



First finding of a fossil fern (Matoniaceae) in the paleontological site of Pietraroja (Benevento, Southern Italy)

Antonello BARTIROMO, Maria Rosaria BARONE LUMAGA & Sergio BRAVI

A. Bartiromo, Dipartimento di Scienze della Terra, Università degli Studi di Napoli "Federico II", Largo San Marcellino 10, I-80138 Napoli, Italy; a.bartiromo@unina.it

M.R. Barone Lumaga, Orto Botanico Università degli Studi di Napoli "Federico II", Via Foria 223, I-80139, Napoli, Italy; mrbarone@unina.it

S. Bravi, Dipartimento di Scienze della Terra, Università degli Studi di Napoli "Federico II", Largo San Marcellino 10, I-80138 Napoli, Italy; sergiobravi@libero.it

KEY WORDS - *Matoniaceae*, *Lower Cretaceous*, Fossil-Lagerstätte, *Southern Italy*.

ABSTRACT - The Fossil-Lagerstätte of Pietraroja (Benevento province, Southern Italy) is a paleontological site of international relevance mostly known for the discovering of the theropod dinosaur *Scipionyx samniticus*. The site has been recently dated to the early (basal) Albian on the grounds of the microfossils yields.

The fossil fern described in this paper has been collected at "Le Cavere" (a quarry close to the Pietraroja village). It is preserved as a fossil plant impression and is at present stored at the Museo di Paleobotanica (Orto Botanico di Napoli). General and fine morphology of the fossil, a pinna fragment, allow us to ascribe it to the family Matoniaceae and probably to the genus *Phlebopteris*.

RIASSUNTO - [Primo ritrovamento di una felce fossile (Matoniaceae) nel giacimento di Pietraroja (Benevento, Italia meridionale)] - Il giacimento di Pietraroja, un geosito internazionalmente noto anche grazie al ritrovamento del dinosauro *Scipionyx samniticus*, è stato recentemente attribuito all'Albiano basale in base alle associazioni microfossilifere contenute nei suoi strati ed in quelli subito sottostanti.

Nella località nota come "Le Cavere", è stato raccolto il campione oggetto del presente studio, costituito dall'impressione di una pinna con relative pinnule. Il fossile è preservato in matrice calcarea a grana fine. Le pinnule sono: lineari, con apice ottuso, con margine basale da decorrente a leggermente decorrente e nervatura mediana ben evidente. Sono parzialmente visibili le nervature secondarie che si distaccano dalla nervatura centrale della pinnula con un angolo di 50°. In prossimità delle nervature primarie delle pinnule si osservano strutture circolari con un diametro di circa 0,5 mm. La struttura generale del fossile e la sua morfologia fine ne permettono l'attribuzione alla famiglia delle Matoniaceae e nell'ambito di essa, con molta probabilità al genere *Phlebopteris* Brongniart.

INTRODUCTION

Since the end of the XVIII century the Pietraroja Cretaceous Fossil-Lagerstätte has been the object of several paleontological studies and observations (Breislak, 1798; Costa, 1853-1864) and later on, of geological and stratigraphical studies as well (D'Argenio, 1963; Catenacci & Manfredini, 1963; Freels, 1975; Bravi & Garassino, 1998). The majority of fossil remains is represented by fishes, mostly assigned to the genera "*Coelodus*" (fam. Pycnodontidae), *Lepidotes* (fam. Semionotidae), *Belonostomus* (fam. Aspidorhynchidae), *Clupavus* (fam. Clupavidae), *Diplomystus* (fam. Paraclupeidae *incertae sedis*), together with other relatively rare genera. Decapod crustaceans are frequent (Bravi & Garassino, 1998); lacertilian reptiles, mesosuchids and dinosaurs (e.g. *Scipionyx samniticus* Dal Sasso & Signore, 1998) are also present, although rare. Recently, some fossil plants from this site have been studied: some leaves were assigned to the genus *Zamites*, Order Bennettitales, while some branches were assigned to *Brachyphyllum* (Bravi & Garassino, 1998).

