

# A NEW LIBELLULOID FAMILY FROM THE UPPER PALEOCENE OF ARGENTINA

by JULIÁN F. PETRULEVICIUS, ANDRÉ NEL *and* JAVIER MUZÓN

ABSTRACT. A new family of dragonflies, Palaeomacromiidae, based on *Palaeomacromia multicellulata* gen. et sp. nov., is described from the Late Paleocene Maíz Gordo Formation of north-western Argentina. The present discovery demonstrates that the present knowledge of the Early Cenozoic insect fauna of the Neotropical region remains very poor.

THE Late Paleocene Maíz Gordo Formation (Vokheimer *et al.* 1984; Marshall *et al.* 1997) is a lacustrine sequence that crops out in north-western Argentina (Del Papa and Marquillas 1990). It contains a diverse insect fauna composed of fragmentary specimens of Dermaptera, Orthoptera, Trichoptera, Hemiptera and Coleoptera described by Cockerell (1925*a*, 1925*b*, 1926*a*, 1926*b*, 1936), some freshwater vertebrates (Gasparini and Baez 1975; Baez and Gasparini 1977; Cione 1978) and a terrestrial mammal (Bardack 1961; Pascual *et al.* 1981).

The dragonfly was collected by the first author from a small section (0.7 m thick) of the Maíz Gordo Formation. The section is composed of green mudstones (probably corresponding to the middle part of the formation), 6 km from the village of La Mendieta (24° 21' S; 64° 59' W), in the Province of Jujuy (north-western Argentina). This is the first Odonata described from the formation.

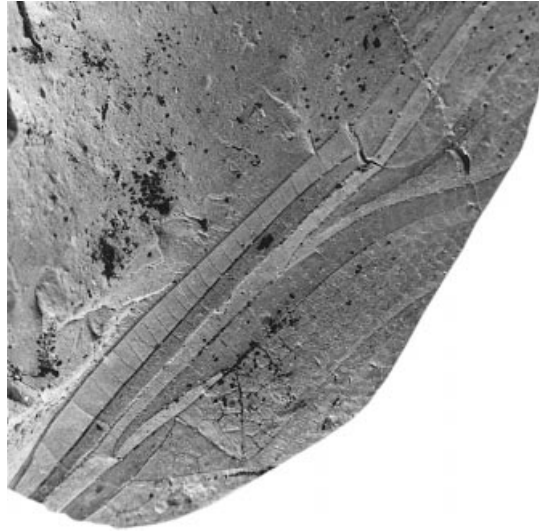
In the following study we use the wing venation nomenclature of Riek (1976) and Riek and Kukalová-Peck (1984), amended by Kukalová-Peck (1991), Nel *et al.* (1993) and Bechly (1995, 1996). We follow the phylogenetic classification of Anisoptera proposed by Bechly (1996, 1997).

## SYSTEMATIC PALAEONTOLOGY

Order ODONATA Fabricius, 1793  
Suborder ANISOPTERA Selys, 1854  
Family PALAEOMACROMIIDAE fam. nov.

*Type genus.* *Palaeomacromia* gen. nov.

*Diagnosis.* The main venational characters of this family are as follows: (1) discoidal triangle divided into numerous (eight) cells; (2) sub-triangle divided into five cells; (3) hypertriangle, median and submedian spaces free of crossveins; (4) no bridge-crossveins; (5) primary antenodals distinctly stronger than the numerous secondaries; (6) RP3/4 and MA distally undulate; (7) 'cordulegasterid' and 'libellulid' gaps present for a long distance basal and distal of the subnodus; (8) Rspl and Mspl distinct; (9) two rows of cells between Rspl and IR2; (10) the area between IR2 and RP2 is greatly widened distally; (11) the anal area between AA and posterior wing margin is very broad, with five rows of cells; (12) CuA has no strong posterior branches; (13) postdiscoidal area very broad, with five rows of cells between MA and MP. Character '1' is a unique autapomorphy, characters '2', '10', '11', '12', '13' are autapomorphies convergently present in some Libellulidae but strictly absent in more basal Brachystigmata.



