NYMPHAEA Folia naturae Bihariae	XXXVI	5 - 26	Oradea, 2009

Banatozamites calvus Czier sp. nov. and *Bucklandia aninaensis* Czier sp. nov. from the Lower Jurassic of Anina, Romania

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Abstract. The new Bennettitalean species *Banatozamites calvus* and *Bucklandia aninaensis* are described from the mining locality Anina, situated in Banat region, Romania. The material originates from the Valea Terezia Member of the Steierdorf Formation, from Hettangian *pro parte* – Sinemurian continental deposits of the Getic Realm. *Banatozamites calvus* is a leaf with narrow pinnae, possessing half-concealed rachis and closely set or slightly distanced flat pinnulae. The pinnulae possess asymmetrical rounded apex, and usually simple veins. The lamina is lack of trichomes and of papillae. The adaxial epidermis consists of very sinuous-walled epidermal cells. The abaxial epidermis is differentiated into stomatal-free and stomatal bands. Stomata are densely scattered, arranged mainly in three rows. The stomatal apparatus, having semi-oval guard cells and mostly rectangular subsidiary cells, is not covered by roof cells. *Bucklandia aninaensis* is a small stem with petioles, belonging very probably to the plant that has *Banatozamites calvus* leaves. The stem and the petioles possess fine longitudinal ridges, and cuticle that indicates rows of rectangular to rounded-elongated cells. *Banatozamites calvus* and *Bucklandia aninaensis* appear in the *Banatozamites chlamydostomus* Subzone of the *Clathropteris meniscioides* Biozone. The genus *Banatozamites* with its species, *B. chlamydostomus*, *B. remotus*, *B. calvus*, as well as the species *Bucklandia aninaensis,* is endemic element of the European Mesophytic.

Keywords. Macroflora, Mesophytic, Romania.

Introduction

Fourteen years ago, the Bennettitalean genus *Banatozamites* was known solely based on the genotype *B. chlamydostomus* Czier 1996. The second species, named *Banatozamites remotus* Czier 2008, has been recently created only after a time longer than a decade. This was possible owing to fortunate discoveries of new leaf impressions and cuticle-bearing compressions. Some of the newly identified specimens, kept in the collections of the Botanical Department of the Hungarian Natural History Museum at Budapest (HNHM-BP), however, are not assignable to these two species, although their characters show assignment to the genus. Such fossil leaves and a stem constitute subject of this study.

Collected presumably in the 19th Century, the specimens originate from the lower Jurassic Anina coal bed, which belongs to the Getic Realm of the Southern Carpathians. All specimens originate from the litho- and biostratigraphic units from where the already known species of *Banatozamites* originate. The geological data regarding the fossiliferous deposits around the mining locality Anina (Banat region, Romania) were extensively presented and discussed by numerous authors, e.g. Kudernatsch (1855, 1857), Andrae (1855), Hantken (1878), Krasser (1921), Mutihac (1959, 1990), Semaka (1962), Năstăseanu (1964, 1984), Humml (1969), Biţoianu (1987), Bucur (1991, 1997), Givulescu (1998), Czier (2000a, 2000b, 2000c, 2008).

Material and methods

The material that constitutes the subject of this study consists of three hand specimens (HNHM-BP. 602481/1A1, 602481/1A2, 602481/1B), two light microscope slides (LM 3, 4) and a scanning electron microscope stub (SEM 5).

The specimens are on the faces of a grey-blackish piece of finely granulated sandstone. This kind of rock commonly appears at Anina, in the sterile intercalations of the coal seams. The leaves are mainly preserved as impressions, but fortunately, some leaflets possess well-preserved cuticles. Although the stem is a completely coalified compression, and such samples seldom are suitable for cuticular analysis, as an exception to this rule, contains some cuticle-bearing parts.

Preparations have been done by macerating a pinnula, and a small part of the stem, respectively, in Schulze's reagent (HNO_3 plus $KClO_3$). After the washing with water, the solution has been neutralized with KOH, and then cleared with distillate water. Cuticles were mounted in glycerine-jelly either for LM or on transparent film for SEM.

Systematic palaeontology

SPERMATOPHYTA
CYCADEOIDALES

Banatozamites Czier 1996

Type. *Banatozamites chlamydostomus* Czier, 1996

Banatozamites calvus Czier sp. nov.
Plate 1, figures 1, 2 *pro parte*; Plate 2, figures 1 – 2; Plate 3, figure 2; Text-figures 1 – 6

Derivation of name. Latin *calvus*, glabrous, hairless, smooth. After the smooth lamina, bearing no trichomes, no papillae, and no stomatal-covering roofs. For details, see Váczy (1980).
Holotype. Hand specimen HNHM-BP. 602481/1A1 (Pl. 1, fig. 1; Text-figs. 1, 2, 3), LM slide 4 (Pl. 2, figs. 1, 2; Text-fig. 4), SEM stub 5 (Pl. 3, fig. 2; Text-figs. 5, 6).
Paratype. Hand specimen HNHM-BP. 602481/1A2 (Pl. 1, fig. 2 *pro parte*).
Repository. Botanical Department of the Hungarian Natural History Museum, Budapest, Hungary.
Type locality. Anina, Romania.
Lithostratigraphic unit. The Valea Terezia Member of the Steierdorf Formation (Bucur 1991).
Biostratigraphic unit. The *Banatozamites chlamydostomus* Subzone of the *Clathropteris meniscioides* Biozone (Czier 1999).
Age. Hettangian *pro parte* - Sinemurian.
Diagnosis. Leaf possessing strongly to slightly but mainly normally asymmetrical narrow pinnae. Rachis semi-concealed by the base of pinnulae. Pinnulae set close together or slightly distanced each from the others, disposed alternately to oppositely, flat, linear, with margins entire and asymmetrical rounded apex. More or less obliquely arising veins, usually simple, occasionally dichotomised once in the basal half of pinnulae, running mostly parallel, in the distal third very slightly curved in the acroscopic direction, ending in the apex and in the distal two third of the acroscopic margin. Non-trichomate and non-papillate lamina. Adaxial epidermis consisting of more or less conspicuous rows of randomly oriented, isodiametric to rectangular epidermal cells. Cell walls very sinuous, with deep sinuosities. Abaxial epidermis differentiated in stomatal-free and stomatal bands. All bands with sinu-

