Pesquisas em Geociências

http://seer.ufrgs.br/PesquisasemGeociencias

First Permian Insects Forom Uruguay

Irajá Damiani Pinto, Graciela Piñero, Mariano Verde
Pesquisas em Geociências, 27 (1): 89-96, maio/ago., 2000.

Versão online disponível em:
http://seer.ufrgs.br/PesquisasemGeociencias/article/view/20183

Publicado por
Instituto de Geociências

Data de publicação - maio/ago., 2000.
Instituto de Geociências, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil

Pesquisas em Geociências, 27 (1): 89-96, 2000
ISSN 1518-2398

Instituto de Geociências, UFRGS
Porto Alegre, RS - Brasil

First Permian Insects from Uruguay

IRAJÁ DAMIANI PINTO[1]; GRACIELA PIÑEIRO[2] & MARIANO VERDE[2]

[1] Instituto de Geociências, Universidade Federal do Rio Grande do Sul, Caixa Postal 15001
CEP 91509-970, Porto Alegre, RS - Brasil
[2] Departamento de Paleontologia, Facultad de Ciencias, Universidad de la República, Iguá 4225
CP 11400, Montevideo, Uruguay

(Recebido em 04/00. Aceito para publicação em 07/00)

Abstract - For the first time insects and crustaceans from the Mangrullo Member of the Melo Formation (Permian) of Uruguay are registered. The insects belong to the species of Ordo Hemiptera – Sub-Ordo Homoptera – *Paracicadopsis mendezalzolai* gen. et sp. nov. of the family Cicadopsyllidae Martinov, 1931 and from Ordo Perlaria *Perlapsocus formosoi* gen. et sp. nov. of the new Perlapsocidae family. Associated to these insects, crustaceans belonging to the Ordo Pygocephalomorpha were for the first time found and are under study, beside fish scales, plant remains and Mesosaurideos already registered.

Keywords - insecta, Permian, Uruguay

INTRODUCTION

Recent paleontological research at the Mangrullo Member of the Melo Formation (Permian), at the locality "El Barón", in the Cerro Largo Department, Northwest region of Uruguay supplied numerous fossil remains, many of which were new for the country (Piñeiro & Verde, 1996; 1997; Piñeiro *et al.*, 1998). Part of this material provide the first insect and crustacean fossil records not only for that formation but to the whole Country. The location and stratigraphic position of the fossil remains were done by Piñeiro and Verde and they are represented in the map location (Fig. 1) and stratigraphic profile (Fig. 2). The insect taxonomy and the correlation were done by Pinto and Piñeiro. Important taxonomic results have been reached despite the difficulties of having partial superposition of other undetermined wings and round spots. The result was one new species and new genus of the Sub-Ordo Homoptera and another new species of new genus and new family of the Ordo Perlaria. Their relationship indicate a Permian age for the strata they came from.

MATERIAL AND METHODS

The studied material is stored at the fossil Invertebrates Collection (FCDPI) of the Paleontology Department of the Facultad de Ciencias, Universidad de la República del Uruguay. The specimens were found associated with mesosaurian reptiles, fishes, plants and crustacean fossil remains. As the material is not very easy to be seen, drawings in clear camera and photos in high magnification have been used to get better details.

GEOLOGY AND STRATIGRAPHY

The outcrops of the Melo Formation are located in the northwest region of Uruguay and it extends to north, toward Brazil where it is correlated to Irati Formation.

Such new complexity of the formation was proposed by Ferrando & Andreis (1986) and includes the Frayle Muerto, Mangrullo and Paso Aguiar Members, which were previously described as formations by Bossi (1966) and several authors. The reason presented by those authors was the fact that the region could not be cartographed in a 1/ 100.000 scale (Bossi & Navarro, 1991).

The stratigraphical section of the studied locality (Profile, Fig. 2) shows a lithological succession nearly 17 m. high, which corresponds to complete depositional cycles of regression-transgression sea level (Mackinon & De Santa Ana, 1982). Its base is characterized by dark gray clay siltstones which gradually become more sandy, with parallel lamination. Such color probably denotes the presence of abundant organic material. From these

