Anais da Academia Brasileira de Ciências (2004) 76(3): 595-609
(Annals of the Brazilian Academy of Sciences)
ISSN 0001-3765
www.scielo.br/aabc

# *Sommerxylon spiralosus* from Upper Triassic in southernmost Paraná Basin (Brazil): a new taxon with taxacean affinity

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*Manuscript received on September 25, 2003; accepted for publication on January 5, 2004;*
*presented by* ALCIDES N. SIAL

**ABSTRACT**

The anatomical description of silicified Gymnospermae woods from Upper Triassic sequences of southernmost Paraná Basin (Brazil) has allowed the identification of a new taxon: *Sommerxylon spiralosus* n.gen. et n.sp. Diagnostic parameters, such as heterocellular medulla composed of parenchymatous and sclerenchymatous cells, primary xylem endarch, secondary xylem with dominant uniseriate bordered pits, spiral thickenings in the radial walls of tracheids, medullar rays homocellular, absence of resiniferous canals and axial parenchyma, indicate its relationship with the family Taxaceae, reporting on the first recognition of this group in the Triassic on Southern Pangea. This evidence supports the hypothesis that the Taxaceae at the Mesozoic were not confined to the Northern Hemisphere.

**Key words:** fossil wood, taxacean affinity, Upper Triassic, Paraná Basin.

## INTRODUCTION

The petrified woods from several paleontological sites in the central portion of Rio Grande do Sul State (Brazil) have been ascribed to distinct ages and correlated to different stratigraphic units, such as the Rosário do Sul Formation – Triassic according to Gamermann (1973), the Caturrita Member of the Botucatu Formation with an age Jurassic as suggested by Bortoluzzi (1974), the Caturrita Formation of a Upper Triassic age according to Andreis et al. (1980) and the Mata Sandstone referred to the Rhaetian by Faccini (1989). Fossil woods occur as silicified fragments that are usually found as rolled pieces in sedimentary rocks, although they seldom occur included within the sedimentary deposits. The fossil record comprises mainly conifer-related gymnosperm forms and possibly represents a mesophytic flora originated when climate changes took place during the Meso-Neotriassic transition. The so called Conifer Flora is supposed to correspond to a younger association that the *Dicroidium* Flora, represented by impressions referred to the Asselian-Ladinian sedimentary sequences of the Santa Maria Formation (*sensu* Bortoluzzi 1974).

These occurrences of petrified wood in the Mesozoic of southernmost Paraná Basin have been know from more a century. They have been generally included by different authors in the genus *Araucarioxylon* Kraus (1870) and have been considered as indicative of Coniferales. According to Gram-

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bast (1960), Greguss (1967), Lepekhina (1972) and Mussa (1982), this genus is broad defined, encompassing almost all the possible variation in characters, and thus embracing a large group of plants. Consequently this taxon doesn't have taxonomic and phytostratigraphic relevance. Bamford and Philippe (2001) ratify that *Araucarioxylon* is illegitimate, and consider that most of wood species included of this genus should be transferred to *Agathoxylon* Harting.

The present study aims to describe and identify an association of silicified wood composed of specimens not decorticated, complete, recovered at the Linha São Luiz outcrop, district of Faxinal do Soturno at Rio Grande do Sul State southernmost Paraná Basin (Brazil). The sedimentary sequence which the outcrop is included, according to Rubert (2003) using litostratigraphic criteria, in the base of Caturrita Formation (*sensu* Andreis et al. 1980). Pires (2003) included the outcropping rocks in the Carnian-Eonorian Sequence according to Scherer et al. (2000). Besides silicified wood, different fossils were identified at this outcrop, represented by vertebrates (fish-scales, procolophonides, dinosaurs, mammals, cinodonts), invertebrates (conchostraceans and insects), icnofossils, shoots and reproductive structures of gymnosperms (Ferigolo and Ribeiro 2000, 2001). Impressions of leaves are included in the genus *Brachiphyllum* Brogniart by Bolzon et al. (2002) and the silicified woods are identified as *Araucarioxylon* Kraus. On the other hand, Dutra and Crisafulli (2002) characterized two different patterns of leaves: type-*Cyparissidium* and type-*Pagiophyllum*.

## MATERIALS AND METHODS

The 31 fragments of wood on which the present study is based, were collected from the same stratigraphic horizont in the Linha São Luiz outcrop (UTM: 22J0262516E/66277528N) in different missions, by researchers of UFRGS, UNIVATES and Fundação Zoobotânica do Rio Grande do Sul. Preservation is usually good, specimens are mostly silicified. Dense impregnation by iron oxide is a common feature. The type material is deposited in the Paleobotanical Sector of the Departamento de Estratigrafia e Paleontologia of the Instituto de Geociências of the Universidade Federal do Rio Grande do Sul, Rio Grande do Sul State, Brazil. The specimens were cut in transversal, radial and tangential planes; observations were made on polished surfaces, with incident light; anatomic details were observed from petrographic slides mounted in Canada balsam, in transmitted light.

## DESCRIPTION

### *Sommerxylon spiralosus* n.gen. et n.sp.

**Holotip –** PB 3784.

**Paratips –** MCN PB 338; MCN PB 339; MCN PB 340; MCN PB 357; MCN PB 366; PB 3779; PB 3789; PB 3790; PB 3810; PB 278.

**Locality –** Linha São Luiz outcrop, (UTM: 22J0262516E/66277528N), Faxinal do Soturno, Rio Grande do Sul State, Brazil.

**Horizon –** basal section of Caturrita Formation (*sensu* Andreis et al. 1980).

**Age –** Upper Triassic.

**Derivatio Nominis –** generic name: is attributed in honor to Dr. Margot Guerra Sommer; specific epithet – to derive from the presence of spiral thickenings in the radial wall of the tracheids.

## DIAGNOSIS

### *Sommerxylon* n.gen.

Gymnospermous wood consisting of pith, primary xylem, secondary xylem, phloem and cortex. Pith solid, circular to sub-circular, with occasional large gaps, irregularly shaped heterocellular. Thin walled parenchymatous cells of the pith, rounded or polygonal in cross section, grouped in solid nests. Thick walled sclerenchymatous cells, polygonal, walls heavily pitted, single and isolated or in small nests, not oriented. Protoxylem endarch, centrifugal, wedge shaped. Growth rings distinct, large, with a gradual transition from early to late wood; early

wood wide. Bordered pits in radial walls of secondary xylem uniseriate (99%), isolated or contiguous, locally biseriate (1%) alternate or opposite. Medullary ray homocellular, uniseriate. Cross-field pits single, small, 1–4 pits per cross-field, irregularly disposed. Radial spiral thickenings single in radial walls, inclination against the wall of tracheids 40–45°. Wood parenchyma and resinous canals absent. Phloem not differentiated in primary and secondary phloem, showing parenchymatous cells with dark contents and phloematic rays; resinous canals absent. Cortex with parenchymatous cells and canals.

