Enigmatic clubmosses in the Lower Jurassic

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Despite their decline at the Carboniferous-Permian boundary, clubmosses continued to play an important role in the Triassic period. Although they no longer achieved the gigantic growth seen in the Carboniferous period (*Sigillaria, Lepidodendron*), some lycophyta in the Triassic still grew to heights of 2 to 3 m (Pleuromeia, Lycopia), surpassing modern lycophytes. In addition to the isosporous clubmosses with uniform spores (*Lepidodendron, Lycopia*), there were a greater number of heterosporous with different macro- and microsporangia (*Sigillaria, Sigillcampeia, Pleuromeia, Selaginellites, Isoeites, Lepacyclotes, Eocyclotes*). Two strange clubmosses emerged in the Lower Jurassic of northern Bavaria. One of them, *Bernettia inopinata,* could only be classified based on extensive findings to determine its lineage. The different descriptions of individual parts of these clubmosses, such as their long, lanceolate leaves (*Desmiophyllum gothani*), sterile spore leaves (*Chlamydolepis lautneri)*, microsporophylls (*Piroconites kuespertii)*, and macrosporophylls (*Bernettia inopinata*) made classification difficult, with only the discovery of heterosporous parts enabling their identification as club mosses. Of particular interest is *Bavarostrobus friessii* n. sp., discovered in abundance in the sand pits at Pechgraben (Bayreuth).

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Clubmosses in the Lower Jurassic: On the left, we find ***Bernettia inopinata***, on the right ***Bavarostrobus friessii.*** Both were characterised by their heterosporous sporophylls. Present-day descendants of these species are unknown.

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Bernettia inopinata, one of the most enigmatic plants from the Lower Jurassic (Hettangian) period around Bayreuth (Gothan, 1914), is a collective term encompassing various organ parts described over time, including *Desmiophyllum gothanii* leaves (Florin, 1936), *Piroconites kuespertii* microsporophylls (Gothan, 1914), *Chlamydolepis lautneri* sterile spore leaves (Cittert, 1992), and *Bernettia inopinata* macrosporophylls (Gothan, 1914).
Bernettia inopinata has been found in several locations, including the original description area of Gothan (1914), Hohe Warte, Wolfshöhe, and Grossbellhofen (Kirchner, 1992). However, the largest collections were found near the hamlet Pechgraben (northeastern Bavaria), particularly in the Küfner sand pit where layers rich in fossil plants are abundant. Among the thick and almost fossil-free sandstone packages, there are clay lenses up to 1 m thick, believed to be relics of small ponds or sea tributaries, containing well-preserved diverse flora.
The various sites around Bayreuth, Bamberg, Kulmbach, and Coburg have attracted the interest of researchers since the early 1800s, especially due to the activities of Münster, who lived in Bayreuth, and Kaspar Graf Sternberg. Despite the presence of rich ferns, cycads, and coniferous flowers, *Bernettia inopinata* remained unrecognised in the quarries of that time due to its rarity.
It was not until Walter Gothan's observations in 1914 that the unique "female sporophylls" were noticed, initially thought to belong to cycads, but later identified as fructifications of the enigmatic fern genus *Thinnfeldia*, which was abundant in the same strata. In the same work, he also described a microsporophyll called *Piroconites kuesperti.*

The reddish lens on the southern edge of the Küfner sand pit yielded the richest finds of *Bernettia inopinata.*

Bernettia inopinata Gothan 1914

1914 *Bernettia inopinata* Gothan, p. 146, pl. XXVII, 1–4, pl. XXXIV, 4, text-fig. 5

1992 *Bernettia inopinata* Gothan, Kirchner, p. 32, pl. VIII, 1–3, text-fig. 5

2016 *Bernettia inopinata* Gothan, Kustatscher, pl. 1-3

1914 *Piroconites kuespertii* Gothan, p. 130–132, pl. XXVIII, 4, text-fig. 4

1992 *Piroconites kuespertii* Gothan, Kirchner, p. 34–35, pl. VIII, 4–6, text-fig. 5

1992 *Piroconites kuespertii* Gothan, Van Konijnenburg-van Cittert, p. 241–246, 253, pl. I, 2-3, pls. II–III

1984 *Aphlebia lautneri* Boersma Plate I, 1; Plate III

1992 *Chlamydolepis lautneri* nov. comb. Van Konijnenburg-van Cittert, Pl. 1, fig.1

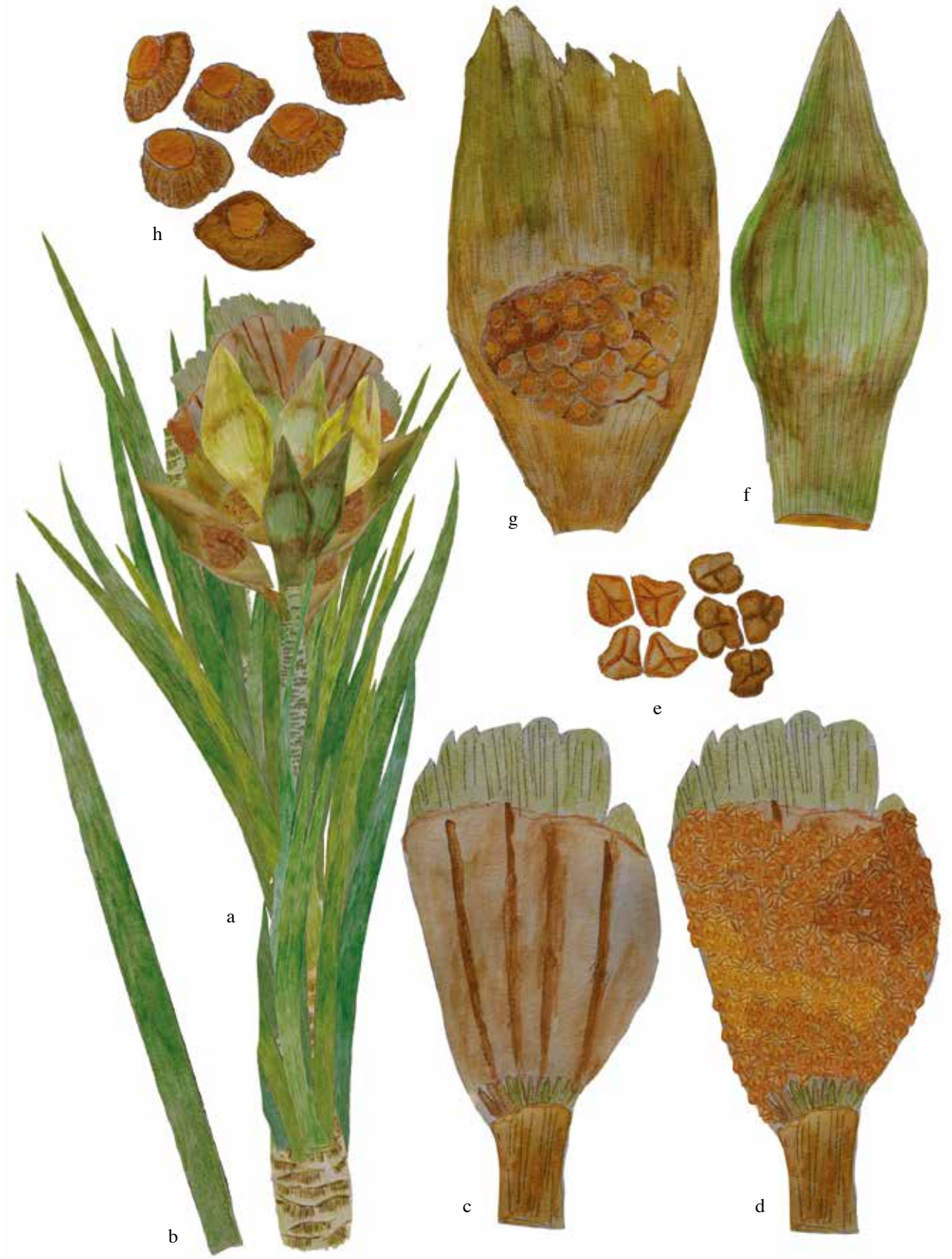
1878 *Desmiophyllum gracile* Lesquereux, p. 322, p. 556, pl. 82 fig. 1