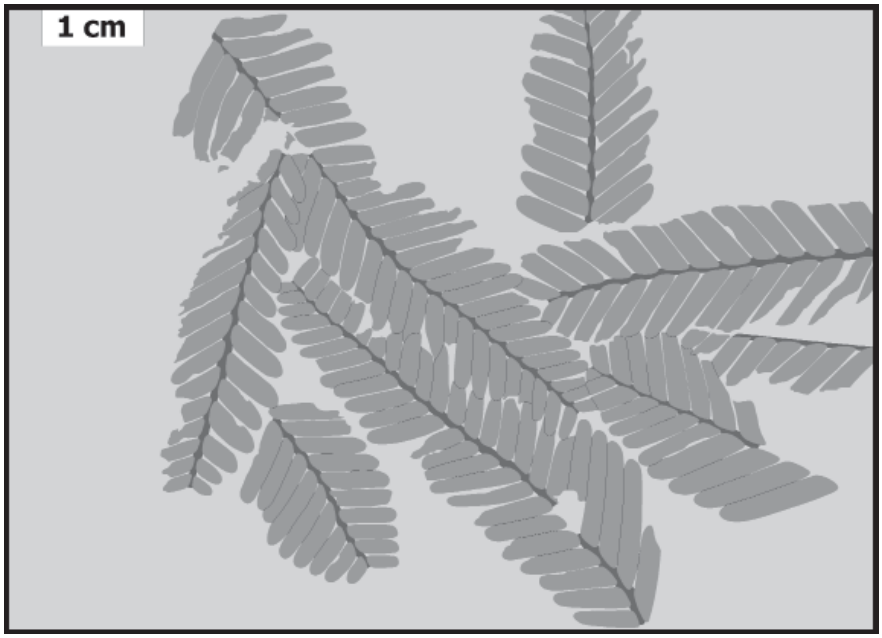

Fig. 1. *Banatozamites calvus* sp. nov. Narrow pinnae. Holotype.

ous-walled epidermal cells, slightly larger than the cells of the adaxial epidermis. Stomata arranged mostly in three rows per stomatal band. Stomatal apparatus possessing guard cells with spindle-shaped thickenings, and mostly rectangular, sometimes rounded or irregular subsidiary cells. Guard-cells semi-oval, characterised by width/length ratio ⅓. Walls of the subsidiary cells usually very sinuous or sinuous, sometimes almost straight. Stoma-covering roof lacking.

Supplementary description. The almost parallel disposition of several pinnae (Fig. 1) suggests a possibly and very probably bipinnate habit of the leaf. On the upper face of the rock there are 28 pinnae belonging to the holotype (Pl. I – Fig. 1). The pinna on the lower face of the rock is the paratype (Pl. I – Fig. 2 *pro parte*). Supposing the bipinnate habit, all the pinnae were initially disposed in a single direction. Their slightly disordered appearance may be the result of their break in fragments during the sedimentation. A young pinna is preserved on a length of 50 mm. Although it has incomplete base and apex, the reconstruction (Fig. 2) shows that initially, the entire pinna was no much longer, just of about 62 mm.

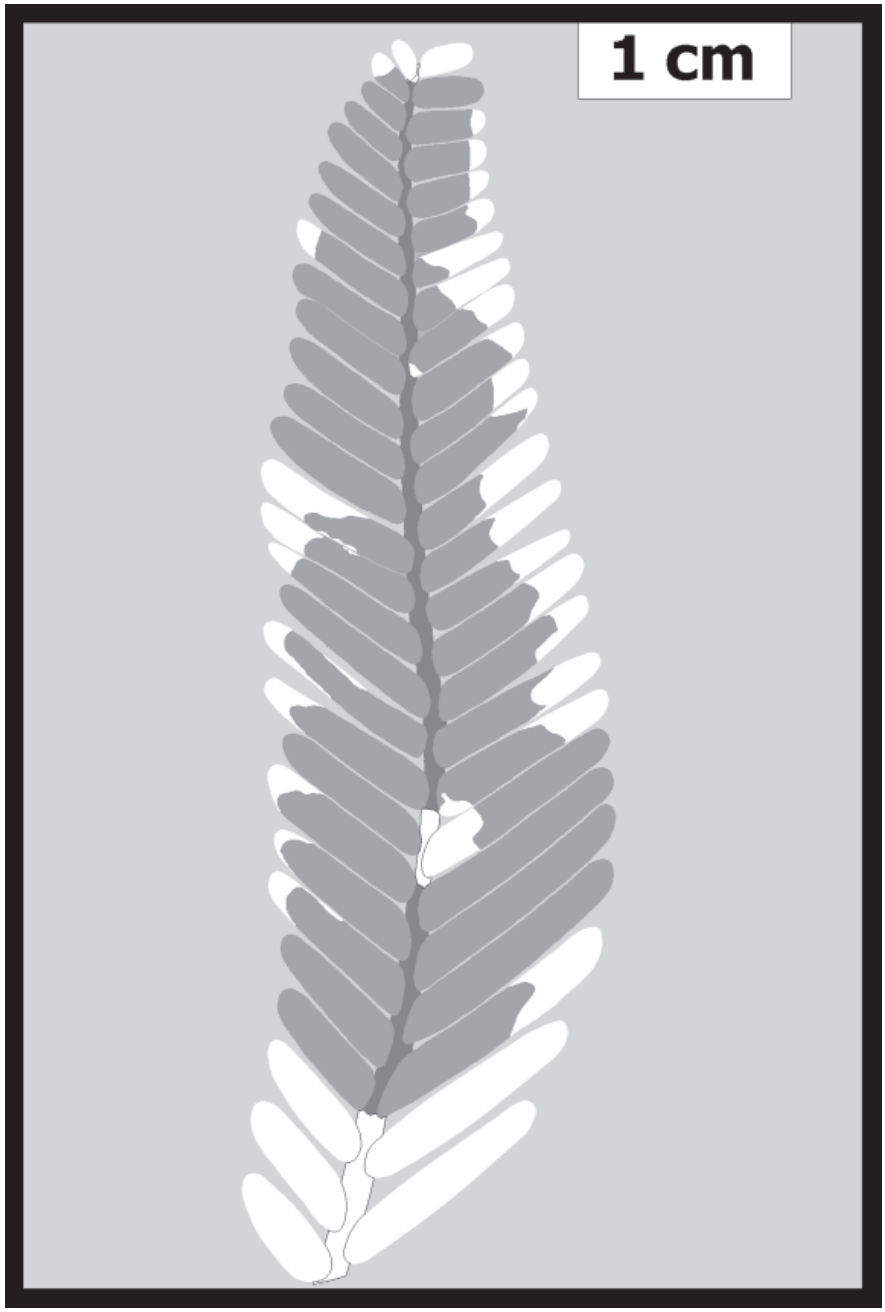

Fig. 2. *Banatozamites calvus* sp. nov. Reconstruction of a young pinna. Holotype.

