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Plant Microfossils from the Neogene of East Marica Coal Basin, Bulgaria

K. UZUNOVA

Kurzfassung
Am untersuchten Fundort Marica in Bulgarien wurden verschiedene Microfossilen gefunden: Kutikulen, Samenschalen, Fruchtwände, Spelzen und Antheren. Es wurden 16 Pflanzenarten festgestellt, davon elf monocotyle Formen. Es wird eine neue Art beschrieben- *Laurophyllum maricii* sp. nova. Die Artenzugehörigkeit der Palaeoflora zeigt, dass sie autochtonen Character hat (Wasser- und Sumpfpflanzen wie *Glyptostrobus* und Poaceae), einen kleineren Teil auch von den umgebenden Hügeln (allochthon, Lauraceae).

Abstract
Various microfossils-cuticles, seed and fruit coats, glumes and anthers have been found in the investigated localities at Marica in Bulgaria. Sixteen species, eleven of the them monocotyledons were established. A new species- *Laurophyllum maricii* is described. The systematic composition of the palaeoflora pointed out the autochthonous character of the assemblage (with *Glyptostrobus* ans Poaceae). A few of the species have been grown on the nearby slopes (allochthonous).

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Schüsselworter: Paläophytologie, Tertiar, Kutikulen, Diasporen.
Key words: Palaeophytology, Tertiary, Cuticles, diaspores.

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1. Introduction

Marica coal basin is situated in Southeastern Bulgaria and is divided into West Marica and East Marica coal basins. It is the biggest lignite coal basin in Bulgaria.
Geological age of the sediments from both parts of the basin is subject of dispute still and includes the interval from the Middle Oligocene to the Pliocene (KAMENOV & PANOV 1976, BRANKIN 1978, NEDJALKOV 1979). After PANOV (1981) East Marica coal bearing layers are within an Early- to Middle Miocene age. PALAMAREV(1994) on the base of palaeofloristic composition and especially of the stratigraphic distribution of the fossil species reject Oligocene and Lower Miocene age and proposed Middle to Upper Miocene as a more probable timespan.

2. Material and methods

The investigated samples were taken from Trojanovo-West- Core No 73 (between 39.50-67.70 m) and Trojanovo-North coal bearing horizon 116 (between 51.60- 75.0 m), and horizon 106D (between 51.60- 75.0 m). Fossil bearing beds are built up from black clay with coal nuts, carbonate clays and interlayers from schist clay. Those beds belong to Trojanovo layer of the Marica Formation (PANOV 1984).

The samples with organic material were soaked with water for 3- 7 days and than washed into coarse and fine sieves. The residue consisting of cuticles, seed and fruit coats and parts of stems. Cuticles were clarified with Schultze solution or 20% perhydrol. 24 glycerin- gelly mounts were made. They are stored in the collection of the Department of Paleobotany, Botanical Institute, BAN

3. Systematic descriptions

3.1 Pteridophyta

Polypodiaceae

Polypodiaceae gen. et sp. indet.
Pl. I, figs.1-3

The upper cuticle constructed from cells 27.50-45.00 x 25.0-37.5μm wide with deep undulate anticlinal walls, wave amplitude up to 10.0μm. The lower epidermis constructed from irregularly cells with deep undulate anticlinal walls 40.0-60.0 x 30.0-50.0μm. Wave amplitude up to 8.0μm. In two of the samples the outline of the cells is hardly distinguishable. The stomata are with narrow elliptical form 30.0 x 15,0μm. Stomatal type is polocytic. The only subsidiary cell is about 50.0μm long.
Discussion: It is not possible to determine the genus of the cuticle because of the fragmentary and not very well preserved samples. The undulate epidermal cells and polocytic stomatal type posses many ferns especially from family Polypodiaceae (Van COTHEM 1970). The combination of polocytic stomatal type (stoma surrounded by one cell with undulate walls), randomly distributed epidermal cells on the lower epidermis and parallel on the upper epidermis can be observed in some species of the genus *Pteridium* (*P. aquilinum*).
Location: Layer 106D, Nos: 32, 35, 36, 38

3.2 Gymnospermae
Taxodiaceae
***Glyptostrobus europea* (BRONGN.) UNGER**
Pl. I, fig.4

1833 *Taxodium europeus* BRONGNIART, p.168
1850 *Glyptostrobus europeus* (BRONGNIART) UNGER, p.434
1984 *Glyptostrobus europea* (BRONGNIART) UNGER - UZUNOVA, p.73
Remarks: This species has been found many times in Bulgarian Tertiary Flora as macrofossils or dispersed cuticles. (PALAMAREV 1970, UZUNOVA 1984). The cuticles are identical with other ones described from Melnik (UZUNOVA 1984)
Location: Layer 106D, Nos. 29, 34, 35, 36, 38, 116 No 17

3.3 Angiospermae
3.3.1 Dicotyledoneae

Lauraceae
***Laurophyllum maricii* sp. n.**
Pl. I, fig. 5, Pl. II, figs. 1-4, Pl. III, 1-3
Holotypus: Pl. II, figs. 1-4; Paratype Pl. III, figs. II, figs. 2,3; Pl. III, figs. 1-3

Derivatio nominis: after the name of river Marica
Locus typicus: Trojanovo West, Core 73 (67.7m)-
Material: 32 pieces of abaxial and adaxial cuticle
Stratum typicum: Oligocene to Lower Miocene (?) or Middle to Upper Miocene browncoal-layers (Trojanovo layer) of the Marica Formation.

