical interpretations has been avoided as much as possible. Where this was not possible, I had to select reference works as guides for naming morphological parts, mainly those of CHAO (1953), NEEDHAM & WESTFALL (1955) and O'FARRELL (1970). This of course does not mean that I necessarily agree with the nomenclature they use. For example, the still controversial problem of wing venation. The generally accepted interpretations of TILLYARD & FRASER (1938-1940), based on comparative evolutionary studies of rather specialized wings, are now seriously challenged by the discovery of fossils of Namurian age (RIEK & KUKALOVA-PECK, 1984). This fossil-based phylogenetical approach probably constitutes the ideal way to resolve the very frustrating and fundamental problem of dragonfly wing vein homology. In addition, an experimental study of the morphogenetical induction of wing veins in dragonflies should definitely shed light on the problem of the validity of the COMSTOCK (1918) and NEEDHAM (1903) interpretations based on the ontogenesis of larval tracheation. This approach can be founded on the latest knowledge concerning morphogenesis and may be expected to give relatively quick results.

This first paper describes a new genus and species from Madagascar. The single known specimen was kindly made available by J. LEGRAND of the Muséum national d'Histoire Naturelle (M.N.H.N.) in Paris. I have named it in honour of its native collector, ANDREA ROBINSON.

DESCRIPTION

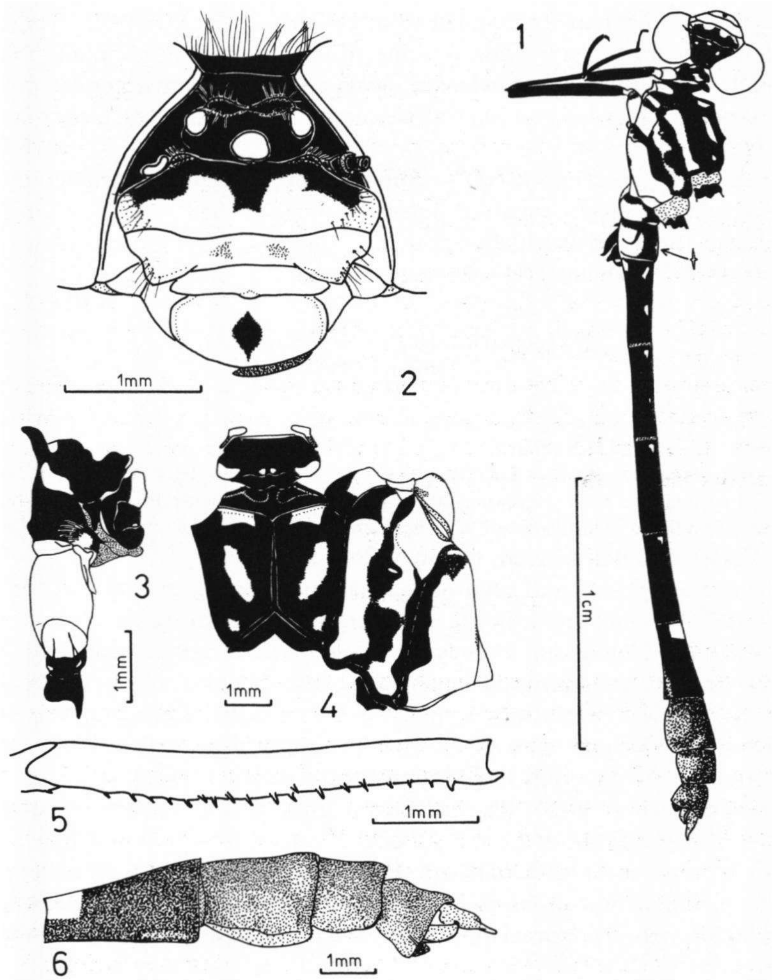
MALGASSOGOMPHUS GEN. N.

Size small.

Frontal crest rounded, head slightly prognathous.

