Carboniferous plant-fossil Paleoweichselia halfa n.sp.

A new species of the Genus *Paleoweichselia* POTONIE & GOTHAN (1909) in North Africa (Sudan/Egypt)

7 pages, 8 figures, 3 plates

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Introduction

In 2009 Geologists of the University of Dongola (Sudan) found in sediments of Wadi Halfa pinna-imprints from supposedly to the genus *Weichselia* associated plant. *Dr. Mutwakil Nafi* (Univ. Dongola) had send to the author photos for the determination. The author found, that the venation on the pinnules is not compatible with the Cretaceous *Weichselia reticulata*. The mesh venation is clear imperfect, similar to the Genus *Paleoweichselia* (*defrancei*) from the Carboniferous in the Saarland (Germany). Other forms of Carboniferous flora in parallel horizons of Wadi Halfa (*Rhodea, Calamites, Stigmaria*) confirm this determination. Based on the findings from the Wadi Halfa, the author has then reviewed all them available and unpublished photos from the Egyptian Gilf Kebir, and actually he found some evidence that prove the presence of the same *Paleoweichselia* in Carboniferous layers of this region. The images from the Gilf Kebir plateau are not particulary revealing. The best images are from specimens which were found in the center of a subvolcanic "Clayton Crater" south of the plateau. Unfortunately the venation of the about 0.5 cm long pinnules are in poor condition. But the reticulate venation is be seen in the approach. *Andras Zboray* and *Gabor Merkl* (Hungary) have made detailed photos.
The genus *Paleoweichselia* was created in 1909 by POTONIE & GOTHAN. *Paleoweichselia* is like *Pecopteris* in the appearance, but the pinnules have an irregularly developed mesh-venation. Carboniferous species with a like mesh venation are known from the genus *Linopteris* (e.g. *obliqua* BUNBURY). However, the pinnula shapes of *Linopteris* are mostly linguaeform and the mesh venation is regularly. *Paleoweichselia* is more comparable to *Weichselia* from the Cretaceous time, which also has a mesh-venation. However, *Weichselia* has a regularly and close-mesh structured venation.

So far, there was only one species of *Paleoweichselia* -- *Paleoweichselia defrancei* BRGNT. -- from the Westfal D in Saarland (Germany). The plant has been found in a tunnel of a coal mining.
The author is of the opinion that due to the enormous geographic distance to the Carboniferous deposits of Saarland as well as differences in shape and venation of the pinnule, he can create a new (second) species of *Paleoweichselia* for the occurrence in North Africa.

Pteridophyllopsidae
Pecopteridae
Paleoweichselia GOTHAN & POTONIE (1909)

1828-1832-----*Pecopteris Defrancei* -- BRONGNIART, Hist. de veget. foss., pp. 325-327, pl. 111, 112
1903----------*Lonchopteris Defrancei*--POTONIE, Abb. und Beschr. foss. Pflanz., Preussische geol. Landesanst., Lief. 1, no. 16
1909----------*Paleoweichselia Defrancei* -- POTONIE & GOTHAN, *Paleoweichselia*, Abb. und Beschr. foss. Pflanzen-Reste, Preussische geol. Landesanstalt, Lief. 6, no. 116

Only one species of the genus *Paleoweichselia* is known. This *Paleoweichselia defrancei* BRGNT. is considered as a local types in the Westphalian D period of the Carboniferous time in Saarland (Germany). *Gothan* and *Potonie* in 1909 had for this type, originally determinated as *Pecopteris* or *Pecopteridium*, a new separate genus *Paleoweichselia* created.
They compared *Pecopteris defrancei* BRGNT. with *Weichselia reticulata* STOKES & WEBB from the Wealden period of the Cretaceous time. Both differ only slightly in the appearance. Importantly is, however, that *Weichselia reticulata* a typical regularly and close-mesh structured venation shows. In compare *Paleoweichselia* shows an irregulary (chaotic) and incomplete mesh venation. In addition, there is a great period of time between both forms.

But a precise definition of the genus *Paleoweichselia* is not available. Thus in publications since POTONIE & GOTHAN deviations from the holotype were repeatedly made. As a result, there an confuse definition for *Paleoweichselia* in which the typical features from the holotype of this genus (pinnula shape and mesh venation) are not considered.
The images, available for the author, show negative pinna-imprints of the holotypes, which has led to a continued false derivation of the pinnule-venation. Only by a color reversal in the photos is the true venation visible. Therefore, in this publication a binding new diagnosis for the genus *Paleoweichselia* is presented, using the holotype only.

Diagnosis (new defined)

The pinnules of *Paleoweichselia* (*defrancei*) has a pecopteriod shape, a flexuose and partly anastomosing (mesh) venation. The pinnules somewhat obliquely at the midaxis of the pinna (costa) set. Proximal, the pinnules may be either free or weakly joined together. The side margins are more or less parallel to weakly conical. The distal margin of the pinnule is usually evenly rounded.
The flexuos arranged veins are very irregularly developed and often visually difficult to identify. It is particularly noticeable that a typical midaxis (costule) is barely recognizable in the pinnule. If recognizable, they ends before the middle of the pinnule length. Characteristic is the course of the costule. It begins in the pinnule proximal at a very acute angle, almost parallel to the midaxis of the pinna, and then bends in the middle of the pinnule-base to a perpendicular course.
Also are the roots of the veins at the costule quite difficult to identify. Distal they apparently do not begin into any definite angle from the imaginary midaxis into the pinnule. All the veins curl toward the pinnule-margin, which they then meet obliquely or even vertically. The mesh-areolae are mostly angular shaped, concentrated near the imaginary costule and decrease in the direction to the pinnule margin. Some larger elongate mesh-areolae lie lengthwise with the imaginary costule. All areolae are open to the margin of the pinnule.
The impression of the very irregular venation is additionally emphasized by flexible secondary veins, the course of which is strongly influenced by the mesh development in between.