***Sommerxylon spiralosus* n.gen. et n.sp.**

Gymnospermous wood consisting of pith, primary xylem, secondary xylem, phloem and cortex. Pith almost circular, with irregular boards, small to medium size (2,5–7,75 mm in diameter), heterocellular, composed by parenchymatic and sclerenchymatic tissues. Medullar parenchyma comprising thin walled cells irregularly rectangular to sub-circular grouped in nests. Sclerenchymatous cells thick walled, heavy pitted, polygonal interposed singly or in irregularly nests with parenchymatic tissue. Large mesh gaps of irregular shape not orientated dispersed in the pith. Primary xylem easily distinguished in transverse section, endarch, dispersed in wedge shaped bundles at the periphery of the pith composed by cells thin walled. Secondary xylem centrifuge, radially disposed. Distinct growth rings 1,12-6 mm wide, showing a gradual transition from early to late wood. Early wood 58-150 cells (1-4 mm), tracheids wide, polygonal lumen almost rectangular. Late wood narrow 6-20 cells (0,08-0,95 $\mu$m), compressed radially with a compressed lumen, rectangular in shape. False growth rings not continuous all over the diameter are frequent. Radial walls of tracheids with bordered pits, mainly uniseriate (99%), circular, isolate or contiguous flattened; partially biseriate (1%), alternate or opposite. Medullary rays homocellular, uniseriate, cells oval in tangential view, 1-22 cells high (average height 6 cells). 1-4 circular and small pits per cross-field; pit pore is usually centric, circular to sub circular. Spiral thickenings in radial walls of tracheids, distance between the bands 10 to 28 $\mu$m, running parallel, about 2 $\mu$m in thickness; individual bands are flat, inclination against the walls 40° to 45°. Wood parenchyma and resinous canals absents. Phloem not differentiated in primary and secondary phloem, showing parenchymatous cells with dark contents and phloematic rays; resinous canals absent. Cortex with circular cells (parenchymatous cells) and canals.

The material corresponds of fragments of petrified wood, measuring 2-10 cm in length and 2-8,5 cm in diameter (Fig. 1,a), cylindrical, sometimes slightly compressed in transversal view.

All the specimens are composed by pith, primary xylem, secondary xylem, phloem and cortex. The pith is circular (Fig. 1,d), centric or eccentric, small to medium (2,5-7,75 mm), solid (Fig. 1,d), or with mesh gaps in some levels, which are irregularly shaped and disposed without any kind of organization, probably originated by cellular decay (Fig. 1,c; Fig. 3,e).

The pith is heterocellular, composed by parenchymatic and sclerenchymatic tissues (Fig. 1,d). Parenchymatous cells are circular to sub-rectangular or polygonal in shape, of different sizes. Large cells occur dispersed trough the pith (D: 24-40 $\mu$m) and smaller ones forms solid clusters (D: 18-22 $\mu$m) (Fig. 3,e).

The sclerenchymatous cells are either single or grouped in nests dispersed all over the pith without any kind of arrangement (Fig. 1,c). These cells vary in size (42-180 $\times$ 32-150 $\mu$m) are usually isodiametric in transverse section (Fig. 1,b) and rectangular in longitudinal view. Their walls show several layers of thickenings and are heavy pitted, radial canals can be observed running from the external radial walls to the lumen (Fig. 1,b).

The primary xylem encircles the pith disposed in wedge shaped bundles, and in some places projects into the pith. It is endarch and can be distinguished from secondary xylem in transverse section having thinner walls and tracheids being circular to sub-circular in shape (Fig. 1,c). The endarch dispo-

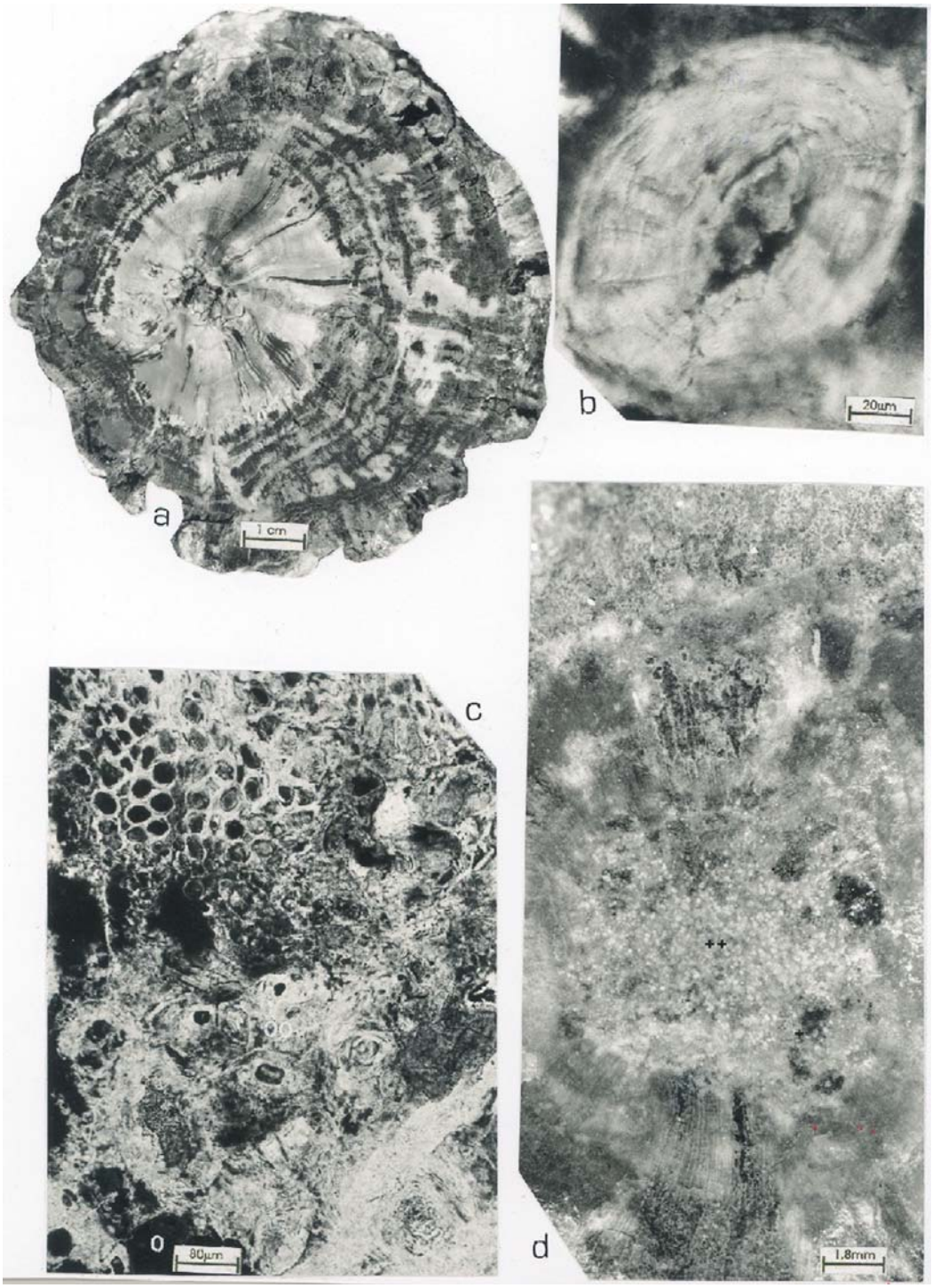


Fig. 1 – *Sommerxylon spiralosus* n.gen. et n.sp. Transverse section **a:** distinct growth rings, represented by clear and dark bands – Pb 278. **b:** Sclerenchymatous thick walled cell, heavy pitted. **c:** primary xylem endarch, wedge shaped, outlying the periphery of the pith, nest of sclerenchymatous cells irregularly gaps. d: solid pith heterocelular – PB 3782.

sition was not confirmed in the radial longitudinal section, where primary xylem was not preserved.

