Sbor. geol. věd	Paleontologie 30	Pages 123—158	14 figs.	3 tabs.	12 pls.	Praha 1989 ISSN 0036-5297

Stephanian and Permian species of Alethopteris from Bohemia and Moravia

Alethopteridy stefanu a permu Čech a Moravy

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Received June 30, 1986

Šimůnek Z. (1989): Stephanian and Permian species of *Alethopteris* from Bohemia and Moravia. — Sbor. geol. Věd, Paleont., 30, 123—158. Praha.

Abstract: Revision of Bohemian and Moravian findings exhibited a presence of four species of the genus *Alethopteris* STERNBERG: *Alethopteris bohemica* FRANKE, *Alethopteris moravica* AUGUSTA, *Alethopteris schneideri* (STERZEL) STERZEL and *Alethopteris zeilleri* (RAGOT) WAGNER. Their charakteristics were complemented by a description of the cuticle structure and variability of pinnules statistically treated in the genera *Alethopteris bohemica* and *Alethopteris zeilleri*. *Alethopteris schneideri* is for the first time reported from the Permian on the Czechoslovak territory.

Earlier identified representatives of the genus Alethopteris from the Stephanian and Permian of Czechoslovakia: *Alethopteris costei* ZEILLER (PURKYNĚ 1929b, pl. I, fig. 1) belongs to the species *Praecallipteridium jongmansii* P. BERTR.) WAGNER (WAGNER 1963), *Alethopteris neessii* (GOEPP.) PFESL in STBG. belongs to the genus *Callipteris* BGT. (FRANKE 1912), *Alethopteris pteroides* (BGT.) GEIN. (FEISTMANTEL 1885, pl. II, figs. 2—4) belongs to *Pecopteris polymorpha* BGT. (NĚMEJC 1934), *Alethopteris punctata* AUGUSTA (AUGUSTA 1927, pl. I, fig. 2, pl. II, figs. 1,2) is probably *Pecopteris* (*Scolecopteris*) *pseudobucklandii* (ANDRAE in GERMAR) STUR (BARTHEL 1981, p. 923).

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Introduction

The aim of this work is to characterize more precisely the youngest representatives of the genus *Alethopteris* STERNBERG in Czechoslovakia. Variability of pinnule fronds, cuticles, geographic distribution and stratigraphic range are discussed. These data also permit to assess ecological demands of the described plants.

The paper is based on the study of material from the following collections (in the chapter on the occurrence and stratigraphic range the following abbreviations were used):

NM — National Museum, Prague
ÚÚG — Geological Survey, Prague
UK — Faculty of Science, Charles University, Prague
UJEP — Faculty of Science, J. E. Purkyně University, Brno

MM — Moravian Museum, Brno
SM — Silesian Museum, Opava

The author's data on the occurrence, which rest mainly upon the material from mines and outcrops, supplement the notes after the late Dr. J. Šetlík (Š) describing prevailingly material from boreholes.

If a more precise lithostratigraphic classification of some specimens is known it is expressed by the following abbreviations:

t — Týnec Formation
j — Jelenice Member
m — Mšec Member
h — Hředle Member
ko — Kounov group of seams
kl — Klobuky horizon
ra — Radvanice group of seams
šč — Štěpanice-Čikvásky horizon
sy — Syřenov group of seams

The author established the following species of the genus *Alethopteris* in limnic regions of the Bohemian and Moravian Stephanian and Permian:
Alethopteris bohemica FRANKE (Stephanian B) — Slaný Formation, Jívka Member, ?Stephanian C in the Blanice Furrow.
Alethopteris zeilleri (RAGOT) WAGNER (Stephanian B) — ?Týnec Formation, Slaný Formation, Jívka Member; (Stephanian C) — Líně Formation, Semily Formation, Blanice and Boskovice Furrows; (Autunian) — Boskovice Furrow.
Alethopteris moravica AUGUSTA (lowermost Autunian) — Boskovice Furrow.
Alethopteris schneideri (STERZEL) STERZEL (Autunian) — Boskovice Furrow.

Alethopteris STERNBERG, 1825

A complete synonymy of the genus is listed in the work of JONGMANS (1957): Fossilium Catalogus, II. Plantae, pars 30, no. 3. Additional extensive synonymies are given in the works of BUISINE (1961, p. 65) and WAGNER (1968, p. 22).

1820 *Filicites* SCHLOTHEIM; Schlotheim, p. 411
1825 *Alethopteris* STERNBERG; Sternberg, p. 21

Alethopteris bohemica FRANKE, 1912

Text-figs. 1—3, pl. I, figs. 1—6, pl. II, figs. 1—3

A comprehensive synonymy of the species was presented by WAGNER (1968).

1890 *Alethopteris aquilina* BRONG.; GRAND 'EURY, p. 290—291, pl. 21, figs. 3—6.
1912 *Alethopteris bohemica* n. sp.; FRANKE, p. 75—77, figs. 1—2.
1929a *Alethopteris Serli* BGT.; PURKYNĚ, p. 12—13, pl. 3, fig. 4, pl. 4, fig. 2.

1960 *Alethopteris bohemica* FRANKE; OBRHEL, p. 86–91, pl. 1, figs. 1–4 [fragment of frond together with male fructifications ? *Dolerotheca fertillis* (RENAULT)], figs. 5–7 [pollen grains of the type *Schopfipollenites ovatus* (SCHOPF)], pl. 2, figs. 1,2 (*Schopfipollenites ovatus*).

1963 *Alethopteris bohemica* FRANKE; BARTHEL, p. 53–54, text. figs. 1–2 (structures of epidermis), pl. 1, fig. 1 (fragment of a frond), figs. 2–7 (structures of epidermis), pl. 2, figs. 1–9 (structures of epidermis).

1964 *Alethopteris bohemica* FRANKE; HAVLENA in SVOBODA et al., p. 243, pl. 53, fig. 2.

1968 *Alethopteris bohemica* FRANKE; WAGNER, p. 49–57, text-figs. 9, 10 (copies from GRAND 'EURY, 1890, pl. 21, figs. 4, 4 A), pl. 9, figs. 29, 29a, 30, 30a (photographs of FRANKE's types, 1912, figs. 1, 2), figs. 31–32a, pls. 10–14, figs. 33–42a.

1977 *Alethopteris bohemica* FRANKE; ŠETLÍK in HOLUB - WAGNER, p. 315–340, pl. 12, fig.2.

Syntypes: FRANKE (1912), figs. 1,2 – deposited in Die Arbeitsstelle für Paläobotanik und Kohlenkunde der Deutschen Akademie der Wissenschaften, Berlin – quotation from WAGNER (1968).

Type locality: Mine works between Slaný and Blahotice, Kladno Basin, Czechoslovakia.

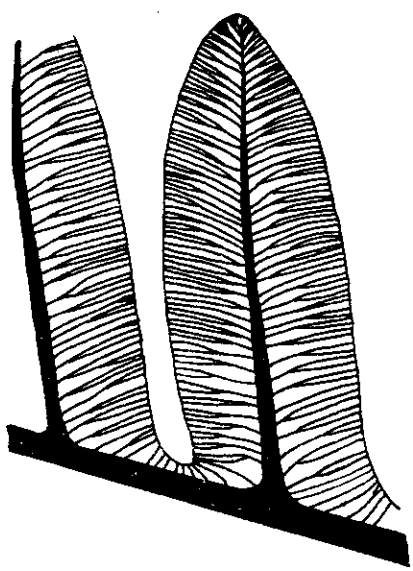
Type horizon: Slaný Formation, Otruby Member, Kounov group of seams – Stephanian B.

Material: Approximately 70 fragments of fronds preserved in grey siltstones to fine-grained sandstones.

Diagnosis: WAGNER (1968).

Description: Fronds are imparipinnate into higher orders. Fronds of the last order are 15–45 mm wide. Rachises of the last order are 0,5–2 mm wide and up to 110 mm long (in uncomplete specimens).

Pinnules are tongue-shaped with bluntly pointed apexes and are set on the rachis of the last order at the angle of 55 through 75°. They are 5 to 20.5 mm long and 4 to 9.5 mm wide at the base and 4–9 mm wide in the middle of the pinnule. At the base the pinnules are connected with a rim which is usually 1 mm wide, in greater pinnules almost imperceptible and in younger pinnules up to 2.5 mm



1. Venation of pinnules of *Alethopteris bohemica* FRANKE, locality Libovice, Mine Jiřina 2, Stephanian B, ×4

wide. Terminal pinnule is small, relatively wide, of oval shape. It is terminated by a blunt apex 5—8 mm long and 3—5 mm wide.

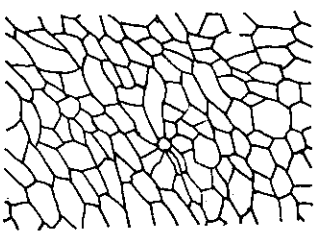
Venation is pennate. Midvein is thick, rigid, running almost straight through the leaf blade and is distinct even at the pinnule apex. Lateral veinlets branch off from the midvein into the blade, they are once or twice forked and reach the pinnule border at almost right angles. Lateral veinlets are fine and venation considerably dense (39 through 52 veinlets per 1 cm of pinnule border). Subsidiary veins running through the pinnule rim are straight or once forked.

Cuticles: Cuticles were prepared from the material from the borehole 8200/VI (pl. I, fig. 4).

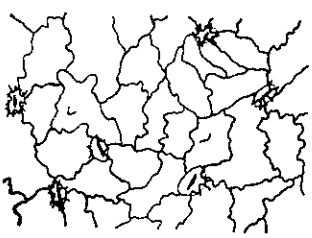
Adaxial cuticle (text-fig. 2, pl. I, fig. 6, pl. II, fig. 2): Cells are polygonal, unoriented and have a diameter of 40 to 50 μm. In costal and intercostal areas the cells are undistinct. Anticlinal walls are straight. Cuticles show fine-grained sculpturing. Rare hair bases on the adaxial cuticle are formed by one cell of circular shape with 20—25 μm in diameter. In the site of the midvein and rachis of the last order the adaxial cuticle has cells more oblongly oriented in the direction of the midvein and rachis.

Abaxial cuticle (text-fig. 3, pl. I, fig. 5): Epidermis very weakly cutinized and considerably disturbed in our specimen, cell outlines poorly visible. Costal and intercostal areas undiscernible. Cells are unoriented (approximately 1.5—2.5 times longer than wide), of irregular shape. They are 30 to 50 μm long and 15 to 25 μm wide. Anticlinal cell walls are undulated. Periclinal wall shows tiny weakly cutinized papillae of 10 μm in diameter which are poorly visible due to ill preservation.

Stomata weakly oriented, submerged below epidermis level and covered by papillae of subsidiary cells. Papillae on some subsidiary cells undiscernible.



2. Adaxial cuticle of *Alethopteris bohemica* FRANKE, central Bohemian region, Stephanian B, × 100



3. Abaxial cuticle of *Alethopteris bohemica* FRANKE, central Bohemian region, Stephanian B, × 250

Stomata are haplocheilic, monocytic, of anomocytic type, elliptical, 14—18 μm long and 10—12 μm wide. They are surrounded by 4—6 subsidiary cells of identical shape as that of a normal epidermal cell.

Cuticles of rachis of the last order and of the abaxial side of the midvein (pl. II, fig. 1): Cells are oriented and considerably elongated in the direction of the course of the midvein or rachis. They are trapezoidal to spindle-like in shape. Their anticlinal walls are straight or slightly bent. Cells are 90—180 μm long and 10—25 μm wide. Among these cells are scattered hair bases formed by one cell of 15—25 μm in diameter.

Comparison: The species *Alethopteris bohemica* FRANKE resembles the species *Alethopteris schneideri* (STERZEL) STERZEL. The latter species, however, exhibits relatively wider and more asymmetric pinnules with broadly rounded apexes.

Alethopteris zeilleri (RAGOT) WAGNER differs from *Alethopteris bohemica* FRANKE in having broadly rounded pinnule apexes and thinner venation (28 through 43 veinlets per 1 cm of pinnule border).

Comparison with the species *Alethopteris kanisi* WAGNER, *Alethopteris densinervosa* WAGNER, *Alethopteris pontica* ZEILER and *Alethopteris missouriensis* (D. WHITE) WAGNER was done by WAGNER (1968).

Remarks: NĚMEJC (1936) identified the species presented as *Alethopteris grandini* (non BRONGNIART) ZEILLER [present *Alethopteris zeilleri* (RAGOT) WAGNER] with the species *Alethopteris bohemica* FRANKE and from the Stephanian horizons of Bohemia reported solely the species *Alethopteris bohemica* FRANKE. It turned out later that this assumption had been wrong and at the present two species of the genus *Alethopteris* has been reported from the Stephanian of Bohemia.

Besides two findings from the Stephanian C of the Blanice Furrow classified as *Alethopteris* cf. *bohemica* FRANKE, this species occurs in the Stephanian B of the central Bohemian region. The most abundant findings were made in the Plzeň Basin (see table 2). *Alethopteris bohemica* is most frequently preserved in grey siltstones, clayey-sandy rocks to fine-grained sandstones. Rarely it occurs also in pelite-carbonate rocks of the Kounov group of seams and light-coloured tuffaceous rocks locally called "kamínek". Due to ill-preserved coal mass in coarser rocks it is difficult to prepare cuticles from this species.

Cuticles of *Alethopteris bohemica* prepared by the author are similar to those prepared by BARTHEL (1963) in shape and size of the cells and stomata on the abaxial cuticle. Cells of the adaxial cuticle are smaller compared with those of BARTHEL. Hair bases on the adaxial cuticle and in the site of the midvein have 20—25 μm in diameter while on the cuticles prepared by BARTHEL (1963) the hair bases (described as papillae by BARTHEL) exhibit about 40 μm in diameter (see table 1).

According to the character of preservation in the rock and structure of cuticle

(abaxial cuticle exhibits xenomorphic features) this species corresponds to specimens of the Stephanian extra-seam flora which probably grew on margins of coal-bearing basins.

Occurrence and distribution: Central Bohemian region, Slaný Formation, Stephanian B.

Plzeň Basin: Chotíkov (NM, Š) — gulch, boreholes Co-3 (ko), Co-11, Cho-1 (ko), Cho-2 (ko), V-48, 56, 58, 62, 63, Ledce (Š) — borehole LV-2, Líně (Š) — borehole PP-11 (j), Lochotín (Š) — outcrops in an antiaircraft shelter, Nevřeň (Š) — borehole Ge-37, Radčice (ÚÚG, Š) — borehole PP-1 (base of the Slaný Formation), pit Š-80, Tlučná (NM, Š) — Mine Krimich II (ko), borehole Tl-1 (j), Třemošná (Š) — borehole Tř-10, Vejprnice (Š) — boreholes Vj-3 (m), Vj-8 (j, ko), Ves Touškov (Š) — borehole VT-1 (j), V Propastech (Š) — material from a well, ?Žilov (Š) — borehole Ge-45. Rakovník Basin: Děkov (Š) — s. of the road Děkov — Nová Ves, e. of the village, Chrášťany (Š) — borehole Chr-18 (ko), Kounov (NM) — Mine Kateřina (ko), Kroučová (NM, Š) — Mine Adolf (ko), borehole Kr-11 (ko), Rakovník (NM) — n. of the town, Záboř (NM). Kladno Basin: Dolín (Š) — borehole D1-2 (m, h), Drnov (Š) — borehole Dv-1 (ko), Hobšovice (Š) — borehole Hš-1 (ko), Kralupy (NM), Kvílice (NM) — Mine Magdalena (ko), Libovice (NM, ÚÚG) — Mine Jiřina 2 (ko), Plchov (ÚÚG) — refuse pile, Skury (Š) — borehole Sy-1 (m), Slaný (NM) — Mine Caroli (ko). Mšeno Basin: Chloumek (Š) — borehole MB-3 (m), Jelenice (Š) — borehole MJ-1 (m).