TEXT-FIG. 1. *Palaeomacromia multicellulata* gen. et sp. nov.; MLP.28157 (holotype); La Mendieta, province of Jujuy, north-west Argentina, at longitude 64° 59' W, latitude 24° 21' S; Maíz Gordo Formation, Upper Paleocene;  $\times 3$ .

Genus PALAEOMACROMIA gen. nov.

*Derivation of name.* After palaeo and *Macromia*, in reference to its similarities with the genus *Macromia*.

*Type species.* *Palaeomacromia multicellulata* sp. nov.

*Diagnosis.* That of the family.

*Palaeomacromia multicellulata* gen. et sp. nov.

Text-figures 1–2

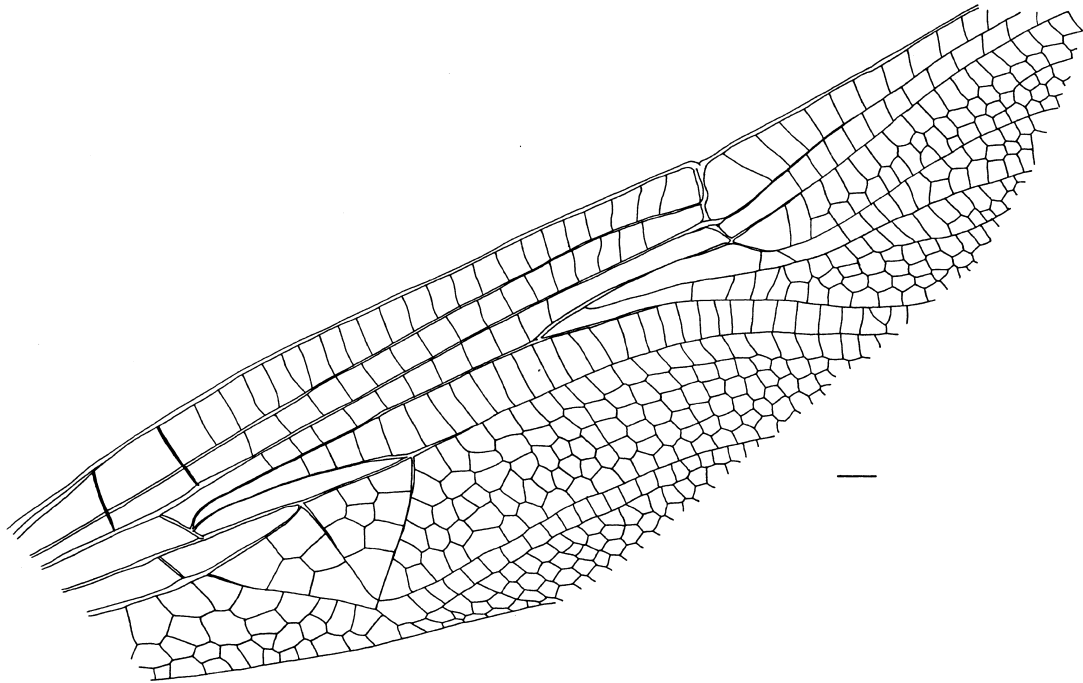
*Derivation of name.* After the great number of cells in the wing venation.

*Holotype.* Specimen 28157 (part and counterpart), in the Departamento Científico Paleozoología Invertebrados, Museo de la Plata, Argentina.

*Type locality and horizon.* La Mendieta, province of Jujuy, north-western Argentina, at latitude 24° 21' S, longitude 64° 59' W. Maíz Gordo Formation, Upper Paleocene (Volkheimer *et al.* 1984; Marshall *et al.* 1997; Quattrocchio *et al.* 1997).

*Diagnosis.* That of the family.