The secondary xylem is centrifuge, radially disposed; growth rings are distinct (Fig. 1,a), with gradual transition from early to late wood (Fig. 4,a). The circular cross-section of the growth rings indicated a possible relation of the specimens with vertical stems according the criteria of Schweingruber (1996). Rings 62-170 tracheids wide, 1,12-6 mm broad.

Early wood in each ring is wide, 58 to 150 cells deep; the width of the early wood varies from 1 to 4 mm; the tracheids are rectangular in transverse section (20-50 $\mu$m) with circular lumen (4-32 $\mu$m).

Late wood is narrow, 6 to 20 cells deep and the tracheids are radially compressed (10-30 $\mu$m) and have a small lumen (2-30 $\mu$m), rectangular in shape. The width of the late wood varies from 0,08 to 0,95 $\mu$m.

False growth rings are common along different levels of the secondary xylem, characterized by being not uniform and continuous rings around the transverse section.

Radial walls of tracheids have bordered pits showing dominantly uniseriate disposition (99%), closely spaced (Fig. 2,b,c) or contiguous slightly flattened (Fig. 2,e). When the pits are separated, they are more or less circular (D: 8-11 $\times$ 26-50 $\mu$m) with a spacing of 2 to 4 $\mu$m. The disposition partially biseriate altern or opposite were very rarely observed (1%) (Fig. 2,a,d). The pit pore is usually centric, circular to sub-circular (D: 2-4 $\mu$m) (Fig. 2,e).

Spiral thickenings are common on radial walls of tracheids (Fig. 3,a,b,c) rarely in longitudinal walls. The individual bands are flat, wide, single, running parallel; the distance between the bands of the spiral is about 10-28 $\mu$m. In some tracheids the individual bands of the spiral thickenings are superposed, resembling as double (Fig. 3,c). The inclination of different spirals against the wall of the tracheids is 40 to 45°. Tangential walls of tracheids are unpitted.

Medullary rays are homocellular, parenchymatous, smooth, uniseriate, 1 to 22 cells high (average 6 cells) (Fig. 3,d); their thick varies from 7 to 26 $\mu$m and their height from 114 to 496 $\mu$m. Ray cells are oval to sub-circular in tangential view. The density of the rays is 4 to 6 per millimeters square.

Cross-field pits are badly preserved (Fig. 2,f), varying from 1-4 pits per field (Fig. 2,g), and seems to be ordered in irregularly rows; they are circular, small (2 to 4 $\mu$m in diameter) with a round central pore (Fig. 2,h).

Axial parenchyma and resinous canals were absent in the secondary xylem.

Cellular elements of the cambium have collapsed, giving the appearance of a continuous, all around gap, in transversal section.

Due to poor preservation not much is know about the phloem and cortex. The phloem and cortex have partially decomposed and only little information is available about its structures. The phloem is not differentiated in primary and secondary phloem; parenchymatous cells with dark contents are observed and phloematic rays are represented as dark bands (Fig. 4,b); resinous canals and fibers were not visualized. The cortex is characterized by circular cells (parenchymatous cells?) and the presence of canals (Fig. 4,c).

## DISCUSSION

The main features presented by the studied specimens are heterocellular pith with sclerenchymatic nests in a parenchymatic matrix, endarch protoxylem, uniseriate pits in radial walls of tracheids, medullary rays homocellular uniseriate, spiral thickenings in radial walls of tracheids, absence of axial parenchyma and resiniferous canals.

*Taxopitys* Kräusel (1928), a Permian gonduanic morphogenus [*Taxopitys Africana* Kräusel (1928), South Africa; *Taxopitys alves-pintoi* Kräusel and Dolianiti (1958) and *Taxopitys jolyi* Mussa (1982), Permian, Paraná Basin, Brazil] besides heterocelular medula with sclerenchymatous nests, presents protoxylem centripetal, mesarch, medullary rays uniseriate, cross-field with little pits, horizontal spiral thickenings and araucarioid pitting in secondary

