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3. WOOD ANATOMY OF A SILICIFIED TRUNK FROM THE KHARGA OASIS, EGYPT

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Abstract

This paper presents the detailed LM anatomy of a gymnospermous fossil wood from the Late Cretaceous layers of the Kharga Oasis. The pitting of the radial wall of the tracheids is of an early "araucarioid" type. In comparison to the previous fossil wood data the following anatomical characteristics may be emphasized: 1. The ray cells are 3 - 52 cells high. 2. The great number (21, 24) of the pits in the cross fields. 3. The transverse walls of the longitudinal parenchyma cells are smooth. Based on these LM characteristic features this fossil wood is described as *Agathoxylon lifiyii* sp. nov.

Key words: Xylotomy, fossil, *Agathoxylon*, Upper Cretaceous, Egypt.

Introduction

Four genera and seven species of petrified *gymnosperm* wood have, so far, been reported from Egypt (in addition to unidentified specimens) as tabulated below:

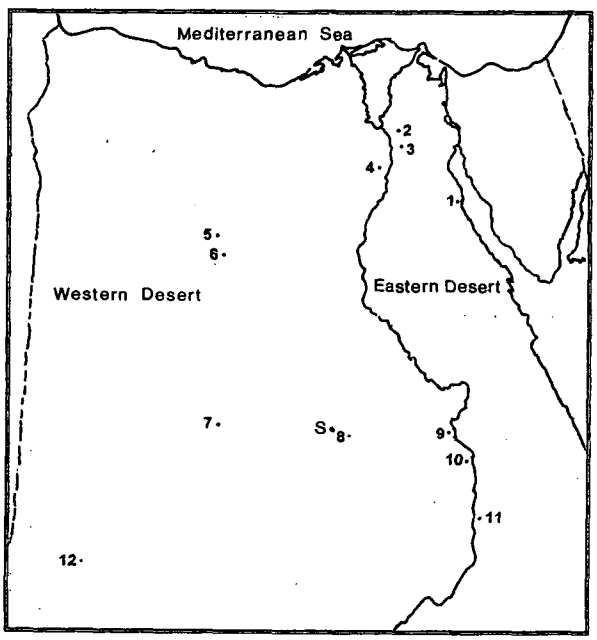
Taxa	Permian Jurassic	Late Cretaceous	Tertiary (Oligocene)	Site	Reference
Family: Araucariaceae					
Dadoxylon: Endlicher 1847					
D. aegyptiacum Unger 1858		+		1,5,6,7,8,9,10	Unger, 1858-59
D. dallonii Boureau 1948	+			12	Duperon-L&Lejal-N., 1981
D. mokattamensis Kräusel 1924			+	3	Kräusel, 1924
D. sudanense Duperon-L.&Lejal-N., 1981	+			12	Duperon-L&Lejal-N., 1981
Family: Cupressaceae					
Cupressinoxylon Goeppert 1850					
?C. sp Kräusel 1924		+		5,6	Kräusel, 1924-39
Family: Podocarpaceae					
Mesembrioxylon (Podocarpoxylon)					
aegyptiacum (Kräusel) Boureau 1950			+	3	Kräusel, 1939
Protophyllocladoxylon Kräusel 1939					
P. leuchsi Kräusel 1939		+		7,8	Kräusel, 1939
Unidentified gymnosperm wood		+		11	Youssef, 1993

For names and locations of these sites see map in text-fig. 3.1.

The aim of this paper is to report on the occurrence of a Late Cretaceous petrified trunk of a *gymnosperm* tree, the xylotomy of which is quite distinct from, not only all those described earlier from Egypt but also from all those described in the available literature from other parts of the world.