Mature pinnae are about twice longer, the most complete of them being preserved on a length of 98 mm. They are about 15 mm wide on a rather long portion, the width decreasing gradually to about 5 mm near the apex. The pinnae are generally characterised by long and narrow habit, acute to acuminate end. Despite of the fact that the pinnae of *Banatozamites calvus* are narrower than the pinnae of *B. chlamydostomus* and *B. remotus*, they are so long, that their surface may exceed the value known in the case of the latter species. For the most part, the pinnae are normally asymmetrical, regarding the pinnulae insertion angle and their length. The rest of the pinnae are strongly, slightly, or very slightly asymmetrical. The rachis is smooth and slender, not wider as 1 mm, with average width of 0.8 mm, the width decreasing distally to about 0.5 mm. It appears as a narrow channel on the face of the pinna. The pinnulae are attached with their whole bases on the upper face of the rachis, at angle of about 60°, in many instances between 55° – 65°. The pinnulae of the reconstructed asymmetrical young pinna arise at angle of 70° at the left of the rachis, and 45° at the right of it. The attachment angle may be therefore between 45° – 70°. This range is useful in the taxonomy of the *Banatozamites*, although it is not a specific diagnostic character. Some pinnulae of *B. chlamydostomus* and *B. remotus* may be attached at angles between the limits measured on *B. calvus*, but this happens only in few cases. Growing alternately to oppositely, the pinnulae may change their position even in the same pinna, but they never overlap each other. In all the cases, at least a very small gap exists between them. They are linear, with margins entire, slightly narrowing near the apex. The acroscopic margin is straight on its almost whole length. The basiscopic margin, however, in the apical part bends forward, the result being an asymmetrical apex. The asymmetry of the pinnula apex is a specific character, present in all *Banatozamites calvus* pinnulae. This feature appears also in other cases, but it is not exclusiveness of the other species too. In two third of the cases has been observed on *B. chlamydostomus* pinnulae, but just in half of the cases on the pinnulae of *B. remotus*. Mature *B. calvus* pinnulae, in the medial portion of the pinnae, are 8 – 12 mm long and 2 mm wide (1.5 – 3 mm). In the apical portion of the pinna, the pinnulae are much smaller, their length decreasing to about four mm, and the width even to one mm. Venation consists typically of nine (eight to ten) veins, arising more or less obliquely from the whole base of pinnula. Almost each vein of each pinnula is simple. Just in few cases have been observed pinnulae of which one vein dichotomises. In such cases, that vein forks only once, in the basal half of the pinnula (Fig. 3). Owing to the simplicity of the venation, taking also the occasional dichotomisation into consideration, the number of veins in the middle of the pinnulae is between eight and eleven. The venation's density in the middle of a typical pinnula is between strict limits, of four to five veins per mm.

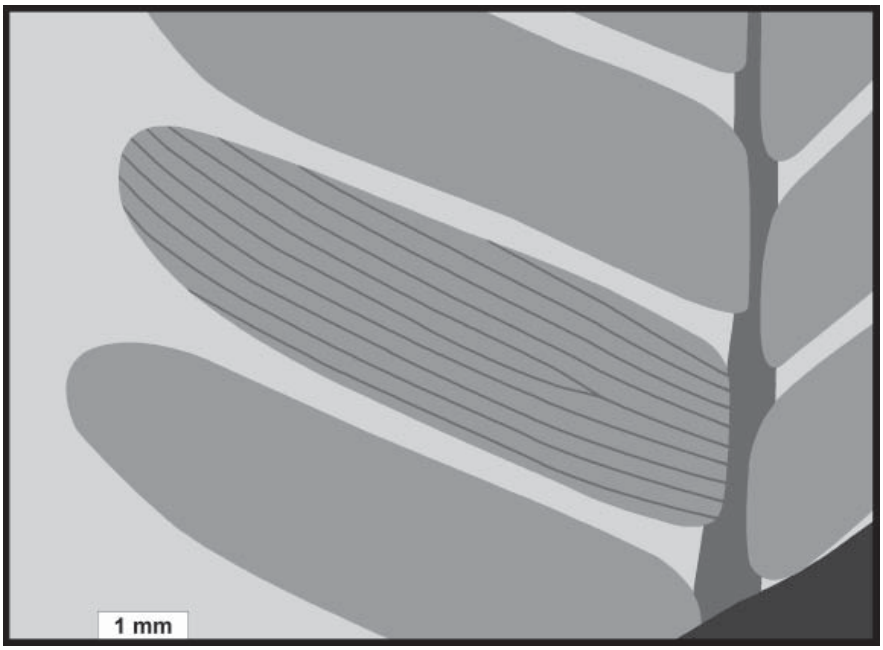

Fig. 3. *Banatozamites calvus* sp. nov. Shape, attachment, and venation of pinnulae. Veins directions based on macro- and microscopic analysis. Holotype.

Although cuticles are preserved on rather small areas of the pinnulae, they are normally detachable where present, being sufficiently thick and hard to give very good quality to all preparations. The cuticular analysis has clearly demonstrated the hypostomatic character of the lamina. The upper cuticle shows no differences between the epidermal cells of the venal or intervenal regions (Pl. II – Fig. 1). The adaxial epidermis contains cells with dimensions of 24 - 48/ 20 - 40 µm. All the cell walls have deep sinuosities. The length of the sinuosities is between 10 – 25 µm („wave-length"), their width between 7 - 20 µm („amplitude") (Fig. 4). Abaxial epidermis (Pl. II – Fig. 2) consists of 80 – 150 µm wide bands of epidermal cells (corresponding to the veins) and of 90 – 210 µm broad stomatal bands (corresponding to the regions between the veins). The epidermal cells of the abaxial epidermis have dimensions of 24 - 66/ 18 - 64 um. They are oriented parallel with the veins. Their walls are sinuous, although the wall's sinuosities are slightly smaller than those of the adaxial epidermal cell's are. The stomata in the stomatal bands are the most frequently in three rows, sometimes in two or four rows. Occasionally, bands formed by a single row of stomata also appear, where a vein dichotomises.

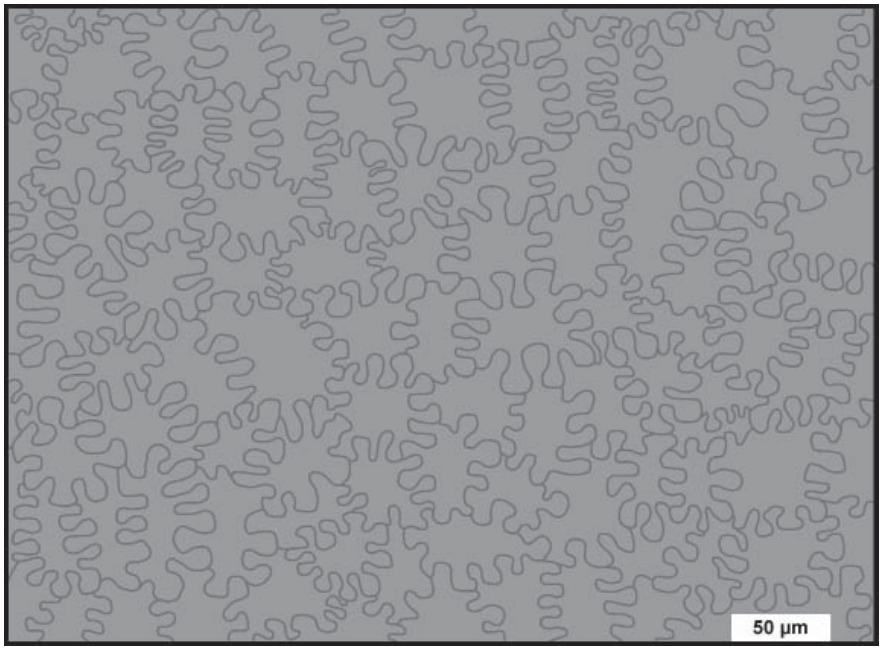

Fig. 4. *Banatozamites calvus* sp. nov. Adaxial cuticle showing very sinuous-walled epidermal cells. Holotype.

