Argentinopanorpa miguezi gen. et sp. nov.: first record of Triassic Mecoptera (Permochoristidae) from the Cuyo Basin (Mendoza, Argentina)

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A new genus and species of Permochoristidae, *Argentinopanorpa miguezi*, is described based on a complete forewing from the Upper Triassic Potrerillos Formation (Mendoza Province, Argentina). The new taxon is placed in the subfamily Agetopanorpinae and distinguished from other genera by the following combination of characters: Rs+MA with six branches, MP with eight branches (MP_1 and MP_3 with additional forks), CuA and MP fused basally for a short distance. This is the first record of Permochoristidae in the Triassic of South America and the first formal description of Mecoptera from the Cuyo Basin. Previously reported taxa attributed to Mecoptera from the Triassic of South America are briefly discussed with notes on their systematic position.

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Key words: Mecoptera, Permochoristidae, new genus, new species, Triassic, Potrerillos Formation, Argentina.

THE EXTINCT family Permochoristidae Tillyard, 1917 is a very diverse and apparently paraphyletic group of Mecoptera, comprising about 40 genera and more than 150 described species from the Permian to the Jurassic of Eurasia, Australia, South Africa, and North and South America (Novokshonov 1997a, 2002, Lin *et al*. 2010). They were particularly well represented and dominant among mecopteran faunas throughout the Permian. However, from the Triassic they greatly decreased in diversity and abundance to become quite rare in the Jurassic, having been replaced by more derived groups. Triassic permochoristids are known mainly from Central Asia and Australia (Riek 1955, Novokshonov 1997b, 2001), and by rare specimens recorded from Europe, South Africa and China (Riek 1974, Papier *et al*. 1996, Guo & Hong 2003).

The first mecopteran recorded from the Triassic of South America (Argentina) is *Tipulidites affinis* Wieland, 1925 from the Potrerillos Formation (Cuyo Basin), originally described as a tipuloid dipteran, and later considered a trichopteran (Wieland 1926) or possibly mecopteran (Martins-Neto *et al*. 2003). As far as preserved, *T. affinis* shows characters typical of Mesopsychidae as defined by Bashkuev (2011): two-branched Rs and MA with relatively short forks, four (?)-branched MP, and very characteristic crossvein arrangement and, therefore, it is attributed to this family herein. Gallego (1997) mentioned the presence of *Orthophlebia?* sp. (Orthophlebiidae) in the Los Rastros Formation (Ischigualasto-Villa Unión or Bermejo Basin). Later, Gallego & Martins-Neto (1999, fig. 14) erected a new genus and species of Mesochoristidae (=Permochoristidae), *Argentinochorista pulchella* nom. nud., without providing a formal description or information about the source locality. Later, both Orthophlebiidae and Mesochoristidae were listed by Gallego & Martins-Neto (2006, table 1) among the insects known from the upper section of the Los Rastros Formation. However, the venation of *A. pulchella* does not support its attribution to Mecoptera; it may represent a blattoid hindwing ('*Volztiablatta*'-group *sensu* Vršanský 2008). Finally, Brauckmann *et al*. (2010) described the problematic species *Mendozachorista volkheimeri* from the Llantenes Formation (Malargüe Basin), Mendoza Province, representing the monotypic family Mendozachoristidae, which was considered a '?stem-group of Hymenoptera+Mecopterida or ?Trichoptera'. However, its attribution to Mecoptera and even to Insecta is doubtful.

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Here we describe a new genus and species, *Argentinopanorpa miguezi*, attributed to the Permochoristidae and Agetopanorpinae, which represents the first record of this family and subfamily for the Triassic of South America (if we exclude the above-mentioned *Argentinochorista pulchella*). The new, well-preserved material enables us to provide a complete description and enrich the knowledge of this group in Gondwana.

