Horsetails in the Lower Jurassic of Middle Europe

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Surprisingly, horsetails are not commonly found in the Lower Jurassic (Hettangian) of Germany, unlike the ubiquitous ferns (Matoniaceae: *Phlebopteris, Laccopteris*; Dipteridaceae: *Thaumatopteris, Chlathropteris, Dicytophyllum, Sagenopteris*; Schizaeaceae: *Thinnfeldia, Phialopteris*; Marattiales: *Marattiopsis*; Cyatheaceae: *Cyatheites*), conifers (*Swedenborgia, Podozamites, Hirmeriella)*, cycads (*Nilssonia, Ctenis, Macroateniopteris)*, and clubmosses (*Bernettia, Bavarostrobus)*. Nevertheless, there are enough specimens to classify into two genera, namely *Equisetites muensteri* and *Schizoneura silberhornii* n. sp. They can be distinguished by their foliage, trunk grooves, and sporophylls. In contrast to the Triassic period, where horsetails had monopodial hollow trunks up to 20 cm in diameter, their size in the Lower Jurassic was reduced to a still impressive 10 cm.

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Horsetails in the Lower Jurassic. On the left, we see ***Schizoneura silberhornii,*** on the right ***Equisetites muensteri.*** Both genera were already widespread during the Triassic period. They were characterised by massive, thick trunks and a large number of sporophylls on each plant. They lost their former greatness in the present day, with their features appearing different from their ancestors.

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The two fossil horsetail genera found in the Lower Jurassic of Upper Bavaria can be distinguished based on their characteristics. *Equisetites muensteri* features monopodial trunks with closely spaced grooves and rounded sporangiophores, while *Schizoneura silberhornii* stood out due to its broad stem ridges and long lateral leaves.

Equisetites muensteri (Sternberg 1833)

1833 *Equisetites muensteri* Sternb., vol. II, 5/6, p. 43, pl. 16, fig. 1-5

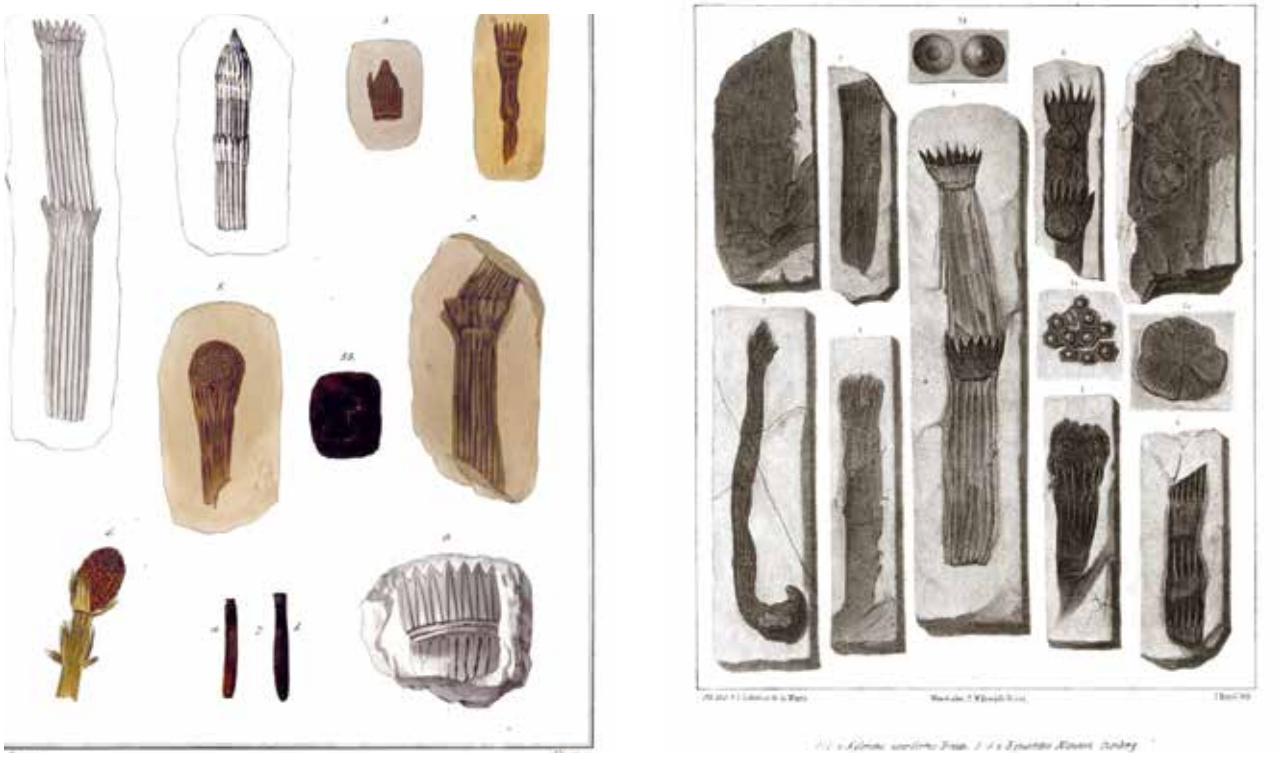
1847 *Equisetites muensteri* Braun, p. 27