?Lugicum area, Jívka Member, Stephanian B. Intrasudetic Basin: Žabokrky (HAVLENA 1956, NĚMEJC 1958).

Alethopteris cf. *bohemica* FRANKE, Stephanian C.

Blanice Furrow: Dolní Peklov near Kostelec n. Černými lesy (NM).

Alethopteris zeilleri (RAGOT, 1955) WAGNER, 1958

Text-figs. 4—8; pl. II, figs. 4—7; pls. III—VIII

Extensive synonymy of the species is presented in WAGNER (1968).

1888 *Alethopteris Grandini* BRONGNIART (sp.); ZEILLER in RENAULT - ZEILLER, p. 203—207, pl. 21, figs. 1—4, (? fig. 5), figs. 6—8.

1899 *Alethopteris Grandini* GOEPP.; HOFMANN - RYBA, pl. 8, figs. 4,5.

1899 *Alethopteris Serli* BRONGN.; HOFMANN - RYBA, pl. 8, fig. 2.

1936 *Alethopteris bohemica* FRANKE; NĚMEJC, p. 2—8, text-fig. 1a, b, pl. 1, fig. 1.

1955 *Alethopteris grandini* forma *zeilleri*: RAGOT, p. 47—56, pl. 7, fig. 3 (after Wagner, 1968).

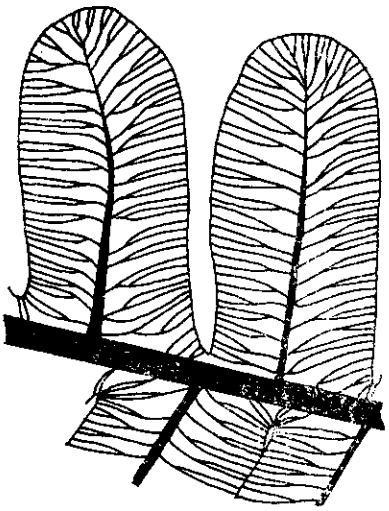
1958 *Alethopteris zeilleri* RAGOT; WAGNER - BREIMER, p. 18.

1968 *Alethopteris bohemica* FRANKE; NĚMEJC, p. 169, pl. 20.

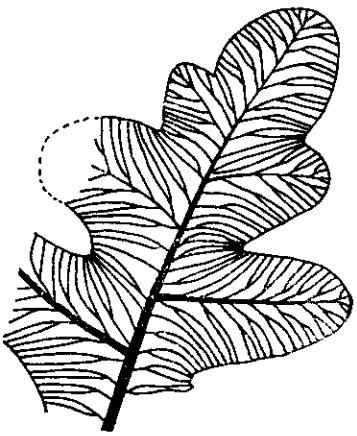
1968 *Alethopteris zeilleri* RAGOT; WAGNER, p. 158—169, text-fig. 52—55, pl. 63, figs. 176—178, pl. 64, figs. 179—181a.

1977 *Alethopteris zeilleri* (RAGOT ex REMY et alii); ŠETLÍK in HOLUB - WAGNER, p. 315—340, pl. 12, fig. 1.

Holotype: ZEILLER (1888), pl. 21, fig. 8 — datum from WAGNER (1968).
Type locality: Commentry, pit Forêt, 8th level, France.
Type horizon: Seam Roseaux, Stephanian, Carboniferous.
Material: More than 200 fragments of fronds preserved in grey to black mudstones, coal claystones, in some places in siderite concretions.
Diagnosis: Wagner (1968).



4. Venation of pinnules of *Alethopteris zeilleri* (RAGOT) WAGNER, locality Kvílice, Mine Magdalena, Stephanian B, ×4



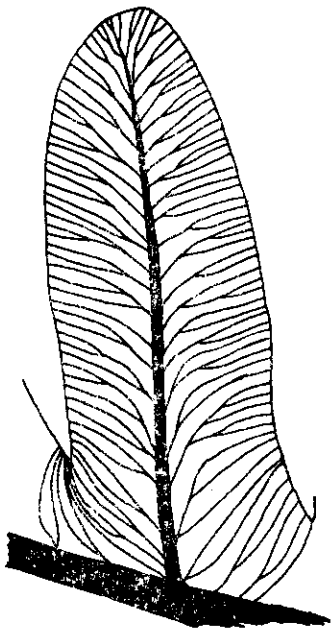
5. Venation in the terminal part of the pinna of the last order of *Alethopteris zeilleri* (RAGOT) WAGNER, locality Kvílice, Mine Magdalena, Stephanian B, ×4

Description: Fronds are imparipinnate into higher orders. Rachis of the last order is up to 1.5 mm wide. Fronds of the last order are 50 to 220 mm long and 15 to 40 mm wide. Rachises of the last but one oder are up to 2.5 mm thick.

Pinnules are tongue-shaped with broadly rounded apexes. With the rachis of the last order they contain an angle of 55 to 80°. Length of pinnules is 6 to 24.5 mm, width at the base 4—11 mm and 4—10 mm in the middle of the pinnule. Pinnules at the base are conjoined by a rim usually 1 mm wide. Sometimes the rim is narrower, almost imperceptible. Conversely, in younger pinnules it can reach width of over 2 mm. Terminal pinnule is small, relatively broad, with rounded apex. Its length is 4—8 mm, width 3—5 mm.

Venation is pinnate. Midvein is conspicuous and usually follows a straight course through the lamina. Lateral veins branch off from the midvein, they are once or twice forked, predominantly follow a straight course towards the pinnule margin which is attained at almost right angle. Venation is rather thin (28—43 veins per 1 cm of the pinnule margin). Subsidiary veins entering the pinnule rim are usually bifurcated, branching off directly from the rachis of the last order.

Cuticles: Cuticles were prepared from the material from Kvílice, Mine Magdalena (pl. III, fig. 1), from Libovice, Mine Jiřina 2 (pl. II, fig. 6) and from Oslavany, Mine Kukla (pl. VIII, fig. 4).



6. Pinnule venation of *Alethopteris zeilleri* (RAGOT) WAGNER, locality Oslavany, Mine Kukla, Stephanian C, ×4

Adaxial cuticle (pl. IV, pl. VI, fig. 6, pl. VII, figs. 2, 3, text-fig. 7): Cells in the costal and intercostal areas differ in shape. Cells of the costal area are markedly oriented parallel to the venation and are 60 to 100 μm long and 20—35 μm wide. They are usually quadrangular with undulated anticlinal walls.

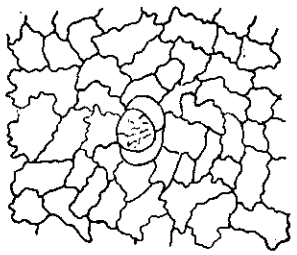
Cells in the intercostal region are unoriented, of irregularly polygonal shape, occasionally elongated, 60—80 μm long and 30—60 μm wide. Anticlinal walls are undulated. The cuticle shows fine-grained sculpturing.

Adaxial cuticle exhibits irregularly dislocated hair bases of ovate shape and 80—100 μm in diameter. The hair basis is surrounded by 6—8 subsidiary cells which are similar to other cells in the intercostal area.

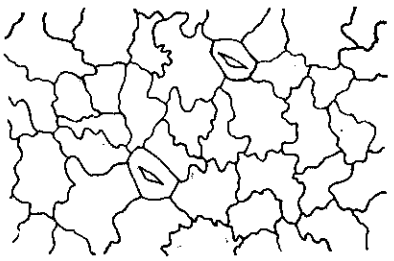
Hairs (pl. VII, figs. 2, 3) are simple, uniseriate. Terminal parts of hairs are formed by 6—8 cask-shaped cells. Hairs are up to 230 μm long and 55—65 μm wide. All their apexes are broken.

Abaxial cuticle (text-fig. 8, pl. III, fig. 2, pl. VI, figs. 3, 4): Abaxial cuticle is very weakly cutinized. Cells of the intercostal and costal areas are differentiated. Cells in the costal area are longitudinally oriented in the direction of lateral veins. Intercostal cells show papillae and wavy anticlinal walls. Cells are irregularly polygonal, unoriented, 30—50 μm long and 20—30 μm wide.

In the intercostal area irregularly scattered anomocytic stomata of monocyclic type are present. Stomata are widely elliptical, up to 24—28 μm long and 16—20 μm wide, surrounded by 5—6 subsidiary cells of almost identical shape and size as that of normal epidermal cells.



7. Adaxial cuticle of *Alethopteris zeilleri* (RAGOT) WAGNER, locality Libovice, Mine Jiřina 2, Stephanian B, × 100



8. Abaxial cuticle of *Alethopteris zeilleri* (RAGOT) WAGNER, locality Libovice, Mine Jiřina 2, Stephanian B, × 250

Cuticles of the rachis of the last order and of abaxial side of the midvein (pl. II, fig. 7, pl. VI, figs. 1, 2, 5): Cells are elongated in the direction of the rachis or midvein course, quadrangular, with straight anticlinal walls. They are 40—100 μm long and 20—30 μm wide. Between these cells are frequently found hair bases of broadly elliptical shape and more strongly cutinized than other cuticles. The hair basis is formed by a pair of rounded cells which set on a larger epidermal cell having 70—90 μm in diameter (pl. VI, fig. 2). Hairs are simple, uniseriate and are formed by approximately 5 cells. Hair apexes are unknown. Some hairs have the second basal cell considerably narrow (pl. VI, fig. 1). The hairs are 45—50 μm wide and up to 350 μm long.

Cuticles examined by electron microscope (SEM) (pl. V, figs. 1—3): Adaxial cuticle (pl. V, figs. 1, 2). Cell contours are indistinct, periclinal walls wavy and bear plenty of flat bulges of 10—20 μm in size. Surface of the bulges is furrowed into tiny ridges 2—3 μm wide. Minute rounded formations are probably traces after corrosion (pl. V, fig. 2).

Abaxial cuticle (pl. V, fig. 3). Outlines of cells on the abaxial cuticle are not even apparent. Papilla is elliptical, 15 μm long and 9 μm wide. Its vicinity shows radially arranged furrows. Otherwise, the surface of the abaxial cuticle is smooth and bears tiny round formations 1—4 μm in diameter, probably traces after corrosion.

Comparison: *Alethopteris zeilleri* (RAGOT) WAGNER has pinnules very similar to the pinnules of the species *Alethopteris grandinioides* KESSLER but their venation differs. Lateral veins in *Alethopteris grandinioides* are broadly branched and inserted obliquely to the pinnule border while the veinlets in *Alethopteris zeilleri* follow a straight course perpendicularly to the pinnule border. *Alethopteris grandinioides* has thinner venation with 20—26 veinlets per 1 cm of pinnule border while *Alethopteris zeilleri* exhibits 28—43 veinlets per 1 cm of pinnule border. Terminal pinnules of *Alethopteris grandinioides* are longer and narrower than those of *Alethopteris zeilleri.*

Alethopteris serlii (BRONGNIART) GOEPPERT has pinnules with convex borders and bluntly pointed apexes while the pinnules of *Alethopteris zeilleri* have straight borders and broadly rounded apexes. *Alethopteris serlii* occurs in the Westphalian and *Alethopteris zeilleri* is reported from the Stephanian.

Alethopteris grandini (BRONGNIART) GOEPPERT differs from *Alethopteris zeilleri* (RAGOT) WAGNER in having smaller pinnules with convex borders. *Alethopteris grandini* has arched veinlets and thinner venation (25—30 veinlets per 1 cm of pinnule border. The veinlets in *Alethopteris zeilleri* follow almost a straight course and the venation is more dense (28—43 veinlets per 1 cm of pinnule border).

Alethopteris bohemica FRANKE differs from *Alethopteris zeilleri* in exhibiting more dense venation (39—53 veins per 1 cm of pinnule border), thicker midvein and bluntly pointed apex of the pinnule.

WAGNER (1968) published a comparison of *Alethopteris zeilleri* (RAGOT) WAGNER with other species: *Alethopteris pennsylvanica* LESQUEREUX, *Alethopteris magna* GRAND 'EURY, *Alethopteris distantinervosa* WAGNER and *Alethopteris barruelensis* WAGNER.

Relationship: WAGNER (1968) presumes that in northwestern Spain the species *Alethopteris zeilleri* (RAGOT) WAGNER developed from the species *Alethopteris grandinioides* KESSLER via the variety *Alethopteris grandinioides* KESSLER var. *subzeilleri* WAGNER in the Westphalian D through the lower Stephanian A.

Remarks: NĚMEJC (1936) held the specimens of the species *Alethopteris bohemica* described by FRANKE (1912) for a special mode of preservation of the species *Alethopteris grandini* ZEILLER (non BRONGNIART) and that is why he ranged all the specimens of the *Alethopteris* species from the Stephanian of Bohemia with the single species *Alethopteris bohemica* FRANKE.

Alethopteris zeilleri is abundant in the Stephanian. It is known predominantly from mining works in central Bohemian region, namely from the Kladno Basin since it occurs most probably close to seams. It is frequently found in grey to black-grey mudstone rocks in which it is usually preserved in the state suitable for preparation of cuticles. It is often found also in siderite concretions. In younger sediments (Stephanian C—Autunian) this species becomes rare and is preserved also in grey or sometimes brownish siltstones.

I got an opportunity to study several specimens of *Alethopteris zeilleri* from the

Permian of the Boskovice Furrow which are deposited in the collections of the Moravian Museum in Brno. Augusta classified them as *Alethopteris grandini*. In this collection many specimens of the species *Callipteris conferta* (STERNBERG) BRONGNIART were also ranged under the same name.

Cuticles of *Alethopteris zeilleri* from Bohemia are identical with the cuticles depicted in the work of BOUREAU (1975) on fig. 294 bis.

The species *Alethopteris zeilleri* corresponds with the elements of the Stephanian seam-forming flora by its mode of preservation in the rocks and by the cuticle structure (abaxial cuticle shows mesomorphic features). By the end of the Stephanian and in the Permian *Alethopteris zeilleri* probably replaced the species *Alethopteris bohemica* FRANKE also in the marginal parts of the basins.

Occurrence and distribution: Central Bohemian region, Slaný Formation, Stephanian B.

Plzeň Basin: Líny (NM) — (ko), Mrtník (Š) — borehole KZ II [?t (Stephanian A), base of the Slaný Formation], Ves Touškov (Š) — borehole VT-1 (j).

