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Paleobotanical and Paleozoological Age Divergences in South American Strata

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Abstract - Through plants and palynomorphs, an extensive number of strata have been attributed to a Permian age in Brazil and Argentina. The study of fossil insects discovered later, agrees with that age for only some of those strata however, for others, the insects lead to the conclusion of a Carboniferous age. Associated to this paleoentomofauna attributed to the Carboniferous, Arachnida of a typically Carboniferous taxon in Europe and in the United States, was also found in Argentina. This paper presents the different taxa studied up till now and the age attributed to them is discussed.

Resumo - Paleobotânicos e palinólogos têm, tradicionalmente, atribuido idade permiana para um grande número de estratos, tanto no Brasil como na Argentina. Entretanto, estudos mais recentes com base em insetos têm demonstrado que alguns daqueles estratos possuem idade carbonífera. Na Argentina, o Carbonífero identificado pela paleoentomofauna é corroborado pela presença de um taxon de aracnídeo característico do Carbonífero da Europa e Estados Unidos. O presente trabalho discute as idades atribuidas pelos diferentes grupos fósseis aos estratos em estudo.

INTRODUCTION

The present paper discusses the age reached by the taphoflora at certain Argentinian and Brazilian Permo-Carboniferous formations. As the plants were found mostly in terrestrial sediments and the taphofauna was very poorly represented, the age was dated basically by the eventual nearest marine sediments or by other Gondwana flora, because the paleobotanists have some difficulties in accepting comparisons with the taphoflora of the northern hemisphere. The discovery of diversified paleofauna of Insecta in Brazil, and Insecta and Arachnida in Argentina, brought a new perspective for chronological determinations.

Only the age of the formations where the taphofauna mentioned before was associated to specific taphoflora will be analysed and discussed here. To avoid a very extensive reproduction of the history and also of the large amount of publications, just some comments and analysis will be made here, especially on the synthesis from where these data and references can be obtained.

REMARKS ON THE AGE DIVERGENCES

Argentina

There are three paleozoic formations to be analysed: Malanzan Formation (Insecta), Bajo de Veliz Formation (Insecta and Arachnida), Rio Genoa Formation, Piedra Shotle Facies and Nueva Lubecka Facies (Insecta).

Malanzan Formation

From this formation two insects were described by Riek & Kukalová-Peck (1984): *Eugeropteron lunatum* Riek and *Geropteron arcuatum* Riek from La Divisoria Member, Malanzan, Cuesta de la Herradura, La Rioja, Argentina. These authors reached to the conclusion of a Namurian age, possibly Lower Namurian, due to the grade of evolution of those insects. From the same Member La Divisoria *Xenoptera riojaensis* Pinto, 1986 was also described which is similar to Alectoneuridae from Lower Permian of Moravia, but it has the costal area and wing base broader which indicates more primitive characteristics. According to Archangelsly *et al.* (1986 p.282) those insects are in the Biozone NGB (*Nothorhacopteris argentinica, Botrychiopsis weissiana, Ginkgophyllum diazii*), which taphoflora listed in Chart 2, p.125 and the palinological species in Chart 3, p.126, 127 also agree with a Carboniferous age.

Bajo de Veliz Formation

The age of Bajo de Veliz Formation based on plants and palinology has suffered changes between Carboniferous and Permian. Through the presentation of Azcuy *et al.* (1986 p.46) it is possible to get a good idea of the studies carried out about that formation, including on its flora and age. Frenguelli (1944) and Casas (1950) put it in the Upper Carboniferous; Menendez (1971) and other paleobotanists in a study of the taphoflora reached to the conclusion of a Lower Permian age. Archangelsky (1971) doing a revision and synthesis of that taphoflora recognized a melange of Nordic and Gondwana elements. The presence of Insecta and one Arachnida in this formation has given new elements for the age determination, as will be discussed later. These data were partially registered by Archangelsky *et al.* (1986:123), who have also done biozone correlations and presented very interesting data. In p.284, they say that Zona *Gangamopteris* is locally seen as indicative of a Lower Permian age, however they have recorded some data that show a possible Carboniferous age, including that obtained by insects and arachnid in the Bajo de Veliz Formation. On the other hand they have also registered in this zone the presence of besides *Pecopteris* cf. *andersonii* Halle, found in the Permian strata of China; was also found *Corynopteris* genus restricted to the Carboniferous at the Equatorial fringe.

Azcuy *et al.* (1986 p. 50) discuss the age of the Bajo de Veliz Formation saying that, based on the analysis of the megaflora of the Pallero Member, it has been considered from the Upper Carboniferous (Frenguelli,1944), to the Lower Permian (Menendez, 1971). In a revision work Archangelsky

& Arrondo (1971) maintain a Carboniferous-Permian age for the paleofloristic association. Later Archangelsky & Azcuy (1978) and Archangelsky *et al.* (1980) restricted it to the Carboniferous-Permian limit. They commented briefly the work about Insecta and Arachnida which attributed a late Stephanian age to this Formation. So, a definitive data was not reached through the study of the taphoflora, and apparently, they accepted the possibility of an Upper Carboniferous age for the Bajo de Veliz Formation.