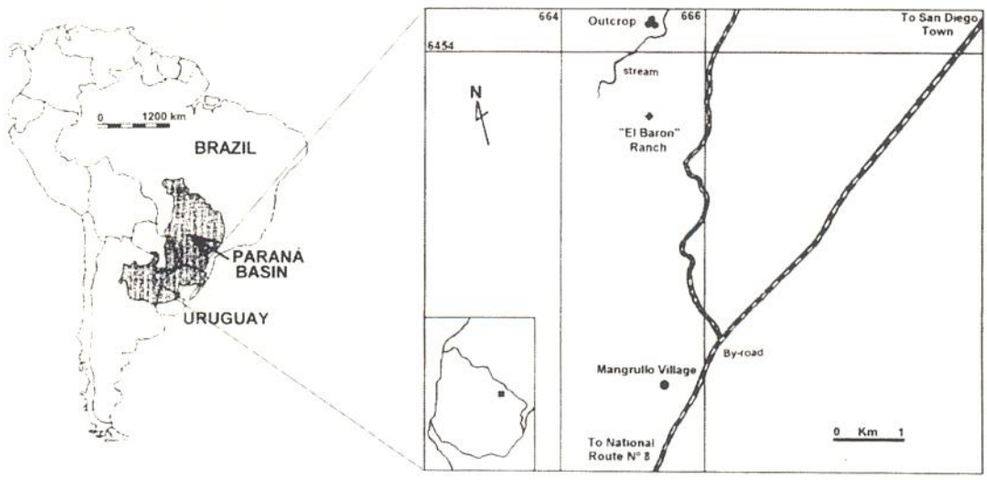

Figure 1. Geographical position of El Baron ranch outcrop where insects, crustaceans, fish scales, mesosaurian reptiles and plant remains were found.

levels paleonisciforms fish remains had been found, represented by scales, teeth and bone fragments.

Overlapping this bed, there is a layer of grayish calcareous sandstones, with tractive structures mainly of the ripple mark kind. The fossil insects remains studied here come from this strata, associated with desarticulated mesosaurian bones (bone beds) and Pygocephalomorph crustacean remains.

The overlaying strata are composed by pirobituminous shale with an important degree of meteorization containing articulated mesosaurid remains with abundant plant material and fish scales under study.

Towards the top of the outcrop, strata of dark gray siltstones gradually become more clayey and lighter colored, ending in green clayey sediments containing abundant teeth and scales of paleonisciform fishes (Piñeiro & Verde, 1996).

According to the senior author this stratigraphic column presents close similarity with those presented by Vieira *et al.* (1991) for the Iratí Fm. in Paraná Basin Brazil at p. 227 chart 1 "Correlation between the Iratí Formation of the States of Goias (SW region) and São Paulo".

PALEOENVIRONMENTS

The calcareous sandstone level, where the studied fossil remains come from, represent the moment of maximum regression. So, the presence of a shallow water environment with a great coastal influence can be inferred evidence being the presence of ripple marks.

There are still doubts about the salinity of waters, because groups that denote a specific salinity are unknown. However, the palinological studies, carried out in samples of the immediately overlapped levels, showed a complete absence of marine elements. By these analyses was characterized a flora of xerophilous and mesoxerophilous environments, corresponding to arid climatic conditions (Piñeiro *et al.*, 1998).

AGE

The Iratí Formation, that can be correlated to the Mangrullo Member of the Melo Formation of Uruguay (Bossi & Navarro, 1991), has been dated by several authors with an age that goes from Lower Permian (e.g. Oelofsen, 1981; Oelofsen & Araújo, 1987), to Upper Permian (e.g. Pinto, 1972a; Mezzalira, 1980). The palynological analysis of these deposits pointed out to an Upper Permian Age, based on the correlation with palinofloras for the Paraná Basin, in Brazil and Chaco Paranense Basin in Argentina (Beri & Daners, 1995; Piñeiro *et al.*, 1998). Presently, a new controversy about the age has come out. At the First Paleoentomological Conference in Moscow (1998) the eminent paleoentomologist Prof. Alexandr Ponomarenko called the attention of Prof. I. D. Pinto (senior author), who had described the paleoentomofauna from Irati as Upper Permian (Kazanian), suggesting it is much more similar to another russian-european paleoentomofauna of the Lower Kazanian. Due to this new information the data established by Pinto (1965, 1972a,b, 1995) turned to be more precise as Lower Kazanian. The relationship of the new species points out to a Permian age but it is not yet defined as either a Lower or Upper Permian age.