GEOLOGICAL SETTING

The "Civita di Pietraroja" (I.G.M. map 162 III SW - Cusano Mutri) is a faulted monocline with an average strata dip of 15° E-SE; it is located at the eastern edge of the Matese massif (Fig. 1). The "Civita" is well limited by fault slopes showing a NW-SE and NE-SW orientation. The western side of the Civita is a 400 m-high, vertical slope (960 m a.s.l.), but the eastern side declines slightly.

From a palaeogeographic point of view, the structure is referred to the Abruzzi-Campania carbonate platform (D'Argenio et al., 1973; D'Argenio & Sgroso, 1974) which is characterized by an erosive gap, marked by bauxites, in the middle Cretaceous, cropping out in the north-western area of the southern Apennine (D'Argenio et al., 1987).

The "Ichthyolitic level of Pietraroja" crops out widely in the central part of the Civita, close to the Pietraroja village. It is about 20 m thick and has recently been dated to the early (basal) Albian (Bravi & Garassino, 1998) on the grounds of its foraminiferal content,



Fig. 1 - Map showing the location of the studied area (I.G.M. sheet 1:25000: 162 III SW - Cusano Mutri).

including *Ovalveolina reicheli* De Castro, *Paracoskinolina tunesiana* Peybernes, and *Cribellopsis cf. arnaudae* Chiocchini (Fig. 2).

The sedimentological and palaeoenvironmental data indicate that the ichthyolitic level formed into a shallow, carbonate platform lagoon environment, frequently isolated from the open sea, dominated by slight tidal currents and exposed to storms (Bravi & Garassino, 1998). In the strata of the fossil site two main facies are usually alternated: one constituted by thin laminated mudstones and/or microdetritic limestones 1 to 10 cm thick, and the other represented by millimetric laminae sets of marly limestones, often rich in land plants remains, fossil fishes and sometime reptiles. The dinosaur *Scipionyx samniticus* Dal Sasso & Signore was found into one of the latter levels.

About 2 km NE from the “Civita di Pietraraja”, at the Mutria Mount, a bauxite level crops out. The limestones underlying this level show the same biofacies

and a well-comparable age as the Pietraraja ichthyolitic level. This leads us to identify the Mutria Mount area as an emerged land that, in the early Albian was already rising out of the water and bordered the “Pietraraja lagoon”.

MATERIAL AND METHODS

The specimen described in this paper (Pl. 1) has been found in the “Le Cavere” locality, from which some plant remains in a calcareous-marly matrix have been already reported by Bravi (1996).

The specimen, temporarily stored in the Paleobotanical Museum of the “Orto Botanico di Napoli” (the definitive location will be indicated by the Soprintendenza ai Beni Archeologici di Salerno, Benevento, Avellino), is classifiable as an impression, according to the categories elaborated by Schopf (1975) for modes of plant fossil preservation.

This state of preservation has remarkably influenced the study, due to the scarcity of organic matter. Observations carried out at low angle sunlight, allowed the definition of some morphological features (Pl. 1, figs. 1-2). The UV-light study (Transilluminator Lourmat UV TFX-20:M, $\lambda=312$ nm) allowed the identification of the scarce organic remains not otherwise visible, and helped to better define the morphology and the structure limits of the fossil (Pl. 1, figs. 3-5). The macro-photos have been taken with a Fuji s5000 digital camera, both in solar and UV light.