Rakovník Basin: Děkov (Š) — s. of the road Děkov—Nová Ves, cut in the road to Vlkov, Rakovník (NM) — n. of the town, Záboř (NM).

Kladno Basin: ?Dolín (Š) — borehole Dl-1 (h), Hobšovice (Š) — borehole Hš-1 (m), Jedomělice (Š) — borehole M2, Kněževes (Š) — borehole Kn-25 (ko), Kralupy (NM), Kvíc (Š) — borehole Kc-2a (m), Kvílice (NM) — Mine Magdalena (ko), Libovice (NM, ÚÚG) — Mine Jiřina 2 (ko), Lotouš (UK) — Mine Jiřina 1 (ko), Sazená (Š) — borehole Sz-1, ?Slaný (Š) — boreholes Sa-9 (m), Sa-11, Trpoměchy (Š) — borehole Ty-1, Tuřany — Hvězda (NM) — abandoned claim near the road (ko), Vítov (Š) — borehole Vt-1 (ko), Zlonice —Páleček (Š) — borehole Z-16, ?Zvoleněves (Š) — borehole B3.

Mšeno Basin: Hleďsebe (Š) — borehole MB-6 (m).

Líně Formation, Stephanian C.

Kladno Basin: Klobuky (Š) — outcrop e. of sugar factory (kl.).

Lugicum area.

Krkonoše Piedmont Basin: Syřenov Formation, Stephanian B — Syřenov (Š) — borehole Sy-3, Ústí (Š) — borehole UT-2, Semily Formation, Stephanian C — Čikvásky (NM) — (šč), Nedvězí (NM, UK) — pit tip B (šč), Štěpanice (NM) — (šč), Tužín (ÚÚG).

Intrasudetic Basin: Jívka Member, Stephanian B — Chvaleč (SM) — borehole Chv-3 (ra).

Furrow region. Blanice Furrow, Stephanian C: *Alethopteris* cf. *zeilleri*, Dolní Peklov near Kostelec nad Černými lesy.

Boskovice Furrow, Rosice-Oslavany group of seams, Stephanian — lowermost Autunian: Babice near Zastávka (NM) — Mine Ferdinand, Oslavany (NM, SM, ÚÚG) — Mine Nosek, Zbýšov (NM, MM, ÚÚG) — Mine Antonín, top wall (between the 1st and 2nd seam), top wall of the 2nd seam. Grey horizons in the main red-brown formation, Autunian: Zbýšov (MM).

Alethopteris moravica AUGUSTA, 1927

Text-fig. 9; pls. IX–XI; pl. XII, figs. 1–4

1927 *Alethopteris moravica* n. sp.; AUGUSTA, p. 3–6, text-fig. 1a,b, pl. 1, fig. 1.

1967 *Alethopteris moravica* AUGUSTA: WAGNER, p. 53–55, pl. 5, figs. 1, 1a, 1b (photograph of holotype and its details).

Holotype: AUGUSTA (1927), text-fig. 1a,b, pl. 1, fig. 1. Holotype is deposited in the Department of Geology and Palaeontology, Faculty of Science, Jan Evangelista Purkyně University in Brno under the number E 3961.

Type locality: Zastávka near Rosice, pit Julius, Rosice-Oslavany Basin, Boskovice Furrow, CSSR.

Type horizon: Rosice-Oslavany group of seams, surroundings of the 1st (main) seam, lowermost Autunian, Permian.

Material: Three fragments of fronds preserved in grey mudstones.

Diagnosis: WAGNER (1967).

Description: Only fragments of pinnae of the last order are known; the longest fragment measures 80 mm (pl. X, fig. 1), the broadest is 30 mm wide (pl. IX, fig. 3). Rachis of the last order is narrow, up to 1 mm thick, gently flexuose, in the basal part straight, with fine longitudinal ridges (pl. IX, fig. 3).

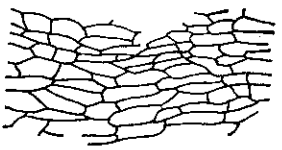
Pinnules set on the rachis of the last order at angles of 50 to 70°, they are asymmetric, on the basiscopis side running down the rachis of the last odrer. Pinnules are mutually joined with a rim which is narrow, in places almost imperceptible even in small pinnules. Its greatest width is 1.5 mm, incisions between pinnules are acute. Pinnules have convex margins and bluntly pointed apex, they are 3 to 4 times longer than broad, they are 7–21 mm long and 3–6 mm broad in the middle and 4–7 mm broad at the base of the pinnule.

Midvein is distinct, straight or secondarily bent, reaching almost the apex of the pinnule. Venation is dense (55–65 veins per 1 cm of pinnule border). Lateral veins are once or rarely twice forked, they branch off from the midvein at sharp angles, they are arcuate and reach the pinnule margins almost perpendicularly. Subsidiary veins on the basiscopic side are simple or once forked.

Cuticles: Cuticles were prepared from holotype and another specimen determined by J. Augusta as *Alethopteris decurrens*. Both specimens come from Zastávka near Rosice and the cuticles confirm that they belong to one species.

Adaxial cuticle (text-fig. 9, pl. IX, fig. 5, pl. XI, figs. 3, 4, pl. XII, figs. 1–4): Cells are weakly cutinized, discernible in costal and intercostal areas, they are oriented in the direction of lateral veinlets and exhibit elongated quadrangular to pentagonal shape. In the costal area they are longer (60–100 μm long and 10–20 μm wide) than in the intercostal area (40–70 μm long and 15–30 μm wide). Anticlinal walls are straight or moderately bent. The cell walls in the costal area are probably more strongly cutinized than those in the intercostal area since after maceration only stripes of cells above lateral veins were preserved while the cells in the intercostal areas disintegrated into small fragments.

Abaxial cuticle (pl. X, figs. 5, 6, pl. XI, fig. 5): Abaxial cuticle is very weakly cutinized and therefore during maceration it disintegrates into small fragments. The cell walls are indistinct and the cuticle rather corroded. The shape of the cells is probably irregularly polygonal, cells are unoriented, 1.5 to 2 times longer than



9. Adaxial cuticle of *Alethopteris moravica* AUGUSTA, locality Zastávka, Mine Julius, lowermost Autunian, ×100

wide, 40—70 μm long and 20—40 μm wide. Anticlinal walls are undulated. Stomata are indiscernible due to poor preservation.

Cuticle in the site of the midvein (pl. XI, figs. 1, 2): Cells are strongly oriented parallel to the course of the midvein, elongatedly quadrangular in shape, 80—150 μm long and 15—35 μm wide. Anticlinal walls are straight or mildly bent. Between these cells occur hair bases which are formed by a single elliptical cell 45 μm long and 30 μm wide (pl. XI, fig. 1).

Hairs (pl. X, fig. 4, pl. XI, figs. 6—8): Hairs grew probably in the site of the midvein and above the pinnule veins. They are simple, uniserial cover hairs formed by up to 6 cask-shaped cells, 70—95 μm wide and up to 500 μm long. They were identified only in the paratype Alethopteris moravica, holotype exhibits only hair bases of a smaller diameter than that of the above described hairs. The hair bases are composed of one cell with a diameter about 45 μm.

Comparison: *Alethopteris moravica* AUGUSTA differs from the remaining species of the genus *Alethopteris* STERNBERG, beside other features, in having more dense venation. A similar venation density exhibit also the Namurian through the lower Westphalian species *Alethopteris decurrens* (ARTIS) ZEILLER (52—76 veins per 1 cm of the pinnule border) according to the measuring performed on the material from the Intrasudetic Basin.

Alethopteris lonchitica shows relatively longer pinnules than *Alethopteris moravica*, pinnule borders are parallel, in smaller pinnules convex. *Alethopteris moravica* has asymmetrical pinnules which are convex only on the acroscopic side of the pinnule. Lateral veins of *Alethopteris lonchitica* are once or twice forked, they branch off the midvein in a small arch and follow a straight course through the pinnule lamina almost perpendicularly to the pinnule border. *Alethopteris moravica* shows once or twice forked lateral veins running an arched course through the pinnule lamina and reach the pinnule border almost perpendicularly.

Alethopteris decurrens (ARTIS) ZEILLER has narrower and usually longer pinnules than *Alethopteris moravica*, which exhibits pinnules 3 to 4 times longer than wide. In *Alethopteris decurrens* the pinnules are 5 to 10 times longer than wide and have a greater distance between individual pinnules in comparison with *Alethopteris*

moravica. Lateral veins of *Alethopteris decurrens* are once forked, rarely undivided arching from the midvein and reaching the pinnule border somewhat obliquely.

AUGUSTA (1927) presented a comparison with the following species: *Alethopteris decurrens* (ARTIS) ZEILLER and *Alethopteris lonchitica* (SCHLOTHEIM) ZEILLER.

WAGNER (1967) presented a comparison with the following species: *Alethopteris leonensis* WAGNER, *Alethopteris missouriensis* (D. WHITE) WAGNER, *Alethopteris westphalensis* WAGNER, *Alethopteris robusta* LESQUEREUX var. *longipinnata* WAGNER and *Alethopteris lesquereuxii* WAGNER.

Remarks: When describing this species, AUGUSTA (1927) and WAGNER (1967) had only holotype. I have found another specimen of *Alethopteris moravica* referred by AUGUSTA to *Alethopteris decurrens* (pl. X, fig. 1) in the collections of the Faculty of Science, J. E. Purkyně University, Brno. It has longer pinnules than the holotype but the venation in both the specimens is identical. The third specimen of *Alethopteris moravica* is deposited in the National Museum, Prague and it was determined by J. Augusta as *Alethopteris bohemica* (pl. IX, fig. 3) and represents the basal part of the pinna of the last order with considerably long pinnules secondarily bent towards the pinna apex and thus resembling at the first sight *Alethopteris decurrens*. However, the type of venation and broader pinnules than those of *Alethopteris decurrens* suggest that the specimen should be classified as *Alethopteris moravica*.

On the basis of remarks obtained on the Faculty of Science, J. E. Purkyně University, Brno, F. Němejc assumed that *Alethopteris moravica* is a terminal part of the pinna of some already described *Alethopteris*.

I endorse the opinion of AUGUSTA (l.c.) that *Alethopteris moravica* is a rare endemic species hitherto known from a single locality in the Rosice-Oslavany Basin and can be well distinguished from the remaining species of the genus *Alethopteris* especially on the basis of venation density. The last reported occurrence of the species with a similar venation density is from the Westphalian A while *Alethopteris moravica* is known from the lowermost Autunian.

Occurrence and distribution: Boskovice Furrow, Rosice-Oslavany Basin, Zastávka near Rosice (UJEP, NM), pit Julius, Ist seam — lowermost Autunian.

Alethopteris schneideri (STERZEL, 1881) STERZEL, 1918

Text-fig. 10; pl. XII, figs. 5, 6

1881 *Callipteridium Schneideri* nov. sp.; STERZEL, p. 262.

1918 *Alethopteris schneideri* STERZEL; STERZEL, p. 289, pl. 9, fig. 93, pl. 10, figs. 92, 92a, 94, pl. 15, fig. 93a.

1962 *Alethopteris schneideri* STERZEL; BARTHEL, p. 35–36, figs. 54–55 (cuticles), pl. 16, figs. 2–6 (cuticles), pl. 17, figs. 1 and 2.

1964 *Alethopteris schneideri* STERZEL; REICHEL - BARTHEL, p. 212, fig. 2, pl. 6, figs. 3,4, pl. 5, pl. 7, figs. 3 and 4, pl. 8, figs. 11, 12, pl. 9, figs. 2, 3, pl. 10, figs. 2, 3.

1976 *Alethopteris schneideri* STERZEL; BARTHEL, p. 881–883, fig., pl. 1 and 2.

Lectotype: STERZEL (1918) pl. 10, fig. 94, deposited in the collections of GFE Freiberg (after BARTHEL 1976).

Type locality: Krušné hory Mts. basins, Oelznits, Deutschland-Schacht, depth 501 m, "Wildes Kohlengebirge", GDR.

Type horizon: Härtensdorf Member, Autunian, Permian.

Material: 2 specimens preserved in grey mudstones.

Diagnosis: BARTHEL (1976).

Description: Pinnules are convergent, tongue-shaped, with broadly rounded apex. Pinnule borders are convex, pinnules are 5—7 mm long, at the base 5 mm and in the middle 4—4.5 mm wide.

10. Pinnule venation of *Alethopteris schneideri* (STERZEL) STERZEL, locality Zbýšov, Autunian, × 4

Midvein is broad, distinct and persists almost to the pinnule apex. From the midvein commence at sharp angles once or twice forked lateral veins and curve gradually to reach the pinnule border somewhat obliquely. Lateral veins bifurcate from the rachis of the last order and are usually once or twice divided. Venation is rather dense 42—48 veinlets per 1 cm of pinnule border).

Cuticles: Cuticles could not be prepared from the Moravian material. They were detailedly described by BARTHEL (1962) and REICHEL and BARTHEL (1964).

Comparison: *Alethopteris schneideri* (STERZEL) is very similar to *Alethopteris bohemica* FRANKE, however, the latter exhibits relatively narrower pinnules and bluntly pointed apexes. The veins in *Alethopteris bohemica* follow a straight course almost perpendicularly to the pinnule border, in *Alethopteris schneideri* they curve away somewhat obliquely to the pinnule border. The appearance of the pinnules in *Alethopteris schneideri* is more asymmetrical.

Alethopteris schneideri differs from *Alethopteris zeilleri* in having more dense venation and asymmetrical appearance of the pinnules.

Alethopteris schneideri cannot be mistaken for the species *Alethopteris moravica*. *Alethopteris moravica* has even more dense venation and bluntly pointed pinnule apexes.

Remarks: I have learnt about the occurrence of the species *Alethopteris schneideri* (STERZEL) STERZEL in the Permian of Moravia from the materials after the late J. Šetlík in which I found also photographs of two species from the Boskovice Furrow taken by BARTHEL (fig. 10, pl. XII, figs. 5, 6). Both specimens are deposited in the Moravian Museum in Brno. They were studied by BARTHEL

there in 1976. On my visit to the Moravian Museum I had an opportunity to examine only the better preserved specimen from Zbýšov. I had not seen the second specimen which was described by BARTHEL from Moravský Krumlov in 1976. The overall appearance of the pinnules and venation unmistakably suggest that these specimens belong to the species *Alethopteris schneideri* (STERZEL) STERZEL. So far, they represent the only finds of this species in Czechoslovakia.

Occurrence and distribution: Boskovice Furrow, grey horizons in the main red-brown formation, Autunian: Zbýšov (MM), Moravský Krumlov (MM).

Results of investigation of the present material

Fructifications

Fructifications of *Alethopteris moravica* AUGUSTA and *Alethopteris schneideri* (STERZEL) STERZEL are unknown.

NĚMEJC (1936) described seeds which were frequently found together with the pinnules of *Alethopteris bohemica* NĚMEJC (1936) = *Alethopteris zeilleri* (RAGOT) WAGNER. From the Bohemian region NĚMEJC (1936) described 2 kinds of seeds of the type *Pachytesta* BRONGNIART.

