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A new triadotypomorphan insect from the Anisian (Middle Triassic), Buntsandstein facies, Spain

Un nuevo insecto triadotipomorfo del Anisiense (Triásico Medio), facies Buntsandstein, España

O. Béthoux[1,2] *, R. De la Horra[3], M.I. Benito[3], J. F. Barrenechea[4], A.B.Galán[3], J. López-Gómez[3]

[1]Freiberg University of Mining and Technology, Institute of Geology, Department of Palaeontology, Bernhard-von-Cotta Str. 2, D-09596 Freiberg, Germany
[2]Senckenberg Natural History Collections of Dresden, Museum of Zoology, Königsbrücker Landstrasse 159, D-01109 Dresden, Germany
[3]Departamento de Estratigrafía, Instituto de Geología Económica (CSIC-UCM), Facultad de CC. Geológicas, Universidad Complutense de Madrid, c/ José Antonio Naváis, 2, 28040 Madrid, Spain
[4]Departamento de Cristalografía y Mineralogía, Facultad de CC. Geológicas, Universidad Complutense de Madrid. C/ José Antonio Nováis, 2. 28040 Madrid, Spain
**Corresponding author: obethoux@yahoo.fr*

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Abstract

The species *rubra* sp. nov., a new triadotypomorphan insect from the Iberian Ranges, is described on the basis of a newly discovered specimen, found in fine grained sandstones of alluvial origin, in the lowermost part of the Eslida Formation (Buntsandstein facies), in the central part of the Iberian Ranges. The occurrence of a triadotypomorphan suggests an Anisian age of the Eslida Formation. The species represents the oldest Mesozoic insect described from Spain, and provides interesting information to better appreciate the process of ecosystems recovery after the Permian-Triassic boundary crisis.

Keywords: Odonatoptera, *rubra* sp. nov., *Rabru rubra* gen. & sp. nov., biostratigraphy, Triassic, Iberian Ranges, Buntsandstein, cladotypic nomenclature.

Resumen

La especie *rubra* sp. nov., un nuevo insecto triadotipomorfo de la Cordillera Ibérica, es descrito en este trabajo en base a un nuevo espécimen hallado en un nivel de areniscas de grano fino de origen aluvial en la parte más baja de la Formación Eslida (facies Buntsandstein), en la zona central de la Cordillera Ibérica. La aparición de este triadotipomorfo confirma la edad Ansíense (Triásico Medio) de la Formación Eslida. La especie encontrada representa el insecto más antiguo hallado en el Mesozoico de España y una interesante información para comprender mejor el proceso de recuperación de los ecosistemas tras la crisis del límite Pérmico-Triásico.

Palabras clave: Odonatoptera, *rubra* sp. nov., *Rabru rubra* gen. & sp. nov., bioestratigrafía, Triásico, Cordillera Ibérica, Buntsandstein, nomenclatura cladotípica .

1. Introduction

The present-day Iberian Ranges (Fig. 1) are the result of several compressive phases experienced by the Iberian Basin during the Alpine Orogeny (Arche and López-Gómez, 1996). The Iberian Basin started its development under an extensional tectonic regime, with several synrift-postrift phases that lasted from Early Permian to Late Triassic-Early Jurassic (Sopeña *et al.*, 1988; López-Gómez *et al.*, 2002; Vargas *et al.*, 2008).

The Eslida Formation, defined by López-Gómez and Arche (1993), is the uppermost alluvial unit of the Buntsandstein facies of the central Iberian Basin (Fig. 2). It is mainly composed by red to pink sandy braided river deposits of simple or amalgamated sheet complexes with abundant red silty floodplain sediments (Arche and López-Gómez, 1999; Alonso-Azcárate *et al.*, 1997). The age of the Eslida Formation has been considered early Anisian (Aegean-Bithynian) (Arche and López-Gómez, 1999) based on the well-known age of the uppermost part of the underlying Cañizar Formation and the overlying Marines Formation, both of Anisian age (Fig. 2) (Doubinger *et al.* 1990). However, up to now, biostratigraphical data was totally lacking.

