

# Early Permian ferns from the Fore-Urals

by Michael Wachtler

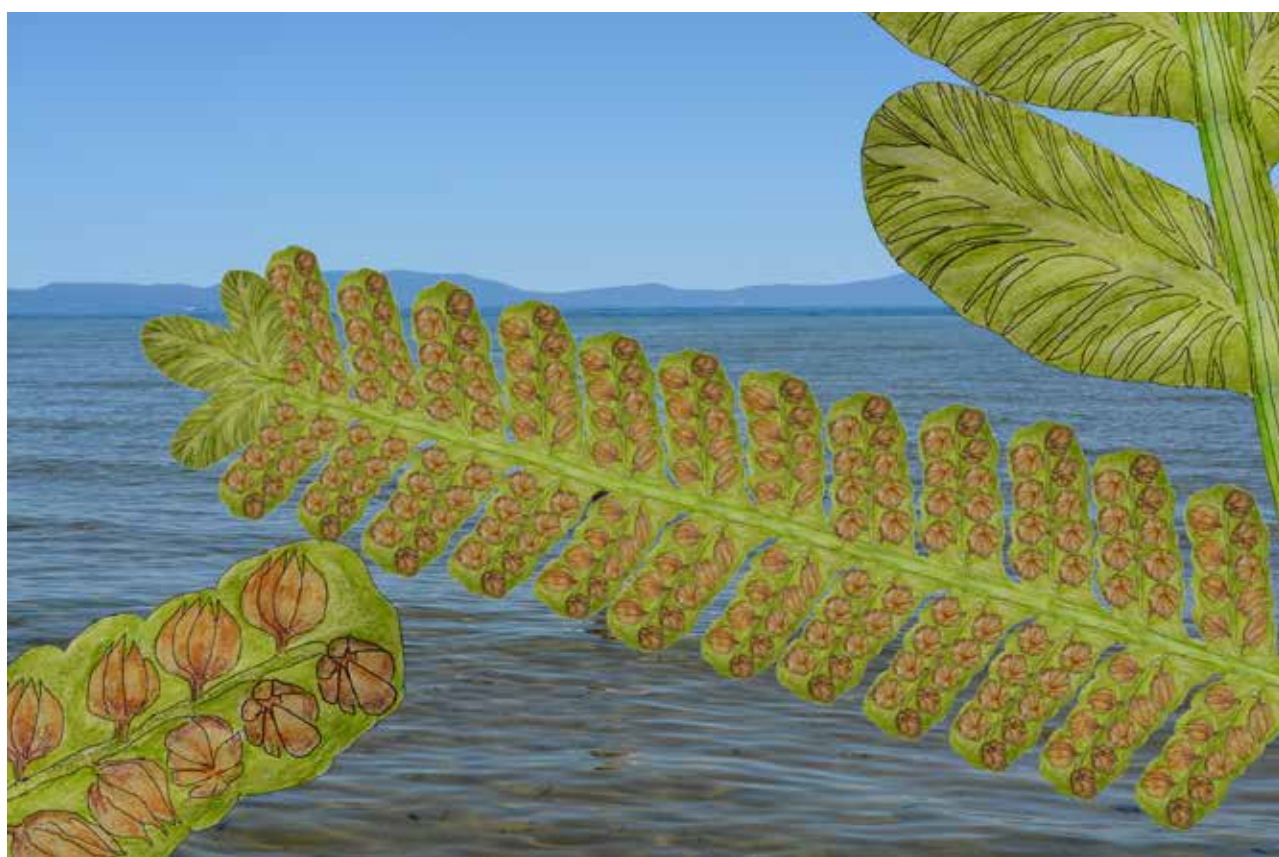
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## Abstract

The Pteridophyta play in the Early Permian floras of the old Angara-Land only a minor role behind the highly interesting Paleoangiosperms, the sphenophyta or the conifers. Some of them, like *Pecopteris anthriscifolia* cannot be classified in one of the fern-families till fertile fronds are found. Another common fern *Convexocarpus distichus* can be compared—due to the arrangement of its synangia—with coeval *Scolecopteris* (or *Asterotheca*) ferns from Permian fossil sites in Europe. This work describes the ferns from two localities: Panteleykovo near Arti (Sverdlovsk Oblast, of Artinskian period and Matvéevo (Lyswa-district) of Kungurian age.

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Key words: Permian floras, ferns, Angara, Fore-Urals



Early Permian (Kungurian) Angaran pteridophyta: Widespread was the fern *Convexocarpus distichus*, characterized by their eight till ten (normally nine) synangia on each leaflet.