The study area

The study area (Text-fig. 3.1.) lies about 12 km to the north-west of Kharga Oasis and about 12 km to the north of bench mark 15 on the Kharga-Dakla Oases road, and stretches almost till Gebel Abo-Tartour (Wadi El-Lifiya). This Late Cretaceous area is covered by Nubia Sandstone (G.S.E., 1982). The fossil woods lie horizontally on the surface and are in the form of large tree trunks (12 trunks were counted) and many fragments of variable size. Most trunks are about 15 m long and 20-35 cm in diameter. No branches, roots, fruits, leaves were found. The woods are highly silificied and variously coloured from white to dark.



Text-fig. 3.1.

Map showing sites of collection of gymnospermous fossil woods in Egypt.

1 - Wadi Araba. 2 - Gebel Ahmar. 3 - Gebel Mokattam. 4 - Gebel Qatrani. 5 - Bahariya Oasis. 6 - Gebel Hufhuf. 7 - Dakhla Oasis. 8 - Kharga Oasis. 9 - Esna. 10 - Road between Esna and Wadi Haifa. 11 - Aswan Area. 12 - Gilf Kebir.

S - Study Area.

Materials and Methods

Twelve specimens were chopped off from the 12 large trunks. The majority of specimens range between 5-10 cm in width and 10-20 cm in length. Thin-ground sections (T.S., T.L.S. and R.L.S.) were prepared (e.g.: cf. LACEY, 1963) from all collected specimens. They all proved to belong to *gymnosperms*. However, only four specimens were found to be well preserved and permit identification to generic or lower level. Only one of these will be described here, while the other three will be the subject of forthcoming publications. The following basic publications were used: GREGUSS (1955, 1958, 1967, 1968a,b, 1972), JANE (1970), MÄGDEFRAU (1953), MOLISCH (1954), SAID (1990).

The specimens and slides are deposited in the paleobotanical collection of the Department of Botany, University of Zagazig, Benha, Egypt.

Results

The specimen to be described here was taken from a tree trunk about 15 m long and 20 cm in diameter.

Cross section (Plate 3.1., figs. 1,2)

The secondary wood is made of tracheids, ray parenchyma, vertical resin ducts and xylem parenchyma, and sometimes traumatic tissue (Plate 3.1., figs. 1,2). Vertical resin ducts are usually present in tangential bands in late wood (Plate 3.1., figs. 1,2) and sometimes found solitary within the early wood: 74-133 µm in diameter. Walls of the resin ducts are thick; 15 - 44 µm in thickness. Annual rings distinct, variable in width from 375 to 1875 µm (Plate 3.1., fig. 1; text-fig. 3.2.). Transition from early to late wood is gradual in the wider rings and abrupt in the narrower rings; the late wood is very narrow from 2 to about 4 cells. Discontinuous rings sometimes present (Plate 3.1., fig. 1). Tracheids in early wood quadrate, spherical and elliptical; 32 - 72 µm and 36 - 65 µm in radial and tangential diameters respectively; thick walled; 4 - 7 µm. Late woods tracheids smaller in radial diameter: 18-36 µm with thick walls; 4-11 µm.

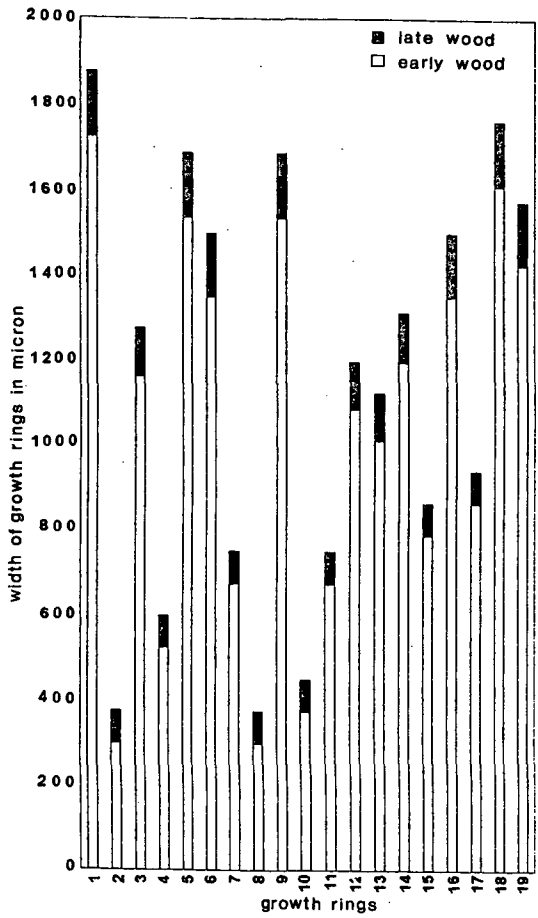
Tangential section (Plate 3.2., figs. 1- 5)