Wings (Figs 7-9) without basal subcostal crossvein. Primary antenodals 1 and 5. Arculus straight and aslant, at or just after Ax_2; sectors separated at their base. Forewings with 2-2 crossveins between sectors of arculus, hindwings 1-1. Median fork symmetrical in forewings, very slightly asymmetrical in hindwings. Bridge linking fork of upper sector of arculus to IR_3 asymmetrically attached proximally. Median space without crossveins. Each wing with one Ac, lying near second anal crossvein (as counted from the wing base) in forewings and lying proximal to the anal brace (vein A_3) in hindwings. Triangles and subtriangles without crossveins. Triangles with distal side slightly broken in forewings. Subtriangles with posterior border broken and with distal angle shaped such as to form a fourth short side. Anal triangle of 4 cells, the smallest not typically rectangular. Tornus slightly projecting, without particular spines. Anal field with first cell (first postanal cell of FRASER, 1934; cell p of NEEDHAM & WESTFALL, 1955) not extending distally further than basal quarter of posterior margin of subtriangle. No anal loop. Discoidal field of 2 rows of cells, expanding just before nodus.

Hind femora (Figs 4-5) elongate, with a single row of unspecialized spines along ventro-exterior surface; scattered ventral spines and some shorter ones along ventro-interior surface. When extended, the hind femora reach the anterior



Figs 1-6. *Malgassogomphus robinsoni* gen. n., sp. n., holotype: (1) Complete insect with wings removed, in profile; — (2) Face, anterior view; — (3) Prothorax, right lateral view; — (4) Thoracic pattern; — (5) Left hind femur; — (6) Abdominal segments 7-10 and appendages, lateral view.

margin of abdominal segment 2. Foretibial comb made of a single row of specialized spines, not reaching much beyond basal third of tibia. Foretibial lamina absent.

Accessory genitalia (Figs 14-18). — Anterior lamina depressed, not visible in lateral aspect. Anterior hamuli short, transverse, not hook-like; posterior hamuli long, curved, with forward turned apical hook.

Auricles not dorsoventrally compressed. Abdominal segments 9 and 10 of equal length, each about half as long as segment 8. Tergum 8 with very narrow ventrolateral foliations (pseudolateral dilatations of CHAO, 1953). Tergum 9 with weakly developed middorsal carina. Male sternum 9 membranous postero-laterally and posterior to gonocoxae. Male gonocoxae with anterolaterally directed points. (Figs 1, 6 and 10). 11th sternite without dorsolateral processes (Figs 10, 11 and 13).

Anal appendages (Figs 10-13). — Superior appendages approximately as long as segment 10, slightly incurved. Inferior appendage half as long as superiors, bifid, its extremities widely divergent.

Type-species: *Malgassogomphus robinsoni* spec. nov.

MALGASSOGOMPHUS ROBINSONI SP. N.

Figures 1-26

Material. — **Holotype** ♂: Madagascar, (île) Ste Marie, Forêt de Valaleo, III-1960, Andrea Robinson leg., in M.N.H.N., Paris.

Measurements (in mm). — Total length: 32.1; — abdomen (without appendages): 23.4; — superior appendages: 1.1; — forewing: 20; — hindwing 18.5; — anterior edge of pterostigma, f-wing: 1.7 (left), 1.9 (right), h-wing 1.9; — hind-femur: 4.3.

Coloration well developed, mainly yellow and black.

Head (Fig. 2). — Genae yellow-green; labrum yellow-green, its lower margin blackish brown (not visible in Fig. 2); a conspicuous black median vertical spot. Anteclypeus yellow-green. Postclypeus with a pair of symmetrical spots near center. Frons yellow-green, the upper zone black. Antennae black. Vertex black with symmetrical protrusions behind the lateral ocelli, having rather yellow-brown hairs. Occipital crest black, sinuous, much broader than long, fringed posteriorly with numerous long, yellow-brown hairs.