Insecta and Arachnida - These two groups of fossils found at Bajo de Veliz indicate clearly a Carboniferous age for the following reasons: Insecta from Bajo de Veliz have been registered by Kurtz (1921) and by Fossa-Mancini (1940) in inadequate systematic position. The description of the paleofauna of this Formation began with Pinto & Ornellas (1978a). According to them the species and the age are as follows:

Philiasptilon huenicheni Pinto & Ornellas, 1978a. This genus was found only in the Carboniferous of Russia (Asia) and belongs to the family Diaphanopteridae which were found exclusively in the Carboniferous of France and Russia.

Paranarkemina kurtzi Pinto & Ornellas, 1980a. Belongs to the Family Narkeminidae of the Group Cacurgidae-Narkemidae exclusive of the Carboniferous of USA and Russia.

Paranarkemina velizensis Pinto & Ornellas, 1981a and *Paranarkemina amosi* Pinto, 1992. Also belong to the Narkeminidae.

Sphecorydaloides lucchesei Pinto, 1994a. It is quite similar to the Corydaloididae and Sphecopteridae two Upper Carboniferous families of Commentry, France.

Gondwanarachne argentinensis Pinto & Hünicken, 1980 belongs to an order of Arachnida Trigonotarbida, exclusively Carboniferous in Europe and North America.

Besides the arthropods data, if one analyses critically the paleobotanical data registered in the paper by Archangelsky (1986 p. 278, 282) will reach to the same result, for the reasons presented in that paper as follows:

1. The presence of bisaccate striate grains, which were considered indicative of Permian age is not a valid argument any more because they have been found in Carboniferous sequences in Europe and Russia.

2. In Continental facies the appearance of Glossopteridales and constant bisaccate striate grains, which are also used to define the Permian, is not valid because, Glossopteridales were found in Australia in strata dated by isotopic methods, in 294 m.y. and thus Carboniferous.

3. The Bajo de Veliz Formation corresponds geochronologically to La Colina Formation and this was dated in 294 m.y. thus, also Carboniferous.

Through the analysis of all these data one can obviously only attribute a Carboniferous age for the Bajo de Veliz Formation.

Rio Genoa Formation

Andreis *et al.* (1986), p. 163 and 172, mention Piedra Shotle and Nueva Lubecka as facies of Rio Genoa Formation. They wrote that these two facies, which were known before as Piedra Shotle Formation and Nueva Lubecka Formation, are now facies of the Rio Genoa Formation in a sequence of about 1,000 meters where marine, plant and coal strata alternate, being Piedra Shotle the lowest and Nueva Lubecka the topmost facies.

Piedra Shotle Facies ("Formation")

Gamerro & Archangelsky (1981) list palinomorphs found in Estancia La Cacilda and Cañadon Pastos Blancos, Chubut, Argentina. According to them the taphoflora levels studied could be referred to the "*Cristatosporites* Zone", but the majority of the species, are also present in the "*Potonieisporites-Lundbladispora* Zone" and these sections, found in the Central Patagonia basin, could integrate the scheme of correlation belonging to the Carboniferous-Permian biozones of that country. At the same time they point out the relationships between the "*Gangamopteris*" and "*Cristatisporites*" zones. They also present a table showing a list of species and their zonal distribution.

The insects found in the Piedra Shotle Facies are:

1. *Breyeria brauckmanni* Pinto, 1992. This genus was found exclusively in the Upper Carboniferous in France, Belgium, Germany, Czech Republic, Holland, England and USA.

2. *Archaemegaptilus ferreirai* Pinto, 1994b. This genus was only found in the Upper Carboniferous of France.

So, once more, a Carboniferous age can be attributed to these *Gangamopteris* and *Cristatisporites* zones.

Nueva Lubecka Facies ("Formation")

At Nueva Lubecka Facies a Blattoid *Archangelskyblatta vishniakovae* Pinto, 1972a from Betancourt, Chubut was described. It belongs to the Family Archimylacridae, Upper Carboniferous to Permian and was placed by Pinto (*op. cit.*) in the Permian, based solely on paleobotanical information (Suero, 1958), however it must be changed to the Upper Carboniferous Insect Group now for the reasons mentioned before.

Brazil

Paleozoic insects have been found in several States of Southern Brazil, in the Paraná basin: Itararé and Guatá Subgroups. Too many papers have been written on these formations especially on the taphoflora. To avoid to be extremely extensive, only data and the last papers about formations where insects have been found will be analysed here.

A good and very interesting insect fauna was found by Mezzalira (1968), in a drilling for water, in Boituva, State of São Paulo. This paleoentomofauna was studied by Pinto and Ornellas and the Carboniferous age was reached for that strata through the following species:

Narkemina rohdendorfi Pinto & Ornellas, 1978b; and three *Narkemina* spp. A, B, and C.

Narkemina is a genus belonging to a group of Cacurgidae-Narkemidae. Cacurgidae are exclusive of the Carboniferous of Illinois and Missouri (USA). *Narkemina* a

genus of the Upper Carboniferous (Lower Balachonian) of the Kusnetzk basin of Russia and of Missouri (USA).

Proedischia mezzalirai Pinto & Ornellas, 1978b similar to Stenaropodidae, and Oedischidae and *Anepitodius giraffa* from the Upper Carboniferous of Mazon Creek (USA).