The new fossil material derives from the Potrerillos Formation (early Late Triassic) at the Quebrada del Durazno locality, south of Cerro Cacheuta, Mendoza Province, Argentina (Fig. 1). The palaeoenvironment of this formation is reconstructed as braided fluvial systems developed in an alluvial plain to delta (for further details on the geology, see Martins-Neto *et al*. 2008). Eleven insect orders (Hemiptera, Coleoptera, Blattodea, Mecoptera, Miomoptera, Orthoptera, Plecoptera, Grylloblattida, Odonatoptera, Diptera and Hymenoptera), 13 families and 23 species have been described from this formation (Wieland 1925, 1926, Cabrera 1928, Carpenter 1960, Pinto & Purper 1978, Storozhenko 1997, Martins-Neto & Gallego 1999, Martins-Neto *et al*. 2003, 2007, 2008, Gallego *et al*. 2011, Lara & Lukashevich 2013, Lara *et al*. 2014).

Material and methods

The specimen MCNAM-PI 24608 described below is housed in the collection of the Museo de Ciencias Naturales y Antropológicas 'Juan Cornelio Moyano' (Mendoza City). Photographs were taken using an Olympus SZ51 stereomicroscope with an Olympus SP–350 digital camera (8.0 megapixels), with subsequent adjustments made using CorelDraw X5. The wing venation terminology follows Novokshonov (2002).

Systematic palaeontology

Order MECOPTERA Packard, 1886
Family PERMOCHORISTIDAE Tillyard, 1917
Subfamily AGETOPANORPINAE Carpenter, 1930

Argentinopanorpa gen nov.

Type species. Argentinopanorpa miguezi gen. et sp. nov.

Etymology. Named after Argentina and the genus *Panorpa*.

Diagnosis. Forewing characters only. Sc long, with at least one anterior branch, located before Rs+MA bifurcation. R_1 with oblique branch at base of pterostigma. Rs with four branches. Stem Rs_{1+2} shorter than stem Rs_{3+4}. MA with two branches. MP with eight branches (additional forks on MP_1 and MP_3). Base of CuA strong and inclined; CuA fused with MP for a short distance. Crossveins numerous between Rs, MA and MP branches. Anal area with three veins long and joined by crossveins.

Remarks. The new genus is attributed to Permochoristidae based on: Rs being dichotomously branched, and veins CuA and MP being fused basally for a short distance. *Argentinopanorpa* gen. nov. differs all other genera of Agetopanorpinae in its wing shape and Rs+MA having six branches (*Gigantoageta* Novokshonov, 1993), and MP with eight branches (*Seniorita* Novokshonov, 1993, *Tsherkardopanorpa* Novokshonov, 1993). The higher taxonomic attributions are evaluated further in the *Discussion*.

Argentinopanorpa miguezi sp. nov. (Fig. 2A–C)

Etymology. In honour of Oscar Miguez for generously allowing access to the Triassic strata exposed on his farm.

Holotype. MCNAM-PI 24608 (part and counterpart of preserved isolated wing).

Type locality, unit and age. Quebrada del Durazno, southern flank of Cerro Cacheuta, southern end of the Precordillera, Cuyo Basin, Mendoza Province, Argentina; upper section of the Potrerillos Formation; early Late Triassic (Carnian).

Diagnosis. Large insects (forewing length, 26.7 mm). Stem Sc+R+M and base of R sclerotized strongly. Stems Rs+MA and MP beginning and forking at the same levels. Stem Rs_{3+4} *ca* 2.5 times longer than stem Rs_{1+2}. Terminal forks of MP_1, MP_2 and MP_3 of nearly the same length, fork of MP_4 much longer; MP_4 forking extremely close to fork of MP_{3+4}. Wing deeply pigmented; colour pattern stained, dark, with uncoloured rounded spots confluent into transverse fasciae, in the distal half of wing located mainly around crossveins.

Description. Forewing with subcostal area twice as wide as costal area. Costal margin with basal one-third convex and distal two-thirds absent. Counterpart with costal margin destroyed. Pterostigma nearly lanceolate and elongate. Sc long (7.9 mm) convex and bifurcated distally into at least two branches. Veins Sc, R and M fused at wing base into strong convex sclerotized vein (3.07 mm), then diverging. R_1 long (13 mm), curved posteriorly at pterostigma, with oblique distal branch. Rs+MA long (6.06 mm), arched, originating from R_1 and forking into Rs and MA near mid-length of wing. Rs (2.84 mm) with four branches running parallel to each other and reaching apical margin. MA (2.35 mm) bifurcated into MA_1 and MA_2, long (both 11.37 mm), straight and reaching apical margin. Stem MP long