1879 *Desmiophyllum gracile* Lesquereux, pl.82, fig. 1

1936 *Desmiophyllum gothani* Florin p. 49, pl. 6, 8, 9, text-8c

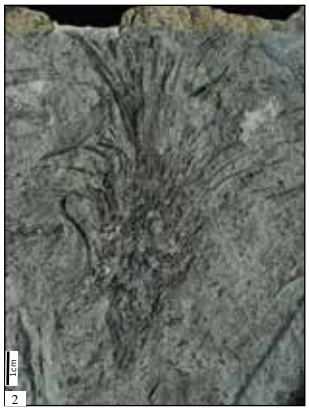
Description

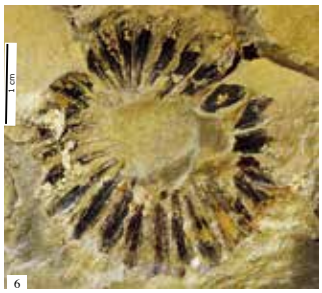
Entire plant: *Bernettia inopinata* grows to a height of around 1 m, with long, narrow leaves in the lower portion and sporophylls in the upper portion, which are divided into mega- and microsporophylls. The strobili can reach up to 15 cm in length and consist of broad-leaf-shaped, partially fertile scales arranged helically around an axis. Juvenile cone structures are located close to the axis, while adult structures protrude. Macrosporophylls are found in the lower or outer areas of the sporophyll crest, while microsporophylls are located in the inner and upper areas.
Leaves: The leaves of *Desmiophillum gothani* are narrow and can grow up to 50 cm long, with a maximum width of 1.5 to



***Bernettia inopinata*. Lower Jurassic (Hettangian)**

a. Whole plant; b. Single leaf; c. Microsporophyll, reverse side; d. Microsporophyll with microsporangia; e. Microsporangia, immature on the right, mature on the left; f. Macrosporophyll, outside; g. Macrosporophyll, inside with view of the macrospores; h. Macrospores





2.0 cm. They spiral up on a thin main stem, have entire edges, taper to a point, and are traversed by barely perceptible parallel nerves. The stems are marked with scars after the leaves fall off.

Macrosporophylls: Macrosporophylls belonging to *Bernettia inopinata* and *Chlamydolepis lautneri* are broad-leaved, bottle-shaped, and crossed by parallel veins that taper to the apex. They are located in the inner and lower areas of the sporophyll crest and may be partially or completely covered by a velum. Outer leaves may develop few to no macrosporophylls (*Chlamydolepis lautneri)*, the sterile ones of which are usually thinner and more easily destroyed. Megasporophylls contain approximately 20 to 30 basally developed megasporangia, each raised in a cushion shape, ranging from rhombic to ellipsoid. These megasporangia taper to a point at both ends, reaching 0.5 cm in length and 0.3 cm in width, and are covered with fine leaf hairs.

Microsporophylls: The microsporophylls of the *Piroconites kuespertii* plant feature a leaf lamina that reaches a length of 3 to 6 cm and width of 2 to 4 cm. The base of the lead is narrowly bottle-shaped, gradually widening and tapering off to a rounded shape at the top. The microspores densely cover the entire lamina, with each spore reaching a maximum of 1 mm in length and 0.8 mm in width. These spores are rounded in shape but often become deformed due to their immediate proximity to neighbouring spores. Additionally, the microsporophylls are segmented three to four times.

Remarks

Decades of research are required to accurately identify the appearance and characteristics of a fossil plant, as exemplified with *Bernettia inopinata,* a commonly found plant in the sand pits around the Pechgraben near Bayreuth. *Desmiophyllum gothani* is often considered the top choice for the first description (Lesquereux, 1878; Florin, 1936). The

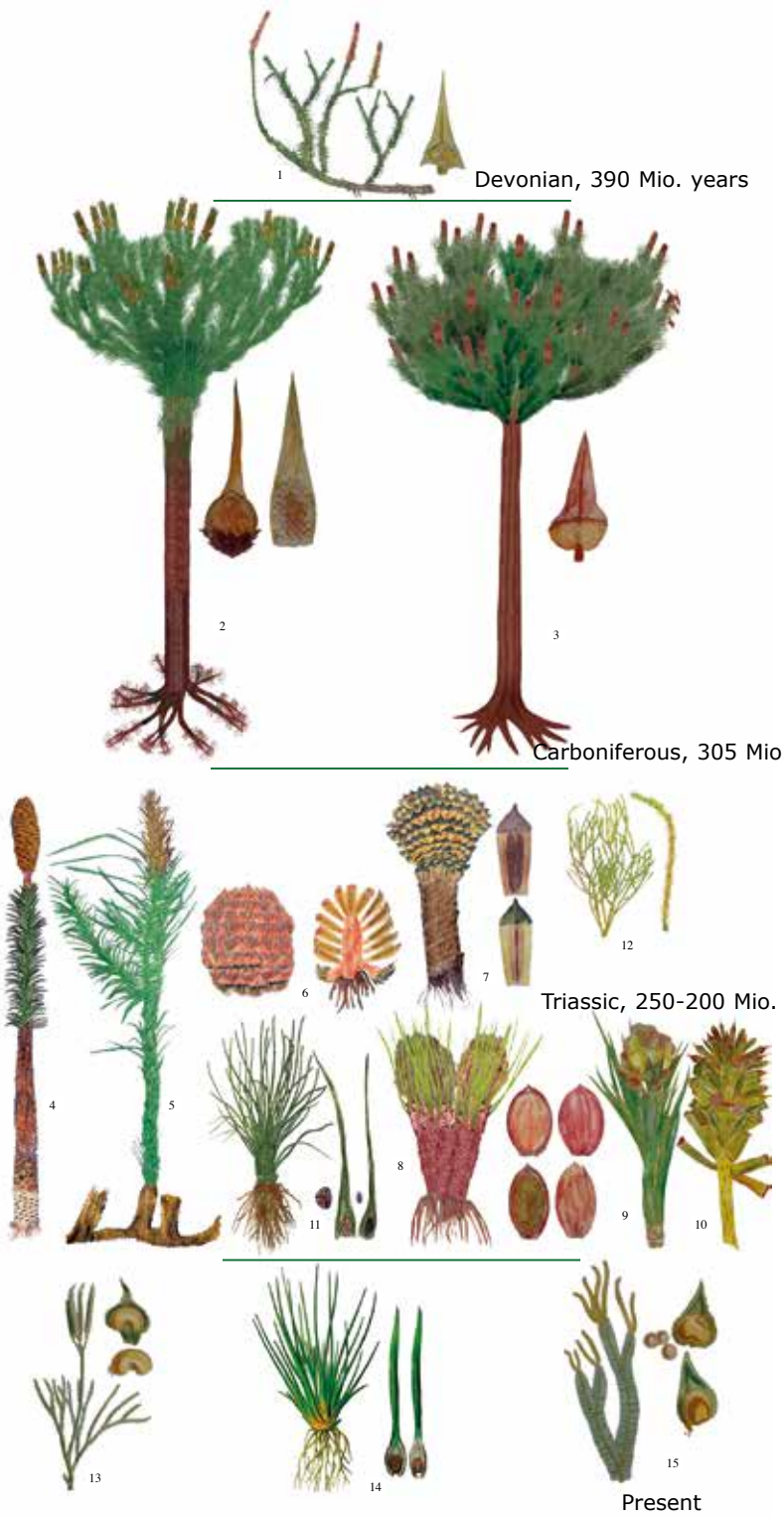
Triassic club mosses

Lower Middle Triassic (Anisian): 1. *Lycopia dezanchei* (KÜH 1423, Dolomites), 2. *Isoetites brandneri* (KÜH 035); 3. *Eocyclotes alexawachtleri (KÜH 1272,* Dolomites); *4. Sigillcampeia nana* (PIZ 742, Dolomites); 5. *Selaginellites leonardii* (KÜH 956, Dolomites); **Middle Triassic (Ladinian):** 6. *Lepacyclotes zeilleri* (Ilsfeld, ILS 595) (All Dolomythos-Museum); **Upper Triassic (Carnian):** 7. *Porastrobus bergomensis* (Monte Pora, Museo Bergamo)

genus *Desmiophyllum (gracile)* was first described in 1878 by the French-born Swiss palaeobotanist Leo Lesquereux (1806–1889), who emigrated to America. The plant is characterised by elongated, linear leaves with parallel veins, resembling "*Cordaites* leaves", found in the carbon coals of Beaver County Pennsylvania. The name *Desmiophyllum* was later revived by Solms-Laubach in 1904 for *Podozamites*-like leaves and further used by Nathorst (1907) to describe his Lower Jurassic finds from Siberia. The Swedish palaeobotanist Florin (1936) then established *Desmiophyllum gothanii* for long tongue-shaped leaves from European Jurassic deposits.