This entomofauna certainly proves a Carboniferous age for the Boituva facies. In this case there is no controversy regarding the data reached by Lima *et al.* (1983); Millan (1987, 1991) because they attributed a Carboniferous age for the Monte Mor, Cesário Lange and Itapeva formations. The first two formations are just below and the third just above Boituva facies.

However Petri & Souza (1993) disagree with those results, and in a short analysis accept Guerra-Sommer & Cazzulo-Klepzig (1983) interpretation. Divergences also occur with some paleobotanists as Cazzulo-Klepzig & Guerra-Sommer (1993) on the age of some formations in the State of Santa Catarina and Rio Grande do Sul. These positions will be discussed later.

State of Paraná - Several species of Blattoid Insecta were found at the Teixeira Soares Formation, represented in the revision of the Brazilian Blattoids by Pinto & Purper (1979). They considered them as Carboniferous but as Schneider (1983), makes some systematic changes they cannot be used for age determination until they are determined with assurance.

State of Santa Catarina - The insect *Carpenteroptera onzii* Pinto, 1990a was found in Anitápolis, in the Itararé Subgroup. It is similar to the group Cacurgidae-Narkemidae, exclusively Carboniferous in USA and Asia as it was pointed out before.

State of Rio Grande do Sul - Besides the Permian insects of the Irati Formation, in Durasnal, Caçapava do Sul, in the Itararé Subgroup was found the insect *Narkemina rochacamposi* Pinto & Ornellas, 1978b which belongs to the same group as Cacurgidae-Narkemidae, exclusively Carboniferous in USA and Russia.

The associated taphoflora in those places (Itararé Subgroup) according to Dias (1993 p.121), the main genera are: *Punctatisporites, Lophotriletes, Granulatisporites, Cyclogranisporites, Cristatisporites, Vallatisporites, Lundbladispora, Calamospora, Verrucosisporites, Apiculatisporis, Leiotriletes, Retusotriletes, Kraeuselisporites, Horriditriletes, Murospora, Spelaeotriletes, Foveosporites, Reticulatisporites, Acanthotriletes, Plicatipollenites, Cannanoropollis, Potonieisporites, Caheniasaccites, Vesicaspora, Limitisporites.*

According to Guerra-Sommer & Cazzulo-Klepzig (1993) in the same type of sediments where the fossil insects were found, the taphoflora is represented by: *Gangamopteris buriadica, G. angustifolia, G. obovata, Rubidgea lanceolata, Glossopteris indica, Chiropteris reniformis, Cornucarpus patagonicus, Botrychiopsis plantiana, Samaropsis seixasi, Cordaites hislopi, Cordaicarpus* sp., *Buriadia isophylla, Phyllotheca indica* and *Scutum* sp.

Cazzulo-Klepzig & Guerra-Sommer (1983) as many other paleobotanists maintain the Permian age based in a dogmatic idea about Gondwana flora and in arguments such as:

a) The taphoflora is correlated with the Gondwana flora only because it has nothing to do with the northern hemisphere flora, of the Carboniferous-Permian age.

This is not true for Insecta and Arachnida, and now some paleobotanists also accept that some species have their correspondent in the northern hemisphere. Archangelsky (1986).

b) In the Permian taphoflora, the presence of typical Carboniferous species are relictual.

Perhaps it would be better to check whether the other species had not appeared before.

c) The Carboniferous species of the northern hemisphere present in Gondwana associations are Permian because the climatic conditions at that time (glacial) were not favourable to them and for this reason they moved to the South later.

If this argument is valid it will be very difficult to explain the fact below:

According to those authors and based on that theory the insects of Brazil and Argentina, correlated to those of the Carboniferous of the Kusnetzk basin (Asia) are Permian.

If so, how can the age of the insects of the Irati Formation which are correlated also to insects of the same Kusnetzk basin in Asia be explained.

The insects found in Rio Grande do Sul in the Irati Formation, Kazanian for the paleobotanists, are similar and perfectly correlated to the Kazanian insects of the Kusnetzk basin.

Petromantis rieki Pinto, 1972b; *P. evansi* Pinto, 1972b; *Asiachorista beckermigdisovae* Pinto, 1972b; *Kaltanicupes ponomarenkoi* Pinto, 1987b; *Protocupoides rohdendorfi* Pinto, 1987a; *Prosbole iratiensis* Pinto, 1987b. All these genera are Permian, Kazanian in the Kusnetzk basin, Russia;

Gondwanaptera capsii Pinto & Ornellas, 1981b simi-

Plate 1

All specimens about 1.3x

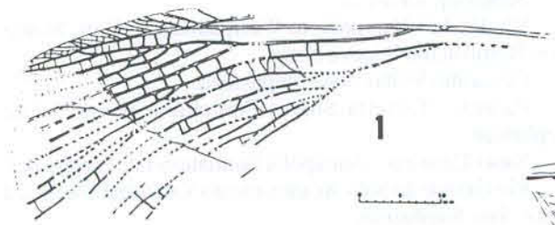
Argentina

Carboniferous

Bajo de Veliz Formation
Figure 1 - *Paranarkemina velizensis* Pinto & Ornellas, 1981
Figure 2 - *Philiasptilon huenickeni* Pinto & Ornellas, 1978
Figure 3 - *Paranarkemina amosi* Pinto, 1992
Figure 4 - *Paranarkemina kurtzi* Pinto & Ornellas, 1978
Figure 5 - *Sphecorydaloides lucchesei* Pinto, 1994
Figure 6 - *Gondwanarachne argentinensis* Pinto & Hünicken, 1980

