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Carboniferous alethopterids of the Karviná and Žacléř Formations (Czech Republic)

Karbonské alethopteridy karvinského a žacléřského souvrství

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Abstract: Revision of the genus *Alethopteris* STERNBERG has led to specification of 11 species from the Žacléř Formation (Intrasudetic Basin) and 6 species from the Karviná Formation (Upper Silesian Basin). Both these formations contain *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *Alethopteris decurrens* (ARTIS) FRECH, *Alethopteris urophylla* (BRONGNIART) GOEPPERT and *Alethopteris valida* BOULAY. From the Upper Silesian Basin *Alethopteris havlenae* sp. nov. is described, while *Alethopteris pilosa* sp. nov., likely evolved by retardation from the species *Alethopteris valida* BOULAY, comes from the Intrasudetic Basin. The species *Alethopteris* aff. *valida* Boulay from the Intrasudetic Basin differs from *Alethopteris valida* BOULAY in cuticles. The author has managed to prepare cuticles of 10 species of the genus *Alethopteris* STERNBERG. The specimens of *Alethopteris urophylla* from the Upper Silesian and Intrasudetic Basins have somewhat different cells of the adaxial cuticle and a various size ot trichomes. The difference between the populations of *Alethopteris decurrens* (ARTIS) FRECH from the Upper Silesian and the Intrasudetic Basin becomes more apparent if we statistically evaluate the pinnule variability using the histograms width of pinnules in the midpart and number of veins per 1 cm at the pinnule margin. They reveal that *Alethopteris decurrens* from the Upper Silesian Basin has narrower pinnules with a lesser venation density. This is because of a higher representation of the form *Alethopteris decurrens* forma *gracillima* BOULAY in the Upper Silesian Basin. The histograms of pinnule length, pinnule width in the midpart and at the base, number of veins per 1 cm at the pinnule margin, compiled on the basis of measurements of *Alethopteris urophylla* and *Alethopteris valida*'s specimens derived from the both basins are comparable.

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Introduction

The paper deals with the species of the genus *Alethopteris* STERNBERG from the Žacléř Formations of the Intrasudetic Basin and the Karviná Formation of the Upper Silesian Basin. The alethopterids of the Intrasudetic Basin have not been systematically evaluated yet. The species of the genus *Alethopteris* appeared only in the floral lists of the Intrasudetic Basin published by NĚMEJC (1933, 1958), NĚMEJC - ŠETLÍK (1950), ŠETLÍK in HOLUB - WAGNER (1977), and ŠETLÍK in TÁSLER et al. (1979).

The species of the genus *Alethopteris* from the Ostrava Formation (Upper Silesian Basin) were precisely characterised by PURKYŇOVÁ (1970). Their specimens are strongly coalified and therefore unsuitable for the cuticular study. That is why they are not concerned in this paper. The species of the genus *Alethopteris* from the Karviná Formation of the Upper Silesian Basin have been described by ŠUSTA (1928, 1929), lately by HAVLENA (1984) using a borehole-derived material.

The present paper was based on the collections of F. NĚMEJC and K. DRÁBEK in the National Museum, Prague, collections of J. ŠETLÍK, Z. RIEGER, and the author's own collection in the Czech Geological Survey, Prague, E. PURKYŇOVÁ's collection in the Silesian Museum in Opava, and the collections of V. ŠUSTA, E. PURKYŇOVÁ and V. HAVLENA in the Ostrava Museum.

The revision of the species of the genus *Alethopteris* STERNBERG revealed that *Alethopteris serlii* (BRONGNIART) Goeppert, formely reported from the Intrasudetic Basin, actually refers to the species *Alethopteris valida* BOULAY and *Alethopteris* cf. *lancifolia* WAGNER (1 specimen), several alleged specimens of *Alethopteris lonchitica* SCHLOTHEIM ex STERNBERG refer to the species *Alethopteris* aff. *valida* BOULAY (probably a new species). Recently renamed *Alethopteris distantinervosa* WAGNER and *Alethopteris missouriensis* (D. WHITE) WAGNER (ŠETLÍK in HOLUB-WAGNER 1977, ŠETLÍK in TÁSLER et al. 1979) should better keep their original names *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT and *Alethopteris lonchitifolia* P. BERTRAND (e.g. NĚMEJC 1958).

From the revision of the species of the genus *Alethopteris* STERNBERG from the Upper Silesian Basin it follows that the relicts regarded as *Alethopteris serlii* (BRONGNIART) GOEPPERT in fact belong to the species *Alethopteris havlenae* sp. nov., *Alethopteris urophylla* (BRONGNIART) GOEPPERT and *Alethopteris valida* BOULAY. Exceptionally some specimens identified as *Alethopteris*

urophylla (BRONGNIART) GOEPPERT refer to the species *Alethopteris jongmansii* ŠUSTA and *Alethopteris havlenae* sp. nov.

Alethopteris refracta FRANKE known from the Polish part of the Upper Silesian Basin was not detected in the collections of the Silesian and Ostrava Museums.

Some species from the Upper Silesian Basin formely assigned to the genus *Alethopteris* STERNBERG are associated with the genus *Neuralethopteris* CREMER. JOSTEN (1983) detailedly analyzed their nomenclature. *Alethopteris decurrens* forma *intermedia*, described by FRANKE (1912) and depicted in fig. 5, later on redepicted by GOTHAN (1953) on pl. 14, figs. 1, 1a under the name *Alethopteris Larischi* ŠUSTA, refers to the species *Neuralethopteris larischii* (ŠUSTA) LAVEINE. The species was originally described by ŠUSTA (1930) as *Neuropteris Larischi* n. sp.

Alethopteris intermedia FRANKE pro var. figured by GOTHAN (1953) on pls. 7 and 8 (pl. 9, fig. 1 is seemingly *Neuralethopteris larischii*) is identical with the species *Alethopteris neuropteroides* ŠUSTA (1929), figured on pl. 1, fig. 2 assigned by JOSTEN (1983) to the genus *Neuralethopteris* CREMER - *Neuralethopteris neuropteroides* (ŠUSTA) JOSTEN. To the same genus I refer also the species *Alethopteris Potoniei* FRANKE, 1912. The characteristic feature of the genus *Neuralethopteris* is well observable on the specimen from FRANKE'S (1912) paper where it is illustrated in fig. 2. These species are not dealt with in this paper.

Moreover, this paper does not mention the fructifications found in the proximity of the pinnae. These are seeds of *Pachytesta* sp. type in *Alethopteris decurrens* (ARTIS) FRECH and *Alethopteris idae* ŠIMŮNEK, and synangia of *Whitlesseya* sp. type in *Alethopteris idae* ŠIMŮNEK and *Alethopteris urophylla* (BRONGNIART) GOEPPERT.

The paper systematically describes the individual species. The morphological description of the species is, if possible, supplemented by a cuticular description. In each species, the material used for the description and serving for statistical evaluation of the pinnule variability was specified.

The part "Occurrence and distribution" gives information on the finding localities, age of the studied specimens of the individual species, boreholes, deposition depth of the oldest (youngest) find, and/or the seams.

Alethopteris STERNBERG, 1825

A complete synonymy of the genus is given in the paper of JONGMANS (1957, p. 89-90). Extensive synonymies gave also BUISINE (1961, p. 65) and WAGNER (1968, p. 22).

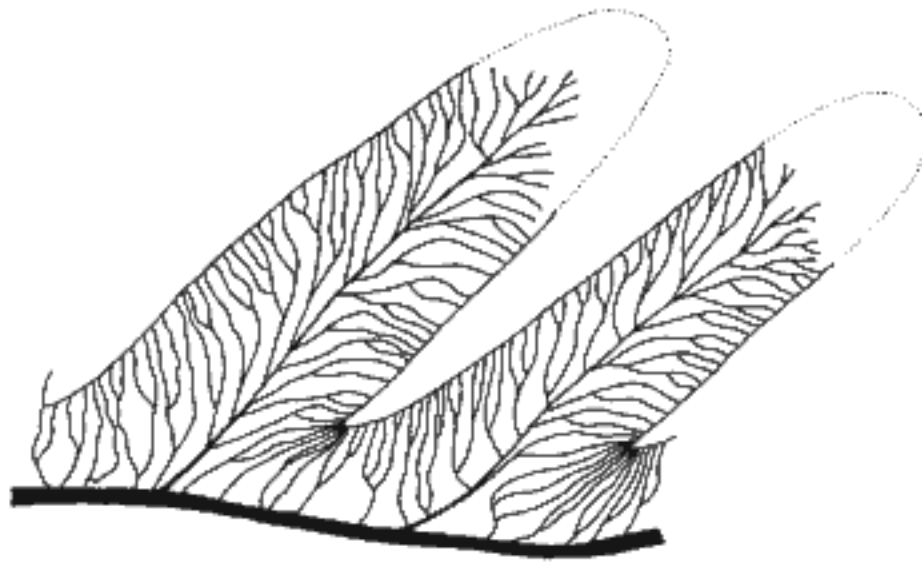
1820 *Filicites*; SCHLOTHEIM: p. 411
1825 *Alethopteris*; STERNBERG: p. 21

Alethopteris davreuxii (BRONGNIART, 1833) GOEPPERT 1836

Text-figs. 1-3, pl. 1

1833 *Pecopteris Davreuxi*; BRONGNIART: p. 279, pl. 88, figs. 1, 2
1836 *Alethopteris Davreuxi* BRONGN.; GOEPPERT: p. 295
1912 *Alethopteris Davreuxi* FRANKE: p. 49-57, figs. 1-3 (non fig.
Alethopteris ambigua LESQUEREUX
1953 *Alethopteris Davreuxi* (BRONGN.) GOEPPERT; GOTHAN, p. 21-23
10, pl. 27, fig. 5
1961 *Alethopteris davreuxi* BRONGNIART; BUISINE: p. 138-155, figs.
(branching of the pinnae) and 13, pls. 33-40

Material: 5 fragments of pinnae preserved in grey mudstones.



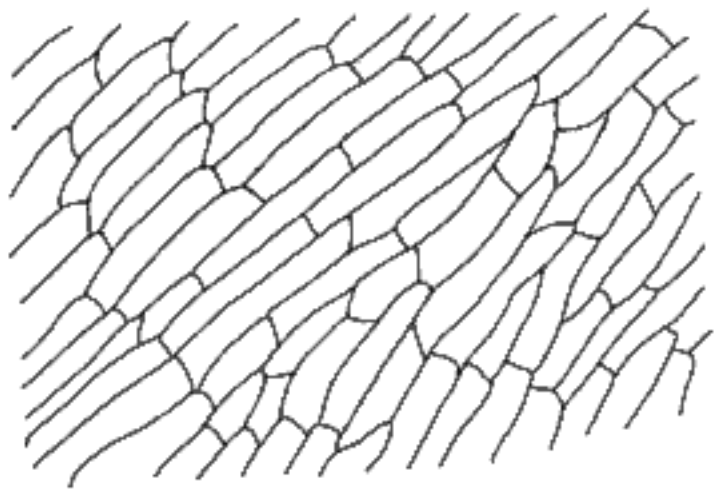
1. Venation of the pinnules of *Alethopteris davreuxii* (BRONGN
GOEPPERT, Upper Silesian Basin, loc. Karviná, borehole NP
Doubrava Member, Westphalian A, x 4.

Description: Probably large pinnae are 3-4x impari
nate. Pinnules considerably differ both in size and sh
They do not touch each other being 1-5 (2-3 on the a
age) mm apart. The cut between the pinnules is rou
or bluntly pointed. Pinnules are 8.5-15 mm long, 4
mm wide at the base and 3.5-4.5 mm in the midpart
the base the pinnules are connected by a 0.5-2 mm
interconnecting limb. Smaller pinnules are roughly t
gular with convex margins. Their lower half is the wi
Longer pinnules are just slightly decurrent on the ra
Their margins are faintly convex, often bent or undul
The pinnules of *Alethopteris davreuxii* from
Intrasudetic Basin are rather pecopterid in shape.

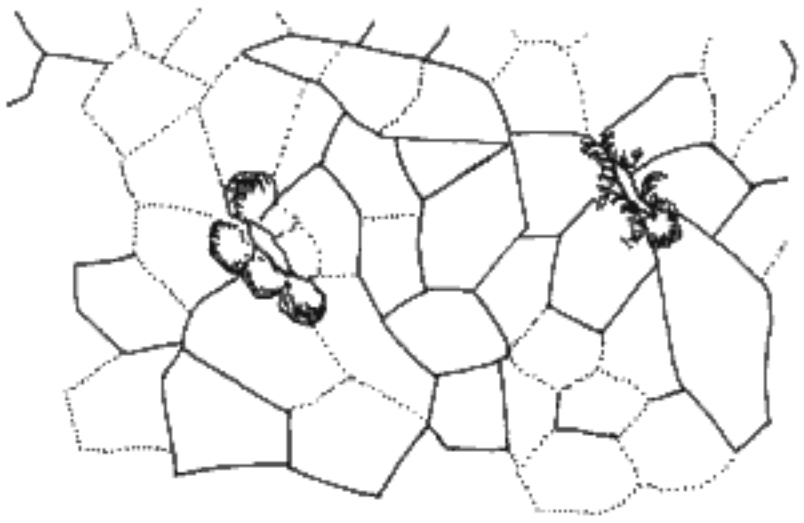
Midrib is wel discernible as far as the apex, being
de, straight, very slightly decurrent on the rachis. La
veins are fine, separating from the midrib under the
les of 60-70°, through the pinnule blade they run s
what flexuous while the pinnule margin they reach al
perpendicularly, forking once to twice before. Subsi
veins almost perpendicularly divorce from the ulti
order rachis and once fork as a rule. Venation is thin
36 veins per 1 cm on the pinnule margin).

Cuticles were prepared from the specimen
Karviná, borehole NP 471, depth 364 m.

Adaxial cuticle (text-fig. 2, pl. I, fig. 5) is weakly
nized. The difference between the costal and interc



2. Adaxial cuticle of *Alethopteris davreuxii*, Upper Silesian Bas
Karviná, borehole NP 471, Westphalian A, x 100.



3. Abaxial cuticle of *Alethopteris davreuxii*, Upper Silesian Basin, loc. Karviná, borehole NP 471, Westphalian A, x 250.

region is obscured. All the cells are mostly elongately tetragonal with mildly bent anticlinal walls. They are orientated concordantly with the course of the veins, being 60-190 µm long and 20-40 µm wide.

Abaxial cuticle (text-fig. 3, pl. 1, figs. 2, 6) is very weakly cutinized. The cells in the costal region have indistinct outline. Those in the intercostal region are randomly orientated, likely polygonal, anticlinal walls of the cells are straight. The cells are roughly isodiametric in shape, 30-50 µm in diameter. Stomata are poorly distinct, supposingly strongly sunken below the the epidermis level and partly overlapped by stronglier cutinized papillae of neighbouring cells which are often unpreserved, on the cuticle looking like dark spots around the stomata. Stomata are elliptical, 28-36 µm long and 12-15 µm wide.

1.1-1.4 mm long and 100-200 µm wide trichomes (pl. I, figs. 3, 4, 8) composed of 12-20 cells, grew possibly in the place of the pinnule midrib. Simple, uniseriate, non-glandular trichomes found on decomposed adaxial cuticles are 500-750 µm long and just 50-70 µm wide. They are composed of 15-18 cells.

Comparison: BUISINE (1961) compares *Alethopteris davreuxii* (BRONGNIART) GOEPPERT with the species *Alethopteris serlii* (BRONGNIART) GOEPPERT, *Alethopteris Corsini* BUISINE, *Alethopteris decurrens* (ARTIS) FRECH, *Alethopteris valida* BOULAY, and *Alethopteris Friedeli* P. BERTRAND.

Remarks: The described specimens from the collections of E. PURKYŇOVÁ deposited in Ostravas Museum in Ostrava, come from the Doubrava Member (Westphalian A). Most finds of this species in the world range with the Westphalian B-D. BUISINE (1961) reports it also from the Westphalian A of northern France and GOTHAN (1953) from the Westphalian A of the Ruhr region. The specimen depicted by HAVLENA (1984) on pl. 3, figs. 4, 5 (herein on pl. IX, fig. 5) under the name *Alethopteris* cf. *davreuxii* (BRONGNIART) GOEPPERT from the Saddle Member of the Namurian B/C boundary refers to the species *Alethopteris jongmansii* ŠUSTA.

The cuticles described here correspond with BARTHEL's (1962) cuticles of *Alethopteris davreuxii* in the presence of trichomes. BARTHEL (1962) reports about 1.2 mm long trichomes and those described here measure 1.1-1.4 mm. Abaxial cuticles of both specimens are almost identical. The adaxial cuticle of the specimen from the Upper Silesian Basin exhibits more expressive orientation of cells than BARTHEL's specimen which, according to WAGNER (1968), should belong to the species *Alethopteris ambigua* LESQUEREUX.

Occurrence and distribution: Upper Silesian Basin, Karviná Formation, Westphalian A:

Doubrava Member: Karviná - Ráj, borehole NP 379, 858 m.

Upper Doubrava Member: Karviná, borehole NP 471, 364 m.

Intrasudetic basin, Žacléř formation, Westphalian B,

Prkenný Důl-Žďárky Member: Lhota, borehole Lh-2, 396-397 m.

Alethopteris decurrens (ARTIS, 1825) FRECH, 1880

Text-figs. 4-7, pls. II, III, pl. IV, figs. 1-3

1825 *Filicites decurrens*; ARTIS: pl. 21

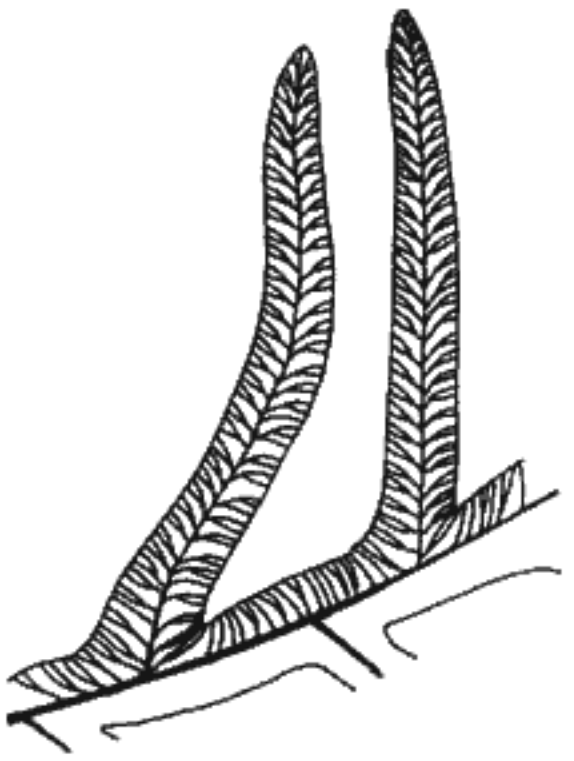
1886 *Alethopteris decurrens* ARTIS (sp.); ZEILLER: (text 1888) p. 221-224, pl. 34, figs. 2, 3, pl. 35, fig. 1, pl. 36, figs. 3, 4.

1912 *Alethopteris decurrens* (ARTIS); FRANKE: p. 42-43, figs. 1-4 (non pl. 5 = *Neuralethopteris larischi* (ŠUSTA) LAVEINE)

1928 *Alethopteris decurrens* (ARTIS) forma *gracillima* BOULAY; ŠUSTA: p. 390, 402, pl. 34, fig. 2 (fruits), figs. 4, 7, 8, pl. 35, fig. 6.

1955 *Alethopteris decurrens* ARTIS sp.; CROOKALL: p. 26-29, text fig. 8 (a copy from ARTIS, 1825, pl. 21), non text fig. 17H = ? *Neuralethopteris larischi* (ŠUSTA) LAVEINE pl. 2, figs. 1-3a (? pl. 6, fig. 3).

1961 *Alethopteris decurrens* ARTIS; BUISINE: 155-168, text-fig. 14, pl. 41, figs. 1-3, pl. 43, figs. 1-3, pl. 43, figs. 1-2 (= *Alethopteris de-*



4. Venation of the pinnules of *Alethopteris decurrens* (ARTIS) FRECH, Intrasudetic Basin, loc. Lampertice near Žacléř, Mine Šverma (Marie Julie), Lampertice Member, Westphalian A, x 4.

5. Venation of the pinnules of *Alethopteris decurrens* (ARTIS) FRECH, Intrasudetic Basin, loc. Na Kupě (near Markoušovice), Prkenný Důl-Žďárky Member, Westphalian B, x 4.

currens forma *gracillima* BOULAY), pl. 45, figs. 1-3, (4, 5 = *Alethopteris decurrens* forma *gracillima* BOULAY).

Material: About 100 fragments of pinnae most frequently preserved in black-gray claystones, rarely in brown-gray to brown siltstones.

Description: Pinnae imparipinnate to higher orders. Pinnules very narrow, long-tongue shaped, often bluntly pointed although some specimens with pointed pinnules exist too. Pinnule size markedly varies in dependence upon the emplacement of the pinnule in the frond pinna. They are 4-33.5 mm long, 1.5-8.5 mm wide at the base and 1-4.5 mm in the middle of the pinnule. As the pinnules were rather fine, sometimes we find them in the rock somewhat bent. Based on the mid-pinnule width, two forms can be distinguished: *Alethopteris decurrens* (ARTIS) FRECH forma *decurrens* with pinnules about 2-4.5 mm wide in the mid-part and *Alethopteris decurrens* (ARTIS) FRECH forma *gracillima* Boulay with mid-pinnule width 1-2 mm. Pinnule margins are parallel, gradually narrowing toward the apex. At the base the pinnules are connected by a limb usually not wider than 1 mm. In larger pinnules it is sometimes hardly discernible. Terminal pinnules are narrow and long.

Venation is pinnate. Lateral veins are once-forked, scarcely they remain simple. They are emanating from a comparatively thin midrib reaching the pinnule margin rather obliquely. The veins are fine and relatively dense (38-70 veins per 1 cm of the pinnule margin, 2 specimens - 76 and 94 veins per 1 cm). Forma *gracillima* is marked by thinner venation (38-50 veins per 1 cm of the pinnule margin). It is more frequent in the Upper Silesian Basin. Subsidiary veins reaching the interconnected limb of the pinnule divorcing from the ultimate order rachis, being either simple or once forked.

6, 7. *Alethopteris decurrens* (6 - adaxial cuticle, 7 - abaxial cuticle). Intrasudetic Basin, loc. Lampertice near Žacléř, Lampertice Member, Westphalian A, x 100.

Cuticles were prepared from the specimens from the Upper Silesian Basin (Doubrava, borehole Do-16, 132 m), from the Intrasudetic Basin [Žacléř, Šverma (formerly Marie Julie) Mine, borehole Š-11, 556 m].

Adaxial cuticle (text-fig. 6, pl. III, figs. 7-9, pl. IV, figs. 2, 3) is weakly cutinized. Cells in the costal and intercostal area are undifferentiated. The cells are directed concordantly with the vein course, their shape is elongately tetragonal, lesser pentagonal. Anticlinal walls of the cells are slightly bent. The cells are approx. 50-100 µm long and 20-45 µm wide. In the specimen from the 10th underlying seam of Šverma Mine (pl. IV. fig. 3) they are distinctly elongated 120-240 µm long. The specimen from the borehole Š-11 of the 18-19th overlying seams of Šverma Mine (pl. III, fig. 7, pl. IV, fig. 2) exhibits less markedly orientated cells. The pinnule fragment, which the cuticles have been prepared from, was less than 3 mm wide. It might have been even a juvenile pinnule of *Alethopteris urophylla* (BRONGNI GOEPPERT whose adaxial cuticle is undistinguishable that of *Alethopteris decurrens* (ARTIS) FRECH.

Abaxial cuticle (text-fig. 7, pl. III, figs. 5, 6, pl. IV 1) is just slightly cutinized. The cells surrounding the mata are usually trapezoidal, roughly as long as wide 40 µm in diameter. Anticlinal walls of the cells are str or slightly bent. All the cells of the abaxial cuticle a once neighbouring cells of the stomata. The stomat anomocytic, of monocyclic type. Guard cells are na elliptical, stomata are weakly sunken, 30-40 µm long 12-16 µm wide. The guard cells are most often surrou by six neighbouring cells.

Trichomes (pl. III, figs. 3, 4) have been detected on the cuticles from the Upper Silesian Basin. Thes non-glandular, uniseriate, 250-400 µm long and 70-9 wide. They are composed of up to nine cells. The tri apex is unknown.

Comparison: Crookall (1955) compares *Alethopter currens* (ARTIS) FRECH with the species *Alethopteris lo tica* SCHLOTHEIM ex STERNBERG, *A. parva* POTONIÉ a *scalariformis* BELL. *Alethopteris decurrens* var. *inter* FRANKE [= *Neuralethopteris larischi* (ŠUSTA) LAVEIN identifies with *Alethopteris decurrens* (ARTIS) FRECH.

Remarks: ŠUSTA (1928) described the sp *Alethopteris gracillima* BOULAY as the form *Aletho decurrens* (ARTIS) FRECH. *Alethopteris decurrens gracillima* differs from *Alethopteris decurrens* form *currens* in even narrower pinnules rather bending t the apex of the ultimate order pinna and having th venation. This form was detected by ŠUSTA (1928) Karviná Member of the Upper Silesian Basin wher more widespread than *Alethopteris decurrens* form *currens*. In turn, in the Intrasudetic Basin *Alethopter currens* forma *decurrens* is more frequent *Alethopteris decurrens* forma *gracillima*.

Occurrence and distribution: Upper Silesian Karviná Formation:

Namurian C, Saddle Member: Doubrava Mine, hole Do-16, 132 m (34th seam), Poruba, Žofie Mine seam; Suchá Member: Horní Suchá, František Min ("D") seam, Karviná, Mír Mine, borehole M-24, 30 1. máj Mine, seams 28-31.

Westphalian A, Suchá Member: Karviná, Hlubi Františka Mines, seams 17-18, and Hohenegger Doubrava Member: Karviná, Hlubina and Fra Mines, seams 14-16; Upper Doubrava Member: K Staré Mesto, borehole NP 385, 840.3 m.

Intrasudetic Basin, Žacléř Formation:

Namurian C - Westphalian B, Lampertice M Lampertice near Žacléř, Šverma (formerly Marie Mine, tops of the 23rd overlying and 7th and 10th laying seams, dump, boreholes La-1, 749-750 m overlying seam), Š-9, 803.6-803.75 m (between th and 23rd underlying seams), Š-11, 720.3-997.55 20th underlying seam, Š-13, 576.2-783.7 m (20th ing to 5th underlying seams); Královec, borehole

201-201.1 m, Kr-2, 984-987 m, Kr-2k, 579-957 m (28th overlying seam to the basement of the 24th underlying seam); Černá voda, borehole ČV-3, 678.7-681.5 m.

Upper Westphalian B, Prkenný Důl-Žďárky Member: Královec, borehole Kr-3, 201-203.25 m, Na Kupě - NW of Markoušovice, trench P-950 (environs of the 8-10th U buku seam).