*Description.* Print of the basal four-fifths of a forewing, no trace of coloration preserved. Length of the preserved part 31 mm; probable length of the wing *c.* 40 mm; width 9.2 mm. Distance from the base to the nodus 20.05 mm; from the arculus to the nodus 17 mm. Pterostigma not preserved. Eleven postnodal crossveins preserved, not aligned with corresponding postsubnodal crossveins between RA and R<sub>1</sub>. The basal first postsubnodal crossveins absent ('libellulid gap' present). Twenty-two secondary antenodal crossveins between arculus and nodus, distal of Ax<sub>2</sub>, not aligned with those of the second row between ScP and RA. The most distal antenodal crossvein of the second row absent. The primary antenodals are distinctly stronger than others. No secondary antenodal crossvein between the two



TEXT-FIG. 2. *Palaeomacromia multicellulata* gen. et. sp. nov.; MLP.28157 (holotype); La Mendieta, province of Jujuy, north-west Argentina; Maíz Gordo Formation, Upper Paleocene; forewing reconstruction. Scale bar represents 1 mm.

primaries and basal of  $Ax_1$ . Eleven crossveins in the area between RA and RP basal of RP3/4, but none between the base of RP3/4 and the subnodus ('cordulegastrid gap' present). No bridge-crossveins (Bqs), except for a short one close to the oblique crossvein 'O'. Discoidal triangle eight-celled, transverse; length of its anterior side 3.01 mm; of distal side 3.9 mm; of basal side 3.25 mm. Supratriangle long and free of crossveins. Median and submedian cells free of crossveins. CuP is 1.2 mm basal of the level of the arculus. RP and MA meet at their very base in the arculus. Arculus straight, with its posterior part distinctly shorter than anterior part. Arculus midway between the two primary antenodal crossveins. A well-defined PsA aligned with basal part of AA, separating a large, five-celled sub-triangle, 4.53 mm long and 3.25 mm wide, more-or-less triangular in shape. Anal area very wide, with three or four rows of cells between AA and the posterior wing margin. CuA weak with no well-defined posterior branches, but very long, probably reaching the posterior wing margin at the level of the nodus. Four or five rows of cells in the cubito-anal area. Postdiscoidal area with five rows of cells just distal to the discoidal triangle (3.25 mm wide), not distinctly broader along the posterior wing margin. Mspl well defined but parallel with MA, with one row of cells between it and MA. MA and RP3/4 parallel, and somewhat distal of nodus, distinctly undulate. RP2 originating at subnodus. One oblique crossvein 'O' 1.14 mm distal of the subnodus. Presence of an empty space in the area between IR2 and RP2 just distal of vein 'O'. The 'libellulid oblique vein' is absent in the area between RP1 and RP2. IR2 gently curved. RP2 more undulate. Three rows of cells between IR2 and RP2 6.9 mm distal of the subnodus, well basal of the level of the pterostigma. Rspl well defined, rounded with two rows of cells between it and IR2. Interspace between RP1 and RP2 stays only unicellular for a very short distance (two cells) and distally more than five rows of cells between RP1 and RP2. Possible presence of straight IR1 between RP1 and RP2.

*Remarks.* *Palaeomacromia* gen. nov. has two of the synapomorphies of the Brachystigmata Bechly, 1996 (i.e. sectors of arculus approximate; arculus straight with posterior part shorter than anterior part; RP3/4 and MA parallel with only one row of cells between them). Other characters of Brachystigmata are not preserved, the pterostigmal structures being not preserved. More precisely, it has several synapomorphies of the Eurypalpida Bechly, 1996 (i.e. forewing PsA hypertorqued and sub-triangle widened with a curved