A fragmentary insect wing was recently discovered during investigations carried out in the lower part of the Eslida Formation, near Corbalán village, Teruel province (Fig. 1). The specimen is relevant for biostratigraphic inferences regarding the Eslida Formation as well as a future better understanding of the biological recovery after the Permian-Triassic crisis in this peritethyan area.

2. Material and methods

The specimen described in this contribution is currently housed at the Departamento de Estratigrafía, CSIC-UCM, Universidad Complutense de Madrid, Spain. Pending upon legislation application, it could have to be relocated on middle-term to the Dinopolis Museum (Teruel, Spain). Venation pattern and vein widths were drawn with a stereomicroscope and camera lucida directly from the fossil surface. Photograph was taken using a digital camera Canon EOS 400D and a 50mm Macro lens. One of us (OB, August 2007) carried out limited preparation of the specimen but this could not be pursued as the layer on which the wing remain is preserved could not be identified. The wing venation nomenclature and abbreviations follows Nel *et al.* (1993) and Bechly (1996). They are repeated for convenience: RA, anterior Radius; RP, posterior Radius; RP1, RP2, branches of RP resulting from the fork of the anterior branch of RP; RP3, RP4, branches of RP resulting from the fork of the posterior branch of RP; IR1, IR2, intercalary pseudo-veins between RP1 and RP2, and RP2 and RP3, respectively; MA, anterior Media; MP, posterior Media; CuA, anterior Cubitus; CuP, posterior Cubitus.

Because the generic taxonomy relevant for the new species we describe, elaborated under the Linnaean system, is unsatisfactory (see below), the cladotypic system (Béthoux, 2007a; 2007b; and references therein) is followed. The choice of the taxonomic system is based on the decision of one of us (OB) and does not imply the consent of other authors to all aspects of this system. For convenience, species assigned to the Linnaean taxa Odonatoptera, Palaeodictyopteroidea, Calvertiellidae, and Triadotypomorpha will be referred to as odonatopterans, palaeodictyopteroideans, calvertiellidaeans, and triadotypomorphans, respectively. Throughout this contribution, taxa understood as taken from the Linnaean system are indicated by the mention of their rank.

3. Systematic Paleontology

rubra sp. nov.
Figure 3

Diagnosis. Wings: MA and MP simple for a long distance (most probably simple); RP3/4 branched proximal to its mid-length; RP4 branched opposite its midlength; CuA with 3 (4?) branches; CuP branched.

Etymology. After the colour of the sediment in which the type-specimen is preserved.

Material. Specimen Ant-100c, preserved in a fine-grained pink sandstone (arkose).

Occurrence. Lowermost part of the Eslida Formation, five kilometres north of Corbalán village (Teruel province).

Description. Specimen Ant-100c. Positive imprint of a right wing, poorly preserved; most of wing margins, wing base and apex, and various parts of the wing missing; preserved length about 83 mm, width opposite branching of RP3/4 21.4 mm; RA simple in preserved parts; RP1/2 about 19 mm long before divergence of RP1 and RP2; two concave branches occurring between IR1 and RP3; RP2 branched very distally, with three preserved branches; where preserved, IR2 slightly zigzagging; RP3/4 about 16 mm long before divergence of RP3 and RP4; RP3 with two preserved branches; RP4 branched 14.6 mm distal to its divergence with RP3, with nine preserved branches; convex branches preserved between branches of RP2 and RP4; MA simple in preserved parts, slightly zigzagging;