Alethopteris cf. *grandinii* (BRONGNIART, 1828) GOEPPERT, 1836

Text-figs. 8-10, pl. IV, figs. 4-7, pl. V, figs. 1-4

1828 *Pecopteris Grandini*; BRONGNIART: p. 34

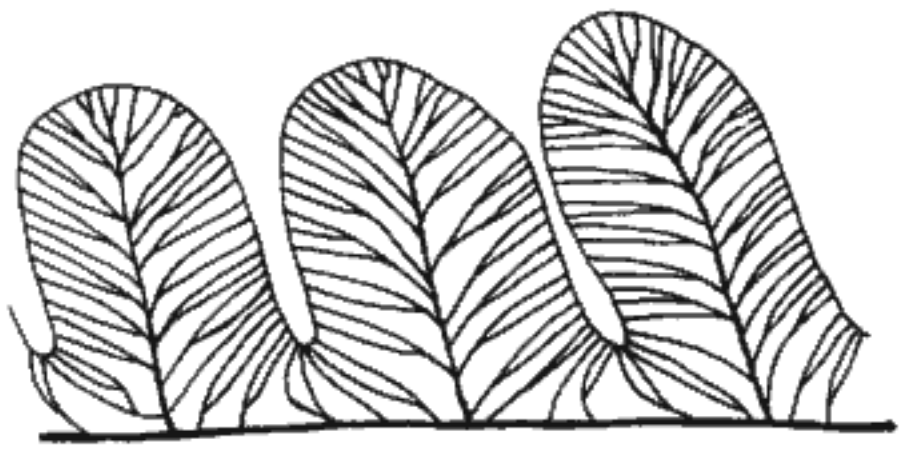
1832/33 *Pecopteris Grandini*; BRONGNIART: p. 286-289, pl. 91, figs. 1-4

1836 *Alethopteris Grandini* (BRONGNIART); GOEPPERT: p. 299-300

1932 *Alethopteris grandini* BRONGNIART SP.; P. BERTRAND: p. 76-82, text-fig. 11 A (non text-fig. 11 B, D = *Alethopteris ambigua* Lesquereux), pl. 43, figs. 1, 1a (copies from BRONGNIART, 1832/1833, pl. 91, figs. 1, 1A), figs. 2, 2a (photographs of BRONGNIART's type depicted as fig. 2), (non fig. 3 = *Alethopteris ambigua* Lesqureux), fig. 4, pl. 43 bis, figs. 1, 1a-c, (non pl. 44, figs. 1 a-b = *Alethopteris ambigua* Lesquereux).

1961 *Alethopteris grandini* BRONGNIART; BUISINE: p. 184-198, text-fig. 17, pls. 50-55

Material: About 20 fragments of pinnae (mostly from boreholes) preserved in grey to dark mudstones.



8. Venation of the pinnules of *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT, Intrasudetic Basin, loc. Rtyně v Podkrkonoší, Nejedlý (Ida) Mine, Prkenný Důl-Žďárky Member, Westphalian B, x 4.

Description: Fragments of ultimate order pinnae with maximum length less than 10 cm have been preserved only. Rachises of the ultimate order are about 0.5 mm thick. Pinnules are wide, tongue-shaped, their borders are rather convex (widest in the midpart) and their apices are rounded. The individual pinnules are set closely side by side, however they do not touch each other. At the base they are connected by a 1.5 mm wide limb. They are 4-11.5 mm long and 3-5 mm wide at the base and 3-4.5 mm in the midpart. A medium-thick midrib runs straightly, reaching nearly the apex of the pinnule. Lateral veins leave the midrib at 45-50° angles, slightly curve, thus reaching the pinnule margin somewhat obliquely (at the angle of about 80°). The lateral veins fork once, sometimes twice, being quite distinct in the blade. The subsidiary veins entering the limb are once forked. Venation is very wide (20-36 veins per 1 cm on the pinnule margin).

Cuticles have been prepared from a specimen derived from Malé Svatoňovice, borehole Ms-1, 976-976.4 m.

Adaxial cuticle (text-fig. 9, pl. V, figs. 1, 2) is slightly cutinized. The cells in the costal and intercostal areas exhibit no marked difference. They are unorientated, of polygonal shape, with straight anticlinal walls, 45-85 μm long and 26-40 μm wide.

Abaxial cuticle (text-fig. 10, pl. V, fig. 3) is very little cutinized and ill-preserved. Anticlinal walls of the cells in the intercostal region are poorly distinct, seemingly strongly bent to slightly undulated. The cells have likely polygonal shape sizing 30-45 μm on the average. Stomata are badly observable, monocyclic, anomocytic. The best preserved stoma is 20 μm long and 9 μm wide, surrounded by six neighbouring cells with strongly cutinized walls and papillae which partly overlap it. Guard cells, probably considerable sunken under the epidermis level, have not been preserved. The cells in the costal part are orientated in the direction of the vein course. They are tetragonal with straight or bent anticlinal walls. The cells are 45-100 μm long and 20-30 μm wide.

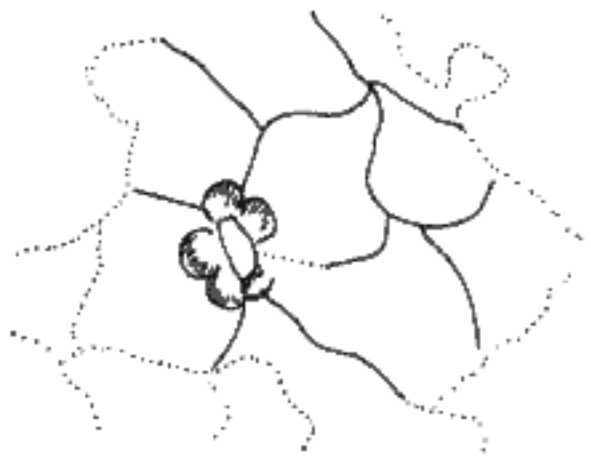
Minute trichomes (pl. V, fig. 1) are thinly spread over the costal region of the adaxial cuticle. A trichom base (having 90 μm in diameter) is composed of 2 cells 58 μm in diameter. Terminal part of a trichom is formed of 4-6 cells and it is maximally 160 μm long.

Comparison: This species is similar to the species *Alethopteris grandinii* (BRONGNIART) GOEPPERT and *Alethopteris grandinioides* KESSLER.

Remarks: It is unclear that *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT from the Intrasudetic Basin should really be referred to this species which may be endemic to the Saar-Lorraine Coalfield (C. J. Cleal, pers. comm.). The *Alethopteris* cf. *grandini* specimens from the Czech Republic are similar to *Alethopteris grandinii* as illustrated by Buisine (1961) from northern France, which Dr. Cleal (pers. comm.) regards as possibly a new species.

Among the typical specimens of the species

9. Adaxial cuticle of *Alethopteris* cf. *grandinii*, Intrasudetic Basin, loc. Malé Svatoňovice, borehole MS-1, Prkenný Důl-Žďárky Member, Westphalian B, x 100.



10. Abaxial cuticle of *Alethopteris grandinii*, Intrasudetic Basin, loc. Malé Svatoňovice, borehole MS-1, Prkenný Důl-Žďárky Member, Westphalian B, x 250.

Alethopteris cf. *grandinii* (BRONGNIART) GOEPPERT, an ultimate order pinna with very narrow pinnules (pl. IV, fig. 4) was found in the borehole Ma-2 near Markoušovice. It resembles *Alethopteris decurrens* (ARTIS) FRECH in appearence, but its venation is, on the other hand, typical of *Alethopteris grandinii* (BRONGNIART) GOEPPERT. BERTRAND (1932) described similar pinnules as *Alethopteris Friedeli* P. B., the same as 2 out of 4 BRONGNIART's (1832/1833) syntypes of *Alethopteris grandinii*. CROOKALL (1955) described BERTRAND's species *Alethopteris Friedeli* as *Alethopteris Davreuxi* Brongniart sp. var. *Friedeli* P. BERTRAND. WAGNER (1968) considers all BRONGNIART's (1832/1833) figures as representing the only species *Alethopteris grandinii* (BRONGNIART) GOEPPERT.

NĚMEJC (1958) reported the species *Alethopteris grandinii* from Markoušovice, U buku Gallery and Petri Mine. In the list of flora from the Prkenný Důl-Žďárky and Petrovice Members ŠETLÍK in TÁSLER (1979) reports however the species *Alethopteris distantinervosa* WAGNER. Unfortunately I failed to find this species in Šetlík's collection. *Alethopteris grandinii* is morphologically very similar to the species *Alethopteris distantinervosa* WAGNER and/or *Alethopteris grandinioides* Kessler var. *distantinervosa* WAGNER from the Central Bohemian Region. However, quite different cuticles have been obtained from these two taxa (see ŠIMŮNEK 1988).

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Prkenný Důl-Žďárky Member: Rtyně v Podkrkonoší, Z. Nejedlý Mine (formerly Ida Gallery), Lhota, borehole Lh-2, 392.7-393 m, Malé Svatoňovice, borehole MS-1, 976-976.4 m (4th Žďárky seam), Mokřiny (near Žďárky), trench Žď-10. Westphalian C, Petrovice Member: Markoušovice, borehole Ma-2, 259-260 m.

Alethopteris havlenae sp. nov.

Text-figs. 11-13, pl. V, figs. 6-8, pl. 6

1928 *Alethopteris Serli* BRONGN.; ŠUSTA: p. 402, pl. 34, fig. 5 [non pl. 34, fig. 1, pl. 35, fig. 5, and pl. 36, figs. 1, 2 = *Alethopteris urophylla* (BRONGNIART) GOEPPERT].

1970 *Alethopteris lonchitica* (SCHLOTH.) f. *serlii* (BRONGN.) GOTHAN; HAVLENA: p. 95-97, pl. 2, fig. 5.

1984 *Alethopteris densinervosa* WAGNER; HAVLENA: p. 370-371, pl. 1, figs. 2, 3, pl. 2, figs. 2, 3 (the same illustration as in HAVLENA (1970) on pl. 2, fig. 5).

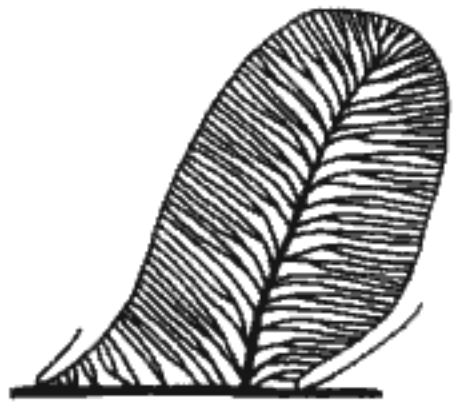
Locus typicus: Karviná, 1. máj - Mír Mine, borehole M-6, depth 200 m, Upper Silesian Basin Czech Republic

Stratum typicum: Karviná Formation, Lower Suchá Member, 27th seam, Westphalian A, Carboniferous.

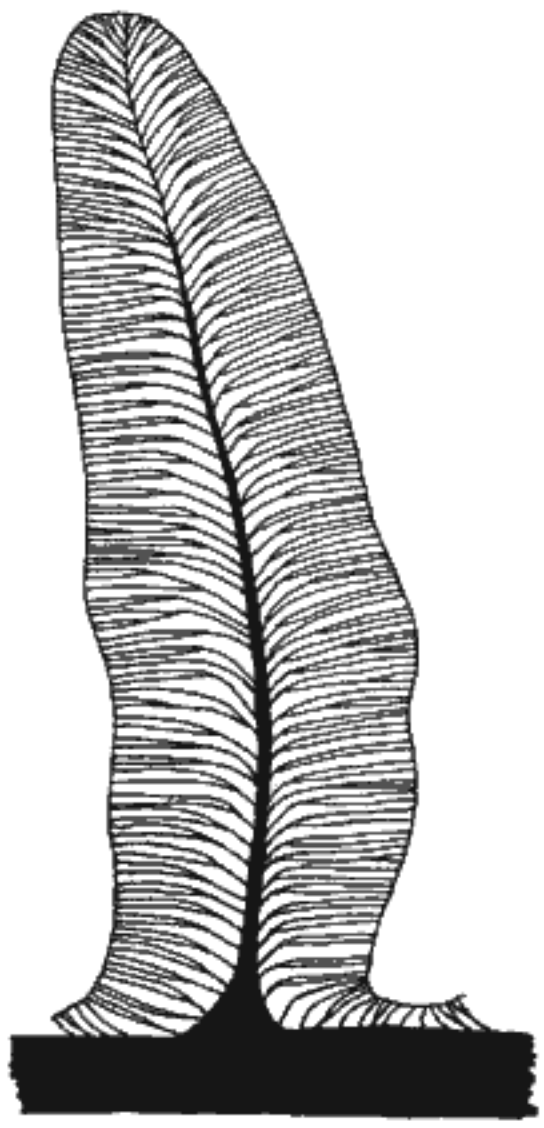
Holotype: HAVLENA (1984), pl. 1, figs. 2, 3, in this paper pl. VI, figs. 2, 3. It is deposited in the Ostrava Museum in Ostrava under the invent. No. A 7724.

Material: 13 fragments of pinnae most often preserved in grey to black mudstones.

Diagnosis: *Alethopteris havlenae* sp. nov. has tongue-shaped pinnules with convex margins and rounded to blunt apices. Midrib is distinct, lateral veins run almost straightly, reaching the pinnule margins at 70-90° angles. They fork once or twice. Venation density: 56-62 veins per 1 cm on the pinnule margin.



11. Venation of the pinnules of *Alethopteris havlenae* sp. nov., Silesian Basin, loc. Karviná, Hlubina Mine, Suchá Me Westphalian A, x 4.



12., 13. Venation of the pinnules of *Alethopteris havlenae* sp. n lotype), Upper Silesian Basin, loc. Karviná, 1. máj - Mír Mine, le M 6, Suchá Member, Westphalian A, x 100.

Description: Fragments of pinnae imparipinnate to the 2nd order have been preserved. Rachises of penultimate order are up to 5 mm thick, the ultimate order ones are 0.5-2 mm thick. The pinnules leave the rachis rather obliquely. They are asymmetrical, widely tongue-shaped, decurrent on the basiscopic side, on the acroscopic side rather narrowed. The pinnules are on the ultimate order rachis arranged closely side by side and differ a lot in size. Their length varies from 6.5 to 21 mm, width at the base makes 4-7 mm and in the middle of the pinnules 3-6 mm. Most pinnules have notably convex margins (most in the midpart) and rounded to blunt apices. Margins of the largest pinnules are lobate. The pinnules are interconnected by a limb, in the some specimens hardly visible, in others even up to 1 mm wide.

The mirdib is distinct, medium-thick, straightly reaching the apex of the pinnule. Lateral veins are fine and very dense (56-62 veins per 1 cm on the pinnule margin, 1 deformed pinnule - 70 veins). Lateral veins leave the midrib almost straightly and on the basiscopic side they reach the pinnule margin under the angle of 70-80°, on the acroscopic one nearly perpendicularly. The veins branch, as a rule, in the proximity of the midrib, and fork once, exceptionally twice. Simple veins are rare. Subsidiary veins entering the interconnecting limb are usually once forked.

Cuticles were prepared from specimens derived from Doubrava, borehole Do-1, 220.7 m, from Karviná, Františka pit, from the 14th seam and from Orlová, Zápotocký Mine, borehole AZ-31, 132.2 m.

The preparations were made of low-macerated pinnules in order to prevent a total decomposition of the cuticle during the leaching process. The cuticles are dark brown, in the place of pinnule veins black. Cell outlines are faintly distinct, or the cuticles are fragmentary. Comparatively best preserved have been the trichomes (see pl. VI, figs. 6 and 8).

Adaxial cuticle is weakly cutinized. Cells have a poorly discernible outline (cuticle is present only in the slides from Doubrava and Orlová). They are randomly orientated, polygonal, nearly isodiametric in shape, 35-50 μm long. Anticlinal cell walls are straight or gently curved.

Abaxial cuticle is very gently cutinized (it is in the slides from Doubrava). The cells are elongated, orientated, tetragonal to spindle-shaped, with rounded corners, 60-120 μm long and 10-25 μm wide. Anticlinal walls are slightly, sometimes even distinctly curved. The cells sometimes display minute, irregularly distributed papillae. Stomata are orientated, likely deeply sunken under the epidermis level and partly overlapped by strongly cutinized walls of the neighbouring cells. Guard cells have not been preserved. The stomata were supposingly 30-40 μm long and 14-18 μm wide.

In the place of the pinnule midrib the cuticle is weakly cutinized. The cell outlines are indistinct (the cuticle is present in the slides of all the three specimens). The cells are orientated, elongately tetragonal (as a rule trapezoidal) or elongately pentagonal. They are cca. 60-80 μm long and 15-25 μm wide. The cells have straight or just gently curved anticlinal walls. Among these cells, most of the found trichomes occur; papillae might have been present too.

Trichomes (pl. VI, figs. 6 and 8) grew probably on the abaxial cuticle in the place of the pinnule midrib and lateral veins. These are non-glandular, uniseriate trichomes, the largest being on the specimen from Doubrava - as much as 900 μm long. On the specimen from the Františka pit the trichomes attain 300-460 μm in length and 70-105 μm in width. They are composed of up to 12 cels and exhibit blunt apices (if preserved).

Comparison: *Alethopteris havlenae* sp. nov. resembles the species *Alethopteris serlii* (BRONGNIART) GOEPPERT in the shape of pinnules. The later species, however, possesses more convex pinnule margins and mostly bluntly pointed apices which are in *Alethopteris havlenae* rounded to blunt. The vanation density varies, too - *Alethopteris havlenae* has 56-62 veins per 1 cm on the pinnule margin whereas *Alethopteris serlii* 30-40.

Another similar species is *Alethopteris densinervosa* WAGNER. But its apex is bluntly pointed and pinnule margins are more convex. *Alethopteris densinervosa* shows wider venation (40-45 veins per 1 cm on the pinnule margin).

The described species is very alike to *Alethopteris urophylla* (BRONGNIART) GOEPPERT. Both species have roughly identically shaped pinnules. The difference consists in the shape of the apices - in *Alethopteris urophylla* they are bluntly pointed whereas in *Alethopteris havlenae* rounded to blunt. Both species have a similar character and density of venation. *Alethopteris havlenae* might be just a variety of the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT.

Remarks: To the species *Alethopteris havlenae* sp. nov. the author has assigned the specimens from the Suchá and Doubrava Members from the collections of ŠUSTA determinated by him as *Alethopteris serlii* (BRONGNIART) GOEPPERT. All these specimens stratigraphically correlater with the Westphalian A. HAVLENA (1984) described this species from the Upper Silesian Basin under the designation *Alethopteris densinervosa* WAGNER and depicted the specimens which come from the Namurian C. In any case, the finds are stratigraphically much older than the so far oldest finds of the species *Alethopteris serlii* (BRONGNIART) GOEPPERT and *Alethopteris densinervosa* WAGNER.

Occurrence and distribution: Upper Silesian Basin, Karviná Formation: Namurian C, Saddle Member: Orlová, A. Zápotocký Mine, borehole AZ-31, 132.2 m, 35th seam; Lower Suchá Member: Karviná, 1. máj - Mír Mine, borehole M6, 200 m, 27th seam, Louky nad Olší, borehole NP 686, 948.2 m. Westphalian A, Upper Suchá Member: Karviná, Hlubina and Suchá Mines, ČSA Mine, 23rd seam; Doubrava Member: Karviná, Františka Mine, 14th seam, pit of the Pokrok Mine.

Alethopteris idae ŠIMŮNEK, 1985
Pl. VII

1985 *Alethopteris idae* sp. n.; ŠIMŮNEK: p. 345-350, pls. 1-4

Description of the species including the cuticular description is given in the above-mentioned paper. This paper provides only supplementary data obtained from a new study material.

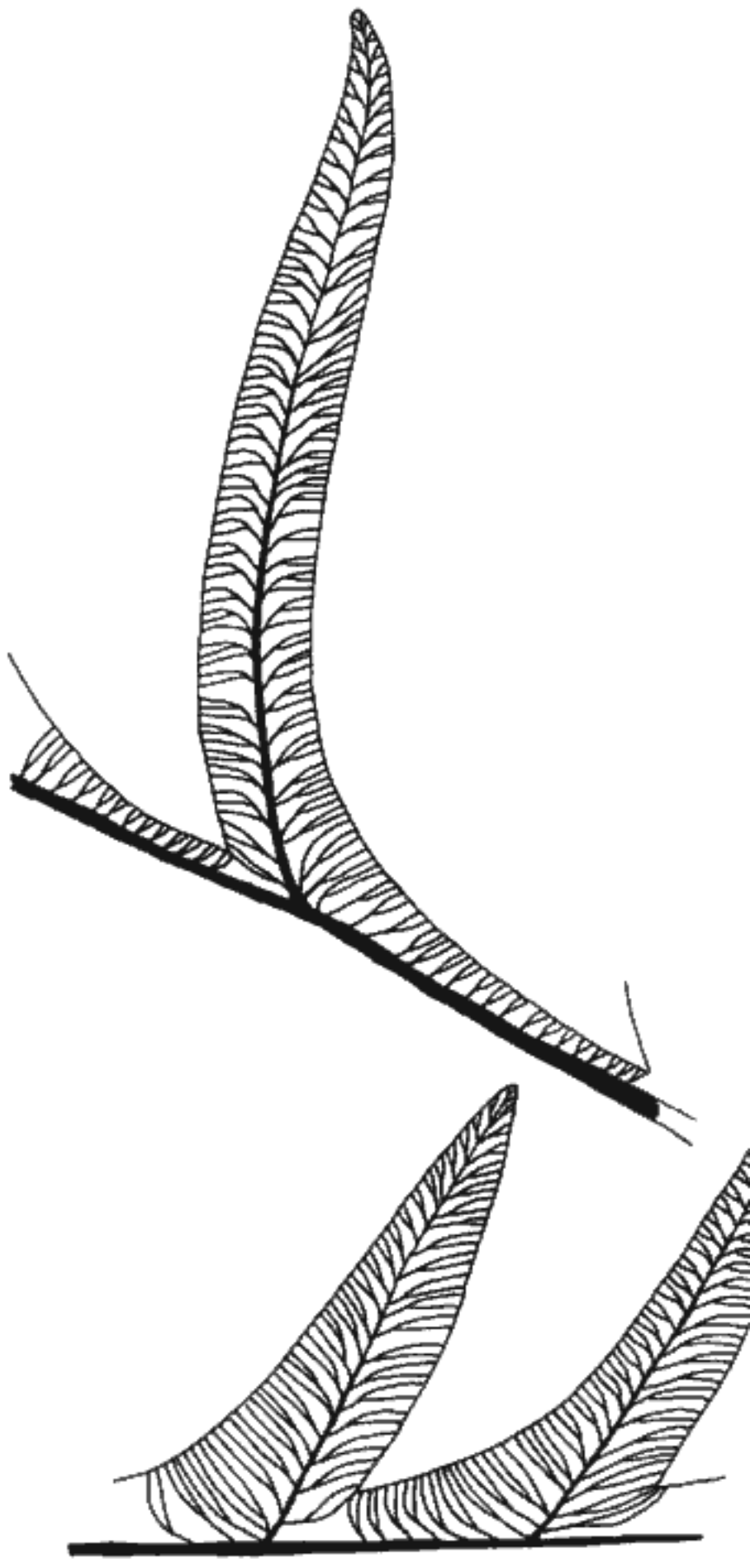
Material: About 90 fragments of pinnae preserved in tuffitic whetstone rocks and 2 pieces preserved in grey mudstones from 1986-1989 collections, 8 specimens from older Šetlík's collections.

Supplementary description: Pinnae imparipinnate to the 4th order. Principal rachis (1st order) is on a 28 cm long fragment 5 cm wide. The 2nd order rachis is in the place of branching 3 cm wide. The 1st and 2nd order rachises are longitudinally striated.

The 3rd (penultimate) order rachises are 5-10 mm thick on the impressions, maximum preserved length makes 25 cm. The 4th (ultimate) order rachises are approximately 1 mm thick and the ultimate order pinnae are maximally 10-12 cm long. Terminal pinnae in the penultimate order pinna look like pinnules 30-40 mm long and 6 mm wide in the midpart. Toward the base, larger ultimate order pinnae start to separate into pinnules. Maximum length of the pinnules in the ultimate order pinna makes 24 mm. The 1st order pinnae might have been as much as 2 m long.

Terminal pinnules are narrow and long, gradually narrowing toward the apex. In small pinnae their separation from other pinnules is indiscernible. Their apices are bluntly pointed. They are 17-25 mm long and 4.5-5.5 mm wide (in the widest place).

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Prkenný Důl-Žďárky Member: Rtyně v Podkrkonoší, Z. Nejedlý Mine (formerly Ida Gallery), Na Kupě NW of Markoušovice, trench P-950 (fragment of a pinnule from the 10th U buku seam). *Alethopteris* cf. *idae* - Mokřiny (near Žďárky), trench Žď-10.



14., 15. Venation of the pinnules of *Alethopteris jongmansii* Šusta pe), Upper Silesian Basin, loc. Karviná, Františka pit, Westphalian

Alethopteris jongmansii ŠUSTA, 1929
Text-figs. 14-15, pls. VIII, IX, figs. 1-5

1928 *Alethopteris Jongmansi*, ŠUSTA; ŠUSTA: pl. 36, fig. 4 (photograph of the holotype).

1929 *Alethopteris Jongmansi*, n. sp.; ŠUSTA: p. 3, pl. 2, fig. 2 (original description).

Material: 14 fragments of pinnae preserved in gray to black, sometimes brown-grey mudstones.

Description: Pinnae are imparipinnate to the 2nd order at least. The ultimate order pinnae are over 12 cm long and their rachises are up to 1 mm thick. Pinnules are narrow triangular in shape, larger pinnules are quite narrow and slightly goosenecked. Their bluntly pointed apices are turned in the basiscopic direction. The pinnules are markedly decurrent on the rachis and at the base they are connected by a 0.5-1.5 mm wide interconnected limb. The pinnules are 7-30 mm long and 3.5-7 mm wide at the base and 2-5 mm in the midpart.

Midrib is discernible nearly as far as the apex of the pinnule. Lateral veins branch from the midrib, then curve, and almost perpendicularly reach the pinnule m Mostly they are once forked. Subsidiary veins, whi ter the interconnected limb directly from the ultim der rachis, fork once as a rule. Venation is dense veins per 1 cm on the pinnule margin).

I did not manage to prepare the cuticles.

Comparison: *Alethopteris jongmansii* ŠUSTA rep a transition between the species *Alethopteris ur* (BRONGNIART) GOEPPERT and *Alethopteris dec* (ARTIS) FRECH, namely as concerns the pinnule Pinnules of roughly the same length are the narro *Alethopteris decurrens*, wider in *Alethopteris jong* and the widest in *Alethopteris urophylla*. Vena *Alethopteris jongmansii* is wider than in the typica mens of *Alethopteris decurrens* and *Alethopteris u la*. The same venation density as *Alethopteris jong* has *Alethopteris decurrens* (ARTIS) FRECH forma g *ma* Boulay, but its pinnules are much narrower. In t

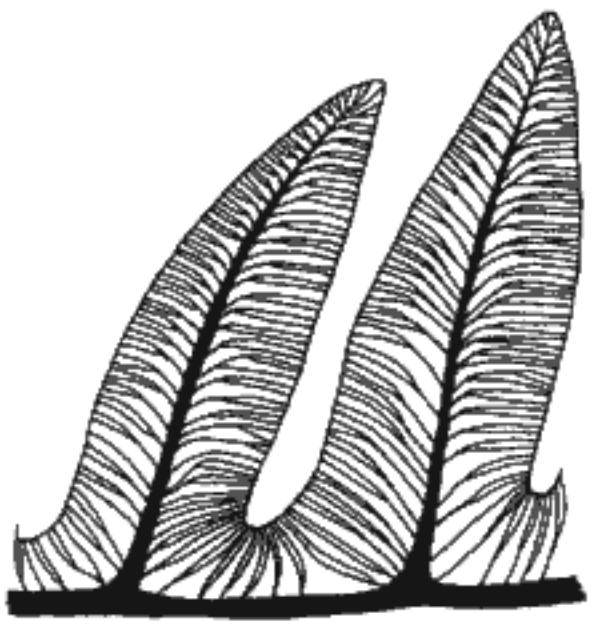
racter of the interconnected limb *Alethopteris jongmansii* is more similar to the species *Alethopteris urophylla*.