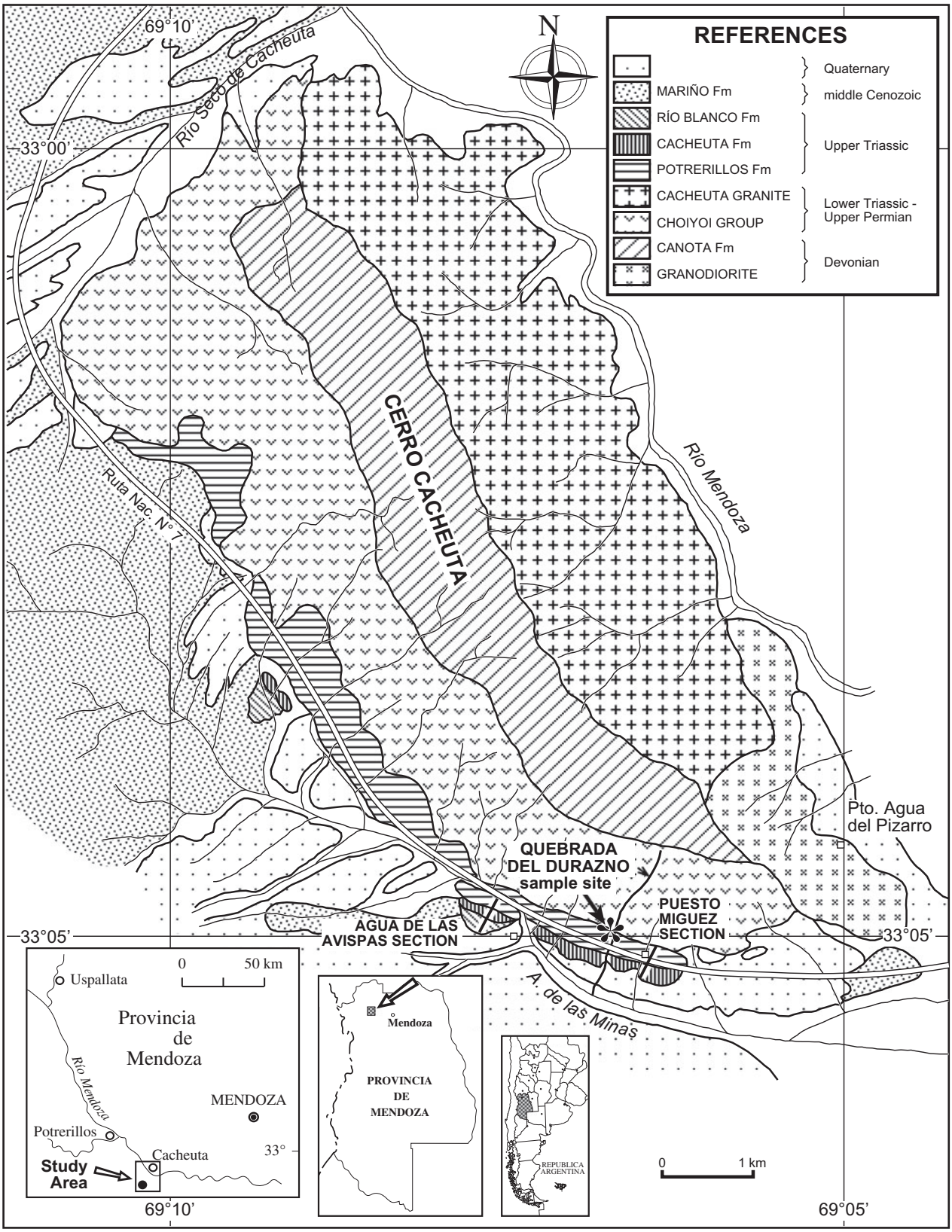

Fig. 1. Geological map of the southern Cerro Cacheuta area and fossiliferous locality at Quebrada del Durazno, Mendoza Province, Argentina (modified from Morel 1994).