1867 *Equisetites muensteri* Schenk Pl. II, Fig. 3-9a. Pl. III

The species and genus *Equisetites muensteri* was first described and illustrated in 1833 by Sternberg, along with co-authors Presl and Corda in their mammoth work "*Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt"* (Attempt at a Geognostic-Botanical Representation of the Flora of the Prehistoric World). Additionally, some associated sporophyll cones were also depicted. The specimens originated from the collection of Münster, who was based in Bayreuth, with the specific location being Strullendorf near Bamberg. Today, these specimens are housed in the collections of the natural history association in Bamberg, the palaeontological collection in Munich, and the botanical garden in Würzburg (Jung & Knobloch, 1972).
Following access to Münster's collections, the German palaeobotanist Schenk reproduced some of the same specimens in 1867, enhancing their quality.

Description

Whole plant: The horsetail has monopodial hollow stems measuring up to 10 cm in thickness, segmented at symmetrical intervals. A large number of side stems branch off from the telescopic internodes in the upper part. A cuff of tapered, basally connected leaves sprout at the ribbed nodes. The lateral branches diverge variably below the cuff, forming sterile and fertile shoots.
Sporophyll cones: They have an ovoid to roundish shape, reaching up to 5 cm in length and 2 to 3 cm in width. They emerge



Illustrations of the first description specimens of *Equisetites muensteri* in Sternberg, 1833 "Attempt at a geognostic-botanical representation of the flora of the prehistoric world", as well as by August Schenk 1867, plate II. Sternberg's figure 1, as well as number 5 by Schenk show the same specimen.

with a typical cuff of leaflets from a short stem, either individually or in multiples, on the side branches of the penultimate to last order. The individual sporophylls consist of numerous hexagonal bracts with a light umbo. The spore sacs hang in the underside of these bracts, around a central axis.

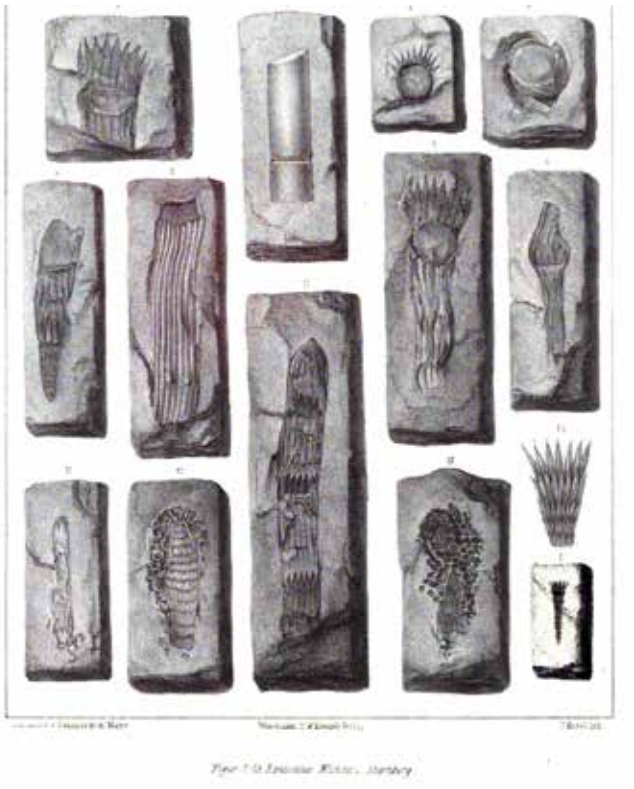
Remarks

The genus *Equisetites,* a precursor of today's horsetails (Equisetum), was fully developed at the Carboniferous-Permian boundary (*Equisetites hemingwayi, Equisetites vaujolyi,* and *Equisetites geraschi* (Perner & Wachtler, 2015). These species could no longer be related to the widely distributed family *Calamites* in the Carboniferous period. Therefore, from the Devonian onwards, *Equisetites* and *Calamites* displayed no parental affinities (Wachtler, 2023). Additional remains of *Equisetites* are available, such as *Equisetites siberi* from the Upper Permian of the Dolomites (Wachtler, 2015).