Diagnosis: Stomatal type paracytic. The pore is spindle like from pole to pole and deep cutinized inner stomatal ridges. Adaxial and abaxial cuticles with many trichome bases surrounded by rosette if cells with deep cutinized walls.
Description: Abaxial cuticle thick. Areolae are indistinct. Epidermal cells are with straight to slightly curved anticlinal walls average sizes: 10.1 x 7.2µm. The cells above primary veins are elongate, almost rectangular. There are many trichome bases with deep cutinized pore and surrounded by rosette of cells. Adaxial cuticle is moderate thick and after premaceration sometimes epidermal cells lose the outlines. The areolae are conspicuous constructed by 2- 3 rows of smaller also rectangular cells. The epidermal cells are with polygonal form and straight to slightly curved anticlinal walls, sizes: 10.0-20.0 x 10.0-15.0µm. Stomata unevenly distributed in areolae in groups. Stomatal type is paracytic. Stomata are ellipsoidal with spindle like pore and deep cutinized distinct inner stomatal ridges. Sizes: 13.75-21.5 x 10.0-15.0µm. Subsidiary cells are 7.5-15.0µm wide and as long as the stomata. Stomatal frequency is (150) 221 (318)/ mm2. There are many trichome bases with deep cutinized pore and rosette of radial cells with deep cutinized tangential walls. Trichome frequency is 0-460/mm2. About 1/3 of the samples are trichomeless. They posses the same distribution, structure of the stomata, stomatal type and stomatal frequency and dimension of the epidermal elements. The cuticle is thinner

and after premaceration frequently the epidermal cells vanish their outlines. It is hard to estimate the taxonomic range of this deviation on account of very strong ecological influence on the trichome frequency. STACE (1965) pointed out that extremes of range of the trichome frequency must be considered. When we are dealing with fossil samples we are not certain which part of the leaf we observe and from which level of the tree are the leaves, which cuticles have been investigated.

Discussion: Described cuticular structure has features that indicate strong affinity to family *Lauraceae* .Comparison with some recent species of the family shows some similarities in the structure of the stomatal apparatus especially the spindle like pore in *Beilschmiedia pendula* (SW.) BENT. ET HOOK.(Pl. III, fig. 4). but the species is trichomless. Abundant trichome bases can be observed in *Litsea khasyana* MEISN (Pl. III, fig. 4) but peculiarities of the trichome bases and stomatal apparatus are different.
The described species is similar to some species of the fossil genus *Daphnogene*. *Daphnogene bilinica* (UNG.) KVACEK & KNOBLOCH (KVACEK 1971), *D. lanceolata* UNG (BUZEK, HOLY& KVACEK 1976), *D. polymorpha* (A. BRAUN) ETTINGSH. (BUZEK, HOLY& KVACEK 1996) consist of hairless and dense hairy samples. In *D. bilinica* (UNGER) KVACEK et KNOBLOCH trichome bases are without deep cutinized rosette of cells around them. The biggest difference is in the stomatal structure. Stomata in *Daphnogene* are with small pore like a split but in *L. maricii* the pore is from pole to pole wide open and with deep cutinized inner stomatal ridges so the resemblance is superficial.
Location: Core 73, Nos: 1a, 1b, 1c, 3a, 23, 37, Layer 116: No 19

Rosaceae
Rosaceae gen. et sp. indet.
Pl. IV, figs. 1-3

Very well preserved stamens. The filament is long and relatively thin. The theques are connected with wide connectivum. There are some pollen grains in the anthers. Pollen morphology indicate Rosaceae affinity. (kindly determinated by Dr. L. FILIPOVICH).
Location: Layer 106D, Nos. 29, 34, 35, 39

Fam. Incertae sedis
Dicotyledoneae incertae sedis
Pl. V, figs. 1-5

Cuticles with uncertain origin, probably from stipules, leaves and petioles. One of the samples is almost whole leaf (stipule) 0.3 mm long and 0.175mm wide. The different pieces of cuticle are with various structures. Epidermis constructed by polygonal to elongate cells with curved to deep undulate anticlinal walls 10.0 - 12.0 m in diameter. There are a few elliptic stomata 27.5 x 15.5µm arranged in almost longitudinal rows. The guard cells are with deep cutinized inner stomatal rim. Different parts of the cuticles are covered with the two types of nonsecretory trichomes. The simple single trichomes are disposed on the margin or on the other places. They are with variable sizes: diameter in the

base 10.0- 25.0μm and length from 20.0 to 500μm. There are somewhere two branched trichomes, fused at the base. On some places there are many stellate trichomes constructed from 6- 12 rays, 6.0- 7.5μm in diameter and 30.0 - 200μm long.
Discussion: There is no palaeotaxa with close to the described specimen structure. Probably these cuticles are from small shrubs or herbs and specific conditions for fossilization have permitted their preservation.
Location Layere 106 D Nos: 34, 35, 36

3.3.2 Monocotyledoneae
Araceae
***Araceophyllum elongatum* JUCHNIEWICZ**
Pl. VI, fig. 1

1975 *Araceophyllum elongatum* JUCHNIEWICZ, p. 129, Pl. XXXIII, figs. 5, 6

The cuticle is very delicate and poorly preserved. There are many fungi especially around the stomata. The epidermal cells are almost rectangular in form with slightly curved anticlinal wals, 15.0-18.0μm in diameter, arranged in longitudinal rows. Stomatal type is tetracityc. Stomata with ellipsoidal form and deep cutinized inner stomatal rim, 33.0 x 25.0μm
Discussion: Described by Juchniewizc (1975) dispersed cuticle was established for the second time in the European fossil flora. The sample from Maritza Istok show big similarity with JUCHNIEWICZ species. All features with taxonomic value as stomatal type, structure of the guard cells and arrangement of the stomata and epidermal cells are identical. The only difference is the sizes of epidermal cells, which is variable feature.

Dioscoreaceae
***Dioscorea liblarense* (KR. et WLD) PETERS**
Pl. VI, fig. 2

1954 *Dioscoreophylum liblarense* KR. etWEYLAND, 96, p. 118 Taf. 21, Fig. 5- 7, Taf.. 22, fig. 1,2
1963 *Dioscorea liblarense* (KR. et WLD) PETERS, p. 15, Taf. 5, fig. 28- 31
1984 *Dioscorea liblarense* (KR. et WLD.) PETERS, UZUNOVA, p. 74, Pl. 2, fig. 3, 4

The species was established for the second time for the fossil flora of Bulgaria.The cuticles are very delicate,poorly preserved, but they posses all features of the epidermal structure which allow its identification. The trichome bases are more frequent but this feature is variable.
Location: Core 73, No 3

Juncaceae
***Juncus cf. subnodulosus* SCHR.**
Pl. VI. Figs. 3- 5

The seed (seed coat) is with wide oval form about 560.0μm x 305.0μm. The basal part is not preserved. The testa constructed by polygonal cells, somewhere elongate with straight to slightly curved anticlinal walls. The cell walls are regularly punctate thickened.
Discussion: The form and sizes of the seed are very close to *J. balticus* WILLD. but the form and type of cell walls are very different (GROHNE 1964).The seed form of *J. subnodulosus* is symmetrically oval but the outline of the testa cells and especially the punctate thickenings are the same as in *J. subnodulosus*. Our specimens includes the limits of the sizes of this species.
Location: Layer 106D No 22