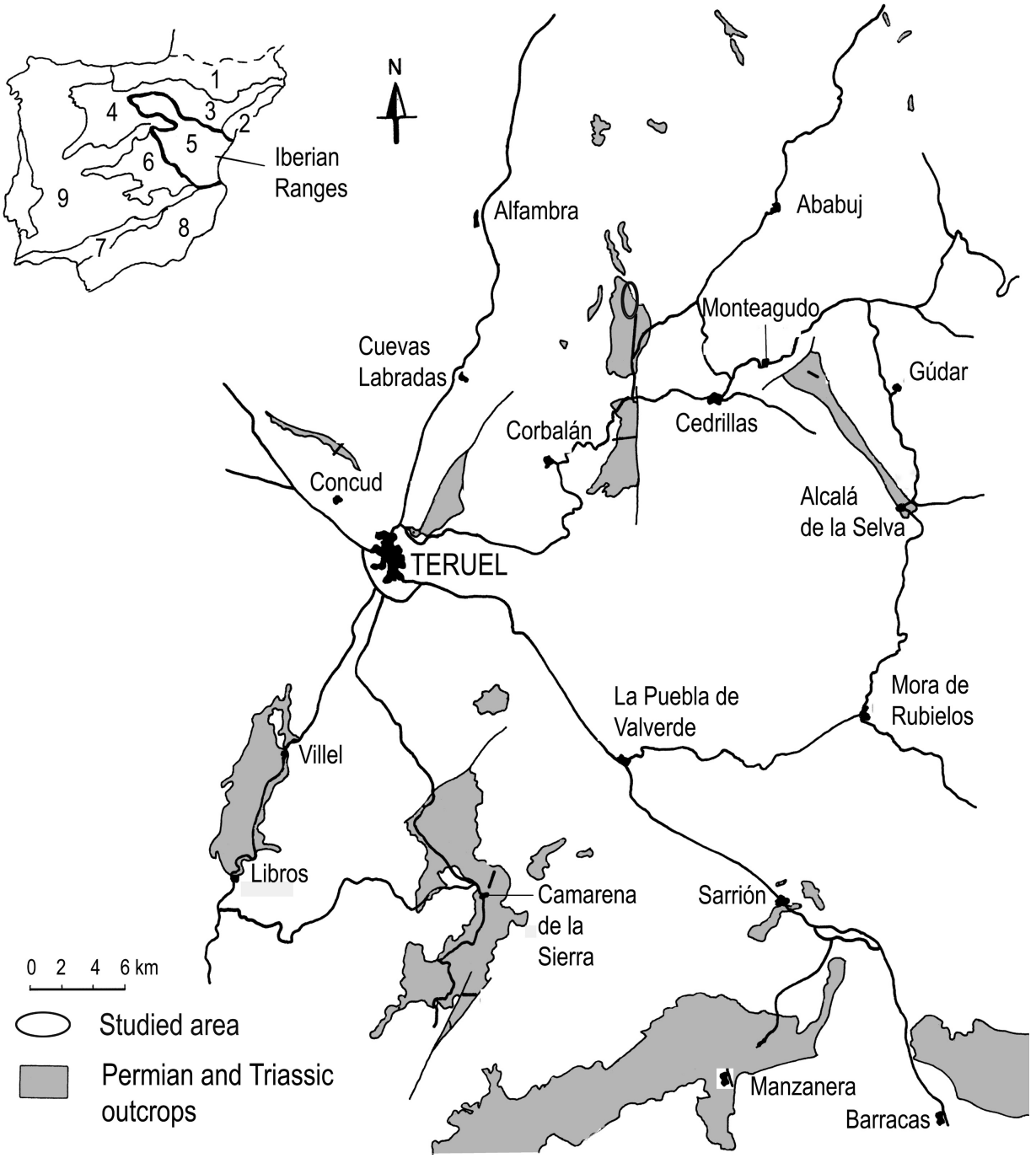

Fig.1.- Location of Permian and Triassic outcrops in the studied area, central part of the Iberian Ranges. Main present-day basins and Ranges of the Iberian Peninsula in the map of the top at the left: 1- Pyrenees, 2- Catalan Coastal Ranges, 3- Ebro Basin, 4- Duero Basin, 5- Iberian Ranges, 6- Tagus Basin, 7- Guadalquivir Basin, 8- Betic Cordillera, 9- Hesperian Massif.