The Calamitaceae, which dominated the Carboniferous period with their slender bracts clasping the sporangia, became extinct in the Upper Permian period with its last representative *Neocalamites behnkeae* (Wachtler, 2015). *Equisetites* experienced an extraordinary distribution from the Triassic onwards and grew into giant horsetails with trunk diameters of up to 20 cm.

Notably, the species *Equisetites mougeotii* in the Lower Triassic and *Equisetites arenaceus* in the Middle Triassic dominated the landscapes. Particularly, the quarries around Ilsfeld (Baden-Württemberg) gained world recognition owing to the large number of well-preserved trunks and fruit clusters from the Middle Triassic Erfurt Formation (Wachtler, 2016).

Equisetites arenaceus were characterised by their massive hollow trunks, divided into various internodes, as well as whorls, sheaths, and branches of the first to third order. The spherical to slightly elongated sporophyll stands also served as a distinctive feature. These cones were found individually, but often in large numbers, on the branches of the last and penultimate order. Examples from Ilsfeld revealed that up to 20 fruit clusters were found grouped along a lateral axis.



From August Schenk 1867, Tafel III. *Equisetites muensteri*

Compound of modern horsetails by the private researcher Sepp Hauptmann

Schizoneura silberhornii Wachtler, 2024 n. sp.

1828 *Convallarites erecta* Brongniart, p. 454, Pl. 19

1844 *Schizoneura paradoxa* Schimper & Mougeot p. 50, pl. 25, 26

1931 *Neocalamites carcinoides* Harris, p. 25, pl. 4, figs 2, 3, 5, 7, pl. 5, figs 1–6, text-fig. 5 A–D

1968 *Schizoneura carcinoides* Weber, p. 39, pl. 1 figs 5, 6, text-figs. 6a,b

Geology

Hettangian, Lower Jurassic

Holotype

BT 014954.00 Bocksrück, Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth); **Paratype:** PECH 240, Pechgraben, sandpit Küfner, Coll. Wachtler, Dolomythos Museum

Etymology

The plant is named in honour of the dedicated private researcher Peter Silberhorn (1943–2021) from Langenbrettach (Heilbronn district, Baden-Württemberg). Over the course of many decades, he meticulously documented various sites in Upper Franconia, with a particular focus on Bocksrück, Schnabelwaid, and the sand pits at Pechgraben.

Diagnosis

The plant's stems feature widely spaced grooves and lateral branches, which are interrupted by broad leaf sheaths. Within the internodes, four slender, elongated leaves are arranged in bundles of two branches. The strobili are cone-like, with small, hexagonal sporangiophores and spore tubes hanging from the underside of the cover plates.

Description

Whole plant: The stems of the plant can measure up to 10 cm in thickness and are segmented in internodes that are characterised by smooth leaf sheaths up to 1 cm wide. These leaf sheaths are free-standing up to the base of the nodes and do not fuse with the leaf sheath. Secondary stems exhibit a similar wide-margined grooved pattern as the main axis. Below the leaf sheaths, divided leaf heads branch off in bundles of four. These are up to 10 cm long and 0.5 cm wide.
Sporophyll strobili: They are cone-like in shape, ranging from rounded to elliptical, with several arising from the internodes at the same level. The sporangiophores are small and hexagonal, with spore sacs hanging down from the underside.