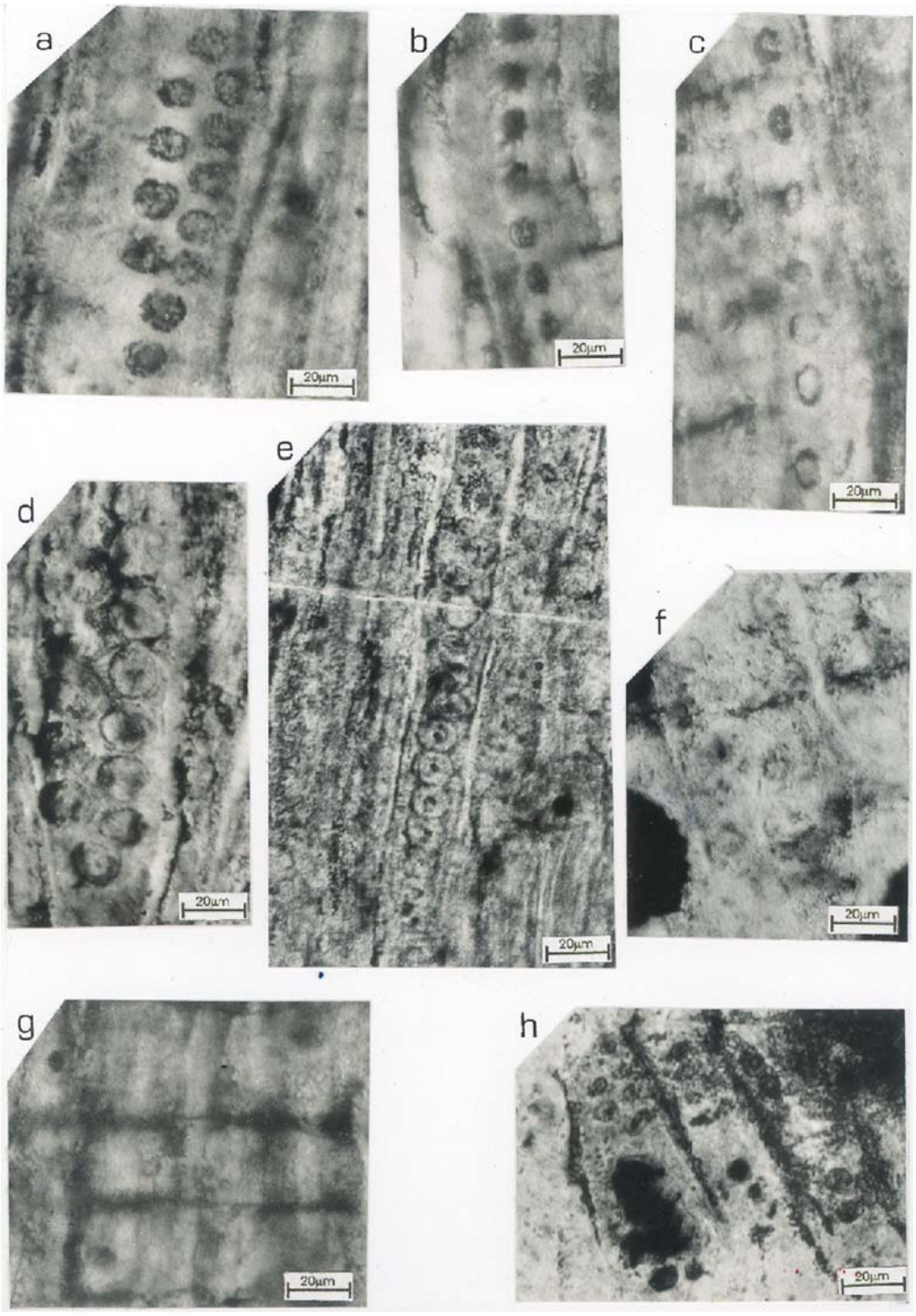


Fig. 2 –*Sommerxylon spiralosus* n.gen. et n.sp. Radial section **a:** tracheid with bordered pits partially biseriate alternate. **b:** tracheid with bordered pits uniseriate isolated. **c:** tracheid with bordered pits uniseriate isolated. **d:** tracheid with bordered pits partially biseriate alternate. **e:** tracheid with bordered pits uniseriate contiguous. **f, g:** cross-fields with not well preserved pits, circular. **h:** cross-field with 1-4 pits in irregularly rows.

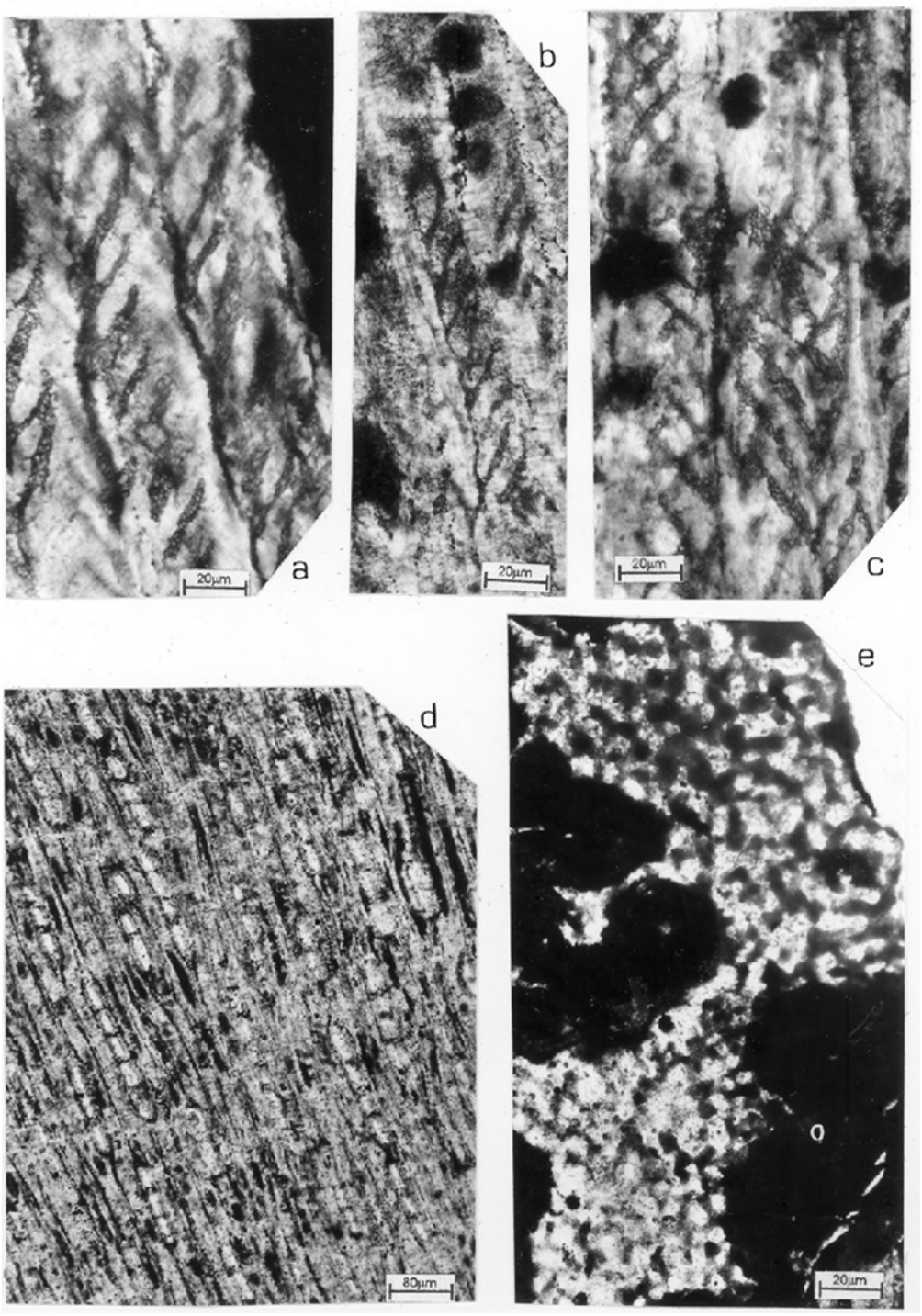


Fig. 3 – *Sommerxylon spiralosus* n.gen. et n.sp. Radial section – **a, b:** detail of simple spiral thickenings in the walls of the tracheids. **c:** spiral thickenings superposed. Tangential section – **d:** medullary rays. Transverse section – **e:** nest of parenchymatous cells in the pith associated to the irregularly gaps.