The rays are uniseriate and 3 - 52 cells high. The preservation of the wood was not so well for quantitative evaluation of the number of the ray cells. The cell number of 99 rays was counted, the greatest part, 75 rays were between 3 - 19 cells high, and 24 were 20 - 52 cells high. The cross section of the cells is sometimes deformed by fossilization, they are mostly squares, circles or upright ellipses, 14-22 µm in diameter. The horizontal wall of the longitudinal parenchyma is smooth. There are dark resinous remnants in these cells. (Plate 3.2., figs. 3-5).

Radial section (Plate 3.2., figs. 6-9, plate 3.3., figs. 1-5)

The areolate pits of the radial walls of the tracheids uni- or biseriate (Plate 3.3., figs. 1-4) with round apertures, 7-11 µm. Typically araucarioid pitting is well shown in figs. 1 and 2 on Plate 3.3. In the cross fields there are several (21, 24) simple pits, arranged in two or four but mostly in three rows. Generally in the late wood, spiral wall structure of the tracheids was observed (Plate 3.3., fig. 5). This kind of thickening was discussed by GREGUSS (1967) and HUARD (1966), but this seems to be an early characteristic (cf. SIMONCSICS, 1955).

Taking into consideration the previously described wood anatomical characteristic features, this fossil wood is a new "araucarioid type" for the literature.



Text-fig. 3.2.

Showing variation in width of growth rings (early and late wood).

Agathoxylon lifiyii sp. nov. (Plate 3.1 - 3.3)

Diagnosis

Secondary wood is homoxyl, with vertical resin ducts, and annual rings. The rays are 3 - 52 cells high, the greatest part until 19 cells. The areolate pits of the radial wall are typically early, araucarioid type. The number of the simple pits in the cross fields is high; 21, 24, arranged into 2 - 3 - 4 rows. Spiral wall structure of the tracheids occurred in general in the late wood.

Holotype: Deposited in the Department of Botany of the Zagazig University, Benha, Egypt.

Locus typicus: Kharga-Dakhla Oases.

Stratum typicum: Late Cretaceous, Nubia Sandstone.

Derivatio nominis: From Wadi Lifiya, the site of the collection.

Differential diagnosis: The relatively high number of the ray cells and the simple pits in the cross fields separate this wood well from the similar fossil woods of *Araucariaceae,* namely from *Agathoxylon hungaricum* (ANDREÁNSZKY 1949) GREGUSS 1952,