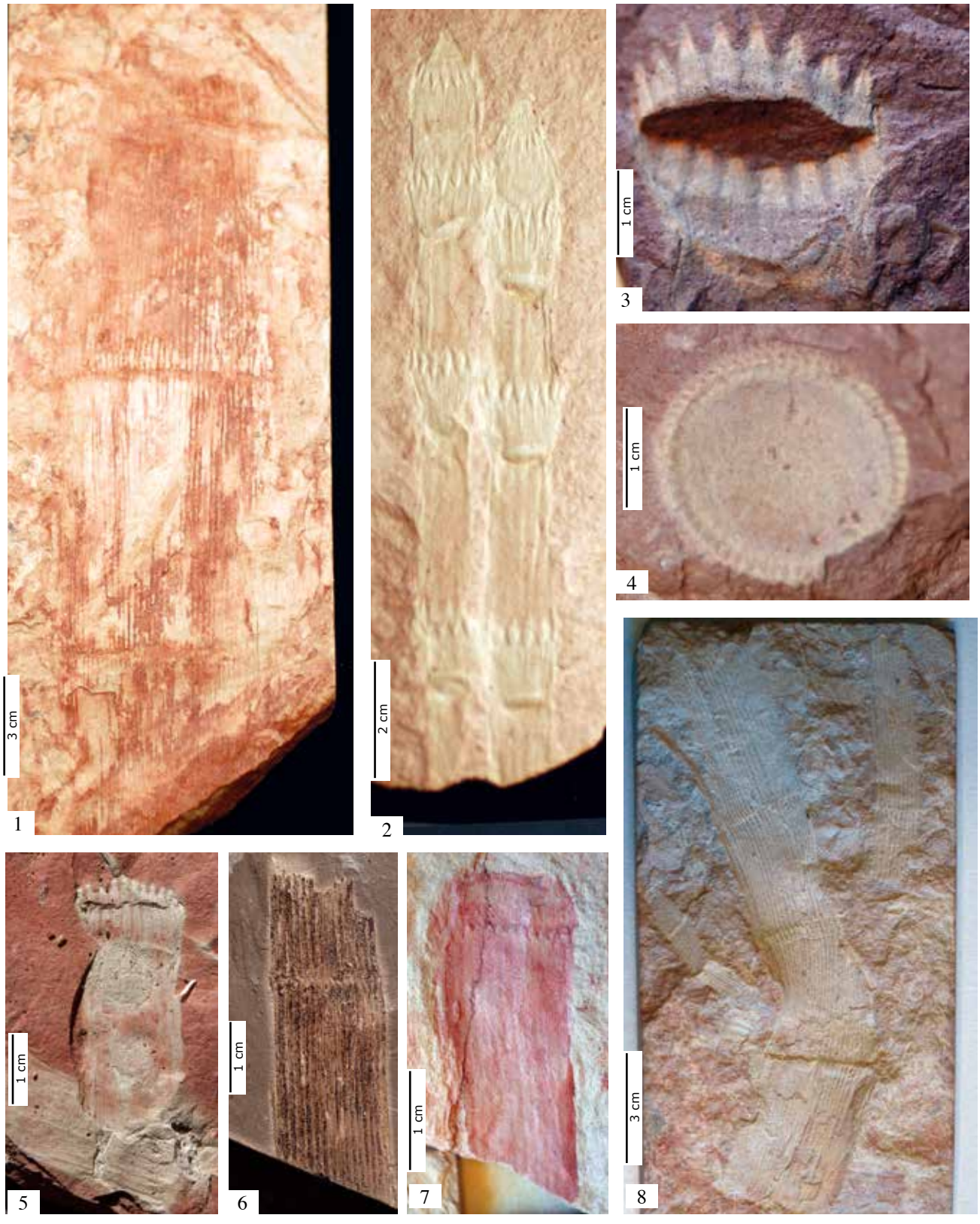
Remarks

Since the Triassic period, together with *Equisetites,* another genus of horsetail was found that caused confusion for a long time due to the absence of fertile parts. In 1844, palaeobotanists and Antoine Mougeot named the new genus *Schizoneura paradoxa.* However, in 1908, Thore Gustaf Halle

Pond horsetail (*Equisetum fluviatile)*. Different growth stages of the sporophyll strobili, as well as details of the table-shaped sporangiophores, are depicted here. Apart from the size, *Equisetites muensteri* from the Lower Jurassic may have had similarities to this species.