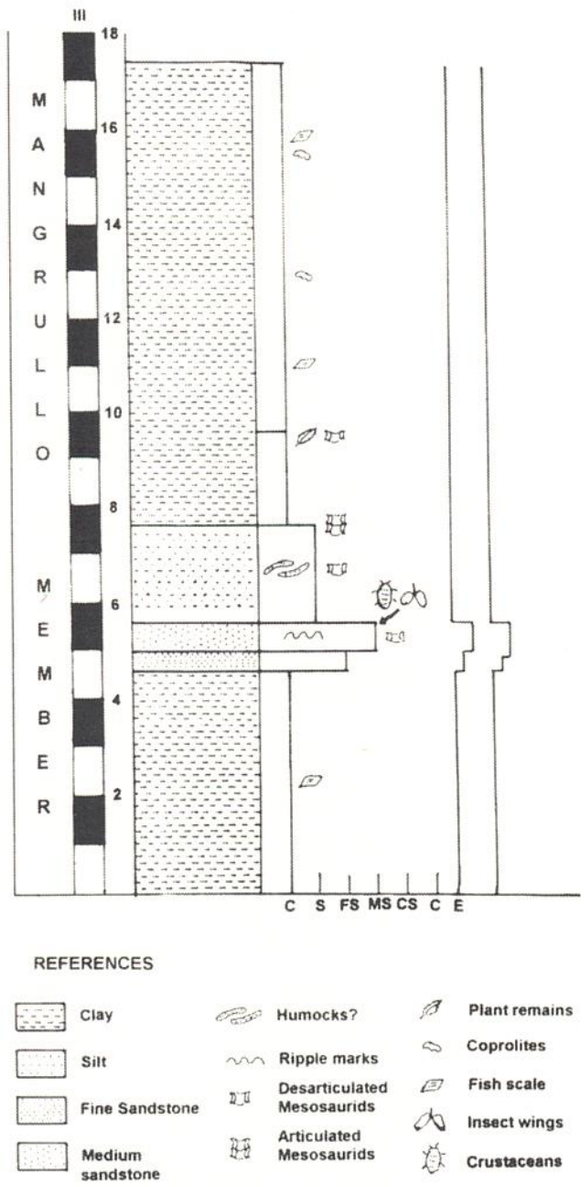

Figure 2 - Profile at El Baron ranch outcrop, showing the stratigraphical distribution of the faunulae and plant remains.

SYSTEMATIC

Classis Insecta
Sub-Classis Pterigota
Infra Classis Neoptera
Ordo Hemiptera Linne, 1758
Sub Ordo Homoptera Leach, 1815
Familia Cicadopsyllidae Martinov, 1931

Diagnosis - Forewing elongate, SC apparently close to costal margin; RS long, ending near wing apex; M arising from stem of R; CuA originating independently of R+M.

Genus *Paracicadopsis* Pinto et Piñeiro, gen. nov.

Forewing elongate oval, anterior margin slightly convex; SC apparently separating from the stem of R+M near the base bending toward and running closely along the costal margin showing, in high magnification, a very narrow strape with numerous straight thin veinlets; R parallel with the costal border resulting in a relatively narrow band like costal space. R and RS long ending at wing apex. RS originated well before wing midlength. M originated from R stem near the base and forks distally in three branches. CuA forking a little before M furcation, it has an independent origin and touches basely the junction of R and M before turning back and linking with CuP; CuP straight obliquely bent and directed forward the posterior margin, one unbranched anal vein parallel to CuP and another concave anal vein, not very clear, running closely to the posterior margin.

Type species *Paracicadopsis mendezalzolai* Pinto et Piñeiro, gen. et sp. nov.

Remarks - The new genus (Fig. 3, Fig. 4A1) is very similar to the genus *Cicadopsis* Becker-Migdisova, 1959, type species *Cicadopsis rugosipenna* Becker-Migdisova, 1959 (Fig. 4 A2) from the Lower Permian of Russia. It is also similar to some specimens of the genus *Scytoneura* Martinov, 1935 as *Scytoneura elliptica* Martinov, 1935 (in part) one of the specimens represented in Fig. 20d p. 48 of Becker-Migdisova, 1960, (Fig. 4 A3) from the Kazanian, Permian of Russia, but differs from them in not having a triangular enlarged basal costal space but an uniformily narrow spaced costal area; R, RS, M, CuA and CuP almost parallel to costal margin. Another difference is the size, which being 7.3 mm for this *Cicadopsis*, between 7.0 to 9.6 mm for the *Scytoneura*, while 3.75 mm for the type species of the new genus. *C. rugogipenna* differs yet in having two crossveins between M and CuA. The specimen of *Scytoneura elliptica* mentioned above in Becker-Migdisova (1960) probably does not belong to *Scytoneura* genus because it doesn't have R linked to C.

***Paracicadopsis mendezalzolai* Pinto et Piñeiro, gen. nov., sp. nov.**
Fig. 3; Fig. 4 A1; Fig. 6

Designatio nominis: In the memory of Prof. Dr. Rodolfo Mendez Alzola, a prominent Uruguayan Paleontologist

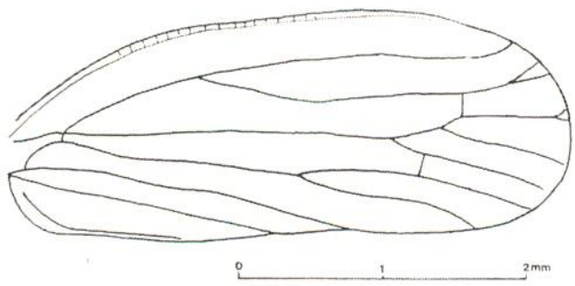

Figure 3. *Paracicadopsis mendezalzolai* Pinto et Piñeiro, gen. nov., sp. nov. Holotype FC DPI 3283 Faculdad de Ciencias del Uruguay, Mangrullo Member, Melo Formation, Permian Uruguay. Length 3.75 mm

Holotypus: Positive and negative imprints of wing, FC-DPI 3283 Facultad de Ciencias del Uruguay
Locus typicus: Estancia "El Barón", Cerro Largo Department, Uruguay
Stratum typicum: Mangrullo Member, Melo Formation, Permian, Uruguay