Large elliptical seeds 6—8 cm long and 4—5 cm wide, collected in the Kladno and Rakovník Basins (1 finding from Chotíkov in the Plzeň Basin) NĚMEJC (l. c.) assigned to the species *Pachytesta insignis* K. FEISTMANTEL and compared it with the species *Pachytesta gigantea* GRAND 'EURY.

In the Plzeň and rarely in the Rakovník Basins (Kounov) NĚMEJC (1936) found smaller seeds 4—5 cm long and approximately 2.5 cm wide, with distinct longitudinal ridges, and assigned them to the *Pachytesta* sp.

NĚMEJC (1936) was not able to interpret the parallel occurrence of two types of seeds with one plant species: "The fact that fronds of *Alethopteris bohemica* FRANKE are found in associations with seeds of two various kinds, points that we have not yet any definitive information as to the plants which bore the mentioned *Pachytesta* seeds."

On the basis of the present knowledge I assume that the seeds of *Pachytesta insignis* K. FEISTMANTEL belong to the species *Alethopteris zeilleri* (RAGOT) WAGNER with the most abundant occurrence in the Kladno Basin and the seeds of *Pachytesta* sp. (NĚMEJC 1936) are affiliated with the species *Alethopteris bohemica* FRANKE, which is also very abundant in the Plzeň Basin.

Male fructifications are known only from the species *Alethopteris bohemica* FRANKE. They are large bell-shaped synangia of the type *?Dolerotheca fertilis* (RENAULT) HALLE (OBRHEL 1960), with large pollen grains of the type *Schopfipollenites ovatus* (SCHOPF).

Cuticles

Cuticles are known from all the species of the genus *Alethopteris* STERNBERG occurring in the Stephanian and Permian on the territory of Bohemia and Moravia (see table 1).

The cuticles of all the four species differ from each other. Cells on the abaxial cuticle in the site of the midvein and rachis of the last order are most alike. Here are the cells of all the described species markedly longitudinally quadrangular, with straight or bent anticlinal walls oriented parallel to the midvein or rachis. Between these cells are situated hair bases of various sizes according to the species. Such cuticles were observed also in other genera (e. g. *Neuropteris* BRONGNIART). Hair bases occur also on the adaxial cuticle in *Alethopteris bohemica* FRANKE and *Alethopteris zeilleri* (RAGOT) WAGNER, and on the abaxial cuticle in *Alethopteris schneideri* (STERZEL) STERZEL. Hairs were found in the species *Alethopteris moravica* AUGUSTA and *Alethopteris zeilleri* (RAGOT) WAGNER. They are multicellular, simple, uniserial cover hairs, up to 0.5 mm long. The remaining species exhibited no hair; they either fell off already in the early life of the plant or disappeared due to unfavourable deposit conditions.

Cells of the abaxial cuticle show irregularly polygonal shape with undulated anticlinal walls; only *Alethopteris schneideri* (STERZEL) STERZEL has straight or mildly bent anticlinal walls.

Stomata in all the species are haplocheilic, monocyclic, of an anomocytic type. However, they differ in size, presence of papillae on subsidiary cells and sinking of the stoma. Stomata in *Alethopteris bohemica* are sunken below the level of the epidermis and subsidiary cells exhibit papillae. In *Alethopteris schneideri* the stomata are sunken and subsidiary cells are without papillae. *Alethopteris zeilleri* has stomata on the epidermis level and subsidiary cells without papillae.

Features like sinking of the stoma below the epidermis level, papillae or thickened walls of the subsidiary cells which superimpose the stoma are considered as xeromorphic.

They occur in plants restricting transpiration out of two reasons: a) the plants grow on dry habitats with lack of water, b) the plants grow in boggy environment with a surplus of humic acids, low pH value and lack of nitrogen accessible by plants (physiologic dryness).

Xeromorphic features are manifest in *Alethopteris bohemica* and *Alethopteris schneideri*. According to the environment in which these species were found I presume that they truly grew in dry places of coal-bearing basins or in the vicinity of episodic lakes.

The species *Alethopteris zeilleri* with mesomorphic features represents a typical element of hygrophylous seam-forming flora.

Adaxial cuticles of the described species differ from each other. *Alethopteris bohemica* has unoriented polygonal cells with straight anticlinal walls, *Alethopteris*

Table 1

Most important features of cuticles in described species of the genus *Alethopteris* STERNBER

	abaxial cuticle					
	differentiation of costal and intercostal area	cell orientation	cell shape	anticlinal walls	cell size (intercostal area) (μm)	
					length	width
A. bohemica (M. Barthel 1963) loc. Libovice	distinct	unoriented	irregular	mildly undulated	35—50	
A. bohemica loc. borehole 8200/IV	indistinct	unoriented	irregular	mildly undulated	30—50	15—25
A. moravica loc. Zastávka near Rosice	?	? unoriented	?irregular	undulated	40—70	20—40
A. schneideri (M. Barthel 1962, W. Reichel - M. Barthel 1964) Krušné hory Mts. basins	very distinct	unoriented	irregularly polygonal	straight to mildly bent	20—40	
A. zeilleri loc. Libovice, Kvilice	distinct	unoriented	irregularly polygonal	undulated	30—50	20—30

	adaxial cuticle				
	differentiation of costal and intercostal area	intercostal area			
		cells (orientation and shape)	anticlinal walls	all size (μm)	
				length	width
A. bohemica (M. Barthel 1963)	none	unoriented, polygonal	straight	50—80	
A. bohemica borehole 8200/IV	none	unoriented polygonal	straight	40—50	
A. moravica	distinct	strongly oriented, longitudinally quadrangular	straight to mildly bent	40—70	15—30
A. schneideri	indistinct	longitudinally oriented, irregularly polygonal to rectangular	straight to mildly bent	60—150	20—50
A. zeilleri	distinct	unoriented, irregularly polygonal	undulated	60—80	30—60

ab. — abaxial, ad. — adaxial

Table 1

abaxial cuticle						
stomata				subsidiary cells of the stoma		
orientation	length (μm)	width (μm)	sinking	number	papillae	cutinization
ndistinct ongitudinal	18	12	below epidermis level	4—6	on all cells (⌀ 10 μm)	weak
ndistinct	14—18	10—12	below epidermis level	4—6	on some cells	weak
?	?	?	?below epidermis level	?	?	?very weak
rregular	? 20—35	? 10—17	very sunken	4—6	—	stronger
ndistinct	24—28	16—20	on epidermis level	5—6	—	weak

hairs and hair bases					papillae	
site of base occurrence hairs designated (H)]	number of cells forming a base	base diameter (μm)	hairs		site of occurrence	diameter (μm)
			length (μm)	width (μm)		
—	—	—	—	—	ad. cuticle midvein ab. cuticle	40 10
ad. cuticle midvein	1	20—25	—	—	ab. cuticle	10
midvein (H) ?costal area	1	45	up to 500	70—95	—	—
ab. cuticle midvein	1	12—15	—	—	—	—
ad. cuticle (H) midvein (H)	1 2	80—100 70—90	up to 320 up to 350	55—65 45—50	ab. cuticle	up to 15

moravica has oriented longitudinally quadrangular cells with straight or gently bent anticlinal walls, *Alethopteris schneideri* has oriented, irregularly polygonal through rectangular cells with straight or gently bent anticlinal walls, *Alethopteris zeilleri* has unoriented, irregularly polygonal cells with undulated anticlinal walls.

Palaeoecology and palaeosociology

The most abundant species of all Alethopterids comming from mines is *Alethopteris zeilleri* (RAGOT) WAGNER. In the Kladno Basin, the Mine Jiřina 2 at Libovice exhibited 77 % and Mine Magdalena at Kvílice 93 % of specimens of the genus *Alethopteris* STERNBERG pertaining to the species *Alethopteris zeilleri*. This species occurs predominantly in the vicinity of seams. *Alethopteris zeilleri* is not connected with coal seams only in the Permian grey horizons in the Boskovice Furrow. *Alethopteris zeilleri* in the Stephainan B is accompanied by rich seam-forming flora; the following are the most important species according to HAVLENA (1964): *Annularia spicata* GUTB., *A. sphenophylloides* ZENKER, *A. stellata* SCHL., *Asterophyllites equisetiformis* SCHL., *Sphenophyllum oblongifolium* GERM. et KAULF., *S. longifolium* (GERM.) GUTB., *Sigillaria brardi* STBG., *S. ichthyolepis* BGT., *Asolanus camptotaenia* WOOD, *Nemejcepteris feminaeformis* (BGT.) BARTHEL, *Pecopteris arborescens* SCHL., *P. lepidorachis* KIDST. et auct., *P. polymorpha* BGT., *P. polypodioides* STBG., *Dicksonites plückeneti* SCHL., *Pseudomariopteris ribeyroni* (ZEILL.) CORSIN, *Odontopteris subcrenulata* ROST, *Mixoneura neuropteroides* (GOEPP.) ZEILL. and *Callipteridium trigonum* FRANKE.

In the Stephanian C *Alethopteris zeilleri* is accompanied by additional species which transgress into the Permian: *Calamites gigas* BGT., *Pecopteris permica* NJC. and *Odontopteris osmundaeformis* (SCHL.) ZEILL.

In the Rosice-Oslavany group of seams from the Stephanian-Autunian boundary *Alethopteris zeilleri* is accompanied mainly by the following species (NĚMEJC 1953): *Annularia stellata* SCHL., *A. sphenophylloides* ZENKER, *Asterophyllites equisetiformis* SCHL., *Sphenophyllum oblongifolium* GERM. et KAULF., *S. angustifolium* GERM., *S. emarginatum* BGT., *Nemejcopteris feminaeformis* (BGT.) BARTHEL, *Pecopteris polypodioides* STBG., *P. permica* NJC., *P. hemitelioides* BGT., *P. densifolia* GOEPP., *P. candoleana* BGT., *Alethopteris moravica* AUGUSTA, *Linopteris germari* GIEBEL, *Odontopteris osmundaeformis* SCHL., *O. minor* BGT. and *Mixoneura auriculata* BGT.

The species *Odontopteris subcrenulata* ROST, *Sphenopteris germanica* WEISS, *Lebachia piniformis* (STBG.) FL., *Ernestiodendron filiciforme* (STBG.) FL. and *Callipterids* [*Callipteris conferta* (STBG.) BGT. and *C. zbýšovensis* AUGUSTA (AUGUSTA 1946)] which occur in the overlying rock of the first (uppermost) seam are considered by NĚMEJC (1953) as allochthonous elements.

In the Autunian of the Boskovice Furrow the species *Alethopteris zeilleri* is

accompanied especially by the following species (revised after NĚMEJC 1953): *Calamites gigas* BGT., *Asterophyllites equisetiformis* SCHL., *A. longifolius* STBG., *A. dumasi* ZEILL., *Annularia stellata* SCHL., *A. sphenophylloides* ZENKER, *Nemejcopteris feminaeformis* (BGT.) BARTHEL, *Pecopteris hemitelioides* BGT., *P. arborescens* SCHL., *Mixoneura auriculata* BGT., *Odontopteris subcrenulata* ROST, *Taeniopteris multinervis* WEIS, *T. jejunata* GR. 'EURY, *Callipteris conferta* (STBG.) BGT., *C. lyratifolia* GOEPP., *C. naumanii* GUTB., *C. bergeroni* ZEILL., *Alethopteris schneideri* (STERZ.) STERZ., *Dicranophyllum galicum* GR. 'EURY, *Lebachia piniformis* (STBG.) FL. and *Ernestiodendron filiciforme* (STBG.) FL. According to HAVLENA – PEŠEK (1983) these species grew on the banks of episodic lakes. This flora assemblage is classified as middle Autunian.

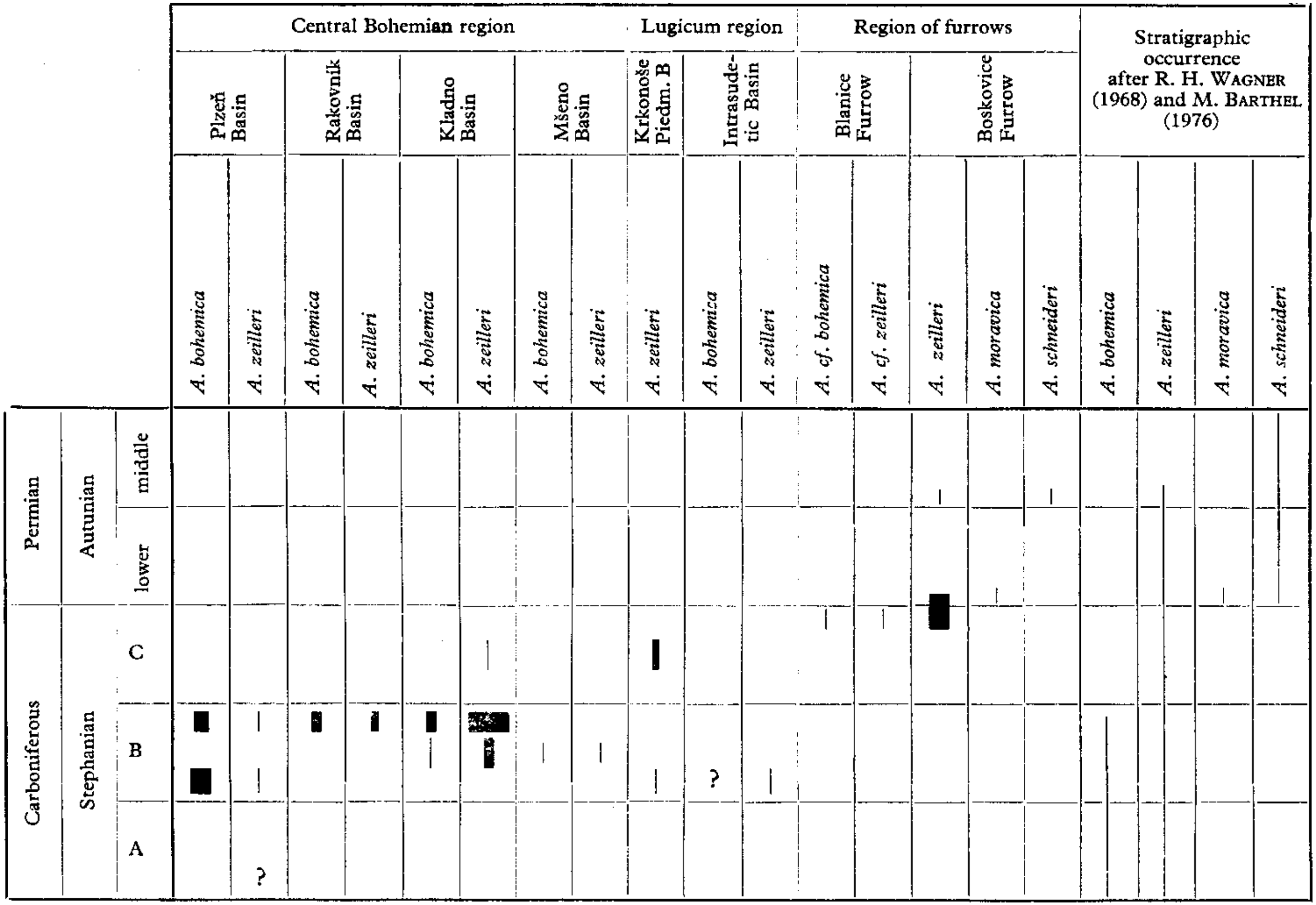
In contrast to *Alethopteris zeilleri* (RAGOT) WAGNER, the species *Alethopteris bohemica* FRANKE occurs in more coarse-grained rocks which are unfavourable for cuticle preservation. The mode of preservation and structure of cuticles (abaxial cuticle exhibits xeromorphic features) of this species corresponds to elements of the Stephanian extra-seam flora that probably grew on margins of coal-bearing basins. The following species are ranged with the extra-seam floral assemblage (HAVLENA 1964): *Linopteris germari* GIEBEL. *L. neuropteroides* (GUTB.) ZEILL. var. *minor* POT., *Callipteridum gigas* GUTB., *Ernestiodendron filiciforme* (SCHL.) FL. and a seed of *Samaropsis moravica* (HELMH.) Sew. *Alethopteris bohemica* can be sporadically found also on mine dumps as an allochthonous element. In these sites *Alethopteris bohemica* is accompanied by the same species as *Alethopteris zeilleri*. In Bohemia, *Alethopteris bohemica* is found solely in the Stephanian B. Two uncertain finds were reported from the Stephainan C of the Blanice Furrow.