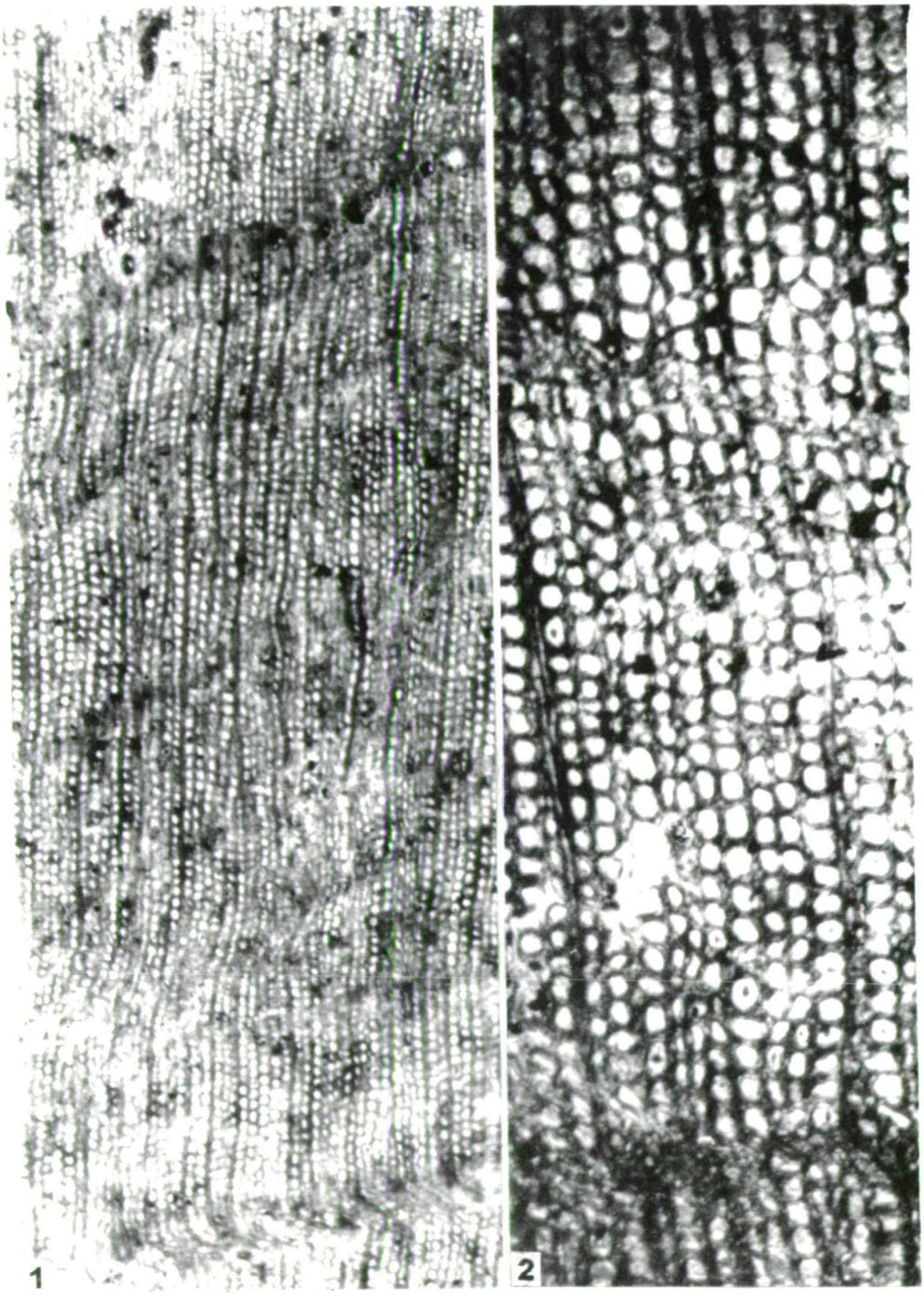


Plate 3.1.