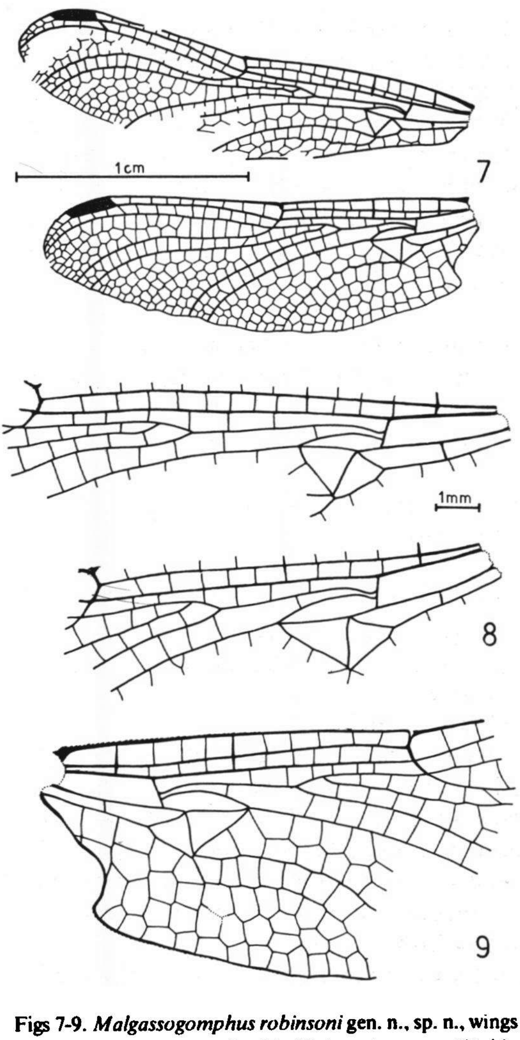
Mandibles (Figs 19-20) blackish brown. Labium dirty green, but anterior border of median lobe and outer surfaces of lateral lobes yellow. Median lobe about 1.2 times in width as in length. Hooks as in Figures 25-26. Maxillae (Figs 22-23) brown, yellow at bases. Middle tooth of posterior maxillary tooth row about 0.9 length of proximal tooth, the two teeth being separated by a U-shaped notch.

Pronotum black above; also crest of posterior lobe. Yellow-green posterolateral and twin central dots (Figs 3-4). Anterior margin of pronotum buff-colored.

Synthorax black marked with yellow as in Figure 4, the broad metepisternal band avoiding the spiracle and slightly interrupted in its middle. Metaposternum and ventral face of synthorax entirely yellow. Meso- and metaparaptera black.

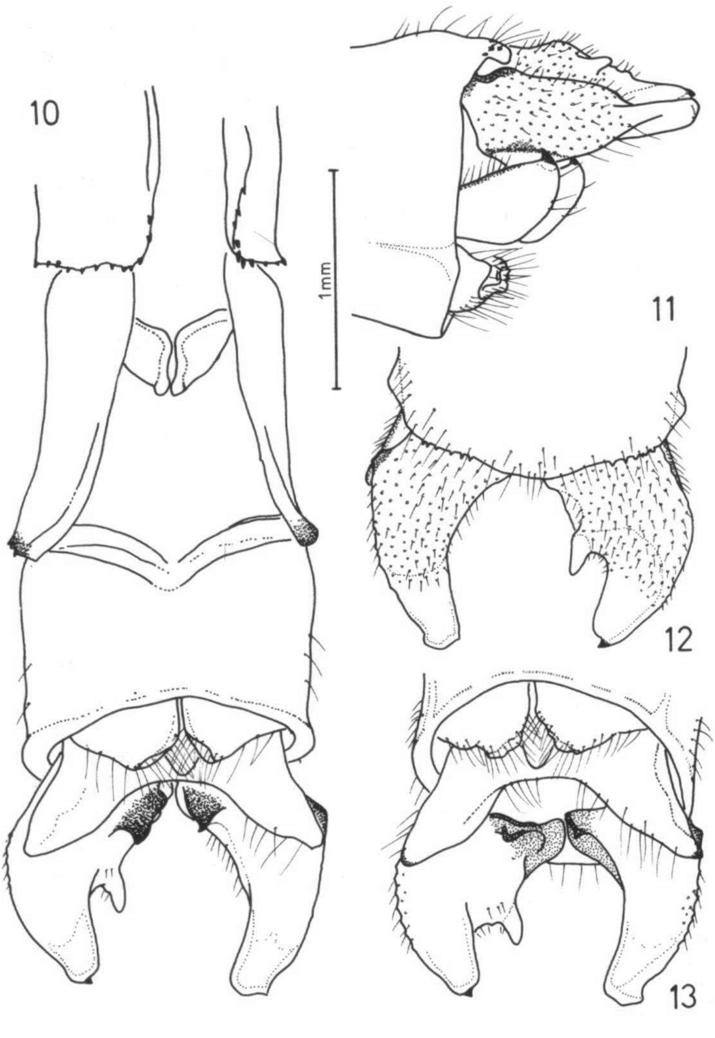
Legs black, coxae yellow with brown anterior spot, trochanters yellow proximally. Foretibiae with 6-7 large, decumbent cleaning-setae on outer ventrodistal surface, these directed forward laterally. Claws with ventral hook.