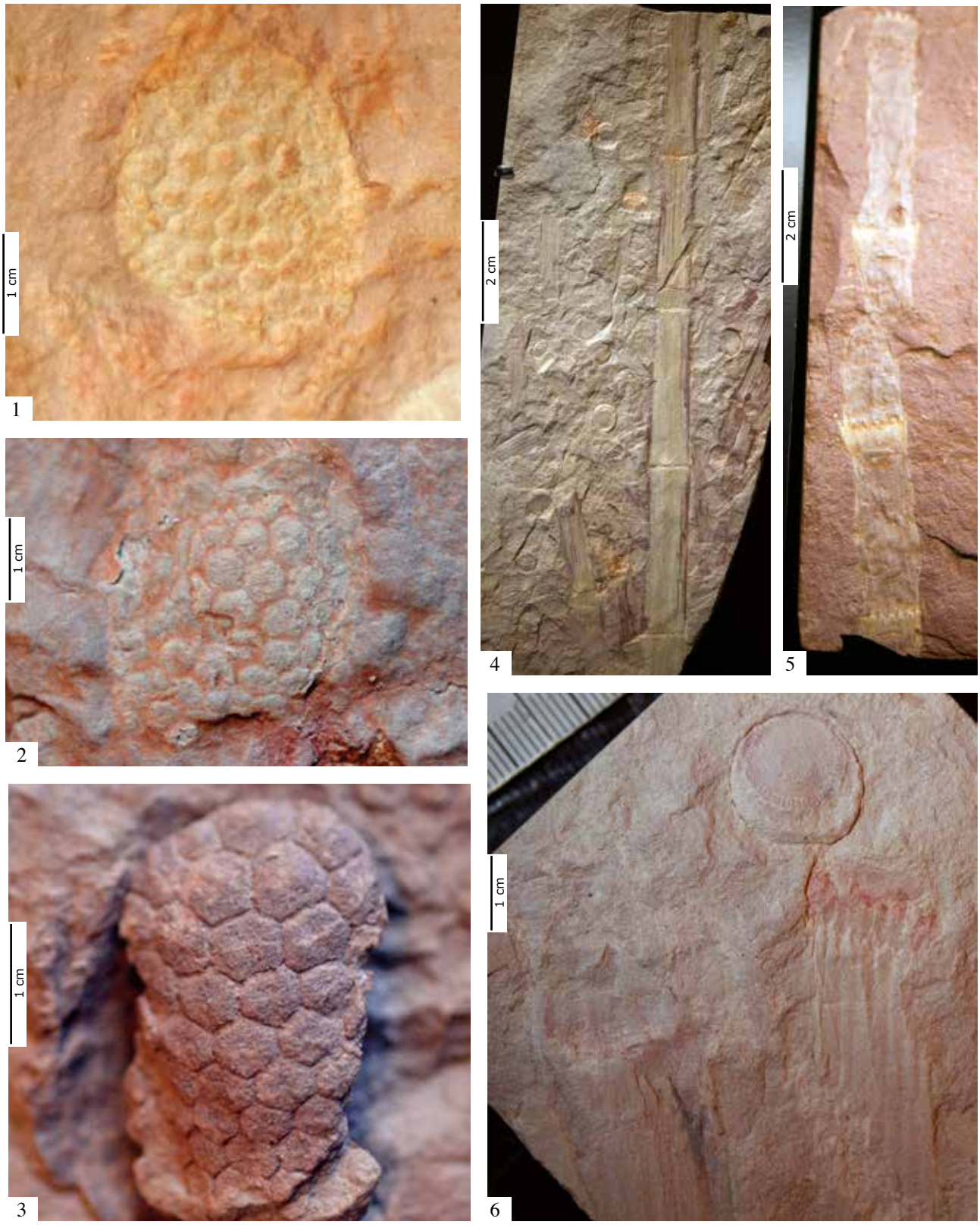
***Equisetites muensteri* and *Schizoneura silberhornii*. Lower Jurassic. Reconstructions**

Equisetites muensteri: a. Whole plant; b. Main axis with leaf sheaths and shoot peaks; c. Side branch sterile; d. Last order side branch with sporophyll strobili e. Immature sporophyll strobilo f. Mature sporophyll cone; G. Detail of the spore sacs, lateral view and bottom view; ***Schizoneura silberhornii:*** h. Whole plant; i. Main shoot axis with leaf sheaths; j. Side branch sterile; k. Last order side branch with sporophyll strobili; l. Sporangiophore cone; m. Detail of the spore sacs, lateral view and top view



Equisetites muensteri. **Lower Jurassic. Main- and lateral branchlets**

1. Basal stem; 2. Shoot summit with telescopic internodes. 3. Side view of the telescopic internodes; 4. Diaphragm; 5-8. Various details of the side branches (Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth)