Diagnosis - Forewing 3.75 mm long, 1.31 mm wide; a simple RS originated before wing midlength, 1.62 mm from the base of the wing, corresponding to 2.5 of the wing length: M and CuA forking distally, M sending three branches and CuA two branches to the apical border; there are two strong crossveins: r-m and m-cu.
Description - Elongate oval wing with costal margin slightly convex; almost straight ventral margin. Wing length of 3.75 mm and width of 1.31 mm, rate 2.86:1 reinforced veins specially at the costal margin, practically all longitudinal main veins are almost straight, parallel to one another ending at the apical border; SC apparently separate at the base from R+M and runs very closely along the costal margin leaving between them a very narrow space full of thin straight small veinlets; R+M is straight; R slightly curved, practically parallel to the costal margin slightly curving distally to the anterior apical margin; RS originated before midlength about 0.25 distally from the base of the wing running parallel to R and being linked to M1 by one crossvein: r-m; M is basally separated from R, running straightly direct to the apical border and distally presenting three branches, M1 and M2 are short branches; M2 is slightly longer than M1; M3+4 is the longest one and is linked to the anterior branch of CuA by a crossvein: m-cu forming a cell longer than that formed by r-m; CuA almost touching R+M close to the point of origin of M, turning backward to links to CuP. CuA forks a little before M furcation forming a narrow cuneiform cell. CuP linked to CuA basally; runs straight obliquely to the posterior margin; anal veins not easily seen, A1 straight parallel to CuP and A2 a slightly concave line at the clavus parallel to the posterior margin.

Remarks - It is not clear if both RS and M present a twig in their endings.

Ordo Perlaria Latreille, 1902

SC almost up to midwing, rarely beyond, not terminating on costa but distally connected to R: RS arising before midwing, commonly having 3 or 4 branches near the base. M coalesced with base of RS; M apparently divided into MA and MP, very close to wing base; MA forked; MP oblique to CuA; CuA diverging from CuP near base. MP+CuA having at least two terminal branches; CuP, 1A, 2A unbranched; usually few crossveins.

Remarks - This new species, set under this Perlaria Order, presents some difficulties in the ordenal position. It has some characteristics that could bring it to other orders. So it has SC shortly linked to R; RS with 2 branches, MA with 4 branches. This leads to the characteristics of the Ordo Psocoptera but differs from this Ordo in having stem of M linked to stem of RS; MP+CuA with three or more branches and CuP furcated distally like the Ordo Protorthoptera. Many other characteristics are like those of Perlaria as can be seen below.

Familia Perlapsocidae Pinto et Piñeiro, fam. nov.

Diagnosis - SC linked to R before midwing; RS with 2 branches; it forks before midwing just after the level where SC links to R; MA linked basally to stem of RS, forking more basally than RS and having 4 branches distally; MP+CuA straight with 3 or more oblique branches forward the posterior and apical margin and linked basally to CuP; CuP furcated distally, short anal area being A1 unbranched; few costal veinlets; between main veins straight openly spaced crossveins.

Type species *Perlapsocus formosoi* Pinto et Piñeiro, gen. et sp. nov.

Remarks - It presents similarities with the genera of the following families: Palaeoperlidae Sharov, 1961, *Palaeoperla exacta* Sharov, 1961 (Fig. 4 B3); Perlopsidae Martinov, 1940, *Perlopsis filicornis* Martinov, 1940 from the Permian of Asiatic Russia.