Poaceae
***Puccinellia cf. distans* (L.) PARL.**
Pl. VII, figs. 1, 2

Elongate oval fruit 1.2mm long ,0.7 mm broad. The cells of pericarp are rectangular arranged in longitudinal rows. Hilum disposed 160μm from the base of the fruit, 150.0μm long and 66.0μm broad. There are some brown deposits, more frequent on the upper part of the pericarp.
Discussion: The described fruit possesses many features with taxonomic value very close to *Puccinellia distans* (GROHNE, 1964).The difference is in the size (our specimen is shorter) and pericarp cells are almost quadriangular. Dispersed cuticle with presumable *Puccinellia* affinity has been found in Melnic coal basin (UZUNOVA 1984)
Location: Layer, 106D, No 34

***Agrostis cf. stolonifera* L.**
Pl. VII, fig. 5

Fruit with oval form and almost parallel lateral walls. Sizes: 1.11 x 0.51 mm. The hilum is in median position, 134.0μm at the base, 165.0μm long and about 40.0μm wide. There is a brown deposition on the base. The cells of pericarpe are elongate ,with slightly curved anticlinal walls and oblique ends. On the apex of the pericarpe the cells are smaller and narrower.
Discussion: The described fruit belongs undoubtley to family *Poaceae*. The sizes and ratios between length and wide connected strongly this fruit with *Agrostis stolonifera* (GROHNE 1964). The outline of the fruit is different. (GROHNE 1964) pointed out that the form and disposition of the hilum are very variable especially in subfossil samples.
Location: Layer 106D, No 35

Poaceae gen. indet. sp. 1
Pl. VII, figs. 3,4

Fruit 1.9 mm long and 0.9 mm wide with oval form and slightly assimertic. The tubular appendage (remind of the style) bent aside during the fossilization. The hilum is elliptical disposed at 180 m from the base in lateral position. The cells of the pericarp are almost isodiametric, rounded with sizes 17.0- 20.0 x 17.0μm.

Discussion: The form and sizes of the fruit and presence if the tubular appendage connected this sample with genus *Alopecurus (A. geniculatus* L.) but in this species the hilum is disposed immediately at the base and the pericarpe cells are elongate (GROHNE 1964).
Location: Layer 106D, No- 35

Poaceae gen. indet. sp. 2
PL. VII, fig. 6

Fruit with missing base, part with hilum. The fruit has oval form, is about 3.3 mm long and 1.9 mm wide. The cells of pericarp are very delicate appearing as translucent.
The outline of the fruit and peculiarities of the pericarp are very similar to *Poa pratensis* especially subfossil forms (GROHNE 1964).The missing part with the hilum does not allow the identification of the sample.
Location: Layer 106D, No 28

Poaceae gen. indet. sp. 3
Pl. VII, fig. 7

Fruit with narrow oblong form about 5.1 mm long and 1.8 mm wide. Ratio L: D is 2.8. The apex of the fruit is blunt rounded. The pericarp is constructed by longitudinal cells with waved to curved, relatively thick anticlinal walls. The hilum is at median position, straight, conspicuous, bifurcate at the end, dark brown, ending at some distance from the apex. There are some brown deposits like dots.
Discussion: The described fruit posses some features that are close to some *Bromus* species (GROHNE 1964), but characteristic radial arranged cells of pericarp on the apex has been not observed.
Location: Core 73, No 31

Poaceae gen. indet. sp. 4
Pl. VIII, fig. 1

Fruit with narrow oblong form and missing upper part approximately 1.1 mm long and 0.4 mm wide. The cells of the pericarp are elongate and almost rectangular 15.0μm in diameter. The hilum is disposed at the base of the fruit.
The place of the hilum and sizes are very close to *Poa palustris* L. (GROHNE 1964), but the outline of the fruit is somewhere different. The missing part of the fruit does not allow the identification of the specimens but id undoubtedly belongs to fam. Poaceae.
Location: Layer 106D, No 28

Poaceae gen. indet. sp. 5
PL. VIII, figs. 2-6

A glume with certain Poacean affinity. The outline of the glume is oblong lanceolate. The cuticle consist of long cells with low undulate walls, 15.0μm in diameter. The short cells

are single or in pairs. Silica short cells are with ellipsoidal to reniform form. The cork cells are small spheroidal relatively rare. There are some pricle 22.0μm in diameter up to 25.0 μm long. Somewhere there are some stomate distributed in longitudinal rows near to the costal area.
Discusson: The structure of the cuticle connected this samples with Poaceae. There are no fossil Poaceae with similar structure. I did not find in investigated recent material from Poaceae a species with similar epidermal structre.
Location : Core 73, Nos 31, 32

Monocotyledoneae incertae sedis
***Carpolithes cf. hamsteadensis* COLLINSON**
PL. VIII, fig. 7

1983. *Carpolithes hamsteadensis*, COLLINSON, p. 217, fig. 21

Elongate ovoid fruit or seed narrowing at the apex as a rounded beak and well preserved stalk at the base. Sizes: 1.0 mm long, 0.5mm wide. Inner cell layer with dark collar like band arround the fruit which ends with dark deposits at the base. The outer cell layer is composed by longitudinal cells in parrallel rows with bead like thickened anticlinal walls.
Discusson: The described specimen in all features with taxonomical value is very close (allmost identical) with the species described by COLLINSON (1983). It also includes the size of the English material.
Location: Core 73, No 21

4. Conclusions

Identified 18 species enlarged the list of the determinate by carpological method- 28 species (PALAMAREV 1994) and by leaf imprints- 5 species (KITANOV 1990). Most of the established genera are aquatic or marginal aquatic plants (*Salvinia, Nuphar, Sparganium* (PALAMAREV 1994), and *Nelumbo, Typha, Phragmites* (KITANOV 1990). The established palaeofloristic complex consists of species of an association of plants most of which are marginal aquatic plants too (*Juncus* cf. *subnodulosus, Araceophyllum elongatum,* Poaceae, *Glyptostrobus europea, Carpolithes hamsteadensis*). A few are plants that habit nearest slopes as *Laurophyllum maricii*, *Dioscorea liblarense* and ferns. The only common species between both localities is *Laurophyllum maricii*. The layer 106D contains more rich assemblage of plants all of them most probably autochtonous. The poor floristic list of Core 73 is due more probably to the less amount of material.