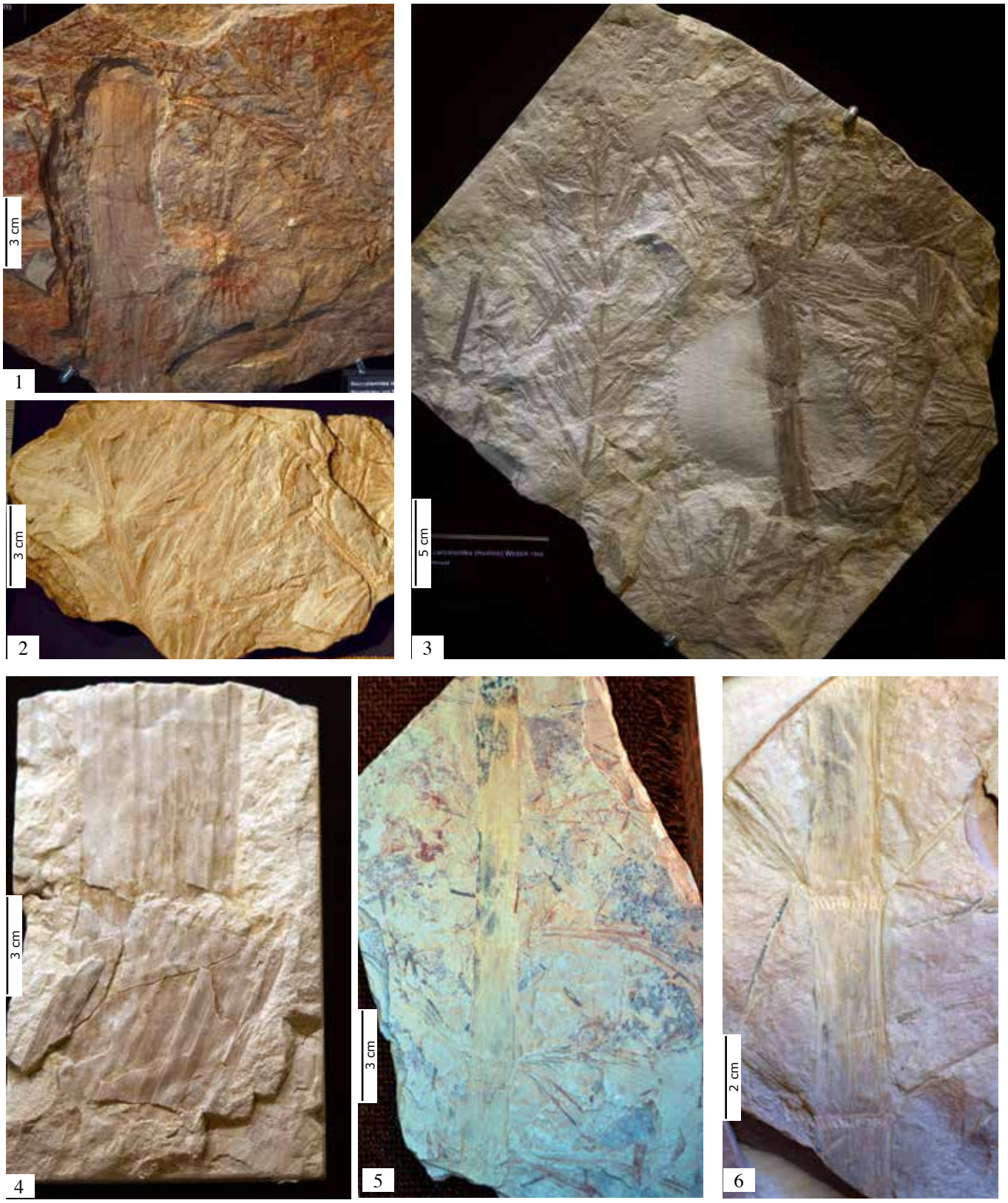


***Equisetites muensteri*. Lower Jurassic. Strobili**

1-3. Strobili in different growth phases; 4-5. Various details of the side branches with internodes; 6. Side branches with diaphragm;(Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth)

***Schizoneura silberhornii*. Lower Jurassic. Holotype and plant**

1. Part of a stem with foliage (BT 014954.00 Bocksrück, designated holotype, Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth); 2. Leaf whorl with strobilo (PECH 240, paratype, Pechgraben, Küfner, Coll. Wachtler, Dolomythos-Museum); 3. Part of a branchlet (PECH 340, Pechgraben, Küfner, Coll. Wachtler, 4. Large slab with stems and foliage; Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth)



***Schizoneura silberhornii*. Lower Jurassic. Main- and lateral branchlets**

1. Trunk part with sheath from above Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth); 2. Stem part with leaf whorl (Pechgraben, Küfner, Ex. Hauptmann, Coll. Tischlinger, Stammham); 3. Plate with branch; 4. Trunk with dissolving segments; 5-6. Trunks with lateral leaf tufts (Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth)