There are known only three specimens of *Alethopteris moravica* AUGUSTA preserved in grey claystones accompanying the first (youngest) seam of the Rosice-Oslavany group of seams. Whether they represent a seam-forming or allochthonous element in the basin remains a question. However, *Alethopteris moravica* should be certainly considered a rare endemic species of the Boskovice Furrow. Its accompanying assemblage is given in the description of the Rosice-Oslavany group of seams, which occurs with *Alethopteris zeilleri* (RAGOT) WAGNER.

The ecologic-sociologic amplitude of *Alethopteris schneideri* (STERZEL) STERZEL is relatively wide according to BARTHEL (1976). It is abundant in open pioneer assemblages with very unquiet stationary conditions. The species is significant especially for the middle and upper parts of the Autunian. The accompanying assemblage is given in the description of the Autunian assemblage of *Alethopteris zeilleri* (RAGOT) WAGNER.

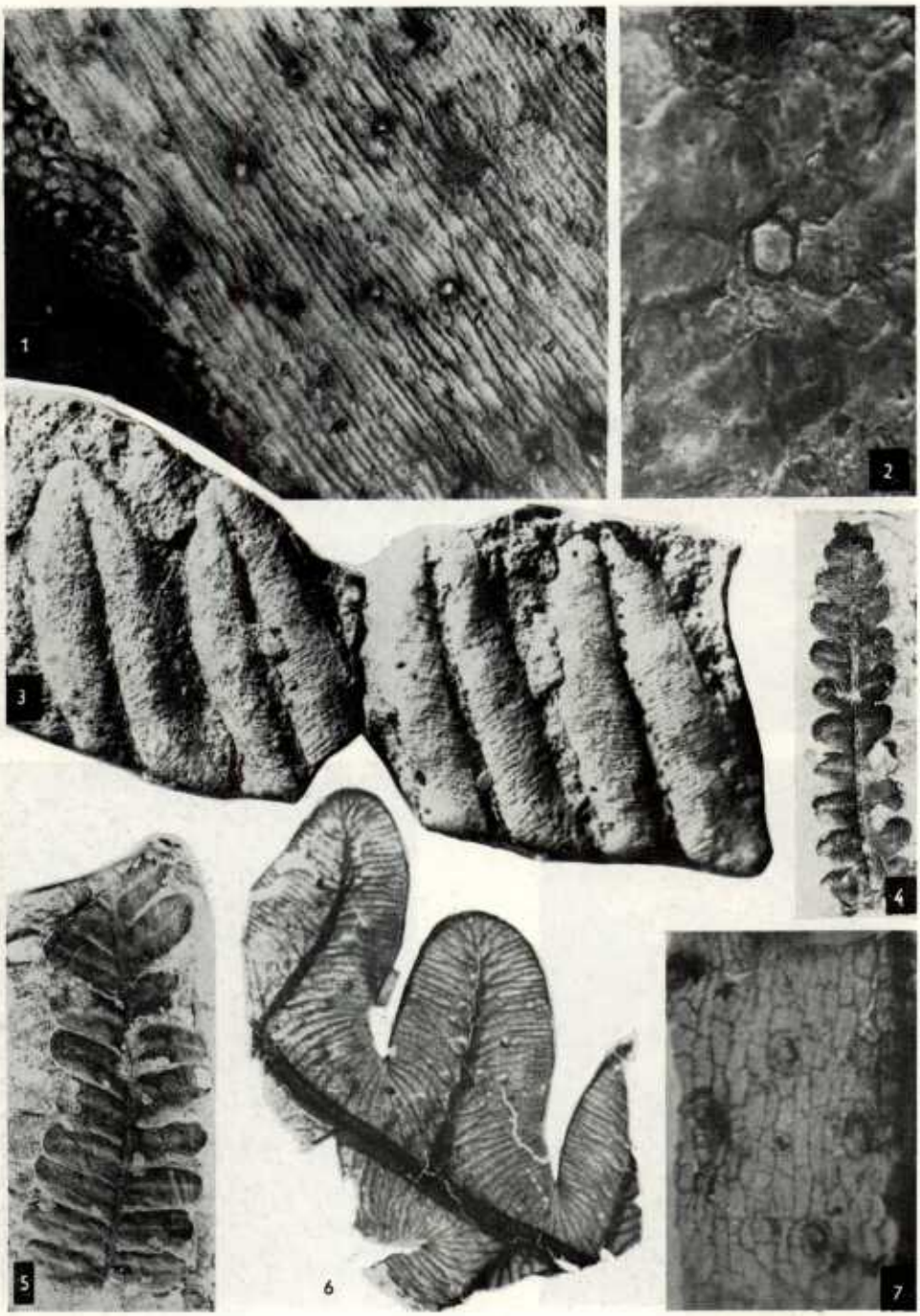
Table 2

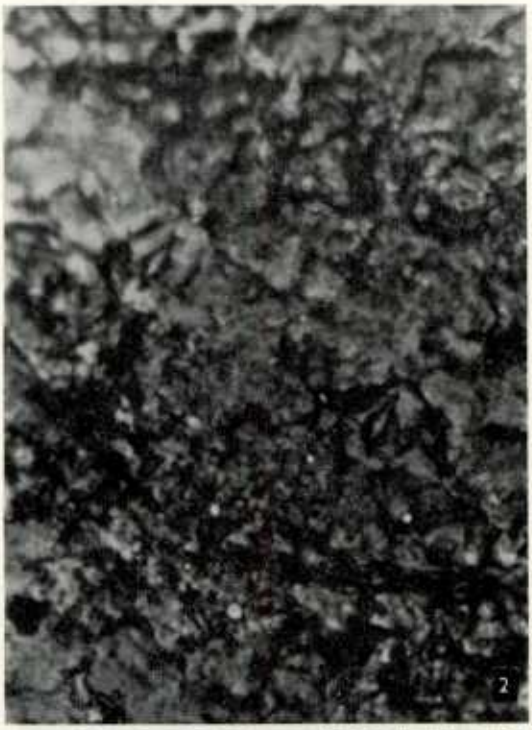
Occurrence of the genus *Alethopteris* STERNBERG in the Stephanian and Permian of Bohemia and Moravia



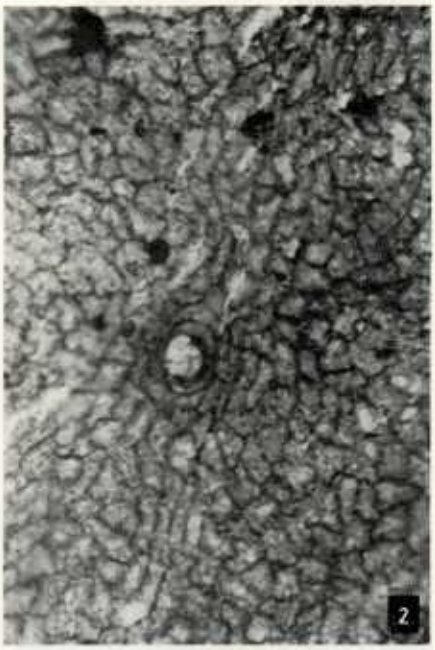
Width of line denotes extent of occurrence (thin line — isolated occurrence), ? — uncertain or undocumented occurrence.