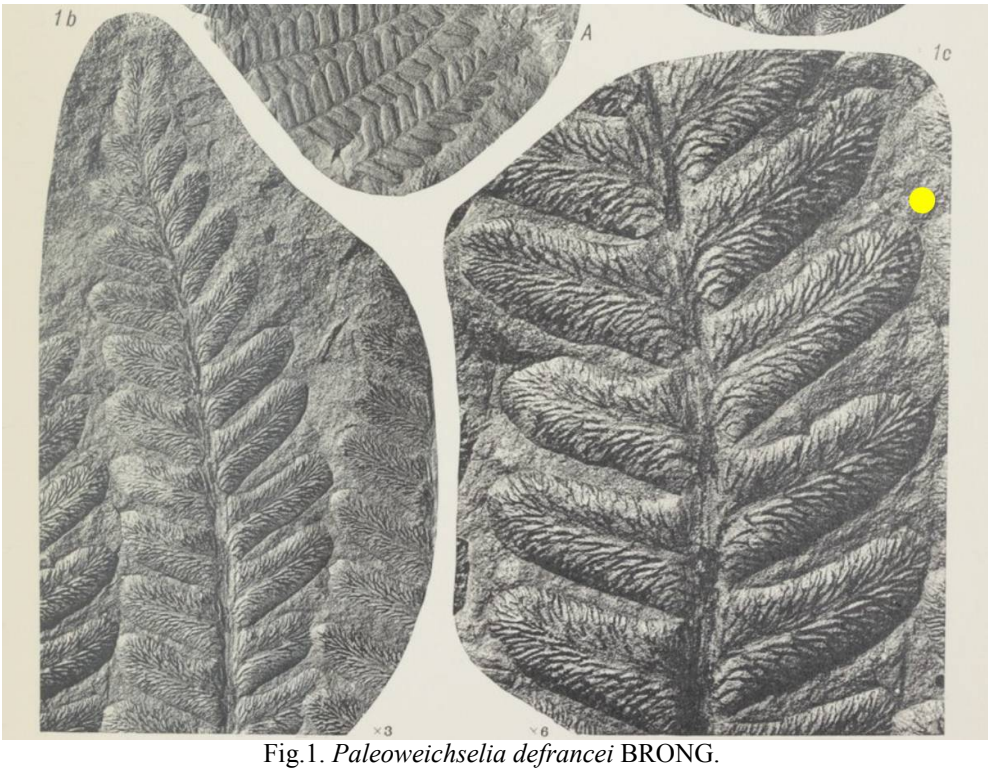

Fig.1. *Paleoweichselia defrancei* BRONG.
Holotype (negative imprint); source: Bertrand 1932 [1]

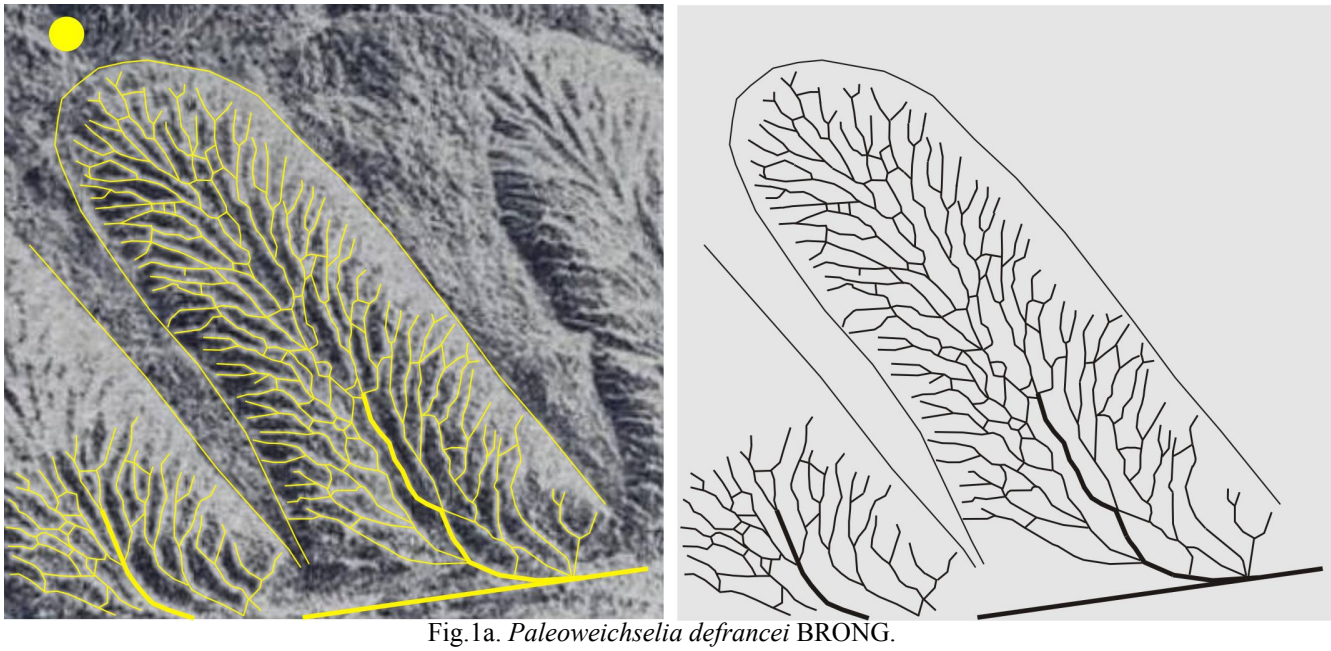
Fig.1a. *Paleoweichselia defrancei* BRONG.
Drawing of the pinnule-venation after color reversal from a negative imprint sample of the holotype, made by the author

Storage: The originals of *Paleoweichselia defrancei* are stored in the Geol. Museum of the University Strasbourg (France).

Paleoweichsela halfa n.sp.