Venation and anterior margin of costa black. Antenodals and postnodals of first series: 9:13-12:10 / 10: 10-9:9 in fore- and hindwings respectively. Nodus black above, paler below. Bridge crossveins: 5-5 / 5-5. Pterostigma brown, framed in darker veins, surmounting 3--2.6 cells in forewings, 2.3-3.4 in hindwings. Smallest cell in anal triangle not typically rectangular, minute in left hindwing. Posterior margin of anal triangle slightly sinuous. Membranula absent. One row of cells between Cu_1 and Cu_2, expanding slightly before nodus in all wings. Wing membrane faintly tinged yellowish before nodal level.



Figs 7-9. *Malgassogomphus robinsoni* gen. n., sp. n., wings of holotype (transposed): (7) Right wings; — (8) id., showing details of arculus and triangles; — (9) Basal half of left hindwing.

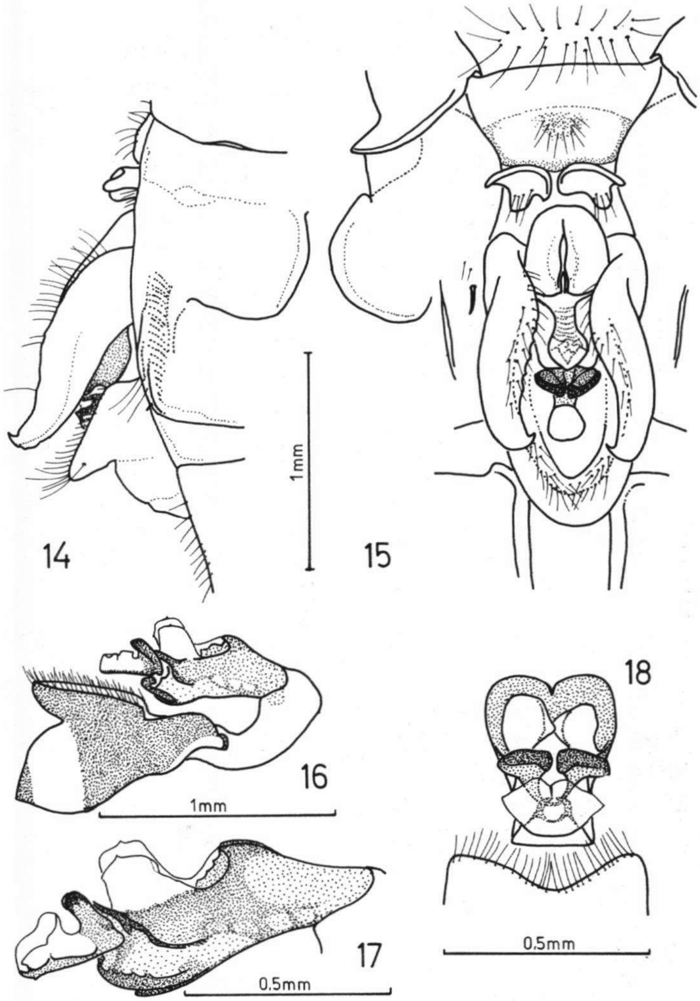
Accessory genitalia (Figs 14-18). — Hamuli blackish brown. Anterior hamuli small, transverse and (nearly) contiguous medially; with anterior semicircular ridge. Posterior hamuli powerful, long and curved, ending in a forwardly inturned hook. Penis (Figs 16-18): segment 1 black, but bulb of vesicle yellow-green. Its sheath hairless, blackish brown. Median segment supporting two erect, non-