5. References

BRANKIN, K. 1979: New data about the age of the coal bearing sediments of West marica basin., J. Bulg. Geol. Sos., 39 (2): 153- 158 (in bulg.)

BRONGNIART, A. (1933): Notice sur un Conifere fossile du terrain d,eau douce de l'ile d Iliodroma. - Ann. Sci. Nat., 30: 168-176

BUZEK, C., HOLY & F. KVACEK, Z. (1976): Tertiary flora from Volcanogenic Series at Markvartice and Veselicko near Ceska Kamenice (Ceske stredohori Mts.). - Sbor. geol. ved Paleont., P, 18: 69- 132

BUZEK, C., HOLY& F. KVACEK, Z. (1996) Early Miocene flora of the Cyprus shale (Western Bohemia). - Acta Mus. Nat. Prage, Ser.B, Hist. Nat., 52 (1-4): 1-

COLLINSON, M. (1983): Paleofloristic assamblages and palaeoecology of the Lower Oligocene Bembridge Marls, Hamstead Ledge, Isle of Wight.- Bot. J. Linn. Soc., 86 (1-2): 177-225

COTHEM, W. Van (1970): Comparative morphological study of the stomata in Filicopsida. - Bull. Jard. Bot. Nat. Belg., 40: 81- 239

GROHNE, U. (1964): Bestimmungsschlussel für subfossile *Juncus*samen und Gramineenfrüchte. - Probleme der Küstenforschung in südlichen Nordseegebiet., Band 7: 1 47, 21 Taf.

JUCHNIEWICZ, K.(1975): The fossil flora from Turow near Bogatynia studied by cuticular analysis. - Prace Muz. Ziemi, 24:65- 132

KAMENOV, B. & PANOV, G. (1976): Geological connection between the coal bearing layers of Marica-West and Marica-East in the Marica Istok coal basin.- Oil and coal geology, 4: 60- 71 (in bulg.)

KITANOV, G. 1990: Short paleofloristic data about East Marica coal basin. - Fitol., 38: 89- 91

KVACEK, Z. (1971): Fossil Lauraceae in the Stratigraphy of the North-Bohemian Tertiary. - Sbor. Geol. Ved., Paleont., P., 13: 47-86

KVACEK, Z. & WALTHER H. (1974): Bemerkenswerte und seltene cinnamomoide Blätter aus dem Grenzbereich des Oligo-Miozäns Mitteleuropas. - Abh. Staatl. Mus. Mineral Geol., 21 (8): 197-221

NEDJALKOV, N.(1979): East Marica lignite basin-mine -geological conditions, quantitive characteristicand peculiarities of the locality. Coal, 9: 8- 12 (in bulg.)

PALAMAREV, E. (1991): Composition, structure and main stages in the evolution of the Miocene flora of Bulgaria. - Doc. Sci. thesis, Sofia, 497p. (in bulg.)

PANOV, G. (1981): Tertiary coalbearing sedimentation in the Upper Thracian tectonic .- Ph. D. thesis, Commity of Geology, S. 172p. (in bulg.)

PETERS, I. (1963): Die Flora der Oberpfälzer Braunkohle und ihre ökolog ische und stratigraphische Bedeutung. - Palaeontographica, B, 112, 1-3: 1-50, 15 Taf., 18 Abb., Stuttgart.

STACE, K. (1965): Cuticular studies as an aid to plant taxonomy. - Bull.Brit. Mus. (Nat. Hist.) Bot., 4 (1): 1-78

UZUNOVA, K.(1984): Dispersed cuticles of Pontian sediments in Melnic basin. - Fitol., 25: 71-83

6. Explanations of the Plates

Plate I

Polypodiaceae gen.et sp. Indet.

Fig. 1: Lower epidermis, x 800

Fig. 2: Single stoma with subsidiary cell, x 800

Fig. 3: Upper epidermis, x 400

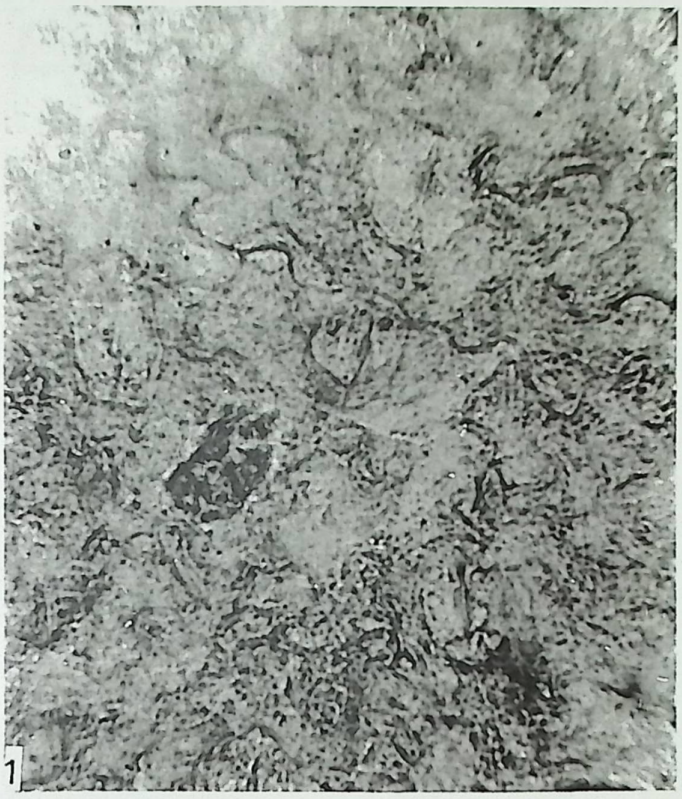
***Glyptostrobus europaea* (BRONGNIART) UNGER**

Fig. 4: Part of the cuticle with a row of stomata

***Laurophyllum maricii* sp. nova**

Fig. 5: Adaxial cuticle with trichome bases surrounded by rosette of cells, x 800