Fig.2 to 4; plate I: fig. 1 to 3

Diagnosis

The pinnule of the new species - *Paleoweichselia halfa* n.sp. - from the Carboniferous layers of Wadi Halfa (Northern Sudan) has the typical imperfect mesh venation of the genus *Paleoweichselia* GOTHAN & POTONIE. The anastomosing venation with mesh-areolae appears in *Paleoweichselia halfa* n.sp. in principle similar to *Paleoweichselia. defrancei*. As in *Paleoweichselia defrancei*, a typical midaxis (costule) is barely developed in the pinnule. If recognizable, they ends before the middle of the pinnule. So the roots of the veins mostly can not be identified. The characteristic course of the costule is difficult to recognize. But similar to *Paleoweichselia defrancei* begins the costule in the pinnule proximal at a very acute angle, almost parallel to the midaxis of the pinna, and then bends in the middle of the pinnule-base to a perpendicular course.

The mesh-areolae are angular shaped, concentrated near the imaginary costule and decrease in the direction to the pinnule margin. Elongate mesh-areolae, that lie lengthwise with the imaginary costule, are not to see. Similar areolae are in contrast to *Paleoweichselia defrancei* reduced formed. To the margin of the pinnule are the areolae open.

Noticeable is the knotted and pointed appearance of the mostly wavy veins. The pointed veins shows that the meshes are partly developed in an initial phase.

The typical pecopteroid shape of the pinnules differs only slightly from *Paleoweichselia defrancei*. The pinnules sit slightly obliquely on the pinna midaxis (costa), are about 0.50 to 0.55 cm long and at the base about 0.25 cm wide . In contrast to *Paleoweichselia defrancei* they are developed more stocky in shape and are always separated from each other on the costa. The distal margin of the pinnules are evenly rounded to slightly pointed. Due to the more stocky shape of the pinnule, the venes run in a shallower arch against the margin.

Unfortunately the venation on the pinnules of the finds in the Gilf Kebir is not very good. The best preserved finds were made in broken silty to fine-grained sandstones in a subvolcanic structure (Clayton Crater) south of the Gilf Kebir plateau. But the venation of these smaller specimens is so structured that we can believe that these are juvenile specimens. Areolae are still rare developed along a already wavy axis (pl.III, fig.5). On the other hand, a well-developed mesh venation can be seen on an adult fragment from the Aqaba passage (pl.II, fig.5; determined by LEJAL-NICOL in 1979 as Weichselia reticulata).

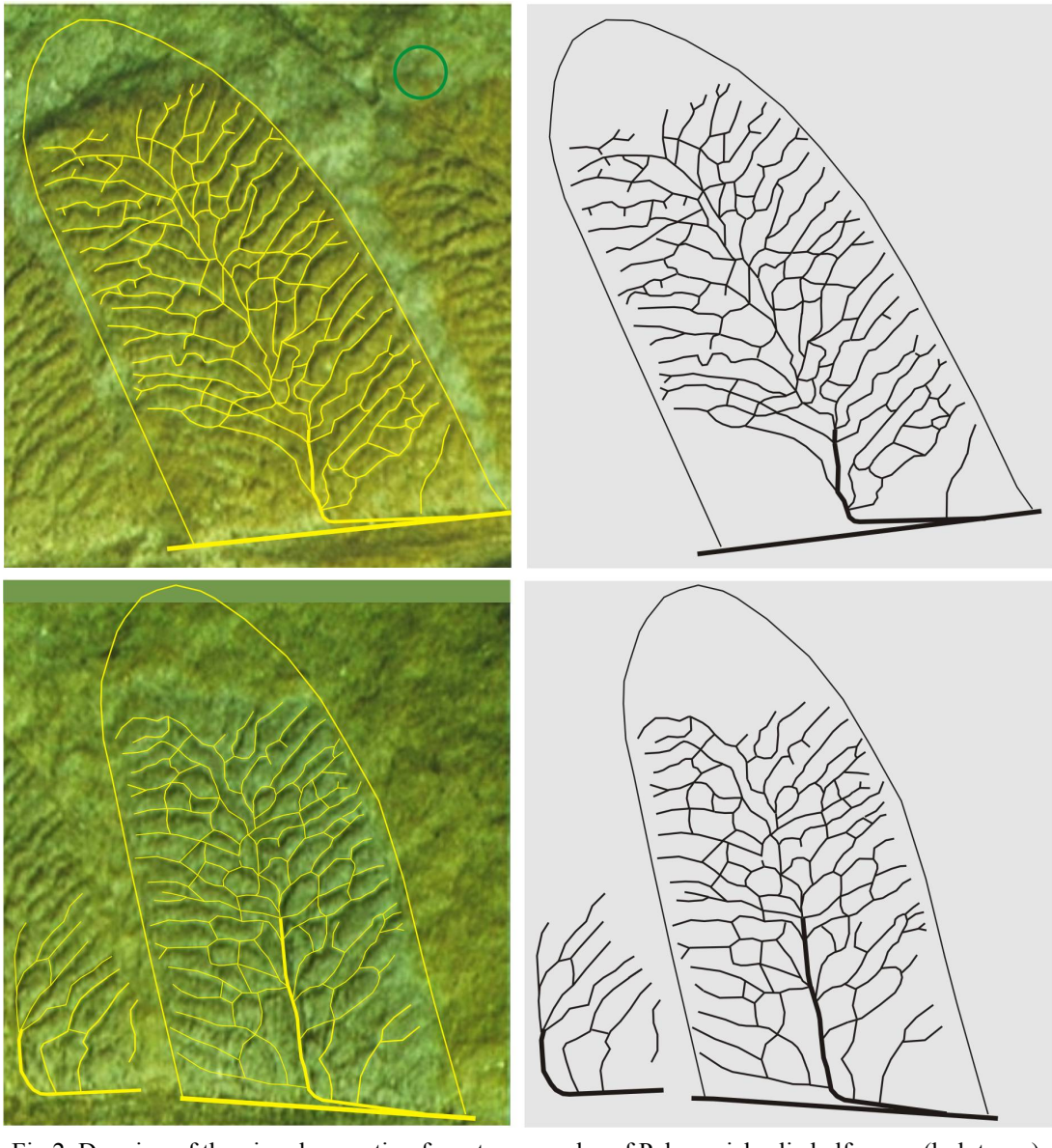

Fig.2. Drawing of the pinnule-venation from two samples of Paleoweichselia halfa n.sp. (holotypes)

Stratigraphic position: Carboniferous (Visean to Westphalian)

Storage

The holotype of *Paleoweichselia halfa* n.sp. and relevant finds are held by the University of Dongola (Sudan). The pieces of *Paleoweichselia halfa* n.sp. from the Gilf Kebir and the Clayton Crater are privately owned or have remained on site, and only exist as photos.
Not clarified is the storage of the depicted piece from the Aqaba passage (pl.II, fig.5), which first time was determined by LEJAL-NICOL (1987) as *Weichselia reticulata*.