All stomata are transversely oriented, the pore direction being perpendicular to the veins (Fig. 5). The stomatal apparatus is paracytic (Fig. 6). Stoma is oval, typically 45 µm long and 30 µm wide (Pl. III – Fig. 2). In other words, each of the two guard cells has semi-oval shape, having the width/length ratio of ⅓. This is a very characteristic value for the species *Banatozamites calvus*, easily distinguishable from the value ¼ in the case of *B. chlamydostomus*, and ½ in the case of *B. remotus*. Owing to the outer thickenings, the guard cells appear as pointed at the ends. The subsidiary cells that usually are rectangular, and just in very few cases rounded or irregular in shape, are about 30 µm (12 – 48 µm) wide. With few exceptions when their walls are almost straight, the walls of these cells are sinuous to very sinuous. The length of the pore is about 18 µm. Stomata are densely scattered, with density of 115/ mm^2 (100 – 130/ mm^2). Stomatal index is about 12 (10 – 14).

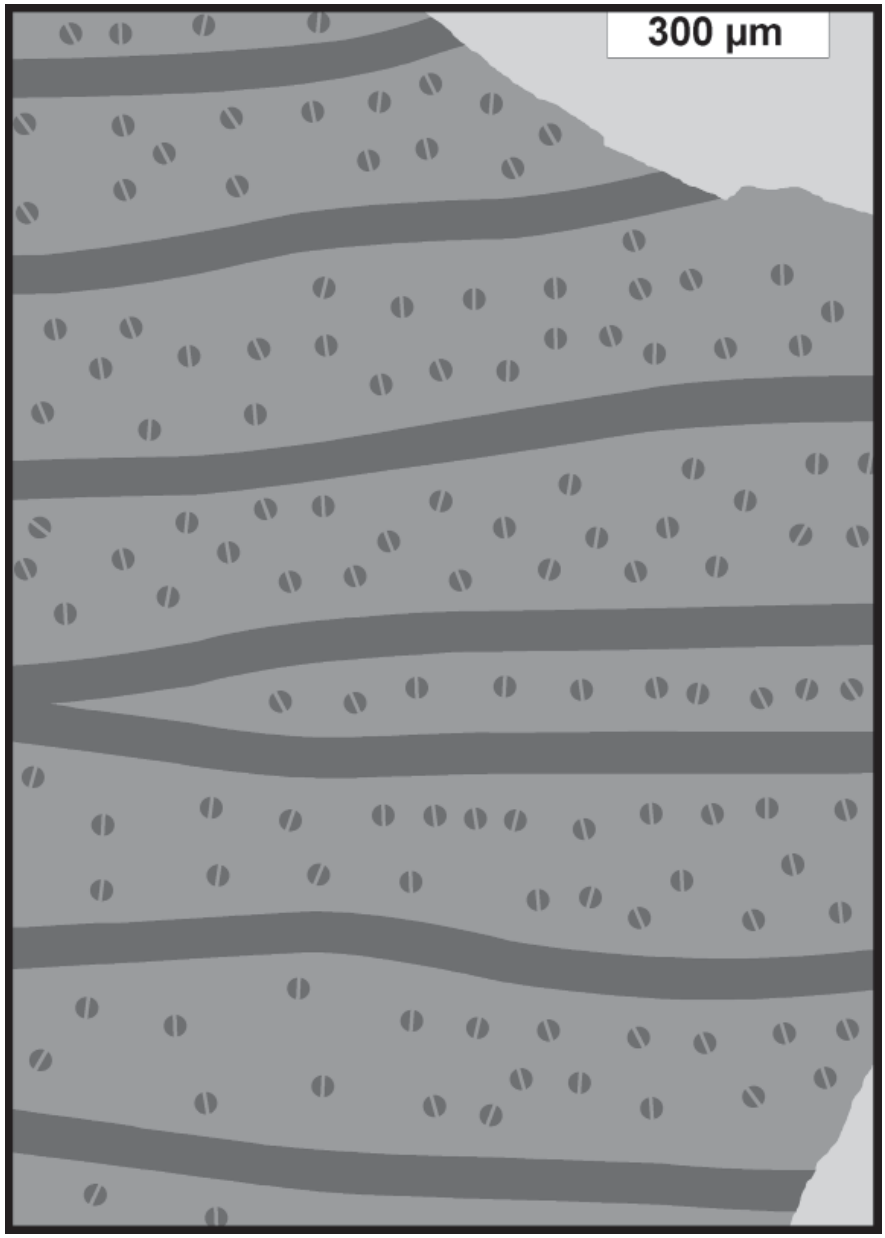

Fig. 5. *Banatozamites calvus* sp. nov. Abaxial cuticle. The continuous dark bands correspond to the veins. Stomata are represented by circles, each with a line in the middle, which indicates the direction of the pore. Holotype.