Remarks: Typical specimens of *Alethopteris jongmansii* Šusta are known only from the Upper Silesian Basin. Very much alike pinnules displays the specimen *Alethopteris* cf. *jongmansii* Šusta from the Intrasudetic Basin (pl. VIII, fig. 2). These might be, however, also atypical pinnules of *Alethopteris valida* Boulay.

Occurrence and distribution: Upper Silesian Basin, Karviná Formation: Namurian C, Saddle Member: Orlová, A. Zápotocký Mine, borehole AZ 43, between 37-38th seams; Lover Suchá Member: Frenštát pod Radhoštěm, borehole NP 533, 961.1-963.6 m, Prstná, borehole NP 892, 815.5 m, Suchá, ČSA Mine, borehole I 9, 39.3 m (between the 31st-33rd seam). Westphalian A, Suchá to Doubrava members: Karviná, Františka Mine, between the 14-19th seam, Suchá Stonava, borehole SS-29, 55 m, 26th seam.

Alethopteris cf. *lancifolia* Wagner, 1961
Text-fig. 16, pl. IX, fig. 6

1961 *Alethopteris lancifolia* nov. sp.; Wagner: p. 6-8, text-fig. 6, pls. 1-4.
Material: A specimen preserved in grey mudstone.



16. Venation of the pinnules of *Alethopteris* cf. *lancifolia* Wagner, Intrasudetic Basin, loc. Rtyně v Podkrkonoší, borehole Rt-3, Prkenný Důl-Žďárky Member, Westphalian B, x 4.

Description: Part of an ultimate order pinna has been preserved. Rachis is thin - 0.5 mm thick.

Pinnules set a bit obliquely on the ultimate order rachis being decurrent on the basiscopic side. They are elongately tongue-shaped. The pinnules are approx. 3x longer than wide, 12 mm long and 4.5 mm wide in the midpart and 5.5 mm at the base. From the base to the half the pinnules exhibit roughly the same width, from the half they gradually narrow to a bluntly pointed apex.

Midrib is distinct, straight as far as the pinnule apex. Lateral veins are thin, numerous, from the midrib slightly arching, then running straightly toward the pinnule margin reaching it almost perpendicularly. Usually they fork once and in irregular intervals. Venation is dense (64 veins per 1 cm on the pinnule margin).

I did not manage to prepare the cuticles.

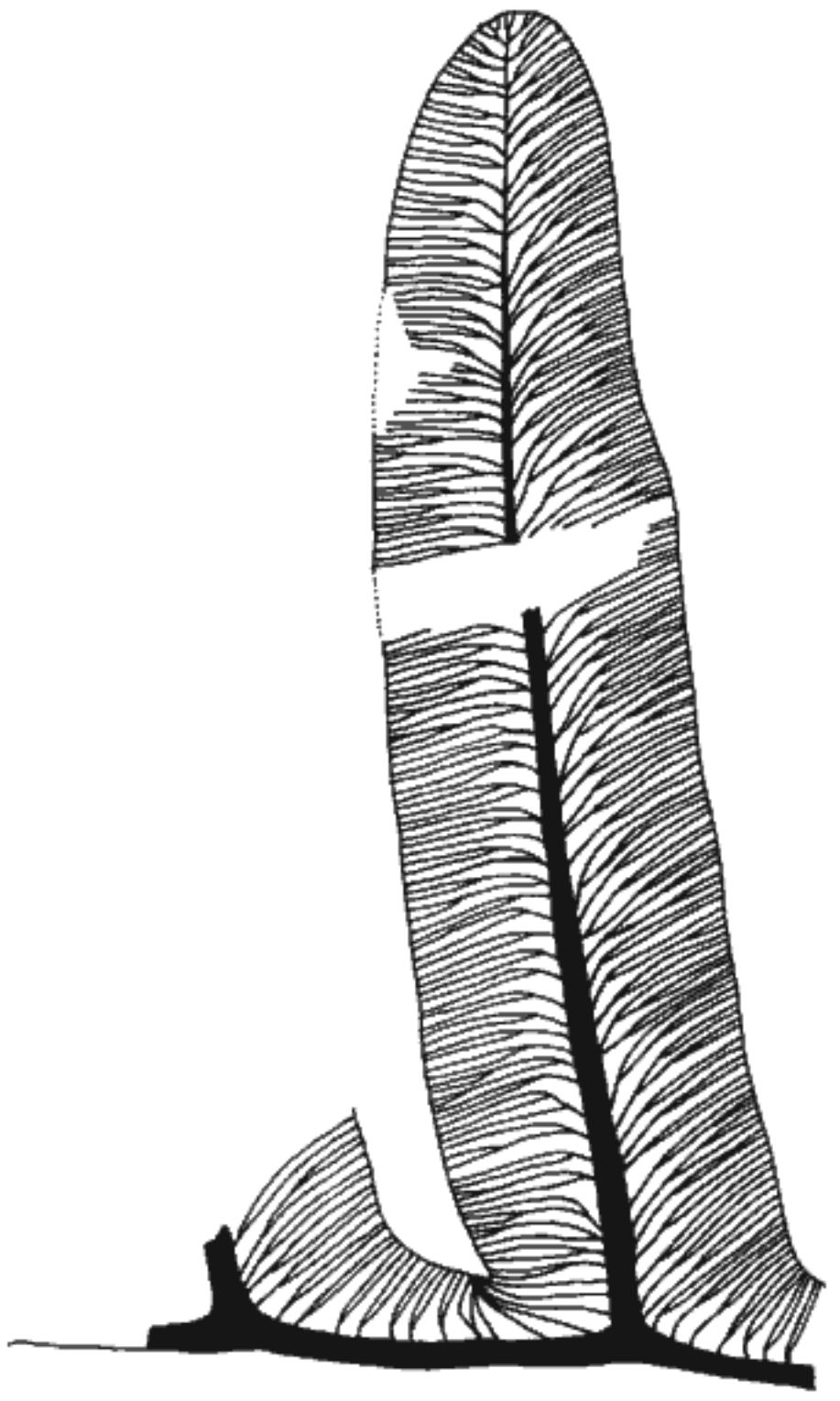
Comparison: Wagner (1961) compares *Alethopteris lancifolia* Wagner with the species *Alethopteris serlii* (Brongniart) Goeppert, *A. lonchitica* Schlotheim ex Sternberg, *A. bertrandi* Bouroz and *A. lonchitifolia* P. Bertrand.

Remarks: The specimen of *Alethopteris* cf. *lancifolia* from the Intrasudetic Basin differs from the depiction of *Alethopteris lancifolia* in Wagner (1961) in the venation density. Wagner (1961) reports 50 veins per 1 cm on the pinnule margin, while *Alethopteris* cf. *lancifolia* from the Intrasudetic Basin has 64 veins per cm on the pinnule margin. This specimen was identified by J. Šetlík as *Alethopteris serlii* (Brongniart) Goeppert.

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Prkenný Důl-Žďárky Member: Rtyně v Podkrkonoší, borehole Rt-3, 832.9-834.25 m.

Alethopteris urophylla (Brongniart, 1828) Goeppert, 1836
Text-figs. 17-23, pls. X-XIII, pl. XIV, fig. 1

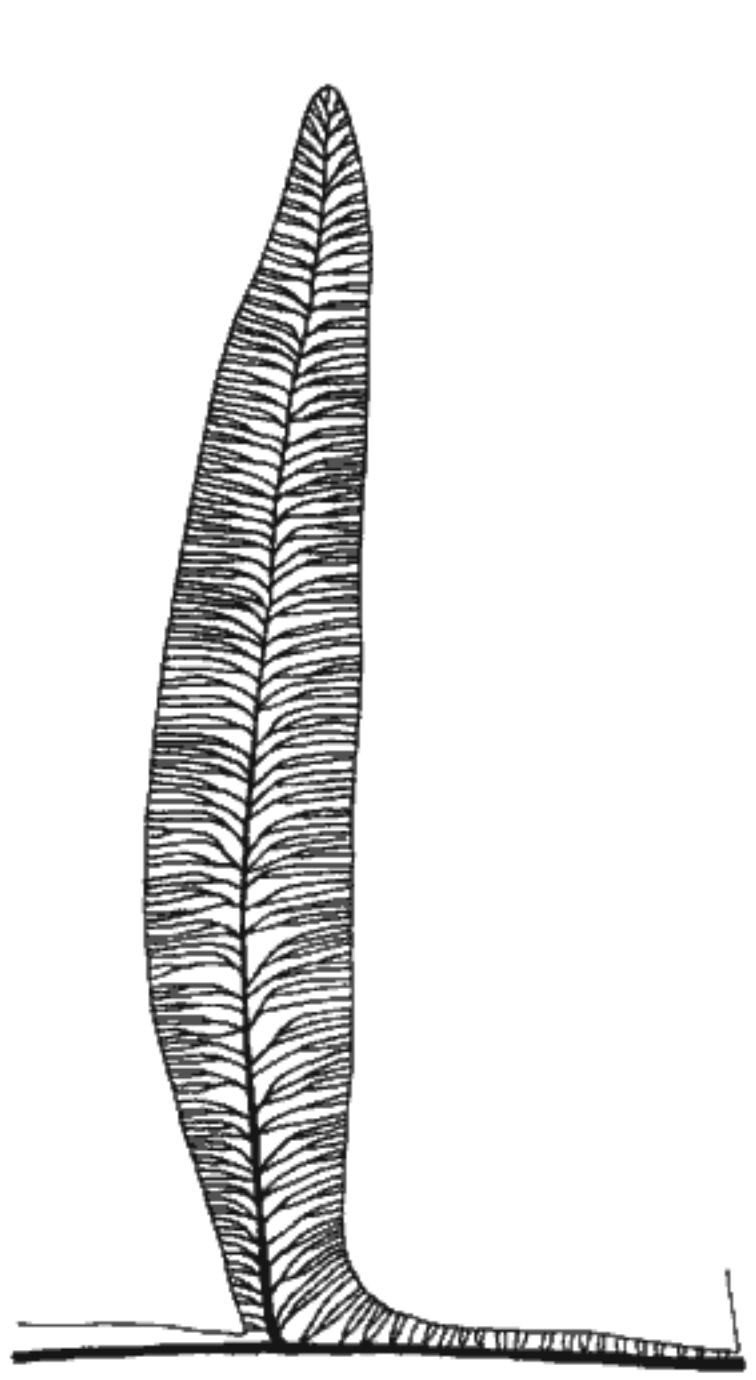
1828 *Pecopteris urophylla*, Brongniart: p. 290-291, pl. 86.
?1828 *Pecopteris lonchitica* Schlotheim; Brongniart: p. 275-278, pl. 84, fig. 1.
1836 *Alethopteris urophylla* (Brongniart); Goeppert: p. 300.
1899 *Alethopteris lonchitica* (Schlotheim); Hofmann - Ryba: p. 55, pl. 8, figs. 1, 1a.
1928 *Alethopteris lonchitica* Schlotheim; Šusta: p. 439, pl. 34, fig. 3, pl. 35, fig. 3.



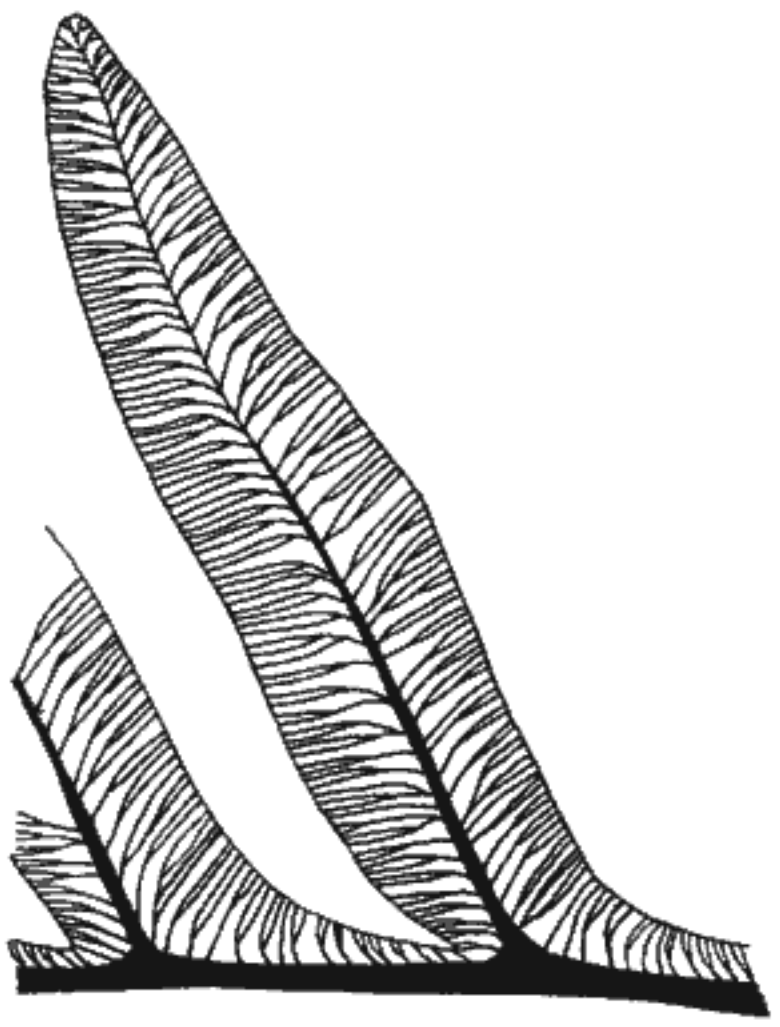
17. Venation of the pinnules of *Alethopteris urophylla* (Brongniart) Goeppert, Upper Silesian Basin, loc. Karviná, Hlubina Mine, Suchá Member, Westphalian A, x 4.

1928 *Alethopteris Serli* BRONGN.; ŠUSTA: pl. 35, fig. 5, pl. 36, figs. 1, 2, (non pl. 34, fig. 1 = *Alethopteris havlenae* sp. nov.).

1953 *Alethopteris lonchitica* (SCHLOTHEIM) UNGER incl. f. *Serli* (BRONGNIART) pro spec.; GOTHAN: p. 16-18, pl. 2, figs. 3, 4, pl. 4, figs. 2, 5 (non pl. 4, fig. 1 = *Alethopteris lancifolia* WAGNER, figs. 3, 4 = *Alethopteris westphalensis* WAGNER), pl. 5, figs. 1, 4, 5 (non pl. 5, figs. 2, 2a = ? *Alethopteris missouriensis* (WHITE) WAGNER,



18. Venation of the pinnules of *Alethopteris urophylla* (BRONGNIART) GOEPPERT. Upper Silesian Basin, loc. Staré Město, borehole NP 385, Upper Doubrava Member, Westphalian A, x 4.



19. Venation of the pinnules of *Alethopteris urophylla* (BRONGNIART) GOEPPERT, Intrasudetic Basin, loc. Lampertice near Žacléř, Šverma Mine (Marie Julie), Lampertice Member, Westphalian A, x 4.

non fig. 3 = ?), pl. 6, figs. 2-4, (non pl. 6, fig. 1 = *Aleth*
westphalensis WAGNER).

1955 *Alethopteris lonchitica* SCHLOTHEIM sp.; CROOKALL: p. 22-2
figs. 7, 14H (non text-fig. 7 = *Alethopteris lonchitica* SCHL
ex STERNBERG), pl. 5, fig. 2 (non fig. 1 = *Alethopteris lan*
WAGNER), pl. 10, figs. 1, 3.

1957 *Alethopteris lonchitica* SCHL.; PURKYŇOVÁ: p. 293-305, pl.
3, 6.

1961 *Alethopteris lonchitica* (SCHLOTHEIM) ZEILLER; BUISINE: p.
text-fig. 9, pls. 13-20

1970 *Alethopteris lonchitica* (SCHL.) f. typica GOTHAN; HAVLENA
97, pl. 1, fig. 11.

1977 *Alethopteris lonchitica* (V. SCHLOTHEIM) ZEILLER; PURKY
HOLUB - WAGNER: pl. 4, fig. 2.

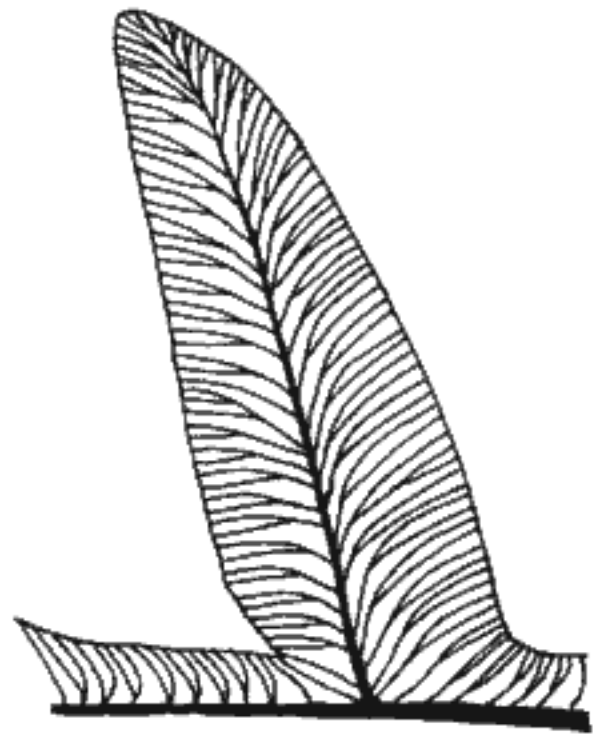
1983 *Alethopteris lonchitica* (SCHLOTHEIM) STERNBERG; JOSTEN:
129, text-fig. 91, pl. 47, figs. 1, 1a.

1984 *Alethopteris lonchitica* (SCHLOTHEIM) ZEILLER; HAVLENA:
372, pl. 1, fig. 1, pl. 2, figs. 1, 4, 5, pl. 3, figs. 1-3, 6-9, pl.
1, 4, 5.

1986 *Alethopteris lonchitica* (SCHL.); PURKYŇOVÁ: p. 57-63, pl. 4

Material: Nearly 200 fragments of pinnae preserved in light to da
mudstones.

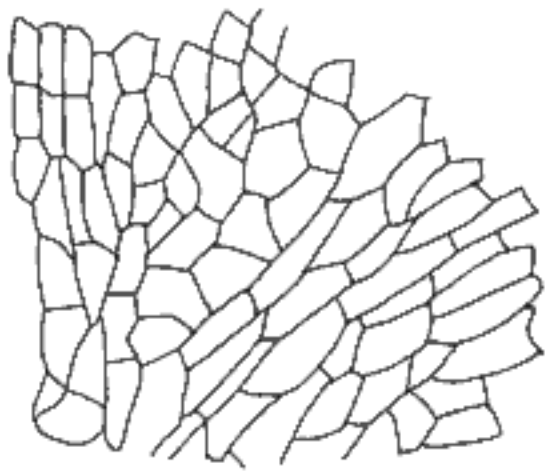
Description: Pinnae are imparipinnate to higher
being at least 3x pinnate. The principal rachis is up
mm wide on the specimens, the penultimate order rac
to 6 mm wide and the ultimate order one about 1 mm



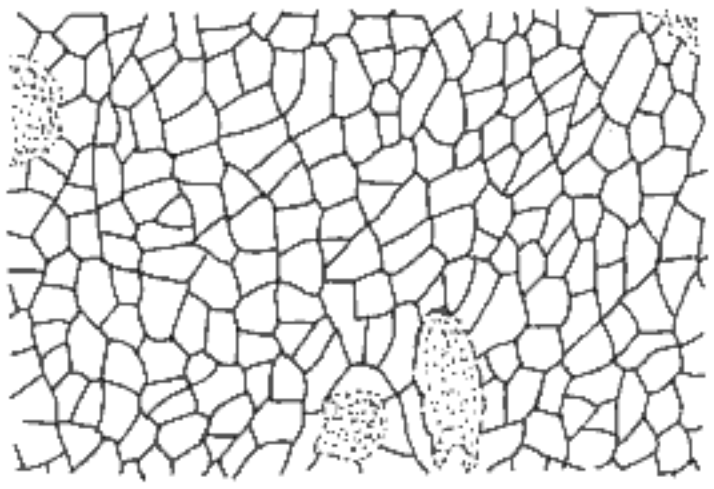
20. Venation of the pinnules of *Alethopteris urophylla* (BRON
GOEPPERT, Intrasudetic Basin, loc. Lampertice near Žacléř,
S-9, Prkenný Důl-Žďárky Member, Westphalian B, x 4.

The pinnules are long-tongue shaped with
pointed apices. They are 5.5-42 mm long and 3-
wide at the base and 2-7.5 mm in the midpart. Larger p
have mostly parallel margins gradually narrowing
the apices whereas the shorter ones are the wides
lower third of their length. More common larger p
do not touch each other by their margins being pla
mm apart on the average. At the base the pinnules
terconnected by a variously wide limb. In smaller
les it attains maximum width (up to 1 mm), how
large pinnules in the lower part of the pinna it is ha
sible. The terminal pinnule is long-tongue shaped
mm long narrowing toward the apex. It is terminat
bluntly pointed apex. It is terminated by a bluntly
apex.

The midrib is prominent nearly as far as the



21. Adaxial cuticle of *Alethopteris urophylla*, Intrasudetic Basin, loc. Lampertice near Žacléř. Lampertice Member, Westphalian A. x 100.

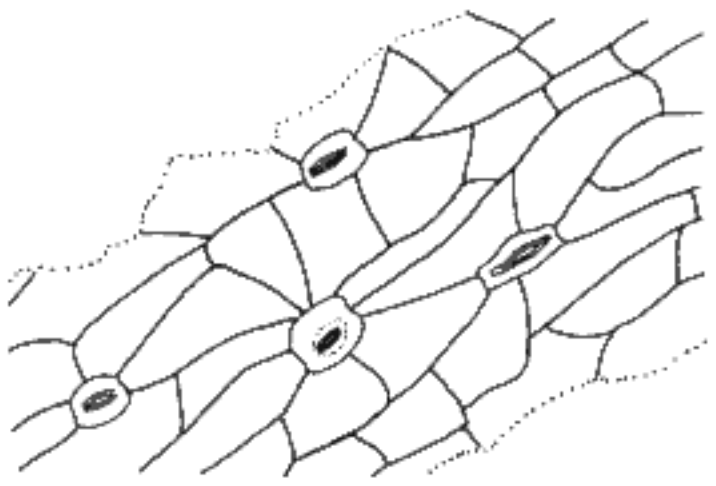


22. Adaxial cuticle of *Alethopteris urophylla*. Upper Silesian Basin, loc. Darkov, borehole NP 441, Upper Doubrava Member, Westphalian A. x 100.

apex. Lateral veins separate from the midrib under acute angles, slightly arch and on the basiscopic side they reach the pinnule margin at the angles of 70-80°, on the acroscopic side almost perpendicularly. Lateral veins are prevailingly once, sometimes twice forked. The subsidiary veins enter the interconnected limb directly from the rachis of the ultimate order pinna. They are simple or once-forked. Venation is comparatively dense (40-72 veins per 1 cm on the pinnule margin).

Cuticles have been prepared from specimens from the Upper Silesian Basin - from Poruba, Žofie mine, from Karviná, Mír and Františka Mines, from Darkov, Borehole NP 441, in the Intrasudetic Basin from Žacléř, Šverma Mine (formerly Marie Julie).

Adaxial cuticle (text-figs. 21-22, pl. XI, fig. 2, pl. XII, figs. 8, 9, pl. XIII, figs. 2-4) is weakly cutinized. Cells in the costal and intercostal fields are indistinctly differentiated. In the cuticles from the Upper Silesian Basin there are cells polygonal in shape, randomly orientated, with straight anticlinal walls. The cells are 30-65 μm long and 15-35 μm wide. On the adaxial cuticles of the Intrasudetic Basin specimens a feeble orientation of cells in the intercostal field is traceable. In the costal field the cells are more elongate and more expressively orientated. Some stratigraphically younger specimens from the Intrasudetic Basin have more distinctly elongated and orientated cells in the intercostal field so the difference between the costal and intercostal fields fades away.



23. Abaxial cuticle of *Alethopteris urophylla*, Upper Silesian Basin, loc. Darkov, borehole NP 441, Upper Doubrava Member, Westphalian A, x 250.

Abaxial cuticle (text-fig. 23, pl. XI, figs. 5, 6, pl. XIII, figs. 1, 5, 6) is very slightly cutinized, being of the same type in the specimens from both the Upper Silesian and Intrasudetic Basins. There is a very little difference between the cells of the costal and intercostal fields. The cells in the costal regions are longer and orientated concordantly with the vein course direction. Orientation of the cells in the intercostal area is apparent too. The cells are variously shaped - trapezoidal, rectangular, even elongately polygonal. They are 30-70 μm long and 10-30 μm wide. Anticlinal walls are straight or slightly curved. The cells are mostly at once neighbouring cells of the stomata which are on the cuticle from the Upper Silesian Basin orientated, on that from the Intrasudetic Basin weakly orientated. The stomata are anomocytic, of monocyclic type. They are narrow, sometimes also comparatively wide, mostly elliptical and this shape is sometimes changed by a limitation of the neighbouring cells. Guard cells are somewhat sunken under the epidermis level and surrounded by 5-8 (most often 6) neighbouring cells. Stomata are 18-26 μm long and 14-18 μm wide.

The cells on the cuticles in the place of the pinnule midrib (pl. XI, figs. 4, 7) are markedly orientated in the same direction as the midrib. They are rectangular, trapezoidal, and even spindle-shaped. Anticlinal walls of the cells are straight, or just slightly bent. The cells have 40-150 μm in length and 10-30 μm in width. Trichom bases can be traced among them. The bases are narrow-elliptical, formed of a single cell or a couple. They are 50-65 μm long and 20-24 μm wide.

Two types of trichomes can be distinguished: 1. (pl. XII, fig. 10) simple, uniseriate, small non-glandular trichomes occurring in the place of the pinnule midrib. They are 120-170 μm long and 36-50 μm wide, composed of 5-6 cells. Their bases are built of a cell couple. The trichom apices are bluntly pointed (if preserved at all). These trichomes occur in the place of the pinnule midrib in the Intrasudetic Basin specimens. 2. (pl. XI, fig. 2) the trichomes of the same shape, but larger - 400 to 500 μm long occur in the place of the midrib in specimens from the Upper Silesian Basin.

Comparison: *Alethopteris urophylla* (Brongniart) Goeppert, *Alethopteris decurrens* (Artis) Frech and *Alethopteris jongmansii* Šusta are all very similar. *Alethopteris decurrens* has more slender pinnules than *Alethopteris urophylla*. Difficulties with distinguishing these two species may arise in the case of relatively narrow pinnules of *Alethopteris urophylla* and relatively wide pinnules of *Alethopteris decurrens*. Venation characters are decisive for the recognition of these species in such cases.

Remarks: Holotype of *Alethopteris lonchitica* SCHLOTHEIM ex STERNBERG has been described and figured from Upper Westphalian sediments of the Saar region and it is very probable that the stratigraphically older species belongs to another species. According to WAGNER (1968) the type of *Alethopteris lonchitica* has been illustrated only by a diagramatic drawing which does not permit an adequate comparison to be made. Since the type seems have been lost and its origin has been started in general terms, there is little possibility of finding what its exact characteristics were. WAGNER (1968) suggested to replace the name *Alethopteris lonchitica* used for stratigraphically older specimens by the name *Alethopteris urophylla* (BRONGNIART) GOEPPERT, which is generally quoted in the synonymy of *Alethopteris lonchitica* (CROOKALL, 1955, p. 22 and BUISINE, 1961, p. 99) and comes from Great Britain, the locality Merthyr Tydwil. WAGNER (1968) also advised to abandon the name *Alethopteris lonchitica* owing to unsatisfactory taxonomic position of this species. I have possibly to study holotypes neither of *Alethopteris lonchitica*, nor *Alethopteris urophylla*.