Piedra Shotle Facies
Figure 7 - *Archaemegaptilus ferreirai* Pinto, 1994
Figure 8 - *Breyeria brauckmanni* Pinto, 1992
Nueva Lubecka Facies
Figure 9 - *Archangelskyblatta vishniakovae* Pinto, 1972
Malanzan Formation
Figure 10 - *Eugeropteron lunatum* Riek, 1984
Figure 11 - *Geropteron arcuatum* Riek, 1984
Figure 12 - *Xenoptera riojaensis* Pinto, 1986.

ARGENTINA
Carboniferous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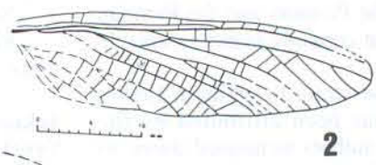
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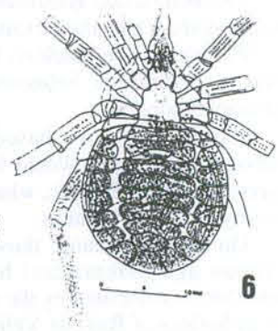
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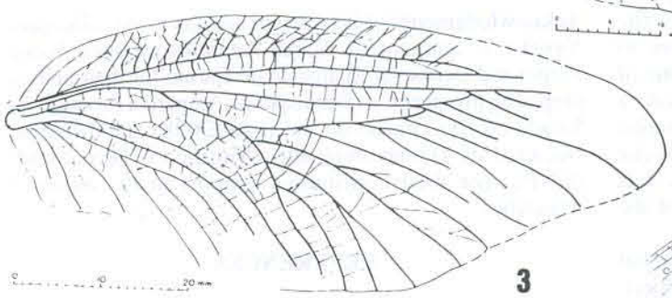
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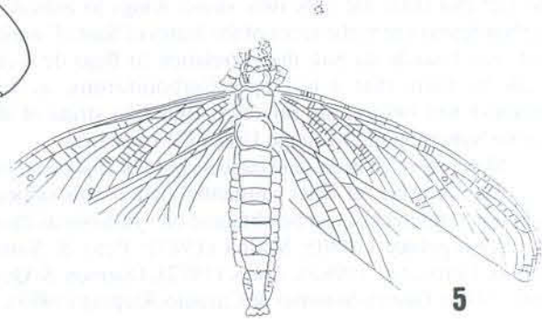
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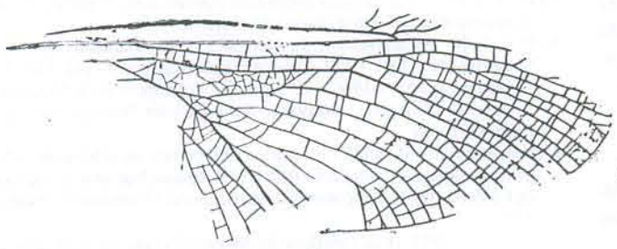
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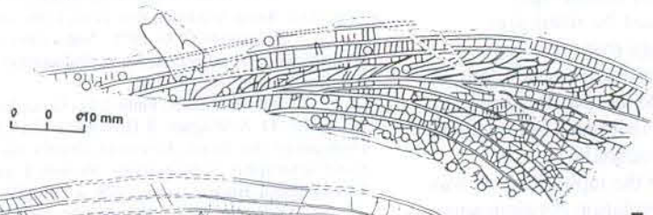
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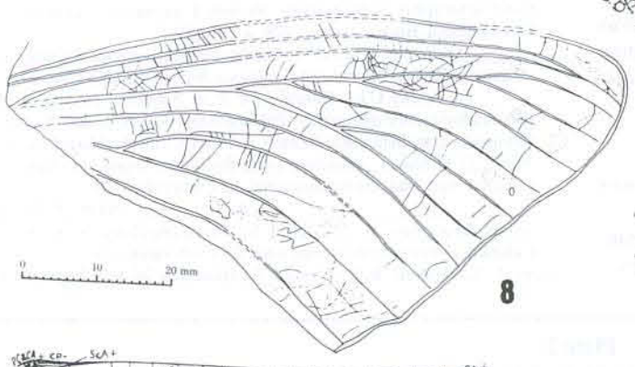
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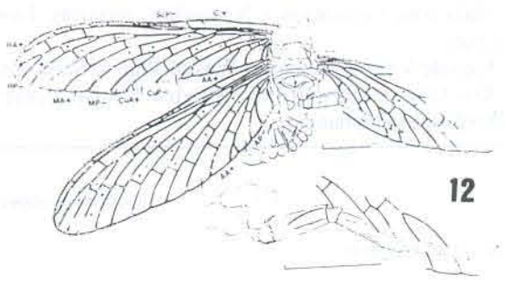
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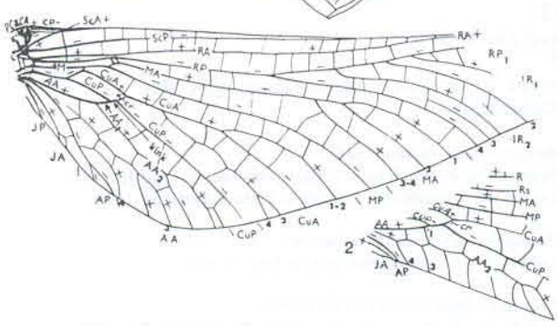
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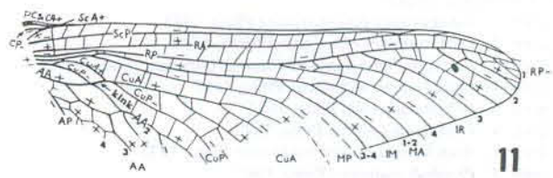
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lar to *Neuropibrocha ramisubcostalis* Becker-Migdisova, 1961 from the Kazanian, Kusnetzk basin.