However, it is questionable to combine names for isolated leaf finds without understanding their fertile connections over periods of time, as in this case, more than a 100 million years. In the Carboniferous period, similar sword-shaped leaves could belong to *Lepidodendron, Sigillaria* or the enigmatic *Cordaites.* Large lanceolate leaf shapes persisted in some clubmoss families during the Triassic period. Therefore, *Desmiophyllum gothanii* may not be the appropriate name for these Lower Jurassic plants. The name *Bernettia inopinata* chosen by Gothan in 1914 is more suitable, especially considering the nomenclature requirements of *Piroconites kuespertii* described in the same work (Cittert, 1992). *Bernettia* is classified as a macrosporophyll. However, it must now be clarified which extended family this plant belongs to.

In the field of palaeobotany, there has been a longstanding suspicion that *Bernettia inopinata, Piroconites kuespertii, Desmiophyllum gothanii* and *Chlamydolepis lautneri* (Cittert, 1992) may all belong to a single plant. The primary objective in palaeobotany is to integrate individual components of a plant into a cohesive whole. Currently, heterospores, which are plants that carry different types of spores within

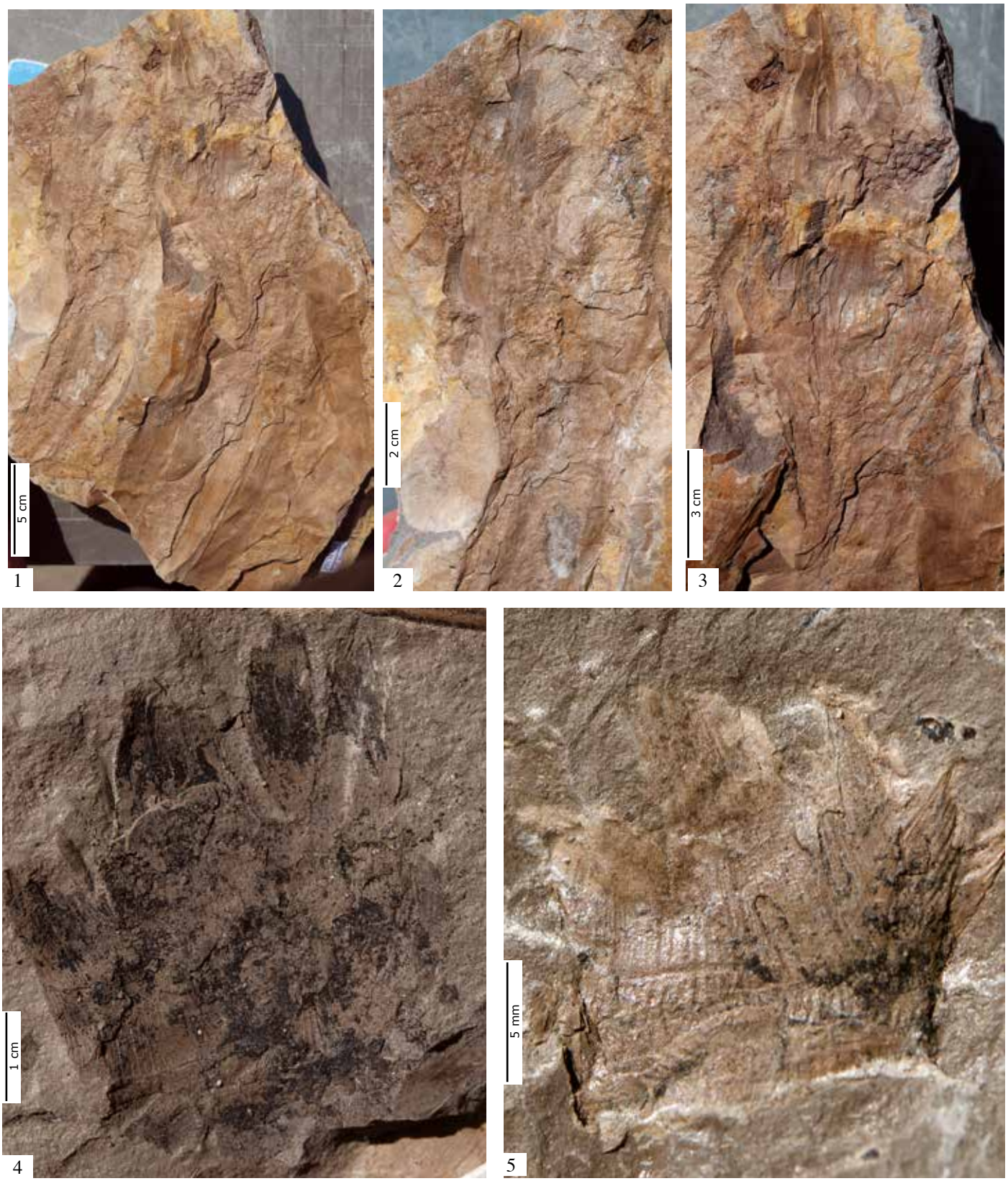


400 million years of club mosses

The first clubmosses appeared about 390 million years ago (Early Devonian) as small plants named ***Protolepidodendron*** (1); in the Carboniferous era, they developed into mighty giant trees such as ***Lepidodendron*** (2) or the heterosporous ***Sigillaria*** (3). There was a huge gap between the Carboniferous and Permian boundaries, and the lycophytes reduced in size. From the beginning of the Triassic period, we found tree-shaped developments such as ***Pleuromeia*** (4) or ***Lycopia*** (5). However, most of them only formed low-growing heterosporous clubmosses such as ***Lepacyclotes*** (6), ***Eocyclotes*** (7) or ***Sigillcampeia*** (8), which only forms a shadow of its Sigillaria predecessors. This group included the heterosporous ***Bernettia*** (9) and ***Bavarostrobu***s (10) from the Lower Jurassic period. However, at least from the early Triassic onwards, all of today's clubmoss families were already developed in their current form. This applies to ***Isoetites*** (11) and ***Selaginellites*** (12). Today, both isosporous clubmosses such as ***Lycopodium*** (13) as well as the heterosporous ***Isoetes*** (14) and ***Selaginella*** (15) can be found.

***Bernettia inopinata*. Lower Jurassic (Hettangian).Whole plant**

1-2. Seedlings (PECH 190, PECH 175); 3-4. Part of a trunk and the basal leaves (PECH 192, BT 012369, Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth); 5. Juvenile plant (PECH 372); 6. Stem part (PECH 226); All Pechgraben, sandpit Küfner, Coll. Wachtler, Dolomythos-Museum