Occurrence and distribution: Upper Silesian Basin, Karviná Formation: Namurian B, Saddle Member: Stonava, ČSM Mine, borehole 9, 510 m, 38th seam. Namurian C, Saddle Member: Karviná, 1. máj - Mír Mine, seam 37a, borehole M-4, 292.4 m, seam 37c, Doubrava, borehole Do-61, 444 m, 36th seam, Poruba, Žofie Mine, 34th seam, Čeladná, borehole SV-6, 1 089.35 m, Stonava, ČSM Mine, borehole 4, 199m, 35th seam; Lower Suchá Member: Horní Suchá, Gottwald (formerly František) Mine, 31st (D) seam, borehole G 6, 37.5 m, 31st-32nd seam, Karviná, 1. máj - Mír Mine (formerly Gabriela), 31st seam, borehole M-24, 307.5 m, borehole NP 749, 1 013.7 m, Kunčice pod Ondřejníkem, borehole NP 811, 1 089.35 m, Orlová II, A. Zápotocký Mine, 28th seam, borehole AZ 21, 10-99 m, 29th-32nd seam. Westphalian A, Suchá Member: Karviná, ČSA, Františka, Hlubina and Jindřich Mines (mostly between the 23rd-26th seams), Hohenegger, 1. máj - Mír Mines, borehole M-6, 200 m, 27th seam, Doubrava - Kozinec, borehole SDF No. 5, 961.65 m, Stonava, ČSM Mine, borehole J-31, 70.5 m; Doubrava Member: Karviná, Františka, Hlubina, Mír, Doubrava, Eleonóra Mines (mostly between the 7th -15th seams); Upper Doubrava Member: Darkov, borehole NP 441, 404.4 m, Doubrava, borehole NP 442, 753.2 m, Staré Město, borehole NP 385, 864.1 m.

Intrasudetic Basin, Žacléř Formation: Namurian C - Lower Westphalian B, Lampertice Member: Lampertice near Žacléř, Šverma Mine (formerly Marie Julie), tops of the 7th, 10th and 11th underlying seam, excavation of the pit Jan (12th-23th overlying seam), boreholes La-l, 546-546.5 m (9th overlying seam), Š-9, 800-811.2 m (22nd-23rd underlying seam), Š-11, 387.9-820.3 m (4th overlying - 10th underlying seam), Š-13, 576.2-785.9 m (20th overlying - 5th underlying seam), Š-14, 634.75-1 089.2 m (32nd overlying - 24th underlying seam); Žacléř, boreholes B, 460-480 m (8th underlying seam), C, Š-10, 392.7-392.85 m (19th overlying seam); Krá boreholes Kr-2, 304-703.1 m, Kr-2k, 393-958 m overlying - 24th underlying seam), Kr-3, 338.2-37 Černá voda, borehole ČV-3, 444.8-445.2 m. Westp B, Prkenný Důl-Žďárky Member: Lampertice near Ž borehole Š-9, 26.3-26.7 m (? Štrumpfbach s Královec, boreholes Kr-1, 35-35.2 m, Kr-3, 203. 25 m.

Alethopteris lonchitifolia P. BERTRAND, 1932

Text-figs. 24-25, pl. XIV, figs. 2-6

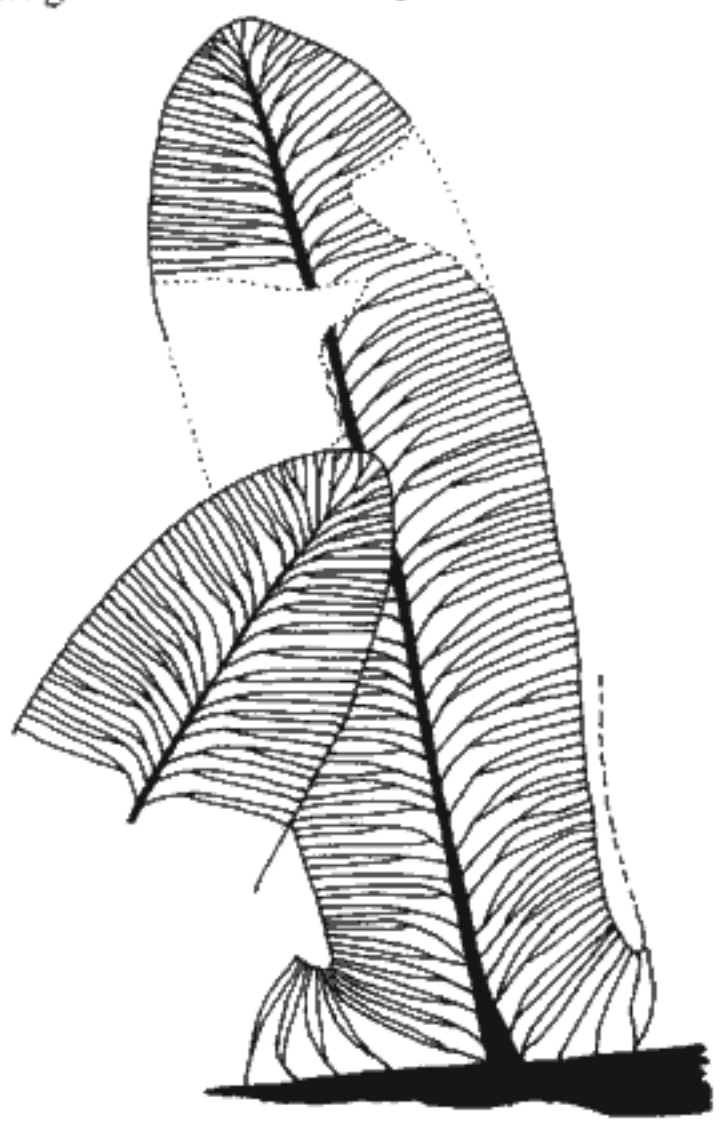
1932 *Alethopteris lonchitifolia* P. B.; BERTRAND: p. 67-69, fig. 9, 34.

1974 *Alethopteris densinervosa* WAGNER = *Alethopteris lonc* BERTRAND; DOUBINGER - GERMER: p. 153-154, text-figs. 14, figs. 1-4, pl. 15, figs. 1-3a.

1986 *Alethopteris lonchitifolia* BERTRAND; GERMER - ENGEL: text-figs. 3, 4, pl. 1, fig. 2 (the same figures as DOU GERMER (1974), text-figs. 1, 2, pl. 14, fig. 3).

Material: About ten fragments of pinnae and pinnules preserved to brown-gray mudstones to silty fine-grained sandstones

Description: Of the ultimate order pinnae maxi cm long fragments have been preserved. Ultimat



24. Venation of the pinnules of *Alethopteris lonchitifolia* B Intrasudetic Basin, loc. Mokřiny (near Žďárky), Prkenný D Member, Westphalian B, x 4.

25. Adaxial cuticle of *Alethopteris lonchitifolia*. Intrasudetic Mokřiny (near Žďárky), Prkenný Důl-Žďárky Member, Westp 100.

rachises are up to 2 mm thick and finely longitudinally striated.

Pinnules are elongately tongue-shaped with almost parallel margins and blunt to bluntly pointed apices. At the base they are connected by an up to 2 mm wide limb. Pinnules are 7.5-23 mm long and 4-7 mm wide at the base and 2-6 mm in the midpart of the pinnule.

The midrib is conspicuous and discernible almost as far as the pinnule apex. Lateral veins are fine, arcuately separating from the midrib, gently arcing through the pinnule blade, almost perpendicularly reaching the pinnule margin. Lateral veins dichotomize as a rule once not far from the midrib. Subsidiary veins forking just once or not at all enter the limb on both sides of the midrib. Venation is fairly dense (46-54 veins per 1 cm on the pinnule margin).

Cuticles have been extracted from the specimen from Mokřiny (near Žďárky), trench Žď-59. A weakly cutinized adaxial cuticle (text-fig. 25, pl. 14, figs. 3, 6) has been preserved. Cells are elongate, of irregularly polygonal shape. Their anticlinal walls are undulated. The cell orientation in the direction of the vein course is apparent. The cells are 40-95 μm long and 12-35 μm wide. Trichomes have not been found.

Comparison: BERTRAND (1932) gives a comparison of *Alethopteris lonchitifolia* BERTRAND with the species *Alethopteris serlii* (BRONGNIART) GOEPPERT, *A. lonchitica* SCHLOTHEIM ex STERNBERG and *A. ingbertensis* BENECKE mspt.

Alethopteris lonchitifolia P. BERTRAND moreover resembles the following species: *Alethopteris densinervosa* Wagner, *Alethopteris missouriensis* (D. WHITE) WAGNER and *Alethopteris westphalensis* WAGNER. These species exhibit roughly the same vein density and their pinnules have very similar shape. They differ, however, in the course of the lateral veins and partly in the shape of the terminal pinnules.

Remarks: Especially the minute pinnules of the above-given species are very hardly determinable because of insufficiently evolved diagnostic features. Compare e. g. WAGNER (1968) text-fig. 30 and text-fig. 49. DOUBINGER and GERMER (1974) consider the species *Alethopteris lonchitifolia* P. BERTRAND and *Alethopteris densinervosa* WAGNER as identical. These species might really be various forms of the one species.

The specimens of *Alethopteris lonchitifolia* P. BERTRAND from the Bohemian part of the Intrasudetic Basin possess a rather denser venation than BERTRAND's (1932) types.

ŠETLÍK in HOLUB - WAGNER (1977) and ŠETLÍK in TÁSLER at al. (1979) reports the species *Alethopteris missouriensis* (D. WHITE) WAGNER from the Prkenný Důl-Žďárky Member (Westphalian B) of the Intrasudetic Basin. This species occurs in the Radnice Member (Westphalian C) in the Central Bohemian Region. *Alethopteris lonchitifolia* and *Alethopteris missouriensis* are very much alike as I have mentioned already in the above-text. However, the structure of their cuticles is diametrically different. I think it was by mistake that J. ŠETLÍK designated the specimens of *Alethopteris lonchitifolia* P. B. as *Alethopteris missouriensis* (D. WHITE) WAGNER.

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Prkenný Důl-Žďárky Member: Mokřiny (near Žďárky), trench Žď-59 (intercalation of the 4th seam); Lhota, borehole Lh-2, 485.5-486.1 m, Petrovice Member: Strážkovice, borehole St-7, 456.5-456.65 m.

Alethopteris refracta FRANKE, 1912

Text-fig. 26, pl. XIV, fig. 7, pl. XV, figs. 1-6

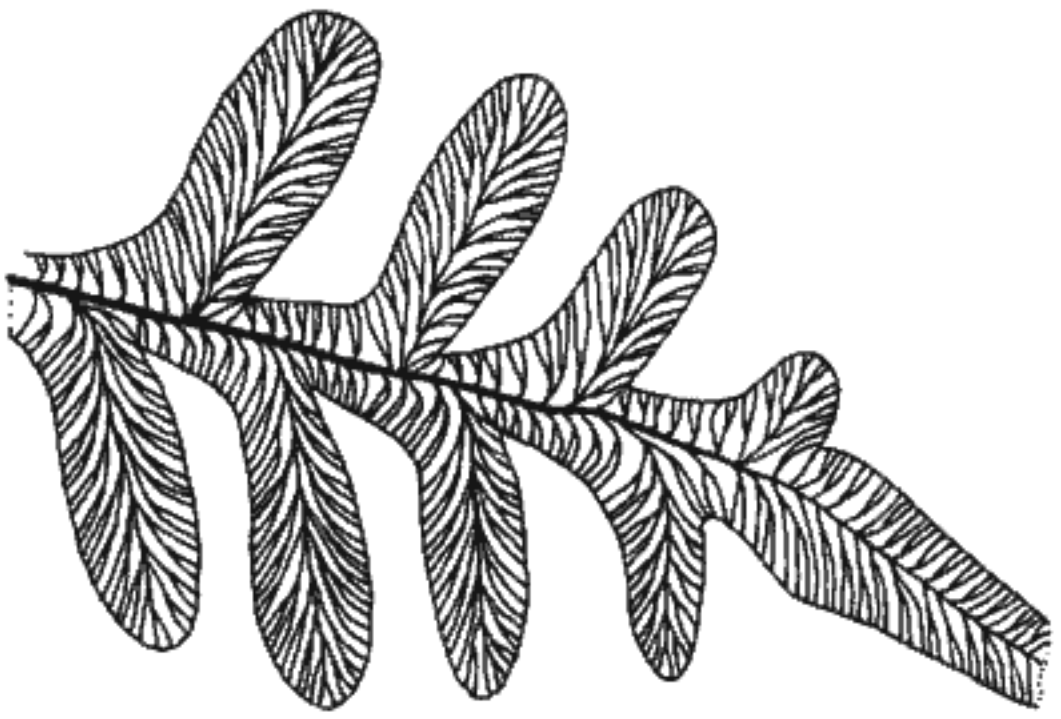
1912 *Alethopteris refracta* n. sp.; FRANKE: p. 64-66, figs. 1, 2.
1957 *Alethopteris refracta* FRANKE; Stopa: p. 85, pl. 32, (? pl. 31, fig. 4).
Material: 10 specimens preserved on dark grey mudstones.

Description: Fragmentary material yielded only ultimate order pinnae with thin rachises (up to 0.5 mm wide).

Pinnules are tongue-shaped to oblong with rounded to blunt apices. They are 5-17 mm long and 2.5-6 mm wide in the midpart and 3.5-7.5 mm at the pinnule base. The pinnule margin is mostly convex with a cut on the acroscopic side. Another acroscopic pinnule is sharply attached by a gradually widening limb in the place of the attachement usually 0.5-1 mm wide. Terminal pinnule is triangular, 12-15 mm long and 2-3 mm wide, its apex is pointed.

Midrib is distinct almost as far as the pinnule apex. Lateral veins dichotomize several times, at sharp angles with the midrib, they run across the pinnule blade in a broad arc, and reach the pinnule margin obliquely, most often at 70-85° (see pl. XV, figs. 3, 4). Subsidiary veins entering the limb fork once as a rule. Venation is not very dense (36-44 veins per 1 cm on the pinnule margin).

Cuticles (pl. XV, figs. 5, 6) have been prepared from specimens detected during the excavation of the pit Jan of the Šverma Mine at Lampertice near Žacléř. Unfortunately, the cells on the cuticles are undistinguishable, only darker strips in the place of the pinnule veins can be traced. The SEM provides a similar view (pl. XV, fig. 6); pinnule veins are more expressively protruding in its light.



26. Venation of the pinnules of *Alethopteris refracta* FRANKE, Intrasudetic Basin, loc. Lampertice near Žacléř, Šverma Mine (Marie Julie), Lampertice Member, Westphalian A, x 4.

Comparison: FRANKE (1912) compares the species *Alethopteris refracta* FRANKE with the species *Alethopteris lonchitica* SCHLOTHEIM ex STERNBERG and *Alethopteris serlii* (BRONGNIART) GOEPPERT. As characteristic features of the species *Alethopteris refracta* he considers the folds on the basiscopic side of the pinnules.

Remarks: FRANKE (1912) described the species *Alethopteris refracta* FRANKE from the Polish part of the Upper Silesian Basin. Stopa (1957) reports the same species from the same basin, from the Ruda Śląska to Orzesze Members (Namurian C-Westphalian B). I have not seen the specimens of *Alethopteris refracta* from the Bohemian part of the Upper Silesian Basin.

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Namurian C-Westphalian B, Lampertice Member: Lampertice near Žacléř, Šverma Mine, excavation of the pit Jan (12th-14th overlying seam), boreholes Š-11, 820.1-820.3 m (10th underlying seam), Š-13, 1 020.7-1 021 m (between the 18-20th underlying seam).

Alethopteris valida BOULAY, 1876

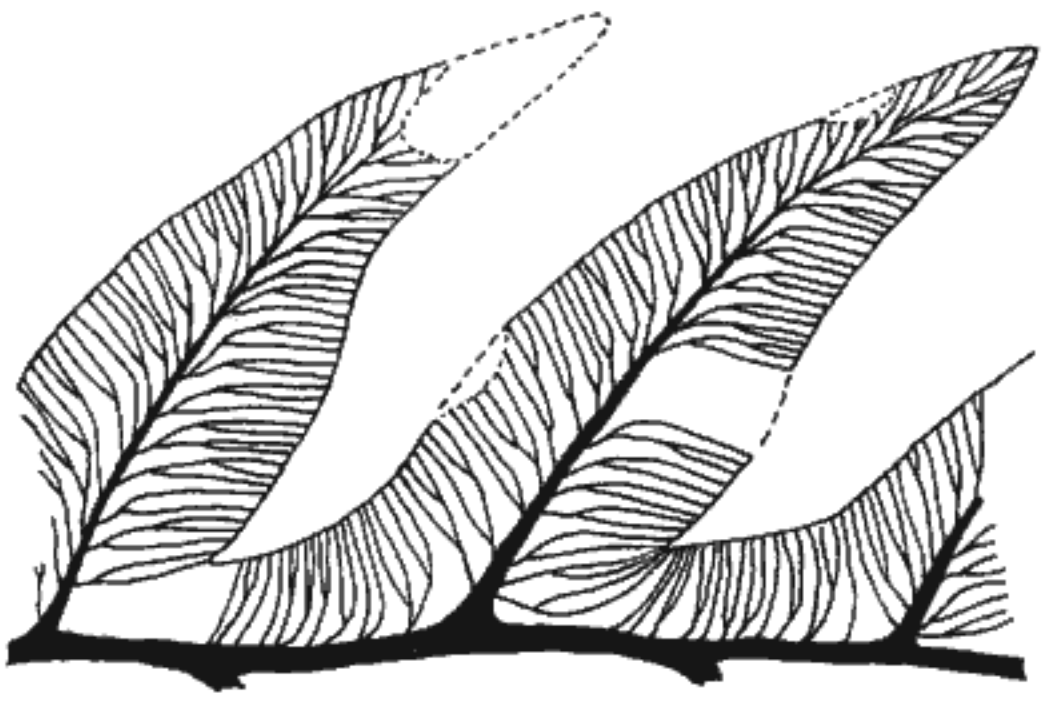
Text-figs. 27-31, pl. XV, figs. 7, 8, pls. XVI, XVII, XVIII

1876 *Alethopteris valida*; BOULAY: p. 35, pl. 1, fig. 8.
1912 *Alethopteris valida* (BOULAY); FRANKE: p. 57-62, figs. 2, 3, 4 a, b, (cf. fig. 1).
1955 *Alethopteris valida* BOULAY; CROOKALL: p. 13-17, text-figs. 5 A, B, C (copies from BOULAY, 1876, pl. 1, fig. 8), pl. 1, figs. 3-5, 5a.
1961 *Alethopteris valida* BOULAY; BUISINE: p. 168-179, text-fig. 15, pl. 45, figs. 1, 1 a, b (photograph of BOULAY's type, 1876, pl. 1, fig. 8), 2, 2 a, pls. 46-48.
?1983 *Alethopteris valida* BOULAY; JOSTEN: p. 131-132, text-fig. 94, pl. 48, figs. 1, 1 a, 2, 2 a.

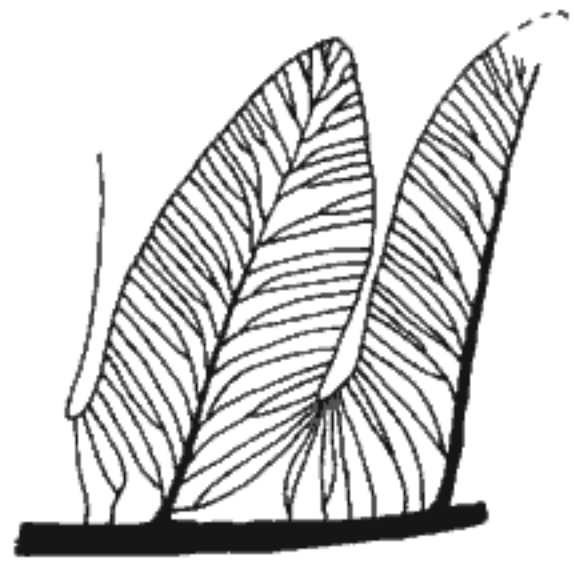
Material: Over 130 specimens preserved in light to dark grey mudstones, rarely also in whetstone tuffitic rocks and fine-grained sandstones.

Description: Pinnae imparipinnate to the 3rd to 4th order. Penultimate order rachis up to 2 mm thick and finely longitudinally striated on the imprints. The preserved parts of the ultimate order pinnae are up to 10 cm long and their rachises are 0.5-1 mm thick.

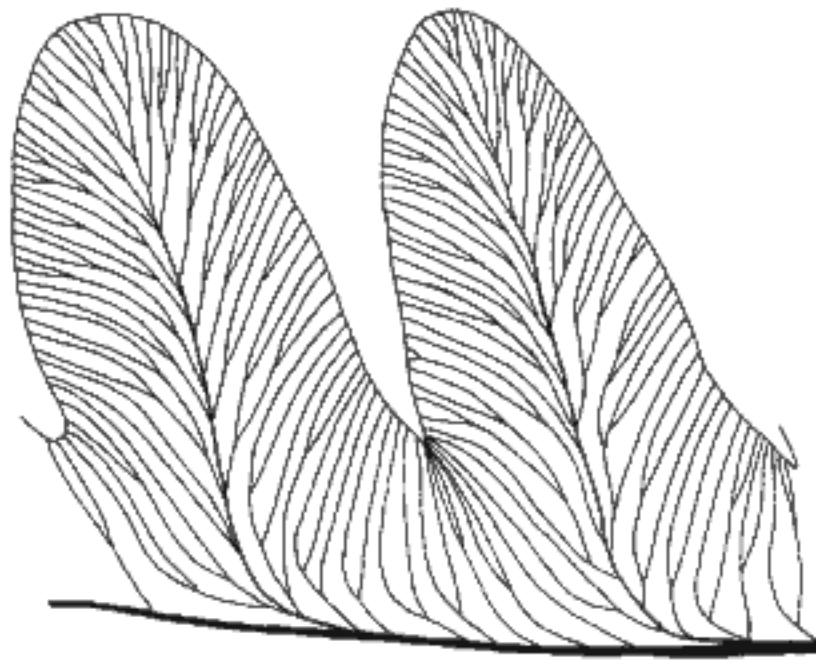
The shape of the pinnules greatly varies. They are triangular, tongue- to elongately tongue-shaped. The pinnule apices are rounded to bluntly pointed (rarely pointed).



27. Venation of the pinnules of *Alethopteris valida* BOULAY, Intrasudetic Basin, loc. Rtyně v Podkrkonoší, Nejedlý (Ida) Mine, Prkenný Důl-Žďárky Member, Westphalian B, x 4.



28. Venation of the pinnules of *Alethopteris valida* BOULAY, Intr Basin, loc. Markoušovice, Pětiletka (U buku) Mine, Prkenný D ky Member, Westphalian B, x 4.



29. Venation of the pinnules of *Alethopteris valida* BOUL Silesian Basin, loc. Darkov, borehole NP 131, Doubrava Westphalian A, x 4.

The pinnules are 6-27 mm long and 3.5-12 mm wid base and 2.5-10 mm in the midpart of the pinnu pinnule margins are convex so that their widest pa the lower third of the pinnule. The pinnules are in nected by a limb which is 2-3 mm wide. The fol ween the pinnules are bluntly pointed. The pinn not touch each other with their margins being 1-4 mm on the average) apart. Terminal pinnules are lan 30-40 mm long, narrow toward the apex which pointed than that of the lateral pinnules.

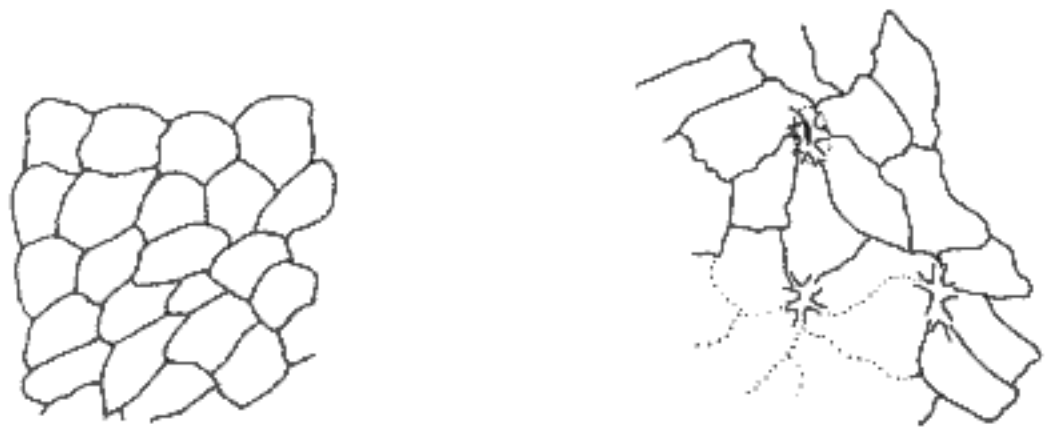
Midrib is distinct virtually as far as the ape straight or slightly bent. Lateral veins leave the m the angle of approx. 45°, slightly bend and then run straightly toward the pinnule margin reaching it at (in small pinnules sometimes at 45°). The latera usually once or twice fork, firstly some 1 mm fr midrib, secondly (if at all) roughly in the half-way b the midrib and the pinnule margin. Vein density is ry high - 28-44 veins per 1 cm on the pinnule [3 specimens from Markoušovice, Pětiletka Mine phalian B) show 58-60 veins per 1 cm on the pinnu gin]. Besides the lateral veins, also the subsidia occur branching directly from the ultimate order n

Cuticles have been prepared from specimens f Intrasudetic Basin, from Žacléř, Šverma Mine (f Marie Julie), borehole Š-2, 25.7-26 m, Rtyně krkonoší, Nejedlý Mine (formerly Ida Gallery), a the specimen from the Upper Silesian Basin, Dar

rehole NP 131, 1 212 m. Cells are observable only in the slides from the Intrasudetic Basin specimens.

Adaxial cuticle (text-fig. 30, pl. XVIII, figs. 2, 6, 7) is very weakly cutinized, cell outlines are very faint. The cells in the intercostal field are randomly orientated, of polygonal shape. Their anticlinal walls are however curved and roundded in the corners. The cells have 40-65 µm in diameter. The cells in the costal field are elongated, orientated in the direction of the course of the lateral veins.

Abaxial cuticle (text-fig. 31, pl. XVIII, fig. 3) is very weakly cutinized and the cell outlines are badly distinguishable. The cells in the intercostal field are randomly orientated, polygonal in shape, 24-40 µm long and 16-26 µm wide. Anticlinal walls are bent, in places gently undulated. Among these cells anomocytic stomata of monocyclic type occur. They are elliptical, 12-15 µm long and 6-7 µm wide. They are surrounded by 5-6 neighbouring cells shaped like normal epidermal cells. Toward the stoma, a more cutinized papillae grow up from them which partly overlap the stoma markedly sunken under the epidermis level.



30, 31. *Alethopteris valida*, Intrasudetic Basin, loc. Rtyně v Podkrkonoší, Prkenný Důl-Žďárky Member, Westphalian B (30-adaxial cuticle, x100, 31-abaxial cuticle, x250).