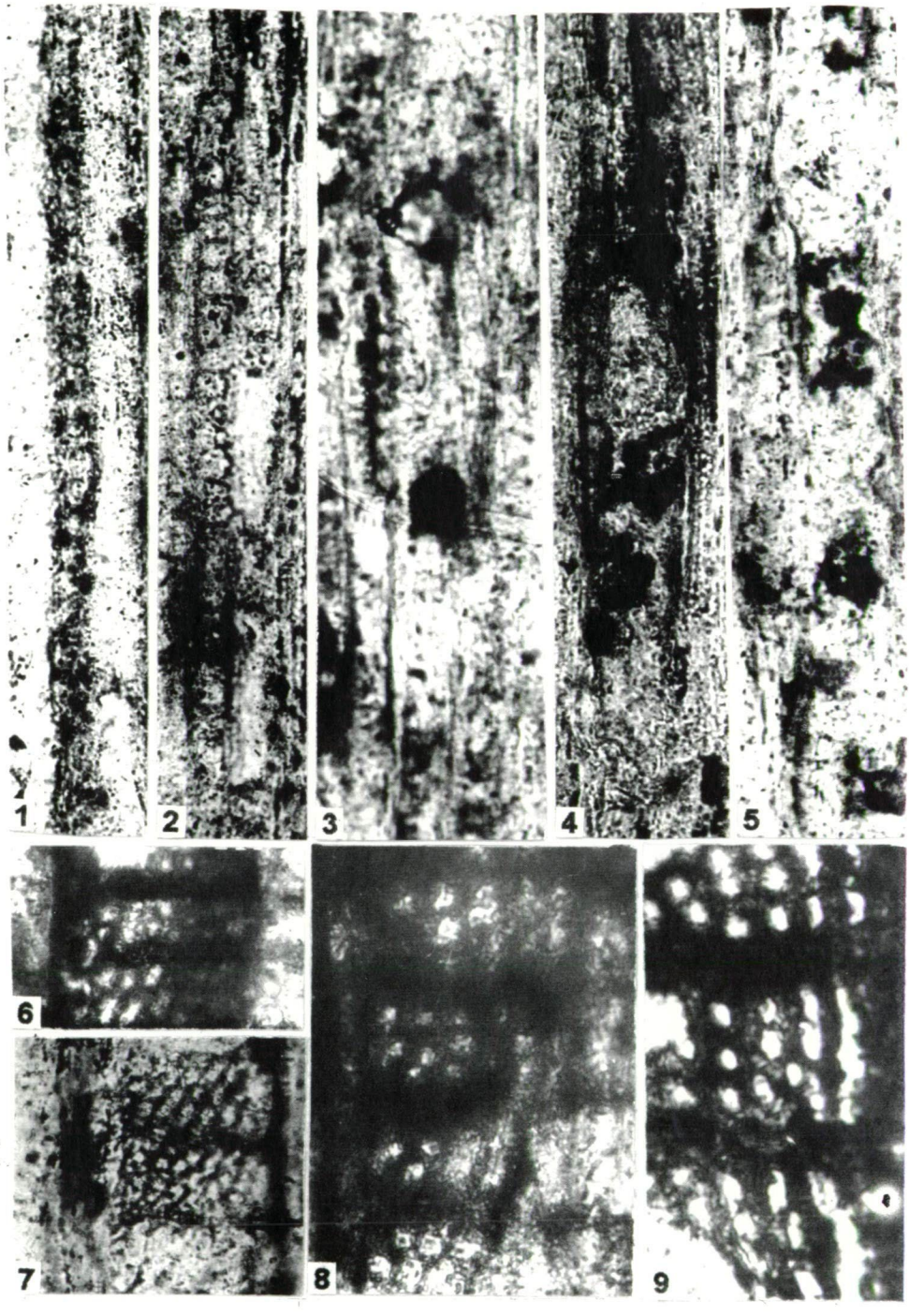


Plate 3.2.