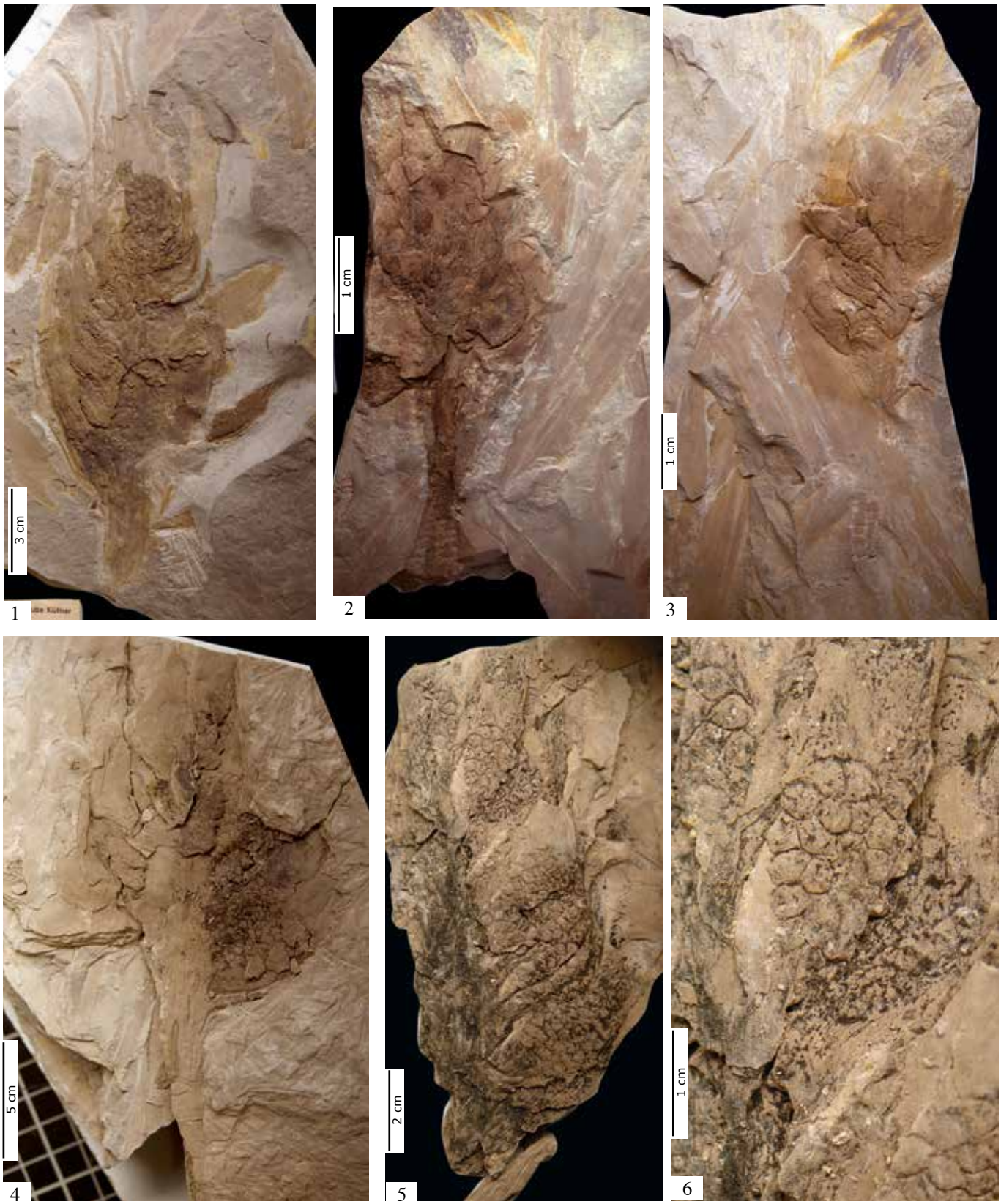


***Bernettia inopinata*. Lower Jurassic (Hettangian).Whole plant**

1-3. Complete plants on a large slab (PECH 218, Coll. Wachtler); 4-5. Apical parts with shed sporophylls (PECH 725, PECH 715, Ex.Coll. Silberhorn, Coll. Wachtler); All Pechgraben, sandpit Küfner, Dolomythos-Museum

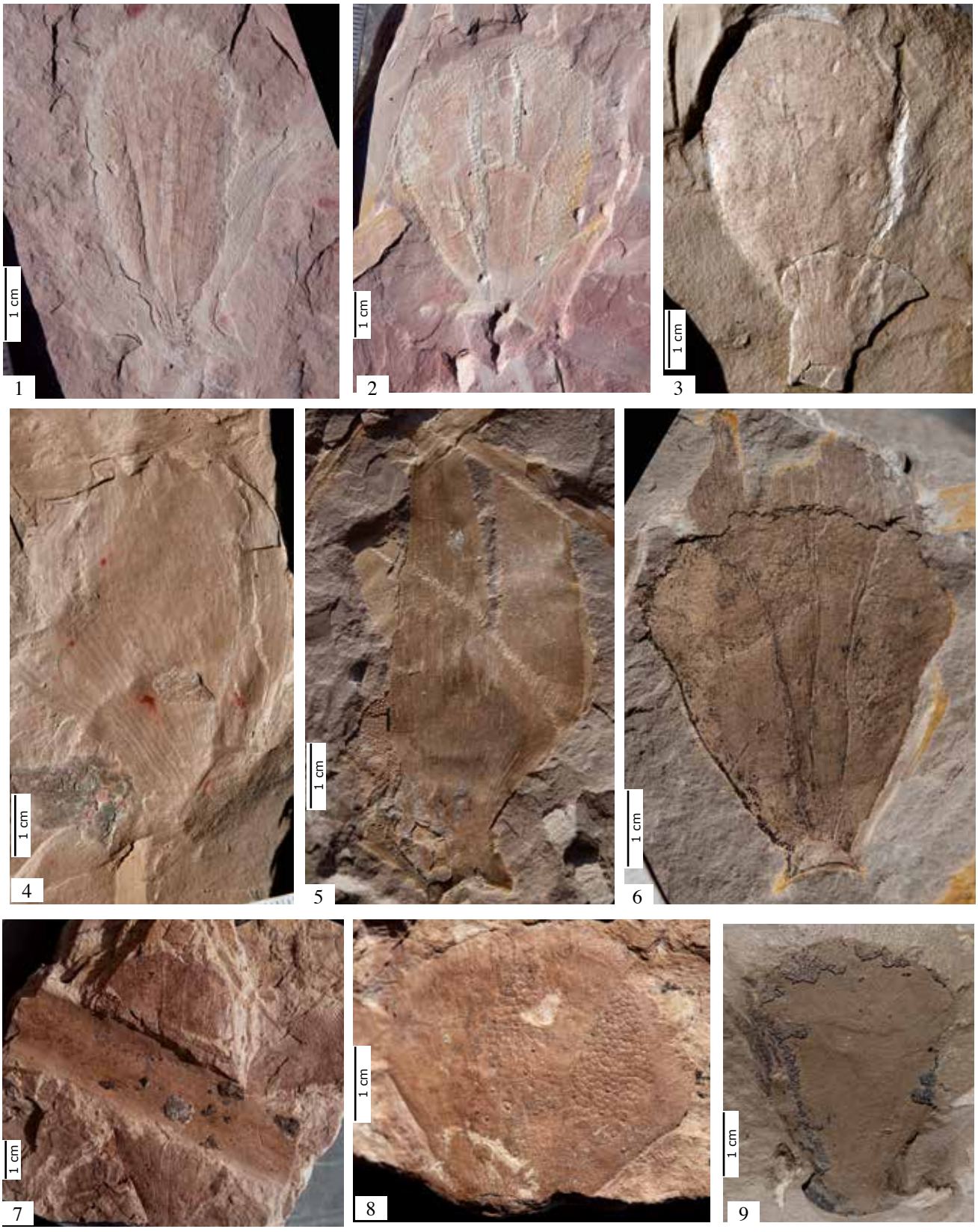
***Bernettia inopinata*. Lower Jurassic (Hettangian). Foliage**

1. Stemlet with leaves (PECH 447); 2-3. Branch with leaves (PECH 283); 4. Isolated foliage (PECH 219); 5-8. Isolated leaves (PECH 456, PECH 340 PECH 416, PECH 435); All Pechgraben, sandpit Küfner, Dolomythos-Museum



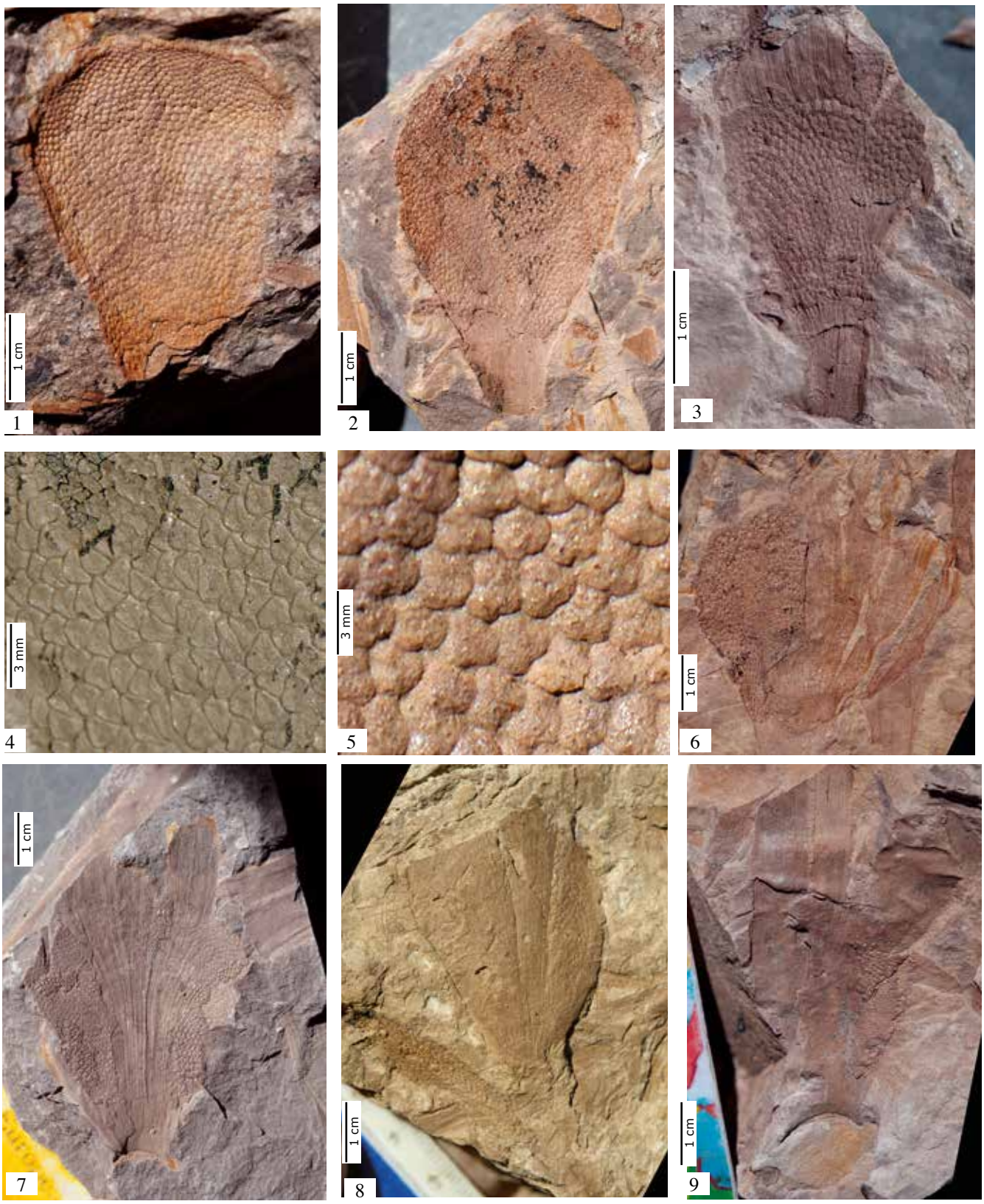
***Bernettia inopinata*. Lower Jurassic (Hettangian). Strobili**