Trichomes (pl. 17, figs. 5-7, pl. XVIII, figs. 4, 5, 8) grow from the adaxial as well as abaxial cuticle. The largest trichomes appear in the place of the midrib. These are non-glandular, simple, uniseriate, up to 2 mm long and 250 µm wide. The size of the other trichomes varies, attaining to 300-400 µm in length and 80-100 µm width. Some trichomes are only 40-50 µm wide - these are simple and uniseriate trichomes with respect to their function divided into non-glandular and glandular. The base of the non-glandular trichom is formed of a single cell (or a couple of cells), the base of the glandular trichom is always a single cell. This trichom is terminated by a ball secretion cell 40-50 µm in diametr. The apices of the narrow non-glandular trichomes are bluntly pointed, and those of the wide trichomes are widely circular. These trichomes consists of 7-12 cells. Trichomes grew also from the pinnule margin (pl. XVII, fig. 7).

Along the vein margin, sporangia of a parasitic fungi have been detected on the cuticle (pl. XVII, fig. 2). They measure 35-50 µm in diameter being composed of several stronglier cutinized cells.

Comparison: CROOKALL (1955) compares the species *Alethopteris valida* Boulay with the species *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. grandinii* (BRONGNIART) GOEPPERT, *A. serlii* (BRONGNIART) GOEPPERT, *A. lonchitica* SCHLOTHEIM ex STERNBERG, *A. parva* POTONIÉ and *A. integra* GOTHAN (originally described as *Desmopteris integra* GOTHAN).

Remarks: *Alethopteris valida* BOULAY occurs rarely in the Upper Silesian Basin and is restricted to the Suchá and Doubrava Members of Westphalian A age. The Namurian C yielded only uncertin discoveries.

The specimens of *Alethopteris valida* were in the Intrasudetic Basin boreholes encountered much deeper than had been reported by NĚMEJC (1958) on the basis of collections from the seams of Šverma Mine. NĚMEJC's (1958) oldest find comes from the 16th overlying seam. In ŠETLÍK's collections Alethopteris valida appears rarely from the 10th underlying seam; the oldest find is reportedly that from Z. Rieger's collections from the 23rd underlying seam of Šverma Mine (Namurian C). The youngest so far detected finds come from the Petrovice Member being Westphalian B in age.

The above-given stratigraphic range corresponds to that mentioned by LAVEINE (1986) - Namurian C to Westphalian B. JOSTEN (1983) reports the oldest finds from the Namurian B. The pinnules of his specimens have identical shape as those of *Alethopteris valida* H, however, the veins of large pinnules of JOSTEN's (1983) specimens reach the pinnule margins perpendicularly and that is not typical of *Alethopteris valida*. In this species the veins reach the pinnule margin at 60-70° angles.

Occurrence and distribution: Upper Silesian Basin, Karviná Formation: Westphalian A, Lower Suchá Member: Staré Město, borehole NP 397, 1 211.8 - 1 212 m ? 26th seam; Upper Suchá Member: Karviná, Hlubina Mine, 17th seam, Doubrava-Kozinec, SDF borehole No. 5, 1 019.5 m, Staré Město, borehole NP 397, 1 134.8 m (? 23rd seam); Doubrava Member: Darkov, borehole NP 131, 817.9 m.

Intrasudetic Basin, Žacléř Formation: Namurian C, Lampertice Member: Lampertice, borehole Š-9, 847.3-847.5 m (23rd underlying seam). Westphalian A-B, Lampertice Member: Lampertice near Žacléř, Šverma Mine (formerly Marie Julie), tops of the 13th, 14th, 16th overlying seam, excavation of the pit Jan (5th-32rd overlying seam, boreholes: La-1, 546-826.3 m (9th overlying-2-nd underlying seam), Š-9, 319-428.5 m (7-18th overlying seam), Š-11, 814.5-815.2 m (10th underlying seam), Š-13, 489-628 m (10th-23rd overlying seam); Žacléř, boreholes A, 40-41 m, B, 160.3 m (23rd overlying seam), C, 86.5 m (25th overlying seam), Š-10, 714.6-714.7 m (9th underlying seam); Královec, boreholes Kr-1, 356-356.3 m, Kr-2, 304-306 m (5th overlying seam), Kr-2k, 307-699 m (7th overlying - 6th underlying seams). Westphalian B, Prkenný Důl-Žďárky Member: Lampertice, boreholes Š-9, 75.6-75.7 m (? Štrumpfbach seam), Š-2, 25.7-26 m (? Štrumpfbach seam); Královec, boreholes Kr-3, 20-39.15 m, Kr-4, 49.2-49.4 m; Lhota, borehole Lh-2, 565-572 m (? 1st-2nd U buku seam); Markoušovice, trench P-1300 (10th U buku seam), boreholes Ma-2, 629.4-630.4 m, S-662, 161-163.7 m, Pětiletka

Mine (formerly U buku, with the gallery Xaverova Dědičná and the pit Petri); Malé Svatoňovice, borehole MS-1, 946-947 m (5th U buku seam); Odolov, borehole St-4, 880-885 m (5th Žďárky seam); Rtyně v Podkrkonoší, borehole Rt-3, 822-826.7 m (6th Žďárky seam), Nejedlý Mine (formerly Ida Gallery); Žďárky u Hronova, Vilemína Mine, Mokřiny (near Žďárky), trenches Žď-10, Žď-59 (4th seam) and Žď-61; Vysoká Srbská, borehole VS-2, 490-491 m. Westphalian B, Petrovice Member: Lhota, railroad Trutnov-Teplice, NE side, 2 520 km - P-626.

Alethopteris aff. *valida* BOULAY

Text-figs. 32-34, pls. XIX, XX, XXI, figs. 1-7

Material: 5 fragments of pinnae preserved in grey mudstones.

Description: The pinnae are imparipinnate at least to the 2nd order. The penultimate order rachis is up to 7 mm, the ultimate order one up to 1 mm wide.

Pinnules are elongately tongue-shaped, 17-40 mm long, 7-9 mm wide at the base and 5.5-8.5 mm in the mid-part of the pinnule. Pinnule margins are almost parallel, at about 1/3 to 1/4 from the apex they gradually narrow toward a rounded or bluntly pointed apex. The pinnules are in the pinna inserted very closely side by side but do not touch each other. At the base they are connected by a pinnule limb which is about 1 mm wide.

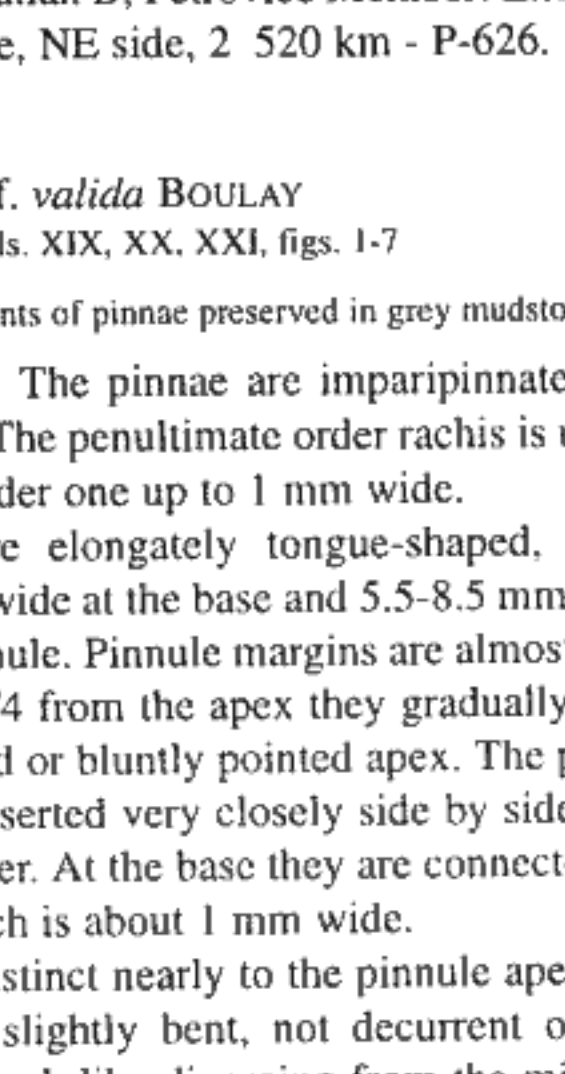
Midrib is distinct nearly to the pinnule apex. Mostly it is straight or slightly bent, not decurrent on the base. Lateral veins arch-like diverging from the midrib run almost straightly toward the pinnule margin at the angles of 80-90°. They fork once, rarely twice, sometimes they are simple. Subsidiary veins entering the pinnule lim simple or once forked. Venation is quite wide veins per 1 cm on the pinnule margin).

Cuticles were prepared from specimens from Šverma Mine and from Rtyně v Podkrkonoší, Z. N Mine.

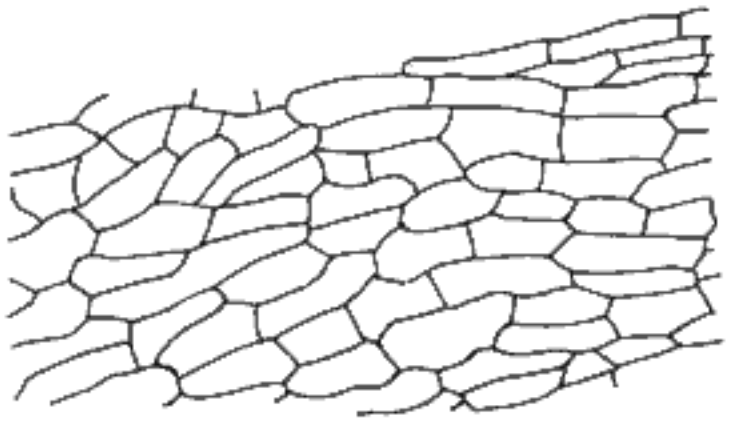
Adaxial cuticle (text-fig. 33, pl. XIX, fig. 2 a XXI, fig. 3) is weakly cutinized. The cells are orie in the direction of the vein course and the differen ween the costal and intercostal fields is inexpressiv cells are longitudinally polygonal to tetragonal in with straight or gently bent anticlinal walls. They a 110 µm long and 20-40 µm wide. In the costal fi longer cells dominate.

Abaxial cuticle (text-fig. 34, pl. XIX, figs. 3, 4, figs. 4-7) is very slightly cutinized. The cells are longitudinally polygonal, sometimes tetragonal w ticlinal walls, straight to strongly bent. Some ce rounded in the corners. The cells in the intercosta are slightly orientated, 40-80 µm long and 20- wide. Expressive orientation show the cells in the field even 100 µm long and 10-20 µm wide. Ori anomocytic stomata of monocyclic type are quite fr among the cells of the intercostal field. Their guar are notably sunken under the epidermis level and overlapped by strongly cutinized proximal p resulting from thickening and vaulting of walls neighbouring cells over the stoma. The stoma elongately elliptical, 24-38 µm long and 15-18 µm The slit of the stoma is 20-25 µm long. The st surrounded by 5-7 neighbouring cells.

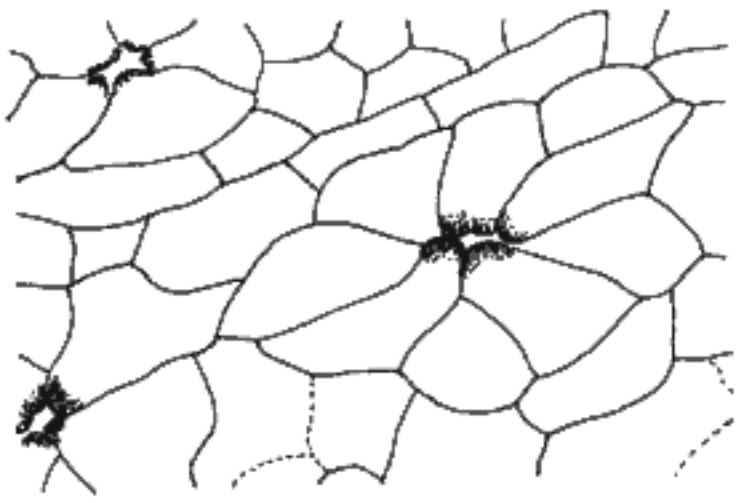
In the place of the midrib the cuticle is weakly zed (pl. XIX, fig. 5, pl. XXI, fig. 5). The cells are sively orientated in the direction of this vein. Th elongated, usually of tetragonal shape, with stra



32. Venation of the pinnules of *Alethopteris* aff. *valida* BOULAY, Intrasudetic Basin, loc. Lampertice near Žacléř, Šverma (Marie Julie) Mine, Lampertice Member, Westphalian B, x 4.



33. Adaxial cuticle of *Alethopteris* aff. *valida*, Intrasudetic B Lampertice near Žacléř, Lampertice Member, Westphalian B,



34. Abaxial cuticle of *Alethopteris* aff. *valida*, Intrasudetic B Lampertice near Žacléř, Lampertice Member, Westphalian B,

slightly bent anticlinal walls. The cells are 60-140 µm long and 20-40 µm wide. In the specimens from Žacléř these cells bear elliptical to almost circular papillae 26-35 µm long and 20-24 µm wide.

Trichomes (pl. XXI, figs. 5, 7) appear in the place of the midrib of the specimen from Rtyně v Podkrkonoší. They are non-glandular, simple, uniseriate, up to 670 µm long and 100-135 µm wide. Termination of the trichomes is unknown.

On the SEM photographs (pl. XXI, figs. 4, 6) the vaulted periclinal cell walls are traceable. In fig. 4 the cuticle is strongly corroded which does not allow to observe the character of the cell walls.

Comparison: In many features this species resembles *Alethopteris valida* BOULAY, therefore herein it is denoted as *Alethopteris* aff. *valida* BOULAY. Both species have a very similar character of venation, its density, and the type of the apex, even though *Alethopteris valida* greatly varies in these features. [The veins of *Alethopteris valida* reach the pinnule margin at the angles of 60-70°, the veins of *Alethopteris* aff. *valida* at 80-90°, the veins of *Alethopteris valida* in JOSTEN (1983) almost perpendicularly.] The difference is in the pinnule size - in *Alethopteris* aff. *valida* they are by 1/3 larger on the average than in *Alethopteris valida*. The two species differ also in the shape of the pinnules: the pinnule margins of *Alethopteris valida* are usually convex, the widest at 1/3 from the base and narrowing to the apex. *Alethopteris* aff. *valida* exhibits almost parallel pinnule margins, in the upper third gradually narrowing to the apex. By this they also resemble the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT, whose pinnules are not as wide as those of *Alethopteris* aff. *valida*. Its apex is bluntly pointed whereas the apex of *Alethopteris* aff. *valida* is blunt. Venation of *Alethopteris urophylla* is much denser than of *Alethopteris* aff. *valida*. The three specimens differ also in the cuticle structure.

Alethopteris aff. *valida* has very similarly shaped pinnules as *Alethopteris havlenae* sp. nov. from the Upper Silesian Basin. The latter has, however, a much denser venation (58-70 veins per 1 cm on the pinnule margin), whereas *Alethopteris* aff. *valida* displays 34-40 veins per 1 cm on the pinnule margin. In the shape and size of the pinnules *Alethopteris* aff. *valida* resembles the species *Alethopteris valida* BOULAY from the Namurian B in the Ruhr Region (JOSTEN 1983, text-fig. 95, pl. 48, figs. 2. 2a); the apices of the later are, however, more pointed.

Remarks: The species described is in some features closer to the species *Alethopteris valida* BOULAY, in others to the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT. The relationship to these species based on the cuticles is unprovable. From this reason, in this paper it is described as *Alethopteris* aff. *valida* BOULAY even though we cannot exclude the possibility that it is a new species.

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Lampertice Member: Lampertice near Žacléř, Šverma Mine (formerly Marie Julie), excavation of the pit Jan (14-16th overlying seam).

Prkenný Důl-Žďárky Member: Rtyně v Podkrkonoší, Z. Nejedlý Mine (formerly Ida Gallery) - dump.

Alethopteris pilosa sp. nov.

Text-fig. 35, pl. XXII, figs. 4-9, pls. XXIII, XXIV

1987 *Validopteris integra* (GOTHAN) BERTRAND; ŠIMŮNEK: p. 207-212, text-figs. 1-3 (non text-fig. 4), pls. 1, 2.

Holotype: ŠIMŮNEK (1987), pl. 1, fig. 1 (deposited in the National Museum in Prague under the number E 5000).

Derivatio nominis: according to pilosus - hairy.

Locus typicus: Rtyně v Podkrkonoší, Nejedlý Mine (formerly Ida Gallery), Intrasudetic Basin, Czech Republic.

Stratum typicum: Žacléř Formation, Prkenný Důl-Žďárky Member, Westphalian B, Carboniferous.

Material: Nearly 50 fragments of pinnae preserved almost exclusively in tuffitic whetstone rocks, silty to fine-grained sandy, light brown, light to dark grey, occasionally in dark grey mudstones.

Diagnosis: Pinnae are imparipinnate to the 3rd order at least. Small pinnae of the ultimate order are shaped like large serrate or lobate pinnules because the pinnules of these small pinnae are not sufficiently separated. In larger pinnae the pinnules are distinctly separated, triangular in shape, with an almost pointed apexes. At the base the pinnules and pinnae of the ultimate order are connected by a limb. Venation is pinnate with various density of veins in dependence on the shape and size of the pinnules (26-52 veins per 1 cm on the pinnule margin). Lateral veins are 1-2 x forking.

Description: Pinnae are imparipinnate at least to the 3rd order. The principal rachis is on the 13 cm long fragment 16 mm wide. Near the branching, the penultimate order rachis is 7 mm thick and the ultimate order rachises are about 1 mm thick. These rachises are finely longitudinally striated.

Small pinnae of the ultimate order up to 5 cm long (e.g. pl. XXII, figs. 3, 6, 7) have small, hardly from each other distinguishable pinnules. These pinnae look like serrate or lobate pinnules 8-16 mm wide. At the base these underdeveloped pinnules are connected by an up to 4 mm wide limb (minimally to the pinnule 1/2 length). The pinnules are 4-8 mm long and at the base 4-6 mm wide. The pinnule apex is usually blunt. Midrib is unconspicious having the same thickness as the lateral veins, which leave the midrib at very acute angles, once or rarely twice dichotomize, almost straightly pass through the pinnule blade and the margin they reach slightly obliquely. Subsidiary veins fork once as a rule.

Larger, even about 10 cm long ultimate order pinnae (e.g. pl. XXII, fig. 2) have triangular pinnules wide at the base 6-8 mm and in the middle 4-5 mm, and 10-20 mm long (in larger pinnules serrate or slightly lobate margins may occur). The pinnules are interconnected by a 1.5-3 mm wide limb (in larger pinnules the limb is narrower). The pinnule apex is bluntly pointed to almost pointed. Midrib is straight, well discernible almost as far as the apex of the pinnule, being up to 0.5 mm thick. Dichotomizing lateral veins leave the midrib at sharp angles, slightly bend and rather obliquely reach the pinnule margin. Subsidiary veins fork usually once and run almost perpendicularly out of the ultimate order rachis and almost perpendicularly reach the margin of the limb conne-

cting the pinnules at the base. Venation density varies in dependence upon the shape and size of the pinnules (26-52 veins per 1 cm on the pinnule margin - in larger pinnules even more).

Terminal pinnules are 15-20 mm long and 5-6 mm wide on the average. Their margins (sometimes slightly lobate) gradually narrow into a bluntly pointed apex.

The ultimate order pinnae are at the base interconnected by a 1-3 mm wide limb (= typical feature). The pinnae lie 1.5-3 cm apart.

Cuticles have been prepared from the specimen from Žacléř, Šverma Mine, excavation of the pit Jan, and several specimens from the dump of Nejedlý Mine at Rtyně v Podkrkonoší.

Adaxial cuticle (pl. XXIV, fig. 7) is weakly cutinized. The cells are differentiated both in the costal and intercostal fields. In the costal field the cells are orientated, tetragonal (rectangular, rhomboidal, trapezoidal) or even elongately pentagonal in shape. Anticlinal walls are straight. Cells are 32-70 µm long and 20-30 µm wide. The cells in the intercostal field have polygonal shape. They are weakly orientated, 25-55 µm long and 20-40 µm wide. Anticlinal walls of the cells are straight or slightly bent.

The adaxial cuticle of the specimen from Žacléř (pl. XXII, fig. 5) has differently shaped cells. They are elongate, tetragonal, orientated, undifferentiated in the costal and intercostal fields, 100-200 µm long and 15-30 µm wide. Anticlinal walls are straight. Neither papillae, nor trichom bases have been found among them.

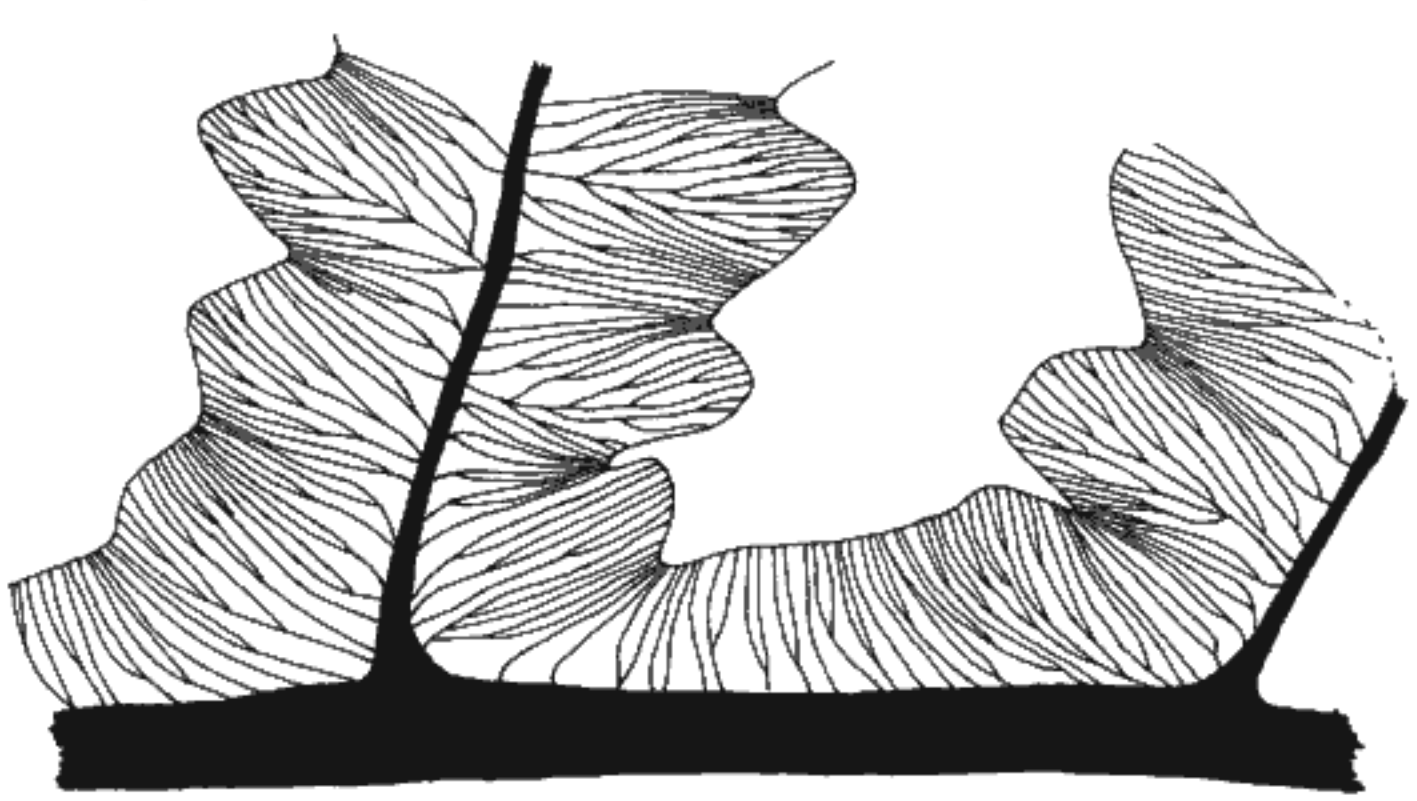
Abaxial cuticle (pl. XXII, figs. 7-9) is very weakly cutinized. The cell outlines are indistinct, stomata are faintly indicated. Owing to strong corrosion, the shape and size of the cells and stomata are undeterminable. More prominent are tiny papillae and bases of trichomes. They are elliptical, 60-80 µm long and 40-55 km wide.

The cuticle in the place of the midrib and the ultimate order rachis (pl. XXIV, figs. 5, 8) exhibits orientated cells of tetragonal (rectangular, rhomboidal or trapezoidal) shape. Anticlinal walls are straight. The cells are 45-90 µm long and 25-40 µm wide. Among the cells there are numerous bases after the broken off tricho elliptical shape, as a rule 2x longer than wide. Th 40-85 µm long and 20-40 µm wide.

The presence of trichomes is typical of this spec XXII, fig. 6, pl. XXIV, figs. 2, 9). The trichomes observed even with a naked eye as points or lines on the specimens (see pl. XXIII, figs. 1, 4, 5). The trichomes (up to 4.5 mm long) grow from the ra From the pinnule margins grow about 1 mm long mes. The trichomes in the slides grow usually place of the midrib, smaller trichomes also fr abaxial cuticle. These are mostly non-glandular, uniseriate trichomes af various size (360 µm to 3 m and 45-285 µm wide). They composed of 7-1 (according to the dimensions of the trichomes). chomes gradually narrow (except for some large o ward bluntly pointed apices. In most of the tricho apices are, however, missing. Two small glandular mes have been ascertained (pl. XXIV, fig. 9) a 250-400 µm in length and 30-35 µm width comp 3-5 cells. The trichomes probably grew from the cuticle. The secretion cell terminating the trichom spherical, 28-40 µm in diameter. In one case this underlain by a narrowed shortened cell.

Comparison: *Alethopteris pilosa* sp. nov. striki sembles the species *Alethopteris valida* B *Alethopteris valida* has long terminal pinnules mm), whereas *Alethopteris pilosa*'s terminal pinn just 15-20 mm long. The ultimate order pi *Alethopteris pilosa* are at the base connected by a limb which is absent in *Alethopteris valida*. *Alet pilosa* has smaller, less developed pinnule *Alethopteris valida*. The average length of the stud nules makes in *Alethopteris valida* 12.26 *Alethopteris pilosa* 7.46 mm, width at the base m *Alethopteris valida* 6.85 mm and in *Alethopteri* 5.70 mm on the average.

Both species are close to each other as concerned sence of large trichomes which are larger than in othe of the genus *Alethopteris* STERNBERG. *Alethopteri*



35. Venation of small pinnules and the interconnected limb between the ultimate order pinnae of the species *Alethopteris pilosa* sp. nov., I Basin, loc. Rtyně v Podkrkonoší, Nejedlý (Ida) Mine, Prkenný Důl-Žďárky Member, Westphalian B, x 4.

BOULAY exhibits up to 2 mm long trichomes, those of *Alethopteris pilosa* sp. nov. are up to 3 mm long, on rachises up to 4.5 mm long. Glandular trichomes occur in both species.

These two species have very little cutinized and very badly preserved cuticles which makes a more detailed comparison of the cuticles unfeasible. Despite of this fact, there seemingly exists a certain similarity in the cuticles of these species (especially in those of the specimens from Rtyně v Podkrkonoší).