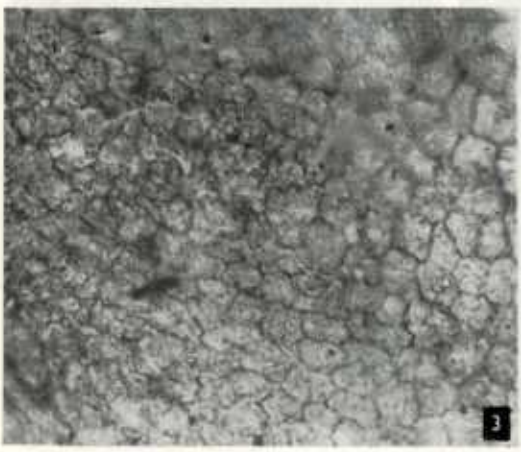
Pl. II

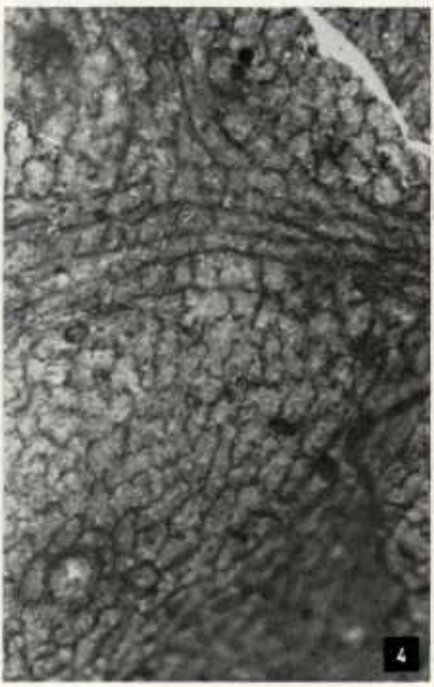


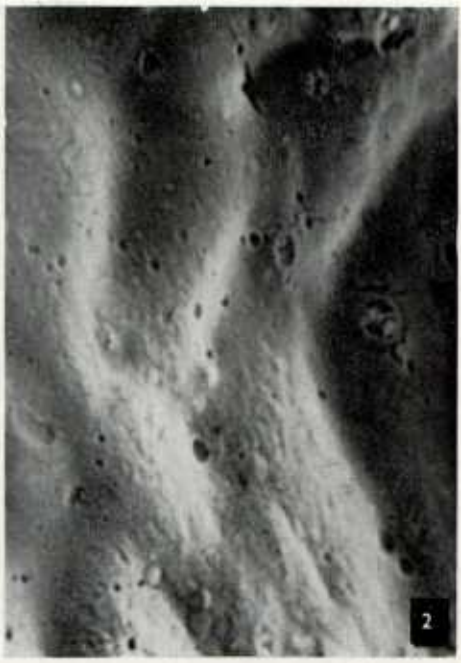


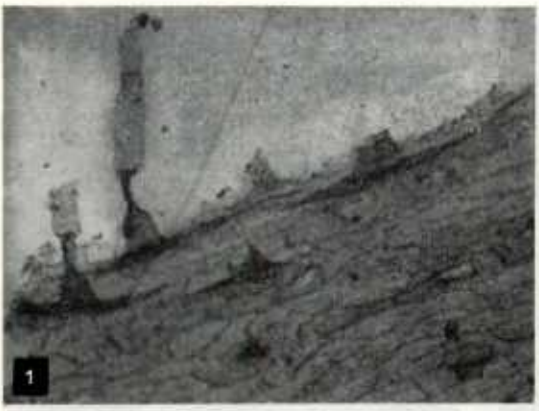
Pl. IV







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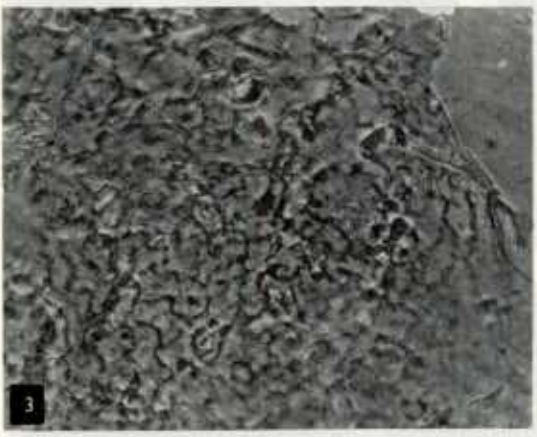
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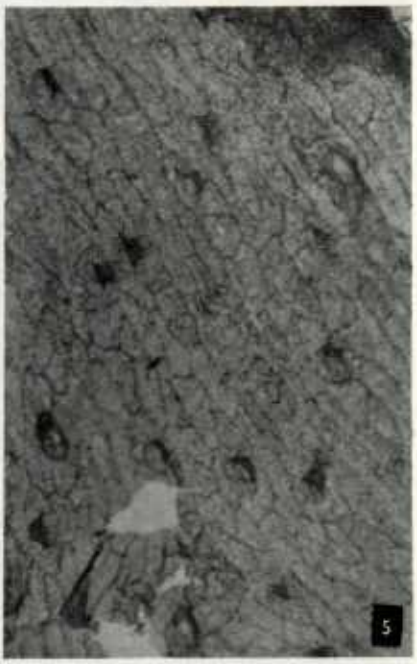
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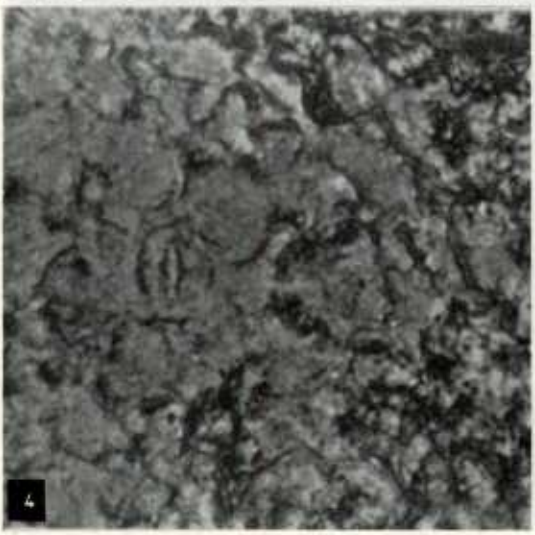
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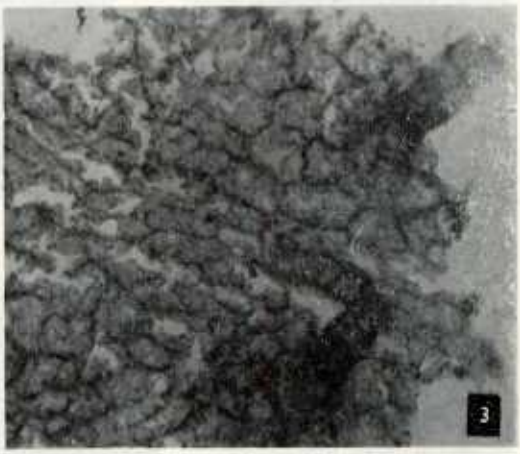
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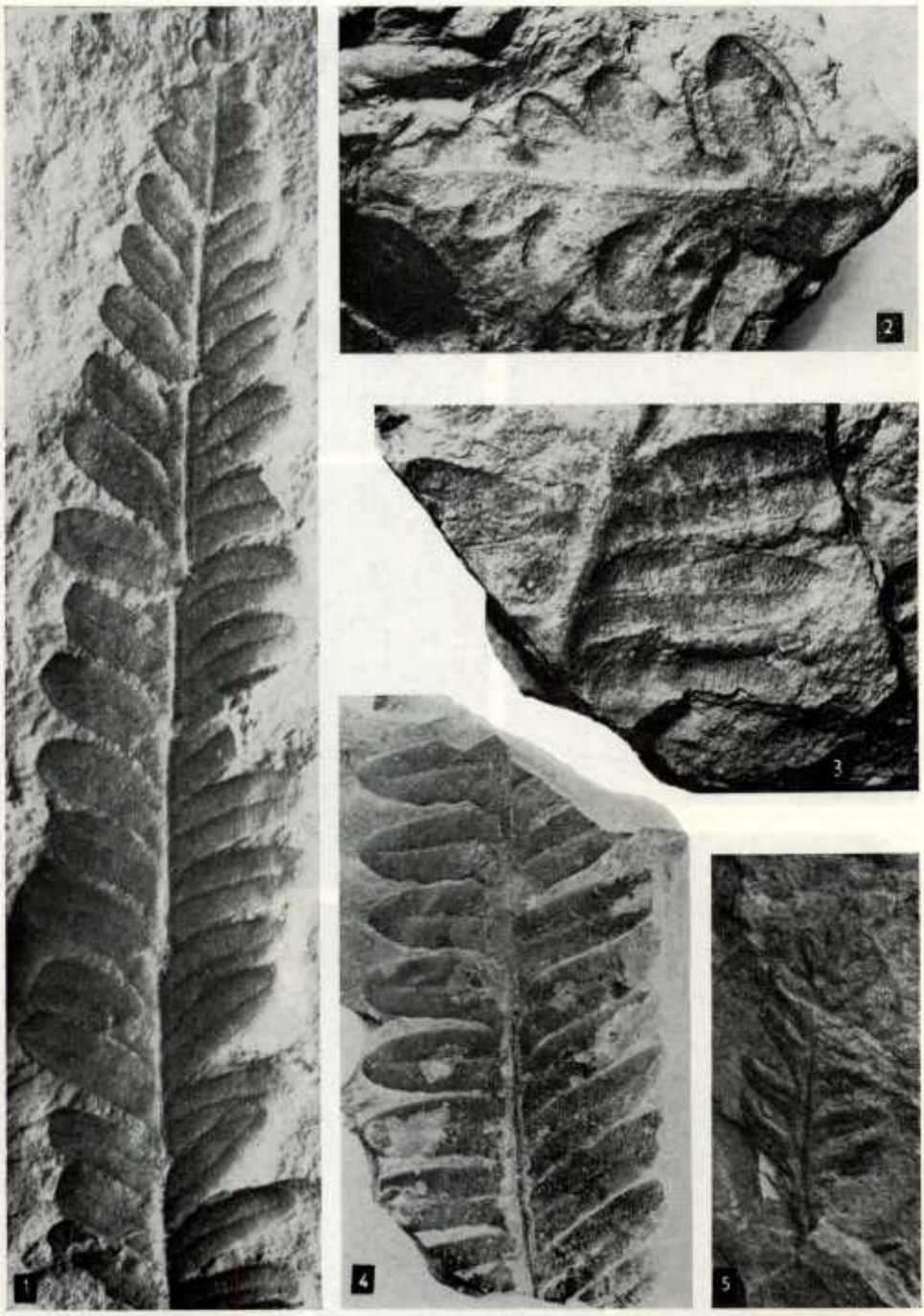
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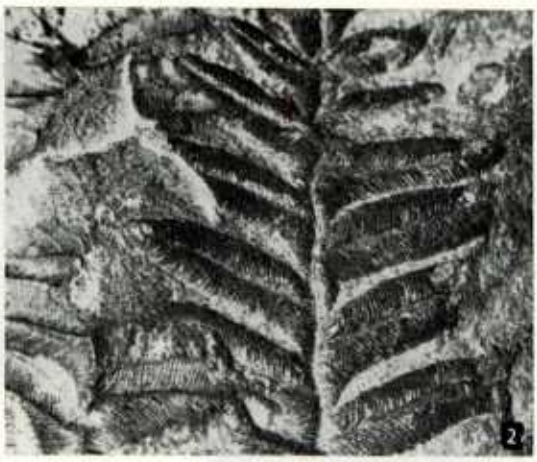

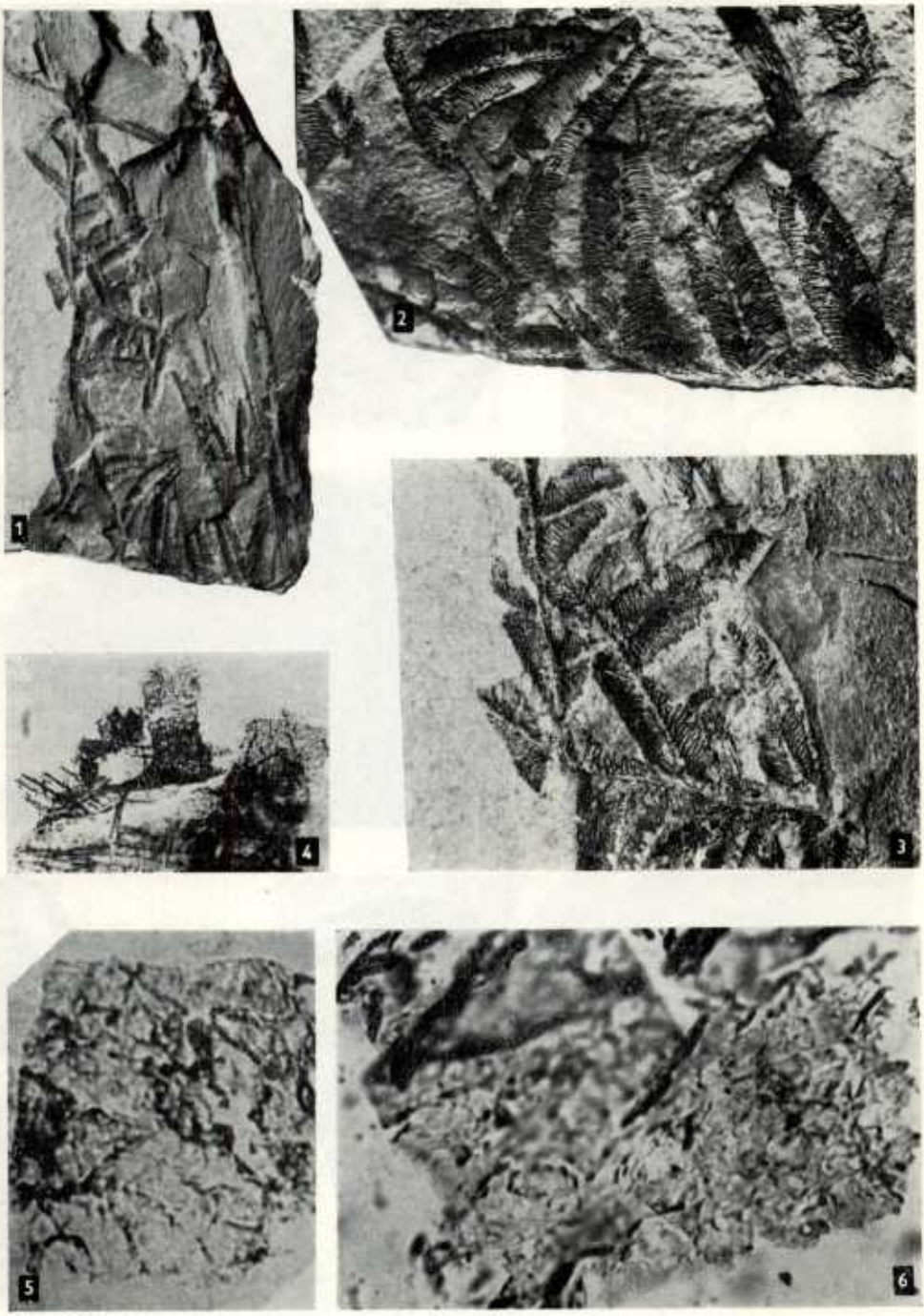
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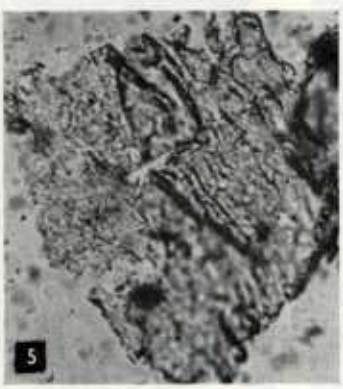
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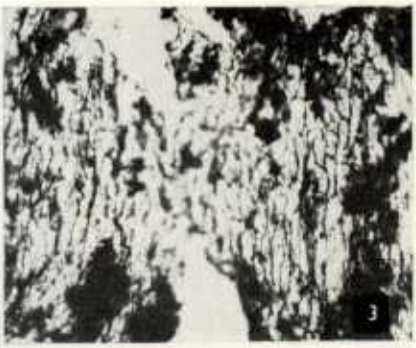
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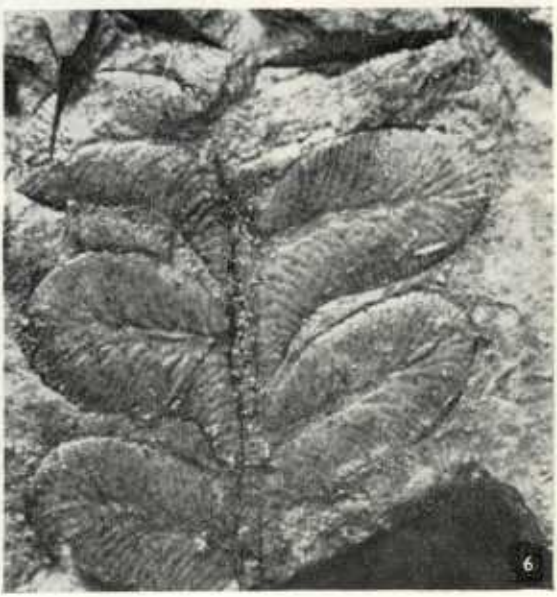
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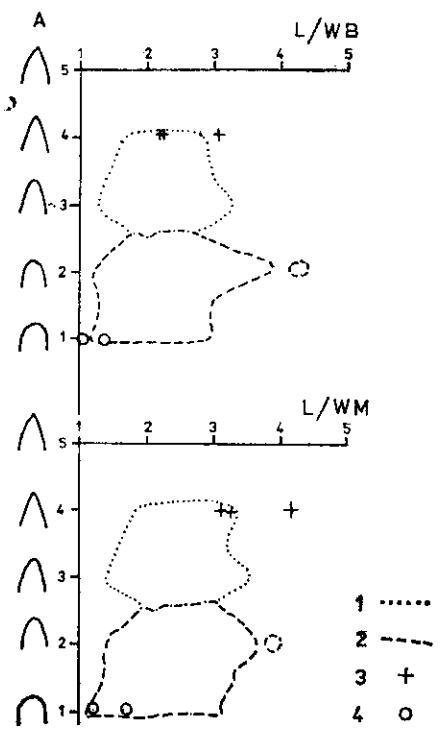
Remarks on stratigraphy

Lithostratigraphic tables of the Intrasudetic Basin, Krkonoše Piedmont Basin and central Bohemian region were recently presented in the paper of ZAJÍC and ŠTAMBERG (1986). According to the present knowledge (HAVLENA-PEŠEK 1980), the Mělník group of seams in the Jelenice Member in central Bohemian region, Syřenov group of seams in the Krkonoše Piedmont Basin and Radvanice group of seams in the Intrasudetic Basin (Stephanian B) mutually correlate. The Kounov group of seams in central Bohemian region is younger (upper Stephanian B). The Klobuky horizon in central Bohemian region correlates with the upper Ploužnice horizon (also called the Štěpanice-Čikvásky horizon) in the Krkonoše Piedmont Basin (Stephanian C). In central Bohemian region in the Slaný Formation (Stephanian B) some authors unify Mšec and Hředle Members under Malesice Member and Ledce, Kounov and Kamenný Most Members under the name Otruby Member.

The lower two seams of the Rosice-Oslavany group of seams in the Boskovice Furrow are considered Stephanian but the uppermost seam (lst main) is ranged with the Autunian according to finds of the genus *Callipteris* BRONGNIART in the seam roof. Grey horizons in the main red-brown formation in the overlying rock of the Rosice-Oslavany group of seams are classified as middle Autunian (HAVLENA - PEŠEK 1983).

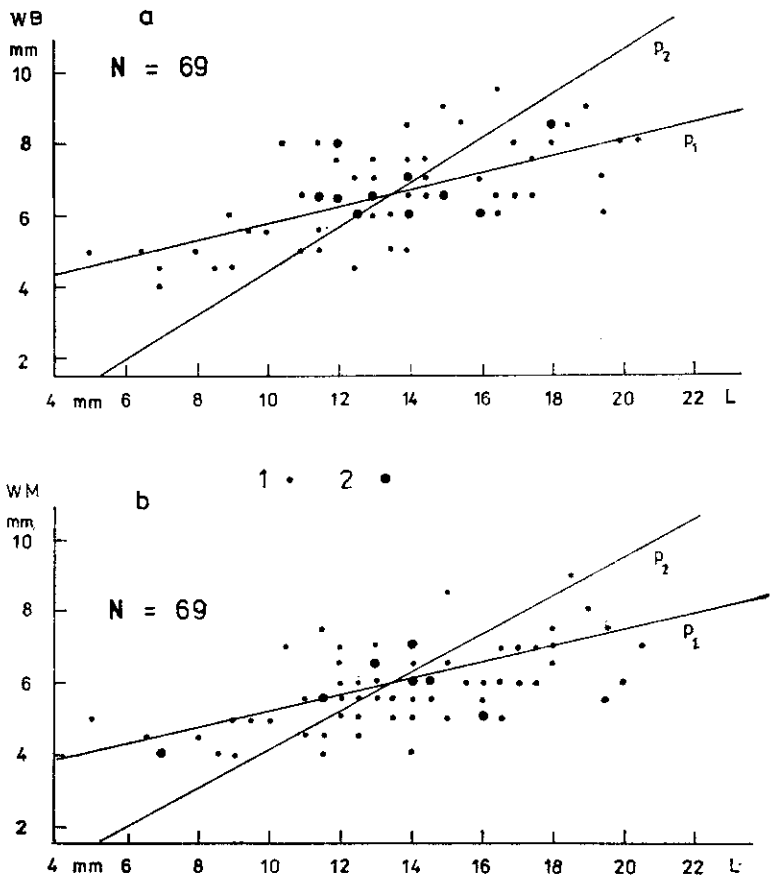


11. Relation between type of apex and pinnule length/width ratio
A — type of apex, *L/WB* — length/width of pinnules at base, *L/WM* — length/width of pinnules in the middle
1 — *Alethopteris bohemica* FRANKE (69 specimens), *2* — *Alethopteris zeilleri* (RAGOT) WAGNER (166 specimens), *3* — *Alethopteris moravica* AUGUSTA (3 specimens), *4* — *Alethopteris schneideri* (STERZEL) STERZEL (2 specimens)

Statistical evaluation of the material

The studied samples of *Alethopteris bohemica* FRANKE and *Alethopteris zeilleri* (RAGOT) WAGNER were statistically measured to establish the range of shape variations of these species. The lenght of pinnules, pinnule width at the base and in the middle, number of veins per 1 cm of pinnule border was measured and the type of the pinnule apex determined.