PALEONTOLOGICAL DESCRIPTION

Class FILICOPSIDA

Order FILICALES

Fam. MATONIACEAE

Genus *Phlebopteris* Brongniart, 1836

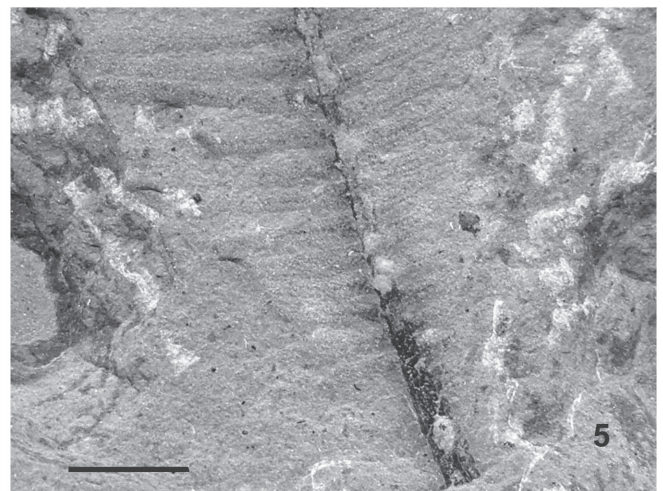
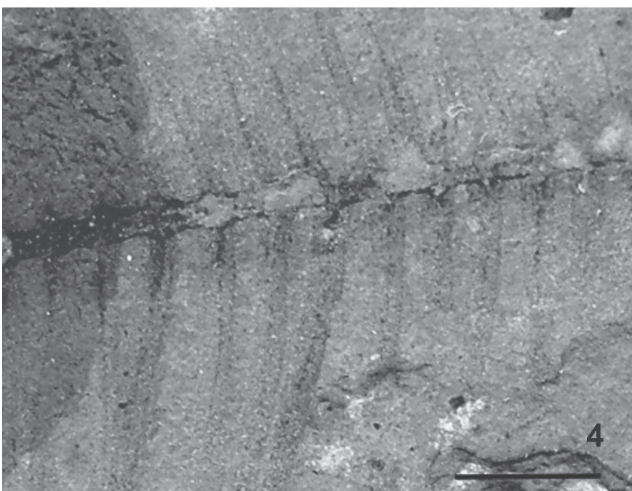
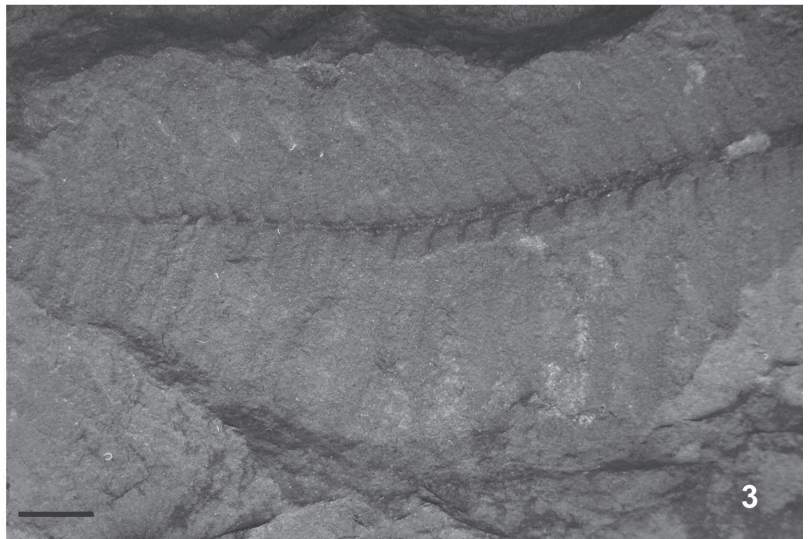
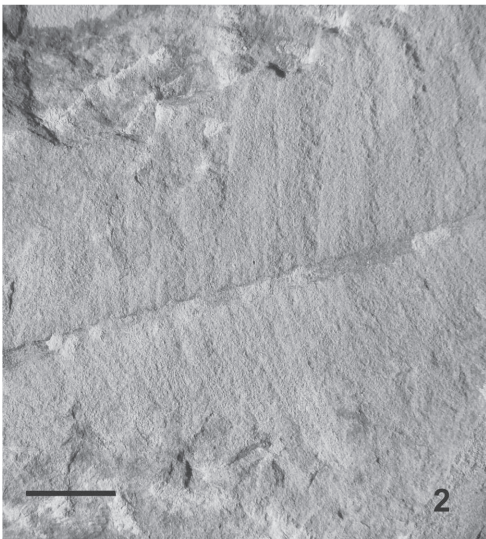