introduced a new name, *Neocalamites,* for stem elements with broad ridges and grass-like leaflets protruding from the nodes. Since this plant strobili were unknown until this point, questions arose about whether *Neocalamites* could be considered a successor to the *Calamites* family from the Carboniferous era and if its strobili were similarly shaped.
Further research revealed that the sporophyll cones of *Neocalamites* had more similarities to Equisetum horsetails, with spore tubes hanging down from protective shields (Wachtler, 2016). Therefore, any connection with *Calamites* plants seemed unlikely.
From the Middle Triassic to the Upper Triassic, a gradual decline of the horsetails began, which was primarily reflected in a reduction in size and intensified towards the Raibl catastrophe (Carnian stage). It was only from the Triassic-Jurassic transition that the horsetails somewhat recovered, but they never regained their former prominence.
A distinguishing feature between *Schizoneura* and *Equisetites* is the transverse grooves that are much further apart and the grass-like leaves in two-part clusters of four, as well as the smaller sporophyll stands in the former species.
Today's horsetails (Equisetum) exist as a mono-genus with around 30 subspecies, populating all continents with the exception of Australia, where they are not native. These plants have adapted to a wide range of climates, from tropical to temperate and cool regions. Most horsetails are herbaceous, perennial land or swamp plants, with some like *Equisetum giganteum* or *Equisetum myriochaetum* reaching heights of up to 4 to 6 m (max. 7.3 m but only 4 cm thick) and a diameter of 10 cm at a height of 2 m, like *Equisetum schaffneri.*
Horsetails grow from underground-crawling rhizomes, producing above-ground shoots that are typically separated by a series of nodes with internodes in between. These shoots are surrounded by whorls of small, scale-like leaves (microphylls) on the sheaths. While some horsetails, like *Equisetum hyemale*, have unbranched shoot axes, many species form side branches. In cases of normally unbranched species where the main axis is injured or broken, side branches may also form. However, side shoots almost never go beyond the second or third degree.
The stem axis of horsetails consists of an internal marrow cavity, which is interrupted by diaphragms only at the nodes. The vascular bundles are arranged around these in a ring-like manner and are enclosed on the outside by alternating longitudinal ribs. A closed vascular bundle ring is only present at the nodes. The leaves are attached to the stem axis in whorls and are strongly fused together to form a closed sheath. In the lower part of the leaf sheath, nodes are formed, through which the side branches later emerge.
The strobili of modern horsetails emerge at the end of either the main stem or secondary shoots and can vary in shape from spherical to elongated. These strobili are composed of screw-shaped cone structures. The individual sporangiophores are made up of an apical, umbrella-shaped shield that is connected to the axis by a central stalk. Typically, between five to 10 elongated spore tubes develop beneath the shield (Wachtler, 2016).

References

Braun, 1847. Die fossilen Gewächse aus den Gränzschichten zwischen dem Lias und Keuper des neu aufgefundenen Pflanzenlagers in dem Steinbruche von Veitlahm bei Culmbach 81-87, Flora oder Allgemeine Botanische Zeitung, Bd. 30

Halle, T.G. 1908. Zur Kenntnis der mesozoischen Equisetales Schwedens, Kungliga Svenska Vetenskapsakademiens Handlingar, 43, 1–56, Stockholm

Harris T.M. 1931. The fossil flora of Scoresby Sound East Greenland, 1: Cryptogams exclusive of Lycopodiales. Medd. om Grønland, 85(2): 1–102

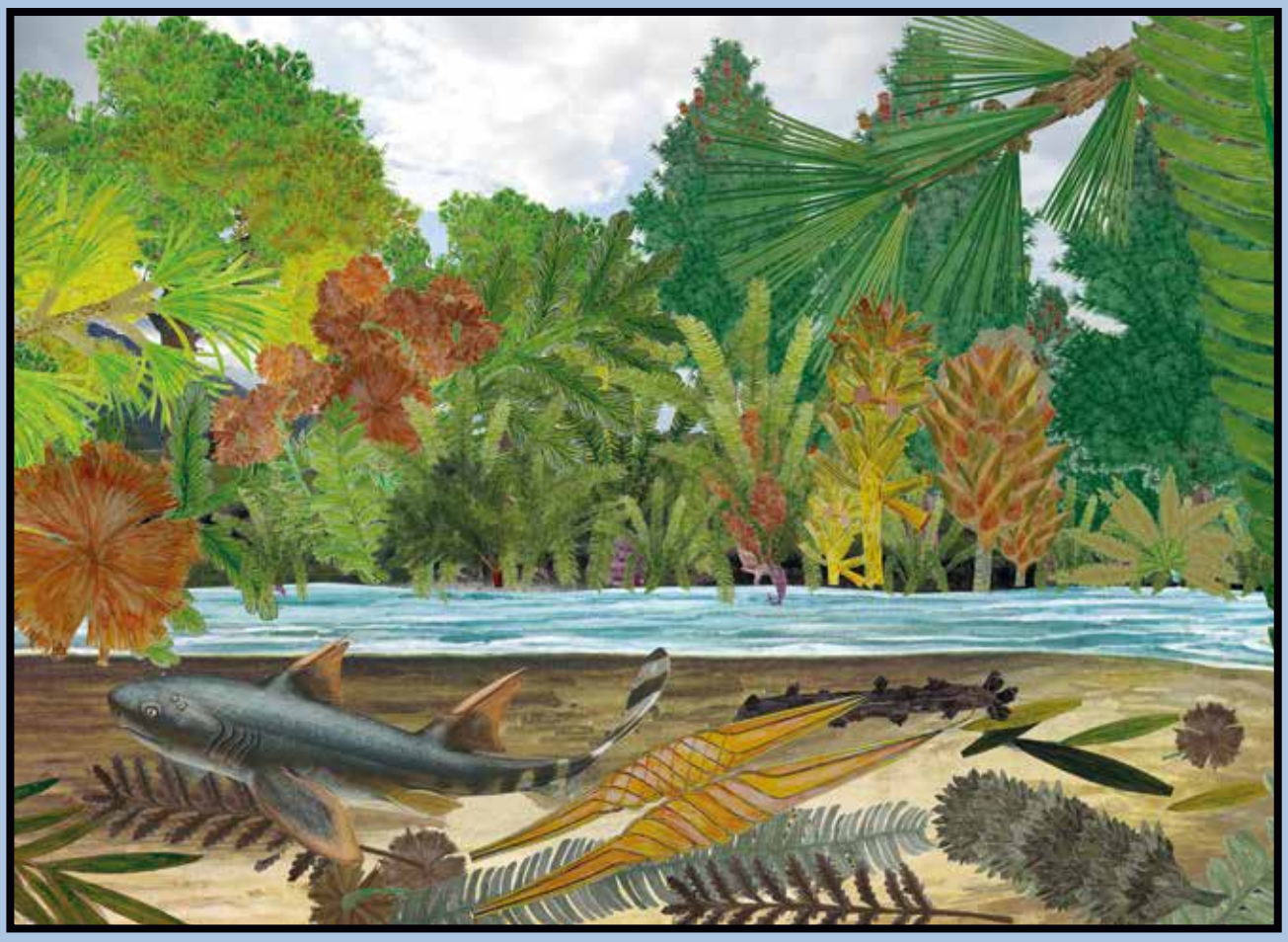
Jung, W., Knobloch, E. 1972. Die "Sternberg-Originale" der Bayerischen Staatssammlung für Paläontologie und historische Geologie zu München; Mitt. Bayer. Staatsslg. Paläont. hist. Geol., 12: 105-111,1 Abb. München