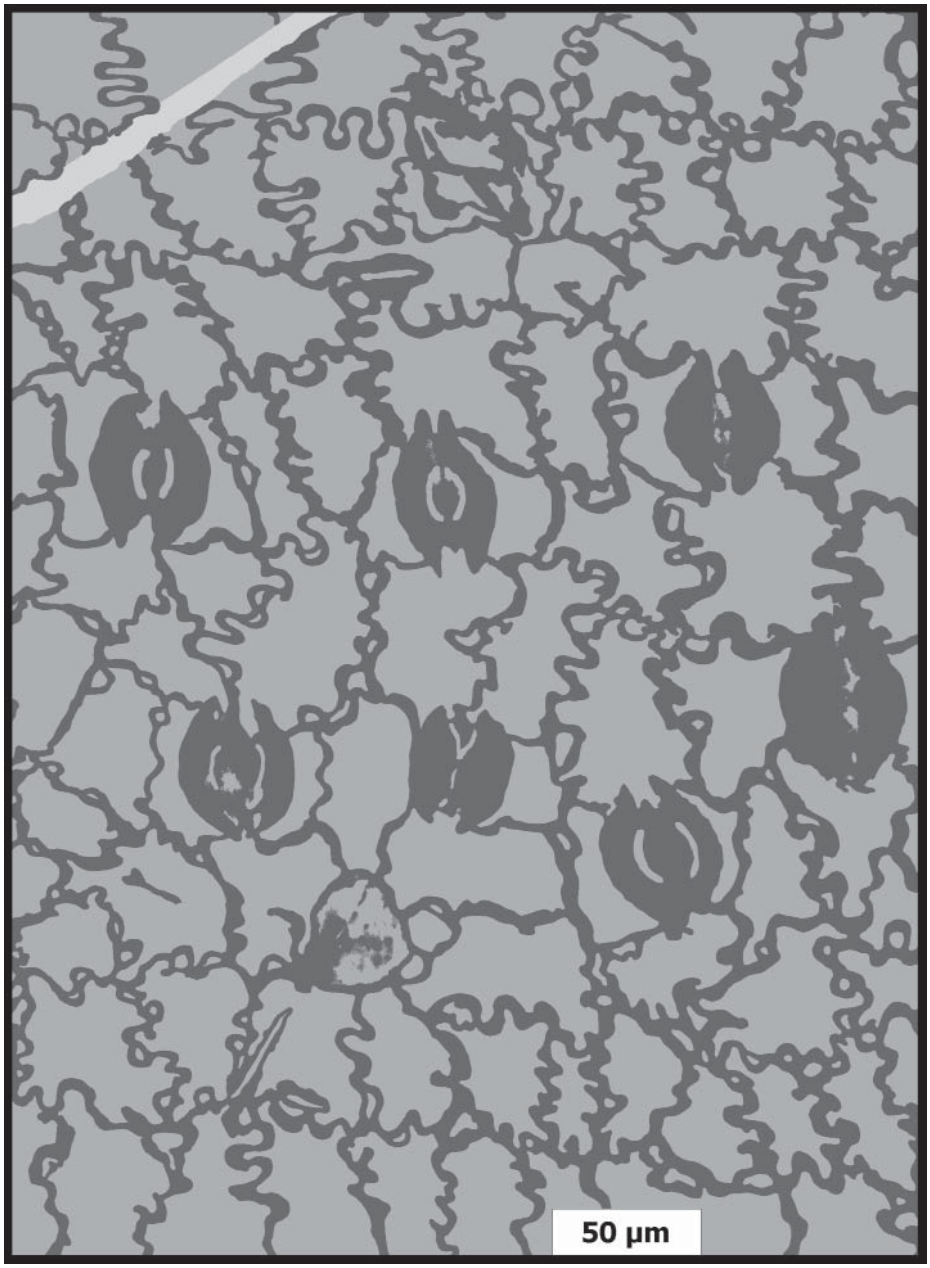

Fig. 6. *Banatozamites calvus* sp. nov. Abaxial cuticle, showing a stomatal band between two non-stomatal bands. Holotype.

Bucklandia Presl in Sternberg 1825

Type. *Bucklandia anomala* (Stokes & Webb 1824) Presl in Sternberg 1825

Bucklandia aninaensis Czier sp. nov.
Plate 1, figure 2 *pro parte*; Plate 3, figure 1

Derivation of name. After the mining locality Anina.
Holotype. Hand specimen HNHM-BP. 602481/1B (Pl. 1, fig. 2 *pro parte*), LM slide 3 (Pl. 3, fig. 1).
Repository. Botanical Department of the Hungarian Natural History Museum, Budapest, Hungary.
Type locality. Anina, Romania.
Lithostratigraphic unit. The Valea Terezia Member of the Steierdorf Formation (Bucur 1991).
Biostratigraphic unit. The *Banatozamites chlamydostomus* Subzone of the *Clathropteris meniscioides* Biozone (Czier 1999).
Age. Hettangian *pro parte* - Sinemurian.
Diagnosis. Stem at least 10 cm long and about 1.5 cm broad, bearing petioles. Petioles about 5 mm wide, longer than 2 cm, arising at angle of about 40°. Surface of stem and of petioles with fine longitudinal ridges. Cuticle showing rows of rectangular to rounded-elongated cells with straight and smooth walls.
Supplementary description. The stem is a 16 mm wide compression, preserved on a length of 112 mm (Pl. I – Fig. 2 *pro parte*). It is strongly coalified in the matrix, being visible half of its surface. Where visible, a number of 38 longitudinal prominent ridges are seen, running equidistantly, parallel with the straight margins of the compression. Two petiole fragments are present at one side of the stem; the distance between the petioles is three cm. One petiole arises from the stem. The other, lying near the stem, is broken. The petioles have on their exposed face four to five ridges, slightly stronger than the ridges of the stem. A single kind of cuticle is present, and only on small areas, on the exposed face of the stem, where a coalified layer of one to two mm thickness preserves them. The rows in which the cells are, almost everywhere are conspicuous (Pl. III – Fig. 1).

Discussions and comparisons

Preserved usually as fragments, the vegetative organs of the plants assigned to order Bennettitales (Cycadeoidales) only in exceptional cases remain

anatomically connected in fossil state. As a rule, they are preserved on the faces of different rock samples collected from the same fossiliferous deposit, or on the face of the same sample, but at certain distance one from other. Palaeobotanists can say therefore, that such fossil impression or compression fragments belong probably, or perhaps just possibly, to one or several plant specimens. This is why they provide different organs with different generic names, even in those few cases when the fragments very probably belong to the same plant. The famous middle Jurassic flora of Yorkshire is a good example in this respect. Harris (1969), described from there leaves, stems, and reproductive organs, assigning them to different Bennettitalean genera. He tried to associate *Ptilophyllum pecten* leaves with *Bucklandia pustulosa* stems and *Williamsonia leckenbyi* ovulate cones, but the resulting plant reconstruction shows a rather unusual cycadophyte habit. Moreover, he found some stems, indistinguishable from *Bucklandia pustulosa*, associated with *Ptilophyllum pectinoides* leaves and *Williamsonia hildae* cones, but he did not gave figured restoration for a theoretical association. According to Delevoryas (1975), however, Harris „emphasised that he has seen no organic connection of parts but felt strongly that consistent association of parts cannot be ignored".

Being a follower of Harris' conception, I feel strongly that the Anina leaves and the stem probably belong to the same plant, but I emphasize, that there is no organic connection between these organs. Based on the generic characters, the leaves belong to the genus *Banatozamites* Czier 1996, and the stem to *Bucklandia* Presl in Sternberg 1825. Many characters do not allow assignment of the leaves to the existent species. For this reason, the new species *Banatozamites calvus* is proposed. The table below (Tab. 1) presents the main differences between the new species and the other two species of the genus.

Since Seward (1917) pointed out, it is widely known that the genus *Bucklandia* contains stems of many Mesophytic Bennettitales. Because this generic name designates stems of plants with leaves attributed to several genera like *Ptilophyllum* and *Zamites*, I consider that we may use it also for stems of plants having *Banatozamites* leaves. The Anina stem almost surely belongs to the plant with leaves assigned to the new species *Banatozamites calvus*. This is a supplementary reason, why *Bucklandia aninaensis* also is proposed as new species.

The asymmetry of the pinnae, caused by the different attachment angles and length of the pinnulae, is an interesting character worthy to detailed future investigations. This character is present in all the described specimens of the genus *Banatozamites*, so it might be a generic character. A conclusion in this respect will result hopefully when the study of all the specimens will arrive to the end.

Tab. 1. Main differences between the species of genus *Banatozamites*.