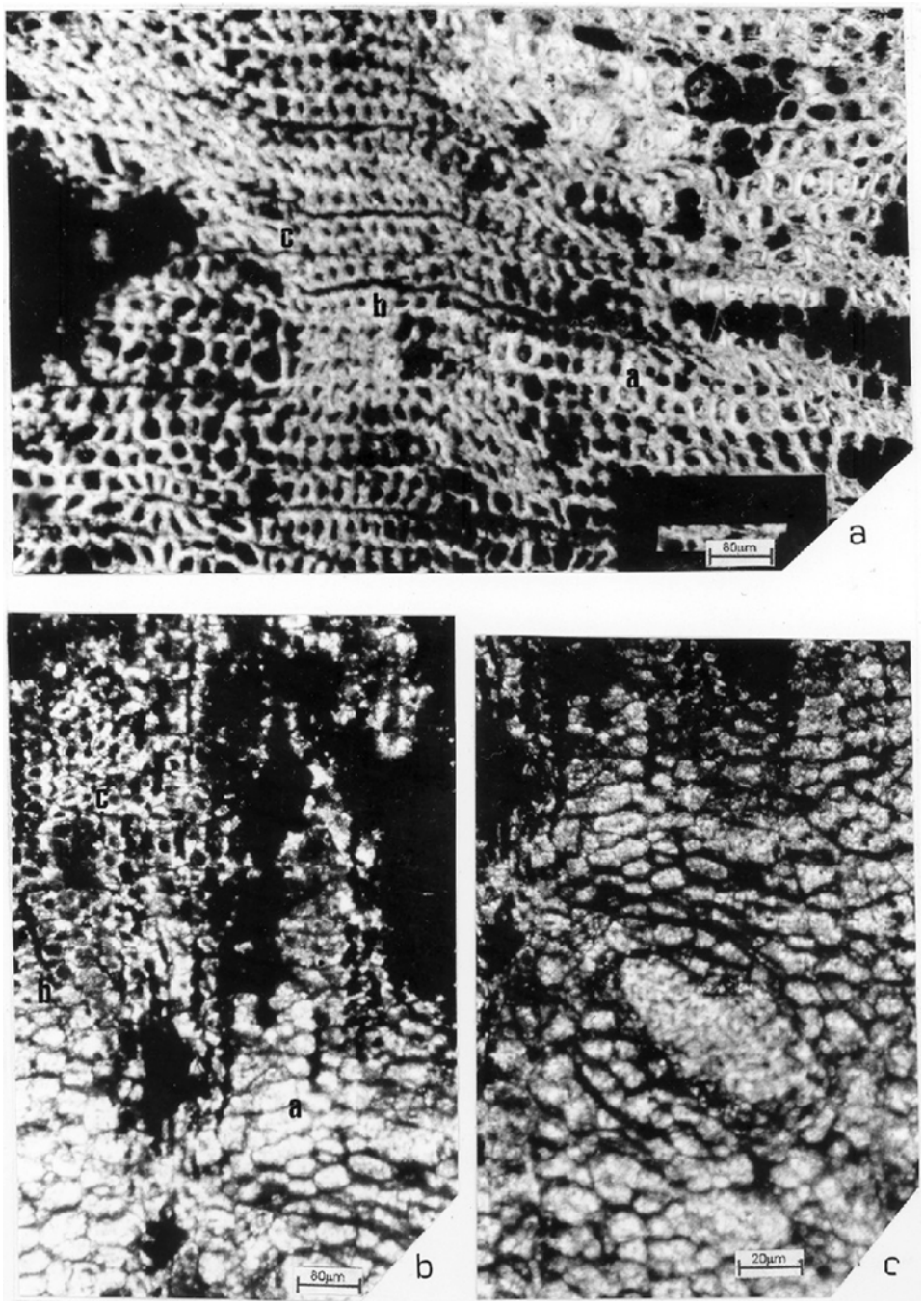


Fig. 4 – *Sommerxylon spiralosus* n.gen. et n.sp. Transverse section – **a:** secondary xylem showing the limit of growth ring; a – early wood; b – late wood; c – limit of the ring. **b:** limit among tissues; a – cortex; b – limit among issues; c – phloem with parenchymatous cells (clear with dark contents) and phloematic rays (dark radial bands). **c:** cortex with circular cells and channel.

xylem. The two last characters are different from the specimens here analyzed. At the same way, diagnostic parameters of the morphogenus *Parataxopitys*, (*P. brasiliana* Maniero (1951) and *P. Americana* Milanez and Dolianiti (1950) of Permian Paraná Basin, Brazil) as araucarioid pitting and the structure of spiral thickenings show distinct in relation to the specimens studied in this paper (Table I-A).

Dutra and Crisafulli (2002) cited *Kaokoxylon zalesskyi* (Sahni) Maheshwari, from the Linha São Luiz outcrop at the same level from were collected the present specimens. Taxonomic diagnostic features are neither cited, nor described or figured. However the characterization of *Araucarioxylon* type of secondary wood and the non-reference of spiral thickenings, indicates distinct taxonomic affinity from the specimen named as *Kaokoxylon* by Dutra and Crisafulli (2002).

Descriptions of homoxylous morphogenera restrict to secondary wood prolififerate in literature mainly in Mesozoic and Cenozoic periods. Table I-B gives complete data and important xylotomical features of this genus compared with the new taxon here proposed. The relevant character for comparison was the presence of true spiral thickenings in secondary xylem. According to Barefoot and Hankins (1982), spiral thickenings are genetic feature and so have diagnostic importance.

*Prototaxoxylon (= Spiroxylon)* Kräusel and Dolianiti (1958) correspond to a morphogenus defined originally from Upper Paleozoic at that time represented by *P. indicum (= Spiroxylon)* (Metha) Prakash and Srivastava (1961) (Permian- India), *P. (= Spiroxylon) africanum* (Walton) Kräusel and Dolianiti (1958) (Permian- Karoo Basin – South Africa), *P. brasilianum* Kräusel and Dolianiti (1958) (Upper Permian – Paraná Basin, Brazil), *Prototaxoxylon (Spyroxylon) intertrappeum* Prakash and Srivastava (1961) (Upper Cretaceous- India) and *Prototaxoxylon andrewsii* Agashe and Chitnis (1971). This wood, besides to be characterized by true spiral thickening on the radial walls of tracheids, differs from the specimens under examination by having radial walls of tracheids characterized by 1-3 seriate circular – slightly horizontally compressed bordered pits. The specimen identified as *P. intertrappeum* by Lutz et al. (1999), from the Upper Triassic of North then Chile, seems to correspond by the characters figurate, to *Taxaceoxylon* Kräusel (1949) instead of *Prototaxoxylon*.

The presence of bars of Sanio and axial parenchyma are important and distinctive characters in the genus *Platyspiroxylon* Greguss (1961) described from the Jurassic of Hungry (*P. heteroparenchymatosum* Greguss 1961) and *P. parenchymatosum* from the Permian of Hungry (Greguss 1967) and Upper Cretaceous of Canada Ramanujam (1972). A comparison with *Torreyoxylon boureaurii* Greguss (1967), Lower Cretaceous from Hungry, make evident important differences, such as the presence of axial parenchyma and spiral thickenings in doubles bands.

The genus *Taxaceoxylon* Kräusel (1949) was proposed in substitution of *Taxoxylon* Kraus (1870) originally described as *Taxites scalariformis* (Goeppert) {= *Taxoxylon Goepperti* Unger = *Taxaceoxylon escalariforme* (Goeppert) Seward (1919)} which was invalidated.

This taxon includes specimens of secondary homoxylic wood with true spiral thickenings and abietinean type of pitting in the radial walls of tracheids, medullary rays homocellular, absence of resiniferous cells or ducts and axial parenchyma. The identification was based only on the characters of the secondary wood; some distinguishing features of the pith corresponding to thick walled polygonal cells dispensed in the parenchymatous tissue, were mentioned by Kräusel (1949), but not included in the diagnosis of the genus.

Kräusel and Jain (1963) have shown that only a few woods described as *Taxaceoxylon (Taxoxylon)* really belongs to the Taxaceae, corresponding to *Taxaceoxylon torreyanum* Shimakura (1936) from Pliocen of Japan, *Taxaceoxylon (=Taxoxylon) antiquum* (Boeshore and Gray) Kräusel (1949) from the Upper Cretaceous of North Caroline (EUA) and *Taxaceoxylon rajmahalense* (Bhandwaj) Kräusel and Jain (1963) from Jurassic of India.