On the newly constructed road from the hamlet Panteleykovo in the direction to Arti (Sverdlovsk Oblast, GPS: Latitude 56°22'59.47" N, longitude 58°41'41.19" E) Artinskian sediments—consisting of alternating sandstones, siltstones and argillites—crop out. Some of the layers hold abundant and well-preserved plants, especially Psymophyllaceae, and in minor amount horse-tails and ferns. No conifers were found. Two kinds of fossil ferns are common: One described from slightly younger Kungurian beds as *Convexocarpus distichus* (Naugolnykh, S.V., 1995), the other was till now classified as *Pecopteris anthriscifolia*, but its state of preservation, especially of the fertile parts is not enough allow a more precise placement in one of the known fern-groups. Better conserved are the Pteridophyta in the other fossil site Matvéevo (Lysva-district), about 15 km south-west of Kormovishche, (GPS: Latitude 57°47'1.80" N, longitude 57°50'59.60" E) of Kungurian age. There finest-grained gray to yellow terrigenous siltstones crop out in diverse beds. The conservation is unique and mainly all details of the insects, but also the plants, including their filigree parts were maintained. This location was studied especially by the Russian paleontologist M. D. Zalesky (1937b, 1939) and recently by Serge V. Naugolnykh (2014). Also, there the two main ferns *Convexocarpus distichus* and *Pecopteris anthriscifolia* dominate.

Division: Pteridophyta

## ***Convexocarpus distichus* NAUGOLNYKH, 1995**

1995 *Convexocarpus distichus* (Naugolnykh), Naugolnykh comb. nov. Plate 7, figs. 1–7; Plate 8, figs. 1 and 3

*Ptychocarpus* (?) sp. Naugolnykh, 1998c, text figs. 20F–20H; pl. VIII, fig. 1.

H o l o t y p e. GIN, no. 3773(11)/27(89), middle part of a fertile frond; Chekarda 1 locality, Bed 10; it was figured by Naugolnykh (1995, text fig. 5A–5C, pl. I, figs. A–D, pl. II, figs. A–C.

**Whole plant:** Bi-till probably tripinnate fronds with lateral branchlets in an opposite or alternate attachment.

**Sterile leaves:** Rounded, slightly elongated leaflets up to 1 cm long and 0.8 cm wide. One main venation reaching the pinnule apex, this strong, forking into lateral veins,

which divide only once towards the end of apex.