Figs 10-13. *Malgassogomphus robinsoni* gen. n., sp. n., terminalia of holotype: (10) Segments 9-10, ventral view; — (11) Appendages, lateral view; — (12) Appendages, dorsal view; — (13) Appendages, oblique ventral view.

-sclerotized "ears". Glans ending in a cupule without flagella.

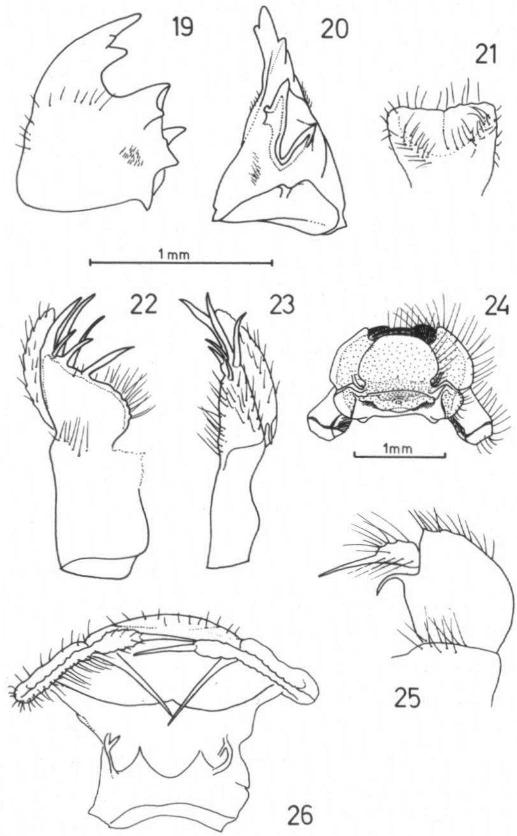
Abdomen black, marked as in Figure 1 with yellow spots. Segment 1 rounded. Segment 2 with a small cruciform yellow spot on its middorsum and a large yellow lateral spot, covering auricles. Auricles yellow with black lateral border; edge not serrated, except 4 very minute black posterolateral teeth. Segments 3



Figs 14-18. *Malgassogomphus robinsoni* gen. n., sp. n., secondary genitalia of holotype: (14) In situ, left lateral view; — (15) In situ, ventral view; — (16) Penis; — (17) Details of median segment and glans of penis; — (18) id., posterior view.

and 4 with two pairs of dorsolateral yellow spots and segment 3 also with a pair of dirty yellow spots at anteroventral margin. Segments 5 and 6 with only the anterodorsal pair of spots. Segment 7 blackish brown with a large yellow spot, covering its dorsum and half of its sides. Also a dark yellow line near postero-ventral margin of tergite. Segments 8-10 dark reddish brown dorsally, ochraceous-red at sides; tergum 8 with ochraceous pseudolateral dilatations, narrow but thick. Segment 9 with weakly developed middorsal crest; 9-10 about equal in length, segment 9 about half as long as 8.

Anal appendages (Figs 10-13). — Superior appendages curiously asymmetrical, yellow-brown, with short hair and the apices yellow. Base of left superior appendage with a dark dorsolateral callosity and a black, ventral, spiniform process. Right superior appendage bifid, ending in a black spine, instead of the rather flat extremity of the left appendage; ventrally, with basal black process. Inferior appendage symmetrical, yellow-brown, half as long as superiors, ending in an upturned, hooked black spine.