**TABLE I-A**

**Characterization of fossil woods with spiral thickenings in radial walls of tracheids. Fossil with primary structures.**

| Species | Locality / Horizon / age | Cross field | Medullary rays | Bordered pitting | Spiral thickenings |
|---|---|---|---|---|---|
| *Taxopitys africana* Kräusel (1928) | South Africa - Kaoko Formation - Permian | 2 to 8 minute pits per cross field, aperture obliquely oriented | Uniseriate, up to 18 cells high, walls smooth | Uniseriate occasionally biseriate, alternate, aperture circular | Ticklish and forked |
| *Toxopitys alves-pintoi* Kräusel & Dolianiti (1958) | Brazil - Irati Formation - Permian | 1-4 pits per cross field arranged in 2 rows, rarely 6 pits arranged in 3 rows | Uniseriate, 2-6 cells high | Uniseriate occasionally triseriate alternate | Ticklish, horizontal |
| *Toxopitys jolyi* Mussa (1982) | Brazil - Irati Formation - Permian | 1-4 minute pits per cross field, aperture circular or obliquely lenticular | Uniseriate, up to 8 cells high, rarely partly biseriate | Late wood: normally uniseriate and contiguous, compressed in shape with aperture circular; sometimes biseriate alternate, sub-circular to sub-hexagonal | Single, occasionally double, horizontal |
| *Parataxopitys brasiliana* Maniero (1951) | Brazil - Irati Formation - Permian | 4-6 pits per cross field | Uniseriate, 2-7 cells high, in transverse section the average of high is 20,5 $\mu$m | Uniseriate, contiguous, compressed in shape, 10-20 $\mu$m in diameter; occasionally biseriate, alternate, 14-16 $\mu$m in diameter; border circular, aperture 1-2 $\mu$m in diameter; | Ticklish, horizontal, sometimes with a forked thicken distance 6-8 $\mu$m |
| *Parataxopitys americana* Milanez & Dolianiti (1950) | Brazil - Irati Formation - Permian | 4-6 pits per cross field | Uniseriate | Uniseriate rarely biseriate alternate | Ticklish, horizontal |

After the revision of Kräusel and Jain (1963) new species were described *T. cupressoides* Sharma (1970), from Jurassic Sequences of India, *T. japonomesozoicum* Nishida (1973), from Cretaceous of Japan e *T. mcmurrayensis* Roy (1972) registered from Lower Cretaceous of Canada.

Bamford and Philippe (2001) revised the generic names of Jurassic/Cretaceous homoxylons wood, applying the roles of the International Code of Botanical Nomenclature (Greuter et al. 1999), and indicate that *Taxoxylon* should be abandoned and *Taxaceoxylon* preferred.

A detailed comparison with regard to the nature of bordered pits, spiral thickenings, medullary rays, number of cross-field pits and absence of resin ducts and axial parenchyma (Table IA-B) shows that the studied specimens are more closely comparable to the genus *Taxaceoxylon*. The identification however is impossible because the diagnosis of *Taxaceoxylon* is based exclusively in characters of secondary wood. On the other hand, the specimens, under study presents distinguished features of the

**TABLE I-B**

**Characterization of fossil woods with spiral thickenings in radial walls of tracheids. Fossils restricted to secondary wood.**

| Species | Locality / Horizon / age | Cross field | Medullary rays | Bordered pitting | Spiral thickenings |
|---|---|---|---|---|---|
| *Prototaxoxylon indicum* (Metha) Prakash & Srivastava (1961) | India - Permian | 6-7 pits per cross field, border elliptical, 6-8×3-4 $\mu$m in size | Uniseriate, 1 cell high, fairly thick walled, squarish, 20 $\mu$m vertical height | Uniseriate or irregularly biseriate (then alternate or opposite), contiguous (occasionally separate); circular or horizontally elliptical in shape, 14,5×15,5 $\mu$m (in early wood), smaller pits 4 $\mu$m in diameter | 1-2 seriate, passing in between the pits or across the borders of contiguous pits |
| *Prototaxoxylon brasilianum* Kräusel & Dolianiti (1958) | Brazil - Estrada Nova Formation - Permian | 1-4 pits per cross field, broadly oval, slit like oblique opening | Uniseriate, often biseriate, 1-6 (1-2) cells high, cells broadly oval | Single series (usually crowded) occasionally biseriate and alternate | Close, narrow and nearly horizontal, bands across the pits, look like scalariform pitting |
| *Prototaxoxylon africanum* (Walton) Kräusel & Dolianiti (1958) | South Africa - Permian | 2-8 pits per cross field | Almost uniseriate 1-18 cells high, average height 31 $\mu$m | Normally uniseriate and contiguous, occasionally biseriate (mostly alternate an rarely opposite), often vertically compressed, 11-13 $\mu$m in size | 1-2 seriate, confined to the wall between the pits |
| *Prototaxoxylon intertrappeum* Prakash & Srivastava (1961) | India - Deccan Intertrappean Series - Upper Cretaceous | 1-10 pits per cross field, 6-11 $\mu$m in size, scattered or arranged in 1-3 horizontal rows; aperture circular or obliquely lenticular | 1-3 seriate (usually 1-2 seriate, exceptionally triseriate), 2-30 cells high (often up to 50); cells usually oblong, average height 24 $\mu$m, horizontal and tangential walls smooth and unpitted | Normally uniseriate and contiguous, sometimes biseriate (mostly alternate, occasionally opposite), circular or vertically compressed in shape (sometimes hexagonal), 13-20 $\mu$m in size, circular or obliquely lenticular aperture | 2-3 seriate, 5-11 $\mu$m thick, close, both left and right-handed, inclined at 50-70°, pass usually across the borders of contiguous pits or trough the space between the separate pits or become thin and pass trough the rim of the pore |

pith, primary xylem, phloem and cortex. Consequently, considering the restrictions of the International Code of Botanical Nomenclature (Greuter et al. 1999), a new taxon is proposed: *Sommerxylon spiralosus* nov. gen. et. nov. sp. The present wood possesses all the general anatomical characters of a taxacean wood, as it was referred by Kräusel (1949), and Kräusel and Jain (1963) based in Florin (1940). It's important to observe that, even not including pith studies in the diagnosis, Kräusel (1949) refers to the