Fulgoringruo kukalovae Pinto, 1990b similar to *Ingruina* sp. Becker-Migdisova from Kazanian, Russia.

Prosbolecicada gondwanica Pinto, 1987b similar to *Austroprosbole maculata* Evans, 1943 Permian of Australia.

Permipsythone panfilovi Pinto & Ornellas, 1980b similar to *Permithone belmontensis* Tillyard, 1922 Upper Permian, Australia.

Using the theory based on climatic reasons the Carboniferous insects would be Permian and the Permian insects would be Triassic, what certainly is not acceptable even by the paleobotanists.

On the other hand, those strata to which a Lower Permian age (Sakmarian) has been attributed by the taphoflora is correlated by the authors mentioned above, to the taphoflora of Bajo de Veliz, Argentina. So, in spite of the fact that there are only two insect wings to indicate a Carboniferous age to the strata of the States of Santa Catarina and Rio Grande do Sul, the correlation to Bajo de Veliz made by them that it is Upper Carboniferous, as was demonstrated before, the Southern Brazilian strata of the Itararé Subgroup must also be Upper Carboniferous .

Many more citations and papers could be discussed but they can not bring no other substantial data to this subject. Additional references can be obtained on synthesis as those of Archangelsky (1986); Millan (1987); Petri & Souza (1993); Lima *et al.* (1983); Amos (1972), Daemon & Quadros (1974), Guerra-Sommer & Cazzulo-Klepzig (1993).

CONCLUSION

The analysis made show that the insects found in the strata mentioned below are Carboniferous despite some paleobotanical analysis could reach a Permian age.

The strong arguments that must be used are:

1) the insects have a shorter range than the plants;

2) practically all insects found in those strata belong to Carboniferous groups in Asia, Europe and North America;

3) the arachnids associated with that fauna belong to an exclusive Carboniferous Order of Arachnida.

Considering these facts and that the taphoflora, as was pointed out before, shows a clear correlation between some strata of Argentina and Brazil the age of the strata below is:

In Argentina

Malanzan Formation - Namurian, possibly Lower Namurian.

Bajo de Veliz Formation - Westphalian to Stephanian.

Rio Genoa Formation - Piedra Shotle Facies - Westphalian to Stephanian.

Nueva Lubecka Facies - late Westphalian to Stephanian.

In Brazil

Subgroup Itararé in:

São Paulo - Namurian to Westphalian for Buri, Monte Mor, Boituva and Itapeva strata.

Cerquilho Velho - late Stephanian.

Paraná - Teixeira Soares Formation- possibly late Stephanian.

Santa Catarina - Anitápolis Formation-late Stephanian

Rio Grande do Sul - Acampamento Velho and correlated strata - late Stephanian.

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REFERENCES

Amos, A. J. 1972 - Las cuencas carbónicas y pérmicas de Argentina. *Anais Academia Brasileira de Ciências* 44 (Supl.):21-36.

Andreis, R.R.; Archangelsky, S.; Gonzalez, C.R.; Gamundi, O. L. & Sabattini, N. 1986 - VII Cuenca Tequel-Genoa p. 155-182. In: Archangelsky, S. - 1986 - *El Sistema Carbonífero en la República Argentina (Síntesis)*. Córdoba: Subcomisión Internacional del Carbonífero. 2v.

Archangelsky, S. (ed.) 1986 - El sistema Carbonífero en la República Argentina (Síntesis). Córdoba: CONICET / Academía Nacional de Ciencias de Córdoba, 399 p. (Subcomisión Internacional del Carbonífero. Projecto 211).

_____ 1971 - Las Tafoflora del Sistema Paganzo en la República Argentina. *Anais Academia Brasileira Ciências*, **43**(supl.):67-88.

_____ & Arrondo, O. G. 1971 - Notas sobre los vegetales carbónicos y pérmicos de la colección Kurtz. Palaeophytologia Kurtziana, II. 1, *Ameghiniana*, **8**(3-4):181-188.

_____; Arrondo, O. G.; Pinto, I. D.; Gonzales, C.A.; Marques Toigo, M. Rösler, O. & Wagner, R.H. 1980 - The Carboniferous and Early Permian of the South American Gondwana Area: a Summary of biostratigraphic information. Primer Congreso Argentino de Paleontología, Buenos Aires, 1978, 4:257-269.