Wachtler M., 2015. Two new species of Sphenophyta from the Wuchiapingian (Lopingian, Permian) of the Dolomites, Northern Italy in Wachtler M., Perner T., Fossil Permian plants from Europe and their evolution. Rotliegend and Zechstein-Floras from Germany and the Dolomites. Dolomythos Museum, Innichen, South Tyrol, Italy, Oregon Institute of Geological Research, Portland, OR, (USA)

Wachtler M., 2016. Die Entwicklung der Schachtelhalme im Mesozoikum anhand der Fundstelle Ilsfeld (Unter-Keuper, Ober-Ladin, Mitteltrias) S. 22-52, in The Middle Triassic Flora of Ilsfeld (Germany) Ladinian, Erfurt Formation - Die mitteltriasische Flora von Ilsfeld (Deutschland) Ladin, Erfurt-Formation, Dolomythos Museum, Innichen, South Tyrol, Italy

Wachtler M., 2023b. The Middle Devonian Flora Explosion; in Wachtler M., Wachtler N. 2023: The Middle Devonian Flora Explosion. ISSN 2974-7376, Dolomythos_ Innichen (Italy), pp. 17-72

Weber R. 1968. Die fossile Flora der Rhät-Lias-Übergangsschichten von Bayreuth (Oberfranken) unter besonderer Berücksichtigung der Coenologie. Erlanger Geol. Abh., 72: 3–73



The Fossil Flora of Early Jurassic

A catastrophic decline in vegetation during the Upper Triassic period was followed by a remarkable resurgence of flora in the Lower Jurassic era. However, the family of flowering plants, which is prevalent today, was clearly absent during this time. Even potential ancestors of these plants remain unidentified. During the Lower Jurassic period, conifers such as Podozamites, Swedenborgia, and Hirmeriella dominated, although they are now only found in limited areas in East Asia, represented by species like the golden larch (Pseudolarix), umbrella fir (Sciadopitys), Taiwania, and precursors of ginkgo (Ginkgoites). Cycads, including the two-seeded Nilssonia and Ctenis, as well as the multi-seeded Macrotaeniopteris, were also quite common. Interestingly, ferns that are now rare, such as Matonia (Phlebopteris, Laccopteris) and ancestors of Dipteris (Thaumatopteris, Chlathropteris, Dicytophyllum, Sagenopteris, Otozamites), played an important role during this period. Another notable fern, Thinnfeldia, which can be classified within the large Schizaeales group due to its distinct trophophyll and sporophyll fronds, was abundant. Precursors of Marattiales (Marattiopsis) were numerous. Horsetails were represented by Equisetites and Schizoneura, while strange clubmosses such as Bernettia, Bavarostrobus and Lepacyclotes also had a notable presence, with no clear descendants identified.

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