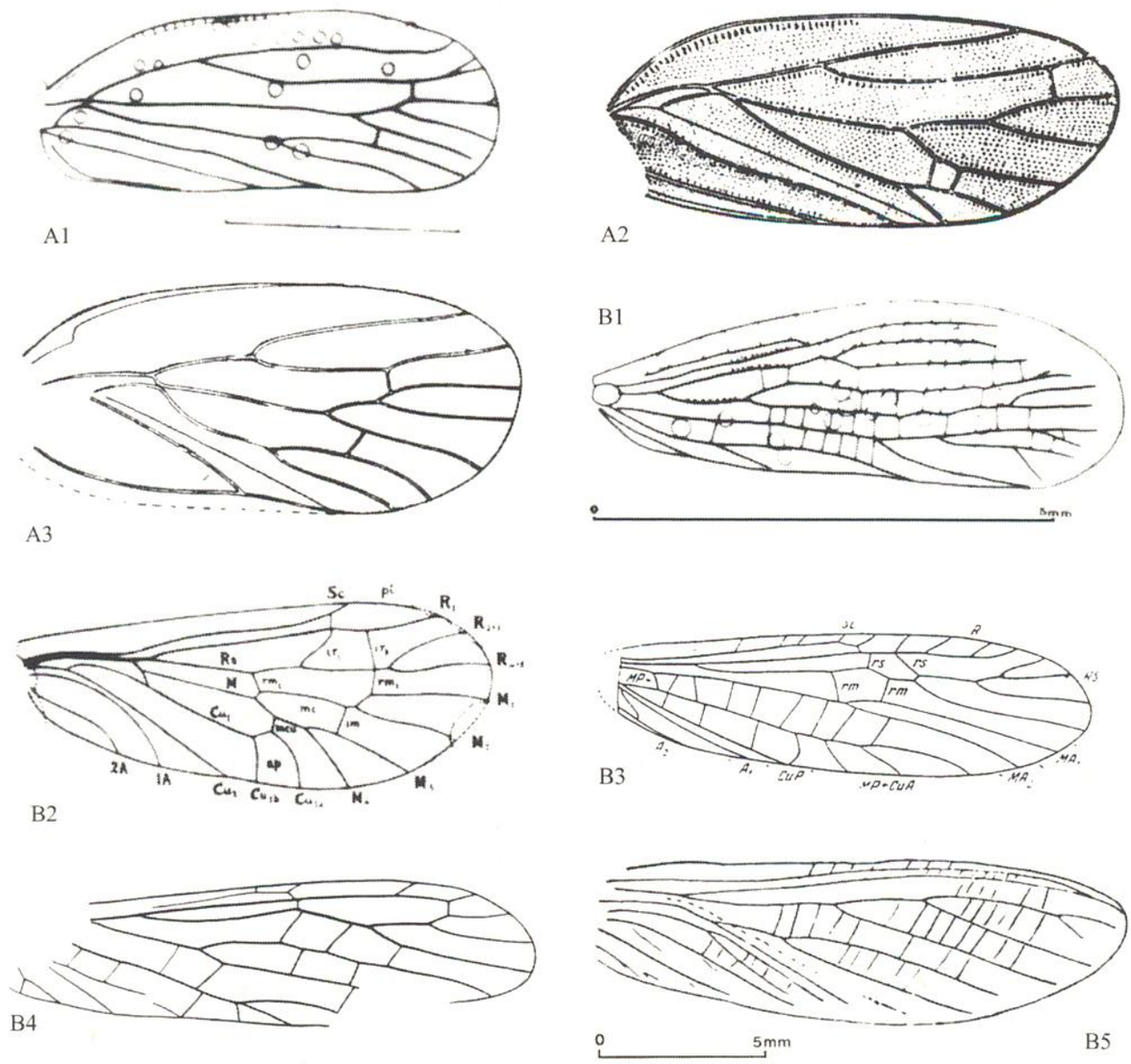

Figure 4. News and comparative species. All at the same scale. A1. *Paracicadopsis mendezalzolai* Pinto et Piñeiro, gen. et sp. nov. from the Mangrullo Member, Melo Fm., Permian. El Baron ranch, Uruguay. Length 3.75 mm A2. *Cicadopsis rugosipenna* Becker-Migdisova, 1959 from Kusnestsian Series, Lower Permian, East Kaltan, Asiatic Russia. Length 7.3 mm. A3. *Scytoneura elliptica* Martinov, 1935 (in Becker-Migdisova, 1960 Fig. 20a in part) from Ietopaia, Lower Kazanian, Russia. Length 8.45 mm. B1 *Perlapsocus formosoi* Pinto et Piñeiro, gen. et sp. nov. from Mangrullo Member, Melo Fm. Permian. El Baron ranch, Uruguay. Length 5.6 mm. B2 *Permopsocus latipennis* Tillyard, 1926 from Kansas, Permian, USA. Length 4.6 mm B3 *Palaeoperla exacta* Sharov, 1961 from Usinskian Horizon. Kusnestsian Series, Lower Permian Kaltan, Asiatic Russia. Length 9.45 mm. B4 *Euxenoperla simplex* Riek, 1973 from Middle Beaufort Series, Upper Permian. Natal, South Africa. Length 19.5 mm B5 *Hapaloptera gracilis* Handlirsch 1906 from the Pennsylvanian, Upper Carboniferous, Pennsylvania, USA. Length 15.0 mm.

It differs, however, from them and all other Permian Perlaria families by having SC shortly linked to R before midwing; RS 2 branches and MA with 4 branches. The latter characteristics, even RS with 2 branches, can be seen in the Psocoptera Order in species of the family Psocidiidae Tillyard, 1926, species *Dichentomum tinctum* Tillyard, 1926 or family Permopsocidae Tillyard, 1926, species *Permopsocus latipennis* Tillyard, 1926 (Carpenter, 1932) (Fig.4 B2). But they differ in having much less crossveins; more distal bifurcation of RS and MA. Furthermore, the new family differs still in having MA, MP+CuA straight forward to the wing apex; and MP+CuA with 3 or more branches and CuP branched. The new family also presents some characteristics of species of the Ordo Protorthoptera as *Hapaloptera gracilis* (Carpenter, 1965) (Fig. 4 B5) of the family Hapalopteridae Handlirsch 1906 from the Upper Carboniferous of USA. They have similar number of crossveins and similarities of

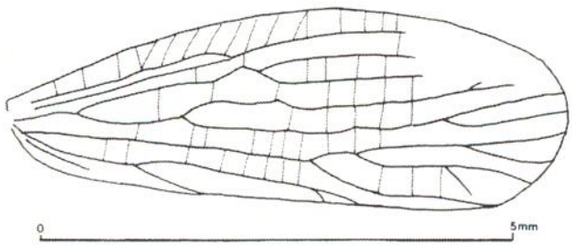

Figure 5. *Perlapsocus formosoi* Pinto et Piñeiro, gen. et sp. nov. Holotype FC DPI 3282 Faculdad de Ciencias del Uruguay, Mangrullo Member, Melo Formation, Permian Uruguay. Length 5.6 mm

CuA and CuP veins, but they differ in that SC vein is not linked to R, but to C; RS with several branches and M with only 2 branches. According to all these data the new family is put under the order Perlaria with some restriction.