**TABLE I-B (continuation)**

| Species | Locality / Horizon / age | Cross field | Medullary rays | Bordered pitting | Spiral thickenings |
|---|---|---|---|---|---|
| *Prototaxoxylon andrewsii* Agashe & Chitnis (1971) | India - Barakar Stage - Lower Permian | 2-6 pits per cross field; pits round to horizontally oval; type cupressoid; 8-10 $\mu$m, with circular to oblique pore (2 $\mu$m) | 1-2 seriate, predominantly uniseriate, 1-8 cells high; vertical diameter 29-40 $\mu$m | 1-3 seriate slightly horizontally compressed; biseriate are contiguous, alternate, subopposite or opposite; triseriate are alternate and contiguous; 10-12 $\mu$m in diameter | 3-11 $\mu$m in thickness, closely spaced, run clockwise or anticlockwise, single or double |
| *Platyspiroxylon heteroparenchy-matosum* Greguss (1961) | Hungry - Lower Jurassic | 1-6 pits callitroids per cross field, broadly elliptical | 40 cells high, smooth walls | Uniseriate, occasionally biseriate circular, contiguous or isolated, aperture oval | Parallel, large and compressed lines, type-callitoid, with bars of Sanio |
| *Platyspiroxylon parenchymatosum* Greguss (1967) | Hungry - Permian Canada - Upper Cretaceous | 1-6 pits callitroids per cross field, pits broadly elliptical | 3-8 cells high, 25-30 $\mu$m in diameter; radial diameter 170-200 $\mu$m; smooth walls | Uniseriate occasionally biseriate circular, contiguous or isolated, aperture oval | Parallel, large and compressed lines, type-callitoid, with bars of Sanio |
| *Torreyoxylon boureaui* Greguss (1967) | Hungry - Lower Cretaceous | Broadly triangular, squarish or polygonal | Uniseriate, 1-8-10 cells high, 18-20 $\mu$m in diameter, walls smooth and unpitted | Uniseriate, occasionally locally biseriate opposite, aperture obliquely | Rare, ticklish, single or double, distance 15-20-30 $\mu$m |
| *Taxaceoxylon torreyanum* Shimakura (1936) | Japan - Kanagawa Basin - Pliocene | — | — | Uniseriate isolated rarely opposite | Single, occasionally double |
| *Taxaceoxylon antiquum* (Boeshore & Gray) Kräusel (1949) | United States of America - Upper Cretaceous | 2-4 pits per cross field | 1-21 cells high, mostly uniseriate but with paired cells in place; lateral walls with small round pits, 2-4 per tracheid | Uniseriate occasional biseriate | 2-4 series in the early wood and placed at approximately 45° angles with the long axis of the tracheids (tangential section) |
| *Taxaceoxylon rajmahalense* (Bardwaj) Kräusel & Jain (1963) | India - Rajmahal Stage - Jurassic | Not preserved | Simple, uniseriate, rarely partly biseriate, 1-22 cells high, tangential walls smooth | Uniseriate, circular, 10 $\mu$m in diameter, aperture circular, 6 $\mu$m wide | Visible both on the radial and tangential walls, sometimes single but mostly double, running parallel, distance 10-30 $\mu$m, inclination against the wall of the tracheid 40-70° |

**TABLE I-B (continuation)**

| Species | Locality / Horizon / age | Cross field | Medullary rays | Bordered pitting | Spiral thickenings |
|---|---|---|---|---|---|
| *Taxaceoxylon cupressoides* Sharma (1970) | India -Rajmahal Stage - Jurassic | 1 or rarely 2 large pits simple or bordered per cross field vertically arranged, circular or ovoid, 5-7,5 $\mu$m in long diameter | Uniseriate sometimes partially biseriate, 1-14 cells high, tangential walls smooth, radial walls with simple or bordered pits | Uniseriate or biseriate, opposite separate or contiguous, rounded with circular apertures | Single or double |
| *Taxaceoxylon japonomesozoicum* Nishida (1973) | Japan - Cretaceous | 1-2 pits per cross field, circular or ovoid, vertically arranged | Oblong or rectangular in tangential section, 18-25 $\mu$m and 9-14 $\mu$m in vertical height and horizontal width respectively, pitted only on the radial walls | Uniseriate, 11-13 $\mu$m in diameter, circular apertures with 5 $\mu$m in diameter | Single spirals solitary running with a pith of 7-15 $\mu$m, sometimes 20 $\mu$m |
| *Taxaceoxylon mcmurrayensis* Roy (1972) | Canada - McMurray Formation - Lower Cretaceous | 4-6 minute pits per cross-field, generally cupressoid, ocassionally tending to be taxodioid, aperture obliquely, horizontal walls smooth, thick, without any pits | Uniseriate, occasionally biseriate; 2-12 cells high, 15-20 $\mu$m in diameter | Uniseriate, circular, discrete, vestured, pores circular or oblique | One or two helices; nearly perpendicular to the vertical axis or at an acute angle to it |

similarity between the pith nature of *Taxaceoxylon* and that one of the extant genus *Torreya*. The same structures can be found in the pith of the specimens under the examination, and this evidence ratifies the botanical affinity between extant and fossil forms.

The occurrence of fossil representatives of the extant Taxaceae are mainly concentrated on the bases of leaf branches, the oldest one corresponding to *Paleotaxus rediviva* Nathorst (1908), from Upper Triassic of South Sweden; on the other hand, the oldest dated Taxacean petrified wood up till now was *Taxaceoxylon rajmahalense* (Bardwaj) Kräusel and Jain (1963) from Middle Jurassic from India. The identification of *Sommerxylon spiralosus* nov. gen. et nov. sp. in Upper Triassic sequences of southern Pangea supports the hypotheses of Kräusel and Jain (1963) based on Florin (1940) and Studt (1926) that in the Mesozoic the Taxaceae were not confined to the Northern Hemisphere.

**ACKNOWLEDGMENTS**

This work received financial support from the CAPES-MEC, Universidade do Vale do Taquari (UNIVATES) and Fundação Nacional de Desenvolvimento do Ensino Superior Particular (FUNADESP).

the authors thank Prof. Dr. Robson Tadeu Bolzon (Universidade Federal do Paraná) and Prof. Dr. Jorge Ferigollo (Fundação Zoobotânica do Rio Grande do Sul) for loan of specimens.

**RESUMO**

A descrição anatômica de lenhos silicificados de Gymnospermae em seqüência do Triássico Superior no sul da Bacia do Paraná (Brasil), possibilitou a identificação de um novo taxon: *Sommerxylon spiralosus* n.gen. et n.sp. Parâmetros diagnósticos tais como medula heterocelular, composta por células parenquimáticas e esclerenquimáticas, xilema primário endarco, xilema secundário com pontoações areoladas unisseriadas dominantes, espessamentos espiralados nas paredes radiais dos traqueídeos, raios lenhosos homocelulares, ausência de canais resiníferos e de parênquima axial, indicam a sua vinculação à família Taxaceae, constituindo-se em reconhecimento inédito da presença deste grupo no Triássico Superior no sul do Pangea. Esta evidência suporta a hipótese de que a família Taxaceae não estava confinada ao Hemisfério Norte durante o Mesozóico.

**Palavras-chave:** lenho fóssil, afinidade com taxaceae, Triássico Superior, Bacia do Paraná.

**REFERENCES**

Agashe SN and Chitnis SR. 1971. Studies on the fossil gymnosperms, part III: *Prototaxoxylon andrewsii* a new species of taxinean wood from the lower Gondwana strata. Palaeontograph Abt B 133: 52–60.

Andreis RR, Bossi GE and Montardo DK. 1980. O Grupo Rosário do Sul (Triássico) no Rio Grande do Sul, Brasil. In: Congresso Brasileiro de Geologia, 31, 1980, Balneário Camboriú, Anais... SBG, 2: 659–673.

Bamford MK and Philippe M. 2001. Jurassic-Early Cretaceous Gondwanan homoxylous woods: a nomenclatural revision of the genera with taxonomic notes. Rev Palaeobot Palynol 113: 287–297.

Barefoot AC and Hankins FW. 1982. Identification of modern and tertiary woods. Oxford: Oxford University Press, 189p.