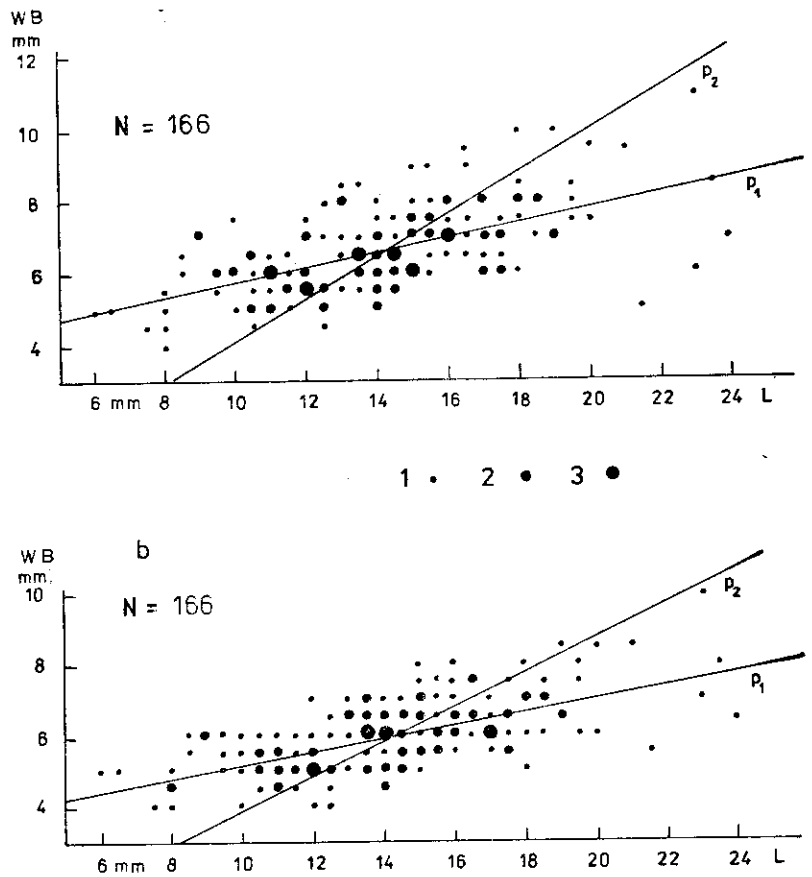
The measured data were used for plotting linear dependencies of the pinnule length and width at the base and in the middle and regression lines for *Aletho-*



12. Linear dependency of length and width of pinnules of *Alethopteris bohemica* FRANKE
N — number of specimens, *L* — length of pinnules, *WB* — width of pinnules at base, *WM* — width of pinnules in the middle; regression lines: p_1 — dependence of *WB* (*WM*) on *L*, p_2 — dependence of *L* on *WB* (*WM*); critical value of correlation index *r* on level 1 — $\alpha = 0.999$: 0.393, correlation index *r* for fig. *a* — 0.606, for fig. *b* — 0.585; *1* — 1 specimen, *2* — 2 to 3 specimens

pteris bohemica and *Alethopteris zeilleri* were drawn. For the regression lines were calculated correlation indexes. The calculated value of the correlation index (cca 0.6) always exceeds its critical value on the level $1 - \alpha = 0.999$. It indicates, roughly speaking, that there exists a correlation between the length and width of the pinnules.

Polygones of relative frequency of measured indexes were constructed: length of pinnules, width of pinnules at the base and in the middle and number of veins per 1 cm of pinnule border. The plotted points correspond with the number of samples in the given frequency class expressed in per cents. The plots have several



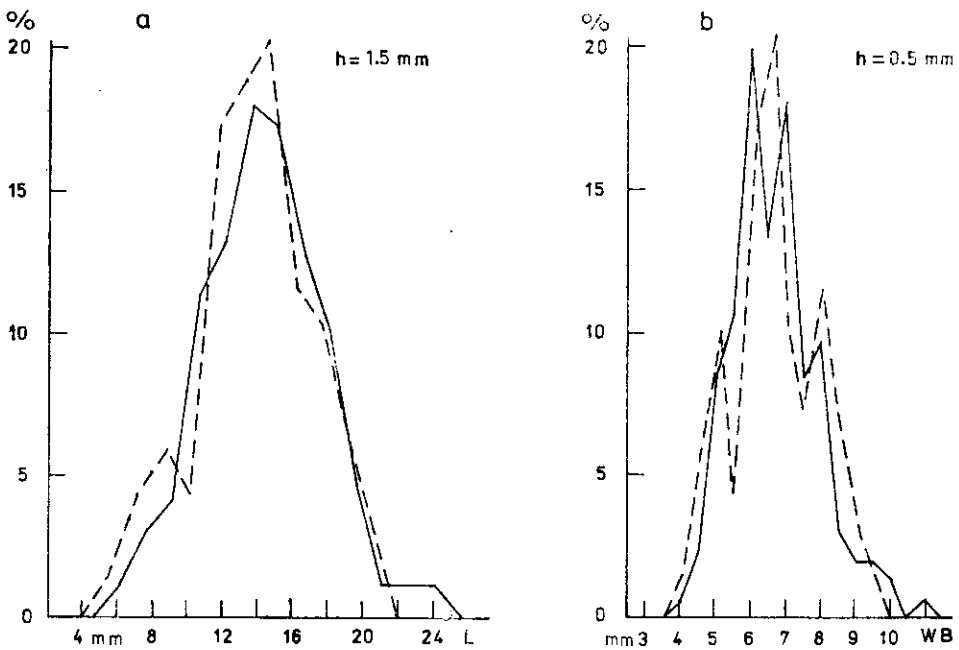
13. Linear dependency of length and width of pinnules of *Alethopteris zeilleri* (RAGOT) WAGNER
N — number of specimens, *L* — pinnule length, *WB* — width of pinnules at base, *WM* — width of pinnules in the middle; regression lines: p_1 — dependence of *WB* (*WM*) on L, p_2 — dependence of *L* on *WB* (*WM*); critical value of correlation index *r* on level $1 - \alpha = 0.999$: 0.294, correlation index *r* for fig. *a* — 0.589, for fig. *b* — 0.629; *1* — 1 specimen, *2* — 2 to 3 specimens, *3* — 4 to 5 specimens

Table 3

Some measured features of the described species of the genus *Alethopteris* STERNBERG

	number of measured specimens N	length of pinnules (mm)		width of pinnules at base (mm)	
		arithmetical mean	devitaion	arithmetical mean	deviation
A. bohemica	69	13.59	± 7	6.62	± 2.5
A. moravica	3	14.33	± 7	6.33	± 1
A. schneideri	2	6	± 1	5	± 0
A. zeilleri	166	14.25	± 8	6.65	± 2.5

apexes however the central apex is always the highest one and lower apexes are statistically insignificant (they originate due to small measuring inaccuracies in a relatively small statistical set). It follows from the plots that *Alethopteris bohemica* FRANKE and *Alethopteris zeilleri* (RAGOT) WAGNER cannot be distinguished from



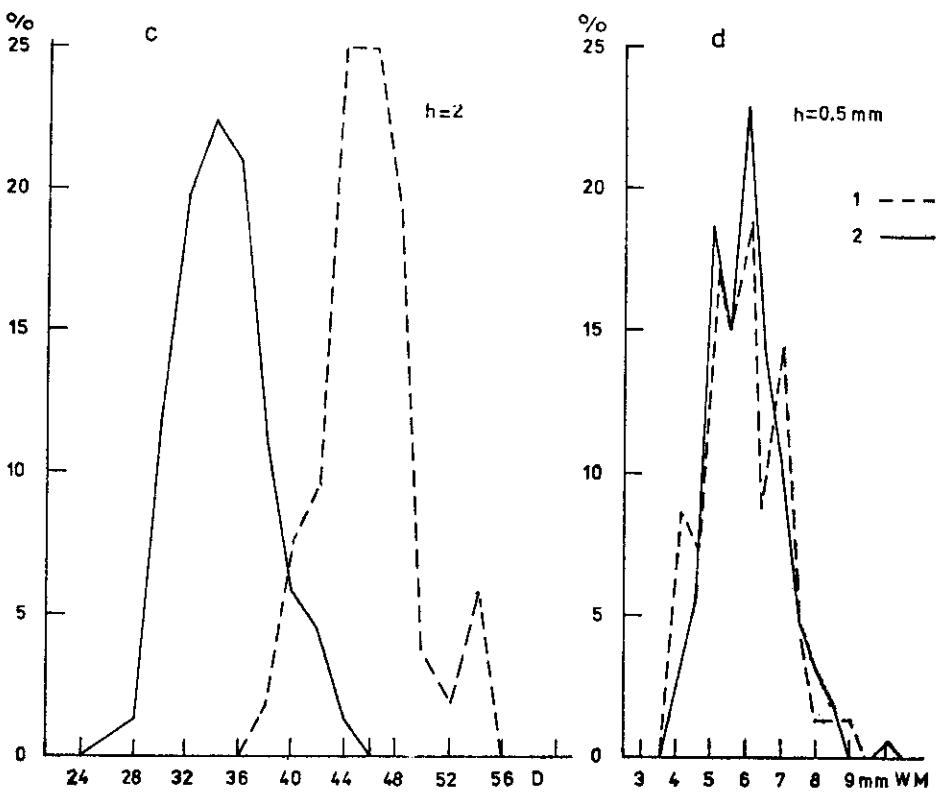
14. Polygones of relative frequencies of length, width at base and in the middle and venation density in pinnules of the species *Alethopteris bohemica* FRANKE and *Alethopteris zeilleri* (RAGOT) WAGNER
L — length of pinnules, *WB* — width of pinnules at base, *D* — number of veins per 1 cm of pinnule border, *WM* — width of pinnules in the middle, *h* — length of class, *1* — *Alethopteris bohemica* (figs. *a*, *b*, *d* of 69 specimens, fig. *c* of 52 specimens), *2* — *Alethopteris zeilleri* (figs. *a*, *b*, *d* of 166 specimens, fig. *c* of 152 specimens)

Table 3

width of pinnules in the middle (mm)		number of veins per 1 cm of pinnule border		type of pinnule apex
arithmetical mean	deviation	arithmetical mean	deviation	
5.83	±2.5	45.6	±8	bluntly pointed
4.66	±1.5	60	±5	bluntly pointed
4.25	±0.25	45	±3	broadly rounded
5.97	±2.5	34.7	±9	broadly rounded

each other on the basis of the pinnule length and width. Greater difference between the two species shows the plot "number of veins per 1 cm of pinnule border" (text-fig. 14c).

Relationship between the type of the pinnule apex and the length/width ratio



(at the base and in the middle) of the pinnules was calculated after the work of SCHEIHING and PFEFFERKORN (1980). On the basis of this relationship the species *Alethopteris bohemica* and *Alethopteris zeilleri* can be well distinguished according to different types of pinnule apexes. The plot (fig. 11) shows also 5 measured samples of the species *Alethopteris moravica* AUGUSTA and *Alethopteris schneideri* (STERZEL) STERZEL from the territory of Czechoslovakia.

Conclusion

The Stephanian and Permian of Bohemia and Moravia exhibit 4 species of the genus *Alethopteris* STERNBERG: *Alethopteris bohemica* FRANKE, *Alethopteris moravica* AUGUSTA, *Alethopteris schneideri* (STERZEL) STERZEL and *Alethopteris zeilleri* (RAGOT) WAGNER. Specimens of *Alethopteris zeilleri* (RAGOT) WAGNER from various places of Czechoslovakia were long time described under the name *Alethopteris bohemica* FRANKE. *Alethopteris bohemica* together with *Alethopteris zeilleri* are widespread especialy in the basins of Central Bohemian region with Stephanian sediments. *Alethopteris bohemica* is most numerous in the Plzeň Basin. *Alethopteris bohemica* was not confirmed from the Intrasudetic Basin, and from the Blanice Furrow were reported specimens designated as *Alethopteris cf. bohemica* (pl. I, fig. 3). On the other hand, *Alethopteris zeilleri* is widespread in all regions with the Stephanian and Permian sediments. It is most abundant in the Kladno Basin and also very common in the Boskovice Furrow in the Rosice-Oslavany group of seams. Both species exhibit different morphologic features and cuticles. *Alethopteris bohemica* disappears by the end of the Stephanian, *Alethopteris zeilleri* transgresses into the Autunian. *Alethopteris bohemica* is an element of the extra-seam flora while *Alethopteris zeilleri* belongs to elements of the seam-forming flora. In the Permian, it occurs also in grey sediments accompanying the extra-seam flora. *Alethopteris schneideri* (STERZEL) STERZEL known solely from the Permian of the Boskovice Furrow on the Czechoslovak territory was found in similar sediments.

The species *Alethopteris moravica* AUGUSTA is very rare endemic species of the Rosice-Oslavany group of seams of the Boskovice Furrow. Holotype is complemented with another 2 findings and cuticles with hairs. Hairs were also established in *Alethopteris zeilleri* which exhibited mesomorphic features of cuticles.

Xeromorphic features on the abaxial cuticle (according to the structure of the stoma) were observed in *Alethopteris bohemica* and *Alethopteris schneideri.*

It follows from the statistical evaluation that the species *Alethopteris bohemica* and *Alethopteris zeilleri* can be differentiated in the plot showing the venation density and in the plot showing the dependence of the length/width ratio on the type of apex.

K tisku doporučila E. Purkyňová
Přeložila T. Hlavatá

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Explanation of plates

All photographs besides those given below are made by the author. Photographs on pl. V by J. Kulich, on pl. XII, figs. 5, 6 by M. Barthel. Photographs were not retouched; all preparations for microphotographs are deposited in the Geological Survey, Prague.

Pl. I

Alethopteris bohemica FRANKE

1. Pinnae of the last order, locality Radčice, digged test pit Š-80, Plzeň Basin, Stephanian B. Coll. J. Šetlík, Geological Survey, Prague, no. YA 1273, full size.
2. Terminal part of pinna of the last order, locality Radčice, digged test pit Š-80, Plzeň Basin, Stephanian B, Coll. J. Šetlík, Geological Survey, Prague, no. YA 1275, ×2.
3. *Alethopteris* cf. *bohemica*, pinna of the last order, locality Dolní Peklov near Kostelec nad Černými lesy, Blanice furrow, Stephanian C. Coll. F. Němejc, National Museum, Prague, full size.