Plate I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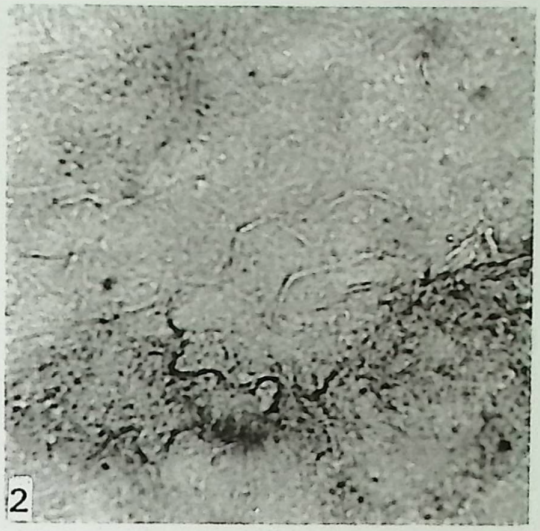
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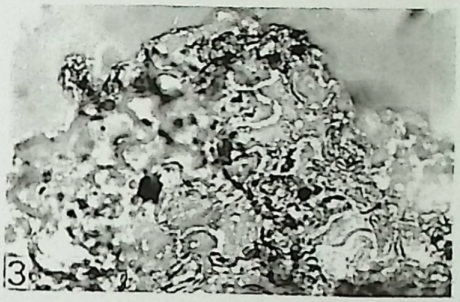
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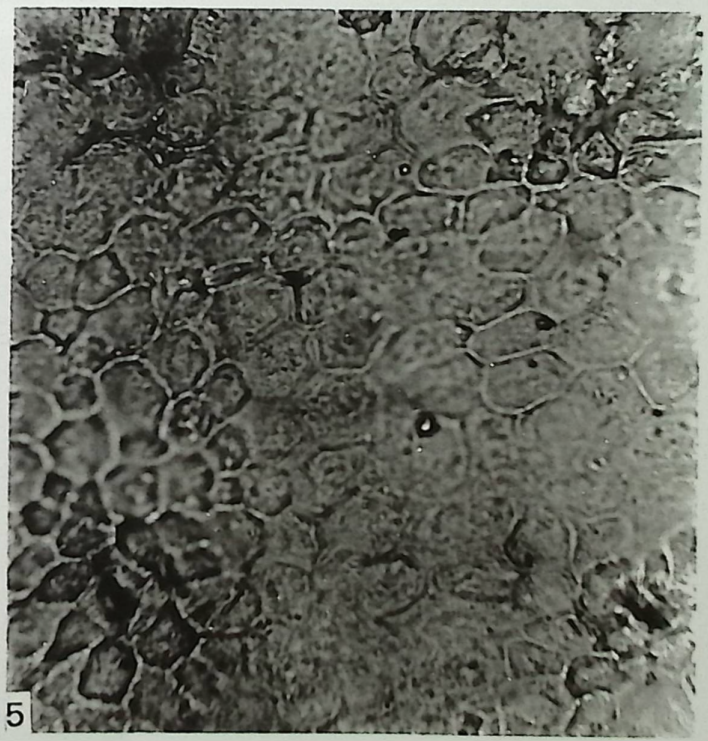

5

Plate II

Laurophyllum maricii sp. nova

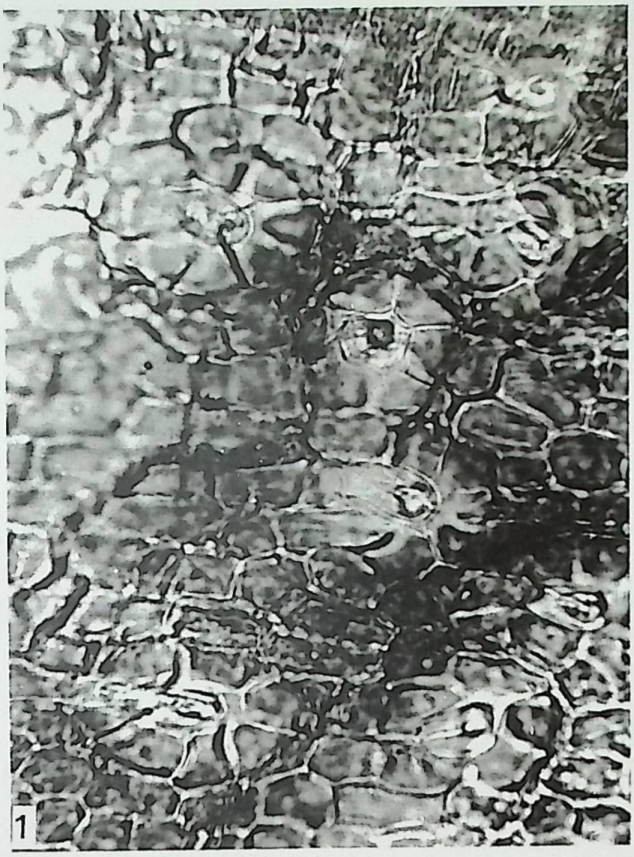
Fig. 1: Abaxial cuticle on the vein with partly preserved lower part of the trichomes, x 800

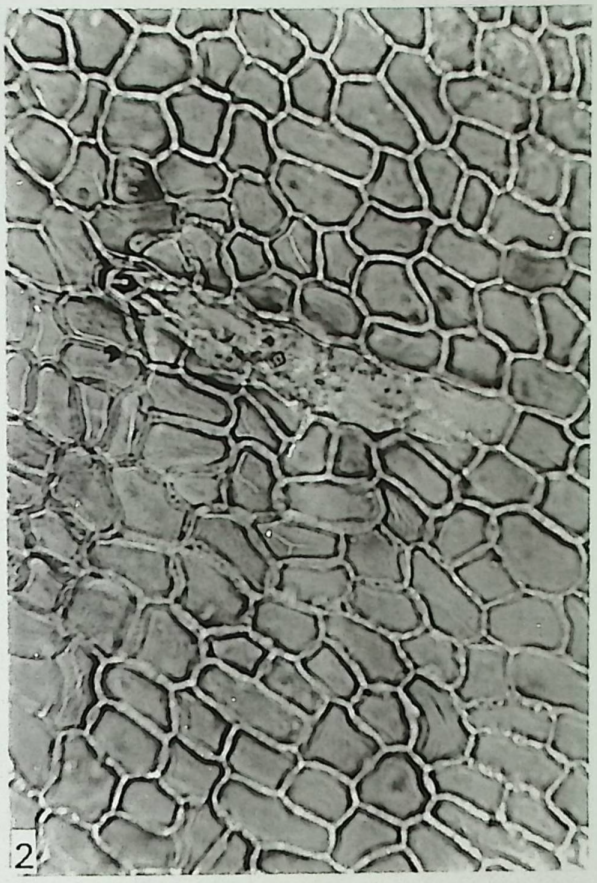
Fig. 2: Abaxial cuticle with a single trichome base and bad preserved trichome, x 800