Formerly I erroneously took *Alethopteris pilosa* sp. nov. for the species *Validopteris integra* (GOTHAN) BERTRAND which in the pinnule size and venation resembles to the species described. However, it lacks the limb between the ultimate order pinnae. The generic diagnostic features of *Validopteris integra* are identical with those of the genus *Alethopteris* STERNBERG and therefore WAGNER (1968) assigned it to this genus.

Relationships: From the given comparison with the species *Alethopteris valida* BOULAY I am of the opinion that the species *Alethopteris pilosa* sp. nov. evolved from the species *Alethopteris valida* BOULAY by retardation during the Lower Westphalian B. According to R. GASTALD's personal communication similar specimens occur also in the USA.

Very interesting is the difference of the adaxial cuticle in the Lampertice Member (Žacléř) speciemen and the specimens from the Prkenný Důl-Žďárky Member (Rtyně v Podkrkonoší).

Occurrence and distribution: Intrasudetic Basin, Žacléř Formation: Westphalian B, Lampertice Member: Lampertice near Žacléř, Šverma Mine, excavation of the pit Jan (? 5-7th overlying seam). Prkenný Důl-Žďárky Member: Rtyně v Podkrkonoší, Z. Nejedlý Mine (formerly Ida Gallery).

Alethopteris sp.
Pl. XXI, fig. 8, pl. XXII, figs. 1-3

This designation refers to the specimens from the Intrasudetic as well as Upper Silesian Basin whose pertinence was undeterminable.

Interesting is the specimen from the Intrasudetic Basin (pl. XXI, fig. 8) having as robust pinnules as *Alethopteris valida* BOULAY but gently lobate pinnule margins and denser venation. Further three specimens depicted on pl. XXII come from the Upper Silesian Basin. The specimen in fig. 1 was identified by HAVLENA as *Alethopteris* cf. *davreuxii* (BRONGNIART) GOEPPERT. However, its considerable stratigraphic age (Namurian C) the same way of presentation of the pinnules do not allow this identification. In fig. 2 there is an ultimate order pinna with small pinnules and venation directed obliquely toward the pinnule margin, Namurian B in age. These are likely very young pinnules of *Alethopteris urophylla* (BRONGNIART) GOEPPERT. A similar specimen classified by E. PURKYŇOVÁ as ? *Alethopteris* cf. *valida* BOULAY is in fig. 3. It comes from the Namurian C and its venation is wider than that of the specimen in fig. 2.

In the collections studied there are about 100 specimens from both basins denoted as *Alethopteris* sp. These specimens were not involved in the statistical processing of the pinnule variability.

Evaluation of the material studied

Remarks on the stratigraphy

The described species come from two regions - the Intrasudetic and the Upper Silesian Basins, and two formations - Žacléř and Karviná.

The phytostratigraphic classification of the Žacléř Formation I took over from PURKYŇOVÁ (1986) and that of the Karviná Formation from PURKYŇOVÁ (1967). In the Upper Silesian Basin the Karviná Formation falls in the Saddle, Suchá and Doubrava Members, being Namurian B to Westphalian A in age. The Namurian B builds an inextensive section at the base of the Saddle Member (39th and 38th seam). The Namurian C sets on with the appearance of the species *Paripteris gigantea* (STBG.).

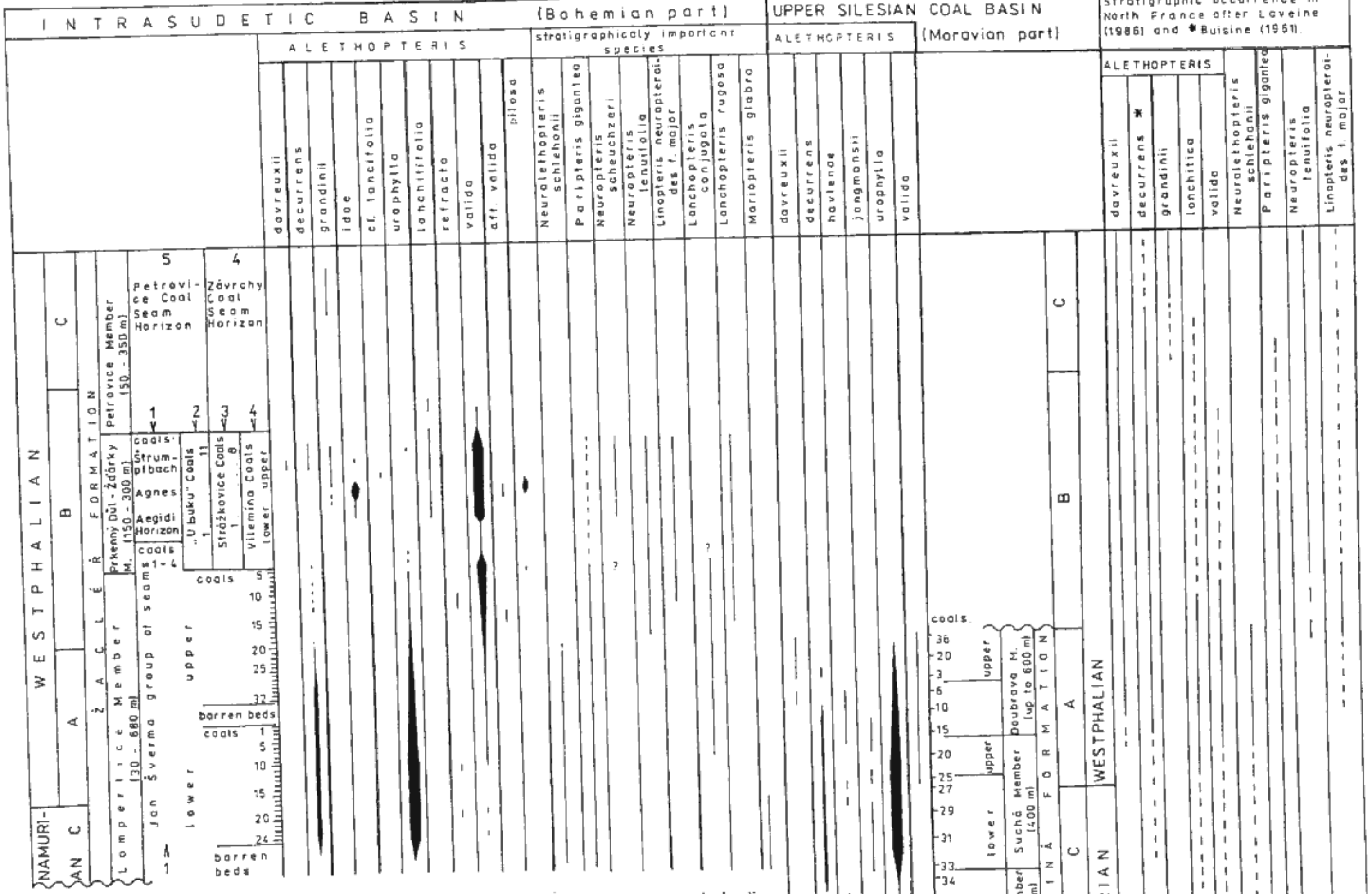
In the Lower Silesian Basin the Žacléř Formation falls in with the Lampertice, Prkenný Důl-Žďárky, and Petrovice Members. The formation is Namurian C to Westphalian C in age. To the Namurian C belongs the lowermost part of the Lampertice Member roughly to the 16th underlying seam of the Šverma Mine with the occurrence of the species *Mariopteris glabra* STOPA the last occurrences of which in the Polish part of the Intrasudetic Basin delimit the Namurian C/Westphalian A boundary. As the Namurian C ŠETLÍK in STŘEDA (1972) takes only small seamless section at the base of the Lampertice Member (formerly denoted as the Biały Kamień Member to the base of the cycle of the 7th underlying seam of the Šverma Mine). In RIEGER's (1974) conception the Westphalian A identifies with this section as far as the base of the cycle of the 11th overlying seam of the Šverma Mine. The species *Paripteris gigantea* STBG. becomes ubiquitous already from the base of the Lampertice Member.

The Westphalian A in the Ruhr Region ends by the last occurrence of the species *Neuralethopteris schlehanii* (STUR). In the Intrasudetic Basin this species disappears around the 20th overlying seam of the Šverma Mine group of seams. In the Upper Silesian Basin this species occurs still throughout the whole Doubrava Member.

Tásler at al. (1979) place the lithological boundary of the Westphalian A and B in the Intrasudetic Basin on the boundary of the Lampertice and Prkenný Důl-Žďárky Members, i.e. above the cycle of the overlying seam No. 5 in the Šverma Mine group of seams.

In the Intrasudetic Basin, the entire Prkenný Důl-Žďárky Member refers to the Upper Westphalian B, because the species *Paripteris gigantea* (STBG.) has occurred even in the uppermost seams of these members. This accords with ŠETLÍK in STŘEDA (1972) as well as with ŠETLÍK in TÁSLER et al. (1979). Of the stratigraphically significant

Table 1. Occurrences of the species of the genus *Alethopteris* STERNBERG and of some stratigraphically significant species in the Intrasudetic and Upper Silesian Basins



Full line in the columns of species from France and of stratigraphically significant species represents a common occurrence; broken line - rare occurrence; full line in the columns *Alethopteris* from Czech Republic represents a comparatively rare continuous occurrence of the species; short lines - occasional occurrences; thick lines - more frequent to very frequent occurrences; ? - uncertain finds; P - data from PURKYŇOVÁ (1976) (specimens were not at disposal); + - location of the specimen *Alethopteris* cf. *valida* BOULAY from the borehole Čeladná (NP 552). In the Intrasudetic Basin the columns designated 1-5 correspond to various regions: 1 - Žacléř region; 2 - Lhota-Markoušovice region; 3 - Strážkovice region; 4 - Žďárky region; 5 - Petříkovice-Markoušovice region. Remark: The reduced Lampertice Member (with 3 seams) is also in Strážkovice region. As no alethopterids have been found there, it was not mentioned in Table 1. The stratigraphic charts of the Upper Silesian and Intrasudetic Basins are schematic. Stratigraphically correlating are only the members of the two basins, not the seams.

species of these members here occur *Laveineopteris* (al. *Neuropteris*) *tenuifolia* (STBG.) CLEAL, SHUTE et ZODROW and *Linopteris neuropteroides* GUTB. forma *major* POT.

Owing to a shortage of flora the exact delimitation of the Westphalian B/C boundary is unfeasible. This boundary stretches somewhere in the lower part of the Petrovice Member. The upper part of the Petrovice Member (with the coal seams) already contains flora typical of the Westphalian C.

Table 1 presents schematic illustrations of stratigraphic occurrences of the described species from the Intrasudetic and Upper Silesian Basin. Occurrences of some stratigraphically significant species are recorded and compared with the occurrences of these species in France (LAVEINE, 1986, BUISINE, 1961).

The species *Alethopteris urophylla* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH and rarely *A. valida* BOULAY and *A. refracta* FRANKE occur in the Intrasudetic Basin aldeady in the Namurian C.

In the Upper Silesian Basin the species *Alethopteris urophylla* and probably also *Alethopteris decurrens* occur in the Namurian B. Already from the Lower Namurian C they are being accompanied by rare species *Alethopteris jongmansii* ŠUSTA and *Alethopteris havlenae* sp. nov. The species *Alethopteris valida* BOULAY is safely proved as late as in the Westphalian A (in the Namurian only uncertain finds). The species *Alethopteris davreuxii* (BRONGNIART) GOEPPERT has been detected only in the Doubrava Member (Westphalian A).

In the Westphalian B of the Intrasudetic Basin the most frequent species are *Alethopteris valida* BOULAY, *A. idae* ŠIMŮNEK and *A. pilosa* sp. nov. Rare is the occurrence of *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. grandinii* (BRONGNIART) GOEPPERT, *A.* cf. *lancifolia* WAGNER, *A. lonchitifolia* P. BERTRAND, and *A.* aff. *valida* BOULAY. *Alethopteris decurrens* (ARTIS) FRECH, *A. urophylla* (BRONGNIART) GOEPPERT, and *A. refracta* FRANKE occur here for the last time.

The Westphalian C of the Intrasudetic Basin has yielded very little floral finds. Only one species of the genus *Alethopteris* - *Alethopteris grandinii* (BRONGNIART) GOEPPERT has been detected here.

The floral associations of the Lampertice, Prkenný Důl-Žďárky, and Petrovice Members are given in the papers by ŠETLÍK in HOLUB - WAGNER (1977) and ŠETLÍK in TÁSLER at al. (1979), Saddle, Suchá and Doubrava members in the paper by PURKYŇOVÁ (1963).

Statistical evaluation of the material

621 pinnules of different specimens and species of the genus *Alethopteris* Sternberg have been measured. The measurements have concentrated on the following five features: length of pinnules, width of pinnules at the base, width of pinnules in the midpart, number of veins per 1 cm on the pinnule margin, and type of the pinnule apex.

The features pinnule length, width in the midpart and at the base have been measured with the accuracy of 0.5 mm. The pinnule length has been measured from the contact place of the midrib and rachis toward the pinnule apex, the pinnule width at the base corresponds to the distance between two reference points in the folds on boht sides of the pinnule. The pinnule width in the midpart is the distance between the pinnule margins measured in the middle of the pinnule perpendicularly to the midrib.

As a rule, the number of veins per 1 cm on the pinnule margin was measured on 0.5 cm marginal segment in the midpart of the pinnule. The measurement accuracy per 1 cm attained to ±2 veins. Check measurements have revealed that in different places of one pinnule the venation density may vary. For example in *Alethopteris urophylla* (BRONGNIART) GOEPPERT the difference in the venation density on the basiscopic and acroscopic side of one pinnule may be even 8 veins per 1 cm on the pinnule margin. In some worse preserved pinnules the venation density could not be determined at all.

The apex type was estimated according to the prepared scale: 1. widely rounded, 2. rounded, 3. blunt, 4. bluntly pointed, 5. pointed.

The results of the measurements are summarized in table 2, where minimum, maximum, mean values and standard deviations of the measured features of the individual species of the genus *Alethopteris* STERNBERG are specified.

As concerns the species *Alethopteris decurrens* (ARTIS) FRECH, *Alethopteris urophylla* (BRONGNIART) GOEPPERT and *Alethopteris valida* BOULAY occurring both in the Intrasudetic and Upper Silesian Basins, their populations have been evaluated separately, sometimes even the Lampertice and Prkenný Důl-Žďárky Member populations have been differentiated.

The species *Alethopteris decurrens* (ARTIS) FRECH from the Upper Silesian Basin more frequently exhibits narrower pinnules than that from the Intrasudetic Basin. This is due to a higher representation of the angustifoliate form *gracillima* BOULAY in the Upper Silesian Basin. *Alethopteris decurrens* from the Upper Silesian Basin shows the average width of the pinnules in the middle part 2.06 mm whereas that from the Intrasudetic Basin 2.37 mm. Their venations have a corresponding density - forma *gracillima*'s venation is a bit wider than that of forma *decurrens*. *Alethopteris decurrens* from the Upper Silesian Basin has the average venation density 47 veins per 1 cm on the pinnule margin, that from the Intrasudetic Basin 59 veins per 1 cm on the margin.

The values of all the features measured in the populations of the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT from the Karviná Formation and the Lampertice Member are comparable.

The same holds for the features of the populations of the species *Alethopteris valida* BOULAY from the Upper Silesian Basin, Lampertice and Prkenný Důl-Žďárky Members.

From the measurements of the species *Alethopteris decurrens* (ARTIS) FRECH, *Alethopteris urophylla* (BRONGNIART) GOEPPERT, *Alethopteris valida* BOULAY,

Table 2. Statistical evaluation of the studied specimens of *Alethopteris* STERNBERG

species members	numbers of specimens	length of pinnules					width of pinnules in the midpart					width of pinnules at the base					type of pinnule apex					numbers of specimens	number of veins per 1 cm on pinnule margin				
		min. (mm)	max. (mm)	x (mm)	GM (mm)	S (mm)	min. (mm)	max. (mm)	x (mm)	GM (mm)	S (mm)	min. (mm)	max. (mm)	x (mm)	GM (mm)	S (mm)	min. (mm)	max. (mm)	x (mm)	GM (mm)	S (mm)		min. (mm)	max. (mm)	x (mm)	GM (mm)	S (mm)
davreuxii	5	8.5	15	11	11.24	2.57	3.5	4.5	4.1	4.12	0.42	4.5	6.5	5.6	5.64	0.74	2.5	3.5	2.7	2.7	0.4	5	30	36	32	32	3
decurrens in total	89	4	33.5	15.31	13.96	6.27	1	4.5	2.24	2.11	0.75	1.5	8.5	4.72	4.46	1.52	4	5	4.3	4.3	0.3	85	38	94	54	54	9
Karviná Formation	32	5	28	13.66	12.58	5.44	1	4	2.06	1.96	0.68	2	8	4.47	4.22	1.56	4	5	4.4	4.3	0.3	31	38	56	47	47	5
Lampertice Member	50	4	33.5	16.25	14.79	6.6	1	4.5	2.37	2.23	0.81	1.5	8.5	4.89	4.61	1.53	4	5	4.3	4.3	0.3	48	44	94	59	58	9
cf. grandinii	19	4	11.5	7.47	7.25	1.85	2	4.5	3.58	3.59	0.53	3	5	4.13	4.10	0.55	1	4.5	1.9	1.8	0.7	19	20	36	25	25	4
havlenae	13	6.5	21	11.52	11.02	4.03	3	8	4.77	4.7	0.83	4	7	5.85	5.77	0.92	3	3.5	3.2	3.2	0.3	13	56	70	59	59	4
idae	88	6	30.5	12.74	12.16	4.01	3	6.5	4.41	4.34	0.78	4	10	5.98	5.90	0.97	2.5	4.5	3.3	3.3	0.5	84	32	52	44	43	5
jongmansii	14	7	29.5	15.32	14.35	5.86	2	5	3.32	3.29	0.82	3.5	7	5.32	5.19	1.2	3.5	5	4.3	4.3	0.5	14	36	46	42	42	4
cf. lancifolia	1	12	12	12	12	0	4.5	4.5	4.5	4.5	0	5.5	5.5	5.5	5.5	0	4	4	4	4	0	1	64	64	64	64	0
urophylla in total	192	5.5	42	18.47	17.31	6.76	2	7.5	4.21	4.1	0.98	3	13	6.15	5.97	1.51	3.5	5	4.1	4.1	0.3	188	40	72	58	57	6
Karviná Formation	78	5.5	42	19.84	18.3	8.01	2	6.5	4.29	4.2	0.92	3	13	6.26	6.03	1.8	3.5	5	4.2	4.2	0.3	77	42	68	57	56	6
Lampertice Member	110	7	35	17.61	16.77	5.44	2	7.5	4.17	4.04	1.02	3.5	10	6.07	5.93	1.3	3.5	4.5	4.1	4.1	0.3	107	40	72	58	58	6
lonchitifolia	6	7.5	23	16	16.8	5.61	2	8.5	5.08	5.46	2.18	4	14	6.83	7.6	3.66	3.5	4	3.8	3.8	0.3	6	46	56	52	52	4
refracta	10	5	17	9.1	8.53	3.59	2.5	6	3.55	3.49	1.07	3.5	7.5	4.65	4.71	1.27	2.5	4	3	3	0.5	10	36	44	40	40	3
valida in total	129	6	27	12.26	11.69	3.89	2.5	10	5.24	5.05	1.44	3.5	12	6.85	6.66	1.65	2.5	5	3.3	3.3	0.5	120	28	60	37	36	6
Karviná Formations	10	7.5	21.5	12.8	12.22	4.37	2.5	7	5.2	4.99	1.33	4	8.5	6.6	6.46	1.42	3	4	3.7	3.6	0.3	10	32	44	37	37	5
Lampertice Member	71	6.5	27	12.23	11.59	4.18	3	9	5.32	5.14	1.31	4	12	7.05	6.86	1.66	2.5	5	3.4	3.3	0.6	67	28	44	36	36	4
Prkenný Důl-Žďárky Member	48	5.5	21.5	12.19	11.73	3.38	2.5	10	5.14	4.94	1.46	3.5	12	6.6	6.41	1.68	2.5	4.5	3.2	0.5	0.5	43	28	60	38	37	7
aff. valida	5	17	40	28.8	30.03	9.52	5.5	8.5	7.5	7.57	1.17	7	10	8.6	8.65	1.68	2.5	3.5	3	3	0.4	5	34	40	36	36	3
pilosa	46	3	15	7.46	7	2.69	3	6	3.89	3.84	0.65	3.5	11	5.7	5.5	1.64	2	4	3.1	3	0.6	41	26	52	36	36	6
in total	621	3	42	14.35	13.01	6.48	1	10	4.14	3.89	1.40	1.5	14	5.94	5.71	1.63	1	5	3.7	3	0.7	595	20	94	47	46	12

Explanations: type of apex - 1 - widely rounded, 2 - rounded, 3 - blunt, 4 - bluntly pointed, 5 - pointed, x - arithmetic mean, GM - geometric mean, S - standard deviation.

Alethopteris idae ŠIMŮNEK and *Alethopteris pilosa* sp. nov. histograms of relative frequencies have been compiled (see figs. 36-39).

Similar histograms have been worked out for the whole genus *Alethopteris* STERNBERG (fig. 40). Below the histograms "Number of veins per 1 cm on the pinnule margin" and "Type of pinnule apex" there is an explanation which species and in what proportion have been represented in these histograms. Alike histograms have been published by SCHEIHING - PFEFFERKORN (1980).

Evaluation of the cuticles

Cuticles have been prepared only from 10 species of the genus *Alethopteris* STERNBERG (see table 3). Of the species *Alethopteris lonchitifolia* P. BERTRAND and *Alethopteris pilosa* sp. nov. only adaxial cuticles have been extracted in a good state.

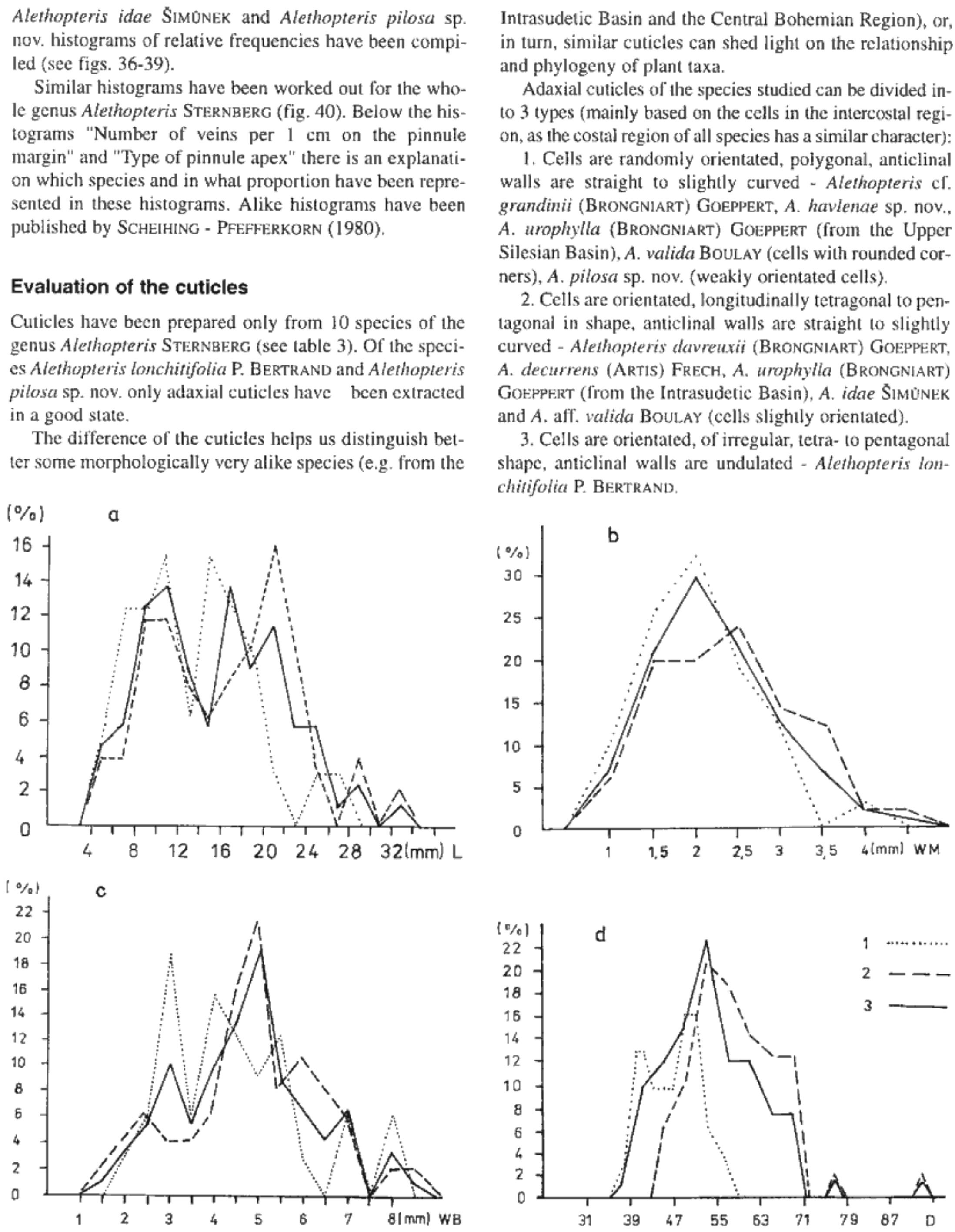
The difference of the cuticles helps us distinguish better some morphologically very alike species (e.g. from the Intrasudetic Basin and the Central Bohemian Region), or, in turn, similar cuticles can shed light on the relationship and phylogeny of plant taxa.

Adaxial cuticles of the species studied can be divided into 3 types (mainly based on the cells in the intercostal region, as the costal region of all species has a similar character):

1. Cells are randomly orientated, polygonal, anticlinal walls are straight to slightly curved - *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT, *A. havlenae* sp. nov., *A. urophylla* (BRONGNIART) GOEPPERT (from the Upper Silesian Basin), *A. valida* BOULAY (cells with rounded corners), *A. pilosa* sp. nov. (weakly orientated cells).

2. Cells are orientated, longitudinally tetragonal to pentagonal in shape, anticlinal walls are straight to slightly curved - *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH, *A. urophylla* (BRONGNIART) GOEPPERT (from the Intrasudetic Basin), *A. idae* ŠIMŮNEK and *A.* aff. *valida* BOULAY (cells slightly orientated).

3. Cells are orientated, of irregular, tetra- to pentagonal shape, anticlinal walls are undulated - *Alethopteris lonchitifolia* P. BERTRAND.



36. Histograms of relative frequencies of the length of pinnules, width of pinnules in the midpart and at the base, and of the number of vein per 1 cm on the pinnule margin in the species *Alethopteris decurrens* (ARTIS) FRECH.
L - length of pinnules, WM - width of pinnules in the midpart, WB - width of pinnules at the base, D - number of veins per 1 cm on the pinnule margin, 1 - *Alethopteris decurrens* from the Karviná Formation (figs. a, b, c from 32 specimens, fig. d from 31 specimens), 2 - from the Lampertice Member (figs. a, b, c from 50 specimens, fig. d from 48 specimens), 3 - *Alethopteris decurrens* in total (figs. a, b, c from 89 specimens, fig. d from 85 specimens).

The abaxial cuticle can be evaluated on the one hand according to the orientation and shape of the cells, on the other according to the orientation, size, shape and sinking of the stomata.

On the basis of the cells in the intercostal region the cuticles can be assignated to the 4 types:

1. Cells are randomly orientated, polygonal, anticlinal walls are straight - *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, anticlinal walls are curved to slightly undulated - *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT and *A. valida* BOULAY.