and angled posterior margin; forewing discoidal triangle distinctly transverse; wing with the characteristic 'libellulid gap' in the basal part of the postsubnodal space), but none of the Chlorogomphida Bechly, 1996. *Palaeomacromia* gen. nov. is not related to any of the monotypic Mesozoic families of the basal Paneurypalpida ('pan-monophylum' of the Eurypalpida), i.e. Nannogomphidae Bechly, 1996 (*Nannogomphus* Handlirsch, 1906; Bechly *et al.* 1996), Eocorduliidae Bechly, 1996 (*Eocordulia* Pritykina, 1986), Condaliidae Bechly, 1996 (*Condalia* Whalley and Jarzembowski, 1985), Valdicorduliidae Bechly, 1996 (*Valdicordulia* Jarzembowski and Nel, 1996) and Araripelibellulidae Bechly, 1996 (*Araripelibellula* Nel and Paicheler, 1994 and *Cretaneophya* Jarzembowski and Nel, 1996). Within the Eurypalpida, *Palaeomacromia* gen. nov. is not related to the Synthemistidae because its basal area of the wing is free of crossveins and it has no secondary antenodal crossvein between  $Ax_0$  and  $Ax_1$ . The Gomphomacromiidae (*sensu* Bechly 1996) are to be excluded because *Palaeomacromia* gen. nov. has a well defined Rspl (synapomorphy of the Trichopalpida Bechly, 1996) and a well-developed five-celled sub-triangle. Within Trichopalpida, *Palaeomacromia* gen. nov. shares with Macromiidae the veins RP3/4 and MA distinctly undulate. Nevertheless, it has several plesiomorphic conditions absent in Macromiidae, i.e. primary antenodal crossveins very distinct from the secondaries; sectors of the arculus not stalked; the areas without crossveins basal and distal of the subnodus are not shortened, cubito-anal interspace between CuP and PsA without crossveins. Furthermore, the veins RP3/4 and MA distinctly undulate are convergently present in Idomacromiidae (*sensu* Bechly 1996). Within this last family, it shares with the Idomacromiinae the presence of very distinct Rspl and Mspl and a very dense venation. Nevertheless, its primary antenodal crossveins very distinct from the secondaries and cubito-anal interspace without crossveins are plesiomorphic conditions absent in Idomacromiinae but still present in the subfamily Nesocorduliinae *Nesocordulia* MacLachlan, 1882; see Martin 1906; Bechly 1996). *Palaeomacromia* gen. nov. has its bridge-space free, which is the main synapomorphy of the more advanced Liberaponsida Bechly, 1996, absent in the more basal Macromiidae and Idomacromiidae. Within this group, Cordulephyidae (*sensu* Bechly 1996) are to be excluded because of the shape of the discoidal triangle and of the postdiscoidal area. Its well developed Mspl and the presence of two rows of cells between Rspl and IR2 are apomorphic conditions absent in Oxygastridae Bechly, 1996. The forewing triangle and sub-triangle divided in many cells, and the presence of a well defined Mspl are synapomorphies of Italoansida Bechly, 1996. Within this last group, the absence of the 'libellulid' oblique vein between RP1 and RP2, just distal of the level of the subnodus, RP1 and RP2 strongly diverging, both with the presence of strong primary antenodals are plesiomorphic conditions that would exclude any relationships with the Libellulida (*sensu* Bechly 1996, = Macrodiplacidae + Libellulidae). We consider that it belongs to a highly specialized family Palaeomacromiidae fam. nov., whose relationships with the Corduliidae (*sensu* Bechly 1996) and Hemicorduliidae Bechly, 1996 remain uncertain because of the lack of the hindwing and body characters.

## CONCLUSIONS

Even if the antiquity of the Brachystigmata, or even of the Libellulidae, extends back at least to the Early Cretaceous, the present discovery demonstrates that this group was very important during the Paleocene. It is highly probable that numerous Mesozoic and Cenozoic taxa of suprageneric rank remain to be discovered within this group, especially in the Neotropical region.

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JULIÁN F. PETRULEVICIUS

Departamento Científico Paleozoología Invertebrados  
Museo de La Plata  
Paseo del Bosque, s/n, 1900 La Plata, Argentina  
e-mail levicius@netverk.com.ar

ANDRÉ NEL

Laboratoire d'Entomologie  
Muséum National d'Histoire Naturelle  
45 rue Buffon, F-75005, Paris, France  
e-mail anel@mnhn.fr

JAVIER MUZÓN

Instituto de Limnología Dr. Raúl A. Ringuelet  
C.C. 712, 1900 La Plata, Argentina  
e-mail muzon@ilpla.edu.ar

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