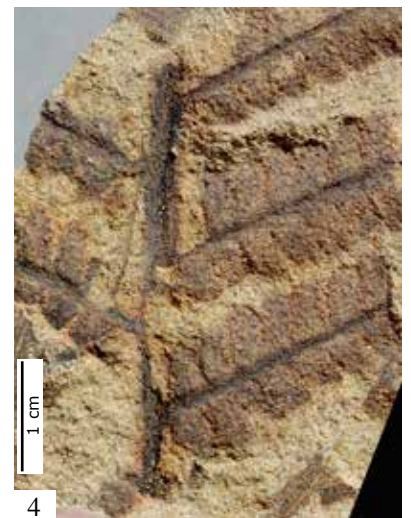
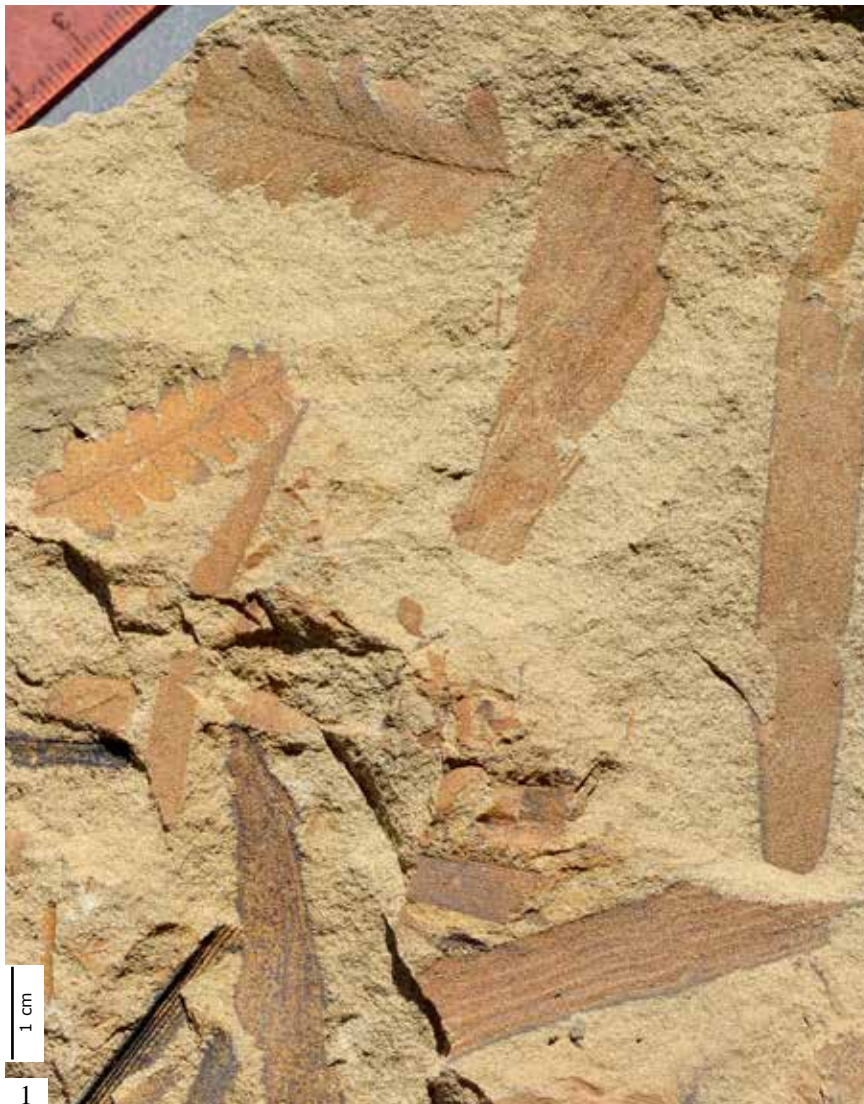
**Fertile leaves:** Similar to the sterile ones in size, venation not visible. Single fertile pinnula equipped with eight till nine synangia situated on the underside of the leaflets. The synangia are attached to the basal part of lateral veins, usually at a distance of 0.3–0.4 mm from the midvein of fertile pinnule. Synangia radially symmetrical, varying from 1.3 to 1.8 mm in diameter, positioned close to each other in two parallel rows extending along the mid-vein of fertile pinnule. Each synangium consisting of eight or, less often, nine or ten sporangia, which are fused by the basal margins almost throughout the length, except for the apical part. The central part of the synangium contained the receptacle, providing attachment for sporangia. The sporangia are elongated, 0.7 mm long and 0.2 mm of maximum width, with rounded bases and a pointed or extended apex. The synangia are often preserved lying on one side, and therefore only four sporangia located on the side of the synangium turned to the observer are usually seen. If they are pressed from the upper side, so the eight till ten sporangia can be observed. The sporangial wall is multilayered, consisting of four or five cell layers. The synangium is 0.7 mm long and of 0.6 mm of maximum width (Naugolnykh, 2014).

## **Remarks**

Paleozoic tripinnate fronds with elongated rounded pinnules, holding a midrib with forking lateral veins, are generally known from Euramerican fossil sites as *Pecopteris* or *Scolecopteris* (Millay, 1979). Most of them are recorded without any knowledge of the fertile parts and a classification will be difficult; however, some foliage with isolated radially symmetrical synangia on the lower side is known. Due to constant findings of *Psaronius*-stems in the same sediments it can be assumed that they primarily generate *Scolecopteris* fronds Perner & Wachtler, 2013).

Sometimes beginning from the Permian this kind of common ferns were classified as *Asterotheca* (*sternbergi*) and especially from the German Middle Triassic aesthetic *Asterotheca merianii*-fronds were widespread (Wachtler, 2016). Effectively, the similarities between Permian and Triassic *Asterotheca*