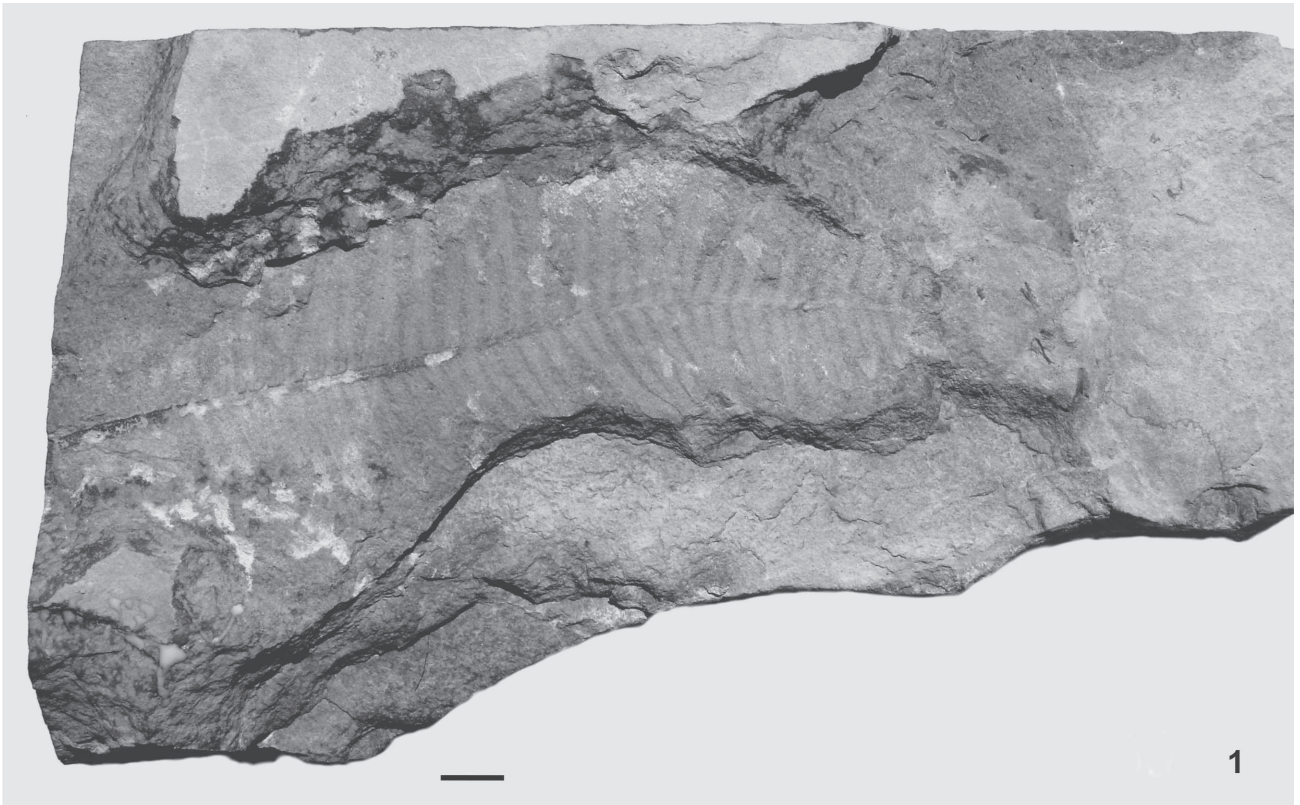
The Matoniaceae have been recorded from the Late Triassic up to the present, but the family was common and widespread during the Jurassic and Early Cretaceous both in the Northern and Southern Hemisphere (Van Konijnenburg-van Cittert, 1993).