Bolzon RT, Guerra-Sommer M, Mirlean N, Vieira CEL, Scherer CMS and Marchiori JNC. 2002. Tafonomia de fósseis de coníferas de Faxinal do Soturno (Triássico), Estado do Rio Grande do Sul, Brasil. In: Congresso Argentino de Paleontologia e Bioestratigrafia, 8, Corrientes, Resumos... 2002, p. 30.

Bortoluzzi CA. 1974. Contribuição à Geologia de Santa Maria, Rio Grande do Sul, Brasil. Pesquisas 4: 7–86.

Dutra TL and Crisafulli A. 2002. Primeiro registro de uma associação de lenhos e ramos de coníferas em níveis do final do Triássico Superior no sul do Brasil (Bacia do Paraná, Formação Caturrita). In: Congresso Argentino de Paleontologia e Bioestratigrafia, 8, Corrientes. Resumos... 2002, p. 32.

Faccini UF. 1989. O Permo-Triássico do Rio Grande do Sul. 121 f. Dissertação (Mestrado em Geociências), Instituto de Geociências, Curso de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul, Porto Alegre.

Ferigolo J and Ribeiro AM. 2000. Projeto Pró-Guaíba 2000: novos dados sobre o Triássico/?Jurássico do Estado do Rio Grande do Sul, Brasil. In: Reunión sobre el Triássico del Cono Sur, 4, San Luis, Boletim de Resumos..., 2001, p. 9.

Ferigolo J and Ribeiro AM. 2001. Estudos sobre o Triássico/Jurásico do RS: O projeto Pró-Guaíba. In: Congresso Brasileiro de Paleontologia, 17, Rio Branco, Boletim de Resumos..., 2001, p. 170.

Florin R. 1940. The tertiary fossil Conifers of South Chile and their phyto-geographical significance. With a review of the fossil Conifers of Southern lands. K svenka Vetensk Akad Handl 2: 1–107.

Gamermann N. 1973. Formação Rosário do Sul. Pesquisas 2: 5–35.

Grambast L. 1960. Remarques sur les *Dadoxylon* permo-carboniferes dês territoires à flore Gondwana. Ann Mus Roy Congo Belge Tervuren Ser In 8, Sc. Geol 30: 11–21.

Greguss P. 1961. Permische fossile Hölzer aus Hungam. Palaeontograph Abt B 109: 131–146.

Greguss P. 1967. Fossil gymnoperm woods in Hungary from the Permian to the Pliocene. Budapest: Akademiai Kiado. 136p.

Greuter W, McNeill J, Barrie FR, Burdet HM, Demoulin V, Filgueiras TS, Nicolson DH, Silva PC, Skog JE, Trehane P, Turland NJ and Hawksworth DL. 1999. International Code

of Botanical Nomenclature, Tokyo Code. Adotado no 15° Congresso Internacional de Botânica, Yokohama, Agosto-Setembro 1998. Regnum Veg, 131p.

KRAUS G. 1870. Bois Fossiles de Coniferes. In: SCHIMPER WP (Ed.), Traité de Paléontologie Végetale, Strasbourg: J B Baillière et fils 2: 363–385.

KRÄUSEL R. 1928. Paleobotanische Notizen 10, Uber ein Keperholz cordaitoidem Merk-Senckend. Leth 6: 34–52.

KRÄUSEL R. 1949. Die fossilen Koniferen-Hölaer (unter Ausschluss von Araucarioxylon Kraus) ll. Kritische Untersuchungen zur Diagnostik lebender und fossiler Koniferen-Hoölzer. Palaeontograph Abt B 89: 83–203.

KRÄUSEL R AND DOLIANITI E. 1958. Gymnospermen hölzer aus dem Paläozoikum Brasiliens. Palaeontograph Abt B 104: 115–137.

KRÄUSEL R AND JAIN KP. 1963. New fossil coniferous woods from the Rajmahal Hills, Bihar, India. Palaeobot 12: 59–67.

LEPEKHINA VG. 1972. Woods of Paleozoic pycnoxylic gymnosperms with special reference to North Eurasia representatives. Palaeontograph Abt B 138: 44–106.

LUTZ AI, CRISAFULLI A AND HERBST R. 1999. Gymnospermous woods from the Upper Triassic of northern Chile. Palaeobot 48: 31–38.

MANIERO J. 1951. *Parataxopitys brasiliana*, gen. n. sp. n., madeira nova do Permiano Inferior. An Acad Bras Cienc 23: 105–112.

MILANEZ E AND DOLIANITI E. 1950. Nova gimnosperma do Permiano Inferior. Arq Jard Bot 10: 117–129.

MUSSA D. 1982. Lignitafofloras permianas da Bacia do Paraná, Brasil (Estados de São Paulo e Santa Catarina). 2v. Tese (Doutorado), Instituto de Geociências, Curso de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul, Porto Alegre.

NATHORST AG. 1908. Palaeobotanische Mitteillungen. 7. Über *Palyssya*, *Stachyotaxus* und *Paleotaxus*. K svenka Vetensk Akad Handl 8: 1–16.

NISHIDA M. 1973. On some petrified plants from the Cretaceous of Chishi, Chiba Prefecture VI. Bot Mag 86: 189–202.

PIRES EF. 2003. *Sommerxylon spiralosus* n.gen. et n.sp. no Mesozóico do Rio Grande do Sul: significado taxonômico e paleoclimático. 134f. Dissertação (Mestrado em Geociências) – Instituto de Geociências, Programa de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul, Porto Alegre.

PRAKASH U AND SRIVASTAVA K. 1961. On a gimnospermous fossil wood from Sitapuri, District Dhar in Madhya Pradesh. Paleobot 10: 10–17.

RAMANUJAM CGK. 1972. Fossil coniferous wood from Oldman Formation (Upper Cretaceous) of Alberta. Can Journ Bot 50: 595–602.

ROY SK. 1972. Fossil wood of Txaceae from McMurray Formation (Lower Cretaceous) of Alberta. Can Journ Bot 50: 349–352.

RUBERT RR. 2003. Possibilidades de estabelecimento de um novo horizonte de correlação para o Triássico Sul-rio-grandense. 69f. Dissertação (Mestrado em Geociências) – Instituto de Geociências, Programa de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul, Porto Alegre.

SCHERER CMS, FACCINI UF AND LAVINA EL. 2000. Arcabouço Estratigráfico do Mesozóico da Bacia do Paraná. In: HOLZ M AND DEROS LF (Ed.), Geologia do Rio Grande do Sul, Porto Alegre: CIGO/UFRGS, p. 335–354.

SCHWEINGRUBER FH. 1996. Tree rings and environment dendroecology. Stuttgard: Swiss Federal Institute for Forest, Snow and Landscape Research. 609p.

SEWARD AC. 1919. Fossil plants. New York: Cambridge 4: 541p.

SHARMA BD. 1970. *Taxaceoxylon cupressoides* sp. nov. from Dhokoti in the Rajmahal Hills, India. Amegh 3: 257–278.

SHIMAKURA M. 1936. On the fossil wood of *Torreya nucifera* Sieb. et Zucc. from the Pleistocene of Kanagawaken. J Geol Soc Japan 612: 297–302.

STUDT W. 1926. Die heutige und frühere Verbreintung der Koniferen und die Geschichte ihrer Arealgestaltung. Mitt Inst Allg Bot Hamb 2: 26p.