(10.13 mm), separating from CuA approximately at the basal 1/4 of wing length, straight, divided into two main branches, MP_{1+2} (4.35 mm) and MP_{3+4} (1.34 mm), at the same level as forking of Rs+MA. MP_1, MP_2 and MP_3 with terminal forks of nearly the same length, whereas that of MP_4 is much longer and MP_4 forking extremely close to fork of MP_{3+4}. Basal portion of Cu, before dividing into CuA and CuP, long (3.7 mm), arched, nearly parallel to MP. CuA (11.6 mm long) straight then deflecting towards the apical margin, connected with MP by long and straight crossvein mp-cua. CuP (8.7 mm long) simple, nearly straight, fused with anal margin. Anal area with three simple anal veins: A_1, A_2 and A_3, all clearly separated at the base of wing. A_1 (10.8 mm long) fused at base with Cu, curved initially then running straight towards anal margin. A_2 (6.4 mm long) and A_3 (3.4 mm long) slightly curved anteriorly, reaching anal margin. Crossveins in the anal area arranged in stepwise fashion and at the same inclination. Posterior margin of wing is distinctly emarginated at the CuP veinal apex. Wing deeply pigmented, with distinctive stained colour pattern (Fig. 2A).

Measurements (in mm). Forewing length, 26.7; width 8.13; length/width ratio 3.28.

Discussion

The general wing shape and venation of *Argentinopanorpa miguezi* gen. et sp. nov. are consistent with the ground pattern of Permian and Triassic Mecoptera. The Rs is dichotomously branched, rather than pectinate: the terminal fork of Rs_{1+2} is quite long, and Rs_1 lacks forking throughout its length (as preserved), whereas, in the typical pectinate Rs of Parachoristidae (and of Orthophlebiidae and other panorpoid families), its anterior branch forks regularly or becomes denser apically. Veins CuA and MP are fused basally for a short distance, which is also more typical of Permochoristidae