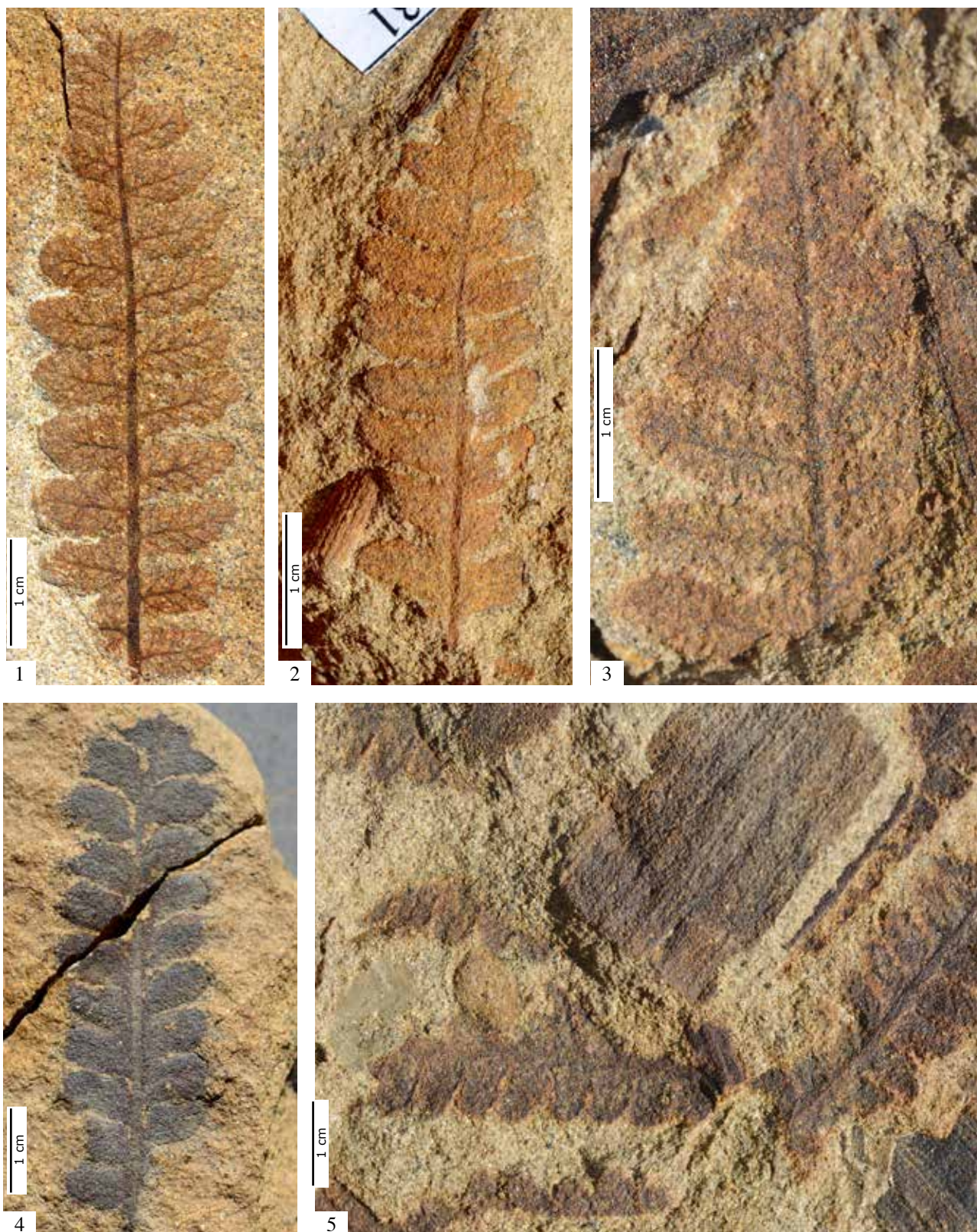




### Different ferns from Early Permian. Fore Urals, Russia

1. Slab with an agglomeration of different ferns, *Psymphyllum*-leaves and horsetails, (*Paracalamites* and/or *Equisetina*)(ARTI 30); 2. Two different ferns *Pecopteris anthriscifolia* (left); *Convexocarpus distichus* (right) ARTI 31); 3-4. Pinnula and frond of *Convexocarpus distichus* (ARTI 51, ARTI 31); Coll. Dolomythos, Arti, Artinskian