2. Cells are randomly orientated, trapezoidal to pentagonal in shape, anticlinal walls are straight to slightly curved - *Alethopteris decurrens* (ARTIS) FRECH and *A. idae* ŠIMŮNEK.

3. Cells are slightly orientated, of different, irregularly tetragonal to longitudinally polygonal shape, anticlinal walls are straight to strongly curved - *Alethopteris urophylla* (BRONGNIART) GOEPPERT and *A.* aff. *valida* BOULAY.

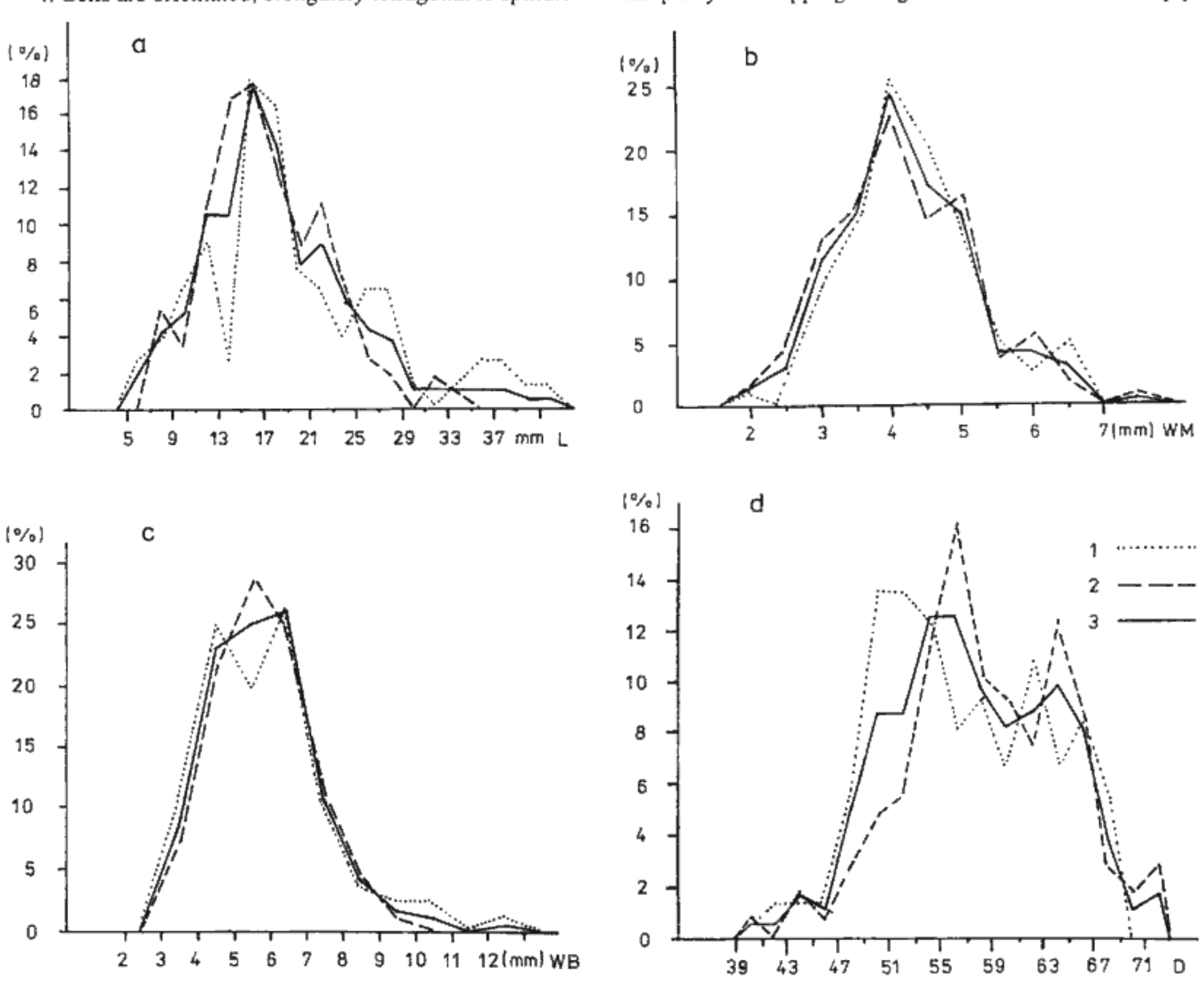
4. Cells are orientated, elongately tetragonal to spindle-shaped, anticlinal walls are slightly to expressively curved - *Alethopteris havlenae* sp. nov.

The stomata of the species studied refer, according to their origin, to haplocheilic type. According to the shape of the neighbouring cells the stomata are anomocytic (except *Alethopteris idae* ŠIMŮNEK having actinocytic stomata), the neighbouring cells are monocyclic.

The smallest stomata exhibits *Alethopteris valida* BOULAY - 12-15 µm long. 20-30 µm long stomata show the species *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT, *A. urophylla* (BRONGNIART) GOEPPERT and *A. idae* ŠIMŮNEK, while 30-40 µm long stomata possess the species *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH and *A. havlenae* sp. nov. *Alethopteris* aff. *valida* BOULAY has 24-38 µm long stomata.

According to the presence of the papillae, the stomata can be divided into two large groups:

1. On the neighbouring cells of the stoma grow papillae partly overlapping the guard cells which are deeply



37. Histograms of relative frequencies of length of pinnules, width of pinnules in the middle and at the base, and of the vein number per 1 cm on the pinnule margin of the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT.
L - length of pinnules, WM - width of pinnules in the midpart, WB - width of pinnules on the base, D - number of veins per 1 cm of the pinnule margin. 1 - *Alethopteris urophylla* from the Karviná Formation (figs. a, b, c from 78 specimens, fig. d from 77 specimens), 2 - from the Lampertice Member (figs. a, b, c from 110 specimens, fig. d from 107 specimens), 3 - *Alethopteris urophylla* in total (figs. a, b, c from 192 specimens, fig. d from 188 specimens).

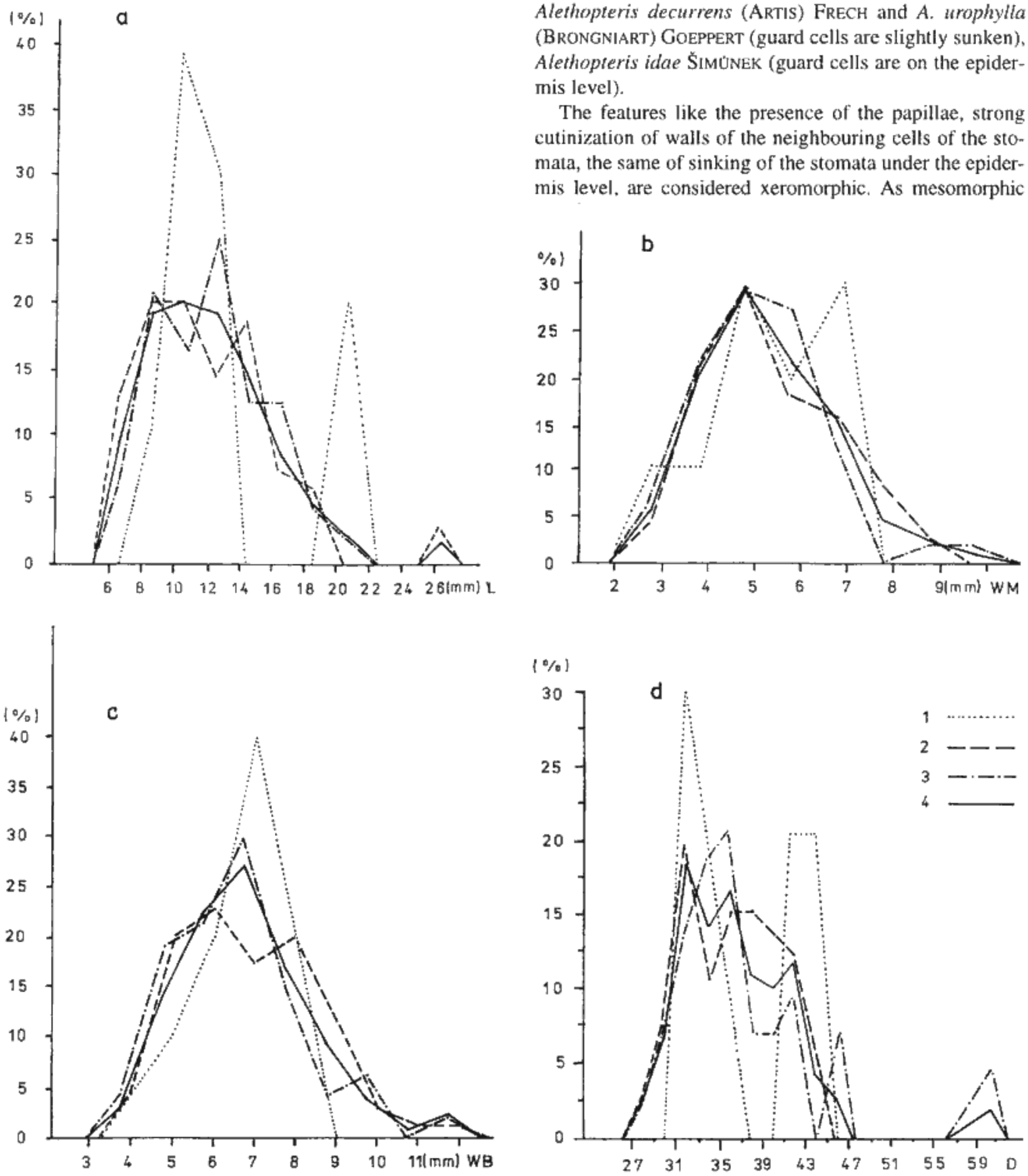
sunken under the epidermis level. Papillae are cutinized stronglier in *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, and *A. grandinii* (BRONGNIART) GOEPPERT, lesser in *Alethopteris valida* BOULAY.

2. Neighbouring cells of the stoma are without papillae.

a) Cutinization of the anticlinal walls of the neighbouring cells is strong toward the stoma - *Alethopteris havlenae* sp. nov. (guard cells are deeply sunken), *Alethopteris* aff. *valida* BOULAY (guard cells are slightly sunken).

b) Cutinization of the neighbouring cells is weak - *Alethopteris decurrens* (ARTIS) FRECH and *A. urophylla* (BRONGNIART) GOEPPERT (guard cells are slightly sunken), *Alethopteris idae* ŠIMŮNEK (guard cells are on the epidermis level).

The features like the presence of the papillae, strong cutinization of walls of the neighbouring cells of the stomata, the same of sinking of the stomata under the epidermis level, are considered xeromorphic. As mesomorphic



38. Histograms of relative frequencies of length of pinnules, width of pinnules in the midpart and at the base, and of the number of veins per 1 cm on the pinnule margin in the species *Alethopteris valida* BOULAY from the Upper Silesian and Intrasudetic Basins.
L - length of pinnules, WM - width of pinnules in the midpart, WB - width of pinnules at the base, D - number of veins per 1 cm on the pinnule margin. 1 - *Alethopteris valida* from the Karviná Formation (from 10 specimens), 2 - from the Lampertice Member (figs. a, b, c from 71 specimens, fig. d from 67 specimens), 3 - from the Prkenný Důl-Ždárky Member (figs. a, b, c from 48 specimens, fig. d from 43 specimens), 4 - *Alethopteris valida* from all these units (figs. a, b, c from 129 specimens, fig. d from 120 specimens).

to hygromorphic are identified are cuticles lacking papillae and with stomata at the epidermis level. During this classification also the degree of cutinization of the papillae and cuticles, the sinking rate and the size of the guard cells (stomata) must be taken into consideration.

Trichomes belong to very significant features of the cuticles. All the trichomes are polycellular, simple, uniseriate. Based on their function they are divided into non-glandular and glandular. The glandular trichomes are terminated by a spherical secretion cell. They were found only in the species *Alethopteris valida* BOULAY and *A. pilosa* sp. nov.

The non-glandular trichomes are of various shape and size. They grow boht on the adaxial and abaxial cuticle, in the place of the midrib, on rachises, and from pinnule margins as well.

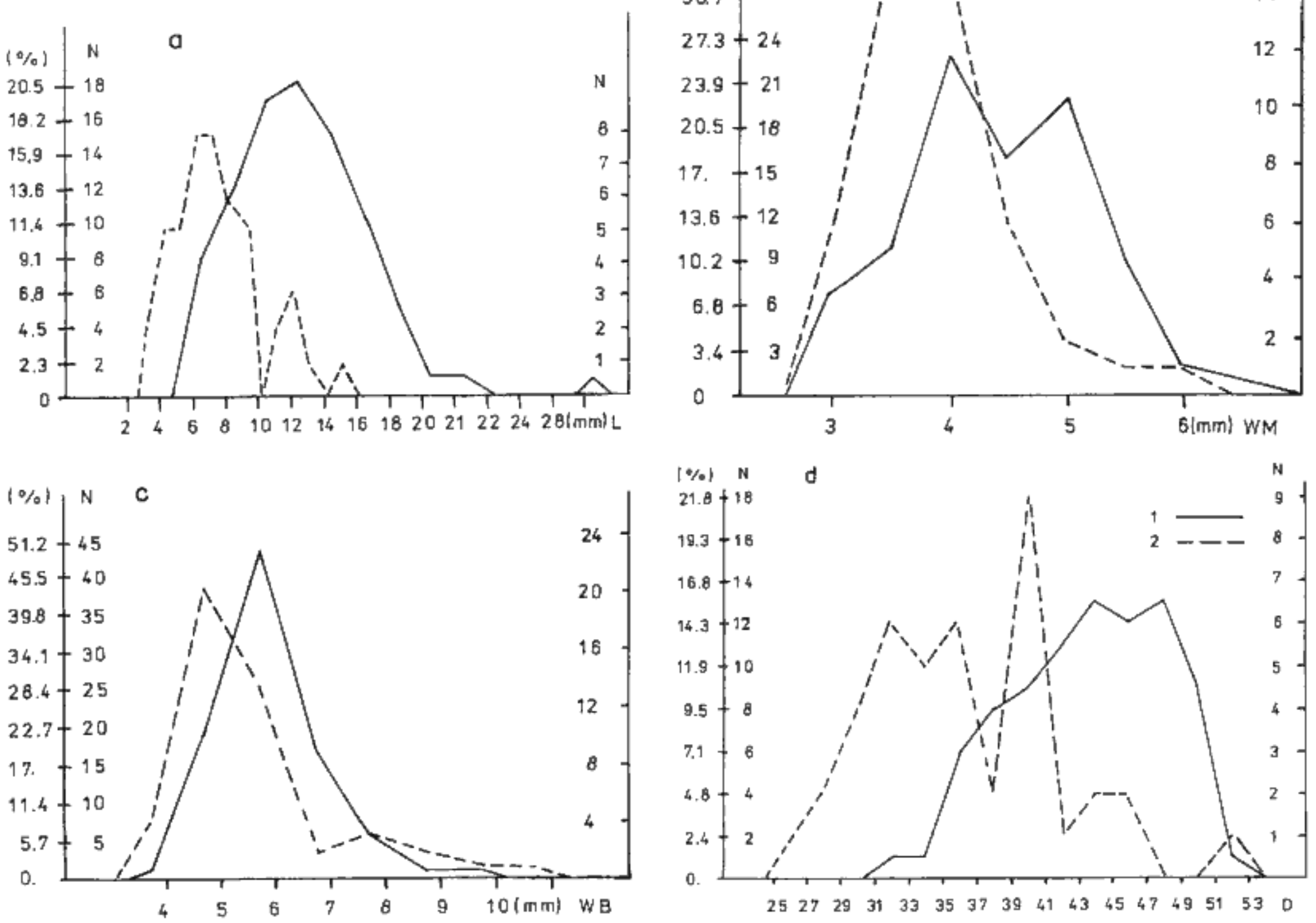
The longest trichomes grew from the penultimate order rachis of the species *Alethopteris pilosa* sp.nov. - up to 4.5 mm, in the place of the midrib in the species *Alethopteris pilosa* - up to 3 mm, in *Alethopteris valida* BOULAY up to 2 mm, in *A. davreuxii* (BRONGNIART) GOEPPERT - up to 1.4 mm and in *Alethopteris havlenae* sp. nov. to 0.9 mm. The trichomes of the adaxial and abaxial cuticles are most often 300-750 µm long - in *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH, *A. havlenae* sp. nov. and *A. valida* BOULAY.

The smallest trichomes occur in *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT - 160 µm (adaxial cuticle) and in *Alethopteris urophylla* (BRONGNIART) GOEPPERT (cuticle on the pinnule midrib).

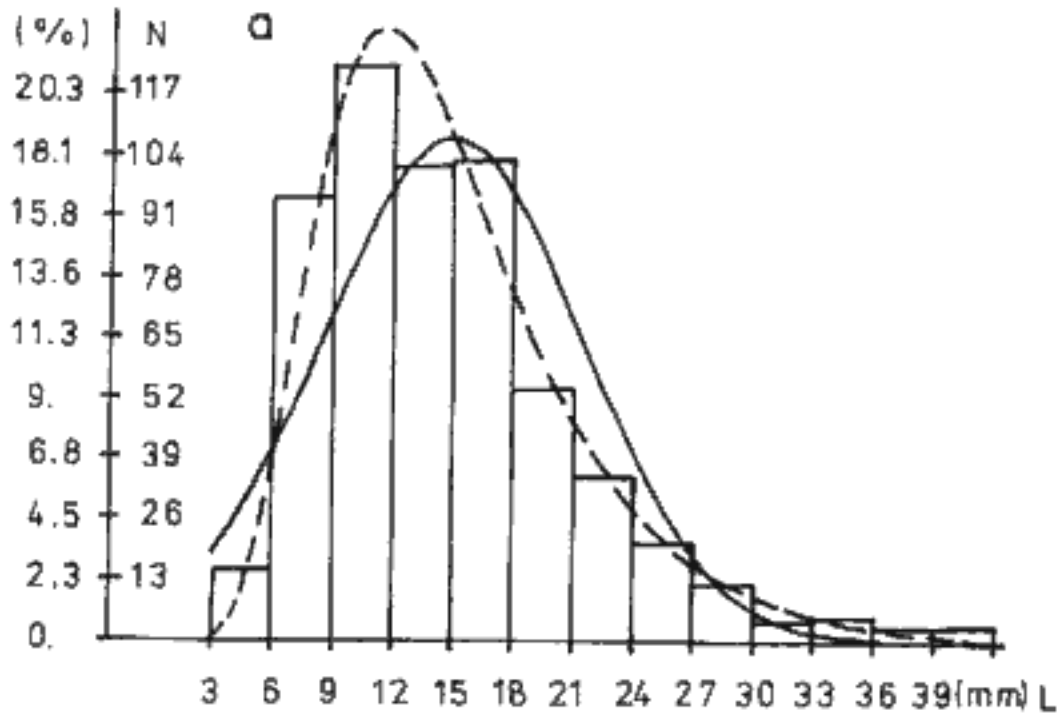
The function of the trichomes still remains partly obscured. The trichomes of the abaxial cuticle could help lowering of transpiration, those of the adaxial cuticle seemingly protected the plant from higher insolation.

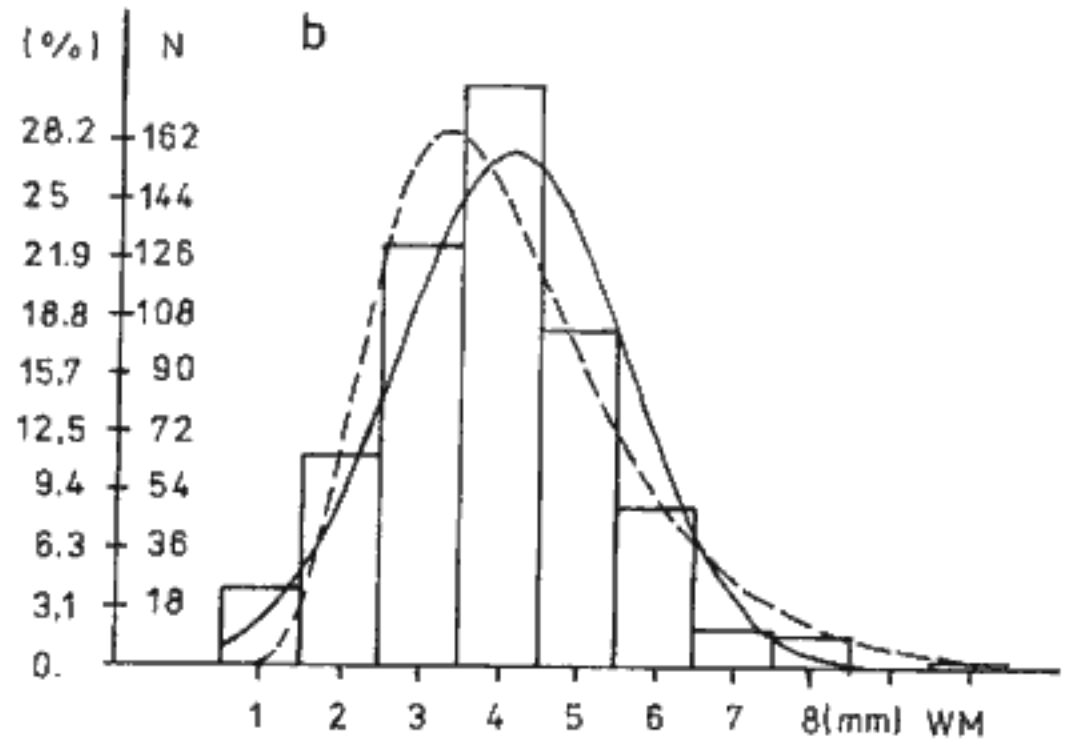
On the cuticles prepared from the same species from the Upper Silesian and Intrasudetic Basin certain differences are apparent. For example, in the species *Alethopteris decurrens* (ARTIS) FRECH from the Intrasudetic Basin no trichomes have been found. As concerns the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT derived from both basins, there is a marked difference in the orientation of the cells of the adaxial cuticle as well as in the trichom size (see table 3).

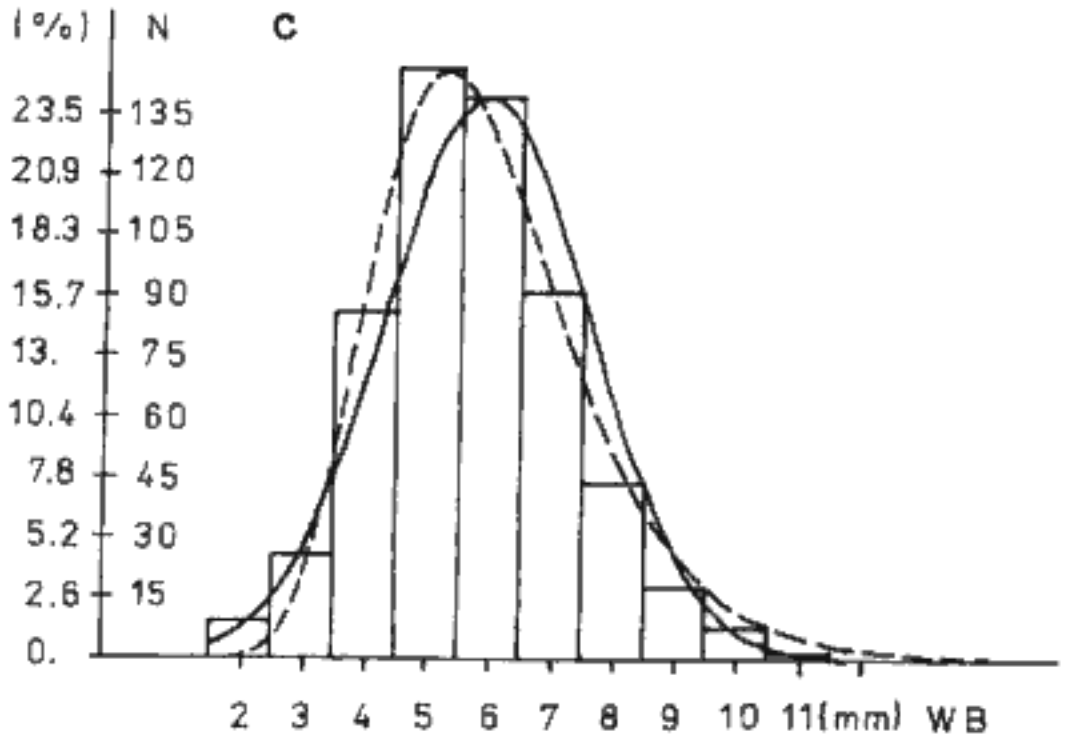
The abaxial cuticle of *Alethopteris davreuxii*

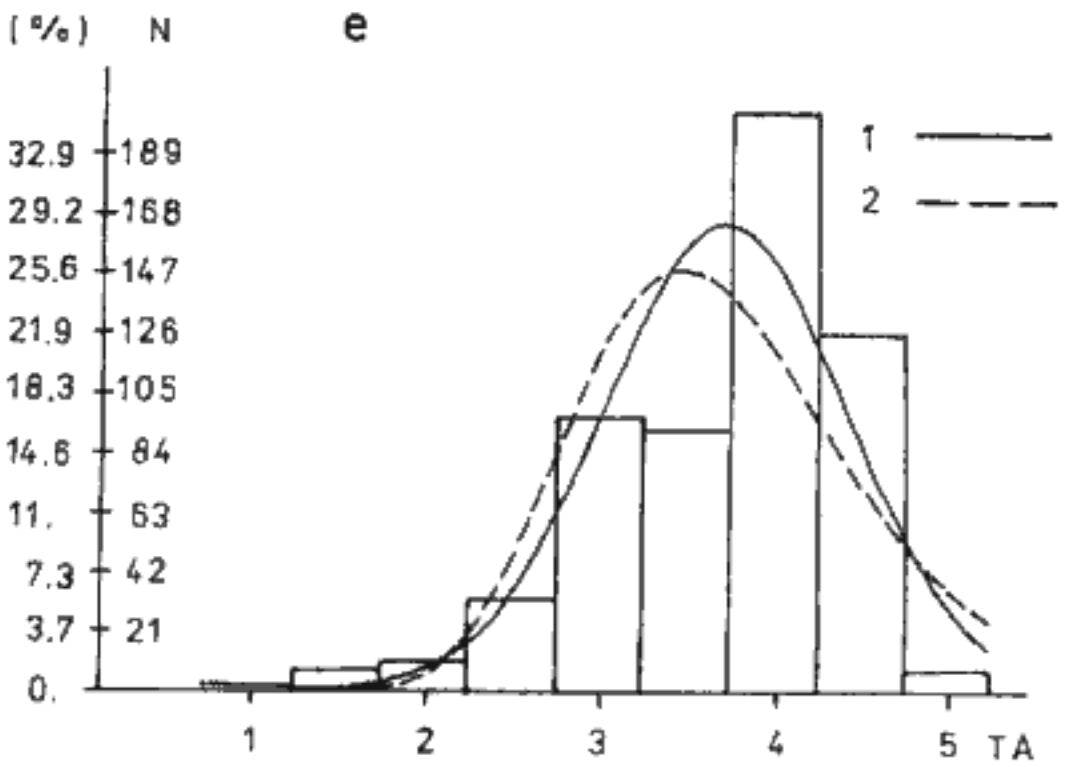


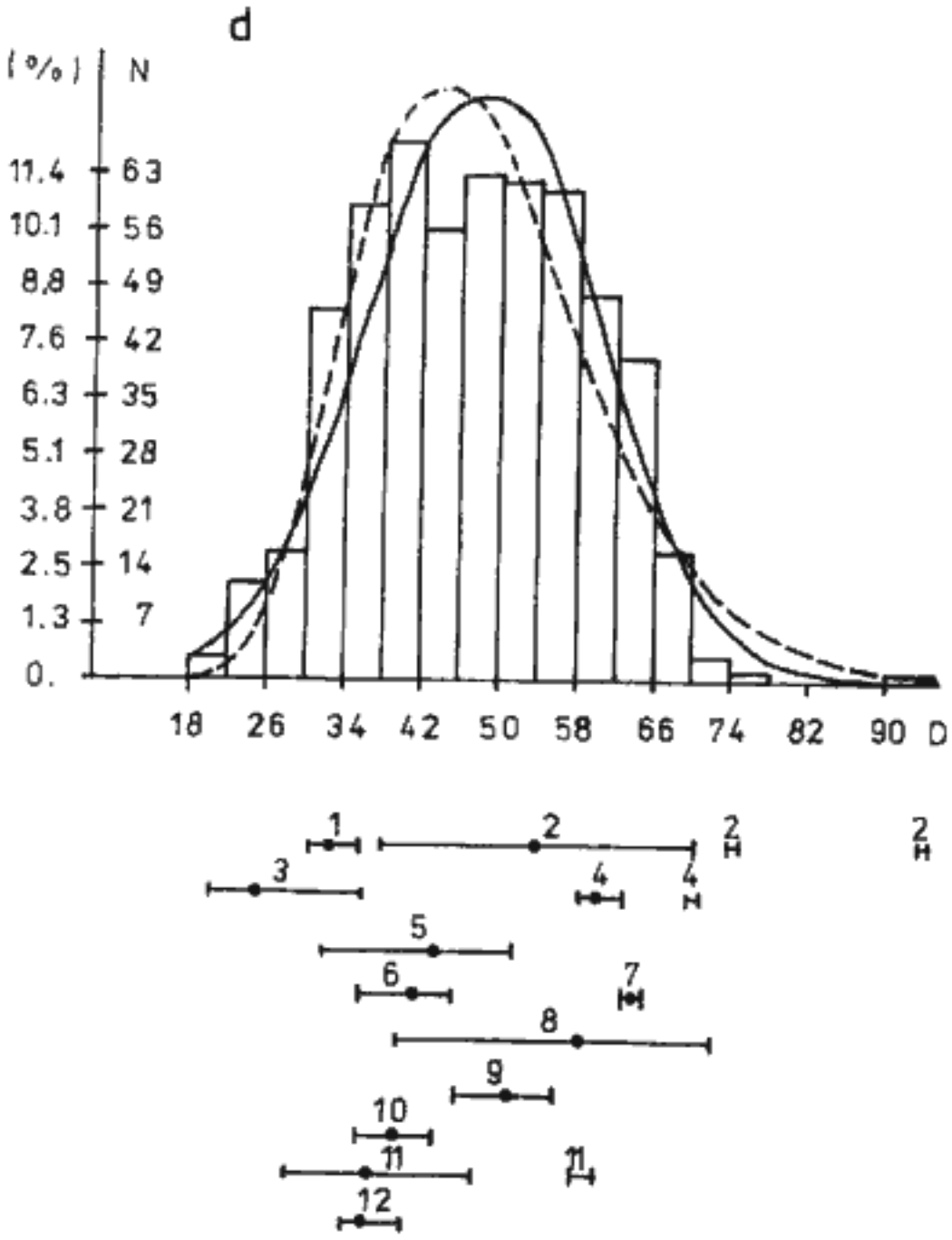
39. Histograms of relative frequencies of length of pinnules, width of pinnules in the midpart and at the base, and of the number of veins per 1 cm on the pinnule margin in the species *Alethopteris* idae ŠIMŮNEK and *Alethopteris pilosa* sp. nov.
L - length of pinnules, WM - width of pinnules in the midpart, WB - width of pinnules at the base, D - number of veins per 1 cm on the pinnule margin. 1 - *Alethopteris idae* (figs. a, b, c from 88 specimens, fig. d from 84 specimens) 2 - *Alethopteris pilosa* (figs. a, b, c from 46 specimens, fig. d from 41 specimens), the left scale of specimen number is for *Alethopteris idae*, the right one for *Alethopteris pilosa*.