Fig.3. Holotype of *Paleoweichselia halfa* n.sp.

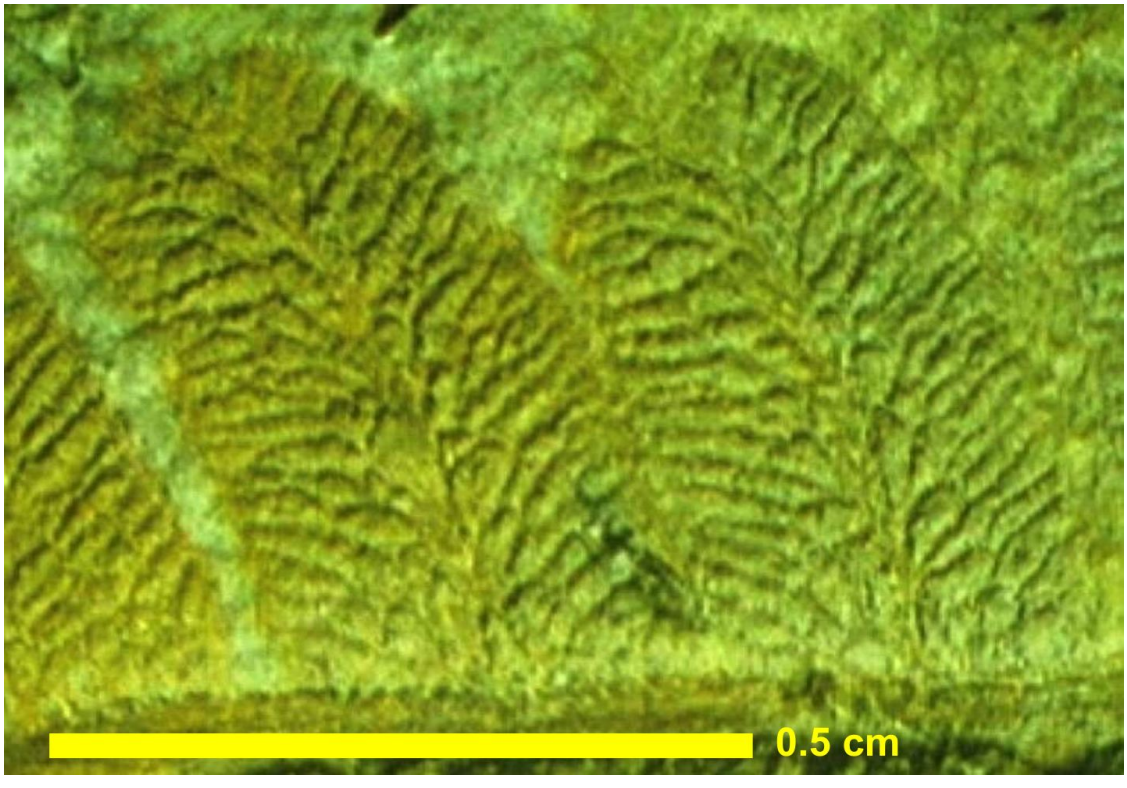

Fig.4. Venation of *Paleoweichselia halfa* n.sp. (holotype)

Locations

Sudan -- Wadi Halfa (holotypus), Karb El-Toum (?)
Egypt -- Gilf Kebir: Wadi Talh, Aqaba passage, Clayton Crater, Wadi Wassa