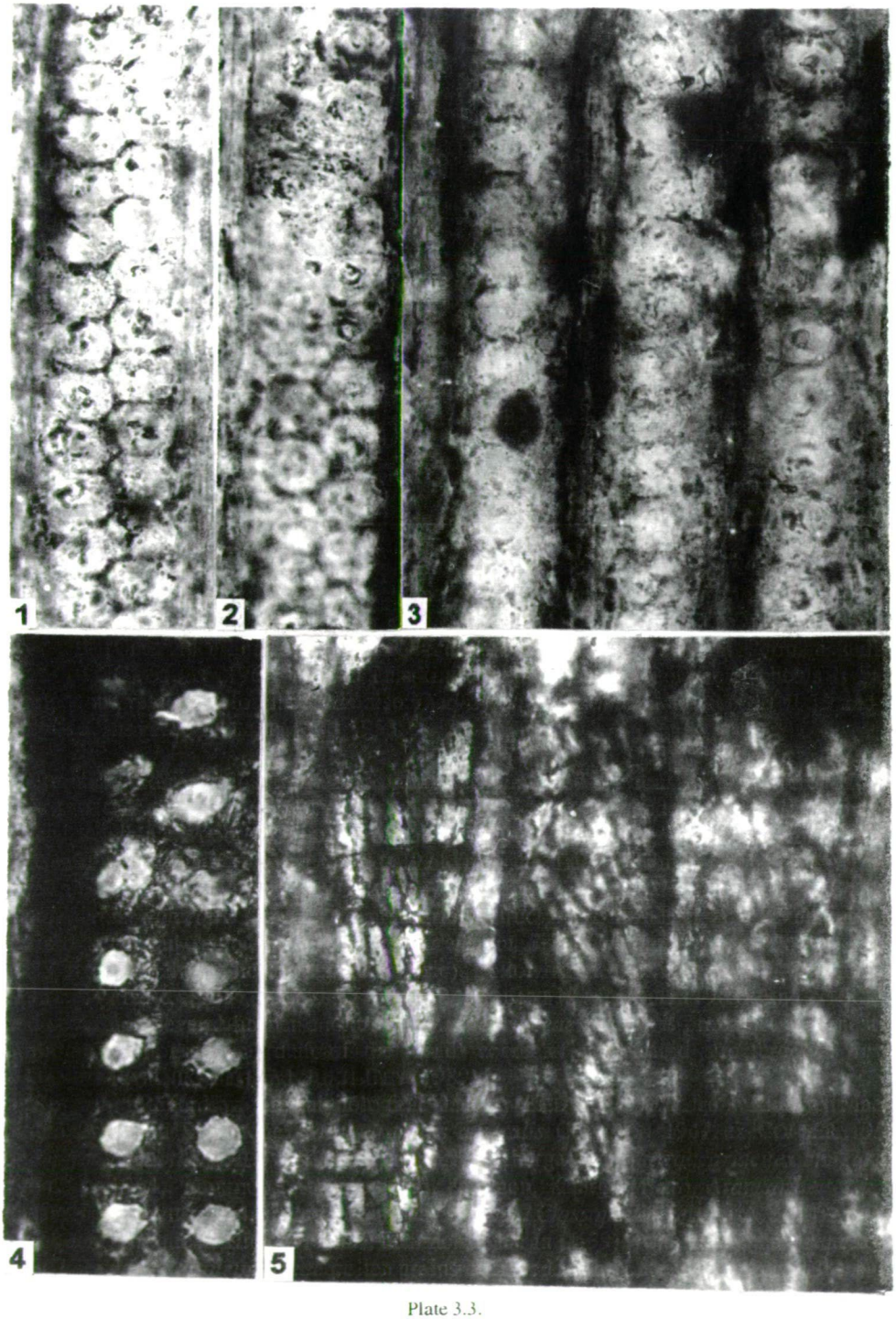


Plate 3.3.

Plate 3.1.

1,2. *Agathoxylon lifiyii* n. fsp., cross section.
1. Showing growth rings, position of resin ducts and diffuse xylem parenchyma with dark contents. 25x.
2. Annual rings, rays with dark contents and xylem parenchyma. 100x.

Plate 3.2.

1-9. *Agathoxylon lifiyii* n. fsp.
1-5. Tangential sections, uniseriate long rays. 250x.
3,4. Xylem parenchyma with dark drops. 250x.
6-9. Radial section, pitting of the cross fields.
6,7. 500x.
8,9. 1000x.

Plate 3.3.

1-5. *Agathoxylon lifiyii* n. fsp., radial sections.
1,2. Typical biseriate areolate araucarioid pits of the radial wall of the tracheids. 500x.
3. Uniseriate areolate pits of the radial wall of the tracheids. 500x.
4. Biseriate pits of the radial wall of the tracheids. 500x.
5. Cross fields of the late wood, showing peculiar spiral thickenings of the tracheids. 500x.