The genus *Phlebopteris* Brongniart has been subject of various revisions (Harris, 1961; Van Konijnenburg-van Cittert, 1993). The fronds of this genus are

EXPLANATION OF PLATE 1

- fig. 1 - General view.
- fig. 2 - Detail of the basal segment of the pinna, photographed in the sunlight.
- fig. 3 - General view of the specimen photographed in UV light.
- fig. 4 - Detail of the median segment of the pinna, photographed in UV light.
- fig. 5 - Detail of the basal segment of the pinna, photographed in UV light.

Bar scale = 1 cm.



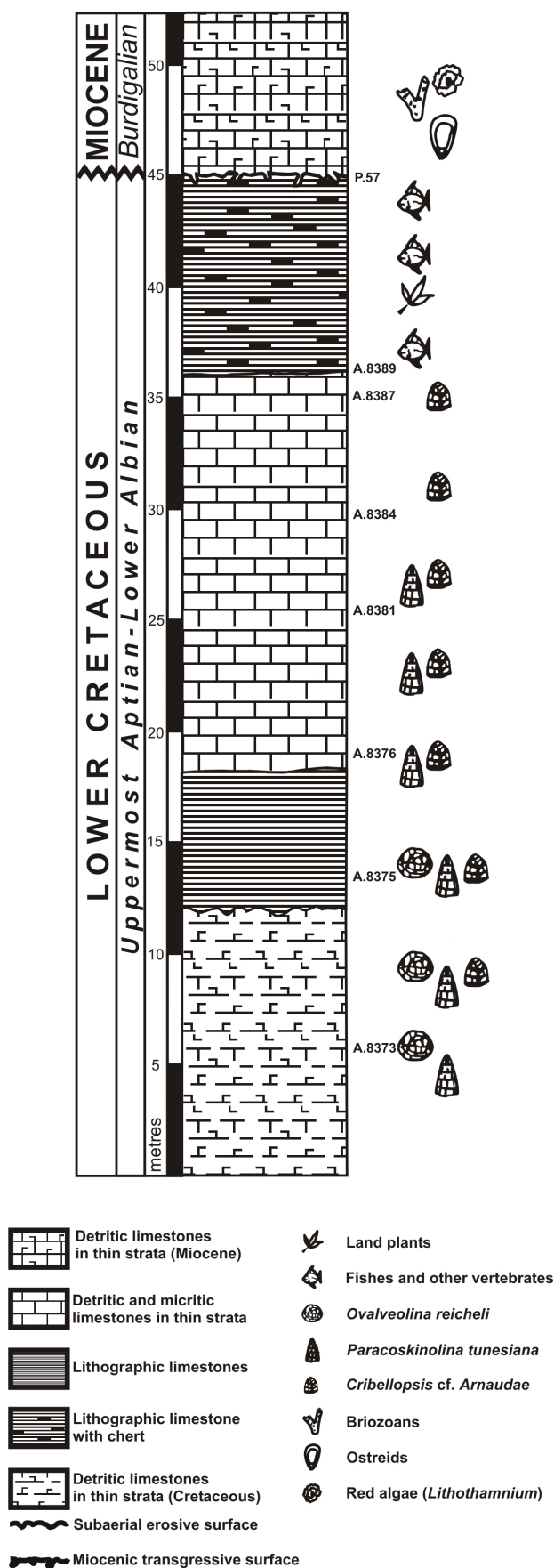


Fig. 2 - Stratigraphical sequence of the northeastern side of the Civita di Pietraraja. Modified after Bravi & Garassino (1998).

characterized by a basal dichotomy with both the branches supporting numerous pinnae further subdivided into linear pinnules with a blunt apex. In some species, anastomosed lateral venations depart from the midrib of the pinnules. The sori are arranged in two rows flanking the midrib of the pinnules and are without indusium (Meyen, 1987; Taylor & Taylor, 1993; Givulescu & Popa, 1998; Harris, 1961; Hirmer & Hoerhammer, 1936; Lundblad, 1950; Van Konijnenburg-van Cittert, 1993).

Description - The sample is composed of part and counterpart of a pinna fragment. The central axis is generally straight, except for a slight curvature in the medial-distal portion (Pl. 1, fig. 1).

The visible part of the rachis, which is interrupted in its basal portion, is about 14 cm long, 3 mm wide at the base and tapers progressively towards the apex (Fig. 3), reaching a minimum width of 1 mm. The pinnules, well observed under UV light (Pl. 1, figs. 3-5), vary in length from 8 to 25 mm and have a width of about 2 mm. They are linear, with an obtuse apex and the basal part runs from not decurrent to lightly decurrent; their attachment on the rachis varying from 75° to 85°. Moreover, they present a well evident midvein. The observations related to the features of the secondary veins course and to the presence of sori tracks were carried out under sun light conditions (the UV light was not useful to identify these characters). Not far from the primary venations of the pinnules some circular structures with a diameter of about 0.5 mm are present. Such structures are faintly visible in the medial portion of the pinnae.

Concerning the secondary venations of the pinnules, they arise at an angle of 50° from the midvein, it was possible to partially observe the venations course, close to the branching point, the rest having not been preserved.