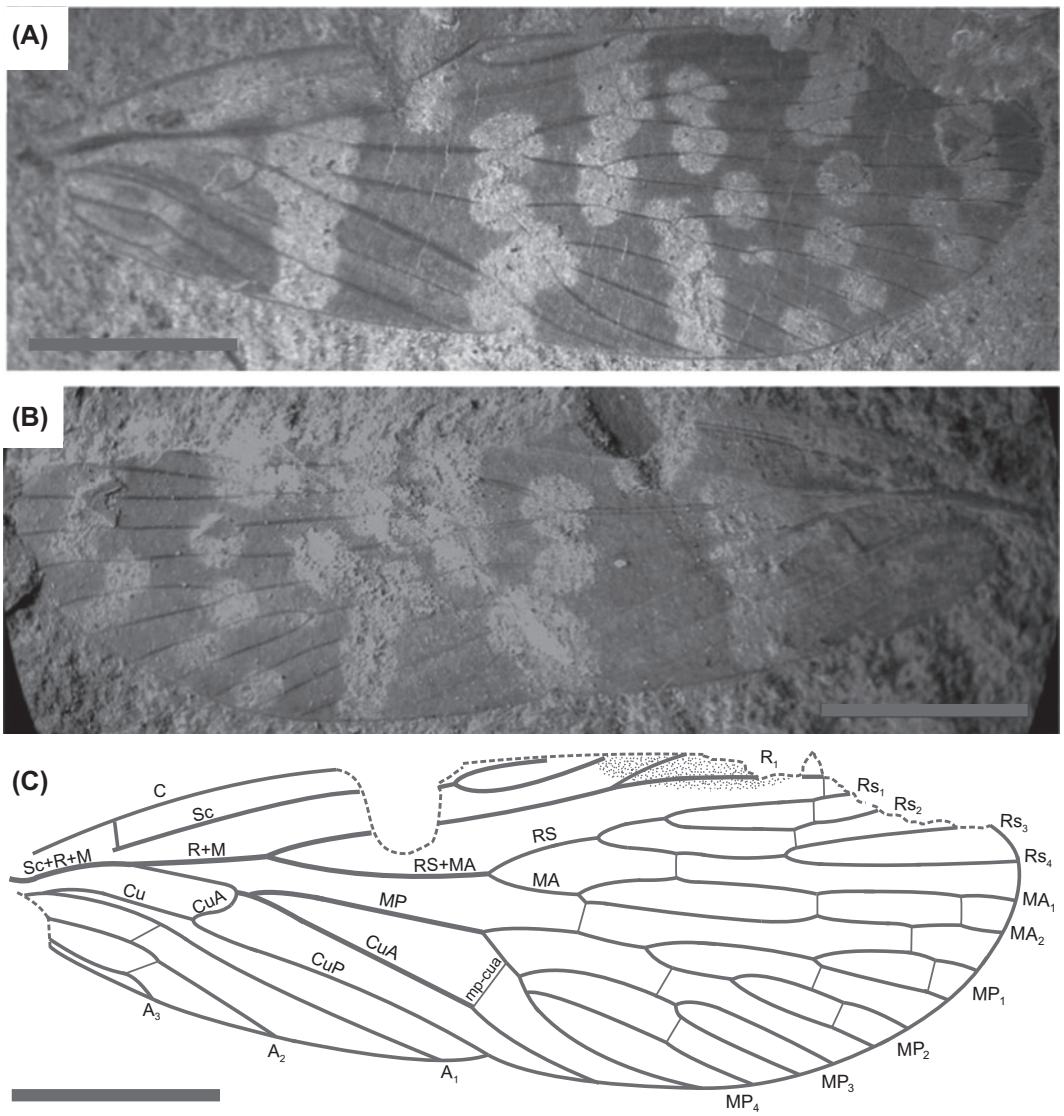

Fig. 2. Argentinopanorpa miguezi gen et. sp. nov., holotype MCNAM-PI No. 24608: **A,** Photograph of part; **B,** Photograph of counterpart; **C,** Line drawing. Scale bars = 4.7 mm.

than of Parachoristidae, albeit that this trait occurs in some parachoristid genera (*viz*., *Triassochorista* Willmann, 1989 and *Neoparachorista* Riek, 1955, which were separated by Novokshonov (1997a) into the subfamily Neoparachoristinae Willmann, 1978, based exactly on this character). Thus, we attribute the new species to Permochoristidae rather than to Parachoristidae or Orthophlebiidae.

The most relevant classification of Permochoristidae proposed by Novokshonov (1997a) includes four subfamilies: Permochoristinae Tillyard, 1917, Agetopanorpinae Carpenter, 1930, Pseudonannochoristinae Novokshonov, 1994 and Sylvopanorpinae Novokshonov, 1997a. However, in his monograph, Novokshonov (1997a) emphasized only Permian taxa, whereas classification of many Triassic species, attributed to Permochoristidae, is difficult, especially regarding those from the Triassic of Australia and Central Asia (such as *Mesageta* Novokshonov, 1997b or *Xenochoristella* Riek, 1955). The subfamily classification is based mainly on venational characters, such as the number of branches of Sc, Rs, MA and MP. Based on these features, *Argentinopanorpa miguezi* gen. et sp. nov. can be attributed to Agetopanorpinae. The main diagnostic characters of Agetopanorpinae as listed by Novokshonov (1997a), are as follows: Sc with two or three anterior branches (rarely with one); number of Rs+MA branches 5–8; and MP branches usually six (but the largest species, *Gigantoageta perforata* Novokshonov, 1993 has nine). In *Argentinopanorpa* gen. nov., Sc has at least two terminations, although the presence of an additional branch can not be ruled out. Among the known genera, it is most similar to *Tshekardopanorpa* Novokshonov, 1993 in the branching of Rs+MA (but differs in the much deeper fork of Rs_1); and to *Uraloageta* Novokshonov, 1993 (Sylvopanorpinae) in the branching of MP (with all MP_1, MP_2, MP_3 and MP_4 having terminal forks). Both genera are known from the Early Permian. However, the number of Rs, MA and MP branches in Agetopanorpinae and Sylvopanorpinae genera is somewhat variable, probably with increased wing size (as in many other insects with multi-branched longitudinal veins). Therefore, the similarity in the number of branches in *Argentinopanorpa* gen. nov. and Early Permian genera does not necessarily imply their close affinity, especially considering their great difference in geological age.

The record of Permochoristidae (if correctly classified) in the Upper Triassic of South America is novel but not entirely unexpected considering the global distribution of this family, with abundant records in Gondwana: Permian of Brazil and India, Permian and Triassic of Australia and South Africa (Tillyard 1917, Riek 1953, 1955, 1974, Pinto 1972, Srivastava 1997).