Fig. 1.- Localización de los afloramientos del Pérmico y Triásico de la zona estudiada, en el sector central de la Cordillera Ibérica.Principales cuencas y cordilleras actuales de la Península Ibérica situadas arriba a la izquierda: 1-Pirineos, 2- Cordillera Costero Catalana, 3- Cuenca del Ebro, 4- Cuenca del Duero, 5- Cordillera Ibérica, 6- Cuenca del Tajo, 7- Cuenca del Guadalquivir, 8- Cordillera Bética, 9- Macizo Hespérico.

area between MA and MP broader than between RP3/4 (and RP4) and MA; MP simple in preserved parts; CuA with three preserved branches, zigzagging; a set of concave secondary branches occurs in the area anterior to the posterior branch of CuA; near the posterior wing margin, a convex secondary vein preserved between two of these concave secondary branches; CuP with two main stems, the anterior one being posteriorly pectinate, with six concave branches reaching the posterior wing margin; convex secondary veins preserved in the area posterior to the

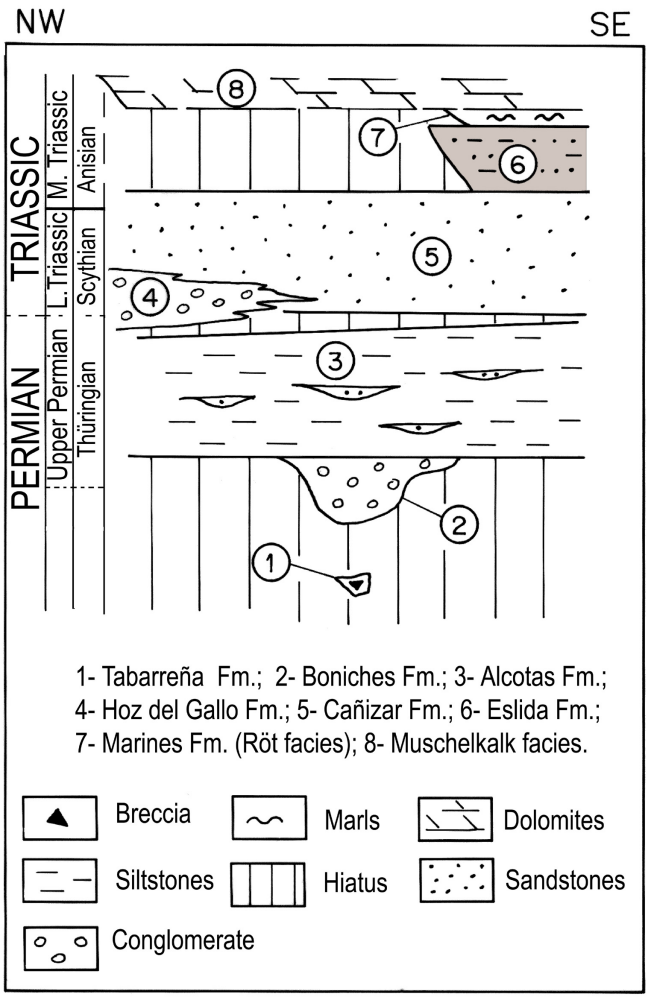

Fig. 2.- Stratigraphical location and age of the Eslida Formation. The sketch represents the Permian-Middle Triassic units of the central part of the Iberian Ranges.

Fig. 2.- Localización estratigráfica y edad de la Formación Eslida. El esquema representa a las unidades del Pérmico y Triásico Medio de la parte central de la Cordillera Ibérica.

anterior-most branch of CuP and the area anterior to the posterior-most branch of CuP; a simple, convex, and zigzagging branch occurring posterior to CuP; cross-veins regularly spaced out.