Character	***Banatozamites chlamydostomus***	***Banatozamites remotus***	***Banatozamites calvus***
Asymmetry of pinnae	normal	very strong	strong to very slight; mainly normal
Value that the pinnae surface may exceed (Value that the pinnae length may exceed x Value that the pinnae width may exceed)	6600 mm^2 (110 mm x 60 mm)	1155 mm^2 (55 mm x 21 mm)	1470 mm^2 (98 mm x 15 mm)
Average width of pinnae rachis	1.5 mm	1.2 mm	0.8 mm
Measure in which the rachis is concealed by the basal portion of pinnulae	Almost entirely	Partly	Half
Setting of pinnulae	Closely	Distanced by gaps equalling about half of their width	Closely or slightly distanced by small gaps
Disposition of pinnulae	Alternately	Alternately	Alternately to oppositely even in the same pinna
Shape of pinnulae	Linear or rectangular, sometimes slightly falcate	Linear or slightly falcate	Linear
Measure of the pinnulae convexity toward the adaxial surface	More or less	Slightly	Not at all
Attachment angles of pinnulae	65° – 80°	45° – 90°	45° – 70°
Shape of the pinnula apex	Rounded	Rounded to slightly obtuse	Rounded
Asymmetry of the pinnula apex	In two third of the cases	In half of the cases	Always
Dimensions (Length / Width) of pinnulae	22 – 32 mm / 6 – 11 mm	9 – 12 mm / 1.7 – 2.5 mm	4 – 12 mm / 1 – 3 mm
Arisement of the veins	Perpendicularly	Slightly obliquely	More or less obliquely
Direction of the veins	Slightly divergent	Almost parallel	Parallel
Appearance of simple veins in each pinnula	Occasionally	Half of the total number of veins	Always
Appearance of forked veins in each pinnula	Always	Half of the total number of veins	Occasionally
Dichotomization of the veins	Once or repeatedly at all levels	Once at all levels	Once in the basal half of pinnulae
Ending of the veins	In the apex, in the whole acroscopic margin, and in the distal half of the basiscopic margin	In the apex and in the distal half of the margins	In the apex and in the distal two third of the acroscopic margin

Number of veins per base of a typical pinnula	16	8	9
Density of the venation in the middle of a typical pinnula	3 veins/mm	5 veins/mm	4 – 5 veins/mm
Detachability of the cuticles	Normal	Easy	Normal
Thickness of the cuticles before the maceration	Normal	Thick	Normal
Conspicuousness of the rows of the adaxial epidermal cells	More or less	Dominant	More or less
Orientation of the adaxial epidermal cells	Usually with their longest sides parallel	Usually with their longest sides parallel	Randomly
Presence or absence of trichomes on the adaxial epidermis	Absent	Present	Absent
Shape of the epidermal cells of the adaxial epidermis	Rectangular	Rectangular	Isodiametric to rectangular
Dimensions (Length / Width) of the epidermal cells of the adaxial epidermis	40 – 60 µm / 25 – 40 µm	30 – 110 µm / 30 – 70 µm	24 – 48 µm / 20 – 40 µm
Shape of the cell-walls of the adaxial epidermal cells	Markedly sinuous, with normal sinuosities	Markedly sinuous, with normal sinuosities	Very sinuous, with deep sinuosities
Dimensions („Wavelength" / „Amplitude") of the cell-walls sinuosities of the adaxial epidermal cells	5 – 13 µm / 8 – 15 µm	8 – 24 µm / 5 – 13 µm	10 – 25 µm / 7 – 20 µm
Presence or absence of stomatal bands in the abaxial epidermis	Present	Absent	Present
Arrangement of stomata in the abaxial epidermis	In stomatal bands, in 2 (1 – 3) rows; almost always in 2 rows, sometimes in 3 rows; in a single row where a vein dichotomises	Irregularly scattered	In stomatal bands, in 3 (1 – 4) rows; the most frequently in 3 rows, sometimes in 2 or 4 rows; occasionally in a single row where a vein dichotomises
Width of the stomatal bands / Width of the non-stomatal bands	60 – 220 µm / 130 – 200 µm	Not measurable (epidermis not differentiated)	90 – 210 µm / 80 – 150 µm
Presence or absence of trichomes on the normal epidermal cells of the abaxial epidermis	Absent	Present (very numerous)	Absent
Presence or absence of papillae on the normal epidermal cells of the abaxial epidermis	Present	Present	Absent
Shape of the guard cells	Semi-ellipsoidal	Semi-circular	Semi-oval

Width/Length ratio of each guard cell	¼ (12 µm / 50 µm)	½ (20 µm / 40 µm)	⅓ (15 µm / 45 µm)
Shape of the guard cell thickening	Crescent	Half-ring	Spindle
Shape of the subsidiary cells	Rounded	Rectangular to rounded	Mostly rectangular, sometimes rounded or irregular
Width of each subsidiary cell	18 µm (12 – 24 µm)	45 µm (30 – 60 µm)	30 µm (12 – 48 µm)
Shape of the walls of the subsidiary cells	Almost straight	Almost straight	Usually very sinuous or sinuous, sometimes almost straight
Length of the porus	30 µm	20 µm	18 µm
Stomatal density	40 – 50 stoma/mm^2	80 – 90 stoma/mm^2	100 – 130 stoma/mm^2
Stomatal index	9 (8 – 10) %	14 (12 – 16) %	12 (10 – 14) %
Presence or absence of the stoma-covering roof	Present	Present	Absent

At least some of the following characters also might be generic, but not differentially diagnostic: the fact that the pinnula base never covers the base of the pinnula on the opposite side of the rachis, the entire margins of pinnulae, the very good preservation state of the cuticles, the adaxial cuticle showing no differentiation of the epidermal cells of the venal or intervenal regions, the arrangement in rows of the adaxial epidermal cells, the absence of papillae on the adaxial epidermis, the orientation parallel with the veins of the epidermal cells in the abaxial epidermis. Next researches probably will clarify these problems too. The discovery of the new species *Banatozamites calvus* has now proven that numerous other characters might be not generic. These are specific characters, namely the alternate disposition of the pinnulae, the dichotomisation at all levels of some veins, the rectangular shape of the adaxial epidermal cells, the orientation of the adaxial epidermal cells usually with their longest sides parallel to the margins, the markedly sinuous walls of the adaxial epidermal cells, the presence of papillae on the abaxial epidermis, and the almost straight walls of the subsidiary cells of the stomatal apparatus.

Bucklandia anomala, a combination based on *Clathraria anomala* Stokes & Webb 1824, is the genotype of *Bucklandia* Presl in Sternberg 1825. This genus is distinct from *Bucklandia* R. Brown ex Griffith 1836, which is a later homonym referring to Hamamelidae specimens. According to Zhang (1999), that is a synonym of *Exbucklandia* R. W. Brown 1946.

Harris (1969) described from the Jurassic of England the species *Bucklandia gigas* Seward 1917, and *B. pustulosa* Harris 1969. Barale *et al.* (1974) described from the Jurassic of France *Bucklandia insignis* (Saporta) Barale *et al.* 1974. Several species, published by Sharma (1971, 1972, 1974), originate from the Jurassic deposits of India: *Bucklandia sahnii* Bose 1953, *B. guptai* Sharma 1967, *B. dichotoma* Sharma 1969. The genus is known also from Cretaceous deposits, several species being described from Japan, e.g. *Bucklandia choshiensis* Nishida 1969, *B. tsuruokae* Nishida & Nishida 1983, *B. kerae* Saiki & Yoshida 1999.