1-3. Sporophyll strobilo with micro- and macrosporangia, as well as sterile leaves BT 012371 (Wolfgang Häckel); BT 010377.00 (Wolfgang Häckel), BT 012369); 4. Sporophyll tuft with macrosporophylls; 5-6. Macrosporophyll tuft and detail (BT 012370); All Pechgraben, sandpit Küfner, Coll. Hauptmann, Urwelt-Museum Oberfranken, Bayreuth



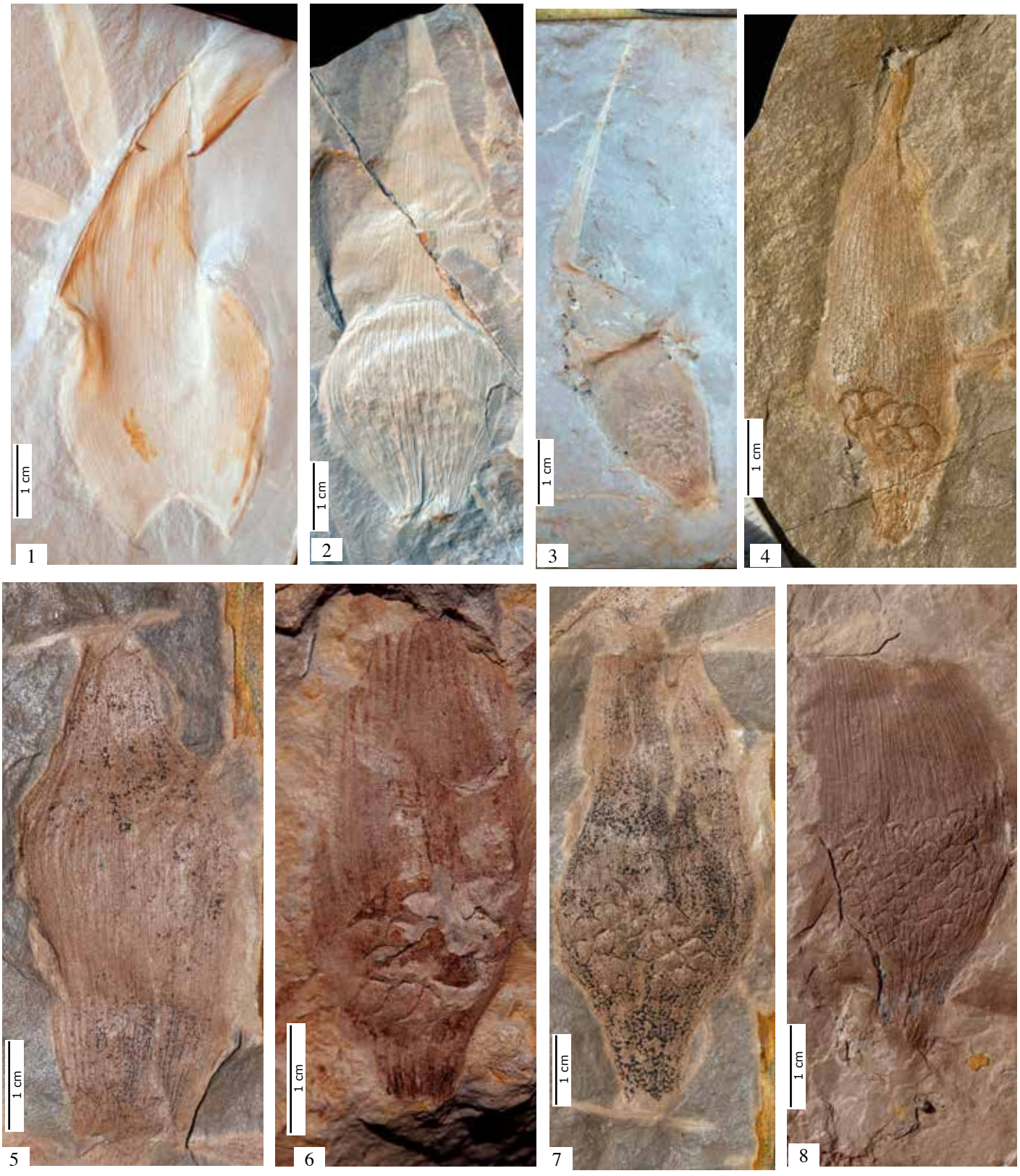
***Bernettia inopinata*. Lower Jurassic (Hettangian). Microsporophylls**

1-3. Microsporophylls (juvenile or apical area with few spores (PECH 127, PECH 128, PECH 718); 4-5. Sterile bracts (PECH 51, PECH 516) 7-9. Microsporophylls (PECH 185, PECH 84, PECH 470); All Coll. Wachtler, except PECH 718, Ex.Coll. Silberhorn); Pechgraben, sandpit Küfner, Dolomythos-Museum