Discussion. The specimen was found exposed and bears evidence of weathering. Most convex veins are not readily identifiable but their occurrence is evidenced by the elevation of the wing surface on which they were located. The vein interpreted as 'CuP' is branched several times, and with convex iconvex intercalary pseudo-veins between some of its branches. Therefore CuP itself is unlikely an intercalary concave pseudo-vein.

The occurrence of simple convex branches occurring between main RP branches (*i.e.* IR1, IR2, and IR3) is diagnostic of odonatopterans and of some palaeodictyopteroideans, notably the calvertiellidaeans (see Béthoux *et al.*, 2007). The occurrence of branches of CuA excludes relationships with the latter group, in which this vein is simple. Within odonatopterans, *rubra* sp. nov. shares with the triadotypomorphans *guillaumei* Grauvogel and Laurentiaux, 1952, *gelasii* Reis, 1909, and *sodgianus* Pritykina, 1981 [after Nel *et al.* (2001), the former species belongs to the genus *Triadotypus* Grauvogel and Laurentiaux, 1952 and the two latter species belong to the genus *Reisia* Handlirsch, 1912] an area between MA and MP broader than that between RP3/4 (or RP4) and MA. The species *rubra* sp. nov. differs from *gelasii* by a more proximal branching of RP3/4 into RP3 and RP4. The species *rubra* sp. nov. differs from *sodgianus* by a more distal branching of RP4. Location of branchings of RP branches and of IR intercalary veins is similar in *rubra* and *guillaumei*. However, although drawing and description of *guillaumei* in Nel *et al.* (2001) does not allow the number of CuA branches to be determined accurately, this species exhibits at least 13 branches of CuA, while *rubra* has probably three branches, maybe four if the anterior-most branch of CuA is forked (not preserved). In that respect, *rubra* is more similar to *gelasii* (although wing base is incomplete in the material assigned to the latter). All these differences support the erection of a new species.

The species *rubra* nov. sp. cannot be assigned to any taxon which name has been associated with a cladotypic definition. Therefore it is left without taxonomic address. However, it arguably belongs to the triadotypomorphans (as understood by Nel *et al.*, 2001).

Assigning the species to a genus, mandatory under the Linnaean system, is problematic: all species mentioned in this discussion are known after a very small number of specimens, all of them being incomplete in some respect. In addition, the polarity of character states mentioned above is unknown. However, and only in order to allow the mention of this species under the Linnaean framework, the new genus *Rabru* gen. nov. is erected (etymology: anagram of *rubra*; type-species *Rabru rubra* nov. sp.; diagnosis: same as *rubra* nov. sp.). A phylogenetic analysis of the group, hardly achievable at the moment, might prove this genus to be a junior synonym of another.

4. Conclusions

Due to scarce biostratigraphical data of these siliciclastic sediments of alluvial origin, the occurrence of *rubra* sp. nov. is of importance. Triadotypomorphans are represented in the Triassic only (Nel *et al.,* 2001). Therefore, the discovery of a species belonging to this group in the Eslida Formation provides additional support to the