Conclusions

The leaf *Banatozamites calvus* principally is characterised by narrow pinnae with half concealed rachis, closely set or slightly distanced flat pinnulae with asymmetrical rounded apex and almost always simple veins, lamina without trichomes and papillae, adaxial epidermis with very sinuous-walled epidermal cells, abaxial epidermis differentiated in stomatal-free and stomatal bands, densely scattered stomata arranged mainly in three rows, stomatal apparatus with semi-oval guard cells and mostly rectangular subsidiary cells, not covered by roof. *Bucklandia aninaensis* is a small stem with petioles, which very probably belongs to the plant with *Banatozamites calvus* leaves. The stem and the petioles possess fine longitudinal ridges, and cuticle indicating rows of rectangular to rounded-elongated cells with straight and smooth walls.

Like the two previously known species *Banatozamites chlamydostomus* and *B. remotus*, the new species *B. calvus* appears in the *Banatozamites chlamydostomus* Subzone of the *Clathropteris meniscioides* Biozone. All the specimens originate from the same fossil locality, Anina, from the same lower Jurassic (Hettangian pro parte – Sinemurian) continental deposits of the Getic Realm. Other occurrences being not known, *Banatozamites* still appears to be an endemic genus of the autochthonous European Mesophytic flora. The low stomatal index of all the *Banatozamites* species indicates in my opinion warm and wet climate, and high CO_2 level, but this is only a preliminary statement.

Acknowledgements

I am most grateful to the Director General of the Hungarian Natural History Museum (Budapest), Dr. István Matskási, and to the Director of the Botanical Department of the Museum, Dr. Lilla Hably, for allowing me to undertake this research on the

material. Special thanks are addressed to the Director of the Geological Institute of Hungary (Budapest), Prof. Dr. László Kordos, for providing access to the SEM Laboratory and the Library of the Institute. Many thanks are expressed also to Prof. Dr. Theodore Delevoryas (Department of Botany of the University of Texas at Austin, USA) for the hard to get papers that he so kindly sent me along many years of our scientific correspondence. Finally yet importantly, I wish to express all my thanks to the Hungarian Academy of Science for the financial support of the „János Bolyai" Grant.

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Plates

Plate I. 1. *Banatozamites calvus* sp. nov. Leaf with numerous pinnae. Holotype. 2. Upper left corner – centre – lower right corner: *Bucklandia aninaensis* sp. nov. Stem. Holotype. Lower left corner: *Banatozamites calvus* sp. nov. Leaf fragment. Paratype.

Plate II. *Banatozamites calvus* sp. nov. Cuticles (LM). Holotype. 1. Adaxial cuticle, indicating rows of epidermal cells. 2. Abaxial cuticle, with stomatal-free bands between stomatal bands.

Plate III. 1. *Bucklandia aninaensis* sp. nov. Cuticle (LM). Holotype. 2. *Banatozamites calvus* sp. nov. Stomatal apparatus (SEM). Holotype.

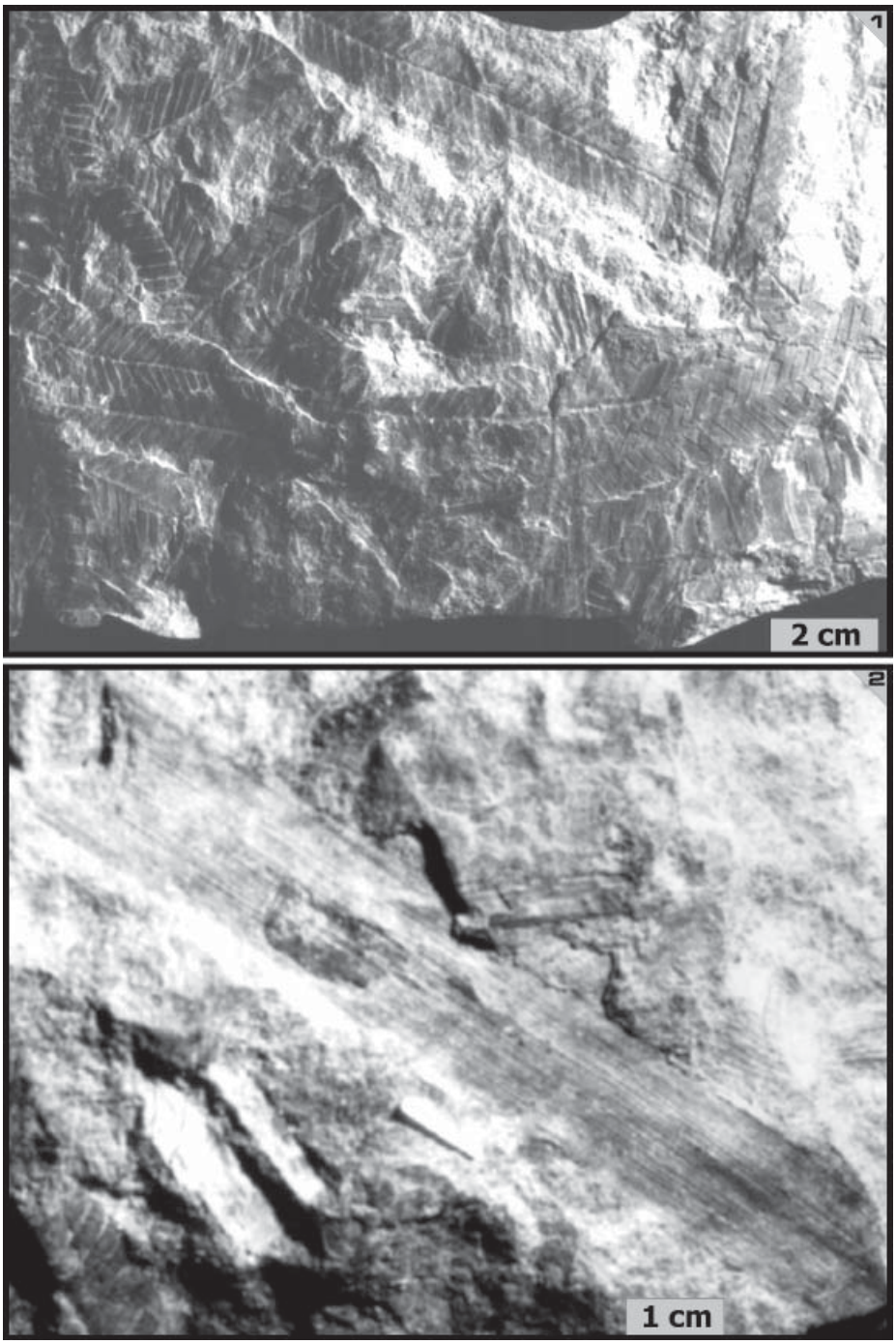

Plate I.