Fig. 3: Adaxial cticle, trichome bases with well differentiated rosette, x 800

Fig. 4: Adaxial cuticle, x 400

Plate II





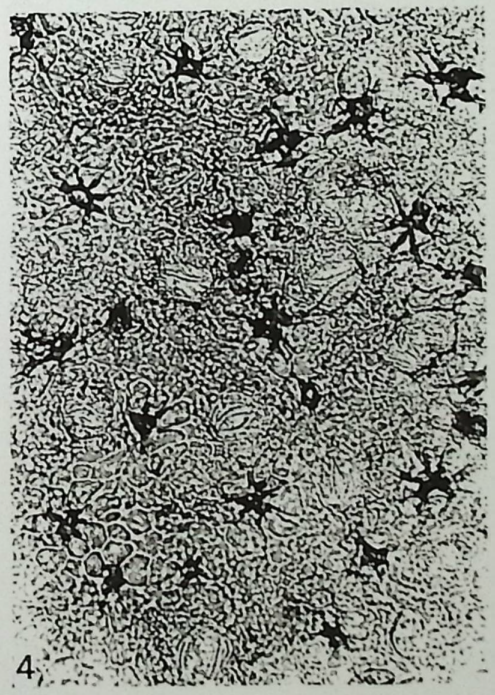


Plate III

***Laurophyllum maricii* sp. nova**

Fig. 1: Adaxial cuticle of hairless form, x 800

Fig. 2: Adaxial cuticle ,epidermal cells with straight wall and paracytic stomata, x 800

***Neolitsea seriacea* (BL.) KOIDZ.**

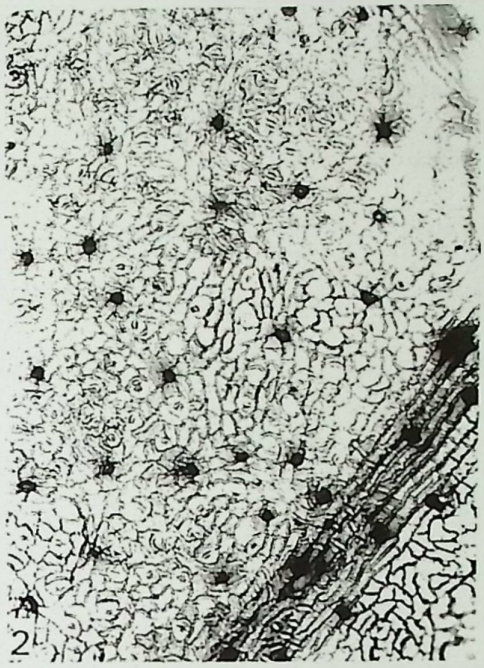
Fig. 3: Lower epidermis with trichome bases surronded by a rosette of radial cells, x 240

***Beischmidia pendula* (SW.) BENT. et HOOK.**

Fig. 4: Stomata with deeply cutinized inner stomatal rim

Plate III


1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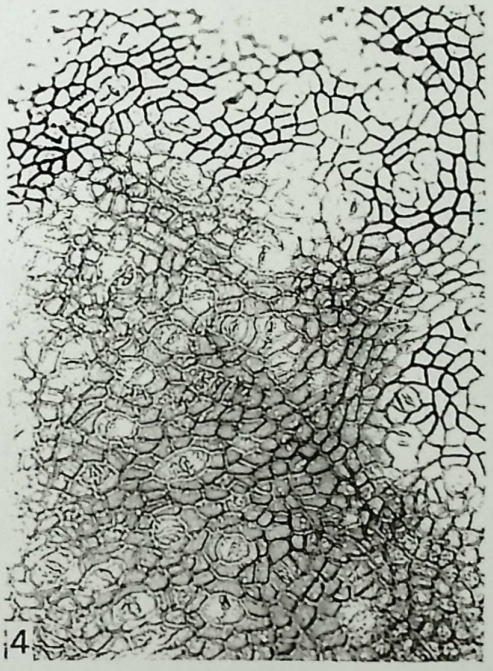
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Plate IV

Rosaceae gen. et sp. indet.