Genus *Perlapsocus* Pinto et Piñeiro, gen. nov.

Diagnosis - SC close to R and linked to it before midwing; MA stem originated from the stem of RS; MA forked before level of end of SC with 4 terminal branches; MP+CuA straight sending off three or more branches oblique forward to posterior margin; CuP branched; few veinlets from SC and R to the costal margin; several straight spaced crossveins all over the wing; main veins direct to the apex and parallel to anterior margin and to each other.

Type species *Perlapsocus formosoi* Pinto et Piñeiro, gen. et sp. nov.

Perlapsocus formosoi Pinto et Piñeiro, gen. et sp. nov. Fig. 5; Fig. 4 B1; Fig. 7

Derivatio nominis: In honour to Emeritus Prof. Dr. Milton Luiz Laquintinie Formoso of Universidade Federal do Rio Grande do Sul
Holotypus: An almost complete wing imprint FC-DPI 3282, Facultad de Ciencias del Uruguay
Locus typicus: Estancia "El Baron", Cerro Largo Department, Uruguay
Stratum typicum: Mangrullo Member, Melo Formation, Permian, Uruguay

Diagnosis - It is the same of the genus as it is a monospecific species.

Description - Forewing with anterior margin well curved; around 5.6mm long, 2.0mm wide, SC parallel and close to R and distally connected to it before midwing; SC and R with few veinlets leading to wing anterior margin. R almost straightly unbranched and parallel to costal margin; RS raising at base from R and forking before midwing just after the connection level of SC to R in two long parallel branches; MA separated near the base from the stem of RS and forks just before the SC end level; each of the two branches straight forward to the apex and forking distally in four branches: MA1+2 forks slightly before the bifurcation of MA3+4; MP is basally linked to CuA, MP+CuA straight forward to apex, parallel to MA sending off at least three forward oblique branches to the apical border; CuP straight linked basally to CuA, slightly diverging from it and it bifurcates before the bifurcation of MA and again distally at the end. Not very clear anal vein, apparently unbranched and parallel to the margin of the wing. Many openly spaced crossveins all over the wing. RS stem is arched before its bifurcation promote by one crossvein between R and itself. This crossvein is at midlength between the level where SC is linked to R and the bifurcation of RS. There are other crossveins, one between RS and M1+M2 and another between RS2 and M1+M2. These three crossveins promote a central pentagonal cell.

Remarks - This central pentagonal cell can also be seen in *Paleoperla exacta* Sharov, 1961 (fig. 5 B3) and species from the Permian of South Africa as *Euxenoperla simplex* Riek, 1973 (Fig. 5 B4); and *Euxenoperla oliveri* Riek 1976 put in uncertain family by Carpenter, 1992 but it differs from them in being much smaller, not having a large radial cell, RS with 2 branches and M with 4 branches. The cubital branches present a disposition more similar to *Hapaloptera gracilis* Handlirsch 1906 (Fig. 4 B5) from the Pennsylvanian but differs because the subcostal vein of this species is not linked to R.

Acknowledgments - Thanks a lot to Prof. Dr. Ivone Purper for her continuous help on this research. Piñeiro and Verde also thank PEDECIBA and CSIC of Uruguay for their support to the researches. Many thanks also to Conselho Nacional de Desenvolvimento Científico e Tecnológico do Brasil (CNPq) and Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (FAPERGS) for their continuous support to the researches of the senior author.

REFERENCES

Becker-Migdisova, E. E. 1959. Some representatives of the Sternorrhyncha from the Permian and Mesozoic of the USSR. **Materialy k osnovam paleontologii, 3**:104-116, fig. 1-10.

Becker-Migdisova, E. E. 1960. New Permian Homoptera from European USSR. **Trudy paleontologischeskogo instituta akademii nauk SSSR. 76**:1-112, text-fig. 1-49. (in Russian)