_____ & Azcuy, C. L. 1978 - Primeros resultados para el Carbónico - Pérmico, *Revista Asociación Geológica Argentina*, **33**(3):246-247.

_____; Azcuy C.L.; Gonzalez, C.R. & Sabattini, N. 1986a - V Paleontología, Bioestratigrafía y Paleoecología de las Cuencas Paganzo, Calingasta-Uspallata y Río Blanco. p. 119-137. In: Archangelsky, S. - 1986 - *El Sistema Carbonífero en la República Argentina (Síntesis)*. Córdoba: Subcomisión Internacional del Carbonifero, 2v.

_____; _____; _____ & _____. 1986b - XIV Edad de las Biozonas. p. 277-285. In: Archangelsky, S. 1986 - . Córdoba: Subcomisión Internacional del Carbonífero, 2v.

Azcuy, C. L.; Andreis, R. R.; Cuerda, A.; Hünicken, M.A. & Pensa, M.V.

Plate 2

All specimens about 1.3x, except 1 to 4 more than 5x

Brazil

Permian - Irati Formation

State of Grande do Sul

Figure 1 - *Kaltanicupes ponomarenkoi* Pinto, 1987
Figure 2 - *Protocupoides rohdendorfi* Pinto, 1987
Figure 3 - *Permipsythone panfilovi* Pinto & Ornellas, 1980
Figure 4 - *Fulgoringruo kukalovae* Pinto, 1987
Figure 5 - *Petromantis rieki* Pinto, 1972
Figure 6 - *Petromantis evansi* Pinto, 1972
Figure 7 - *Asiachorista beckermigdisovae* Pinto, 1972
Figure 8 - *Prosbole iratiensis* Pinto, 1987
Figure 9 - *Gondwanaptera capsii* Pinto & Ornellas, 1981

Figure 10 - *Prosbolecicada gondwanica* Pinto, 1987

Carboniferous

Boituva - State of São Paulo

Figures 11a, b - *Narkemina rohdendorfi* Pinto & Ornellas, 1978
Figure 12 - *Proedischia mezzalirai* Pinto & Ornellas, 1978