Figs 19-26. *Malgassogomphus robinsoni* gen. n., sp. n., mouth parts of holotype: (19) Right mandible, ventral view;.— (20) id., medial view; — (21) Hypopharynx; — (22) Right maxilla, ventral view; — (23) id., medial view; — (24) Labium, ventral view; — (25) id., detail of left labial palpus, dorsal view; — (26) Labium, anterior view. — [M.T.: middle tooth of posterior tooth row; —P.T.: proximal tooth. — All drawings on the same scale, except Fig. 24].

DISCUSSION

Malgassogomphus robinsoni is a small gomphid, distinguished readily from the known genera by several morphological features mainly found in the wing venation, the accessory genitalia, and the terminalia.

The classification of Gomphidae is very complicated and serious attempts to clarify it have only recently been made by CHAO (1984), WATSON & O'FARRELL (1985) and, in a more accurate way, by CARLE (1986).

Following CARLE's (1986) subfamily definition, *Malgassogomphus robinsoni* appears referable to his Phyllogomphinae (monotribal, comprising the African genera *Phyllogomphus* Selys. *Ceratogomphus* Selys and *Isomma* Selys) by its abdominal segment 9 provided with a dorsomedial carina (although very weakly developed), a membranous sternum and by its nearly medially contiguous short anterior hamuli, with transversal apices. Other characters shared with the Phyllogomphinae are: ligula, larger in width than in length, absence of foretibial lamina (although present in *Isomma*), posterior tibial spines not basally enlarged, hindwing with 2 rows of cells between RP_1 and RP_2 at half or a third of distance between nodus and pterostigma, tergites 7-9 with lateral extensions (weakly developed in *Malgassogomphus*), posterior hamuli curved and penis with a well developed sheath.

Within the Phyllogomphinae, the Malagasy endemic *Isomma* seems to be the most closely related to *Malgassogomphus*.

If we neglect the mediodorsal and lateral carina of terminalia in *Malgassogomphus*, because they are vestigial, we may be tempted to find affinities with other gomphid groups. It is within the Oriental tribe Cyclogomphini Carle (genera *Cyclogomphus* Selys, *Platygomphus* Selys, *Burmagomphus* Williamson and *Anormogomphus* Selys), belonging to the subfamily Gomphinae sensu Carle, 1986, that one will find the most characters in common with *Malgassogomphus* that are not shared with the Phyllogomphinae: long posterior femur, male gonocoxae larger in width than in length (?), and segment 2 with low anterior lamina. However, this small number of common features shows that *Malgassogomphus* fits better in the Phyllogomphinae than in the Cyclogomphini.

It must also be stressed that *Malgassogomphus* has some peculiarities, which are shared neither with the Phyllogomphinae nor with the Cyclogomphini, viz. the maxillae with median tooth of posterior row not fused with the apical tooth, the two teeth being separated by a U-shaped notch (instead of a V-shaped notch in the two tribes); this median tooth has 0.95 times the length of the proximal tooth (instead of 0.0 as in *Ceratogomphus* and *Phyllogomphus*, 0.2-0.3 in *Isomma* or 0.35 times as in the Cyclogomphini); anal triangle is 4-celled (instead of 0 to 3 or 5 and more) and it is greater in width than in length (1.25 times instead of 0.5 to 1.0); membranula is absent (although vestigial in *Isomma*); segment 3 of penis is provided with a pair of dorsolateral erected "ears" (instead of nothing to be seen laterally); and the apex of penis terminates in a cupule (instead of a pair of flagella).

The female of *M. robinsoni* is unknown. Information concerning its auricles, sternum 9 and hind femoral spines would help to place the new genus definitely within or outside of the Phyllogomphinae.

Other gomphids share some characters with *Malgassogomphus*, some of them are probably due to convergence.

Like *Malgassogomphus*, the wings of the dragonflies pertaining to the subfamily Gomphinae, as defined by CHAO (1984) are characterized by having triangles and subtriangles free, absence of anal loop and anal triangles 4-celled but with the smallest cell not typically rectangular (which is the case in Onychogomphinae Chao, 1984). The placing of *Malgassogomphus* in Gomphinae Chao, 1984, is further supported by the structure of the inferior anal appendage (short and broad, distally fairly deeply emarginate, with its two branches far distant from each other) and by the shape of the posterior hamuli, and to some extent, by the shape of the penis (CHAO, 1984 and pers. comm.).