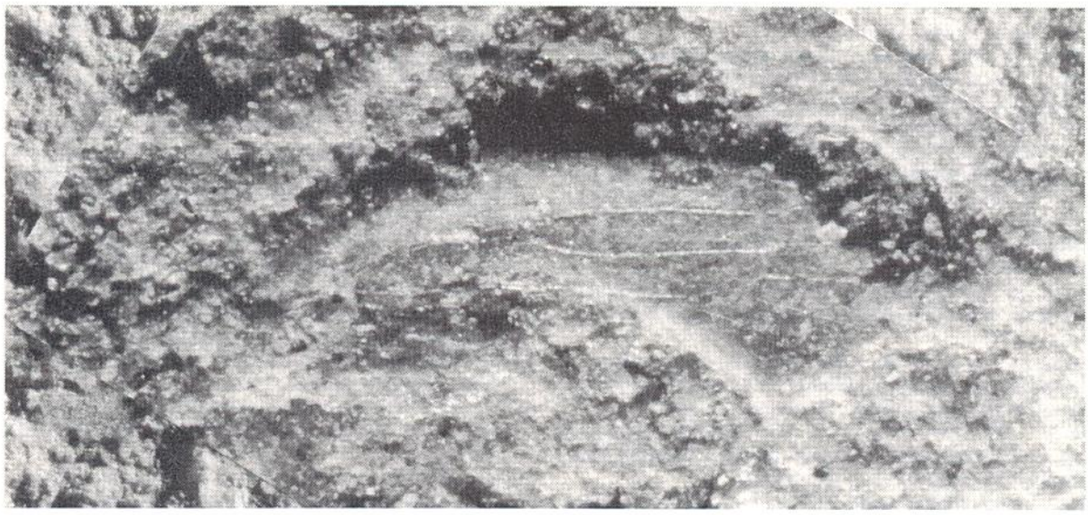

Figure 6. *Paracicadopsis mendezalzolai* Pinto et Piñeiro, gen. nov., sp. nov. Holotype FC DPI 3283 Faculdad de Ciencias del Uruguay, Mangrullo Member, Melo Formation, Permian Uruguay. Length 3.75 mm

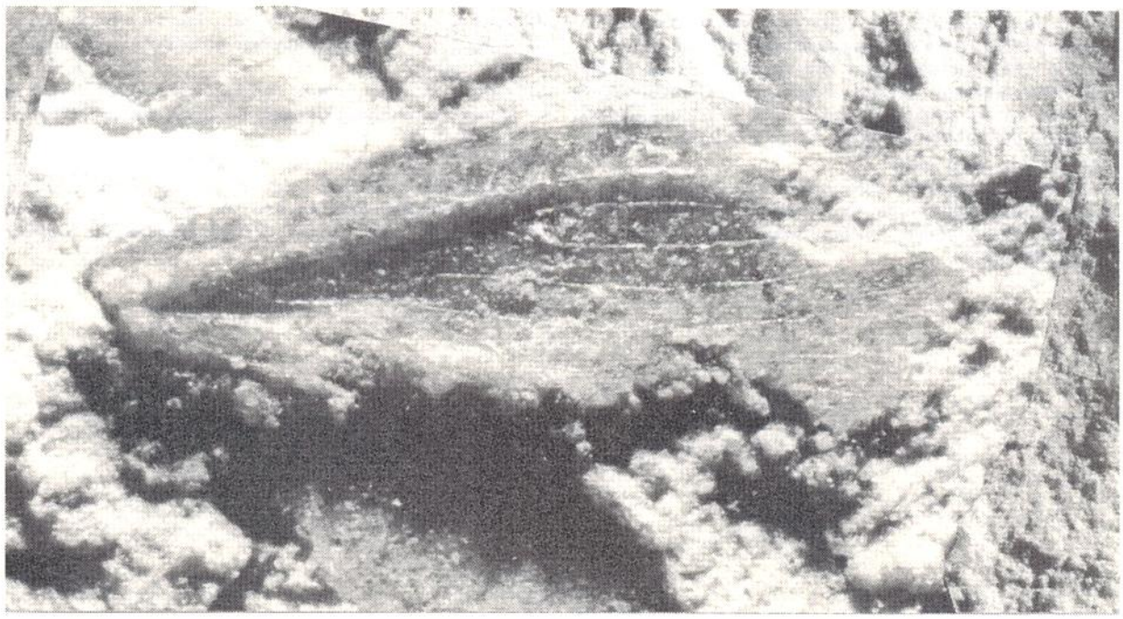

Figure 7. *Perlapsocus formosoi* Pinto et Piñeiro, gen. et sp. nov. Holotype FC DPI 3282 Faculdad de Ciencias del Uruguay, Mangrullo Member, Melo Formation, Permian Uruguay. Length 5.6 mm

Beri, A & Daners, G. 1995. Palinología de la Perforación N 221, Pérmico, R. O. del Uruguay. **Geociências**, **14**(2):145-160.

Bossi, J. 1966. **Geología del Uruguay**. Depto. de Publicaciones, Universidad de la República. Montevideo, Uruguay. 411 pp.

Bossi, J. & Navarro, R. 1991. **Geología del Uruguay**. Depto. de Publicaciones, Universidad de la República. Montevideo, Uruguay. 970 pp.

Carpenter, F. M. 1932. The Lower Permian insects of Kansas. Part 5. Psocoptera and additions to the Homoptera. **American Journal of Science** (series 5) **24**:1-22, text-fig. 1-11.

Carpenter, F. M. 1965. Studies on North American Carboniferous insects. 4. The genera *Metropator*, *Eubleptus*, *Hapaloptera*, and *Hadentomum*. **Psyche 72**:175-190, text-fig. 1-7.

Carpenter, F. M. 1992. Superclass Hexapoda. In: Moore, R. C.; Kaesler, R. L.; Brosius, E.; Keim, J.; & Priesner, J. (eds). **Treatise on Invertebrate Paleontology**. Part R Arthropoda 4, v. 3-4, 655 p.