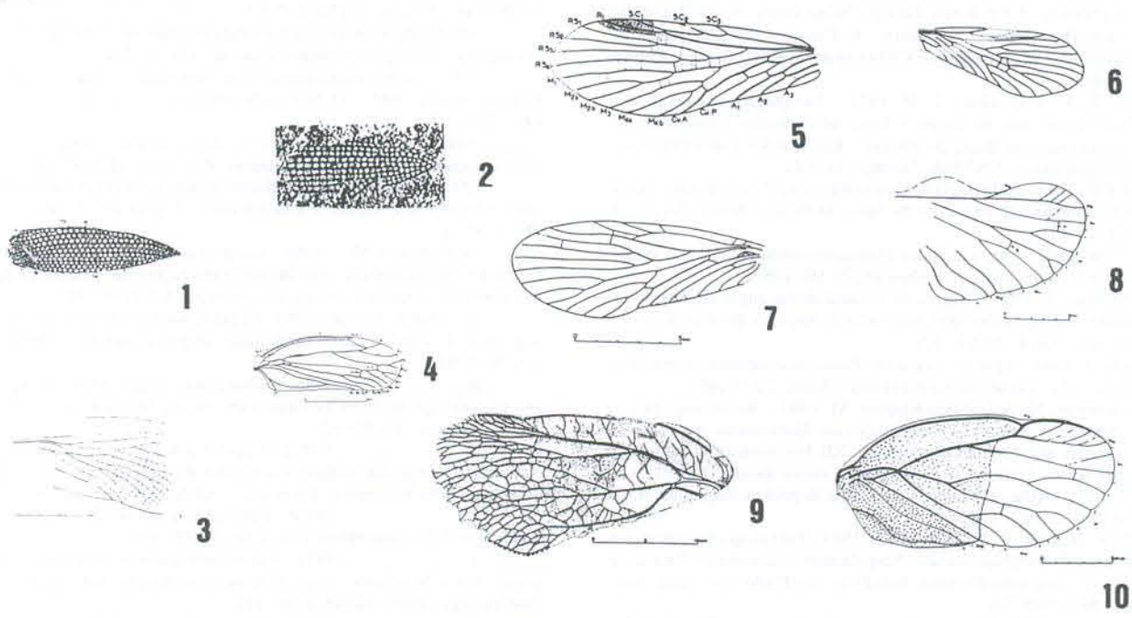
Anitapolis - State of Santa Catarina

Figure 13 - *Carpenteroptera onzii* Pinto, 1990

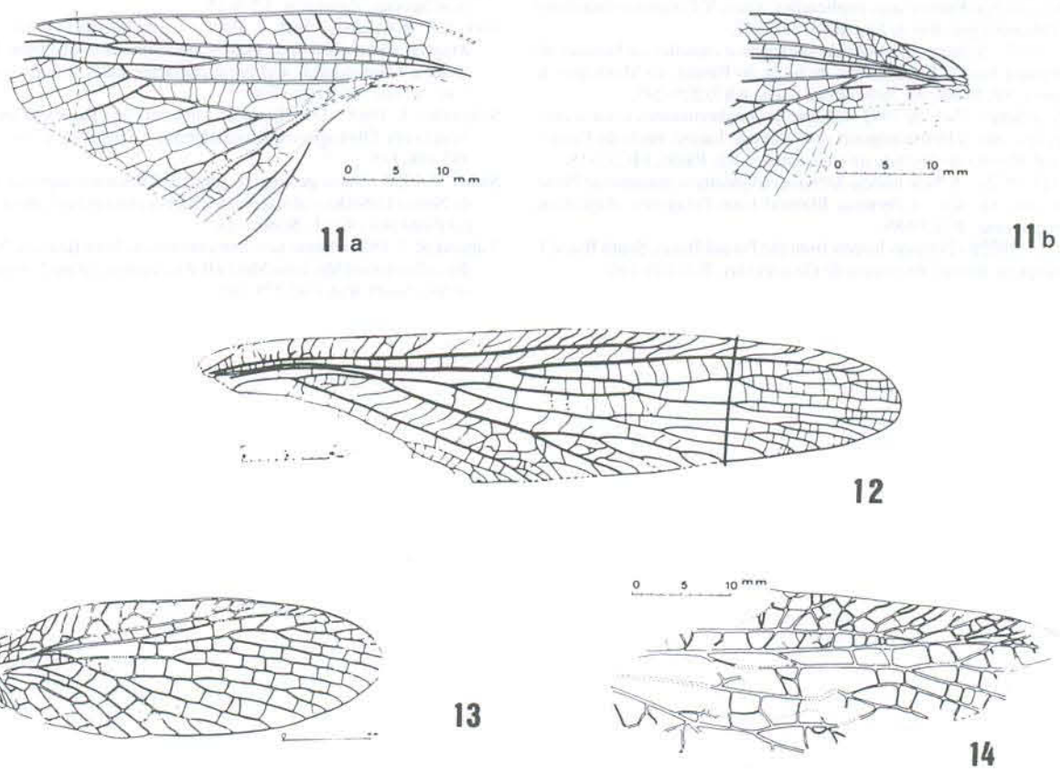
Durasnal - State of Rio Grande do Sul

Figure 14 - *Narkemina rochacamposi* Pinto & Ornellas, 1978

Permian



Carboniferous



1986 - III Cuenca Paganzo. p. 39-91. In: Archangelsky, S. 1986 - *El Sistema Carbonífero en la República Argentina (Síntesis)*. Córdoba: Subcomisión Internacional del Carbonífero, 2v.

Casas, J.H. 1950 - Estudio geologico del Bajo de Veliz, Provincia de San Luis y contribución al conocimento de su flora fósil. *Tesis inédita*, Fac. Cs. Ex. Fis. y Ns., Univ. Nac. Córdoba.

Cazzulo-Klepzig, M. & Guerra-Sommer, M. 1983 - Relationship between the taphoflora of the Itararé Group, Paraná basin, South Brazil and Permocarboniferous boundary. X Congrés International du Estratigraphie et Geologie du Carbonifère, Madrid, *Compte Rendus* 4:395-408.

Daemon, R. F. & Quadros, L. P. 1974 - Integração dos resultados palinológicos aos de fauna e flora de camadas fossilíferas do Neopaleozóico da Bacia do Paraná - Implicações Estratigráficas e Paleoegeográficas. *UNIMAR*, Maringá, 1:25-41.

Dias, M.E.R. 1993 - Palinologia do Grupo Itararé na Porção Centro-Sul do Rio Grande do Sul, Permiano da bacia do Paraná, Brasil. *Pesquisas*, **20**(2):119-131.

Evans, J. W. 1943 - Upper Permian Homoptera from New South Wales. *Records from the Australian Museum*, 21:180-198.

Fossa Mancini, F. 1940 - Acerca de la edad de las capas fosilíferas del llamado "Bajo de Veliz" en la provincia de San Luís. *Revista Museo La Plata* (n.s.). Geol., 5(161-232).

Frenguelli, J. 1944 - Apuntes acerca del Paleozoico superior del noroeste argentino. *Revista Museo La Plata* (n.s.). Geol., 2:213-265.

Guerra-Sommer, M. & Cazzulo-Klepzig, M. 1993 - Bioestratigraphy of the Southern Brazilian Neopalaeozoic Gondwana sequence: a preliminary paleobotanical approach. XII International Congress of Carboniferous-Permian, Buenos Aires, *Compte Rendus* 2:61-72.

Kurtz, F. 1921 - Atlas de plantas fósiles de la República Argentina. *Actas Acad. Nac. Cienc.*, 7:129.

Lima, M.R. de; Dino, R. & Yokoya, N.S. 1983 - Palinologia de concreções calcíferas do Subgrupo Itararé (Neopaleozóico da bacia do Paraná) na região de Araçoiaba da Serra, Estado de São Paulo. *An. Acad. Bras. Cien.*, **55**(2):195-208.

Menendez, C.A. 1971 - Estudio palinológico del Permico de Bajo de Veliz, Provincia de San Luis. *Rev. Mus. Arg. Cienc. Nat. B. Rivadavia, Paleont.*, **1**(9):263-306.

Mezzalira, S. 1968 - Nota sobre a ocorrência de insetos fósseis em testemunhos de sondagem em Boituva, Estado de São Paulo. *Rev. Inst. Geogr. Geol. S. Paulo*, 20:61-64.