With the East Palearctic monotypical genus *Gastrogomphus* Needham and with many species of the Notogean genus *Austrogomphus* Selys (sensu FRASER, 1953), *Malgassogomphus* shares a combination of the following features: a low number of crossveins between sectors of arculus, the symmetry of the fork and the position of Ac, proximal to the level of the inner border of anal triangle (vein A_3). But this is all. *Gastrogomphus abdominalis* (Mc Lachlan) differs from *Malgassogomphus robinsoni* by having 3-celled anal triangles, by the different development of its frontal crest, penis, anterior lamina and anterior hamuli, by the greater length of its hind femora, reaching the beginning of the third abdominal segment and by having cerci of another kind (cerci well separated basally and then gradually convergent apically). The *Austrogomphus* species have 3-celled anal triangles. With their relatives of the genus *Antipodogomphus* Fraser, they differ also by having superior anal appendages provided with a well developed ventrobasal branch curved forward, extending between the branches of the inferior appendage (cf. figs in FRASER, 1953 and in WATSON & O'FARRELL, 1985). In *M. robinsoni* the branches of the superior appendages bear only a reduced ventral apophysis, a situation differing from the highly specialized pattern common to some Notogean (*Austrogomphus, Antipodogomphus, Austroepigomphus* Fraser) and Neotropical (*Agriogomphus*-complex) genera.

On the whole, the cerci of *Malgassogomphus* pertain to a somewhat generalized pattern to be found in many genera: it is a "*Gomphus* pattern", provided with small ventro-basal processes. The posterior hamuli of *Malgassogomphus* also have a generalized structure common to many Gomphinae.

Unlike the situation in some Notogean genera (cf. WATSON & O'FARRELL, 1985) and in many Neotropical taxa (incl. *Neogomphus* Selys), in *Malgassogomphus* the 11th sternite lacks a dorsal process. The latter does occur in such remote genera as *Hagenius* Selys and *Petalura* Leach (Petaluridae).

The penis of *M. robinsoni* appears, at first sight, very different from that of other known gomphines. But there can be such a variability in the form of this organ, even within the same genus, that it may be meaningless to use it to search for affinities among genera. All we can speculate is that the two "ears" of the median segment in *M. robinsoni* may derive from the small appressed dorsolateral diverticules, not visible from the side, found in many other species, and which seem well developed in *Austrogomphus ochraceus* (Selys) and probably also in *Antipodogomphus proselytus* (Martin) (cf. FRASER, 1953, figs 10-A, 10-B). As for the presence of an terminal cupule on the glans, the study of Oriental and African genera (e.g. *Neurogomphus* Karsch) shows that a cupule can have its origin in the common base of the two (sometimes minute) terminal flagella.

The asymmetrical shape of the cerci of the only known specimen of *Malgassogomphus robinsoni,* may be due to a teratological process. Supplementary material would clarify this question.

In order to establish the exact degree of affinities between *Malgassogomphus* and other genera, it appears necessary to carefully study not only the morphology but also the karyotypes and the biochemistry (proteinograms, etc.) of the Gomphinae genera. It is not unthinkable that the discovery of new taxa may also help to solve this problem.

ACKNOWLEDGEMENTS

For helpful comments concerning the possible affinities of *M. robinsoni,* the author is indebted to Professor HSIU-FU CHAO (Fujian Agricultural College, People's Republic of China), J.A.L. WATSON (CSIRO, Canberra, Australia) and F.L. CARLE (New Jersey, USA). J. LEGRAND (Muséum national d'Histoire Naturelle, Paris) provided a drawing of the accessory genitalia of *Isomma hieroglyphicum.* Thanks are also due to ELISABETH EVESHAM (Clayesmore School, Dorset, England), ELLIOT PINHEY (Chepstow, England) and to MÉLANIE and RENÉ LESSEUX (Brussels) for kindly correcting the English version of the manuscript.

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