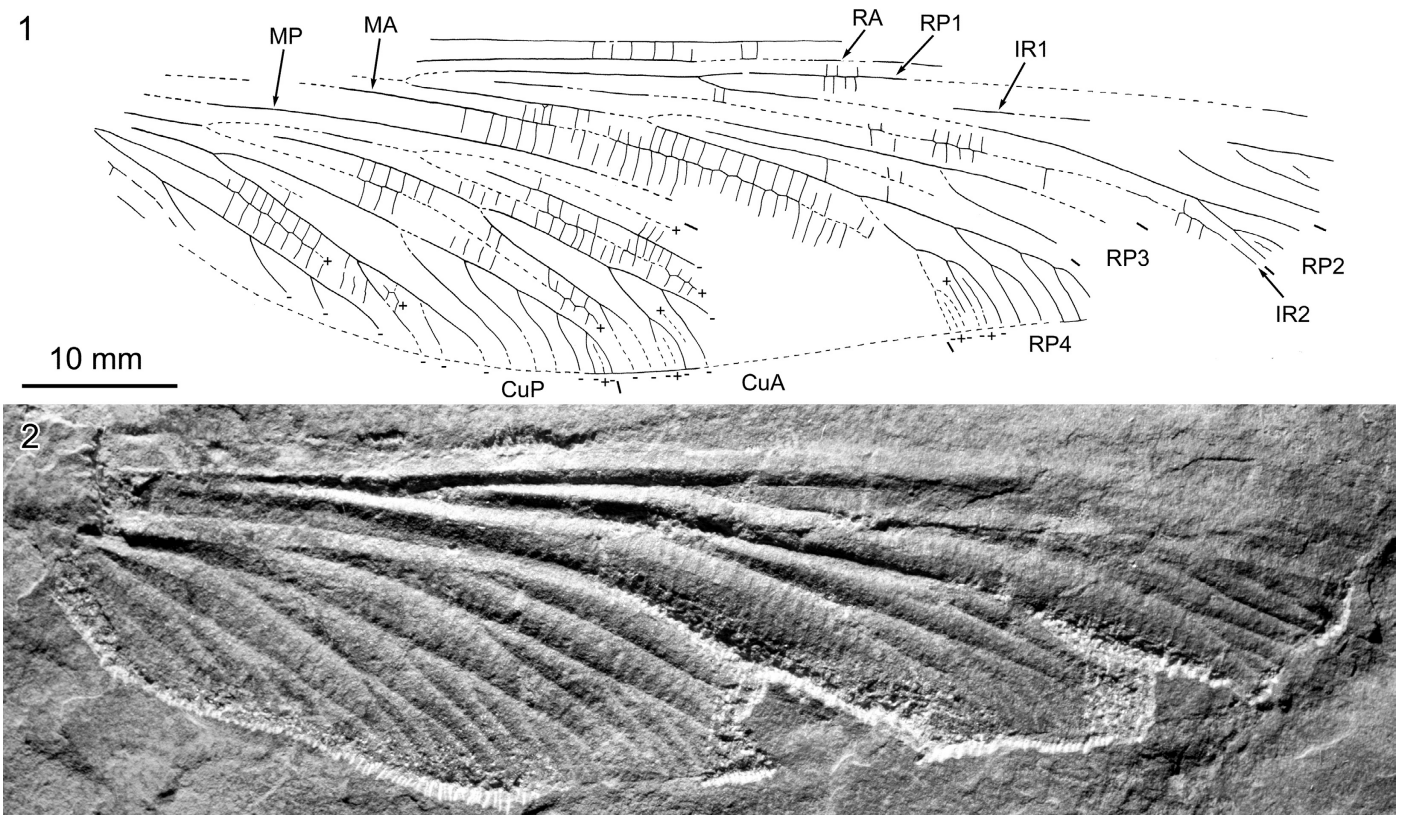

Fig. 3.- Species *rubra* sp. n. (right wing, holotype specimen Ant-100c). 1. Reconstruction (+ and - signs indicate convex and concave veins, respectively). 2. Photograph.

Fig. 3.- Especie *rubra* sp. n. (ala derecha; especímen del holotipo Ant-100c). 1. Reconstrucción (los símbolos + y – indican venas cóncavas y convexas respectivamente).

hypothesis that the section is of Triassic age (Arche and López-Gómez, 1999). In addition, this species represents the oldest Mesozoic insect of the Iberian Peninsula. This is an important discovery, because data on Early Triassic entomofaunas are not abundant. Future paleoecological investigations to be carried out in outcrops of the Early Anisian Eslida Formation will be important to better appreciate the process of ecosystems recovery after the Permian-Triassic boundary crisis.

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References

Alonso-Azcárate, J., Arche, A., Barrenechea, J. F., López-Gómez, J., Luque, F. J., Rodas, M. (1997): Palaeogeographical significance of clay mineral assemblages in the Permian and Triassic sediments of the SE Iberian Ranges, eastern Spain. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 136: 309-330.