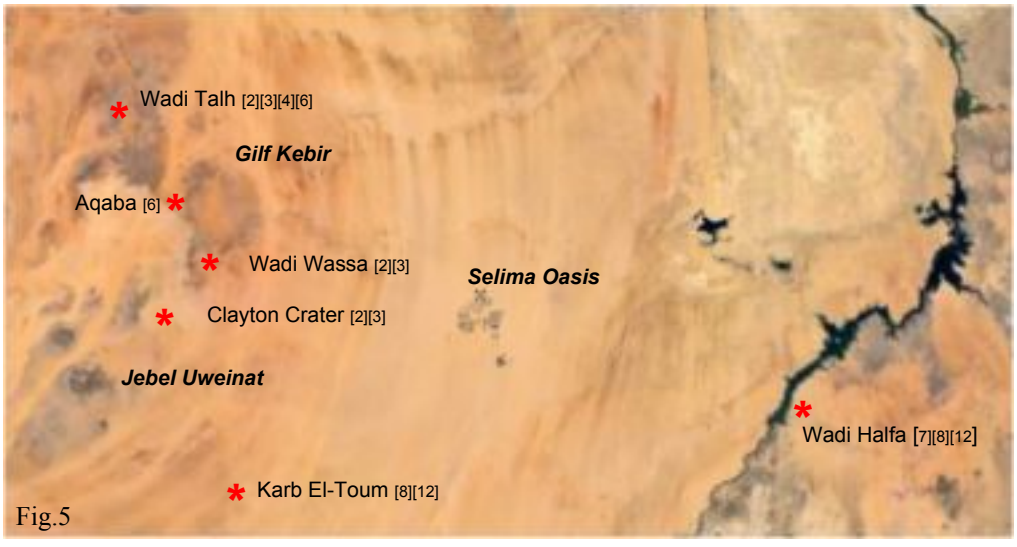

Fig.5

Associated Flora

Wadi Halfa [7][8]
Sigillaria, *Calamites*, *Rhodea aff. lontzenensis* STOCKM. & WILL.
Gilf Kebir [2][3][4][5][6]
cf. *Amadokia boureaui* LEJAL-N., cf. *Heleniella costulata* LEJAL, *Eskdalia malikense* LEJAL-N., *Caenodendron primaevum* ZALESSKY, *Rhacopteris ovata* WALKOM, *Triphyllopteris gothani* DABER, *Eremopteris whitei* BERRY, *Lepidodendron volkmannianum* STERNB., *Lepidodendron veltheimii* STERNB., *Lepidosigillaria intermedia* LEJAL, *Pseudolepidodendropsis klitzschii* LEJAL-N., *Lepidodendropsis* cf. *sinaica* JONGM., Lepidodendropsis lissoni JONGM., *Lepidodendropsis vandergrachti* JONGM., *Lepidodendropsis africanum* LEJAL, *Lepidodendropsis fenestrata* JONGM., *Lepidodendropsis hirmeri* LUTZ, *Nothorhacopteris* sp., *Protosalanus* sp., *Archaeosigillaria minuta* LEJAL, *Sublepidodendron fasciatum* JONGM., *Prelepidodendron lepidodendropsis* LEJAL, *Prelepidodendron rhomboidale* CORSIN, *Pseudolepidodendropsis klitzschii* LEJAL-N., *Cordaites regularis* LEDRAN, *Cordaites angulostriata* GRAND., *Rhodea lontzenensis* STOCKM. & WILL., cf. *Asterocalamites*.

Lithostratigraphy

1. Carboniferous layers in the Wadi Halfa region (Sudan)
[7][8]
"The strata of Northern Sudan have been mapped before as Cretaceous sediment and no Paleozoic strata. Recent works by the University Dongola in Northern and Northwestern Sudan (Wadi Halfa, Argein, Lakia Arabian, Jebel Toshka), indicated the presence of marine and continental sediments ranging in age from Carboniferous to Permo-Triassic. A major cycle of regressive and transgressive lithofacies consists of diamictites, varves with dropstones, sandstones, conglomeritic sandstone, siltstones, shales and thin beds of oolitic ironstone. The age of Carboniferous layers (Wadi Halfa and Argein region) is based on the presence of plant fossils *Sigillaria, Calamites, Rhodea aff. lontzenensis, Paleoweichselia aff. defrancei (halfa n.sp.)*. Marine sediments were indicated by the presence of ichnofossils."

These strata reach more than 100 meters of thickness and they are called Wadi Malik Formation (KLITZSCH 1979).The sediments of the Wadi Malik Formation rests over an eroded base of the Ordovician to Devonian sandstones unconformably. A rich flora was discovered in the Wadi Abdel Malik type area, including: *Rhacopteris ovata, Triphyllopteris gothani*. At Wadi Abdel Malik, were found this flora several meters below intercalations containing remains of different brachiopods, for example *Camerotoechia sp.* as well as abundant marine ichnofossils including *Asterichnus, Bifungites, Nereites, Zoophycos, Scolitia, Conostichus, Phycosiphon (*Seilacher 1983).
The uppermost parts of the underlying strata contain plant remains like *Triphyllopteris gothani*.

2. Carboniferous layers in the Gilf Kebir region (Egypt)
[10]
"At the Wadi Abdel Malik respectively at the western part of the Abdel-Malik Plateau (Wadi Talh area), shallow marine sandstone, siltstone and shale prevail, containing - apart from plants -*brachiopodes, lamellibranchiates* and different *ichnofossils*.

The upper part of he formation, which is here approximately 50-55 m thick, is overlain by a thin conglomerate followed by sandstone, containing among others *Cordaites angulostriata*. Moreover, the upper part of the Formation - directly below the conglomerate - contains *Rhodea lontzenensis*."

In the last fifteen years, the search by interested participants of trekking-groups (Andras Zboray, Ursula Steiner, Norbert Brügge) has brought many new discoveries of carboniferous plant-imprints in the Egyptian Gilf Kebir region. This also includes Paleoweichselia halfa n.sp.
Unfortunately is the precise position of the finds in the lithostratigraphic context not noted. But, the widespread new finds of these Carboniferous plants document that Carboniferous deposits are confined not only to the northern part of Gilf Kebir and Jebel Uweinat.