Fig. 1: 1. Stamens, x 240

Fig. 2: Pollengrains from the anthers, x 800

Fig. 3: Anther, x 800

Plate IV

1

2

3

Plate V

Dicotyledonae incertae sedis

Fig. 1: Cuticle with two branched and stelate trichomes, x 240

Fig. 2: Margin with single trichome with different diameters, x 240

Fig. 3: Cuticle with stellata trichomes and clustered crystals, x 400

Fig. 4: Stellate trichome, x 400

Fig. 5: Vein and stomata, x 400

Plate V

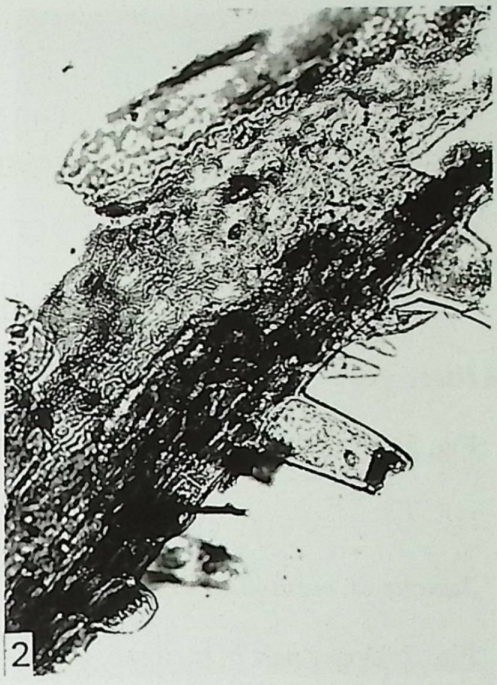


Plate VI

***Araceophyllum elongatum* JUCHNIEWICZ**

Fig. 1: Adaxial cuticle, x 800

***Dioscorea liblarense* (KR. et WLD.) PETERS**

Fig. 2: Adaxial cuticle with trichome bases, x 400

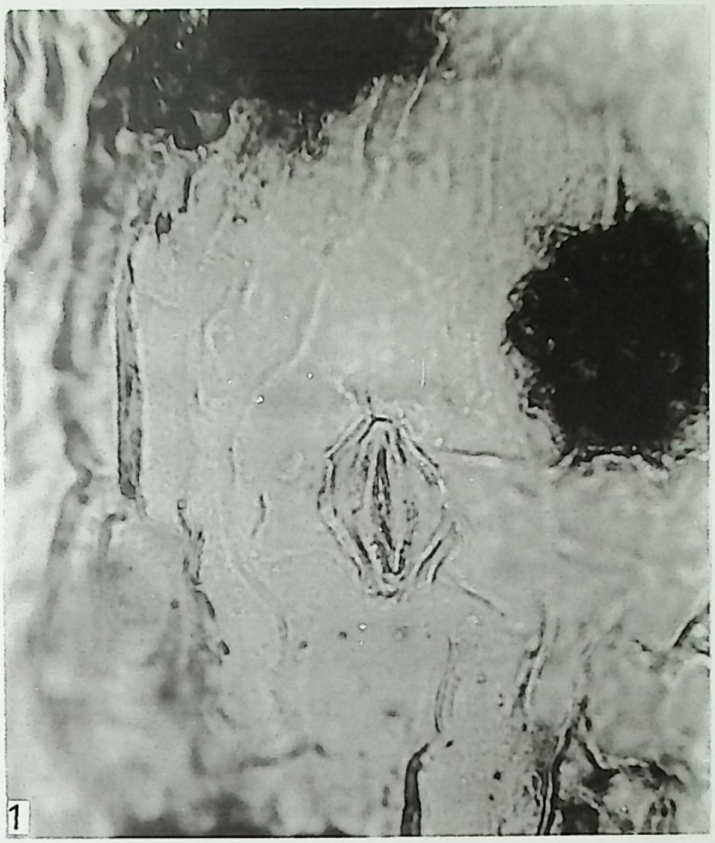
***Juncus* cf. *subnodulosus* SCHR.**

Fig. 3: Upper part of the seed, x 160

Fig. 4: Lower part of the seed , x 160

Fig. 5: Cells of the testa, x 400

Plate VI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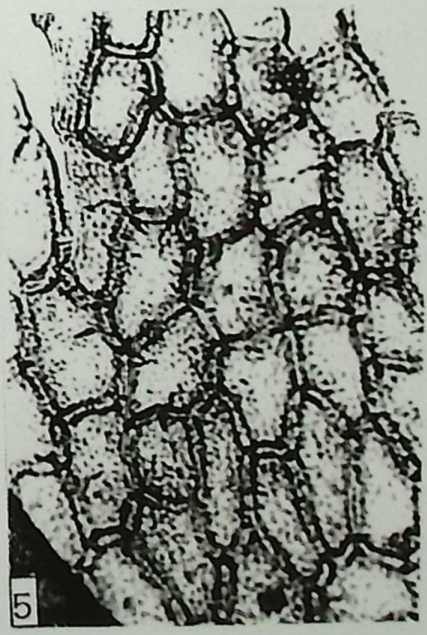
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Plate VII