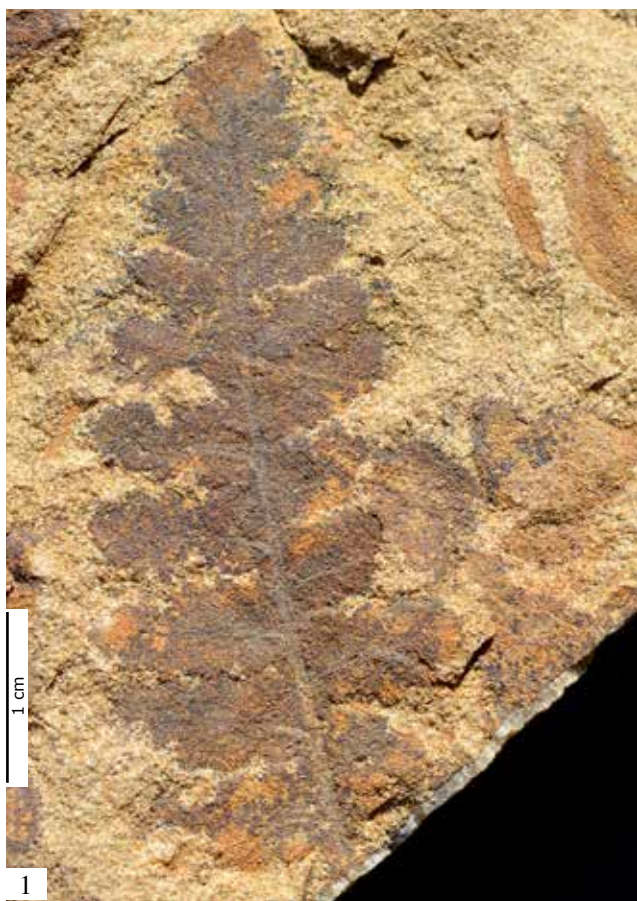




***Convexocarpus distichus*, fern, from Early Permian. Fore Urals, Russia**

1-2. Sterile pinnulas (ARTI 06 Coll. Gerasch, ARTI 31); 3-5. Fertile pinnulas (ARTI 34, ARTI 24, ARTI 23); Coll. Dolo-mythos, Arti, Artinskian





***Pecopteris anthriscifolia*, fern, from Early Permian. Fore Urals, Russia**

1-3. Several pinnae and pinnulas ARTI 31, 14, 08); Coll. Dolomythos, Arti, Artinskian

and *Scolecopteris*-fertile fronds are undeniable (Perner & Wachtler, 2015). Therefore, some assumptions suggest genealogical relationships. The number of synangia

for each pinna usually varies between five till nine, each containing only three till five, usually four sporangia. This is the main distinction feature between *Convexocarpus distichus*.

A classification in one of the today existing fern-groups is difficult. Often, they were compared with *Angiopteris* or *Marattia* (Naugolnykh, 2014) widespread in the tropics around the world, but their synangia are too different from the Permian ferns (*Scolecopteris*, *Asterotheca* or *Convexocarpus*). The only existing fern with synangia resembling the Paleozoic-Mesozoic is those of *Psilotum nudum* (whisk fern), a fernlike plant, found in tropical and subtropical areas around the world, where one synangium is formed from three sporangia.