4. Part of frond of the last order which served for preparation of cuticle preparates no. 127/1, 127/2 (cuticles in plates I and II), loc. borehole 8200/IV, depth 20.2 m, Stephanian. Coll. J. Šetlík, Geological Survey, Prague, no. YA 1276, ×2.
5. Abaxial cuticle with stomata, preparate no. 127/2 (impression on fig. 4), loc. borehole 8200/IV, depth 20.2 m, ×500.
6. Adaxial cuticle with hair base, preparate no. 127/2 (impression on fig. 4), loc. borehole 8200/IV, depth 20.2 m, ×200.

Pl. II

Alethopteris bohemica FRANKE (figs. 1–3)
Alethopteris zeilleri (RAGOT) WAGNER (figs. 4–7)

1. Abaxial cuticle in the site of pinnule midvein with hair bases, preparate no. 127/2 (impression on pl. I, fig. 4), loc. borehole 8200/IV, depth 20.2 m, ×100.
2. Hair base on adaxial cuticle, preparate no. 127/2 (impression pl. I, fig. 4), loc. borehole 8200/IV, depth 20.2 m, ×500.
3. Pinnules with characteristic venation, locality Libovice, Mine Jiřina 2, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. Z. Šimůnek, Geological Survey, Prague, no. YA 1283, ×3.

Alethopteris zeilleri (RAGOT) WAGNER

4. Small pinna of the last order, locality Kvílice, Mine Magdalena, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. K. Feistmantel, National Museum, Prague, no. 1643, full size.
5. Pinna of the last order, locality Kvílice, Mine Magdalena, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. K. Feistmantel, National Museum, Prague, no. E 5001, full size.
6. Isolated pinnules after maceration serving for preparation of cuticles no. 1/29–34, locality Libovice, Mine Jiřina 2, Kladno Basin, Kounov group of seams, upper Stephanian B, ×3.
7. Abaxial cuticle in the site of midvein, preparate no. 36/2 (impression pl. III, fig. 1), locality Kvílice, Mine Magdalena, Stephanian B, ×100.

Pl. III

Alethopteris zeilleri (RAGOT) WAGNER

1. Pinna of the last order which served for preparation of cuticles no. 36/1–18 (cuticles on pl. II, IV, VI), locality Kvílice, Mine Magdalena, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. K. Feistmantel. National Museum, Prague, ×2.
2. Abaxial cuticle with stomata, preparate no. 36/25 (impression not figured), locality Libovice, Mine Jiřina 2, Stephanian B, ×500.
3. Terminal part of pinna of the last order, locality Kvílice, Mine Magdalena, Kladno Basin, upper Stephanian B. Coll. K. Feistmantel, National Museum, Prague, ×3.
4. Fragment of pinna of the last order with pinnules showing more dense venation than that of typical pinnules, locality Libovice, Mine Jiřina 2, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. Z. Šimůnek, Geological Survey, Prague, no. YA 1277, ×3.

Pl. IV

Alethopteris zeilleri (RAGOT) WAGNER

1. Adaxial cuticle, preparate no. 1/12 (impression not figured), locality Libovice, Mine Jiřina 2, Stephanian B, ×200.
2. Adaxial cuticle with hair base, preparate no. 1/34 (impression on pl. II, fig. 6), locality Libovice, Mine Jiřina 2, Stephanian B, ×100.
3. Adaxial cuticle, preparate no. 36/39 (impression not figured), locality Kvílice, Mine Magdalena, Stephanian B, ×100.

4. Adaxial cuticle, preparate no. 36/3 (impression on pl. III, fig. 1), locality Kvílice, Mine Magdalena, Stephanian B, ×100.

Pl. V

Alethopteris zeilleri (RAGOT) WAGNER

1. Adaxial cuticle with gently furrowed and bumpy periclinal walls, locality Libovice, Mine Jiřina 2, Stephanian B, ×500.
2. Detail from fig. 1, ×5000.
3. Abaxial cuticle with papilla, locality Libovice, Mine Jiřina 2, Stephanian B, ×1000.
(SEM photomicrographs of cuticles, photo J. Kulich)

Pl. VI

Alethopteris zeilleri (RAGOT) WAGNER

1. Abaxial cuticle in site of midvein with hairs, preparate no. 1/30 (pinnules on pl. II, fig. 5), locality Libovice, Mine Jiřina 2, Stephanian B, ×100.
2. Hair base on abaxial cuticle in site of midvein, preparate no. 36/9 (impression on pl. III, fig. 1), locality Kvílice, Mine Magdalena, Stephanian B, ×500.
3. Abaxial cuticle with stomata, preparate no. 36/25 (impression not figured), locality Libovice, Mine Jiřina 2, Stephanian B, ×200.
4. Abaxial cuticles with stoma, preparate no. 36/9 (impression on pl. III, fig. 1), locality Kvílice, Mine Magdalena, Stephanian B, ×500.
5. Abaxial cuticle in site of midvein with numerous hair bases, preparate no. 36/2 (impression on pl. III, fig. 1), locality Kvílice, Mine Magdalena, Stephanian B, ×100.
6. Adaxial cuticle, preparate no. 36/45 (impression on pl. VIII, fig. 8), locality Oslavany, Mine Kukla, Stephanian C–Autunian, ×200.

Pl. VII

Alethopteris zeilleri (RAGOT) WAGNER

1. Pinna of the last order, locality Libovice, Mine Jiřina 2, Kladno Basin, Kounov group of seams, upper Stephanian B. Coll. Z. Šimůnek, Geological Survey, Prague, no. YA 1278, ×2.
2. Hair on adaxial cuticle (detail from fig. 3), locality Libovice, Mine Jiřina 2, Stephanian B, ×200.
3. Hairs on adaxial cuticle, preparate no. 1/34 (impression on pl. II, fig. 6), locality Libovice, Mine Jiřina 2, Stephanian B, ×100.
4. Pinna of the last order, locality Nedvězí, Krkonoše Piedmont Basin, Stephanian C. Coll. V. Havlena, Faculty of Science, Charles University, Prague, full size.
5. Terminal part of pinna of the last order, locality Zbýšov, Mine Antonín, Boskovice Furrow, Rosice-Oslavany group of seams, Stephanian C–Autunian. Coll. J. Šetlík - Z. Špinar, Geological Survey, Prague, no. YA 1279 white-coated, full size.
6. Pinna of the last order, locality Chvaleč, borehole Chv-3, depth 345.5 m, Intrasudetic Basin, Jívka Member, Stephanian B. Coll. E. Purkyňová, Silesian Museum, Opava, Acc. cat. 1/82, inv. no. F-3581a, white-coated, ×2.

Pl. VIII

Alethopteris zeilleri (RAGOT) WAGNER

1. Pinna of the last order, locality Babice near Zastávka, Mine Ferdinand, Boskovice furrow, Rosice-Oslavany group of seams, Stephanian C–Autunian. Coll. F. Němejc. National Museum, Prague, full size.
2. Terminal part of pinna of the last order, locality Zbýšov, Boskovice furrow, Autunian. Coll. Moravian Museum, Brno, acc. no. 68, ×2.

3. Fragment of pinna of the last order, locality Zbýšov, Boskovice furrow, Autunian, Coll. Moravian Museum, Brno, acc. no. 68, ×2.
4. Pinna of the last order which served for cuticle preparate no. 36/45 (pl. VI, fig. 6), locality Oslavany, Mine Kukla, Boskovice furrow, Rosice-Oslavany group of seams, Stephanian C—Autunian. Coll. F. Němejc, National Museum, Prague, no. 25980, full size.
5. Terminal part of pinna of the last order, locality Nedvězí, Stephanian C, Krkonoše Piedmont Basin. Coll. V. Havlena, Faculty of Science, Charles University, Prague, full size.

Pl. IX

Alethopteris moravica AUGUSTA

1. Pinna of the last order (holotype) — served for cuticle preparations no. 140/1 and 140/2 (on pls. X and XI), locality Zastávka near Rosice, Mine Julius, 1. (main) seam, Boskovice furrow, Rosice-Oslavany group of seams, lowermost Autunian. Coll. J. Augusta, Faculty of Science, Jan Evangelista Purkyně University, Brno, inv. no. E 3961, full size.
2. Detail of pinnules of terminal part of pinna from fig. 1, ×3.
3. Pinna of the last order, locality Zastávka near Rosice, Boskovice Furrow, Rosice-Oslavany group of seams, lowermost Autunian. Coll. J. Augusta, National Museum, Prague, full size.
4. Detail of pinna of the last order from fig. 1.
5. Adaxial cuticle, preparate no. 139/3 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.

Pl. X

Alethopteris moravica AUGUSTA

1. Fragment of pinna of the last order which served for cuticle preparates nos. 139/1—3 (cuticles on pls. IX, X, XI and XII), locality Zastávka near Rosice, Mine Julius, Boskovice Furrow, Rosice-Oslavany group of seams, lowermost Autunian. Coll. J. Augusta, Faculty of Science, Jan Evangelista Purkyně University, Brno, inv. no. 4604, full size.
2. Detail from fig. 1, ×3.
3. Detail from fig. 1, ×3.
4. Hair on adaxial cuticle, preparate no. 139/2 (impression on fig. 1), Zastávka near Rosice, Mine Julius, Autunian, ×100.
5. Abaxial cuticle, preparate no. 139/3 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×200.
6. Ditto, ×500.

Pl. XI

Alethopteris moravica AUGUSTA

1. Hair base on abaxial cuticle in site of midvein, preparate no. 140/1 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×500.
2. Abaxial cuticle in site of midvein, preparate no. 140/1 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.
3. Adaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×200.
4. Adaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.
5. Abaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×200.
6. Hair, preparate no. 139/1 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.
7. Hair on cuticle in site of midvein, preparate no. 139/2 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.

8. Hair on adaxial cuticle, preparate no. 139/3 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×200.

Pl. XII

Alethopteris moravica AUGUSTA (figs. 1–4)
Alethopteris schneideri (STERZEL) STERZEL (figs. 5–6)

1. Adaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.
2. Adaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka, Mine Julius, Autunian, ×200.
3. Adaxial cuticle, preparate no. 139/2 (impression on pl. X, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.
4. Adaxial cuticle, preparate no. 140/2 (impression on pl. IX, fig. 1), locality Zastávka near Rosice, Mine Julius, Autunian, ×100.

Alethopteris schneideri (STERZEL) STERZEL

5. Frond of the last order, locality Moravský Krumlov, Boskovice furrow, Autunian, Coll. Moravian Museum, Brno, photo M. Barthel , ×4.
6. Frond of the last order, locality Zbýšov, Boskovice furrow, Autunian. Coll. Moravian Museum, Brno, acc. no. 68, photo M. Barthel, ×5.

Alethopteridy stefanu a permu Čech a Moravy

(*Résumé anglického textu*)

ZBYNĚK ŠIMŮNEK

Předloženo 30. června 1986

Ve stefanu a permu Čech a Moravy se vyskytují 4 druhy rodu *Alethopteris* STERNBERG: *Alethopteris bohemica* FRANKE, *Alethopteris moravica* AUGUSTA, *Alethopteris schneideri* (STERZEL) STERZEL a *Alethopteris zeilleri* (RAGOT) WAGNER.

Pod jménem *Alethopteris bohemica* FRANKE byly dlouhou dobu popisovány ukázky *Alethopteris zeilleri* (RAGOT) WAGNER z různých míst ČSSR. *Alethopteris bohemica* spolu s *Alethopteris zeilleri* je rozšířena hlavně v pánvích středočeské oblasti se stefanskou výplní, a to nejvíce v plzeňské pánvi. Ve vnitrosudetské pánvi není doložena a z blanické brázdy jsou známy ukázky označené jako *Alethopteris* cf. *bohemica* (tab. 1, obr. 3). Naproti tomu *Alethopteris zeilleri* je rozšířena ve všech oblastech výskytu stefanu a permu. Nejhojnější je v kladenské pánvi, velmi hojná je rovněž v boskovické brázdě v rosicko-oslavanském souslojí. Oba druhy se liší morfologickými znaky i kutikulami. *Alethopteris bohemica* mizí koncem stefanu, *Alethopteris zeilleri* přechází do autunu. *Alethopteris bohemica* patří mezi prvky mimoslojové flóry, *Alethopteris zeilleri* mezi prvky slojotvorné květeny. V permu se však nachází také v šedých sedimentech ve společnosti mimoslojových rostlin. V podobných sedimentech se objevuje i *Alethopteris schneideri* (STERZEL) STERZEL, známá v ČSSR pouze z permu boskovické brázdy.

Druh *Alethopteris moravica* AUGUSTA je velmi vzácný, endemický druh rosicko-oslavanského souslojí boskovické brázdy. Holotyp doplňují další 2 nálezy a kutikuly, na kterých byly zjištěny trichomy. Trichomy byly zjištěny také u *Alethopteris zeilleri*, která má mezomorfní znaky kutikul.

Xeromorfní znaky na spodní kutikule (podle stavby průduchů) jsou u druhů *Alethopteris bohemica* a *Alethopteris schneideri*.

Ze statistického zpracování vyplývá, že druhy *Alethopteris bohemica* a *Alethopteris zeilleri* můžeme rozlišit v grafu s hustotou žilnatiny a v závislosti poměru délky a šířky lístků na typu vrcholu.

Алетоптеридные стефанского яруса и пермской системы Чехии и Моравии

Ревизией находок в Чехии и Моравии доказано присутствие 4 видов рода *Alethopteris* STERNBERG, именно: *A. bohemica* FRANKE, *A. moravica* AUGUSTA, *A. schneideri* (STERZEL) STERZEL

и *A. zeilleri* (Ragot) Wagner. Их характеристики были дополнены описанием строения кутикул, изменяемости листков, обработанной систематически у видов *A. bohemica* и *A. zeilleri*. *A. schneideri* доказана в перми на территории ЧССР в первый раз.

Некоторые окаменелости из стефана и перми ЧССР, которые раньше считались представителями рода *Alethopteris*, относятся к другим родам или же видам, именно: *A. costei* Zeiller (Purkyně, 1929b, табл. 1, рис. 1) относится к виду *Praecallipteridium jongmansii* (P. Bertr.) Wagner (Wagner, 1963), *A. neessii* (Goepp.) Presl in Stbg. — к роду *Callipteris* Bgt. (Franke, 1912), *A. pteroides* (Bgt.) Gein. (Feistmantel O., 1885, табл. 2, рис. 2—4) — к *Pecopteris polymorpha* Bgt. (Němejc, 1934), *A. punctata* Augusta (Augusta, 1927, табл. 1, рис. 2, табл. 2, рис. 1, 2) является, вероятно, видом *Pecopteris* (*Scolecopteris*) *pseudobucklandii* (Andrae in Germar) Stur (Barthel, 1981, стр. 923).

Přeložil A. Kříž