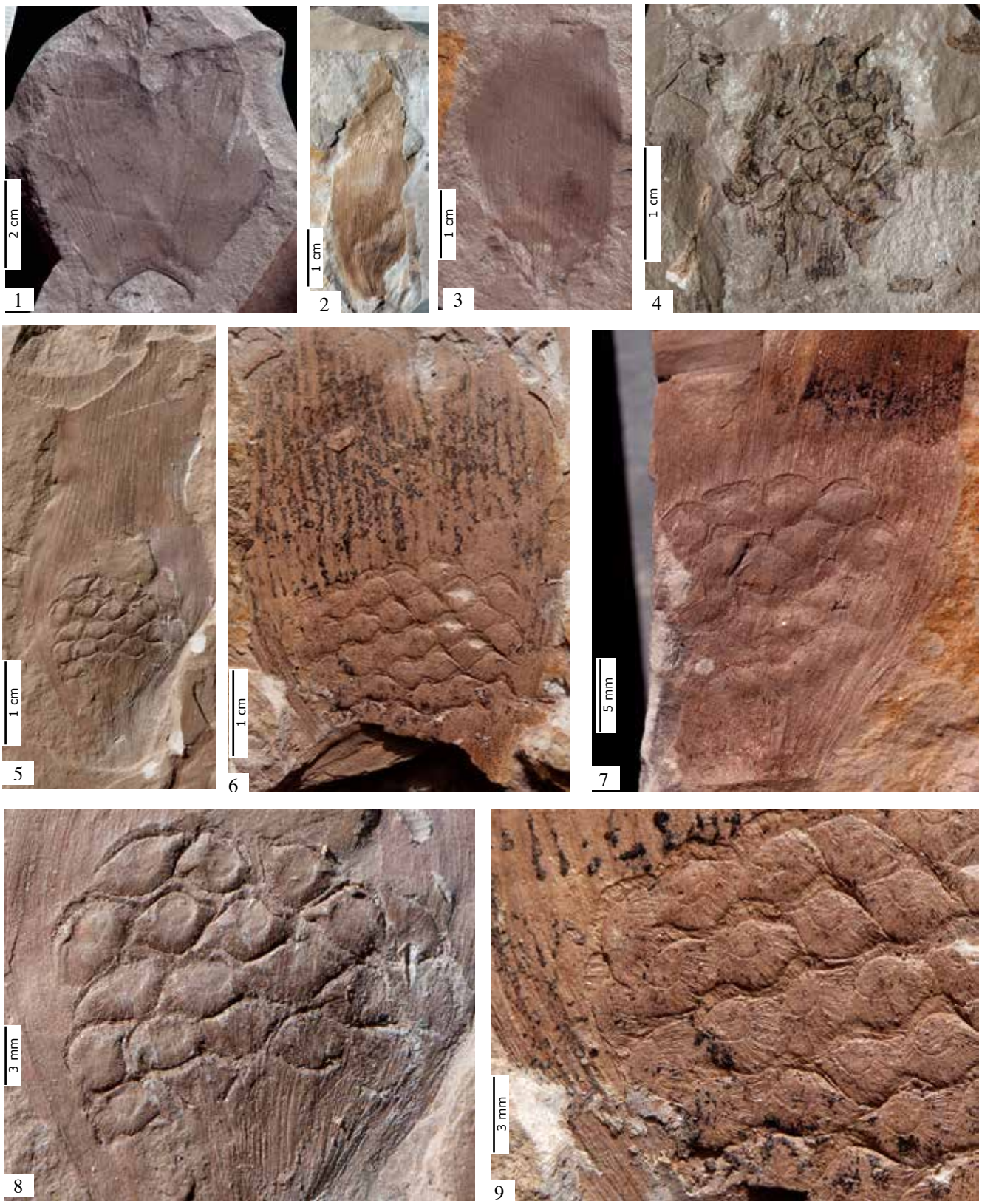
***Bernettia inopinata*. Lower Jurassic (Hettangian). Microsporophylls**

1-3. Isolated microsporophylls (PECH 228, PECH 227, PECH 187); 4. Sporophyll with immature microsporangia (PECH 433); 5. Mature microsporangia (PECH 228); 6-9. Microsporophylls (PECH 230, PECH 721, PECH 70, PECH 242); All Coll. Wachtler, except PECH 721, Ex.Coll. Silberhorn); Pechgraben, Sandgrube Küfner, Dolomythos-Museum



Bernettia inopinata. **Lower Jurassic (Hettangian). Macrosporophylls**

1-2. Sterile enveloping leaves (Coll. Hauptmann); 3. Juvenile Macrosporophyll (Coll. Hauptmann); 4. Juvenile Macrosporophyll (PECH 44); 5. Macrosporophyll, outside (PECH 422); 6-8. Macrosporophylls with well preserved macrosporangia (PECH 425, PECH 422, PECH 52); Pechgraben, sandpit Küfner, Coll. Wachtler, Dolomythos-Museum



Bernettia inopinata. **Lower Jurassic (Hettangian). Macrosporophylls**

1-3. Sterile enveloping leaves (PECH 719, PECH 714, Ex. Coll. Silberhorn), PECH 358); 4. Megasporophyll with isolated macrosporangia on the left edge (PECH 46); 5-7. Macrosporophylls well preserved macrosporangia (PECH 483, PECH 174, PECH 221); 8-9. Detail of the macrosporangia (PECH 483, PECH 174); All Pechgraben, sandpit Küfner, Coll. Wachtler, Dolomythos-Museum

one fruit cluster, can be found today in angiosperms and about half of clubmosses. This has led to the speculation that *Bernettia* could potentially be early precursor to flowering plants. However, upon closer examination of their development, this can be ruled out, pointing instead to a classification as a lycophyte. This assumption is based on the arrangement of macro- and microsporophylls in *Bernettia*, which resemble the structure of modern *Isoetes* or *Selaginella* clubmosses.

In fact, evidence suggests that, akin to present-day quillworts, the megasporophylls were positioned externally on *Bernettia,* while the microsporophylls were located on the inside or in upper areas. The abundance of microsporophylls compared to megasporophylls indicates a potential distribution pattern within the plant.

While a relationship with *Isoetes* may be proposed, the existence of similar forms dating back to the early Middle Triassic, such as *Isoetites brandneri* (Wachtler, 2011), rules out this possibility. Spikemosses in the form of *Selaginellites* have been documented from the Carboniferous period through the entire Triassic era, including species like *Selaginellites leonardii* (Lower Triassic) and *Selaginellites perneri* (Upper Triassic) (Wachtler, 2016a, b, c). However, no closer relationship has been identified for this, nor with *Eocyclotes alexawachtleri* and L*epacyclotes bechstaedtii* (Anisian) or *Lepacyclotes zeilleri* from the Ladinian period (Wachtler, 2016).

The Triassic Sigillaria species (Wachtler, 2016), specifically *Sigillcampeia nana* (Anisian) and *Sigillcampeia blauii* (Carnian), bear a striking resemblance to *Bernettia.* The lanceolate leaves and microsporophylls are of these species were comparable, with *Sigillcampeia* developing only a single megasporangia instead of a plurality of macrosporangia, similar to the *Sigillaria* in the Carboniferous era (Wachtler, 2023). If *Bernettia* exhibited apical dichotomous stem division, which is visible in some stems, then *Sigillaria* would be its closest relative.

Overall, it can be summarised that following their immense growth during the Carboniferous period, clubmosses persisted throughout the Triassic, with some species reaching small tree-like sizes before gradually diminishing in size over time.

Class Lycopodiopsida

Order Clubmosses (Lycopodiales)

Family: Lycopodiaceae

Bavarostrobus Wachtler, 2024

Etymology

The etymology of the *Bavarostrobus* plant is derived from Bavaria, which is the Latin name for the area from where it was first found, and "strobus", which stands for cone.

Diagnosis

Bavarostrobus has a crest-like strobilo, consisting of a large number of micro- and macrosporophylls.

Bavarostrobus friessii sp. n. Wachtler 2024

Holotype

PECH 425 **Paratypes:** PECH 173 (Microsporophyll); PECH 481 (Macrosporophyll)

Additional specimen

Approximately 50 pieces

Deposit:

Dolomythos Museum, Innichen (Italy)

Etymology

Bavarostrobus friessii was named in honour of the private researcher Gerald Friess from Großbottwar (Baden-Württemberg), who curated a rich palaeobotanical collection and made it accessible to the scientific community. Friess, along with his friend Peter Silberhorn, spent years meticulously collecting fossils from various sites in central and southern Germany, particularly in the area around Bayreuth.

Type locality:

Pechgraben, sandpit Küfner

Stratigraphic horizon

Hettangian, Lower Jurassic

Diagnosis

The plant is structured in such a way that macro- and microsporophylls cluster in multiple numbers at the end of a petiole. These structures are strong, elongated, and

possess a smooth surface at the ends or tapered heads.

Description

Whole plant: The plant features a plethora of spatula-shaped sporophylls emerging from the upper part of a long petiole measuring 2 to 3 cm in width. These sporophylls disintegrate easily, leaving behind delicate leaf cushions.