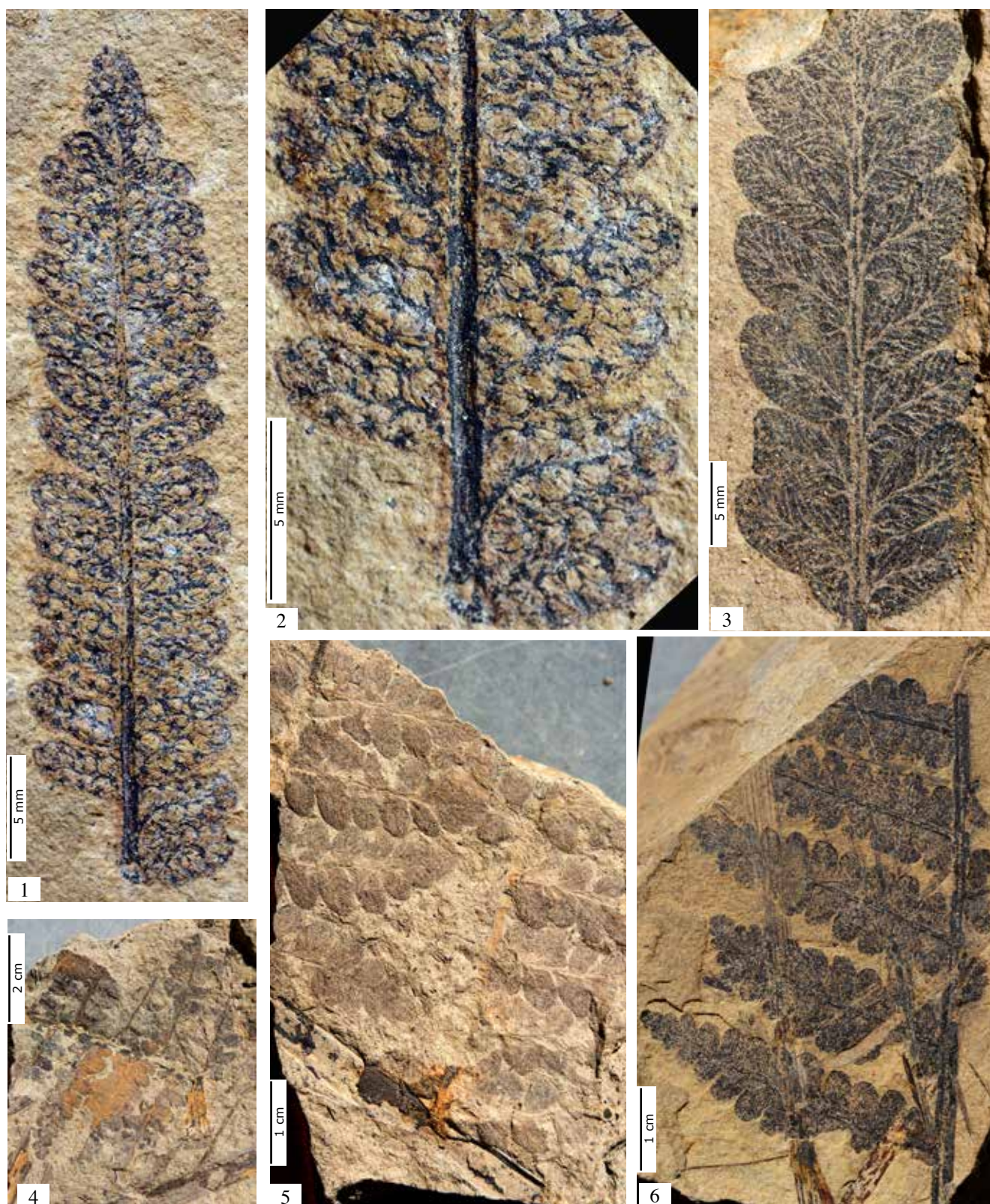
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Three sporangia forming a synangia of *Psilotum nudum* (whisk fern), a primitive fernlike plant.

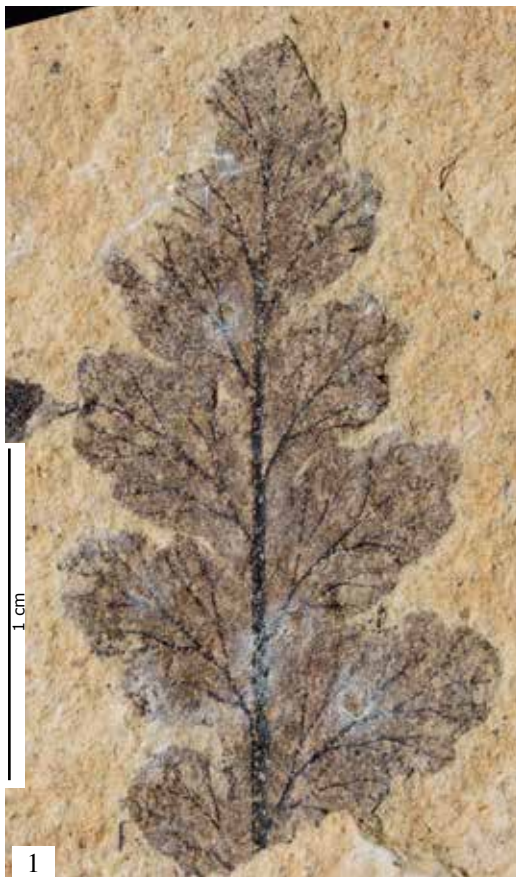




***Convexocarpus distichus*, fern, from Early Permian. Fore Urals, Russia**

1-2. Fertile pinnae with detail of the synangial structure (MAT 51); 3. Sterile pinnula with strong veins on the single blades (MAT 265); 4-6. Several parts of fronds (MAT 260, 484), Matvéevo, Kungurian (Early Permian) Coll. Perner & Wachtler, Museum Dolomythos





***Pecopteris anthriscifolia*, fern, from Early Permian. Fore Urals, Russia**

1. Pinna of the last order showing well the venation of the fragile leaflets (MAT 277); 2. Apical part of a frond (MAT 278); 3. Pinnula (MAT 59); 4. Sterile pinnula (MAT 482); Matvéevo, Kungurian (Early Permian) Coll. Dolomythos

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