Lithostratigraphical sections

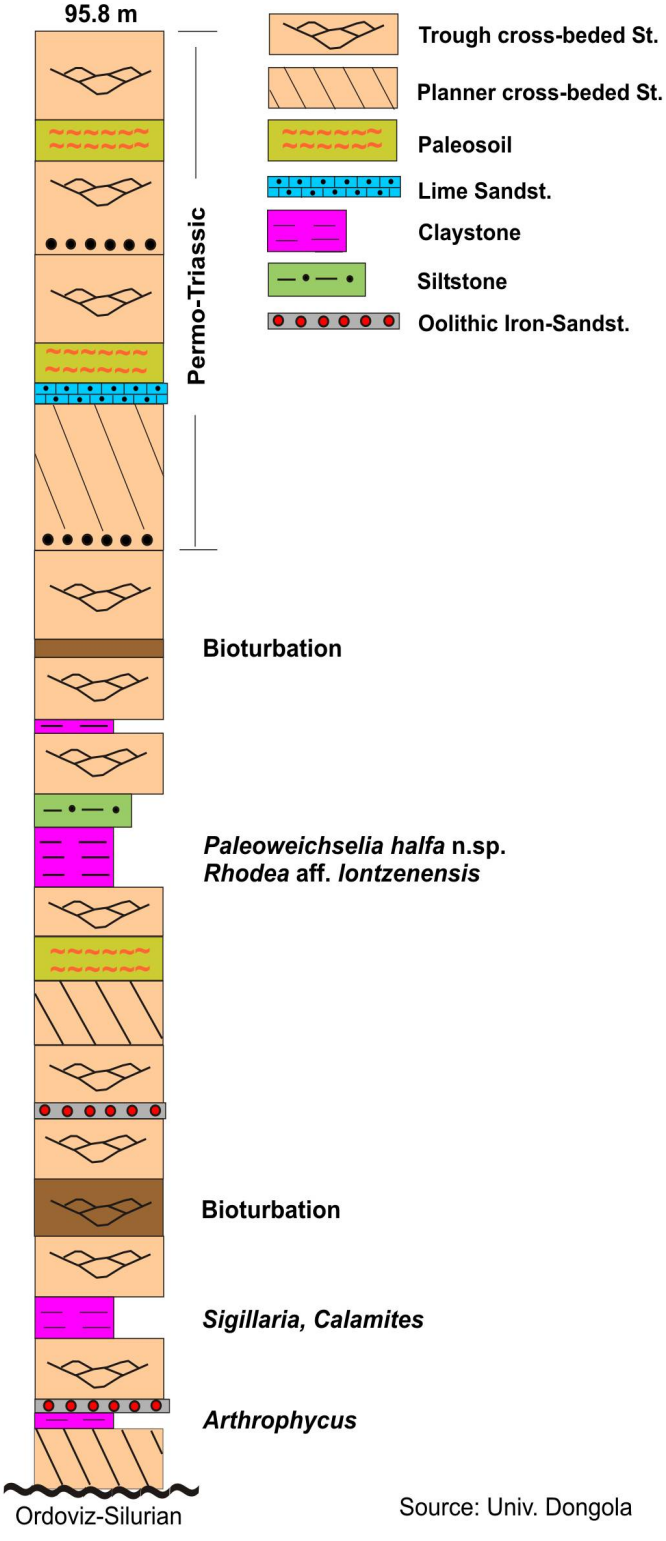

Fig.6a. Generalized geological profile of Wadi Halfa [12]

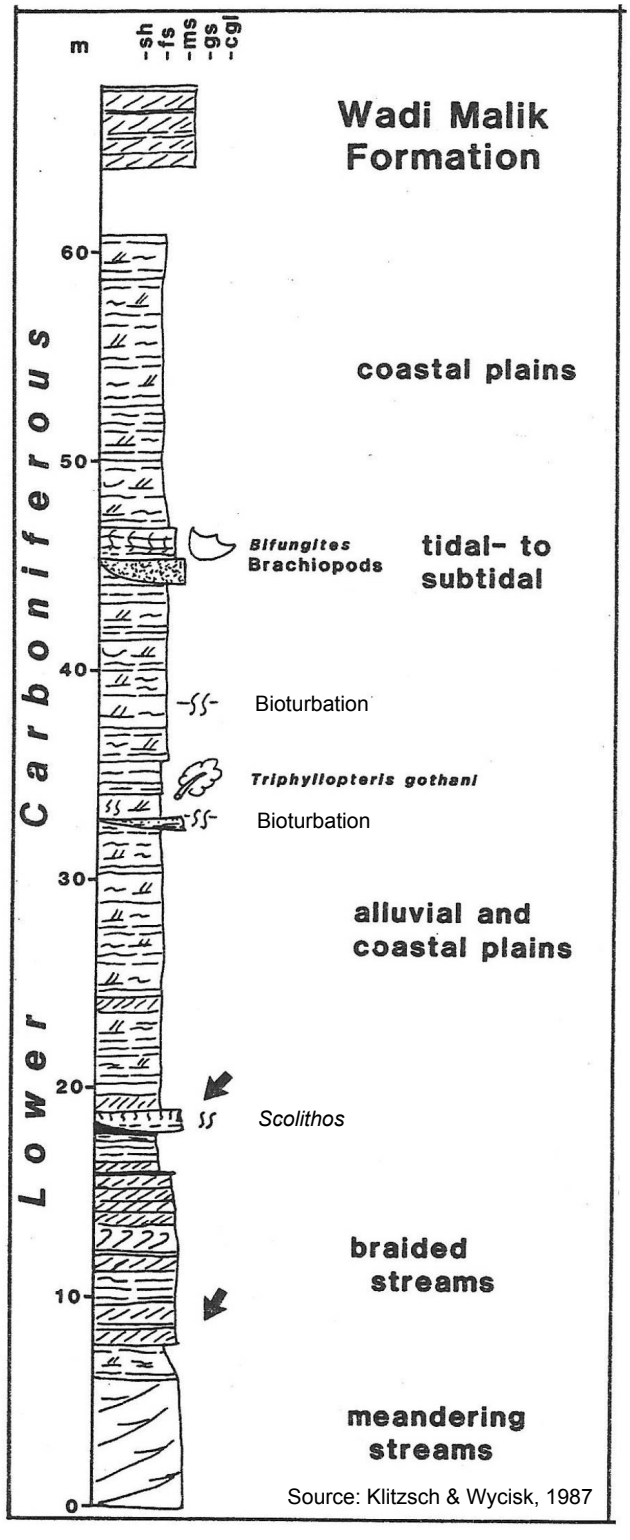

Fig.6b. Generalized geological profile of Gilf Kebir [5]

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[1] **Bertrand, P.** -- Alethopteridees, bassin de la Sarre et de la Lorraine.
Etudes des Gites Mineraux de la France, Flore Fossile, 2me fascicule (1932)

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Wiss. Mitt. Inst. Geol., TU Bergakademie Freiberg (Germany), Heft 45, S. 44-45
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[11] **The Geology of Egypt**, A.A. Balkema/Rotterdam (1990)
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Chapter 29: Fossil flora (Lejal-Nicol, A.)

[12] **University of Dongola** (Sudan). Faculty of Earth Sciences and Mining. Dep. of Petroleum Geology.
Not published geological documentations (copies in personal archive Brügge)

Plate I. Wadi Halfa (Sudan)