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References

Bashkuev, A.S., 2011. The earliest Mesopsychidae and revision of the family Mesopanorpodidae (Mecoptera). *ZooKeys 130*, 263–279.

Brauckmann, C., Gallego, O.F., Hauschke, N., Martins-Neto, R.G., Groening, E., Ilger, J.M. & Lara, M.B., 2010. First Late Triassic record of a paleoentomofauna from South America (Malargüe Basin, Mendoza Province, Argentina). *Acta Geologica Sinica 84*, 915–924.

Cabrera, A., 1928. Un segundo ortóptero del Triásico argentino. *Revista Española de Entomología 4*, 371–373.

Carpenter, F.M., 1930. The Lower Permian insects of Kansas: Part 1. Introduction and the Order Mecoptera. *Bulletin of the Museum of Comparative Zoology 70*, 69–101.

Carpenter, F.M., 1960. A Triassic odonate from Argentina. *Psyche 67*, 71–75.

Gallego, O.F., 1997. Hallazgos de insectos triásicos en la Argentina. *Ameghiniana 34*, 511–516.

Gallego, O.F. & Martins-Neto, R.G., 1999. La entomofauna mesozoica de la Argentina: Estado actual del conocimiento. *Revista de la Sociedad Entomológica Argentina 58*, 86–94.

Gallego, O.F. & Martins-Neto, R.G., 2006. Propuesta preliminar sobre la distribución estratigráfica de las faunas triásicas de insectos y conchostracos de Argentina, Chile y sur de Brasil. *XII Reunión de Comunicaciones Científicas y Tecnológicas, Junio de 2006*. Secretaría General de Ciencia y Técnica, Universidad Nacional del Nordeste, Corriente (Argentina), Resumen B-009.

Gallego, O.F., Rébori, L.O., Zavattieri, A.M., Sinitshenkova, N., Lara, M.B. & Martins-Neto, R.G., 2011. The most ancient Platyperlidae (Insecta–Perlida = Plecoptera) from the early Upper Triassic deposits in southern South America. *Ameghiniana 48*, 447–461.

Guo, X.R. & Hong, Y.C., 2003. New genus and species of Permochoristidae Tillyard (Insecta, Mecoptera) from the Middle Triassic Tongchuan Formation, Shaanxi Province, China. *Acta Zootaxonomica Sinica 28*, 712–715.

Lara, M.B. & Lukashevich, E.D., 2013. The first Triassic Diptera (Insecta) from South America, with review of Hennigmatidae. *Zootaxa 3710*, 81–92.

Lara, M.B., Rasnitsyn, A.P. & Zavattieri, A.M., 2014. *Potrerilloxyela menendezi* gen. et sp. nov. from the Late Triassic of Argentina: The oldest representative of Xyelidae (Hymenoptera: Symphyta) for Americas. *Paleontological Journal 48*, 182–190.

LIN, Q.B., NEL, A. & HUANG, D.Y., 2010. The first agetopanorpine mecopteroid insect from Middle Permian of China (Insecta: Mecoptera: Permochoristidae). *Annales de la Société entomologique de France 46*, 62–66.

MARTINS-NETO, R.G. & GALLEGO, O.F., 1999. The Triassic insect fauna from Argentina. I. Auchenorrhyncha, Miomoptera and Ensifera. *Revista Española de Paleontología 14*, 191–202.

MARTINS-NETO, R.G., GALLEGO, O.F. & MELCHOR, R.N., 2003. The Triassic insect fauna from South America (Argentina, Brazil and Chile): a checklist (except Blattoptera and Coleoptera) and descriptions of new taxa. *Acta Zoologica Cracoviensia 46*, 229–256.

MARTINS-NETO, R.G., GALLEGO, O.F. & ZAVATTIERI, A.M., 2007. A new Triassic insect fauna from Cerro Bayo, Potrerillos (Mendoza Province, Argentina): with descriptions of new taxa (Insecta: Blattoptera and Coleoptera). *Alcheringa 31*, 199–213.