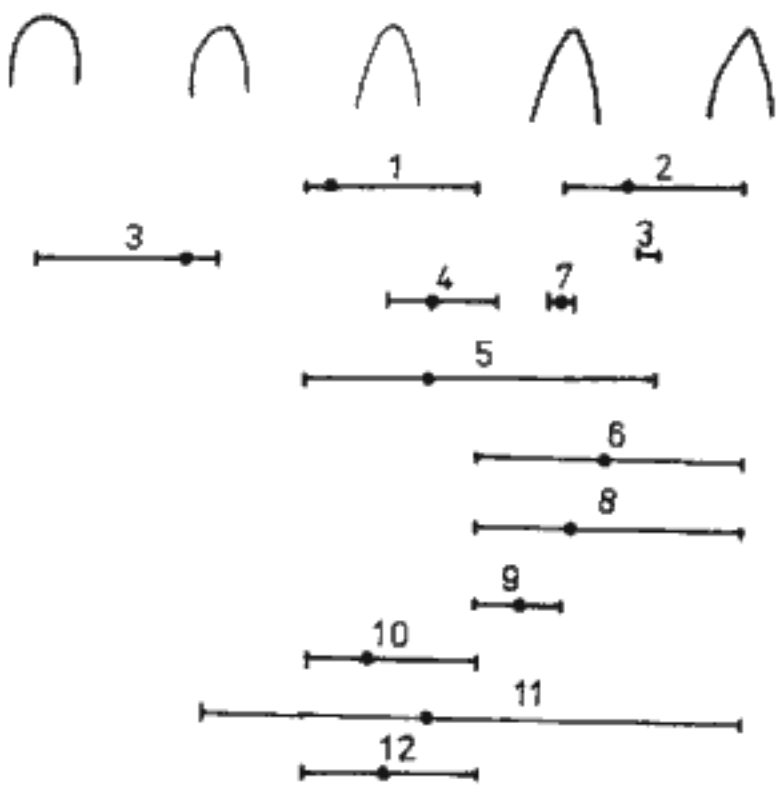












40. Histograms of relative frequencies of length of pinnules, width of pinnules in the midpart and at the base, and of the number of veins per 1 cm on the pinnule margin, and of the type of pinnule apex generally for the whole genus *Alethopteris* STERNBERG.
L - length of pinnules, WM - width of pinnules in the midpart, WB - width of pinnules at the base, D - number of veins per 1 cm on the pinnule margin, TA - type of pinnule apex. In figs. d, e there is a schematic information on the individual rates of the studied species in the histograms: 1 - *Alethopteris davreuxii*, 2 - *A. decurrens*, 3 - *A.* cf. *grandinii*, 4 - *A. Havlenae* sp. nov., 5 - *A. idae*, 6 - *A. jongmansii*, 7 - *A.* cf. *lancifolia*, 8 - *A. uro-phylla*, 9 - *A. lonchitifolia*, 10 - *A. refracta*, 11 - *A. valida*, 12 - *A.* aff. *valida*. Small black circles indicate the average values for the given species (figs. a, b, c from 575 specimens, fig. d from 554 specimens), curves 1 and 2 illustrate the normal and lognormal distribution.

Table 3. Significant features of cuticles of the species *Alethopteris* STERNBERG

species	adaxial cuticle					trichomes and trichom bases				papillae	
	difference between costal and intercostal field	intercostal field				ioccurrence of trichomes and their bases	diameter of trichom base (μm)	trichomes		occurrence on cuticle	diameter (μm)
		cells (orientation and shape)	anticlinal walls	size of the cells				length (μm)	width(μm)		
				length (μm)	width (μm)						
davreuxii	hardly distinct	orientated, mostly elongately tetragonal	gently curved	60-190	20-40	in the place of midrib adaxial cuticle	? ?	1 100-1 400 500-750	100-200 50-70	-	-
decurrens	no difference	orientated, mostly elongately tetragonal, less often pentagonal	gently curved	50-100	20-40	?	?	250-400	70-90	-	-
cf. *grandinii*	hardly distinct	randomly orientated, polygonal	straight	45-85	26-40	adaxial cuticle	90	up to 160	58	abaxial cuticle	around 10
havlenae	?	randomly orientated, polygonal	straight to gently curved	35-50		midrib, lateral veins	?	300-900	70-105	abaxial cuticle ? in the place of midrib	small ?
idae	hardly distinct	orientated, elongately tetragonal	straight to gently curved	50-120	20-40	-	-	-	-	in the place of midrib	very small
urophylla K = Karviná Formation L = Lampertice Member	K - no difference L - distinct to almost indistinct	K - randomly orientated, polygonal L - slightly orientated to orientated, polygonal to longitudinally quadrangular	K+L - straight to gently curved	30-65	15-35	K - midrib L - midrib	? 50-65 (maybe more) 35-65	400-500 120-170	90-120 36-50	-	-
lonchitifolia	hardly distinct	orientated, irregular, quadrangular to pentagonal	undulate	40-95	12-35	?	?	?	?	?	?
valida	hardly distinct	randomly orientated, polygonal, rounded at the corner	curved	on average 40-65		midrib adaxial and abaxial cuticle pinnule margin	? 90-100 20 ?	up to 2000 300-450 ? up to 300	up to 250 70-80 ? 40-50	?	?
aff. *valida*	hardly distinct	slightly orientated, polygonal	gently curved	60-110	20-40	midrib	?	up to 670	100-135	midrib	25-35
pilosa P = Prkenný Důl Žďárky Member L = Lampertice Member	distinct	orientated P - tetra- to pentagonal L - longitudinally quadrangular	straight to gently curved	P- 35-70 L-100-200	P-20-30 L-15-30	abaxial cuticle midrib penultimate order rachis pinnule margin	60-80 40-85 ? ?	250-400 360-3000 up to 4500 800-1000	30-35 45-285 150-250 80-130	abaxial cuticle	minute

Table 3 (continued)

species	abaxial cuticle					stomata				neighbouring cells of the stomata		
	difference between costal and intercostal region	intercostal region										
		cells (orientation and shape)	anticlinal walls	size of the cells		orientation	length (µm)	width (µm)	guard cells	number	papillae	cutinization
				length µm)	width							
davreuxii	?	randomly orientated, polygonal	straight	cca 30-50		?	28-36	12-15	deeply sunken	5-6	toward the stoma Ø10-12	stronger
decurrens	marked	randomly orientated, trapezoidal to pentagonal	straight to gently curved	cca 30-40		slight	30-40	12-16	slightly sunken	6	-	weak
cf. *grandinii*	?	randomly orientated, polygonal	? very curved	cca 30-45		?	20	9	deeply sunken	6	toward the stoma	stronger
havlenae	small	monooriented, trapezoidal to irregularly polygonal	slightly to distinctly curved	60-120	10-25	parallel to veins	30-40	14-18	deeply sunken	4-6	-	stronglier toward the stoma
idae	marked	randomly orientated, trapezoidal to irregularly polygonal	straight to distinctly curved	Ø 30-50		random	24-30	16-20	at the epidermis level	5-7	-	weak
urophylla K = Karvinná Formation L = Lampertice Member	small	slightly orientated, different shapes - trapezoidal, oblong and irregular, some cells are distintly elongate,	straight to slightly curved	30-70	10-30	K - parallel to veins L - slight	18-26	14-18	slightly sunken	5-8	-	weak
valida	?	randomly orientated, irregularly plygonal	curved to slightly undulate	24-40	16-26	slight	12-15	6-7	deeply sunken	6	toward the stoma Ø8-10 µm	weak
aff. *valida*	marked	slightly orientated, longitudinally polygonal to quadrangular	straight to distinctly curved	40-80	20-30	parallel to veins	24-38	15-18	deeply sunken	5-7	-	stronglier toward the stoma

(BRONGNIART) GOEPPERT from the Upper Silesian Basin resembles the abaxial cuticle of the same-designated species from BARTHEL's (1962) paper. The difference consists in the absence of papillae on the normal epidermal cells from the Upper Silesian Basin. The trichom size is comparable. Further difference is in the adaxial cuticle. BARTHEL's specimen shows irregular to polygonal randomly orientated cells, the specimen from the Upper Silesian Basin has orientated cells, mostly tetragonal in shape. According to WAGNER (1968), BARTHEL's specimen refers to the species *Alethopteris ambigua* LESQUEREUX.

The specimen *Alethopteris* cf. *grandini* (BRONGNIART) em. GOTHAN from the paper by BARTHEL (1962) from the Lower Permian of the Krušné hory (Erzgebirge) Basin resembles the specimen *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT from the Intrasudetic Basin as concerns the adaxial cuticle. These specimens, however, differ in the shape of the cells of the abaxial cuticle and in the presence of large trichomes in the specimen of BARTHEL (1962). According to the comparison of the synonyms given by BARTHEL (1962) and WAGNER (1968) for the species *Alethopteris grandinii*, BARTHEL's (1962) specimen does not belong to this species, but maybe to the species *Alethopteris* cf. *pensylvanica* LESQUEREUX.

I have already mentioned the differences in the cuticles of *Alethopteris urophylla* (BRONGNIART) GOEPPERT from the Intrasudetic and Upper Silesian Basins. As to the cell shape, the cuticles are comparable to those of *Alethopteris lonchitica* (SCHLOTHEIM) em. GOTHAN from BARTHEL's (1962) specimens paper. These cuticles differ only in somewhat smaller stomata and absence of trichomes in *Alethopteris lonchitica* from BARTHEL's (1962) specimens. BARTHEL's specimens are younger (Westphalian C, D), than the given specimens of this species (Namurian B - Westphalian B).

Palaeoecology and relationships

The species of the genus *Alethopteris* STERNBERG from the Žacléř and Karviná Formations occur mostly in grey, dark grey to black mudstones near the seams being part of the peat-forming flora.

In Z. Nejedlý Mine at Rtyně v Podkrkonoší, plant fossils are found in different rock types. Here, the Žďárky seams of the Strážkovice group of seams (Westphalian B) was being mined. They contain ubiquitous tuffitic, whetstone intercalations called tonsteins which are locally rich in plant fossils. Tonsteins with the best preserved flora come from the 3rd Žďárky seam. The tonstein flora differs from that of mudstone. It lacks some typical peat-forming taxa (e.g. Lepidodendraceae), on the other hand, it contains some species that are very rare in mudstones or do not occur in them at all (e.g. the species *Alethopteris idae* ŠIMŮNEK comprises locally as much as 30 % of the number of species in the tonsteins). The character of the flora of the tuffitic rocks has remained uncertain.

Several specimens of the species *Alethopteris valida* BOULAY were recorded even in fine-grained sandstones of the upper part of the Prkenný Důl-Žďárky Member and Petrovice Member. These ill-preserved specimens have probably been redeposited.

The representation of the described species from the Prkenný Důl-Žďárky Member in the tuffitic facies and in the claystone facies is shown in Table 4.

From the pinnule resemblance and also from the structure of the cuticles (if prepared at all) certain relationships between the species, and (or even some evolution trends can be followed (see text-fig. 41).

Table 4. Representation of the described species of *Alethopteris* STERNBERG from the Prkenný Důl-Žďárky Member in the tuffitic facies and in the claystone facies

	species	tuffitic facies (tuffitic rocks, tonsteins, fine-grained sandstones with tuffitic admixture)	claystone facies (claystones, light grey, dark grey to black mudstones)
Alethopteris	*davreuxii*	-	o
	decurrens [1]	-	vr
	cf. *grandinii*	-	r
	idae	mo	vr
	cf. *lancifolia*	-	o
	urophylla [1]	-	vr
	lonchitifolia	-	r
	valida	vr	f
	aff. *valida* [1]	-	o
	pilosa [2]	f	o

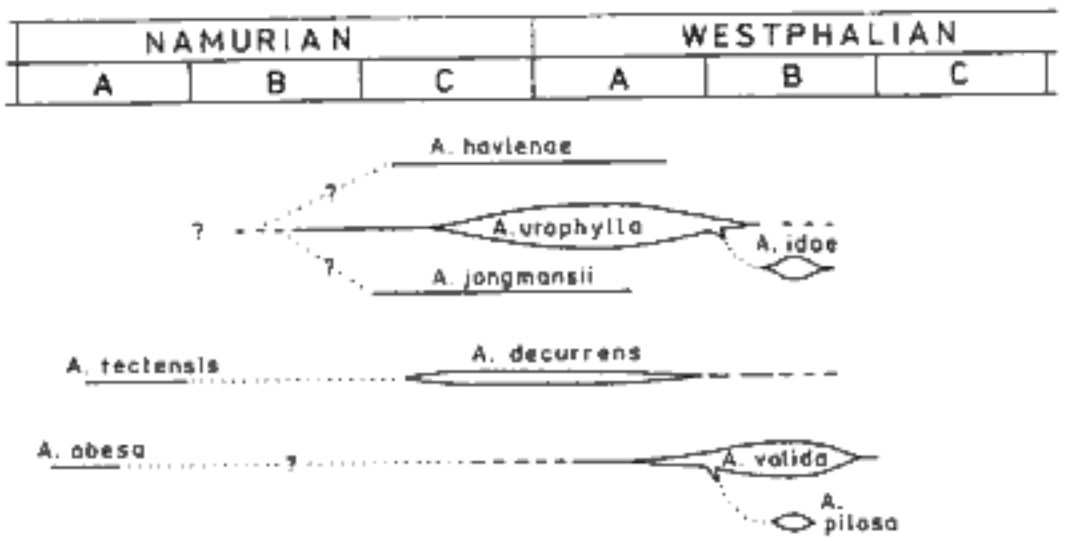
Explanations:

o	- occasional	(1-2 specimen(s))
vr	- very rare	(3-9 specimens)
r	- rare	(10-20 specimens)
f	- frequent	(21-50 specimens)
mo	- mass occurrence	(over 50 specimens)

[1] species passing from the Lampertice to the Prkenný Důl-Žďárky Member whose last occurrences come from the similar rocks as in the Lampertice Member

[2] a species occasionally occurring in the Lampertice Member, in the Prkenný Důl-Žďárky Member it is more frequent in the tuffitic facies

The species *Alethopteris urophylla* (BRONGNIART) GOEPPERT seems to be related to the species *Alethopteris havlenae* sp. nov. Both species have similarly shapes pinnules and alike venation density. They differ in the pinnule apex type, shape and orientation of the cells of the abaxial cuticle. In the stratigraphically younger specimens of



41. Supposed relationships between some species of the genus *Alethopteris* Sternberg from the Upper Silesian and Intrasudetic Basins.

Alethopteris urophylla from the Lampertice Member of the Intrasudetic Basin some changes occur with lead to the species *Alethopteris idae* ŠIMŮNEK in the Prkenný Důl-Žďárky Member. The pinnule apex changes from bluntly pointed into blunt, venation density is being reduced, uniform orientation of the cells of the adaxial cuticle becomes more expressive, whereas the orientation of the stomata becomes more diverse. The stomata are still slightly sunken under the epidermal level being smaller than in *Alethopteris idae* from the Prkenný Důl-Žďárky Member. Except for these modified specimens, also the typical specimens of *Alethopteris urophylla* occur very rarely in the uppermost part of the Lampertice Member. The specimens of *Alethopteris urophylla* occur only in mudstone whereas those of *Alethopteris idae* mostly in tuffitic rocks (tonsteins).

Another species related to *Alethopteris urophylla* is *Alethopteris jongmansii* ŠUSTA representing a morphological transition between the species *Alethopteris urophylla* and *Alethopteris decurrens* (ARTIS) FRECH. *Alethopteris jongmansii* has wider venation and narrower pinnules than *Alethopteris urophylla* and wider pinnules than *Alethopteris decurrens*.

PURKYŇOVÁ (1970) is of the opinion that *Alethopteris decurrens* has evolved from a similar species *Alethopteris tectensis* Stockmans et Williére from the Namurian A. Both species possess very narrow pinnules and similar appearance and therefore this possibility seems quite real. However, a cuticular verification is unfeasible.

Despite their similarity, the relationship of *Alethopteris valida* Boulay to *Alethopteris obesa* PURKYŇOVÁ is uncertain. There is a great stratigraphic difference between the two species and also their pinnules somewhat differ.

The relations of *Alethopteris valida* to a newly described species *Alethopteris pilosa* sp. nov. seem more probable. The later might have evolved from the former by retardation. Of the two species, the following features are typical: similar shape with a great pinnule variability, very weakly cutinized cuticles, presence of large trichomes. *Alethopteris pilosa* occurs most frequently in tuffitic rocks (tonsteins), whereas *Alethopteris valida* in mudstones.

Conclusion

The paper presents a description of 13 species of the genus *Alethopteris* STERNBERG, out of which 2 are newly described.

11 species of the genus *Alethopteris* have been detected in the Žacléř Formation in the Intrasudetic Basin and 6 species in the Karviná Formation in the Upper Silesian Basin. The species common to both of these formations are *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH, *A. urophylla* (BRONGNIART) GOEPPERT and *A. valida* BOULAY. But for the species *Alethopteris davreuxii*, which is very rare (in the Intrasudetic Basin in the Westphalian B and in the Upper Silesian Basin in The Westphalian A), the other 3 species are very frequent (over 70 % the specimens studied). The species *Alethopteris decurrens* and *A. urophylla* are most frequent in the Upper Namurian and Westphalian A. The Westphalian B yielded only sporadic finds. The species *Alethopteris valida* is rare in the Upper Silesian Basin. It occasionally appears in the Namurian C, it is, however, most frequent at the end of the Westphalian A and in the Westphalian B.

Statistical measurements of the pinnule variability of the populations of *Alethopteris urophylla* and *A. valida* from the Karviná and Žacléř Formations show comparable values of all the features measured - pinnule length, pinnule width at the base and in the middle, number of veins per 1 cm on the pinnule margin, and the type of the pinnule apex. The population of the species *Alethopteris decurrens* in the Upper Silesian Basin has narrower pinnules (in the midpart) with lesser venation density than in the Intrasudetic Basin which might be attributed to a greater representation of the angustifoliate form *Alethopteris decurrens* forma *gracillima* BOULAY in the Upper Silesian Basin. On the cuticles of *Alethopteris decurrens* from the Intrasudetic Basin no trichomes have been found. The cuticles of *Alethopteris urophylla* from both basins imperceptibly differ in the shape and orientation of the cells of the adaxial cuticle and, moreover, in the size of trichomes.

The species known exclusively from the Karviná Formation of the Upper Silesian Basin are as follows: *Alethopteris jongmansii* ŠUSTA and *A. havlenae* sp. nov., both of them rarely found in the Namurian C to Westphalian A.

Of the area of the Bohemian Massif, only in the Žacléř Formation the folowing species occur: *Alethopteris refracta* FRANKE (only in the Lampertice Member - Namurian C to Westphalian B), *Alethopteris* aff. *valida* BOULAY (Lampertice and Prkenný Důl-Žďárky Members - Westphalian B), *Alethopteris idae* ŠIMŮNEK and *A.* cf. *lancifolia* WAGNER (Prkenný Důl-Žďárky Member - Westphalian B), *Alethopteris lonchitifolia* P. BERTRAND and *A.* cf. *grandinii* (BRONGNIART) GOEPPERT (Prkenný Důl-Žďárky and Petrovice Members - Westphalian B and C).

Cuticles were prepared from 10 of the described species. On the basis of similarity shaped pinnules and cuticles, two evolutionary lines were established, the first leading from the species *Alethopteris urophylla* (BRONGNIART) GOEPPERT to *Alethopteris idae* ŠIMŮNEK, the second from the species *Alethopteris valida* BOULAY to *Alethopteris pilosa* sp. nov., probably retardation-evolved.

As far as we know, in the Central Bohemian basins and in the Intrasudetic Basin no species related to the genus *Alethopteris* STERNBERG has been identified so far in units older than Stephanian.

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Karbonské alethopteridy karvinského a žacléřského souvrství

(*Résumé anglického textu*)

ZBYNĚK ŠIMŮNEK

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V práci je popsáno 13 druhů rodu *Alethopteris* STERNBERG, z nichž dva jsou popsány jako nové.

Jedenáct druhů rodu *Alethopteris* bylo zjištěno v žacléřském souvrství ve vnitrosudetské pánvi a 6 druhů v karvinském souvrství v hornoslezské pánvi. Společné pro obě souvrství jsou druhy: *Alethopteris davreuxii* (BRONGNIART) GOEPPERT, *A. decurrens* (ARTIS) FRECH, *A. urophylla* (BRONGNIART) GOEPPERT a *A. valida* BOULAY. Kromě druhu *Alethopteris davreuxii*, který je velmi vzácný (ve vnitrosudetské pánvi ve westphalu B a v hornoslezské pánvi ve westphalu A), se ostatní tři druhy vyskytují velmi hojně (přes 70 % studovaných exemplářů). Druhy *Alethopteris decurrens* a *A. urophylla* jsou nejhojnější ve svrchním namuru a ve westphalu A, z westphalu B pocházejí jen sporadické nálezy. Druh *Alethopteris valida* je v hornoslezské pánvi vzácný, naproti tomu je hojný ve vnitrosudetské pánvi. Ojediněle se objevuje v namuru C, nejhojnější však je až na konci westphalu A a ve westphalu B.

Statistická měření variability lístků populací *Alethopteris urophylla* a *Alethopteris valida* z karvinského a žacléřského souvrství vykazují srovnatelné hodnoty všech měřených znaků - délky lístků, šířky lístků při bázi a uprostřed, počtu žilek na 1 cm okraje lístku a typu vrcholu lístku. Populace druhu *Alethopteris decurrens* v hornoslezské pánvi má užší lístky (uprostřed) a menší hustotu žilnatiny, což je patrně způsobeno větším zastoupením úzkolisté formy *Alethopteris decurrens* forma *gracillima* BOULAY v hornoslezské pánvi. Na kutikulách *Alethopteris decurrens* z vnitrosudetské pánve nebyly zjištěny trichomy. Kutikuly *Alethopteris urophylla* obou pánví se nepatrně liší tvarem a orientací buněk adaxiální kutikuly a dále také velikostí trichomů.

Druhy známé pouze z karvinských vrstev hornoslezské pánve jsou: *Alethopteris jongmansii* ŠUSTA a *Alethopteris havlenae* sp. nov. Oba druhy se vzácně vyskytují od namuru C do westphalu A.

Na území Českého masívu pouze v žacléřském souvrství se vyskytují druhy: *Alethopteris refracta* FRANKE (pouze v lampertických vrstvách - namur C až westphal B), *Alethopteris* aff. *valida* BOULAY (lampertické a dolsko-žďárecké vrstvy - westphal B), *Alethopteris idae* ŠIMŮNEK a *Alethopteris* cf. *lancifolia* WAGNER (dolsko-žďárecké vrstvy - westphal B), *Alethopteris lonchitifolia* BERTRAND a *Alethopteris* cf. *grandinii* (BRONGNIART) GOEPPERT (dolsko-žďárecké a petrovické vrstvy - westphal B a C).

Kutikuly byly připraveny od 10 popisovaných druhů. Na základě podobného tvaru lístků i kutikul byly sestaveny dvě vývojové linie. Jedna směřující od druhu *Alethopteris urophylla* (BRONGNIART) GOEPPERT k druhu *Alethopteris idae* ŠIMŮNEK a druhá od druhu *Alethopteris valida* BOULAY k druhu *Alethopteris pilosa* sp. nov., který patrně vznikl retardací.

Podle dosavadních znalostí nejsou shodné druhy rodu *Alethopteris* STERNBERG v pánvích středočeské oblasti a ve vnitrosudetské pánvi v jednotkách starších než stephan.