Discussion - The characters observed in the specimen under study, in particular the width of the pinna, the shape and size of the pinnules, the course of primary and secondary veins of the pinnules, and the presence of marks referable to sori track, agree with the features of the family Matoniaceae, and in particular with the genus *Phlebopteris* Brongniart.

PHILOGENETICAL AND STRATIGRAPHICAL CONSIDERATIONS

The Matoniaceae, along with Gleicheniaceae, Dipteridaceae, and Hymenophyllaceae, are among the most ancient lineages of extant leptosporangiate ferns, with an evolutionary history tracing back to the early Mesozoic (Skog, 2001). At present, the Matoniaceae are considered a systematically isolated group having a basal position in the leptosporangiate ferns phylogenesis. Even though the remaining taxa of the Matoniaceae are today limited to the Malaysian archipelago (Kato, 1998), numerous Mesozoic remains have been found in every continent, including the Antarctic (Skog, 2001).

CONCLUSIONS

This is the first specimen among the fossils plants found at Pietraraja ascribed to the Filicales. It is also the first finding of the genus *Phlebopteris* Brongniart in the locality. This finding is of particular paleontological interest as it testifies the presence of

Matoniaceae in the Pietraraja site. The previous findings of xerophilous forms like Bennettitales and Araucariaceae (Bravi, 1996), in addition to the presence of *Phlebopteris*, give important insights in understanding the floristic composition of the lands once surrounding the Cretaceous Pietraraja lagoon.

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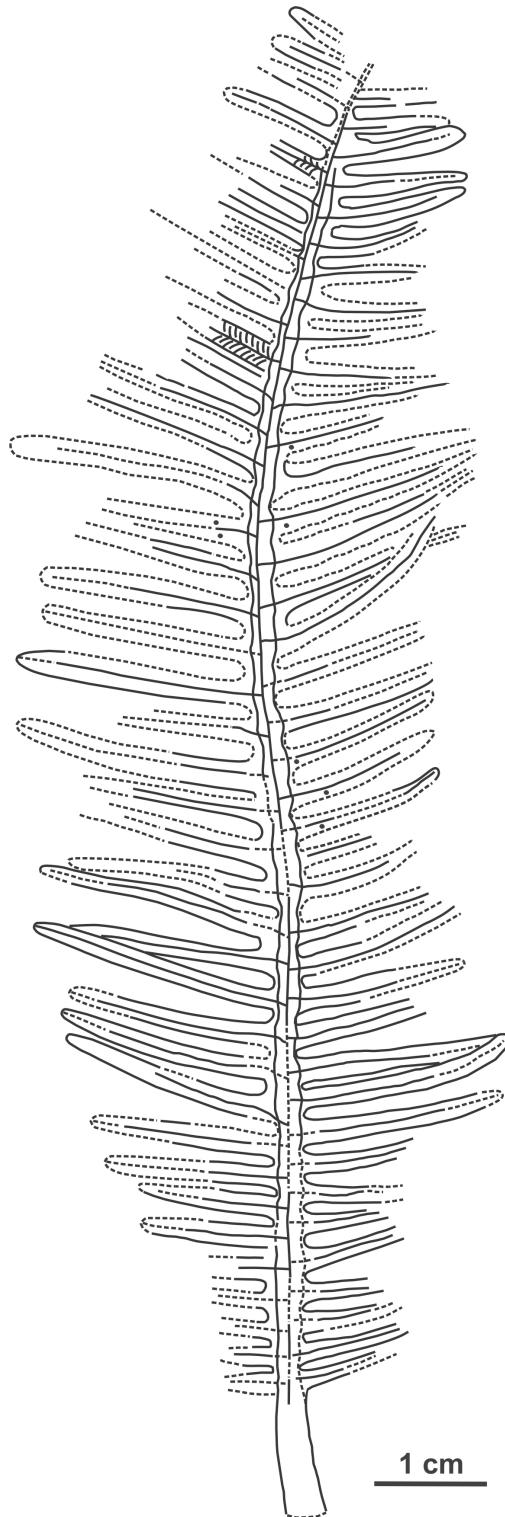


Fig. 3 - Sketch draw of the specimen.

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