MARTINS-NETO, R.G., GALLEGO, O.F. & ZAVATTIERI, A.M., 2008. The Triassic insect fauna from Argentina: Coleoptera, Hemiptera and Orthoptera from the Potrerillos Formation, south of Cerro Cacheuta, Cuyana Basin. *Alavesia 2*, 47–58.

MOREL, E.M., 1994. El Triásico del Cerro Cacheuta, Mendoza (Argentina). Parte I. Geología, contenido paleoflorístico y cronoestratigrafía. *Ameghiniana 31*, 161–176.

NOVOKSHONOV, V.G., 1993. New and little known Permian scorpion flies (Insecta, Mecoptera = Panorpida) of the family Agetopanorpidae from Perm and Arkhangel'sk oblasts. *Paleontological Journal 27*, 70–89.

NOVOKSHONOV, V.G., 1994. Permian scorpion flies (Insecta, Panorpida) of the Families Kaltanidae, Permochoristidae and Robinjohnidae. *Paleontological Journal 28*, 79–95.

NOVOKSHONOV, V.G., 1997a. *Rannyaya evolyutsiya skorpionnits (Insecta: Panorpida)* [*Early evolution of the scorpionflies (Insecta: Panorpida)*]. Nauka Press, Moscow 1–140. (in Russian).

NOVOKSHONOV, V.G., 1997b. New Triassic scorpionflies (Insecta, Mecoptera). *Paleontological Journal 31*, 628–635.

NOVOKSHONOV, V.G., 2001. New Triassic scorpionflies (Insecta, Mecoptera) from Kyrgyzstan. *Paleontological Journal 35*, 281–288.

NOVOKSHONOV, V.G., 2002. Order Panorpida Latreille, 1802. In *History of Insects*. RASNITSYN, A.P. & QUICKE, D.L.J., eds, Kluwer Academic Press, Dordrecht, 194–199.

PACKARD, A.S., 1886. A new arrangement of the orders of insects. *American Naturalist 20*, 808.

PAPIER, F., NEL, A. & GRAUVOGEL-STAMM, L., 1996. Deux nouveaux insectes Mecopteroidea du Buntsandstein supérieur (Trias) des Vosges (France). *Paleontologia Lombarda 5*, 37–45.

PINTO, I.D., 1972. Permian insects from the Paraná Basin, South Brazil—I. *Mecoptera. Revista Brasileira de Geociências 2*, 105–116.

PINTO, I.D. & PURPER, I., 1978. A new genus and two species of plecopteran insects from the Triassic of Argentina. *Pesquisas 10*, 77–86.

RIEK, E.F., 1953. Fossil mecopteroid insects from the Upper Permian of New South Wales. *Records of the Australian Museum 23*, 55–87.

RIEK, E.F., 1955. Fossil insects from the Triassic beds at Mt. Crosby. *Queensland. Australian Journal of Zoology 3*, 654–691.

RIEK, E.F., 1974. Upper Triassic insects from the Molteno 'Formation', South Africa. *Palaeontologia Africana 17*, 19–31.

SRIVASTAVA, A.K., 1997. Insect and insect activities in Permian Gondwana of India. *Permophiles 30*, 17.

STOROZHENKO, SYU, 1997. New Triassic genera of the Family Atactophlebiidae (Grylloblattida). *Far Eastern Entomologist 40*, 8.

TILLYARD, R.J., 1917. Permian and Triassic insects from New South Wales, in the collection of Mr. John Mitchell. *The Proceedings of the Linnean Society of New South Wales 42*, 720–756.

VRŠANSKÝ, P., 2008. Late Jurassic cockroaches (Insecta, Blattaria) from the Houtiyn-Hotgor locality in Mongolia. *Paleontological Journal 42*, 36–42.

WIELAND, G.R., 1925. Rhaetic crane flies from South America. *American Journal of Sciences 9*, 21–28.

WIELAND, G.R., 1926. South American fossil insects discovery. *American Journal of Sciences 12*, 130–135.

WILLMANN, R., 1978. Mecoptera (Insecta, Holometabola). *Fossilum Catalogus, Animalia 124*, 1–139.

WILLMANN, R., 1989. Evolution und phylogenetisches System der Mecoptera (Insecta: Holometabola). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 544*, 1–153.