Ferrando, L. & Andreis, R. 1986. Nueva estratigrafía en el Gondwana de Uruguay. In: CONGRESO LATINOAMERICANO DE HIDROCARBUROS, ARPEL.I, 1986, Buenos Aires, **Anais...** Buenos Aires I:295-323.

Handlirsch, A. 1906. Revision of American Paleozoic insects. **Proceedings of the United States National Museum 29**:661-820, text-fig. 1-109.

Mackinnon, J. & De Santa Ana, H. 1982. Contribución al conocimiento del Paleozoico Superior de la Cuenca del Paraná del Uruguay. **Publicación ANCAP**, Montevideo. 30 pp.

Martinov, A. 1931. New fossil insects from Tikhie Gory, Division Neoptera II. **Trudy geologicheskogo muzeya, akademii nauk SSSR 8**:149-212, text-fig. 1-29 (in Russian)

Martinov, A. 1935. Permian fossil insects from Arkhangelsk District. Part 5. Homoptera. **Trudy paleozoologicheskogo instituta akademii nauk SSSR. 4**:1-35, pl. 1.

Martinov, A. 1940. Permian fossil insects from Chekarda. **Trudy paleontologicheskogo instituta akademii nauk SSSR 11**(1):1-63, text-fig. 1-46, pl. 1-6 (in Russian)

Mezzalira, S. 1980. Bioestratigrafia do Grupo Passa Dois no Estado de São Paulo. **Revista do Instituto Geológico de São Paulo, 1**(1):15-34.

Oelofsen, B. 1981. **An anatomical and systematic study of the family Mesosauridae (Reptilia, Proganosauria) with special reference to its asociated fauna and paleoecoloogical environment in the White Hill sea**. 163 p, PhD thesis. University of Stellenbosh, South Africa.

Oelofsen, B. & Araújo, D. 1987. *Mesosaurus tenuidens* and *Stereosternum tumidum* from the Permian Gondwana of both Southern Africa and South America. **South African Journal of Science, 83**:370-372.

Pinto, I. D. 1965. Novos insetos da Formação Irati e o problema da idade das Formações Irati e Rio Bonito. **Avulso Divisão Geologia e Mineralogia**, Rio de Janeiro, GB 40:61,62.

Pinto, I. D. 1972a. Late Paleozoic insects and crustaceans from Parana Basin and their bearing on chronology and continental drift. **Anais da Academia Brasileira de Ciências** (Suplemento) **44**: 247-254, pl. 1-4, 1tab.

Pinto, I. D. 1972b. Permian Insects from the Parana Basin South Brazil. 1. Mecoptera. **Revista Brasileira de Geociências**, São Paulo **2**:105-116.

Pinto, I. D. 1995. Paleobotanical and Paleozoological age divergences in South American strata. **Pesquisas**, **22**(1-2):46-52.

Piñeiro, G., Beri, A. & Verde, M. 1998. Estudio de una asociación fosilífera de la Formación Mangrullo (Pérmico Tardío) del Uruguay. In: CONGRESO URUGUAYO DE GEOLOGIA, 2, 1998, Punta del Este **Anais...** Punta del Este, Uruguay:202-204.

Piñeiro, G. & Verde, M. 1996. Avances en la prospección fosilífera realizada en la Formación Mangrullo (Pérmico) del Uruguay. Tafonomía y paleoecología. In: JORNADAS DE ZOOLOGIA DEL URUGUAY, 4, 1996, Uruguay. **Actas...** Uruguay. Res.:33

Piñeiro, G. & Verde, M. 1997. Tafonomía y paleambientes de la Formación Mangrullo (Pérmico Superior) de Uruguay. In: CONGRESSO BRASILEIRO DE PALEONTOLOGIA, 15, 1997. São Pedro, **Boletim...** São Pedro, p. 165.

Riek, E. F. 1973. Fossil insects from the Upper Permian of Natal, South Africa. **Annals of the Natal Museum 21**(3):513-532, text-fig. 1-15.

Riek, E. F. 1976. New Upper Permian insects from Natal, South Africa. **Annals of the Natal Museum 22**(3):755-789.

Sharov, A. G. 1961. Order Plecoptera, p. 225-234, text-fig. 166-175, pl. 19. In: Rohdendorf, B. B.; Becker-Migdisova, E. Eh., Martynova, O. M. & Sharov, A. G. (eds) **Paleozoic insects of the Kuznetsk basin**. Trudy paleontologicheskogo instituta akademii nauk SSSR 85. (in Russian)

Tillyard, R. J. 1926. Kansas Permian Insects. Part 8. The order Copeognatha. **American Journal of Science** (series 5) **11**:315-349, text-fig. 1-19.

Tillyard, R. J. 1926. Kansas Permian Insects. Part 9. The order Hemiptera. **American Journal of Science** (series 5) **11**:381-395, text-fig. 1-19.

Vieira, P. C., Mezzalira, S. & Ferreira, F. J. 1991. Mesosaurideo (*Stereosternum tumidum*) e crustaceo (*Liocaris huenei*) no membro Assistência da Formação Irati (P) nos municípios de Jatai e Montevidiu, Estado de Goias. **Revista Brasileira de Geociências**, São Paulo **21**(3):224-235.