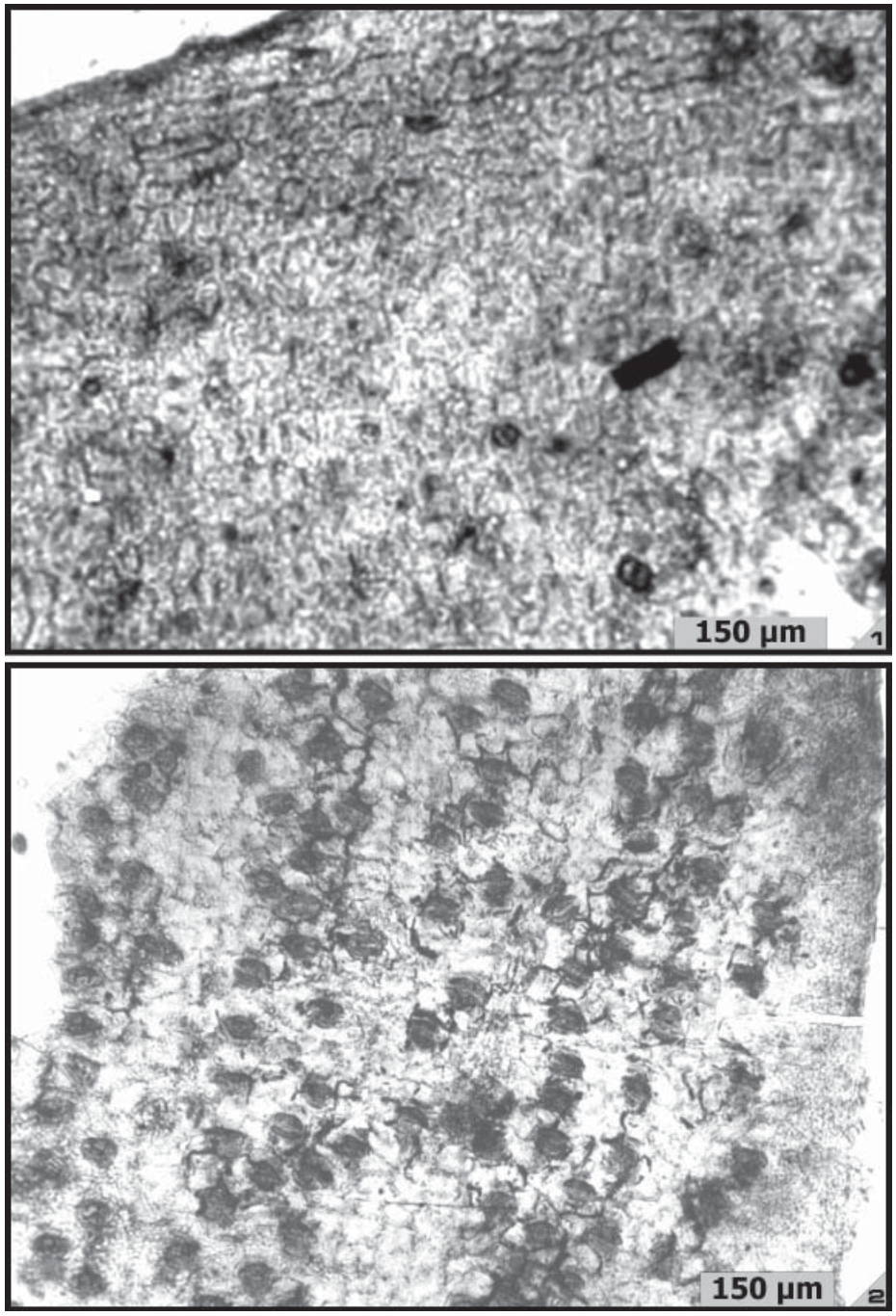

Plate II.

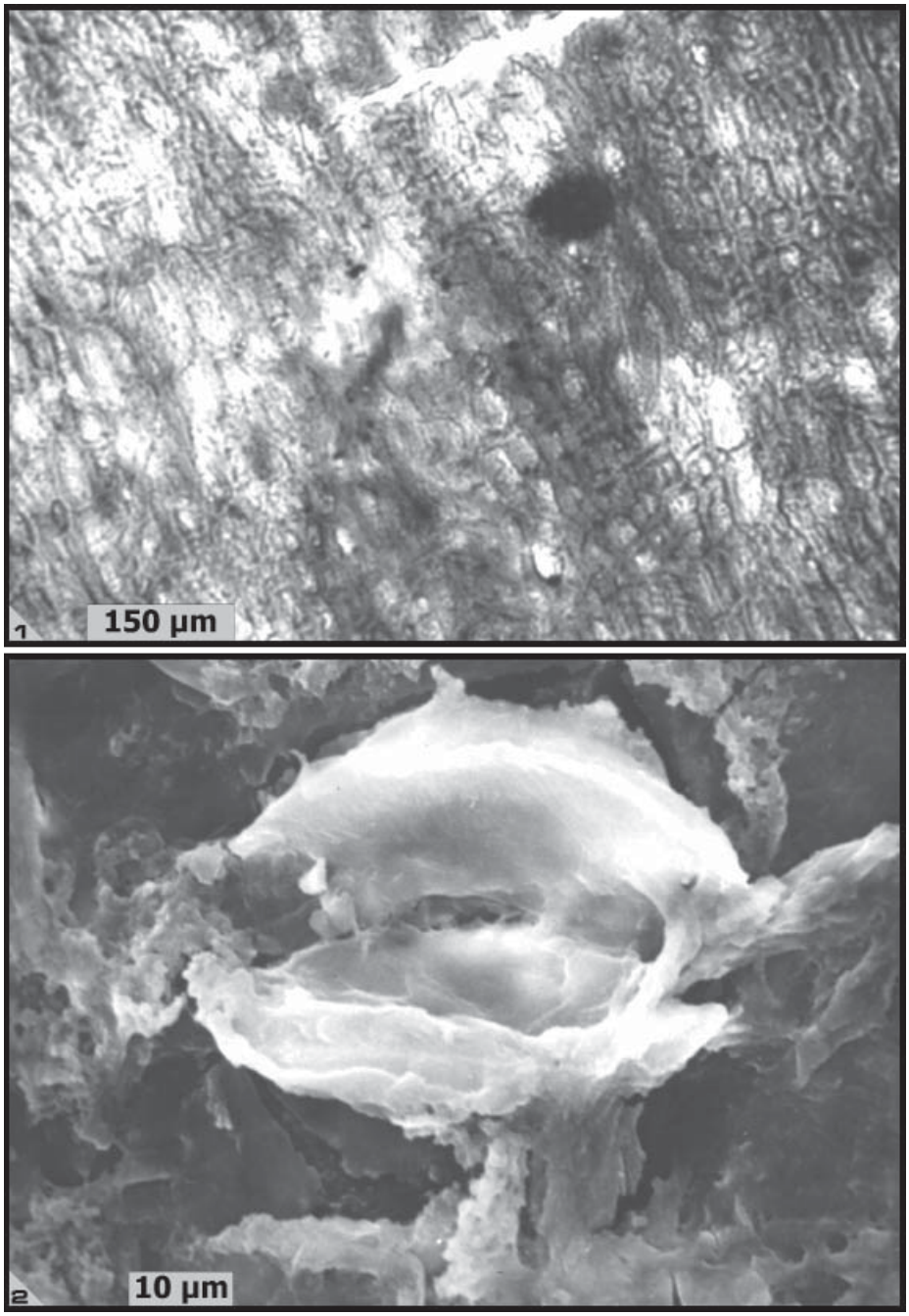

Plate III.