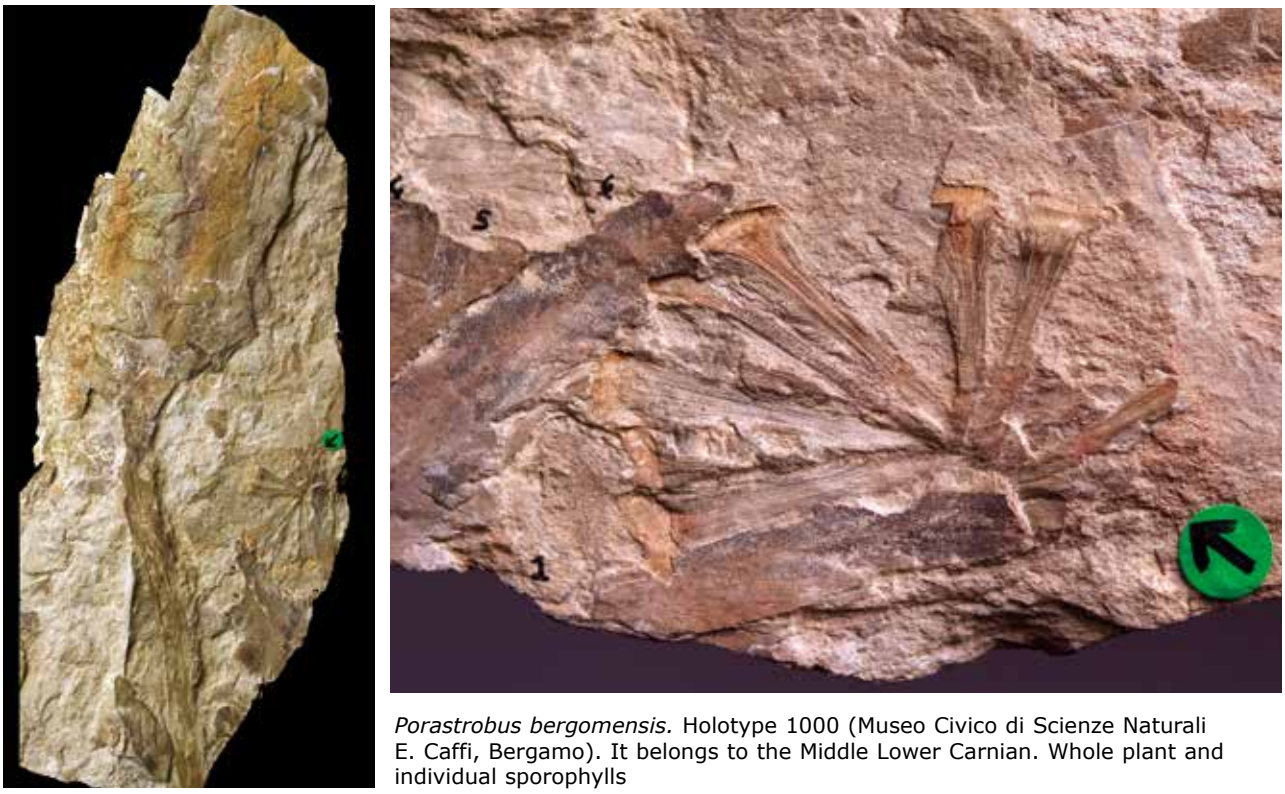
Macrosporophylls: They are located in the lower part of the strobilo, measuring about 1 to 1.2 cm wide. They are slightly thickened at the base, with a maximum length of 5 to 6 cm. These structures are segmented twice along their entire length in the middle, with a basal thickening that is concave and an apical end that is cut off.

Microsporophylls: They are situated in the upper area of the plant. They are similar in length to the macrosporophylls (5–6 cm) but narrower (0.5–0.7 cm). These structures are thickened at the base, tapering apically with a long, pointed end, and divided into two in the middle. The spores are covered by an outer tissue until they are fully ripe. Upon ripening, the velum breaks open. The plant's ligula is only visible sporadically, and its microspores have an oval to roundish shape, measuring 20 to 25 µm.

Remarks

Bavarostrobus is another commonly found clubmoss at the southwest end of the Küfner sand pit (50°00'04.1"N 11°32'26.4"E). The history of exploration surrounding this species remains unclear, highlighting the limited importance of palaeobotany in our society.

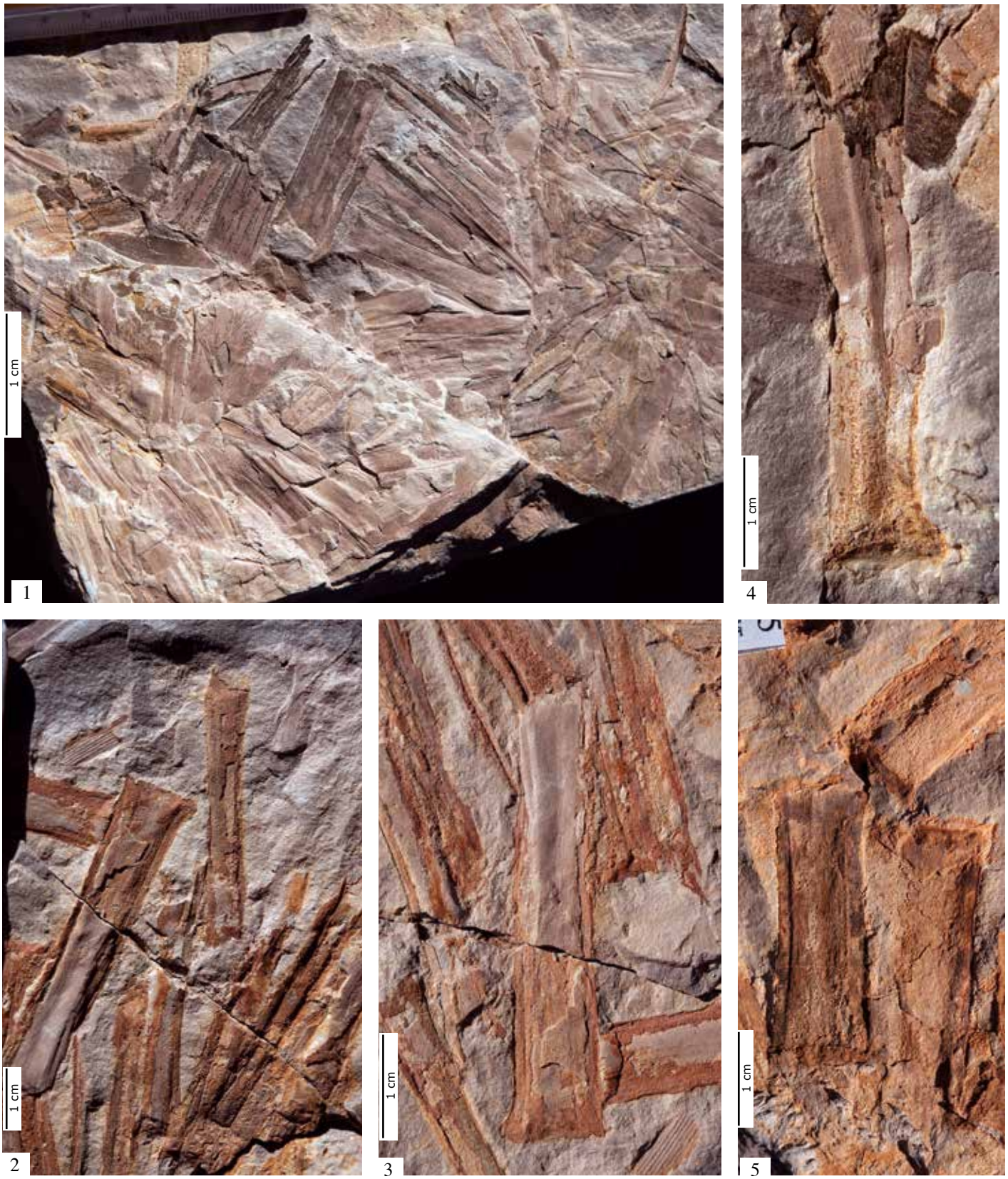
In 1999, Italian natural science student Luisa Passoni edited a scientific publication establishing the new genus and species *Porastrobus bergomensis.* However, this publication was deemed invalid according to the "*International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code)",* Chapter IV, Article 30, due to being part of a doctoral thesis (Turland et al., 2018). The location given was the Monte Pora, near Bergamo, Italy, and the Gorno Formation from the Middle Lower Carnian was given as the stratigraphic horizon. Various specimens were found, including an excellently preserved strobilo with individual sporophylls lying alongside it. Despite later publishing an official work, the original name was not mentioned (Passoni & Cittert, 2002); the designation was merely classified as an "*Unknown Fructification"* (p. 339–342, Plate VII, 2; Plate VIII), rendering the name



Porastrobus bergomensis. Holotype 1000 (Museo Civico di Scienze Naturali E. Caffi, Bergamo). It belongs to the Middle Lower Carnian. Whole plant and individual sporophylls

***Bavarostrobus friessii.* Lower Jurassic (Hettangian). Plant**

1-2. Plant with attached sporophylls and detail (PECH 616); 3. Petiole with sporophylls (PECH 429); 4. Various fallen sporophylls and a sporophyll tuft (PECH 425, designated holotype) All Pechgraben, sandpit Küfner, Coll. Wachtler, Dolomythos-Museum



***Bavarostrobus friessii*. Lower Jurassic (Hettangian). Sporophylls**

1. Large slab with sporophyll carpet (PECH 481); 2-3. Various individual sporophylls, some with recognizable spores (PECH 480) 4. Single sporophyll with spores (PECH 481, paratype); 5. Single sporophylls (PECH 475); All Pechgraben, Sandpit Küfner, Coll. Wachtler, Dolomythos-Museum

***Bavarostrobus friessii.* Lower Jurassic (Hettangian). Microsporophylls**

1-2. Microsporophyll aggregate (PECH 173, Paratype); 3-6. Various individual microsporophylls with typical pointed appendages (PECH 231, PECH 649, PECH 489, PECH 473, PECH 426, PECH 425); All Pechgraben, Sandpit Küfner, Coll. Wachtler, Dolomythos-Museum

***Bavarostrobus friessii*. Lower Jurassic (Hettangian). Micro- and Macrosporophylls**

1. Various microsporophylls (PECH 480) 2-4. Details of microsporophylls with spores (PECH 481); 5-8. Various macrosporophylls (PECH 481, Paratyp, PECH 446, PECH 429, PECH 591); 9. Macrosporophyll with macrosporangia, upper view (PECH 473); All Pechgraben, Sandpit Küfner, Coll. Wachtler, Dolomythos-Museum

Porastrobus bergomensis unrecognised. This turn of events led to the end of Luisa Passoni's commendable research in palaeobotany, as she transitioned to the IT industry for better career prospects.