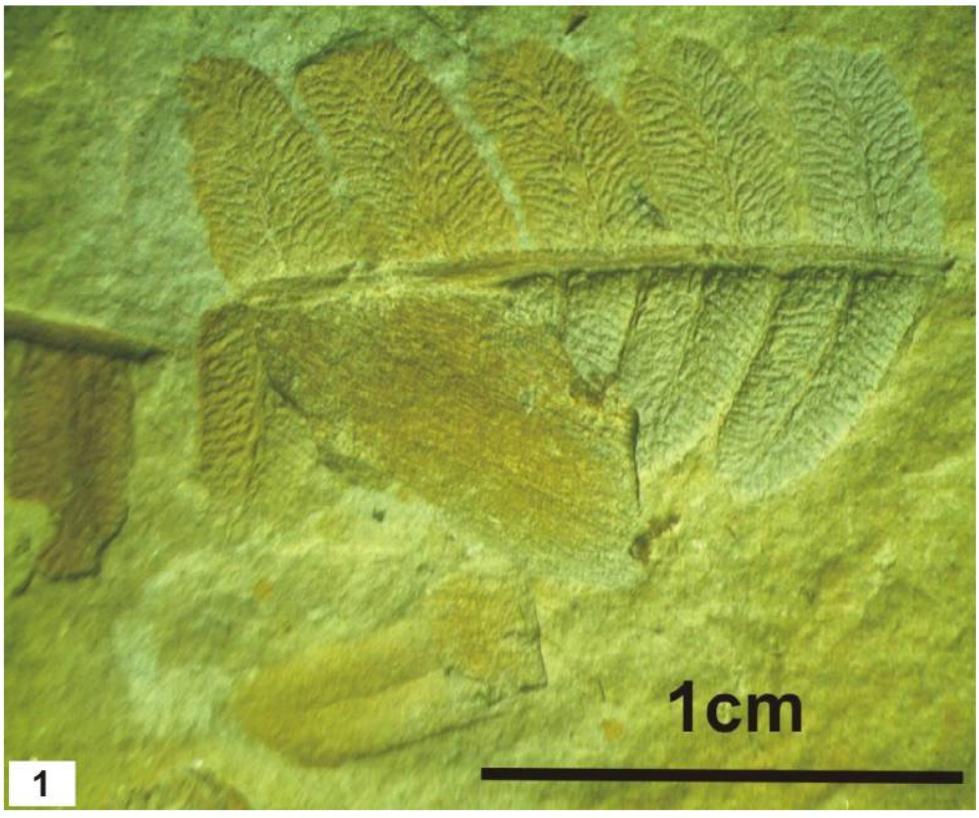

Fig.1. *Paleoweichselia halfa* n.sp. Holotype with typical mesh venation [8][12]

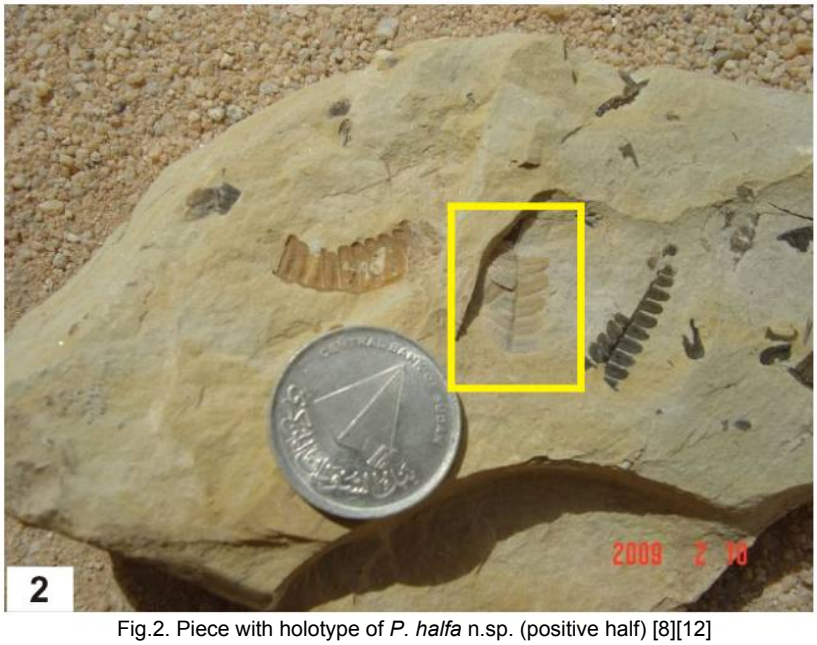

Fig.2. Piece with holotype of *P. halfa* n.sp. (positive half) [8][12]

Fig.4. *Rhodea* aff. *lontzenensis* in the same layer [12]

Fig.3. Piece with holotype of *P. halfa* n.sp. (negative half) [8][12

Fig.5. *Paleoweichselia* or *Cladophlebis* ?, Karb El-Toum [8][12]

Plate II. Gilf Kebir (Egypt)

Fig.1. Carboniferous layers (northern Gilf Kebir) [3]

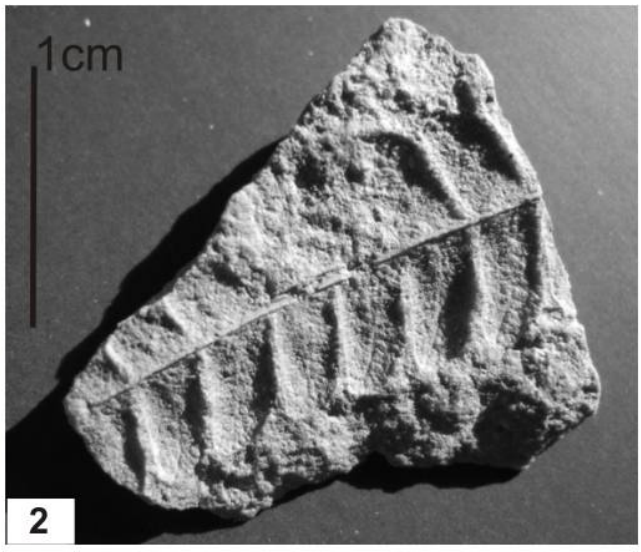

Fig.2. Piece from the Wadi Abdel Malik (Wadi Talh site) [3]