Millan, J.H. 1987 - Os pisos florísticos do carvão do Subgrupo Itararé do Estado de São Paulo e suas implicações. *Anais* X Congresso Brasileiro de Paleontologia, Rio de Janeiro, p. 832-857.

_____ 1991 - Sobre a Sphenopsida associada a camadas carbonosas do Subgrupo Itararé, Eogondwana da bacia do Paraná, no Município de Itapeva, SP, Brasil. *An. Acad. Bras. Cien.*, **63**(3):229-245.

Petri, S. & Souza, P. A. de 1993 - Sintese dos conhecimentos e novas concepções sobre a bioestratigrafia do Subgrupo Itararé, bacia do Paraná, Brasil. *Revista do Instituto de Geociências*, São Paulo, **14**(2):7-18.

Pinto, I.D. 1972a - A New Insecta *Archangelskyblatta vishiniakovae* Pinto, gen. nov. sp. nov., a Permian Blattoid from Patagonia, Argentina. *Ameghiniana*, **9**(1):79-89.

_____ 1972b - Permian Insects from the Paraná Basin, South Brazil I. Mecoptera. *Revista Brasileira de Geociências*, **2**(2):105-116.

_____. 1986 - Carboniferous Insects from Argentina, III - Familia Xenopteridae Pinto, nov. Ordo Megasecoptera. *Pesquisas*, **18**:23-29.

_____ 1987a - Permian insects from Paraná basin, South Brazil - IV Coleoptera. *Pesquisas*, 19:5-12.

_____ 1987b - Permian insects from Paraná basin, South Brazil - IV Homoptera - 2 - Cicadidae. *Pesquisas*, 19:13-22.

_____ 1990a - New Upper Carboniferous Paraplecopteran Insect from South Brazil. *Pesquisas*, **17**(1-2):7-10.

_____ 1990b - Permian insects from Paraná basin, South Brazil - VI - Homoptera - 3. Fulgoringruidae. *Pesquisas*, **17**(1-2):3-6.

_____ 1992 - Carboniferous insects from Argentina. V Narkeminidae Pinto & Ornellas, 1991 - Ordo Paraplecoptera. *An. Acad. Bras. Cien.*, **64**(3):289-292.

_____ 1994a - *Sphecorydaloides lucchesei*, a new Carboniferous Magasecopteran Insecta from Argentina. *Pesquisas*, **21**(2):85-89.

_____ 1994b - A new species of Palaeodictyopteran Insecta from Piedra Shotle Formation, Upper Carboniferous, Argentina. *Pesquisas*, **21**(2):107-111.

_____. & Hünicken, M.A. 1980 - *Gondwanarachne* a New Genus of the Order Trigonotarbida (Arachnida) from Argentina. *Boletin de la Academía Nacional de Ciencias de Córdoba*, **53**(3-4):307-315.

_____ & Ornellas, L.P. de 1978a - Upper Carboniferous insects from Argentina. I - Familia Diaphanopteridae (Megasecopteridea). *Pesquisas*, 10:87-95.

_____ & _____ 1978b - Carboniferous insects (Protorthoptera and Paraplecoptera) from the Gondwana (South America, Africa and Asia). *Pesquisas*, 11:305-321.

_____ & _____ 1980a - Upper Carboniferous Insects from Argentina II - Familia Narkemocacurgidae (Paraplecoptera). *Boletim de la Academía Nacional de Ciencias, Córdoba*. **53**(3-4):287-291.

_____ & _____ 1980b - Permian insects from Paraná basin, South Brazil. II - Neuroptera. *Pesquisas*, 13:155-159.

_____ & _____ 1981a - A new Carboniferous Paraplecopteran insects from Argentina. *Anais* II Congresso Latino-Americano de Paleontologia, Porto Alegre, 1:107-111.

_____ & _____ 1981b - Permian insects from Paraná basin, South Brazil. III - Homoptera. I Pereboridae. *Anais* II Congresso Latino-Americano de Paleontologia, Porto Alegre, 1:209-219.

_____ & _____ 1991 - Substitute names for the extinct Insecta Families Narkemocacurgidae Pinto & Ornellas, 1978 and Cacurgonarkemidae Pinto, 1990. *Pesquisas*, 18(1):93.

_____ & Purper, I. 1979 - Brazilian Paleozoic Blattoids: Revision and New Species. *Pesquisas*, 12: 9-23.

Riek, E.F. & Kukalová-Peck, J. 1984 - A new interpretation of dragonfly wing venation based upon Early Carboniferous fossils from Argentina (Insecta Odonatoidea) and basic character states in pterygote wings. *Can. J. Zool.*, 62:1150-1166.

Schneider, J. 1983 - Die Blattodea (Insecta) des Paläozoikums. Teil I: Systematik, Ökologie und Biostratigraphie. *Freiberger Forschungshefte* 382:106-145.

Suero, T. 1958 - Datos geologicos sobre el Paleozoico superior de la zona de Nueva Lubecka y alrededores (Chubut extraandino). *Revista Museo La Plata (n.s.) Geol.*, **5**(30):1-28.

Tillyard, R. J. 1922 - Some new Permian insects from Belmont N. S. W. in the collection of Mr. John Mitchell. *Proceedings of the Linnean Society of New South Wales* 47:279-292.