Arche, A., López-Gómez, J. (1996): Origin of the Permian-Triassic Iberian Basin, central-eastern Spain. *Tectonophysics*, 266: 443-464.

Arche, A., López-Gómez, J. (1999): Tectonic and geomorphic controls on the fluvial styles of the Eslida Formation, Middle Triassic, Eastern Spain. *Tectonophysics*, 315: 187-207.

Bechly, G. (1996): Morphologische Untersuchungen am Flügelgeäder der rezenten Libellen und deren Stammgruppenvertreter (Insecta; Pterygota; Odonata) unter besonderer Berücksichtigung der Phylogenetischen Systematik und des Grundplanes der Odonata. *Petalura*, special volume 2: 1-402.

Béthoux, O. (2007a): Propositions for a character-state-based biological taxonomy. *Zoologica Scripta*, 36: 409–416.

Béthoux, O. (2007b): Cladotypic taxonomy revisited. *Arthropod Systematics & Phylogeny*, 65: 127-133.

Béthoux, O., Nel, A., Schneider, J. W., Gand, G. (2007): *Lodetiella magnifica* nov. gen. and nov. sp. (Insecta: Palaeodictyoptera; Permian), an extreme case in wing morphology of palaeopterous insects. *Geobios*, 40: 181-189.

Grauvogel, L., Laurentiaux, D. (1952): Un protodonate du trias des Vosges. *Annales de Paleontologie, Invertébrés*, 38: 121-129.

Handlirsch, A. (1912): Über Insektenrest aus der Trias Frankens. *Abhandlungen der Naturhistorischen Gesellschaft zu Nürnberg*, 18: 79-82.

López-Gómez, J., Arche, A. (1993): Sequence stratigraphic analysis and paleogeographic interpretation of the Buntsandstein and Muschelkalk facies (Permian-Triassic) in the SE Iberian Ranges, E. Spain. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 103: 179-201.

López-Gómez, J., Arche, A., Pérez-López, A. (2002): Permian and Triassic. In: W. Gibbons, T. Moreno (eds), *The Geology of Spain*. Published, London: 185-212.

Nel, A., Martínez-Delclòs, X., Paicheler, J. C., Henrotay, M. (1993): Les «Anisozygoptera» fossiles. Phylogénie et classification (Odonata). *Martinia*, hors-série 3: 1-311.

Nel, A., Béthoux, O., Bechly, G., Martínez-Delclòs, X., Papier, F. (2001): The Permo-Triassic Odonatoptera of the "protodonate" grade (Insecta: Odonatoptera). *Annales de la Société Entomologique de France (N.S.)*, 37: 501-525.

Pritykina, L. N. (1981): Novye triasovye strekozy srednej Azii. In: V. N. Vishniakova, G. M. Dlussky, L. N. Pritykina (eds), *Novye iskopaemye nasekomye s Terrotorii SSSR*, Moscow: 5-42.

Reis, O. M. (1909): Handlirschia gelasii nov. gen. et spec. aus dem Schaumkalk Frankens. *Abhandlungen der Koeniglich Bayerischen Akademie der Wissenschaftern, Mathematisch-Physikalischen Klasse*, 23: 659-694.

Sopeña, A., López-Gómez, J., Arche, A., Pérez-Arlucea, M., Ramos, A., Virgili, C., Hernando, S. (1988): Permian and Triassic rift basins of the Iberian Peninsula. In: W. Manspeizer (ed.), *Triassic-Jurassic rifting*. Published, Amsterdam: 757-786.

Vargas, H., Gaspar-Escribano, J.M., López-Gómez, J., Van Wees, J.D., Cloetingh, S., De la Horra, R., Arche, A. (2008): A comparison of the Iberian and Ebro Basins during the Permian and Triassic, eastern Spain: A quantitative subsidence modelling approach. *Tectoniphysics*, in press (doi:10.1016/j.tecto.2008.06.005).