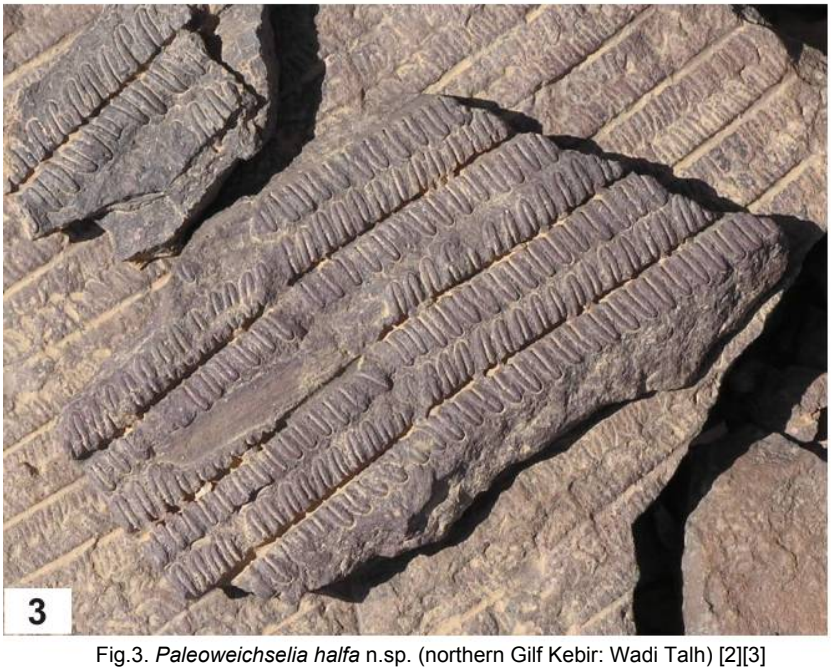

Fig.3. *Paleoweichselia halfa* n.sp. (northern Gilf Kebir: Wadi Talh) [2][3]

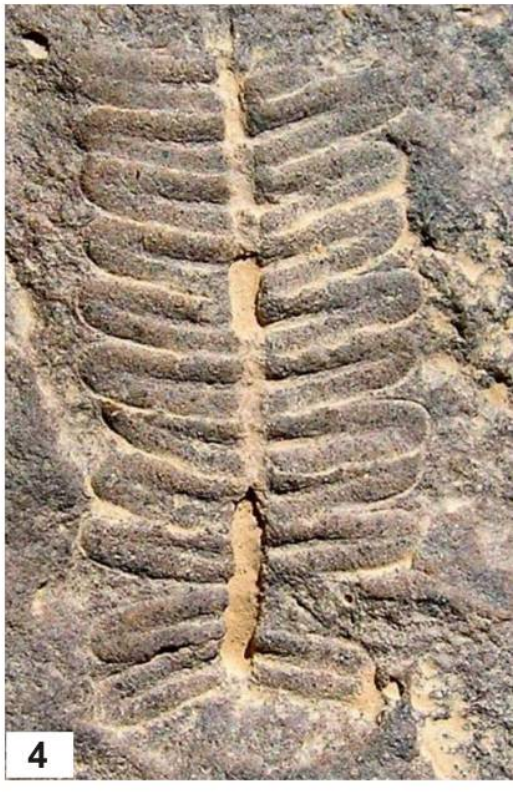

Fig.4. *Paleoweichselia halfa* n.sp. (Wadi Talh) [2][3]

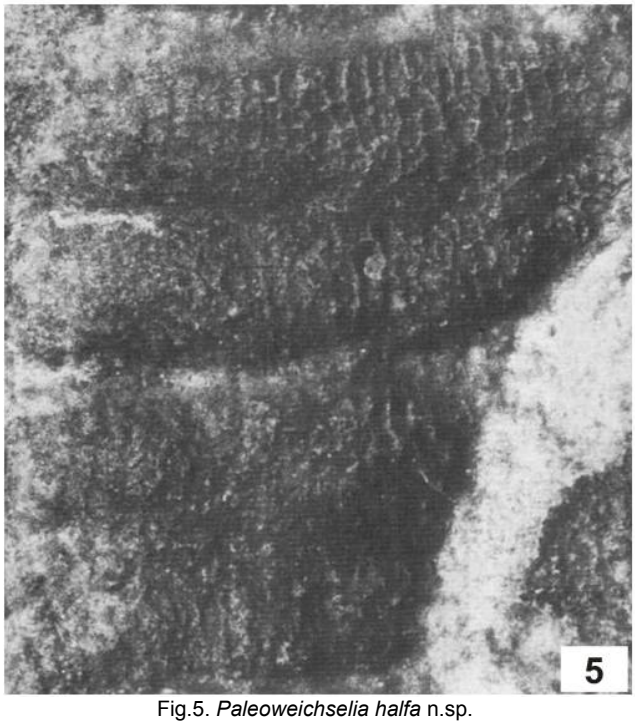

Fig.5. *Paleoweichselia halfa* n.sp.
(southern Gilf Kebir, Aqaba passage) [6]

Fig.6. *Paleoweichselia* (southern Gilf Kebir: Wadi Wassa) [2][3]

Plate III. Clayton Crater (Egypt)

Fig.1. Broken Carboniferous sandstone in the crater [3]

Fig.2. Piece with *Paleoweichselia* imprints [3]

Fig.3. Single piece of *Paleoweichselia halfa* n.sp. [2][3]

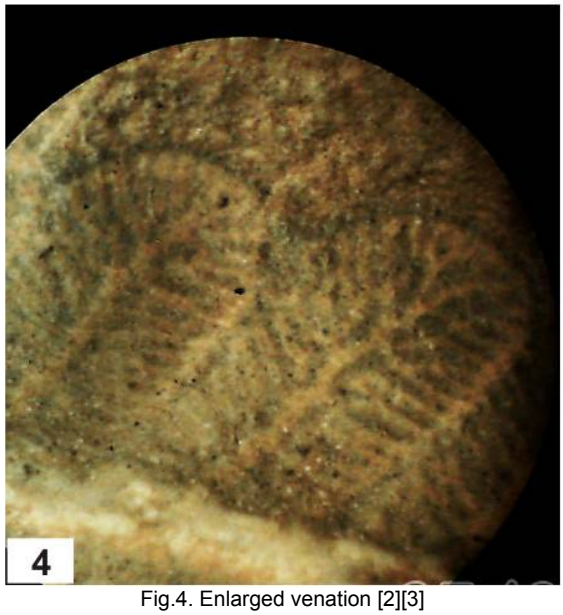

Fig.4. Enlarged venation [2][3]

Fig.5. Small pinnules of *Paleoweichselia halfa* n.sp. in poorly visible venation [2][3]