After considering the significant time gap, a period of almost 30 million years, between the Upper Triassic (Carnian) and Lower Jurassic (Hettangian) period, a new genus name was chosen for the Lower Jurassic plant in collaboration with Ms. Passoni. The name *Bavarostrobus* was selected due to its association with Bavaria, denoting the Latinised name for Bayern, and the plant's robust sporophylls, making it a fitting classification.

In the rich Triassic world of clubmosses, there existed a diversity of species that remains unmatched today. Alongside the Selaginella or Isoetes ancestors that still thrive today, there were also small tree-shaped descendants of the Lepidodendrales (*Lycopia*) and Sigillarias (*Sigillcampeia)*, as well as short-stemmed, unbranched Lycophytes. These species likely evolved from tree-shaped relatives in the Carboniferous period, such as *Pleuromeia, Eocyclotes*, and *Lepacyclotes* (Wachtler 12/2011, Wachtler 2016a,b,c). During the Lower Jurassic of northern Bavaria, two extremely peculiar clubmosses dominated the landscape, only to become extinct during the Middle Jurassic: *Bernettia inopinata* and *Bavarostrobus friessii.* These species may have had relationships with *Lepacyclotes* and *Eocyclotes,* especially in terms of monopodial stems and the development of heterosporous sporophylls. While *Lepacyclotes* from the Early Middle Triassic (*Lepacyclotes brandneri*) throughout the Middle Triassic (*Lepacyclotes zeilleri*, Ladinian), as well as *Lepacyclotes kirchneri* (Bauer et al., 2015) in the Upper Triassic (Carnian), remained small and spherical and small in stature (Wachtler, 2016; Bauer et al., 2015), *Eocyclotes alexawachtleri* from the Lower Middle Triassic (Wachtler, 2021) displayed a more robust stem structure, with a distant similarity to *Bavarostrobus* with its spatula-shaped sporophylls. The foliage of *Eocyclotes* also featured similar sterile and fertile leaflets on the trunk, mirroring characteristics of *Bavarostrobus*.

In contrast, the dominant lycophyte during the Hettangian period in southern Germany was *Bernettia inopinata*, characterised by sword-shaped, elongated leaves that could reach lengths of up to 50 cm. The micro- and macrosporophylls of this species were equally distinctive. In terms of the chlorophyll content necessary for photosynthesis in *Bavarostrobus*, it is assumed that, similar to today's Isoetes plants, all leaf organs, including both the sterile and partially fertile leaf greens, contained chlorophyll.

Bavarostrobus friessii was a prevalent and important plant in the Pechgraben region, although it was rarely collected due to its unattractive leaf shapes. Like modern quillworts, such as the common *Bernettia inopinata, Bavarostrobus friessii* likely thrived in brackish water areas or shallow seas, as evidenced by the large number of sporophylls found in isolation. This characteristic aligns it with other Triassic plants, particularly recent clubmosses and quillworts (Isoetes).

Count Kaspar Maria Sternberg (1761 Prague–1838 Brzezina) with a steel engraving around 1845. He is considered one of the co-founders of palaeobotany (Coll. Wachtler, Dolomythos-Museum).

***Bavarostrobus friessii*. Lower Jurassic (Hettangian). Reconstructions**

a. Whole plant; b. Stem part with isolated macrosporangia; c. Macrosporophyll, top view; d. Macrosporophylls; e. Microsporophylls; f. Microsporophyll with spores; g. Microspores

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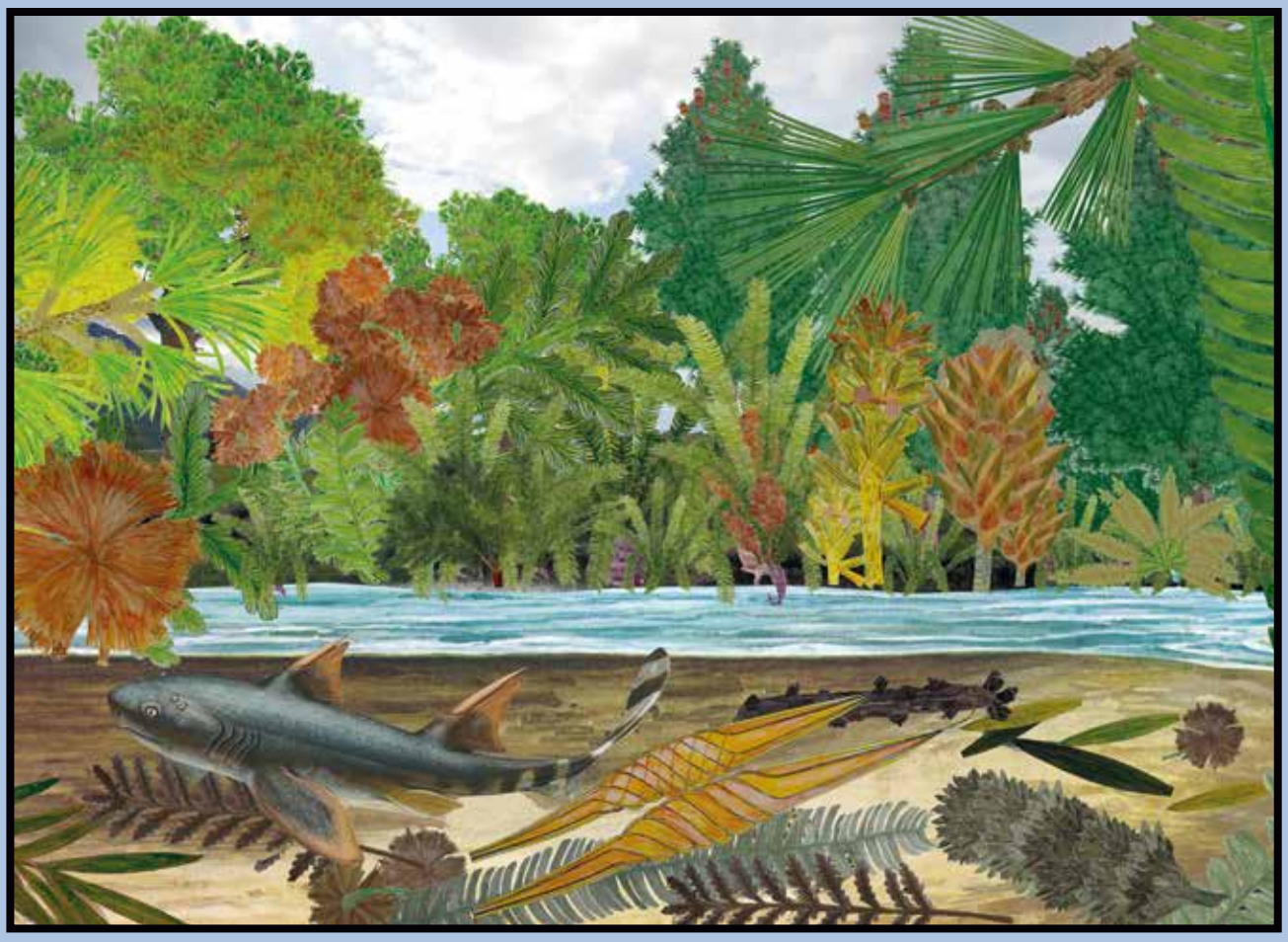

The Fossil Flora of Early Jurassic

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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