Araucarioxylon resiniferum GREGUSS 1967 and *Dadoxylon agathiforme* KEDVES 1955. The number of the cross-field pits of the early types is less than the described n. sp., but the spiral wall structure of the tracheids is present; cf. *Dadoxylon schrollianum* GOEPPERT and *D. transdanubicum* SIMONCSICS 1955, from Permian sediments; cf. GREGUSS (1961, 1967). This kind of spiral structure of the tracheids is known from Cretaceous fossil woods also: *Dadoxylon implexum* ZIMMERMANN 1953 and *D. graminovillae* ZIMMERMANN 1953.

Remarks. - Araucarioid pitting was published previously from different ages and taxa. MÄGDEFRAU (1953) published the Permian (Rotliegendes) *Dadoxylon* remnant as *Cordaites* wood. GOULD (1971) and TAYLOR (1981) published as *Cycadaceae* fossil the *Lyssoxylon grigsbyi* GOULD 1971 from the Triassic Chinle Formation, Arizona. ALVIN et al. (1981) and ALVIN (1982) based on *Pseudofrenelopsis parceramosa* the *Cheirolepidaceous* wood is of araucarioid structure. BARALE et al. (1991) published araucarioid secondary wood structure from *Brachyphyllum trautii* BARALE and CONTINI 1973 from the Bajocian (Jurassic). Following ANDREÁNSZKY (1949, 1954), GREGUSS (1952, 1967), KEDVES (1955), BERTOLANI MARCHETTI (1963), and STOCKEY (1982) and several further authors, the *Araucariaceae* affinity is probable. The most important bibliographical data of the fossil woods of araucarioid structure was reviewed by RAJANIKANTH and SUKH-DEV (1989).

Regarding the palynological data by KEDVES (1997) from Kharga (Maestrichtian, Nubia Sandstone) *Araucariacites australis* COOKSON 1947 ex COUPER 1953 subfsp. *aegypticus* KEDVES 1997, infrequent, Kharga (1-28), *Araucariacites hungaricus* DEÁK 1964, common, Kharga (1-39), common, Kharga (1-28), *Araucariacites balinkaense* KEDVES 1974, infrequent, Kharga (1-39), *Classopollis perplexus* BOLTENHAGEN 1973, infrequent, Kharga (1-39), common, Kharga (1-39). In this way the *Araucariaceae* and the *Cheirolepidaceae* pollen grains occurred in the Late Cretaceous of the Nubia Sand-

stone of Kharga. The botanical affinity of the fossil wood remnant presented herein may be the *Araucariaceae* or *Cheirolepidaceae.*

Beside all that is mentioned above the climate of Egypt in Cretaceous time was warm with dry and rainy seasons (SAID, 1990), which may be comparable to the climate of the area of the extant species of the family *Araucariaceae.*

Discussion and Conclusions

In conclusion it may be said that there are now 3 species of gymnospermous wood reported from the road between Kharga-Dakhla Oases namely: *Dadoxylon aegyptiacum, Protophyllocladoxylon leuchsi,* and *Agathoxylon lifiyii,* in addition to nine species of angiospermous wood namely: *Celastrinoxylon celastroides (Celastraceae), Detarioxylon aegyptiacum (Leguminosae), Ebenoxylon ebenoides (Ebenaceae), Ficoxylon sp. (Moraceae), Hibiscoxylon niloticum (Malvaceae), Proteoxylon khargaense (Proteaceae), Terminalioxylon intermedium (Combretaceae) Ternstroemioxylon dakhlaense (Ternstroemiaceae)* and *Palmoxylon zitteli (Palmae).*

KOENIGUER (1971) published Dicotyledonous woody remnants from the Paleocene layers of Sessao (Niger). It is worth of mentioning, that from the Upper Senonian of Sanhirer BUSSON (1967) published a *Dadoxylon* sp. (type araucarioid) and KOENIGUER (1967) the *Euphorbioxylon bussonii* n sp.

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