***Puccinelia* cf. *distans* (L.) Parl.**

Fig. 1: Fruit, x 60

Fig. 2: Hilum and brown deposits, x 45

Poaceae gen. indet. sp. 1

Fig. 3: Fruit with brown deposits, x 45

Fig. 4: Fruit, bent tubular appendage, hilum at the base, x 60

***Agrostis* cf. *stoloniofera* l.**

Fig. 5: Fruit, hilum in median position, x 60

Poaceae gen. indet. sp. 2

Fig. 6: Fruit, x 60

Poaceae gen. indet. sp. 3

Fig. 7: Fruit with missing upper part, hilum at the base, x 60

Plate VII

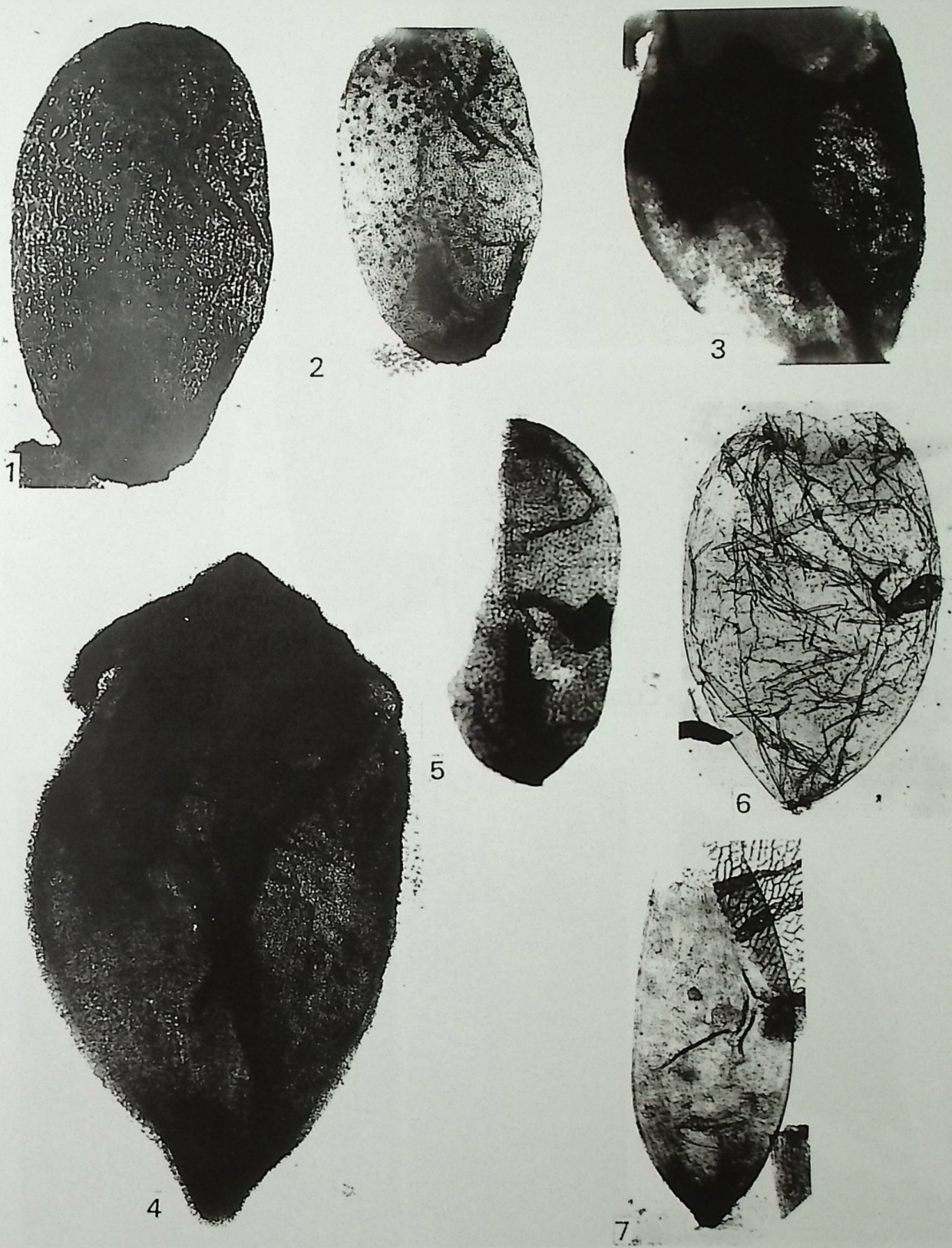


Plate VIII

Poaceae gen. indet. sp. 4

Fig. 1: Fruit, x 60

Poaceae gen. indet. sp. 5

Fig. 2: Glume, x 60

Fig. 3: Epidemis with long and short cells, x 400

Fig. 4: Epidermis, x 400

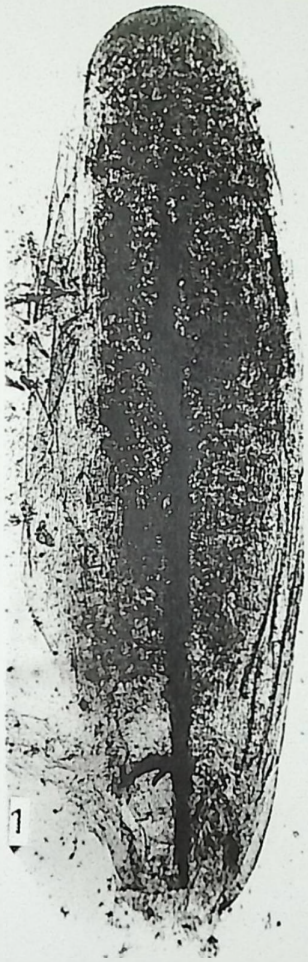
Fig. 5: Stomata x 400

Fig. 6: Stomata x 400

***Carpolithes hamsteadensis* COLLINSON**

Fig. 7: Fruit (seed?), x 60

Plate VIII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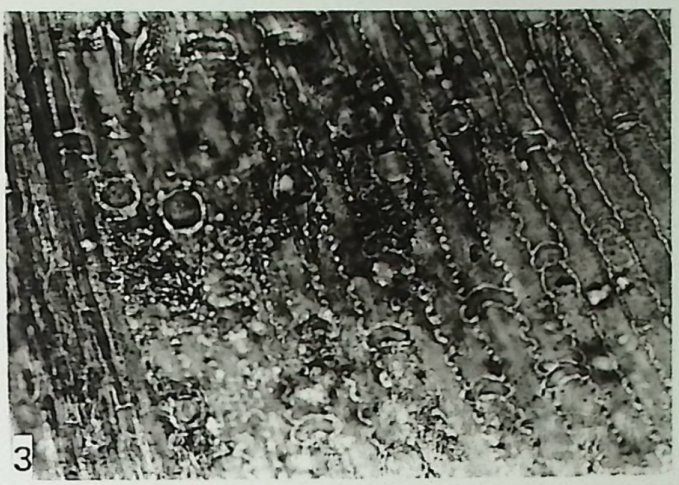
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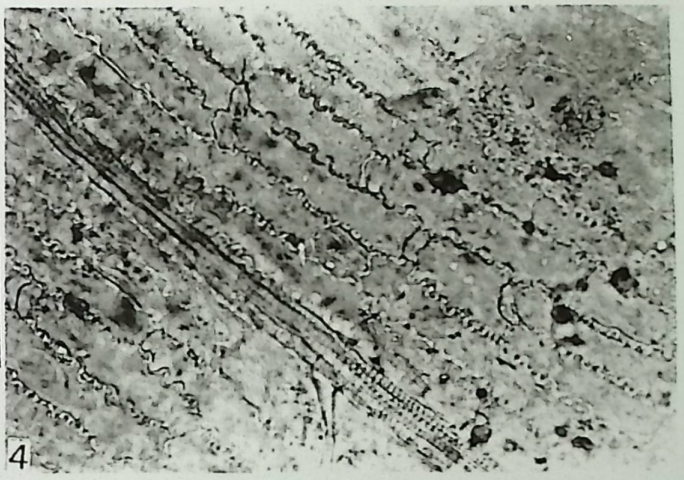
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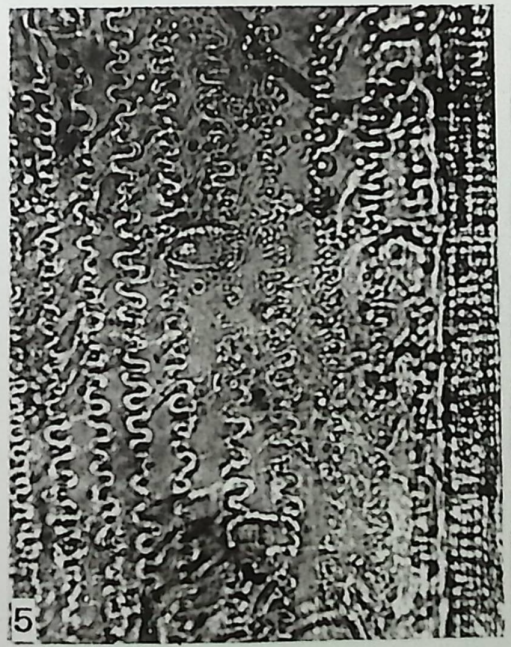
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